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FORMER HICKLETON COLLIERY, BARROWFIELD ROAD, THURNSCOE, BARNSELY

PRIORITY SPACE (HICKLETON) LTD

SITE ASSESSMENT - RISK FROM COAL MINING & HISTORIC LAND USE

11525

OCTOBER 2019

Contract: Former Hickleton Colliery, Barrowfield Road, Thurnscoe, Barnsley**Document Title:** Site Assessment - Risk from Coal Mining & Historic Land Use**Our Ref:** 11525/12**Prepared by:** W. Dixon BSc (Hons) MSc FGS **Date:** October 2019**RECORD OF AMENDMENTS TO DOCUMENT**

Ref	Description	Date

Verified by: A.C. Gibson BEng CEng MICE MCIHT **Date:** October 2019
MIRSE

SITE ASSESSMENT - RISK FROM COAL MINING & HISTORIC LAND USE

FORMER HICKLETON COLLIERY, BARROWFIELD ROAD, THURNSCOE

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Introduction

William Saunders are appointed by Priority Space (Hickleton) Ltd in connection with the proposed light-industrial development on the former Hickleton Colliery, Barrowfield Road, Thurnscoe, Barnsley.

This report has been written with the intention of discharging condition 18 of the planning application 2019/0010. Condition 18 states the following:

*"The site is located in a Coal Authority coal mining referral area due to the presence of a mineshaft. The land could therefore potentially be at risk from mining legacy risks such as ground instability and fugitive gas migrations. The layout of the proposed development will need to take account of the shaft positions via suitable standoffs to the buildings and / or mitigating actions such as suitable foundation design. The site investigations recommended in the William Saunders Phase one Geo-environmental report ref 11525 must therefore be undertaken as advised by a suitably qualified engineer to ascertain the extent and level of the shaft cap (and any other below ground structures from the former use of the site that may be present) and the depth to rock head so that suitable stand-off from the shaft can be agreed. The investigations and subsequent development must be undertaken in compliance with Construction Industry Research and Information association publication 32 'construction over abandoned mine workings' where applicable. A report undertaken by a suitably qualified engineer detailing the findings of the investigation and any recommended mitigation shall be submitted for approval in writing by the local planning authority, the development thereafter shall be carried out in accordance with the approved details. Responsibility for securing a safe development rests with the developer and / or landowner. **Reason: Land stability in accordance with NPPF Sections 178, 179 and 170.**"*

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Stage 1: Obtain Coal Mining Information

A Non-Residential Mining Report was obtained from The Coal Authority on 8th February 2017, ref 51001377318001, see Appendix A.

The Coal Authority's interactive mapper as well as historical Ordnance Survey maps and a colliery surface plan have been used to gain knowledge of the site. Various reports have also been sourced from the previous landowner, Homes England, which date from the redevelopment of the colliery and the reclamation of Phoenix Park including the site and the surrounding area.

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Stage 2: Relevant Coal Mining issues noted from the initial Coal Mining Risk Assessment

The Coal Authority's Mining Report, Appendix A, notes that: -

There are 3 mine entries in, or within 20m of, the site, although records may be incomplete and entries may exist that the CA are not aware of.

- **446405-001** – This mine shaft is in the centre of the site. Filled in 1986 and capped in 1990.
 - o Top of cap is reportedly 47.069m AOD and the cap diameter is 11.0m. (WYG Environment Planning Transport Ltd. A097680. Former Hickleton Colliery, HCA Asset No. 03270: Ground Conditions Review. August 2016).
 - o An International Mining Consulting Limited (IMC) report, "Hickleton Colliery Site Investigation. November 1997" has been referred to within the WYG report, this gives the following information:
 - § GR 446443, 405335 coordinates of the mine shaft. Shaft depth 513m, shaft diameter of approx. 5m. Shaft filled on 11th September 1986.
- **446405-002** – This mine entrance lies beyond the site approx. 12m from the western boundary. The shaft is filled with hardcore and was capped with a 750mm thick reinforced hexagonal cap in August 1994 and is plugged with concrete to an unknown depth beneath the cap. A 600mm diameter vent is installed through the cap and concrete plug.
 - o The previously mentioned IMC report, 1997, includes the following information on this shaft and its treatment:
 - § GR 446387E 405333N coordinates of the mine shaft. Shaft depth 755.6m, shaft diameter of approx. 5m. This shaft is filled with hardcore. A reinforced concrete cap fitted with a gas vent pipe was installed prior to December 1995.
 - o This shaft has previously been used for methane extraction although William Saunders have been informed by Infinis in November 2018 that the gas extraction has ceased.
- **446405-010** – This mine entrance lies along/beyond the southern site boundary. No treatment details are available from the Coal Authority.
 - o The previously mentioned IMC report, 1997, includes the following information on this shaft and its treatment:
 - § GR 446470E 405290N (in the vicinity of), depth 21m, diameter not known.

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- § This was proved to be a well by the South Yorkshire Mining Advisory Service, Barnsley MBC, who installed a reinforced concrete cap on 9 March 1995.
- § Excavations adjacent to a peg set out at GR 446470E 405290N on 25 July 1997 proved fill materials to a depth of 3.6m.
- § A concrete slab 0.2m in thickness, 2.7m wide and a minimum of 4m in length was located 1m to the east of the peg at a depth of 2.8m. This slab has been plotted on a drawing as accurately as possible, Appendix B.
- o The level of the shaft cap is not known as levels in the 1990s may have been different to present.
 - § Records from unconfirmed source. Mineral Report. M4186. Well (IMC Shaft no. 10) On the 20th February 1995, what was thought to be a possible mineshaft was unearthed in reclamation works on the Hickleton Colliery site. However, subsequent investigations on the 24th February 1995, by drilling 3 boreholes, proved that a well to the Ackworth Rock sandstone at 21m bgl had been discovered.
 - § William Saunders approached SYMAS in September 2018 and received the following document. SYMAS record sheet dated 9th March 1995 written by I. Johnson. *"On Friday 24th February 1995 I supervised the drilling of 3 boreholes at the above location, to ascertain whether the brick structure found during the roadworks was a shaft or a well.....From the details shown in the Hickleton Shaft Section book, this would indicate that the structure was a well sunk into the Ackworth Rock."*
 - SYMAS confirmed the did not have any details of the shaft capping.
 - This location coincides with a well indicated in historical mapping.
- o It is stated in a report by WYG that The South Yorkshire Mining Advisory Service proved this by drilling to be a well of 21m depth and treated it with a reinforced concrete cap in March 1995.

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Stage 3: Site Investigation Works

A general site investigation was carried out on the site by Solmek Ltd in November 2018 in accordance with the William Saunders Phase 1 Geo-Environmental report. Refusal of trial pits and boreholes occurred within areas in the south of the site coinciding with building footprints from the surface plan provided by the Coal Authority.

Shaft 446405-001 – Located in the centre of the site.

- The central shaft (001) cap was temporarily exposed with dimensions measured as well as the thickness of concrete and the level of the top of the cap all taken, photographs can be seen in Appendix C.
- The central shaft cap is hexagonal, the radius to each corner is 5.5m. The depth to the top of the shaft cap was measured to be 0.9m from the existing ground level giving a level of 48.10m AOD. The cap was measured to be 1.1m thick concrete.

Shaft 446405-002 – Located approx. 12m west of the site.

- As the shaft cap is located beyond the site boundary within a developed site it has not been possible to further investigate this cap to accurately locate it and confirm details such as depth and thickness.

Shaft 446405-010 – Located immediately beyond the southern boundary.

- Investigations to locate this capped shaft have proved unsuccessful. Excavation to rockhead up to the site boundary have failed to locate it. As such it can only be assumed to lie beyond the extent of the site.

Below Ground Obstructions

- The below ground obstructions were investigated further to identify the positions, depths and thicknesses. Reinforced concrete relic foundations were discovered from 3.10m bgl to at least 4.2m bgl west of the site centre assumed to be left in-situ from the former winding house. Red brick masonry foundations from 2.2m bgl to 3.5m bgl were found beneath the footprint of the former power house towards the south of the site.
 - o Refer to William Saunders drawing 11525-WMS-ZZ-XX-DR-S-20100-S2-P1, Appendix D, for details of relic foundations.

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Stage 4: Identify how Coal Mining issues have influenced the proposed Development and whether any other mitigation measures are required.

Shaft **446405-001** – Located in the centre of the site.

- This shaft is filled and capped. The top of the cap has been measured to be 0.9m below the existing ground level, the cap is 1.1m thick concrete. The level of rockhead has been estimated from the previous site investigations to be approx. 47.00m AOD at this location. It is therefore considered that the base of the cap has been constructed at the level of rockhead.
- A suitable standoff zone has been calculated, Appendix E, in which no buildings/foundations will be placed so as not to impose any load on the cap.
- A general earthworks cut and fill operation is proposed across the site excluding the area above the shaft to avoid disturbance to the shaft and cap. The earthworks specification comprises the excavation of all made ground and any obstructions down to rockhead, processing of the material and subsequent filling and compaction of the resulting material to levels to suit the proposed development.
- The shaft is to be located beneath an area of service yard to be trafficked by HGVs, refuse lorries and delivery vehicles. A minimal vegetation strip will be undertaken in this area before the yard construction is placed directly over this formation level. A suitable yard construction will be specified with the proposed ground level being approx. 0.65m above the existing ground level.
- It is proposed to reinforce the proposed yard area over the shaft with the inclusion of a geogrid which will be placed at formation level around the shaft spanning the zone of influence. The area of geogrid is to be a square/rectangular area spanning a distance of 5m greater than the calculated zone of influence/standoff zone of the cap.
 - o The placement of a geogrid is considered a suitable solution to allow the development of a service yard above. Any failure of the underlying shaft cap would be evident by subsequent subsidence of the yard area with the geogrid preventing any major collapse.
 - o An alternative treatment of the existing cap of placing a reinforced concrete slab above the cap was discounted as any failure of the shaft cap below would occur with no visible evidence at the surface resulting in an underlying hazard which could potentially lead to a greater failure.
 - o It is however considered highly unlikely that the existing cap will fail as it is assumed that the cap complies with the normal British Coal/Coal Authority standards of the time

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which would have specified a reinforced concrete slab construction which would have been designed to allow for yard construction above.

Shaft **446405-002** – Recorded location approx. 12m west of the site. Unable to locate.

- The level of rockhead at this location has been estimated from the site investigations to be approx. 44.7m AOD at this location. This has been interpolated from the average gradient of rockhead across the site from east to west to the approximate location of the shaft. The shaft cap is assumed to be placed at the level of rockhead or lower with the standoff zone calculated accordingly.
- A suitable standoff zone has been calculated, Appendix E, in which no buildings/foundations will be placed so as not to impose any load on the cap.

Shaft **446405-010** – Recorded location at/beyond the southern boundary. Unable to locate.

- The level of rockhead has been estimated from the site investigations to be approx. 47.00m AOD at this location. The level of the cap is anticipated to be above the level of rockhead. Due to the positional uncertainty relating to the shaft and the cap, the standoff zone has been calculated from the level of rockhead to give a greater radius.
- A suitable standoff zone has been calculated from the anticipated northernmost anticipated position of the capping slab from the information discussed in the previous section, see Appendix E for calculations. No buildings/foundations will be placed within this standoff zone so as not to impose any load on the cap.

Residual risks:

- Controlled subsidence of the service yard if a failure of the central shaft cap should occur.

APPENDIX A

Coal Authority Mining Report



The Coal
Authority

Resolving the **impacts** of mining

CON29M Non-Residential Mining Report

SITE AT HICKLETON
DONCASTER
SOUTH YORKSHIRE

Date of enquiry: 08 February 2017
Date enquiry received: 08 February 2017
Issue date: 08 February 2017

Our reference: 51001377318001
Your reference: 113395959_2|



CON29M Non-Residential Mining Report

This report is based on, and limited to, the records held by the Coal Authority and the Cheshire Brine Subsidence Compensation Board's records, at the time we answer the search.

Client name

LANDMARK INFORMATION GROUP LIMITED

Enquiry address

SITE AT HICKLETON, DONCASTER, SOUTH YORKSHIRE

How to contact us

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NG18 4RG

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 /company/the-coal-authority
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Approximate position of property



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Summary

Has the search report highlighted evidence or potential of		
1	Past underground coal mining	Yes
2	Present underground coal mining	No
3	Future underground coal mining	Yes
4	Mine entries	Yes
5	Coal mining geology	No
6	Past opencast coal mining	Yes
7	Present opencast coal mining	No
8	Future opencast coal mining	No
9	Coal mining subsidence	No
10	Mine gas	No
11	Hazards related to coal mining	No
12	Withdrawal of support	No
13	Working facilities order	No
14	Payments to owners of former copyhold land	No
15	Information from the Cheshire Brine Subsidence Compensation Board	No

Further recommended reports
Mine entry interpretive report
Mine entry plan and data sheets

For detailed findings, please go to page 4.

Detailed findings

1. Past underground coal mining

The property is in a surface area that could be affected by underground mining in 3 seams of coal at 360m to 730m depth, and last worked in 1949.

Any movement in the ground due to coal mining activity should have stopped.

2. Present underground coal mining

The property is not within a surface area that could be affected by present underground mining.

3. Future underground coal mining

The property is not in an area where the Coal Authority has plans to grant a licence to remove coal using underground methods.

The property is not in an area where a licence has been granted to remove or otherwise work coal using underground methods.

The property is not in an area likely to be affected from any planned future underground coal mining.

However, reserves of coal exist in the local area which could be worked at some time in the future.

No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

4. Mine entries

Within, or within 20 metres of, the boundary of the property there are 3 mine entries, the approximate positions of which are shown on the enquiry boundary plot.

Our records disclose the following information:

446405-010. No treatment details.

446405-002. is filled with hardcore and was capped with a 750mm thick reinforced hexagonal cap in August 1994 and is plugged with concrete to an unknown depth beneath the cap. A 600mm diameter vent is installed through the cap and concrete plug.

446405-001. was filled in 1986 and capped in 1990.

For an additional fee, the Coal Authority can provide a Mine Entry Interpretive Report. The report will provide a separate assessment for the mine entry/entries referred to in this report. It gives an opinion on the likelihood of mining subsidence damage caused from ground movement as a consequence of the mine entry/entries. It also gives details of the remedies available for subsidence damage where the mine entry was sunk in connection with coal mining.

Please note that it may not be possible to produce a report if the main building to the property cannot be identified from Coal Authority plans (ie for development sites and new build).

For further advice on how to order this additional information please visit www.groundstability.com.

5. Coal mining geology

The Coal Authority is not aware of any damage due to geological faults or other lines of weakness that have been affected by coal mining.

6. Past opencast coal mining

The property is within the boundary of an opencast site from which coal has been removed by opencast methods.

7. Present opencast coal mining

The property does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.

8. Future opencast coal mining

There are no licence requests outstanding to remove coal by opencast methods within 800 metres of the boundary.

The property is not within 800 metres of the boundary of an opencast site for which a licence to remove coal by opencast methods has been granted.

9. Coal mining subsidence

The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres, since 31 October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

10. Mine gas

The Coal Authority has no record of a mine gas emission requiring action.

11. Hazards related to coal mining

The property has not been subject to remedial works, by or on behalf of the Authority, under its Emergency Surface Hazard Call Out procedures.

12. Withdrawal of support

The property is not in an area where a notice to withdraw support has been given.

The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.

13. Working facilities order

The property is not in an area where an order has been made, under the provisions of the Mines (Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof.

14. Payments to owners of former copyhold land

The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

15. Information from the Cheshire Brine Subsidence Compensation Board

The property lies outside the Cheshire Brine Compensation District.

Comments on the Coal Authority information

The Coal Authority own the copyright in this report and the information used is protected by our database right.

The boundary plot shows the approximate location of the disused mine entry/entries referred to in this report. For reasons of clarity, mine entry symbols may not be drawn to the same scale as the plan.

Property owners have the benefit of statutory protection (under the Coal Mining Subsidence Act 1991*). This contains provision for the making good, to the reasonable satisfaction of the owner, of physical damage from disused coal mine workings including disused coal mine entries. A leaflet setting out the rights and obligations of either the Coal Authority or other responsible persons under the 1991 Act can be obtained by visiting www.groundstability.com.

If you wish to discuss the relevance of any of the information contained in this report, you should seek the advice of a qualified mining engineer or surveyor. If you or your advisor wish to examine the source plans from which the information has been taken, these are available to view, free of charge, at our Head Office in Mansfield. To book an appointment please ring 01623 637225. Should you or your advisor wish to carry out a physical investigation that may enter, disturb or interfere with any disused mine entry, prior permission of the owner must be sought. For coal mine entries, the owner will normally be the Coal Authority.

The Coal Authority, regardless of responsibility and in conjunction with other public bodies, provide an emergency call out facility in coalfield areas to assess the public safety implications of mining features (including disused mine entries). Our emergency telephone number is 01623 646333.

*Note, this Act does not apply where coal was worked or gotten by virtue of the grant of a gale in the Forest of Dean, or any other part of the Hundred of St. Briavels in the county of Gloucester.

In view of the mining circumstances a prudent developer would seek appropriate technical advice before any works are undertaken.

Therefore if development proposals are being considered, technical advice relating to both the investigation of coal and former coal mines and their treatment should be obtained before

beginning work on site. All proposals should apply good engineering practice developed for mining areas. No development should be undertaken that intersects, disturbs or interferes with any coal or mines of coal without the permission of the Coal Authority. Developers should be aware that the investigation of coal seams/former mines of coal may have the potential to generate and/or displace underground gases and these risks both under and adjacent to the development should be fully considered in developing any proposals. The need for effective measures to prevent gases entering into public properties either during investigation or after development also needs to be assessed and properly addressed. This is necessary due to the public safety implications of any development in these circumstances.

Additional remarks

Information provided by the Coal Authority in this report is compiled in response to the Law Society's Con29M Coal Mining and Brine Subsidence Claim enquiries. The said enquiries are protected by copyright owned by the Law Society of 113 Chancery Lane, London WC2A 1PL. Please note that Brine Subsidence Claim enquiries are only relevant for England and Wales. This report is prepared in accordance with the Law Society's Guidance Notes 2006, the User Guide 2006 and the Coal Authority and Cheshire Brine Board's Terms and Conditions applicable at the time the report was produced.

Disclaimer

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Alternative formats

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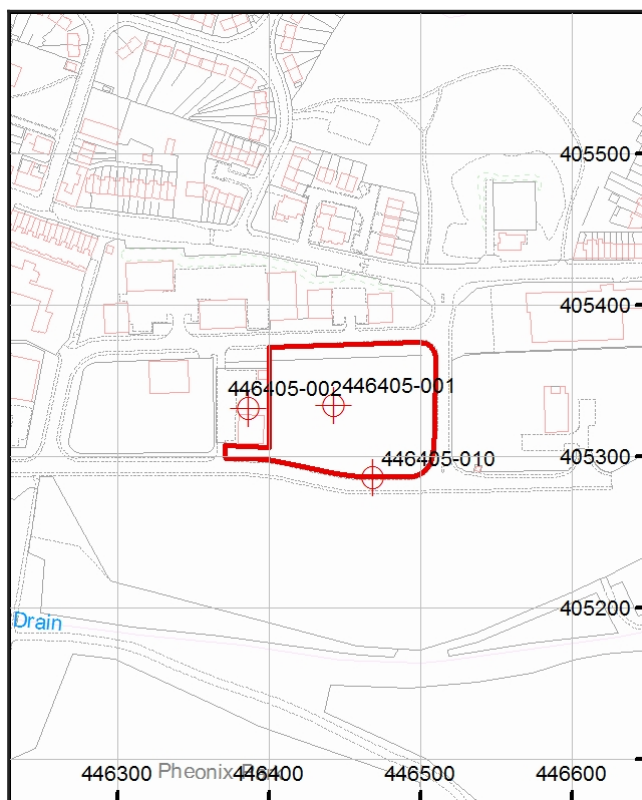
Enquiry boundary

Key

Approximate position of enquiry boundary shown



Disused mineshaft



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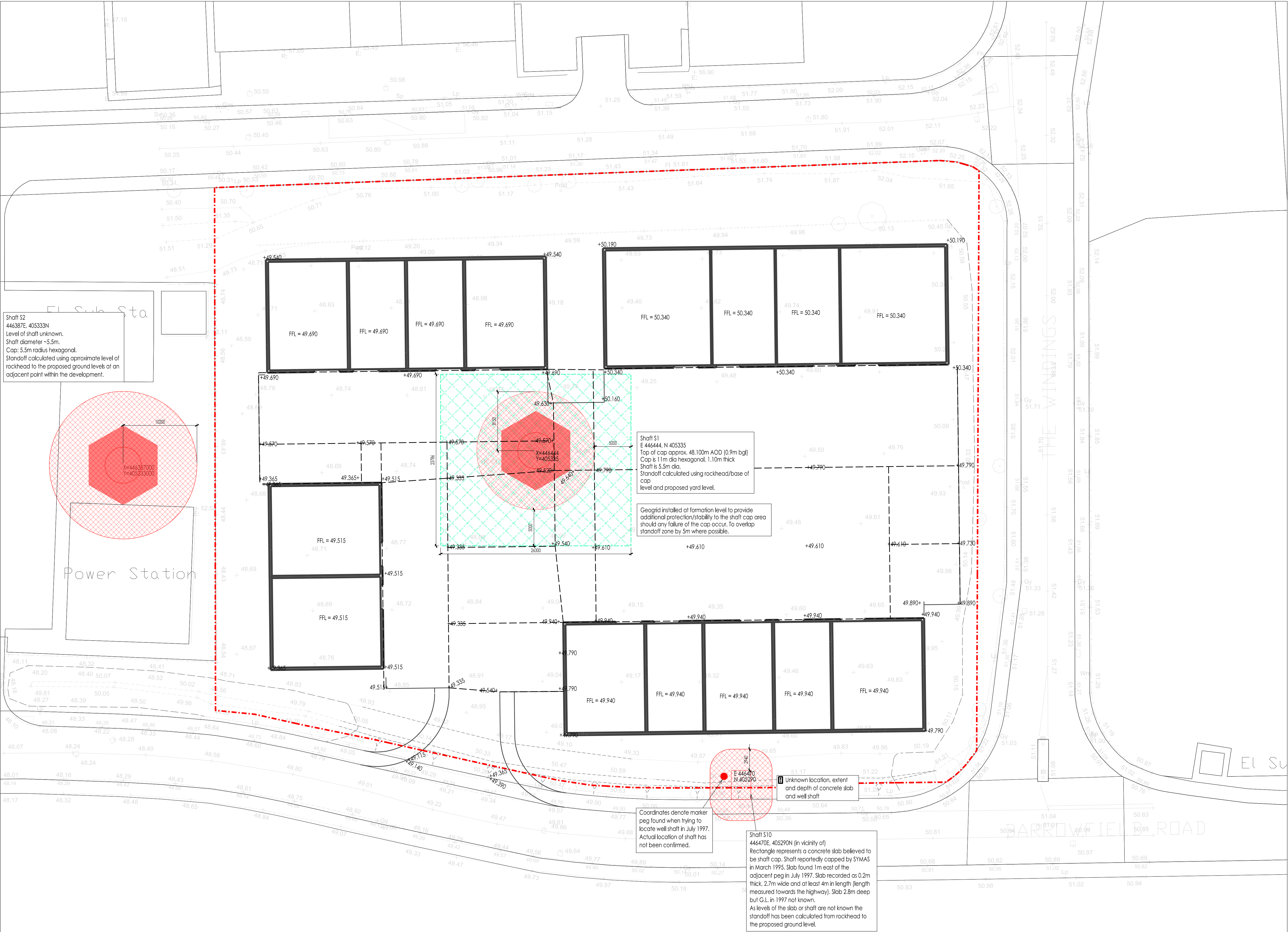
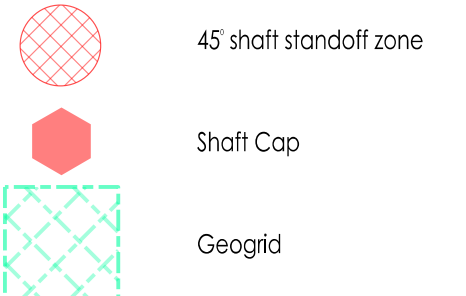
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APPENDIX B

Shaft Constraints Plan

Key:



P2	Geogrid added. Notes ammended.	WD	PAE	04/10/19
P1	Initial issue	WD	PAE	25/09/19
Rev	Description	Drm	Vfd	Date
As outlined in section 2.3 of the CIB Industry Guidance to Designers, insignificant risks can usually be ignored, as can risks arising from routine construction activities, unless the design compounds or significantly alters these risks. In accordance with CDM Regulations 8, 9 and 11, any significant risks relating to the design features shown on this drawing have been identified and are annotated thus:				
☐ No significant risks have been identified.				
☒ Significant risks have been identified - refer to notes on drawing for information on residual risks and any control measures to be employed.				
Refer to the current Designer's Risk Assessment sheets for further details.				
Designer's Signature		WD	Date 09/2019	

Drawing Status REGULATORY APPROVAL

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Project									
Proposed Development Former Hickleton Colliery Thurnscoe Barnsley									
Client									
Priority Space (Hickleton) Ltd.									
Title									
Mining Constraints									
WmS Project Ref.		Drawn		Date		Scale		@ A1	
11525		WD		10/2019		1:250			
Drawing/Document Reference									
Project		Originator		Zone		Level		Type	
11525		WMS		ZZ		XX		DR	
C		39604		S8		P2			

APPENDIX C

Photographs of Exposed Shaft Cap

SHAFT CAP TRIAL PITS



Title	Date
Shaft Cap Trial Pit Photographs	January 2019
Project	Fig No.
Hickleton Colliery, Thurnscoe	Figure 6
Client	Scale
William Saunders	Do Not Scale
Key	

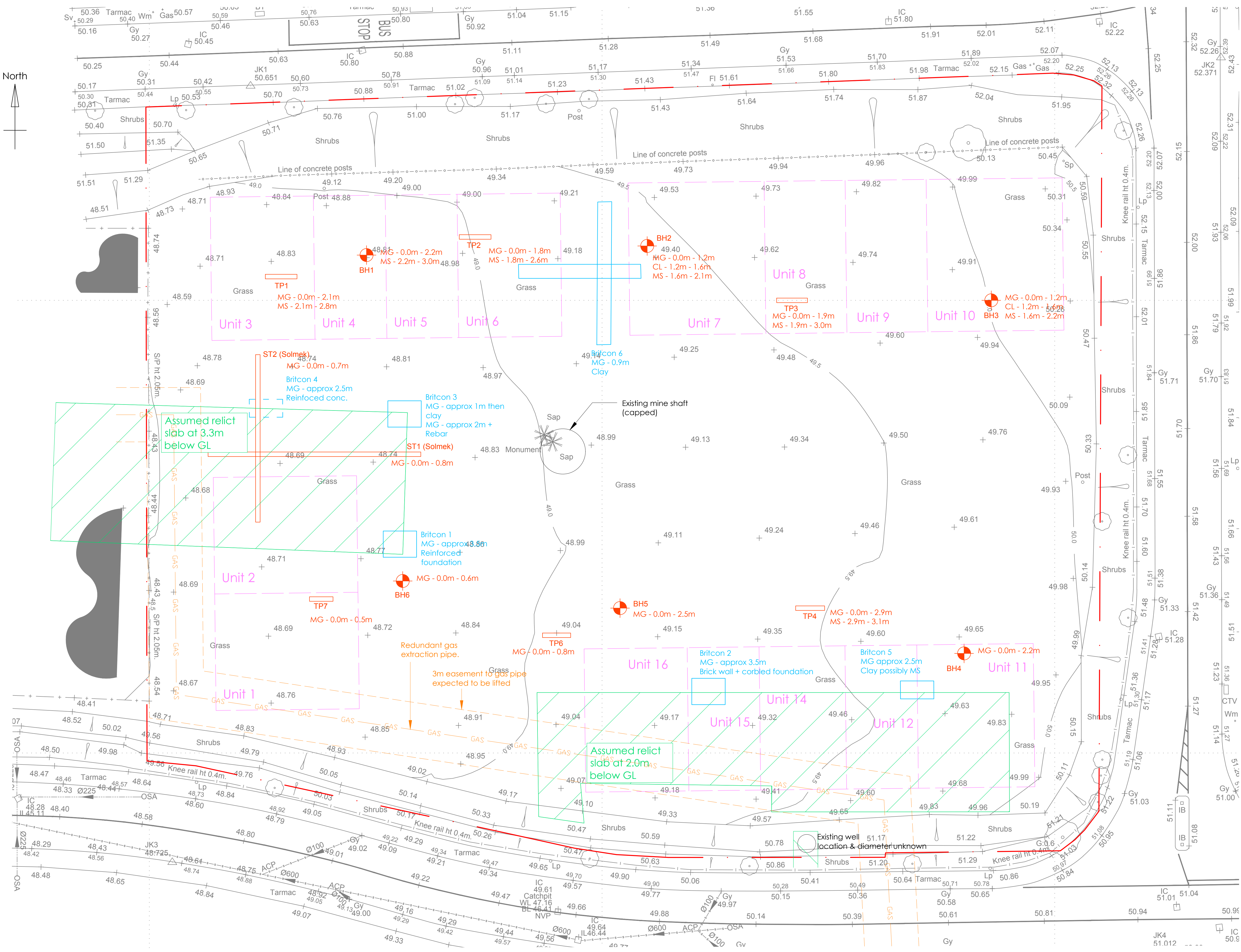
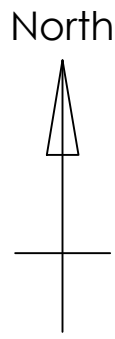
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APPENDIX D

Site Investigation Location & Relic Foundations Plan



William Saunders is the trading name of Wm Saunders Partnership LLP.
Wm Saunders Partnership Limited Liability Partnership is registered in England and Wales with the Registration number OC 308323.
The Registered Office is Sheppard Lockton House, Cafferata Way, Newark on Trent, Notts, NG24 2TN.

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Contractors must verify all dimensions, levels and co-ordinates at the site before commencing any work or making any shop drawings: no dimensions to be taken from drawing.

- Approx Solmek BH location (1-6)
- Approx Solmek trial pit location (TP1 - TP7 + ST1 - ST2)
- Trial pits by Britcon
- Assumed relict foundation slabs
- GAS Dissused gas extraction pipe

PI	First issue - preliminary	AA	PJ	14/6/19
Rev	Description	Dm	Vfd	Date
As outlined in section 2.3 of the CIB Industry Guidance to Designers, insignificant risks can usually be ignored, as can risks arising from routine construction activities, unless the design compounds or significantly alters these risks. In accordance with CDM Regulations 8, 9 and 11, any significant risks relating to the design features shown on this drawing have been identified and are annotated thus:				
☒ No significant risks have been identified.				
☐ Significant risks have been identified - refer to notes on drawing for information on residual risks and any control measures to be employed.				
Refer to the current Designer's Risk Assessment sheets for further details.				
Designer's Signature		Date		

Drawing Status
PRELIMINARY

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Project								
Industrial Development at the former hickleton Colliery, Thurnscoe.								
Client								
Priority Space (Hickleton) Ltd.								
Title								
Summary of Site Investigation Works								
WmS Project Ref.		Drawn	Date	Scale		© A1		
11525		AA	May 2019	1:200				
Drawing/Document Reference								
Project	Originator	Zone	Level	Type	Role	Number	Status	Rev.
11525	WMS	ZZ	XX	DR	S	20100	S2	P1

APPENDIX E

Shaft Standoff Zone/Zone of Influence Calculations

CALCULATION SHEET

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architecture : engineering : building consultancy

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Nottinghamshire, NG24 2TN

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W: wm-saunders.co.uk

Project: Hickleton Our Ref: 11525

Calculations for: Central Shaft S1 : Standoff Zone. Using Depth found by Solmer

Volume: Section: Revision:

Calc by: WD Date: 01/10/19 Checked by: PE Date: 01/10/19 Sheet 1 of 3

Cap: 446444E, 405335N

Radius 5.5m, hexagonal

Depth to surface : 900mm $\Rightarrow$ Level 49.00 - 0.9 = 48.10m AOD

Cap thickness : 100mm $\Rightarrow$ Level of base = 48.10 - 1.1 = 47.00m AOD

Rockhead level $\Rightarrow$ 46.95 to 47.05m AOD. Cap likely placed on rockhead.

Proposed ground level 49.65m AOD

Proposed depth (to base) = 49.65 - 47.00
= 2.65m

Standoff from cap centre at 45°:

= radius + depth

= 5.5 + 2.65

= 8.15m radius

Project: Hickleton Our Ref: 11525

Calculations for: Standoff Zone, Shaft 2 (Western)

Volume: / Section: / Revision: /

Calc by: WD Date: 01/10/19 Checked by: PE Date: 01/10/19 Sheet 2 of 3

Location = 446387E, 405333N

Approx. (worst case) GL. ^{within development} ~~within development~~ = 49.40 m AOD

Approx. (worst case) GL. over shaft = 48.47 m AOD

Approx. rockhead level = 44.7 m AOD

Cap: Radius 5.5m Octagonal

Depth to top = 5.5m (anecdotal)

Cap thickness = 750mm (anecdotal)

Level of cap base = 48.47 - 5.5 - 0.75 = 42.22 m AOD

Rockhead is at a higher level than the base (or top) of the shaft
Cap $\Rightarrow$ use rockhead level in calculation of Standoff.

Standoff

$\Rightarrow$ Taken from rockhead level from cap edge at 45° to proposed ground level.

$\Rightarrow$ From centre point of shaft. Taking radius as 5.5m

Cap radius + depth

= 5.5 + 4.7

= 10.2m radius Standoff from centre point of cap.

CALCULATION SHEET

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Project: Hichleton Our Ref: 11525

Calculations for: Standoff Distance: Southern Shaft S10

Volume: Section: Revision:

Calc by: WD Date: 01/10/19 Checked by: PE Date: 01/10/19 Sheet 3 of 3

Southern (well) shaft location: 446470E, 405290N

Rockhead level (approx): 47.00m AOD

Ground level at shaft = ~50.41m AOD

Ground level in development = 49.94m AOD

Cap depth = 2.8m bgl (anecdotal info.)

Cap level $\geq$ 50.41m AOD - 2.8m = 47.6m AOD

Cap thickness unknown, said to be a 200mm thick slab in this location. Due to uncertainty calculate standoff down to rockhead. Rockhead is deeper than the cap base and will therefore generate a greater standoff zone.

Shaft Standoff:

= Proposed Gt - rockhead

= 49.94 - 47.00

= 2.94m radius from edge of slab.

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