BAXI HEATING UK LIMITED

WYRE STREET, PADIHAM

Geological & Mining Desk Study Report

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DRAWINGS

LE12082/002 Geological and Mining Settings ................................................................. 1:2,500
1 INTRODUCTION

1.1 By instruction dated 1st October 2013 from Mr Peter Alcock of Alps Group Limited, Wardell Armstrong were commissioned to carry out desk study researches to establish the geological and mining settings at the site of a proposed residential development. The site is located as shown on Drawing Number LE12082/001.

1.2 The desk study researches were carried out during October 2013 and involved the examination of:

- Published geological maps and memoirs prepared by the British Geological Survey (BGS) and their predecessors including:
  - Lancashire sheet SD73SE on the 6 inch to 1 mile scale;
  - Lancashire sheet SD83SW on the 6 inch to 1 mile scale;
  - Unpublished borehole data held by the BGS;
  - The geology of the Accrington area; and
  - The geology of the Burnley area.

- A Coal Authority mining report dated 2nd October 2013 and referenced 51000378173001;

- A Coal Authority report (shaft plan and data sheets) dated 8th October 2013 and referenced 51000387963001;

- Information supplied by Alps Group Limited; and

- Published and unpublished geological and mining information from the Wardell Armstrong archives

1.3 This report summarises the results of the desk study researches and provides recommendations for site investigation works to confirm the mining/geological setting at the site.
2 RESULTS OF THE DESK STUDY RESEARCHES

2.1 Site Location and Description

2.1.1 The site is located in Padiham and is accessed from Wyre Street which connects to Burnley Road (A671). Padiham is located 3 miles west of Burnley. The site is a vacant single storey manufacturing complex within three storey offices and associated car parking and internal roads. The eastern area of the site is grassland used for grazing. Details relating to the site including location plans are attached at Appendix A.

2.1.2 The site is bounded by residential to the north, employment land to the west, the River Calder to the south and grassland to the east.

2.2 Superficial Geology

2.2.1 The published geological mapping Lancashire sheet SD73SE and SD83SW on the 6 inch to 1 mile scale indicates that beneath any made ground that may be present, the site is underlain by Alluvium and boulder clay deposits. BGS boreholes in the vicinity of the site suggest the superficial deposits are between 10 and 14 metres in thickness.

2.2.2 A borehole located on site, within the footprint of the single storey building suggests clays, sands and gravels to 11.66 metres in thickness. The borehole log is attached at Appendix B and its position is shown on Drawing Number LE12082/002.

2.2.3 The geological mapping for the area records the course of the River Calder to be different to its present position. The former course is shown on Drawing Number LE12082/002 and the nature of the infilling is unknown.

2.3 Solid Geology

2.3.1 The superficial deposits are recorded to be undertaken by Lower Coal Measure strata of Carboniferous age generally comprising mudstones, sandstones, siltstones, coal seams and associated seatearths. The site lies immediately to the east of the recorded sub drift outcrop position of the Padiham Thick Mine.

2.3.2 The Padiham Thick Mine is an amalgamation of two coal seams (King and Fulledge Thin coals) and forms the thickest seam in the south Lancashire Coalfield. The
borehole log located on site records the coal seam as 3.86m thick. This is made up of 2 coal seams with a 1.32m thick parking. The seam is recorded to have been worked at Gawthorpe Hall Opencast site located to the north east of the site.

2.3.3 The strata are recorded to dip to the east at the unrecorded gradient.

2.3.4 There are several unnamed geological faults recorded in the vicinity of the site that are conjectured to outcrop at surface (below superficial deposits). There also several other faults proven at depth beneath the site.

2.4 Mining

Underground

2.4.1 There are recorded workings in 3 seams of coal from shallow depths to 180 metres beneath or adjacent to the site with the last date of working being 1940. A copy of the Coal Authority Mining Report is attached at Appendix C. The shallowest recorded workings are likely to be in the Padiham Thick Mine which outcrops in the west corner of the site.

2.4.2 The Padiham Thick Mine is recorded to have been worked extensively in the area and has a recorded thickness of approximately 3.86 metres beneath the site. The seam is conjectured to be between 10 metres and 50 metres below ground level beneath the site.

2.4.3 The principal coal seams in the geological sequence below the Padiham Thick Mine are shown in the table below.

<table>
<thead>
<tr>
<th>Principal Coal Seam</th>
<th>Conjectured Depth Beneath Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>China Mine</td>
<td>93m – 133m</td>
</tr>
<tr>
<td>Crackers Mine</td>
<td>110m – 150m</td>
</tr>
<tr>
<td>Dandy Mine</td>
<td>127m – 167m</td>
</tr>
<tr>
<td>Arley Mine</td>
<td>160m – 200m</td>
</tr>
</tbody>
</table>
2.4.4 The site is not within the zone of likely physical influence at the surface from any present underground coal workings.

*Opencast*

2.4.5 The Coal Authority report suggests that the property is not located within the geographical boundary of an opencast site that has or is extracting coal. Gawthorpe Hall opencast site was located to the north east of the site. There are no current licences to extract coal by opencast methods or licences awaiting determination within 800 metres of the site.

*Subsistence*

2.4.6 The Coal Authority has no record of any damage notices, claims or requests having been made to the site to execute preventative works under S.33 of the Coal Mining Subsistence Act 1991.

*Mine Entries*

2.4.7 The Coal Authority report indicates the presence of 3 shafts/adits within 20 metres of the site boundary. The approximate positions of all of the mine shafts have been plotted either from copies and tracings of the geological sheets for the area and the Coal Authority Mining report. Because of inaccuracies in the original documents and difficulties in transposing archive information onto modern day topographical mapping, the “best plot” position cannot be regarded as the definitive location of the shaft. Consideration must be given to possible plotting error and zones of uncertainty regarding the plotting of the shafts. The best plot positions of the shafts are shown on Drawing number LE12082-002. A copy of the Coal Authority Shaft Plan and Data Sheets is attached at Appendix D.

2.4.8 Notwithstanding the above, the records held by the Coal Authority are incomplete and therefore, the possibility of unrecorded shafts/adits being present on the site cannot be discounted.

2.5 *Mines Gas*

2.5.1 Abandoned mine workings can contain pockets of mine gases (‘firedamp’ - which has elevated methane concentrations and ‘blackdamp’ - which is oxygen deficient air with elevated concentrations of carbon dioxide). Under certain conditions, mine gases can be forced to the surface along conduits such as broken ground associated with geological faults or collapsed mine workings at shallow depth or mine shafts.
The Coal Authority hold no records of mines gas emissions requiring their attention, however, the possibility of mines gas present at the site cannot be discounted.
3 CONCLUSIONS AND RECOMMENDATIONS

3.1 From the results of the desk study researches obtained to date there are a number of potential constraints, which will have to be carefully considered prior to any development of the site. The three most significant constraints are detailed below.

3.2 Ground movement from collapse of abandoned recorded and unrecorded shallow mine workings

3.2.1 The desk study has identified recorded and conjectured positions of shallow coal seams and associated workings at the site and there is therefore a potential for ground instability associated with abandoned mine workings at shallow depth in the Padham Thick Mine beneath the site. There are also areas of recorded abandoned mine workings in seams deep beneath the site.

3.2.2 Where abandoned workings are present at shallow depth, they can remain open or only partially collapsed for many hundreds of years. Should such workings collapse and/or settle at some point in the future, there is a possibility that the stability of the surface (including any overlying development) could be compromised. For such workings, it is generally accepted that upwards "migration of voids" can occur until a limiting thickness of rock cover above the working has been reached, at which point the voids became totally "choked" and upward movement ceases. This limiting rock cover thickness is generally taken to be about 10 times the workable seam thickness (10t) i.e. circa 40 metres for the Padham Thick Mine. The conjectured maximum extent of potential ground instability from abandoned mine workings are shown on drawing number LE12082-002.

3.2.3 The collapse and/or settlement of abandoned mine workings at shallow depth normally results in either the formation of crown hole type collapse features or abnormal surface settlements over a wider area depending upon the nature of the overlying strata. Crown hole type collapses are more normally associated with large "standing open" workings at very shallow depth. In addition to crown holes it is also possible that any collapse and/or settlement of abandoned workings in the shallow seams could result in abnormal and unpredictable ground settlements over a wider area.
3.2.4 Where a risk of collapse of shallow mine workings has been identified, we recommend that further investigation to confirm their position and if appropriate, treatment of the workings is undertaken. Treatment would normally comprise the drilling and pressure grouting of voids generally in accordance with guidance given in CIRIA document 32 “Investigation and treatment of Shallow abandoned mineworkings”.

Ownership and liability issues

3.2.5 Ownership of coal mine workings and entries is normally vested in The Coal Authority by virtue of the provisions of the Coal Industry Act 1994. However, the extent to which workings and entries are vested is open to interpretation and may be subject to legal opinion in certain circumstances. Generally, the Coal Authority claims ownership of abandoned mine workings and entries, but this may not always be the case. We are currently unaware of the detailed circumstances relating to mineral ownership and rights at the site.

3.2.6 Prior to any investigation/treatment works commencing consideration should be given to notifying the Coal Authority in accordance with their procedures. On completion of any works the Coal Authority will require a copy of the investigation/treatment report for their records.

3.3 Ground instability associated with abandoned mine shafts / adits

3.3.1 The Coal Authority Mining report identifies three mine shafts recorded beneath the site. There are no specific treatment details for the majority of the shafts.

3.3.2 As in any former mining area, the possibility that unrecorded mine entries might exist at the site cannot be discounted. A careful watch should therefore be maintained during any works on the site and should any feature which may indicate the presence of an unrecorded mine entry (such as circular brickwork, anomalous areas of fill, etc) be discovered, it should be reported, investigated and treated as necessary.

3.4 Engineering Strategy – Mining issues

3.4.1 All the above constraints can be overcome with relatively straightforward engineering solutions using industry accepted techniques and methods that have been used on many similar sites when developing in mining affected areas.
3.4.2 The risk of abnormal ground settlement is not normally acceptable beneath developments. Further investigation to confirm the geological / mining position and treatment of shallow workings beneath any development within the zones of potential surface instability will therefore be required to ensure their future long term stability.

3.4.3 Prior to the development, we recommend that the geotechnical, geological and mining settings beneath the site are confirmed by drilling 3 to 5 cable percussion boreholes followed on by rotary cored boreholes to depths of up to 50 metres below rockhead.

3.4.4 Appropriate further investigation and treatment might involve, the pressure grouting of boreholes drilled to intercept the horizons of the proven shallow coal seam (Padiham Thick Mine), on a regular grid pattern beneath and adjacent to the development. Depending upon the results of these primary works, secondary drilling and grouting may also be required to ensure that any workings beneath the development are properly consolidated and/or stabilised.

3.4.5 The precise depths, extent of investigation, treatment, limits of the zones of potential surface instability, etc would be confirmed during the ongoing progress of the drilling and pressure grouting works.

3.4.6 Although roads, car parks and services have a degree of flexibility in their structures and it is not usual to investigate and treat abandoned mine workings at shallow depth beneath these structures (where only a risk of abnormal settlement is proven, they would not normally be expected to withstand the formation of crown hole collapse beneath them. Therefore, wherever a significant risk of crown hole collapse is established on the site it may be appropriate to treat these structures by drilling and pressure grouting to ensure their long-term stability. However, this approach is usually confirmed with the adopting authorities.

3.5 Other considerations

3.5.1 It would also be prudent to investigate the ground conditions along the former route of the River Calder. This would likely be a combination of shallow depth boreholes and trial pits with insitu testing.