

Note / Memo

**HaskoningDHV UK Ltd.
Industry & Buildings**

To: David McCabe
From: Darren Banner-Perry
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Subject: BGS-WHBC Note

1 Introduction

Royal HaskoningDHV (RHDHV) has been commissioned by Tarmac to provide advice regarding potential land quality issues associated with the redevelopment of a site southeast of Welwyn Garden City. Two RHDHV reports were subsequently provided to the Local Planning Authority to support the allocation of the site for housing.

RHDHV have subsequently continued to be engaged on the development proposals and are preparing an Environmental Statement Chapter as part of a broader EIA to support the forthcoming planning application. However, we understand that the two Local Plan Inspectors have requested further submission of evidence on the matter before committing to a date for the joint Examination hearing. In response to this, RHDHV has been requested to focus on providing key information to demonstrate the following:

- confirmation that the areas proposed for development are not contaminated / have not been land filled, summarising and appending relevant borehole records; and
- confirmation that the area proposed as informal parkland ("Birchall Common") would be viably remediated for safe use for that purpose, again summarising and appending relevant evidence to this effect.

2 Land South and West of Cole Green Landfill

2.1 Evidence to confirm site not part of landfill

The assessment of land quality with respect to potential risk to human health and controlled waters as a result of the ground conditions follows a risk based phased approach. The first step in the process is the development of Preliminary Risk Assessment ("PRA"), a desk based study which reviews existing publicly available information as well as information available from the land owner. It is also common practice to procure third party reports providing environmental, regulatory and historical plans.

To support the development of the PRA, RHDHV procured an Envirocheck report containing information on the environmental setting, regulatory information and historical plans. The historical maps covered the period 1883 to 2012. Although there are gaps in the data set the plans clearly show the extent of the workings on the Cole Green site and confirm the works did not extend onto the area to the south and west. The historical plans are attached (Landmark Information Group. 2012. Envirocheck Report Cole Green).

Regulatory information i.e. information on the Environment Agency (EA) website indicates the southern part of the site may also have been part of the landfill. However, such plans are not proof that a permitted activity was ever implemented over all or any of the area permitted. It was common in post war Interim Development Order (IDO) consents and also early Town and Country Planning Act 1947 consents for much greater areas of land to be permitted than would ever be worked; the degree of detailed mineral proving simply did not exist in those days and the system did not demand this. The classic examples of this are the Northamptonshire ironstone and limestone IDO consents (and Lincolnshire/Scunthorpe area) where huge areas of land were permitted for mineral working and only a small proportion was ever worked. These consents subsisted into the 2000s and distorted the national land bank of minerals for decades.

RHDHV has been provided with plans of the works (attached) which consistently indicate the landfill does not extend on the land to the south and west. These are:

- Phase of infilling showing extent of fill dated July 1984
- Currently approved contours dated September 1985
- Tipping records

Five intrusive ground investigations have also been undertaken across the land to the south and west for various reasons. These are summarised below:

- Investigation undertaken by Tarmac comprises 117 boreholes located across the site including boundary with the landfill, borehole depths range from 2.4m to 10.97m, date unknown but probably 1976-1984 – all confirm natural deposits
- Investigation undertaken by Tarmac in 1984 and comprises 25 boreholes located across the site, borehole depths range from 4.02m to 11.7 - all confirm natural deposits
- Investigation undertaken by Tarmac in 1988 comprises 23 boreholes located across the site, borehole depths range from 5.1m to 15.1 - all confirm natural deposits
- Royal HaskoningDHV ground investigation undertaken in 2013/14 comprising 10 trial pits and 23 boreholes located across the site including boundary with the landfill. Depths range from 3.0m to 10.5m. Boreholes were installed with combined groundwater and gas monitoring wells – all generally confirm natural deposits, some limited evidence of Made Ground, but no waste materials
- Archaeology investigations undertaken in 2015 comprising 53 trial trenches typically 50m long by 1.8m wide and extending to a maximum depth of around 1.0mbgl – encountered topsoil, subsoil and natural deposits

The above equates to a total of 188 boreholes and 63 excavations, which taking a 65 hectare site area is equivalent to a grid spacing of 16m centres.

2.2 Borrow Pit

A limited area of land in the southern part of the site was excavated in the early 1980s as a borrow pit to provide engineering fill materials for the A414 widening and it was immediately filled in again using natural arisings from the excavation of the road line. The fill material was very similar but more clayey material to the excavated material.

2.3 RHDHV Ground Investigation

The RHDHV ground investigation comprised 10 trial pits and 23 boreholes located across the site including along the boundary with the landfill. Non-statutory guidance documents (e.g. BSI. 2011. Investigation of potentially contaminated sites. BS10175) suggest typical grid spacing's for exploratory holes for different phases of investigations, however this approach can result in extensive ground investigation and significant

costs, and can be disproportionate. It is therefore important for the Engineer to understand the conceptual site model as well as the purpose of the investigation in designing an investigation. When designing the ground investigation RHDHV had a significant amount of information which indicated the site had not been used for landfilling (evidenced from existing historical ground investigations etc), and had for many years been in agricultural use. The purpose of the ground investigation was to verify existing evidence and also to gain a preliminary understanding of the ground conditions to determine any significant constraints to redevelopment. The number of exploratory holes progressed was therefore based on this information and considered to be an appropriate approach. The strategy was to locate the holes at appropriate locations across the site and along the landfill boundary to provide information from across the site and to confirm the landfill boundary. All boreholes were installed with combined groundwater and gas monitoring wells.

Samples were generally taken from the top metre of the soil profile as the assumption utilised in the standard land use models assumes soil contamination is uniformly distributed across the site to a depth of least 1.0m (Environment Agency, 2009, Updated technical background to the CLEA model, Science Report SC050021/SR3), and is the critical zone where site users could come in to contact with contamination if present in the soil. Some samples were also taken from deeper depths for confirmatory purposes. Soil samples were recovered from all the exploratory holes.

Groundwater samples were recovered from all monitoring wells where groundwater was present (16 wells) on three occasions, and gas monitoring was undertaken at the same time. Surface water samples were also recovered from key locations.

Soil and groundwater samples were analysed at an accredited laboratory for a wide spectrum of 155 potential contaminants of concern given the adjacent landfill history.

2.4 Ground Conditions

The investigation confirmed the following general soil sequence, consistent with the findings of the other investigations summarised in Section 2.1:

- Top soil, (sometimes made ground in areas of tracks)
- Clay
- Sand
- Grey clay
- Gravel
- Chalk

2.5 Data Assessment

The human health assessment utilised conservative General Assessment Criteria (GAC) for a residential end use based on standard land use settings and assuming a soil organic matter content of 1%. The GAC were derived by RHDHV using the Contaminated Land Exposure Assessment Tool in line with current guidance applicable at the time of the assessments. The assessments confirmed benzo(a)pyrene (hydrocarbon type substance) and asbestos was present at a limited number of locations associated with tracks across the site.

Since completion of the assessments there has been further development with respect to assessment criteria for assessing risk to human health. Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH) have derived new GAC for a range of end uses and soil organic matter content. RHDHV has reviewed the data for the site using the latest GAC developed by LQM/CIEH and assuming 1% soil organic matter. The reassessment confirms that benzo(a)pyrene does not exceed the

GAC and does not represent a potential unacceptable risk to human health (this is because the revised GAC is less conservative than that originally adopted by RHDHV). So the only potential contaminant of concern is asbestos for which mitigation works will be undertaken (see Section 4). The asbestos analysis was based on a presence/absence test only and was not quantified., therefore as part of the mitigation works additional samples will be recovered and the samples submitted for asbestos presence/absence and quantification analysis.

Groundwater (including samples from the Secondary A Aquifer) and surface water samples do confirm contamination is present and is likely to be associated with leaching from Cole Green landfill. Contamination was generally confined to metals, although some hydrocarbons were present to a much lesser extent. However, it should be noted that site users will not come into contact with groundwater and there were no volatiles present in the groundwater that could migrate to the surface. Surface water samples were screened using standards for assessing drinking water and are therefore significantly conservative. Contamination within groundwater and surface water is unlikely, therefore to represent a risk to human health. Further monitoring of groundwater and surface waters at the site is ongoing to corroborate the data previously recovered and to support Regulatory discussions regarding baseline groundwater and surface water conditions, however mitigation works will be undertaken to improve baseline groundwater and surface water conditions.

Ground gases were not generally detected. However, an increased flow rate and slightly increased concentration of carbon dioxide was recorded at one monitoring well during one of the monitoring rounds but was not replicated in the other two rounds. Gas Characteristic Situation 2 was calculated based on the increased flow and carbon dioxide, and indicates a low risk. However, higher values have been recorded within the landfill. Mitigation works will be incorporated in the development (see Section 4).

2.6 Leachate Breakouts

Leachate breakouts have been noted within the copse in the west of the site and probably contributes to the surface water contamination noted in this area. Mitigation works will be incorporated in the development to address this (see Section 4).

3 Landfill

3.1 Ground Investigation 2014

Following completion of the site wide Preliminary Risk Assessment (referred to in Section 2.1 above) and completion of the ground investigation across the agricultural land to the south and west RHDHV undertook three phases of ground investigation within the landfill area, the boundary of which was determined by the plans previously referred to and attached.

The investigation and sampling strategy was based on the following rationale:

- Preliminary investigation
- Site levels will largely remain unchanged
- Site is to be utilised as public open space comprising green infrastructure, access routes
- No houses will be constructed across the landfill
- The critical receptor is human health (site users/construction workers/maintenance workers) that could be at risk from potential contaminants within the shallow soil/fill deposits
- Investigations on adjacent site did not record volatiles within the perched groundwater

- If the former use of the site has resulted in groundwater contamination any future mitigation is likely to focus on limiting any further expansion of contaminant plumes, therefore a preliminary assessment of the potential risks to the wider groundwater regime/surface waters has been undertaken as part of an assessment of the land to the south and west and Birchall Farm to the north

A total of forty-nine exploratory holes were completed. The exploratory holes were progressed using a hand auger to a target depth of approximately 1.0 metre below ground level (mbgl) to provide an indication of the nature and distribution of the shallow soils and to facilitate the collection of disturbed soil samples for laboratory analysis.

Soil samples were analysed at an accredited laboratory for a wide spectrum of 155 potential contaminants of concern given the landfill history.

3.2 Ground investigation 2015 (northern extent)

A preliminary ground investigation was undertaken on the northern extent of the landfill adjacent to Hollwell Hyde Lane to develop a preliminary understanding of the ground conditions and potential significant constraints associated with the potential construction of a building on this part of the landfill (note this will not be progressed as part of the proposed development). The investigation comprised 4 boreholes and 10 trial pits located across the site, the latter equating to a grid spacing of 50m. The boreholes were advanced to depths ranging from 15.5m and 28.5mbgl, and the maximum depth of the trial pits was 4.56mbgl. The main aim of the boreholes was to determine depth to rock head, with the trial pits providing information on the soil and waste across the site. Boreholes were installed with combined groundwater and gas monitoring wells.

Soil samples were analysed at an accredited laboratory for a wide spectrum of 155 potential contaminants of concern given the landfill history.

3.3 Ground Investigation 2017 (southern extent and delineation)

The data assessment associated with 2014 and 2015 intrusive investigation indicated that asbestos and polychlorinated biphenyls (PCB) were present in a limited number of the soil samples within the top metre of the soil profile and may represent a risk to site users. To provide a greater degree of certainty with respect to the presence of asbestos and PCB at the site a further phase of intrusive investigation was undertaken.

The investigation comprised the recovery of three further samples by hand augur at each of the locations where asbestos and PCB had been identified. The hand augers were positioned around the perimeter of each existing location at an approximate distance of five metres from the centre, and soil samples were recovered from the same depth (<1.0m below ground level) at which the original soil sample had been taken. Additional samples were also recovered from the northeastern and southern extent of the landfill.

All samples were scheduled for asbestos presence/ absence and quantification (the latter, if asbestos was encountered) and PCB analysis.

In total (across all phases of investigation) ninety-two samples were tested for asbestos and fifty-six samples were tested for PCB.

3.4 Ground conditions

The ground investigations generally confirmed top soil at the majority of exploratory holes which was underlain by Made Ground which was generally described as a clay. The Made Ground sometimes contained anthropogenic material such as clinker, plastic, glass etc within a lower permeability clay matrix. Waste materials were noted across the landfill area beneath the Made Ground albeit at different thicknesses. Putrescible material was not identified at the surface. The waste is underlain by natural deposits including lower permeability clay deposits.

3.5 Data Assessment

The human health assessment utilised GAC for a residential without plant uptake end use based on standard land use settings and assuming a soil organic matter content of 1%. The GAC were derived by RHDHV using the Contaminated Land Exposure Assessment Tool in line with current guidance applicable at the time of the assessments. The residential without plant uptake land use is a conservative approach on a site that will be utilised as public open space. The assessments undertaken as part of the 2014 and 2015 investigation indicated that asbestos and polychlorinated biphenyls (PCB) were present at a limited number of locations across the site.

3.5.1 Asbestos

On completion of the 2017 investigation a total of 92 samples had been analysed for asbestos, of which 10 contained asbestos. Quantification analysis was undertaken on the samples recovered as part of the 2017 investigation which confirmed that asbestos was not generally detected above the recommended laboratory detection level of 0.001%, with the exception of one sample which recorded a concentration of 0.0191%.

There are no assessment criteria for asbestos and most of the guidance relating to asbestos is associated with the management of asbestos in buildings and occupational exposure. CIRIA has published guidance to aid in the assessment of asbestos in the ground and this has, therefore been used to assess the risk to site users assuming a public open space end use (CIRIA. 2014. Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks. C733).

Asbestos only represents a risk if fibres are released to the air. During the ground investigations across the former landfill, asbestos containing material were not observed during the intrusive investigations across the landfill. Subsequent laboratory analysis has shown that where asbestos was indicated to be present in the soil sample the quantification analysis confirmed all but one sample recorded results below the laboratory limit of detection. Guidance suggests that there are many other factors (e.g. soil type, moisture content etc) that affect the potential for asbestos to become airborne, and following consideration of these we consider that the asbestos is unlikely to represent a significant risk to site users.

3.5.2 PCB

On completion of the 2017 investigation a total of 56 samples had been analysed for PCB. The data assessment utilised guidance published by the Environment Agency and guidance developed in the Netherlands. Based on the assessments undertaken we consider that the PCB concentrations recorded at the site would not represent a significant risk to site users.

3.6 Landfill Capping

We note the Environment Agency have suggested that the landfill may need capping and this could have implications with respect to landfill gas management. As noted above the investigations and assessment undertaken to date indicate the landfill area is suitable for the proposed open space end use, therefore we have no plans to cap the landfill. There may be a need for localised importation of top soil as a growing medium which will be unlikely to have any detrimental impact. Furthermore, any infrastructure works undertaken on the landfill will be designed and implemented to minimise any impact on the landfill. For example, the proposed access road will generally follow the course of the old landfill haul road across the site.

4 Further Assessment

It should be noted that gas, groundwater and surface water monitoring is ongoing and will feed into the existing assessments, discussions with the Regulators and detailed design phases.

5 Proposed Remedial Works

A draft outline remedial strategy is currently being developed which sets out the proposed approach for addressing the potential issues/risk summarised above. The strategy covers three key aspects as follows.

5.1 Gas mitigation

Landfill gas monitoring undertaken during the site characterisation studies has generally confirmed low gas concentrations and a worst case Gas Characteristic Situation 2 (driven by an increased flow rate and slightly increased concentration of carbon dioxide at CGBH11 on one occasion). Periodically high methane concentrations have also been recorded at a limited number of locations, particularly within the northern extent of the former mineral workings, although preliminary data indicates the high values are generally not sustained and are not supported by a positive flow.

To corroborate the existing data and to ensure appropriate mitigation measures are adopted in the development further gas monitoring will be undertaken, including the adoption of continuous gas monitoring instruments.

A precautionary approach will be adopted and it is envisaged that structures built to the west and south of the former mineral workings will incorporate gas mitigation measures in line with CIRIA guidance. Based on a Gas Characteristic Situation 2 the mitigation measures will include one of the following:

- Reinforced concrete slab cast in situ floor slab (suspended, non-suspended or raft) with at least 1200g damp proof membrane and underfloor venting; all joints and penetrations sealed
- Beam and block or pre-cast concrete and 2000g DPM/ reinforced gas membrane and underfloor venting; all joints and penetrations sealed membrane and underfloor venting

The above solutions are common place as a precautionary measure, for instance in southwest England where there is the potential for high levels of naturally occurring radon gas.

Landfill gas vents were installed as a precautionary measure on the northwestern part of the former mineral workings adjacent to Hollwell Hyde Lane over twenty-five years ago. These vents will be retained and

refurbished. Additional works may also be progressed subject to review of the on-going gas monitoring, and will be agreed with the Regulator in advance of commencing the works.

It should also be noted that the proposed groundwater interceptor drain which will be installed along the western and south-western boundary of the former mineral works may also be designed to act as a passive gas vent, subject to the results of further assessment.

5.2 Soil contamination

Asbestos and benzo(a)pyrene have been recorded at isolated locations within the material forming the thoroughfare from Holwell Hyde Lane and the agricultural track running towards Burnside. It is likely that this material derives from fly tipping and the historically common practice of repairing farm tracks using demolition material.

Given the sensitivity of the proposed development and the likely variability of the material forming the tracks, a precautionary approach will be adopted which will see the tracks excavated and the arisings stockpiled on site prior to reuse in screening bunds (part of the network of green infrastructure to be constructed as part of the development) at a depth greater than 1.0mbgl, assuming the material is suitable for use on the grounds of chemical quality and geotechnical properties. A geotextile separation layer will also be placed above this material prior to completion of the screening bunds. Prior to excavation additional samples shall be recovered from the tracks at 50m intervals and submitted for laboratory analysis to corroborate the previous data and to facilitate an assessment of the potential for re-use within the scheme.

5.3 Groundwater and surface water contamination

Leachate generated by the former mineral workings is currently intercepted by a north south trending drain located to the east of the fishing lake in the north and to the east of the Eastern arm of the Hatfield Hyde Brook further south. The drain collects a combination of leachate and groundwater from the superficial deposits. The interception drain was installed in 1984 to minimise the impact on the wider groundwater and on the eastern arm of the Hatfield Hyde Brook. Whilst this system has worked successfully over the years, some impact does occur on both the shallow groundwater and the brook.

A new interceptor drain will therefore be installed to improve baseline conditions and provide a long term sustainable solution. The existing system will remain in place and has already undergone a series of upgrades including:

- Installation of automatic monitoring and telemetry to control and measure the pumping
- Maintaining a service and emergency call out contract with the pump supplier

The interceptor drain will be installed along the western and south western boundary of the former mineral workings. The drain will extend from the fishing lake in the north and wrap around the south western boundary of the former mineral workings, terminating to the east of a small copse. The new interceptor drain will be approximately 200mm in diameter and will be located at a depth of around 6.5m below ground level within the superficial deposits. The drain will tie into the existing on-site pumping station which pumps effluent to the public sewer in Thistle Grove under a consent to discharge. Inspection chambers will be installed along the length of the drain. The system will be managed and maintained as part of the developments aftercare strategy.

Studies are ongoing and will be utilised to finalise the detailed design of the new interceptor drain, and will be agreed with the Regulator prior to construction.

5.4 Validation

Verification is an essential element of any remedial strategy. The verification process aims to provide assurance that the original risk management objectives have been satisfactorily achieved and so provide confidence to all stakeholders. This requires that the process itself is transparent, robust and provides a data set demonstrating adequate performance of the remediation measures.

Following completion of the remedial works a Verification Report will be prepared and submitted to the Regulator to provide evidence of the satisfactory completion of the works in accordance with this Strategy.

5.5 Remediation Costs

The current build cost estimate (November 2017) of the proposed remediation works is £2.492m¹. This is in line with an estimate of £2.5m provided to WHBC in 2014 and is not considered to be material in terms of financial viability.

¹ Build cost estimates from cost plan report provided by Rider Levett Bucknall with remediation costs provided by TerraConsult