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Your Reference:
Our Reference: D112461/PJS/td
Date: 26 February 2007

Dear John

Middleton Lodge Development Planning Application Comments on Hydrogeology and Hydrology

We are pleased to provide our review of hydrogeological and hydrological issues relating to the above proposals.

In carrying out this review we have assessed the Planning Application documents, primarily Section 13 (Geology, Hydrogeology and Hydrology) of the Environmental Statement. We have also referred back to our original assessment (letter dated 6 April 2006 and attachments which are included as an Appendix to this letter).

In our original assessment, carried out before the Application had been submitted, potential impacts as a result of the proposed development were identified as follows:

- potential impact of the quarry excavations and restoration on spring flow and water quality
- potential impact on groundwater and surface water abstractions
- proximity of the existing landfill
- A1 road drainage
- proximity to and tunnel connection with Barton Quarry
- increased groundwater vulnerability as a result of removal of limestone
- feasibility of water features in base of quarry

Scoping Opinion

The scoping opinion from Yorkshire County Council stated that hydrogeological and hydrological risk assessments were required and should be accompanied by a drainage scheme. These were to form part of the EIA and planning application. Pre-application discussions with the Environment Agency were advised but it is not known whether these have taken place.

Environmental Statement

Section 13 of the Environmental Statement (ES) includes a description of the geology, surface water, groundwater and springs and drainage as well as a summary of the proposed works. The potential for impact is defined in the ES in three ways:

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- physical impact as a result of removal of material
- potential contamination
- water demands

Specific issues raised include the increase in groundwater vulnerability as a result of removal of limestone, contamination by oils, fuels etc., flood risk, spring flows, the use of a borehole for fountain water supply and heave. The EA concludes that, given the mitigation measures incorporated into the site design (principally leaving 1 m of limestone in the quarry garden, appropriate fuel storage and spill procedures, drainage design and monitoring), there are no significant adverse effects predicted upon groundwater or surface water as a result of the Application.

The following sections review this conclusion and identify areas where, in our opinion, there may be insufficient data to support the findings of the ES.

General Comments

We suggest that the level of supporting detail is poor and insufficient to make conclusive statements.

The key assumption regarding the water environment is that the excavation will be above the water table. This is explored in more detail below. Other issues include the potential impact on spring flows, details regarding nearby licensed abstractions, baseline water quality and the possibility of existing contamination, and uncertainty regarding a borehole for water supply.

Groundwater Levels

There are aspects of the hydrogeology that are not fully explained in the ES.

- Piezometry. The piezometry of the confined sandstone aquifer is not shown on any of the cross sections or plans of the site. The piezometric head in this aquifer is important because a significant depth of material will be removed from above it. If the head in the sandstone aquifer is higher than the head in the limestone at the base of the proposed quarry, there is a possibility of water breaking through and heave occurring as identified in the ES.
- The water level in the Limestone is not clearly stated in the report. The geological cross section illustrated in Figure 3.8 does not show the water table or piezometric surface.
- Water Level fluctuations. The report provides average water levels in 5 boreholes over a two month period. Neither the date of the measurements or the longer term fluctuations appear to be recorded. This may be significant to the application and the plan to carry out quarrying activities during the winter months. These are the periods when higher water levels occur in the aquifer naturally. Thus there may be a legitimate concern that the ES does not fully state the possible range of hydrogeological conditions that are likely to occur at the development site.

Findings from Investigation Boreholes

The location of up to 12 boreholes distributed over the site is shown on Figure 3.8 (but does not appear to be mentioned in the text). There are no details of these boreholes in the text. Information on these such as borehole depths, water strikes, lithological logs, losses of circulation or drilling fluids would be needed to substantiate the statements concerning the geology and water table / piezometric surface at the quarry site.

Spring Flows

The surface water intercepted by the quarry is to be directed towards a pond at the base of the quarry. This is to be used as a reservoir to feed the fountain system. The location of the quarry in relation to the catchment of Acre Howden Spring almost certainly means that some of the baseflow that supplies the spring will be intercepted by the quarry and be collected in the holding reservoir.

Spring Investigations

The investigations have looked at the existing springs. These are briefly documented in the ES. There are however aspects that do not seem to have been adequately addressed.

- Details of the spring flow measurement at Acre Howden Spring are not provided. At a minimum one would need to know the date or dates of the spring flow measurement and the means by which the measurement was made in order to judge the potential accuracy of the given flows.
- Other springs. There is no measurement of the spring flow from the un-named (Middleton Lodge) spring, although a water sample was taken as part of the hydrochemical analysis. Grass Kiln Head Spring is not mentioned, although the catchment of this spring could be impacted by the proposed quarrying.
- Spring hydrochemistry. The ES reports that the spring water had a hydrochemical composition similar to groundwater in limestone. It is unfortunate that the study only reports two analyses. No results from the confined sandstone aquifer or limestone aquifer are given for comparison nor are there any samples from the Grass Kiln Head Spring.

Spring Catchment Area

The catchment area of the Acre Howden spring has been estimated on the basis of area apportionment of mean annual recharge. The area of the catchment is measured to be approximately 0.45km². The report gives a mean spring flow of 2.5 l/s, (78,840m³/a). This equates to an average annual recharge of 175mm/a; considered to be a reasonable estimate of recharge for this area of England.

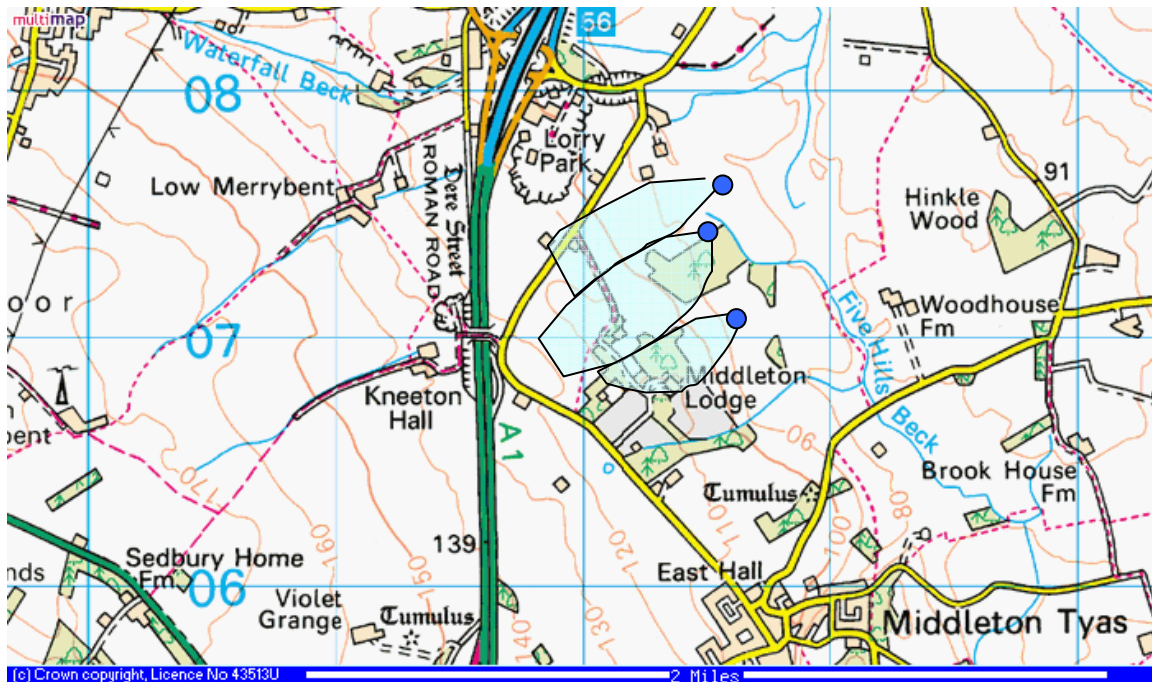
Spring Catchments

The shape of the spring catchment does not appear to be reasonable. The shape of the catchment is likely to be determined by the underlying geological structure at the base of the limestone sequence / top of the shale; the configuration of this surface dips in a north easterly direction at about 1 in 22. An indicative shape is drawn on the OS 1:50,000 sheet extract overleaf. It is noted that although the quarry development does not occupy a majority of the revised catchment area the development straddles the middle of the catchment. This may not have an impact upon the flow at Acre Howden Spring provided that the water table is low and is not intercepted by the quarrying activity. However if the water surface proved to be higher than anticipated the flow would need to be routed through the proposed system of French drains and infiltration system.

Licensed Abstractions

There does not appear to be any information relating to licensed or unlicensed abstractors in the area. This would normally be included in an ES. It is stated in the ES that there is an increase in vulnerability as a result of removal of the limestone and the increase in vulnerability should be assessed in the context of abstraction.

Conjectured Spring Catchments



Baseline Water Quality

The recorded quality of water from the springs is similar, but the elevated concentrations of sodium and chloride ions are not as anticipated for waters of limestone origin. It is possible that there is some pollution source within the catchment that causes the raised chloride ions. The drainage system from Middleton Lodge via the "Victorian Drain" is one possible cause. There is also a landfill at Barton.

If there is existing contamination in the saturated zone or unsaturated zone this may have implications for the quality of the proposed ponds but conclusions cannot be drawn based on the data available.

Water Supply to Fountain Pond

The sunken quarry garden water feature is to be supplied by surface water runoff and to be supplemented during dry summers by one or more boreholes abstracting water from the confined sandstone aquifer. Although the impact may be minor, the ability of the sandstone aquifer to support an abstraction of sufficient magnitude seems doubtful as discussed further below.

There appears to be some uncertainty regarding the usage of groundwater. The ES states that the aquifer would not be significantly impacted and that "pumping from the sandstone aquifer during very dry periods will have little or no effect on the hydrogeology of the surrounding area, principally due to poor lateral hydraulic connectivity within the aquifer." Given the apparent low yield requirements, it is agreed that abstraction from the sandstone aquifer probably will have a small effect but, without a clear statement of water use and predicted effects of pumping, it is difficult to see how this conclusion can be supported.

Adequacy of the Confined Sandstone Aquifer

The aquifer tests on the very shallow borehole are only reported in summary, thus the validity of the analytical technique used to derive transmissivity from a test apparently at 1 l/s for just 24 minutes in which the water level fell to the base of the borehole are extremely doubtful. However it is clear the sandstone can only support a very low abstraction rate. The average demand for make up water in the fountain system to replace water losses from has evaporation and spray has been calculated to be small.

The practicality of operation of a pumping system, at the very low abstraction rate that can be sustained by the apparent hydraulics of boreholes in the confined sandstone, is questioned.

Furthermore it has been assumed that an abstraction licence could be obtained from the Environment Agency. If this is not the case there appears to be no contingency plan.

Inadequacies and Requirement for further information

The ES asserts that there will not be significant impacts on the water environment as a result of the proposed development, on the assumption that quarrying will be above the water table. However it is our view that impacts would be expected and it is considered that there is insufficient supporting data to draw conclusions regarding the magnitude of these impacts.

There are also questions regarding the operation of the quarry and restoration scheme as follows:

- if predicted water levels are incorrect there may be more water in the base of the quarry than predicted, as the water table is intercepted
- the head in the sandstone aquifer does not appear to be fully understood and may have consequences for stability and heave
- the water quality in the proposed pond and elsewhere may be affected by historical drainage from foul sewers
- the feasibility of water supply from a sandstone aquifer borehole is questioned.

Further information on groundwater levels, spring flows, licensed abstractors and groundwater and surface water quality should be requested. Further assessment of impacts on spring flows, other water users, sandstone aquifer heads, pond water quality and the proposed groundwater abstraction should then be made.

An independent assessment of hydrological and hydrogeological issues was provided by Mineral Planning Group (MPG) (your email of 20 February 2007 refers). The conclusions are similar and the requirement for more supporting data is mentioned. MPG also refer to the possible consequences and impact on water sensitive habitats if the Acre Howden spring dries up. We have not assessed the interaction of ecology and water but this is a potentially significant issue if there are important habitats supported by the spring flow.

We trust that these comments are of use and look forward to being of further assistance as required.

Yours sincerely
For and on behalf of **SCOTT WILSON LTD**

Jane Sladen
Technical Director