Memo – Haddiscoe (Norton Subcourse) Geological information

As part of a 2020 acquisition of CEMEX assets by Breedon Trading Limited Norton Subcourse quarry passed from CEMEX ownership to Breedon Trading Limited ownership. Additional to the site, interest in the Haddiscoe site as a potential extension to the operations was also transferred over to Breedon.

At the time of the purchase the mineral exploration work undertaken was at an already advanced stage with CEMEX having drilled the site in 2018.

A site investigation report was provided to Breedon.

The geological information contained with the report has been assessed by the regional Geologist and the regional Land and Mineral Resources Manager. It is considered to be of sound scientific basis and appears to be an accurate account of the site investigation works undertaken. Breedon Trading limited is confident in the evaluation previously undertaken by CEMEX and did not deem it necessary for additional site investigation work to be carried out.

The reports have therefore been attached to provide reasonable proof of the presence of sand and gravel at the site, and, the scientific processes used to derive the reserve calculation for the site.

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Site investigation at

Haddiscoe

Factual and interpretative report

Project No.: 1802-W048

Report Ref: 1802-W048_HAD_SI_R01

May 2018

Report Summary:

A site investigation comprising five (5no.) cable percussion boreholes, laboratory testing and deposit modeling has determined that a sand and gravel resource of approximately 1.17 million tonnes to be present in an area of land located southeast of Norton Subcourse Quarry.

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Site investigation
at
Haddiscoe

Factual and Interpretative Report

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1 INTRODUCTION

A geological investigation has been undertaken by CEMEX UK, National Reserves Department at the site of a proposed new development to the southeast of Norton Subcourse Quarry. The land, identified as 'Haddiscoe' is owned by a Mr. Watson. Instructions were provided by Robert Fairey of Brown & Co, his appointed land agent.

2 OBJECT AND SCOPE OF THE INVESTIGATION

The object of the investigation was to obtain information on the ground and groundwater conditions relating to the potential for the land to be underlain by a viable source of aggregate. The investigation comprised a geological desk study, cable percussion boreholes, laboratory testing and reporting. An interpretation and evaluation of the resource has also been undertaken.

3 THE SITE

3.1 Location

Haddiscoe is located to the east of the village of Haddiscoe, Norfolk. The national grid reference for the site centre is 643900E, 297273N. Drawing No. 1802-W048_HAD_SITELOC, contained in Appendix 1 shows the site location.

3.2 Description

The site comprises one large piece of land, roughly triangular in shape, and covering an area of approximately 20.4 Hectares. It is generally flat, and given over to arable use in its entirety.

3.3 Services

Prior to any intrusive works being undertaken, a detailed search for the presence of any services which may affect the site was carried out. The work was completed by Dial-Before-You-Dig on CEMEX's behalf. The report found no buried services running within the site boundary.

3 PROCEDURE

3.4 General

The procedures followed in this site investigation are based on BS 5930 (1999) - Code of Practice for Site Investigations. The soils and rocks encountered have been described in accordance with Amendment 1 to BS5930, dated December 2007 and BS EN ISO 14688-1 (2002) and BS EN ISO 14689-1 (2003). The Borehole records are included in Appendix 3. The proposed borehole locations are also included in Appendix 3 (drawing 'Proposed Borehole Locations').

The Exploratory Hole locations were selected by CEMEX to provide comprehensive coverage of the site. The coordinates shown on the Exploratory Hole Records were obtained using full-RTK sub-centimetre handheld GPS device. Levels are related to Ordnance Datum. The depths quoted are in metres below ground level.

3.5 Exploratory Holes

Five (5 No.) boreholes (numbered BH01 to BH05) were drilled to a depth 12m below ground level using a cable percussion drilling rig.

The boreholes were drilled between the 8th February and the 12th February 2018, and the work was supervised on site by a geologist. The profiles of strata or other features were recorded as drilling proceeded, and measurements were taken from ground level. Representative samples were taken, where appropriate, for laboratory examination and analysis. Groundwater observations, where made, are also included on the

Borehole Records. Borehole records are held in Appendix 4.

4 LABORATORY TESTING

4.1 Aggregate testing

The laboratory testing schedule was formulated by CEMEX National Reserves Department in order to determine the suitability for use as aggregates. The tests conform to *BS EN 933:2012 Tests for geometrical properties of aggregates* and were carried out in Geotechnics Limited's UKAS accredited Laboratory (Testing No. 1365).

The tests undertaken can be summarised as follows:-

BS EN 933:2012

Test No.		*Test Description*
1	1no.	BS EN 933-1 Particle Size Distribution, sieving method

The results of these tests are presented in Appendix 2 and show that all samples tested comprised gravel, with varying quantities of sand and silt.

5 DESK STUDY

5.1 General

Given that the site is in proximity to both Flixton and Wangford Quarries there is a significant amount of information and knowledge of the ground conditions of the area. Furthermore an area of land approximately 300m southeast of the site has been historically quarried by RMC. Borehole records, surveys, and anecdotal evidence as described below, where available.

5.1.1 Historic Borehole Records

The site has previously been drilled by RMC; in 1999 they undertook an investigation which included thirteen (13no.) continuous flight auger (CFA) boreholes to an approximate depth of between 7 and 13m bgl.

These historic records are held in Appendix 3, and were subsequently used in the modeling of the deposit, discussed later.

The locations of all boreholes used in the modeling of the deposit are illustrated in drawing 1802-W048_HAD_ABBHLP, contained in Appendix 3.

5.2 Site History

The site has, based on local anecdotal evidence, only been used for agricultural purposes. Such a view is confirmed by historic maps which indicate the site has comprised fields from 1884-1980 (old-maps.co.uk, 2017).

5.3 Geology

Information published by the BGS on online resources, maps, geological memoirs, and other relevant literature was consulted. Where appropriate, previous exploratory hole records have been referred to, to give an indication of the regional geology. For this site reference has been made to the following:-

- British Geological Survey GeoIndex Onshore (British Geological Survey 2018a)

5.3.1 Published Information

The geological mapping has been obtained from the Onshore GeoIndex (British Geological Survey, 2018a). The mapping indicates that the site is underlain by the following:

5.3.1.1 Superficial Deposits

The superficial deposits are predominantly identified as the Haddiscoe Sand and Gravel Member, comprising predominantly sand and gravel.

It is described as (British Geological Survey, 2018b):

'black, well-rounded fine to coarse flint gravel. Within the gravel large rotated blocks of sand are preserved, which are thought to have been in a frozen condition at the time of deposition.'

Also mapped within the site boundary, on the western border, are sands of the Happisburgh Glacigenic Formation. This unit is described as (British Geological Survey, 2018b):

'a range of diamictons, sands and gravels, sands and laminated silts and clays. The diamictons (Happisburgh Till, Corton Till and California Till members) are typically sandy matrix-supported diamictons that contain a high abundance of flint and quartzose lithologies relative to chalk, distinguishing them from the more chalky tills of the overlying Lowestoft Formation.'

Diamicton of the Lowestoft member is also mapped within the site boundary (at the very margins of the western boundary), though it is expected this overlies the previously noted superficial deposits and as such is not described further.

The superficial geology in the vicinity of the site is summarized in drawing 1802-W048_HAD_SUPGEO, contained in Appendix 4.

5.3.1.2 Bedrock

The underlying bedrock is comprised of the Crag Group, which is described as (British Geological Survey, 2018b):

'A suite of shallow-water marine and estuarine sands, gravels, silts and clays deposited on the southwest flank of the North Sea Basin. The sands are characteristically dark green from glauconite but weather bright orange with haematite 'iron pans'. The gravels in the lower part of the group are almost entirely composed of flint. Those higher in the group include up to 10% of quartzite from the Midlands, igneous rocks from Wales, and chert from the Upper Greensand of southeastern England.'

5.4 Hydrology

No water bodies exist on the site. Further afield there is a flooded pit approximately 200m southeast of the site, and Landspring Beck (small stream) approximately the same distance to the south.

5.5 Hydrogeology

Groundwater was not encountered during the site investigation in any of the boreholes.

It is not expected that the deposit will be extracted below the water table. However, groundwater monitoring boreholes are expected to be required in advance of a planning application.

5.6 Environmental Issues

The historic arable farming of the site does not cause any environmental concerns.

Consultation of the 'DEFRA MAGIC' online resource reveals that the site is within the impact zone for the Norfolk Broads SSSI Impact zone, and the northern border of the site is directly adjacent to the Norfolk Broads National Park.

Consultation of the GOV.UK flood map for planning reveals the site is within flood zone 1 (low risk of flooding).

6 INTERPRETATION

6.1 Ground Conditions

The borehole logs are held within Appendix 3. On the basis of the expected geology discussed in Section 7.2 and the findings of the exploratory holes it has been possible to classify the various strata proved in the investigation into the following divisions:-

- Topsoil [Overburden]
- Fine Superficial Deposits [Overburden]
- Coarse Superficial Deposits [Mineral]
- Coarse Superficial [Base of Mineral]

Bedrock was not encountered during this site investigation.

The divisions form the basis of the cross-sections drawn through the site, which illustrate the ground conditions across the site. These sections are included in

Appendix 4, along with a section location plan (Drawings 1802-W048_HAD_SEC1, 1802-W048_HAD_SEC2, and 1802-W048_HAD_SLP) They are indicative only and reference should be made to the borehole records for detailed descriptions of the soils and the groundwater conditions encountered. In addition to the cross sections, the exploratory hole data has been used to create contours that show the base of overburden and base of mineral. These drawings, referenced 1802-W048_HAD_BOOBCONT and 1802-W048_HAD_BOMCONT are included Appendix 4. A plan of the site detailing thicknesses of mineral and percentage gravel (referenced 1707-T198_OAK1802-W048_HAD_GRAD) is also contained within Appendix 4.

6.1.1 Topsoil [Overburden]

Material deemed to be representative of topsoil was encountered in all of the boreholes. Topsoil was found to range from 0.30-0.70m thick, but was predominantly 0.40m thick.

6.1.2 Fine Superficial Deposits [Overburden]

A fine superficial deposit, comprising soft to firm dark brown slightly gravelly sandy clay with rare rootlets was encountered in BH03 and BH05 only, over a thickness of 0.30m and 1.70m respectively, directly beneath the topsoil.

6.1.3 Coarse Superficial Deposits [Mineral]

A coarse superficial deposit, predominantly comprising sandy slightly clayey gravel, was encountered in all boreholes, with thicknesses ranging from 3.9-9.4m.

It can be generally described as:

'Sandy slightly clayey to clayey subangular to subrounded fine to coarse gravel of flint and quartzite. Sand is fine to coarse.'

BH01 and BH03 also exhibited a narrow layer (0.30-0.40m thick) of gravelly clayey sand above the gravels. This was counted as Mineral.

6.1.4 Coarse Superficial Deposits [Base of mineral]

With the exception of BH05, which did not intercept a base of mineral boundary, all other boreholes encountered clayey, occasionally gravelly sand beneath the gravel (Mineral) layer. The boundary between these units (i.e. the transition from gravel to sand) has been classed as the base of mineral in this instance.

The thickness of this sand layer has not been proven.

Historic flight auger logs for the site are consistent with these unit classifications, and as such have been included in the creation of surfaces for deposit modeling.

The historic logs are included in appendix 3, and a summary of the mineral thickness encountered can be seen in drawing 1802-W048_HAD_GRAD, held in Appendix 4.

6.2 Groundwater

Groundwater was not encountered in the boreholes. Anecdotal evidence suggests the base of mineral used in this case will be above the highest seasonal groundwater table. Further study, and installation of groundwater monitoring boreholes is expected to be required prior to a planning application.

7 EVALUATION

7.1 Basis for Evaluation

For the purposes of this investigation it is assumed the material from the site, if extracted, would be blended with more sandy material from Norton Subcourse Quarry in order to create a saleable product. With this in mind the primary factor in terms of resource viability is the gravel content.

7.2 Methodology

7.2.1 General

To evaluate the potential quality and quantity of resource at the site, the following process has been adopted:

i. Laboratory test results reviewed
ii. Base models created for:
    a. Topography
    b. Base of overburden
    c. Base of mineral
iii. Constraints plan created
    a. Identification of constraints
    b. Standoff distances developed
    c. Excavation boundary devised
iv. Geotechnical Design Parameters selected
v. Conceptual quarry design devised
vi. Resource assessment undertaken

7.2.2 Evaluation of gradings data

The results of particle size distribution (PSD) tests for samples taken from the site are contained in Appendix 2. These data, combined with gradings data from historic flight auger holes, has been used to create weighted average gravel content on a hole-by-hole basis for the site, illustrated by drawing 1802-W048_HAD_GRAD, held in Appendix 4.

From this drawing it can be seen the gravel content of the mineral at the site ranges from 33-90%. Given the variability of gravel percentage it has not been deemed appropriate to provide an average (weighted or otherwise) gravel content for the site as a whole, though it seems likely that the gravel content at the site is sufficient enough to allow blending with material from Norton Subcourse. It is also assumed that these grading would enable the site to stand alone, providing sufficient volume was available for extraction.

7.2.3 Creation of base models

The base models have been created using the exploratory hole data, taking the reduced levels at the base of overburden and base of mineral/top of bedrock respectively. The levels have been imported into terrain modeling software and conceptual surfaces have been produced. In some cases, extrapolation has been required, which has been undertaken by an experienced geologist.

7.2.4 Creation of Constraints Plan

A reasonable footprint for potential extraction has been devised based on the following constraints and standoffs:

Constraint	Standoff
Roads/Field Boundaries	30m
Eastern Boundary	20m
Residential Buildings	50-80m (dependant on proposed mitigation measures)
Neighboring Fields	10m

7.2.5 Geotechnical Design Parameters

The design parameters for the excavation slope are:

- Overall gradient 1v:1.5h (33°)

7.2.6 Creation of Conceptual Quarry Design

A conceptual quarry design has been devised on the basis of the above parameters using 3D terrain modeling (McCarthy Taylor LSS). It is presented as a full excavation in Drawing No. 1802-W048_HAD_EXT which is included in Appendix 4. Phased extraction is not considered in this case, and will be outlined in separate reports.

7.2.7 Resource assessment

An assessment of the volumes of soil, overburden and mineral, has been undertaken using the following terrain models:

- Ground level
- Base of overburden
- Base of mineral
- Concept excavation void

To convert the mineral volume to tonnes of saleable aggregate, a conversion factor of 1.60 has been applied, followed by a reduction of 10% to account for fines, production losses, and basal sterilization.

The reporting approach is in general accordance with the PERC Reporting Standard (Pan European Reserves and Resources Reporting Committee, 2013)). The assessment will report a *measured resource*. A measured resource is likely to be affected by modifying factors such as environmental, planning, legal and operational issues.

7.3 Results

Tabulated calculations of the volume and tonnage of the deposit are held in Appendix 5. From this table it can be seen that the deposit holds 810,865 m^3 gross volume of mineral, resulting in a *measured resource* of 1.168Mt, with approximately 190,000 m^3 of overburden, giving a stripping ratio of approximately 0.23:1.00.

8 SUMMARY

A site investigation was undertaken at an area of land near CEMEX Norton Subcourse Quarry, known as 'Haddiscoe', to determine the underlying ground conditions and estimate the resource contained. To this end, 5no. cable percussion boreholes were drilled across the site. These were logged, and samples were taken and analysed.

Testwork undertaken on selected samples of material from these boreholes reveals the material contains sufficient gravel in order to be blended with finer material from Norton Subcourse Quarry. It is also assumed that the material is also viable as a standalone resource, should that be required.

Through creation of an ideal quarry design, the site is estimated to contain a *Measured Resource* of approximately 1.2Mt.

9 REFERENCES

British Geological Society (2018a) *GeoIndex Onshore* [online] http://mapapps2.bgs.ac.uk/geoindex/home (accessed on 11th March 2018)

British Geological Society (2018b) *Lexicon of named rock units* [online] http://www.bgs.ac.uk/lexicon (accessed 11th March 2018)

Pan European Reserves and Resources Reporting Committee (2013) *PERC Reporting Standard for Reporting of Exploration Results, Mineral Resources and Reserves*. PERC, Brussels

www.old-maps.co.uk(accessed 11th March 2018)

www.magic.cov.uk/magicmap.aspx (accessed 11th March 2018)

https://flood-map-for-planning.service.gov.uk (accessed 11th March 2018)

APPENDIX 5 – VOLUME & TONNAGE SUMMARY

Haddiscoe: Measured Resource Estimation

Overburden

FILL when survey 2 above survey 1

Survey 1 : 1802-W048_HAD_LIDAR

Survey 2 : 1802-W048_HAD_BOOB

Mineral

FILL when survey 2 above survey 1

Survey 1 : 1802-W048_HAD_BOOB

Survey 2 : 1802-W048_HAD_EXTRACTION 3.0

OVERBURDEN

Area	Workable area (sq.m)	Soils (m.cu)	Overburden (m.cu)
Modelled Extraction	**150,855**	N/A	**190,414**
TOTALS	**150,855**	**N/A**	**190,414**

MINERAL

Area	Workable area (sq.m)	Volume (m.cu)	Tonnage (t)	Conversion
Modelled Extraction	**148,880**	**810,865**	**1,167,645**	**1.6t/m.cu**
TOTALS	**148,880**	**810,865**	**1,167,645**	**1.6t/m.cu**

Figures calculated by:

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