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NORTH HINKSEY GROUNDWATER ASSESSMENT

For

NORTH HINKSEY PARISH NEIGHBOURHOOD PLAN

July 2017

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DRAWINGS

NORTH HINKSEY GROUNDWATER ASSESSMENT

1. INTRODUCTION

GWP Consultants LLP (GWP) has been commissioned by David Kay on behalf of the North Hinksey Parish Neighbourhood Plan Group (the NHPNPG) to identify potential groundwater flooding areas east and north-east of Cumnor Hill, Oxford.

2. LOCATION AND TOPOGRAPHY

North Hinksey Parish is located directly west of Oxford (see Drawing No.HINKGW1707-1 and 2). Topographic elevations decrease from 145 metres above mean sea level (mAmSL) at the top of Cumnor Hurst Hill to 60mAmSL at North Hinksey Lane. East of North Hinksey Lane the ground is relatively flat, varying between 55 and 60mASL (see Drawing No. HINKGW1707-3).

3. GEOLOGY

The geology of North Hinksey Parish is described on British Geological Survey (BGS) Geological Sheets 253 and 254 (see Drawing No. HINKGW1707-4).

3.1 Superficial Geology

Two areas in the eastern most part of the Parish - directly south of Botley Road and east of the A34, are underlain by superficial sand and gravels of the Northmoor Sand and Gravel Member and alluvium comprising of a mixture of clay, silt, sand and gravel.

3.2 Bedrock Geology

Low lying areas to the east and north of the Parish are underlain by the Oxford Clay Formation. The BGS characterise this formation as a "*silicate-mudstone, grey, generally smooth to slightly silty*".

To the south-west, the Kingston Formation overlies the Oxford Clay Formation, outcropping generally between *c.* 90 to 110mASL. The BGS characterise this formation as a "*medium-grained quartzose sand, locally fine and coarse-grained, with carbonate cemented beds and doggers which are sandy limestone or calcareous sandstone*".

The Stanford Formation overlies the Kingston Formation, outcropping generally between *c.* 110 to 125mASL. The BGS characterise this formation as interbedded limestone, marl and mudstones.

The Ampthill Clay Formation overlies the Stanford Formation, described by the BGS as a mudstone. This formation forms the top of the geological sequence within the North Hinksey Parish Boundary. These formations are part of the Corallian Group.

It is also noted that an additional geological unit, the Hazelbury Bryan Formation, outcrops along the north-west slope of Cumnor Hills (see Point A – Drawing HINKGW1707-4), but is not mapped to be present on the northern and eastern slopes. North of the B4044, the Hazelbury Bryan Formation is also mapped as part of the Corallian Group. This formation is described by the BGS as a sandy mudstone.

Lastly, a number of geological slope failures - Mass Movements - are mapped in and around North Hinksey Parish (see Drawing No. HINKGW1707-4). These features are all mapped along the geological contacts between the Kingston/Hazelbury Bryan Formations and the underlying Oxford Clay Formation. Where mass movement events have occurred, slump debris sediments consisting of Hazelbury Bryan and/or Kingston Formations over lay the Oxford Clay Formation some distance downgradient of the contact, *c.* 200m or more (see Drawing No. HINKGW1707-4).

4. HYDROLOGY

Surface water runoff from the impermeable clay cap (Ampthill Clay Formation) on top of Cumnor Hill, drains radially to the surrounding lowlands. In doing so, it is concentrated along flow paths, which in turn have sub-vertically eroded the underlying sediments to form valleys. These valleys cut down through the above mentioned geological formations, truncated at depth by the Oxford

Clay Formation. From north to south, examples of these features are Louie Memorial Playing Fields/Hutchcomb's Copse, Raleigh Park and the area directly north of Hinksey Heights Golf Club.

5. HYDROGEOLOGY

The mudstones associated with the Oxford Clay and Ampthill Clay Formations are impermeable and act as aquicludes; prohibiting the flow of groundwater.

In contrast, the Kingston, Stanford and Hazelbury Bryan Formations are permeable strata. Downward vertical groundwater flow within these formations is blocked at depth by the impermeable Oxford Clay Formation. As a result, 'contact springs' exist along the contact with the underlying Oxford Clay Formation where the contact is exposed, where groundwater is forced to move laterally to surface and discharge out into the surrounding areas.

The BGS has inferred a regional south-east groundwater flow component within the Kingston and Stanford Formations (see Drawing No. HINKGW1707-5). It is not known if groundwater levels have been measured directly or inferred from the elevation of the top of the Oxford Clay. It is clear however that the above mentioned valleys (see Section 4), which cut down vertically through the geological succession, will intersect this groundwater flow. As a result, groundwater flow local to the valleys is diverted, flowing towards the centre of each valley.

Hurst Rise Road is situated within such a valley. Residents noted that groundwater flooding to the area is more prominent along the western sections of the valley.

Therefore, it is evident that regional south-easterly groundwater flow within the Corallian Group is intersected first by the western edges of the Hurst Rise Road valley, and groundwater egresses naturally into the valley, above the contact with the Oxford Clay Formation, as observed by local residents.

During the site visit, groundwater seepage from the Kingston Formation was observed to occur directly above the contact with the Oxford Clay Formation in Raleigh Park. Downgradient of this contact, a holding pond is constructed to collect spring water discharge to supply water for livestock. In Louie Memorial Playing Fields/Hutchcomb's Copse, groundwater seepage from the Kingston Formation was also observed to occur directly above the contact with the Oxford Clay Formation. Again, seepage is collected in a holding pond downgradient of the contact. Lastly, on inspection of Google Earth imagery, 2 No. large holding ponds are also constructed in Oxford Clay Formation downgradient of the Oxford Clay Formation contact with the over lying Kingston Formation, which suggests groundwater seepage is also collected, possibly for irrigation purposes.

Holding ponds in Raleigh Park and Louie Memorial Playing Fields/Hutchcomb's Copse both contained water during the site visit. Although the holding ponds also collect surface water runoff from rainfall events, given Spring to early Summer 2017 has had very little rainfall, the likely source of water maintaining water levels in the absence of rainfall, must be groundwater seepage from the Kingston Formation. Else, the herd of cattle grazing in Raleigh Park, which utilised the holding pond as a water supply, would readily deplete water reserves in the absence of groundwater seepage from the Kingston Formation.

Furthermore, the presence of mass movement slumping along the contact of the Kingston and Oxford Clay Formations suggest the 'contact springs' present along the contact reduce fiction, enabling mass movement events to occur.

The sand and gravels of the Northmoor Sand and Gravel Member are permeable and groundwater levels within them are primarily controlled by water levels of surface water features, *i.e.* Seacourt Stream (see Drawing No. HINKGW1707-4). Groundwater levels within the superficial sediments can exceed ground levels in the wet season, as observed by Ag MacKeith of South View House, Old Botley, Oxford, OX2 0JR.

6. GROUNDWATER FLOOD RISK ZONE DEFINITION

The above information suggests that regional groundwater flow within the Corallian Group is to the south-east, intersected by sub-vertically cutting valley troughs, *i.e.* Louie Memorial Playing Fields/Hutchcomb's Copse, Raleigh Park and Hinksey Heights Golf Club. As a result, groundwater

egress to the valleys occurs above the contact with the underlying Oxford Clay Formations, along 'contact springs'.

Therefore, a 'Zone of Potential Groundwater Flooding' exists on or above the geological contact between the Kingston Formation and the underlying Oxford Clay Formation. The upper most limit of this zone has been assumed to be ten metres in vertical height above this contact, allowing for a 5-7m rise in groundwater levels within the Corallian Group (see Drawing No. HINKGW1707-6 – Groundwater bearing strata above Oxford Clay Formation) and a 3m deep basement excavation.

Although mapped by the BGS, the actual position of the Oxford Clay Formation may vary locally, due to a lack of outcrop for geological mapping purposes, but also the presence of mass movement sediments extending further downgradient of the contact. Therefore the lower most limit of this zone was assumed to be ten metres in vertical height below this contact (see Drawing No. HINKGW1707-6 – Oxford Clay Formation – zone of uncertainty).

It should be noted this zone has been estimated without the availability of groundwater level data. The zone definition should be reviewed periodically based upon available groundwater level monitoring data from future planning applications. A zone of groundwater flood risk has therefore been estimated based upon a 20m vertical height range, centres on the Oxford Clay contact with the overlying Kingston Formation. The width of this zone on the ground varies depending on the ground topographic gradient. It is typically 200-250m wide but can range from 150m just west of Hutchcombe Road to 600m on the southern boundary of the parish.

7. RECOMMENDATIONS

It is advised that any future planning applications located within the 'Zone of Potential Groundwater Flood Risk' undertake a more rigorous groundwater assessment to confirm groundwater conditions beneath the development. Where a development excavation is proposed, the assessment should include:

- A minimum of 3 No. groundwater monitoring boreholes within the planning application boundary to confirm groundwater depths and establish groundwater flow directions.
- A minimum of 3 No. to 6 No. months of groundwater level monitoring, preferably monitoring annual seasonal groundwater fluctuations during the dry and wet season. Where project lead-in times permit, groundwater monitoring should be repeated over multiple years to confirm seasonal groundwater level fluctuations;
- Groundwater monitoring information can be augmented or replaced by local Environmental Agency groundwater level monitoring information if found to exist;
- Groundwater monitoring information should be used to investigate whether or not maximum groundwater levels will come into contact with the proposed development. If so, dewatering requirements during the construction phase should be evaluated and an impact assessment undertaken on local houses, including identification of any necessary mitigation measures;
- Furthermore, an assessment of any post-construction groundwater flow truncation and subsequent groundwater rise effects should be evaluated and mitigation measures proposed if necessary to prevent flooding or damage to adjacent properties.
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The NHPNPG may wish to note that the London Borough of Camden Borough Council has introduced a Basement Impact Assessment methodology as part of its planning application process. Whilst this considers multiple issues as well as groundwater flooding, it provides a useful framework and potential guidance to developers on how to assess and demonstrate adequate consideration and mitigation of groundwater risks to surrounding properties.

The Camden BIA approach and toolkit can be downloaded from the Basement Flooding section of:

https://www.camden.gov.uk/ccm/content/environment/planning-and-built-environment/two/planning-policy/local-development-framework/core-strategy/evidence-and-supporting-documents/

8. CONCLUSIONS AND RECOMMENDATIONS

Publicly available geological, hydrogeological, and topography information, combined with field observations have been used to define a 'Zone of Potential Groundwater Flood Risk' in the North Hinksey Parish.

Information suggests that areas along and up gradient of the geological contact between the Oxford Clay Formation and Kingston Formation are most prone to groundwater flooding as a result of groundwater egress along 'contact springs'.

Geological and topographic modelling techniques have been used to estimate the boundaries of a groundwater flood risk zone within the North Hinksey Parish boundary, using zones of uncertainty above and below the geological contact.

It should be noted this zone has been estimated without the availability of groundwater level data. The zone definition should be reviewed periodically based upon available groundwater level monitoring data from future planning applications.

It is advised that any future planning applications located within this zone undertake a more rigorous groundwater assessment to confirm groundwater conditions beneath the development.

Guidance for investigating and mitigating basement groundwater impacts has been published by the London Borough of Camden Council and may be of value to local regulators and developers.

GWP CONSULTANTS
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