Graven Hill Site D1, Bicester

ABA Review of Geotechnical Investigation Report

Prepared for

Graven Hill Purchaser Ltd.

March 2022

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1.0 Introduction

This note has been prepared by Alan Baxter Ltd on behalf of the Client, Graven Hill Purchaser Ltd, to support the outline planning application submission for the D1 and EL1 sites at Graven Hill, Bicester**.** This note follows our review of the Geotechnical Investigation Report produced by Waterman on behalf of their client, Graven Hill Village Development Company and received by us on 20 November 2020.

We have considered the findings of Waterman's report and their implications on the proposed Civil and Structural design. A separate consultant, RPS, is also commenting on the technical and ground contamination aspects of the report.

2.0 Summary of investigation report findings

2.1 Geology

The site geology consists of made ground over sandy Oxford Clay which is soft at its top but becomes firmer with depth. None of the investigations extended beyond 6.45m below ground level and consequently did not find the bottom of the clay strata. From nearby borehole logs, the bottom of the Oxford Clay strata is expected to be approximately 20-30m below site level.

The investigations included in-situ and laboratory testing to ascertain the soil properties to inform the foundation design. The testing included dynamic probing and undrained shear strength tests. These tests indicated design undrained shear strength of the clay varying from 50kN/m^2 at 1.2m depth to 70kN/m^2 at 3.5m depth. These results showed the soils have properties within the range we would expect for the Oxford Clay strata.

One dimensional consolidation testing showed the soils to be of medium compressibility. Again, this is as we would expect for the Oxford Clay strata.

The In-situ testing included California Bearing Ratio (CBR) tests to understand the strength of the surface soils to support road build-ups. These gave values of between 4% and 10%. These findings are within the range we would expect, and we anticipate the specification of the road build-up will be straight-forward based on these findings.

The report records that there are elevated sulphate levels in the soil. Consequently, the report defines the soils as having a Design Sulphate class of DS-3, and an aggressive chemical environment for concrete class (ACEC class) of AC-3s. Some local areas are class DS-5 (AC-4s or AC-5). The DS-3 class is higher than is typical for soils of this type but not uncommon. The DS-5 class is surprisingly high, but the report says this is localised and recommends further testing. These findings have implications on the specification of the concrete in contact with the ground. In some cases, it may be necessary to provide additional protective measures to buried concrete such as a protective membrane or increased thicknesses of concrete cover to reinforcing steel.

2.2 Hydrogeology

The desk study and on-site monitoring ascertain the site hydrogeological constraints. There is perched water on the top of the clay strata sitting in the made ground. The investigations did not identify any other groundwater, although generally the ground was found to be saturated.

Infiltration testing found the soils to be completely impermeable, which is as we would expect.

The site is not in a Ground Water Source Protection Zone. However, it is in a Drinking Water Safeguard Zone for Surface Water.

2.3 Contamination

This section of the report has been reviewed and commented on by RPS. However, we have noted the following when looking through the report:

Ground gas monitoring showed that there are slightly elevated CO_2 levels (9.9%). The report notes that these are above the threshold requiring gas protection measures to be implemented in the design. All other testing recorded CO_2 levels less than the 5% threshold.

3.0 Implication of findings on the civil and structural engineering design

3.1 General earthworks

Generally, the investigations show that the soils are as we would expect for this area. On this basis, we do not expect special ground improvement measures, to improve the geotechnical properties of the soil, are necessary.

Based on the CBR tests, we do not anticipate any unusual requirements or issues in the specification of the road build-ups. However, the investigations were limited, and more detailed testing is required when the design is progressed to ascertain the soil properties at the actual locations and levels of the proposed roads.

3.2 Drainage

The lack of permeability of the soils is as expected and precludes the use of infiltration techniques in the drainage system. The findings of the report do not change previous advice on the general strategy of the drainage scheme.

RPS are to provide advice on the implications of the site being in a Drinking Water Safeguard Zone for Surface Water. However, given the proposed use of the site, we do not anticipate this having a significant bearing on the proposed design.

3.3 Structures

The geotechnical testing results provide enough information to undertake the preliminary design of shallow spread footings. Based on the loading specification for the warehouse floors, we anticipate that the proposed warehouses will be comprised of ground-bearing slabs, with the structure over bearing onto separate shallow footings. Further evaluation of the results in the report is required in due course.

The compressibility of the soils is as we expect for clay strata; however, the implications of this need consideration in the design of new structures. The compressibility and the high saturation of the soils need care when planning the sequencing of works and understanding of short-term movements of structures. This is to be explored further at the next stage but should not have an impact on the structural viability of the current design.

The elevated sulphate levels and corresponding Design Sulphate classes mean that any structural concrete in contact with the ground needs a higher specification than would typically

be necessary. There are straightforward measures that can be adopted to deal with this, and we do not anticipate this causing difficulty for the structural design.

The gas monitoring showed very localised high levels that would require gas protection measures to be included in the detailing of the buildings. However, as the results were only recorded in one test location further testing would be required to validate the finding.

3.4 Site levels strategy

The overall strategy is to keep site levels as similar as reasonably practical to existing, by working with the existing site gradient. The strategy aims to reduce the volume of material imported to and exported from the site, as well as the quantity of earth moved within the site itself. Arisings from the demolition of existing buildings and roads are to be re-used as fill under the new roads and ground-bearing warehouse slabs.

The geotechnical testing results indicate that the clays underlying the site cannot be re-used as fill under the proposed new buildings. However, it can be used as fill under new roads, or as a general fill in soft landscaped areas. Further evaluation of the results in the report is required in due course to further inform the emerging levels strategy.

4.0 Summary and recommendations

4.1 Summary

Generally, the report provides sufficient geotechnical information to support the initial design of the Civil and Structural Engineering elements of the scheme up to planning. Further investigations will be required to progress the design following the planning submission, which will be reviewed in due course.

The investigations did not evaluate the sub-surface constraints imposed by the existing buildings. Whilst the design can move forward without this information, investigations are required in due course to evaluate these elements.

4.2 Further investigations

The further investigations required for the design following this planning submission include:

- Additional boreholes extending approximately 10m in depth in the location of the new warehouse buildings.
- Further CBR tests at locations and level to suit the proposed road layouts.
- Trial pits to establish footing depths and profiles of existing buildings.
- Further testing to evaluate the aggressive chemical environment for concrete class (ACEC class).
- Further testing to establish requirement for gas protection measures.
- Further in-situ and lab testing to evaluate soil properties.