Pinner Wood School, Latimer Gardens, Pinner, Middlesex HA5 3RA

Interim Interpretive Report on Subsidence Investigation

On behalf of **People's Capital Project Team, Harrow Council**

Project Ref: 35665/3506 | Rev:4 | Date: July 2017

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Non Technical Executive Summary

This report presents the works completed to date at Pinner Wood School following the ground collapse within the car park in August 2015.

Despite significant background research, including searches of the cavities databases held and maintained by PBA, website searches, discussions with local historian Ken Kirkman and other parties with local knowledge PBA has been unable to locate any specific maps showing the location of pits, shafts or historical mine tunnels within the school site boundary.

Initial investigation works were carried out in the car park by The Environmental Protection Group Ltd. This work was aimed at trying to determine the extent and cause of the collapse, but the results of this initial investigation were inconclusive. Therefore, further works were carried out comprising a geophysical survey across the entire school site. The survey is a non-intrusive method to check the nature of the near-surface ground conditions using radar to determine whether anomalous features might be present in the ground. A ground investigation was carried out in the Summer Holidays 2016, coordinated by Peter Brett Associates LLP (PBA) concentrating on the areas with anomalous results identified by the geophysical survey. Whilst most of these anomalies did not find any significant disturbed ground there was a deeper anomalous feature found directly to the south of the school building. The anomaly was found to comprise a significant depth of Made Ground with a void underlying it.

Further to completion of the geophysical survey and ground investigation around the school site Forkers Ltd mobilised to site in November 2016 to commence a ground treatment programme. This work was concentrated on two areas of the site that were considered by PBA to be possible old mine shafts. The first treatment area (Main Shaft) was centred on the collapse in the car park. The second treatment area (Southern Shaft) was located to the south side of the school in the grassed area where the anomalous thickness of Made Ground was found during the investigation described above.

During this phase of the works it became apparent that the grout take into the ground conditions was significantly greater than originally anticipated. It had been thought that the shafts could be treated in isolation however, the grouting work demonstrated that there were potentially inter-connected open mine working voids at depth which were larger than first thought. A second round of boreholes were drilled both at the Main Shaft in the car park and the Southern Shaft. Within some of these boreholes a laser scan survey was completed. The results of this showed there was a significant tunnel network underneath the south eastern corner of the school building. Within this tunnel network there was evidence that the roof of some parts of the tunnels were in a state of collapse At this point, given the risk to the overlying building, Harrow Council took the decision to close the school. Although it was understood that the risk of a sudden and substantial collapse was low based on available information at the time, the consequence of such a collapse endangering staff and pupils was considered to be unacceptably high.

Following this closure, the Council requested that Forkers carry out an investigation throughout the school grounds including playground, playing field, the car park and the central courtyard. This investigation consisted of drilling boreholes on a grid, all from within the school boundary, to check the ground conditions in case of further mine workings and voids in the chalk at depth. Where voids were encountered in the ground further laser scanning was carried out. The results of these additional works and laser scanning showed extensive open voided mine workings in the south east corner of the site, including a large network located under the school building. In addition, there were also a number of voids below the playing field, the northern playground and northern portion of the school building.

A number of these mine voids show signs of ongoing roof collapse with the potential for them to rise to the surface and to cause additional collapse features across the site, including under the school building. There is also evidence of upward migrating voids due to the collapse of mine tunnels below. There were also some mine workings extending beneath Latimer Gardens. The results of the investigations completed to date do not show the workings extending beyond the south east side of the highway or below the neighbouring properties. It should be noted, however, that it is still possible for other unknown workings to be present elsewhere. PBA recommended a phased approach to remedial stabilisation treatment for the school site. Where open voided mine workings were encountered, it is intended that they are to be bulk infilled with a cement grout mix. This will fill the open voided mine workings limiting the potential for future ground collapses to occur. Following the infilling work, a second phase of compaction grouting will occur in areas of ground above and around former open voids or significant soft ground was encountered. This grouting involves pumping a stiffer cement grout mix under pressure into the ground at depths from surface down to competent chalk at depth. This method will not only fill small residual mine voids encountered but will also compact the surrounding soft/ loose ground, thereby increasing its strength and mitigating the potential for future ground movement to occur. The area recommended for this work is the eastern portion of the school building, the southern playground, the car park and part of the northern playground.

The key objective for the ground stabilisation work is to complete the treatment below and around the school building by the end of December 2017, to enable reoccupation of the school building in January 2018.

1.0 Introduction

1.1 General

Peter Brett Associates LLP (PBA) has been commissioned by the People's Capital Project Team, Harrow Council (the Client), to prepare an interpretive report on 'site wide' investigations carried out following a ground collapse within the car park to the east of the main entrance to Pinner Wood School, Latimer Gardens, Pinner, Middlesex, HA5 3RA.

This report is issued as interim only and is subject to change following further interpretation. The site works completed to date are extensive and analysis of the data gathered is still in progress. In addition, significant further works are just commencing. These works will add further data which will enhance and potentially modify the ground model for the site as currently understood.

On completion of all site works, more detailed interpretive reports will be compiled.

1.2 Site Location & Description

The centre of the site is located at approximate National Grid Reference TQ 111 906. It is located north and west of Latimer Gardens and approximately 1km north-east of Northwood Hill Station. The location of the site is presented as **Figure 1.**

The site comprises a primary school and children's centre. The school building consists of one main building, rectangular in outline, with a central courtyard, surrounded by tarmac surfaced playgrounds and open playing fields. The central courtyard is covered with a rubberised soft play surface. The site is accessed by the main gates leading from Latimer Gardens on the eastern boundary with a smaller secondary gated entrance on the south-east corner of the site, also off Latimer Gardens. Part of the main car park is currently cordoned off with timber hoarding as part of preparatory works, planned by the Council, as part of the schools expansion programme.

The ground level on the site varies between 70m and 80m above ordinance datum (AOD) with the highest elevation in the north of the site dipping gently southwards.

The current layout of the site is shown on the Site Layout Plan, presented as **Figure 2.**

1.3 Background

In August 2015, an unexpected ground collapse occurred within the car park to the east of the school building.

The collapse void measured approximately 3m in diameter and 2m in depth. The location of this feature is identified as the 'Main Shaft' on **Figure 2.** It is understood that the collapse void was quickly backfilled, by Harrow Council, with loose free draining aggregate, to address the health and safety risk and reduce the potential for the collapse to expand laterally as the side walls degraded.

Following the ground collapse, a series of ground intrusive and non-intrusive investigations were carried out to determine the cause of the collapse. These investigations took several months to complete, largely due to the iterative nature of the work, with each phase of investigation informing the requirement of the next, but also largely due to the need to keep the school open and in use. This required work to either be carried under tight spatial restrictions and control during term time, or during the holiday periods to carry out the work.

Ground stabilisation works were then carried out in two areas of the site, the original location of the ground collapse and a second area to the south of the school buildings. Further information regarding these works is presented in the following sections of this report.

2.0 The Site

2.1 Site History

Historical information from Ordnance Survey plans suggests that the site remained undeveloped and was used as agricultural land until Pinner Wood School was built around 1938. The school has undergone various alterations over time. Older historical maps also indicate that the school site and adjacent areas was previously named ‘Chalk Pits Field’.

Despite significant background research, including searches of the cavities databases held and maintained by PBA, website searches, discussions with local historian Ken Kirkman and other parties with local knowledge PBA has been unable to locate any specific maps showing the location of pits, shafts or historical mine tunnels within the school site boundary. The only indication of possible past activities has come from the historical field name referred to above. However, a number of historical chalk mines are known to be present in the wider surrounding area of Pinner, with variously detailed information of these on public record.

During the Second World War four air raid shelters were constructed on site along the eastern boundary within part of the playing field and main car park. These were subsequently backfilled, although it is not known precisely when or precisely where they are located. However, no specific evidence of these were found during the investigation works.

This area of Pinner started to develop from the 1930s with residential developments to the south and west of the site. In the 1960s further residential developments to the east and north of the site were constructed.

2.2 Geology

The 1:50,000 scale geological map of the area (Sheet 256, BGS, 2006) (extract shown on **Figure 3**) indicates the site is underlain by the London Clay Formation (~10m thick), overlying the Lambeth Group (~10m thick) and Seaford and Newhaven Chalk Formation at 20-25m bgl. The Hertfordshire Puddingstone is known to be locally present towards the base of the Lambeth Group around 1.5m above the top of the Chalk where it forms a dense cemented layer.

The geology profile encountered below the site by the investigations completed are generally in accordance with the published geology.

2.3 Hydrogeology

The hydrogeological map of Cambridge and Maidenhead, Sheet 14 (BGS, 1984) (extract shown on **Figure 4**) indicates that the groundwater level in the Chalk to be at 20m to 30m AOD. As such the groundwater level in the Chalk aquifer is in excess of 40m below the existing ground level.

The “What’s in your backyard” website hosted by the Environment Agency has been consulted to further define the hydrogeological character of the site. Available groundwater maps show that the site is within a Zone 3 (Total Catchment) Groundwater Source Protection Zone. This is defined as “the area around a source within which all groundwater recharge is presumed to be discharged at the source”. Therefore, the groundwater below the site does not lie in close proximity to any water supply sources, simply forming broad scale background recharge to the underlying aquifers.

3.0 Previous Subsidence Investigations

3.1 Subsidence Investigation (August 2015)

Immediately following the ground collapse, Harrow Council appointed The Environmental Protection Group Ltd (EPG) to complete an initial ground investigation around the backfilled collapse. This was carried out in August 2015 with the results presented in a letter report to Harrow Council (Ref: EPG/2015/PWS/Q3/L1, dated 5 September 2015, see **Appendix A**). PBA also completed a supporting letter report on these results, with further interpretation (Ref: CBH/CNE/SJC/35665, dated 15 September 2015, see **Appendix B**).

During this investigation 9 dynamic probes were sunk in and around the collapse. The probes surrounding the ground collapse (Probes PH1 to PH6) did not indicate the presence of weak, disturbed ground at depth. However, the high ground strength in these locations resulted in the probes being unable to reach the depth of the underlying chalk bedrock, at around 22m bgl.

A further probe, PH7, was sunk through the centre of the backfilled collapse to a termination depth of 26.5m bgl. The ground was shown to be weak and highly disturbed through the majority of the ground profile. Based on the information available at that time, the poor ground conditions were determined to be loose backfill to a probable old chalk mine shaft that has been disturbed, resulting in the sudden settlement of the infill and the formation of a crown hole observed at ground surface.

Two additional probes, PH8 and PH9, were sunk within the car park to the north of the collapse. Probe PH8 indicated a similar profile to probes PH1 to PH6. Probe PH9 indicated a weaker ground profile but was terminated at 9.9m depth, limiting further interpretation.

3.2 Geophysical Investigation (October 2015)

In September 2015, RSK Environmental Ltd (RSK) carried out a geophysical investigation of the site to detect the presence of shallow voids or disturbed ground that might be associated with degraded historical chalk mine workings (Report Ref: 191236- R01, dated 9 October 2015, see **Appendix C**). PBA provided a supporting letter report with an interpretation of the geophysical survey findings (Ref: CBH/CNE/SJC/35665, dated 21 October 2015, see **Appendix D**).

The survey methods used for the geophysical investigation picked up multiple discrete isolated Ground Penetrating Radar (GPR) anomalies, a number of discrete Electromagnetic (EM) anomalies and a series of locations where both the GPR and EM anomalies were coincident.

The results of the GPR survey were processed and interpreted by RSK into three anomaly types:

- Anomaly type A – Indicative of possible voiding or conductive ground conditions
- Anomaly type B – Indicative of buried obstruction or strata boundary
- Anomaly type C – Indicative of disturbed ground

The results of the EM survey were processed and interpreted by RSK into two anomaly types:

- Anomaly type A – Possible linear buried metallic service
- Anomaly type B – Indicative of a change in ground condition

On the basis of the geophysical survey results obtained, PBA recommended a further scope of intrusive ground investigations be carried out to determine the nature of the anomalies identified.

3.3 Ground Investigation (August 2016)

PBA coordinated further intrusive investigations in August 2016, with site works being carried out by Endeavour Drilling, with the factual reports presented in a Ground Investigation Report (Ref: END16-029 dated September 2016, see **Appendix E**).

The ground conditions below the site have been investigated by intrusive investigation techniques, to provide additional information about the geophysical anomalies located by RSK (2015). Three deep hollow auger boreholes were completed along with thirty-eight super heavy dynamic probes and fifteen window sample boreholes. The findings of this investigation were presented by PBA in a Ground Investigation Report (Ref:35665/3502, dated October 2016, see **Appendix F**).

Whilst the geophysics identified a number of anomalies across the site, the results of the intrusive investigation showed these anomalies to be low strength ground in the near surface with competent ground beneath. It was considered likely that these anomalies related to variations in the shallow geology and were largely related to previous landscaping earthworks on site when it was developed as a school. As such, the majority of these anomalies were interpreted not to show evidence of ground disturbance due to historical mine workings.

However, there were two locations of concern encountered during the investigation as follows:

- the initial collapse (BH101)
- south of the school building (WS112)

Based on the data gathered at the time, the Council requested that the suspect areas be stabilised in order to mitigate future subsidence hazard. In response it was recommended that ground stabilisation by grouting be carried out in the car park within the initial collapse and within the other suspect feature detected. Based on PBA's past experience this was considered the most effective long term remedial solution which has a good track record of mitigating the potential for further movement of disturbed and voided ground.

4.0 Ground Stabilisation & Further Investigation

4.1 Ground Stabilisation Strategy

4.1.1 Objectives

In order to mitigate the subsidence hazards posed it was recommended to carry out remedial ground treatment works using grouting techniques as follows.

For the initial collapse area (BH101) it was considered that permeation grouting was the appropriate method of treatment. Permeation grouting serves to penetrate loose infill/collapsed material and fill voids associated with the historical mine workings. The treatment comprises injection into the ground of a sand/ cement and PFA grout mixture under pressure to locally penetrate the ground in three dimensions around the point of injection. The drilling work was undertaken on a 1.5m spaced grid, to depths of 25m bgl. The final extent and depth of the work was dependent on the ground conditions encountered as the works were carried out, the drill holes providing additional information about the ground conditions. The aim of the grouting was to stabilise the deep, loose column of ground present and to reinstate support to the ground above. As the grout is fluid it was anticipated that it would flow into the broken ground around the base of the shaft and would produce a stabilised plug of ground at depth allowing the shaft backfill above to be stabilised as well. The response to the treatment and drilling results was also to be used to evaluate whether further works at depth might be necessary.

At the position of WS112 it was determined that there was a deepened zone of weak Made Ground possibly containing void space. to the south of the school building. Further drilling and ground treatment was recommended to be carried out in this area as well. This was to be completed utilising compaction grouting techniques. Compaction grouting techniques involve the injection of a viscous mortar grout into the ground under high pressure. The grout can radially compact weak, disturbed ground that is micro-voided, strengthening the ground and mitigating against future movement. The beneficial effects of the grouting can be achieved normally to within about 3m below the ground treatment surface. A ground treatment area measuring 6m x 6m in plan was selected centred on the borehole. The treatment grid used a 3m spacing to a depth of 15m bgl. The final area and depth of this work was dependent on ground conditions encountered as the works were carried out since it was recognised that the treatment area and depths may need be extended.

4.2 Ground Stabilisation Works

Shortly after commencement of the ground stabilisation works proposed, additional data was obtained by the drilling, revealing a significantly greater level of ground disturbance than indicated from the earlier limited investigations. The stabilisation strategy and the methodologies adopted were therefore reviewed and revised to suit the ground conditions being encountered.

The grouting works were undertaken between November 2016 and February 2017. The work was carried out in accordance with the specifications set out in the Tender Document for Ground Stabilisation, prepared by PBA during October 2016, see **Appendix G**, and revisions instructed during the works.

4.2.1 Main Shaft

The revised strategy for the main shaft (original collapse) was to undertake treatment of the disturbed ground identified within and immediately surrounding the shaft. On completion of the works, 23 compaction grout holes were drilled in this area. Due to high initial takes of grout, a combination of gravel and grout was placed into a number of the boreholes in order to ‘plug’ the base of the shaft. Gravel and grout was placed into 6 locations within the main shaft, boreholes BH101, BH102, BH103, BH105, BH106, and BH3. After sufficient gravel and grout had been placed to plug the base of the treatment boreholes, compaction grouting continued within the overlying material upwards to the surface.

The locations of the boreholes completed can be seen in **Figure 5**. A summary of the drilling and grouting records are presented as a table in **Appendix H**.

4.2.2 Southern Area

The strategy for the southern area (anomaly centred on WS112) started with treatment boreholes in a grid pattern. Again, due to high initial grout takes, a combination of gravel and grout was placed in the base of a number of the boreholes. Gravel and grout was placed into 12 locations in this area, E5, G5, D6, F6, G6a, H6, J6, E7, G7, I7, H8 and J8. 19 boreholes were treated by compaction grouting within this area with an additional 8 boreholes drilled along a line between this area and the school to assess if there were any weak areas heading towards the school which could affect the building in the future.

The positions of the compaction grout holes are shown in **Figure 5**. A summary of the drilling and grouting records are presented as a table in **Appendix H**.

4.2.3 Assessment of Grout Volumes

The results of the drilling and grouting are summarised in **Appendix H** with a summary of the work undertaken each week. The records show that the grout takes varied from approximately 0.228 tonne to 309.571 tonnes per grout hole as shown on **Figures 5 and 6**.

The total grout take on completion of works equates to about 488 tonnes, or approximately 244m^3, of grout injected into the ground. This comprises of 355 tonnes (177.5m^3) in the Main Shaft and 133 tonnes (66.5m^3) in the Southern Area which appeared to be another shaft location.

The total gravel placed in the Main Shaft was 7.4 tonnes across six locations and in the Southern Area shaft was 8.65 tonnes across 12 locations.

4.3 Further Investigation

Following the completion of the treatment works outlined above, PBA, in consultation with Harrow, recommended a further phase of investigation was carried out to assess the grout takes which inferred further interconnected void space around the bases of the shaft locations. This work was completed in February and March 2017, with boreholes drilled in both locations, as close as practicable to the school buildings, to determine whether the disturbed ground identified in these two areas was localised to the areas previously investigated and treated, or whether further ground hazards extended below the school buildings.

Fifteen boreholes were completed at 1.5m spacing between the Main Shaft and the front of the school building (BH201 to BH215). The locations of these boreholes can be seen in **Figure 7**. In addition, 23 boreholes were drilled to the north east and west of the Southern Shaft (BH216 to BH238). These locations can be seen on **Figure 8**.

The holes drilled indicated open, voided ground in 12 locations between the main shaft and the front of the school building, at depths of between 21.5m to 24m bgl. To facilitate further assessment by underground survey, casing was inserted into four of these boreholes, BH205, BH208, BH211 and BH213.

Borehole logs also indicated open, voided ground in 3 locations on the western side of the southern shaft. To facilitate further assessment by underground survey, casing was inserted into two of these boreholes, BH231 and BH233.

In order to provide further information on the voids encountered to determine whether they were open mine tunnels and if so, the length, direction and condition of the open tunnels, a survey was commissioned using high definition laser scanning technology in the form of a C-ALS 3D laser scanner. The scanner was lowered through the casing inserted into the boreholes. Once the scanner was lowered to a suitable position in the void the instrument was activated from the surface and the laser scan proceeded. In addition, underground visual survey was provided using downhole CCTV equipment. The survey work was carried out by a specialist contractor, Geoterra Ltd in March 2017. A preliminary interpretation of the laser surveys was presented by PBA in Technical Note TN001, dated 17th March 2017, see **Appendix I**.

4.3.1 Underground Survey Results

The processing and compilation of the data gathered on site by the laser survey was carried out by the specialist contractor, Geoterra Ltd, acting under the technical direction of PBA. A series of open mine tunnels were identified around both the Main and Southern Shaft positions. Processing of the data resulted in the production of 3D digital data files, plan layouts of the tunnels around the two Shaft features and the generation of cross sections through the network of tunnels detected around the Main Shaft feature.

4.3.2 Main Shaft – Void 1

A series of open mine tunnels running in a NW-SE orientation and in a NE-SW were identified in the vicinity of the Main Shaft feature (Void 1).

The results show the void space to be variable with the mine tunnel roof level at between 20.49m and 21.74m depth below ground level and the mine tunnel floor level at 23.60m to 23.92m below ground level. The tunnels are typically approximately 2.5m in height and width. The longest tunnels encountered, though laser scanning, were up to approximately 30m in length, with larger open galleries in some areas. There are areas where it is evident that the mine floor level rises at a location where the mine roof level also rises indicating breakdown of the roof is in progress at a location that is vertically below the NE corner (front entrance) of the Children's Centre part of the school building at the surface.

Another mine tunnel is located at a similar variable depth below ground level and extending below the front entrance to the main school building. The north east end of the tunnel appears to shows signs of tunnel roof collapse since the floor level is raised and corresponds to a raised mine roof level immediately above. Similarly, the south west end of the tunnel also shows a rising floor level, again suggesting collapse has occurred. The roof of this end of the tunnel was not detected by the laser scanner, suggesting that void space is migrating upward at this position, taking it out of the line of sight of the laser. The tunnel is also likely to extend further to the south west, below the school building and may intersect other NW-SE trending mine tunnels.

An additional tunnel extends below the majority of the footprint of the school building, below the front entrance to the Children's Centre and possibly as far as the storage sheds on the south western side of the building. The north east end of the tunnel indicates a raised floor level, which can be attributed to the grout infilling works carried out through the Main Shaft location. However, a raised roof level at this end of the tunnel is also indicative of some collapse to the roof in this position. At the south west end of the tunnel, a rising floor level and the absence of a scan of the roof, shows that roof collapse has occurred and the void space is migrating upwards at this position. The tunnel is also likely to extend further to the south west, further below the school building and may intersect other NW-SE trending tunnels.

Additional mine workings appear to pass below the south eastern corner of the Children's Centre and at a similar depth to the other tunnels.

The recti-linear pattern of mine workings is typical of a pillar-and-stall style historical chalk mine dating from the late 18th to early 19th century. It should also be noted that the presence of other shafts within the school boundary cannot be ruled out.

4.3.3 Southern Shaft – Void 2

From the information available, the Southern Shaft feature (Void 2) appears to be a different style of historical chalk mine working, possibly more typical of a Chalkwell. These mines commonly consisted of a central shaft with two to four short tunnels radiating out from the base of the shaft. At around 21m below ground level to the roof of the tunnels is similar to the roof levels at Void 1 although the floor level is at around 22.5m below ground level indicating the tunnels are lower in height than at Void 1.

A single tunnel has been identified trending east to west, splitting into two at the western end and terminating outside the footprint of the school building. The tunnel orientation appears slightly different from those seen in Void 1. At the eastern end of the tunnel, the infill material from the treatment works at the Southern Shaft feature is encountered and it is possible that other tunnels may extend to the east and south.

No clear connection between the two sets of mine workings has been identified from the investigations and surveys completed to date, although their close proximity suggests that they might interlink.

5.0 Site Wide Ground Investigation

5.1 Introduction

Following the initial phase of grouting, further investigations and laser scan surveys and assessment of the potential risks to the users of the school facilities, a decision was taken by the Council to temporarily close the school to enable site wide ground investigations to be carried out.

5.2 Scope of Works

In response to the concerns raised by the Council, PBA produced plans of proposed borehole locations across the site to cover all open areas, on a 5m offset grid spacing. The grid spacing was chosen due to the potential width of mine tunnels, being around 3m, so that with the offset spacing there would be a high probability of locating any former mine workings. In addition, a series of close centred boreholes were located around the outer perimeter of the building and around the inner perimeter of the courtyard. These boreholes were located on a 1.5m spacing. This was to designed to identify whether any of the mine tunnels previously identified, or any other mine tunnels were crossing the perimeter and extending below the school building.

The scope of investigation works was awarded to Forkers Ltd who had also completed the previous drilling and grouting works on site. In order to complete the internal courtyard boreholes, Forkers needed to mobilise a crane to lift the drilling rig over the school building. An additional series of boreholes were therefore drilled to the north of the school building to ensure no mine workings were located under the area to be used as a crane pad.

These investigation boreholes were completed using rotary probing drilling methods. The manner of drilling was kept constant to ensure consistency in the penetration rate readings. The drillers recorded the time it took for each metre to be drilled. This data was used, together with the drillers logs to assess the ground profile of each borehole location.

The locations of the boreholes drilled can be seen on Figure 9. Summaries of the boreholes drilled can be found in **Appendix J**, and penetration rates in **Appendix K**.

5.3 Results of Investigation

5.3.1 General

PBA analysed the borehole data being collected as the information was provided and produced a series of updated interpretive plans on a regular basis as the works progressed. However, it should be noted that analysis of these results and the development of a ground model for the site is still ongoing and will be enhanced by further information yet to be gathered. Interpretive plans presented should therefore be considered as preliminary and liable to future changes. The plans presented are colour coded to show three broad classifications of ground conditions as below:

- Red – where voided or broken ground was encountered, associated with historical mining
- Yellow – where weak and disturbed ground was encountered, possibly associated with historical mining
- Green – undisturbed ground with no evidence of disturbance from historical mining.

Where voided locations were encountered, Forkers installed casing so that down hole CCTV camera and laser scan surveys could be carried out.

CCTV camera surveys were subsequently carried out in 23 of these boreholes and C-ALS, laser surveys carried out in 34 boreholes, the locations of which can be seen on **Figure 9**. Initial interpretation of the Geoterra scans be found on **Figure 10** including cross section alignments. The cross sections can be found in **Figures 11 to 13**.

5.3.2 Courtyard

The majority of the boreholes drilled within the courtyard showed no signs of historical chalk mine workings (Green classification). A small number of boreholes in the south west and south east corners of the courtyard have been classified as Yellow. Due to the localised nature of the ground conditions in the south west corner of the courtyard these areas are interpreted as naturally occurring variation in the geological profile and not associated with historical chalk mining.

The boreholes in the south east corner of the courtyard are located in areas close to open voids and are interpreted to be areas of disturbed ground associated with historical chalk mining.

5.3.3 Western Playground

Boreholes were drilled across the western playground on a 5m offset grid. The majority of these boreholes showed no indication of historical chalk mine workings (Green classification). There were a number of isolated boreholes classified as Yellow, however, due to the localised nature of these ground conditions, these areas are interpreted as naturally occurring variation in the geological profile and not associated with historical chalk mining.

5.3.4 Southern Playground

Boreholes were drilled in all areas not previously investigated, on a 5m offset grid. The majority of these boreholes showed no signs of historical chalk mine workings (Green classification). There were a number of isolated boreholes classified as Yellow, however, due to the localised nature of these ground conditions, these areas are interpreted as naturally occurring variation in the geological profile and not associated with historical chalk mining.

5.3.5 Crane Pad

None of the boreholes completed over the area of the crane lift, indicated the presence of voids, soft or disturbed ground.

5.3.6 Northern Playground

Boreholes were drilled in all areas not previously investigated on a 5m offset grid. The majority of these boreholes showed no indication of historical chalk mine workings (Green classification). One borehole, FU15, indicated a void at a depth of 22.2m to 23m bgl (Red classification). This borehole had a C-ALS laser scan survey carried out within it which indicated the void to be approximately 4m in diameter. The raised floor and roof level at the north east of the void, indicates mine roof collapse has occurred.

A number of other boreholes are classified as Yellow. However, due to the localised nature of these ground conditions, these areas are interpreted as naturally occurring variation in the geological profile and not associated with historical chalk mining.

5.3.7 Playing Field

Within the playing field boreholes were drilled on a 5m offset grid. Over this area, 7 boreholes encountered open void space (Red classification). CCTV camera and laser scan surveys were subsequently carried out in the following exploratory hole locations and depths:

- FC4 – 23.0–24.0m bgl
- FC14 – 23.0–24.0m bgl
- FE15 – 23.0–24.0m bgl
- FG30 – 13.0-15.0m bgl
- FI21 – 22.3–24.0m bgl
- FM17 – 21.3–22.2m bgl
- FO26 – 22.8–24.0m bgl

With the exception of FG30, these voids were all encountered at similar depths within chalk and coincide with the depth to the mine tunnels in chalk encountered below the south eastern part of the school premises.

The void encountered in FG30 is much shallower than the other voids. This is interpreted to be an upward migrating void, as a result of the upward ravelling of the roof to a mine tunnel that originally at greater depth. In addition to these voids some fifty further probe holes within the field encountered soft or very soft ground, classified as Yellow. The majority of these boreholes are located in areas surrounding open voids and are interpreted to be areas of disturbed ground associated with historical chalk mining.

The locations and orientations of the voids can be seen in **Figure 10** with cross sections in **Figures 11 to 13.**

5.3.8 Car Park

The boreholes in the car park on the east side of the school building were drilled on a 5m offset grid. The majority of these boreholes indicated voids or very soft ground profiles over the entire depth, classified as Yellow. CCTV camera and laser scan surveys were carried out in the following locations:

- FAM32 – 21.0-21.8m bgl
- FAO31 – 21.8-23.2m bgl
- FAO35 – 21.3-27m bgl
- BH599 – 18.0-20.0m bgl
- BH602 – 21.5-22.8m bgl

The laser scan survey in boreholes BH599, BH602 and FAO35 showed a limited size void of up to 1.5m diameter. Borehole BH599 is at a shallower depth, indicating that mine workings have previously collapsed and the void is migrating to the surface.

5.3.9 School Building Perimeter

Boreholes were drilled around the outside perimeter of the school at a 1.5m spacing. The boreholes in the south west, west and north west have shown no evidence of voiding or ground disturbance due to historical chalk mine workings (Green classification). A number of these boreholes are classified as Yellow. However, due to the localised nature of these ground conditions, these areas are interpreted as naturally occurring variation in the geological profile and not associated with historical chalk mining.

To the north of the school building, and west of the new kitchen, a number of boreholes encountered open void space (Red classification). CCTV camera and laser scan surveys were carried out in the following locations:

- BH378 – 22.0-24.0m bgl
- BH379 – 22.5-24.0m bgl
- BH380 – 23.0-24.0m bgl

These boreholes were investigated further through CCTV camera and laser surveys. Void space of approximately 8m^3 was identified heading in an easterly direction below the kitchen. The eastern extent of this void was found to be collapsed and so the full extent of the mine workings in this areas is unknown. To the north of the kitchen and the 'Den' part of the school, BH359 to BH370 all found soft disturbed ground, classified as Yellow and interpreted to be areas of disturbed ground associated with historical chalk mining

Three boreholes on the eastern boundary of the school near the car park encountered open void space (Red classification). CCTV camera and laser scan surveys were carried out in the following locations:

- BH346 – 22.2-23.8m bgl
- BH347 – 22.0-24.0m bgl
- BH348 – 22.0-22.8m bgl

These boreholes and laser scan results showed a significant void below the car park and the existing temporary hoarding. The size of this void is approximately 12m in length and 7m in width.

The boreholes along the external eastern perimeter of the school building in the car park, typically found very soft disturbed ground classified as Yellow and interpreted to be areas of disturbed ground associated with historical chalk mining.

5.3.10 South East Corner of School and Children's Centre

Within this area, sixteen boreholes (Red classification) encountered open void space. CCTV camera and laser scan surveys were carried out in the following locations:

- BH306 – 21.8-23.0m bgl
- BH307 – 22.0-24.0m bgl
- BH310 – 14.5-15.5m bgl
- BH313 – 22.0-24.0m bgl
- BH315 – 21.5-23.0m bgl
- BH316 – 21.8-23.0m bgl
- BH317 – 19.5-20.0m bgl
- BH318 – 22.5-24.0m bgl
- BH580 – 21.5-23.5m bgl
- BH581 – 22.5-23.8m bgl
- BH582 – 21.8-23.5m bgl
- BH583 – 22.0-24.0m bgl
- BH586 – 22.0-24.0m bgl
- BH586a – 21.3-24.0m bgl
- BH590 – 21.5-23.0m bgl
- PU57 – 21.0-22.5m bgl

Whilst the majority of the boreholes indicate historical chalk mine workings, BH310 shows evidence of an upward migrating void with the depth of the void being at 14.5-15.5m bgl.

The extent of open mine tunnels this can be seen in **Figure 10**. Tunnels were found to extend under the south east corner of the school and Children's Centre, into open areas and below the edge of Latimer Gardens. Cross sections through the identified tunnels are presented on **Figures 11 - 13**.

5.3.11 Latimer Gardens

A series of boreholes were drilled along the outer eastern boundary of the school, below Latimer Gardens. These boreholes were drilled from within the school boundary. The boreholes are positioned at a 1.5m spacing. Ten boreholes were drilled on this alignment, the majority of which indicated soft ground over the full borehole depth. However, no open voids were encountered.

A second series of boreholes were drilled along the outer southern boundary of the school, below Latimer Gardens. These boreholes were drilled from within the school boundary. The boreholes are positioned at a 1.5m spacing. Ten boreholes were drilled on this alignment, the majority of which indicated soft ground over the full borehole depth. However, no open voids were encountered.

6.0 Ground Stabilisation Works

6.1 General

Based on the results of the site wide investigate, and in conjunction with discussions with the Council, PBA recommended that stabilisation works are carried out in several areas of the site. It is recommended that this works be carried out by a combination of bulk infilling of open void space and compaction grouting of disturbed weak ground overlying the historical chalk mine workings. The latter has been caused by the progressive breakdown and relaxation of the ground over the mine workings as they have degraded with time.

6.2 Treatment Areas

There are four identified treatment areas across the site:

- The eastern side of the school buildings, including the open void spaces proven below the south east corner of the site and southern edge of the buildings plus a surrounding influence zone.
- Car park area to the east of the school buildings and northern playground.
- School playing field to the north of the school buildings.
- Highway alongside the south east boundary of the school site.

6.3 Remedial Stabilisation Strategy

The strategy for ground stabilisation works has been set out by PBA and presented in Technical Note TN004 Rev1, dated 28th May 2017, see **Appendix L**, and Technical Note TN006 Rev1 dated 14th June 2017, see **Appendix M**. The strategy proposed is as follows:

Firstly, bulk infilling of open mine tunnels (void space) detected by downhole laser & CCTV surveys will be carried out, working from the south east corner of the site, including the highway and progress towards the north west, prioritising the infilling of voids below the school buildings. Refer **Figures 14 and 15** defining site areas and sequencing.

Secondly, compaction grouting will be carried. Compaction grout holes shall be set out on a 3m grid with a treatment depth typically to 24m, locally adjusted based on the results of the completed ground investigations.

Compaction grouting will be carried out in two phases. The first phase will concentrate upon the area below the eastern portions of the school buildings, working from the south east towards the north west. A 10m wide treatment ‘buffer zone’ of compaction grouting will be carried out around the school buildings to provide safe support. This dimension is based on an assessment of the ground movement influence zone associated with the depth of the former chalk mine workings and the potential for ground collapse and/or progressive settlement below and around the school building footprint.

Since not all areas of ground that might contain old chalk mine workings have been investigated below the school footprint, the compaction grouting works will extend from areas of known disturbed, mined ground around the school buildings towards and under the adjacent areas of the school buildings where the ground conditions are unknown but where chalk mine workings are strongly suspected. It is not intended that compaction grouting will continue to extend into areas found to be undisturbed by the completed ground investigations.

The second phase of compaction grouting is below the north eastern portion of the school car park.

Following discussions between Harrow Council and PBA regarding consideration of the ground collapse risks, as it is understood that there is no intention to build on the school field, then no compaction grouting is proposed below the school playing field to the north of the school buildings. Bulk infilling of the detected open mine voids below the playing field will be carried out, thereby mitigating the risk of a surface collapse, should any of the detected voids migrate to the surface and open up. The Council understand that ground settlement may still occur in areas where weak, disturbed ground has been encountered. It is understood that the Council will monitor the ground surface as part of its maintenance programme at the school and will attend to any such areas of settlement as part of that programme going forward in the future.

No compaction grouting is proposed below the highway as it is understood that Harrow Council will address any future surface settlement issues as part of its highways maintenance programme.

The Contractor has a programme aimed at completing the stabilisation works before the end of 2017, to enable reoccupation of the school. The progress of the works and the programme will be continually monitored by PBA to meet the completion goal. If it appears that time slippage of the programme may happen then PBA will discuss the situation with Forkers Ltd regarding what measures may need to be put in place (e.g. additional resources) to put the works back on programme and will consult with Harrow Council about this to agree the implementation of any changes needed.

At all times the priority for the site works will be the stabilisation of ground below the school buildings. Should the ground conditions require treatment that extends beyond the end of 2017 then by agreement with Harrow Council, all remaining untreated areas will be securely fenced off to enable site works to resume after December in separately demarcated areas whilst the school buildings are reoccupied.

6.4 Additional Supporting Data

In addition to the stabilisation works outlined above, further information will be obtained on the underlying geology and ground conditions below the site through the use of light cable percussion boreholes.

The purpose of these additional boreholes is to improve the current understanding of the ground conditions and assist in refining the ground model for the site.

7.0 Summary Comments

7.1 Overview

Following a localised ground collapse in the car park outside the eastern front entrance to the school in August 2015, a series of ground investigations were carried to determine the cause of the collapse. Initial investigations indicated the presence of a collapsed shaft extending to the chalk bedrock below. Over the following months further investigations were carried out which indicated a second shaft to the south of the school building.

Stabilisation works were carried out in both of these areas, through a combination of placement of a gravel and grout mix to the base of treatment boreholes and compaction grouting techniques.

Subsequent further investigations, carried out beyond these two treatment areas, indicated the presence of a network of previously unknown open mine tunnels and weak, disturbed ground associated with historical chalk mine workings.

In several areas, including below the main school building, degradation of the workings had resulted in the collapse of the roofs of the tunnels and ravelling of the overlying material, resulting in the upward migration of void space. Whilst the risk of a further sudden and substantial ground collapse was considered to be low, the consequence of such a collapse was considered to be unacceptably high.

In order to assess the safety of the wider area of the school site, additional investigations were carried out across the whole site. These additional investigations have supported the initial assessment as mine tunnels, roof collapses and upward migrating voids have been found below the south east and north east portions of the school buildings as well as below the main car park, northern playground and the playing field. The extent of the workings encountered and their poor condition significantly increases the possibility of a crown hole collapse occurring within the site boundary.

All of the investigations completed to date have been carried out from within the boundary of the school site. Mine tunnels have also been found to extend partially below Latimer Gardens at the south east corner of the site. However, there is no evidence that the open tunnels identified, either within the school boundary or below Latimer Gardens extend beyond the south east side of the highway, or below the neighbouring properties beyond.

PBA has recommended ground stabilisation works be carried out where open mine tunnels have been identified and in further areas where the presence of weak, disturbed ground associated with historical chalk mine workings has been indicated. This work will be carried out through a combination of bulk infilling of open voids and compaction grouting in other areas.

The full extent of the stabilisation works will only be known on completion of the works. The extent of the detected open voids and mine tunnels have been surveyed and the volume of bulk infill defined. However, the full extent of the compaction grouting works, such as below parts of the eastern portion of the school building, cannot be fully determined at this point in time. The final outcome will depend upon the nature of the ground encountered and its reaction to the compaction grouting process hence a larger or smaller quantity than estimated of compaction grouting may be required.

Some flexibility must therefore be maintained throughout the stabilisation works and in the sequencing of the works. However, the key objective is to complete ground stabilisation works below the school building before the end of December 2017, to enable reoccupation of the school building in January 2018.

8.0 References

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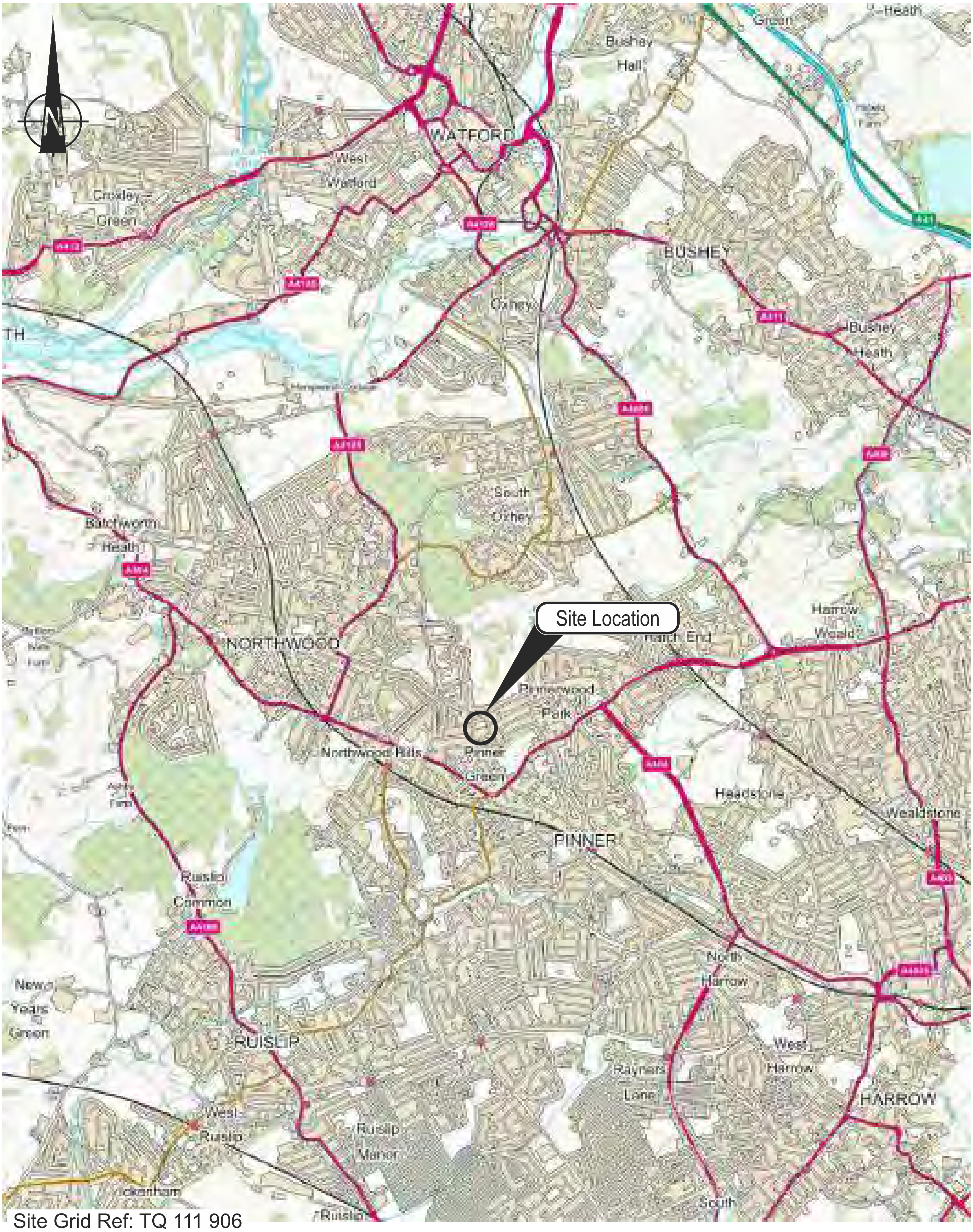
Figures



Site Grid Ref: TQ 111 906

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PINNER WOOD SCHOOL

SITE LOCATION PLAN

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Revision	0

FIGURE 1

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KEY

▨ Building Footprint

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SITE LAYOUT PLAN

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Figure Number
FIGURE 2

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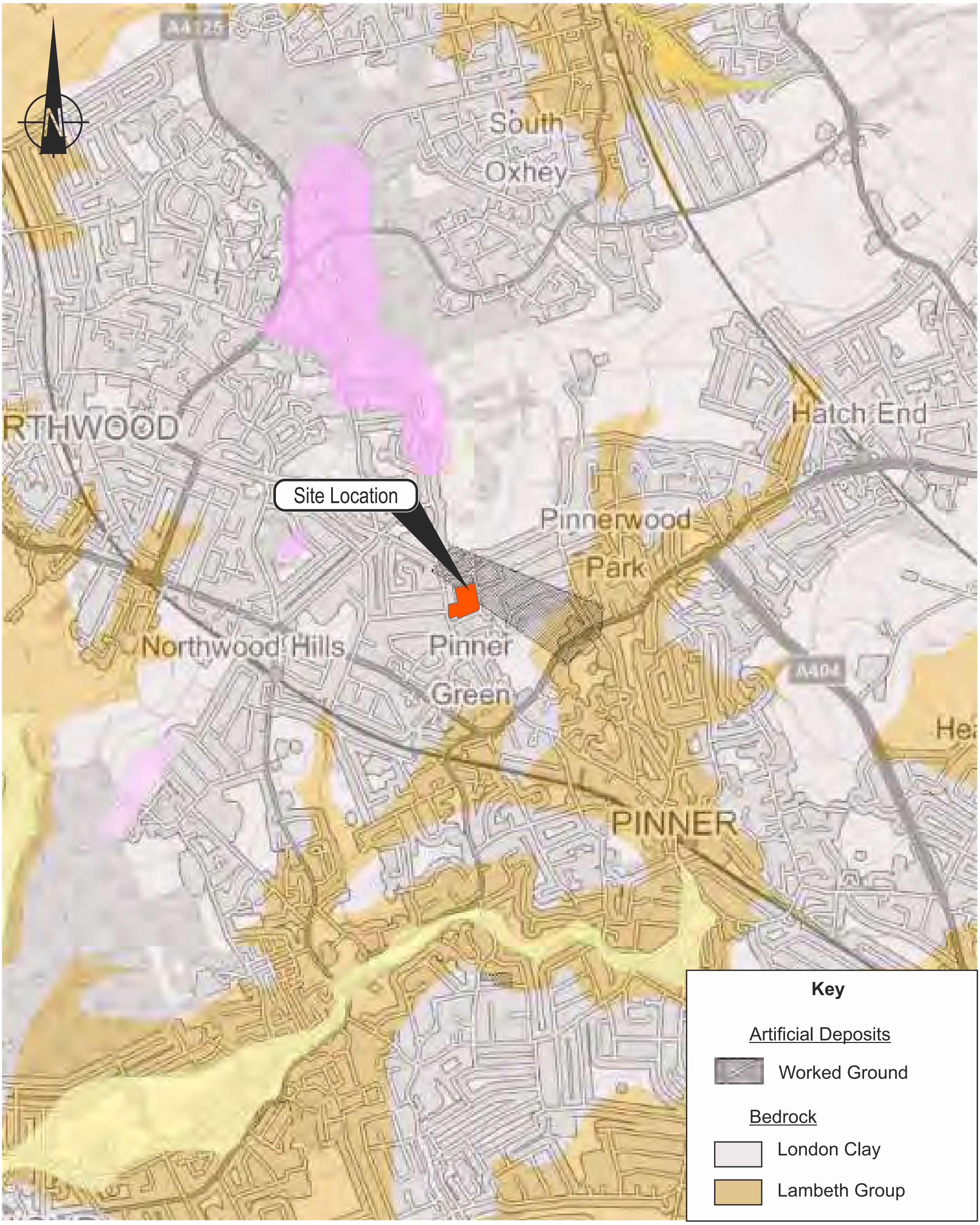

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GEOLOGICAL MAP EXTRACT

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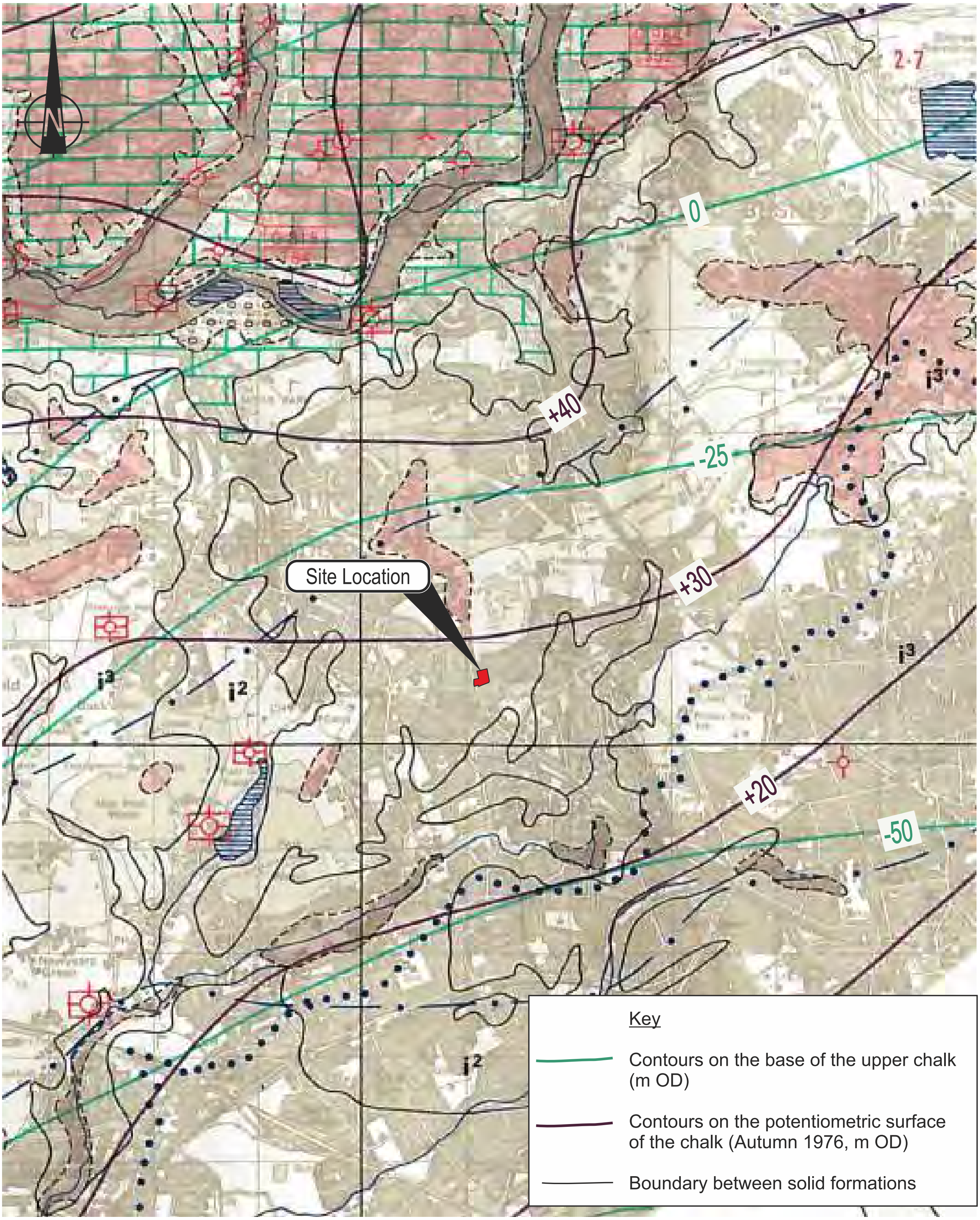
FIGURE 3



Key

🟩	Contours on the base of the upper chalk (m OD)
🟪	Contours on the potentiometric surface of the chalk (Autumn 1976, m OD)
—	Boundary between solid formations

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MAP EXTRACT

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Revision	0

FIGURE 4

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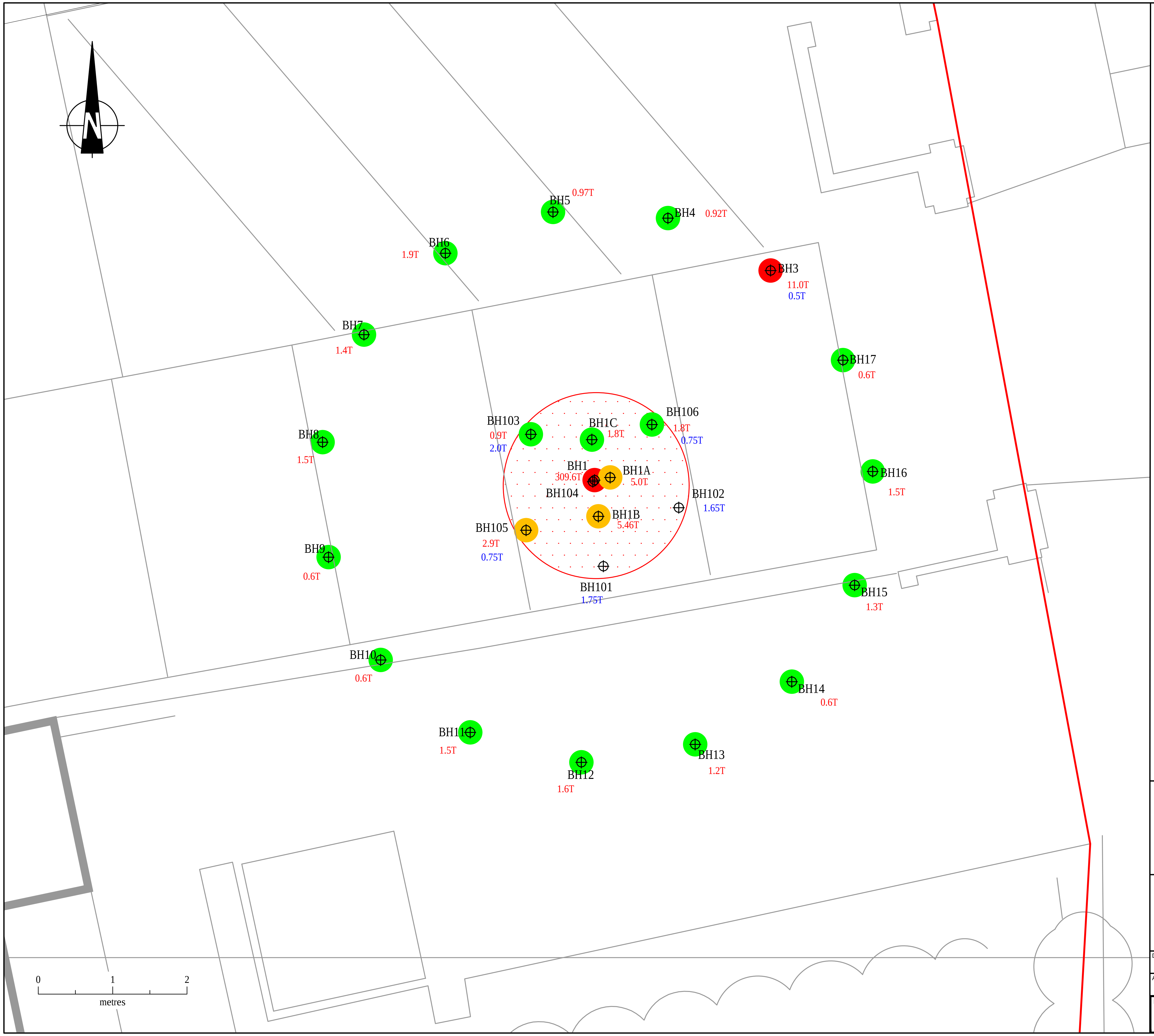

KEY

⊙	Location of Collapse
⊕	Treatment Borehole Location
🟢	Grout Take <2 tonnes
🟠	Grout Take 2-6 tonnes
🔴	Grout Take >6 tonnes
xxT	Grout Takes
xxT	Gravel Takes

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GROUT TAKE PLAN (MAIN SHAFT)

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Figure Number
FIGURE 5

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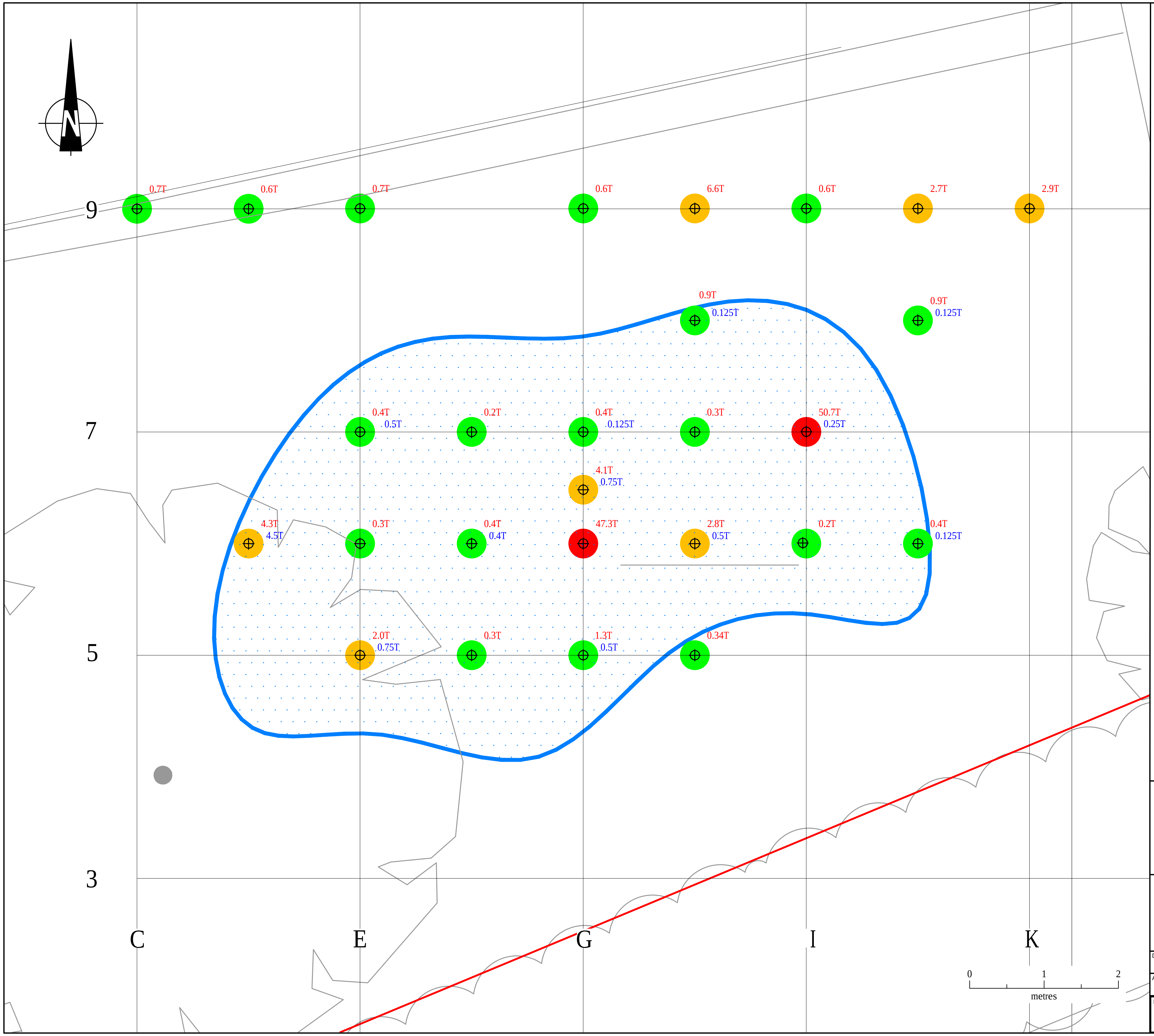

KEY

▨ Ground Penetrating Radar Anomaly

⊕ Treatment Borehole Location

🟢 Grout Take <2 tonnes

🟠 Grout Take 2-6 tonnes

🔴 Grout Take >6 tonnes

xxT Grout Takes

xxT Gravel Takes

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PINNER WOOD SCHOOL

GROUT TAKE PLAN (SOUTHERN AREA)

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Figure Number
FIGURE 6

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KEY

🟥	Location of Collapse
⊕	Treatment Borehole Locations
●	Exploratory Hole Locations

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PINNER WOOD SCHOOL
MAIN SHAFT

EXPLORATORY HOLE LOCATION PLAN

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FIGURE 7

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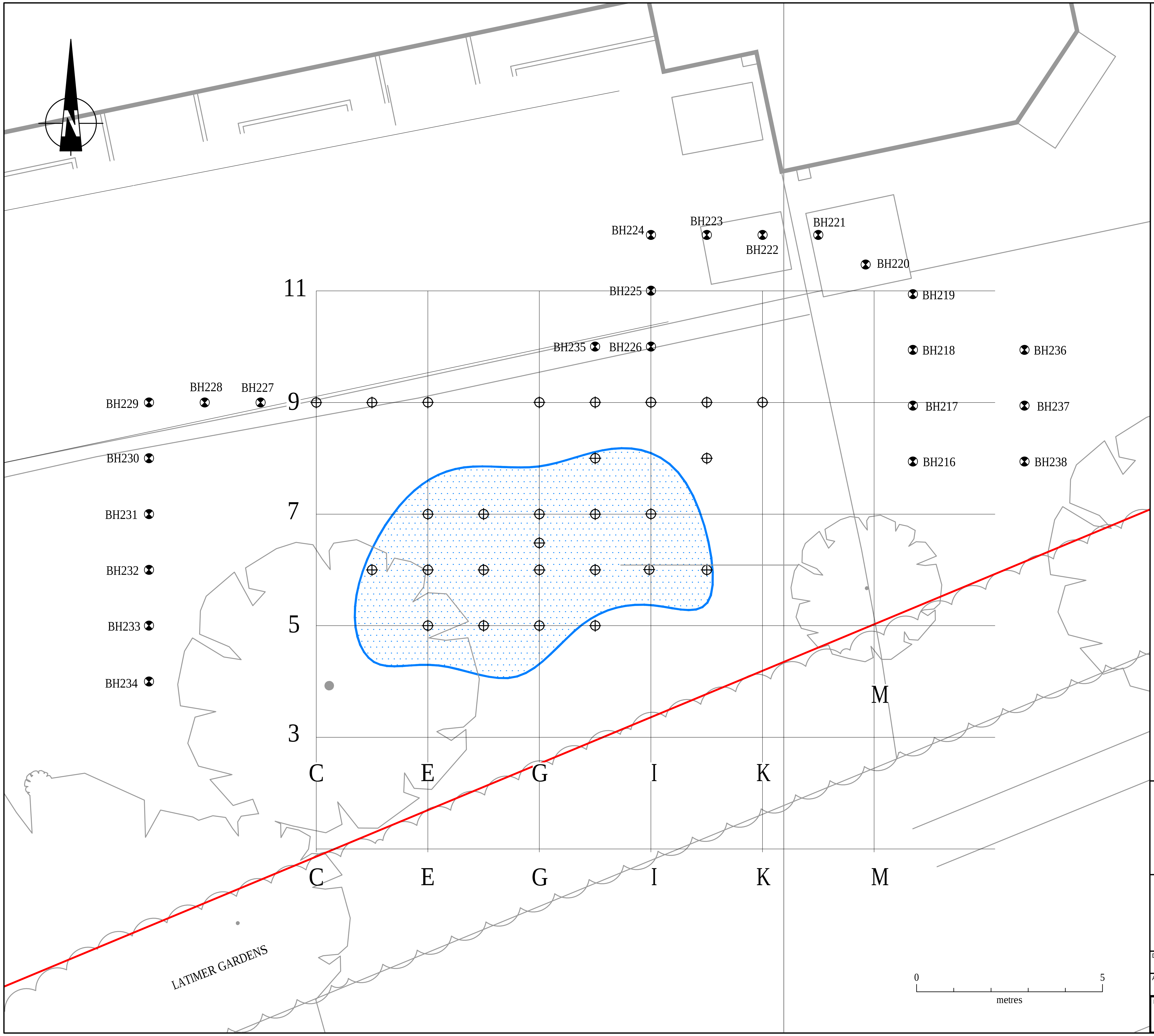

KEY

▨	Ground Penetrating Radar Anomaly
⊕	Treatment Borehole Location
●	Exploratory Hole Locations

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SOUTHERN SHAFT

EXPLORATORY HOLE LOCATION PLAN

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FIGURE 8

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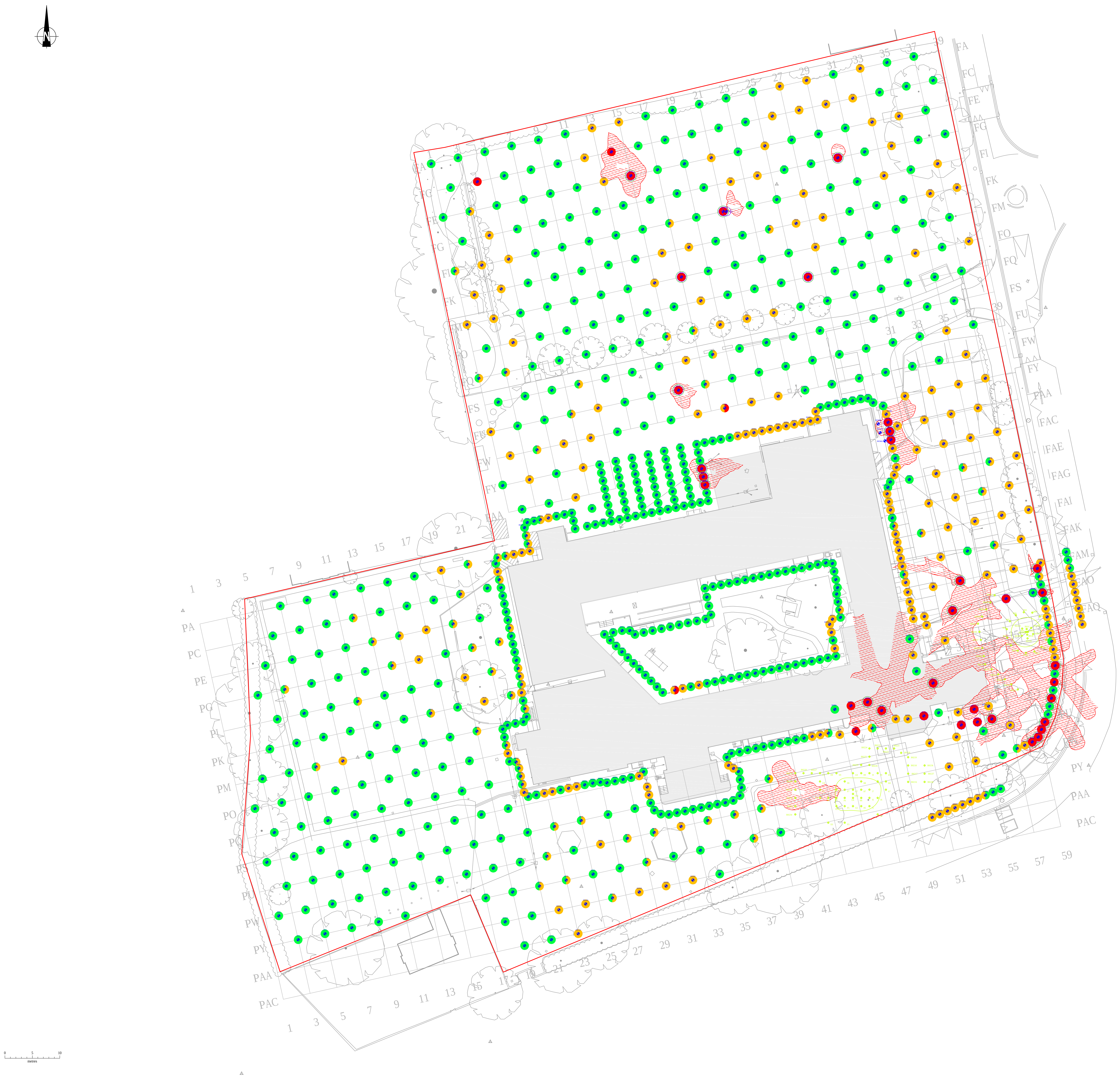

KEY

- ▨ Extent of voids as determined by subsurface laser scan.
- ▭ Building Footprint
- ⊕ Initial Borehole Location
- ◕ Rotary Borehole Location
- 🔴 Boreholes with Evidence of Voids / Broken Ground
- 🟠 Boreholes with Soft / Very Soft Ground Encountered
- 🟢 Boreholes with No Evidence of Voids
- ○ Camera Survey Undertaken
- ○ Laser Scan Locations

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PINNER WOOD SCHOOL

EXPLORATORY HOLE LOCATIONS AND GROUND CONDITION RESULTS

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FIGURE 9

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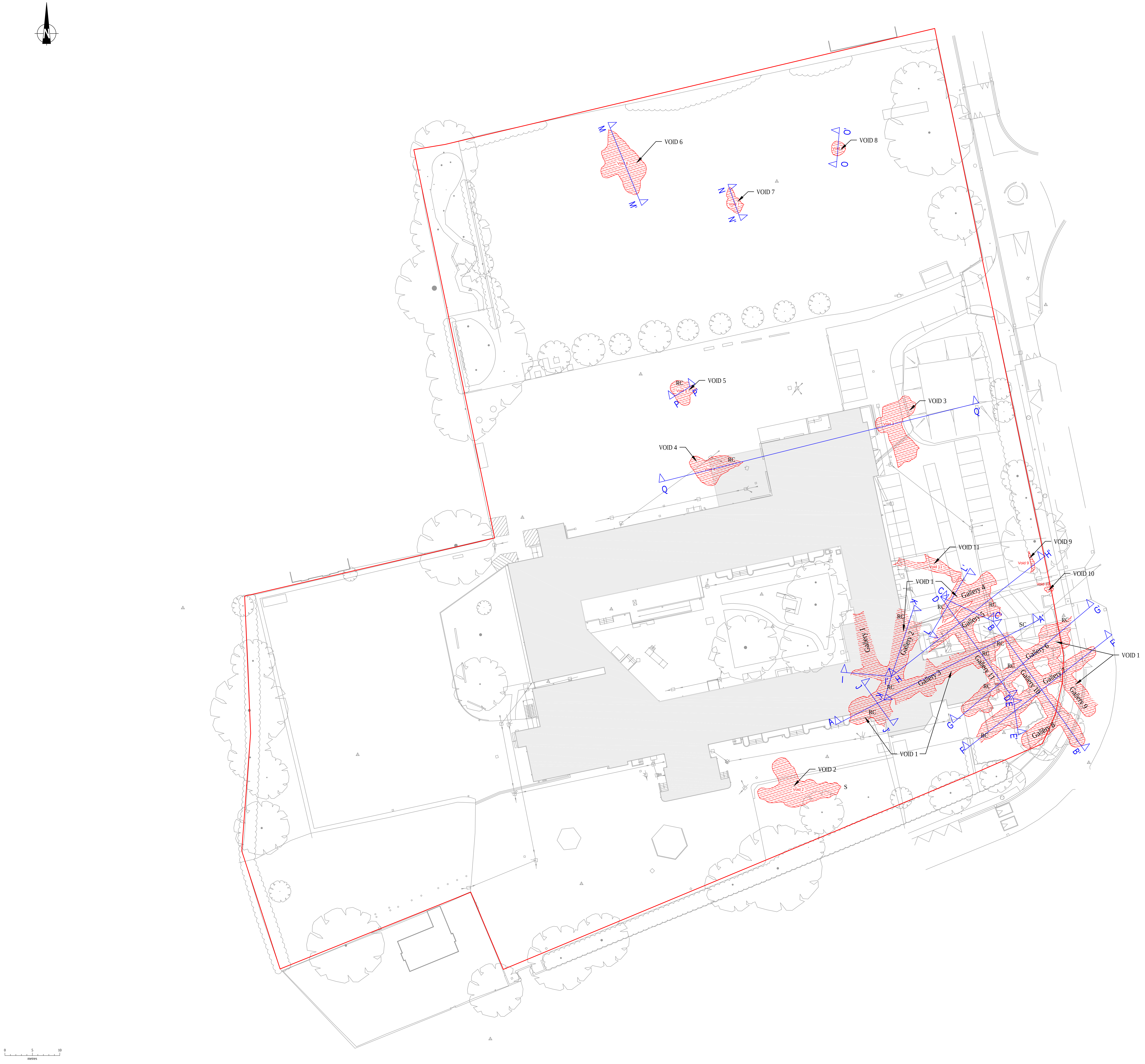

KEY

🟥	Extent of voids as determined by subsurface laser scan.
▨	Building Footprint
RC	Roof Collapse
MV	Migrating Void
S/C	Shaft/Shaft Collapse
Δ——Δ	Cross Section Alignment (Refer to Figures 11-13 for Cross Sections)

PINNER WOOD SCHOOL

INTERPRETIVE PLAN AND CROSS SECTIONS ALIGNMENTS

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FIGURE 10

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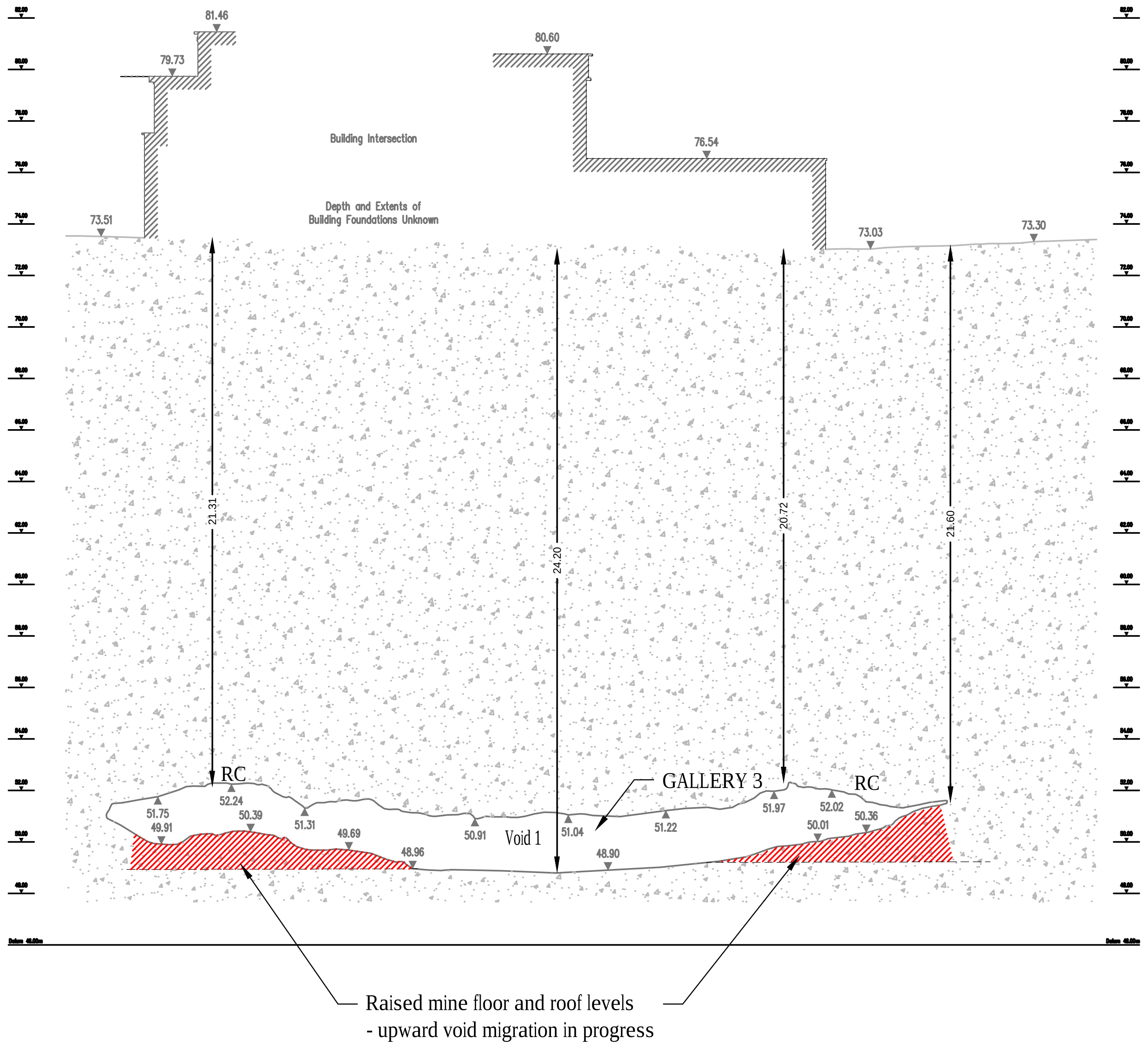
Section A-A'



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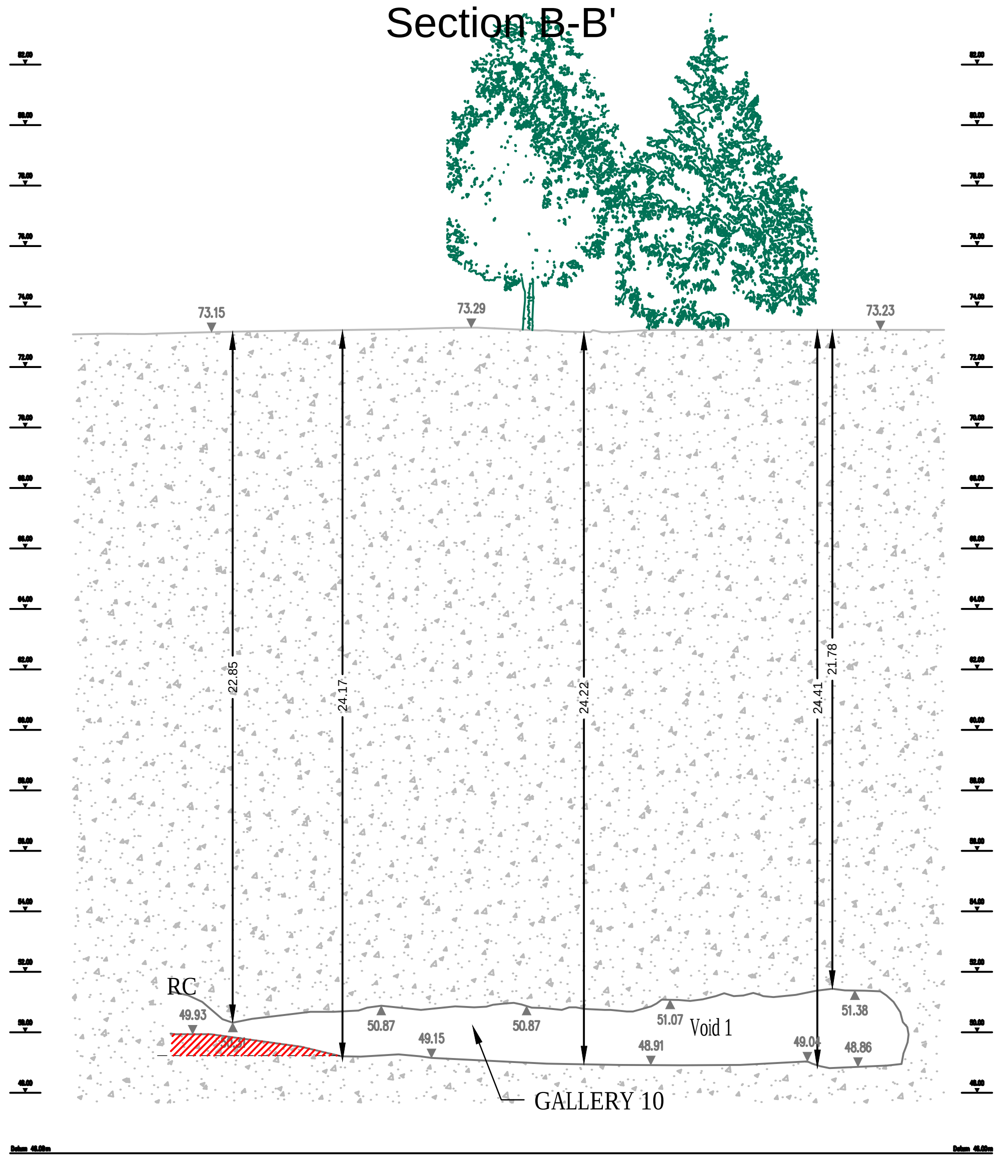
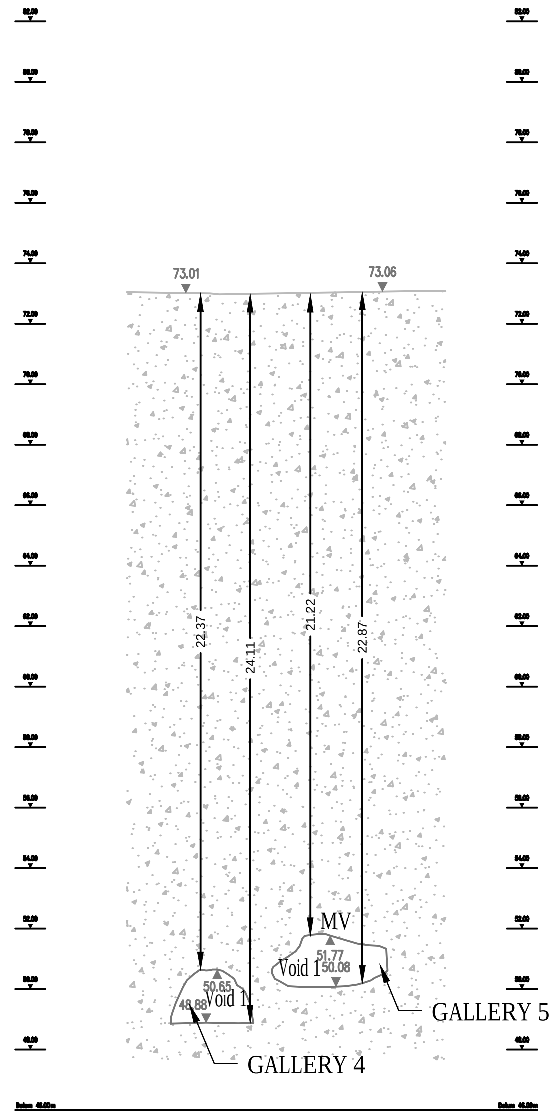


Section C-C'



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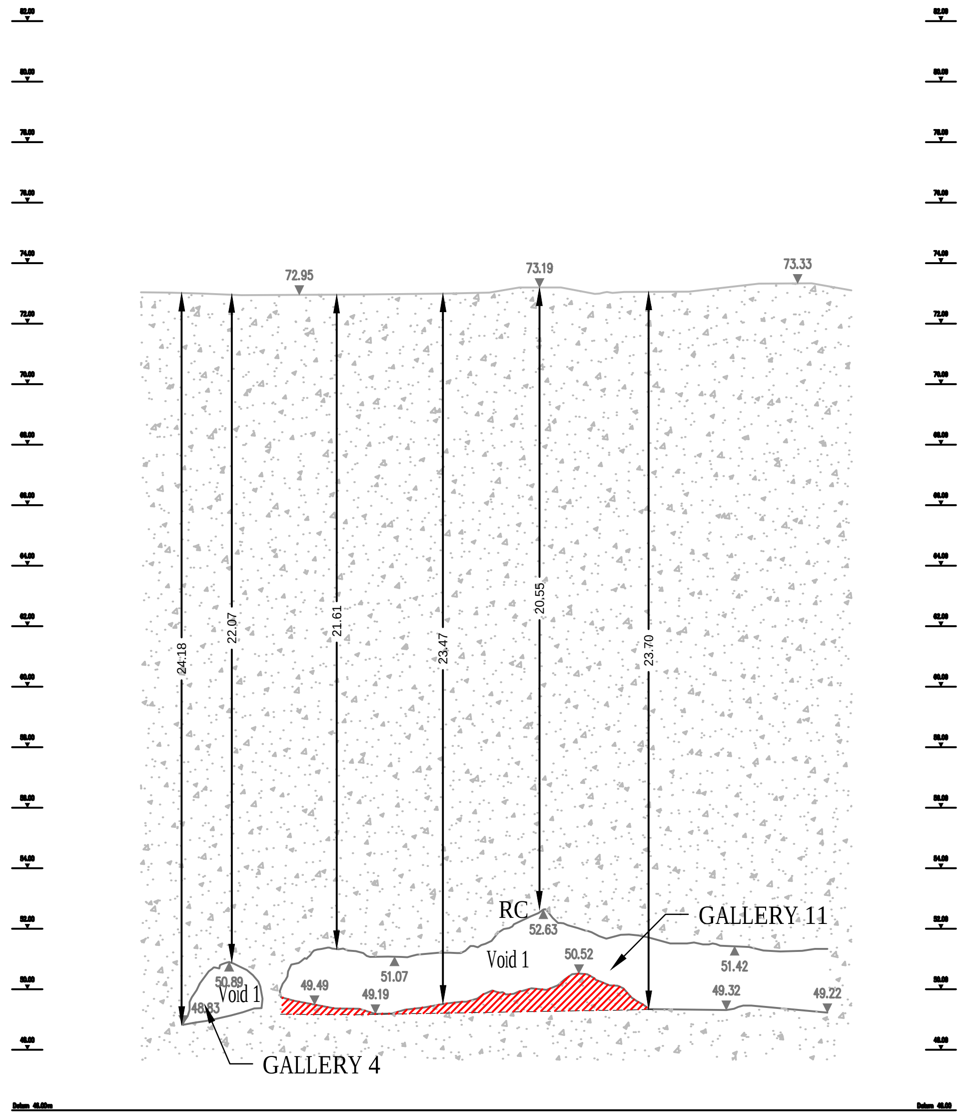

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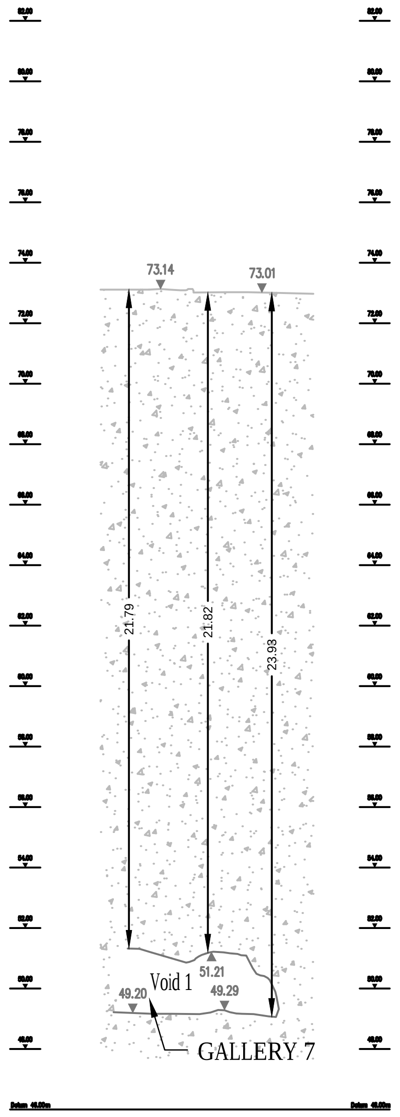

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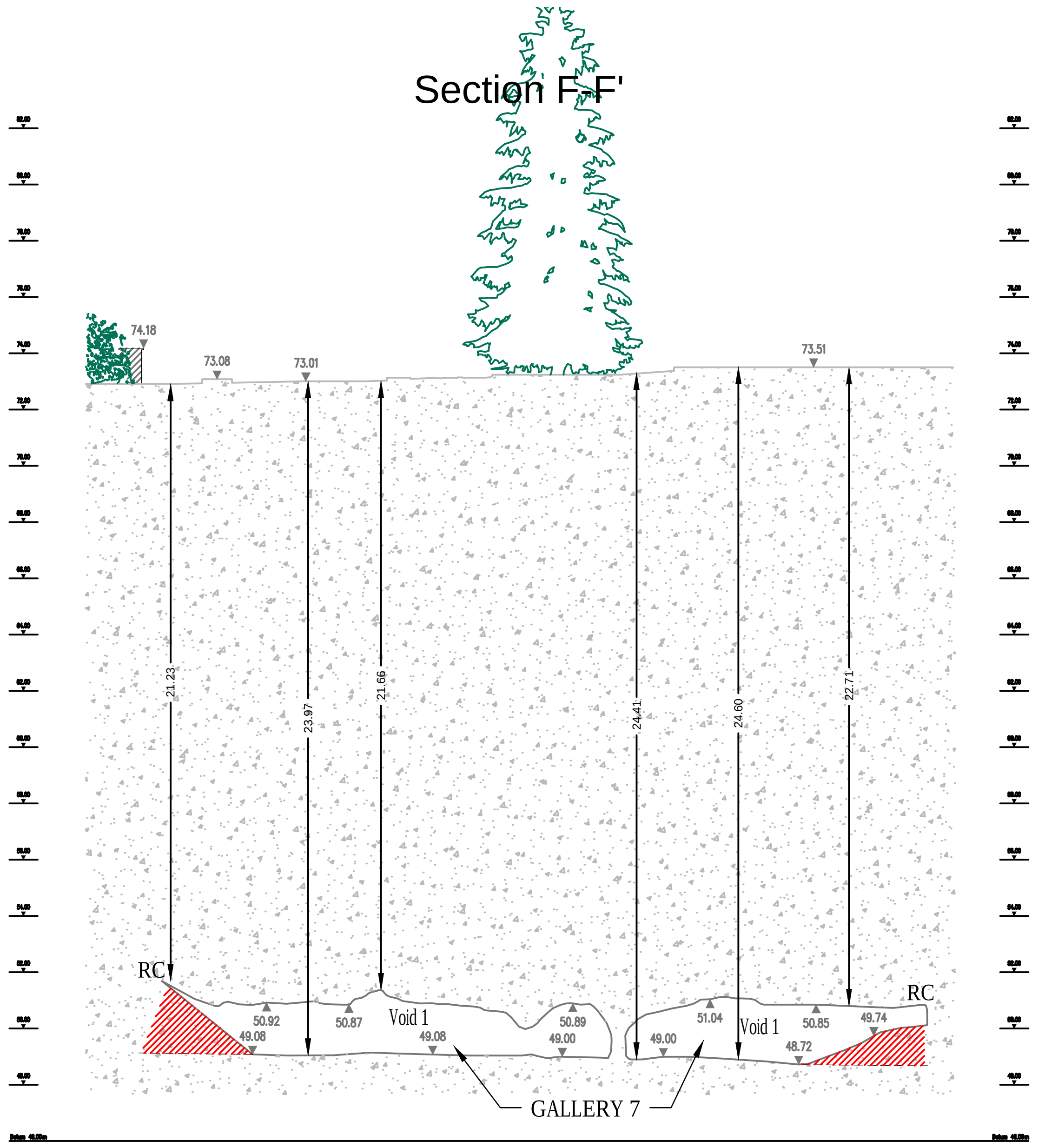
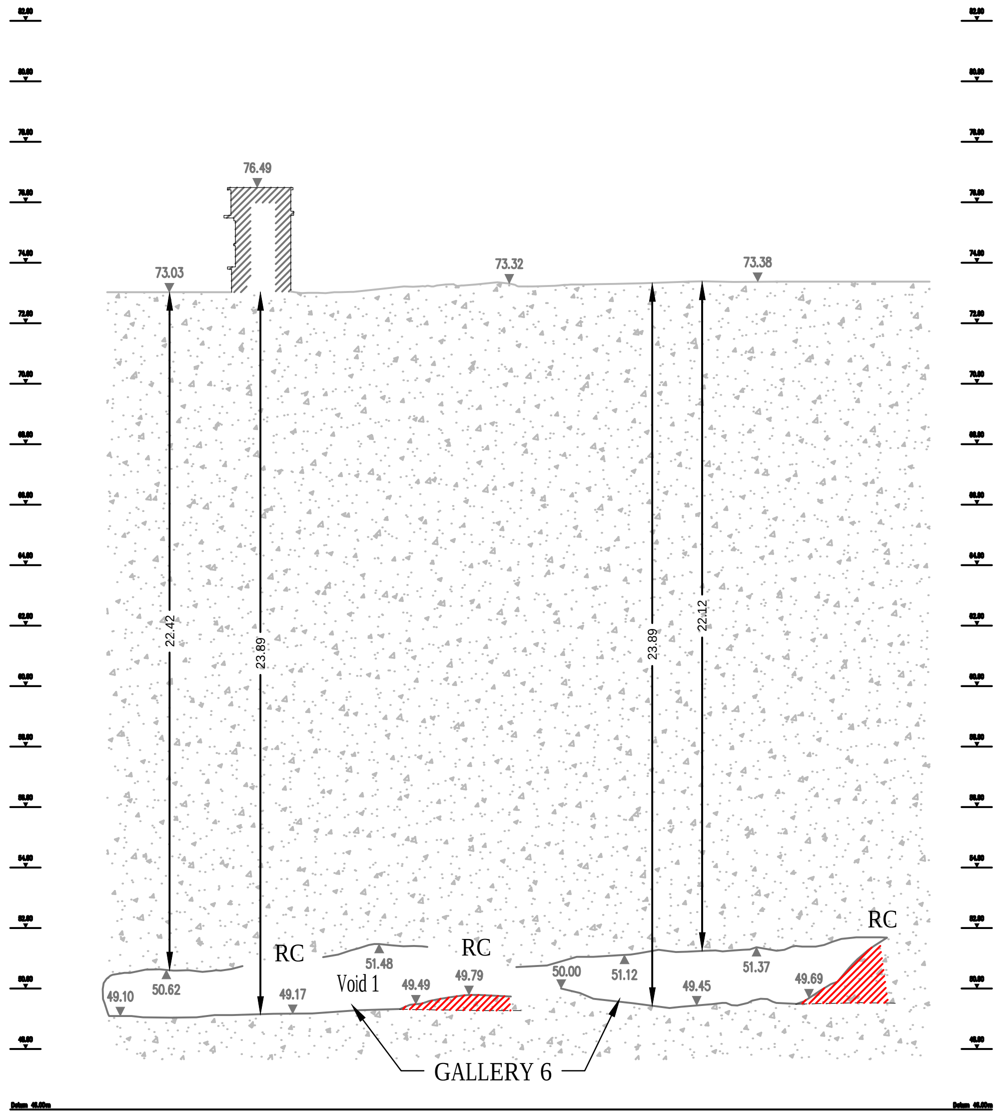


Section G-G'

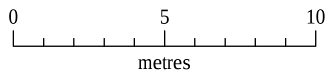


KEY

RC Roof Collapse

MV Migrating Void

Refer to Figure 10 for Cross Section Alignments



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PINNER WOOD SCHOOL

CROSS SECTIONS

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Figure Number
FIGURE 11

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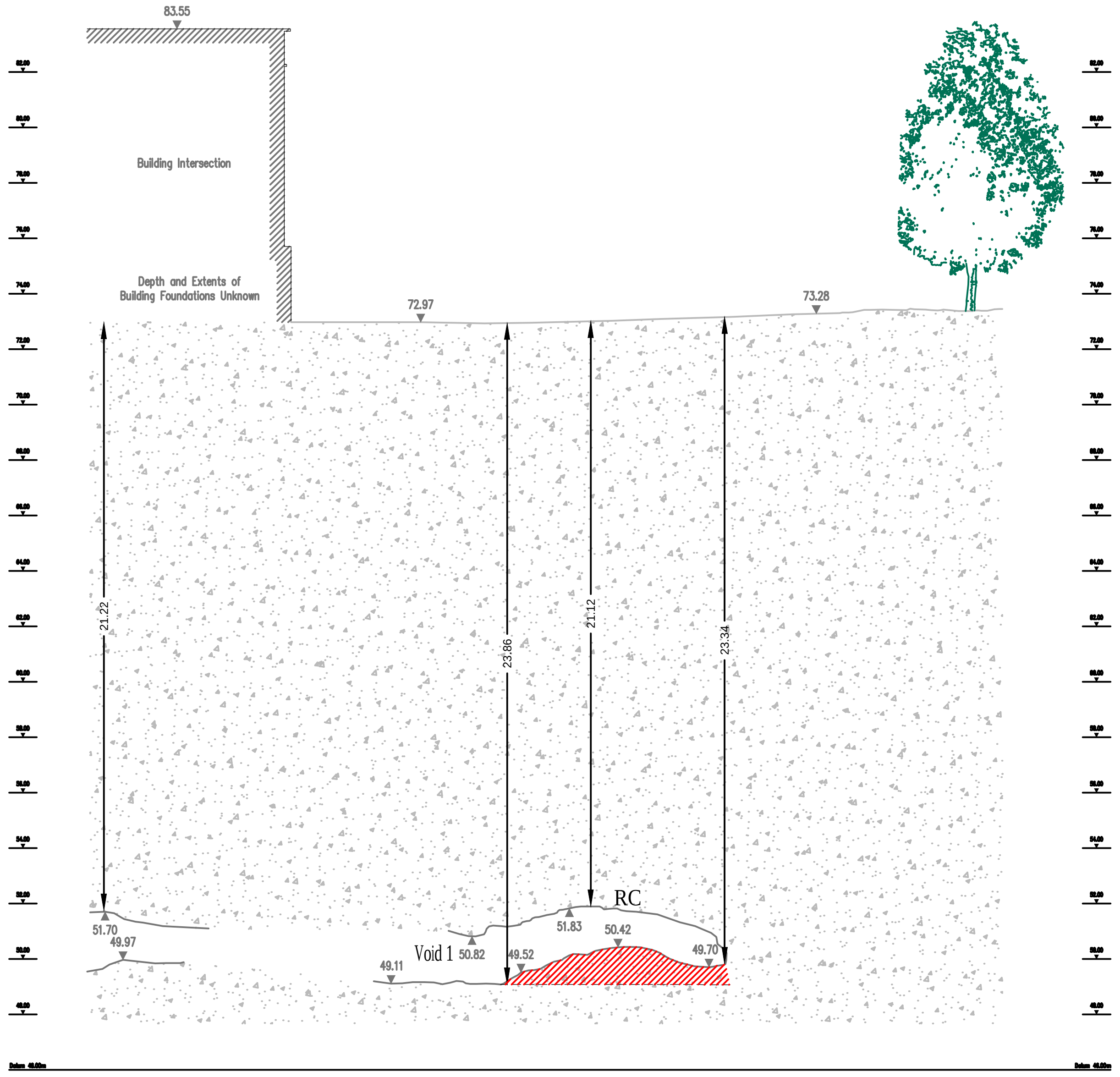
Section H-H'



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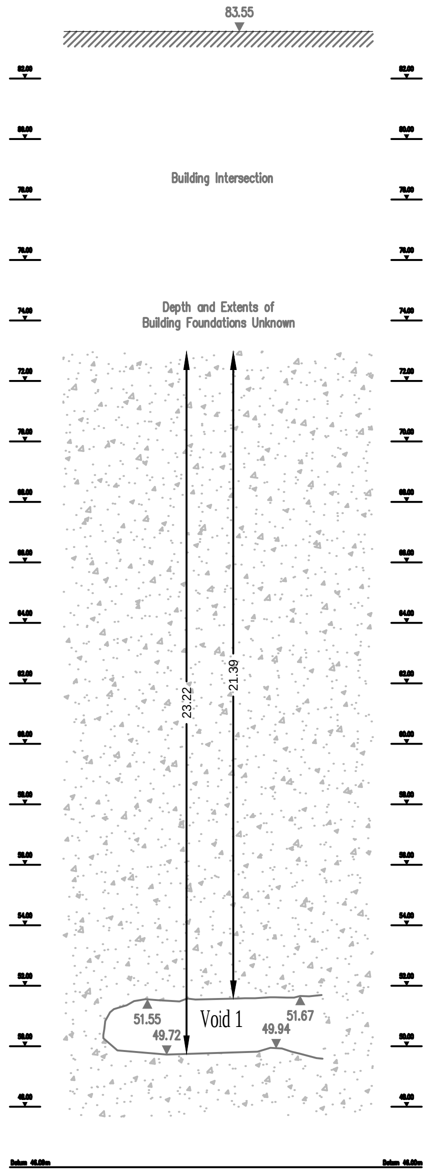

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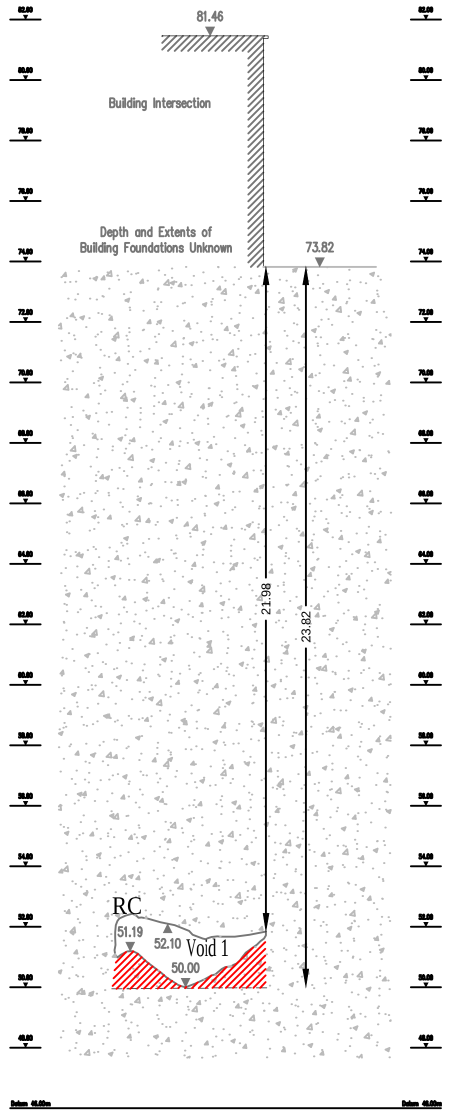

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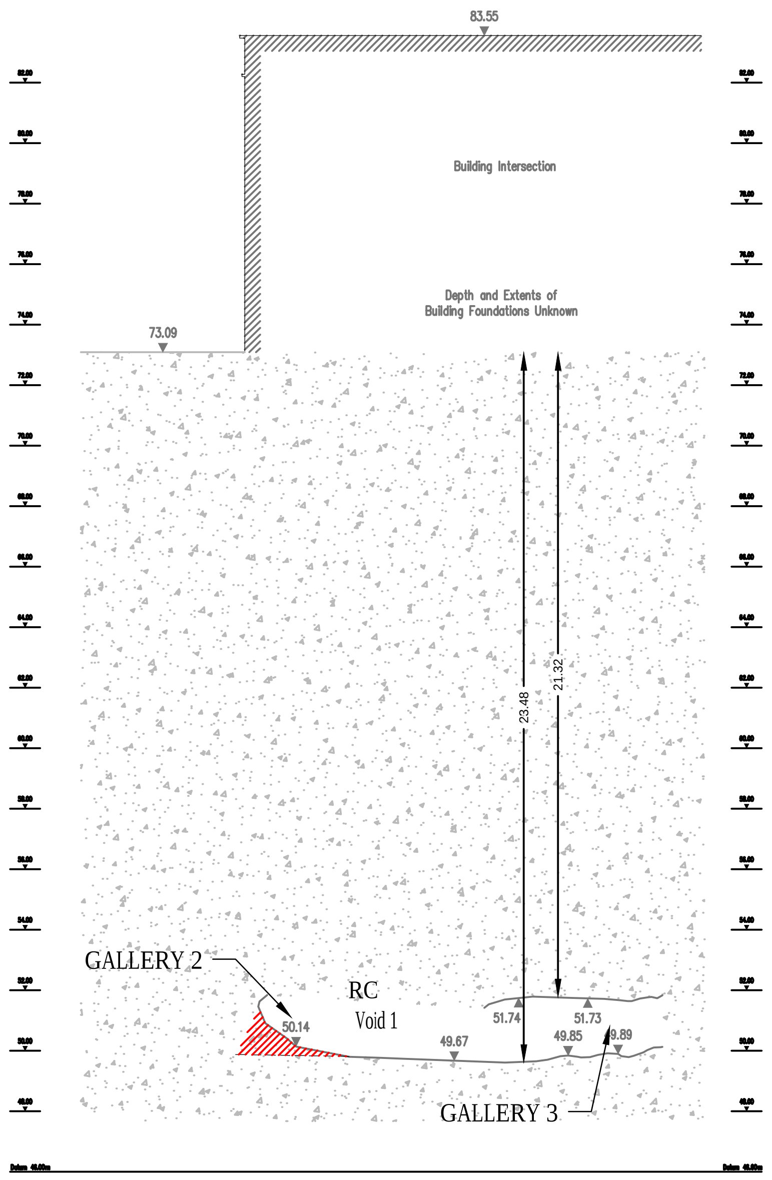

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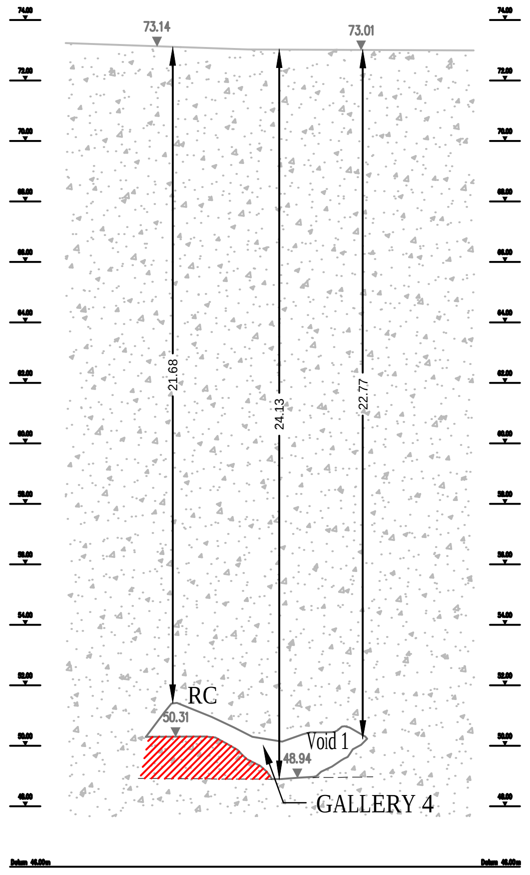
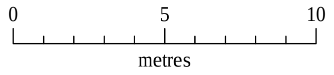


KEY

RC	Roof Collapse
MV	Migrating Void
	Refer to Figure 10 for Cross Section Alignments



This drawing has been produced in colour. Reproduction in black and white may result in misinterpretation of the data and features being presented.

PINNER WOOD SCHOOL

CROSS SECTIONS

Client
People's Capital
Project Team,
Harrow Council

Date of 1st Issue 19.06.2017	Drawn by davco
A2 Scale 1:250	Checked by CW

Figure Number
FIGURE 12

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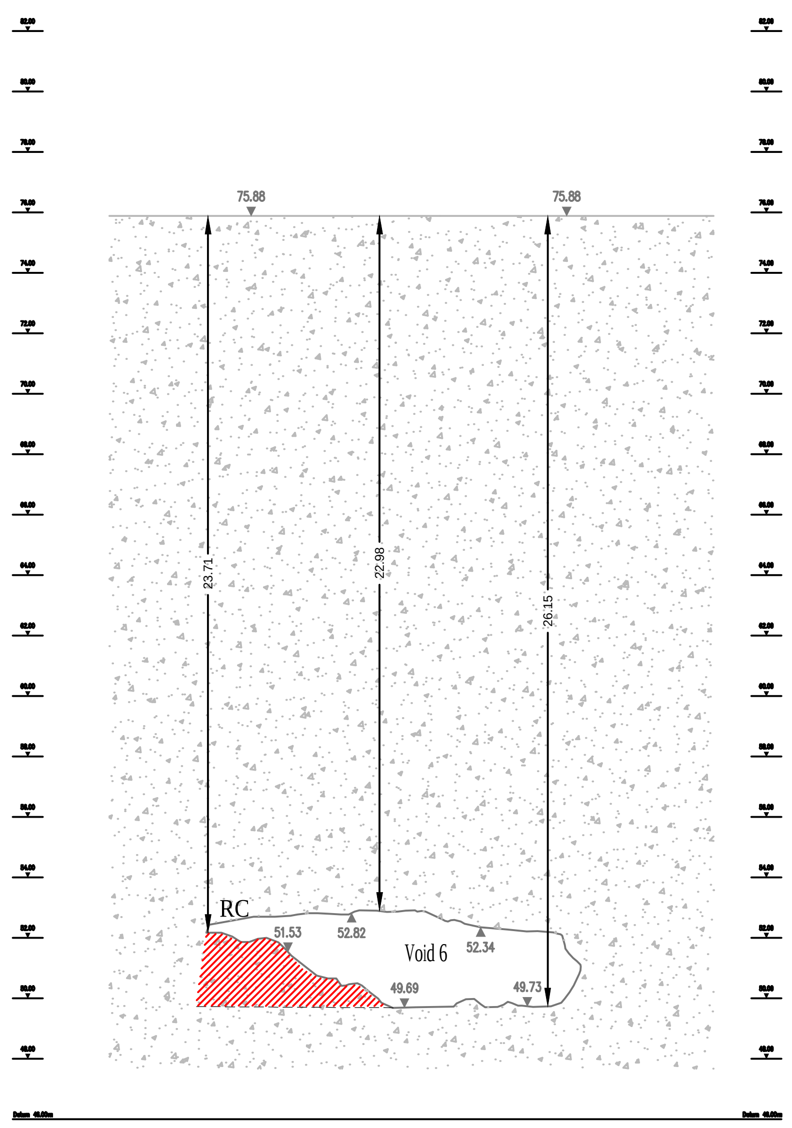
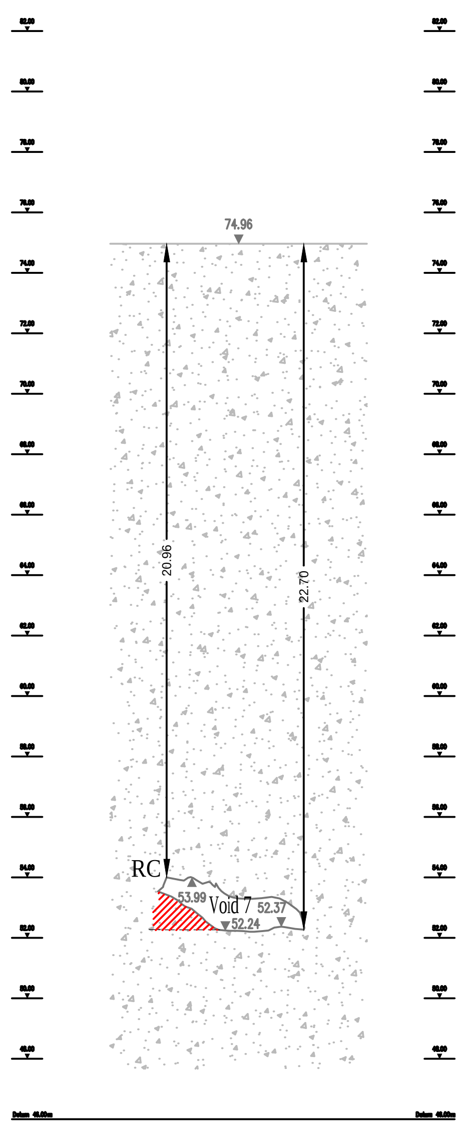
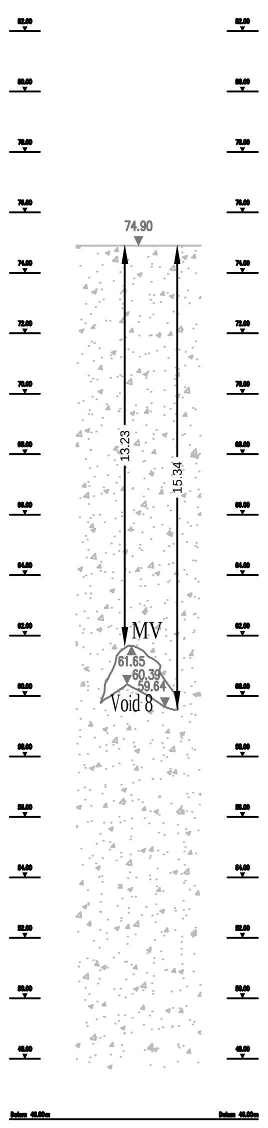
Section M-M'



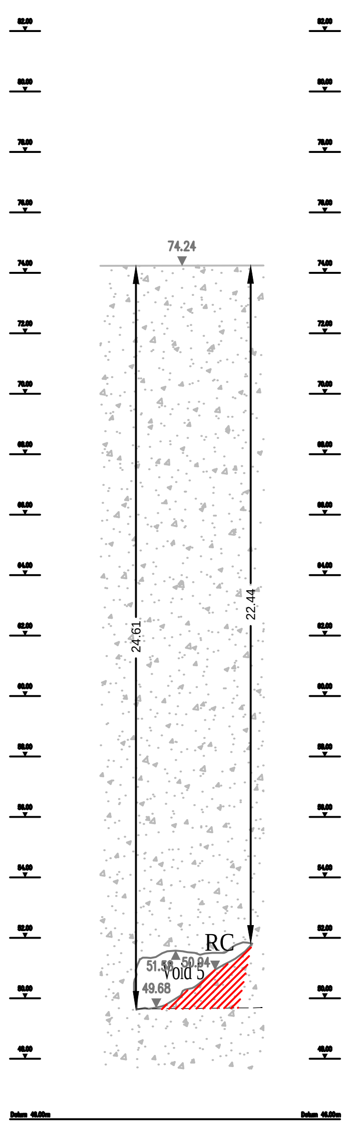
Section N-N'



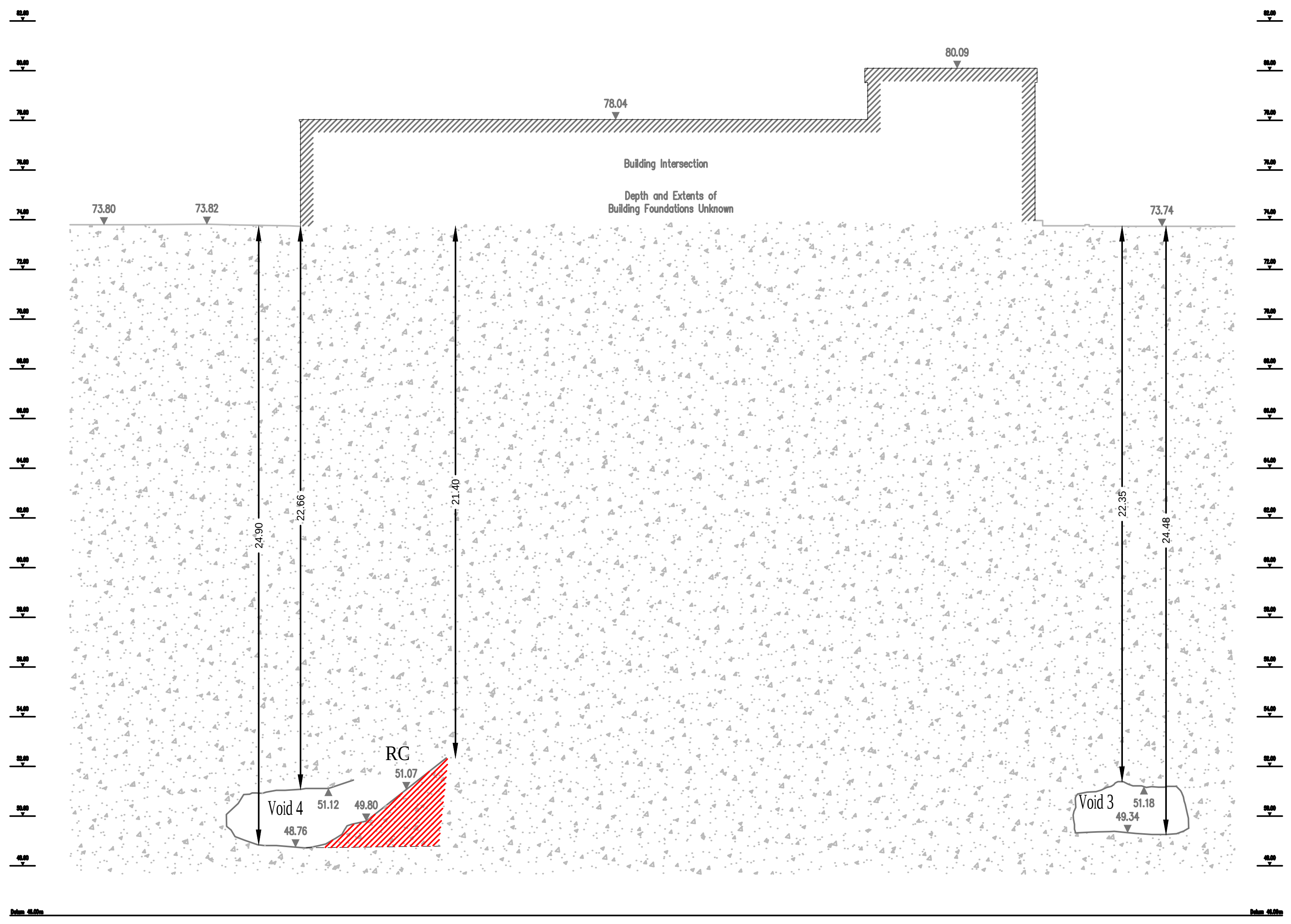
Section O-O'



Section P-P'



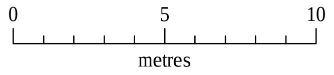
Section Q-Q'



KEY

RC	Roof Collapse
MV	Migrating Void

Refer to Figure 8 for Cross Section Alignments



PINNER WOOD SCHOOL

CROSS SECTIONS

Client
People's Capital Project Team, Harrow Council

Date of 1st Issue 19.06.2017	Drawn by davco
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Figure Number
FIGURE 13

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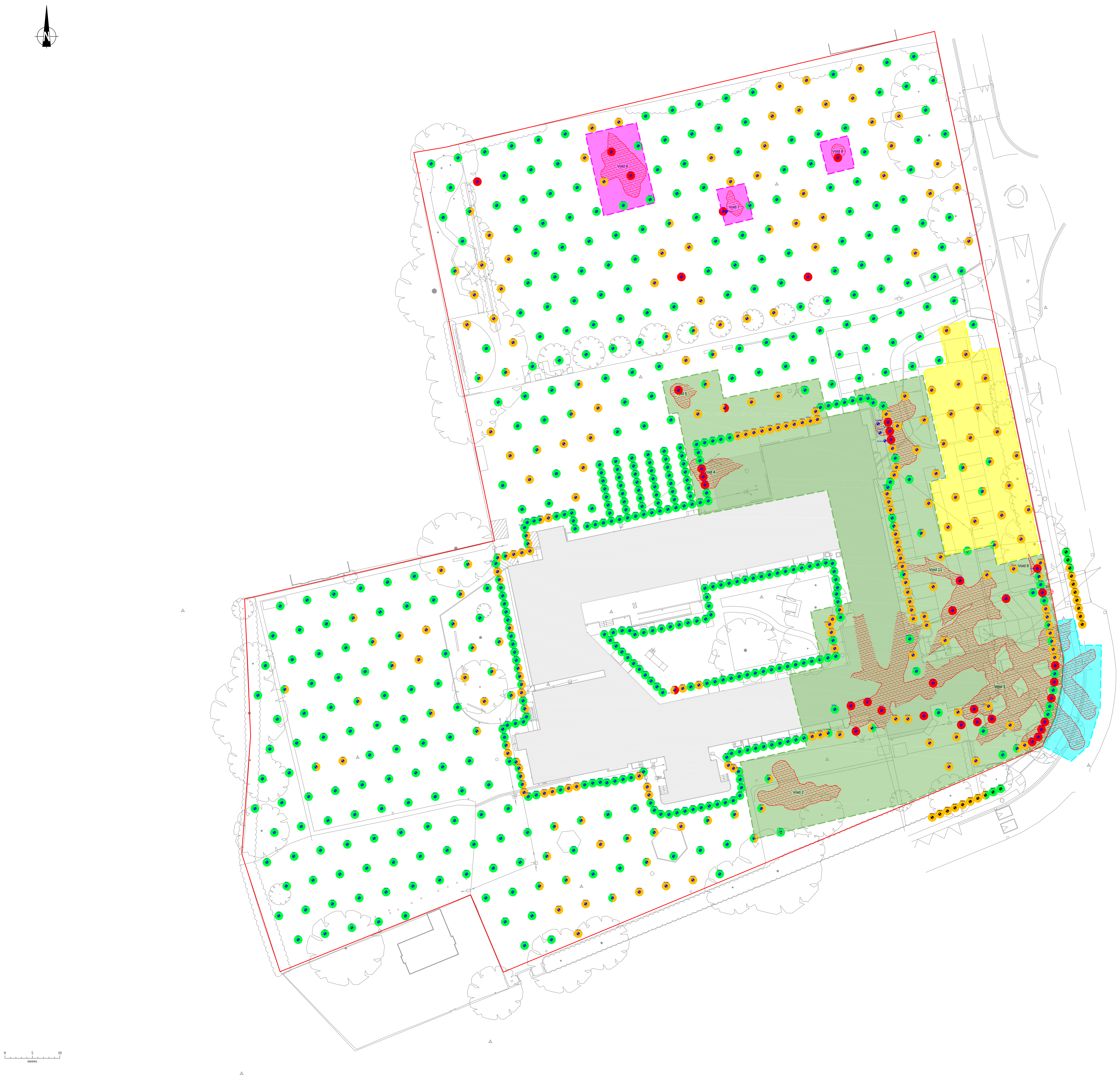

KEY

▨ Extent of voids as determined by subsurface laser scan.

▭ Building Footprint

⊕ Rotary Borehole Location

🔴 Boreholes with Evidence of Voids / Broken Ground

🟠 Boreholes with Soft / Very Soft Ground Encountered

🟢 Boreholes with No Evidence of Voids

TREATMENT PHASES

🟩 🟦 1ST PHASE - BULK FILL ALL VOIDS WITH THE EXCEPTION OF VOIDS UNDER FIELD. COMMENCE FROM SOUTHEAST TOWARD NORTHWEST INCLUDING VOIDS UNDER THE HIGHWAY

🟩 2ND PHASE COMPACTION GROUTING AREA

🟨 3RD PHASE COMPACTION GROUTING AREA

🟪 4TH PHASE - BULK FILL VOIDS UNDER FIELD

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PINNER WOOD SCHOOL

PROPOSED TREATMENT PHASES

Client
People's Capital
Project Team,
Harrow Council

Date of 1st Issue 23.03.2017	Drawn by davco
A0 Scale 1:250	Checked by CW

Figure Number
FIGURE 14

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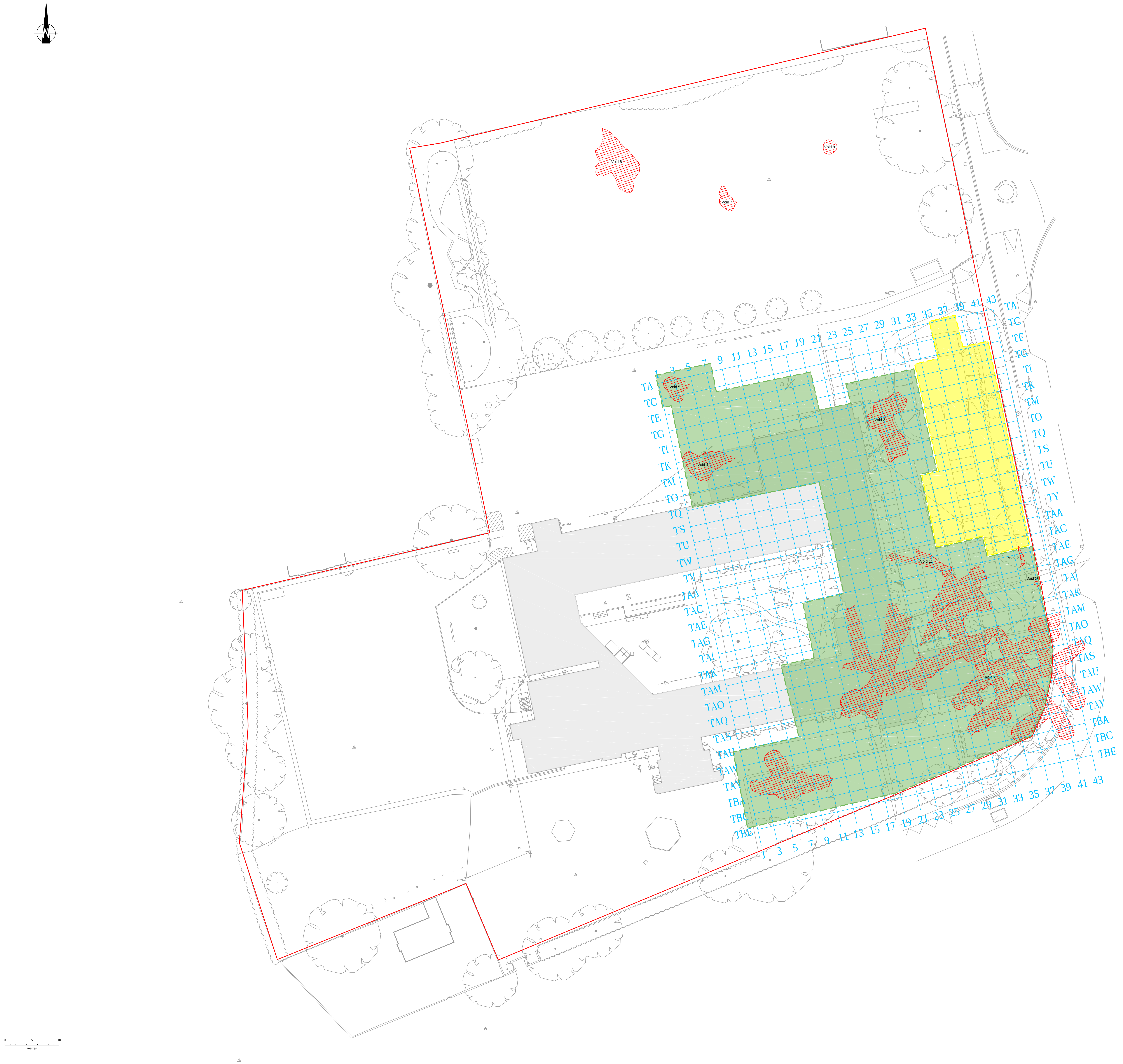
File Location: j:\35665 pinner wood school\03 figures & dwgs\cad\dwgs\3508 completion report figures\35665 - figure 14 (teatment phases).dwg



KEY

🟥 Extent of voids as determined by subsurface laser scan.

▨ Building Footprint

TREATMENT AREAS

🟩 2ND PHASE COMPACTION GROUTING AREA

🟨 3RD PHASE COMPACTION GROUTING AREA

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PINNER WOOD SCHOOL

PROPOSED COMPACTION GROUTING AREAS

Client
People's Capital
Project Team,
Harrow Council

Date of 1st Issue	Drawn by
14.06.2017	davco
A0 Scale	Checked by
1:250	CW

Figure Number
FIGURE 15

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Appendix A

EPG Letter Report, EPG/2015/PWS/Q3/L1

The Environmental Protection Group Ltd
Warrington Business Park
Long Lane
Warrington
WA2 8TX

T: 01925 652980
F: 01925 652983
W: www.epg-ltd.co.uk
E: consultantrequest@epg-ltd.co.uk

5 September 2015

By email to:
Andy Barr
Senior Project Manager
Children's Capital Project Team
Harrow Council
Copy: Debbie Spruce – Head Teacher, Pinner Wood School

Ref: EPG/2015/PWS/Q3/L1

Dear Sirs

PINNER WOOD SCHOOL – HOLE IN CARPARK

We write further to our recent discussions and emails regarding the hole which appeared in the car park of Pinner Wood School (PWS), w/c 17 August 2015. The structure of this correspondence is as follows:

- A review of timescales and works implemented;
- A review of the anticipated ground conditions and collated lines of evidence;
- A summary of the intrusive works completed;
- Conclusions; and
- Recommendations.

Timescales and Works Implemented To Date:

- Hole opened: 18 August 2015.
- EPG initial inspection visit: 21 August 2015.
- EPG inspection visit with Peter Brett Associates (PBA): 24 August 2015.
- Hole cleaned-out, over-hanging tarmac removed and backfilled with Type 1 Aggregate, Heras fencing erected, probe locations marked out and utility scan: 26 August 2015.
- Construction access platform constructed: 27/28 August 2015.
- Series of probes completed: 2/3/4 September 2015.

Anticipated Ground Conditions:

Ground conditions in the proximity of PWS are anticipated to comprise London Clay Formation, underlain by Lambeth Group Formation with Chalk at depth. There are no British Geological Survey (BGS) borehole records in the immediate proximity of PWS. Typically all historical borehole records are located in excess of 0.5km away from PWS and are therefore of limited use. However, for completeness a selection of these logs is appended:

- TQ 195SW13: 10m+ London Clay Formation
- TQ18NW163: 6.5m thickness of River Terrace Deposits, 7.5m London Clay Formation, Lambeth Group encountered at 14mbgl
- TQ19SW40: 10m of London Clay, 10m of Lambeth Group with Chalk at ~20mbgl
- TQ19SW132: 25m of London Clay, 10m of Lambeth Group with Chalk at ~40mbgl

Based on the above log sheets, and the information presented in a book entitled 'Pinner Chalk Mines' (authored by Ken Kirkman and published by the Pinner Local History Society, 1992) it is anticipated that Chalk will be present at between 20m and 25m below ground level.

A copy of the above book has been obtained by EPG, an extract of which is appended. This indicates the site of PWS is located on 'Chalk Pits Field'. Key information from this book relating to the Chalk Pits Field may be summarised as follows:

- The Chalk Pits Field was reinstated for agricultural use in 1815 (therefore any chalk workings at depth would pre-date this time, most likely dating to around 1806);
- The school was constructed in 1938/9 and sits on the old Chalk Pits Field;
- Trial shafts are likely to have been sunk in and around Chalk Pits Field;
- The location of Chalk Pit Field reduces the travel time between the chalk mine shafts and the kiln (which was historically located at Pinner Hill Farm, immediately opposite Albury Drive);
- Shafts in the Pinner area are typically 5-foot (~1.5m) diameter and brick lined.

EPG has spoken to the author of Pinner Chalk Mines, Ken Kirkman. Ken has no definite information regarding the nature of any chalk workings beneath PWS. However, he indicated that anecdotal information suggests that a hole may have previously opened-up (approximately 35-yrs ago), on the grassed playing field which forms the northern portion of the school site.

EPG have reviewed historical Ordnance Survey (OS) maps for the site, copies of which are appended. The earliest OS map is dated 1868 and indicates the site to comprise agricultural fields, with Pinner Hill Farm to the north. There is no development indicated on the site until the mid-1930's, when PWS is constructed. Having reviewed the OS maps there is no indication of any possible structures (e.g. old buildings with cellars, air raid shelters etc.) in the proximity of the hole. Certainly the historical maps are consistent with the 'Pinner Chalk Mines' publication, which indicated any workings were restored to agricultural land use by 1815 (i.e. pre-dating the OS maps).

EPG have contacted Harrow Local History Centre to ask them to review their archives for any available information pertaining to the PWS site. At the time of writing this correspondence no information has been received.

In many instances collapsed drains and sewers can be responsible for holes appearing in the ground. Utility service plans have been provided (see appended), which do not indicate any foul sewers to be present in the immediate proximity of the hole. A surface water drain is present, running parallel with the southern boundary of the hole. During the site works 26 August 2015 manhole covers either side of this section of surface water drain were lifted and a rudimentary dye test completed. Certainly the drain does function, with dye observed at the down-gradient manhole. Notwithstanding this, the fall on the drain was noted to be minimal (0.23m, over an approximate lateral distance of ~10m) and some slight seepage of water could be seen from the sub-grade material around the drain (which appeared to be evident in the southern wall of the hole at 1.2m below ground level). Going forward it would be prudent to have this drain CCTV surveyed. However, the surface water drain is not considered to be the root-cause of the hole which has appeared – although it could be a contributory factor to the main cause of the hole (see discussion below).

Intrusive Works:

On 26 August 2015 EPG supervised the following works:

- Removal of all tarmac over-hanging the hole;
- Removal of all large pieces of tarmac which had fallen into the hole;
- Infilling of the hole with Type-1 aggregate.

Due to concerns about the inherent stability of the underlying hole no compaction of the Type-1 aggregate was undertaken. Instead, the Type-1 aggregate was loose filled into the hole using the JCB's bucket.

On removal of the over-hanging tarmac the hole was found to be roughly circular with a 3m diameter and extended to 2m (maximum) depth.

Soils in the base of the hole were found to comprise soft, orange/brown/grey, highly fissured, clay. The material was evidently reworked, but appeared to be consistent with the presence of London Clay Formation. Similar material was observed in the sides of the hole. There appeared to be vertical fissure surfaces at the edge of the hole.

Once the hole had been filled with Type-1 aggregate 6 No. probe positions (PH1 to PH6) were marked out – offset laterally by 2m from the final extent of the hole. These positions were scanned by a utility detection company to ensure no services were present. A 7th probe position (PH7) was also demarked, immediately through the centre of the backfilled hole.

On 27 and 28 August 2015 Construction Access Limited (CAL) attended site and constructed a reinforced working platform measuring 8m by 8m. The working platform was designed by CAL to provide safe access for a Dando Terrier Rig (see data sheet appended) onto the 7 No. probe locations. A copy of the Handover Certificate for the working platform is appended.

On 2/3/4 September 2015 Geocore Limited attended site with EPG and completed the 7 No. probe locations utilising a super heavy weight DCP rig. The probes were completed in numerical order, with PH1 to PH6 (i.e. those off-set 2m from the hole) completed first and PH7 (i.e. through the hole) completed last. Probe logs for all the positions are appended, as is an annotated plan showing the approximate exploratory hole positions (please note that when the access platform is removed a more accurate plan should be produced, via topographical survey).

PH1 to PH6 consistently recorded evidence of soft / loose ground (N-values less than 5 blows per 100mm ground penetration) to between 3.15m and 5.3m below ground level (mbgl). Below these depths N-values were noted to steadily increase, with refusal (N-values >50 blows per 100mm penetration) recorded at between 8.55m and 16.25mbgl. Sand was noted on the probe rods at between 13m and 14mbgl, which may be representative of the basal beds of the London Clay Formation and/or Lambeth Group. The probe rods extracted from locations PH1 to PH6 were typically dry.

PH1 to PH6 indicated that, although the ground around the collapse hole was soft, it did not appear to be unstable and voids were not detected. Therefore the risk of further collapse was considered low. The construction access platform spreads the load of the drill rig and if further collapse of the central hole occurred the platform would support the rig and crew. Therefore it was considered safe to drill PH7.

PH7 recorded soft / loose ground to 24.7mbgl. Beyond this depth N-values increased, with the position terminated at 25.8mbgl (N-value of 30+). Further penetration risked the rods locking up in the ground, preventing extraction (the access platform was flexing when the drillers tried to pull-back the rods). The rods in PH7 were noted to be moist on extraction indicating the presence of water.

During the drilling works very soft / loose ground was recorded regularly, with the drop hammer of the probing rig observed to fall under its own weight. However, at no time were any voids observed.

Following completion of the above works, 2 No. 'baseline' probeholes were completed. One located approximately 12.5m from the hole (PH8) and one located approximately 25m from the hole (PH9). The results of these probes are appended.

Both PH8 and PH9 were hand-excavated to 1.2mbgl. In PH8 firm, orange/brown/grey, silty clay with orange sand partings was recorded. This material was proven to 1.2m depth, but was noted to be soft below 0.9m. The material encountered was observed to comprise London Clay Formation. In PH9 Made Ground was encountered, comprising gravelly sandy clay, with brick and concrete and frequent small fragments of chalk and some slate. Below 0.9m the Made Ground graded into soft to firm, orange/brown/grey, silty clay with occasional orange sand partings – which is again considered likely to represent the London Clay Formation.

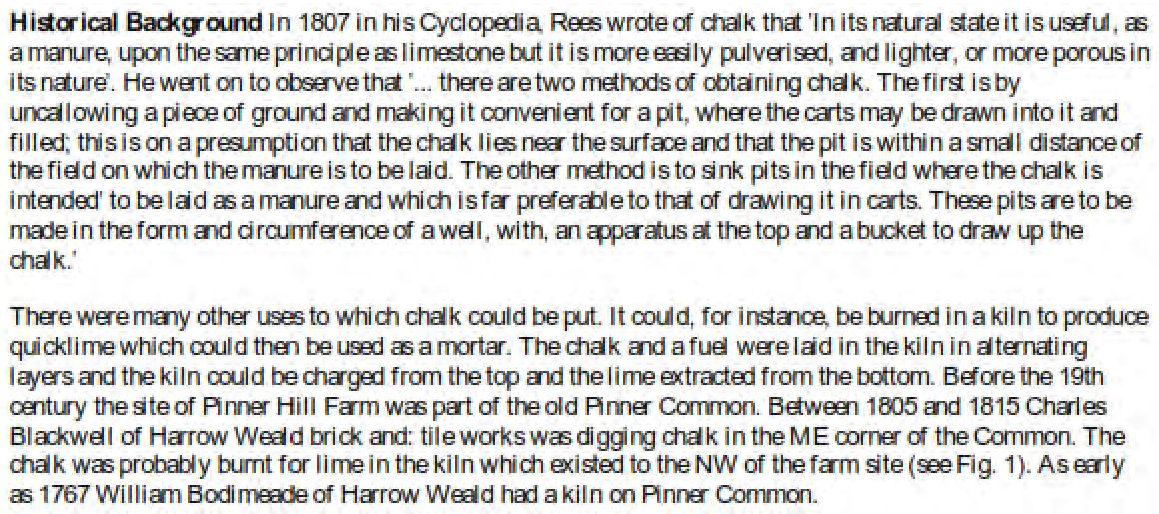
Ground conditions in PH8 were very similar to PH1 to PH6, whereby soft / loose ground was recorded to 4.9mbgl, with N-values steadily increasing with depth (the position was terminated at 7mbgl).

In PH9 soft / loose ground was recorded to the full extent of the probe location at 10mbgl. The base of the soft ground was not proven due to time constraints. In PH9 the drop hammer of the probing rig was observed to fall under its own weight. Again, no voids were observed.

<u>Conclusions:</u>

The results of the intrusive works implemented by EPG suggest that the hole which appeared in the carpark at PWS is most likely associated with a historical shaft. This may have been an exploratory shaft to investigate ground conditions, or a small shaft via which Chalk was historically extracted. The shaft has clearly been backfilled with low-strength material, which is wet (possibly associated with the adjacent surface-water drain) and has recently failed – forming the surface hole. The depth of the shaft (24.7mbgl) appears consistent with anecdotal evidence which suggests that chalk is likely to be present at 'between 20m and 25m below ground level'.

Review of web-based historical information suggests that similar shafts were excavated to the north of PWS, at Pinner Hill Farm (see the extract below from the Greater London Industrial Archaeology Society website, GLIAS). In Paragraph 2 of the below text, if the reference to 'ME' is a typographical error for 'SE' then this would correlate well with the area where the shaft has been identified – i.e. on the south-eastern area of PWS (the general area of which was historically referred to as Pinner Common).



Historical Background In 1807 in his Cyclopedia, Rees wrote of chalk that 'In its natural state it is useful, as a manure, upon the same principle as limestone but it is more easily pulverised, and lighter, or more porous in its nature'. He went on to observe that '... there are two methods of obtaining chalk. The first is by uncallowing a piece of ground and making it convenient for a pit, where the carts may be drawn into it and filled; this is on a presumption that the chalk lies near the surface and that the pit is within a small distance of the field on which the manure is to be laid. The other method is to sink pits in the field where the chalk is intended' to be laid as a manure and which is far preferable to that of drawing it in carts. These pits are to be made in the form and circumference of a well, with, an apparatus at the top and a bucket to draw up the chalk.'

There were many other uses to which chalk could be put. It could, for instance, be burned in a kiln to produce quicklime which could then be used as a mortar. The chalk and a fuel were laid in the kiln in alternating layers and the kiln could be charged from the top and the lime extracted from the bottom. Before the 19th century the site of Pinner Hill Farm was part of the old Pinner Common. Between 1805 and 1815 Charles Blackwell of Harrow Weald brick and: tile works was digging chalk in the ME corner of the Common. The chalk was probably burnt for lime in the kiln which existed to the NW of the farm site (see Fig. 1). As early as 1767 William Bodimeade of Harrow Weald had a kiln on Pinner Common.

No voids have been encountered during the intrusive works. However, as evidenced in all the probehole locations the upper portion of the London Clay Formation (to around 5mbgl) appears very soft. It is considered likely that this material may be reworked, possibly associated with historical quarrying of the London Clay Formation for brick manufacture. This would also explain the requirement to obtain chalk from depth, for use as an additive in the kiln process. This hypothesis would also be consistent with the information obtained from the GLIAS website.

The baseline position PH9 suggests that other areas of softened ground or shafts may be present at PWS.

Recommendations:

On the basis of the works implemented by EPG, the following recommendations are provided:

1. The area where the hole appeared should be regarded as a failed shaft and suitable stabilisation measures provided. This may include stabilisation of the soft backfill and/or a ‘cap’ comprising a reinforced soil raft or a concrete pad. *Note: Going forward, it is noted that a canopy may be intended for construction on this area of the site. The design of this canopy should take account of the ground conditions at depth and the structural design of the shaft cap construction / stabilising works completed.*
2. The potential for other shafts to be present should be noted, as possibly evidenced by the results from PH9. It is recommended that discussions be held with geo-physics companies to discuss the benefit this non-invasive technique could provide in identifying other potential zones of shaft failure or voids beneath the PWS campus. These investigations should be completed as a **matter of urgency**, with any further potential areas of failure targeted for intrusive works accordingly.
3. In the mean-time, EPG’s previous recommendation to undertake daily checks of the building and outdoor areas should continue – with all such inspections documented by PWS.
4. Further to the above, EPG would also recommend that a Structural Engineer visits the site to survey the building, in full knowledge of the contents of this correspondence.
5. A full CCTV survey of all the drainage network at PWS (foul and surface) should also be completed.

We would strongly recommend that this letter is forwarded to PBA for their peer review, recognising that they are generally regarded as the UK experts on chalk workings.

Please do not hesitate to contact me if you have any questions.

Yours sincerely

Steve W

Steve Wilson
Technical Director
On behalf of The Environmental Protection Group Limited
Tel 07971 277869

PAGE: 2

DATE: 24.08.89

LOCATION

ELM PARK ROAD – PINNER

BOREHO

13

DESCRIPTION	REDUCED OD LEVEL m	DEPTH m	LEGEND	SAMPLE TYPE	SAMPLE DEPTH	THICKNESS m	SPT	REMARKS
TOPSOIL	ca +59 →	0.00				0.30		
Stiff sandy CLAY		0.30						
				U100	1.00	1.40		-968 /13 / 1.0U
Medium dense fine SAND		1.70		SPT B	1.80 1.80		30	-968 /13 / 1.8B
				SPT	3.30		34	-
						4.80		
				SPT	4.80		34	-
		5.60w	▽					-Water strike
				SPT	6.00		35	-
Stiff CLAY		6.50				0.40		
SAND		6.90				0.30		
Very stiff brown grey CLAY		7.20		U100	7.50			-968 /13 / 7.5U
						2.80		
				U100	9.00			-968 /13 / 9.0U
Hard grey brown CLAY		10.00		U100	10.50			-968 /13 /10.5U
				U100	12.00	4.00		-968 /13 /12.0U
				U100	13.50			-968 /13 /13.5U
Hard gravelly CLAY		14.00		CPT	14.50	1.00	52	-
		15.00						

TERRAMECH INVESTIGATIONS LIMITED
183 LONG LANE TILEHURST READING

REMARKS:

U100=100mm dia. UNDISTURBED SAMPLE
U38=38mm dia. UNDISTURBED SAMPLE
D=SMALL DISTURBED SAMP
B=BULK SAMPLE
W=WATER SAMPLE
SPT=STANDARD PENETRATION TEST
CPT=CONE PENETRATION TE

2

1063 W.t. 22438/0384 10M 7/45 (51) F.&S.

RECORD OF WELL (SHAFT OR BORE)

(*For Survey use only*)
1-inch Map Registered No.
255 / 137

At Hundred Acre Farm (Express Dairy)

Town or Village Northwood

County Middlesex Six-inch quarter sheet 10 N.W.

For Mr. C. M. Robarts & Son. now Express Dairy Coy

Exact site of well about 1 mile S.E. of Northwood and 1 mile N.E of Ruislip Reservoir TQ1010 9065

Attach a tracing from a map, or a sketch-map, if possible.

Level of ground surface above sea-level (O.D.) — ft.

If well-top is not at ground level, state how far ... ~~above~~; below; 2 ft.

SHAFT ft.; diameter ft. Details of headings

TQ 19/39

BORE 300 ft.; diameter of bore: at top 8 5/8" ins.; at bottom same ins. Lengths, diameters, perforations, etc., of lining tubes 99 ft of 8 5/8" top 2' below

Water struck at depths, below ~~well top~~ surface of (feet) 132'

Rest-level of water 90 ft. ~~above~~ below ~~well top~~ surface Suction at 113'6 ft. Yield on 8 hours' ~~days~~ pumping 2,850 gal per hour with depression to 108 ft. below ~~well top~~ surface, Capacity of pump — g.p.h. Recovery to rest level in — mins. hours Date of measurements April 1936. Date of well same

Quality of water (*attach copy of analysis if available*)

Well made by Legrand, Sutcliff & Gell

Information from Legrand Sutcliff & Gell The Green, Southall; M

Additional notes in space overleaf.

(*For Survey use only*) GEOLOGICAL CLASSIFICATION	NATURE OF STRATA	THICKNESS Feet	THICKNESS Ins.	DEPTH Feet	DEPTH Ins.
	— If measurements start below ground surface, e.g., from bottom of an existing shaft, state how far	—	—	—	—
DRFT	Made ground	0	6	0	6
LC	Mottled Clay	23	6	24	0
	Blue Clay	10	0	34	0
	Conglomerate	6	0	40	0
RB	Mottled Clay	15	0	55	0
	Mottled Clay and Stones	4	0	59	0
	Mottled Loamy Sand	10	0	69	0
	Mottled Clay	10	0	79	0
	Conglomerate	8	0	87	0
	Flints	1	0	88	0
UCK	Chalk & Flints	212	0	300	
		Total		300'	

Date Bank

Continued overleaf

ENVIRONMENT AGENCY

Form WR – 38	*Ref: ellesselle, gate end, northwood.doc*	Agency No.

BOREHOLE RECORD

ACCESSION No. 46977

TQ19/74

TQ19SW/132

A. *SITE DETAILS*

THAMES EA

256

Borehole drilled for:	Mr Lawson			
Location:	Ellesselle, Gate End, Northwood, Middlesex			
N.G.R.:	TQ 101 913			
Ground Level (if known):	SURFACE			
Drilling Company:	W.B. & A.D. MORGAN LTD., PRESTEIGNE, POWYS. LD8 2UF			
Date of Drilling:	**Commenced:**	7/6/07	**Completed:**	20/6/07

B. CONSTRUCTION DETAILS

Borehole datum (if not ground level) GROUNDLEVEL
(Point from which all measurements of depth are taken e.g. flange, edge of chamber, etc.)

Borehole drilled diameter................		315	mm from	Surface	to	43	m/depth
		200	mm from	43	to	75	m/depth
			mm from		to		m/depth
Casing material: u.P.V.C and type (e.g. plain steel, plastic slotted)	diameter	103	mm from	Surface	to	75	m/depth
Plain	diameter	103	mm from	Surface	to	45	m/depth
Slotted	diameter	103	mm from	45	to	63	m/depth
Plain	diameter	103	mm from	63	to	69	m/depth
Slotted	diameter	103	mm from	69	to	75	m/depth

Grouting details:	Pressure grout 43m	to surface
Water struck at:	54	m (depth below datum – mbd)
Rest water level on completion:	44	m (depth below datum – mbd)
Estimated blowout yield:	360	Gallons per hour

C. STRATA LOG

Description of Strata	**Thickness (m)**	**Depth (m)**
Red brick	1	1
Consolidated brown clay with cobbles	9	10
Consolidated grey clay	16	26
Brown clay with yellow/green sands	7	33
Soft brown/yellow/green sands	3	36
Hard black/brown flint	4	40
Medium white chalk & flints	35	75

Other Comments (e.g. gas encountered, saline water intercepted, etc.)		Lined borehole due to flint bands	
Gravel Pack Quantity:	None	Temp Steel Casing: Depth and Diameter	2m x 340mm
Cement:	2,000kg		
Rig & Crew:	Halco V666, D. Morris, J. Scott		

PAGE: 4	LOCATION	BOREHOL 3
DATE:30.01.90	THE RIDGE - SOUTH VIEW ROAD - PINNER	

DESCRIPTION	REDUCED LEVEL m	DEPTH m	LEGEND	SAMPLE TYPE	SAMPLE DEPTH	THICKNESS m	SPT	REMARKS
								510840 191617
Clayey TOPSOIL		0.00				0.30		
Firm brown grey gravelly CLAY		0.30				0.90		
				U100	1.00			--1020/3 / 1.0U
Firm to stiff brown grey CLAY		1.20						
				D	1.50	1.20		--1020/3 / 1.5D
Stiff brown grey CLAY		2.40						
				U100	2.50			--1020/3 / 2.5U
				D	3.00			--1020/3 / 3.0D
				U100	4.00	3.40		--1020/3 / 4.0U
				D	4.50			--1020/3 / 4.5D
				U100	5.50			--1020/3 / 5.5U
Stiff to very stiff blue CLAY		5.80						
				D	6.00			--1020/3 / 6.0D
				U100	7.00			--1020/3 / 7.0U
						4.20		
				U100	8.50			--1020/3 / 8.5U
				D	9.00			--1020/3 / 9.0D
				U100	9.50			--1020/3 / 9.5U
		10.00						
								Borehole remained

TERRAMECH INVESTIGATIONS LIMITED
183 LONG LANE TILEHURST READING

REMARKS:

U100=100mm dia. UNDISTURBED SAMPLE   U38=38mm dia. UNDISTURBED SAMPLE   D=SMALL DISTURBED SAMPLE
B=BULK SAMPLE   W=WATER SAMPLE   SPT=STANDARD PENETRATION TEST   CPT=CONE PENETRATION TEST

PINNER COMMON TODAY – MAP 7

Pinner Common today

The height of the chalk level is the same at Pinner Hill Farm and The Dingles. The overburdens are 30 metres and 15 metres respectively. So at the chalkpits field it would be 20 to 25 metres to chalk. This is deep enough to ensure that a collapse in a mine would not cause any movement at the surface.

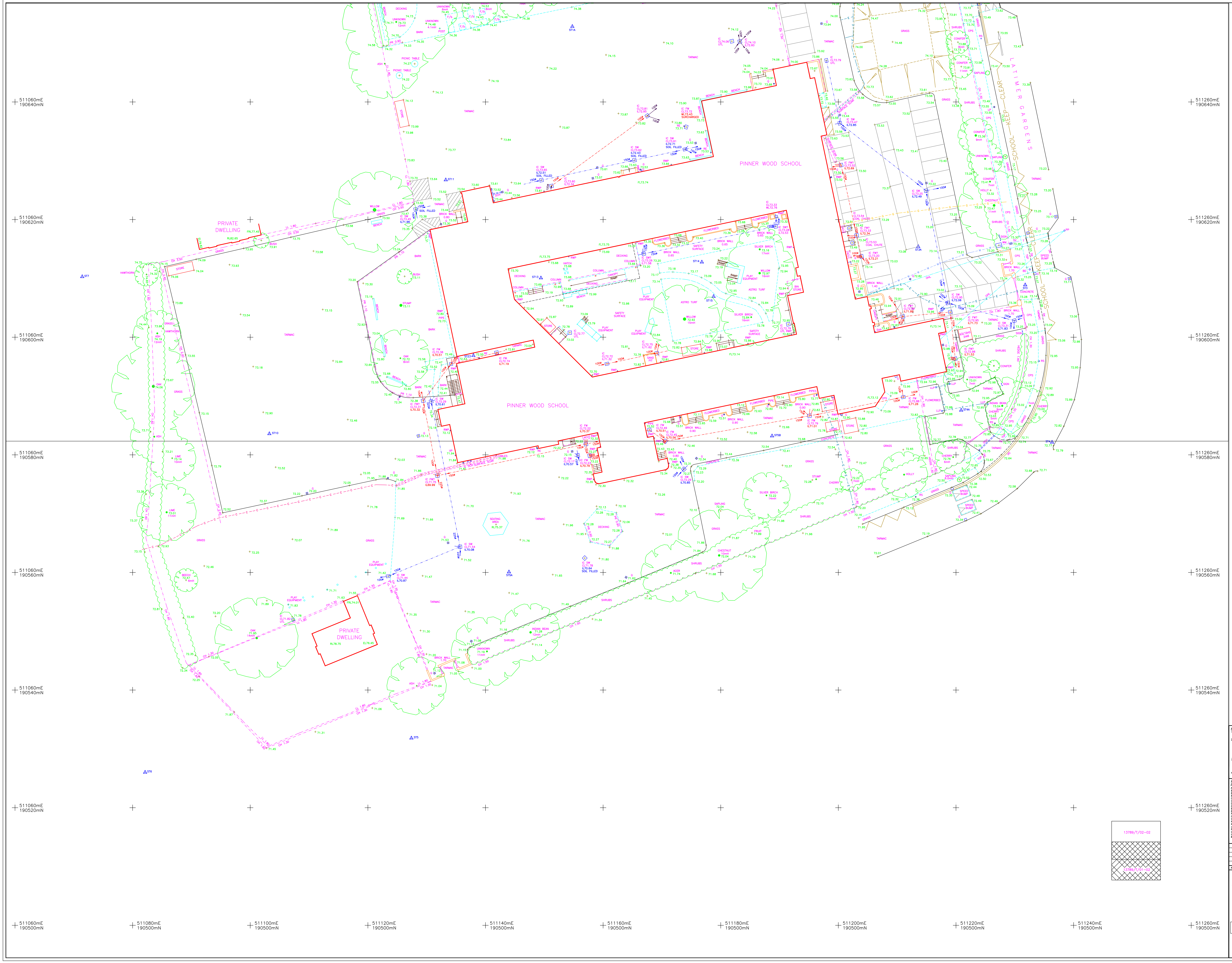
The field was reinstated in 1815 for agricultural purposes. At that time any workings or shafts would have been rendered safe for use by ploughing teams. As far as is known there have been no collapses. If the old resident (see page 21) was correct in that he often heard chalk falling below, it just supports the contention that the London Clay above does not give way over such a depth.

We do, however, have to be aware of excessive influences such as cloudbursts that completely overwhelm the drainage system and seek new outlets, or heavy machinery doing deep digging.

Pinner Wood Schools sit on the old chalkpits field, and the builders in 1938/9 must have been aware of the mines in the vicinity, and taken precautions when constructing the foundations. Certainly 50 years later there is no evidence of any threat.

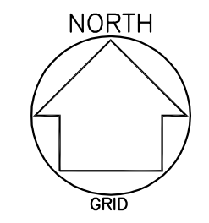
As to whether any other parts of Pinner Common were dug for chalk, we can assume that the Lord of the Manor would have sunk trial shafts and established that the higher fold of chalk runs from Waxwell through The Dingles and north-west to Pinner Hill Farm, passing through the chalkpit field on the way.

The location of the chalkpit field reduces to a minimum the distance between the chalkmine shafts and the kiln. For this reason one must assume that this was the first field to be mined and that mining also finished in this field by 1806. This cannot, however, absolutely rule out the possibility of digging elsewhere on Pinner Common that was reasonably close to the kiln, and the fuel in the woods beyond.



Station Schedule

Station	Easting	Northing	Level	Type
1	511179.553	190687.929	74.986	Peg
2	511228.508	190665.462	73.911	Hilti Nail
3	511231.771	190608.892	73.260	Hilti Nail
4	511236.339	190582.131	72.820	Hilti Nail
5	511127.404	190531.829	71.048	Hilti Nail
6	511082.125	190526.015	71.881	Hilti Nail
7	511071.432	190610.287	74.914	Hilti Nail
10	511103.251	190583.584	72.746	Hilti Nail
11	511133.247	190626.745	73.590	Hilti Nail
12	511145.710	190622.620	73.771	Peg
13	511149.425	190610.070	73.689	Hilti Nail
14	511176.790	190612.765	73.192	Peg
15	511178.792	190606.925	72.980	Peg
16	511180.741	190596.992	73.187	Temporary
17	511175.290	190586.827	73.135	Temporary
18	511211.921	190580.547	72.709	Temporary
19	511220.683	190598.321	73.110	Temporary
1A	511154.767	190652.833	74.360	Hilti Nail
20	511216.441	190648.051	74.136	Temporary
21	511125.548	190603.785	73.112	Temporary
22	511135.677	190597.690	76.722	Temporary
23	511137.949	190596.886	72.568	Temporary
24	511154.732	190580.339	72.222	Temporary
3A	511213.576	190615.413	73.110	Temporary
4A	511220.886	190587.579	72.899	Hilti Nail
5A	511143.991	190560.084	71.593	Hilti Nail
5B	511188.728	190583.202	72.641	Hilti Nail
11A	511123.745	190668.200	75.060	Peg
13A	511152.702	190600.065	73.083	Temporary
14A	511172.617	190616.944	73.766	Temporary
14B	511188.462	190620.374	74.037	Temporary



NOTES:-

1. *The accuracy and content of this drawing are dependent on the original specification and EDI should be consulted before use of other scales or use in CAD form.*
2. *Where underground services are shown, all reasonable care has been taken within the spirit of the original specification and requirement. Before use of this information the user should consult EDI and satisfy themselves of the completeness and accuracy of such detail before undertaking any works. Due to the nature of this work and the limitations imposed by ground conditions and the detection equipment no guarantee can be given that all services have been recorded.*
3. *All reasonable care has been taken in the survey detail represented on this drawing but any discrepancies must be reported to EDI immediately.*
Our aim is to produce the best possible results within the specification and cost constraints of our clients. Any comments are most welcome.
4. *All levels and co-ordinates are related to the datums described.*
Levels shown at kerbs are channel level unless stated.

LEGEND

Features:

AV	Air Valve
BD	Bollard
BS	Bus Stop
BT	British Telecom
CL	Cover Level
CATV	Cable TV Cover
DCH	Drainage Channel
DK	Drop Kerb
EIC	Electricity IC
ER	Earth Rod
FH	Fire Hydrant
G	Gully
GV	Gas Valve
IC	Inspection Cover
IL	Invert Level
JBX	Junction Box
KO	Kerb Outlet
LLP	Low Level LP
LP	Lamp Post
MP	Marker Post
MT	Mercury Telecom
OHL	Overhead Line
PM	Parking Meter
PP	Power Pole
RE	Rodding Eye
RNP	Road Name Plate
RS	Road Sign
RWP	Rain Water Pipe
SD	Service Duct
SV	Stop Valve
TP	Telegraph Pole
TS	Traffic Signal
UTL	Unable to lift
VP	Vent Pipe
WM	Water Meter
WO	Wash Out
WP	Waste Pipe

Surface Types:

C	Concrete
CPS	Concrete Paving Slabs
PAV	Brick Paviors
T	Tarmac
TSP	Textured Safety Paving

Boundary Types:

BW	Barbed Wire
CB	Close Boarded
CH	Chainlink
CI	Corrugated Iron
CP	Chestnut Paling
IR	Iron Railing
IW	Interwoven
LL	Larch Lap
PR	Post & Rail
PW	Post & Wire
RTW	Retaining Wall

Building Level Details

EL	Eave Level
FL	Floor Level
FRL	Flat Roof Level
HL	Head Level
PPL	Parapet Level
RL	Ridge Level
SL	Sill Level

Linetypes:

— — C — —	CATV cables
— — D — —	Data cables
— — E — —	Electric cab.
———	Foul water
— — G — —	Gas pipes
— — SD — —	Service ducts
———	Storm water
— — T — —	Telecom cab.
— — U — —	Unidentified
— — W — —	Water pipes
DYL	Double Yellow Lines

AutoCAD 2007

No.	Job No.	Date	Revision Detail	Surveyor	Checked

EDI SURVEYS LTD.
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Fax: (01473) 221660
Email: enquiries@edisurveys.co.uk

ISO 9001
REGISTERED FIRM

PROJECT
PINNER WOOD SCHOOL
LATIMER GARDENS
PINNER, HA5 3RA

Job No.	13789
Scale	1:200
Surveyor	T HART
Date	Aug. 2013
Checked	GMP

CLIENT
MLM
7200 CAMBRIDGE RESEARCH PARK
CAMBRIDGE
CAMBRIDGESHIRE
CB5 9TL

Notes:
The horizontal and vertical control of this survey is based on Ordnance Survey Datums using OS Net obvervations, corrections made with Leica Smartnet.
We have applied a reverse scale factor to maintain true ground distances, based on station ST1.

DRAWING No.
13789/T/01-02

Dando Drilling International

Dando Terrier

The ultra-small, compact Dando Terrier rig has been designed specifically for sampling and testing for geotechnical and environmental analysis and is crawler mounted for easy site access in difficult conditions. Simple to operate and maintain, extremely reliable and competitively priced.

Made in England since 1867

Dando Terrier

Design Features

Chassis
A fabricated box section sub-frame incorporating drop hammer support, controls, engine mounting and tool storage.

Drop Hammer
A two-piece drop hammer runs on two guide bars. The weight is fully guarded and can be quickly changed for either SPT or dynamic probing standards.

Trip Hammer Speed: 0-50 blows per minute
Trip Hammer Drop: 500mm-750mm
Trip Hammer Weight: 50kg or 63.5 kg

Drill Mast Assembly
A fabricated, welded steel box section construction, hinge pin mounted to main superstructure, hydraulically raised and lowered.

Overall Height: 2.22m-2.85m
Pulldown Capacity: 1000 kgf
Pullback Capacity: 7000 kgf
Width: 655mm (including wheels)
1166m (jacks out)

The entire mast assembly with wheels can be detached from the main superstructure for operation in areas of restricted access.

Carrier
A purpose built crawler chassis with rubber tracks fitted with tilt mechanism, allowing rig to operate vertically on slopes inclined up to 30 degrees from horizontal.

Crawler Width: 800mm
Overall Length (Mast Down): 2.70m
Overall Height (Mast Down): 1.48m
Total Weight: 1126 kg

Engine & Hydraulic PTO
Hydraulic system powered by a 16.8HP water-cooled diesel engine, provides power for drilling, rigging and tracking:

Flow for PTO: 38.88 l/min
Maximum Working Pressure: 175 bar

Options
- Rotary concrete coring head
- Hydraulic remote control valve and stand
- Chalwyn valve and spark arrestor
- Wireless remote for tracking

Compact manoeuvrable crawler-mounted design ideally suited for long wheel-base transit type vans for fast mobilisation to site and secure storage of all equipment.

2-piece drop hammer for sampling and testing incorporated in mast assembly with hydraulic cylinder giving 7000 kgf pullback for recovery of casing and sampling tools. Mast assembly can be detached for remote operation in restricted access locations.

Hydraulic tilting undercarriage allows operation on inclined slopes up to 30 degrees from horizontal. Deck area with storage capacity for all required drilling tools.

Concrete coring head- useful when concrete and tarmac overlie the area to be sampled.

Range of windowless sample tubes with plastic liners ensuring high quality samples, good presentation and ease of handling and transportation.

Construction Access

Tel 0191 2633654 Fax 0191 2633655

Handover Certificate

Contractor EPG Ltd Date 28/8/15

Site Pinner School, Pinner Time

Description of section handed over Platform in car park to allow drilling rig access

Drawing No

(Where applicable)

Scaffolding, as described above, has now been completed and complies with requirements of The Construction (Health, safety and Welfare) Regulations 1996. It is structurally sound and should be used and loaded in accordance with our Quotation

No

If no quotation: (a) use only for Special purpose

(b) loading to be 1no working lifts with distributed load of 4 Kn/m2

The requirements of the Regulations with regard to working platforms, guard-rails and toeboards, have been complied with, Braces and ties have been installed as necessary.

This scaffolding must be inspected at intervals not exceeding 7 day since the last inspection (or following exposure to weather conditions likely to have affected its strength or stability, to following substantial addition, dismantling or other alteration) by the user, and the inspection recorded. This inspection is to confirm that the requirements of the Regulations are complied with.

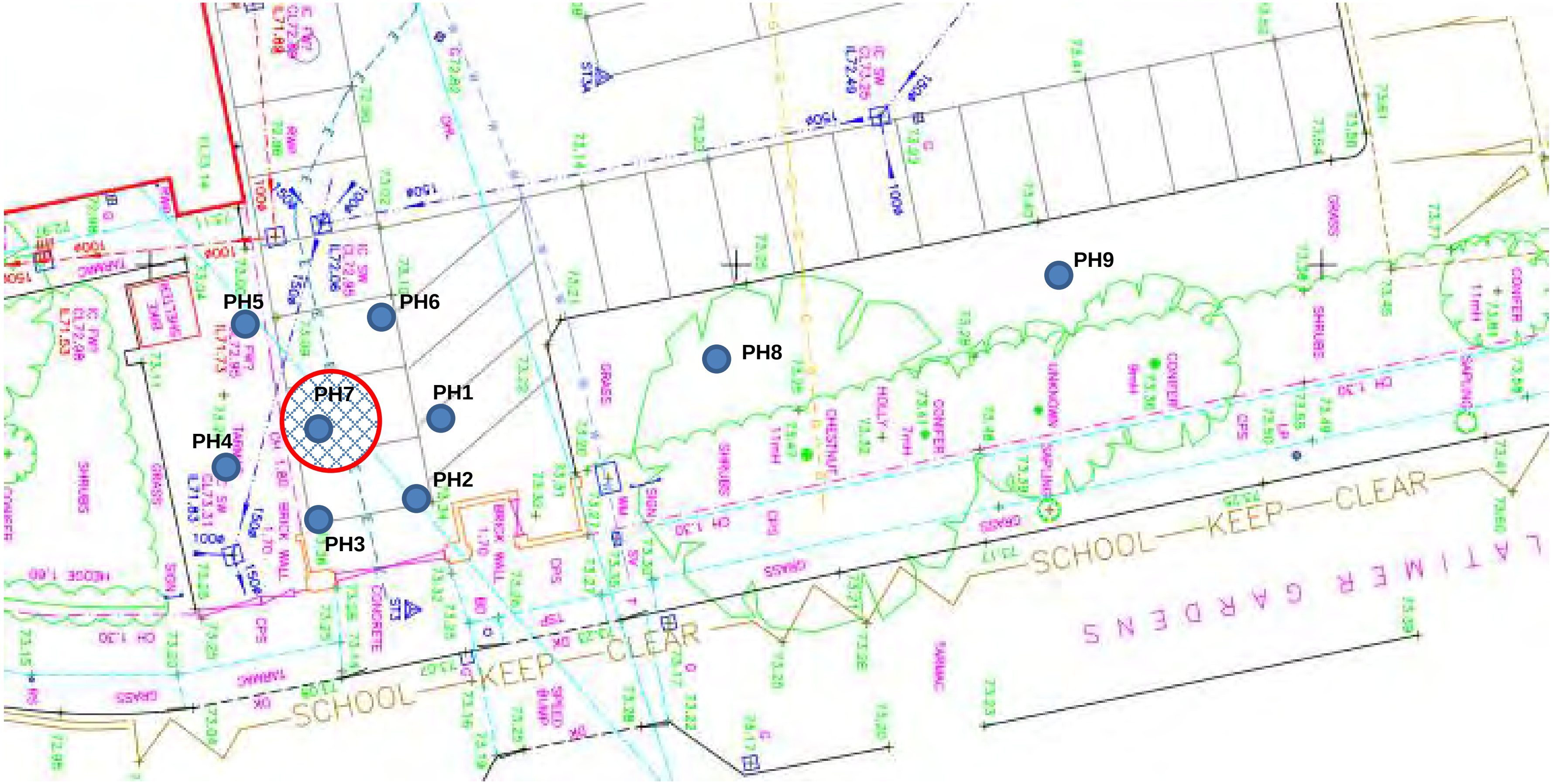
NB. Tarpaulin sheets (or other wind sails) must not be fixed to a scaffold unless it has been specifically designed to take them.

Scaffold Contractor Construction Access NE Ltd Depot Newcastle

Certificate received on behalf of the Contractor

Certificate despatched to Contractor by post date.

Do Not Remove Ties



PINNER WOOD SCHOOL – INTRUSIVE WORKS, 2/3/4 SEPTEMBER 2015

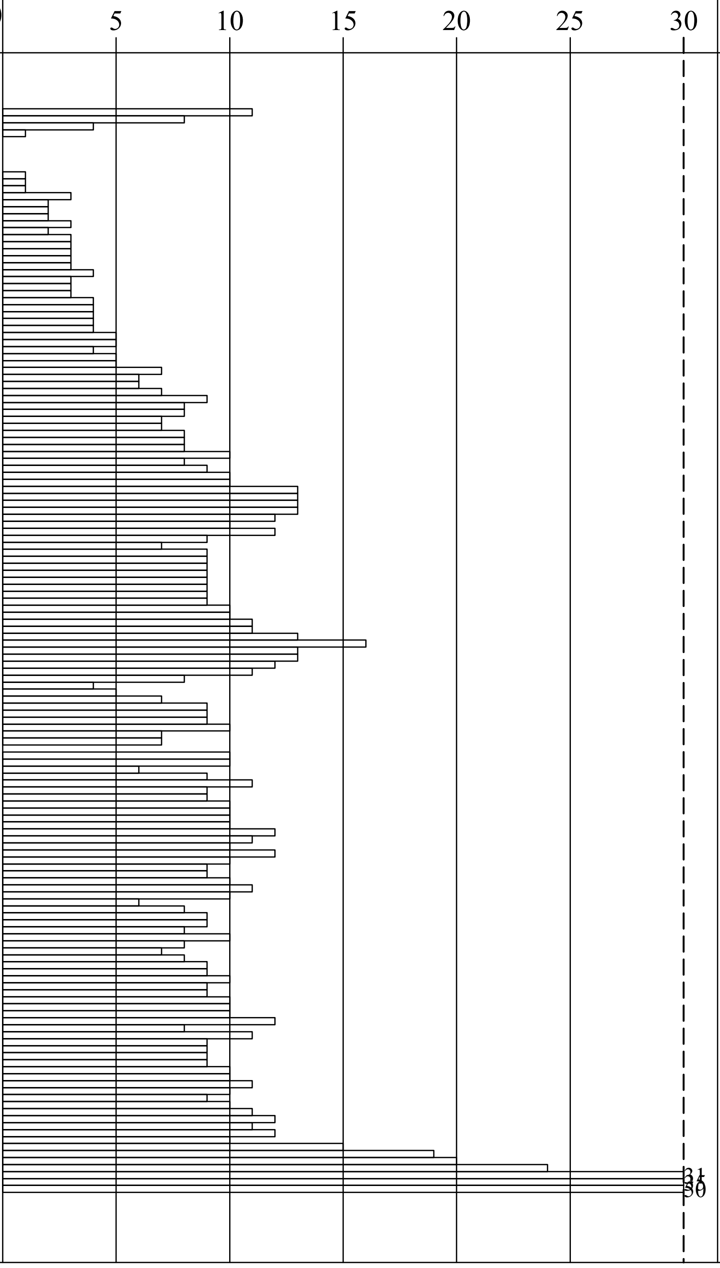
DYNAMIC PROBE LOG

Geocore Site Investigations Ltd

Location	Pinner Wood School, Latimer Gardens, Pinner, Middlesex, HA5 3RA
PROBE No	**PH1**
Job No	MR/15/57626
Date	02-09-15 02-09-15
Ground Level (m)	
Co-Ordinates ()	
Client	The Environmental Protection Group Ltd
Sheet	1 of 1

Depth (m)	Readings (blows/100mm)					Torque (Nm)	Remarks
	0	0	0	0	0		
	0	0	0	11	8		
1	4	1	0	0	0	0	
	0	0	1	1	0		
2	3	2	2	1	1	40	
	2	3	2	2	3		
3	3	4	3	3	3	20	
	4	4	3	3	3		
4	5	5	4	4	4	30	
	7	6	4	5	5		
5	8	8	6	7	9	40	
	8	8	7	7	8		
6	10	10	10	8	9	30	
	13	12	13	13	13		
7	7	9	10	12	9	100	
	9	9	9	9	9		
8	10	11	9	9	10	70	
	13	13	11	13	16		
9	4	5	12	11	8	30	
	9	10	7	9	9		
10	10	10	7	7		40	
	9	9	6	9	11		
11	10	12	10	10	10	40	
	10	9	11	10	12		
12	10	6	9	10	11	40	
	8	10	8	9	9		
13	9	9	8	7	8	30	
	10	10	10	9	9		
14	11	9	10	12	8	20	
	10	10	9	9	9		
15	10	11	11	10	9	20	
	10	15	12	11	12		
16	31	35	19	20	24	90	
			50				
17							

Diagram (N100 Values)



Hammer Wt (kg)	63.5
Hammer Drop (mm)	750
Cone Dia (mm)	50
Cone Type	
Damper	

GENERAL REMARKS

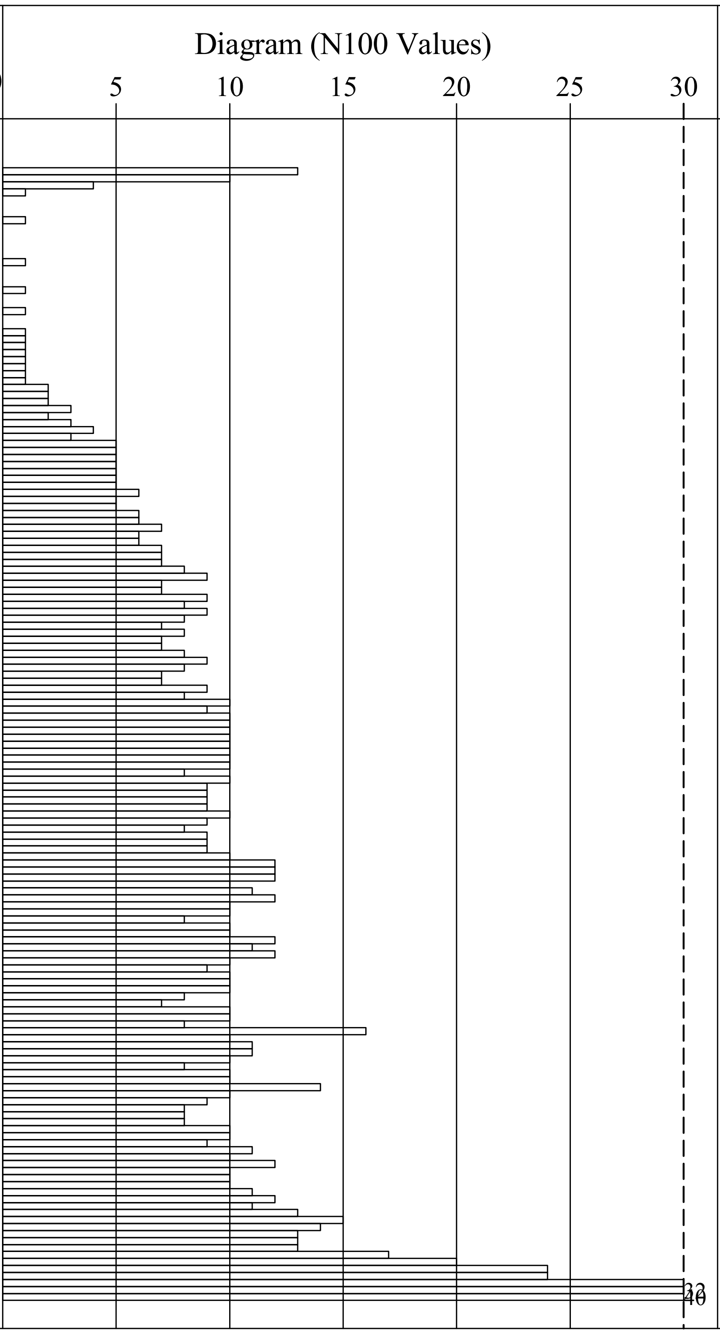
Probehole terminated at 16.20m.

All dimensions in metres Scale 1:108.125	Client Engineer Sarah Mortimer	Method/ Plant Used Dynamic Probe	Logged By Edward Lodge

DYNAMIC PROBE LOG

Geocore Site Investigations Ltd

Location	Pinner Wood School, Latimer Gardens, Pinner, Middlesex, HA5 3RA
PROBE No	**PH2**
Job No	MR/15/57626
Date	02-09-15 02-09-15
Ground Level (m)	
Co-Ordinates ()	
Client	The Environmental Protection Group Ltd
Sheet	1 of 1



Depth (m)	Readings (blows/100mm)					Torque (Nm)	Remarks
	0	0	0	0	0		
	0	0	13	10	4		
1	1	0	0	0	1	0	
	0	0	0	0	0		
2	1	0	0	0	1	0	
	0	0	1	0	0		
3	1	1	1	1	1	0	
	1	1	1	2	2		
4	2	3	2	3	4	50	
	3	5	5	5	5		
5	5	5	5	6	5	30	
	5	6	6	7	6		
6	6	7	7	7	8	30	
	9	7	7	9	8		
7	9	8	7	8	7	40	
	7	8	9	8	7		
8	7	9	8	10	9	20	
	10	10	10	10	10		
9	10	10	10	8	10	40	
	9	9	9	9	10		
10	9	8	9	9	9	30	
	10	12	12	12	10		
11	11	12	10	10	8	30	
	10	10	12	11	12		
12	10	9	10	10	10	30	
	8	7	10	10	8		
13	16	10	11	11	10	40	
	8	10	10	14	10		
14	9	8	8	8	10	40	
	10	9	11	10	12		
15	10	10	10	11	12	80	
	11	13	15	14	13		
16	13	13	17	20	24	80	
	24	30	32	40			
17							

Hammer Wt (kg)	63.5
Hammer Drop (mm)	750
Cone Dia (mm)	50
Cone Type	
Damper	

GENERAL REMARKS

Probehole terminated at 17.00m.

All dimensions in metres Scale 1:108.125	Client Engineer Sarah Mortimer	Method/ Plant Used: Dynamic Probe	Logged By Edward Lodge

DYNAMIC PROBE WITH ALL NUMBERS 57626.GPJ AGS3_ALL.GDT 9/8/15

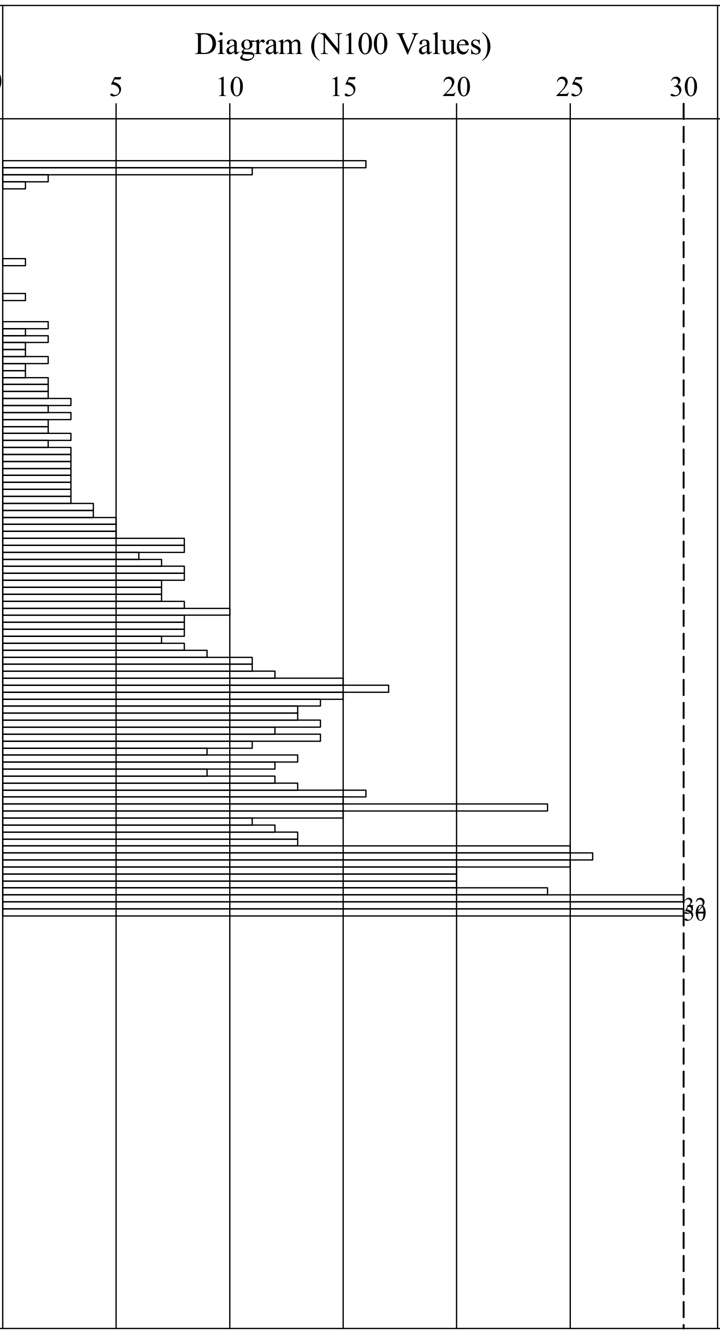
DYNAMIC PROBE LOG

Geocore Site Investigations Ltd

Location	Pinner Wood School, Latimer Gardens, Pinner, Middlesex, HA5 3RA
Job No	MR/15/57626
Date	03-09-15 03-09-15
Ground Level (m)	
Co-Ordinates ()	
Client	The Environmental Protection Group Ltd
PROBE No	**PH3**
Sheet	1 of 1

Readings (blows/100mm)				
0	0	0	0	0
0	16	11	2	1
0	0	0	0	0
0	0	0	0	0
1	0	0	0	0
1	0	0	0	0
1	2	1	1	2
1	1	2	2	2
3	2	3	2	2
3	2	3	3	3
3	3	3	3	3
4	4	5	5	5
8	8	6	7	8
8	7	7	7	8
10	8	8	8	7
8	9	11	11	12
15	17	15	14	13
13	14	12	14	11
9	13	12	9	12
13	16	15	24	15
11	12	13	13	25
26	25	20	20	20
24	30	32	50	

Diagram (N100 Values)



Depth (m)	Torque (Nm)
1	0
2	0
3	0
4	10
5	10
6	20
7	20
8	30
9	30
10	20
11	40
12	
13	
14	
15	
16	
17	

Remarks

Hammer Wt (kg)	63.5
Hammer Drop (mm)	750
Cone Dia (mm)	50
Cone Type	
Damper	

GENERAL REMARKS

Probehole terminated at 11.30m.

All dimensions in metres Scale 1:108.125	Client Engineer Sarah Mortimer	Method/ Plant Used Dynamic Probe	Logged By Edward Lodge

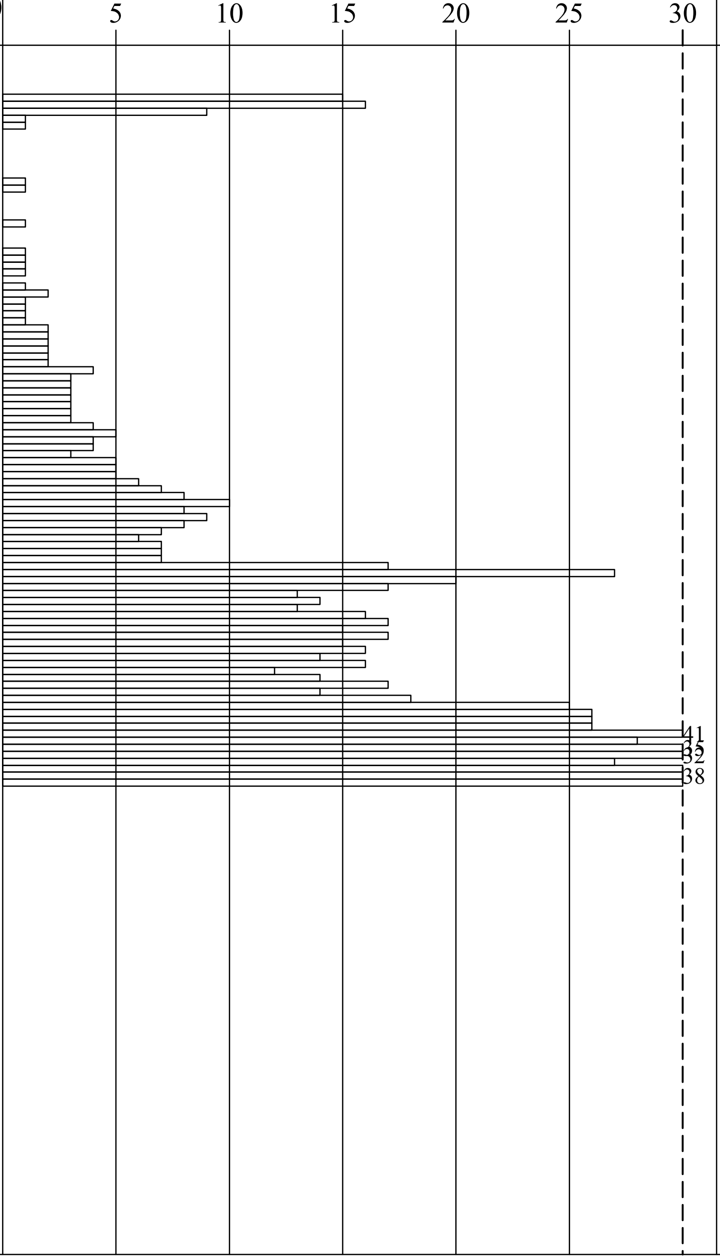
DYNAMIC PROBE LOG

Geocore Site Investigations Ltd

Location Pinner Wood School, Latimer Gardens, Pinner, Middlesex, HA5 3RA				PROBE No **PH4**
Job No MR/15/57626	Date 03-09-15 03-09-15	Ground Level (m)	Co-Ordinates ()	
Client The Environmental Protection Group Ltd				Sheet 1 of 1

Depth (m)	Readings (blows/100mm)	Torque (Nm)	Remarks
	0 0 0 0 0		
	0 0 15 16 9		
1	1 1 0 0 0	0	
	0 0 0 0 1		
2	1 0 0 0 0	0	
	1 0 0 0 1		
3	1 1 1 0 1	0	
	2 1 1 1 1		
4	2 2 2 2 2	0	
	2 4 3 3 3		
5	3 3 3 3 4	0	
	5 4 4 3 5		
6	5 5 6 7 8	10	
	10 8 9 8 7		
7	6 7 7 7 17	10	
	27 20 17 13 14		
8	13 16 17 15 17	10	
	15 16 14 16 12		
9	14 17 14 18 25	20	
	26 26 26 41 28		
10	35 32 27 30 38	60	
	30		
11			
12			
13			
14			
15			
16			
17			

Diagram (N100 Values)



Hammer Wt (kg)	63.5
Hammer Drop (mm)	750
Cone Dia (mm)	50
Cone Type	
Damper	

GENERAL REMARKS

Probehole terminated at 10.50m.

All dimensions in metres Scale 1:108.125	Client Engineer Sarah Mortimer	Method/ Plant Used Dynamic Probe	Logged By Edward Lodge

DYNAMIC PROBE WITH ALL NUMBERS 57626.GPJ AGS3_ALL.GDT 9/8/15

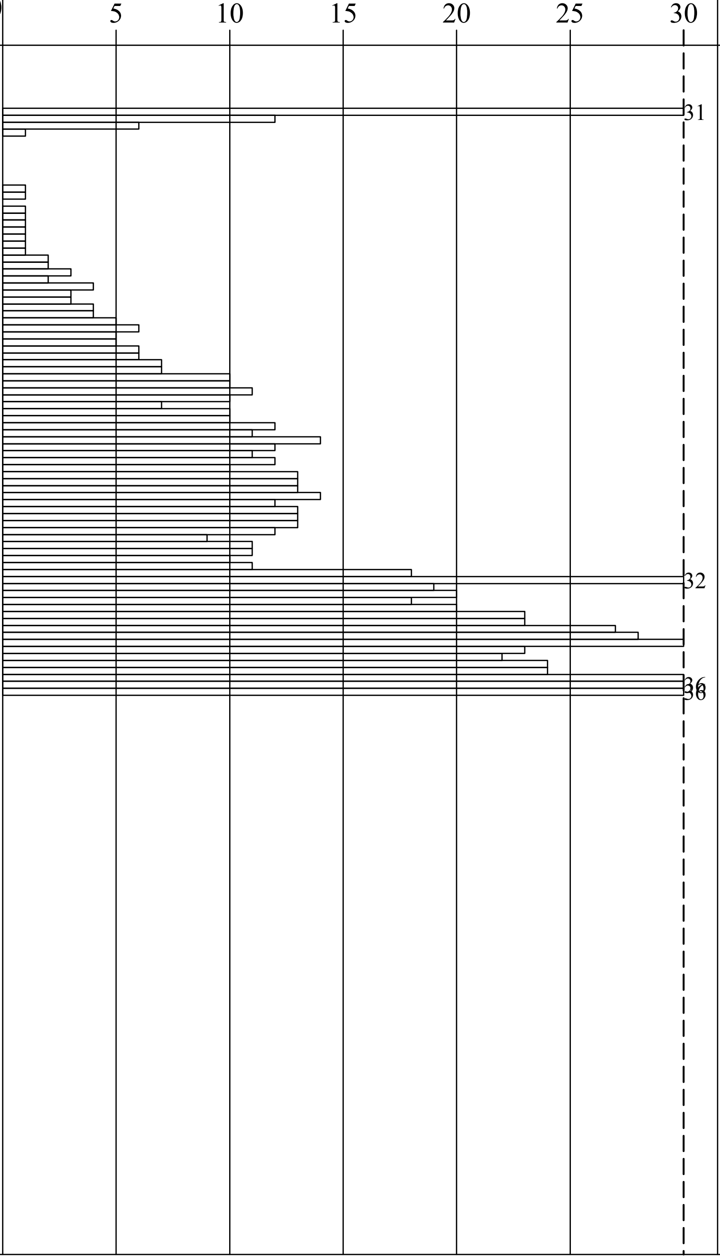
DYNAMIC PROBE LOG

Geocore Site Investigations Ltd

Location Pinner Wood School, Latimer Gardens, Pinner, Middlesex, HA5 3RA	PROBE No **PH5**
Job No: MR/15/57626	Date: 03-09-15 03-09-15
Ground Level (m):	Co-Ordinates ():
Client The Environmental Protection Group Ltd	Sheet 1 of 1

Depth (m)	Readings (blows/100mm)					Torque (Nm)	Remarks
	0	0	0	0	0		
	0	0	0	0	31		
1	12	6	1	0	0	0	
	0	0	0	0	0		
2	1	1	0	1	1	10	
	1	1	1	1	1		
3	2	2	3	2	4	20	
	3	3	4	4	5		
4	6	5	5	6	6	20	
	7	7	10	10	11		
5	10	7	10	10	12	30	
	11	14	12	11	12		
6	10	13	13	13	14	30	
	12	13	13	13	12		
7	9	11	11	10	11	30	
	18	32	19	20	18		
8	20	23	23	27	28	40	
	30	23	22	24	24		
9	30	36	36			80	
10							
11							
12							
13							
14							
15							
16							
17							

Diagram (N100 Values)



Hammer Wt (kg)	63.5
Hammer Drop (mm)	750
Cone Dia (mm)	50
Cone Type	
Damper	

GENERAL REMARKS

Probehole terminated at 9.20m.

All dimensions in metres Scale 1:108.125	Client Engineer Sarah Mortimer	Method/ Plant Used: Dynamic Probe	Logged By Edward Lodge

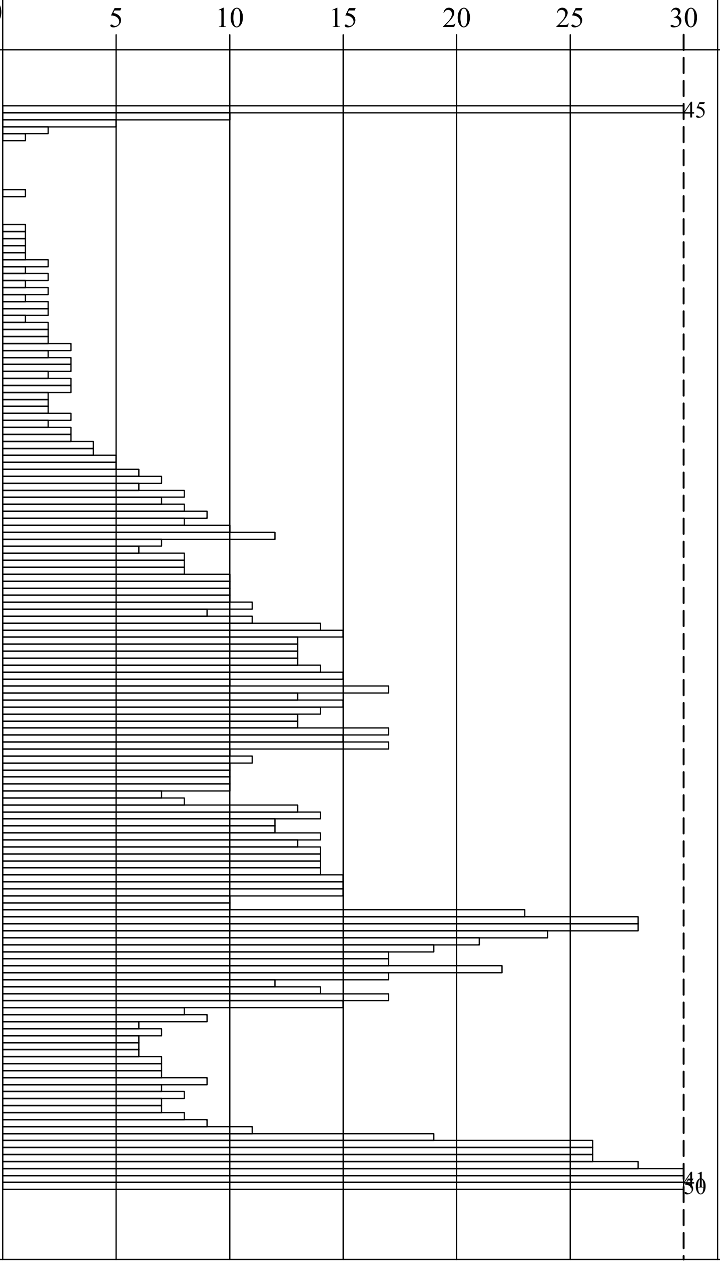
DYNAMIC PROBE LOG

Geocore Site Investigations Ltd

Location Pinner Wood School, Latimer Gardens, Pinner, Middlesex, HA5 3RA	PROBE No **PH6**
Job No: MR/15/57626	Date: 03-09-15 03-09-15
Ground Level (m)	Co-Ordinates ()
Client The Environmental Protection Group Ltd	Sheet 1 of 1

Readings (blows/100mm)				
0	0	0	0	0
0	0	0	45	10
5	2	1	0	0
0	0	0	0	0
1	0	0	0	0
1	1	1	1	1
2	1	2	1	1
1	2	2	1	2
2	2	3	2	3
3	2	3	3	2
2	2	3	2	3
3	4	4	5	5
6	7	6	8	7
8	9	8	10	12
7	6	8	8	8
10	10	10	10	11
9	11	14	15	13
13	13	13	14	15
10	17	13	15	14
13	13	17	15	17
10	11	10	10	10
10	7	8	13	14
12	12	14	13	14
14	14	14	15	15
15	10	10	23	28
28	24	21	19	17
17	22	17	12	14
17	15	8	9	6
7	6	6	6	7
7	7	9	7	8
7	7	8	9	11
19	26	26	26	28
30	41	50		

Diagram (N100 Values)



Depth (m)	Torque (Nm)
1	0
2	5
3	0
4	0
5	0
6	10
7	40
8	20
9	20
10	20
11	20
12	20
13	10
14	20
15	10
16	
17	

Remarks

Hammer Wt (kg)	63.5
Hammer Drop (mm)	750
Cone Dia (mm)	50
Cone Type	
Damper	

GENERAL REMARKS

Probehole terminated at 6.20m.

All dimensions in metres Scale 1:108.125	Client Engineer Sarah Mortimer	Method/ Plant Used: Dynamic Probe	Logged By Edward Lodge

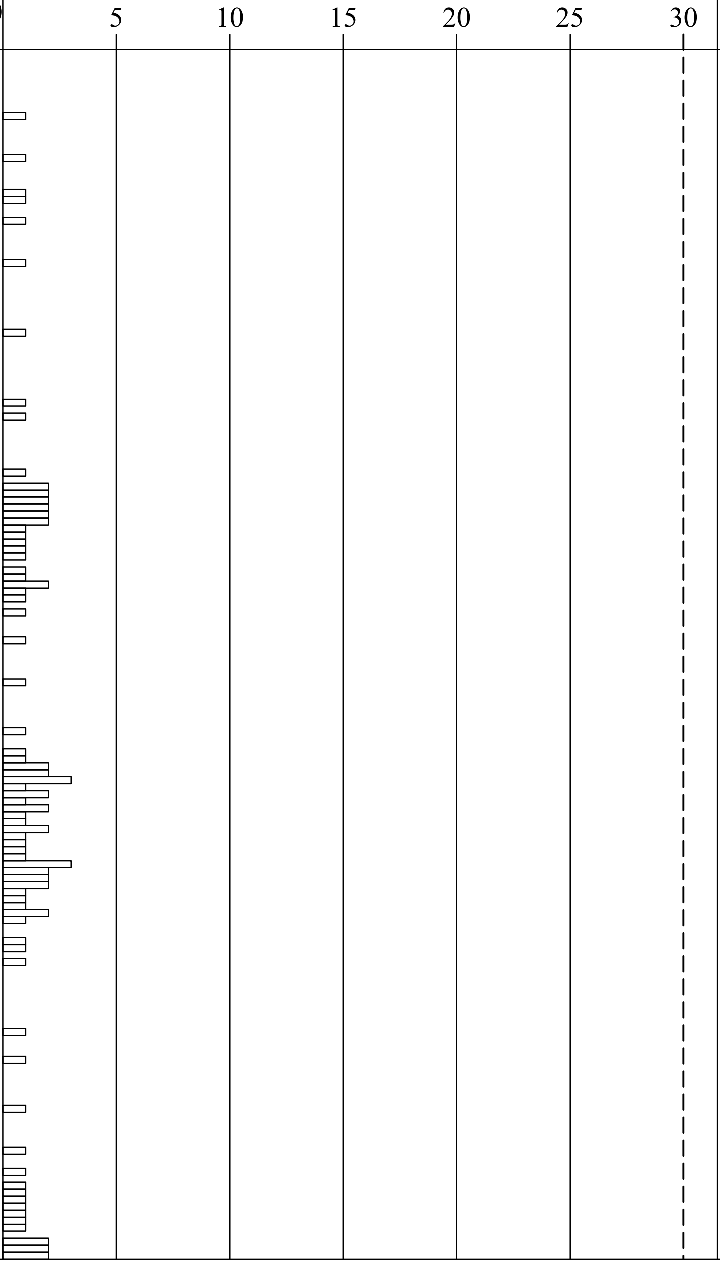
DYNAMIC PROBE LOG

Geocore Site Investigations Ltd

Location				PROBE No
Pinner Wood School, Latimer Gardens, Pinner, Middlesex, HA5 3RA				**PH7**
Job No MR/15/57626	Date 03-09-15 04-09-15	Ground Level (m)	Co-Ordinates ()	
Client The Environmental Protection Group Ltd				Sheet 1 of 2

Depth (m)	Readings (blows/100mm)					Torque (Nm)	Remarks
	0	0	0	0	0		
	0	0	0	0	1		
1	0	0	0	0	0	0	
	1	0	0	0	0		
2	1	1	0	0	1	0	
	0	0	0	0	0		
3	1	0	0	0	0		
	0	0	0	0	0		
4	1	0	0	0	0		
	0	0	0	0	0		
5	1	0	1	0	0		
	0	0	0	0	0		
6	1	0	2	2	2		
	2	2	2	1	1		
7	1	1	1	0	1		
	1	2	1	1	0		
8	1	0	0	0	1		
	0	0	0	0	0		
9	1	0	0	0	0		
	0	0	1	0	0		
10	1	1	2	2	3		
	1	2	1	2	1		
11	1	2	1	1	1		
	1	3	2	2	2		
12	1	1	1	2	1		
	0	0	1	1	0		
13	1	0	0	0	0		
	0	0	0	0	0		
14	1	0	0	0	1		
	0	0	0	0	0		
15	0	1	0	0	0		
	0	0	1	0	0		
16	1	0	1	1	1		
	1	1	1	1	0		
17	2	2					

Diagram (N100 Values)



Hammer Wt (kg)	63.5
Hammer Drop (mm)	750
Cone Dia (mm)	50
Cone Type	
Damper	

GENERAL REMARKS

Probehole terminated at 26.50m.

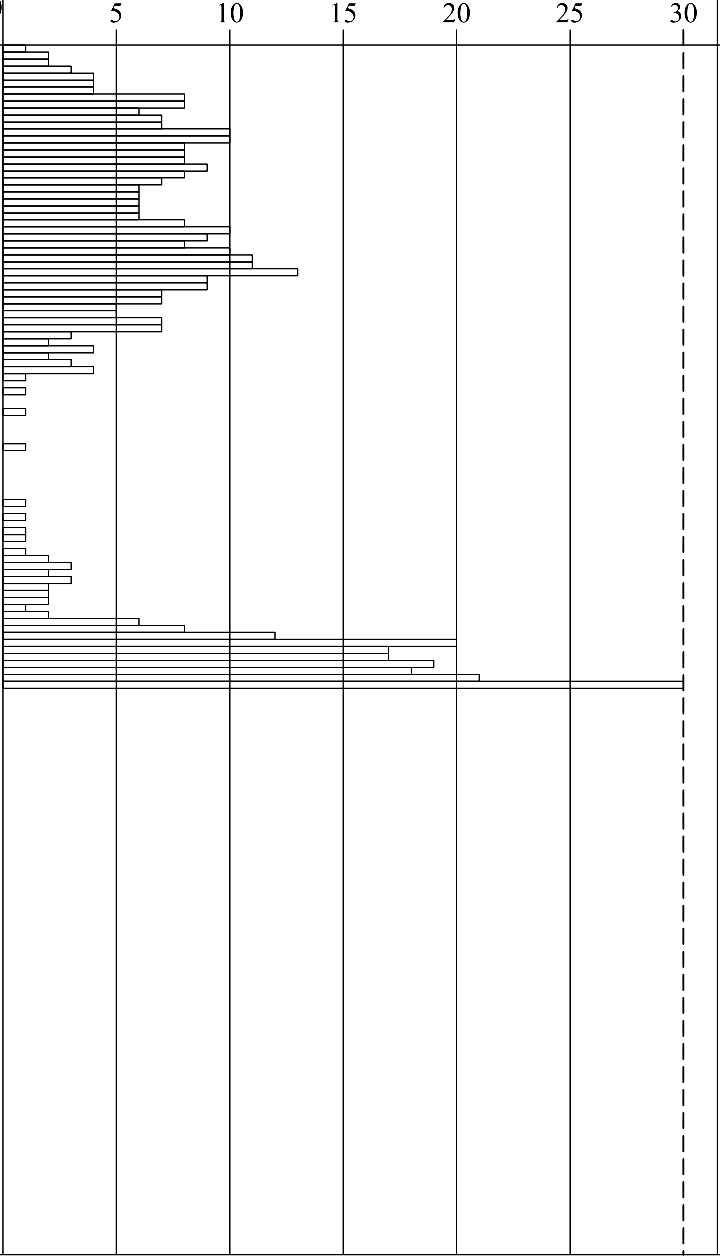
All dimensions in metres Scale 1:108.125	Client Engineer Sarah Mortimer	Method/ Plant Used Dynamic Probe	Logged By Edward Lodge

DYNAMIC PROBE LOG

Geocore Site Investigations Ltd

Location Pinner Wood School, Latimer Gardens, Pinner, Middlesex, HA5 3RA			PROBE No **PH7**
Job No MR/15/57626	Date 03-09-15 04-09-15	Ground Level (m)	Co-Ordinates ()
Client The Environmental Protection Group Ltd			Sheet 2 of 2

Depth (m)	Readings (blows/100mm)					Diagram (N100 Values)	Torque (Nm)	Remarks
			2	1	2			
	2	3	4	4	4			
18	8	8	6	7	7			
	10	10	8	8	8			
19	9	8	7	6	6			
	6	6	6	8	10			
20	9	8	10	11	11			
	13	9	9	7	7			
21	5	5	7	7	3			
	2	4	2	3	4			
22	1	0	1	0	0			
	1	0	0	0	0			
23	1	0	0	0	0			
	0	0	0	1	0			
24	1	0	1	1	0			
	1	2	3	2	3			
25	2	2	2	1	2			
	6	8	12	20	17			
26	17	19	18	21	30			
27								
28								
29								
30								
31								
32								
33								
34								



Hammer Wt (kg)	63.5
Hammer Drop (mm)	750
Cone Dia (mm)	50
Cone Type	
Damper	

GENERAL REMARKS

Probehole terminated at 26.50m.

All dimensions in metres Scale 1:108.125	Client Engineer Sarah Mortimer	Method/ Plant Used Dynamic Probe	Logged By Edward Lodge

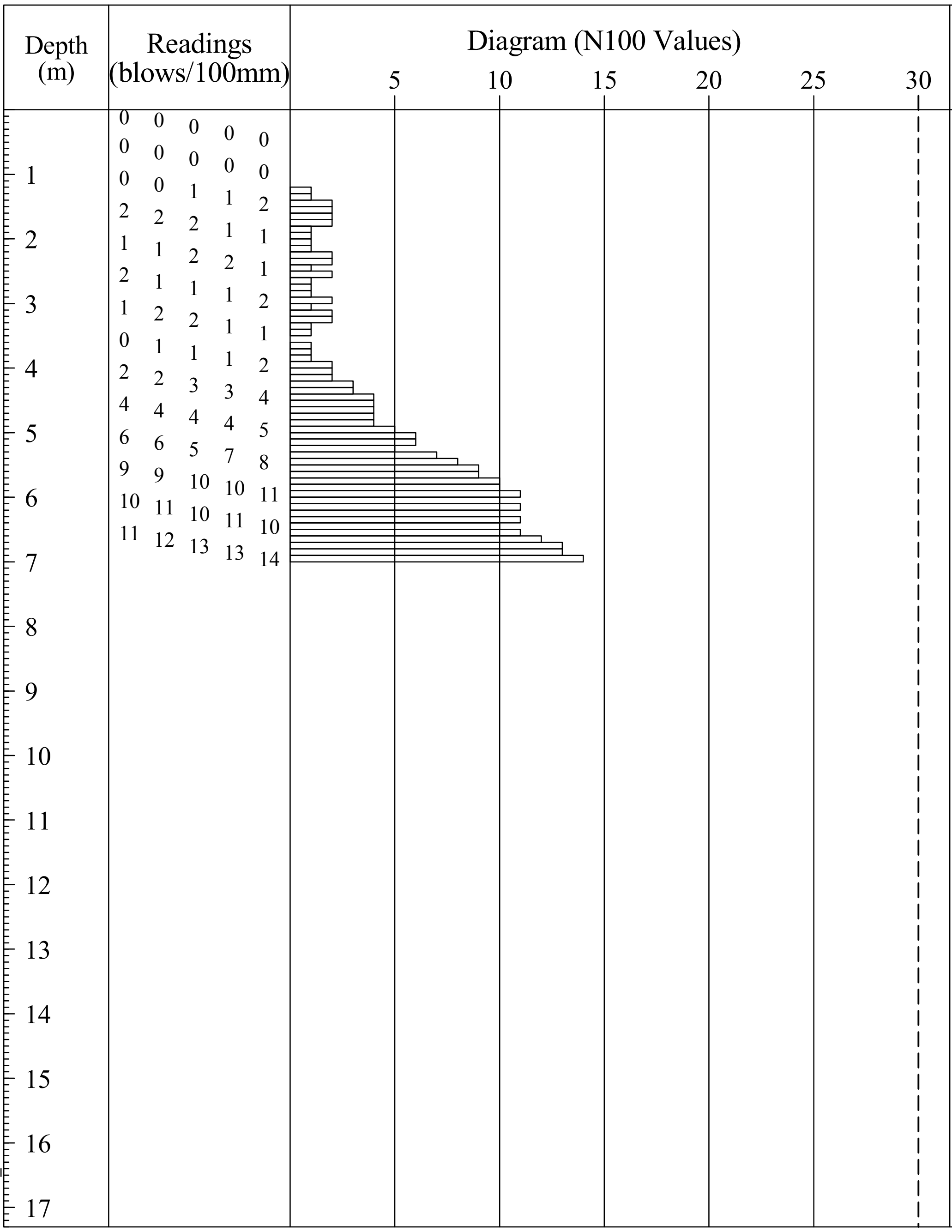
DYNAMIC PROBE LOG

Geocore Site Investigations Ltd

Location Pinner Wood School, Latimer Gardens, Pinner, Middlesex, HA5 3RA				PROBE No **PH8**
Job No MR/15/57626	Date 04-09-15 04-09-15	Ground Level (m)	Co-Ordinates ()	
Client The Environmental Protection Group Ltd				Sheet 1 of 1

Depth (m) | Readings (blows/100mm) | Diagram (N100 Values) | Torque (Nm) | Remarks

0	0	0	0	0
0	0	0	0	0
0	0	1	1	2
2	2	2	1	1
1	1	2	2	1
2	1	1	1	2
1	2	2	1	1
0	1	1	1	2
2	2	3	3	4
4	4	4	4	5
6	6	5	7	8
9	9	10	10	11
10	11	10	11	10
11	12	13	13	14



Hammer Wt (kg)	63.5
Hammer Drop (mm)	750
Cone Dia (mm)	50
Cone Type	
Damper	

GENERAL REMARKS

Probehole terminated at 6.90m.

All dimensions in metres Scale 1:108.125	Client Engineer Sarah Mortimer	Method/ Plant Used: Dynamic Probe	Logged By Edward Lodge

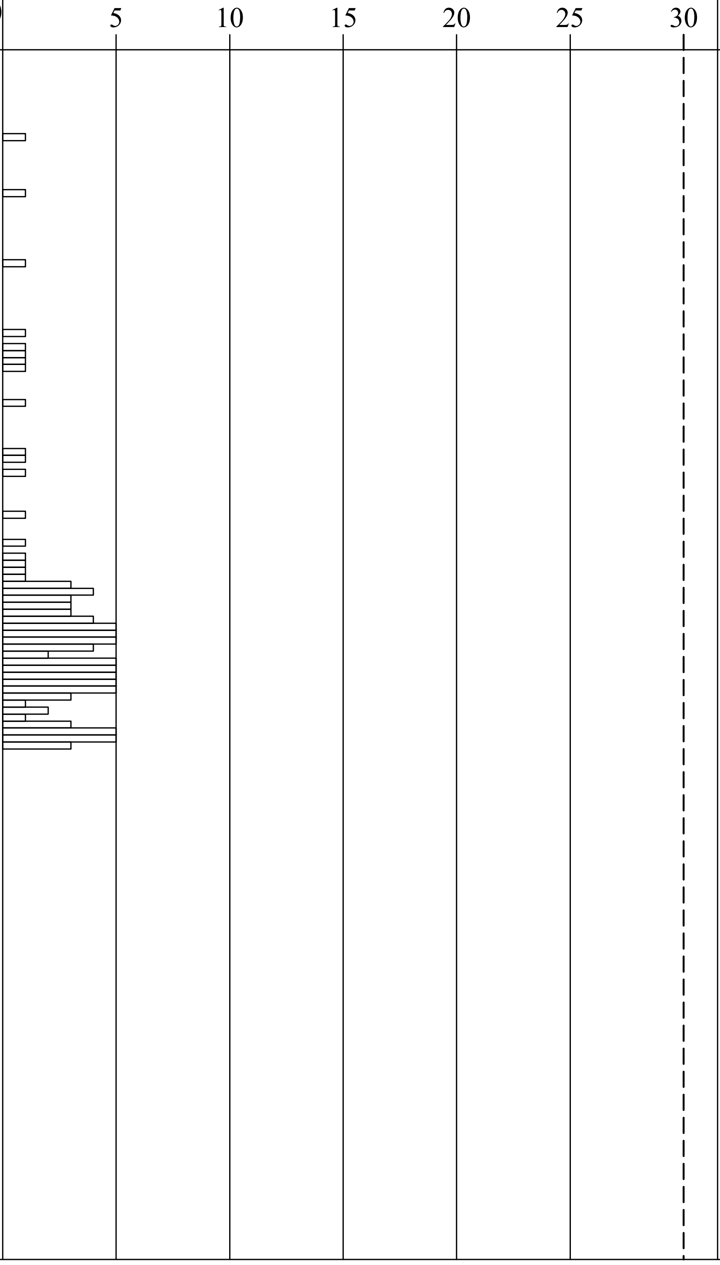
DYNAMIC PROBE LOG

Geocore Site Investigations Ltd

Location	Pinner Wood School, Latimer Gardens, Pinner, Middlesex, HA5 3RA
PROBE No	**PH9**
Job No	MR/15/57626
Date	04-09-15 04-09-15
Ground Level (m)	
Co-Ordinates ()	
Client	The Environmental Protection Group Ltd
Sheet	1 of 1

Depth (m)	Readings (blows/100mm)					Torque (Nm)	Remarks
	0	0	0	0	0		
	0	0	0	0	0		
1	0	0	1	0	0		
	0	0	0	0	0		
2	1	0	0	0	0		
	0	0	0	0	0		
3	1	0	0	0	0		
	0	0	0	0	0		
4	1	0	1	1	1		
	1	0	0	0	0		
5	1	0	0	0	0		
	0	0	1	1	0		
6	1	0	0	0	0		
	0	1	0	0	0		
7	1	0	1	1	1		
	1	3	4	3	3		
8	3	4	5	5	5		
	4	2	5	5	5		
9	5	5	3	1	2		
	1	3	5	5	3		
10							
11							
12							
13							
14							
15							
16							
17							

Diagram (N100 Values)



Hammer Wt (kg)	63.5
Hammer Drop (mm)	750
Cone Dia (mm)	50
Cone Type	
Damper	

GENERAL REMARKS

Probehole terminated at 9.90m.

All dimensions in metres Scale 1:108.125	Client Engineer Sarah Mortimer	Method/ Plant Used Dynamic Probe	Logged By Edward Lodge

Appendix B

PBA Letter, Pinner Wood – Ground Subsidence, CBH/CNE/SJC/35665, dated 15 September 2015

Peter Brett Associates LLP
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Waterman Place, Reading
Berkshire RG1 8DN
T: +44 (0)118 950 0761
F: +44 (0)118 959 7498
E: reading@peterbrett.com

Your ref:
Our ref: CBH\CNE\SJC\35665

15 September 2015

Pinner Wood School
Latimer Gardens
Pinner
Middlesex
HA5 3RA

Attn: Debbie Spruce

Dear Debbie

RE: Pinner Wood School - Ground Subsidence

We refer to our proposal dated 26th August 2015 and our ongoing liaison with The Environmental Protection Group Ltd (EPG) concerning the recent ground investigations carried out at the school that were coordinated by EPG. EPG has also asked for PBA to review and comment on the investigation data as you will be aware and we are pleased to present our response as requested below.

PBA has previously provided comments back to EPG on the probing data obtained from the initial investigation works as they progressed. Our e-mail dated 4th September 2015 provided an assessment of dynamic probes PH1 to PH6, sunk around the perimeter of the ground collapse. An extract of this e-mail is included below for ease of reference:

> *Ground we would classify as disturbed, based on the N300 values, is indicated from ground level in all probe holes to depths of between around 1.25m to 3.45m. A relaxed ground profile [loss of strength due to lateral loss of support as ground moves towards the collapse zone] is also evident in all probe holes, ranging in depth to between around 2.75m and 4.95m. Ground strengths improve in all probes below the relaxed zone. Notable changes in ground strength occur with increase in blow counts at around 7m to 8m and at around 10m to 15m, which is likely to indicate variations in the geological profile and probably a transition from London Clay to the underlying Lambeth Group Deposits.*
>
> *Whilst the near surface profiles are indicative of ground disturbance associated with the nearby ground collapse, a check probe in undisturbed ground would help to validate this interpretation. Significantly disturbed ground to depth, does not appear to be present in the areas investigated, indicating that, at present, the zone of disturbed ground may be fairly localised to the area of the ground collapse itself.*

PBA has now been provided with a copy of EPG's report on the full investigation, dated 5th September 2015 (Ref: EPG/2015/PWS/Q3/L1) and herein we provide further comment on the additional probes completed and the conclusions and recommendations made by EPG.

A further probe, PH7 was sunk through the centre of the backfilled collapse feature to a termination depth of 26.5m bgl. As indicated in the EPG report, the ground is highly disturbed through the majority of the probe profile with blow counts per 100mm of penetration of 0, 1 and 2. PBA notes that ground strength improves significantly between approximately 18m and 21m bgl, however, between approximately 22m and 25.5m bgl blow counts drop suddenly to 0, 1, 2 and 3 before rising again, terminating at 30 blows per 100mm at 26.5m.

We agree that this profile is indicative of loose backfill to a probable old chalk mine shaft that has been disturbed to cause sudden settlement of the infill and the formation of a crown hole. The zone of higher strength material between 18m and 22m bgl suggests a possible ‘plug’ of material that may have dropped down into the shaft at some point and there appears to be void space below of up to 3.5m, before encountering what is presumed to be the base of the shaft. It is evident from the profile that considerably more void space is present at depth in the unstable shaft backfill and it is very likely that further settlement will occur if no stabilisation work is carried out.

Check probes PH8 and PH9 provide a useful reference to compare the ground strength at a distance to the observed feature. PH8 indicates a similar profile to that shown in PH1 to PH6, supporting the current assessment by EPG that the weak near surface materials surrounding the feature are indicative of the wider ground conditions at the school site and are not simply a product of the recent ground collapse alone.

PH9 however, shows a deeper zone of significantly weaker ground, extending to around 7.5m before an improvement in ground strength is noted. This may represent a locally deeper area of made ground or reworked ground, although disturbance due to the presence of chalk mine workings at depth should not be ruled out at this stage. Unfortunately the termination depth of 9.9m bgl does not allow for further interpretation.

With the support of further historical records, EPG conclude that the subsidence feature is most likely to be associated with the collapse of unstable backfill within a shaft, sunk either as a trial excavation to the chalk, or as a mine shaft for the extraction of chalk from historical mine workings at depth. On the basis of the information currently available, PBA agrees with this conclusion.

Going forward EPG has made a number of recommendations and PBA offers the following comments as set out below;

1/ Stabilisation measures - PBA agrees that stabilisation should be carried out and suggests that this would be best achieved by ground treatment of the loose backfill by grouting using compaction grouting techniques. This form of treatment would remove the need for a capping to be constructed over the shaft location. PBA also advises that a capping alone is prone to settlement and potential for ground movement around the edges as soil moves in the future, especially in the presence of water leading to unpredictable failure movement. Therefore a remedial capping solution is not recommended. Prior to carrying out ground stabilisation measures, it will be necessary to prove whether the feature is just an exploratory shaft, or is connected to mine workings at depth. This will influence the lateral extent to which grouting should be undertaken below and around the collapse position based on a risk assessment approach. In PBA’s experience the grouting works are usually carried out using rotary drilling techniques which allows for an investigative stage to be completed before carrying out the grouting works. The rotary drilling works can be specified to measure drilling parameters that can be interpreted to locate mine workings and other downhole techniques like cctv can also be used to view voids as part of the evaluation process.

2/ Geophysical survey - PBA agrees that a geophysical survey to check for the presence of other near surface voids and/or shafts would be useful and provide re-assurance concerning the immediate stability of the site as part of the continuing risk assessment. PBA has considerable experience of using geophysical surveys in these circumstances and could recommend some geophysical survey companies to approach. Techniques that we have used include ground conductivity, resistivity and microgravity surveys – it is very important to have the right cavity model in mind when designing and specifying such surveys to maximise their value – PBA could provide guidance if required. Further follow on intrusive investigations may be necessary in order to provide 'ground truth' where potential anomalies are identified by the surveys.

3/ Agreed

4/ Agreed

5/ Agreed

As indicated above, PBA is generally in agreement with the conclusions and recommendations presented in the EPG report. We have drawn attention to some specific thoughts regarding the way forward for geophysical surveying and remedial stabilisation works preceded by a rotary drilling investigation performed as a single combined contract to reduce timescales and provide best value. PBA will be pleased to continue to work with EPG to provide specialist technical input and experience as required. We look forward to further assisting the school, the council and EPG with resolving matters. Subject to the scope of any further agreed works, we would be happy to provide a further fee proposal for your consideration.

Yours sincerely

Stuart Chandler
Associate
For and on behalf of
PETER BRETT ASSOCIATES LLP

c.c. Sarah Mortimer – EPG Ltd
Andy Barr – Harrow Council

Appendix C

RSK, Pinner Wood Primary School, Geophysical Report, Project Number 191236, dated October 2015

Harrow Council

Pinner Wood Primary School

Geophysical Report

Project no. 191236

OCTOBER 2015

RSK GENERAL NOTES

Project No.:	191236 - R01 (00)
Title:	Geophysical Report, Pinner Wood School
Client:	Harrow Council
Date:	9th October 2015
Office:	RSK, 18 Frogmore Road, Hemel Hempstead, Herts, HP3 9RT Tel: +44 (0)1442 416652 Fax: +44 (0)1442 437550 www.rsk.co.uk
Status:	FINAL

Author	**Joe Hine** Senior Geophysicist	**Technical reviewer**	**Matt Stringfellow** ***CGeol*** Principal Geophysicist
Signature	J Hine	Signature	
Date:	9th October 2015	Date:	9th October 2015
Project manager	**Joe Hine** Senior Geophysicist	**Quality reviewer**	Jess Western
Signature	J Hine	Signature	
Date:	9th October 2015	Date:	9th October 2015

RSK Environment (RSK) has prepared this report for the sole use of the client, showing reasonable skill and care, for the intended purposes as stated in the agreement under which this work was completed. The report may not be relied upon by any other party without the express agreement of the client and RSK. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Where any data supplied by the client or from other sources have been used, it has been assumed that the information is correct. No responsibility can be accepted by RSK for inaccuracies in the data supplied by any other party. The conclusions and recommendations in this report are based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.

No part of this report may be copied or duplicated without the express permission of RSK and the party for whom it was prepared.

Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK Environment.

CONTENTS

FIGURES

APPENDIX A

EXECUTIVE SUMMARY

On the instructions of Andy Barr of Harrow Council, RSK Environment Ltd has carried out a geophysical investigation to investigate the possible presence of historic mine workings, related to a recent surface collapse feature at Pinner Wood Primary School.

Project Findings

Site Setting and Current Usage	The site is located within the grounds of Pinner Wood School, Latimer Gardens, Middlesex, HA5 3RA. The school is currently in use, and has experienced a recent unexpected sudden ground collapse in the car park. The survey area comprises the external areas of the school including sports pitches, playing fields, areas of hard standing and car parks. In addition two interior rooms (a hall and ICT room) were surveyed as a trial for possible further investigation
Survey Objectives	To investigate the presence of possible historic mine workings that may lead to further ground collapses within the school grounds.
Geophysical Techniques Employed	The geophysical techniques employed were Ground Penetrating Radar (GPR) and Electromagnetic (EM) mapping. Initially the GPR system was trialled using three antenna frequencies (120MHz, 200MHz and 400MHz). The purpose of this trial was to determine the most suitable antenna for the ground conditions present on site. The 200MHz antenna was chosen for its deeper penetration depth whilst maintaining sufficient resolution to complete the scope of works. The survey was expanded to include an EM survey of the external areas of the site, using a Geonics EM31 instrument. This detects variations in ground conductivity which may be associated with historic mine workings/voids or the presence of backfilling material which differs in physical properties to the native material.
Geophysical Investigation Findings	A number of discrete GPR anomalies, discrete EM anomalies and coincident GPR & EM anomalies have been identified. Several of these anomalies relate to the locations of historic air raid shelters and may be associated with their removal and remedial works. The remainder of the anomalies are not related to surface or known historic features and as such are thought to potentially be related to historic mine workings The GPR trial conducted within the buildings showed that the GPR system was able to detect subsurface features beneath the ground slabs.
Recommendations	Identified anomalies should be investigated using intrusive methods. Additional investigation should also be considered where anomalies may have been masked by the presence of metallic surface features.

1 INTRODUCTION

1.1 Introduction

On the instructions of Andy Barr of Harrow Council, RSK Environment Ltd has carried out a geophysical investigation to investigate the possible presence of historic mine workings, related to a recent surface collapse feature at Pinner Wood Primary School.

1.2 Details of the Project

The project was carried out to an agreed brief as set out in the RSK proposal letter 191236/TG/01 dated 10th September 2015, and included the following:

- A Ground Penetrating Radar (GPR) survey using the appropriate antenna (120MHz, 200MHz and 400MHz frequencies trialled) to acquire data over all accessible areas of the site.
- Electromagnetic (EM) Mapping Survey to acquire data over all accessible areas of the site.
- An Interpretative report.
- In addition a small GPR trial was conducted within the buildings to assess the feasibility of acquiring data beneath the reinforced concrete floor slabs of existing structures.

1.3 Limitations

Non intrusive geophysical techniques seek to locate boundaries across which there is a marked contrast in physical properties. Such a contrast may be detected remotely because it gives rise to a geophysical anomaly, which is indicative of variation in a physical property relative to some background value. Insufficient contrast (including high levels of cultural noise) can result in masking of the sought anomaly. Therefore, there may be other conditions prevailing at the site which have not been revealed by this investigation and which have therefore not been taken into account in this report.

The response of the ground to different physical forces can be highly variable. Interpretation of the responses contained in this report is based on experience in similar environments and site conditions.

The materials encountered and samples obtained during on-site intrusive investigations represent only a small proportion of the materials present on-site. It should be accepted, therefore, that the interpretation from remotely sensed geophysical data may be inconsistent with that arising from direct methods of investigation.

2 THE SITE

2.1 Location and Regional Setting

The site is located within the grounds of Pinner Wood School, Latimer Gardens, Middlesex, HA5 3RA. The site is located at National Grid reference TQ 111 906. An extract of the 1:25,000 Ordnance Survey map showing the location of the site is displayed in **Figure 1**.

The school is currently in use, and has experienced a recent unexpected sudden ground collapse in the carpark. The survey area comprises the external areas of the school including sports pitches, playing fields, areas of hard standing and car parks. In addition two interior rooms (a hall and ICT room) were surveyed as a trial for future works. **Figure 2** illustrates the site layout, including the extents of the survey area.

Historical records provided by the client show four air raid shelters along the eastern edge of the site. Various alterations to the main school building have also occurred.

2.2 Geology

The underlying geology is understood to comprise London Clay (~10m thickness), over Lambeth Group (~10m) with Chalk at 20 to 25mbgl. It is understood that the site was undeveloped until circa 1935, when the school was built, however there is history of Chalk extraction in the area, so there is a potential for associated shafts and other mine workings to be presented on the site.

As shown in **Table 1** below, 4 (no.) historic solution features have been recorded within a 500m search radius of the centre of the collapse.

Table 1. Recorded Solution Features in the vicinity of the site

Distance from collapse centre (m)	Eastings (m)	Northings (m)	Feature Type
240	511060	190780	Chalk Mne Shaft Entry
276	511010	190780	
295	511500	190500	
295	511500	190500	Solution Pipe

3 THE SURVEY

3.1 Objective and Geophysical Approach

A ground surface collapse feature has opened up within the school grounds. It measures approximately 3m diameter by 2m in depth, the location of the feature is displayed in **Figure 2**. The feature has been investigated by intrusive means (undertaken by others), the intrusive locations are displayed in **Figure 2** (PH1 to PH9). It is thought that the feature is most likely associated to the presence of a disused shaft extending to a depth of ~26mbgl. No further voiding was detected within the collapse feature (PH7) however the infill material was very low strength. No indications of voiding were detected around the perimeter of the collapse feature. However additional soft material was identified at intrusive location PH9 to the north of the collapse feature.

A geophysical survey was commissioned to investigate the possible presence of historic mine workings, related to the recent surface collapse feature across all accessible areas of the site, external to the school buildings.

In addition a small GPR trial was conducted within the school buildings to assess the feasibility of acquiring data beneath the reinforced concrete floor slabs of existing structures.

The geophysical techniques employed were Ground Penetrating Radar (GPR) and Electromagnetic (EM) surveying. The geophysical fieldwork was completed between the 22nd and 25th September 2015.

3.2 The Ground Penetrating Radar Technique

In GPR surveys, electromagnetic waves of frequencies between 50MHz and 1.5GHz are transmitted into the ground or structure. This energy is reflected back to the surface when it encounters significant contrasts in dielectric properties.

3.2.1 Theory

Both surface and borehole GPR techniques use electromagnetic waves of frequencies between 50MHz and 1.5GHz to probe the subsurface (**Figure 3A**). A radio wave transmitter (T_X) is used to generate a short (<20ns) pulse of radio waves of specific frequency (depending on the antenna selected). These radio waves penetrate into the subsurface. Some of the energy carried by these waves is transmitted to greater and greater distances, while some of the energy is reflected back towards the receiver (R_X)

whenever a contrast in electrical properties is encountered. The amount of energy reflected is dependent on the contrast in electrical properties encountered by the radio waves.

The receiver measures the variation in strength of the reflected signals with ***time***. The resulting profile is called a ‘trace’ and is a one-dimensional representation of the subsurface beneath the transmitter and receiver. To build up a two dimensional section of the subsurface (a radargram), the transmitter and receiver are traversed across the surface at a controlled speed.

In order to present time sections as ***depth*** sections, some form of calibration is required through borehole or core information, or through an assessment of the electrical (dielectric) properties of the surveyed materials. It is important to note that such conversions are not always practical.

The higher frequency antennas provide high resolution data over shallow depths (< 0.5m), and are mostly employed for near surface structural investigations (e.g., characterising rebar in concrete, **Figure 3B**). The lower frequency antennas can probe to greater depths (up to 30m, depending on subsurface conditions) but exhibit a reduced degree of resolution. These antennas are typically employed in geological/hydrogeological investigations (e.g., locating cave systems and sinkholes).

3.2.2 Application to Site

Initially the GPR system was trialled using three antenna frequencies (120MHz, 200MHz and 400MHz). The purpose of this trial was to determine the most suitable antenna for the ground conditions present on site. The 200MHz antenna was chosen for its deeper penetration depth whilst maintaining sufficient resolution to complete the scope of works. The 200MHz antenna was also used to collect data in the ICT room and Hall as part of the GPR trial within the buildings.

3.2.3 Equipment

SIR 4000

The equipment used was the SIR (Subsurface Interface Radar) System-4000 manufactured by Geophysical Survey Systems Inc. See equipment specifications in **Appendix A**.

3.3 The Electromagnetic Technique

In electromagnetic surveying the electrical properties of the ground are measured as a function of depth and/or horizontal distance. Different rocks (and buried structures/objects) exhibit different values of electrical conductivity. Mapping variations in electrical conductivity can identify anomalous areas worthy of further geophysical or intrusive investigation.

3.3.1 Theory

The electromagnetic method is based on the induction of electric currents in the ground by the magnetic component of electromagnetic waves generated at the surface (**Figure 4A**). An alternating current, of variable frequency, is passed through a coil of wire (a transmitter coil, T_X). This process generates an alternating primary magnetic field which, in turn, induces very small eddy currents in the earth, the magnitude of which is directly proportional to the ground conductivity in the vicinity of the coil. These eddy currents then generate a secondary magnetic field, a part of which is intercepted by a receiver coil (R_X). The interaction between the primary and secondary magnetic flux and the receiver coil generates a voltage that is linearly related to the electrical conductivity of the subsurface.

Two types of measurements may be recorded in electromagnetic surveying; the *quadrature* component and the *in-phase* response. The quadrature response measures the bulk electrical properties of the ground. The electrical properties are expressed as an apparent electrical conductivity in millisiemens per metre (mS/m). The in-phase response is essentially *metal detector* mode and is expressed in units of parts per thousand (ppt) of the primary transmitted field.

In electromagnetic mapping, individual measurements are recorded across a site at a suitable density and plotted as a contoured map (**Figure 4B**). Measurements may also be recorded at different depths according to the orientation (either vertical or horizontal) of the transmitter and receiver coils.

3.3.2 Application to Site

Discrete shafts and other buried obstructions may have contrasting physical properties compared to the surrounding material. In this instance an area of worked ground, filled or otherwise, would be expected to show a contrast between the manmade material and the surrounding ground, and will generally manifest as a discrete or geometric anomaly that can be identified in the data.

The length of the boom on the EM31 means data can only be collected in large open areas. Therefore no EM data could be acquired internally or in the enclosed play area in the centre of the school, the disabled car park or gated play area in the south east corner of the school.

It should be noted that the presence of surface metallic features may mask the presence of subsurface features by saturating the instrument readings when in close proximity to the surface metallic features (eg. Fences, cars etc ...)

3.3.3 Equipment

EM31

The equipment used was the EM31 (**Appendix A**). This consists of a transmitter and receiver separated at a distance of 3.6m, mounted on a single beam. The coil separation is such that the measurements recorded represent ground conditions down to a depth of 5 to 6m, when measured using the vertical dipole. The Geonics EM31 has the facility to record two types of measurement as the secondary field may be separated into the quadrature component and the in-phase response. The quadrature response measures the bulk electrical properties of the ground. The electrical properties are expressed as an apparent electrical conductivity in millisiemens per metre (mS/m). The in-phase response is essentially the same as a metal detector and is expressed in units of parts per thousand of the primary transmitted field.

3.4 Survey Design

The layout of the geophysical survey is shown in **Figure 2.**

The GPR and EM data were acquired at 2m line intervals on a survey grid in a single orientation over all accessible areas of the site to maximise data coverage in the available survey period.

The location of the GPR survey lines were surveyed using a Leica 1200 series SmartRover, providing accurate location data referenced to the Ordnance Survey OSGB36, British National Grid system.

The EM31 data was acquired with a backpack mounted dGPS, providing realtime positioning of data points.

3.5 Data Processing and Presentation

GPR data examples are presented in **Figure 5 & Figure 9**. EM data is presented in **Figure 6 & Figure 7**.

Following acquisition the data were downloaded at the office for further processing and interpretation. The following data processing steps were applied to the GPR & EM data as presented in Tables 2 & 3 respectively.

Table 2: Summary of GPR processing methods

Method	Justification
Depth calibration	A dielectric constant of 6.25 (typical of concrete) has been assumed in order to give the most accurate indication of depth. The calculated depths are expected to be typically ±20% accuracy.
Zero-offset	To correct the signal to the actual ground surface level.
Gain control	To compensate for the signal attenuation with depth and enhance the signals from deeper reflectors to aid interpretation. Each profile was enhanced with the same gain parameters.
Filtering	High and low pass filters were set at frequencies of 240MHz and 60MHz for the 120MHz antenna; 400MHz and 100MHz for the 200MHz antenna, and 800Mhz and 200MHz for the 400MHz antenna. This was done to remove noise from the data, and to isolate “legitimate” signals from reflections of the pulse from the instrument.

Table 3: Summary of EM processing methods

Method	Justification
Position readings	Rectify EM measurements and GPS locations using system timestamps. Positions the EM data in the correct real world location.
Import Data into Oasis Montaj	Import data into Oasis Montaj software for processing and gridding and additional processing as required.
Gridding	Grid datasets, to produce colour contour plots.
Export	Apply appropriate colour scheme to grids and export datasets for presentation.

4 DATA INTERPRETATION

4.1 Data Quality

Data quality was generally good. The GPR data were acquired using a 200MHz antenna providing data to a depth of ~3mbgl. The penetration depth of the signal was restricted due to presence of clay rich soils. The EM data were acquired using an EM31 ground conductivity meter in a vertical dipole mode providing data to a depth of ~6mbgl. Metallic surface features were present in some areas of the site, these lead to saturation of the EM sensors and may mask geophysical anomalies present within close proximity of these metallic surface features.

4.2 Results

The results of the GPR survey have been processed and interpreted and are presented on **Figure 8**. Full details of the anomalies identified in the GPR data are summarised in **Table 4** (below) and GPR data examples are presented on **Figure 5**.

Table 4: Summary of GPR Anomalies

GPR Anomaly Type	Characteristics	Interpretation
Anomaly Type A	High amplitude, reverberating reflector	Indicative of possible voiding, or conductive ground conditions
Anomaly Type B	High amplitude reflector	Indicative of buried obstruction or strata boundary
Anomaly Type C	Chaotic reflector	Indicative of disturbed ground

The results of the EM survey have been processed and interpreted and are presented on **Figure 8**. The In-phase response (sensitive to metallic features) and the Quadrature response (sensitive to changes in ground conductivity) of the EM instrument are presented in **Figures 6** & **7** respectively. The final data set was contoured to produce coloured contour grids; these are displayed with an accompanying scale bar. The colour scale for each of the ground conductivity maps has been optimised to isolate conductivity anomalies. High conductivity values are displayed with shades of red and pink, through yellows and greens, with shades of blue representing low conductivity values.

Full details of the anomalies identified in the EM data are presented in **Table 5** (below).

Table 5: Summary of EM Anomalies

EM Anomaly Type	Characteristics	Interpretation
Anomaly Type A	Distinct linear anomaly in the In-phase response, also visible in the Quadrature Response	Possible linear buried metallic service (pipe/cable)
Anomaly Type B	High amplitude anomaly in both the In-phase and Quadrature responses, corresponding to the location of metallic surface features	Metallic surface features, may mask the presence of buried anomalies within the EM data due to instrument sensor saturation
Anomaly Type C	Anomalous Quadrature response, displaying a change in ground conductivity (either higher or lower) compared to the background level for the site	Indicative of a change in the ground conditions/composition

4.3 Final Interpretation

The interpreted GPR and EM anomalies are presented on **Figure 8**. This figure does not include the trial GPR survey carried out within the buildings.

Multiple discrete isolated small GPR anomalies that do not correspond with anomalies in the EM data have been identified. These anomalies are distributed around the site and their characteristics and interpreted causative features are detailed on **Figure 8** and in **Table 3**. The anomalies vary in diameter and length between <1m to >8m, however It should be noted that the GPR profiles were spaced at 2m intervals and as such it is possible that these isolated anomalies could extend +/- 2m perpendicular to the orientation of GPR data acquisition. These anomalies may therefore cover a larger area than indicated in **Figure 8**.

Similarly seven EM anomalies have been identified that do not correspond with GPR anomalies. These are located to the North, South and East of the school buildings and vary in width and length between ~2.5m and ~13m. The anomalies located to the North of the school buildings display high amplitude responses and are roughly circular in shape, with diameters of ~2.5m to ~3m, which corresponds well with the dimensions of the recorded collapse feature on site. It is noted that historic record indicate the school building previously extended further north and, as such it is possible that these anomalies are associated with the previous structure. The anomalies located to the South and East of the school buildings display lower amplitude responses and are generally elongated in shape, with dimensions varying between ~3m to ~5m width and ~8m to ~13m in length. The largest of these anomalies corresponds with the recorded position of an historic air raid shelter and is likely to be related to changes in the ground materials associated with the possible removal and remediation of this feature.

Three anomalous areas where both GPR and EM anomalies coincide have also been identified. The first of these is located in the North-eastern corner of the site, and is characterised by a large low amplitude conductivity EM anomaly and a large area of high amplitude reflections in the GPR data, as well as some small regions showing high amplitude reverberating reflections in the GPR data. This are corresponds closely with the locations of two historic air raid shelters and as such is interpreted to be representative of changes in the ground conditions associated with remediation works completed when these features were removed.

The second anomalous area is located north of the school buildings and is characterised by a large high amplitude conductivity anomaly and a small GPR anomaly associated with chaotic reflections (typically indicative of disturbed ground). There were no surface or historical features which corresponded with this anomaly.

The third anomalous area is located south of the school and is characterised by a low conductivity anomaly and a large GPR anomaly associated with chaotic reflections (typically indicative of disturbed ground). This feature is adjacent to a possible buried metallic service and as such may be related to the installation of this feature.

The presence of metallic surface features is likely to have masked the presence of some additional geophysical anomalies (specifically in the car parks). It is understood that at intrusive test location PH9 soft ground was encountered. This was an area where metallic surface features were present, leading to saturation of the instruments sensors, preventing identification of EM anomalies.

4.3.1 Recommendations for further work

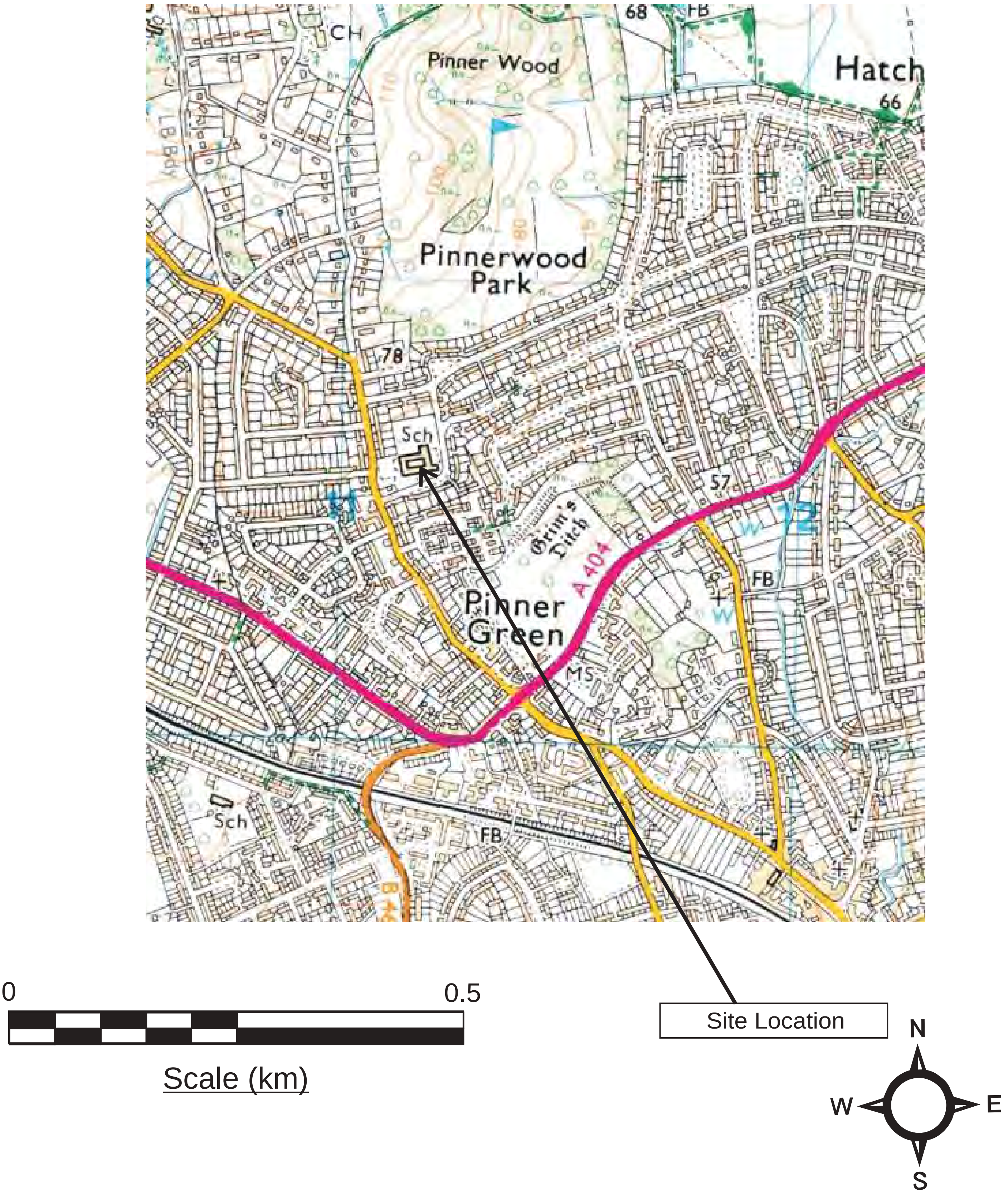
The trial GPR survey within the school buildings indicated that the GPR signal propagated through the concrete floor slab to varying degrees within the trial area. Examples of the data acquired are presented in **Figure 9**. As such we would recommend carrying out a GPR survey within the school buildings to map the location of anomalies beneath the buildings footprint. Due to the large width of the 200MHz GPR antenna it should be noted that only larger rooms will be able to be covered by this technique.

It is recommended that the cause of the discrete GPR Type A and EM type C anomalies and areas where GPR and EM anomalies are co-incident () are investigated further by probing in order to confirm the nature of the ground conditions. A microgravity survey would also show whether these features are associated with low density or voided ground, and also provide information on low density ground and voids to potentially greater investigation depths then the survey subject of this report.

5 CONCLUSIONS

- On the instructions of Andy Barr of Harrow Council, RSK Environment Ltd has carried out a geophysical investigation to investigate the possible presence of historic mine workings, related to a recent surface collapse feature at Pinner Wood Primary School.
- The geophysical techniques employed were Ground Penetrating Radar (GPR) and Electromagnetic (EM) surveying.
- The equipment used for the GPR survey was a SIR-4000 console with a 200MHz antenna, providing data to a depth of approximately 3mbgl. The electromagnetic survey was acquired using a Geonics-EM31 ground conductivity meter, in vertical dipole mode providing data to a depth of ~6mbgl.
- The geophysical survey has identified a number of anomalies that may be related to the presence of historical mine workings. The interpreted results are presented in **Figure 8**.

FIGURES



Notes

Extract from Ordnance Survey 1:50,000 scale map

Reproduced from Ordnance Survey mapping with the permission of the Controller of Her Majesty's Stationery Office.
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SITE LOCATION MAP

National Grid Reference: TQ 111 906

Client:
HARROW COUNCIL

Figure: 1

Job: 191236

Project:
PINNER WOOD SCHOOL

Scale:
As shown

Date:
October 2015

NOTES

The specific risks associated with the content of this drawing are considered to be:–

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(2) Service tracing was completed by others and the information presented on this drawing was taken from EDI Surveys drawing CLT13789/T/01/02 and has not been checked for accuracy.
(3) It is recommended that the Client should confirm the location of the geophysical anomalies with intrusive methods.
(4) Although every reasonable effort has been made to locate possible mine workings, RSK Environment Ltd cannot guarantee that all mine workings have been located.
(5) Refer to Figure 2 of RSK Environment Ltd Report Reference 191236-001 for the extent of the the geophysical survey area.
(6) Coordinates are provided in OSGB1936, British National Grid (Newlyn datum).

KEY

▨	HISTORIC LOCATION OF AIR RAID SHELTERS
—	EXTENDS OF GEOPHYSICAL SURVEY AREA
▨	GPR SURVEY AREA
●	INTRUSIVE SURVEY LOCATIONS
○	LOCATION OF COLLAPSE

Rev.	Date	Amendment	Drawn	Chkd.	Appd.

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Client
HARROW COUNCIL

Project Title
PINNER WOOD SCHOOL

Drawing Title
GEOPHYSICAL SURVEY AREA

Drawn	Date	Checked	Date	Approved	Date
JH	02/10/15	MS	05/10/15	TG	06/10/15

Scale
1:500

Orig Size
A2

Dimensions

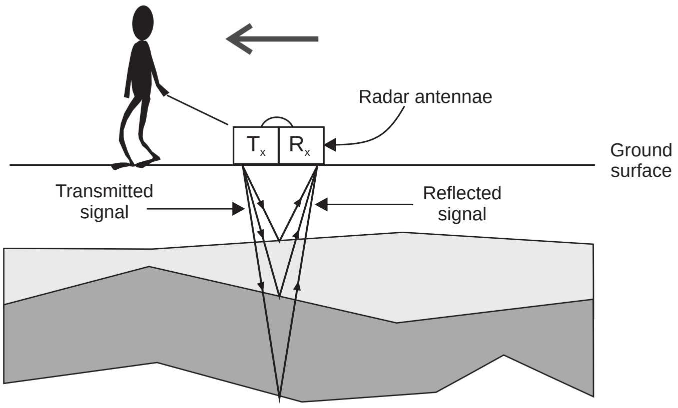
Project No.
191236

Drawing File
191236 Fig. 2

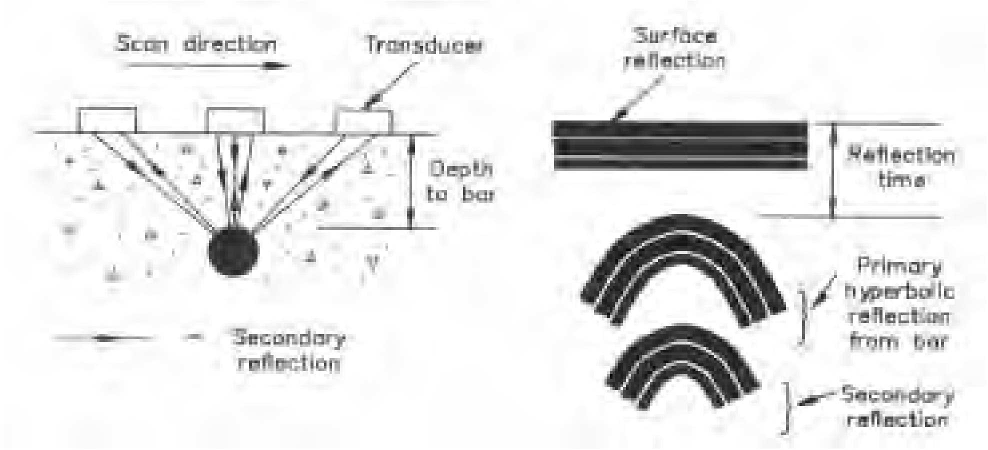
Drawing No.
191236 Fig.2 Sheet 1 of 1

Rev.

Scale
0 5 10 15 20 25m

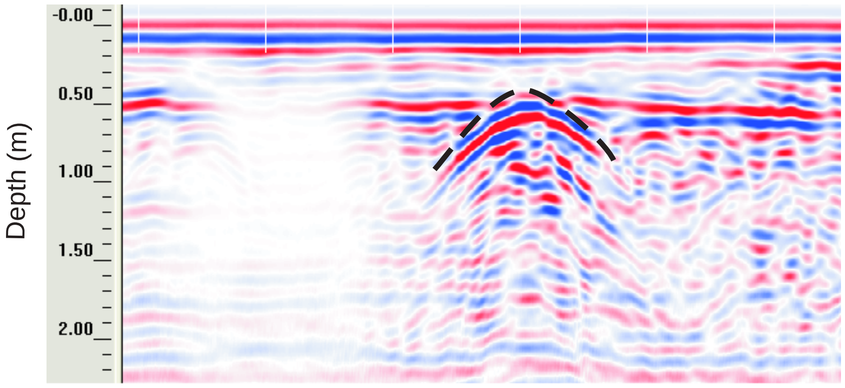


A The principle of ground penetrating radar



B GPR response to rebar or service

C An example of radar data collected over a typical buried utility



THE GROUND PENETRATING RADAR TECHNIQUE

Client:
HARROW COUNCIL

FIGURE 3

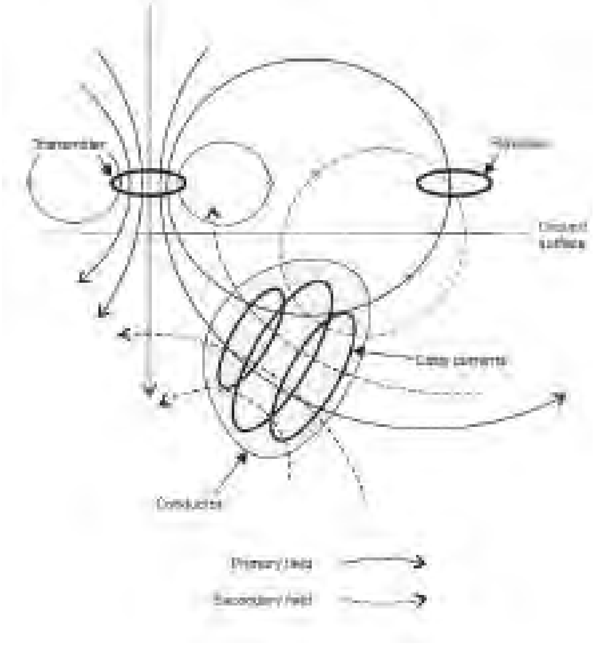
Job: 191236

Site/Project:
PINNER WOOD SCHOOL

SCALE
N/A

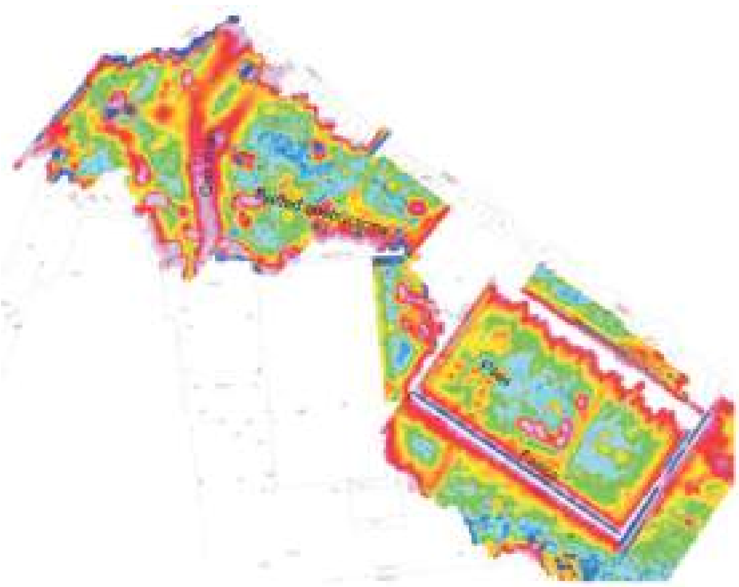
DATE
October 2015

A The principle of electromagnetic induction



B The EM31

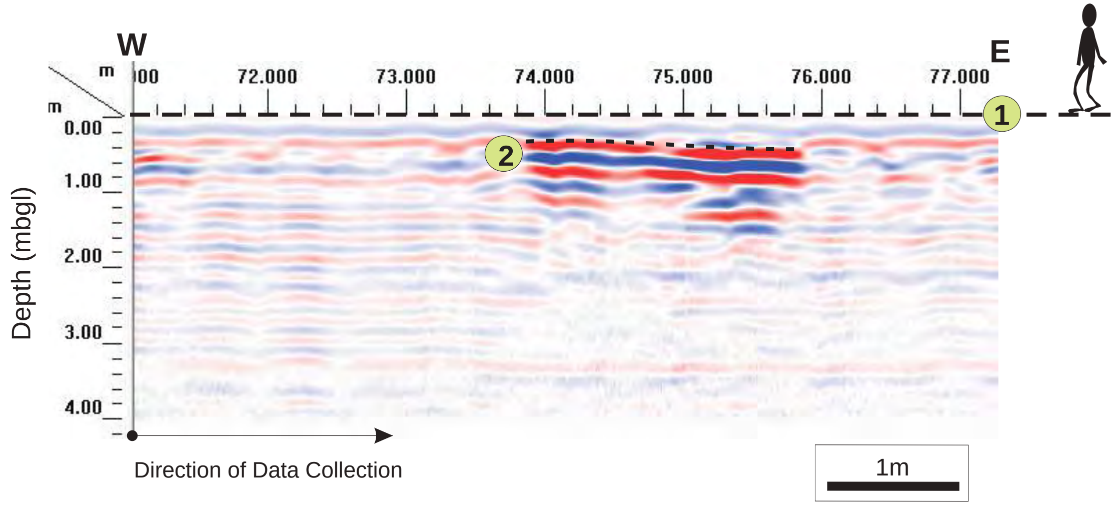
C An example of electromagnetic data showing various buried obstructions



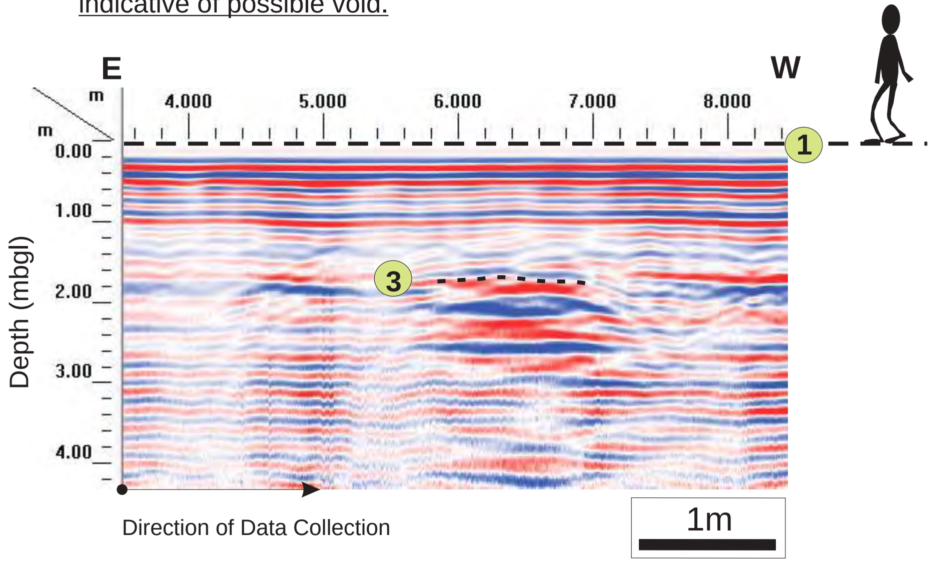
THE ELECTROMAGNETIC TECHNIQUE

Client: **HARROW COUNCIL**	FIGURE 4	Job: 191236
Site/Project: **PINNER WOOD SCHOOL**	SCALE N/A	DATE October 2015

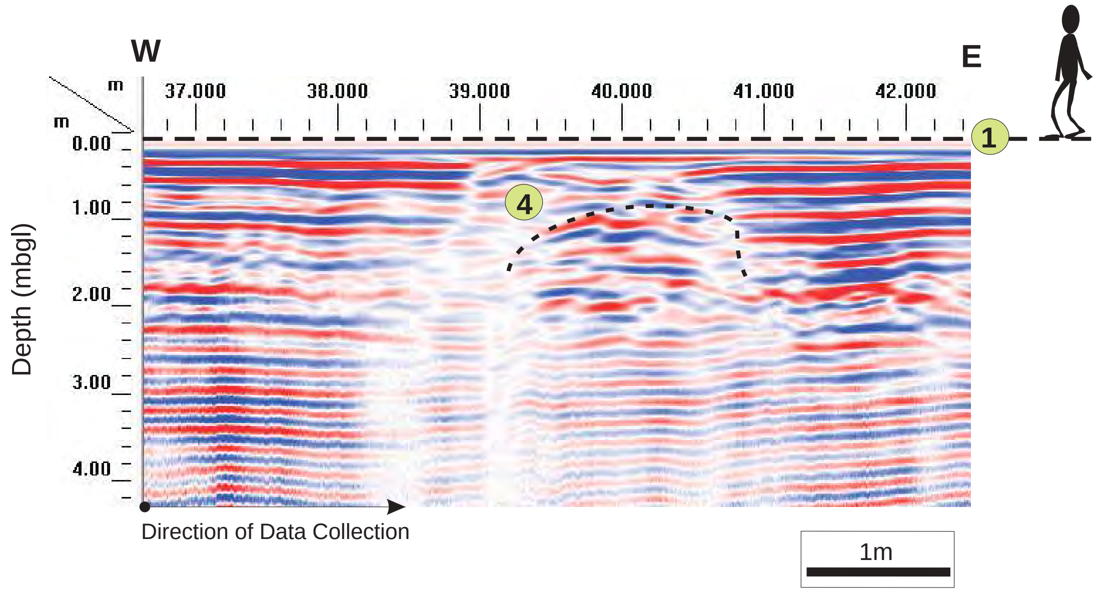
Ⓐ Example 200MHz data showing high amplitude reflector, indicative of obstruction or change in ground conditions.



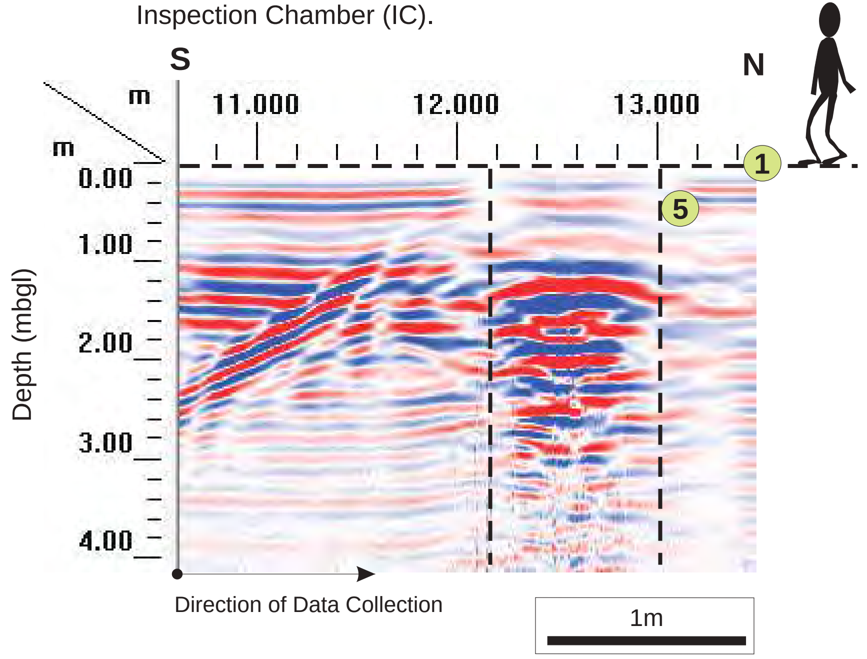
Ⓑ Example 200MHz data showing high amplitude reverberating reflector, indicative of possible void.



Ⓒ Example 200MHz data showing chaotic reflectors, indicative of disturbed ground.



Ⓓ Example 200MHz data showing high amplitude reverberation from the surface indicating the antenna passing over an Inspection Chamber (IC).



Key Features

① Surface of ground.

② High amplitude reflector, indicative of obstruction or change in ground conditions.

③ High amplitude reverberating reflector, indicative of possible void.

④ Chaotic reflectors, indicative of disturbed ground.

⑤ High amplitude reverberation from the surface indicating the antenna passing over an Inspection Chamber (IC).

Notes: Location of scan lines above shown on **Figure 8**

EXAMPLE RADAR DATA

Client: **HARROW COUNCIL**

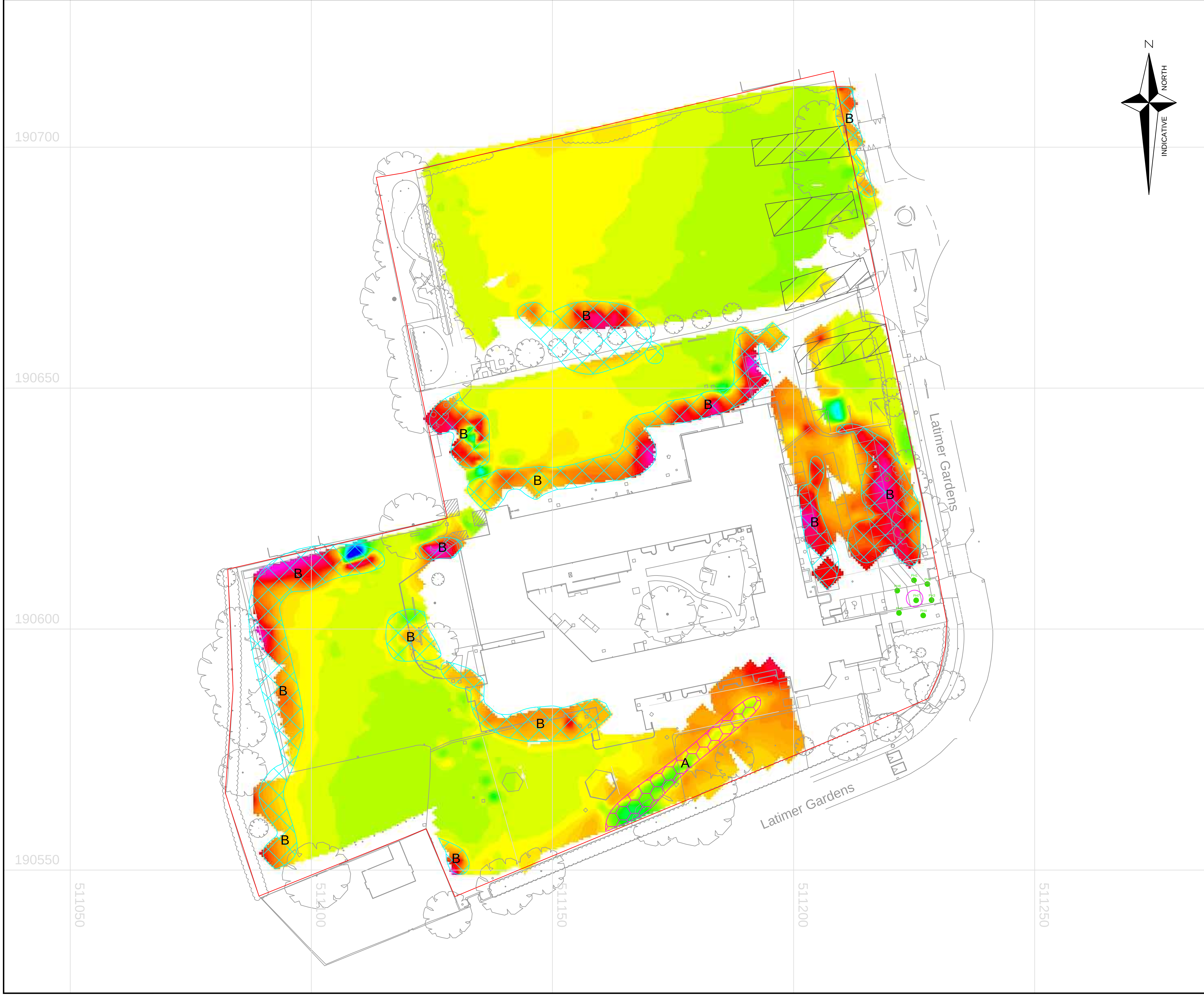
FIGURE 5

Job: 191236

Site/Project: **PINNER WOOD SCHOOL**

Scale: AS SHOWN

Date: OCTOBER 2015



NOTES

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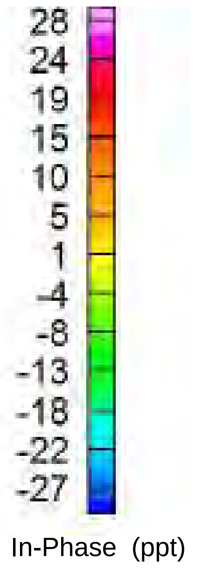
(3) It is recommended that the Client should confirm the location of the geophysical anomalies with intrusive methods.
(4) Although every reasonable effort has been made to locate possible mine workings, RSK Environment Ltd cannot guarantee that all mine workings have been located.
(5) Refer to Figure 2 of RSK Environment Ltd Report Reference 191236-001 for the extent of the the geophysical survey area.
(6) Coordinates are provided in OSGB1936, British National Grid (Newlyn datum).

KEY

▨	HISTORIC LOCATION OF AIR RAID SHELTERS
▦	EM ANOMALY TYPE A - POSSIBLE BURIED METALLIC SERVICE
⊠	EM ANOMALY TYPE B - METALLIC SURFACE FEATURES (MAY MASK ANOMALIES)
●	INTRUSIVE SURVEY LOCATIONS
○	LOCATION OF COLLAPSE
—	EXTENDS OF GEOPHYSICAL SURVEY AREA



Rev.	Date	Amendment	Drawn	Chkd.	Appd.

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Client
HARROW COUNCIL

Project Title
PINNER WOOD SCHOOL

Drawing Title
ELECTROMAGNETIC SURVEY
(IN-PHASE RESPONSE)

Drawn	Date	Checked	Date	Approved	Date
JH	02/10/15	MS	05/10/15	TG	06/10/15

Scale
1:500

Orig Size
A2

Dimensions

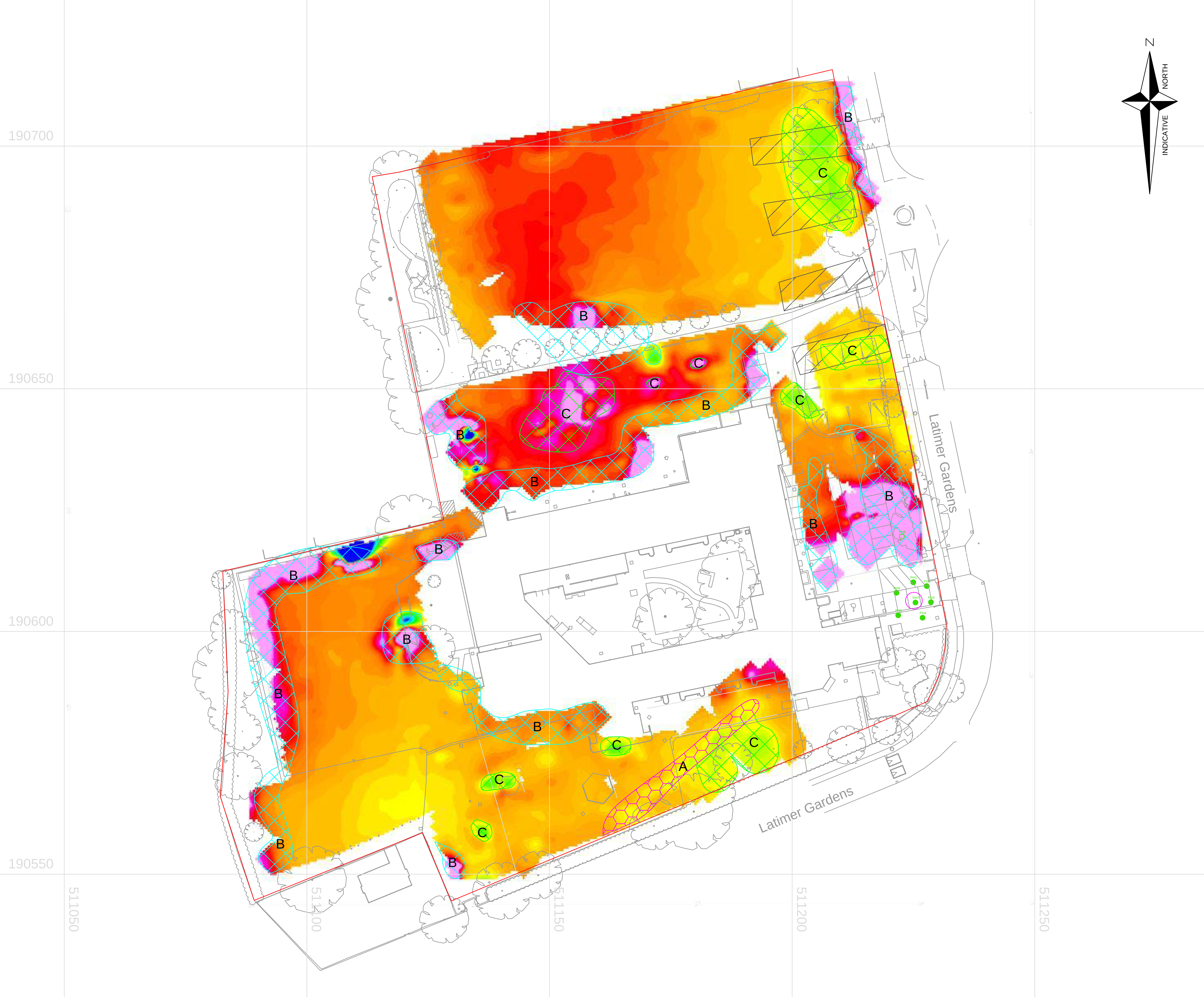
Project No.
191236

Drawing File
191236 Fig. 6

Drawing No.
191236 Fig.6 Sheet 1 of 1

Rev.

Scale
0 5 10 15 20 25m



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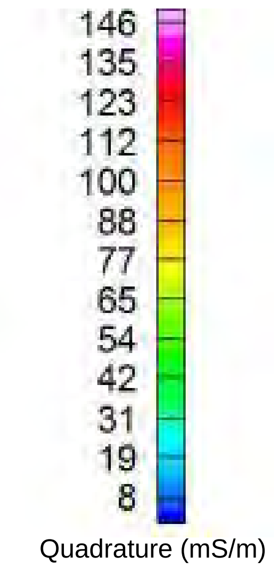
(6) Coordinates are provided in OSGB1936, British National Grid (Newlyn datum).

KEY

▨	HISTORIC LOCATION OF AIR RAID SHELTERS
⬡	EM ANOMALY TYPE A - POSSIBLE BURIED METALLIC SERVICE
⊠	EM ANOMALY TYPE B - METALLIC SURFACE FEATURES (MAY MASK ANOMALIES)
⊠	EM ANOMALY TYPE C - ELECTROMAGNETIC CONDUCTIVITY ANOMALIES
●	INTRUSIVE SURVEY LOCATIONS
○	LOCATION OF COLLAPSE
—	EXTENDS OF GEOPHYSICAL SURVEY AREA



Rev.	Date	Amendment	Drawn	Chkd.	Appd.

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Client
HARROW COUNCIL

Project Title
PINNER WOOD SCHOOL

Drawing Title
ELECTROMAGNETIC SURVEY
(QUADRATURE RESPONSE)

Drawn	Date	Checked	Date	Approved	Date
JH	02/10/15	MS	05/10/15	TG	06/10/15

Scale
1:500

Orig Size
A2

Dimensions

Project No.
191236

Drawing File
191236 Fig. 7

Drawing No.
191236 Fig.7 Sheet 1 of 1

Rev.

Scale
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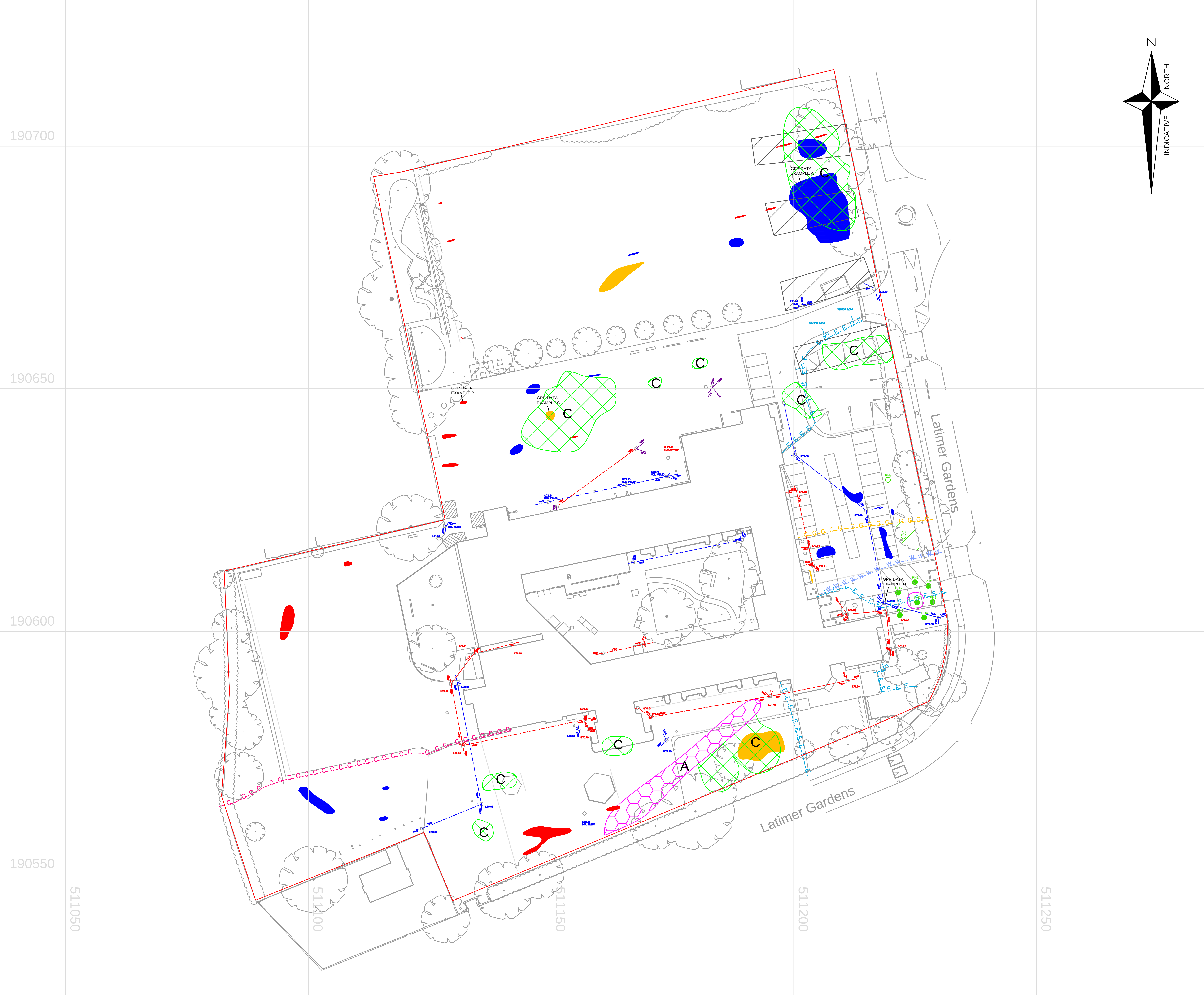

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(5) Refer to Figure 2 of RSK Environment Ltd Report Reference 191236-001 for the extent of the the geophysical survey area.
(6) Coordinates are provided in OSGB1936, British National Grid (Newlyn datum).
(7) GPR examples A-E are displayed on Figure XX.

KEY

▨	HISTORIC LOCATION OF AIR RAID SHELTERS
⬡	EM ANOMALY TYPE A - POSSIBLE BURIED METALLIC FEATURE
☒	EM ANOMALY TYPE B - ELECTROMAGNETIC CONDUCTIVITY ANOMALIES - INDICATIVE OF A CHANGE IN GROUND CONDITIONS
🟥	GPR ANOMALY TYPE A - HIGH AMPLITUDE REVERBERATING REFLECTOR, INDICATIVE OF POSSIBLE VOID
🟦	GPR ANOMALY TYPE B - HIGH AMPLITUDE REFLECTOR, INDICATIVE OF OBSTRUCTION OR CHANGE IN GROUND CONDITIONS
🟧	GPR ANOMALY TYPE C - CHAOTIC REFLECTORS, INDICATIVE OF DISTURBED GROUND
●	INTRUSIVE SURVEY LOCATIONS
○	LOCATION OF COLLAPSE
—	EXTENDS OF GEOPHYSICAL SURVEY AREA

Features extracted from supplied basemap:

︶︶︶	VEGETATION / FOLIAGE
□	GULLY
▭	IC

—C— —	*CATV cables*	— —SD— —	*Service ducts*
—D— —	*Data cables*	———	*Storm water*
—E— —	*Electric cab.*	— —T— —	*Telecom cab.*
———	*Foul water*	— —U— —	*Unidentified*
—G— —	*Gas pipes*	— —W— —	*Water pipes*

Rev.	Date	Amendment	Drawn	Chkd.	Appd.

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Client
HARROW COUNCIL

Project Title
PINNER WOOD SCHOOL

Drawing Title
INTERPRETED GEOPHYSICAL SURVEY RESULTS

Drawn	Date	Checked	Date	Approved	Date
JH	02/10/15	MS	05/10/15	TG	06/10/15

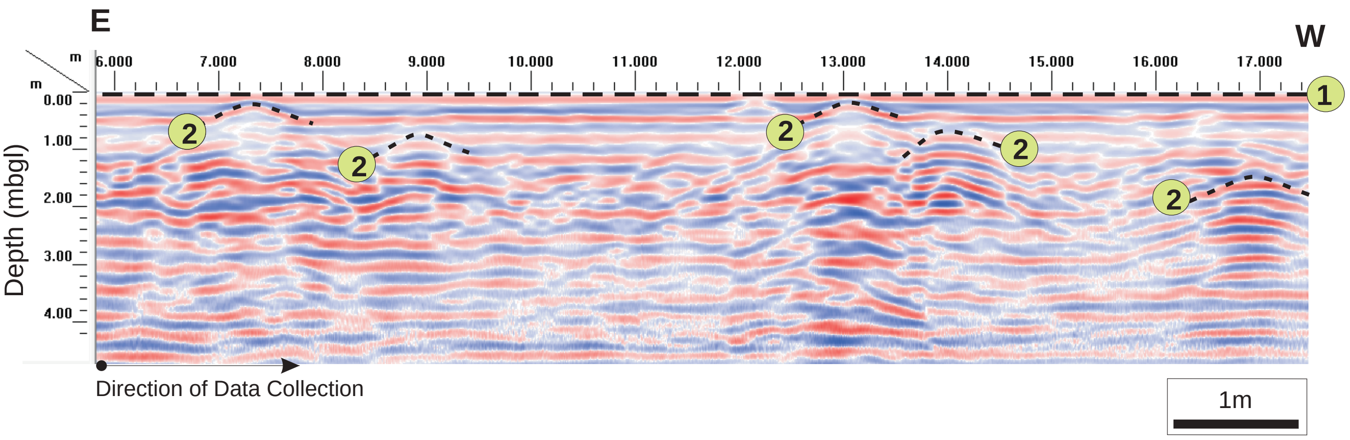
Scale 1:500
Orig Size A2
Dimensions

Project No. 191236
Drawing File 191236 Fig. 8

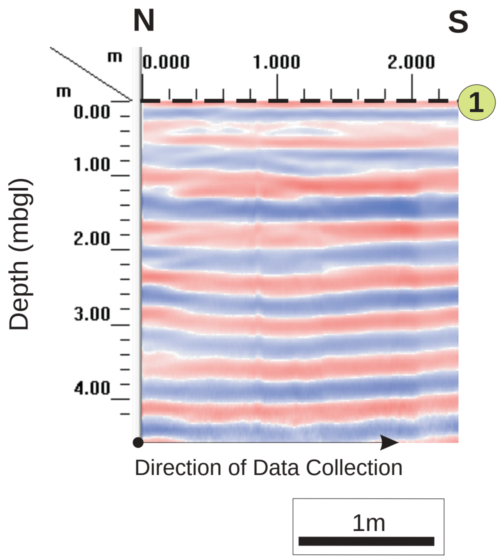
Drawing No. 191236 Fig.8 Sheet 1 of 1
Rev.

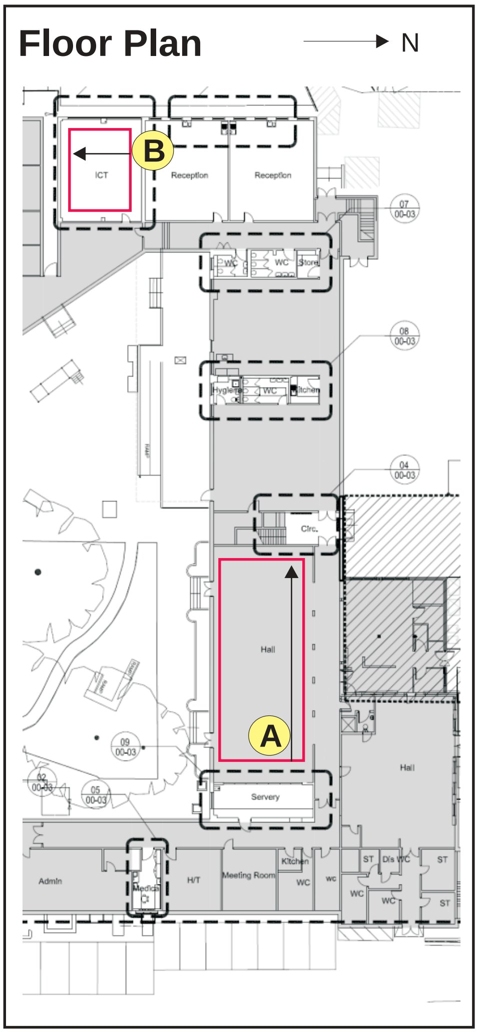
Scale
0 5 10 15 20 25m

A Example 200MHz data collected in the Hall showing anomalous reflectors contrasting with the surrounding subsurface material.



B Example 200MHz data collected in the ICT room showing more uniform reflectors.





Key Features

1. Surface of ground.

2. Anomalous reflectors contrasting with the surrounding subsurface material, possibly relating to services or structural features.

RSK

EXAMPLE RADAR DATA - INTERIOR TRIAL

Client: HARROW COUNCIL

FIGURE 9

Job: 191236

Site/Project: PINNER WOOD SCHOOL

Scale: AS SHOWN

Date: OCTOBER 2015

APPENDIX A

Equipment Specification Sheet

GSSI SIR-4000 RADAR

A portable, digital Subsurface Interface Radar System designed for a broad range of environmental, geotechnical, geological and engineering applications.

The SIR® 4000 is GSSI's first high-performance GPR data acquisition system designed to operate with analog and digital antennas. This evolutionary step allows true versatility and flexibility by supporting a wide range of users, beginner to advanced, in numerous applications.

The SIR 4000 incorporates advanced display modes and filtering capabilities for 'in-the-field' processing and imaging. Fully integrated, the system provides a simple user interface, plug-and-play GPS integration, and WiFi enabled data transfer capabilities.

The SIR-4000 is compatible with all GSSI antennae; frequencies range from 20MHz to 2.5GHz, thus facilitating a broad range of applications.

System	
Antenna Support	Compatible with all GSSI antennas
Number of Channels	Records data from 1 single-frequency antenna or 1 dual-frequency antenna
Data Storage	32 GB
Display	Enhanced 10.4" LED display with internal high brightness. Active matrix 1024 x 768 resolution and 32-bit color
GPS	Data logged internally
Display Modes	Linescan, Linescan plus O-scope, Wiggle trace Full 3D. 256 color bins are used to represent the amplitude and polarity of the signal
Data Acquisition	
Data Format	RADAN™ (.dzt)
Output Data Format	32-bit
Scan Interval	User-selectable, up to 400 scans/sec
Number of Samples per Scan	256, 512, 1024, 2048, 4096, 8192, 16384
Operating Modes	Continuous (time) or survey wheel (distance triggered) or point mode
Time Range	0-20,000 nanoseconds full scale, user-selectable Gain manual adjustment from -42 to +126 dB Number of segments in gain curve is user-selectable from 1 to 8
Standard Real-Time Filters	Infinite Impulse Response (IIR) - Low and High Pass, vertical and horizontal Finite Impulse Response (FIR) - Low and High Pass, vertical and horizontal
Advanced Real-Time Filters	Migration, Surface Position Tracking, Signal Noise Floor Tracking, Adaptive Background Removal
Automatic System Setups	Storage of an unlimited number of system setup files for different survey conditions and/or antenna deployment configurations
Automatic Antenna Recognition	Automatic recognition of Smart Antennas to allow maximum compliant transmit rate
Languages	
	English, Chinese, Japanese, French
Operating	
Operating Temperature	-20°C to 40°C external (-4°F to 104°F)
Battery	Inspired Energy NI2040ED, 3 hour runtime*
Transmit Rate	Up to 800 KHz (International), US/Canada and CE rates depend on antenna model
Input/Output	
Available Ports	Antenna input: analog and digital (one at a time). DC power input. Serial RS232 (GPS port). Accessory connector. HDMI video output. Ethernet to PC. USB 2.0 port, mini USB
WiFi	802.11B/G
Ethernet	RJ45 100BT Ethernet
USB Host	USB Host with external keyboard support, USB flash drive support and USB HUB support
Mechanical	
Dimensions	14x10x2.25 in (36x25x7 cm)
Weight	10 lbs (4.54 kg) with battery
Relative Humidity	<95% non-condensing
Storage Temperature	-40°C to 60°C (-40°F to 140°F)

GSSI SIR 4000
RADAR
SPECIFICATIONS

GEONICS EM31

A portable, lightweight, dual coil ground conductivity instrument designed for a broad range of environmental, geotechnical, geological and engineering applications.

The Geonics EM31 maps geological variations, groundwater contaminants or any subsurface feature associated with changes in ground conductivity, using a patented electromagnetic inductive technique that allows measurement without electrodes or ground contact. With this inductive method, surveys can be carried out under most geologic conditions including those of high surface resistivity such as sand, gravel and asphalt.

Ground conductivity (quad-phase) and magnetic susceptivility (in-phase) measurements are read directly from a digital display. Real-time data collection is available by connecting a data logger or PC directly to the RS232 output port on the front panel.

The effective depth of exploration is about 6m, making it ideal for geotechnical and environmental site characterization. Important advantages of the EM31 over conventional resistivity methods are the speed with which surveys can be performed, the precision in which small changes in conductivity can be measured and the continuous read out and data collection while traversing the area. Additionally, the in-phase component is particularly useful for the detection of buried metallic structure and waste material.

The EM31-SH is a 'short' version of the EM31 offering an effective depth of about 4m. With a smaller coil separation and lighter weight, the EM31-SH offers improvements in sensitivity to smaller near-surface targets, lateral resolution and portability, while maintaining the high levels of accuracy and stability provided by the standard EM31.

Specifications;

Measured quantities:	*1.* Apparent conductivity in millisiemens per metre (mS/m) *2.* In-phase ratio of secondary to primary magnetic field in parts per thousand (ppt)
Intercoil spacing:	3.66m
Operating frequency:	9.8kHz
Power supply:	8 disposable alkaline 'C' cells (approx. 20h continuous use)
Measuring Ranges:	Conductivity: 10, 100, 1000mS/m; In-phase: ±20ppt
Measurement Resolution:	±0.1% of full scale
Measurement Accuracy:	±5% at 20mS/m
Noise levels:	Conductivity: 0.1mS/m; In-phase:0.03ppt
Dimensions:	Boom: 4.0m extended, 1.4m stored Shipping case: 145 x 38 x 23cm
Weights:	Instrument: 12.4kg Shipping: 28kg

Appendix D

PBA Letter, Pinner Wood School – Review of Geophysical Survey, CBH/CNE/SJC/35665, dated 21 October 2015

Your ref:

Our ref: CBH\CNE\SJC\35665

21 October 2015

Peter Brett Associates LLP
Caversham Bridge House
Waterman Place, Reading
Berkshire RG1 8DN
T: +44 (0)118 950 0761
F: +44 (0)118 959 7498
E: reading@peterbrett.com

Harrow Council
Central Depot
Unit 1
Forward Drive
Harrow
HA3 8NT

Attn: Andy Barr

Dear Andy

RE: Pinner Wood School – Review of Geophysical Survey

We refer to the recently completed geophysical survey at Pinner Wood School. Following our review of the report on this survey we, now have pleasure in providing our comments accordingly.

Harrow Council engaged RSK Environment Ltd to carry out geophysical surveys at the school premises following the sudden occurrence of a collapse in the car park. The survey techniques used consisted of electromagnetic conductivity mapping (EM) and ground probing radar (GPR). Both techniques were employed to survey the external areas of the school below hardstanding and playing field areas. The GPR survey was also trialled to survey below the ground floor slab of the hall and ICT room inside the school buildings. The results of the survey are presented in a report prepared by RSK Ref 191236-R01 (00) dated October 2015.

The aim of the surveys was to detect the presence of voids or disturbed ground present at shallow level (between ground level and circa 5m bgl) that might be associated with historical chalk mine workings (e.g. shafts and upward migrating voids) and other past excavations.

The survey techniques and processing of results were carried out as expected by an experienced survey company. The outcome of the surveys found a number of discrete GPR anomalies, a number of discrete EM anomalies and a series of locations where both the GPR and EM anomalies were coincident. From historical information it is known that several of the anomalies relate to the positions of old air raid shelters at the site and therefore provide confidence in the ability of the techniques used to be detecting various forms of ground disturbance. The positions of the detected anomalies are shown on Figure 8 of the RSK report. Excluding the former air raid shelter positions there are a significant number of anomalies surrounding the school buildings.

Given the number of anomalies and uncertainty of their origin it is recommended that an intrusive ground investigation is carried out at each of the anomaly locations to better understand the cause of the apparently disturbed ground/possible voids present. The most cost-effective way to undertake the investigation works is to carry out a series of dynamic probes. Where the anomaly is of limited size a single probe may be sufficient but where anomalies cover larger areas then a grid of probes will be required. The probes should probably be extended to a minimum of 10m below ground level and taken deeper in response to the results obtained.

The probes do not retrieve any soil samples to confirm the nature of the ground conditions and therefore it is also recommended that a series of window/windowless driven sampler boreholes are undertaken as well to provide details of the geological sequence present to aid with interpretation of the probe profiles. In addition during the previous probing work in the vicinity of the collapse probe PH9 found deep disturbed ground and this should now be sampled to understand the nature of the profile – in this area the latest geophysical surveys were unable to provide additional information because of the presence of metallic features.

It is further recommended that going forward there also needs to be some deeper boreholes carried out to provide geological reference profiles to ensure that the geological ground model is correctly defined and that all the other investigation results can be interpreted with confidence. One of these deeper boreholes should be sunk through the centre of the original collapse hole, with the aim of confirming whether the feature represents the collapse of infill deposits to a former exploratory shaft, a mine shaft or some other cause.

On the basis of the above recommendations the scope of intrusive works is as follows:

- Circa 40no dynamic probes taken to a minimum of 10m depth and may need to be extended up to 20m or more in some locations
- Circa 15no window/windowless sampler boreholes taken to depths of 5m to 10m bgl
- 3no light cable percussion boreholes taken to depths of 25m to 30m with in situ testing and aiming to intersect and penetrate the chalk surface at depth

Health and safety considerations during these works will need to include netting of other mitigation measures over areas where ground anomalies are being investigated and reuse of a platform over the area of the original ground collapse.

It should also be noted that RSK claim a plan position accuracy for the anomalies of +/- 2m. Therefore in order to set out the locations of the intrusive exploratory holes it will be necessary to get RSK to set out the positions of the anomalies and mark them with water-soluble spray paint.

Finally it is noted that the GPR results below the floor slabs of the hall and ICT room inside the school buildings found some evidence of disturbance below the hall while the ground below the ICT room appeared undisturbed. It is understood that the GPR survey within the school buildings is to be extended therefore presently PBA will await these results before commenting further on what the implications might be for future investigations internally.

Going forward, PBA would be pleased to provide specifications and further details regarding the next phase of intrusive ground investigations and work in collaboration with EPG, as considered appropriate by Harrow Council. A significant part of the proposed further ground investigations will need to be reactive, responding to the ground conditions encountered as the works progress. In order to provide accurate interpretation and further advice, PBA will need to be present on site during key stages of these investigations. Subject to your specific requirements, a further fee proposal for the next phase can be provided accordingly.

Yours sincerely

SS Chandler

Stuart Chandler
Associate
For and on behalf of
PETER BRETT ASSOCIATES LLP

c.c. Debbie Spruce – Pinner Wood School
Sarah Mortimer – EPG Ltd

Appendix E

Endeavour Drilling, Ground Investigation Report, Report Number END16-029, dated September 2016

GROUND INVESTIGATION REPORT (FACTUAL)

Pinner Wood School,
Latimer Gardens,
Middlesex,

Client: Harrow Council

Consultant: Peter Brett Associates

September 2016

Report No: END16-029

Endeavour Drilling Ltd
Unit 7,
Mapledean Industrial Estate
Maldon Road
Latchingdon
Essex
CM3 6LG

GROUND INVESTIGATION REPORT (FACTUAL)

Pinner Wood School, Latimer Gardens, Middlesex,

Author:	Callum Ginbey MGeol (Hons)

Checked By:	Matthew Somerville Bsc (Hons) FGS CGeol

Revision	Date	Description	Prepared	Checked
Final	19.09.16	Factual Report	CG	MJS

CONTENTS:-

APPENDIX

1. INTRODUCTION

Endeavour Drilling Limited received instruction to carry out a ground investigation at the Pinner Wood School, Latimer Gardens, Middlesex, in order to determine sub-surface ground conditions in proximity to known areas of subsidence and geophysical anomalies, which may be associated with historical chalk workings in the area. The nearest postcode to the site is HA5 3RA.

The ground investigation was instructed by the consultant, Peter Brett Associates, on behalf of the client; Harrow Council.

The ground investigation comprised the forming of three hollow stem auger boreholes, fifteen window sampler boreholes and thirty-eight dynamic probes, with associated sampling and in-situ testing.

This report presents the factual findings of the investigation.

The work was carried out in general accordance with BS EN 1997-2:2007 Eurocode 7: Geotechnical Design, Ground Investigation and Testing and other relevant standards that are referenced within the text.

2. LIMITATIONS

This report is based upon the results of the exploratory boreholes and dynamic probe results and on details of the scheme provided by the Consultant; Peter Brett Associates (PBA).

This report has been prepared for the benefit of Harrow Council and its contents should not be relied upon by others without the written authority of Endeavour Drilling Limited (ED). If any unauthorised third party makes use of this report they do so at their own risk and ED owes them no duty of care or skill.

All information provided by others is taken as being in good faith as being accurate, but ED cannot, and does not accept any liability for the detailed accuracy, errors or omissions within such information. Subsoils are by their nature hidden from view and no investigation can be exhaustive to the extent that all ground conditions are revealed. Conditions may well be present beneath the site which was not evident from the investigations carried out.

3. FIELDWORK

The fieldwork was undertaken between August 8th and August 26th 2016 and comprised the following;

- Three hollow stem auger boreholes formed to a target depth of 30.00mbgl (BH101 & BH103) and 26.00mbgl (BH102).
- Fifteen window sampler boreholes formed to effective refusal or a target depth of 10.00mbgl (WS101 - WS115).
- Thirty-eight dynamic probes to terminate at effective refusal or in competent strata at or beyond 10.00mbgl, with a maximum depth of 14.00mbgl (DP137).

The exploratory hole positions for the hollow stem augers and dynamic probes were predetermined by a representative of PBA prior to undertaking the fieldwork. The positions for the window sampler boreholes were subsequently generated by PBA on the basis of the dynamic probe test results. The exploratory hole location plan is presented as Figure 1 in Appendix A.

All exploratory positions were service traced with a ground penetrating radar and subsequently scanned using a Cable Avoidance Tool (CAT), for the presence of underground buried services by suitably trained ED staff.

3.1. Hollow Stem Auger Boreholes

The hollow stem auger boreholes were drilled using a Comacchio 305 drilling rig, employing 200mm diameter hollow stem, continuous flight auger techniques. This rotary drilling method produces undisturbed core nominally of 88mm diameter, retrieved in rigid plastic core liners.

Within all soils, standard penetration tests (utilising the solid cone, CPT) were carried out at 1.00m centres to 6.00mbgl, followed by 1.50m centres to the base of the borehole. The number of blows required to advance the cone over the final 300mm of a 450mm total drive was recorded and is shown as the penetration resistance (“N” value).

The hollow stem auger borehole records are presented in Appendix B, and give both descriptions and depths of strata encountered, together with details of total core recovery, and any other relevant information.

The borehole was logged and cores photographed to BS EN 1997-2:2007 Eurocode 7 by an ED engineering geologist and typed into AGS4 format using HoleBASE_SI.

3.2. Window Sampler Boreholes

The window sampling utilised a two man crew, operating a track mounted hydraulic power pack and percussive hammer to drive a series of small diameter tubes into the ground.

Within all soils, standard penetration tests (utilising the solid cone, CPT) were carried out at 1.00m centres to the base of the borehole, using an automatic trip hammer. The number of blows required to advance the cone over the final 300mm of a 450mm total drive was recorded and is shown as the penetration resistance ("N" value).

Groundwater observations were undertaken during the drilling of the borehole. When groundwater was encountered, boring was suspended for 20 minutes to measure the change in water levels. Water levels are presented on the respective borehole logs.

The window sampler borehole records are presented in Appendix C and give both descriptions and depths of strata encountered, together with details of samples taken, in-situ tests and any other relevant information.

3.3. Dynamic Probes

The dynamic probing utilised a two man crew, operating a lightweight track mounted hydraulic power pack and percussive hammer to advance rods headed by a sacrificial cone into the ground. Torque readings were undertaken at 1.00m intervals and the blow count recorded for every 100mm of driving.

The super heavy method (DPSH-B), with a uniform weight of 63.5kg and a drop height of 0.75m was preferred, which complies with British and European Standards BS EN ISO 22476-2:2005 Geotechnical Investigation and Testing, Field testing, Part 2, Dynamic Probing.

3.4. Geology

The British Geological Survey, BGS online map viewer indicates no known superficial deposits at the site. Bedrock geology is comprised of the London Clay Formation underlain inturn by the Lambeth Group, Seaford and Newhaven Chalk Formations.

3.5. Groundwater

Groundwater was encountered within a number of exploratory holes. A summary of the groundwater observations are summarised in Table 2 below:

Exploratory Hole Number	Depth Encountered (mbgl)	Rose to after 20mins (mbgl)	Inflow Rate
BH101	Dry	-	-
BH102	14.00	0.80	Fast
BH103	Dry	-	-
WS101	Dry	-	-
WS102	Dry	-	-
WS103	Dry	-	-
WS104	Dry	-	-
WS105	Dry	-	-
WS106	Dry	-	-
WS107	4.20	No rise	Very slow
WS108	6.55	No rise	Very slow
WS109	4.60	No rise	Very slow
WS110	Dry	-	-
WS111	Dry	-	-
WS112	Dry	-	-
WS113	Dry	-	-
WS114	Dry	-	-
WS115	Dry	-	-

APPENDIX A

Site Location Plan

PROJECT: PINNER WOOD SCHOOL

TITLE: EXPLORATORY HOLE LOCATION PLAN

CLIENT: PETER BRETT ASSOCIATES

SCALE:	JOB NO:
NTS	J3091

DRAWN: CG

CHECKED: MJS

DATE: 06/09/2016

KEY:

- HOLLOW STEM AUGER BOREHOLE
- DYNAMIC PROBE
- WINDOWLESS SAMPLE BOREHOLE
- NORTH

REV	DATE	DETAILS	DRN	CHKD

DWG NO: FIGURE 1

REV:

endeavour drilling

APPENDIX B

Hollow Stem Auger Borehole Records

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates			Borehole ID: BH101 Sheet 1 of 6
	Contract Number: J3091	Date Started: 16/09/2016	Logged By: SA	Checked By: MJS	Status: FINAL	
Hollow Stem Auger Borehole Log	Easting: 511223.4	Northing: 190607.1	Ground Level: 72.99mOD	Plant Used: Comacchio 305	Print Date: 19/09/2016	Scale: 1:30

Weather: Fine/Dry

Termination: Target depth achieved

SPT Hammer: GL01 Energy Ratio: 70.68%

In Situ Testing & TCR			Strata Details				Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
				(4.00)	▩	MADE GROUND - (Dense) brown sandy gravel, with occasional brick and asphalt cobbles. Sand is fine to coarse and gravel is fine to coarse angular to sub-rounded of asphalt, ash, brick, chalk and flint. [Backfill]		■
		SPT(C) 4.00m, N=4 (1,1/1,1,1,1)	68.99	4.00				
4.00 - 5.00	40			(1.30)	▤	Very soft slightly sandy CLAY. [London Clay Formation]		■
		SPT(C) 5.00m, N=1 (0,0/0,1,0,0)						
			67.69	5.30				
5.00 - 6.00	40				▤	Soft becoming firm light reddish brown and brownish yellow slightly sandy CLAY, with rare fine to medium sub-angular flint gravel. [Lambeth Group]		■

1
2
3
4
5
6

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
16-08-2016	16:30	15.45						
17-08-2016	16:30	30.30						

Remarks:
1. Hand dug inspection pit excavated to 1.20mbgl prior to drilling. 2. Core recovery starting from 4.00mbgl due to subsidence and backfill of ground collapse. 3. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: BH101
	Contract Number: J3091	Date Started: 16/09/2016	Logged By: SA	Checked By: MJS	Status: FINAL
					Sheet 2 of 6
Hollow Stem Auger Borehole Log	Easting: 511223.4	Northing: 190607.1	Ground Level: 72.99mOD	Plant Used: Comacchio 305	Print Date: 19/09/2016
					Scale: 1:30

Weather: Fine/Dry

Termination: Target depth achieved

SPT Hammer: GL01 Energy Ratio: 70.68%

In Situ Testing & TCR			Strata Details				Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
6.00 - 7.50	53	SPT(C) 6.00m, N=6 (1,0/1,2,1,2) HV 6.50m, 22kPa						
7.50 - 9.00	53	SPT(C) 7.50m, N=2 (0,1/0,1,0,1) HV 7.50m, 30kPa HV 8.50m, 52kPa						
9.00 - 10.50	63	SPT(C) 9.00m, N=10 (1,1/3,3,2,2)		(6.70)		*...becoming firm* *...with thinly inter-bedded yellowish brown and light grey fine to medium sand from 9.95 - 10.00mbgl.*		
10.50 - 12.00	50	SPT(C) 10.50m, N=9 (2,2/3,3,2,1) HV 10.50m, 40kPa	60.99	12.00				

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
16-08-2016	16:30	15.45						
17-08-2016	16:30	30.30						

Remarks:

1. Hand dug inspection pit excavated to 1.20mbgl prior to drilling. 2. Core recovery starting from 4.00mbgl due to subsidence and backfill of ground collapse. 3. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: BH101
	Contract Number: J3091	Date Started: 16/09/2016	Logged By: SA	Checked By: MJS	Status: FINAL
					Sheet 3 of 6
Hollow Stem Auger Borehole Log	Easting: 511223.4	Northing: 190607.1	Ground Level: 72.99mOD	Plant Used: Comacchio 305	Print Date: 19/09/2016
					Scale: 1:30

Weather: Fine/Dry

Termination: Target depth achieved

SPT Hammer: GL01 Energy Ratio: 70.68%

In Situ Testing & TCR			Strata Details				Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
12.00 - 13.50	60	SPT(C) 12.00m, N=7 (1,1/2,1,2,2)		(0.90)		Loose light orangish brown and light grey fine to medium SAND. [Lambeth Group] *...from 12.85mbgl becoming clayey.*		
			60.09	12.90		Stiff reddish brown and dark yellowish brown slightly sandy CLAY. [Lambeth Group]		
13.50 - 15.00	57	SPT(C) 13.50m, N=16 (3,5/5,3,3,5) HV 14.50m, 52kPa				*...from 14.50mbgl becoming firm.*		
15.00 - 16.50	87	SPT(C) 15.00m, N=11 (4,3/4,3,2,2) HV 15.50m, 38kPa		(5.10)		*...with thinly inter-bedded clayey fine to medium sand from 15.80 - 16.00mbgl.* *...from 16.00mbgl clay becoming friable.*		
16.50 - 18.00	23	SPT(C) 16.50m, N=10 (2,3/3,3,2,2)	54.99	18.00				

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
16-08-2016	16:30	15.45						
17-08-2016	16:30	30.30						

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Remarks:

1. Hand dug inspection pit excavated to 1.20mbgl prior to drilling. 2. Core recovery starting from 4.00mbgl due to subsidence and backfill of ground collapse. 3. No groundwater encountered.

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling	Contract Name: Pinner Wood School			Client: Peter Brett Associates		Borehole ID: BH101 Sheet 4 of 6
	Contract Number: J3091	Date Started: 16/09/2016	Logged By: SA	Checked By: MJS	Status: FINAL	
Hollow Stem Auger Borehole Log	Easting: 511223.4	Northing: 190607.1	Ground Level: 72.99mOD	Plant Used: Comacchio 305	Print Date: 19/09/2016	Scale: 1:30

Weather: Fine/Dry

Termination: Target depth achieved

SPT Hammer: GL01 Energy Ratio: 70.68%

In Situ Testing & TCR			Strata Details					Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
18.00 - 19.50	47	SPT(C) 18.00m, N=0 (0,0/0,0,0,0)		(2.25)		Very loose light brown and light grey fine to medium SAND. [Lambeth Group]	19		
19.50 - 21.00	60	SPT(C) 19.50m, N=0 (0,0/0,0,0,0)	52.74	20.25		VOID	20		
21.00 - 22.50	0	SPT(C) 21.00m, N=0 (0,0/0,0,0,0)		(2.25)			21 22		
22.50 - 24.00	75	SPT(C) 22.50m, N=0 (0,0/0,0,0,0)	50.49	22.50 (0.30)		Very loose dark yellowish brown off white and light green slightly gravelly fine to medium SAND. Gravel is fine to coarse angular to sub-rounded of chalk and flint. [Lambeth Group]			
			50.19	22.80		Structureless CHALK composed of soft off white slightly gravelly clayey SILT. Gravel is weak low density fine to coarse angular to sub-angular of chalk. [Seaford and Newhaven Chalk Formation, Grade VI Dm]	23 24		

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
16-08-2016	16:30	15.45						
17-08-2016	16:30	30.30						

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Remarks:

1. Hand dug inspection pit excavated to 1.20mbgl prior to drilling. 2. Core recovery starting from 4.00mbgl due to subsidence and backfill of ground collapse. 3. No groundwater encountered.

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: BH101 Sheet 5 of 6
	Contract Number: J3091	Date Started: 16/09/2016	Logged By: SA	Checked By: MJS	Status: FINAL
Hollow Stem Auger Borehole Log	Easting: 511223.4	Northing: 190607.1	Ground Level: 72.99mOD	Plant Used: Comacchio 305	Print Date: 19/09/2016
Scale: 1:30					

Weather: Fine/Dry

Termination: Target depth achieved

SPT Hammer: GL01 Energy Ratio: 70.68%

In Situ Testing & TCR

Depth	TCR	Test Result
24.00 - 25.50	87	SPT(C) 24.00m, N=50 (3,5/8,13,15,14)
25.50 - 27.00	40	SPT(C) 25.50m, 50 (4,16/50 for 75mm)
27.00 - 28.50	80	SPT(C) 27.00m, 50 (6,8/50 for 225mm)
28.50 - 30.00	30	SPT(C) 28.50m, 50 (6,10/50 for 150mm)

Strata Details

Level (mAOD)	Depth (m) (Thickness)	Strata Description
	(5.40)	*...with fine to coarse angular to sub-angular flint gravel from 27.30 - 27.35mbgl.*
44.79	28.20	Off white moderately to highly weathered CHALK, weak to low density. Discontinuities are sub-horizontal moderately spaced (>500mm), infilled up to 50mm with a chalk gravel in a comminuted chalk matrix. [Seaford and Newhaven Chalk Formation, Grade C2] *...with moderately spaced sub-horizontal discontinuities (>500mm), infilled up to 50mm with fine to coarse angular to sub-angular chalk gravel in a comminuted chalk matrix from 28.20mbgl.*
	(2.10)	

Depth scale: 25, 26, 27, 28, 29, 30

Groundwater: Water Strike | Backfill/ Installation

Continued next sheet

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)
16-08-2016	16:30	15.45		
17-08-2016	16:30	30.30		

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth (m)	Dia (mm)

Remarks:

1. Hand dug inspection pit excavated to 1.20mbgl prior to drilling. 2. Core recovery starting from 4.00mbgl due to subsidence and backfill of ground collapse. 3. No groundwater encountered.

Chiselling

From (m)	To (m)	Duration	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: BH101 Sheet 6 of 6
	Contract Number: J3091	Date Started: 16/09/2016	Logged By: SA	Checked By: MJS	Status: FINAL
Hollow Stem Auger Borehole Log	Easting: 511223.4	Northing: 190607.1	Ground Level: 72.99mOD	Plant Used: Comacchio 305	Print Date: 19/09/2016
					Scale: 1:30

Weather: Fine/Dry | Termination: Target depth achieved | SPT Hammer: GL01 Energy Ratio: 70.68%

In Situ Testing & TCR			Strata Details					Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
		SPT(C) 30.00m, 50 (4,8/50 for 180mm)	42.69	30.30	▦	End of Borehole at 30.300m	31 32 33 34 35 36		■

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
16-08-2016	16:30	15.45						
17-08-2016	16:30	30.30						

Remarks:

1. Hand dug inspection pit excavated to 1.20mbgl prior to drilling. 2. Core recovery starting from 4.00mbgl due to subsidence and backfill of ground collapse. 3. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

BH101: 4.00 - 6.00mbgl

BH101: 6.00 - 9.00mbgl


Job No: J3091
Job Name: Pinner Wood School
Depth from (m): 9.00
Depth to (m): 12.00
BH No: 101
Engineer: SA

BH101: 9.00 – 12.00mbgl


Job No: J3091
Job Name: Pinner Wood School
Depth from (m): 10.50
Depth to (m): 13.50
BH No: 101
Engineer: SA

BH101: 10.50 – 13.50mbgl

Job No: J3091
Job Name: Pinner Wood School
Depth from (m): 13.50 Depth to (m): 16.50
BH No: 101 Engineer: CG

BH101: 13.50 – 16.50mbgl

Job No: J3091
Job Name: Pinner Wood School
Depth from (m): 16.50 Depth to (m): 19.50
BH No: 101 Engineer: SA

BH101: 16.50 – 19.50mbgl

Job No: J3091
Job Name: Pinner Wood School
Depth from (m): 19.50 Depth to (m): 24.00
BH No: 101 Engineer CG

BH101: 19.50 – 24.00mbgl

Job No: J3091
Job Name: Pinner Wood School
Depth from (m): 24.00 Depth to (m): 27.00
BH No: 101 Engineer SA

BH101: 24.00 – 27.00mbgl

BH101: 27.00 – 30.00mbgl

endeavour drilling

Hollow Stem Auger Borehole Log	Contract Name: Pinner Wood School		Client: Peter Brett Associates			Borehole ID: BH102 Sheet 1 of 5
	Contract Number: J3091	Date Started: 24/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	
	Easting: 511108.8	Northing: 190591.2	Ground Level: 72.83mOD	Plant Used: Comacchio 450	Print Date: 19/09/2016	Scale: 1:30

Weather: Fine/Dry

Termination: Target lithology intercepted

SPT Hammer: N/R, Energy Ratio: N/R

In Situ Testing & TCR			Strata Details				Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
			72.73	0.10	▩	ASPHALT		■
			72.53	0.30	▩	SUB-BASE		■
		HV 0.50m, 34kPa			▤	POSSIBLE DISTURBED GROUND - Soft dark bluish grey mottled orange slightly sandy CLAY. [London Clay Formation]		■
0.20 - 1.20	90			(0.80)	▤		▼	■
		SPT(C) 1.20m, N=10 (1,2/1,1,3,5)	71.73	1.10	▤	Firm fissured dark orangish brown slightly sandy CLAY, with bluish grey gleying along fissured surfaces. [London Clay Formation]		■
1.20 - 2.20	100	HV 1.70m, 64kPa			▤			■
		SPT(C) 2.20m, N=8 (1,1/2,1,2,3)			▤			■
					▤	*...with fine to coarse gravel sized pockets of orange fine sand from 2.50mbgl.*		■
2.20 - 3.20	100	HV 2.70m, 46kPa			▤			■
		SPT(C) 3.20m, N=10 (1,2/2,2,3,3)			▤			■
				(4.90)	▤			■
3.20 - 4.20	80	HV 3.70m, 73kPa			▤			■
		SPT(C) 4.20m, N=16 (2,3/3,4,4,5)			▤			■
					▤	*...with occasional fine gravel sized selenite from 4.50mbgl.*		■
4.20 - 5.00	105	HV 4.70m, 72kPa			▤			■
		SPT(C) 5.00m, N=17 (1,2/3,3,5,6)			▤	*...from 5.00 - 5.80mbgl becoming very friable.*		■
5.00 - 6.50	47				▤			■
		HV 6.00m, 28kPa	66.83	6.00	▤			■

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
24-08-2016	17:30	9.81	9.81					
25-08-2016	17:30	21.79	21.79					
26-08-2016	15:45	26.30	26.30	20.50				

Remarks:

1. Pre-cored to 0.10mbgl. 2. Groundwater encountered @ 14.00mbgl, rose to 0.80mbgl after 20mins. 3. Hand vane fails @ >120kpa in Lambeth Group.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
14.00	14.00	14.50	20	0.80	

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: BH102 Sheet 2 of 5
	Contract Number: J3091	Date Started: 24/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
Hollow Stem Auger Borehole Log	Easting: 511108.8	Northing: 190591.2	Ground Level: 72.83mOD	Plant Used: Comacchio 450	Print Date: 19/09/2016
					Scale: 1:30

Weather: Fine/Dry

Termination: Target lithology intercepted

SPT Hammer: N/R, Energy Ratio: N/R

In Situ Testing & TCR			Strata Details				Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
				(0.90)		Stiff dark orangish brown sandy CLAY. [London Clay Formation]		
		SPT(C) 6.50m, N=33 (2,4/5,7,8,13)						
			65.93	6.90		Firm dark brown and light brownish yellow slightly sandy CLAY. [London Clay Formation]		
		HV 7.00m, 71kPa		(0.40)				
6.50 - 8.00	73							
			65.53	7.30		Very stiff becoming firm off white, light grey and light brownish yellow slightly sandy CLAY. [Lambeth Group]		
		HV 7.50m, 120kPa						
		SPT(C) 8.00m, N=50 (5,10/50 for 243mm)				*...from 8.00 - 8.80 becoming firm light brownish yellow sandy clay.*		
				(2.20)				
		HV 8.50m, 47kPa						
8.00 - 9.50	87							
		SPT(C) 9.50m, 50 (7,15/50 for 233mm)	63.33	9.50		Very dense dark brownish yellow very clayey fine to medium SAND. Minimal recovery, fines assumed to be lost out the bottom of the barrel. [Lambeth Group]		
				(0.50)				
		HV 10.00m, 3kPa	62.83	10.00		Very soft dark yellowish brown sandy CLAY. [Lambeth Group]		
9.50 - 11.00	60		62.58	10.25		Firm dark yellowish brown sandy CLAY. [Lambeth Group]		
		HV 10.50m, 51kPa						
				(0.75)				
						...from 10.70mbgl becoming friable.		
		SPT(C) 11.00m, 50 (10,15/50 for 90mm)	61.83	11.00		Very dense dark brownish yellow very clayey fine SAND. Minimal recovery, fines assumed to be lost out of the bottom of the barrel. [Lambeth Group]		
11.00 - 12.50	50			(1.20)				

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
24-08-2016	17:30	9.81	9.81					
25-08-2016	17:30	21.79	21.79					
26-08-2016	15:45	26.30	26.30	20.50				

Remarks:

1. Pre-cored to 0.10mbgl. 2. Groundwater encountered @ 14.00mbgl, rose to 0.80mbgl after 20mins. 3. Hand vane fails @ >120kpa in Lambeth Group.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
14.00	14.00	14.50	20	0.80	

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: BH102 Sheet 3 of 5
	Contract Number: J3091	Date Started: 24/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
Hollow Stem Auger Borehole Log	Easting: 511108.8	Northing: 190591.2	Ground Level: 72.83mOD	Plant Used: Comacchio 450	Print Date: 19/09/2016
					Scale: 1:30

Weather: Fine/Dry

Termination: Target lithology intercepted

SPT Hammer: N/R, Energy Ratio: N/R

In Situ Testing & TCR			Strata Details				Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
			60.63	12.20		Dense dark brownish orange clayey fine to medium SAND. Minimal recovery, fines assumed to be lost out of the bottom of the barrel or by movement of groundwater. Heavily stained by entrained material in groundwater. [Lambeth Group]		
12.50 - 14.00	20	SPT(C) 12.50m, 34 (17,8/34 for 71mm)		(2.80)				
14.00 - 15.50	33	SPT(C) 14.00m, 50 (6,13/50 for 185mm)					▽	
			57.83	15.00		Stiff dark brownish red mottled light bluish grey and off white slightly sandy CLAY. [Lambeth Group]		
		HV 15.20m, 87kPa		(0.50)				
15.50 - 17.00	33	SPT(C) 15.50m, 50 (7,15/50 for 225mm)	57.33	15.50		Very dense dark brownish orange slightly clayey fine to medium SAND. Minimal recovery, fines assumed to be washed out by groundwater strike. Heavily stained by entrained material in groundwater. [Lambeth Group]		
				(2.40)				
17.00 - 18.50	40	SPT(C) 17.00m, 50 (17,8/50 for 75mm)						
			54.93	17.90		Off white to light grey fine to medium SAND. [Lambeth		

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
24-08-2016	17:30	9.81	9.81					
25-08-2016	17:30	21.79	21.79					
26-08-2016	15:45	26.30	26.30	20.50				

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Remarks:

1. Pre-cored to 0.10mbgl. 2. Groundwater encountered @ 14.00mbgl, rose to 0.80mbgl after 20mins. 3. Hand vane fails @ >120kpa in Lambeth Group.

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
14.00	14.00	14.50	20	0.80	

endeavour drilling

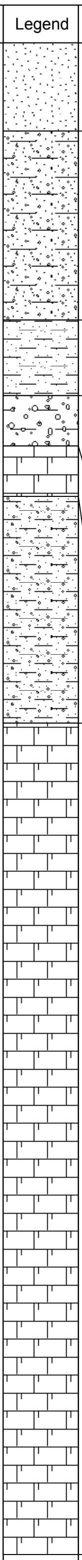
Contract Name: Pinner Wood School			Client: Peter Brett Associates		Borehole ID: BH102 Sheet 4 of 5
Contract Number: J3091	Date Started: 24/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	
Easting: 511108.8	Northing: 190591.2	Ground Level: 72.83mOD	Plant Used: Comacchio 450	Print Date: 19/09/2016	Scale: 1:30

Hollow Stem Auger Borehole Log

Weather: Fine/Dry

Termination: Target lithology intercepted

SPT Hammer: N/R, Energy Ratio: N/R



In Situ Testing & TCR			Strata Details				Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
				(0.45)		Group]		
			54.48	18.35		Very dense dark green slightly clayey glauconitic fine SAND. Gravel is fine to coarse sub-rounded of flint. [Lambeth Group]		
18.50 - 20.00	80	SPT(C) 18.50m, 50 (11,14/50 for 80mm)		(0.75)				
		HV 19.20m, 23kPa	53.73	19.10 (0.30)		Soft light greenish grey mottled brown very sandy CLAY. [Lambeth Group]		
			53.43	19.40		Dark green, dark blue and off white slightly clayey, sandy, gravelly angular COBBLES. Sand is fine to coarse glauconitic and gravel is fine to coarse angular to sub-angular of chalk and flint. [Lambeth Group]		
			53.23	19.60		Structureless CHALK composed of soft off white gravelly clayey SILT. Gravel is weak low density angular to sub-angular of chalk. [Seaford and Newhaven Chalk Formation, Grade VI Dm]		
20.00 - 21.50	53	SPT(C) 20.00m, 50 (12,13/50 for 143mm)	53.03	19.80 (0.90)		Soft dark brownish green sandy gravelly CLAY. Sand is fine to coarse and gravel is fine to coarse sub-angular to sub-rounded of chalk and flint. Minimal recovery, fines assumed to be washed out by groundwater strike. Heavily stained by entrained material in groundwater. [Lambeth Group]		
			52.13	20.70		Structureless CHALK composed of soft off white gravelly clayey SILT. Gravel is weak low density angular to sub-angular of chalk. [Seaford and Newhaven Chalk Formation, Grade VI Dm]		
21.50 - 23.00	33	SPT(C) 21.50m, 50 (8,17/50 for 145mm)		(5.60)				
23.00 - 24.50	0	SPT(C) 23.00m, 50 (10,15/50 for 180mm)						

19
20
21
22
23
24

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
24-08-2016	17:30	9.81	9.81					
25-08-2016	17:30	21.79	21.79					
26-08-2016	15:45	26.30	26.30	20.50				

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Remarks:
1. Pre-cored to 0.10mbgl. 2. Groundwater encountered @ 14.00mbgl, rose to 0.80mbgl after 20mins. 3. Hand vane fails @ >120kpa in Lambeth Group.

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
14.00	14.00	14.50	20	0.80	

endeavour drilling

Contract Name: Pinner Wood School			Client: Peter Brett Associates		Borehole ID: BH102 Sheet 5 of 5
Contract Number: J3091	Date Started: 24/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	
Easting: 511108.8	Northing: 190591.2	Ground Level: 72.83mOD	Plant Used: Comacchio 450	Print Date: 19/09/2016	Scale: 1:30

Hollow Stem Auger
Borehole Log

Weather: Fine/Dry

Termination: Target lithology intercepted

SPT Hammer: N/R, Energy Ratio: N/R

In Situ Testing & TCR			Strata Details				Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		SPT(C) 24.50m, N=25 (4,2/4,3,6,12)						
24.50 - 26.00	50							
		SPT(C) 26.00m, 50 (2,9/50 for 145mm)						
			46.53	26.30		End of Borehole at 26.300m		

25
26
27
28
29
30

Start & End of Shift Observations				
Date	Time	Depth (m)	Casing (m)	Water (m)
24-08-2016	17:30	9.81	9.81	
25-08-2016	17:30	21.79	21.79	
26-08-2016	15:45	26.30	26.30	20.50

Borehole Diameter		Casing Diameter	
Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

1. Pre-cored to 0.10mbgl. 2. Groundwater encountered @ 14.00mbgl, rose to 0.80mbgl after 20mins. 3. Hand vane fails @ >120kpa in Lambeth Group.

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
14.00	14.00	14.50	20	0.80	

Chiselling			
From (m)	To (m)	Duration	Remarks

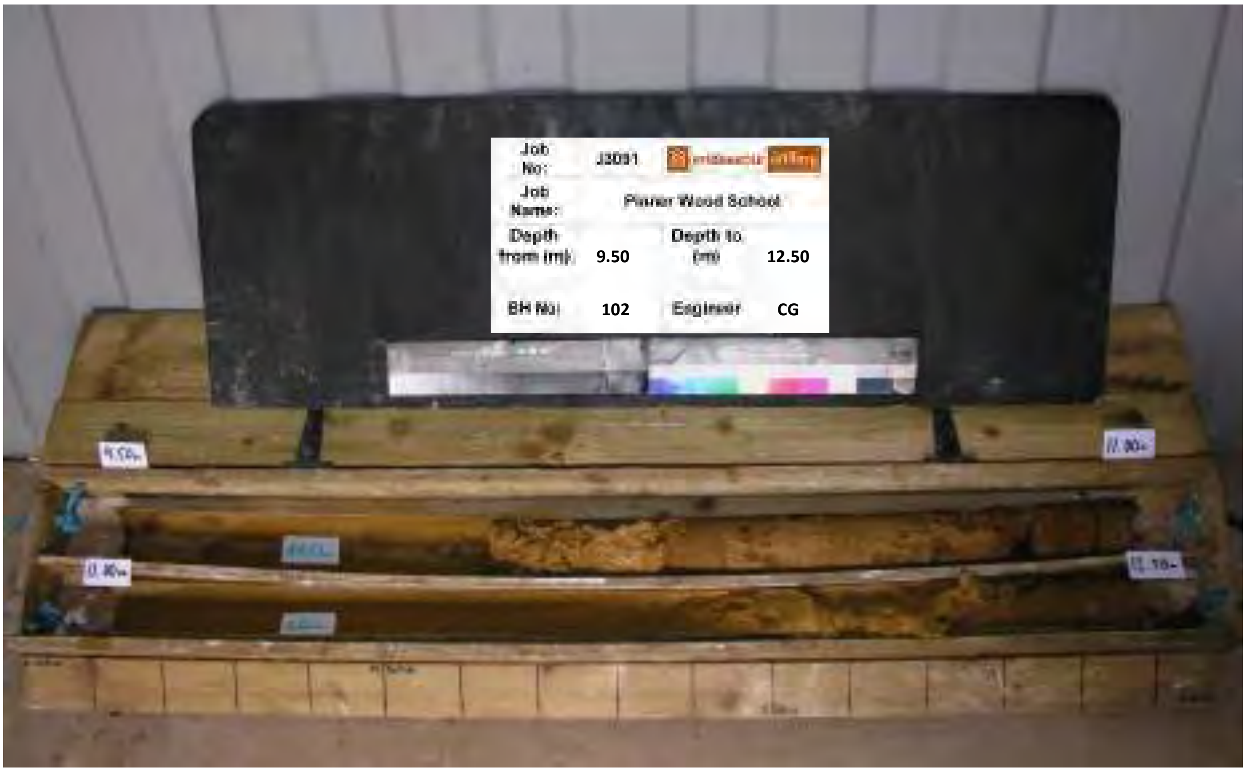
Installation			
Top (m)	Base (m)	Type	Dia (mm)

BH102: 0.20 – 2.20mbgl

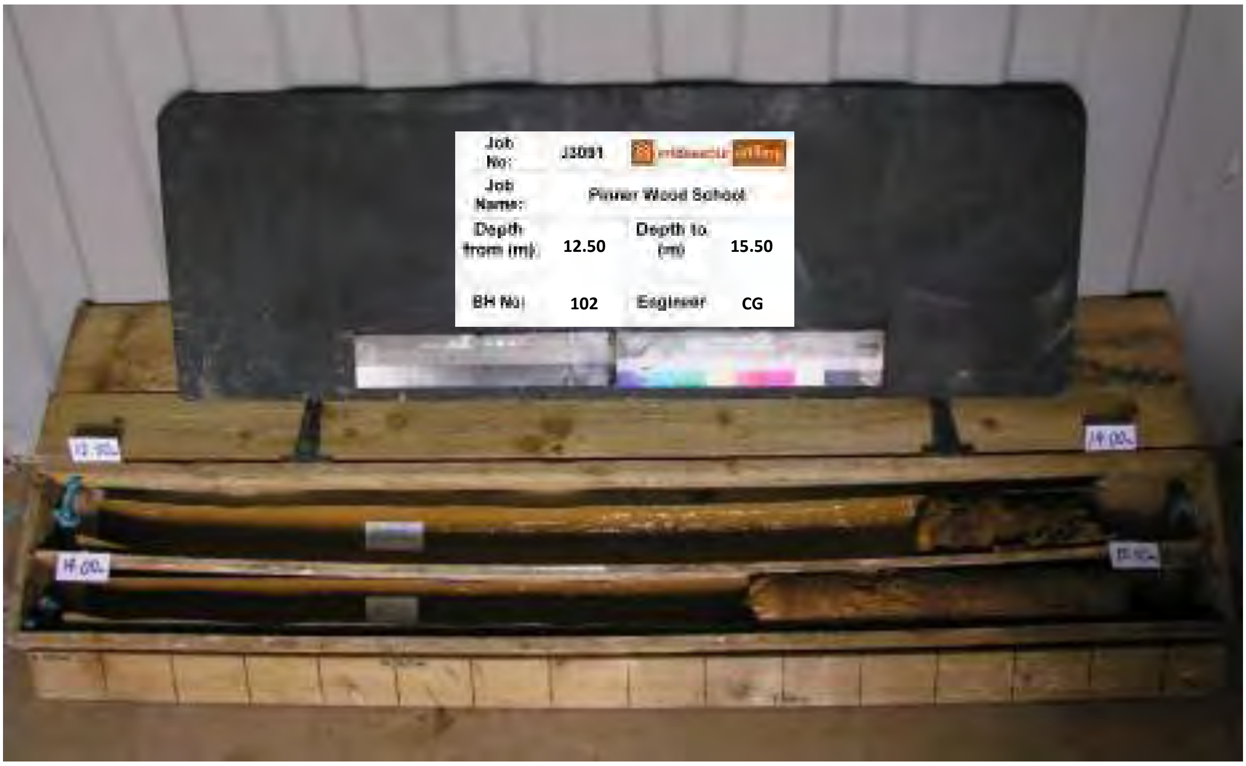
BH102: 2.20 – 4.20mbgl

BH102: 4.20 – 6.50mbgl

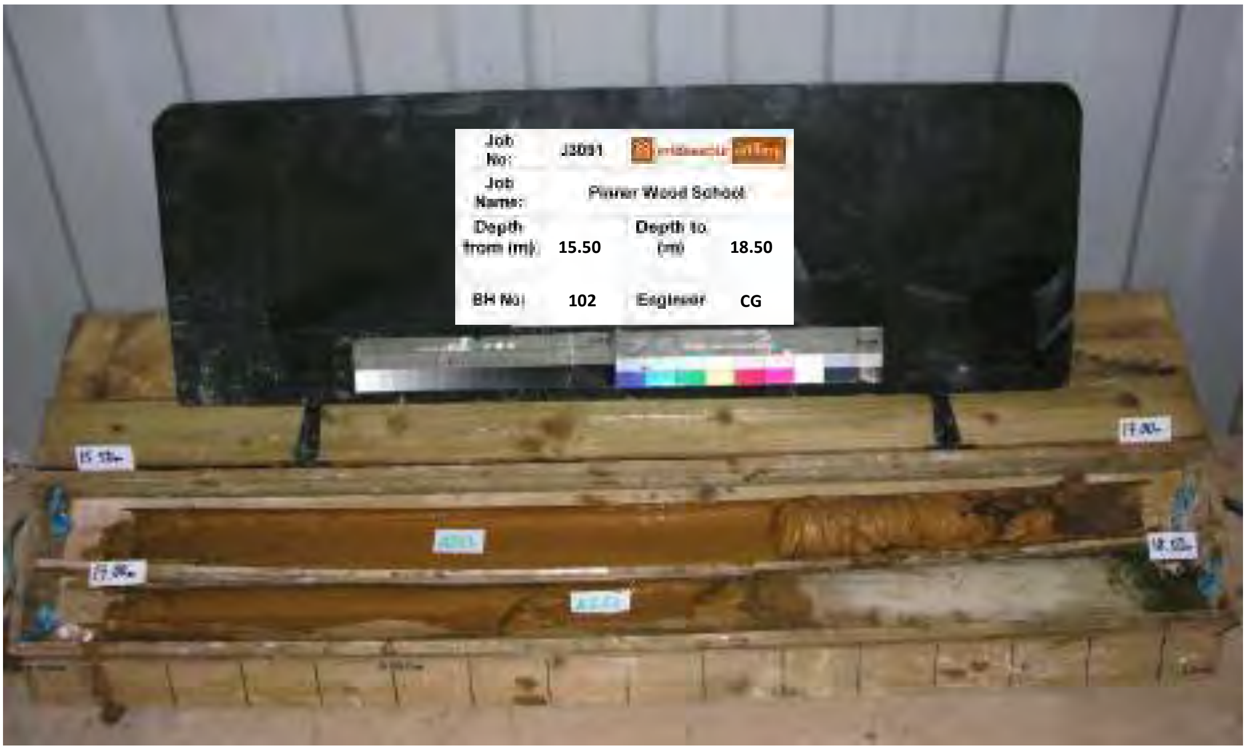
BH102: 6.50 – 9.50mbgl



BH102: 9.50 – 12.50mbgl



BH102: 12.50 – 15.50mbgl



BH102: 15.50 – 18.50mbgl

BH102: 18.50 – 21.50mbgl

BH102: 21.50 – 24.50mbgl

BH102: 24.50 – 26.00mbgl

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates	Borehole ID: BH103 Sheet 1 of 6

Contract Number:	Date Started:	Logged By:	Checked By:	Status:
J3091	08/08/2016	SA	MJS	FINAL

Hollow Stem Auger Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
	511159.2	190687.2	75.49mOD	Comacchio 305	19/09/2016	1:30

Weather: Fine/Dry

Termination: Target depth achieved

SPT Hammer: GL01 Energy Ratio: 71%

In Situ Testing & TCR			Strata Details					Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
			75.39	0.10		TOPSOIL - Dark greyish brown slightly gravelly sandy CLAY, with frequent rootlets. Sand is fine to coarse and gravel is fine angular of chalk and flint.			
				(0.40)		Firm fissured dark orangish brown slightly gravelly slightly sandy CLAY. [London Clay Formation]			
		HV 0.50m, 44kPa	74.99	0.50		Firm locally stiff fissured dark orangish brown slightly sandy slightly gravelly CLAY, with light bluish grey gleying along fissured surfaces and rare partings of silty sand. Sand is fine and gravel is fine angular to sub-rounded of flint. [London Clay Formation]			
0.50 - 1.00	95								
		SPT(C) 1.00m, N=7 (1,2/2,1,2,2)					1		
1.00 - 2.00	105	HV 1.50m, 61kPa							
		SPT(C) 2.00m, N=11 (1,3/2,3,3,3)					2		
2.00 - 3.00	70	HV 2.50m, 97kPa							
		SPT(C) 3.00m, N=17 (3,2/3,5,5,4)					3		
				(8.65)					
3.00 - 4.00	125	HV 3.50m, 75kPa							
						...with fine to coarse angular selenite from 3.80mbgl.			
		SPT(C) 4.00m, N=17 (2,2/4,3,5,5)					4		
4.00 - 5.00	110	HV 4.50m, 28kPa							
		SPT(C) 5.00m, N=18 (2,5/4,5,5,4)					5		
						...from 5.30mbgl becoming dark green brown, increasingly friable.			
5.00 - 6.00	80	HV 5.50m, 82kPa							
						Continued next sheet	6		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
08-08-2016	16:30	9.45						
09-08-2016	16:30	18.36						
10-08-2016	16:30	30.30						

Remarks:

1. Hand dug inspection pit excavated to 0.50mbgl prior to drilling 2. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling

Contract Name:			Client:		Borehole ID:
Pinner Wood School			Peter Brett Associates		BH103
Contract Number:	Date Started:	Logged By:	Checked By:	Status:	
J3091	08/08/2016	SA	MJS	FINAL	Sheet 2 of 6

Hollow Stem Auger Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
	511159.2	190687.2	75.49mOD	Comacchio 305	19/09/2016	1:30

Weather: Fine/Dry

Termination: Target depth achieved

SPT Hammer: GL01 Energy Ratio: 71%

In Situ Testing & TCR			Strata Details				Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
6.00 - 7.50	100	SPT(C) 6.00m, N=15 (2,3/4,4,3,4) HV 6.50m, 62kPa						
7.50 - 9.00	90	SPT(C) 7.50m, N=35 (5,5/7,8,8,12) HV 7.50m, 64kPa HV 8.50m, 28kPa						
9.00 - 10.50	95	SPT(C) 9.00m, N=28 (4,6/8,8,7,5) HV 9.50m, 104kPa	66.34	9.15		Stiff dark yellowish brown and light grey mottled light brown slightly sandy CLAY. [Lambeth Group] *...with fine gravel sized angular selenite vein @10.00mbgl.*		
10.50 - 12.00	100	SPT(C) 10.50m, N=49 (6,6/9,11,11,18) HV 10.50m, 72kPa		(4.75)				

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Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
08-08-2016	16:30	9.45						
09-08-2016	16:30	18.36						
10-08-2016	16:30	30.30						

Remarks:

1. Hand dug inspection pit excavated to 0.50mbgl prior to drilling 2. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling

Contract Name: Pinner Wood School			Client: Peter Brett Associates		Borehole ID: BH103 Sheet 3 of 6
Contract Number: J3091	Date Started: 08/08/2016	Logged By: SA	Checked By: MJS	Status: FINAL	
Hollow Stem Auger Borehole Log	Easting: 511159.2	Northing: 190687.2	Ground Level: 75.49mOD	Plant Used: Comacchio 305	Print Date: 19/09/2016
Scale: 1:30					

Weather: Fine/Dry

Termination: Target depth achieved

SPT Hammer: GL01 Energy Ratio: 71%

In Situ Testing & TCR			Strata Details				Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
12.00 - 13.50	57	SPT(C) 12.00m, N=50 (6,14/50 for 250mm)						
13.50 - 15.00	33	SPT(C) 13.50m, 50 (8,14/50 for 155mm)	61.59	13.90		Very dense dark orangish brown clayey fine to medium SAND [Lambeth Group] - Poor recovery over interval.		
15.00 - 16.50	27	SPT(C) 15.00m, 50 (8,13/50 for 180mm)		(7.60)				
16.50 - 18.00	33	SPT(C) 16.50m, 50 (4,8/50 for 160mm)						

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14
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16
17
18

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
08-08-2016	16:30	9.45						
09-08-2016	16:30	18.36						
10-08-2016	16:30	30.30						

Remarks:
1. Hand dug inspection pit excavated to 0.50mbgl prior to drilling 2. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling

Contract Name: Pinner Wood School			Client: Peter Brett Associates		Borehole ID: BH103
Contract Number: J3091	Date Started: 08/08/2016	Logged By: SA	Checked By: MJS	Status: FINAL	Sheet 4 of 6
Easting: 511159.2	Northing: 190687.2	Ground Level: 75.49mOD	Plant Used: Comacchio 305	Print Date: 19/09/2016	Scale: 1:30

Hollow Stem Auger Borehole Log

Weather: Fine/Dry

Termination: Target depth achieved

SPT Hammer: GL01 Energy Ratio: 71%

In Situ Testing & TCR			Strata Details				Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
18.00 - 19.50	60	SPT(C) 18.00m, 50 (7,16/50 for 225mm)						
19.50 - 21.00	60	SPT(C) 19.50m, 50 (7,15/50 for 190mm)				*...from 19.50mbgl sand becoming light grey.*		
21.00 - 22.50	60	SPT(C) 21.00m, 50 (25 for 75mm/50 for 75mm)	53.99	21.50		Very dense light green slightly gravelly glauconitic fine to medium SAND. Gravel is rounded to sub-rounded medium to coarse of flint. [Lambeth Group]		
22.50 - 24.00	37	SPT(C) 22.50m, 50 (18,7/50 for 100mm)		(4.40)				

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
08-08-2016	16:30	9.45						
09-08-2016	16:30	18.36						
10-08-2016	16:30	30.30						

Remarks:

1. Hand dug inspection pit excavated to 0.50mbgl prior to drilling 2. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: BH103 Sheet 5 of 6
	Contract Number: J3091	Date Started: 08/08/2016	Logged By: SA	Checked By: MJS	Status: FINAL
Hollow Stem Auger Borehole Log	Easting: 511159.2	Northing: 190687.2	Ground Level: 75.49mOD	Plant Used: Comacchio 305	Print Date: 19/09/2016
					Scale: 1:30

Weather: Fine/Dry

Termination: Target depth achieved

SPT Hammer: GL01 Energy Ratio: 71%

In Situ Testing & TCR			Strata Details				Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
24.00 - 25.50	67	SPT(C) 24.00m, 50 (5,18/50 for 85mm)						
25.50 - 27.00	60	SPT(C) 25.50m, 50 (6,14/50 for 225mm)	49.59	25.90 (1.45)		Structureless CHALK, composed of soft off white slightly sandy gravelly clayey SILT and stained greenish brown at the upper contact. Gravel is very weak low density angular to sub-angular of chalk. [Seaford and Newhaven Chalk Formation, Grade VI Dm]		
27.00 - 28.50	83	SPT(C) 27.00m, 50 (4,15/50 for 75mm)	48.14	27.35		Off white moderately to highly weathered CHALK, weak to low density. Discontinuities are sub-horizontal moderately spaced (>500mm), infilled up to 150mm with a slightly gravelly sandy comminuted chalk matrix, with rare fine to medium angular flint gravel. [Seaford and Newhaven Chalk Formation,, Grade C2]		
28.50 - 30.00	73	SPT(C) 28.50m, 50 (7,9/50 for 150mm)		(2.65)				
			45.49	30.00				

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
08-08-2016	16:30	9.45						
09-08-2016	16:30	18.36						
10-08-2016	16:30	30.30						

Remarks:

1. Hand dug inspection pit excavated to 0.50mbgl prior to drilling 2. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates			Borehole ID: BH103 Sheet 6 of 6
	Contract Number: J3091	Date Started: 08/08/2016	Logged By: SA	Checked By: MJS	Status: FINAL	
Hollow Stem Auger Borehole Log	Easting: 511159.2	Northing: 190687.2	Ground Level: 75.49mOD	Plant Used: Comacchio 305	Print Date: 19/09/2016	Scale: 1:30

Weather: Fine/Dry

Termination: Target depth achieved

SPT Hammer: GL01 Energy Ratio: 71%

In Situ Testing & TCR			Strata Details					Groundwater	
Depth	TCR	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
		SPT(C) 30.00m, 50 (13,12/50 for 100mm)							■
						End of Borehole at 30.300m			
							31		
							32		
							33		
							34		
							35		
							36		

Start & End of Shift Observations				
Date	Time	Depth (m)	Casing (m)	Water (m)
08-08-2016	16:30	9.45		
09-08-2016	16:30	18.36		
10-08-2016	16:30	30.30		

Borehole Diameter		Casing Diameter	
Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

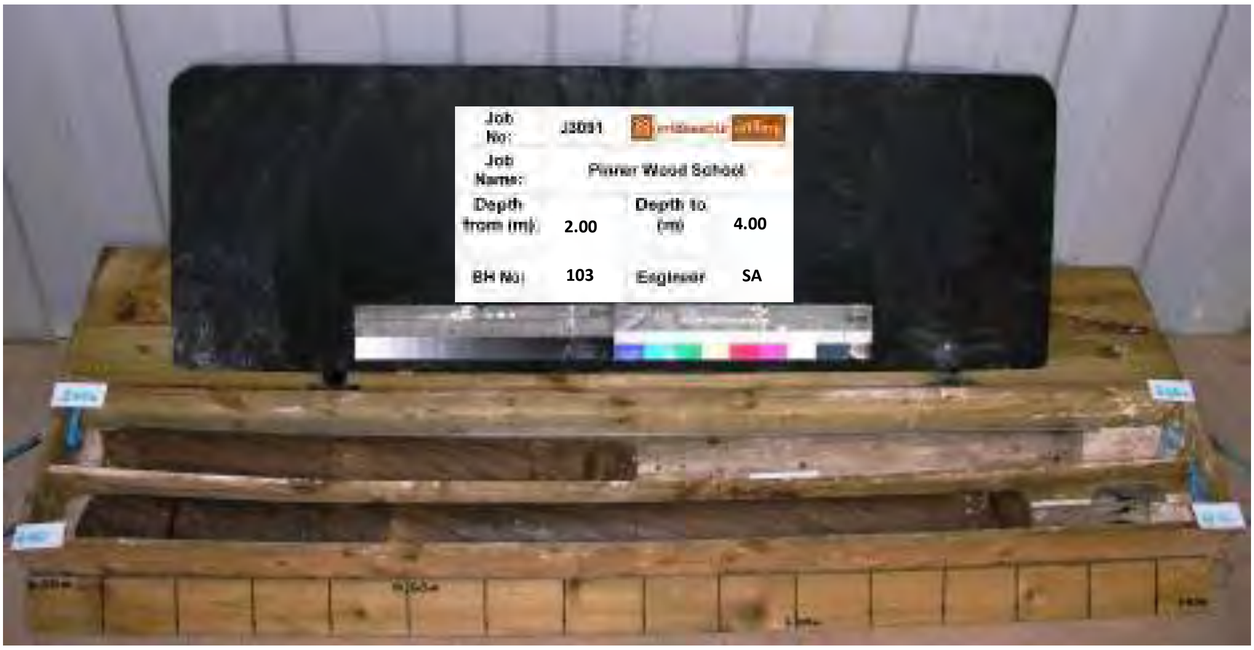
1. Hand dug inspection pit excavated to 0.50mbgl prior to drilling 2. No groundwater encountered.

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

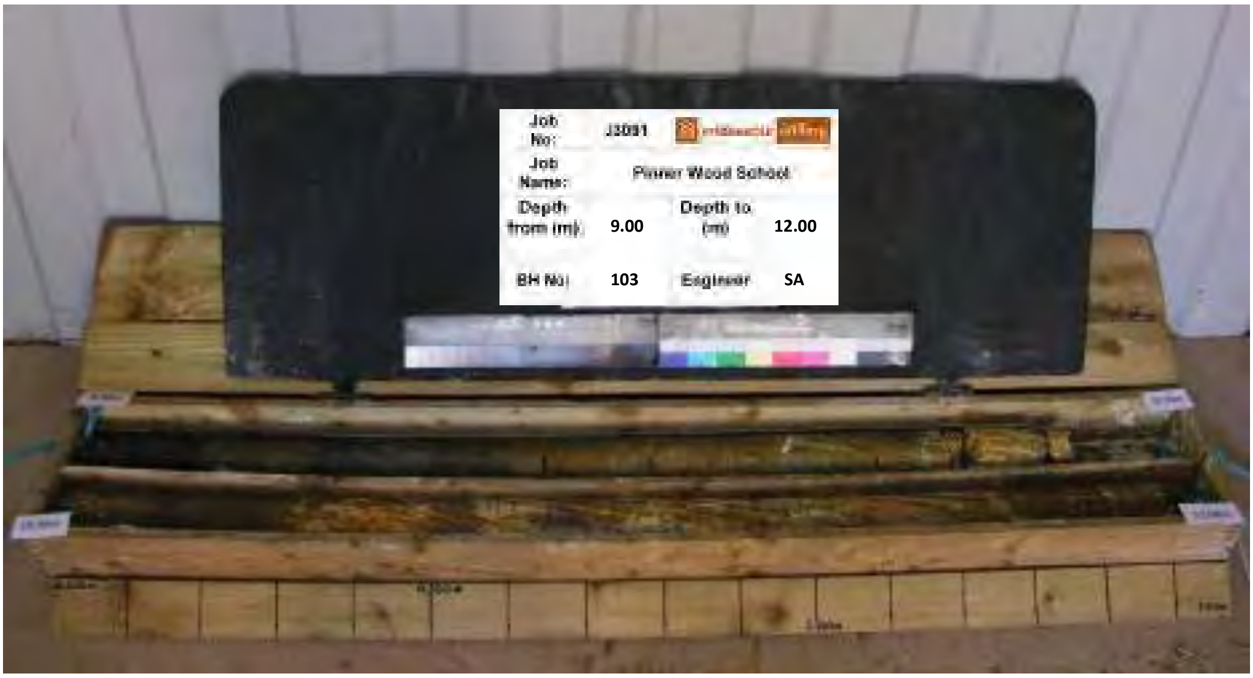
BH103: 0.00 – 2.00mbgl



BH103: 2.00 – 4.00mbgl

BH103: 4.00 – 6.00mbgl

BH103: 6.00 – 9.00mbgl



BH103: 9.00 – 12.00mbgl

BH103: 12.00 – 15.00mbgl

BH103: 15.00 – 18.00mbgl

BH103: 18.00 – 21.00mbgl

BH103: 21.00 – 24.00mbgl

BH103: 24.00 – 27.00mbgl

BH103: 27.00 – 30.00mbgl

APPENDIX C

Window Sampling Borehole Records

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates			Borehole ID: WS101 Sheet 1 of 2
	Contract Number: J3091	Date Started: 10/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	
Window Sample Log	Easting: 511212.1	Northing: 190655.1	Ground Level: 74.41mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30

Weather: Fine/Dry

Termination: Refusal

SPT Hammer: DT/0315 Energy Ratio: 70.02%

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
			74.31	0.10		TOPSOIL - Dark greyish brown slightly gravelly sandy clay, with frequent rootlets. Sand is fine to coarse and gravel is fine to medium sub-angular to sub-rounded of flint.			
		HV 0.50m, 80kPa		(1.10)		MADE GROUND - Stiff dark greyish brown mottled orange sandy gravelly clay, with occasional rootlets. Sand is fine to coarse and gravel is fine to coarse angular to sub-rounded of brick, concrete, clinker, cinder and metal fragments.			
						...from 1.00mbgl gravel becoming rare.	1		
		SPT(C) 1.20m, N=16 (2,2/3,4,4,5)	73.21	1.20		Firm fissured light brown mottled orange slightly sandy CLAY, with light grey gleying along fissured surfaces and occasional partings of fine sand. [London Clay Formation]			
		HV 1.50m, 70kPa							
		SPT(C) 2.00m, N=16 (2,2/2,5,4,5)					2		
		HV 2.50m, 70kPa							
		SPT(C) 3.00m, N=13 (2,2/2,3,3,5)				*...from 3.00mbgl light grey gleying absent .*	3		
		HV 3.50m, 65kPa		(5.50)					
		SPT(C) 4.00m, N=14 (2,1/2,3,3,6)					4		
		HV 4.50m, 60kPa							
		SPT(C) 5.00m, N=17 (3,3/4,4,4,5)					5		
						...with medium to coarse gravel sized sub-rounded to rounded flint gravel from 5.85 - 5.95mbgl.			
							6		

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
10-08-2016	16:00	7.40						

Remarks:

1. Hand dug inspection pit excavated to 1.20mbgl prior to drilling. 2. Hand vane fails @ >120kpa in Lambeth Group 3. No groundwater encountered.

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

endeavour drilling

Contract Name: Pinner Wood School			Client: Peter Brett Associates		Borehole ID: WS101 Sheet 2 of 2
Contract Number: J3091	Date Started: 10/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	
Easting: 511212.1	Northing: 190655.1	Ground Level: 74.41mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30

Window Sample Log

Weather: Fine/Dry

Termination: Refusal

SPT Hammer: DT/0315 Energy Ratio: 70.02%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		SPT(C) 6.00m, N=27 (2,3/3,4,6,14)				...from 6.00mbgl becoming sandy.		
		HV 6.50m, 50kPa						
			67.71	6.70		Very stiff light grey and yellow slightly sandy CLAY, with fine to medium gravel sized angular selenite. [Lambeth Group]		
		HV 6.80m, 120kPa						
		SPT(C) 7.00m, N=72 (8,9/72 for 250mm)		(0.70)				
			67.01	7.40		End of Borehole at 7.40m		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
10-08-2016	16:00	7.40						

Remarks:

1. Hand dug inspection pit excavated to 1.20mbgl prior to drilling. 2. Hand vane fails @ >120kpa in Lambeth Group 3. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

HBSI CP Template Issue Number: 2 Issue Date: 09/06/2015

WS101: 1.20 – 6.00mbgl

WS101: 6.00 – 7.00mbgl

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: WS102 Sheet 1 of 2
	Contract Number: J3091	Date Started: 11/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
Window Sample Log	Easting: 511220.5	Northing: 190629.6	Ground Level: 73.30mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
					Scale: 1:30

Weather: Fine/Dry | Termination: Target depth achieved | SPT Hammer: DT/0315 Energy Ratio: 70.02%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
			73.20	0.10		TOPSOIL - Dark greyish brown slightly gravelly sandy clay, with frequent rootlets. Sand is fine to coarse and gravel is fine to medium sub-angular to sub-rounded of flint.		■
		HV 0.50m, 80kPa		(0.90)		MADE GROUND - Dark greyish brown mottled orange and light grey slightly gravelly slightly sandy clay, with occasional rootlets and roots (<12mm diameter). Sand is fine to coarse and gravel is fine to coarse angular to sub-rounded of cinder, clinker, concrete, flint and brick.		
						...with occasional cobble sized angular brick fragments from 0.55-0.65mbgl.		
						...from 0.80mbgl anthropogenic material becoming rare.		
			72.30	1.00		Firm to stiff locally firm fissured dark orangish brown slightly sandy CLAY, with light grey gleying along fissured surfaces and occasional partings of fine sand. [London Clay Formation]		
		SPT(C) 1.20m, N=14 (1,2/2,4,3,5)						
		HV 1.50m, 80kPa						
		SPT(C) 2.00m, N=17 (2,2/3,4,5,5)						
		HV 2.50m, 64kPa						
		SPT(C) 3.00m, N=14 (1,2/2,4,4,4)		(4.00)				
						...with fine orange sand infill along fissured surfaces from 3.20mbgl.		
		HV 3.50m, 84kPa						
						...with occasional medium to coarse gravel sized angular selenite from 3.60mbgl.		
		SPT(C) 4.00m, N=13 (2,2/3,3,3,4)						
		HV 4.50m, 58kPa						
						...with slightly clayey gravelly glauconitic fine sand from 4.90mbgl. Gravel is medium to coarse sub-rounded of flint.		
		SPT(C) 5.00m, N=11 (2,2/2,3,3,3)	68.30	5.00		Firm brown very sandy CLAY. [London Clay Formation]		
		HV 5.50m, 21kPa						

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
10-08-2016	13:30	10.45						

Remarks:

1. Hand dug inspection pit excavated to 1.20mbgl prior to drilling. 2. Hand vane fails @ >120kpa in Lambeth Group. 3. No groundwater encountered.

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: WS102 Sheet 2 of 2
	Contract Number: J3091	Date Started: 11/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
Window Sample Log	Easting: 511220.5	Northing: 190629.6	Ground Level: 73.30mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
					Scale: 1:30

Weather: Fine/Dry | Termination: Target depth achieved | SPT Hammer: DT/0315 Energy Ratio: 70.02%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		SPT(C) 6.00m, N=17 (2,2/3,4,5,5)						
		HV 6.50m, 30kPa						
				(2.40)				
7		SPT(C) 7.00m, N=18 (1,2/3,4,4,7)						
			65.90	7.40		Stiff orange, reddish brown and light grey slightly sandy CLAY. [Lambeth Group]		
		HV 7.50m, 120kPa						
8		SPT(C) 8.00m, N=23 (5,5/6,6,6,5)						
		HV 8.50m, 120kPa		(2.30)		*...with occasional fine to coarse gravel sized angular selenite from 8.50 - 9.30mbgl.*		
9		SPT(C) 9.00m, N=6 (2,2/1,1,2,2)						
		HV 9.50m, 35kPa				*...from 9.50mbgl becoming soft low strength.*		
			63.60	9.70		Medium dense light orange and grey slightly clayey fine SAND. [Lambeth Group]		
10		SPT(C) 10.00m, N=14 (3,2/2,2,5,5)		(0.75)				
			62.85	10.45		End of Borehole at 10.45m		
11								
12								

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
10-08-2016	13:30	10.45						

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Remarks:

1. Hand dug inspection pit excavated to 1.20mbgl prior to drilling. 2. Hand vane fails @ >120kpa in Lambeth Group. 3. No groundwater encountered.

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

WS102: 1.20 – 6.00mbgl

WS102: 6.00 – 10.00mbgl

endeavour drilling

Contract Name: Pinner Wood School		Client: Peter Brett Associates			Borehole ID: WS103 Sheet 1 of 2
Contract Number: J3091	Date Started: 14/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	
Easting: 511163.6	Northing: 190672.0	Ground Level: 74.71mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30

Window Sample Log

Weather: Fine/Dry | Termination: Hole collapse | SPT Hammer: DT/0315 Energy Ratio: 70.02%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
			74.61	0.10		TOPSOIL - Light greyish brown slightly sandy slightly gravelly clay, with frequent rootlets. Sand is fine to coarse and gravel is fine to medium sub-rounded of flint.		
				(0.50)		MADE GROUND - Firm medium strength dark orangish brown slightly sandy slightly gravelly clay, with occasional rootlets. Sand is fine to coarse and gravel is fine to coarse angular to sub-rounded of brick, chalk, cinder an flint.		
		HV 0.50m, 47kPa						
			74.11	0.60		Firm light brownish orange mottled light grey slightly sandy slightly gravelly CLAY. Sand is fine and gravel is fine to medium sub-angular to sub-rounded of flint. [London Clay Formation]		
				(0.60)				
		SPT(C) 1.20m, N=9 (2,2/2,2,2,3)	73.51	1.20		Firm to stiff fissured dark orangish brown slightly sandy CLAY, with light grey gleying and orange sand infill along fissured surfaces. [London Clay Formation]		
		HV 1.50m, 42kPa						
		SPT(C) 2.00m, N=10 (2,1/2,2,3,3)						
		HV 2.50m, 68kPa						
		SPT(C) 3.00m, N=21 (3,4/3,5,6,7)						
		HV 3.50m, 38kPa				*...with very thinly inter-bedded clayey fine sand from 3.40 - 3.50mbgl.*		
				(6.25)				
		SPT(C) 4.00m, N=10 (0,0/0,0,5,5)						
		HV 4.50m, 93kPa						
		SPT(C) 5.00m, N=23 (2,3/4,5,6,8)						
		HV 5.50m, 99kPa						
						...with thinly inter-bedded brownish yellow fine sand and fissure infill from 5.90mbgl.		

1 2 3 4 5 6

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
14-08-2016	14:00	7.45						

Remarks:

1. Hand dug inspection pit excavated to 1.20mbgl prior to drilling.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: WS103
	Contract Number: J3091	Date Started: 14/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
					Sheet 2 of 2
Window Sample Log	Easting: 511163.6	Northing: 190672.0	Ground Level: 74.71mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
					Scale: 1:30

Weather: Fine/Dry

Termination: Hole collapse

SPT Hammer: DT/0315 Energy Ratio: 70.02%

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
		SPT(C) 6.00m, N=26 (5,5/6,6,6,8)							
		SPT(C) 7.00m, N=34 (6,7/8,8,9,9)					7		
			67.26	7.45		End of Borehole at 7.45m			
							8		
							9		
							10		
							11		
							12		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
14-08-2016	14:00	7.45						

Remarks:

1. Hand dug inspection pit excavated to 1.20mbgl prior to drilling.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

WS103: 1.20 – 6.00mbgl

WS103: 6.00 – 7.00mbgl

endeavour drilling

Contract Name: Pinner Wood School			Client: Peter Brett Associates		Borehole ID: WS104
Contract Number: J3091	Date Started: 15/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	Sheet 1 of 2
Easting: 511200.7	Northing: 190645.6	Ground Level: 73.73mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30

Window Sample Log

Weather: Fine/Dry

Termination: Refusal

SPT Hammer: 004 Energy Ratio: 64%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
			73.63	0.10	▨	ASPHALT		■
					▨	SUB-BASE		■
			73.43	0.30				■
					▤	POSSIBLE DISTURBED GROUND - Firm dark brownish orange mottled light grey slightly sandy CLAY.		■
		HV 0.50m, 49kPa		(0.50)	▤			■
			72.93	0.80	▤	Firm fissured dark orangish brown slightly sandy CLAY, with light grey gleying along fissured surfaces and frequent fine to coarse gravel sized pockets of fine orange sand. [London Clay Formation]		■
1		SPT(C) 1.00m, N=8 (1,2/1,2,3,2)			▤			■
		HV 1.50m, 56kPa			▤			■
2		SPT(C) 2.00m, N=10 (1,1/2,2,3,3)			▤			■
		HV 2.50m, 54kPa			▤			■
				(4.20)	▤	*...with occasional fine to coarse gravel sized angular selenite from 2.80mbgl.*		■
3		SPT(C) 3.00m, N=11 (2,1/2,3,3,3)			▤			■
					▤	*...from 3.20mbgl selenite becoming rare, fine gravel sized.*		■
		HV 3.50m, 61kPa			▤			■
4		SPT(C) 4.00m, N=13 (2,2/3,3,3,4)			▤			■
		HV 4.50m, 39kPa			▤			■
5		SPT(C) 5.00m, N=41 (3,5/6,11,11,13)	68.73	5.00	▤	Stiff brown very sandy CLAY. [London Clay Formation]		■
				(0.95)	▤			■
			67.78	5.95	▤			■
6						Continued next sheet		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
15-08-2016	11:00	6.70						

Remarks:

1. Pre-cored to 0.10mbgl. 2. Hand vane fails @ >120kpa in Lambeth Group 3. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: WS104 Sheet 2 of 2
	Contract Number: J3091	Date Started: 15/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
Window Sample Log	Easting: 511200.7	Northing: 190645.6	Ground Level: 73.73mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
					Scale: 1:30

Weather: Fine/Dry | Termination: Refusal | SPT Hammer: 004 Energy Ratio: 64%

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
		SPT(C) 6.00m, N=50 (2,4/7,12,19,12) HV 6.50m, 120kPa	67.03	(0.75) 6.70	▨	Very stiff light grey and yellow slightly sandy CLAY, with occasional fine to coarse gravel sized angular selenite. [Lambeth Group]			■
						End of Borehole at 6.70m	7 8 9 10 11 12		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
15-08-2016	11:00	6.70						

Remarks:
1. Pre-cored to 0.10mbgl. 2. Hand vane fails @ >120kpa in Lambeth Group 3. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

WS104: GL – 5.00mbgl

WS104: 5.00 – 6.70mbgl

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: WS105 Sheet 1 of 2
	Contract Number: J3091	Date Started: 15/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
Window Sample Log	Easting: 511156.7	Northing: 190644.5	Ground Level: 74.08mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
					Scale: 1:30

Weather: Fine/Dry

Termination: Refusal

SPT Hammer: 004 Energy Ratio: 64%

Samples & In Situ Testing

Depth	Sample ID	Test Result
		HV 0.50m, 34kPa
		SPT(C) 1.00m, N=6 (0,0/1,1,2,2)
		HV 1.50m, 60kPa
		SPT(C) 2.00m, N=5 (0,1/1,1,1,2)
		HV 2.50m, 65kPa
		SPT(C) 3.00m, N=10 (2,1/2,3,3,2)
		HV 3.50m, 66kPa
		SPT(C) 4.00m, N=10 (2,2/2,2,3,3)
		HV 4.50m, 80kPa
		SPT(C) 5.00m, N=12 (2,2/2,3,3,4)
		HV 5.50m, 86kPa

Strata Details

Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description
74.03	0.05	▨	ASPHALT
	(0.30)	▨	SUB-BASE
73.73	0.35 (0.35)	▨	POSSIBLE DISTURBED GROUND - Soft dark brownish orange mottled light grey slightly sandy CLAY.
73.38	0.70 (3.50)	▨	Firm to stiff fissured dark orangish brown slightly sandy CLAY, with light grey gleying along fissured surfaces and frequent fine to coarse gravel sized pockets of orange and yellow fine sand. [London Clay Formation]
69.88	4.20	▨	Firm to stiff fissured dark orangish brown slightly sandy CLAY, with fine yellow sand and rusty iron oxide infill and staining along fissured surfaces (<150mm). Fine to coarse gravel sized angular selenite also present. [London Clay Formation] *...with occasional fine to coarse gravel sized angular selenite from 4.90mbgl.*

Groundwater

Water Strike	Backfill/ Installation

Continued next sheet

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)
15-08-2016	14:00	9.45		

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth (m)	Dia (mm)

Remarks:

1. Pre-cored to 0.05mbgl 3. No groundwater encountered.

Chiselling

From (m)	To (m)	Duration	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: WS105
	Contract Number: J3091	Date Started: 15/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
					Sheet 2 of 2
Window Sample Log	Easting: 511156.7	Northing: 190644.5	Ground Level: 74.08mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
					Scale: 1:30

Weather: Fine/Dry

Termination: Refusal

SPT Hammer: 004 Energy Ratio: 64%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		SPT(C) 6.00m, N=12 (2,2/2,3,3,4)				*...from 6.00mbgl iron oxide staining absent.*		
		HV 6.50m, 88kPa						
7		SPT(C) 7.00m, N=33 (4,5/5,7,9,12)						
				(4.20)				
8		SPT(C) 8.00m, N=20 (4,4/4,4,5,7)						
			65.68	8.40		Soft dark brownish grey very sandy CLAY. [London Clay Formation]		
		HV 8.50m, 35kPa						
				(0.55)				
			65.13	8.95		Very stiff light grey and yellow slightly sandy CLAY, with rare fine gravel sized angular selenite. [Lambeth Group]		
9		SPT(S) 9.00m, N=50 (7,8/8,12,14,16)						
				(0.50)				
			64.63	9.45		End of Borehole at 9.45m		
10								
11								
12								

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
15-08-2016	14:00	9.45						

Remarks:

1. Pre-cored to 0.05mbgl 3. No groundwater encountered.

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

WS105: GL – 5.00mbgl

WS105: 5.00 – 9.45mbgl

endeavour drilling

Contract Name: Pinner Wood School		Client: Peter Brett Associates			Borehole ID: WS106 Sheet 1 of 2
Contract Number: J3091	Date Started: 15/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	
Easting: 511153.2	Northing: 190639.9	Ground Level: 73.97mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30

Window Sample Log

Weather: Fine/Dry | Termination: Refusal | SPT Hammer: 004 Energy Ratio: 64%

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
			73.87	0.10		ASPHALT			
						SUB-BASE			
			73.62	0.35		POSSIBLE DISTURBED GROUND - Soft dark orangish brown mottled light grey slightly sandy CLAY.			
		HV 0.50m, 32kPa							
				(0.65)					
		SPT(C) 1.00m, N=9 (2,1/2,2,2,3)	72.97	1.00		Firm locally stiff fissured dark orangish brown slightly sandy CLAY, with light grey gleying and fine yellow and orange sand infill along fissured surfaces. [London Clay Formation]	1		
		HV 1.50m, 51kPa							
		SPT(C) 2.00m, N=9 (1,1/2,2,2,3)				*...with occasional pockets of medium to coarse gravel sized fine orange sand from 2.00mbgl.*	2		
		HV 2.50m, 77kPa							
				(3.40)					
		SPT(C) 3.00m, N=11 (1,2/2,3,3,3)					3		
		HV 3.50m, 71kPa							
		SPT(C) 4.00m, N=8 (1,2/1,2,3,2)					4		
			69.57	4.40		Stiff to very stiff dark green and brown slightly sandy CLAY, with occasional fine to medium gravel sized angular selenite and fine to medium gravel sized pockets of fine orange sand.			
		HV 4.50m, 102kPa							
		SPT(C) 5.00m, N=17 (3,3/4,4,4,5)					5		
				(2.90)					
		HV 5.50m, 87kPa							
						Continued next sheet	6		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
15-08-2016	16:00	9.39						

Remarks:

1. Pre-cored to 0.10mbgl. 2. Hand vane fails @ >120kpa in Lambeth Group 3. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: WS106 Sheet 2 of 2
	Contract Number: J3091	Date Started: 15/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
Window Sample Log	Easting: 511153.2	Northing: 190639.9	Ground Level: 73.97mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
					Scale: 1:30

Weather: Fine/Dry

Termination: Refusal

SPT Hammer: 004 Energy Ratio: 64%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		SPT(C) 6.00m, N=14 (2,2/3,3,4,4)						
		HV 6.50m, 104kPa						
		SPT(C) 7.00m, N=39 (4,7/6,10,11,12)						
			66.67	7.30		Very soft dark brownish grey very sandy CLAY. [London Clay Formation]		
		HV 7.50m, 19kPa		(0.40)				
			66.27	7.70		Medium dense dark grey very clayey fine SAND. [London Clay Formation]		
		SPT(C) 8.00m, N=25 (3,4/5,6,6,8)						
				(1.10)				
			65.17	8.80		Very stiff off white, yellow and brownish red slightly sandy CLAY. [Lambeth Group]		
		HV 8.90m, 120kPa						
		SPT(S) 9.00m, N=50 (4,8/50 for 240mm)		(0.59)				
			64.58	9.39		End of Borehole at 9.39m		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
15-08-2016	16:00	9.39						

Remarks:

1. Pre-cored to 0.10mbgl. 2. Hand vane fails @ >120kpa in Lambeth Group 3. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

WS106: GL – 5.00mbgl

WS106: 5.00 – 9.45mbgl

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: WS107 Sheet 1 of 2
	Contract Number: J3091	Date Started: 16/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
Window Sample Log	Easting: 511101.8	Northing: 190564.4	Ground Level: 72.22mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
					Scale: 1:30

Weather: Fine/Dry | Termination: Refusal | SPT Hammer: 004 Energy Ratio: 64%

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
			72.07	0.15		TOPSOIL - Light greyish brown slightly sandy slightly gravelly clay, with frequent rootlets. Sand is fine to coarse and gravel is fine to medium sub-angular to sub-rounded of flint and brick.			
			71.82	0.40		MADE GROUND - Light greyish brown sandy gravelly clay. Sand is fine to coarse and gravel is fine to coarse sub-angular to sub-rounded of brick and flint.			
		HV 0.50m, 57kPa				Firm locally stiff fissured dark orangish brown slightly sandy CLAY, with light bluish grey gleying along fissured surfaces and occasional fine to coarse gravel sized pockets of orange fine sand. [London Clay Formation]			
		SPT(C) 1.00m, N=9 (1,2/2,2,2,3)					1		
		HV 1.50m, 55kPa							
		SPT(C) 2.00m, N=9 (1,2/1,3,2,3)					2		
		HV 2.50m, 54kPa							
				(4.80)					
		SPT(C) 3.00m, N=18 (3,2/4,4,5,5)					3		
		HV 3.50m, 86kPa							
		SPT(C) 4.00m, N=12 (2,2/3,2,3,4)					4	▼	
		HV 4.50m, 62kPa							
						...with rusty orange and black staining along yellow sand fissure infill (iron oxide and manganese) from 4.80 - 4.90mbgl.			
		SPT(C) 5.00m, N=16 (2,2/4,4,4,4)					5		
			67.02	5.20		Very soft brown very sandy CLAY. [London Clay Formation]			
				(0.40)					
		HV 5.50m, 12kPa							
			66.62	5.60		Stiff brown slightly sandy CLAY. [London Clay Formation]			
				(0.40)					
			66.22	6.00			6		

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
16-08-2016	10:30	8.45						

Remarks:

1. Groundwater encountered @ 4.20mbgl, no rise.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
4.20			20	4.20	

Contract Name: Pinner Wood School		Client: Peter Brett Associates			Borehole ID: WS107 Sheet 2 of 2
Contract Number: J3091	Date Started: 16/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	
Easting: 511101.8	Northing: 190564.4	Ground Level: 72.22mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30

Window Sample Log

Weather: Fine/Dry

Termination: Refusal

SPT Hammer: 004 Energy Ratio: 64%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		SPT(C) 6.00m, N=18 (3,3/3,5,5,5)				Stiff brown sandy CLAY. [London Clay Formation]		
		HV 6.50m, 38kPa		(1.00)				
		SPT(C) 7.00m, N=20 (2,4/4,5,5,6)	65.22	7.00		Medium dense brown very clayey fine SAND. [London Clay Formation]		
				(0.80)				
			64.42	7.80		Very soft brown very sandy CLAY. [London Clay Formation]		
		SPT(C) 8.00m, N=50 (3,5/8,10,14,18)	64.22	8.00		Very stiff light grey and yellow slightly sandy CLAY. [Lambeth Group]		
				(0.45)				
			63.77	8.45		End of Borehole at 8.45m		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
16-08-2016	10:30	8.45						

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Remarks:

1. Groundwater encountered @ 4.20mbgl, no rise.

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
4.20			20	4.20	

WS107: GL – 5.00mbgl

WS107: 5.00 – 8.00mbgl

endeavour drilling

Contract Name: Pinner Wood School			Client: Peter Brett Associates		Borehole ID: WS108
Contract Number: J3091	Date Started: 16/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	Sheet 1 of 2
Easting: 511115.9	Northing: 190563.8	Ground Level: 71.71mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30

Window Sample Log

Weather: Fine/Dry

Termination: Refusal

SPT Hammer: 004 Energy Ratio: 64%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
			71.61	0.10	▨	TOPSOIL - Light greyish brown slightly gravelly sandy clay, with frequent rootlets. Sand is fine to coarse and gravel is fine to medium sub-angular to sub-rounded of flint and brick.		
			71.41	0.30	▨	MADE GROUND - Dark greyish brown mottled orange gravelly clay, with occasional rootlets. Sand is fine to coarse and gravel is fine to medium sub-angular to sub-rounded of brick and flint.		
		HV 0.50m, 88kPa		(0.70)	▨	Stiff light brownish orange mottled light grey slightly sandy CLAY. [London Clay Formation] *...with frequent fine to medium sub-rounded flint gravel from 0.70 - 0.75mbgl.*		
		SPT(C) 1.00m, N=9 (1,1/2,2,2,3)	70.71	1.00	▨	Firm becoming stiff fissured dark orangish brown slightly sandy CLAY, with light bluish grey gleying along fissured surfaces. [London Clay Formation]		
		HV 1.50m, 61kPa						
		SPT(C) 2.00m, N=8 (1,1/2,2,2,2)						
		HV 2.50m, 69kPa						
		SPT(C) 3.00m, N=14 (1,2/3,3,3,5)		(4.00)				
		HV 3.50m, 78kPa				*...with occasional fine to coarse gravel sized pockets of orange fine sand from 3.40mbgl.*		
		SPT(C) 4.00m, N=12 (2,2/2,3,3,4)						
		HV 4.50m, 101kPa						
		SPT(C) 5.00m, N=15 (2,3/3,3,4,5)	66.71	5.00	▨	Firm brown sandy CLAY. [London Clay Formation]		
		HV 5.50m, 31kPa		(1.00)				
			65.71	6.00				

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
16-08-2016	13:00	7.39						

Remarks:

1. Groundwater encountered @ 6.55mbgl, no rise.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
6.55			20	6.55	

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates			Borehole ID: WS108 Sheet 2 of 2
	Contract Number: J3091	Date Started: 16/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	
Window Sample Log	Easting: 511115.9	Northing: 190563.8	Ground Level: 71.71mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30
Weather: Fine/Dry		Termination: Refusal		SPT Hammer: 004 Energy Ratio: 64%		

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		SPT(C) 6.00m, N=14 (1,3/2,4,4,4)		(0.40)	▨	Medium dense brown very clayey SAND. [London Clay Formation]		■
		HV 6.50m, 21kPa	65.31	6.40 (0.60)	▨	Soft brown very sandy CLAY. [London Clay Formation]	▼	■
7		SPT(C) 7.00m, N=50 (3,7/50 for 235mm)	64.71	7.00 (0.39)	▨	Very stiff light grey and yellow slightly sandy CLAY. [Lambeth Group]		■
			64.32	7.39		End of Borehole at 7.39m		
8								
9								
10								
11								
12								

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
16-08-2016	13:00	7.39						

Remarks:

1. Groundwater encountered @ 6.55mbgl, no rise.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
6.55			20	6.55	

WS108: GL – 5.00mbgl

WS108: 5.00 – 7.00mbgl

endeavour drilling

Contract Name: Pinner Wood School		Client: Peter Brett Associates			Borehole ID: WS109 Sheet 1 of 2
Contract Number: J3091	Date Started: 16/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	
Easting: 511095.7	Northing: 190602.0	Ground Level: 73.53mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30

Window Sample Log

Weather: Fine/Dry

Termination: Refusal

SPT Hammer: 004 Energy Ratio: 64%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
			73.43	0.10	▩	ASPHALT		■
				(0.40)	▩	SUB-BASE		■
		HV 0.50m, 42kPa	73.03	0.50	▩	MADE GROUND - Firm medium strength light grey and blackish brown slightly sandy gravelly clay. Sand is fine to coarse and gravel is fine to medium sub-angular to sub-rounded of brick and cinder.		■
		HV 0.80m, 30kPa	72.78	0.75	▤	POSSIBLE DISTURBED GROUND - Soft dark orangish brown mottled light grey slightly sandy CLAY.		■
		SPT(C) 1.00m, N=7 (0,0/1,1,2,3)		(0.45)	▤			■
			72.33	1.20	▤	Firm locally stiff fissured dark orangish brown slightly sandy CLAY, with light grey gleying along fissured surfaces and frequent fine to coarse gravel sized pockets of orange fine sand. [London Clay Formation]		■
		HV 1.50m, 61kPa			▤			■
		SPT(C) 2.00m, N=8 (1,1/1,2,2,3)			▤	*...with off white fine gravel sized angular selenite infill along fissured surfaces from 2.00 - 2.30mbgl.*		■
		HV 2.50m, 88kPa			▤			■
		SPT(C) 3.00m, N=11 (2,2/2,3,3,3)			▤			■
				(4.20)	▤			■
		HV 3.50m, 69kPa			▤			■
		SPT(C) 4.00m, N=11 (2,1/2,3,3,3)			▤	*...from 4.05 - 4.30mbgl becoming very soft, very sandy.*		■
		HV 4.50m, 46kPa			▤		▼	■
		SPT(C) 5.00m, N=10 (1,1/2,3,2,3)			▤			■
			68.13	5.40	▦	Medium dense brown very clayey fine SAND. [London Clay Formation]		■
				(0.95)	▦			■

Continued next sheet

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)
16-08-2016	16:00	8.90		

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth (m)	Dia (mm)

Remarks:

1. Pre-cored to 0.10mbgl. 2. Groundwater encountered @ 4.60mbgl, no rise.

Chiselling

From (m)	To (m)	Duration	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
4.60			20	4.60	

endeavour drilling	Contract Name: Pinner Wood School			Client: Peter Brett Associates		Borehole ID: WS109 Sheet 2 of 2
	Contract Number: J3091	Date Started: 16/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	
Window Sample Log	Easting: 511095.7	Northing: 190602.0	Ground Level: 73.53mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30

Weather: Fine/Dry | Termination: Refusal | SPT Hammer: 004 Energy Ratio: 64%

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
		SPT(C) 6.00m, N=13 (2,2/2,3,4,4)			▨				■
			67.18	6.35	▨	Stiff dark brown sandy CLAY. [London Clay Formation]			■
		HV 6.60m, 46kPa			▨				■
				(1.05)	▨				■
		SPT(C) 7.00m, N=22 (4,4/5,5,6,6)			▨		7		■
			66.13	7.40	▨	Stiff dark brown very sandy CLAY. [London Clay Formation]			■
		HV 7.50m, 13kPa			▨				■
		SPT(C) 8.00m, N=26 (4,5/5,6,6,9)		(1.15)	▨		8		■
		HV 8.50m, 18kPa SPT(S) 8.55m, N=50 (9,12/50 for 275mm)	64.98	8.55	▨	Very stiff off white, grey and yellow slightly sandy clay. [Lambeth Group]			■
				(0.35)	▨				■
			64.63	8.90		End of Borehole at 8.90m			
							9		
							10		
							11		
							12		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
16-08-2016	16:00	8.90						

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Remarks:

1. Pre-cored to 0.10mbgl. 2. Groundwater encountered @ 4.60mbgl, no rise.

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
4.60			20	4.60	

WS109: GL – 5.00mbgl

WS109: 5.00 – 8.90mbgl

endeavour drilling	Contract Name: Pinner Wood School			Client: Peter Brett Associates		Borehole ID: WS110
	Contract Number: J3091	Date Started: 18/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	Sheet 1 of 2
Window Sample Log	Easting: 511149.8	Northing: 190558.7	Ground Level: 71.60mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30
Weather: Overcast/Dry		Termination: Refusal			SPT Hammer: DART367 Energy Ratio: 70%	

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
			71.50	0.10	▩	ASPHALT			■
				(0.30)	▨	SUB-BASE			■
			71.20	0.40	▨				■
		HV 0.50m, 43kPa			▤	POSSIBLE DISTURBED GROUND - Firm dark orangish brown slightly sandy CLAY.			■
				(0.60)	▤				■
		SPT(C) 1.00m, N=7 (1,0/1,1,2,3)	70.60	1.00	▤	Firm fissured dark orangish brown slightly sandy CLAY, with light bluish grey gleying and fine yellow and orange sand infill along fissured surfaces. [London Clay Formation]	1		■
		HV 1.50m, 68kPa			▤				■
		SPT(C) 2.00m, N=7 (1,1/1,1,2,3)			▤		2		■
		HV 2.50m, 69kPa			▤				■
		SPT(C) 3.00m, N=16 (3,3/3,4,4,5)			▤		3		■
				(4.50)	▤				■
		HV 3.50m, 56kPa			▤				■
					▤	*...from 3.80mbgl light grey gleying absent.*			■
		SPT(C) 4.00m, N=19 (4,4/4,5,5,5)			▤		4		■
		HV 4.50m, 64kPa			▤				■
					▤	*...with occasional fine to medium gravel sized angular selenite from 4.60mbgl.*			■
		SPT(C) 5.00m, N=25 (6,6/6,6,6,7)			▤		5		■
		HV 5.50m, 17kPa	66.10	5.50	▤	Stiff dark brown very sandy CLAY. [London Clay Formation]			■
					▤		6		■

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
18-08-2016	10:00	7.42						

Remarks:

1. Pre-cored to 0.10mbgl 3. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: WS110 Sheet 2 of 2
	Contract Number: J3091	Date Started: 18/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
Window Sample Log	Easting: 511149.8	Northing: 190558.7	Ground Level: 71.60mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
					Scale: 1:30

Weather: Overcast/Dry

Termination: Refusal

SPT Hammer: DART367 Energy Ratio: 70%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		SPT(C) 6.00m, N=22 (5,5/5,5,6,6)			▨			■
				(1.15)	▨			■
		HV 6.50m, 33kPa			▨			■
			64.95	6.65	▨	Very stiff light grey and yellow slightly sandy CLAY. [Lambeth Group]		■
		HV 6.80m, 120kPa			▨			■
		SPT(S) 7.00m, 50 (25 for 125mm/50 for 265mm)		(0.77)	▨			■
			64.18	7.42		End of Borehole at 7.42m		

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Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
18-08-2016	10:00	7.42						

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Remarks:

1. Pre-cored to 0.10mbgl 3. No groundwater encountered.

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

WS110: GL – 5.00mbgl

WS110: 5.00 – 7.45mbgl

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: WS111 Sheet 1 of 2
	Contract Number: J3091	Date Started: 18/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
Window Sample Log	Easting: 511184.3	Northing: 190572.4	Ground Level: 72.15mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
					Scale: 1:30
Weather: Overcast/Dry		Termination: Refusal		SPT Hammer: DART367 Energy Ratio: 70%	

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
			72.05	0.10		TOPSOIL - Light greyish brown slightly sandy clay, with frequent rootlets.			
			71.95	0.20		MADE GROUND - Light greyish brown slightly sandy slightly gravelly clay, with occasional rootlets. Sand is fine to coarse and gravel is fine to medium angular to sub-rounded of cinder, brick, flint, concrete and ceramics.			
		HV 0.50m, 96kPa				Stiff becoming firm light orangish brown mottled light grey CLAY, with occasional fine to coarse gravel sized pockets of orange fine sand and occasional rootlets. [London Clay Formation]			
		SPT(C) 1.00m, N=20 (3,4/5,6,6,3)					1		
		HV 1.50m, 102kPa							
		SPT(C) 2.00m, N=13 (3,3/4,3,3,3)					2		
				(4.20)					
		HV 2.50m, 50kPa				*...with fine gravel sized angular selenite from 2.90 - 2.95mbgl.*			
		SPT(C) 3.00m, N=19 (4,4/4,5,5,5)					3		
		HV 3.50m, 64kPa							
						...with fine orange sand infill and iron oxide staining along fissured surface @ 3.70mbgl.			
		SPT(C) 4.00m, N=19 (3,4/4,4,5,6)				*...with frequent fine to medium gravel sized angular selenite from 3.80 - 4.00mbgl.*	4		
						...with very thinly inter-bedded green fine glauconitic gravelly sand @ 4.30mbg. Gravel is fine to medium sub-rounded of flint.			
			67.75	4.40		Stiff brown very sandy CLAY. [London Clay Formation]			
		HV 4.50m, 17kPa							
		SPT(C) 5.00m, N=21 (5,4/5,5,5,6)					5		
				(1.50)					
		HV 5.50m, 32kPa							
		HV 5.90m, 120kPa	66.25	5.90		Very stiff light grey, yellow and brownish red slightly sandy			
						Continued next sheet	6		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
18-08-2016	13:00	6.45						

Remarks:

1. Hand vane fails @ >120kpa in Lambeth Group 3. No groundwater encountered 3. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: WS111 Sheet 2 of 2
	Contract Number: J3091	Date Started: 18/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
Window Sample Log	Easting: 511184.3	Northing: 190572.4	Ground Level: 72.15mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
					Scale: 1:30

Weather: Overcast/Dry | Termination: Refusal | SPT Hammer: DART367 Energy Ratio: 70%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		SPT(C) 6.00m, 50 (25 for 140mm/50 for 295mm)		(0.55)	▨	CLAY. [Lambeth Group]		■
			65.70	6.45		End of Borehole at 6.45m		

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Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
18-08-2016	13:00	6.45						

Remarks:

1. Hand vane fails @ >120kpa in Lambeth Group 3. No groundwater encountered 3. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

WS111: GL – 5.00mbgl

WS111: 5.00 – 6.50mbgl

endeavour drilling

Contract Name: Pinner Wood School			Client: Peter Brett Associates		Borehole ID: **WS112**
Contract Number: J3091	Date Started: 18/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	Sheet 1 of 2
Easting: 511193.7	Northing: 190578.3	Ground Level: 72.34mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30

Window Sample Log

Weather: Overcast/Dry

Termination: Target depth achieved

SPT Hammer: DART367 Energy Ratio: 70%

Samples & In Situ Testing

Depth	Sample ID	Test Result
		HV 0.85m, 56kPa
		SPT(C) 1.00m, N=6 (1,2/1,1,2,2)
		HV 1.50m, 27kPa
		SPT(C) 2.00m, N=4 (1,1/1,1,1,1)
		SPT(C) 3.00m, N=4 (1,1/1,1,1,1)
		HV 3.70m, 17kPa
		SPT(C) 4.00m, N=6 (1,2/1,1,2,2)
		HV 4.50m, 35kPa
		SPT(C) 5.00m, N=6 (1,1/1,1,2,2)
		HV 5.50m, 19kPa

Strata Details

Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description
72.09	0.25	▨	TOPSOIL - Light greyish brown slightly gravelly sandy clay, with frequent rootlets.
71.99	0.35	▨	MADE GROUND - Light greyish brown clayey sandy fine to coarse angular to sub-rounded clinker and flint gravel, with sub-rounded flint cobble.
71.89	0.45	▨	MADE GROUND - Light greyish brown slightly gravelly slightly sandy clay, with occasional rootlets. Sand is fine to coarse and gravel is fine to medium sub-angular to sub-rounded of flint. (RELICT TOPSOIL)
71.84	0.50	▨	ASPHALT/CLINKER
71.69	0.65	▨	MADE GROUND - Multicoloured slightly sandy fine to coarse angular to sub-rounded glass, ceramic, metal, clinker, ash, brick, slag and flint gravel.
71.59	0.75	▨	ASPHALT/CLINKER
71.34	1.00	▨	MADE GROUND - Firm dark greenish grey slightly sandy slightly gravelly clay. Sand is fine to coarse and gravel is fine to coarse angular to sub-rounded of brick and flint.
70.74	(0.60) 1.60	▨	MADE GROUND - Firm light grey mottled orange slightly sandy slightly gravelly clay. Sand is fine to coarse and gravel is fine to medium sub-angular to sub-rounded of chalk, brick and flint.
70.44	(0.30) 1.90	▨	MADE GROUND - Very soft sandy gravelly clay. Sand is fine to coarse and gravel is fine to coarse sub-angular to sub-rounded of brick chalk and flint.
70.34	2.00	▨	MADE GROUND - Dark grey, off white and orangish red slightly sandy angular flint cobbles. Sand is fine to coarse of crushed brick dust.
69.74	(0.60) 2.60	▨	MADE GROUND - Very soft sandy gravelly clay. Sand is fine to coarse and gravel is fine to coarse sub-angular to sub-rounded of brick chalk and flint. *...with orangish red fine to coarse sand of crushed brick dust from 2.40 - 2.50mbgl.*
69.54	2.80	▨	MADE GROUND - Light yellowish grey and off white slightly sandy very gravelly clay. Sand is fine to coarse and gravel is angular to sub-rounded of chalk and fine to medium angular to sub-rounded of brick and flint.
69.04	(0.50) 3.30	▨	NO RECOVERY
68.74	(0.30) 3.60	▨	MADE GROUND - Soft dark yellowish grey and brown slightly gravelly sandy clay, with frequent rootlets. Sand is fine to coarse and gravel is fine to medium sub-angular to sub-rounded of chalk, flint and brick.
	(2.90)	▨	MADE GROUND - Very soft locally soft dark greenish grey slightly sandy slightly gravelly clay, with rare black rotted organic material and moderate organic odour. Sand is fine and gravel is fine to medium sub-angular to sub-rounded of chalk and brick.

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Groundwater

Water Strike	Backfill/ Installation

Continued next sheet

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)
18-08-2016	16:00	11.45		

Borehole Diameter		Casing Diameter	
Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Remarks:

1. No groundwater encountered.

Chiselling

From (m)	To (m)	Duration	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling

	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: WS112
	Contract Number: J3091	Date Started: 18/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
					Sheet 2 of 2
Window Sample Log	Easting: 511193.7	Northing: 190578.3	Ground Level: 72.34mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
					Scale: 1:30

Weather: Overcast/Dry

Termination: Target depth achieved

SPT Hammer: DART367 Energy Ratio: 70%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		SPT(C) 6.00m, N=5 (1,1/1,1,1,2)			▨			■
		HV 6.50m, 20kPa	65.84	6.50	▨	MADE GROUND - Very soft dark orangish brown slightly gravelly sandy clay. Gravel is fine to medium sub-angular to sub-rounded of flint, brick and chalk.		■
7		SPT(C) 7.00m, N=5 (1,1/1,1,1,2)			▨			■
		HV 7.50m, 16kPa		(2.00)	▨			■
8		SPT(C) 8.00m, N=6 (1,1/1,1,2,2)			▨			■
		HV 8.50m, 16kPa	63.84	8.50 (0.30)	▨	MADE GROUND - Dark reddish orange slightly sandy fine to coarse angular to sub-angular brick gravel.		■
			63.54	8.80		VOID		■
9		SPT(C) 9.00m, N=0 (0,0/0,0,0,0)						■
				(1.20)				■
10		SPT(S) 10.00m, N=33 (7,5/10,6,10,7)	62.34	10.00	▨	NO RECOVERY		■
		SPT(S) 10.50m, N=16 (4,4/4,4,4,4)		(1.45)	▨			■
11		SPT(S) 11.00m, N=21 (5,5/5,3,6,7)			▨			■
			60.89	11.45		End of Borehole at 11.45m		
12								

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
18-08-2016	16:00	11.45						

Remarks:

1. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

WS112: GL – 5.00mbgl

WS112: 5.00 – 10.00mbgl

endeavour drilling

Contract Name: Pinner Wood School			Client: Peter Brett Associates		Borehole ID: **WS113** Sheet 1 of 2
Contract Number: J3091	Date Started: 19/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	
Easting: 511208.7	Northing: 190580.9	Ground Level: 72.61mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30

Window Sample Log

Weather: Overcast/Wet

Termination: Refusal

SPT Hammer: DART367 Energy Ratio: 70%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
			72.51	0.10		TOPSOIL - Dark greyish brown slightly gravelly slightly sandy clay, with frequent rootlets. Sand is fine to coarse and gravel is fine to medium sub-rounded of flint.		
			72.01	(0.50) 0.60		MADE GROUND - Dark greyish black and reddish orange slightly clayey sandy gravel, with sub-angular brick cobble. Sand is fine to coarse and gravel is fine to coarse angular to sub-rounded of brick, chalk, cinder, clinker and metal fragments.		
		HV 0.70m, 78kPa SPT(C) 1.00m, N=8 (2,2/2,2,2,2)	71.41	(0.60) 1.20		MADE GROUND - Stiff dark yellowish brown slightly sandy gravelly clay. Gravel is fine to medium sub-angular to sub-rounded of chalk and brick.		
		HV 1.50m, 45kPa SPT(C) 2.00m, N=4 (0,1/1,1,1,1) HV 2.50m, 34kPa SPT(C) 3.00m, N=17 (3,4/4,4,4,5) HV 3.50m, 38kPa SPT(C) 4.00m, N=12 (2,3/3,3,3,3)	68.21	(3.20) 4.40		POSSIBLE DISTURBED GROUND - Firm becoming soft dark orangish brown mottled dark grey slightly sandy CLAY. *...from 2.50mbgl dark grey mottling absent, becoming dark yellowish brown and grey.*		
		HV 4.50m, 15kPa SPT(C) 5.00m, N=8 (0,0/2,2,2,2)	67.21	(1.00) 5.40		POSSIBLE DISTURBED GROUND - Very soft dark bluish grey and brown sandy CLAY, with faint organic odour. *...with rotted black organic material from 4.50 - 4.60mbgl.* *...with rare shell fragments from 4.70mbgl.*		
		HV 5.50m, 17kPa		(0.80)		Very soft dark brown very sandy CLAY. [London Clay Formation]		

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
19-08-2016	10:00	8.42						

Remarks:
1. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling

	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: WS113 Sheet 2 of 2
	Contract Number: J3091	Date Started: 19/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
Window Sample Log	Easting: 511208.7	Northing: 190580.9	Ground Level: 72.61mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
					Scale: 1:30

Weather: Overcast/Wet

Termination: Refusal

SPT Hammer: DART367 Energy Ratio: 70%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		SPT(C) 6.00m, N=20 (4,5/5,5,5,5)	66.41	6.20	▨	Very stiff light grey and yellow sandy CLAY. [Lambeth Group]		■
		SPT(C) 7.00m, N=20 (5,5/5,5,5,5)			▨			■
				(2.22)	▨			■
		SPT(S) 8.00m, N=50 (7,9/50 for 265mm)			▨			■
			64.19	8.42		End of Borehole at 8.42m		

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Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
19-08-2016	10:00	8.42						

Remarks:
1. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

HBSI CP Template Issue Number: 2 Issue Date: 09/06/2015

WS113: GL – 5.00mbgl

WS113: 5.00 – 6.45mbgl

endeavour drilling	Contract Name: Pinner Wood School		Client: Peter Brett Associates		Borehole ID: WS114 Sheet 1 of 2
	Contract Number: J3091	Date Started: 19/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL
Window Sample Log	Easting: 511224.0	Northing: 190596.2	Ground Level: 73.13mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
					Scale: 1:30

Weather: Overcast/Wet | Termination: Refusal | SPT Hammer: DART367 Energy Ratio: 70%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
			72.98	0.15		TOPSOIL - Dark greyish brown slightly sandy slightly gravelly clay, with frequent rootlets. Gravel is fine to medium sub-angular of flint.		
			72.73	0.40		MADE GROUND - Dark greyish brown clayey gravelly fine to coarse sand. Gravel is fine to coarse sub-angular to sub-rounded of chalk, brick and flint.		
		HV 0.50m, 106kPa				Stiff becoming firm dark orangish brown mottled light grey slightly sandy CLAY, with occasional fine to coarse gravel sized pockets of orange fine sand. [London Clay Formation]		
		SPT(C) 1.00m, N=9 (1,2/2,2,2,3)						
		HV 1.50m, 63kPa						
		SPT(C) 2.00m, N=12 (2,2/3,2,3,4)		(3.20)				
		HV 2.50m, 50kPa						
						...with rare medium gravel sized shell fragments @ 2.90mbgl.		
		SPT(C) 3.00m, N=15 (3,3/4,4,4,3)						
		HV 3.50m, 54kPa						
			69.53	3.60		Stiff dark brown very sandy CLAY. [London Clay Formation]		
		SPT(C) 4.00m, N=21 (3,3/4,5,6,6)						
		HV 4.50m, 23kPa		(1.90)				
						...with fine yellow sand infill along fissured surface @ 4.60mbgl.		
		SPT(C) 5.00m, N=50 (7,8/50 for 285mm)						
			67.63	5.50		Very stiff light grey and yellow slightly sandy CLAY. [Lambeth Group]		
		HV 5.60m, 120kPa		(0.91)				

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Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
19-08-2016	13:00	6.41						

Remarks:

1. Hand vane fails @ >120kpa in Lambeth Group 3. No groundwater encountered.

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Contract Name: Pinner Wood School		Client: Peter Brett Associates			Borehole ID: WS114
Contract Number: J3091	Date Started: 19/08/2016	Logged By: CG	Checked By: MJS	Status: FINAL	Sheet 2 of 2
Window Sample Log	Easting: 511224.0	Northing: 190596.2	Ground Level: 73.13mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016
Scale: 1:30					

Weather: Overcast/Wet

Termination: Refusal

SPT Hammer: DART367 Energy Ratio: 70%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		SPT(S) 6.00m, N=50 (13,12/50 for 255mm)	66.72	6.41	▨			■
						End of Borehole at 6.41m		

Depth scale: 7, 8, 9, 10, 11, 12

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
19-08-2016	13:00	6.41						

Remarks:

1. Hand vane fails @ >120kpa in Lambeth Group 3. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

WS114: GL – 5.00mbgl

WS114: 5.00 – 6.45mbgl

endeavour drilling	Contract Name: Pinner Wood School			Client: Peter Brett Associates		Borehole ID: WS115
	Contract Number: J3091	Date Started: 19/09/2016	Logged By: CG	Checked By: MJS	Status: FINAL	Sheet 1 of 2
Window Sample Log	Easting: 511187.2	Northing: 190576.6	Ground Level: 72.26mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30

Weather: Overcast/Wet

Termination: Refusal

SPT Hammer: DART367 Energy Ratio: 70%

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
			72.16	0.10		TOPSOIL - Dark greyish brown slightly gravelly sandy clay, with frequent rootlets. Sand is fine to coarse and gravel is fine to medium sub-angular to sub-rounded of flint.			
				(0.40)		MADE GROUND - Dark greyish brown sandy gravelly clay, with occasional rootlets. Sand is fine to coarse and gravel is fine to coarse angular to sub-rounded of flint, sandstone, brick, cinder and clinker.			
		HV 0.50m, 98kPa	71.76	0.50		Stiff light orangish brown mottled light grey slightly sandy slightly gravelly CLAY, with occasional rootlets. Gravel is fine to medium sub-angular to sub-rounded of flint. [London Clay Formation]			
				(0.50)					
		SPT(C) 1.00m, N=16 (2,3/4,3,3,6)	71.26	1.00		Firm locally stiff brown slightly sandy CLAY, with frequent fine to coarse gravel sized pockets of orange fine sand. [London Clay Formation]	1		
		HV 1.50m, 67kPa							
		SPT(C) 2.00m, N=19 (3,3/4,5,5,5)				*...from 2.00mbgl pockets of sand becoming rare.*	2		
						...with occasional fine to coarse gravel sized angular selenite from 2.40mbgl.			
		HV 2.50m, 71kPa		(3.00)					
		SPT(C) 3.00m, N=20 (4,4/5,5,5,5)					3		
		HV 3.50m, 81kPa				*...with frequent medium gravel sized shell fragments @3.50mbgl.*			
						...from 3.70mbgl becoming sandy.			
		SPT(C) 4.00m, N=24 (5,5/5,6,6,7)	68.26	4.00		Soft brown very sandy CLAY, with occasional fine to coarse gravel sized pockets of orange fine sand and carbonised organic material. [London Clay Formation]	4		
		HV 4.50m, 25kPa							
				(1.40)					
		SPT(C) 5.00m, N=37 (6,6/9,9,9,10)					5		
			66.86	5.40		Very stiff light grey and yellow slightly sandy CLAY, with occasional fine to medium gravel sized angular selenite. [Lambeth Group]			
		HV 5.50m, 120kPa							
				(1.00)					
							6		

Continued next sheet

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
19-09-2016	16:00	6.40						

Remarks:

1. Hand vane fails @ >120kpa in Lambeth Group 3. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

endeavour drilling

Contract Name: Pinner Wood School			Client: Peter Brett Associates			Borehole ID: WS115 Sheet 2 of 2
Contract Number: J3091	Date Started: 19/09/2016	Logged By: CG	Checked By: MJS	Status: FINAL		
Window Sample Log	Easting: 511187.2	Northing: 190576.6	Ground Level: 72.26mOD	Plant Used: Dando Terrier	Print Date: 19/09/2016	Scale: 1:30

Weather: Overcast/Wet | Termination: Refusal | SPT Hammer: DART367 Energy Ratio: 70%

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
		SPT(S) 6.00m, 50 (25 for 110mm/50 for 250mm)	65.86	6.40	▨			■
						End of Borehole at 6.40m		

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Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)
19-09-2016	16:00	6.40						

Remarks:
1. Hand vane fails @ >120kpa in Lambeth Group 3. No groundwater encountered.

Chiselling				Installation			
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

WS115: GL – 5.00mbgl

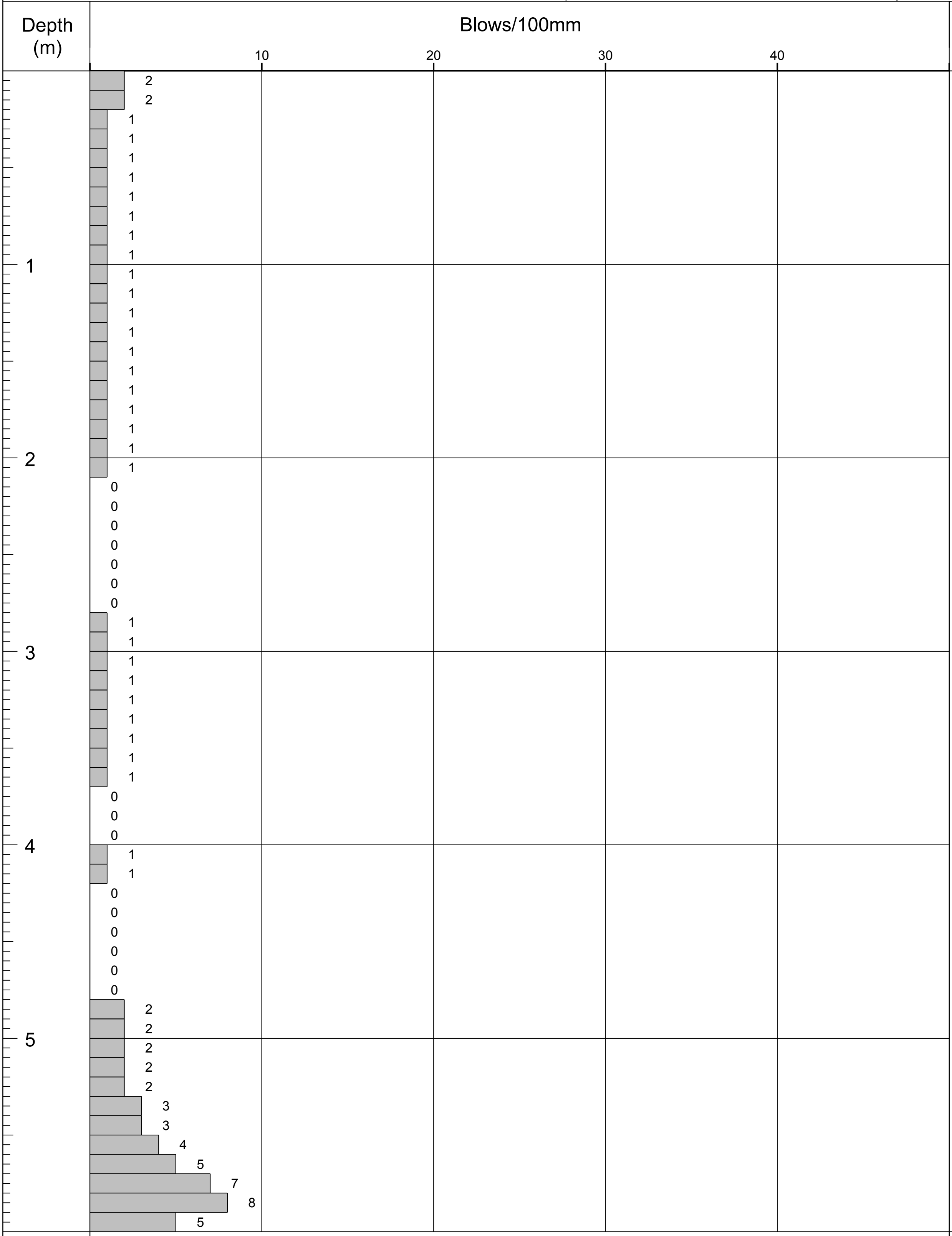
WS115: 5.00 – 6.45mbgl

APPENDIX D

Dynamic Probe Test Results

endeavour drilling	# Probe Log	Probe No DP101 Sheet 1 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 19/08/2016	Logged By CG



Torque (Nm)

0

5

5

5

25

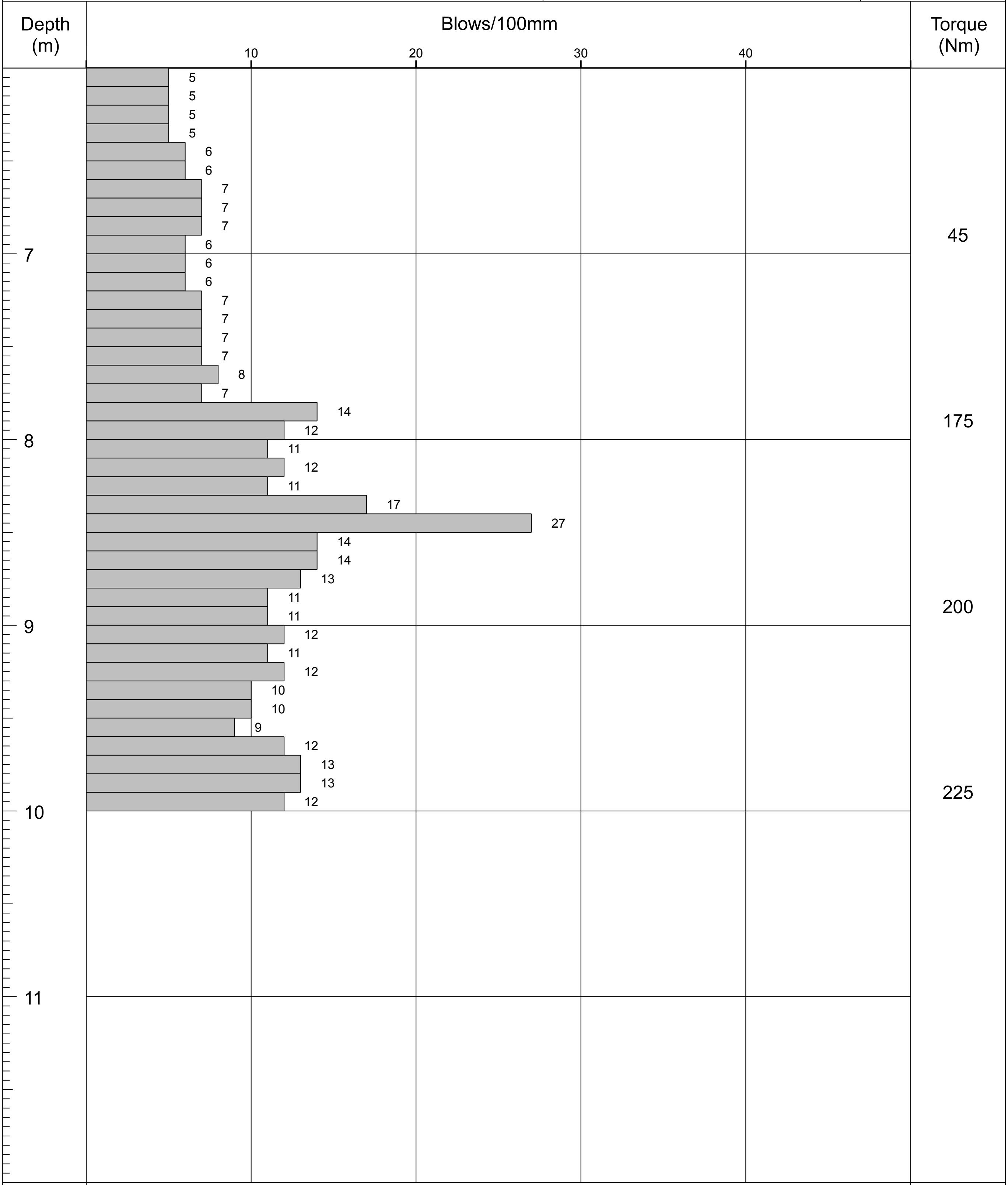
40

Remarks:	Fall Height 760	Cone Base Diameter	AGS
	Hammer Wt 64	Final Depth 10.00	
	Probe Type DPSH-B		

Probe Log

Probe No
DP101
Sheet 2 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 19/08/2016	Logged By CG

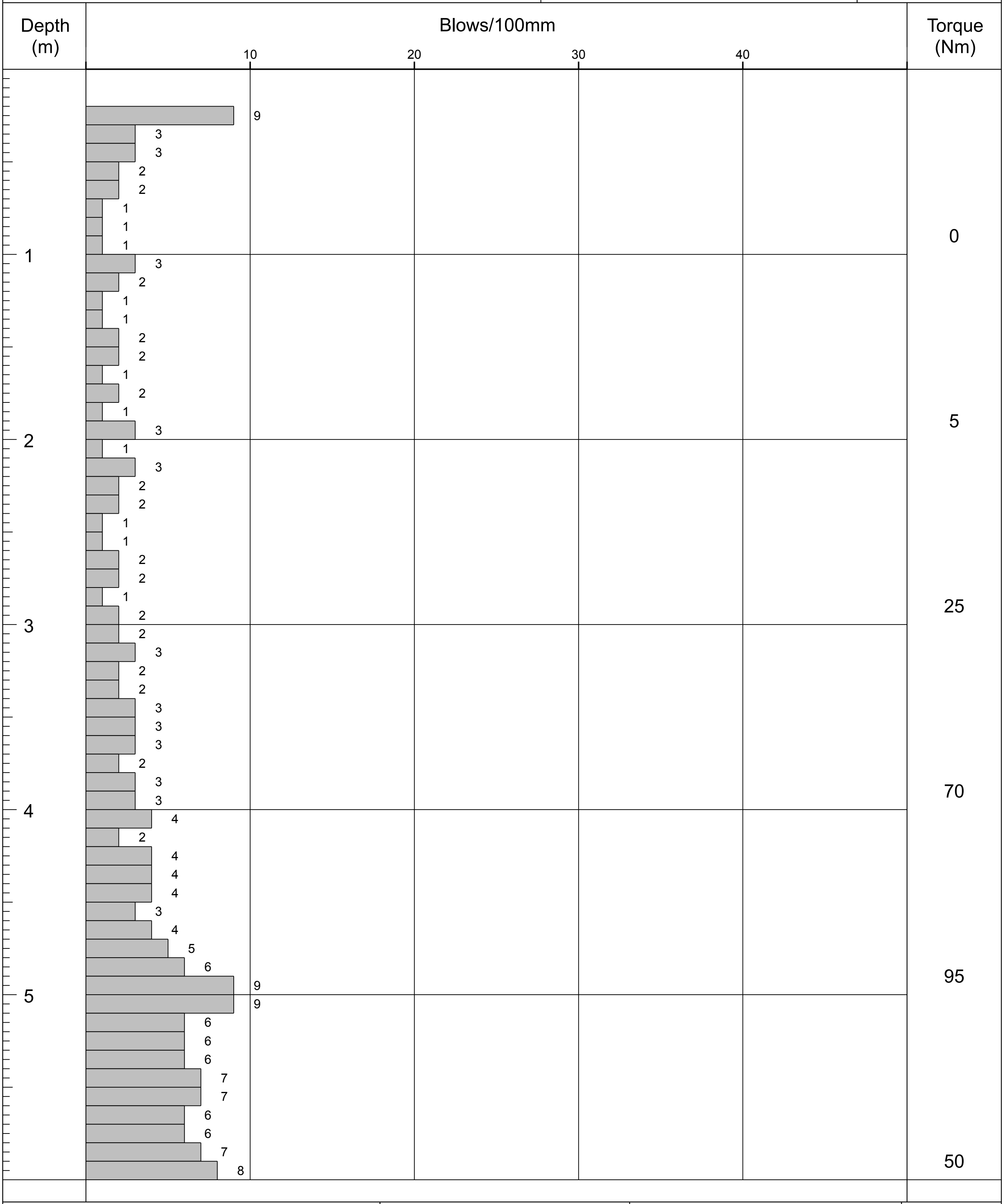


Remarks:

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

Probe Log

Probe No	DP102
Sheet 1 of 2	
Project Name:	Pinner Wood School
Project No.	J3091
Co-ords:	
Hole Type	DP
Location:	Pinner Wood School
Level:	
Scale	1:30
Client:	Peter Brett Associates
Dates:	19/08/2016
Logged By	CG



Remarks:	Fall Height 760	Cone Base Diameter	
	Hammer Wt 64	Final Depth	10.00
	Probe Type DPSH-B		

Probe Log

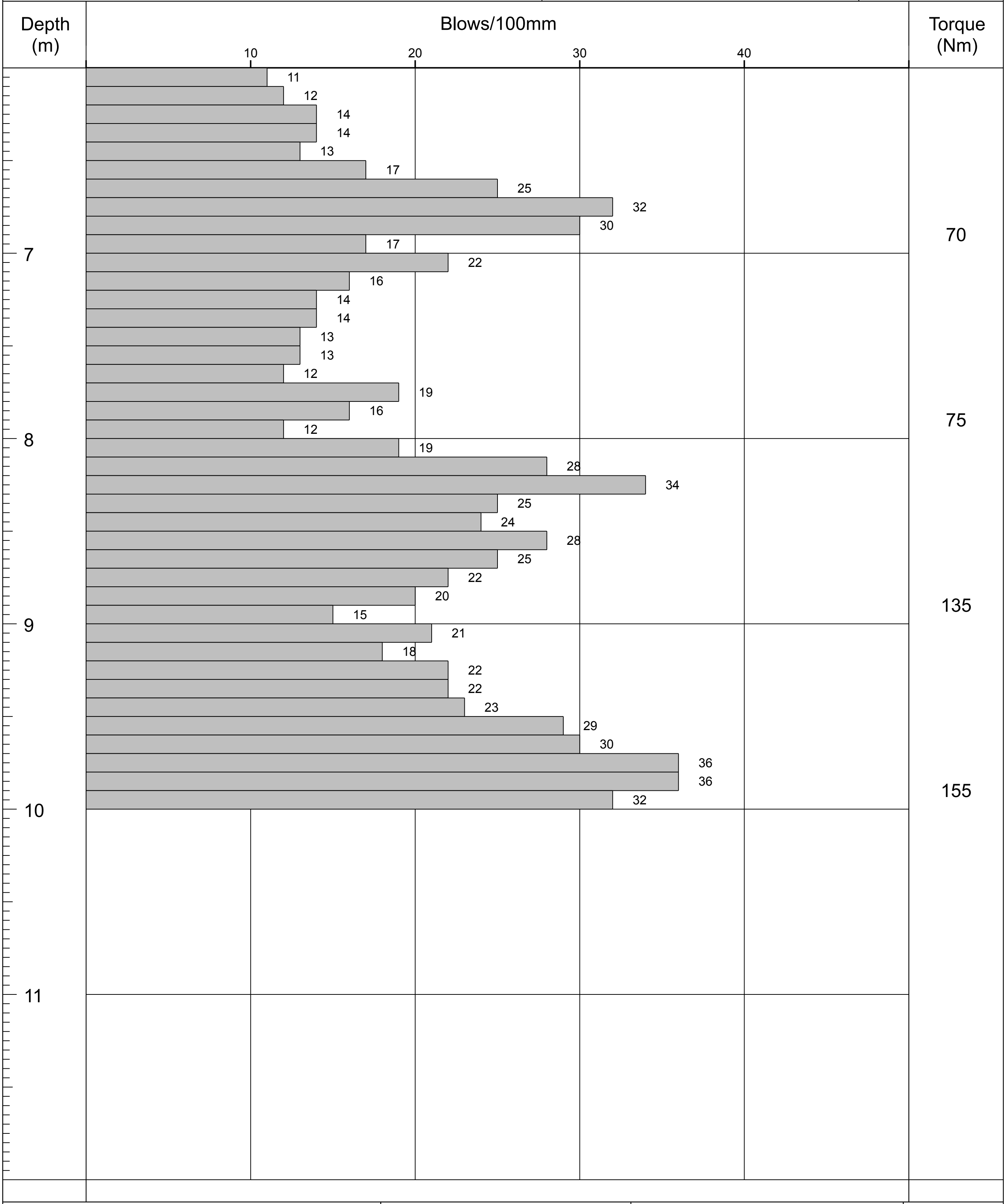
Probe No
DP102
Sheet 2 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:
Location:	Pinner Wood School		Level:
Client:	Peter Brett Associates		Dates: 19/08/2016

Hole Type
DP

Scale
1:30

Logged By
CG



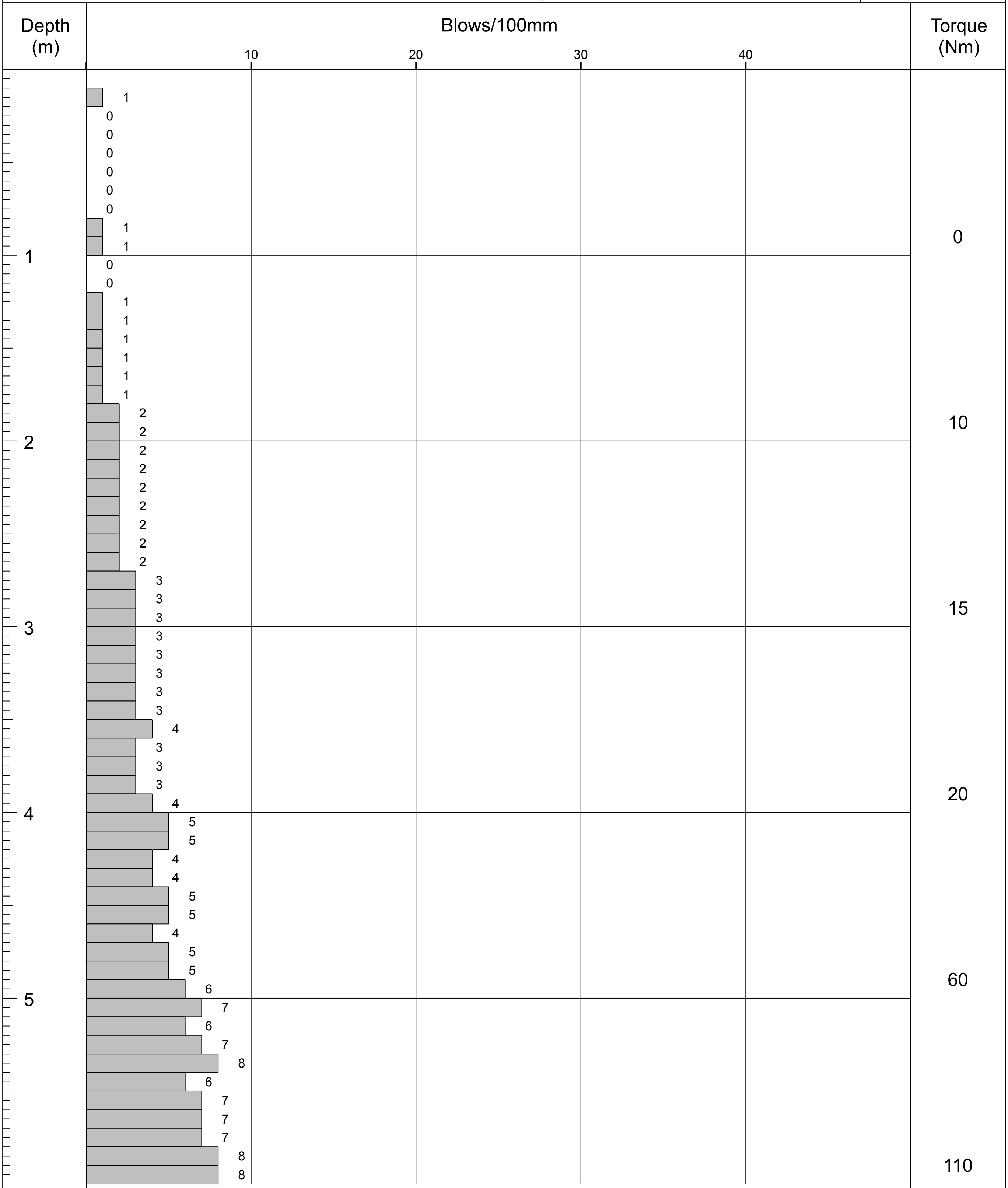
Remarks:

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

Probe Log

Probe No DP103
Sheet 1 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 22/08/2016	Logged By CG



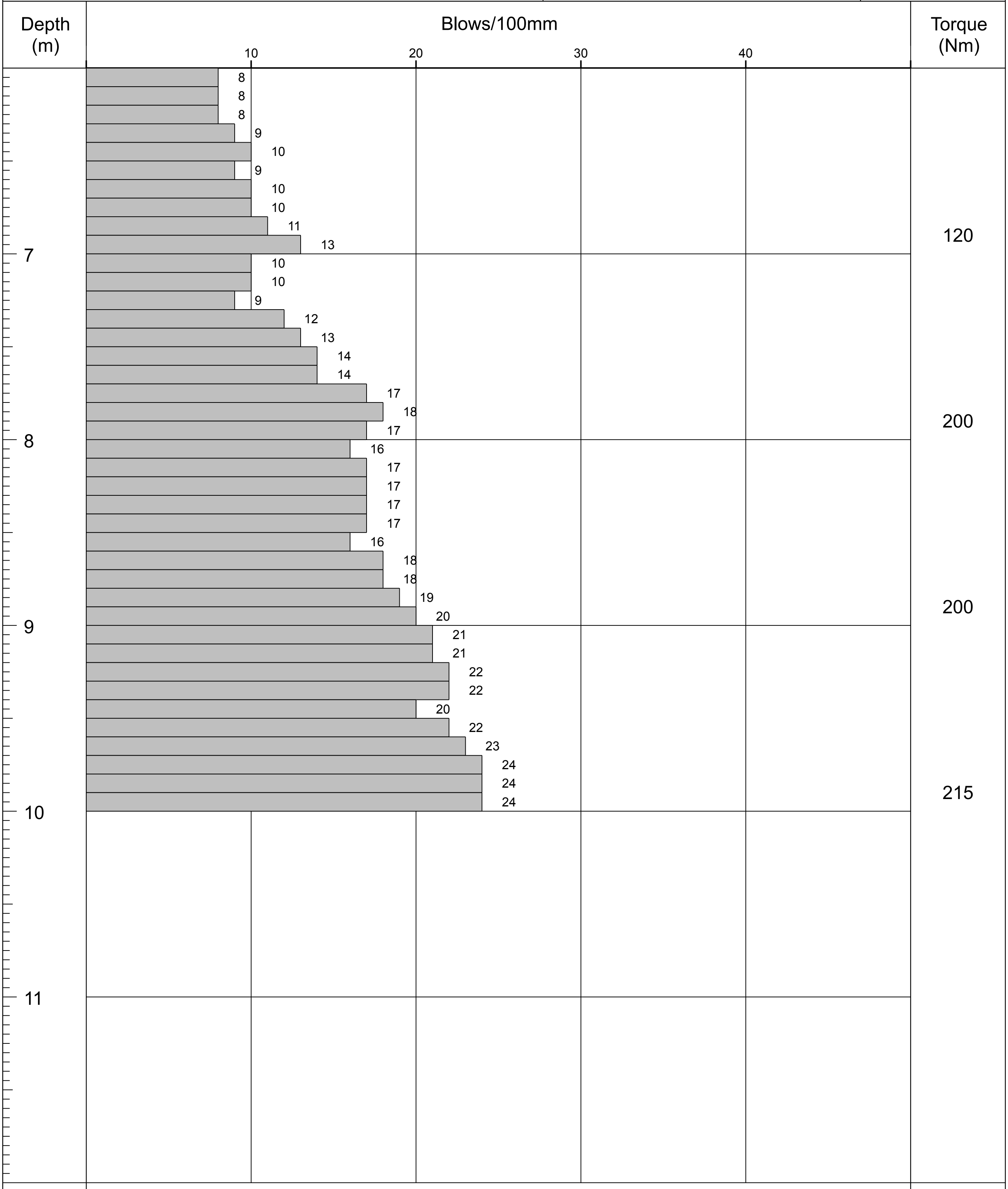
Remarks:
1. Pre-cored to 0.10mbgl

Fall Height 760	Cone Base Diameter
Hammer Wt 64	Final Depth 10.00
Probe Type DPSH-B	

endeavour drilling

Probe Log

Probe No	DP103	Sheet 2 of 2	
Project Name:	Pinner Wood School	Project No. J3091	Co-ords:
Hole Type	DP		
Location:	Pinner Wood School	Level:	
Scale	1:30		
Client:	Peter Brett Associates	Dates:	22/08/2016
Logged By	CG		



Remarks:
1. Pre-cored to 0.10mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

AGS

endeavour drilling

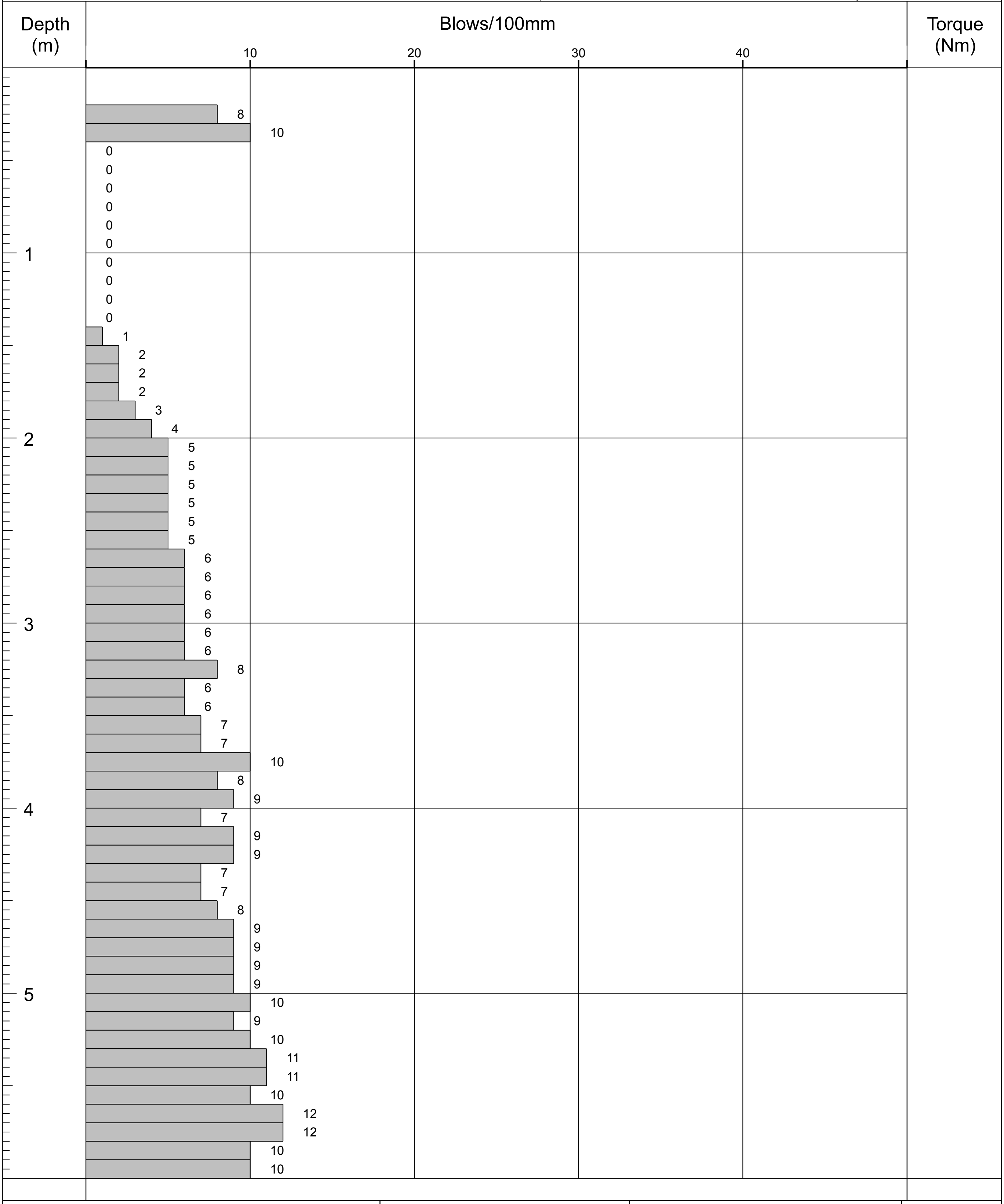
Probe Log

Probe No
DP104
Sheet 1 of 2

Project Name: Pinner Wood School
Project No. J3091
Co-ords:
Hole Type DP

Location: Pinner Wood School
Level:
Scale 1:30

Client: Peter Brett Associates
Dates: 22/08/2016
Logged By CG



Remarks:
1. Pre-cored to 0.20mbgl

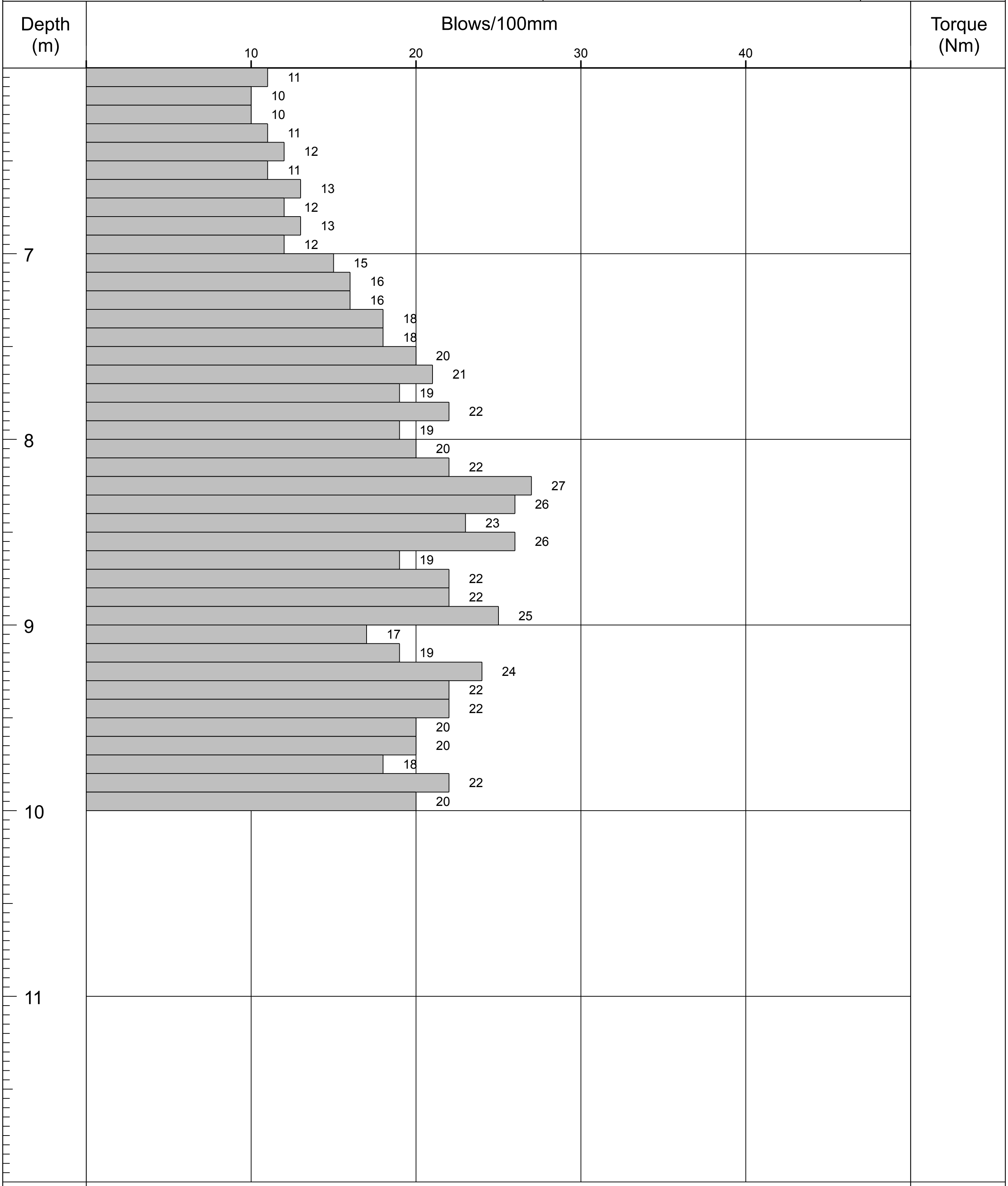
Fall Height 760
Hammer Wt 64
Probe Type DPSH-B
Cone Base Diameter
Final Depth 10.00

AGS

Probe Log

Probe No
DP104
Sheet 2 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 22/08/2016	Logged By CG



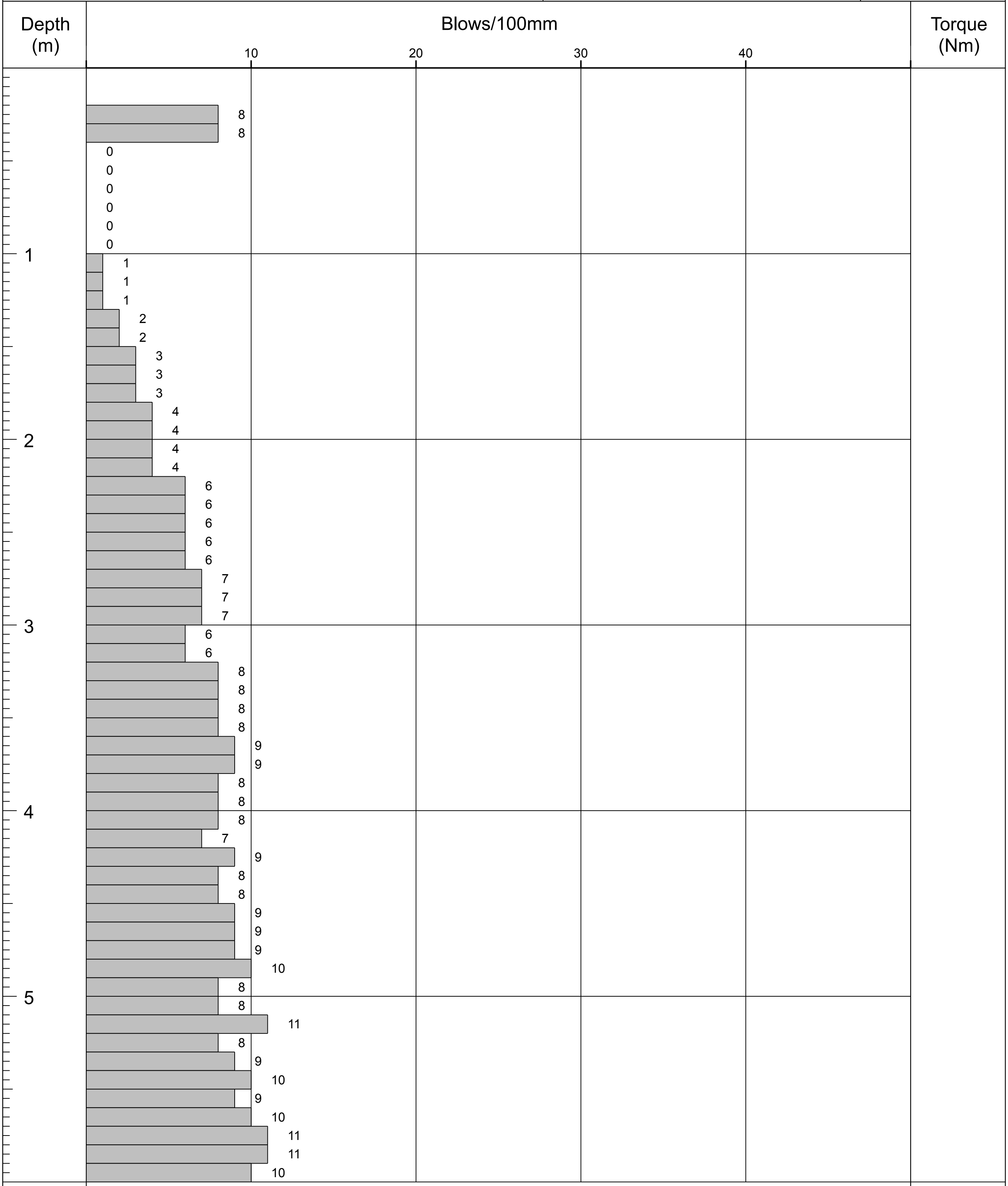
Remarks:
1. Pre-cored to 0.20mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

endeavour drilling

Probe Log

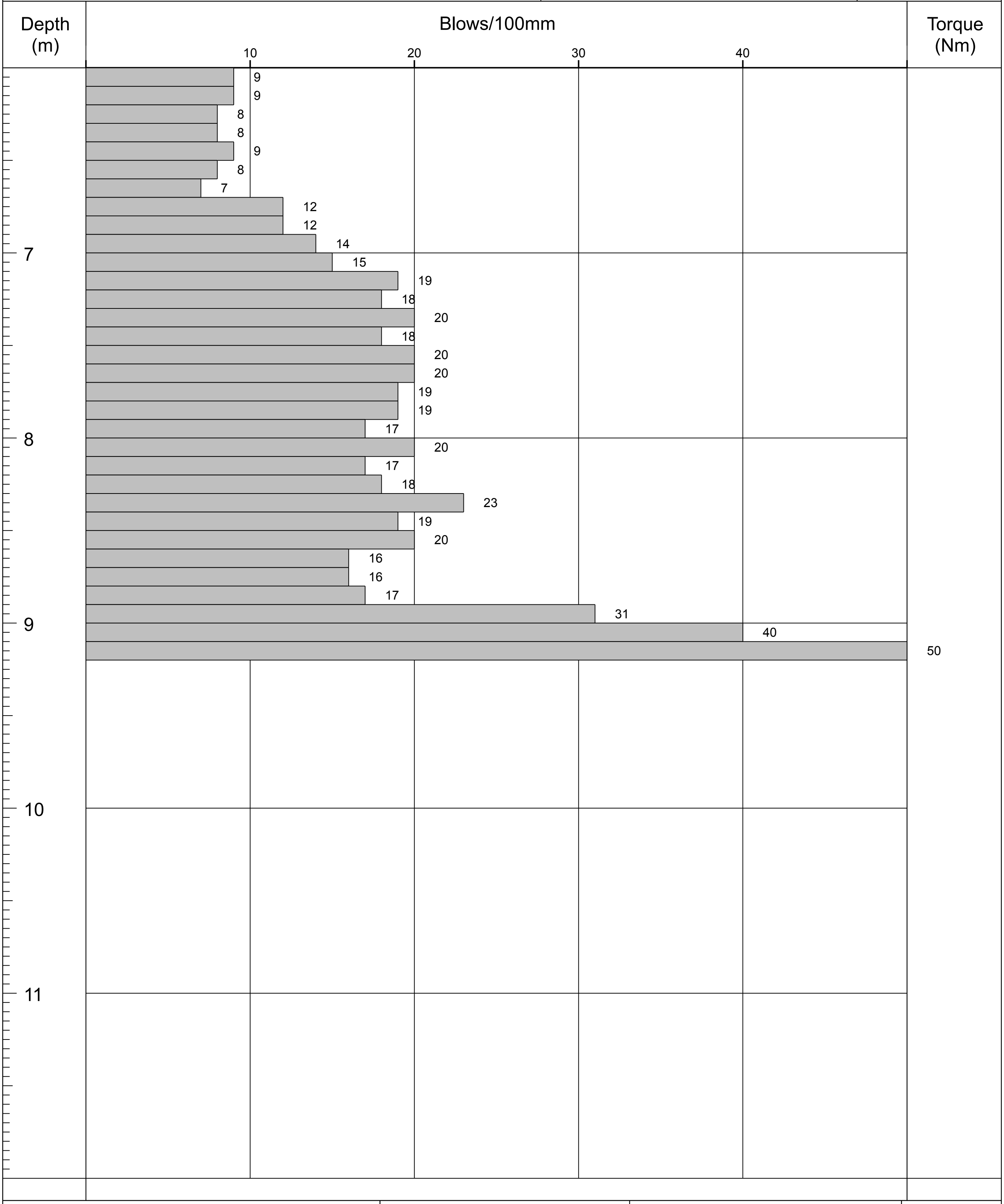
Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP105 Sheet 1 of 2
Location: Pinner Wood School		Level:	Hole Type DP Scale 1:30
Client: Peter Brett Associates		Dates: 22/08/2016	Logged By CG



Remarks: 1. Pre-cored to 0.20mbgl	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 9.20
	Probe Type DPSH-B	

AGS

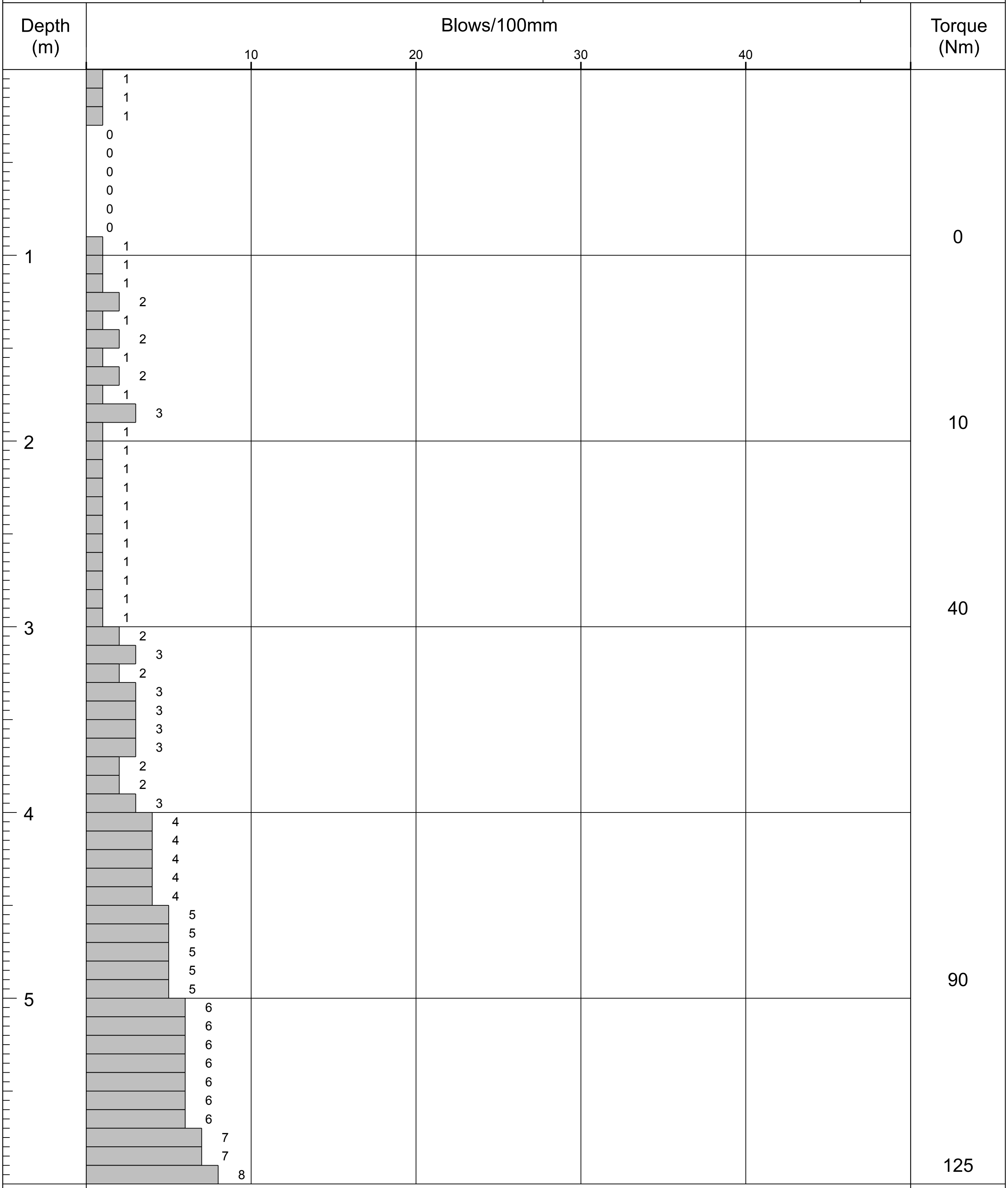
endeavour drilling	# Probe Log		Probe No DP105 Sheet 2 of 2
Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 22/08/2016	Logged By CG



Remarks: 1. Pre-cored to 0.20mbgl	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 9.20
	Probe Type DPSH-B	

Probe Log

endeavour drilling				Probe No DP106 Sheet 1 of 2
Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 22/08/2016	Logged By CG



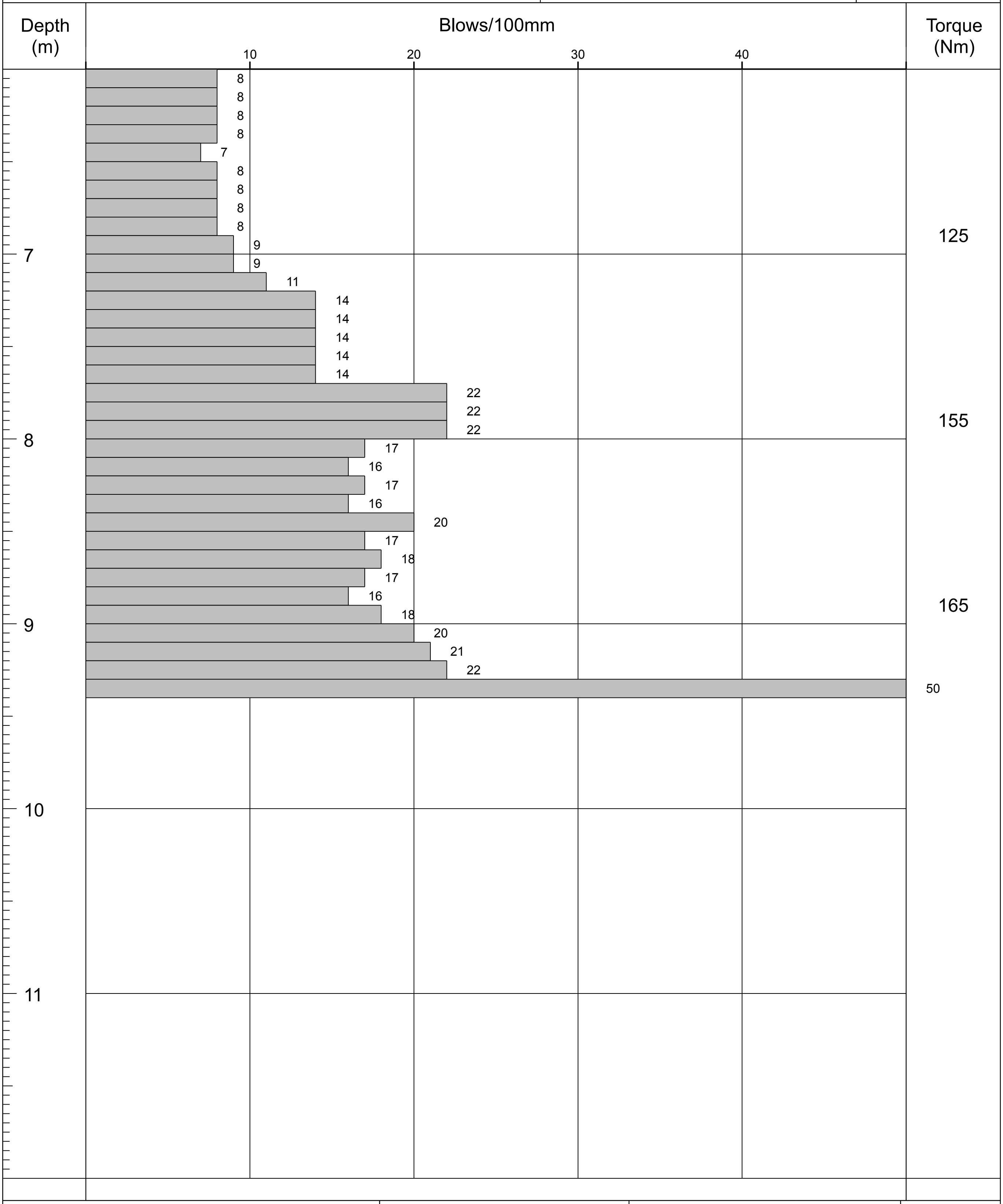
Remarks:	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 9.40
	Probe Type DPSH-B	

endeavour drilling

Probe Log

Probe No
DP106
Sheet 2 of 2

Project Name: Pinner Wood School
Project No. J3091
Co-ords:
Hole Type DP
Location: Pinner Wood School
Level:
Scale 1:30
Client: Peter Brett Associates
Dates: 22/08/2016
Logged By CG



Remarks:

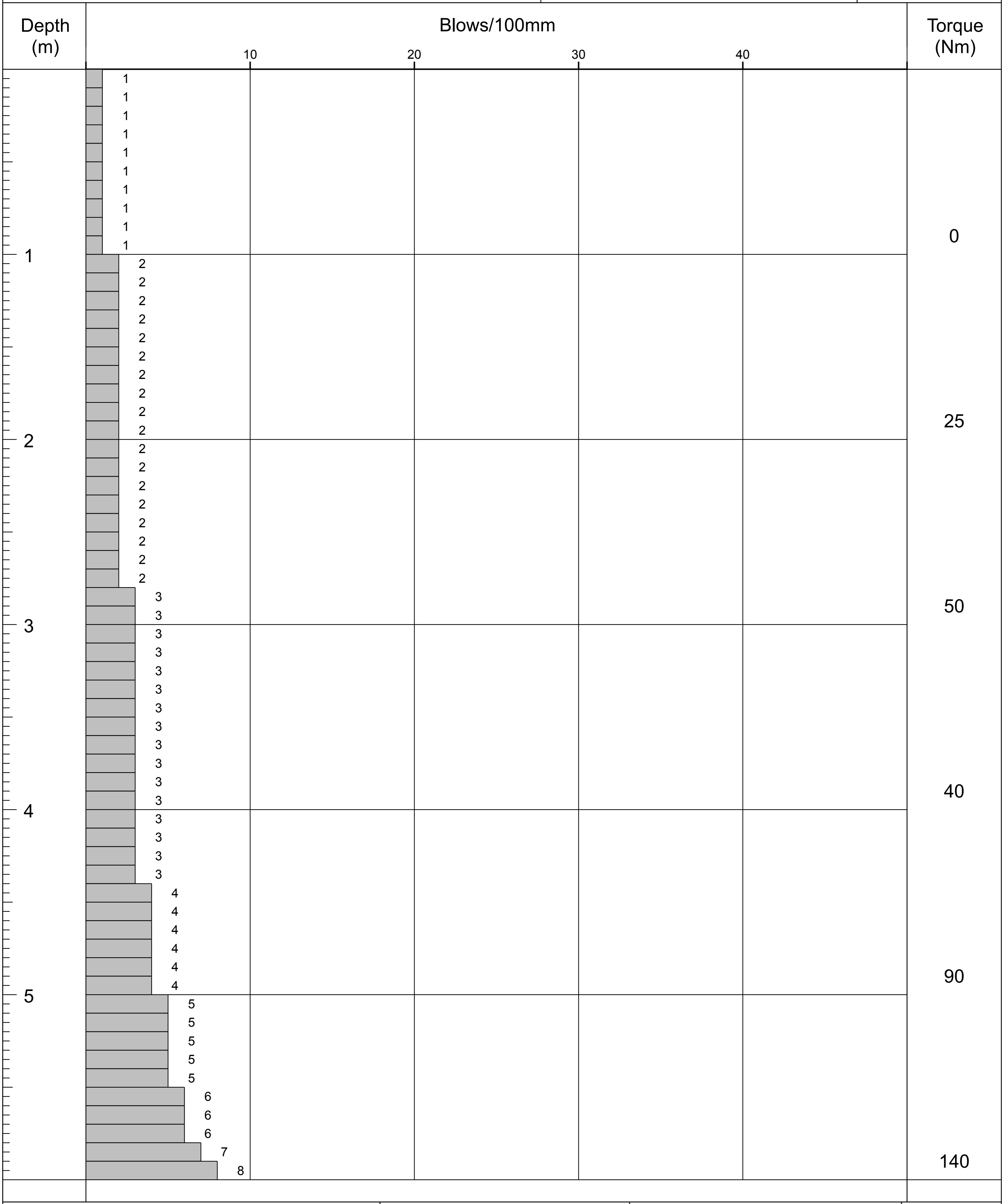
Fall Height 760
Hammer Wt 64
Probe Type DPSH-B
Cone Base Diameter
Final Depth 9.40

AGS

Probe Log

Probe No
DP107
Sheet 1 of 2

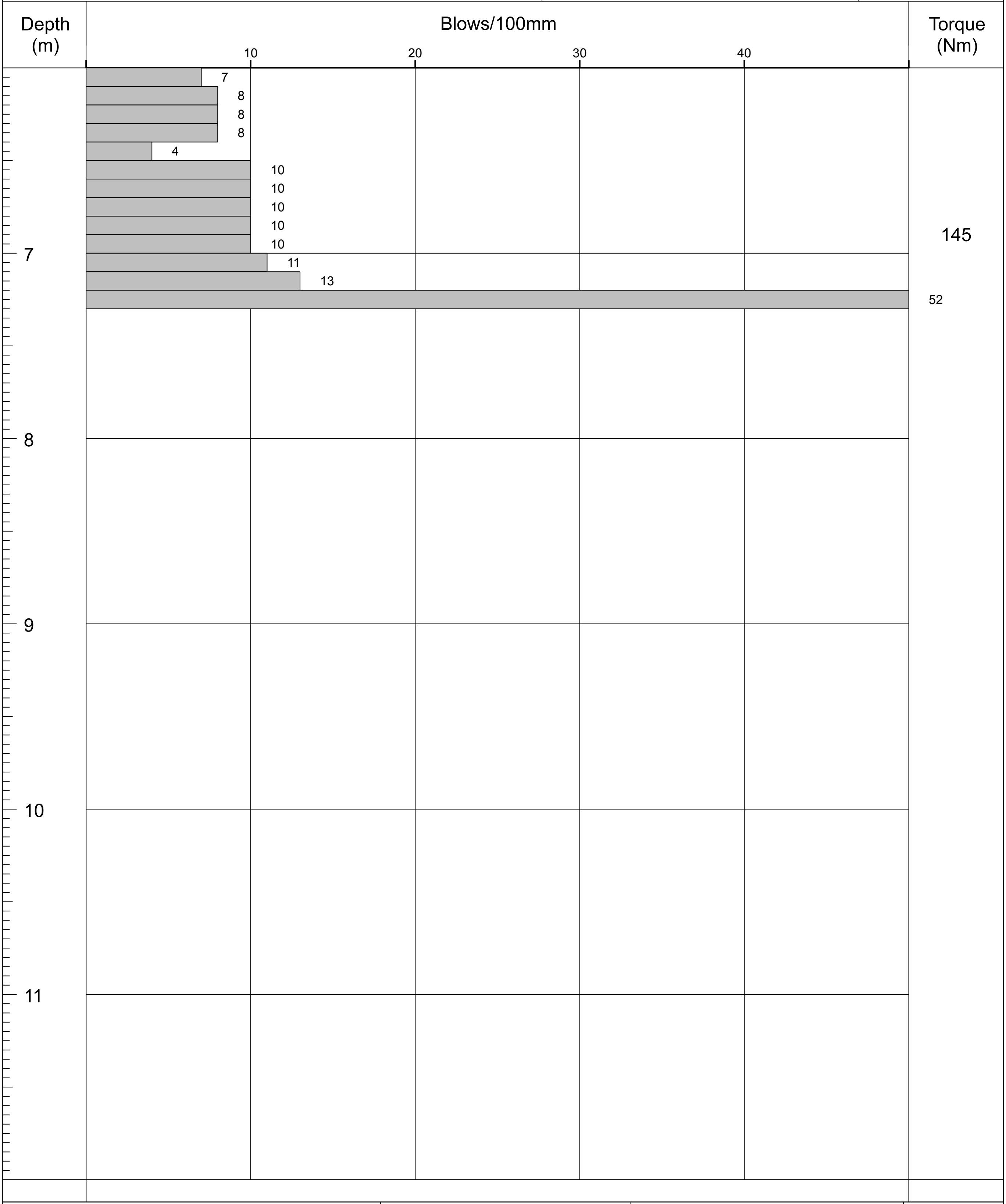
Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 16/08/2016	Logged By CG



Remarks:	
Fall Height 760	Cone Base Diameter
Hammer Wt 64	Final Depth 7.30
Probe Type DPSH-B	

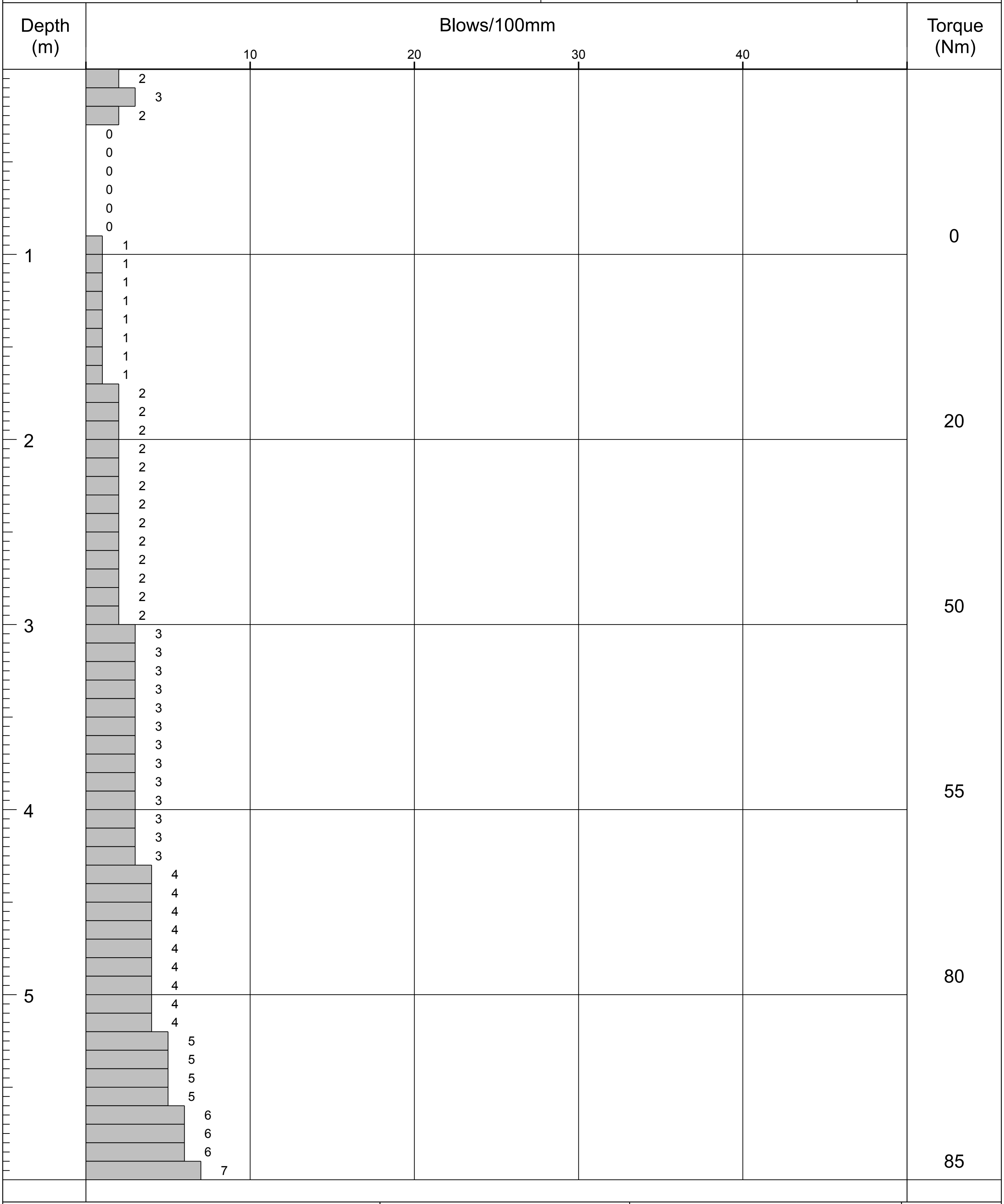
Probe Log

Probe No	DP107	Sheet 2 of 2	
Project Name:	Pinner Wood School	Project No. J3091	Co-ords:
Hole Type	DP		
Location:	Pinner Wood School	Level:	
Scale	1:30		
Client:	Peter Brett Associates	Dates:	16/08/2016
Logged By	CG		



Remarks:	Fall Height 760	Cone Base Diameter	
	Hammer Wt 64	Final Depth	7.30
	Probe Type DPSH-B		

endeavour drilling	# Probe Log		Probe No DP108 Sheet 1 of 2
Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 16/08/2016	Logged By CG



Remarks:	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 10.00
	Probe Type DPSH-B	

Probe Log

Probe No
DP108
Sheet 2 of 2

Project Name: Pinner Wood School

Project No. J3091

Co-ords:

Hole Type DP

Location: Pinner Wood School

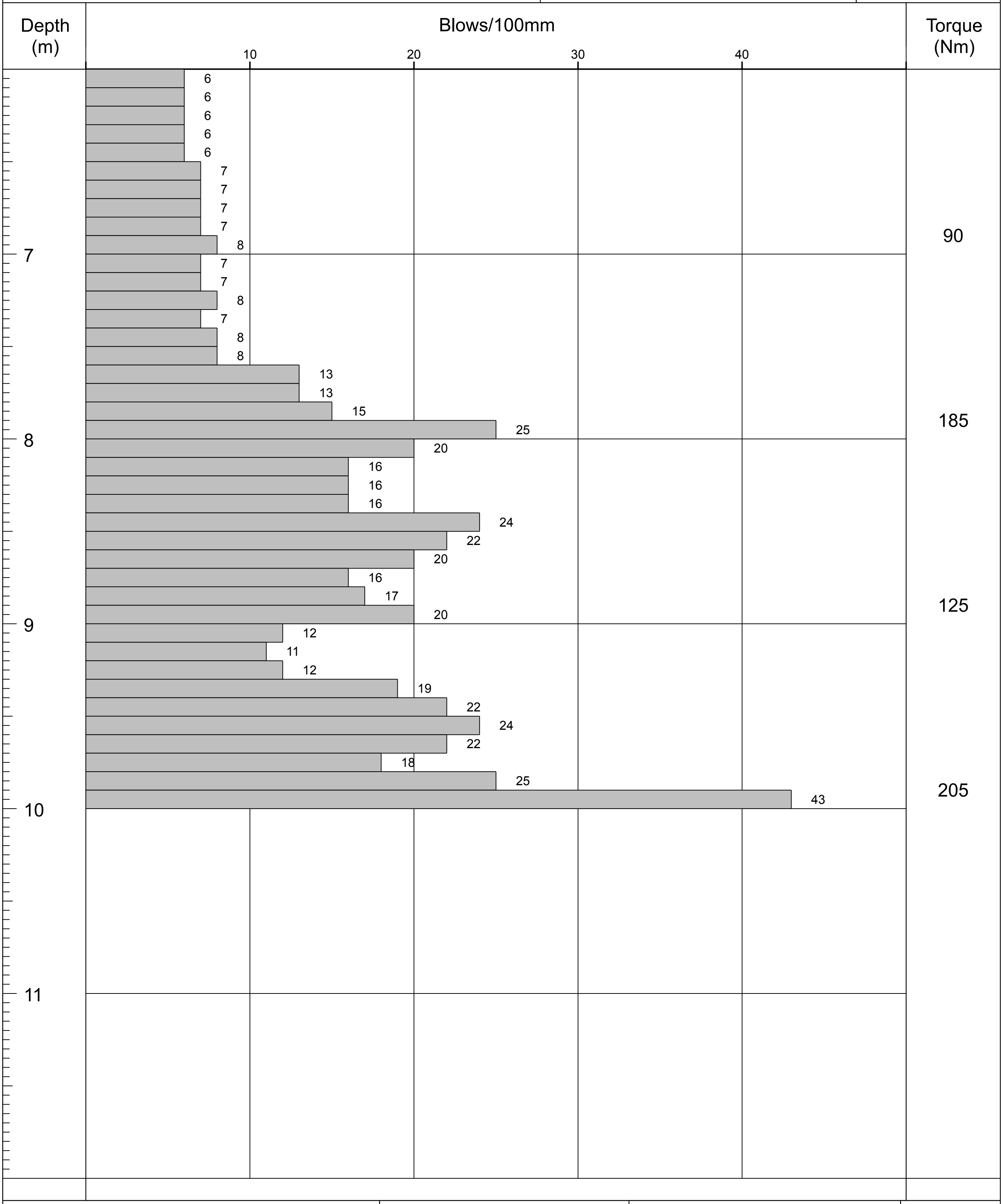
Level:

Scale 1:30

Client: Peter Brett Associates

Dates: 16/08/2016

Logged By CG



Remarks:

Fall Height 760

Hammer Wt 64

Probe Type DPSH-B

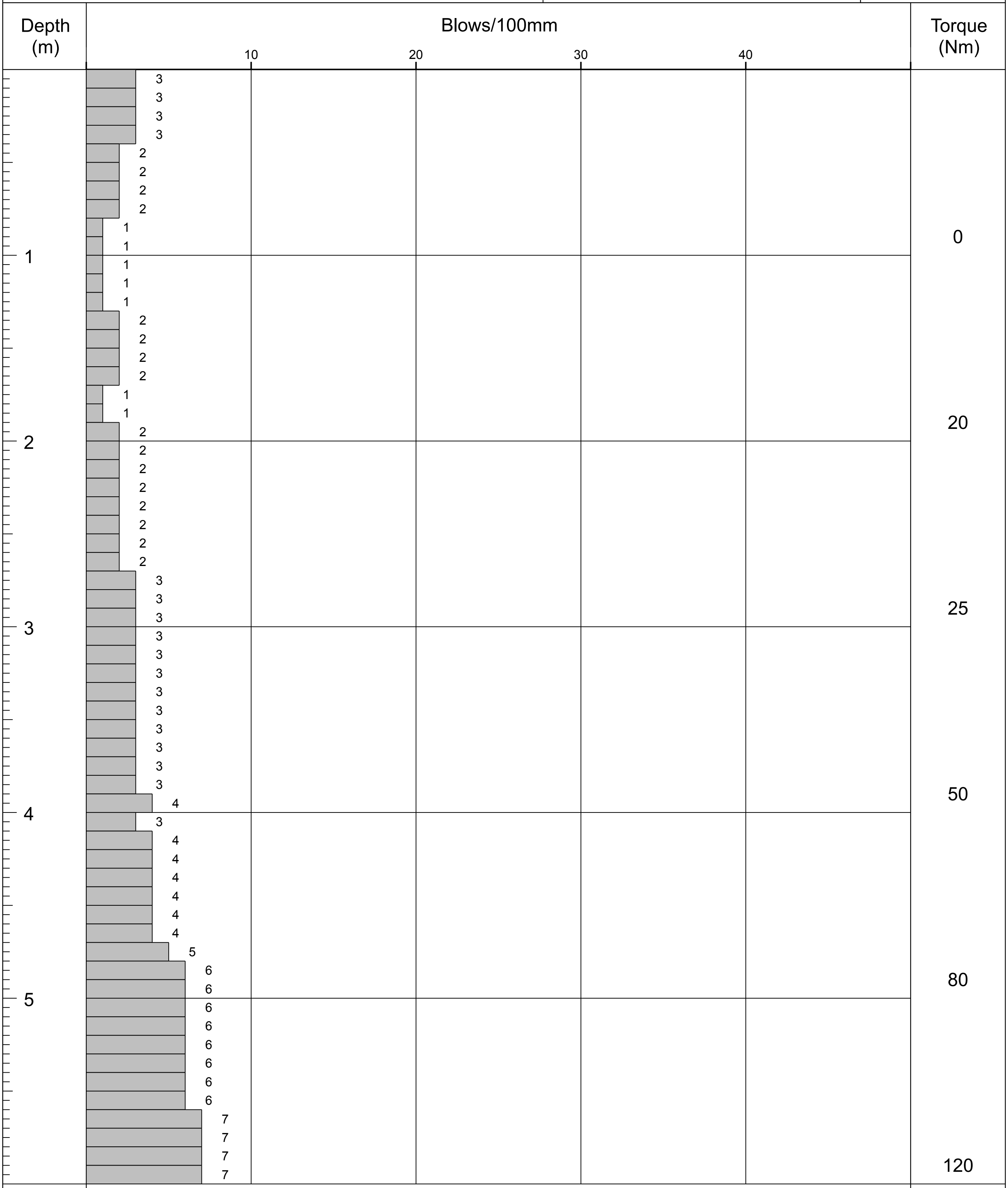
Cone Base Diameter

Final Depth 10.00

AGS

Probe Log

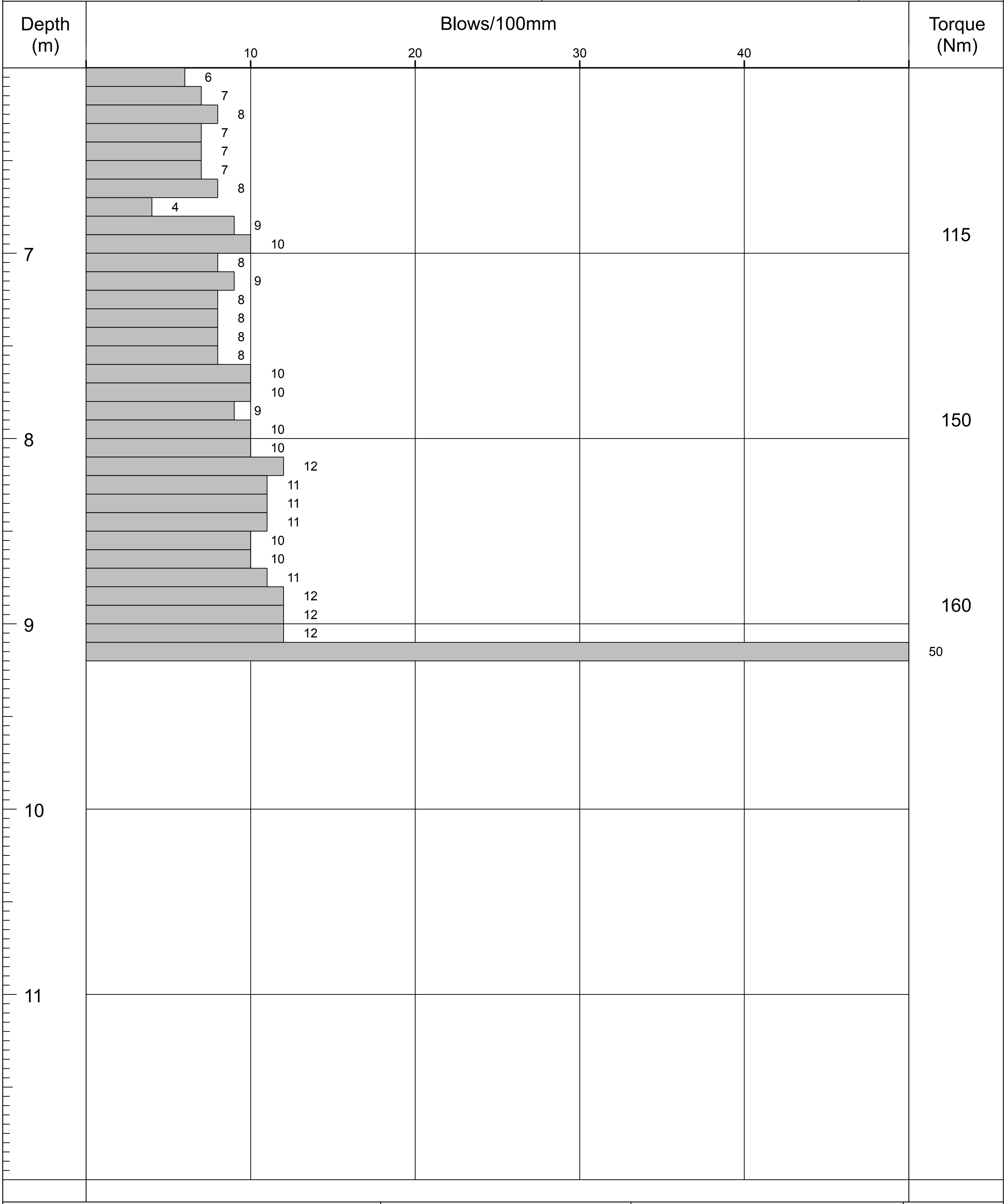
endeavour drilling	Probe Log		Probe No DP109 Sheet 1 of 2
Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 16/08/2016	Logged By CG



Remarks:	Fall Height 760	Cone Base Diameter	AGS
	Hammer Wt 64	Final Depth 9.20	
	Probe Type DPSH-B		

Probe Log

Probe No	DP109	Sheet 2 of 2	
Project Name:	Pinner Wood School	Project No. J3091	Co-ords:
Hole Type	DP		
Location:	Pinner Wood School	Level:	
Scale	1:30		
Client:	Peter Brett Associates	Dates:	16/08/2016
Logged By	CG		

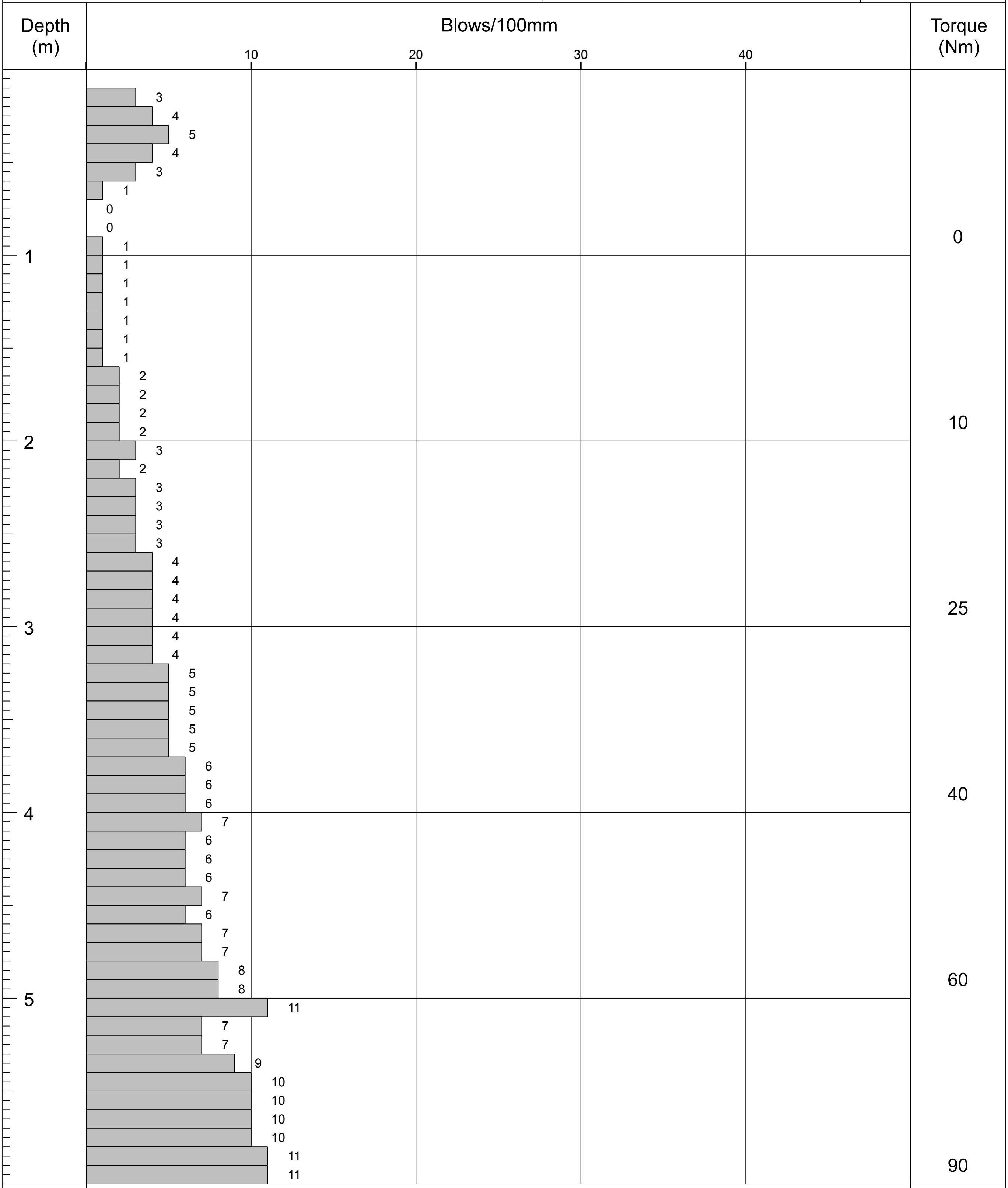


Remarks:	Fall Height 760	Cone Base Diameter	
	Hammer Wt 64	Final Depth	9.20
	Probe Type DPSH-B		

endeavour drilling

Probe Log

Probe No DP110 Sheet 1 of 2			
Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 22/08/2016	Logged By CG



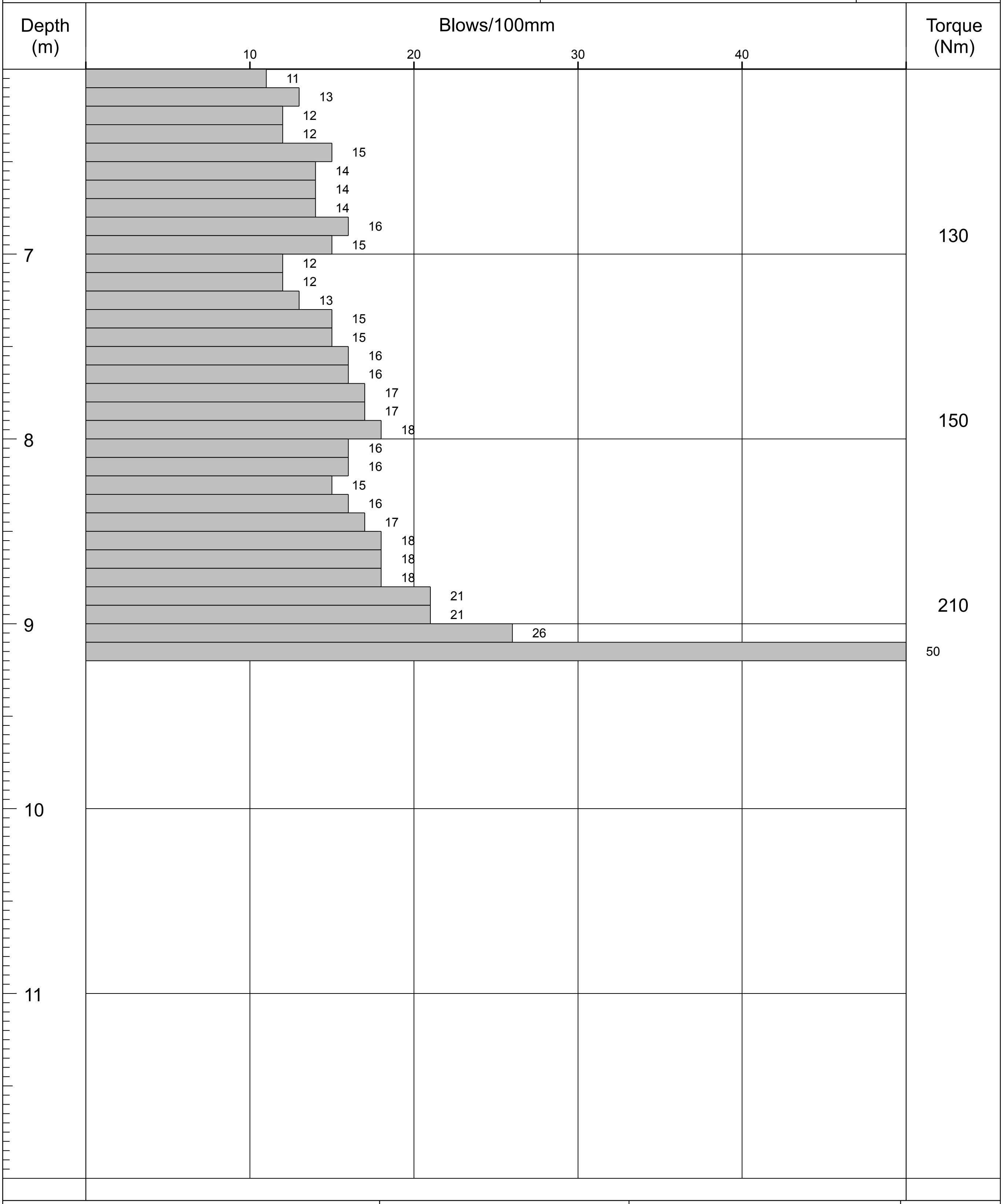
Remarks:
1. Pre-cored to 0.10mbgl

Fall Height 760	Cone Base Diameter
Hammer Wt 64	Final Depth 9.20
Probe Type DPSH-B	

AGS

Probe Log

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP110 Sheet 2 of 2
Location: Pinner Wood School		Level:	Hole Type DP
			Scale 1:30
Client: Peter Brett Associates		Dates: 22/08/2016	Logged By CG



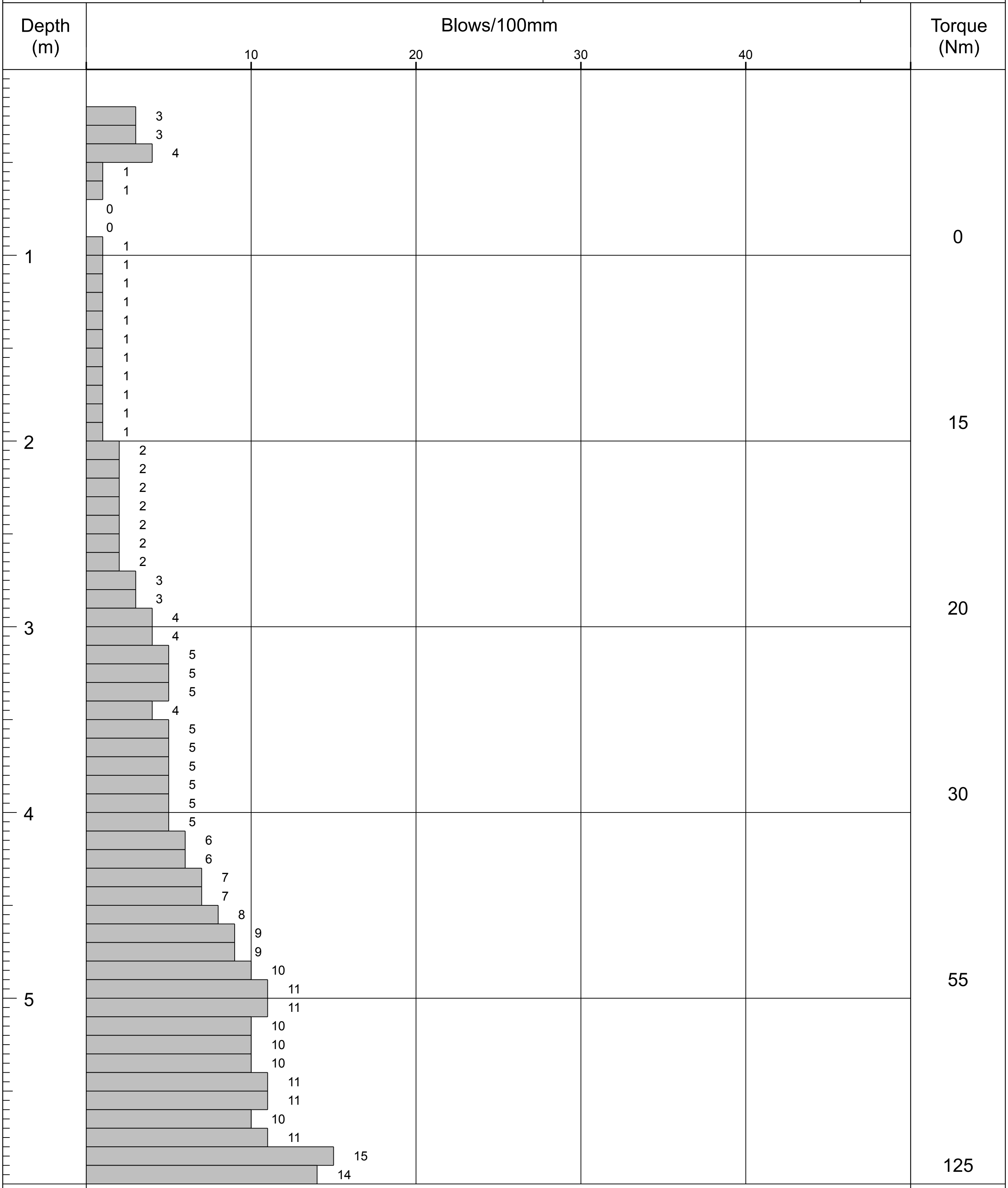
Remarks:
1. Pre-cored to 0.10mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	9.20
Probe Type	DPSH-B		

Probe Log

Probe No
DP111
Sheet 1 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:		Hole Type DP
Location:	Pinner Wood School		Level:		Scale 1:30
Client:	Peter Brett Associates		Dates:	22/08/2016	Logged By CG

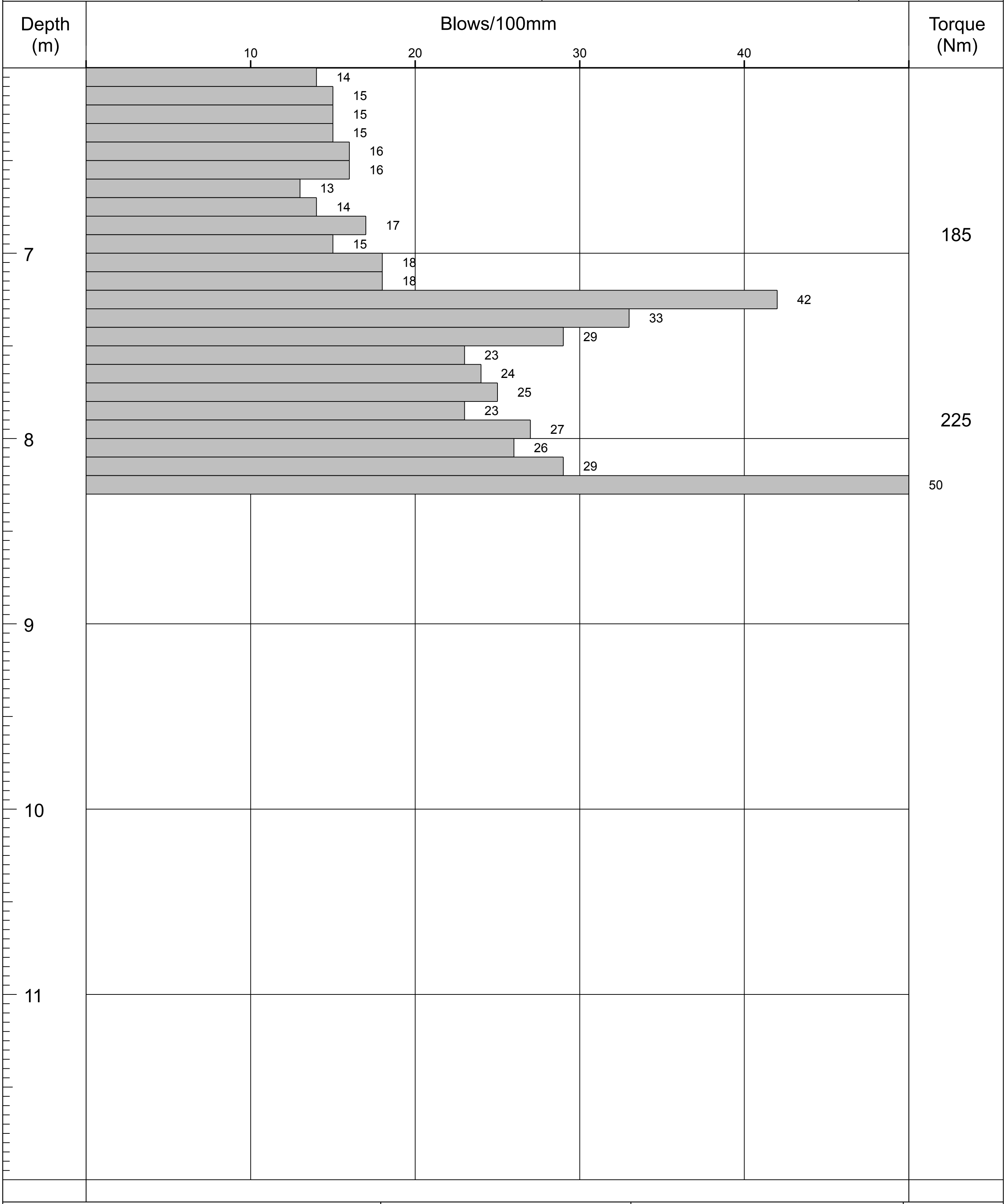


Remarks:
1. Pre-cored to 0.20mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	8.30
Probe Type	DPSH-B		

Probe Log

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP111 Sheet 2 of 2
Location: Pinner Wood School		Level:	Hole Type DP
			Scale 1:30
Client: Peter Brett Associates		Dates: 22/08/2016	Logged By CG



Remarks:
1. Pre-cored to 0.20mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	8.30
Probe Type	DPSH-B		

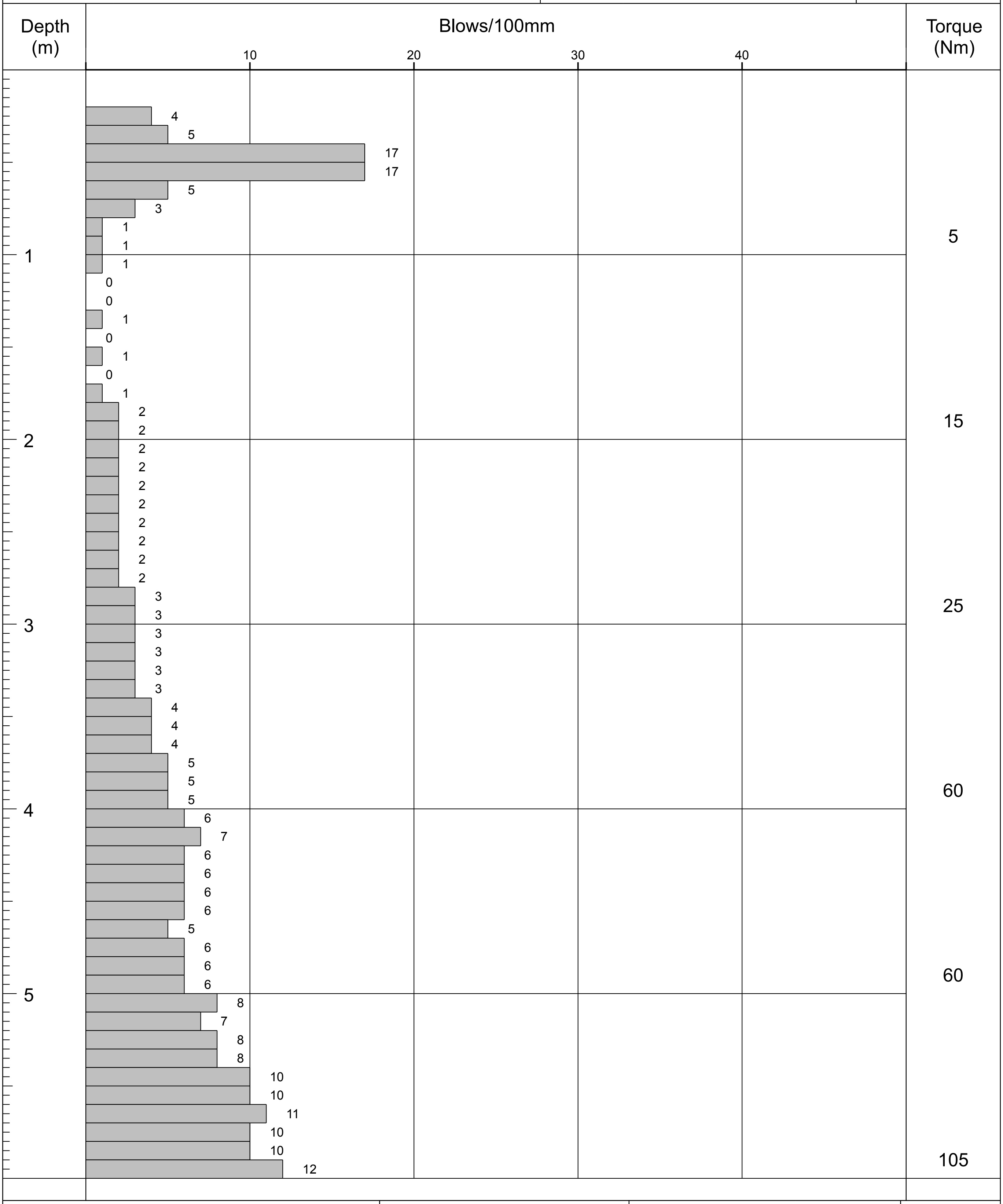
AGS

endeavour drilling

Probe Log

Probe No
DP112
Sheet 1 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:		Hole Type DP
Location: Pinner Wood School		Level:		Scale 1:30
Client: Peter Brett Associates		Dates: 22/08/2016		Logged By CG



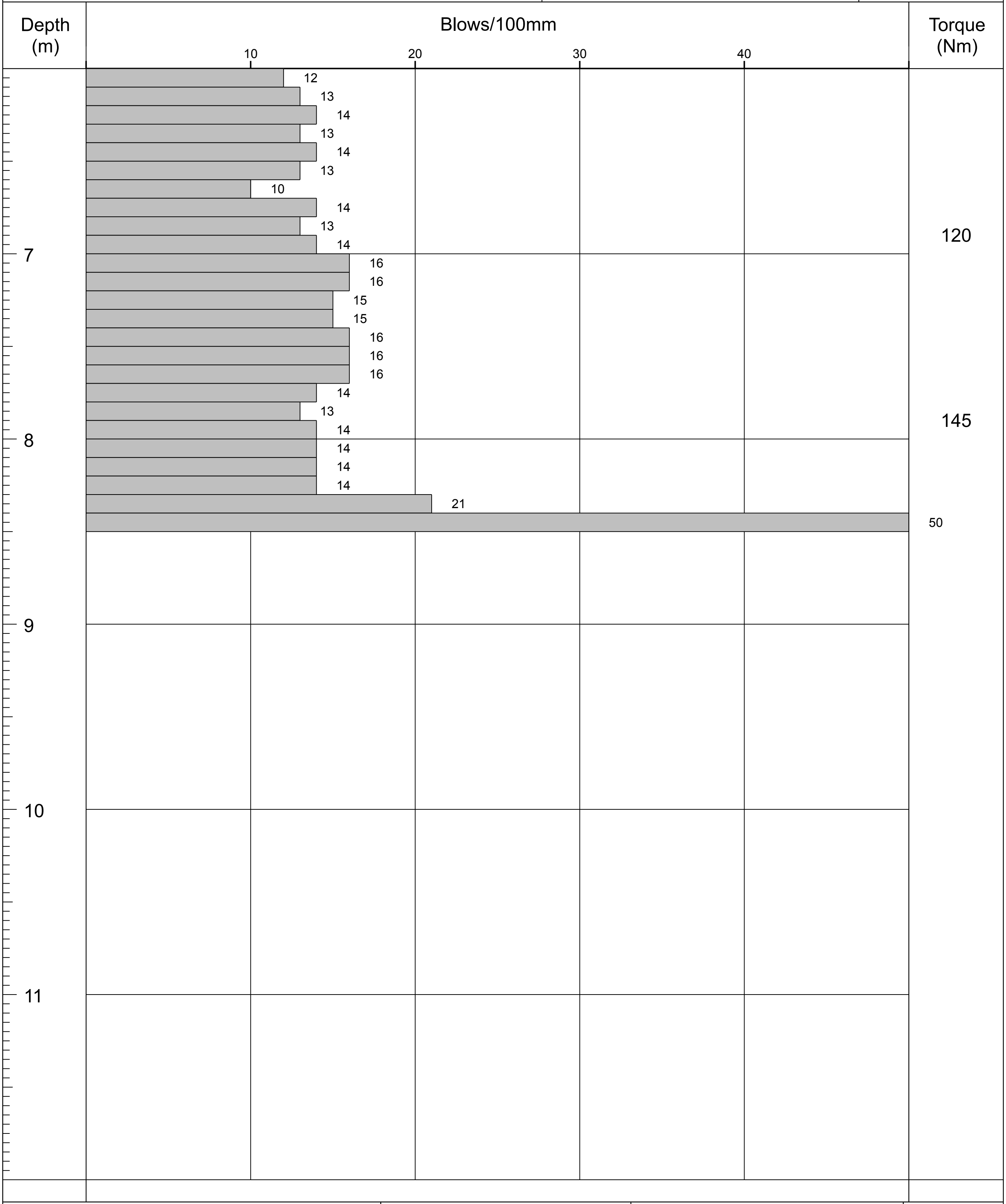
Remarks:
1. Pre-cored to 0.20mbgl

Fall Height 760	Cone Base Diameter
Hammer Wt 64	Final Depth 8.50
Probe Type DPSH-B	

Probe Log

Probe No
DP112
Sheet 2 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:		Hole Type DP
Location: Pinner Wood School		Level:		Scale 1:30
Client: Peter Brett Associates		Dates: 22/08/2016		Logged By CG

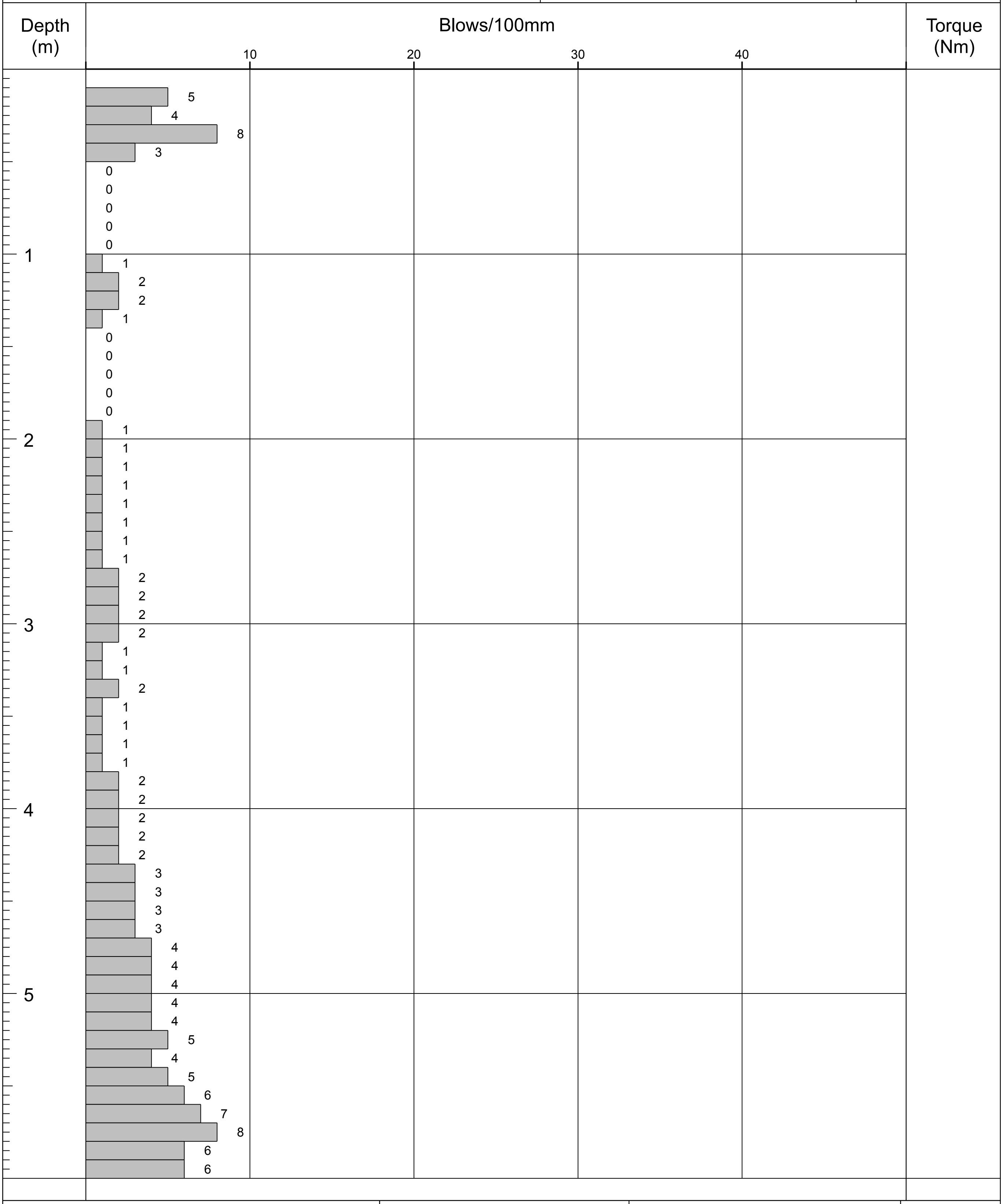


Remarks:
1. Pre-cored to 0.20mbgl

Fall Height 760
Hammer Wt 64
Probe Type DPSH-B
Cone Base Diameter
Final Depth 8.50

endeavour drilling	# Probe Log	Probe No DP113 Sheet 1 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 22/08/2016	Logged By CG

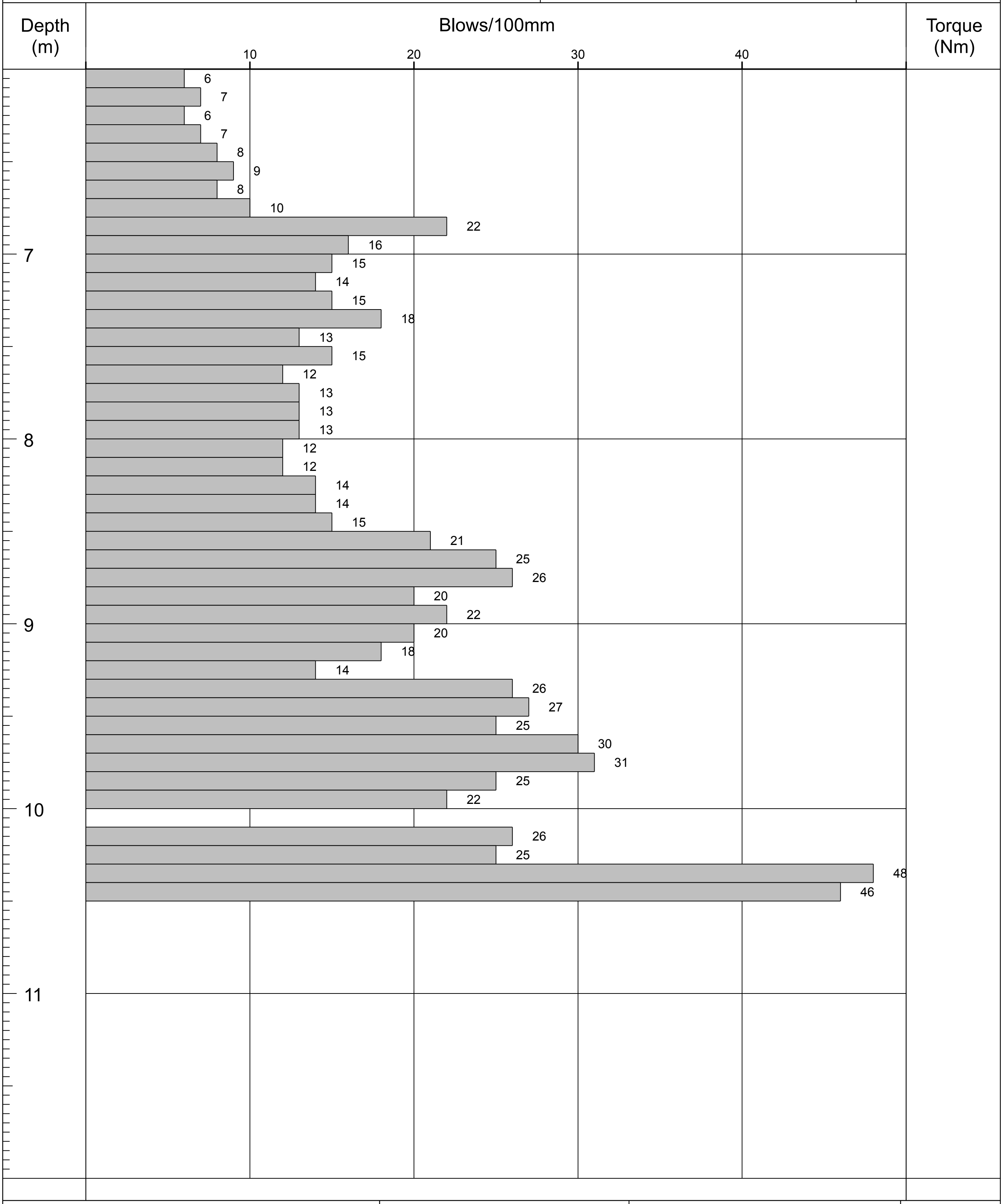


Remarks: 1. Pre-cored to 0.10mbgl	Fall Height 760	Cone Base Diameter	AGS
	Hammer Wt 64	Final Depth 10.50	
	Probe Type DPSH-B		

endeavour drilling

Probe Log

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP113 Sheet 2 of 2
Location: Pinner Wood School		Level:	Hole Type DP Scale 1:30
Client: Peter Brett Associates		Dates: 22/08/2016	Logged By CG

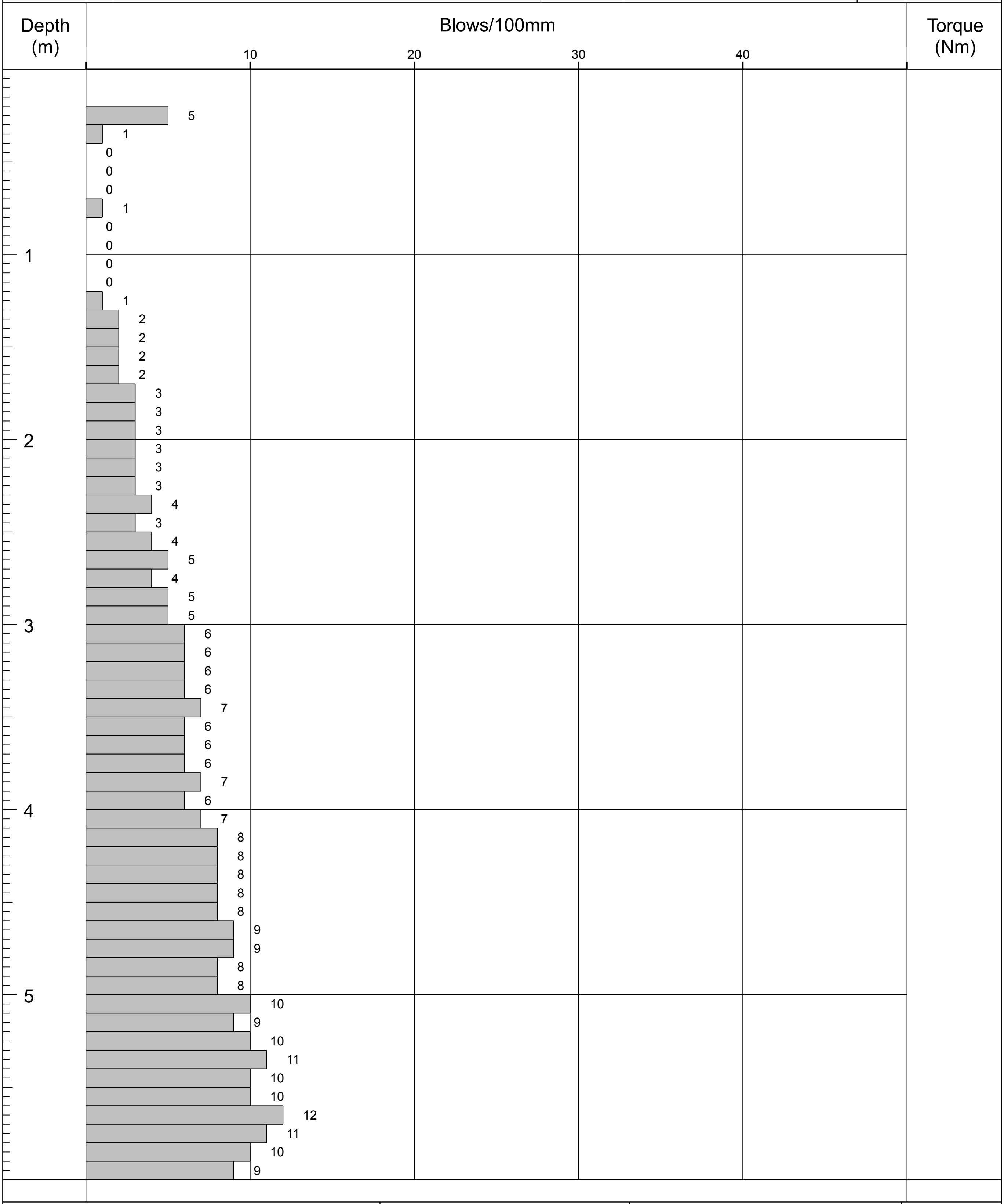


Remarks:
1. Pre-cored to 0.10mbgl

Fall Height 760	Cone Base Diameter
Hammer Wt 64	Final Depth 10.50
Probe Type DPSH-B	

Probe Log

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP114 Sheet 1 of 2
Location: Pinner Wood School		Level:	Hole Type DP Scale 1:30
Client: Peter Brett Associates		Dates: 22/08/2016	Logged By CG

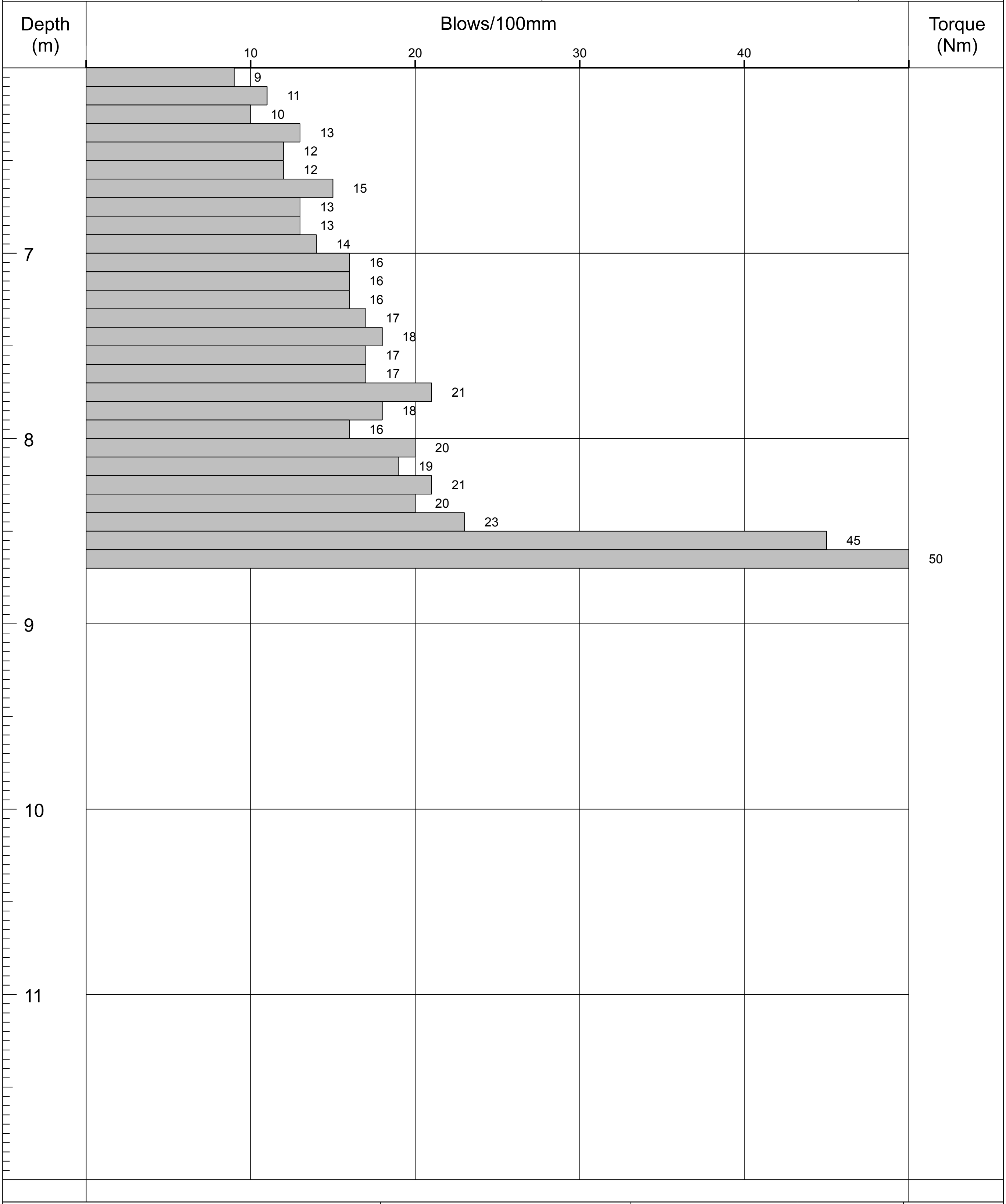


Remarks:
1. Pre-cored to 0.20mbgl

Fall Height 760	Cone Base Diameter
Hammer Wt 64	Final Depth 8.70
Probe Type DPSH-B	

endeavour drilling	# Probe Log	Probe No DP114 Sheet 2 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:		Hole Type DP
Location: Pinner Wood School		Level:		Scale 1:30
Client: Peter Brett Associates		Dates: 22/08/2016		Logged By CG



Remarks:
1. Pre-cored to 0.20mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	8.70
Probe Type	DPSH-B		

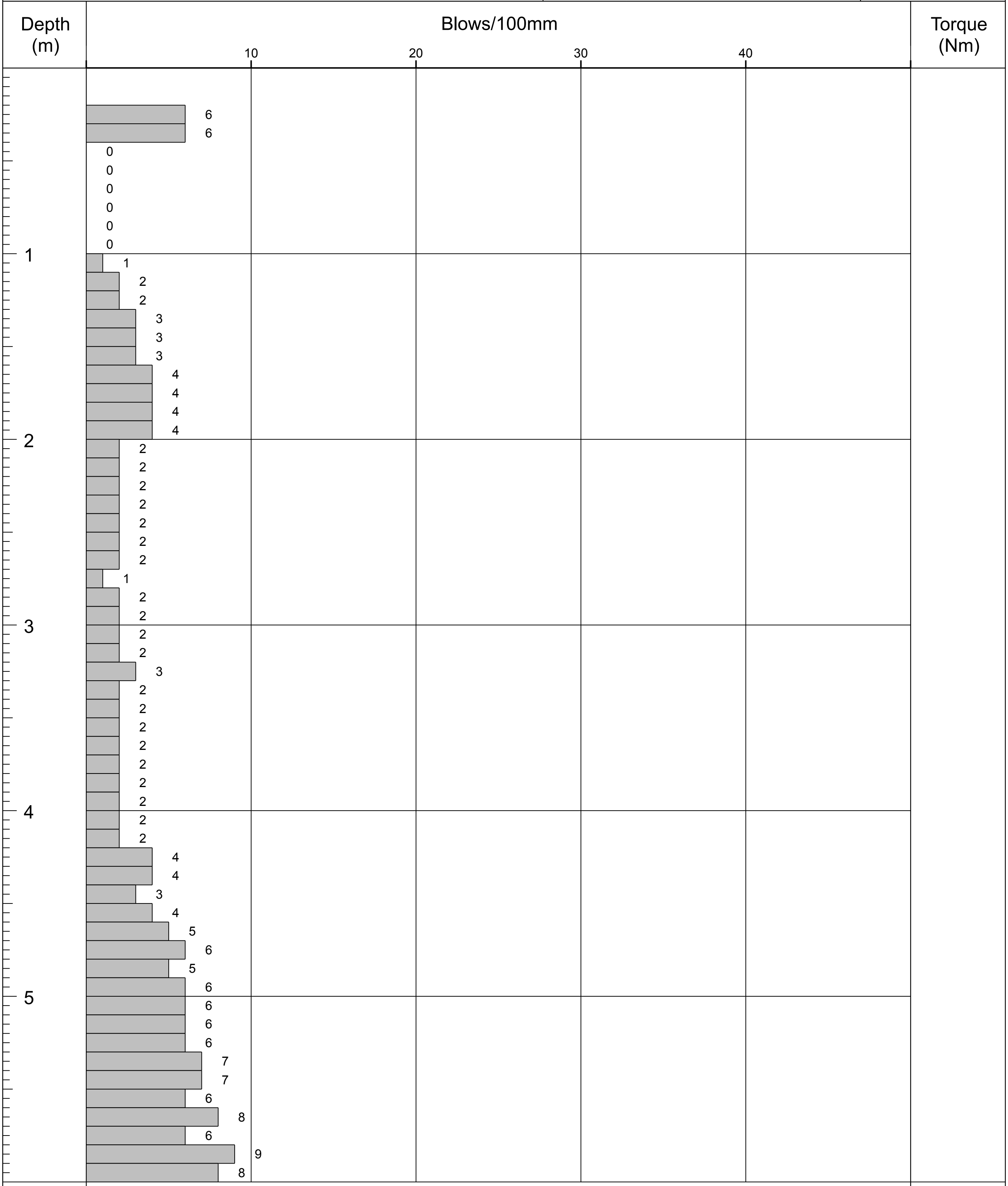
AGS

endeavour drilling

Probe Log

Probe No
DP115
Sheet 1 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 22/08/2016	Logged By CG



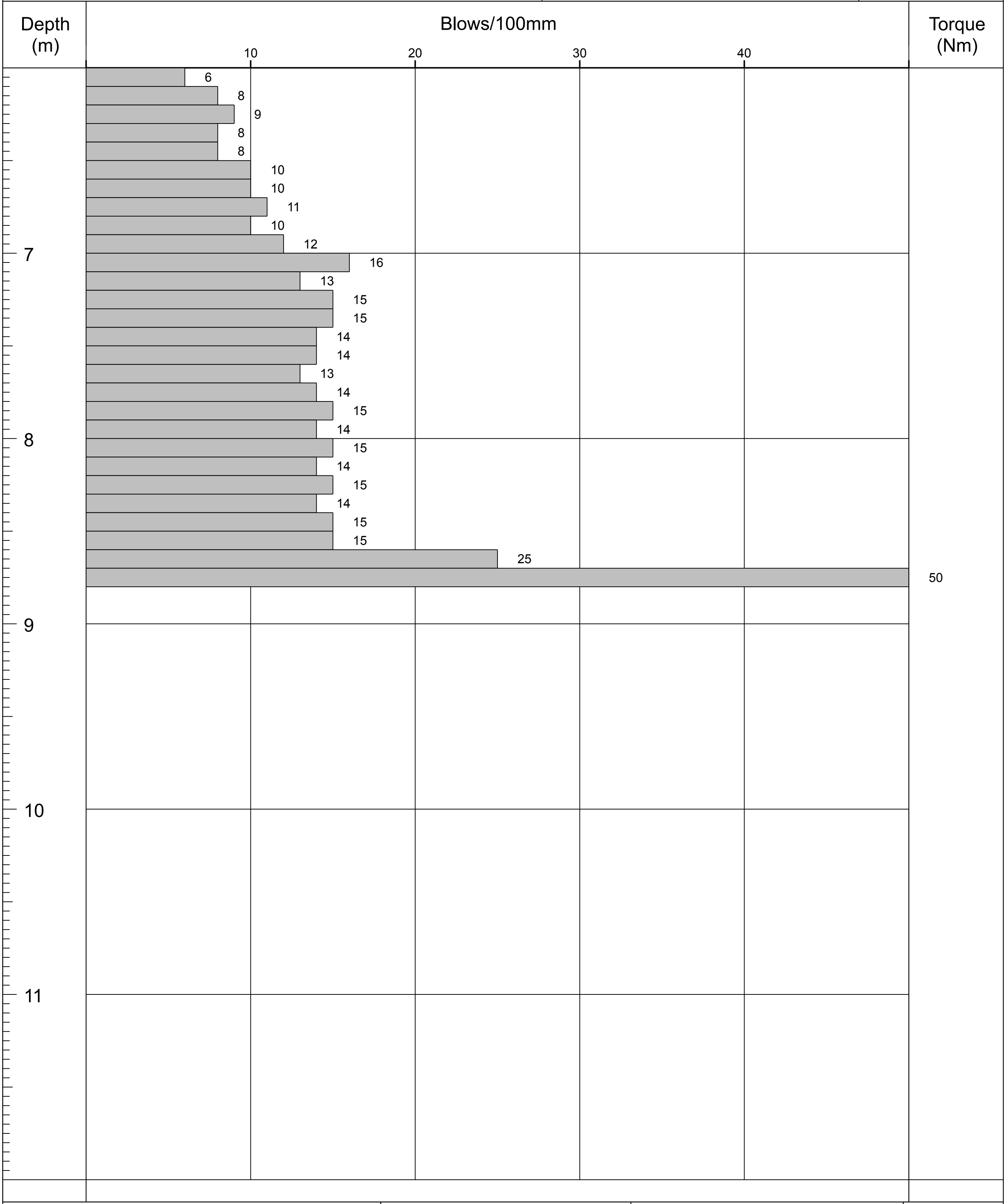
Remarks:
1. Pre-cored to 0.20mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	8.80
Probe Type	DPSH-B		

AGS

Probe Log

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP115 Sheet 2 of 2
				Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 22/08/2016	Logged By CG

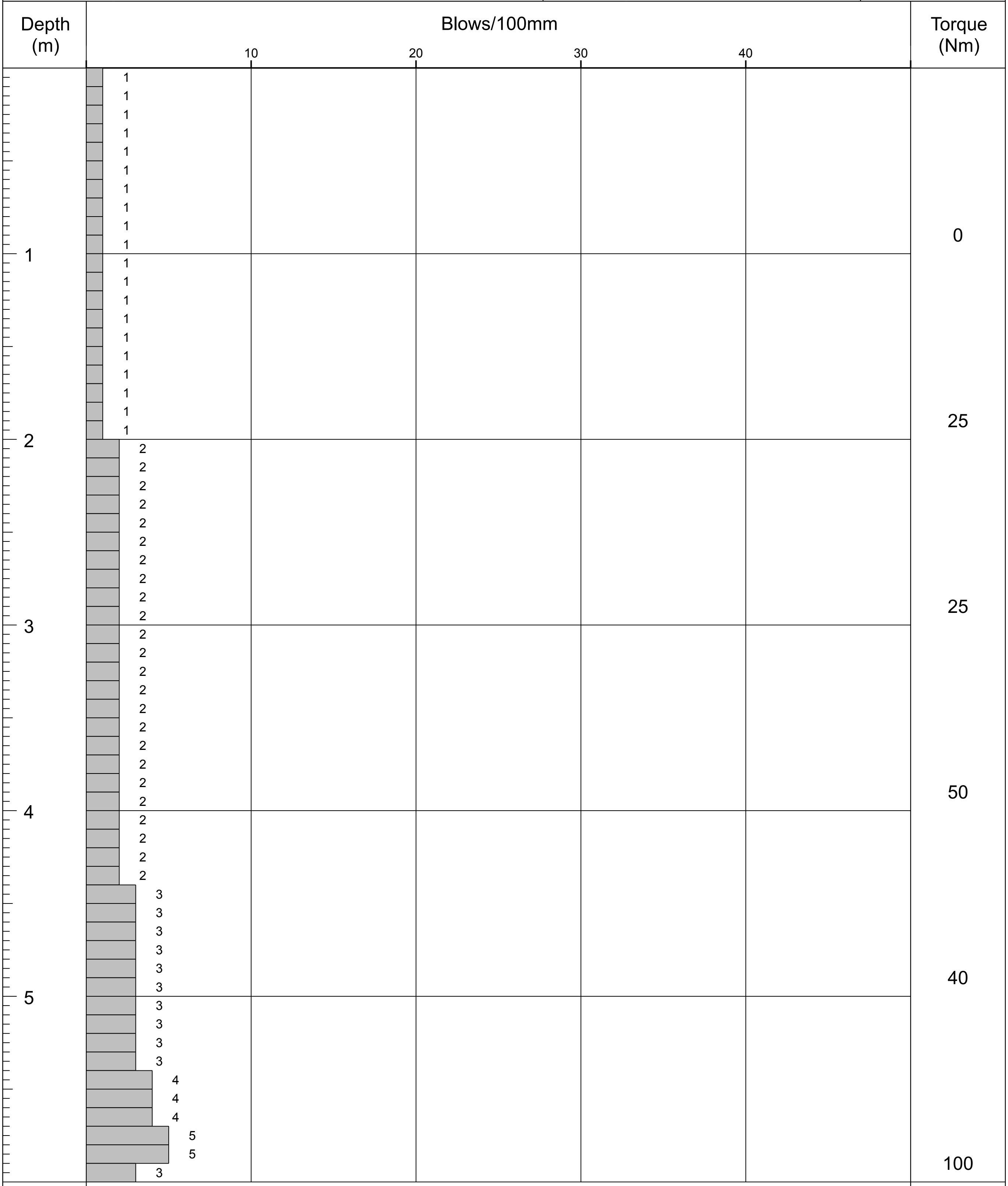


Remarks:
1. Pre-cored to 0.20mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	8.80
Probe Type	DPSH-B		

Probe Log

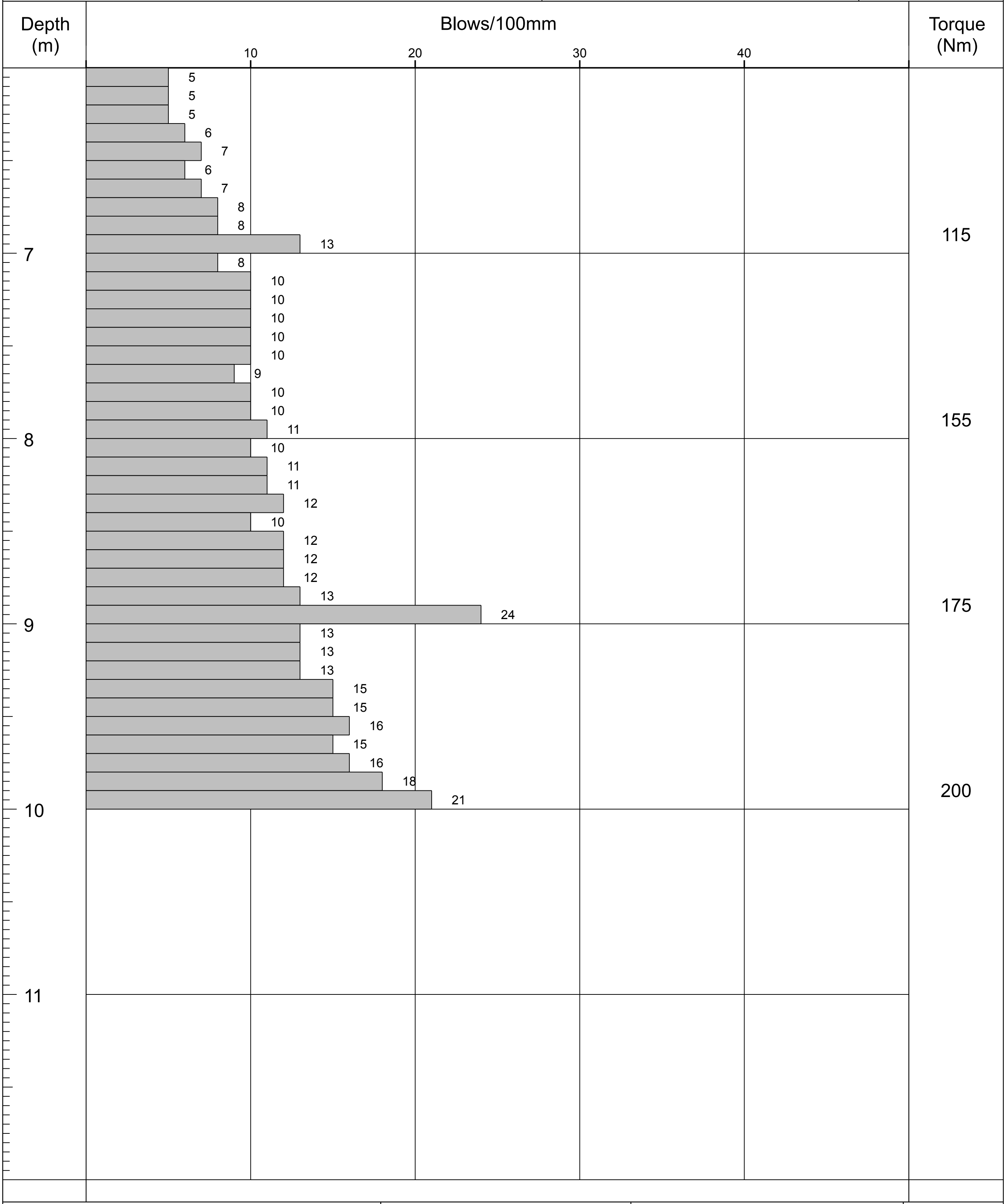
Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP116 Sheet 1 of 2
Location: Pinner Wood School		Level:	Hole Type DP
			Scale 1:30
Client: Peter Brett Associates		Dates: 19/08/2016	Logged By CG



Remarks:	Fall Height 760	Cone Base Diameter	
	Hammer Wt 64	Final Depth	10.00
	Probe Type DPSH-B		

Probe Log

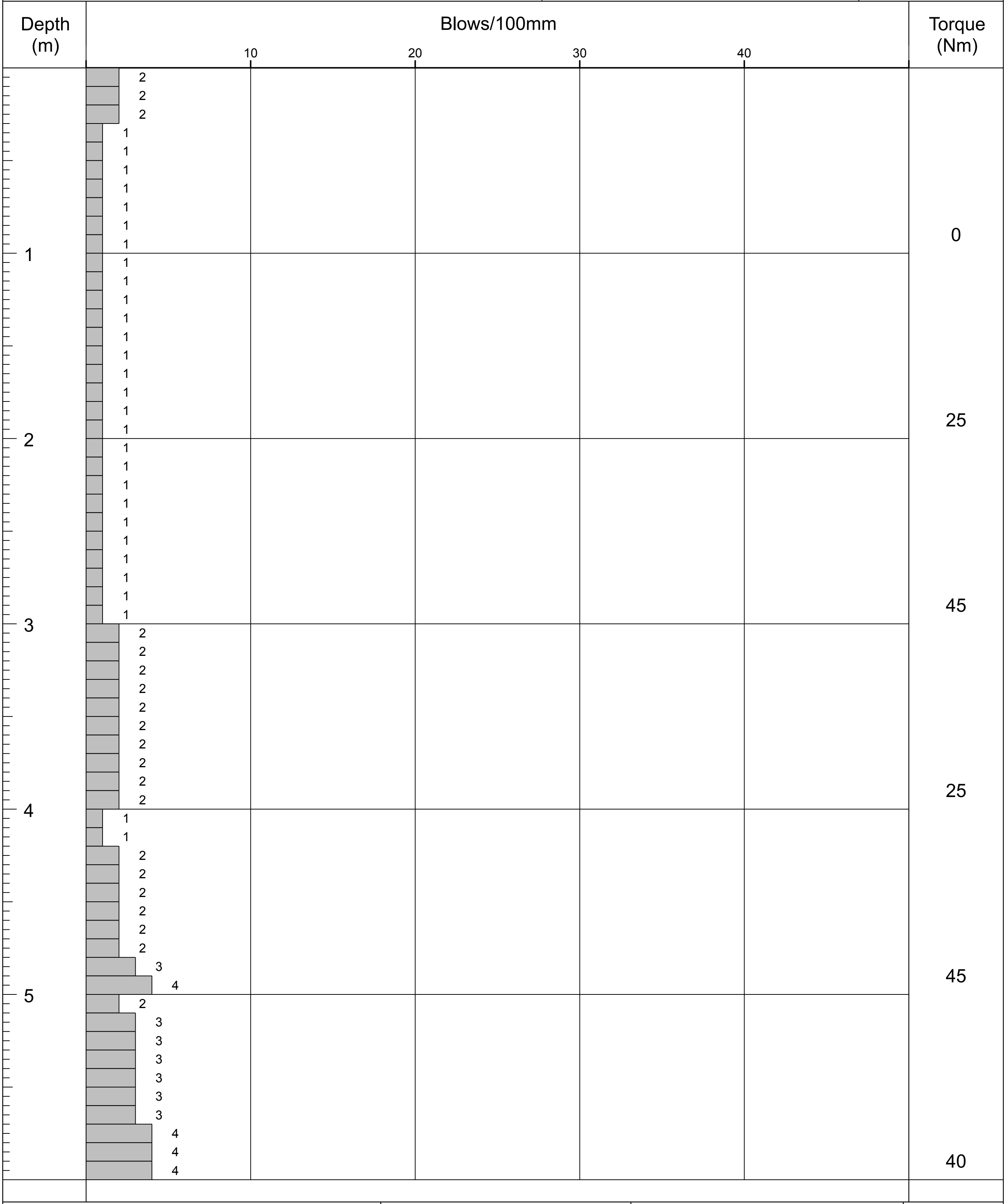
endeavour drilling				Probe No DP116 Sheet 2 of 2
Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 19/08/2016	Logged By CG



Remarks:	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 10.00
	Probe Type DPSH-B	

Probe Log

Probe No	DP117	Sheet 1 of 2	
Project Name:	Pinner Wood School	Project No. J3091	Co-ords:
Hole Type	DP		
Location:	Pinner Wood School	Level:	
Scale	1:30		
Client:	Peter Brett Associates	Dates:	09/08/2016
Logged By	CG		

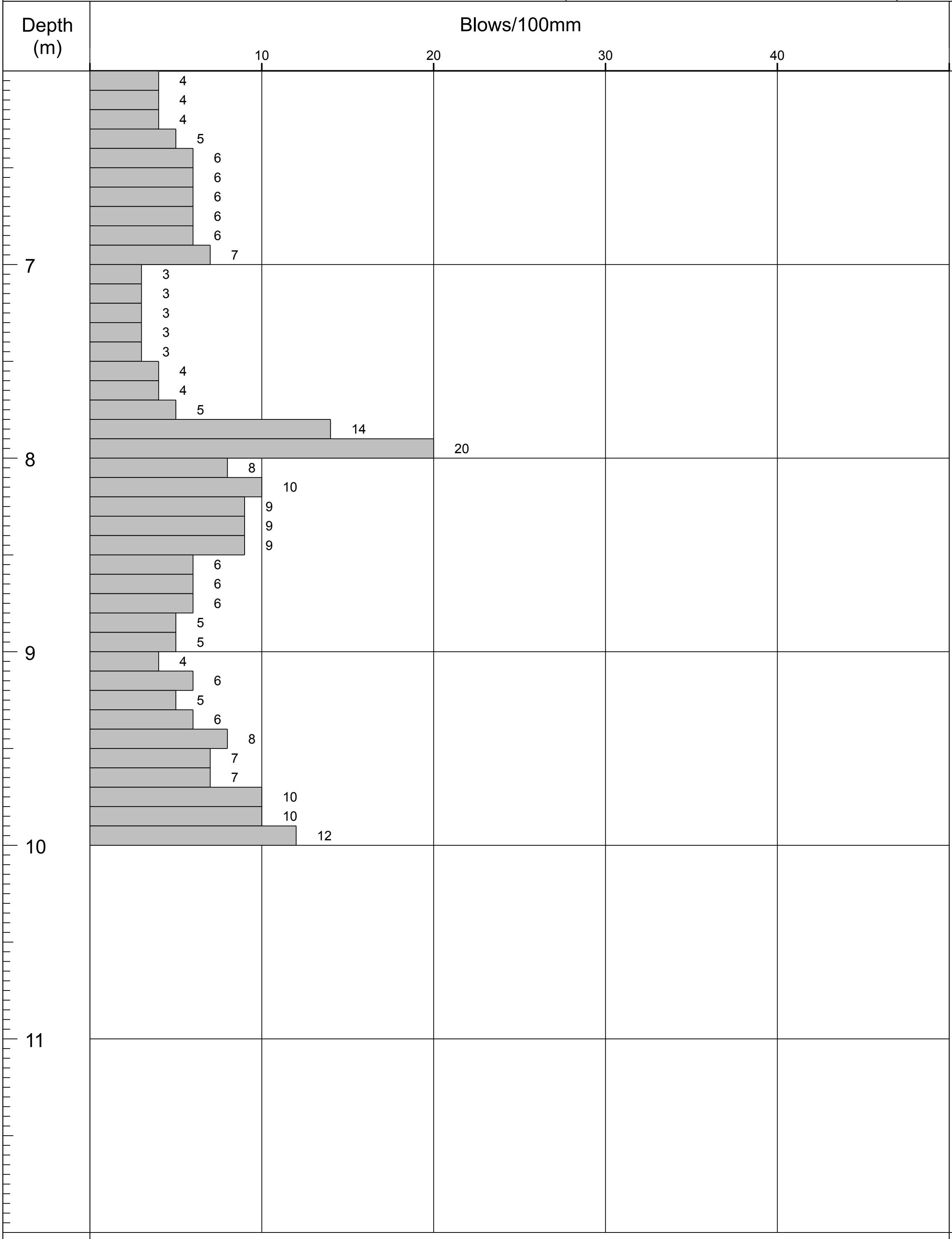


Remarks:	Fall Height 760	Cone Base Diameter	
	Hammer Wt 64	Final Depth	10.00
	Probe Type DPSH-B		

Probe Log

Probe No
DP117
Sheet 2 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 09/08/2016	Logged By CG



Torque (Nm)

70

100

95

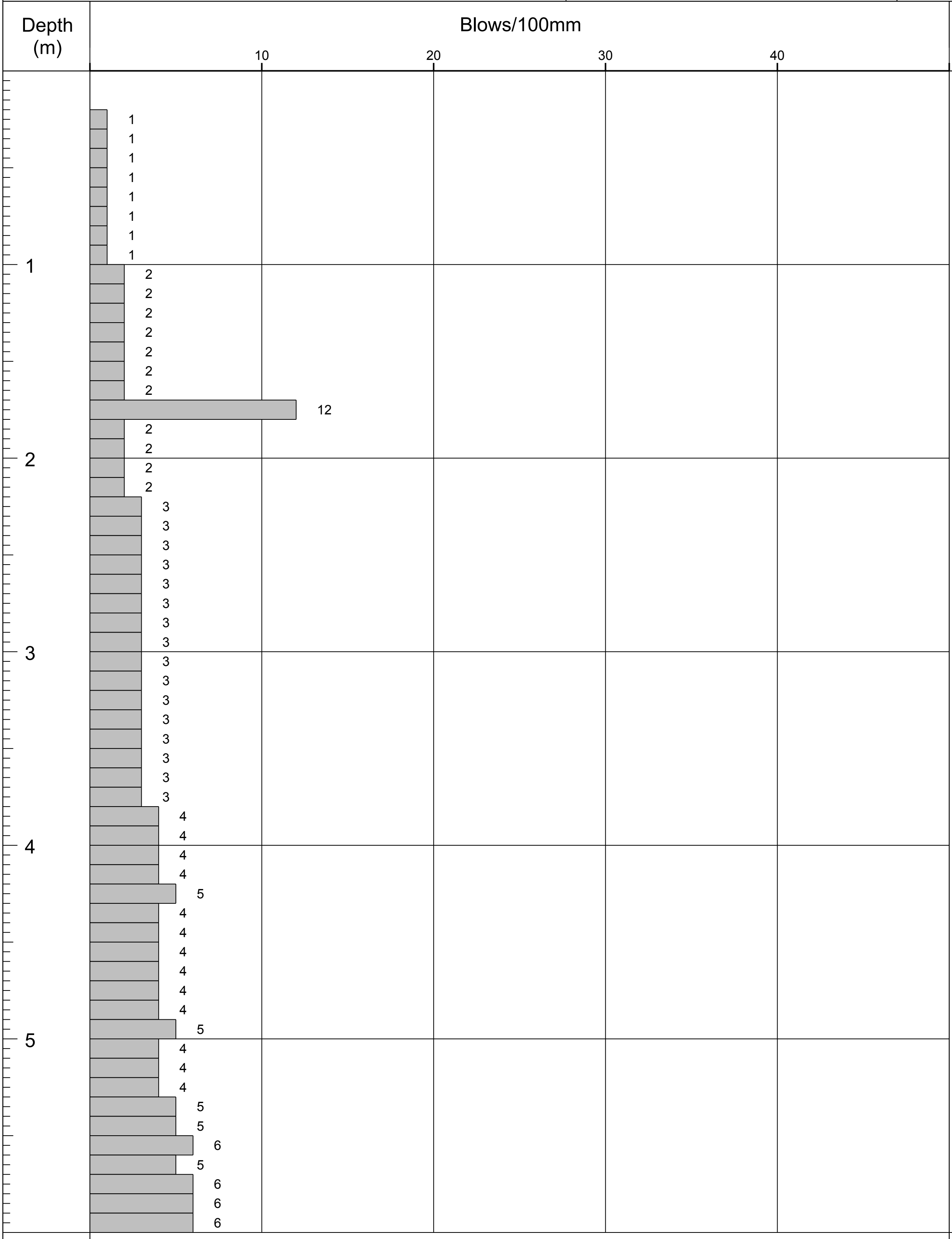
Remarks:

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

Probe Log

Probe No
DP118
Sheet 1 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:		Hole Type DP
Location: Pinner Wood School		Level:		Scale 1:30
Client: Peter Brett Associates		Dates: 17/08/2016		Logged By CG



Torque (Nm)
0
20
25
125

Remarks:
1. Pre-cored to 0.20mbgl

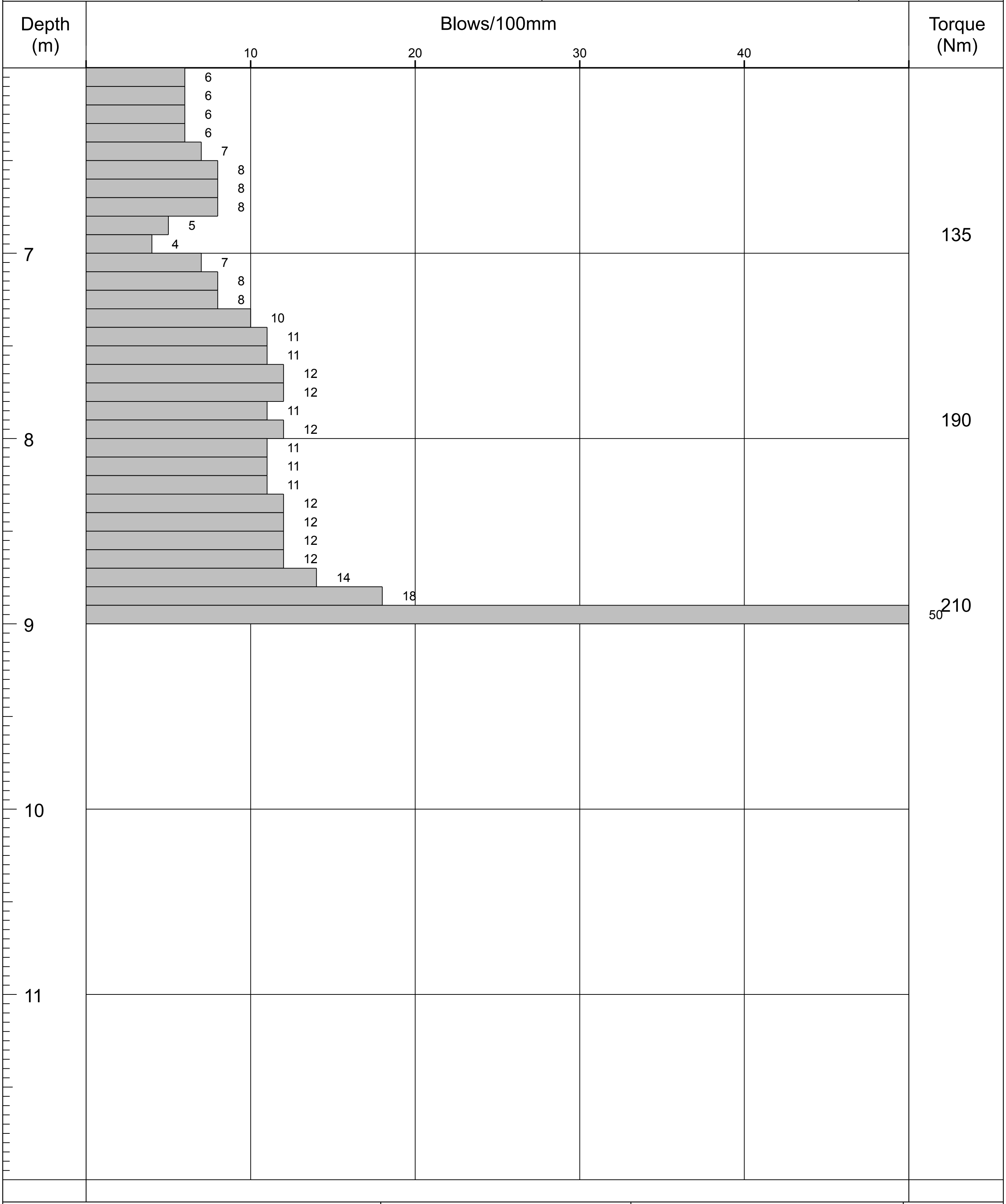
Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	9.00
Probe Type	DPSH-B		

endeavour drilling

Probe Log

Probe No
DP118
Sheet 2 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 17/08/2016	Logged By CG



Remarks:
1. Pre-cored to 0.20mbgl

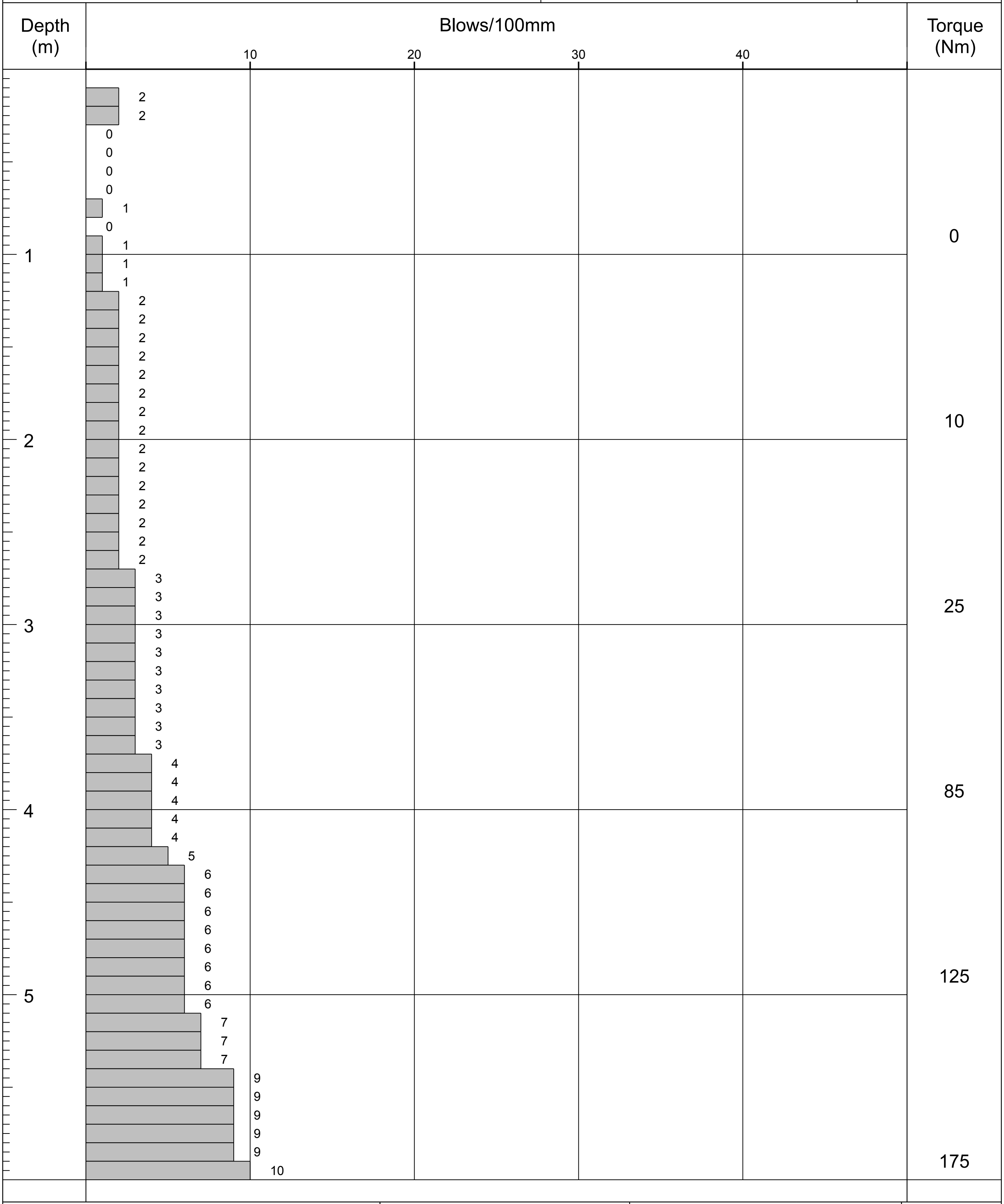
Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	9.00
Probe Type	DPSH-B		

AGS

Probe Log

Probe No
DP119
Sheet 1 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 18/08/2016	Logged By CG



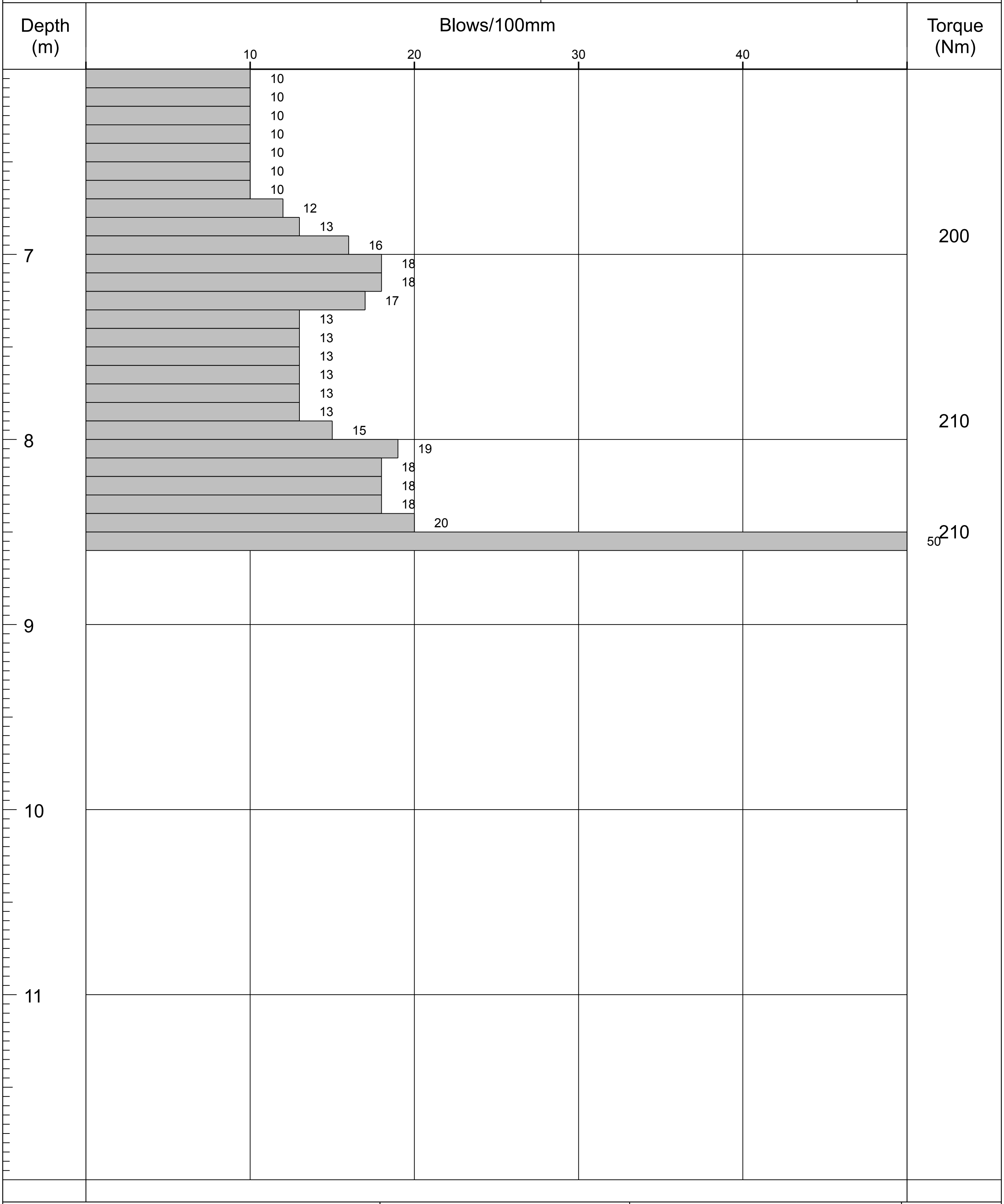
Remarks:
1. Pre-cored to 0.10mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	8.60
Probe Type	DPSH-B		

Probe Log

Probe No
DP119
Sheet 2 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 18/08/2016	Logged By CG

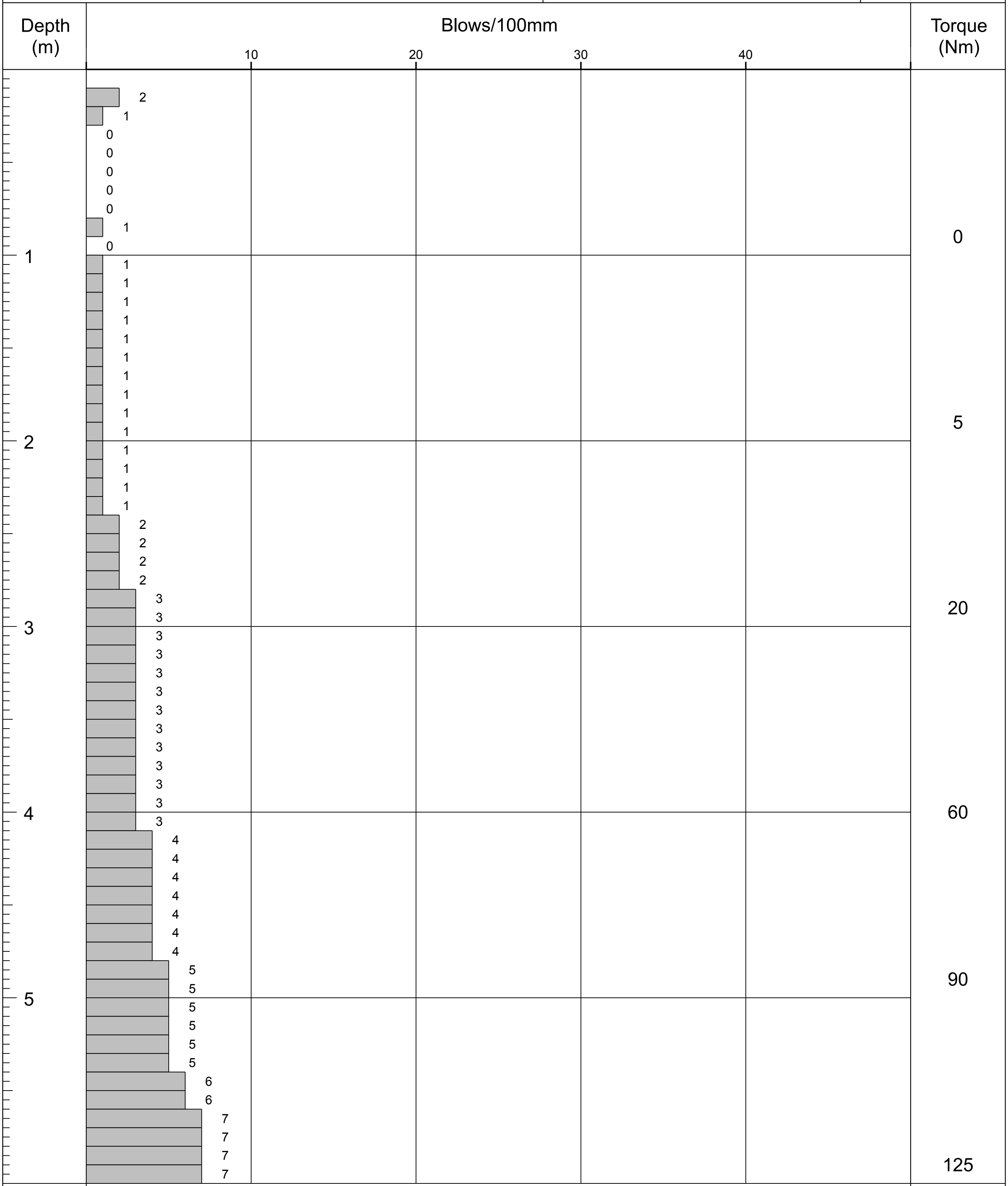


Remarks:
1. Pre-cored to 0.10mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	8.60
Probe Type	DPSH-B		

Probe Log

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP120 Sheet 1 of 2
Location: Pinner Wood School		Level:	Hole Type DP
			Scale 1:30
Client: Peter Brett Associates		Dates: 18/08/2016	Logged By CG



Remarks:
1. Pre-cored to 0.10mbgl

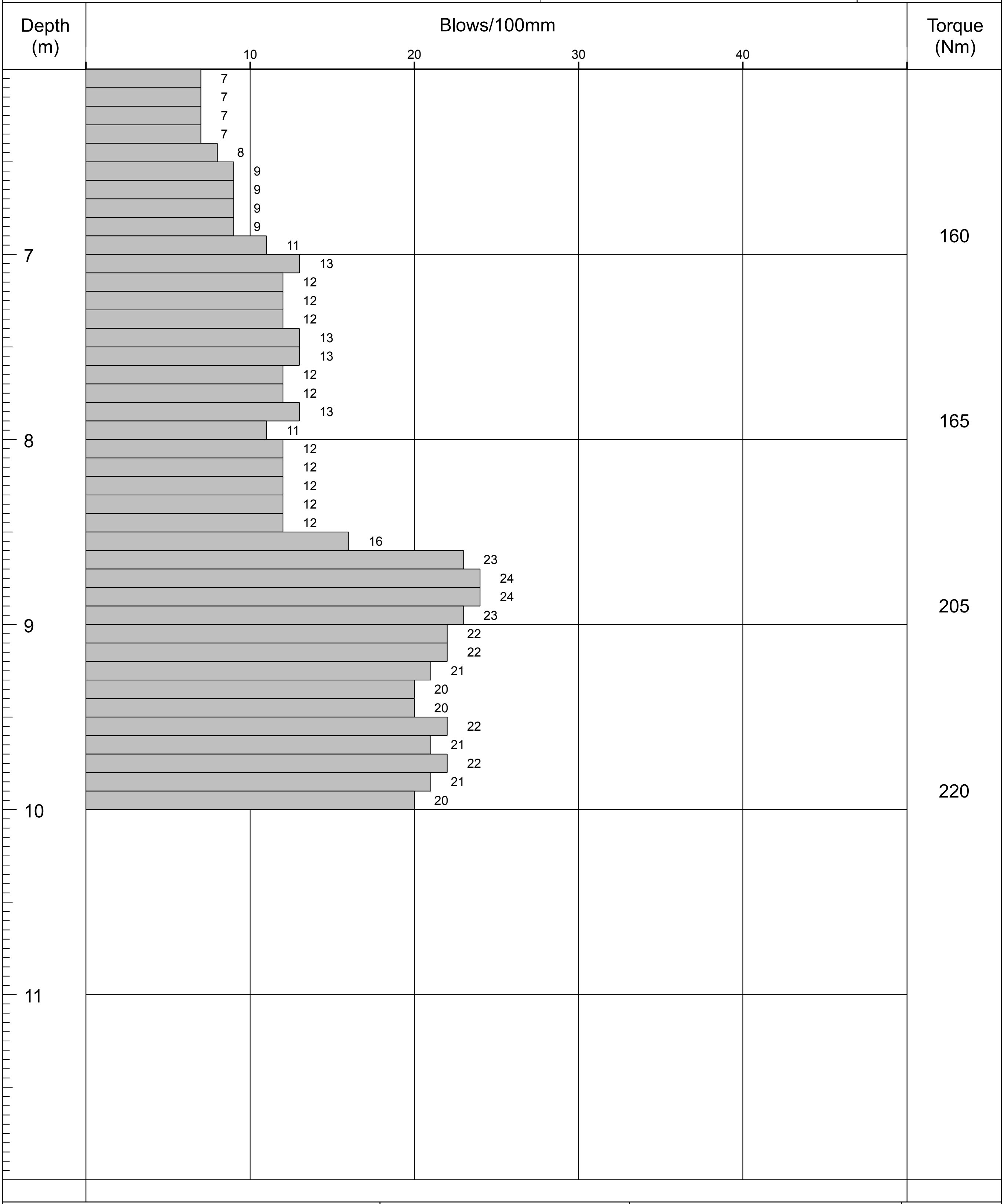
Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

AGS

Probe Log

Probe No
DP120
Sheet 2 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 18/08/2016	Logged By CG



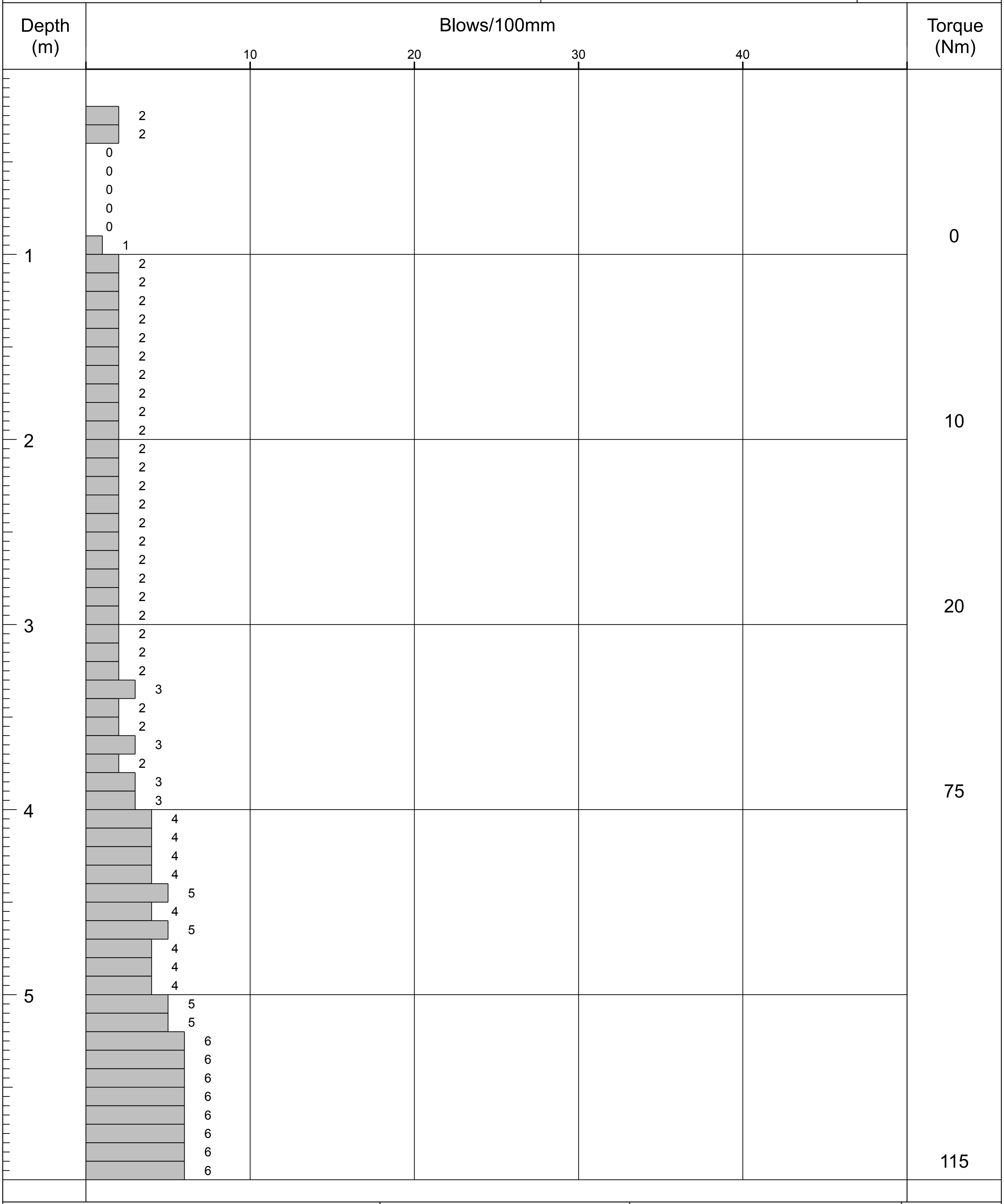
Remarks:
1. Pre-cored to 0.10mbgl

Fall Height 760
Hammer Wt 64
Probe Type DPSH-B
Cone Base Diameter
Final Depth 10.00

Probe Log

Probe No
DP121
Sheet 1 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 12/08/2016	Logged By CG

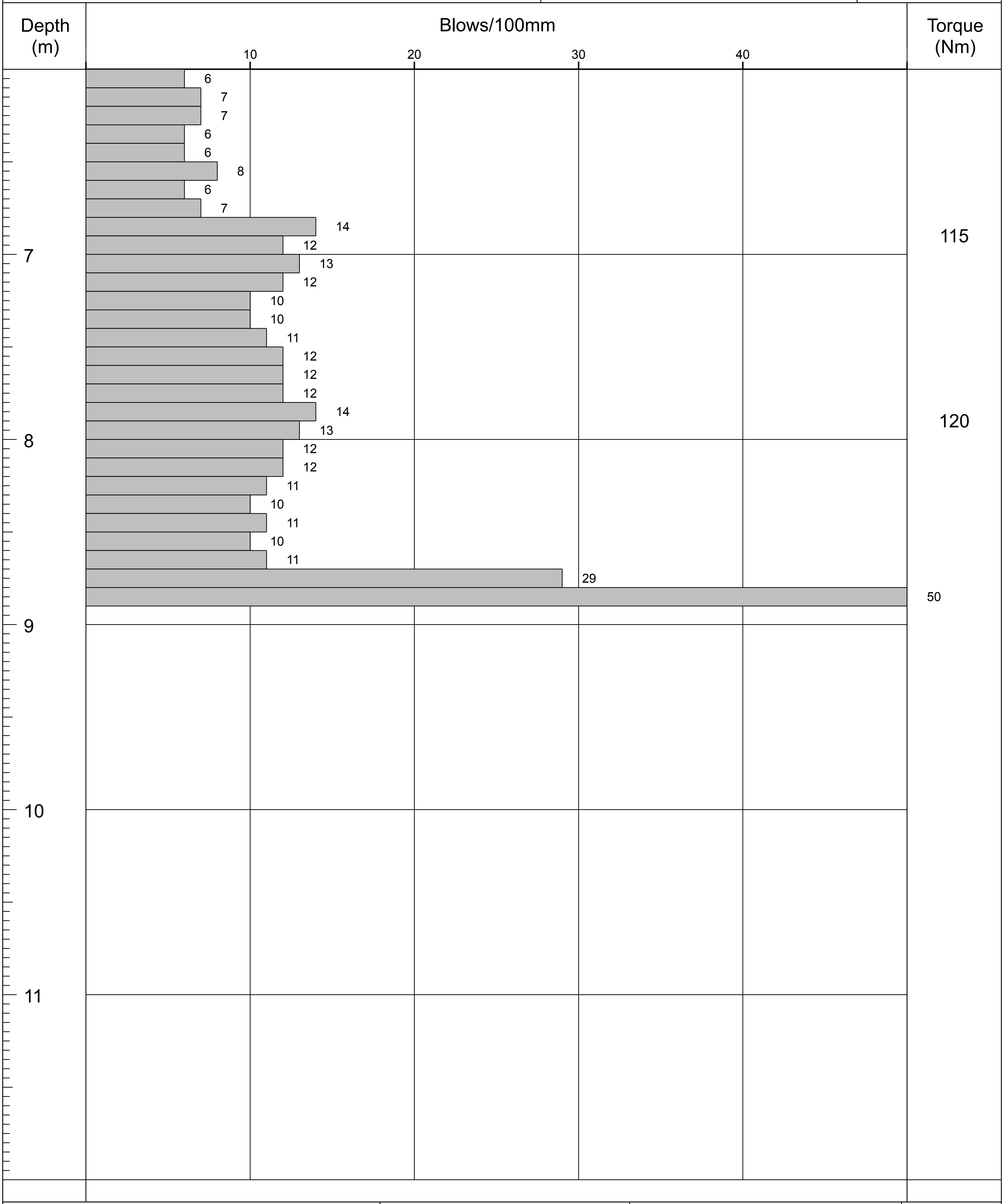


Remarks: 1. Pre-cored to 0.20mbgl	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 8.90
	Probe Type DPSH-B	

Probe Log

Probe No
DP121
Sheet 2 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 12/08/2016	Logged By CG



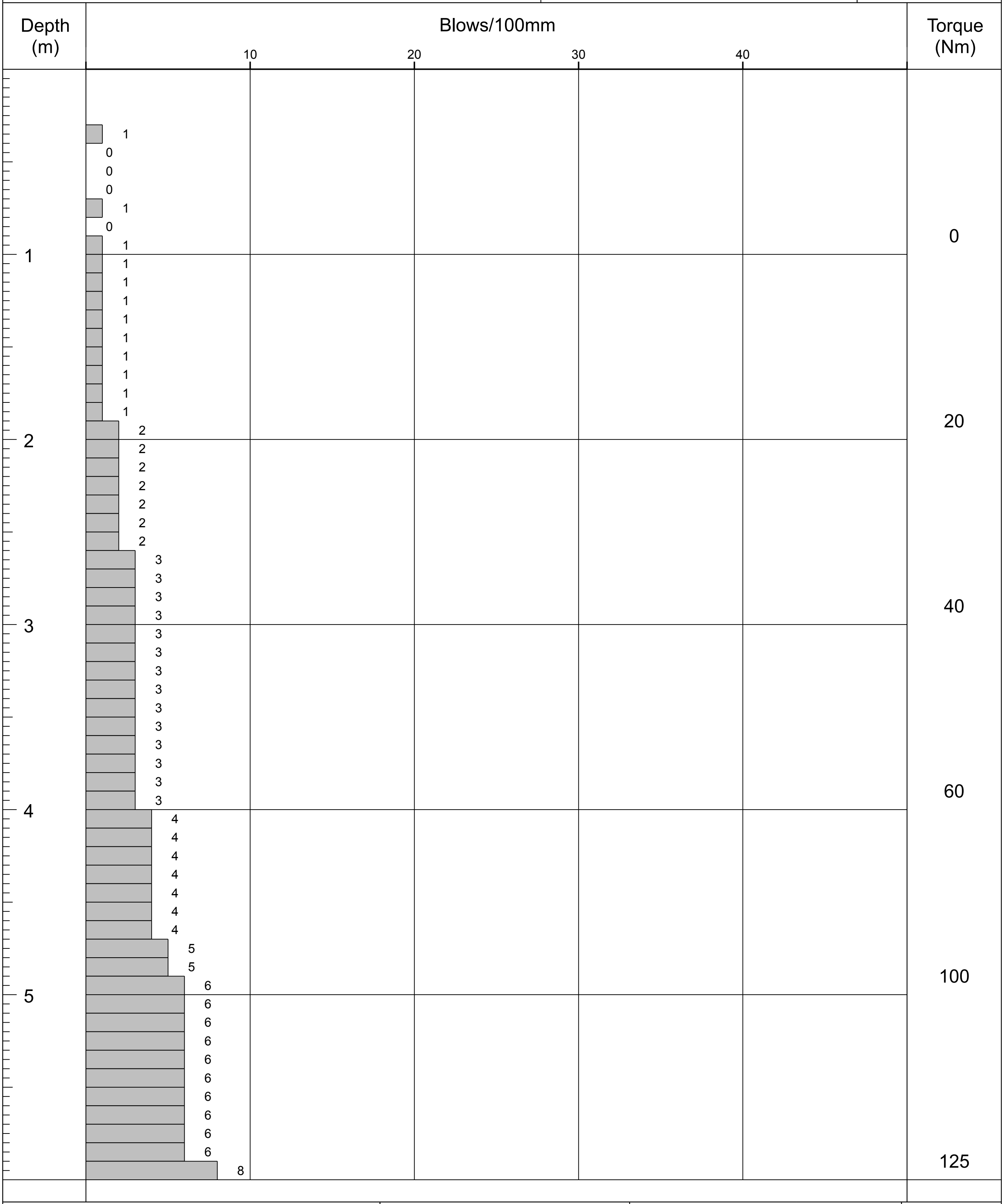
Remarks:
1. Pre-cored to 0.20mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	8.90
Probe Type	DPSH-B		

endeavour drilling

Probe Log

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP122 Sheet 1 of 2
Location: Pinner Wood School		Level:	Hole Type DP Scale 1:30
Client: Peter Brett Associates		Dates: 17/08/2016	Logged By CG



Remarks:
1. Pre-cored to 0.30mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	8.90
Probe Type	DPSH-B		

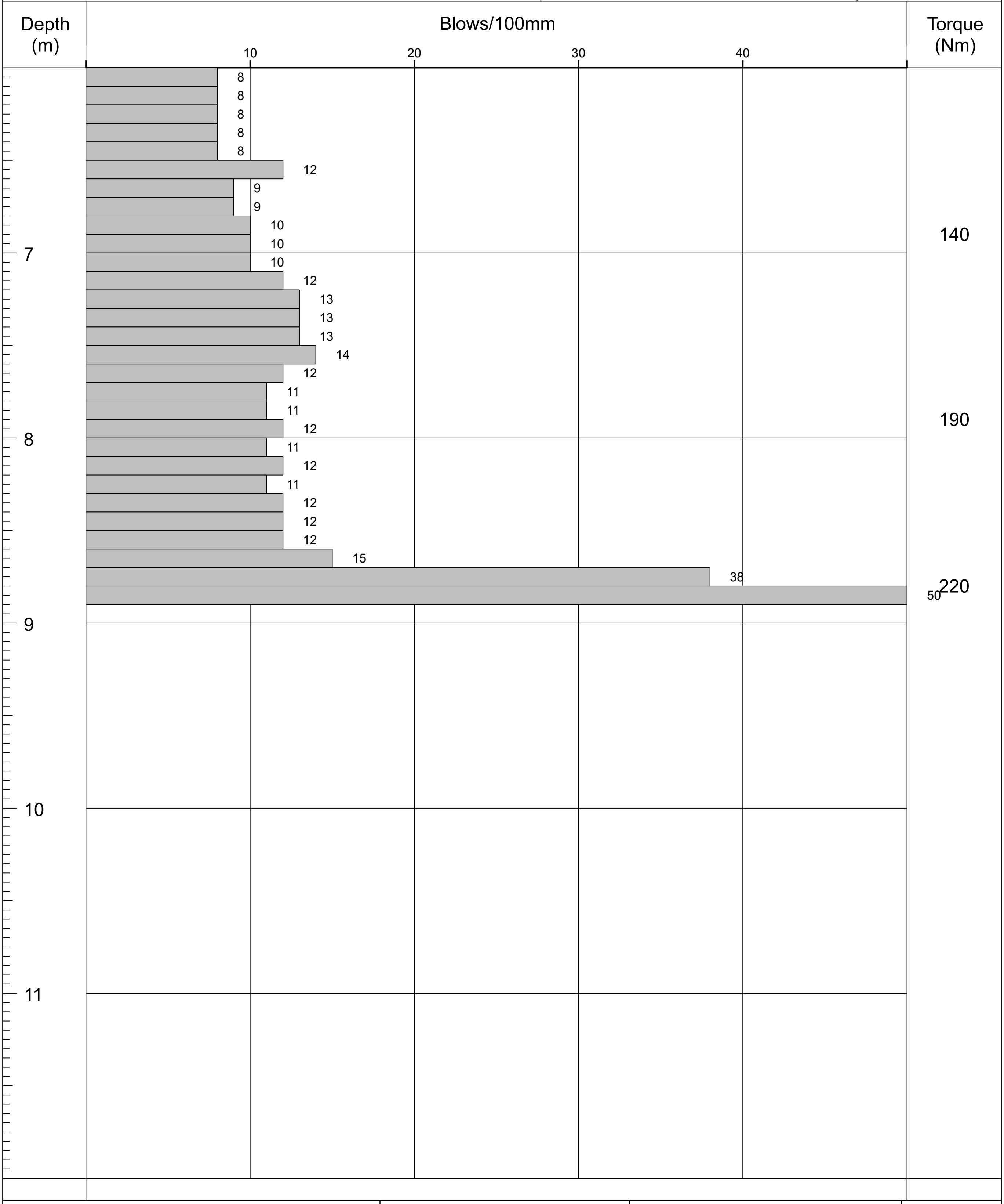
AGS

endeavour drilling

Probe Log

Probe No
DP122
Sheet 2 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 17/08/2016	Logged By CG

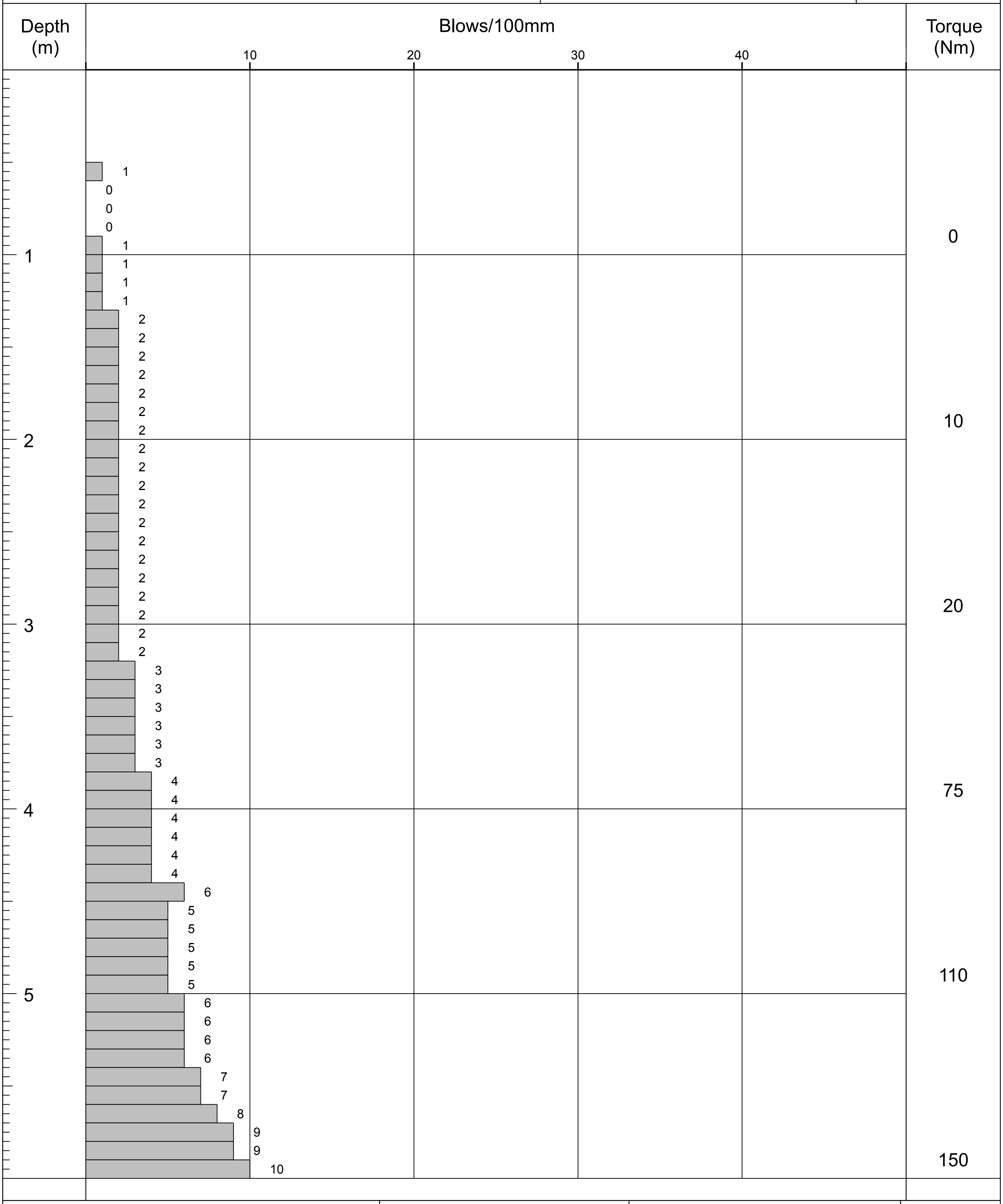


Remarks:
1. Pre-cored to 0.30mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	8.90
Probe Type	DPSH-B		

Probe Log

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP123 Sheet 1 of 2
			Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 11/08/2016	Logged By CG



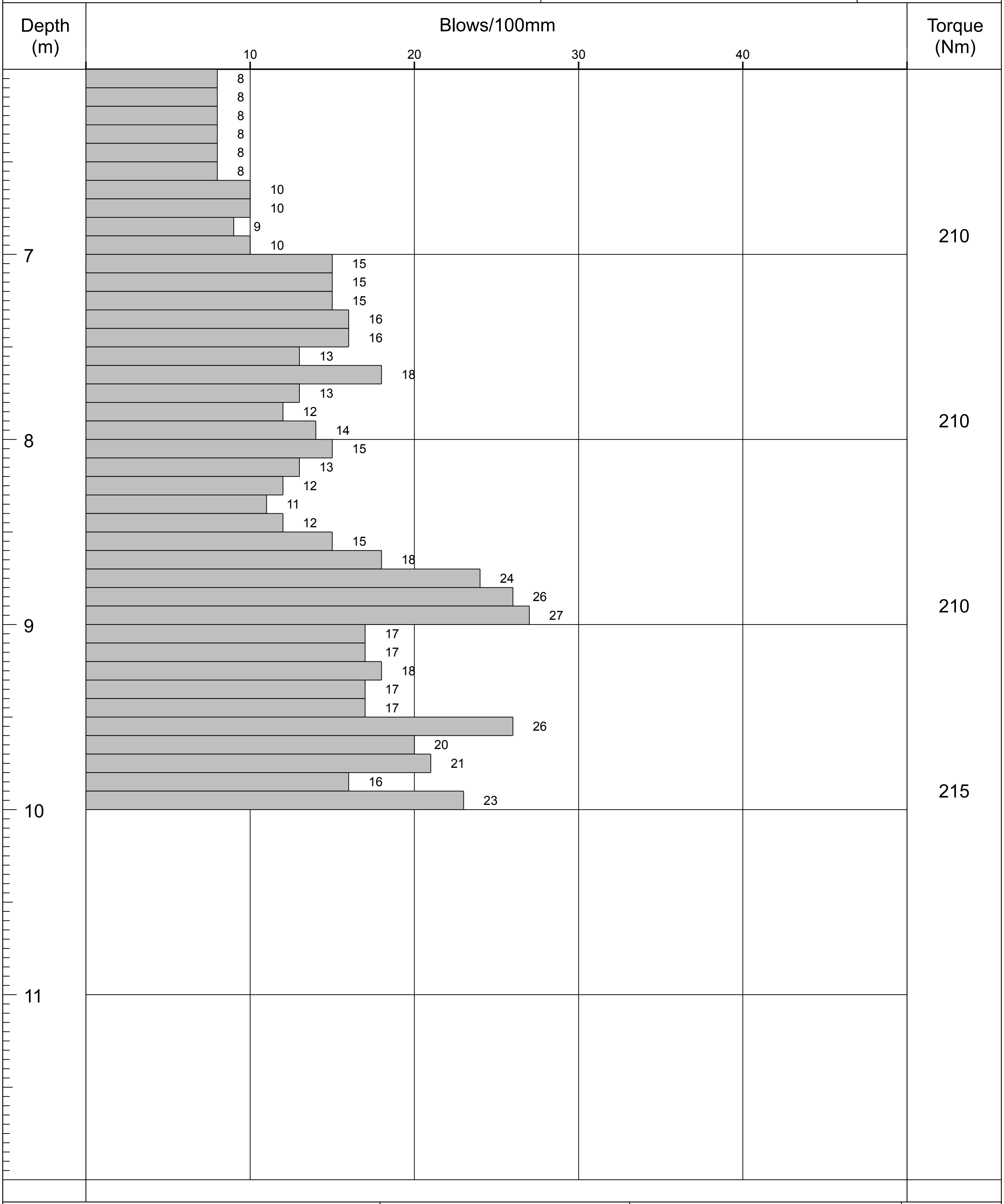
Remarks:
1. Pre-cored and hand pitted to 0.50mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

Probe Log

Probe No
DP123
Sheet 2 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 11/08/2016	Logged By CG



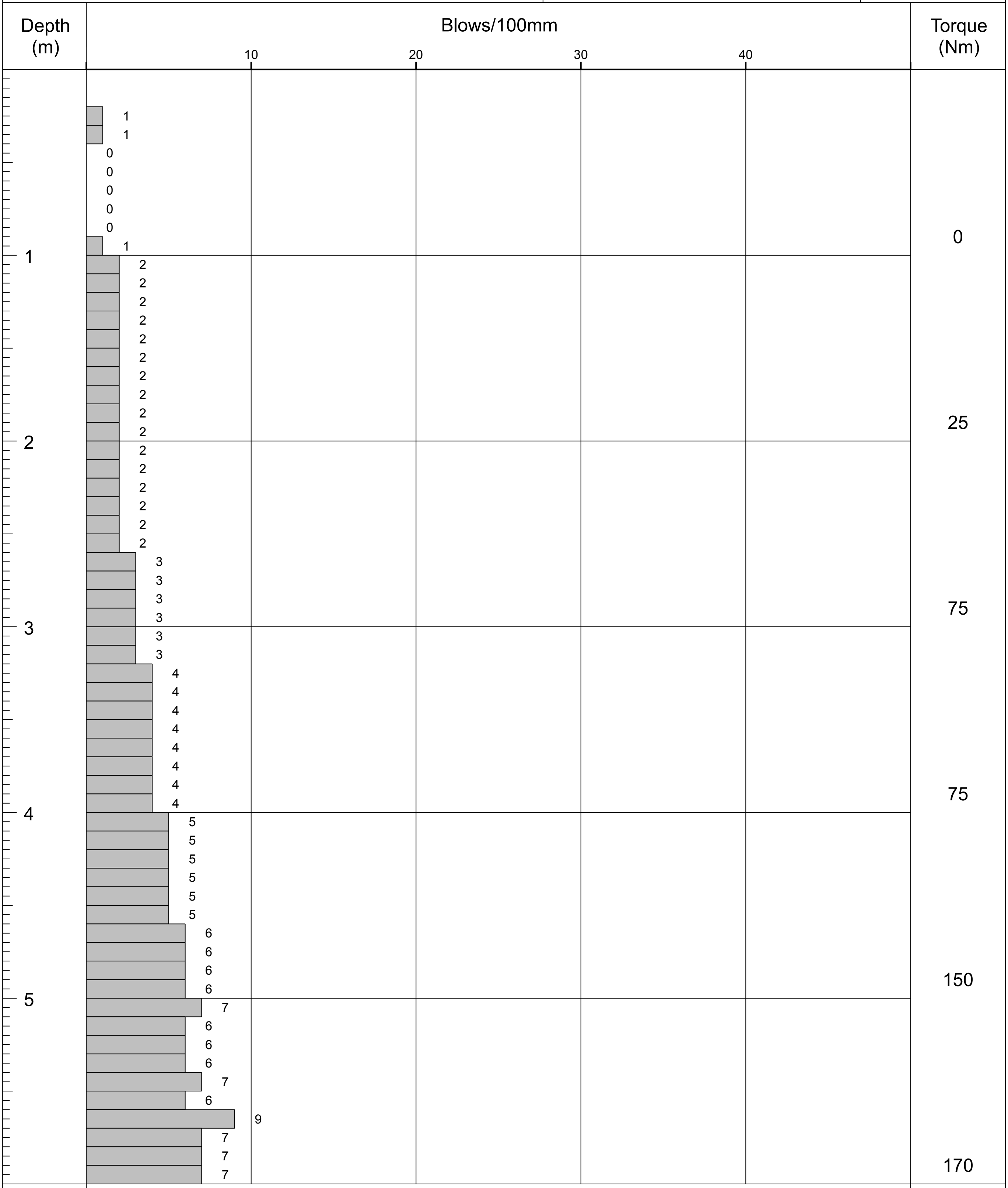
Remarks:
1. Pre-cored and hand pitted to 0.50mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

Probe Log

Probe No
DP124
Sheet 1 of 2

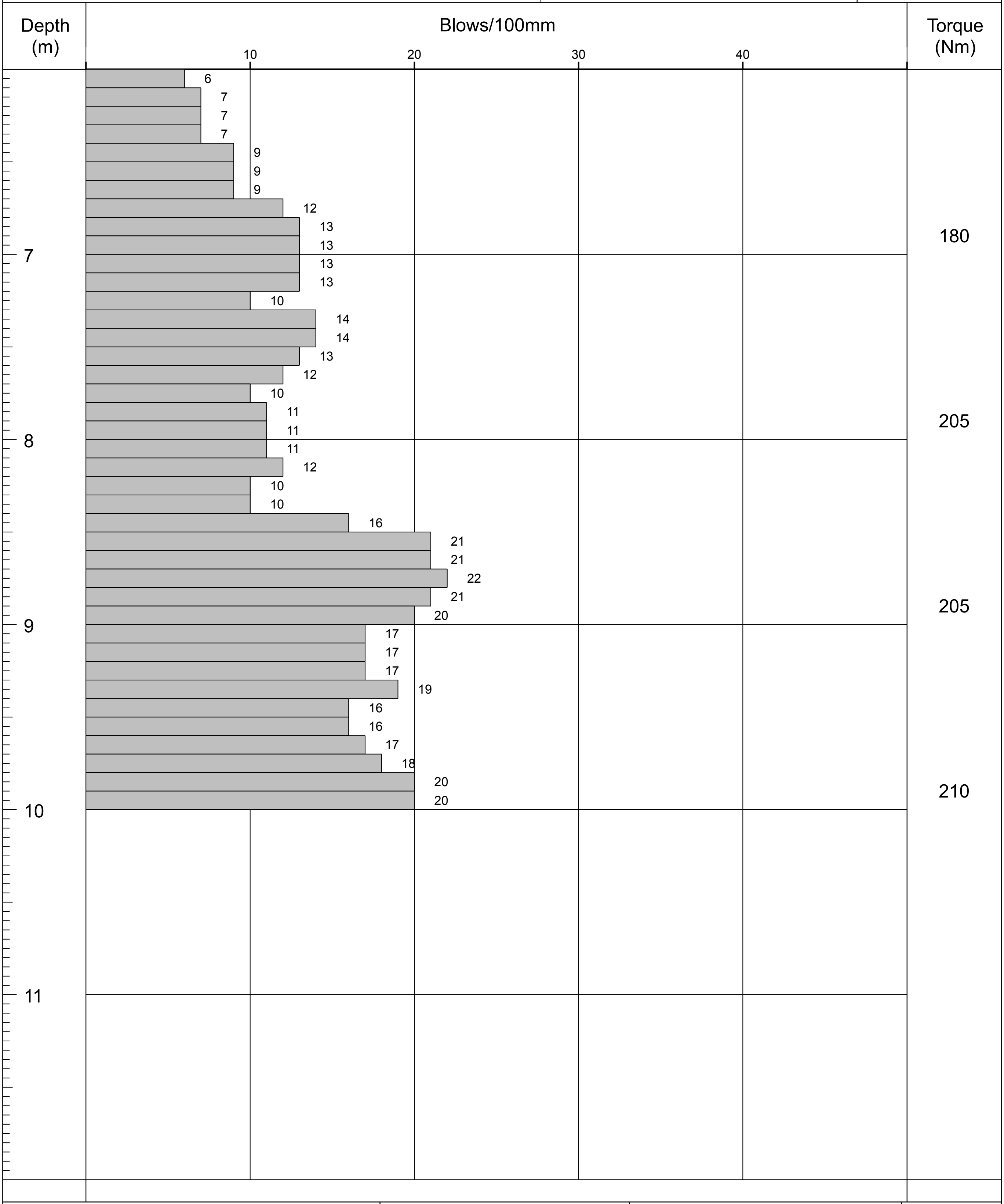
Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 11/08/2016	Logged By CG



Remarks:
1. Pre-cored to 0.20mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

endeavour drilling	Probe Log		Probe No DP124 Sheet 2 of 2
Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 11/08/2016	Logged By CG



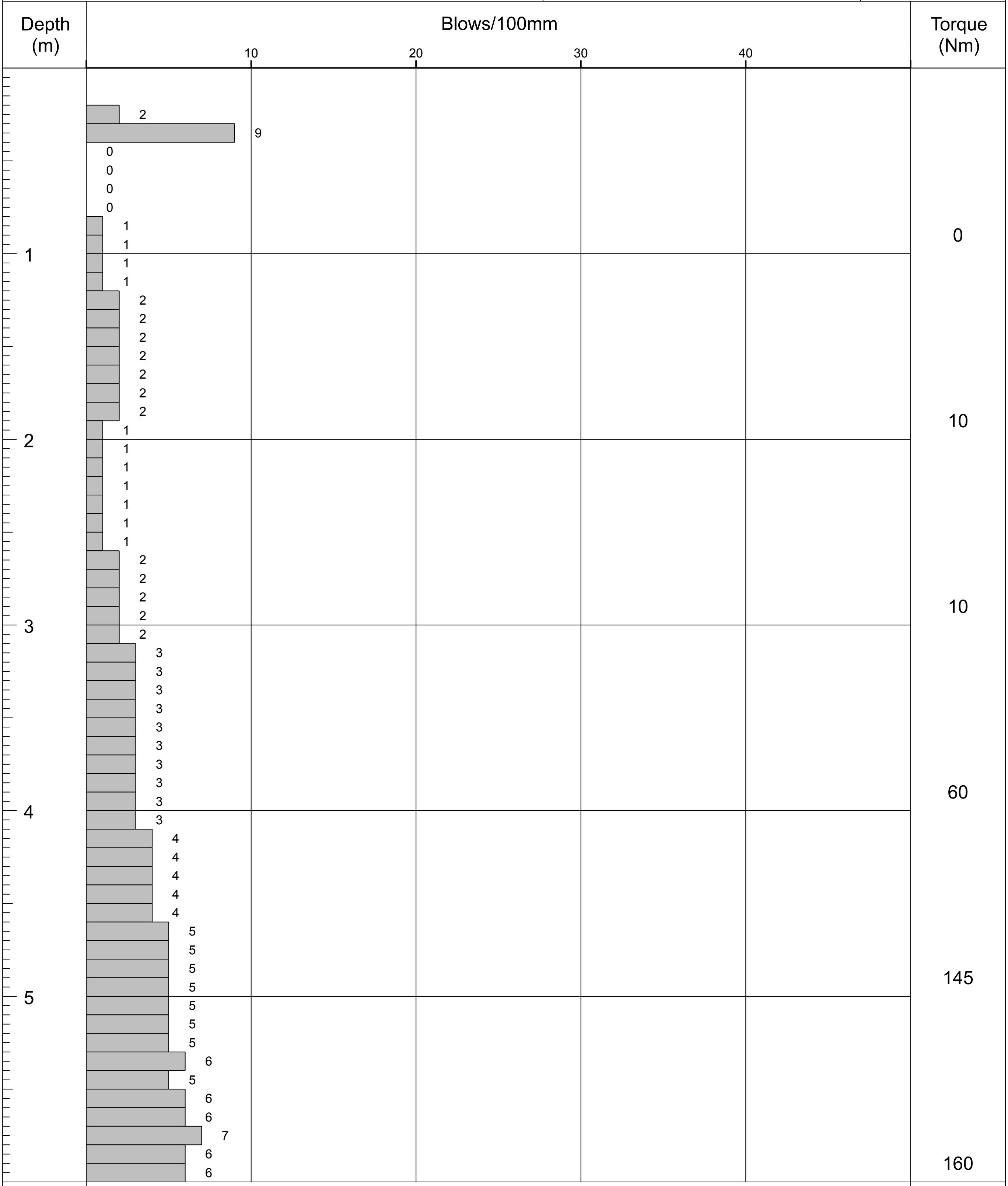
Remarks: 1. Pre-cored to 0.20mbgl	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 10.00
	Probe Type DPSH-B	

endeavour drilling

Probe Log

Probe No
DP125
Sheet 1 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 12/08/2016	Logged By CG



Remarks:
1. Pre-cored to 0.20mbgl

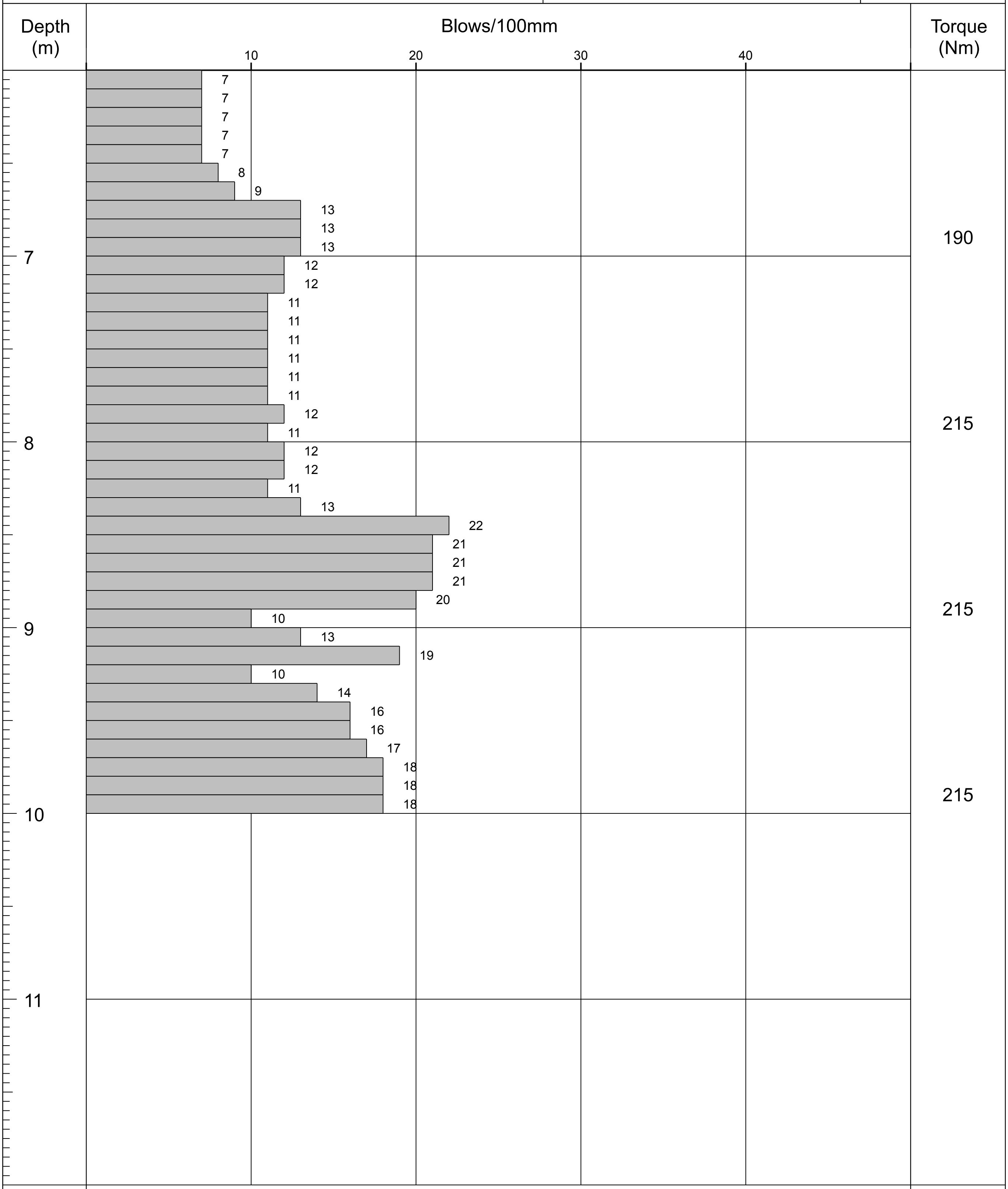
Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

AGS

Probe Log

Probe No
DP125
Sheet 2 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 12/08/2016	Logged By CG

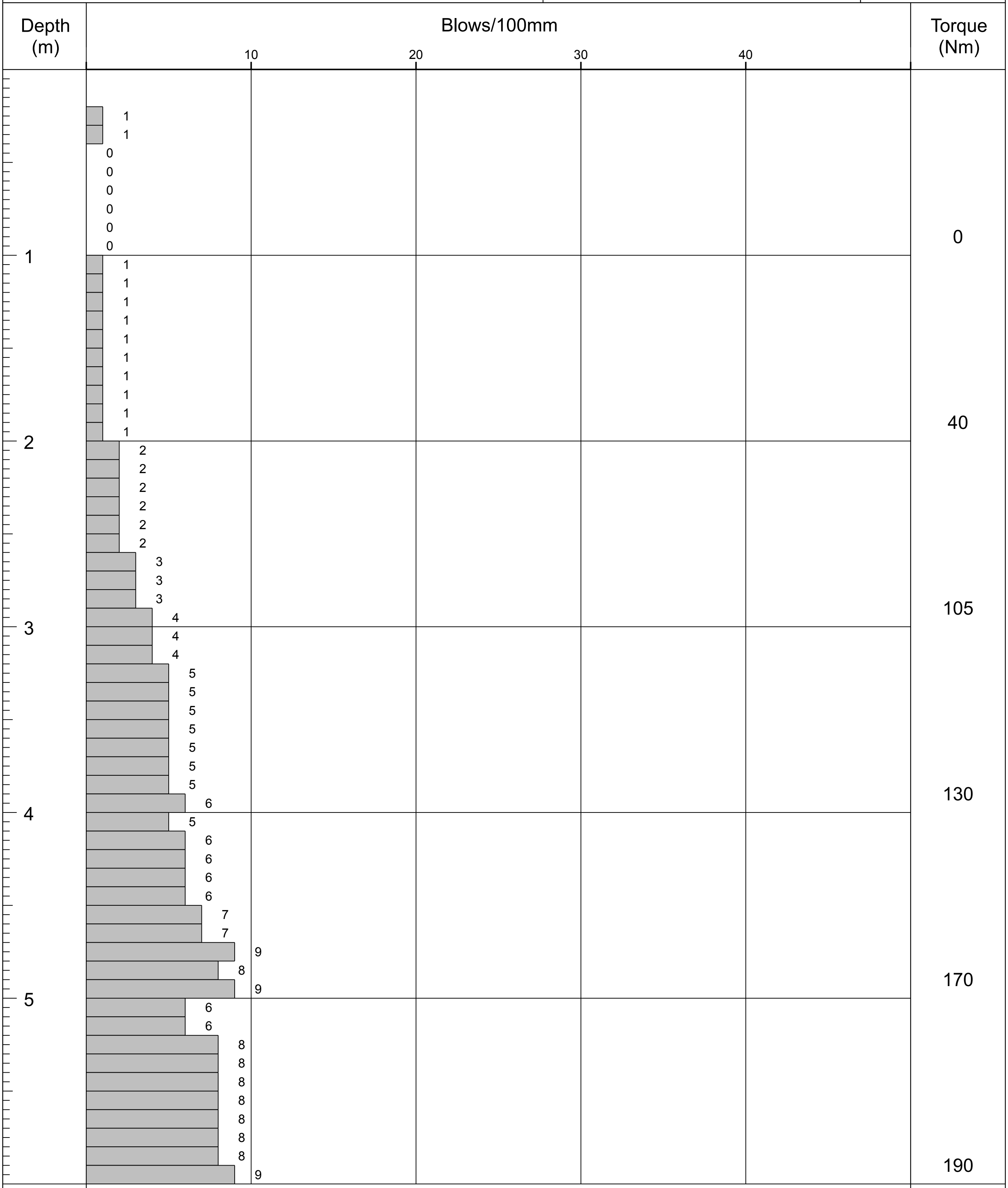


Remarks:
1. Pre-cored to 0.20mbgl

Fall Height 760	Cone Base Diameter
Hammer Wt 64	Final Depth 10.00
Probe Type DPSH-B	

Probe Log

endeavour drilling				Probe No DP126 Sheet 1 of 2
Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 11/08/2016	Logged By CG



Remarks: 1. Pre-cored to 0.20mbgl	Fall Height 760	Cone Base Diameter	AGS
	Hammer Wt 64	Final Depth 9.40	
	Probe Type DPSH-B		

endeavour drilling

Probe Log

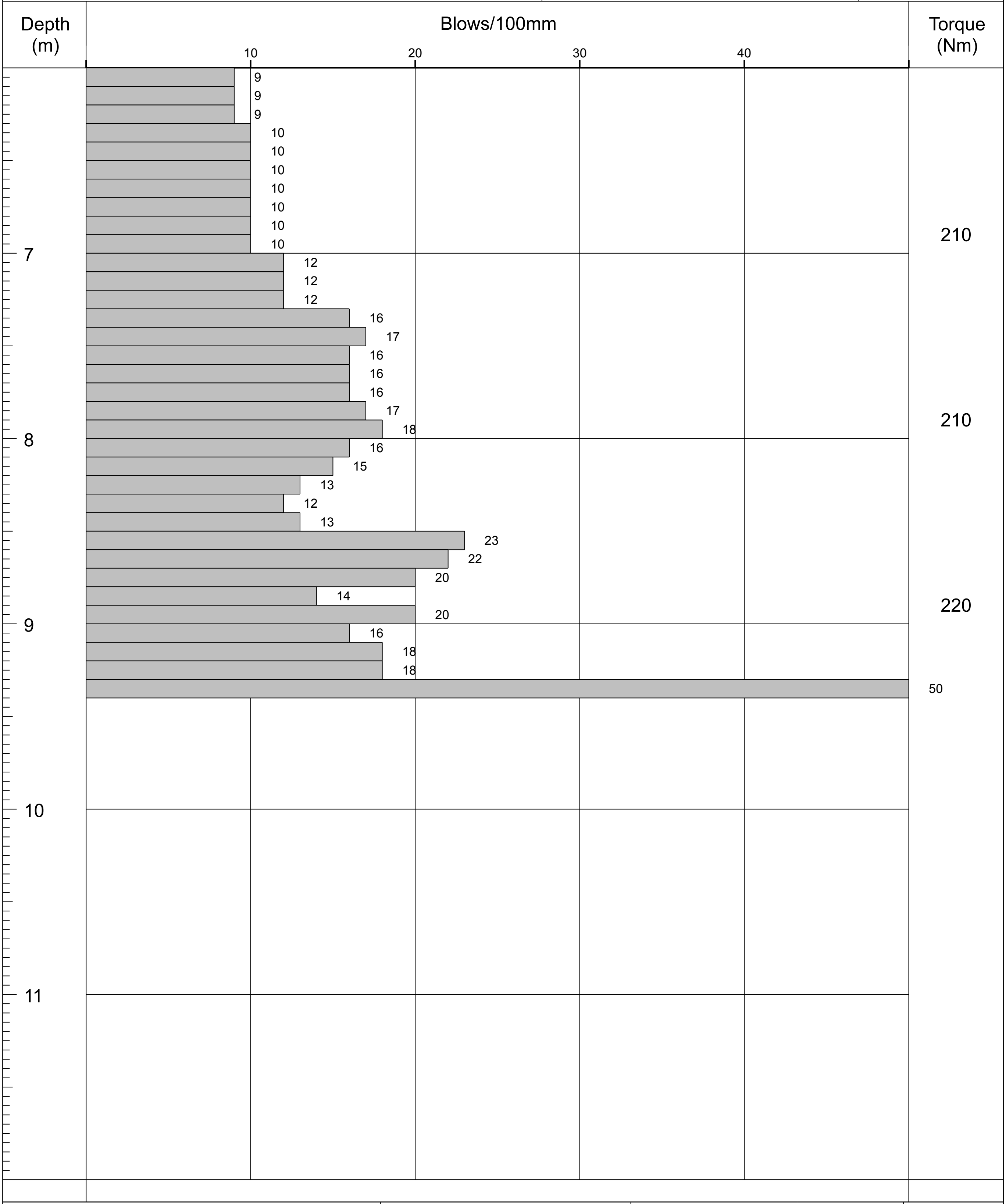
Probe No
DP126
Sheet 2 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:
Location:	Pinner Wood School	Level:	
Client:	Peter Brett Associates	Dates:	11/08/2016

Hole Type
DP

Scale
1:30

Logged By
CG



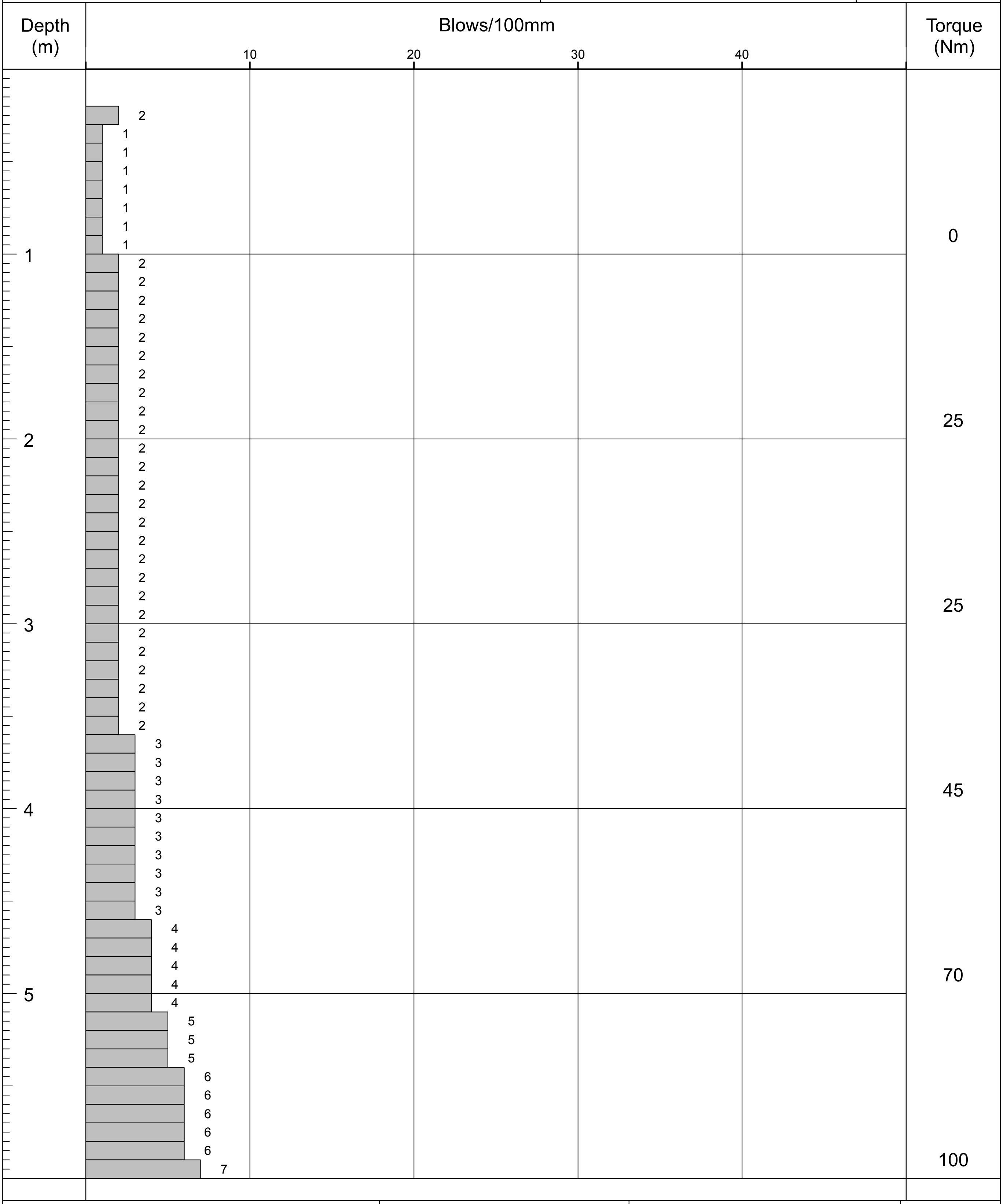
Remarks:
1. Pre-cored to 0.20mbgl

Fall Height 760
Hammer Wt 64
Probe Type DPSH-B
Cone Base Diameter
Final Depth 9.40

AGS

endeavour drilling	# Probe Log	Probe No DP127 Sheet 1 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 11/08/2016	Logged By CG



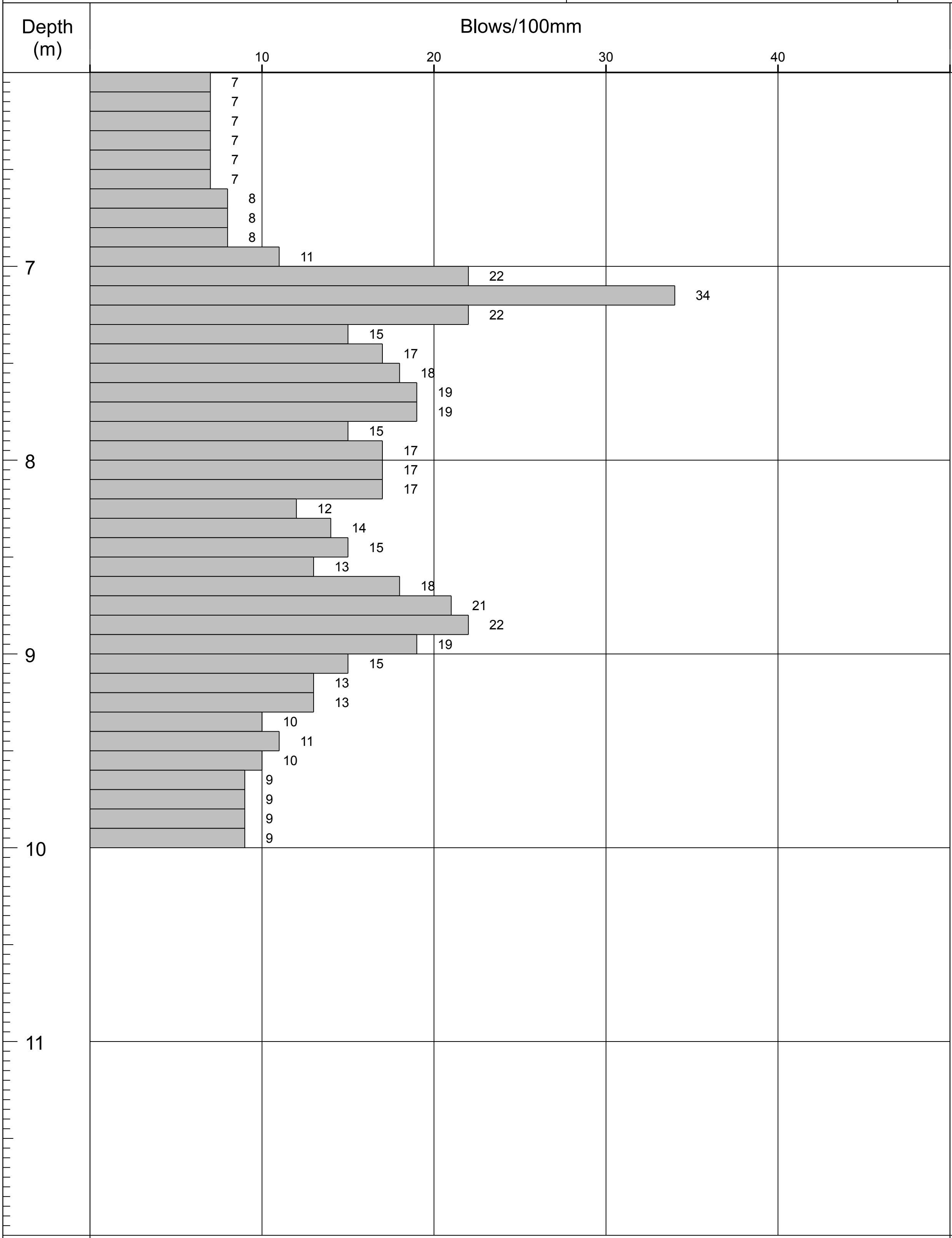
Remarks: 1. Pre-cored to 0.20mbgl	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 10.00
	Probe Type DPSH-B	

endeavour drilling

Probe Log

Probe No
DP127
Sheet 2 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:
Hole Type	DP		
Location:	Pinner Wood School	Level:	
Scale	1:30		
Client:	Peter Brett Associates	Dates:	11/08/2016
Logged By	CG		



Torque (Nm)

110

175

150

150

Remarks:
1. Pre-cored to 0.20mbgl

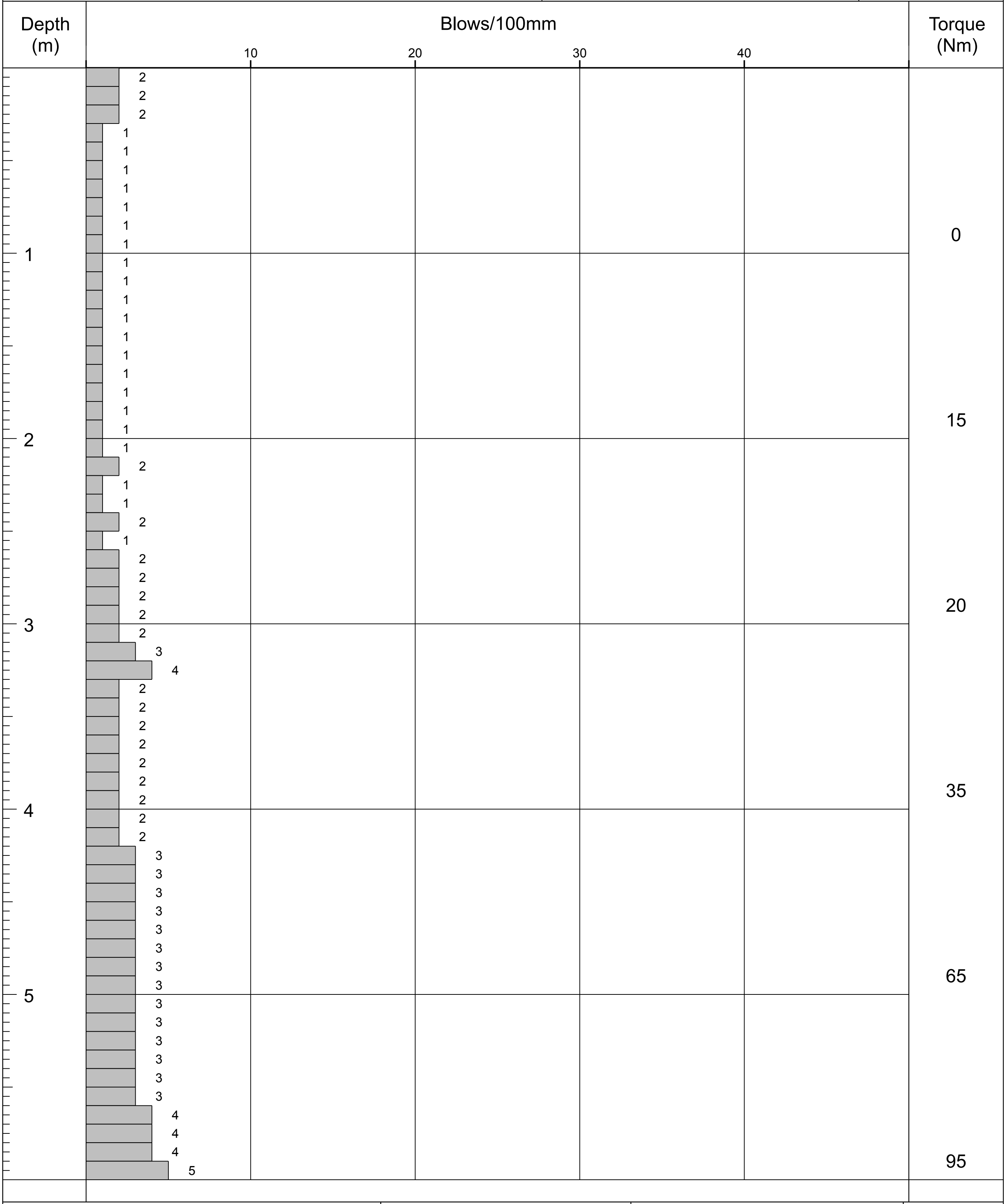
Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

AGS

endeavour drilling

Probe Log

Project Name: Pinner Wood School	Project No. J3091	Co-ords:		Probe No DP128 Sheet 1 of 2
Location: Pinner Wood School		Level:		Hole Type DP
				Scale 1:30
Client: Peter Brett Associates		Dates: 08/08/2016		Logged By CG



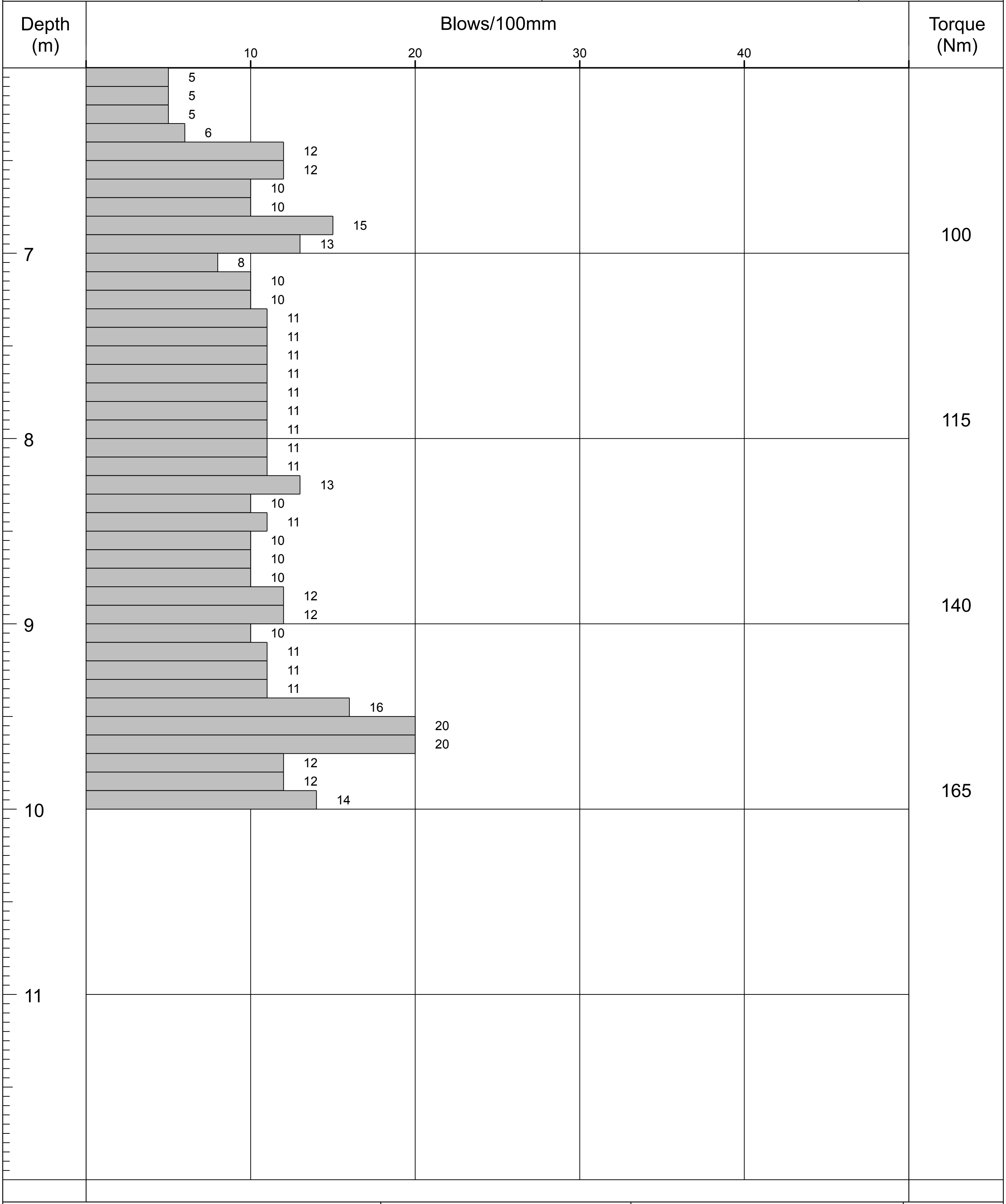
Remarks:	Fall Height 760	Cone Base Diameter	
	Hammer Wt 64	Final Depth	10.00
	Probe Type DPSH-B		

AGS

endeavour drilling

Probe Log

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP128 Sheet 2 of 2
Location: Pinner Wood School		Level:	Hole Type DP
Client: Peter Brett Associates		Dates: 08/08/2016	Scale 1:30
			Logged By CG



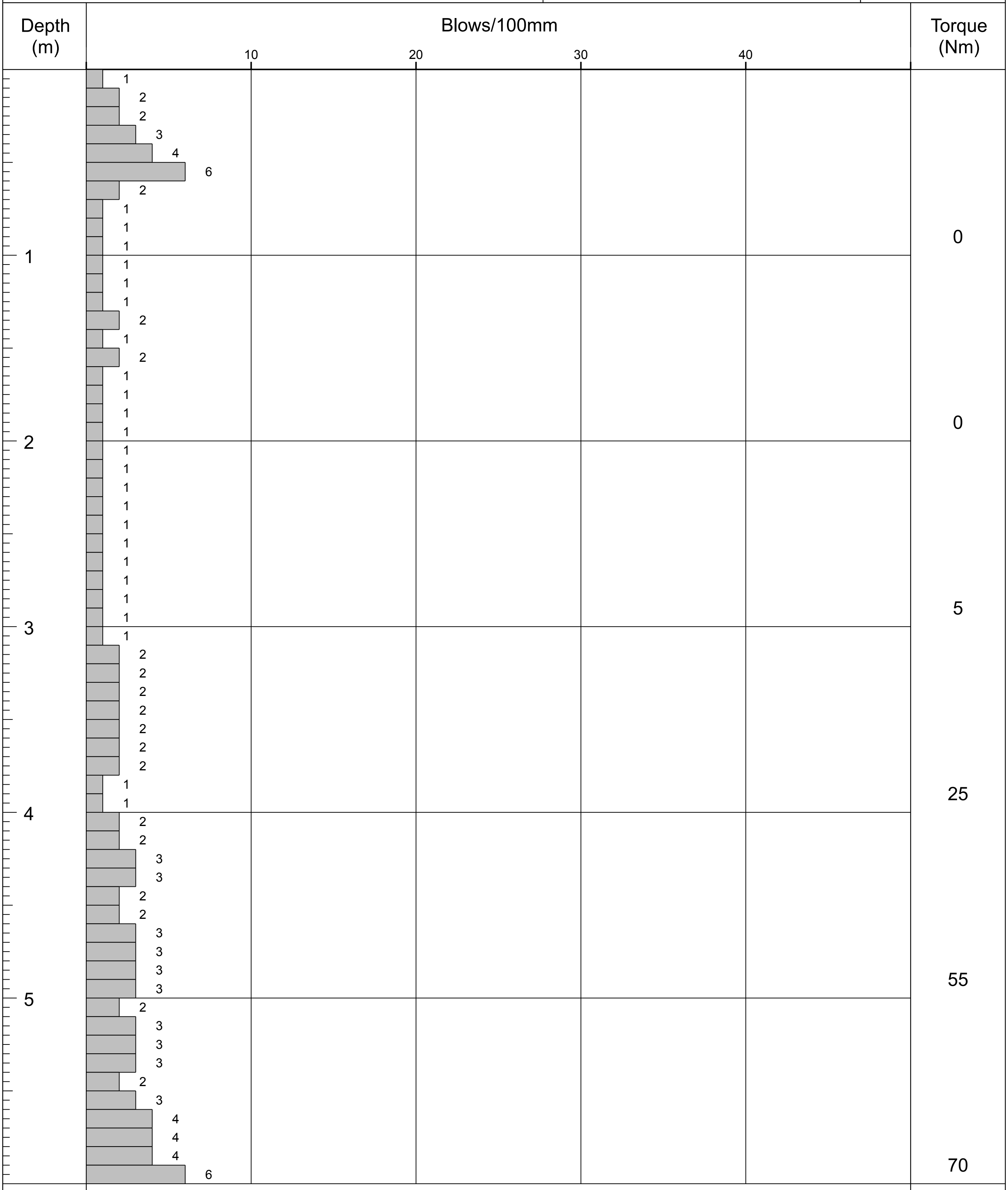
Remarks:	Fall Height 760	Cone Base Diameter	
	Hammer Wt 64	Final Depth 10.00	
	Probe Type DPSH-B		

AGS

endeavour drilling

Probe Log

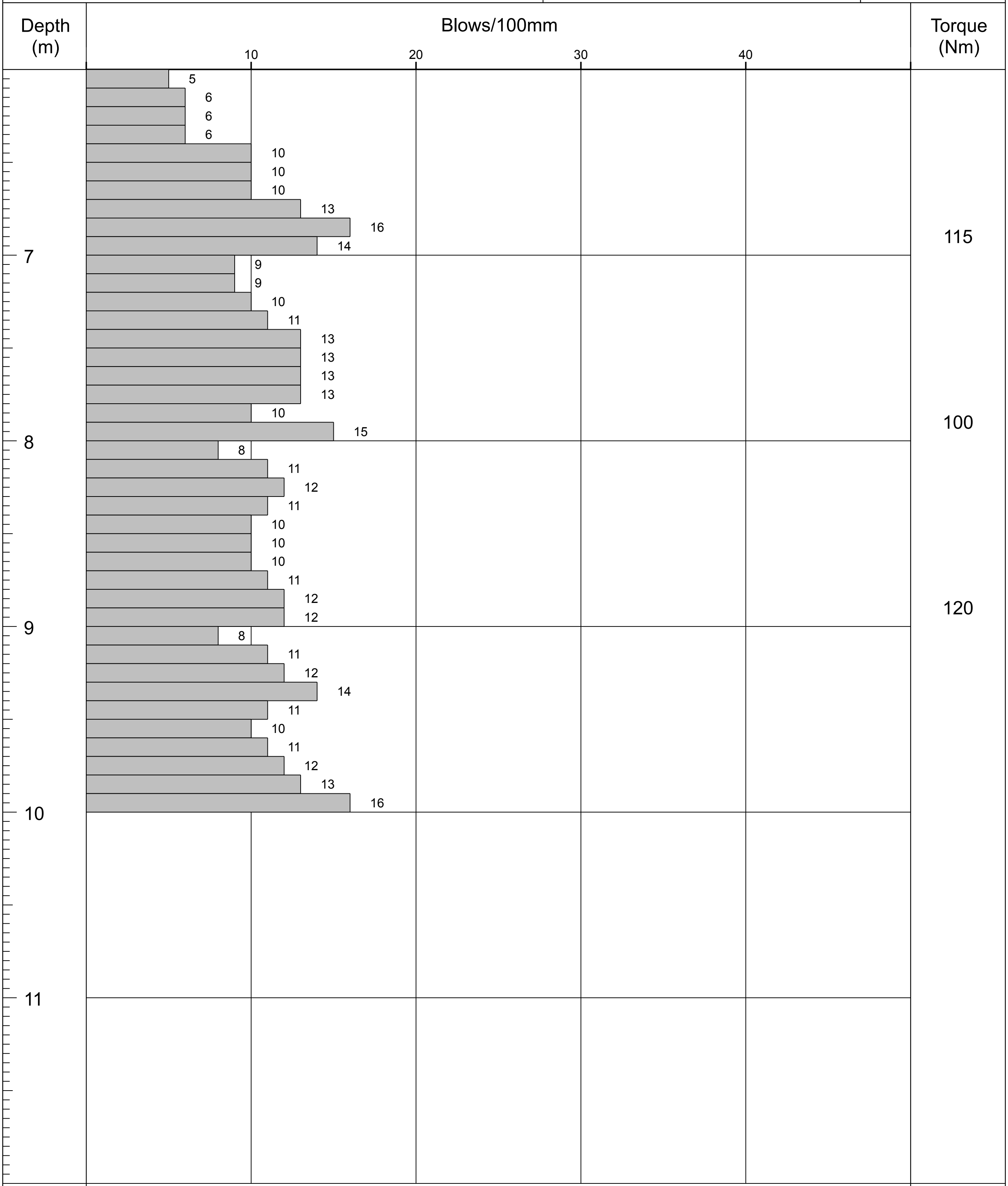
Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP129 Sheet 1 of 2
Location: Pinner Wood School		Level:	Hole Type DP
			Scale 1:30
Client: Peter Brett Associates		Dates: 08/08/2106	Logged By CG



Remarks:	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 10.00
	Probe Type DPSH-B	

Probe Log

endeavour drilling				Probe No DP129 Sheet 2 of 2
Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 08/08/2106	Logged By CG

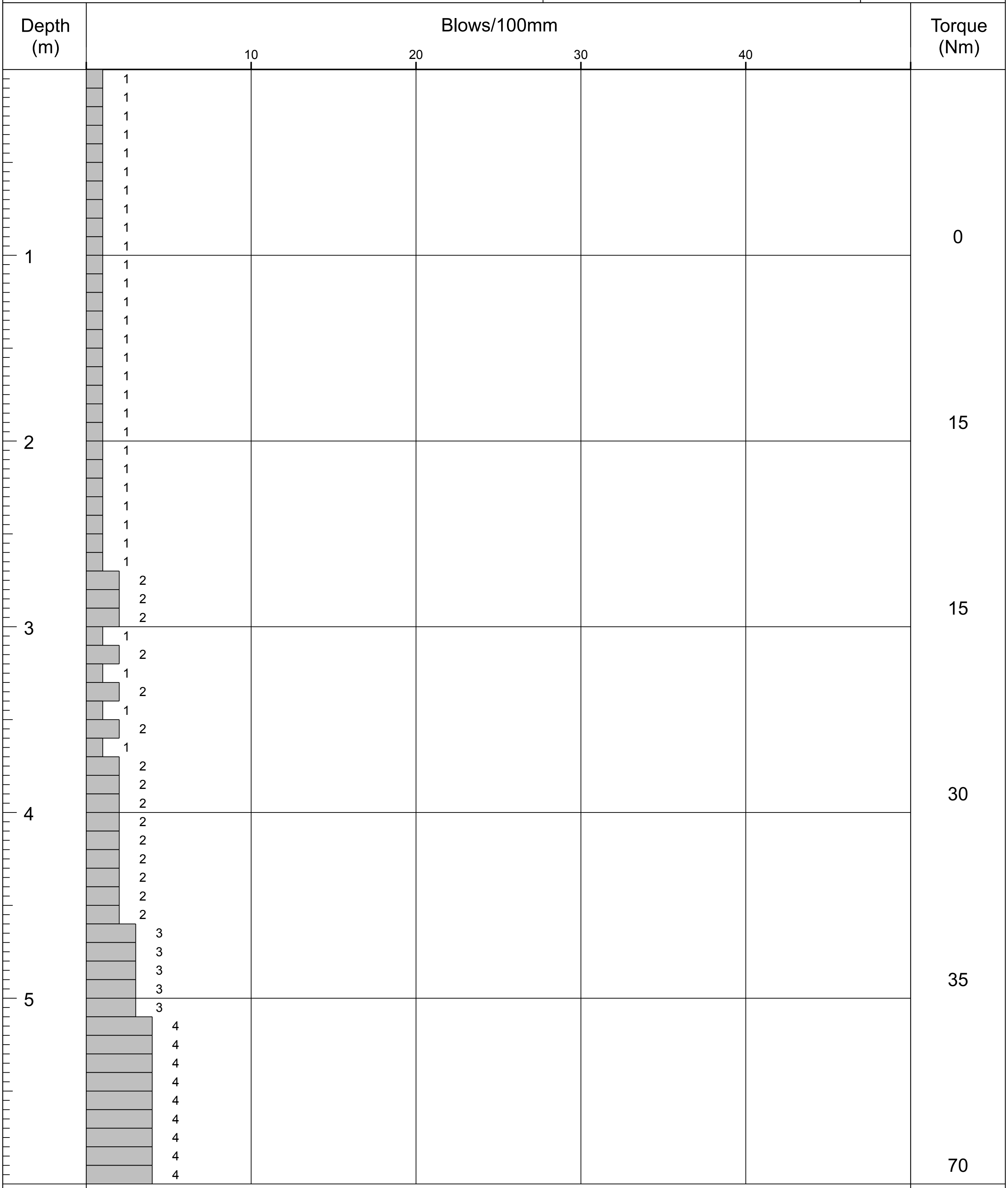


Remarks:	Fall Height	760	Cone Base Diameter	
	Hammer Wt	64	Final Depth	10.00
	Probe Type	DPSH-B		

AGS

Probe Log

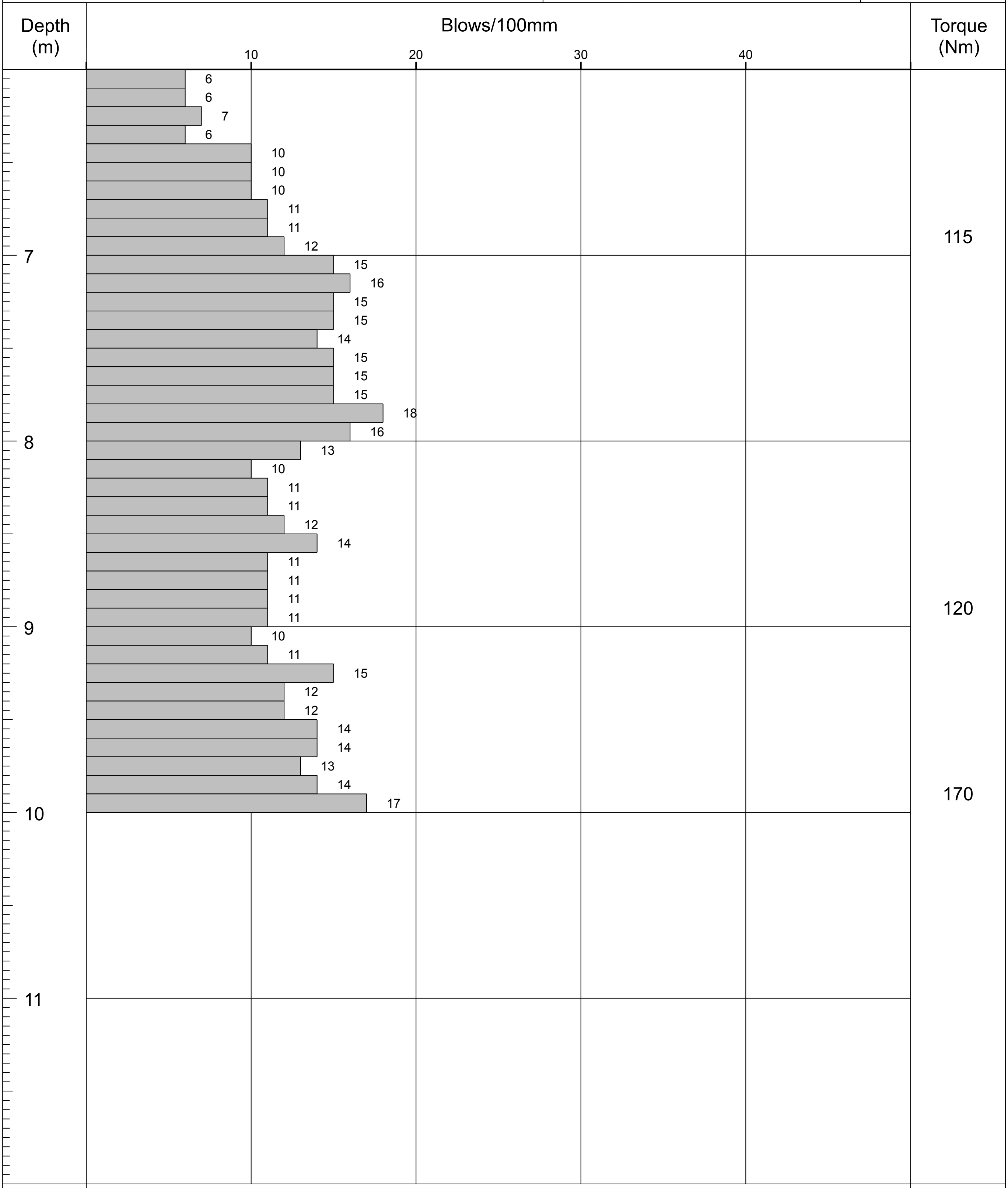
Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP130 Sheet 1 of 2
Location: Pinner Wood School		Level:	Hole Type DP Scale 1:30
Client: Peter Brett Associates		Dates: 08/08/2016	Logged By CG



Remarks:	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 10.00
	Probe Type DPSH-B	

Probe Log

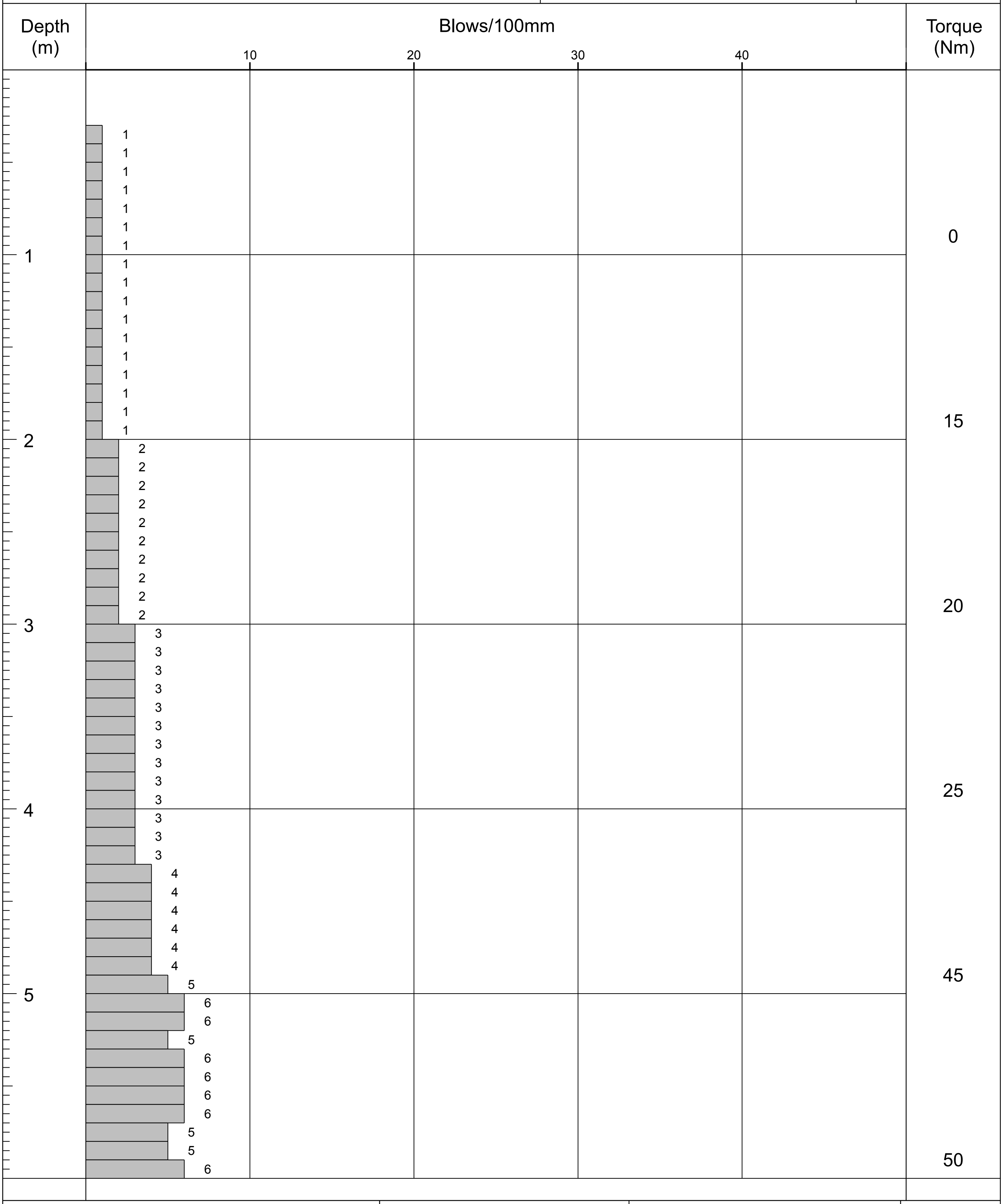
Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP130 Sheet 2 of 2
Location: Pinner Wood School		Level:	Hole Type DP Scale 1:30
Client: Peter Brett Associates		Dates: 08/08/2016	Logged By CG



Remarks:	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 10.00
	Probe Type DPSH-B	

Probe Log

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP131 Sheet 1 of 2
Location: Pinner Wood School		Level:	Hole Type DP
			Scale 1:30
Client: Peter Brett Associates		Dates: 09/08/2016	Logged By CG



Remarks: 1. Pre-cored to 0.30mbgl	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 7.80
	Probe Type DPSH-B	

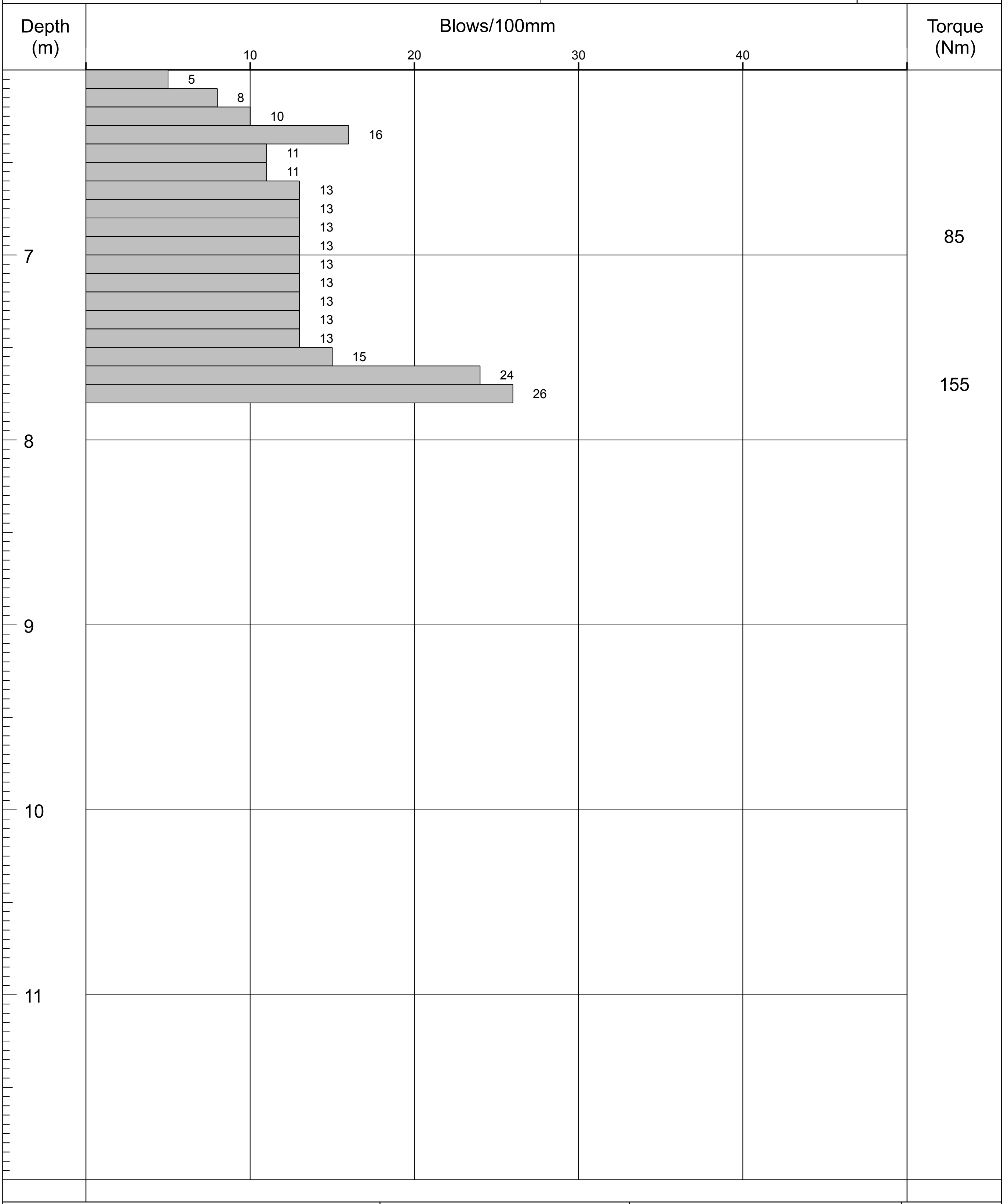
Probe Log

Probe No
DP131
Sheet 2 of 2

Project Name: Pinner Wood School
Project No. J3091
Co-ords:
Hole Type DP

Location: Pinner Wood School
Level:
Scale 1:30

Client: Peter Brett Associates
Dates: 09/08/2016
Logged By CG



Remarks:
1. Pre-cored to 0.30mbgl

Fall Height 760
Hammer Wt 64
Probe Type DPSH-B
Cone Base Diameter
Final Depth 7.80

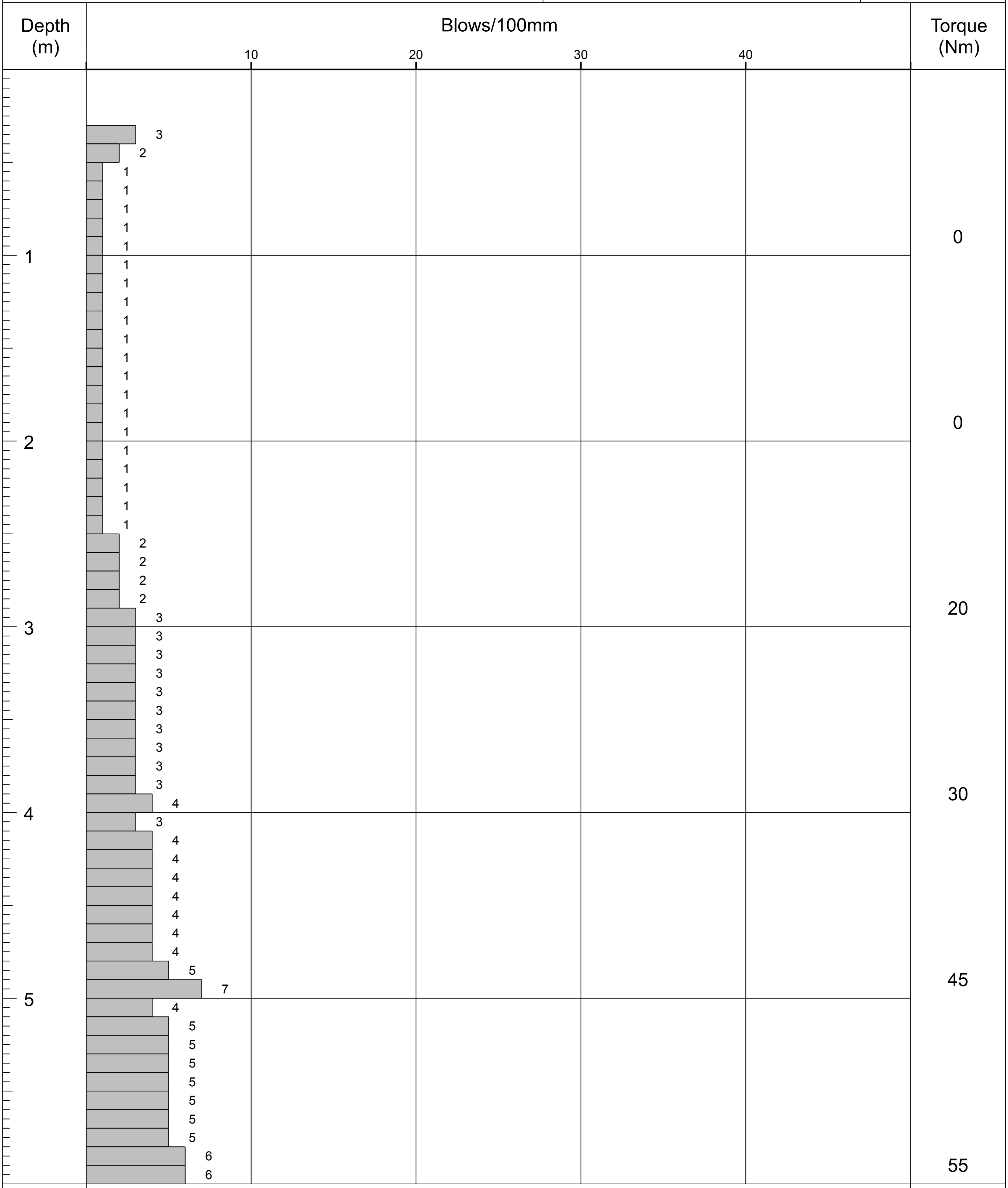
Probe Log

Probe No
DP132
Sheet 1 of 2

Project Name: Pinner Wood School
Project No. J3091
Co-ords:
Hole Type DP

Location: Pinner Wood School
Level:
Scale 1:30

Client: Peter Brett Associates
Dates: 10/08/2016
Logged By CG

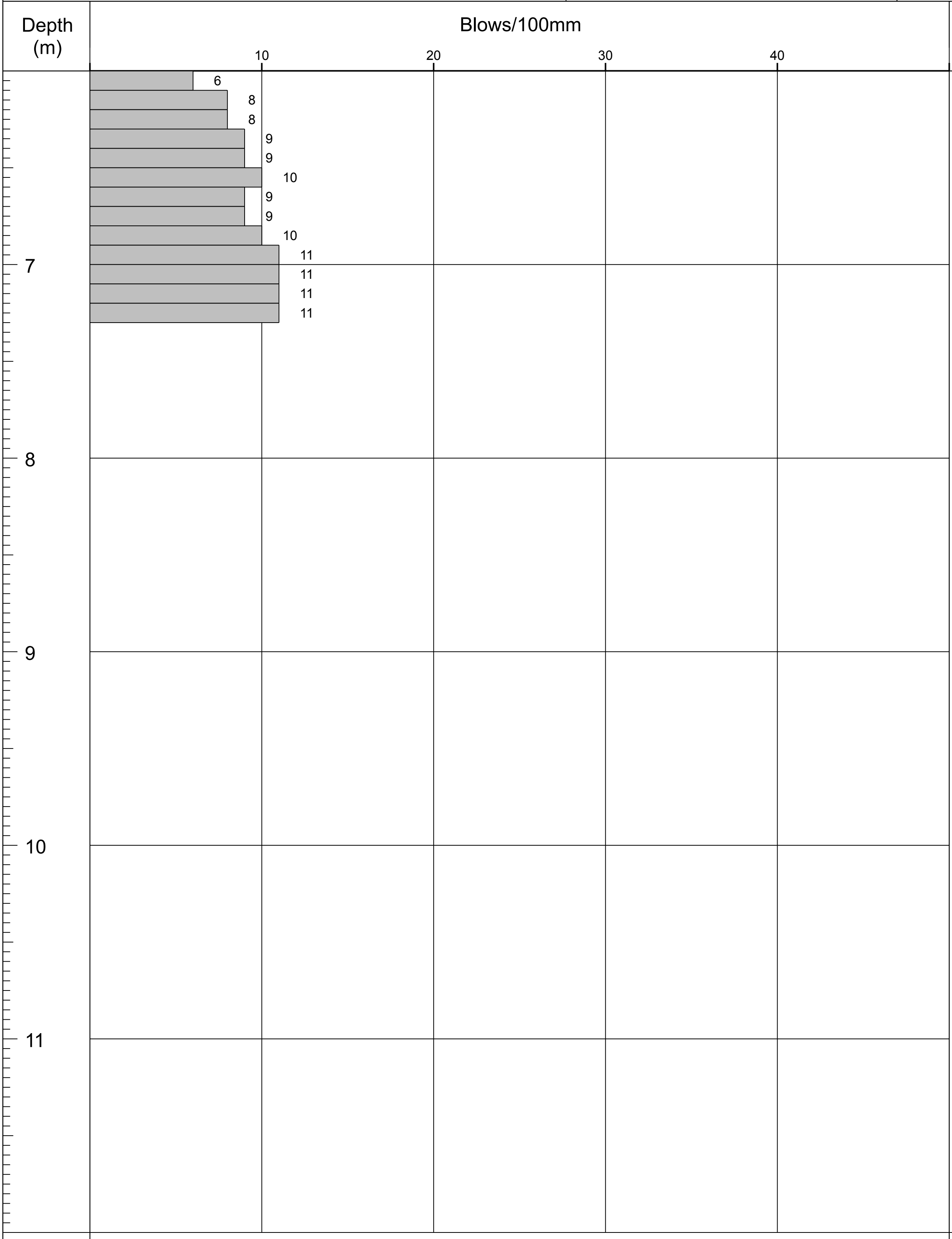


Remarks:
1. Pre-cored to 0.30mbgl

Fall Height 760
Hammer Wt 64
Probe Type DPSH-B
Cone Base Diameter
Final Depth 7.30

endeavour drilling	# Probe Log	Probe No DP132 Sheet 2 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:		Hole Type DP
Location:	Pinner Wood School		Level:		Scale 1:30
Client:	Peter Brett Associates		Dates:	10/08/2016	Logged By CG



Torque (Nm)

85

Remarks: 1. Pre-cored to 0.30mbgl	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 7.30
	Probe Type DPSH-B	

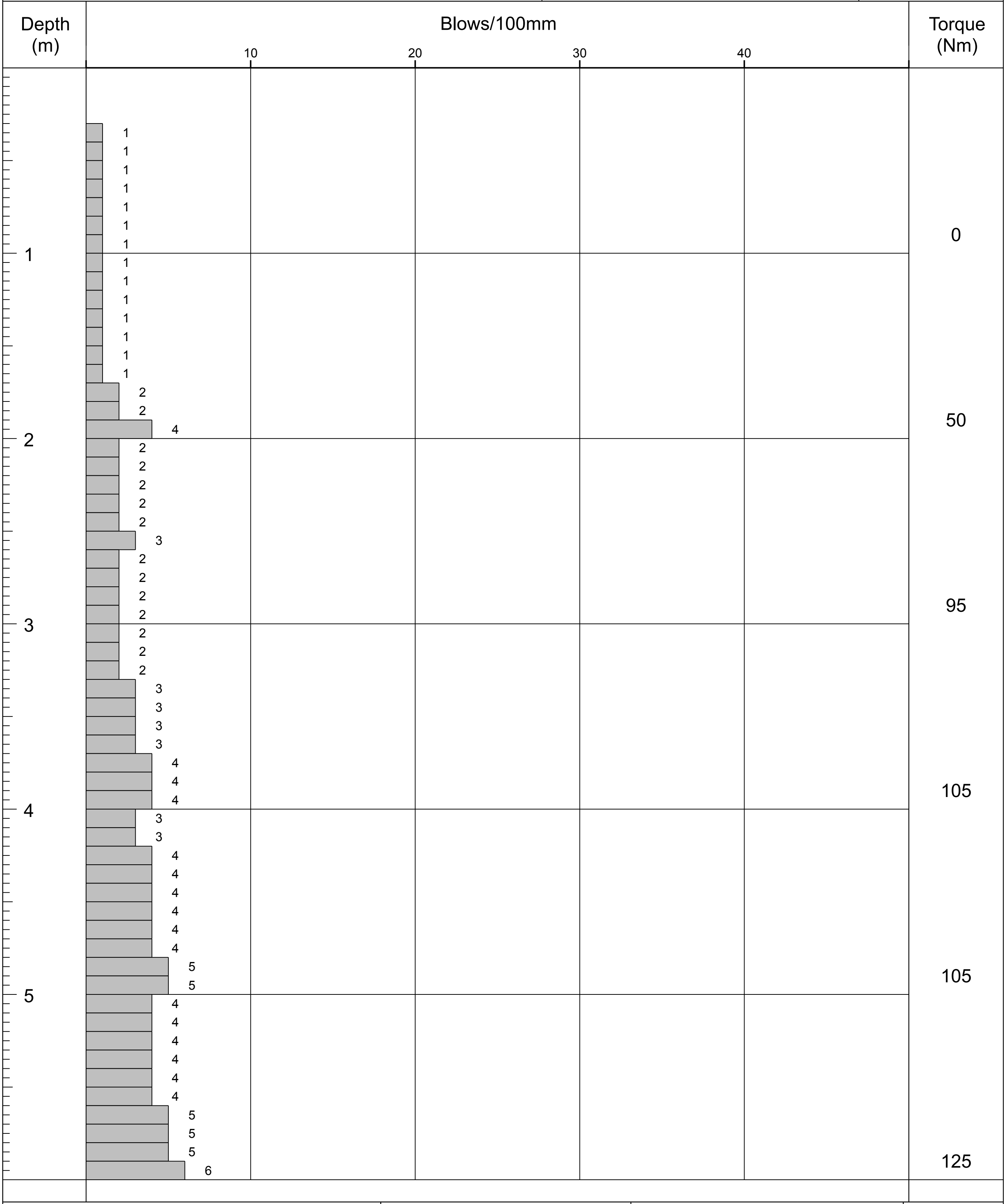
AGS

endeavour drilling

Probe Log

Probe No
DP133
Sheet 1 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 10/08/2016	Logged By CG



Remarks:
1. Pre-cored to 0.30mbgl

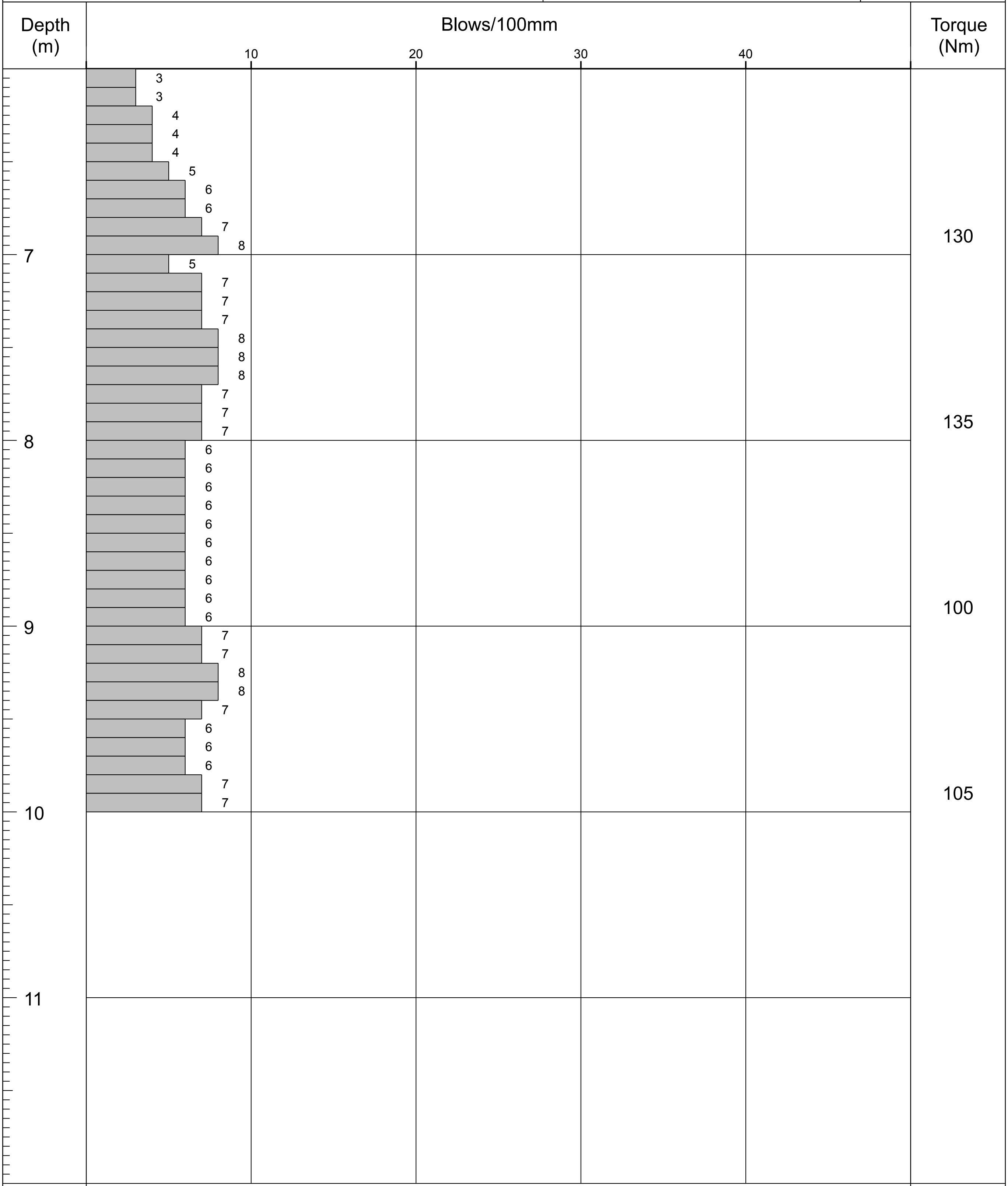
Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

AGS

Probe Log

Probe No
DP133
Sheet 2 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 10/08/2016	Logged By CG

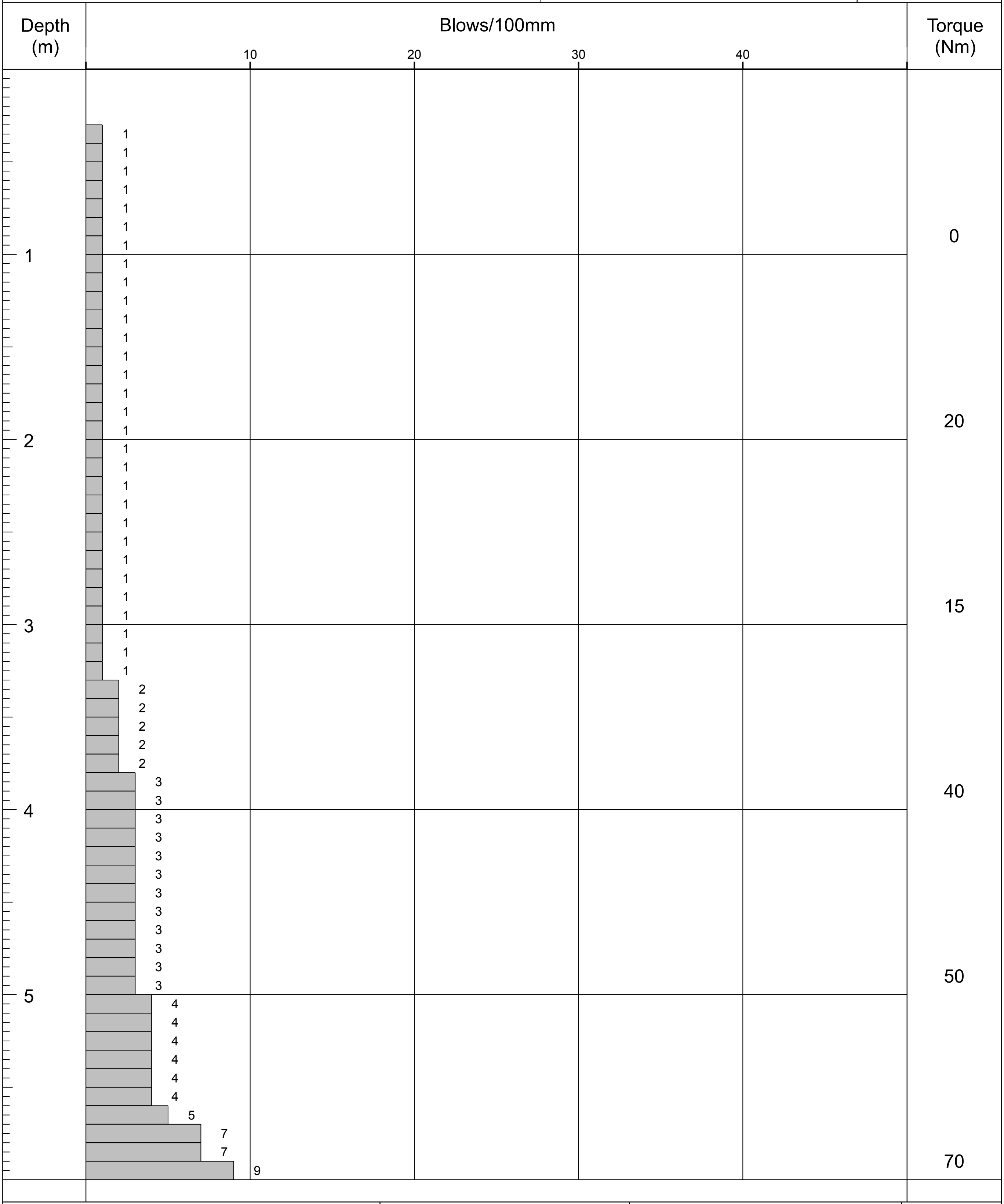


Remarks:
1. Pre-cored to 0.30mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

Probe Log

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP134 Sheet 1 of 2
			Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 10/08/2016	Logged By CG

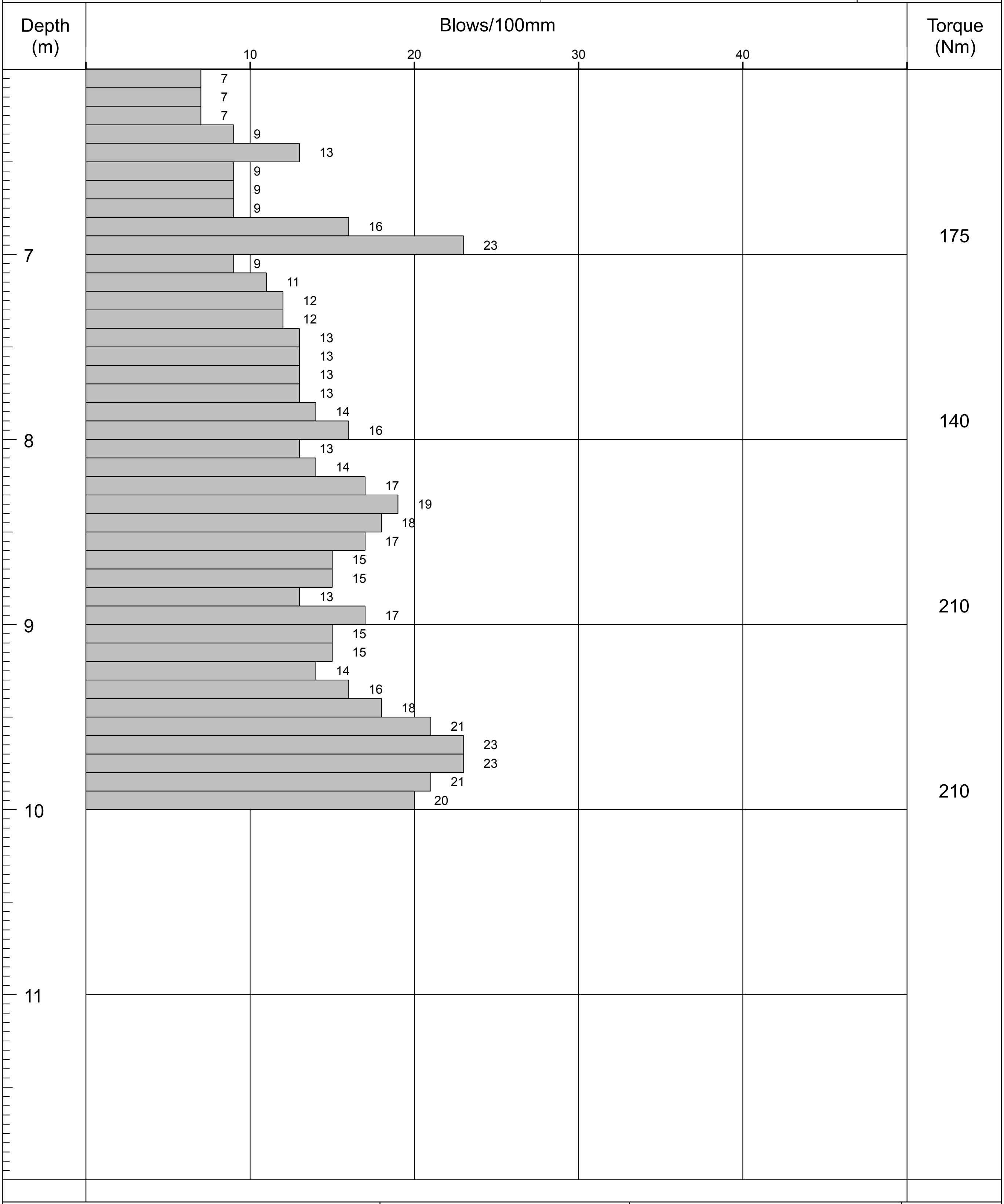


Remarks:
1. Pre-cored to 0.30mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

endeavour drilling	# Probe Log	Probe No DP134 Sheet 2 of 2

Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 10/08/2016	Logged By CG

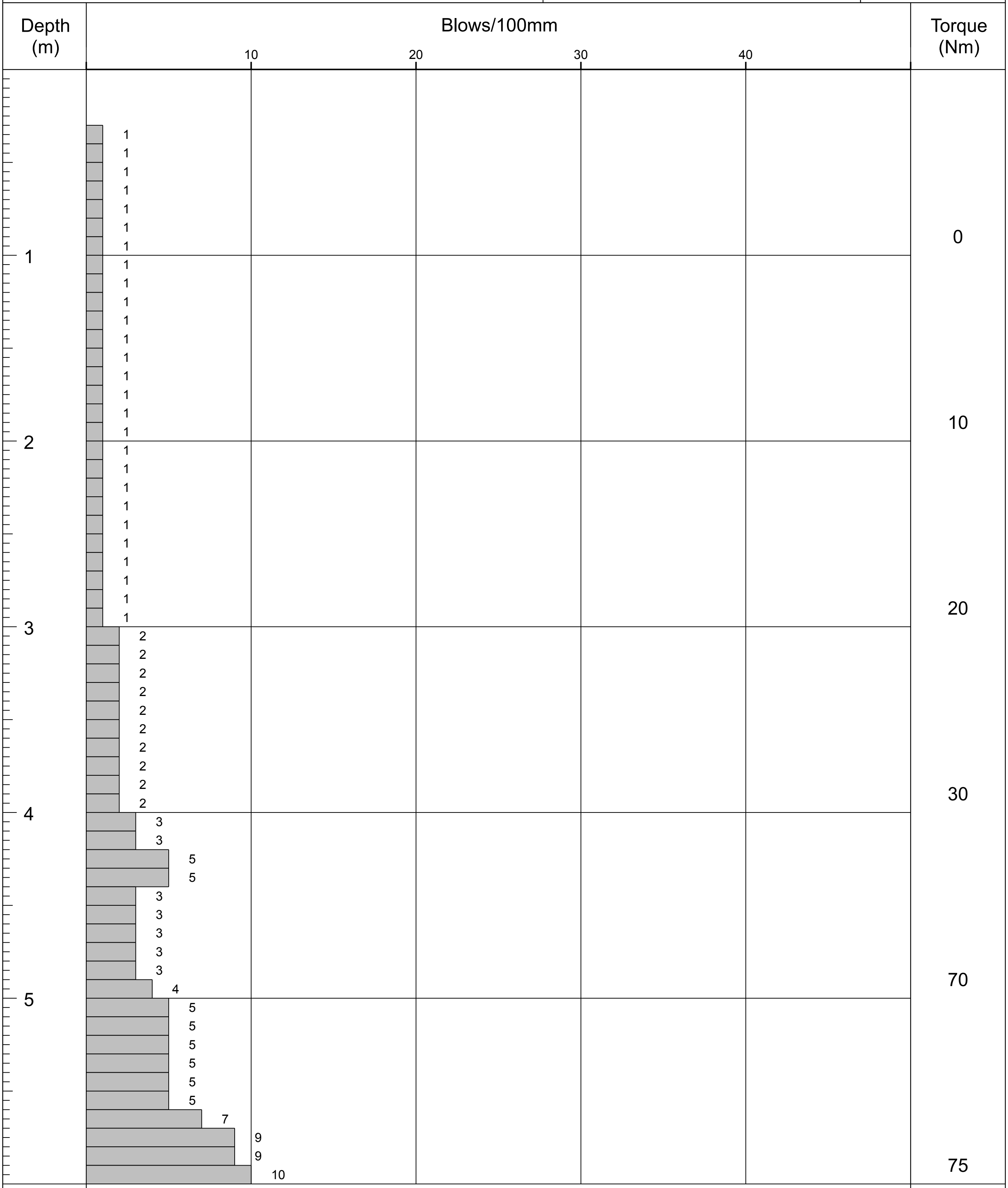


Remarks: 1. Pre-cored to 0.30mbgl	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 10.00
	Probe Type DPSH-B	

AGS

Probe Log

Probe No	DP135
	Sheet 1 of 2
Project Name:	Pinner Wood School
Project No.	J3091
Co-ords:	
Hole Type	DP
Location:	Pinner Wood School
Level:	
Scale	1:30
Client:	Peter Brett Associates
Dates:	09/08/2016
Logged By	CG



Remarks:
1. Pre-cored to 0.20mbgl

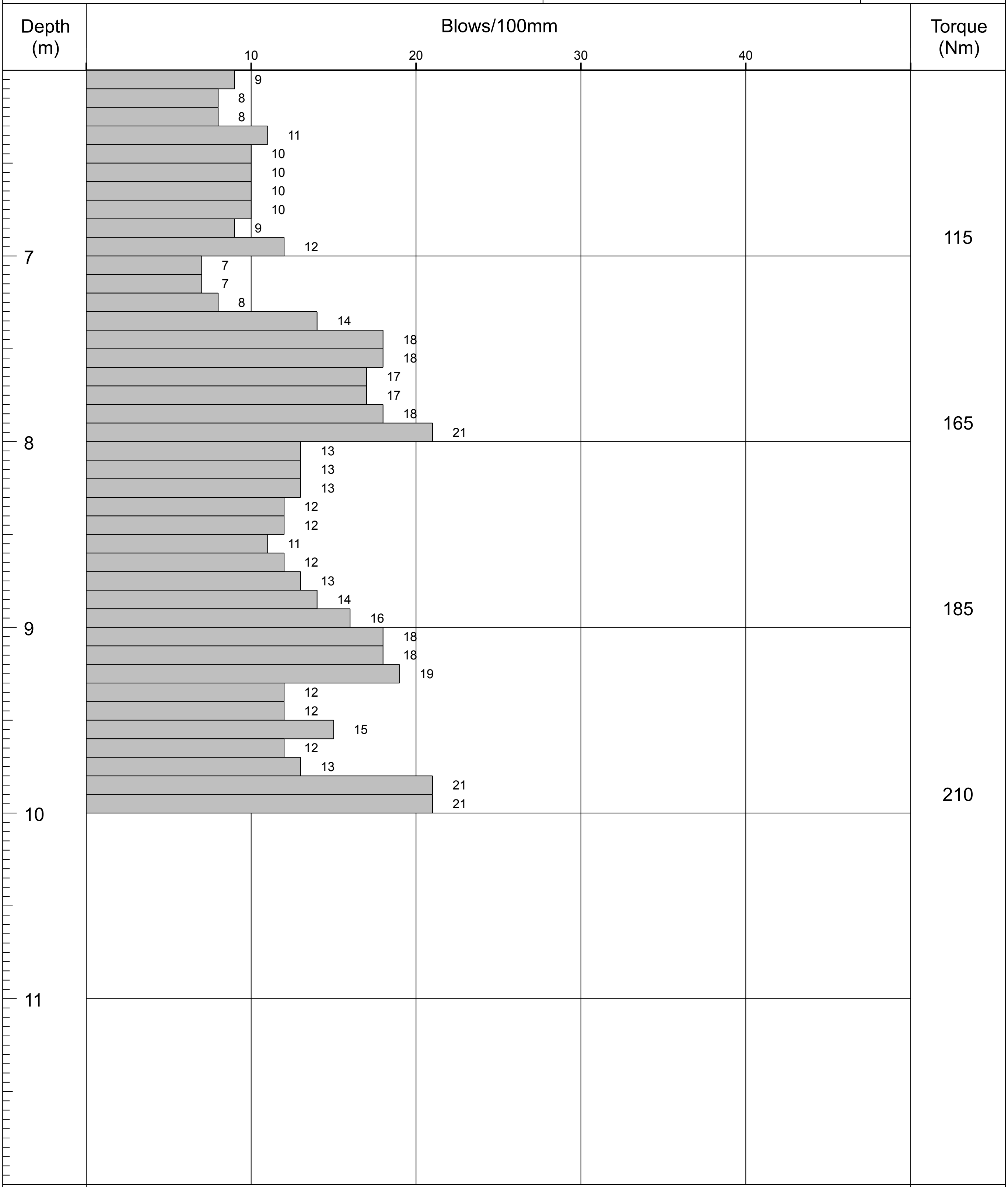
Fall Height	760
Hammer Wt	64
Probe Type	DPSH-B
Cone Base Diameter	
Final Depth	10.00

AGS

Probe Log

Probe No
DP135
Sheet 2 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 09/08/2016	Logged By CG



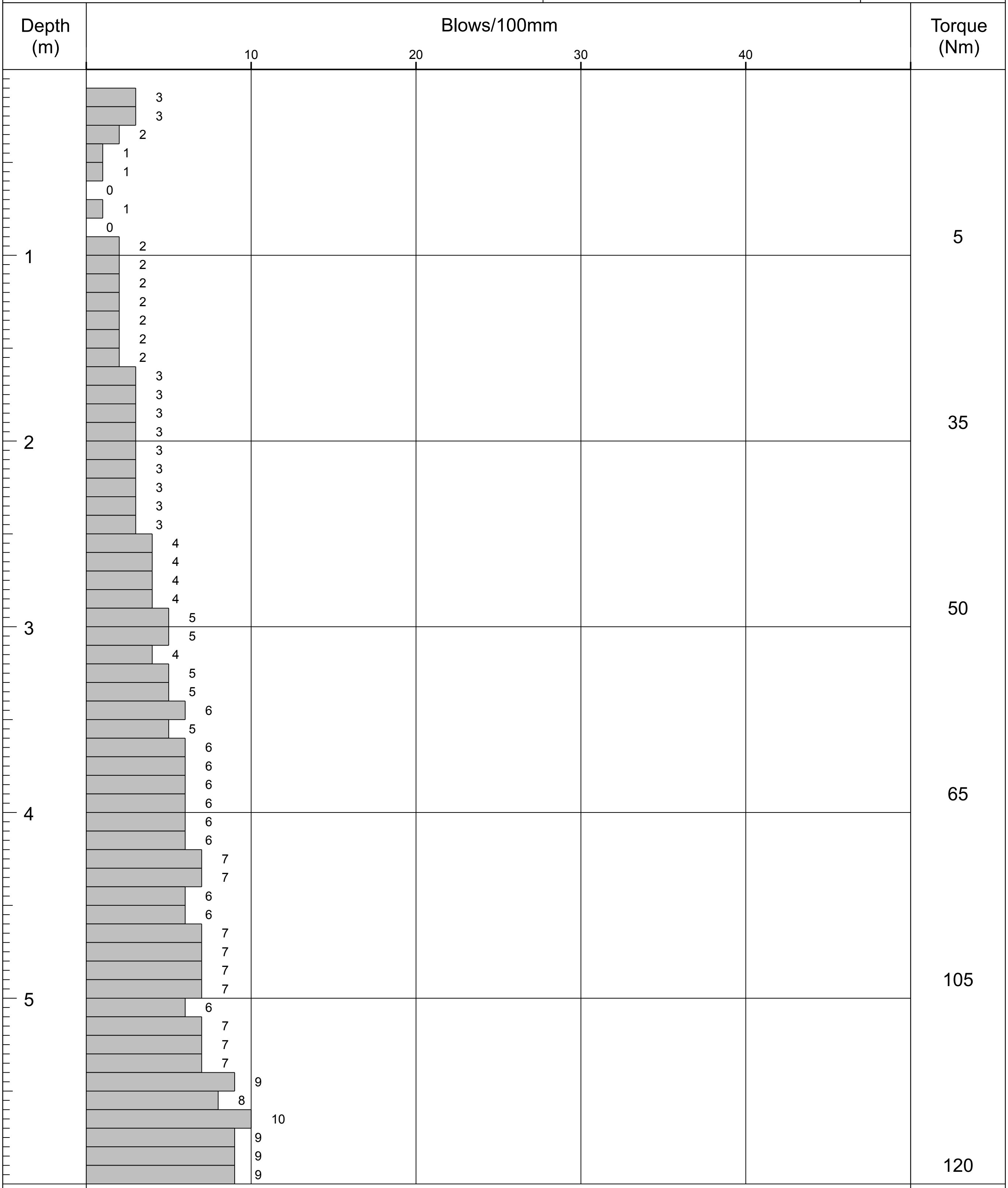
Remarks:
1. Pre-cored to 0.20mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

Probe Log

Probe No
DP136
Sheet 1 of 2

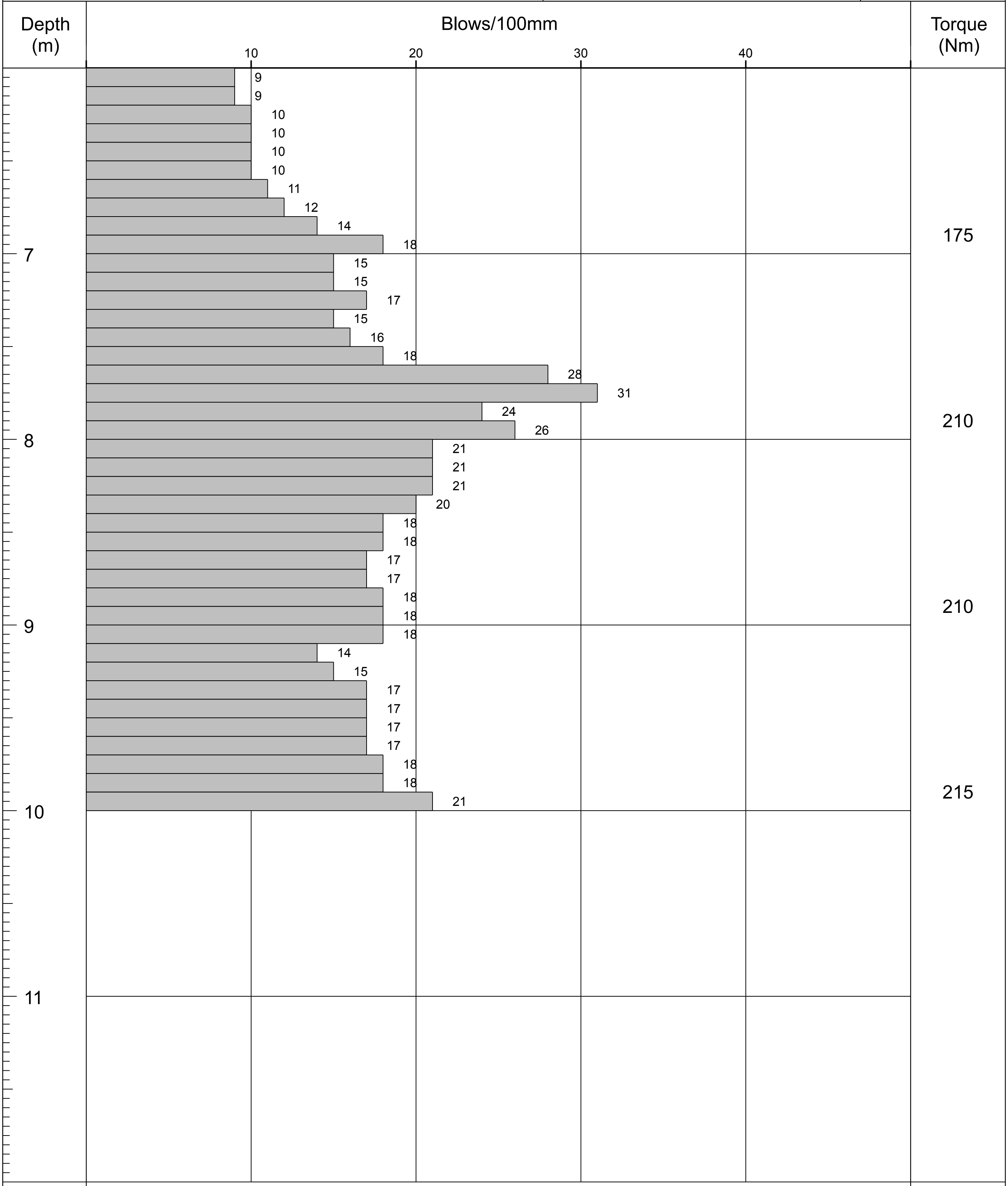
Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 22/08/2016	Logged By CG



Remarks: 1. Pre-cored to 0.10mbgl	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 10.00
	Probe Type DPSH-B	

Probe Log

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Probe No DP136 Sheet 2 of 2
Location: Pinner Wood School		Level:	Hole Type DP Scale 1:30
Client: Peter Brett Associates		Dates: 22/08/2016	Logged By CG

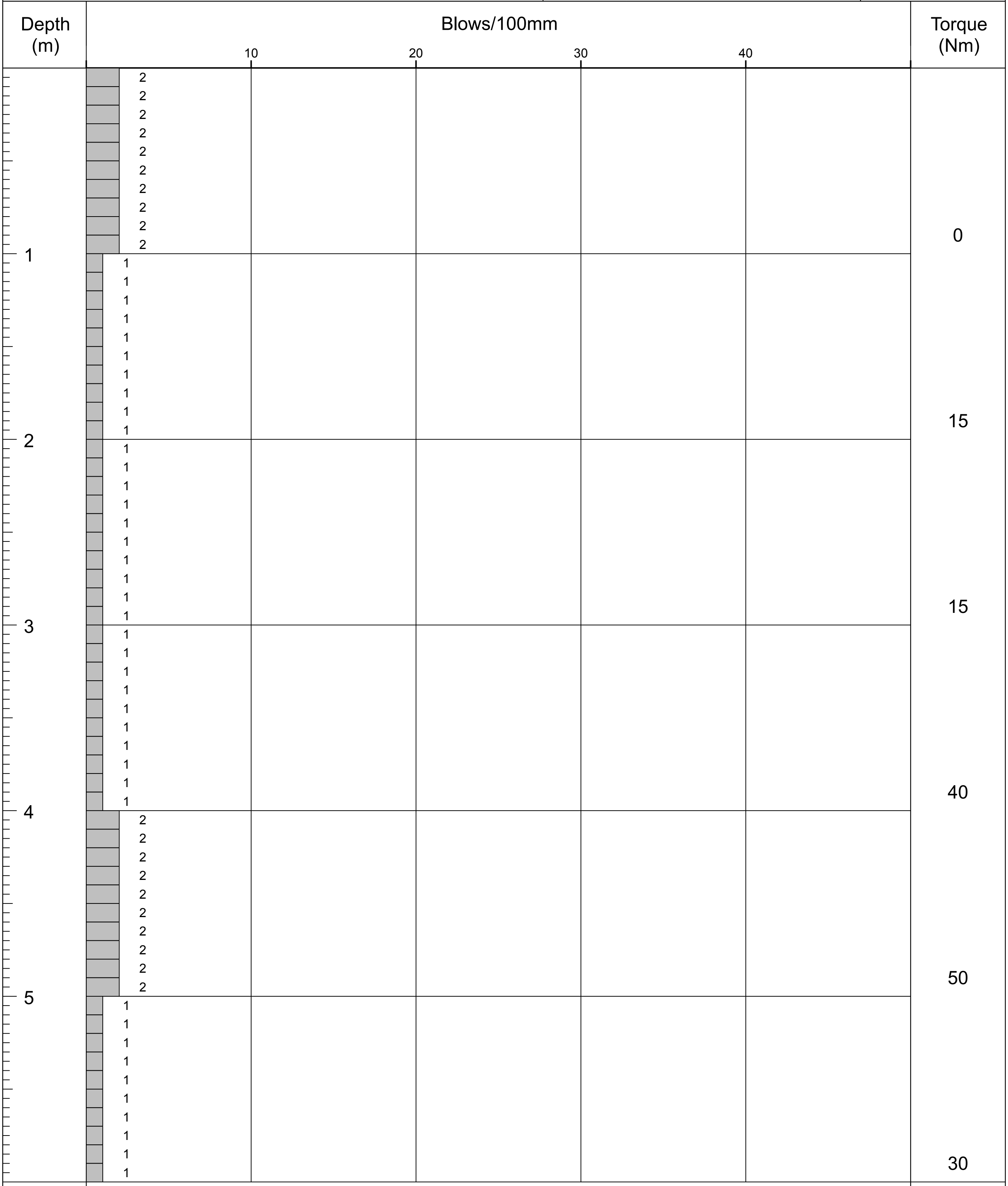


Remarks:
1. Pre-cored to 0.10mbgl

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	10.00
Probe Type	DPSH-B		

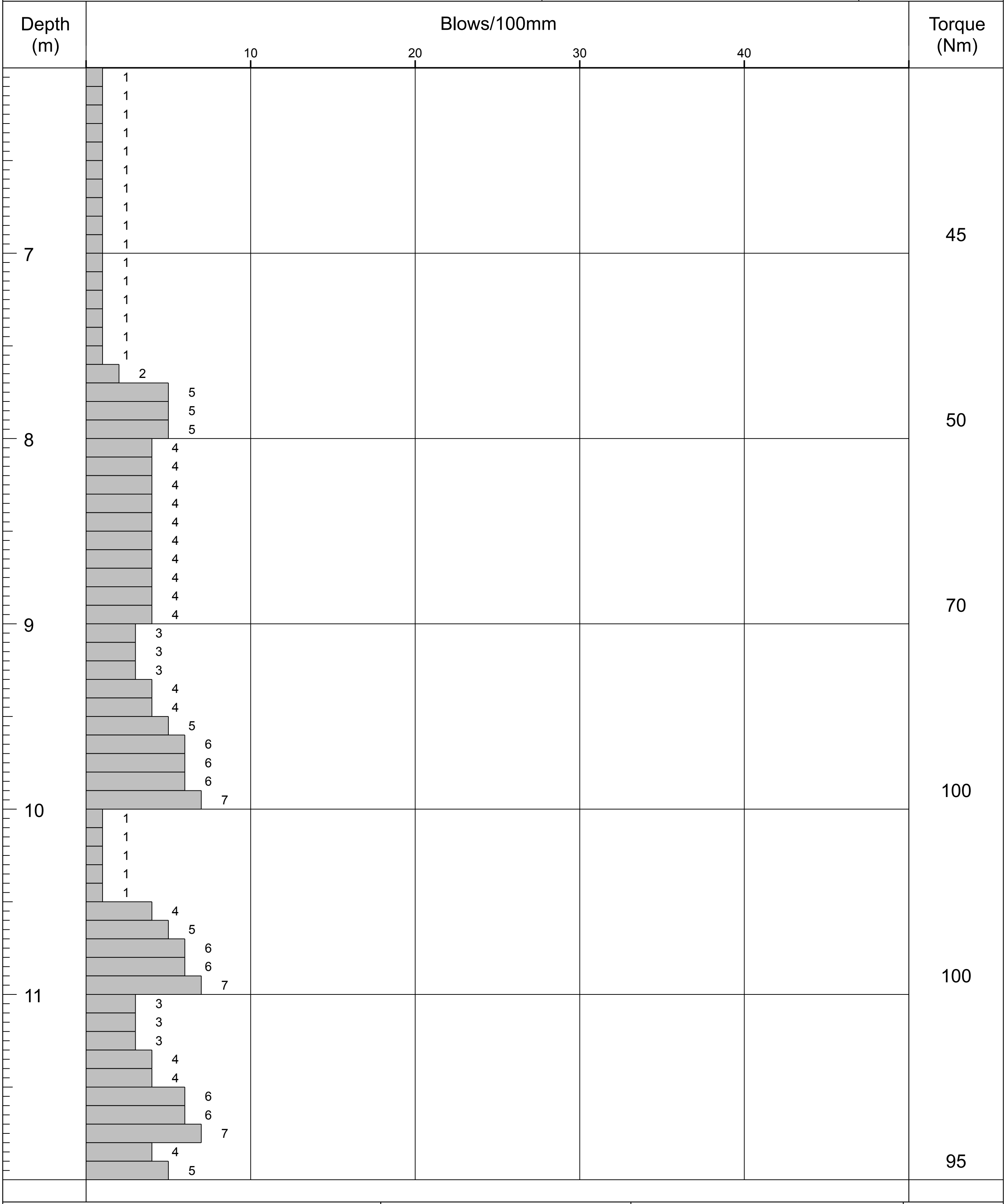
Probe Log

endeavour drilling			Probe No DP137 Sheet 1 of 3
Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 08/08/2016	Logged By CG



Remarks:	Fall Height 760	Cone Base Diameter
	Hammer Wt 64	Final Depth 14.00
	Probe Type DPSH-B	

endeavour drilling	Probe Log			Probe No DP137 Sheet 2 of 3
Project Name:	Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location:	Pinner Wood School		Level:	Scale 1:30
Client:	Peter Brett Associates		Dates: 08/08/2016	Logged By CG

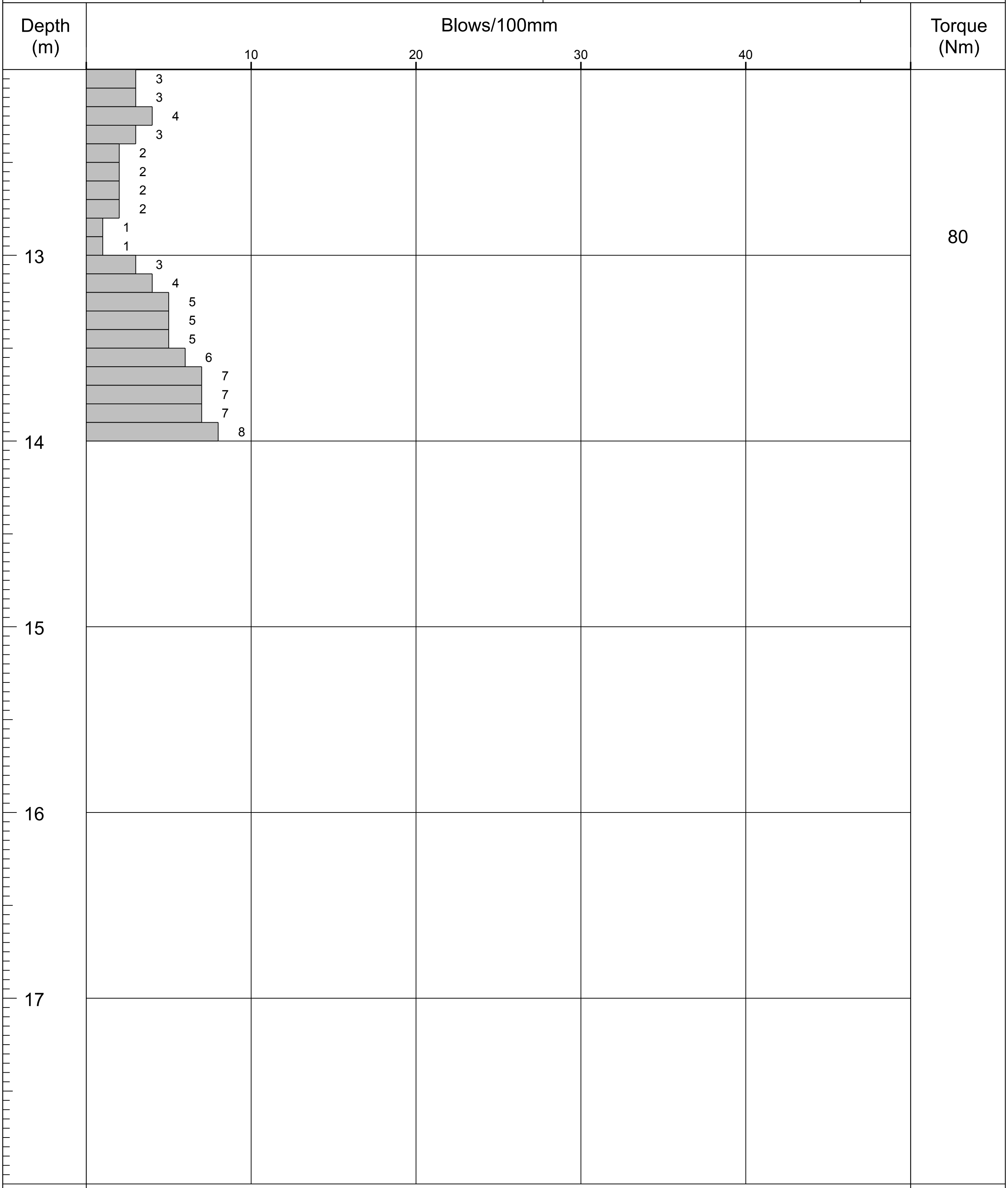


Remarks:	Fall Height 760	Cone Base Diameter	AGS
	Hammer Wt 64	Final Depth 14.00	
	Probe Type DPSH-B		

Probe Log

Probe No
DP137
Sheet 3 of 3

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 08/08/2016	Logged By CG



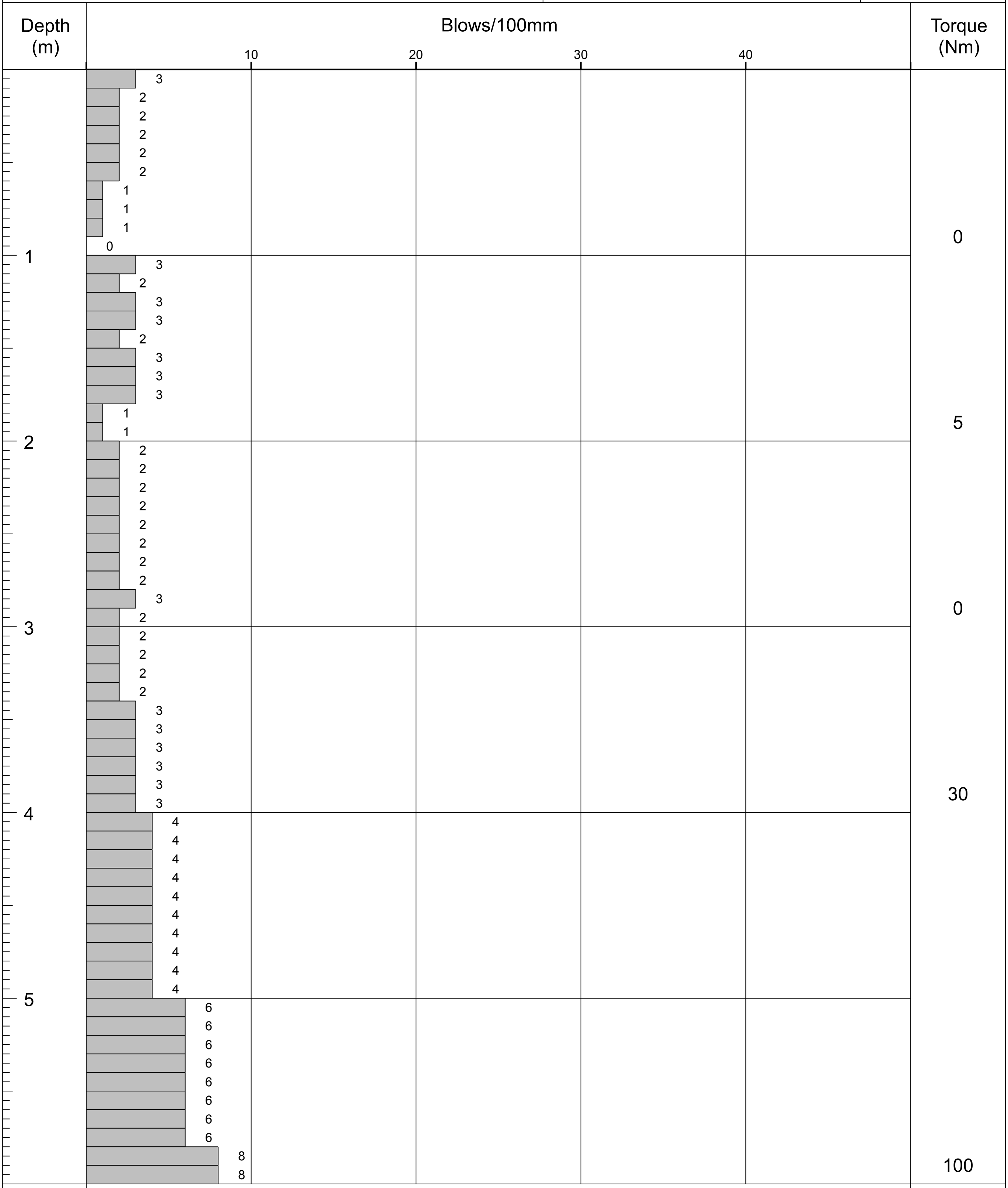
Remarks:

Fall Height 760
Hammer Wt 64
Probe Type DPSH-B
Cone Base Diameter
Final Depth 14.00

Probe Log

Probe No DP138
Sheet 1 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 19/08/2016	Logged By CG



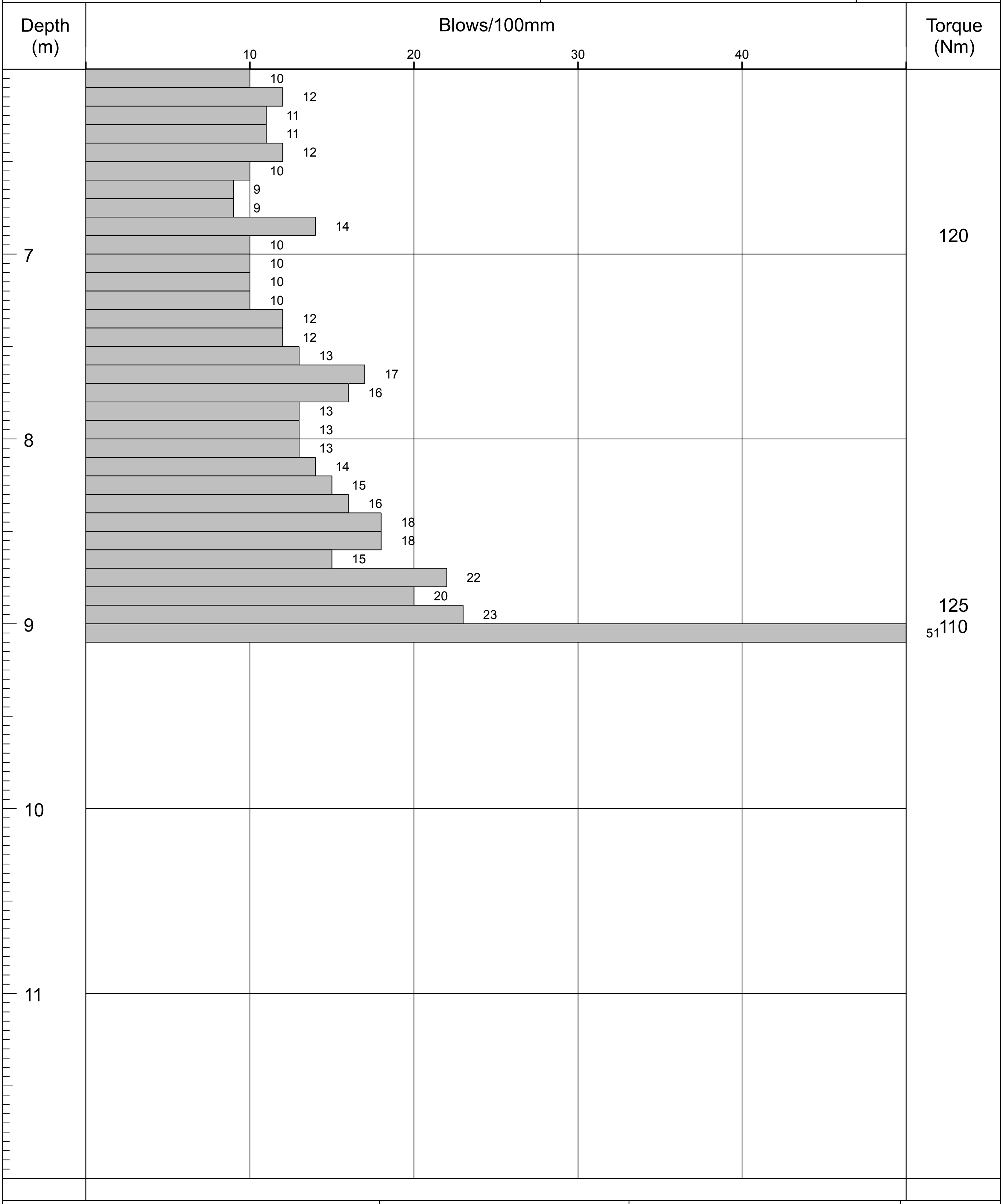
Remarks:

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	9.10
Probe Type	DPSH-B		

Probe Log

Probe No
DP138
Sheet 2 of 2

Project Name: Pinner Wood School	Project No. J3091	Co-ords:	Hole Type DP
Location: Pinner Wood School		Level:	Scale 1:30
Client: Peter Brett Associates		Dates: 19/08/2016	Logged By CG



Remarks:

Fall Height	760	Cone Base Diameter	
Hammer Wt	64	Final Depth	9.10
Probe Type	DPSH-B		

Appendix F

PBA, Ground Investigation Report, Report Number 35665/3502, dated October 2016

Pinner Wood School, Latimer Gardens, Middlesex HA5 3RA

Ground Investigation Report

On behalf of **Children's Capital Project Team, Harrow Council**

Project Ref: 35665/3502 | Rev: 0 | Date: October 2016

Document Control Sheet

Project Name: **Pinner Wood School, Latimer Gardens, Pinner, Middlesex HA5 3RA**

Project Ref: **365665/3502**

Report Title: **Ground Investigation Report**

Doc Ref: **R01/Rev00**

Date: **October 2016**

	Name	Position	Signature	Date
	Claire Walton	Engineer		06/10/2016
Reviewed by:	Stuart Chandler	Associate	Chandler	06/10/2016
Approved by:	Clive Edmonds	Partner	Clive Edmonds	06/10/2016
For and on behalf of Peter Brett Associates LLP				

Revision	Date	Description	Prepared	Reviewed	Approved
Rev0	Oct 2016	Final	CW	SJC	CNE

This report has been prepared by Peter Brett Associates LLP ('PBA') on behalf of its client to whom this report is addressed ('Client') in connection with the project described in this report and takes into account the Client's particular instructions and requirements. This report was prepared in accordance with the professional services appointment under which PBA was appointed by its Client. This report is not intended for and should not be relied on by any third party (i.e. parties other than the Client). PBA accepts no duty or responsibility (including in negligence) to any party other than the Client and disclaims all liability of any nature whatsoever to any such party in respect of this report.

Contents

Figures

Tables

1.0 Introduction

Peter Brett Associates LLP (PBA) has been commissioned by the Children's Capital Project Team, Harrow Council (the Client), to prepare a Ground Investigation Report to assess the geological profile of the area following a ground collapse at Pinner Wood School, Pinner.

Following the ground collapse, the collapse feature was quickly backfilled by Harrow Council with a free draining aggregate and the immediate area was fenced off. An initial ground investigation was carried out by The Environmental Protection Group Ltd (EPG) which subsequently carried out 9 dynamic probes around the ground collapse and produced full ground investigation report dated 5 September 2015 (Ref: EPG/2015/PWS/Q3/L1). Subsequently RSK Environment (RSK) carried out a geophysical investigation over a wider area of the site (Ref: 191236 – R01 (00) dated October 2015) using Ground Penetrating Radar (GPR) and Electromagnetic Conductivity Mapping (EM).

This report has been prepared following a further intrusive investigation, carried out to provide information on the ground conditions paying particular attention to the anomalies identified by RSK through the geophysical investigation.

The fieldwork was carried out by Endeavour Drilling acting under the instruction and technical direction of PBA. The factual results of the investigation are presented in a separate report prepared by Endeavour Drilling (Endeavour 2016). Unless stated otherwise, detailed information from the ground investigation has not been included in this report and, where referenced, the Endeavour Drilling report that presents this information should be read in conjunction with this report.

Guidance on the context of this report and any general limitations or constraints on its content and usage are given in a guidance note included after the text of this report.

2.0 The Site

2.1 Site Location

The centre of the site is located at approximate National Grid Reference TQ 111 906. It is located north of Latimer Gardens, Pinner, Middlesex and approximately 1km north-east of Northwood Hill Station. The location of the site is presented as **Figure 1.**

The site is being used as a primary school, with one main building surrounded by playgrounds covered in tarmac and playing fields covered with grass. The site is accessed by the main gates from Latimer Gardens on the eastern boundary with a smaller secondary entrance on the south-east corner of the site, also off Latimer Gardens. Another part of the car park is currently cordoned off with hoarding (as seen in **Figure 2**) prior to groundworks occurring by the Council, although access was available for the investigation.

The ground level on the site is between 70m and 80m AOD with the highest elevation north of the site and the lowest to the south.

The current layout of the site is shown on the Site Layout Plan presented as **Figure 2** of this report.

2.2 Site History

The site remained undeveloped and was used as agricultural land until the school, that is currently present on the site, was built in circa 1935. The school has undergone various alterations over time.

During the Second World War four air raid shelters were constructed on site along the eastern boundary in the playing fields and car park. These were subsequently backfilled, although it is not known when (**Figure 2)**.

This area of Pinner started to develop from the 1930's with residential developments to the south and west of the site. In the 1960s further residential developments to the east and north of the site were constructed.

The area surrounding Pinner is known to have been a historical centre for chalk mining, mainly using the mined chalk to produce lime for agricultural use. There are some known mining cavities located within the wider vicinity of the site as discussed in Section 2.6.

2.3 Surface Collapse

In August 2015 an unexpected ground collapse occurred within the car park to the east of the school building.

The collapse measured 3m in diameter and 2m in depth, the location of the feature is displayed in **Figure 2.** It is understood that the feature was backfilled, by Harrow Council, with loose free draining aggregate. The aggregate was end-tipped and as such is not compacted. Since the infill of the collapse the feature has settled it has been necessary to refill it over time. An electrical service cable was found traversing the feature and was still connected when the collapse occurred. It is not known if any damage was sustained to the cable during the collapse or backfilling.

At the time of the current investigation the feature was about 3m in diameter and had settled approximately 120mm from the original backfilled level. The electrical cable seen within the collapse was also detected along with a foul water sewer running along the southern edge of the feature.

2.4 Geology

The 1:50,000 scale geological map of the area (Sheet 256, BGS, 2006) indicates the site is underlain by the London Clay Formation (~10m thick), overlying the Lambeth Group (~10m thick) and Seaford and Newhaven Chalk Formation at 20-25m bgl. The Hertfordshire Puddingstone lies towards the base of the Lambeth Group around 1.5m above the top of the Chalk and forms a dense cemented layer.

2.5 Hydrogeology

The hydrogeological map of Cambridge and Maidenhead, Sheet 14 (BGS, 1984) indicates that the groundwater level in the Chalk to be at 20m to 30m AOD. As such the groundwater level in the Chalk aquifer is in excess of 40m below the existing ground level.

The “What’s in your backyard” website hosted by the Environment Agency has been consulted to further define the hydrogeological character of the site area. Available groundwater maps show that the site is within a Zone 3 (Total Catchment) Groundwater Source Protection Zone. This is defined as “the area around a source within which all groundwater recharge is presumed to be discharged at the source”. Therefore, the groundwater below the site does not lie in close proximity to any water supply sources, simply forming broad scale background recharge to the underlying aquifers.

2.6 Natural and Mining Cavities

The Natural and Mining Cavities Database maintained and updated by PBA have been searched for relevant natural and mining cavity results.

A search of the PBA Natural Cavities Database indicated that there is one natural cavity location recorded within 500 m of the site centre, as shown in the Table 2.1 below. The recorded location is given as Pinner Mine, which is referenced in the data in the mining cavities search.

Table 2.1 Results of PBA Natural Cavities Database Search

Approximate NGR	Approximate distance from site centre (m)	Recorded Location	Geology	Natural Cavity Details	Source
TQ 115 905	410 ESE	Pinner Mine, Blythwood Road / Norman Crescent, Pinner, Hertfordshire	**Superficial:** Worked Ground **Solid:** London Clay Formation, Lambeth Group, Chalk Group	4 x Solution Pipes	*Edmonds, C.N. (1987) The engineering geomorphology of karst development and the prediction of subsidence risk upon the chalk outcrop in England. Unpublished PhD thesis. University of London.*

A search of the PBA Mining Cavities Database indicated that there are five recorded man made cavity locations within 500 m of the site centre, as shown in Table 2.2.

Table 2.2 Results of PBA Mining Cavities Database Search

Approximate NGR	Approximate distance from site centre (m)	Recorded Location	Geology	Mining Cavity Details	Source
TQ 111 908	200 N	Pinner Hill Road / Albury Drive / South Way, Pinner	**Solid:** London Clay Formation, Lambeth Group, Chalk Group	'Pinner Hill Road Mine' Shaft Entry Pillar & Stall Chalk Mine	*Chelsea Speleological Society, Volume(s): 11 page(s) : 51-52, 54, Ground Engineering Ltd*
TQ 110 908	220 NNW	Pinner Hill Road / Potter Street, Pinner	**Solid:** London Clay Formation, Lambeth Group, Chalk Group	'Pinner Hill Road Mine' Shaft Entry Pillar & Stall Chalk Mine	*Chelsea Speleological Society, Volume(s): 11 page(s) : 51,53-54, Ground Engineering Ltd*
Centred at TQ 114 906	300 E	Norman Crescent / Jubilee Close	**Superficial:** Worked Ground **Solid:** London Clay Formation, Lambeth Group, Chalk Group	'The Dingle / Pinner Mine' Shaft Entry Pillar & Stall Chalk Mine	*Ground Engineering Ltd, NHBC, Mike Rosenbaum Imperial College, Fieldwork*
TQ115 905	410 ESE	Adjacent to Montesole Playing Fields, A404 Uxbridge Road, Pinner	**Superficial:** Worked Ground **Solid:** London Clay Formation, Lambeth Group, Chalk Group	'Uxbridge Road Mine' shaft Entry Pillar & Stall Chalk Mine-Mined Ground	*Chelsea Speleological Society, Volumes(s): 14 page(s) : 32-34*
Centred at TQ 116 906	500 E	The Dingle, Near A404 Uxbridge Road, Pinner	**Superficial:** Worked Ground **Solid:** London Clay Formation, Lambeth Group, Chalk Group	'The Dingle / Pinner Mine' Shaft Entry Pillar & Stall Chalk Mine	*Ground Engineering Ltd, NHBC, Mike Rosenbaum Imperial College, Fieldwork*

No records could be found relating to historical chalk mine workings directly below Pinner Wood School, however the absence of such records should not be considered as being conclusive.

3.0 Ground Investigation

3.1 Initial Ground Investigation (August 2015)

Harrow Council appointed The Environmental Protection Group Ltd (EPG) to complete an initial ground investigation around the collapse. This was carried out in August 2015 with the results presented in a letter to Harrow Council (Ref: EPG/2015/PWS/Q3/L1 5 September 2015). At Harrow Councils request PBA have also completed a letter report on these results with further interpretation (Ref: CBH/CNE/SJC/35665 dated 15 September 2015).

During this investigation 9 dynamic probes were completed in and around the collapse. PH7 was completed within the original collapse and indicated low strength ground to 17m bgl before increasing in strength. Between 22-24m bgl low strength ground was again encountered. PH1 to PH6 were located around the initial collapse and were completed to depth of between 10 and 17m bgl. PH8 and PH9 were completed within the car park area. Whilst these probes did not show weak ground they did not reach the chalk where the location of the void encountered in the 2016 ground investigation was located.

3.2 Geophysical Investigation

In September 2015 RSK carried out a geophysical investigation of the site to detect the presence of voids or disturbed ground present that might be associated with historical chalk mine workings within the survey area (Ref: 191236- R01 dated 9 October 2015). PBA has provided a letter with an interpretation of the geophysical survey (Ref: CBH/CNE/SJC/35665, dated 21 October 2015). **Figure 2** shows the anomalies picked up by the geophysical survey.

The survey methods used for the geophysical investigation picked up multiple discrete isolated GPR anomalies, a number of discrete EM anomalies and a series of locations where both the GPR and EM anomalies were coincident.

The results of the GPR survey were processed and interpreted into three anomaly types:

- Anomaly type A – Indicative of possible voiding or conductive ground conditions
- Anomaly type B – Indicative of buried obstruction or strata boundary
- Anomaly type C – Indicative of disturbed ground

The results of the EM survey were processed and interpreted into two anomaly types:

- Anomaly type A – Possible linear buried metallic service
- Anomaly type B – Indicative of a change in ground condition

3.3 Recent Ground Investigation (August 2016)

PBA coordinated further investigations of the site in August 2016, with site works being carried out by Endeavour Drilling.

The ground conditions on the site have been investigated by intrusive ground investigation techniques to provide additional information about the geophysical anomalies located by RSK (2015). The scope of the works undertaken are summarised in the following sections of this report.

3.3.1 Aim of the investigation

The aim of the investigation was to determine the general ground conditions at the site to clarify the geological model of the site, with particular attention to the areas where the GPR and EM anomalies were identified in the RSK report.

3.3.2 Fieldwork

The fieldwork for the ground investigation was carried out between 8 and 26 August 2016. The investigation comprised of sinking three deep hollow stem auger boreholes designated BH101 to BH103; thirty-eight super heavy dynamic probes designated DP101 to DP138 and fifteen window sample boreholes designated WS101 to WS115.

The deep boreholes were sunk using a hollow stem auger to between 26.3m and 30.3m below ground level (bgl) and the window sample boreholes were sunk using driven sampling techniques to between 6.45m and 11.45m depth. The boreholes were carried out to provide information on the deep geological conditions.

In both types of boreholes, the geological conditions were investigated by the recovery of disturbed samples and standard penetration tests (SPT).

Super heavy weight dynamic probing (dynamic probes) consists of driving a rod with an oversized cone at its base into the ground with blows from a percussive hammer with a uniform weight (63.5kg) and drop height (750mm). The blow count is recorded for each 100mm of driving (N_{100} value). The results of the probes are presented as N_{100} values versus depth. Side friction on the driving rods or torque is measured every metre. The torque values provide a guide to the friction build up with depth showing the horizons where the recorded blow counts also incorporate a degree of energy input to overcome friction. The method of ground investigation conforms to the British and European Standard BS EN ISO 22476-2:2005 Geotechnical Investigation and Testing, Field Testing, Part 2 Dynamic Probing.

The dynamic probes were positioned over the detected geophysical anomalies and were terminated at depths of between 7.3m to 14.0m bgl, to provide a ground strength profile plotted against depth of penetration. The results informed the decision on the locations of the window samples.

The recorded N_{100} values, plotted versus depth, have been interpreted in terms of profile shape, the blow counts, pattern and side friction. The N_{100} results can be combined over a depth interval of 300mm to derive N_{300} values which in turn can be used to classify the ground from a stability perspective as being undisturbed, reduced strength or low strength as shown in the table below.

Table 3.1 Dynamic Probe Interpreted Ground Conditions

N_{300} Values	Interpreted Ground Conditions
≤ 5	Low strength ground
6 – 10	Reduced strength ground
>10	Undisturbed ground

The records of the exploratory holes are presented in the factual report (Endeavour, 2016) and their locations are shown on the Site Layout Plan, **Figure 2**.

4.0 Ground Conditions

4.1 Stratigraphy

The ground conditions, as revealed by the ground investigation, are in general agreement with the published geological information and known history of the site. The ground investigation identified a stratigraphy comprising London Clay, overlying Lambeth Group and Seaford and Newhaven Chalk Formation. The Hertfordshire Puddingstone was encountered at the base of the Lambeth Group.

Comments on the nature and extent of each stratum are presented in the following sections of this report taking into consideration the findings of the ground investigation.

4.2 Made Ground

Made Ground was only encountered in some of the locations, including BH101, WS101, WS102, WS103, WS107, WS108, WS109, WS111, WS112, WS113, WS114 and WS115. In general, the Made Ground was encountered to depths of up to 1.2m bgl. The Made Ground was typically found to comprise of a gravelly sandy CLAY. The material was generally very soft to firm with the gravel components being brick, chalk and flint.

In WS112 Made Ground was encountered to 8.8m bgl. It is not known if this is the base of the Made Ground due to a void being encountered between 8.8 – 10.0m bgl, with no further recovery to the base of the borehole at 11.45m. In addition, two layers of asphalt/ clinker were encountered between 0.45 – 0.5m bgl and 0.65 – 0.75m bgl.

In WS113 the Made Ground was found to 1.2m bgl, although it was underlain by ‘Possibly Disturbed Ground’ to 5.4m bgl.

The Made Ground encountered in BH101 was the backfill used to fill the void following the collapse. This was encountered to 4m bgl and comprised of sandy gravel with brick and asphalt cobbles. This material was placed by Harrow Council shortly after the collapse occurred.

4.3 London Clay

London Clay was encountered in all locations apart from WS112. In general, the material was found to consist of soft to stiff orange brown sandy CLAY.

The London Clay was found to be between about 5.5m to 9.0m thick extending between 0.1m and 9.15m depth.

4.4 Lambeth Group

The Lambeth Group was encountered in all boreholes apart from WS112. The base of the Lambeth Group was not found within the window sample boreholes, but was encountered in all hollow stem auger boreholes.

The Lambeth Group was found to be between 13.4m and 17.5m thick and was encountered to depths of between 20.7m and 25.9m bgl.

The Lambeth Group material encountered generally comprised of very soft to very stiff/ very dense, yellow brown/ green/ brown red sandy CLAY/ clayey SAND/ gravelly SAND.

The Hertfordshire Puddingstone was encountered in BH102 between 19.4 – 19.6m bgl and consisted of blue, dark green and off white clayey sandy gravelly COBBLES, with the gravel and cobbles composed of chalk and flint. It was not encountered in other locations.

4.5 Chalk

The Seaford and Newhaven Chalk Formation was encountered underlying the Lambeth Group in all three of the hollow stem auger deep boreholes.

The chalk was typically structureless comprising of soft off white slightly gravelly clayey SILT. Gravel is weak low density fine to coarse angular to sub-angular chalk. Using the chalk grading system given in CIRIA C574 (2002) the classification of the material encountered is Grade Dm which relates to a structureless fine soil.

This was underlain by moderately to highly weather chalk comprising of chalk gravel in a comminuted chalk matrix and was classified as Grade C2.

The Chalk was encountered to the maximum investigated depth of 30m below ground level.

4.6 Groundwater

During the fieldwork groundwater was only encountered in BH102, WS107, WS108 and WS109. In BH102, when completing the inspection pit, water was encountered thought to be a locally perched table beneath the sub base. During drilling BH102 groundwater was encountered at 14m bgl but rose to 0.8m bgl after 20 minutes. The groundwater was struck in the Lambeth Group but rose to the London Clay.

In WS107, WS108 and WS109 groundwater was encountered between 4.2 and 6.55m bgl on the completion of the boreholes. All locations where groundwater was found were on the western portion of the site This groundwater was encountered in the London Clay formation.

5.0 Ground Conditions Interpretation

5.1 Interpretation of Dynamic Probe Results

Thirty-eight super heavy dynamic probes were completed across the site, with one of the main objectives to confirm ground conditions where geophysical anomalies were recorded.

In general, with the exception of DP137, the dynamic probes show relatively low strength ground to a maximum of 5.0m bgl, with an average depth of 2.2m. DP101 and DP102 show deeper weak ground but this is likely to be associated with the depth of Made Ground found in the window sample boreholes nearby. DP137 shows a weaker profile to greater depth than the other dynamic probes but terminated in dense strata at 14m depth. A window sample was completed alongside this dynamic probe location and showed competent ground.

Below the low strength ground encountered at shallow level, within the Made Ground, undisturbed ground was encountered. The undisturbed ground was encountered from between 1.6m – 5.9m bgl.

5.2 Interpretation of Window Sample Boreholes

WS112 showed Made Ground to 8.8m bgl with a void extending from 8.8m to 10m bgl. The material under the void is unknown as the method of drilling used (window sample borehole) has limited use at depth. This is due to the casing thickness decreasing with depth. It is also possible that some of the material was lost from the core recovery when pulling up through the void. The SPT results indicated reasonable ground strength between 10.0 and 11.45m bgl with SPT N values ranging from 16 to 33 suggesting competent stable ground below the void.

5.3 Interpretation of Rotary Boreholes

BH102 and BH103 showed ground conditions to be consistent across the site, with the geology comprising Made Ground, overlying London Clay, Lambeth Group and Chalk.

Within BH101 sunk through the collapse backfill, from 18m to 20.25m bgl there was very loose sand with SPT N values of 0. This was underlain by a void which was found in the chalk between 20.25m and 22.5m bgl. At the base of the void the chalk was encountered. The void was investigated utilising a downhole CCTV camera to understand the dimensions, however during the intervening time between completion of the borehole and the camera arriving on site the ground had relaxed, moved and backfilled the void. Therefore, the size of the void could not be determined. The chalk underlying the void was of an undisturbed nature with SPT N values of greater than 50 which indicate the mine floor had been reached. The ground conditions encountered are interpreted to represent a collapsed mine shaft.

5.4 Geophysical Anomaly Interpretation

Three main geophysical anomaly areas have been identified on Figure 2, anomaly 1, 2 and 3. These are the three largest areas where testing was completed.

5.4.1 Anomaly 1

Anomaly 1 is located to the south of the school building and identified through both GPR and EM methods.

Three dynamic probes were completed, DP101, DP102 and DP138. These probes show low strength ground to between 4 and 5m bgl underlain by undisturbed ground. Three window samples were also completed in this area, WS111, WS112 and WS115. WS111 and WS115 indicated 0.2 - 0.5m of Made Ground, underlain by 4.9 – 5.7m of London Clay and then Lambeth Group. WS112 has previously been discussed in Section 5.2 and comprised in excess of 8.8m of Made Ground. With the exception of WS 112, these results show no evidence of any historical mine workings.

5.4.2 Anomaly 2

Anomaly 2 is located in the northern playground and identified through the EM method.

Six dynamic probes (DP120-125) were completed in this area and all the probes show low strength ground down to approximately 6m bgl before increasing in strength. Two window sample boreholes (WS105-106) were completed in this area. These boreholes indicated 0.7 – 1.0m of Made Ground, underlain by 7.8 – 8.25m of London Clay and then Lambeth Group. These results show no evidence of ground disturbance associated with historical mine workings.

5.4.3 Anomaly 3

Anomaly 3 is located within the cordoned area of the car park where an air raid shelter had previously been present. The anomaly was identified through the EM method.

Three dynamic probes (DP128-130) were completed here which indicated low strength ground to up to 6m bgl underlain by increasing strength ground. The window sample boreholes completed in this anomaly indicated 1.2m of Made Ground, underlain by 5.5m of London Clay and then Lambeth Group. These results show no evidence of ground disturbance associated with historical mine workings.

6.0 Conclusions and Recommendations

6.1 Conclusions

In conclusion, the geophysics identified a number of anomalies across the site. The results of the geotechnical investigation showed these anomalies to be low strength ground in the near surface with competent ground beneath. It is likely that these anomalies relate to variations in the shallow geology and also previous earthworks on site. As such the majority of these anomalies, with the exception of two locations, do not show evidence of historical mine workings. The two remaining locations of concern encountered during the investigation are:

- the initial collapse (BH101)
- south of the school building (WS112)

Remedial measures for these two locations, shown on **Figure 3**, are discussed below.

6.2 Recommended Remedial Measures

6.2.1 Initial Collapse

Based on the data gathered to date, it is recommended that ground stabilisation be carried out in the car park within the initial collapse. Based on PBA's past experience this is the most effective long term remedial solution which has a good track record of mitigating the potential for further movement of disturbed ground. The ground treatment method recommended is permeation grouting.

Grouting can be used to stabilise remnant deep, loose ground and reinstate support to the ground above. Work would be carried out through the collapse area to stabilise the shaft area only. It is recommended that the work be completed on a 1.5m spacing grid, to depths of 25m bgl. The size and depth of this work is dependent on ground conditions encountered as the works are carried out.

Permeation grouting serves to penetration the loose infill/ collapsed material and fill voids associated with the historical mine workings. It comprises treatment of the ground by injecting a sand/ cement and PFA grout mixture under pressure to locally penetrate the ground in three dimensions around the point of injection.

6.2.2 South of School Building

Due to the presence of the weak Made Ground and void space identified in WS112 to the south of the school building it is recommended that ground treatment also be carried out in this area. This would be completed utilising compaction grouting.

It is recommended that the work area be about 6m by 6m in plan, with a 3m grid spacing, to depth of 15m bgl. The area and depth of this work will be dependent on ground conditions encountered as the works are carried out. It should be noted that dependant on conditions encountered during the initial works the grid size and depths may require to be extended.

The grouting technique involves the injection of a viscous mortar grout into the ground under high pressure. The grout can radially compact weak, disturbed infills that are micro-voided, strengthening the ground and mitigating against future movement. The beneficial effects of the grouting can be achieved normally to within about 3m below the ground treatment surface.

6.3 Services

In the area of the initial collapse in the car park there is an electrical service crossing through the feature. This is understood not to have been damaged following the ground collapse.

There is also a foul sewer in the vicinity of the collapse. The condition of the sewer is not known and as such it is recommended that a condition survey be completed prior to the ground treatment works. Should there be any damage to the sewer, during the grouting works there is a possibility that grout will enter the sewer and block it during treatment works. As such, should the sewer show signs of damage it is recommended that it be diverted during the grouting works and then following the work the original sewer be repaired and reinstated.

7.0 References

BGS (1984). Hydrogeological map of the Area Between Cambridge and Maidenhead. 1:100,000 Scale Map, Sheet 14. British Geological Survey, (former Institute of Geological Sciences), Keyworth, Notts.

BGS (2006) North London, England and Wales Sheet 256, Solid and Drift Geology, 1 to 50 000 scale. British Geological Survey, Keyworth, Notts.

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BS EN 1997-1 (2004) Eurocode 7 - Geotechnical design - Part 1: General rules. British Standards Institution, London.

BS EN 1997-2 (2007) Eurocode 7 - Geotechnical design - Part 2: Ground investigation and testing. British Standards Institution, London.

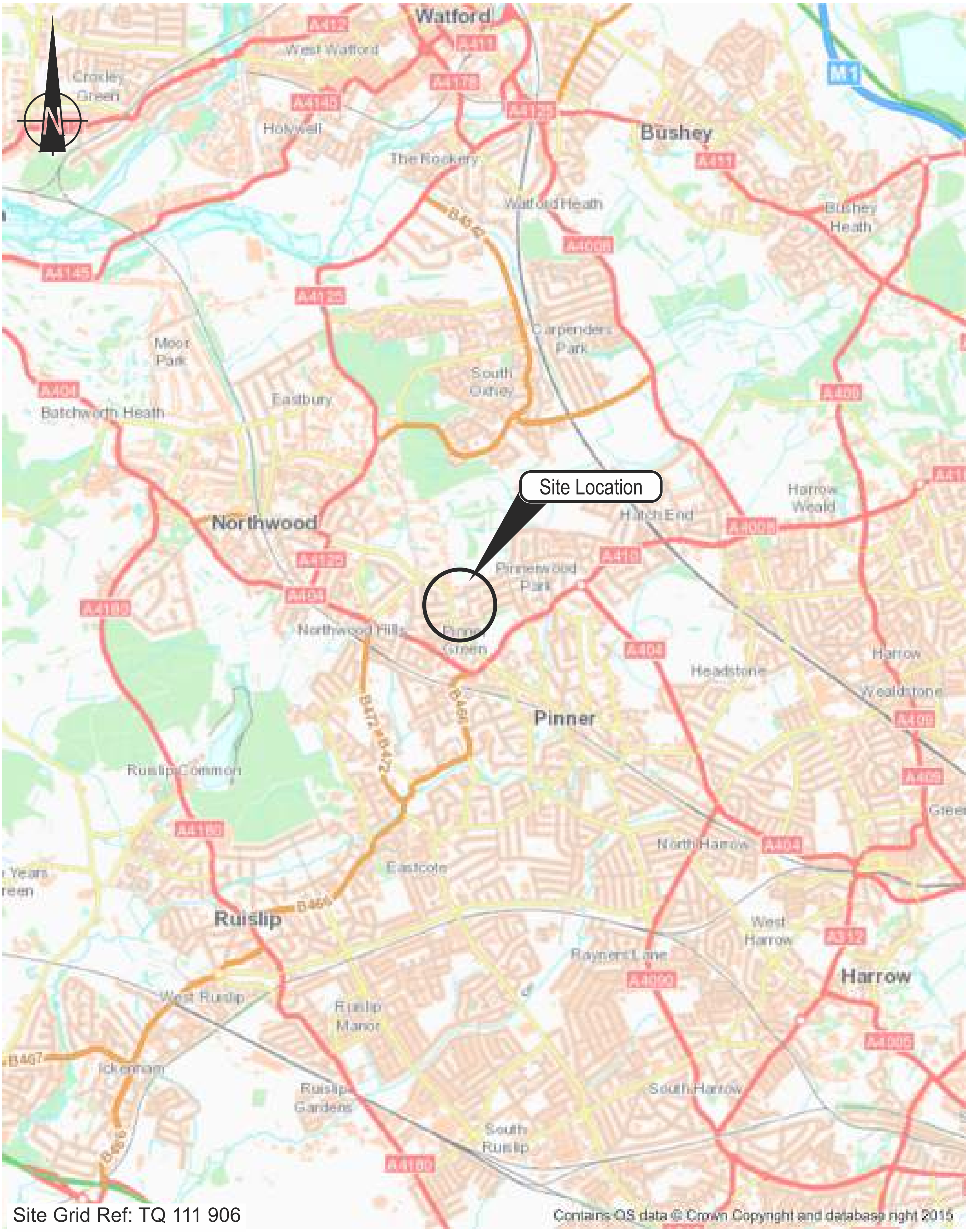
BS EN ISO 22476-2 (2005) Geotechnical investigation and testing – Field Testing – Part 2 Dynamic Probing

CIRIA (2002) Engineering in Chalk, Report C574. Construction Industry Research and Information Association, London.

EPG (2015) The Environmental Protection Group Ltd, Pinner Wood School – Hole in Carpark, 5 September 2015ref: EPG/2015/PWS/Q3/L1

RSK (2015) Pinner Wood Primary School, Geophysical Report, Project no 191236, 9 October 2015

FIGURES



Site Grid Ref: TQ 111 906

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Client

Childrens Capital Project Team, Harrow Council

PINNER WOOD SCHOOL

SITE LOCATION PLAN

Date	22.04.2016
A4 Scale	1:50 000
Drawn by	davco
Checked by	SC
Revision	0

FIGURE 1

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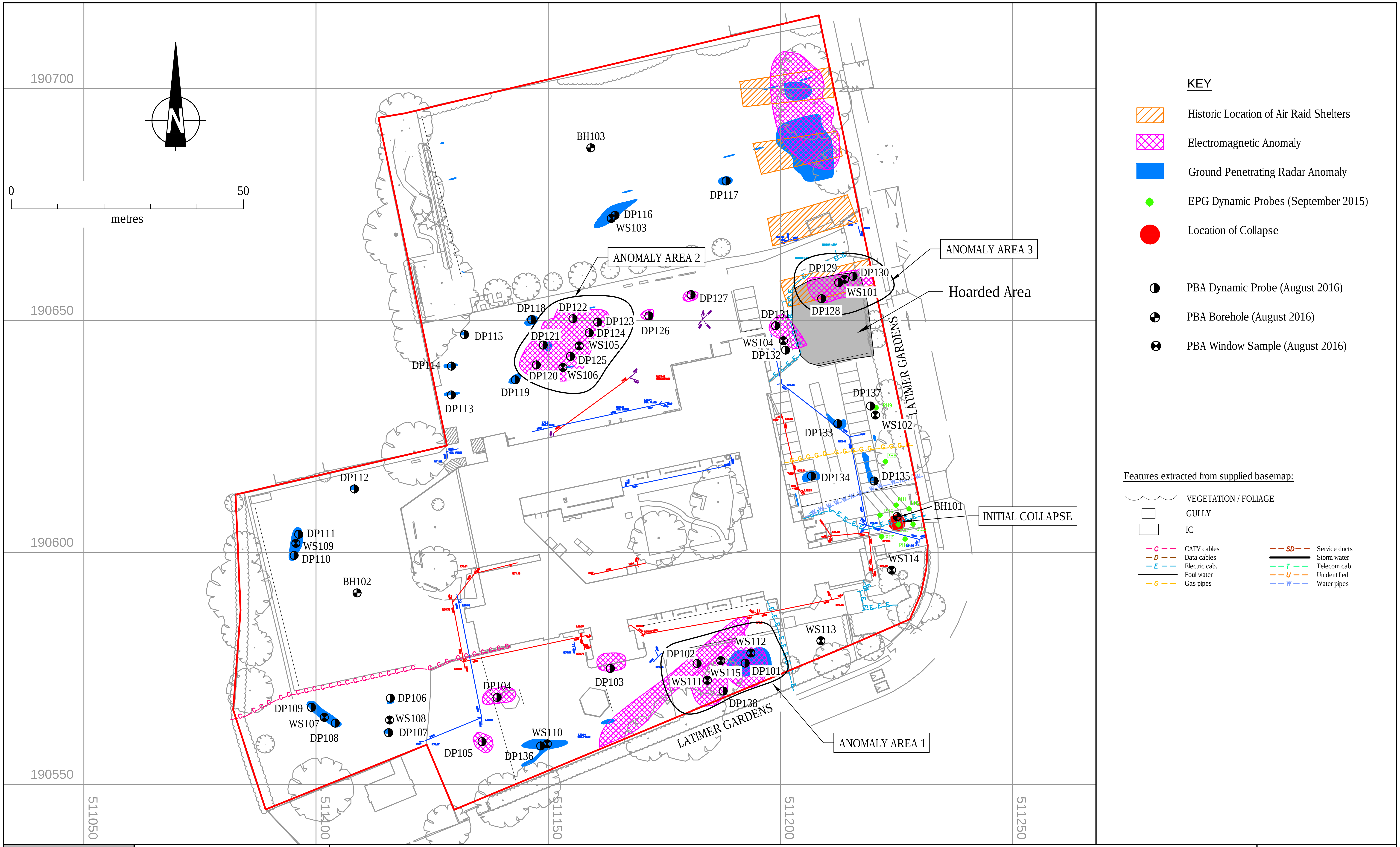

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PINNER WOOD SCHOOL

SITE LAYOUT PLAN

Date	22.04.2016
A3 Scale	1:750
Drawn by	davco
Checked by	SC
Figure Number	2

user name: david cotton

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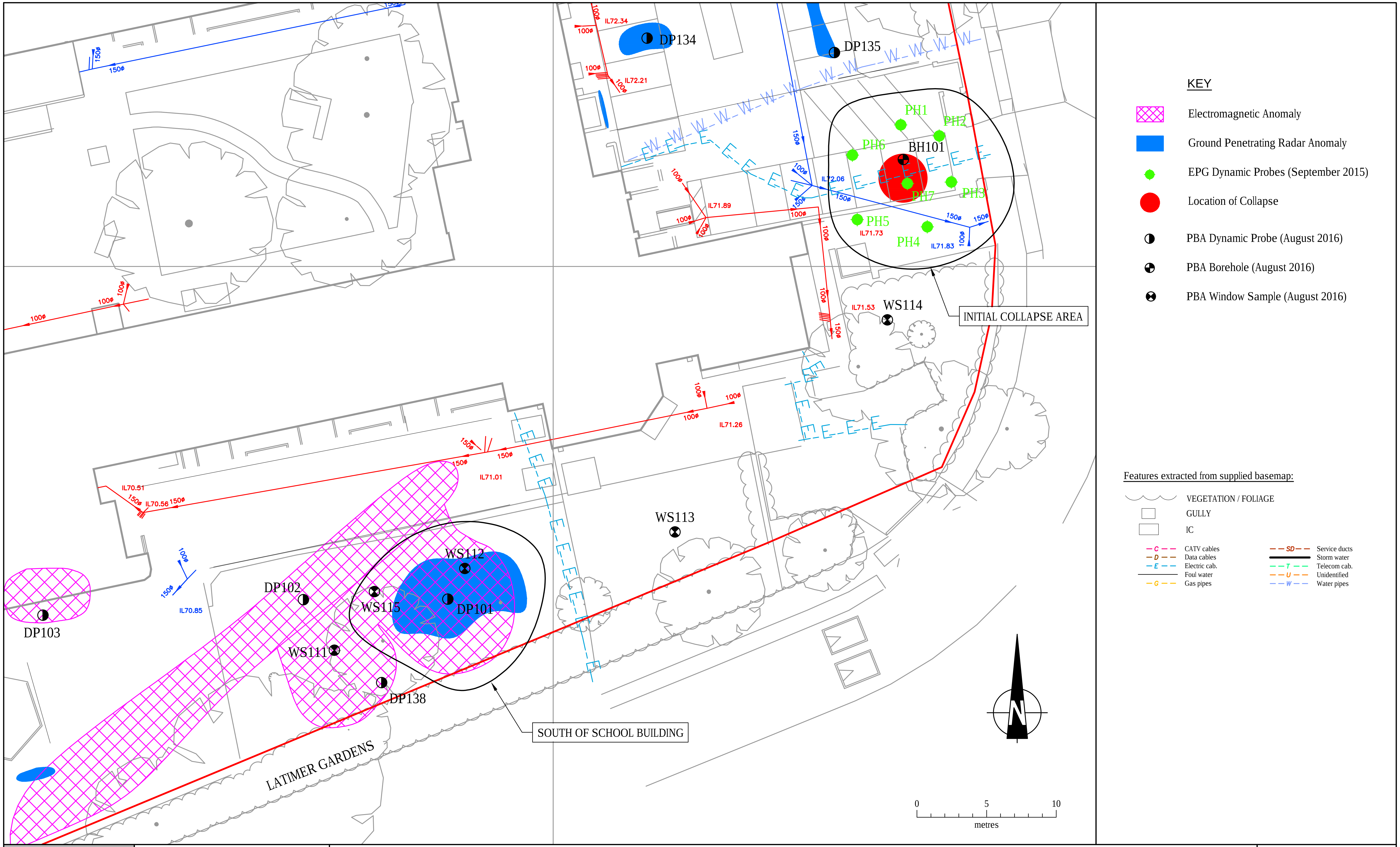

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PINNER WOOD SCHOOL

EXPLORATORY HOLE LOCATIONS
REMEDIAL WORKS AREAS

Date	22.04.2016
A3 Scale	1:250
Drawn by	davco
Checked by	CW
Figure Number	3

user name: david cotton

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Appendix G

PBA, Tender Document for Ground Stabilisation, Report Number 35665/TR001, dated October 2016

Pinner Wood School,
Pinner, Middlesex

Tender Document for Ground Stabilisation

On behalf of **Children's Capital Project Team, Harrow Council**

Project Ref: 35665 |TR001 Rev: 00 | Date: October 2016

Office Address: Caversham Bridge House, Waterman Place, Reading, Berkshire RG1 8DN
T: +44 (0)118 950 0761 F: +44 (0)118 959 7498 E: reading@peterbrett.com

Document Control Sheet

Project Name: **Pinner Wood School, Pinner, Middlesex**

Project Ref: **35665**

Report Title: **Tender Document for Ground Stabilisation**

Doc Ref: **TR001/Rev00**

Date: **October 2016**

	Name	Position	Signature	Date
Prepared by:	Claire Walton	Engineer		06/10/2016
Reviewed by:	Stuart Chandler	Associate		06/10/2016
Approved by:	Stuart Chandler	Associate		06/10/2016
For and on behalf of Peter Brett Associates LLP				

Revision	Date	Description	Prepared	Reviewed	Approved
Rev00	October 2016	Final for issue	CW	SJC	SJC

Contents

Figures

Appendices

1 Instructions to Contractor

THESE INSTRUCTIONS SHALL **NOT** FORM PART OF THE CONTRACT

1.1 Introduction

The main part of this document incorporates the Contract requirements and Bill of Quantities. The Background and General Requirements are included as **Appendix A**, Remedial Stabilisation Works is included as **Appendix B**, the Grouting Specification is included as **Appendix C**, EGP Factual Report is included in **Appendix D**, Endeavour Drilling Factual Report is included as **Appendix E** and the Ground Investigation Report is included as **Appendix F**.

Other items of particular note are:

- Protection and delineation of working area – see A2.2, A2.6, A2.7 and C2.6
- CDM/Health and Safety – see A2.8
- Responsibility for services – see A2.10
- Testing – see C1.6 and C2.3
- Validating performance of works – see C2.4

1.2 Submission of Document

The tender document shall be returned duly completed with the Bill of Quantities having the appropriate columns completed by the person or persons, firm or company making the submission, with quantities, rates and prices on which the submission is based. Where no price is inserted against any item, it will be understood that no charge will be made for that item. In all cases the submission must be for the execution of the work in accordance with the Specification, Bill of Quantities, Conditions of Contract and Drawings included within this document and which the contractor shall be deemed to have examined.

1.3 Inclusions with Submissions

The Contractor shall provide the following information with their submission.

- Method statement and strategy for the works and a programme for carrying out the works.
- Details of their insurer and a copy of his insurance certificate detailing the extent of the cover this insurance affords.
- A copy of the draft warranty to be afforded to the Employer.
- Details of grout mix to be used for grouting and the assumed grout take on which their design is based.
- Drawing detailing working area layout for plant, materials storage and accommodation.
- Completed Form of Tender.

1.4 Inspection of Site

The Contractor shall be deemed to have visited the site of the works and by his own independent observations and enquiries, made himself fully acquainted with the scope of the work and all details necessary for its execution and satisfactory completion, whether specifically mentioned herein or not, before submitting his tender. No claim for additional expenses will be entertained based on ignorance of the works etc. or discrepancies in contract documents. Arrangements for a site visit should be made through Peter Brett Associates LLP.

1.5 Alterations

No unauthorised alteration or addition should be made to any component of this document.

1.6 Names of Parties

Employer:
Children's Capital Project Team
Harrow Council
Central Depot – Unit 1
Forward Drive
Harrow
HA3 8NT

The works are to be performed under the direction of Peter Brett Associates LLP, herein referred to as the Engineer, acting on behalf of the Employer, Children's Capital Project Team for the purposes of the ground stabilisation work.

1.7 Return of Tenders

Tenders are to be returned to:

Claire Walton
Peter Brett Associates LLP
Caversham Bridge House
Waterman Place
Reading
RG1 8DN

The Tenders shall arrive no later than noon on the date stated in the letter of invitation and can be submitted as a PDF via cwalton@peterbrett.com.

2 Form of Tender

All Permanent and Temporary Works in connection with the stabilisation works to protect against future subsidence resulting from the initial collapse area and the potential for collapse south of the school building at:
Pinner Wood School, Pinner, Middlesex, HA5 3RA.

TO:- Children’s Capital Project Team

GENTLEMEN,

Having examined the Drawings, Conditions of Contract, Specification, and Bill of Quantities for the above mentioned works (and the matters set out in the Appendix hereto), we offer to carry out the whole of the said works in conformity with the said Drawings, Conditions of Contract, Specification and Bill of Quantities for such sum as may be ascertained in accordance with the said Conditions of Contract.

We undertake to complete the whole works comprised in the Contract within the time stated in the Appendix hereto.

Unless and until a formal Agreement is prepared and executed, this Tender, together with your written acceptance thereof, shall constitute a binding Contract between us.

This tender will remain open for acceptance for 16 weeks from the date specified for return of tenders unless it is previously withdrawn in writing and certified receipt of its withdrawal occurs before acceptance.

We understand that you are not bound to accept the lowest or any tender you may receive.

We are, Gentlemen,

Yours faithfully,

Signature . . . .

Tenderer . . . .

Address . . . .
. . . .
. . . .
. . . .
. . . .

Date . . . .

3 Form of Contract

THIS SECTION SHOULD **ONLY** BE COMPLETED IF/WHEN THE TENDER HAS BEEN ACCEPTED

THIS AGREEMENT is made the . . . . day of . . . . 2015.

BETWEEN ***Harrow Council*** of (or whose registered office is at) ***Central Depot – Unit 1, Forward Drive, Harrow, HA3 8NT***

(hereinafter called the “Employer”) of the one part

AND . . . .

of (or whose registered office is at). . . . .

(hereinafter called the “Contractor”) of the other part

WHEREAS the Employer wishes to have carried out the following:

Ground stabilisation of collapsed ground at Pinner Wood School, Pinner, Middlesex

and has accepted a Tender by the Contractor for the same.

NOW IT IS HEREBY AGREED AS FOLLOWS:

Article 1 The Contractor will subject to the Conditions of Contract perform and complete the Works

Article 2 The Employer will pay the Contractor such sum or sums as shall become payable under the Contract and in accordance with the Conditions of Contract.

Article 3 The documents listed in the Table of Contents form part of this Agreement.

IN WITNESS whereof the parties hereto have caused this Agreement to be executed the day and year first above written:

Signed for and on behalf of the Employer, ...

Signature…………………………………….
Position…………………………………………………………...

In the presence of ……………………………………………………………………………..
(Witness)

Signed for and on behalf of the Contractor . . . . Ltd/plc

Signature …………………………………….
Position……………………………………………………………

In the presence of …………………………………………………………………………….
(Witness)

4 Conditions of Contract

4.1 Conditions of Contract

The Conditions of Contract shall be the ICC Infrastructure Conditions of Contract, Minor Works Version, published for the Association for Consultancy and Engineering and the Civil Engineering Contractors Association in August 2011 and any subsequent additions/amendments.

The Conditions of Contract shall be deemed to form and shall be read and construed as part of the Contract.

Amendment of October 2011 to allow for amendments to Clauses 7.7(2) and 7.8 with regards to payment provisions. Reference ICC/Payment /October 2011 as follows:

Certificates and payment Notices	7.7(2)	Lines 1/2 delete “no later than five days after” and insert “by” Line 3 after “sub-clause 7.3” insert “the Contractor’s monthly statement given under Sub clause 7.2 shall be the payment notice or, in the event that no monthly statement was given by the Contractor,”
Notice of Intention to withhold payment	7.8	Side Heading: delete “withhold payment” insert “pay less” Line 2: After “is to” insert “pay less than or” Line 2 delete “after the final date for payment” Line 2 delete “of” and replace with “from” Lines 4/5 after “specifying the” delete the remainder of the sentence and insert “sum that the Employer considers due on the date the notice is served and the basis on which that sum is calculated.”

Amendment of May 2015 to allow for amendments to Clause 13 and Appendix to the Conditions of Contract with regards to the CDM Regulations 2015. Reference ICC/CDM/May 2015 as follows:

Heading	13	Replace “2007” with “2015”
Definitions	13.1 (a)	Line 2 delete “2007” and insert “2015”
	13.1 (b)	Line 2 delete “special” and insert “specific” Line 4 delete “23” and insert “12”
	13.1 (c)	Line 1 delete “CDM Co-ordinator” and insert “Principal Designer”
Action to be taken	13.2 (a)	Line 1 delete “CDM Co-ordinator” and insert “Principal Designer”
	13.3 (1) and (2)	Replace the words “CDM Co-ordinator” and insert “Principal Designer”

4.2 Amendments to the Conditions of Contract

Expected Risks	1.2	ADD sub-clause (h): “The event of any negligence or default of the Employer his servants or agents.”
Engineer may suspend the progress of the works	2.6	In line 2 after the word "supervision" INSERT "including professional and technical staff".
Contractor to perform and complete the works	3.2	In line 2 after the word "supervision" INSERT "including professional and technical staff".
Contractor to make repair and make good	3.4(1)	Line four, after “cost” INSERT "save and except in the event of any negligence or default of the Employer his servants or agents".
	3.4(4)	Add new paragraph (4) The Contractor shall be held liable for all damage and interference to roads, bridges, drains, culverts, pipes, ditches, cables, lines, telegraph or electrical apparatus, boreholes and similar services whether at, above or below ground level caused by him or his sub-contractors, in the execution of the works whether or not the location of the damage is within the site boundaries. Should any damage be done, whether or not the location of the item is shown on the drawings, the Contractor must make good the same without delay and do any further work considered necessary by the Engineer or the Owner of the damaged item all at his own cost or, in default of such action, pay the cost incurred by the Employer in undertaking remedial measures. The Contractor will be deemed to have included for this in determining his Tender rates
Contractor’s Responsibility for design	3.9(1)	Substitute Clause 3.9(1) with: The Contractor shall be responsible for the design of the Works except where expressly stated in the Contract.
Contractor’s programme	4.3	DELETE the words “Within 14 days in the first sentence and INSERT “Within 7 calendar days”.

4.3 Special Conditions

Special Conditions	15.1	DELETE existing Clause 15.1 and replace with the following: The following special conditions form part of the Conditions of Contract.

Interference with traffic and adjoining properties

16 (1) All operations necessary for the construction and completion of the Works shall so far as compliance with the requirements of the Contract permits be earned on so as not to interfere unnecessarily or improperly with

(a) The convenience of the public or

(b) The access to public or private roads footpaths or properties whether in the possession of the Employer or of any other person and with the use or occupation thereof.

The Contractor shall indemnify and keep indemnified the Employer in respect of all claims demands proceedings damages costs charges and expenses whatsoever arising out of or in relation to any such matters.

(2) The Employer shall indemnify the Contractor from and against any liability for damages on account of noise disturbance or other pollution which is the unavoidable consequence of carrying out the Works and from and against all claims demands proceedings damages costs charges and expenses whatsoever in regard or in relation to such liability.

Noise Disturbance and Pollution

All work shall be carried out without unreasonable noise disturbance or other pollution.

To the extent that noise disturbance or other pollution is not the unavoidable consequence of constructing and completing the Works or performing the Contract the Contractor shall indemnify the Employer from and against any liability for damages on that account and against all claims demands proceedings damages costs charges and expenses whatsoever in regard or in relation to such liability.

Indemnity by Contractor

The Employer shall indemnify the Contractor from and against any liability for damages on account of noise disturbance or other pollution which is the unavoidable consequence of carrying out the Works and from and against all claims demands proceedings damages costs charges and expenses whatsoever in regard or in relation to such liability.

Indemnity by Employer

Group Guarantee

17 It shall be a condition precedent to the commencement of the Works that a Contractor who is subsidiary company of a Group of Companies shall if requested provide to the Employer a Group Guarantee in the form included in the

Contract and that the Works shall not be commenced until the Guarantee has been received by the Employer.

Gifts, Inducements and Rewards

18 If the Contractor has offered or given or agreed to give any gift or consideration of any kind as an inducement or reward for doing or for forbearing to do or for having done or forborne to do any action in relation to the attaining or execution of this Contract then the Employer shall be entitled to determine the employment of the Contractor under and in accordance with Clause 14.2 of the Conditions of Contract.

Application of Insurance Money

19 Should any works covered by insurance under Clause 10 or any part of such Works be damaged or lost during the continuance of the aforesaid insurance by any risk insured against the Contractor shall if and to the extent required by the Engineer proceed with the utmost dispatch to make good the damage or loss aforesaid and every sum of money received upon the policy or policies whether such insurance shall have been effected by the Contractor or by the Employer shall be paid to the Employer and be paid by him to the Contractor by such advance payments as the Engineer shall think proper and certify having regard to the progress made by the Contractor in making good the damage or loss aforesaid to the extent required by the Engineer. If and so far as the said monies shall not be required for the purposes aforesaid they shall upon the directions in writing of the Engineer and subject nevertheless to the provisions of the Contract and to any claim of the Employer there under be paid over to the Contractor. If and so far as such monies shall be insufficient for those purposes aforesaid, the deficiency shall be borne by the Contractor.

Legal Interpretation and Payments

20 The Contract shall in all respects be construed and operate as an English contract and in conformity with English law and all payments thereunder shall be in sterling money.

Price Fluctuations

21 No contract Price Fluctuations Clause is included in the Conditions of Contract.

Use of Employer's Plant

22 All plant and materials supplied by the Employer to the Contractor for use by the Contractor on the Site or for incorporation in the Works shall remain the property of the Employer but shall be at the sole risk of the Contractor while under his care

5 Appendix to the Conditions of Contract

1) Short description of the works to be carried out under the Contract:

All Permanent and Temporary Works in connection with the stabilisation works to protect against future subsidence resulting from the initial collapse area and the potential for collapse south of the school building at:

2) The payment to be made in accordance with Clause 7 will be ascertained on the following basis: (The alternatives not being used are crossed out).

~~*a) Lump sum*~~

b) Measure and value using a priced Bill of Quantities

~~*c) Valuation based on a Schedule of Rates (with an indication in the Schedule of* the approximate quantities of major items)*~~

~~*d) Valuation based on a Daywork Schedule*~~

~~*e) Cost plus (the cost is to be specifically defined in the Contract and will exclude off site overheads and profit)*~~

3) Where a Bill of Quantities or a Schedule of Rates is provided the method of measurement used is:

Civil Engineering Standard Method of Measurement (Fourth Edition, 2012)

4) Name of Engineer (Clause 2.1):

Stuart Chandler Peter Brett Associates LLP

5) Starting date (Clause 4.1):

To be advised and agreed with Contractor

6) Period for completion (Clause 4.2):

To be advised and agreed with Contractor

7) Period for completion of parts of the Works and details of the work to be carried out within each such part (Clause 4.2):

Not applicable

8) Liquidated damages (Clause 4.6):

£5,000 per working week and/or pro rata for part of a week to apply beyond agreed contract completion date.

These liquidated damages should only be applied where the works overrun by fault of the Contractor and hence it is not deemed that the Employer should be responsible for the payment of the Consultant's extra fees that are a direct consequence of the Contractor's error.

9) Limit of liquidated damages (Clause 4.6):

10% of the final contract value

10) Defects Correction Period (Clause 1.1(2) & 4.7):

12 months

11) Minimum amount of interim certificate (Clause 7.3):

£10,000.00

12) Interest on overdue payments (Clause 7.6):

2% above the base lending rate of Barclays Bank

13) Insurance of the Works (Clause 10.1):

Required

14) Contractor's Insurance (Clause 10.6):

The minimum amounts of insurance and the period for which the Contractor maintains insurance are:

Event	Cover	Period following completion of the whole of the services at intervals no longer than 12 weeks
Failure of the Contractor to use the skill and care normally used by professionals providing services similar to the services.	£5 million in respect of each claim, without limit to the number of claims.	12 years
Bodily injury to or death of a person (not an employee of the Contractor) or loss of or damage to property resulting from an action or failure to take action by the Contractor.	£5 million in respect of each claim, without limit to the number of claims.	12 months
Bodily injury to or death of employees of the Contractor arising out of and in the course of their employment in connection with this contract as required by the Employers Liability (Compulsory Insurance) Regulations, 1998.	£2 million in respect of each claim, without limit to the number of claims.	12 months

15) Name of the Principal Designer (Clause 13(1)(c)):

Peter Brett Associates LLP

16) Name of the Principal Contractor (Clause 13(1)(c)):

Appointed Contractor

17) The Arbitration Procedure to be used is (Clause C2(a)):

The Institution of Civil Engineers' Arbitration Procedure (2012)

6 Preamble to Bill of Quantities

6.1 General Directions

In this Bill of Quantities, the sub-headings and item descriptions identify the work covered by the respective items read in conjunction with the matters listed against the relevant marginal headings ‘Item coverage’ in the Civil Engineering Standard Method of Measurement, Fourth Edition, 2012 (CESMM4). The nature and extent of the work is to be ascertained by reference to the Drawings, Specification, Schedules and Conditions of Contract.

The rates and prices entered in the Bill of Quantities shall be deemed to be the full inclusive value of the work covered by the items including the following, unless expressly stated otherwise:

1) Labour and costs in connection therewith.

2) The supply of materials, goods, storage and costs in connection therewith including delivery to site. Taking delivery of materials and goods supplied by others, unloading, storage and costs in connection therewith.

3) Fixing, erecting and installing or placing of materials and goods in position, including Ancillary Works.

4) Equipment and costs in connection therewith.

5) General obligations, liabilities and risks involved in the execution of the Works set forth or reasonably implied in the documents on which the tender is based.

6) Establishment charges, overheads and profit.

7) Waste.

8) Provision of a water supply and other services required for drilling and grouting.

9) The provision of records of all site operations.

6.2 Preamble Schedule

The Method of Measurement is contract neutral therefore to ensure compatibility the table below indicates the clause in the Conditions of Contract that defines the terminology used in the Method of Measurement.

CESMM4 Section Reference		Contract Provision
1.3	Contractor administrator	Clause 2, Section 5(4)
2.4	Valuation of work executed	Clause 7.1
5.1	Measurement of completed work	Clauses 7.2 and 7.4
5.2	Daywork Schedule	Clause 2.5
5.16	Prime cost items	Not applicable

CESMM4 Section Reference		Contract Provision
5.16	Nominated Sub-contractor	Clause 8 and Section 6.6
5.18	Provision sums	As defined in Section 7
6.1	Currency of contract	GBP
6.4	Interim payments	Clause 7.3
	Interim certificates	Clauses 7.3 and 7.7
	Retention moneys	Not applicable
	Completion	Clauses 4.5, 5.3, 7.4 and 7.5
6.5	Contract price fluctuation	Not applicable
7.6	Admeasurement	Clause 6
	Valuing changes	Clause 6
7.7	Method-Related Charges	Clauses 7.2 and 7.3
8	Class A Coverage rule C1	Section 5(14)
	Class F Definition rule D1	Not applicable
	Class R Definition rule D1	Not applicable

Note:
1. “Clause” refers to ICC Infrastructure Conditions of Contract, Minor Works Version, August 2011
2. “Section” refers to this document

6.3 Measurement

The measurement of work shall be computed net from the agreed records unless stated otherwise in the Method of Measurement.

6.4 Pricing of Items

A price or rate is to be inserted against each item in the Bill of Quantities. If an item is nil rated or if no entry is made against an item, any costs incurred by the Contractor against that item will be deemed to have been covered by other sums within the priced Bill of Quantities. The term ‘Included’ or any such similar term shall be deemed to be nil.

6.5 Privately and Publicly Owned Services and Supplies

The Contractor shall include in his rates and prices for taking measures for the support and full protection of all shallow and deeper level pipes, cables and other apparatus during the progress of the Site Operations and for keeping the Engineer informed of all arrangements he makes with the owners of privately owned services, Statutory Undertakers and Public Authorities as appropriate.

6.6 Labours

Labours in connection with nominated Sub-Contractors shall include:

1) in the case of work or services executed, for affording the use of existing working space, access, temporary roads, erected scaffolding, working shelters, staging, ladders, hoists, storage, latrines, messing, welfare and other facilities existing on site and the provision of protection, water, electricity for lighting and clearing away rubbish and debris arising from the work:

2) in the case of goods, materials or services supplied, for taking delivery, unloading, storing, protecting and returning crates, cartons and packing materials.

6.7 Establishment Charges

In the Bill of Quantities, and in accordance with CESMM4, the establishment charges for bringing a drilling rig/s including all ancillary plant and equipment to site, have not been identified as a separate item. The Contractor is to include his establishment charges as Fixed Charges in Method Related Charges and to include only for “setting up” and “moving” of drilling rigs under items with the Classification Code C41.

6.8 Contract Documentation

The Conditions of Contract, together with the Specifications and the Drawings, are to be read in conjunction with the Bills of Quantities and, insofar as they have any bearing, must be referred to for details of description, quality, test and strength of the material to be used, and the workmanship, conditions, obligations, liabilities and instructions generally, which have to be complied with in carrying out this Contract.

The cost of complying with all conditions, obligations and liabilities described or implied in the Conditions of Contract and Specifications and carrying out the work as shown on the Drawings, shall be deemed to be spread over and included in the rates of prices stated in the Bills of Quantities, unless expressly the subject of a specific item.

6.9 Amendments and Additions to the Method of Measurement

For the purpose of this Contract the Method of Measurement, CESMM4, is amended in accordance with the following:

CLASS C: GEOTECHNICAL AND OTHER SPECIALIST PROCESSES		
FIRST DIVISION	**SECOND DIVISION**	**THIRD DIVISION**
4. Grout holes materials and injections	6. Injection	1. Number of injections

Coverage Rules:

C461. These items for grout injections shall include for:

1) setting up equipment
2) injecting grout
3) complying with required procedures at end and start of shift
4) removal of equipment

7 Bill of Quantities

Item	Item Description	Quantity	Unit	Rate	Amount	
					£	p
	CLASS A : GENERAL ITEMS **STABILISATION OF COLLAPSED/DISTURBED GROUND** **METHOD RELATED CHARGES** The Contractor shall hereunder list any additional items for method related charges which have not been provided for elsewhere in the Bill of Quantities and for which he wishes provision to be made in accordance with Section 7 of the CESMM4. Separate items shall be distinguished between time related charges and fixed charges.					
A12	**Insurance of the Works**		Sum			
A31	**ACCOMMODATION AND BUILDINGS**					
	Fixed (…. weeks)		Sum			
	Time Related (per week)		Rate only		-	-
A33	**PLANT**					
	Fixed (…. weeks)		Sum			
	Time Related (per week)		Rate only		-	-
A37	**SUPERVISION AND LABOUR**					
	Fixed (…. weeks)		Sum			
	Time Related (per week)		Rate only		-	-
A42	**PROVISIONAL SUMS**					
	Validation Dynamic Probing		Rate Only			
	Validation Grouting (Based on 15% of Tender Scheme)		Sum			
	Carry out services search with all main utility providers and services, tracing and protection (both public and private connections)		Sum			
	Carry out all enabling works to facilitate access where required		Sum			
CLASS A SUB-TOTAL						

Item	Item Description	Quantity	Unit	Rate	Amount	
					£	p
	CLASS A : GENERAL ITEMS **STABILISATION OF COLLAPSED/DISTURBED GROUND** **METHOD RELATED CHARGES** **Continued…**					
	Enabling works, including protection of the car park and buildings and preparation of a batching area and areas to be drilled & grouted.		Sum			
	Reinstatement works to all areas including making good any temporary site compound		Sum			
	Protection measures including fencing for site security and protection of property against grout splashes etc.		Sum			
	Security measures for accommodation and plant		Sum			
SUB-TOTAL						
CLASS A SUB-TOTAL BROUGHT FORWARD						
CLASS A TOTAL						

Item	Item Description	Quantity	Unit	Rate	Amount	
					£	p
	CLASS B : GROUND INVESTIGATION **INVESTIGATION & STABILISATION OF COLLAPSED & DISTURBED GROUND**					
	LABORATORY TEST					
B78	Grout cube crushing test (100mm) after 7, 14 and 28 days (set of 3 cubes per test)	6	Set			
CLASS B TOTAL						

Item	Item Description	Quantity	Unit	Rate	Amount	
					£	p
	CLASS C : GEOTECHNICAL AND OTHER SPECIALIST PROCESSES **STABILISATION OF COLLAPSED/DISTURBED GROUND**					
	DRILLING GROUT HOLES THROUGH MATERIAL OTHER THAN ROCK OR ARTIFICIAL HARD MATERIAL: VERTICAL					
C111	Open hole rotary drilling/augering in holes of depth not exceeding 5m		m			
C112	Open hole rotary drilling/augering in holes of depth between not exceeding 5m to 10m		m			
C113	Open hole rotary drilling/augering in holes of depth between not exceeding 10m to 20m		m			
C114	Open hole rotary drilling/augering in holes of depth between not exceeding 20m to 30m		m			
C115	Open hole rotary drilling/augering in holes of depth between not exceeding 30m to 40m		Rate only			
	DRILLING GROUT HOLES THROUGH MATERIAL OTHER THAN ROCK OR ARTIFICIAL HARD MATERIAL: INCLINED					
C121	Open hole rotary drilling/augering in holes of depth not exceeding 5m		m			
C122	Open hole rotary drilling/augering in holes of depth between not exceeding 5m to 10m		m			
C123	Open hole rotary drilling/augering in holes of depth between not exceeding 10m to 20m		m			
C124	Open hole rotary drilling/augering in holes of depth between not exceeding 20m to 30m		m			
C125	Open hole rotary drilling/augering in holes of depth between not exceeding 30m to 40m		Rate only			
	DRILLING GROUT HOLES THROUGH ROCK OR ARTIFICIAL HARD MATERIALS: VERTICAL					
C211	Open hole rotary drilling/augering in holes of depth not exceeding 5m		Rate only			
C212	Open hole rotary drilling/augering in holes of depth between not exceeding 5m to 10m		Rate only			
C213	Open hole rotary drilling/augering in holes of depth between not exceeding 10m to 20m		Rate only			
CLASS C SUB-TOTAL						

Item	Item Description	Quantity	Unit	Rate	Amount	
					£	p
	CLASS C : GEOTECHNICAL AND OTHER SPECIALIST PROCESSES **STABILISATION OF COLLAPSED/DISTURBED GROUND**					
	DRILLING GROUT HOLES THROUGH ROCK OR ARTIFICIAL HARD MATERIALS: VERTICAL **Continued…**					
C214	Open hole rotary drilling/augering in holes of depth between not exceeding 20m to 30m		Rate only			
C215	Open hole rotary drilling/augering in holes of depth between not exceeding 30m to 40m		Rate only			
	DRILLING GROUT HOLES THROUGH ROCK OR ARTIFICIALLY HARD MATERIAL: INCLINED					
C221	Open hole rotary drilling/augering in holes of depth not exceeding 5m		Rate only			
C222	Open hole rotary drilling/augering in holes of depth between not exceeding 5m to 10m		Rate only			
C223	Open hole rotary drilling/augering in holes of depth between not exceeding 10m to 20m		Rate only			
C224	Open hole rotary drilling/augering in holes of depth between not exceeding 20m to 30m		Rate only			
C225	Open hole rotary drilling/augering in holes of depth between not exceeding 30m to 40m		Rate only			
	GROUT HOLES MATERIALS AND INJECTION					
C41	Number of holes		no.			
C411	Provide cement		tonne			
C412	Provide pulverised fuel ash		tonne			
C413	Provide sand		tonne			
C414	Provide gravel		tonne			
C415	Provide bentonite		tonne			
C461	Number of injections		no.			
SUB-TOTAL						
CLASS C SUB-TOTAL BROUGHT FORWARD						
CLASS C TOTAL						

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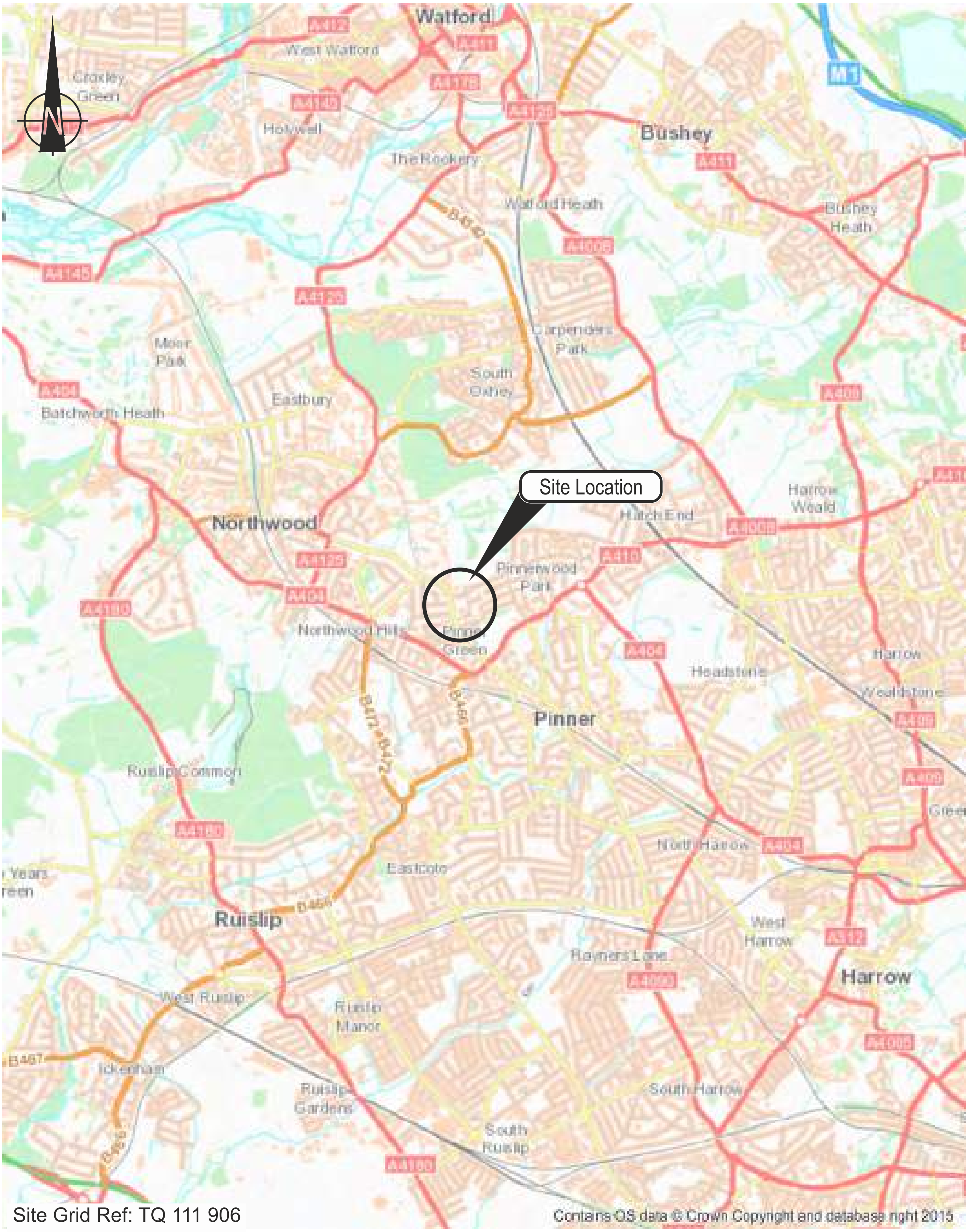
FIGURES



Site Grid Ref: TQ 111 906

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Client

Childrens Capital Project Team, Harrow Council

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PINNER WOOD SCHOOL

SITE LOCATION PLAN

Date	22.04.2016
A4 Scale	1:50 000
Drawn by	davco
Checked by	SC
Revision	0

FIGURE 1

J:\35665 Pinner Wood School\03 Figures & Dwgs\Corel

KEY

▨	Historic Location of Air Raid Shelters
▦	Electromagnetic Anomaly
■	Ground Penetrating Radar Anomaly
●	EPG Dynamic Probes (September 2015)
●	Location of Collapse
◑	PBA Dynamic Probe (August 2016)
◕	PBA Borehole (August 2016)
⊗	PBA Window Sample (August 2016)

Features extracted from supplied basemap:

︶︶︶	VEGETATION / FOLIAGE
☐	GULLY
☐	IC

— C —	CATV cables	— SD —	Service ducts
— D —	Data cables	——	Storm water
— E —	Electric cab.	— T —	Telecom cab.
——	Foul water	— U —	Unidentified
— G —	Gas pipes	— W —	Water pipes

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READING
Tel: 0118 950 0761

Client

Childrens Capital Project
Team, Harrow Council

PINNER WOOD SCHOOL

SITE LAYOUT PLAN

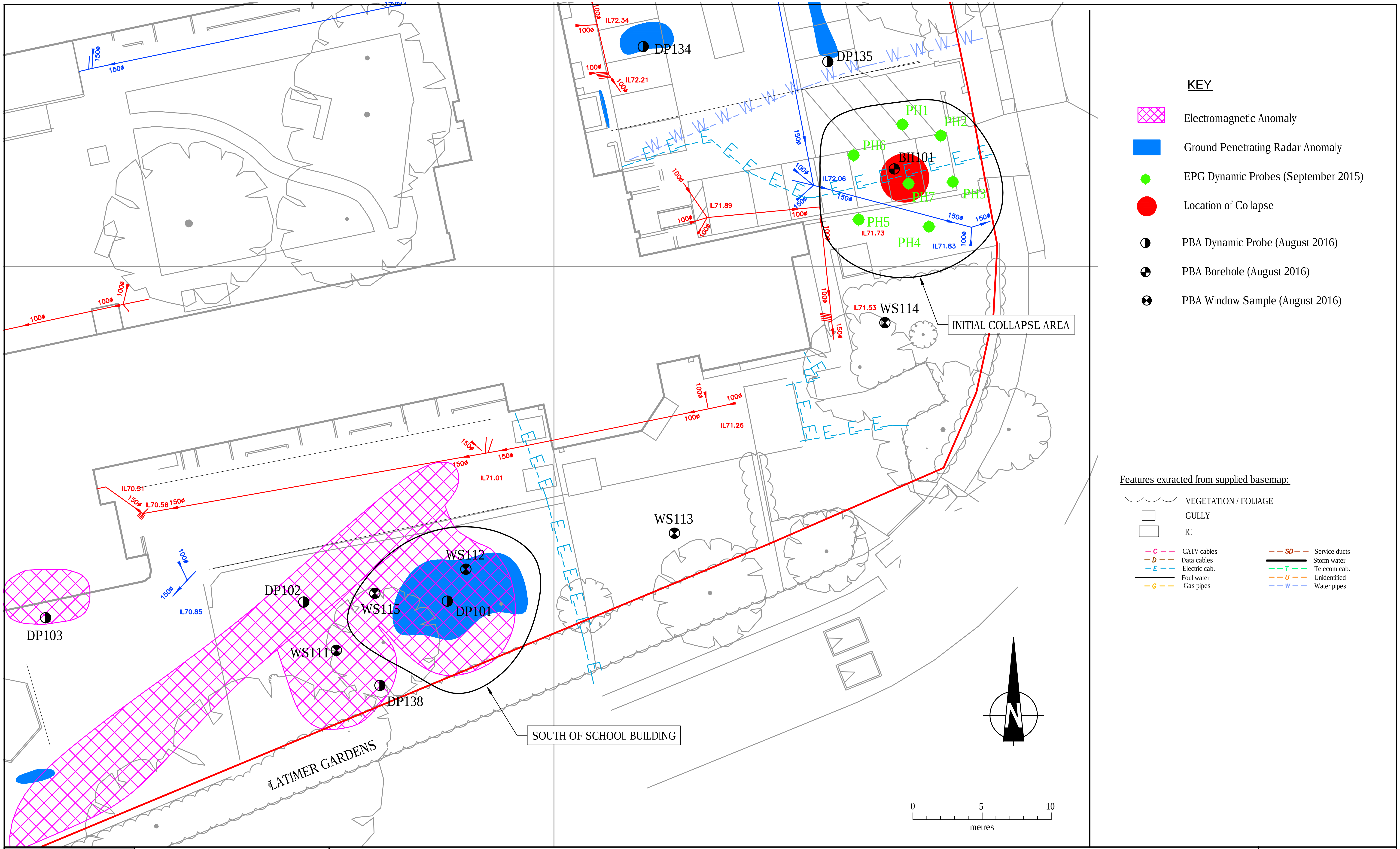
Date	22.04.2016
A3 Scale	1:750
Drawn by	davco
Checked by	SC

Figure Number

2

user name: david cotton

File Location: j:\35665 pinner wood school\03 figures & dwgs\cad\dwgs\figure 2 new.dwg



Client
Childrens Capital Project
Team, Harrow Council

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Tel: 0118 950 0761

PINNER WOOD SCHOOL

EXPLORATORY HOLE LOCATIONS
REMEDIAL WORKS AREAS

Date	22.04.2016
A3 Scale	1:250
Drawn by	davco
Checked by	CW
Figure Number	3

user name: david cotton

File Location: j:\35665 pinner wood school\03 figures & dwgs\cad\dwgs\figure 3 new.dwg

Appendix A Background and General Requirements

A.1 BACKGROUND

A1.1 Introduction

Peter Brett Associates LLP (PBA) has been commissioned to facilitate a suitable remedial solution following a ground subsidence event at Pinner Wood School, Pinner, Middlesex.

A1.2 Location and Description

The school consists of a two storey brick building, with parts of the building being constructed from the 1930s. The site is accessed off the main gates on Latimer Gardens, Pinner, Middlesex. The approximate National Grid Reference is TQ 111 906, as shown in **Figure 1**.

A1.3 Inspection of Collapse Feature

In August 2015 an unexpected ground collapse occurred within the car park to the east of the school building. Subsequent investigations indicated that the collapse was probably associated with the collapse of a shaft associated with historical chalk mining activities.

The collapse measured approximately 3m in diameter and 4m in depth, the location of the feature is shown in **Figure 2.** The feature was backfilled, by Harrow Council, with a free draining aggregate. Since the infill of the collapse the feature has settled and then been refilled over time.

At the time of the investigation the backfill to the feature had settled approximately 120mm from original ground level. The electrical cable seen within the collapse was also detected along with a water sewage main running along the southern edge of the feature.

A1.4 Geology

According to the records of the British Geological Survey (online resources www.bgs.ac.uk) the area is directly underlain by the London Clay and Lambeth Group. This is underlain by the Cretaceous age Chalk Group deposit (Seaford Chalk Formation and Newhaven Chalk Formation) which typically comprises white chalk with bands of nodular flint.

A1.5 Previous Investigations

An initial investigation was carried out by The Environmental Protection Group Ltd (EPG) and comprised of 9 dynamic probes in August 2015. The results are attached in **Appendix D**.

Further to this investigation RSK were engaged to complete a geophysical survey of the site in September 2015. This was to detect the presence of voids or disturbed ground present that might be associated with historical chalk mine workings within the survey area. Peter Brett Associates has provided a letter with an interpretation of the geophysical survey dated 21st October 2015. **Figure 2** shows the anomalies picked up by the geophysical survey.