13.0 HYDROLOGY AND WATER RESOURCES

13.1 INTRODUCTION

This chapter has been prepared by Bureau Veritas UK Ltd to consider the baseline hydrological conditions at the proposed Brickkiln development. It considers the potential effects of the development on the environment, sets out the methodology for the assessment of environmental impacts, describes the baseline geology, hydrogeology and hydrology of the existing site, and considers how potentially adverse impacts might be mitigated.

The impact of the proposed development on water resources (potable water supply) and the existing foul drainage and sewage treatment infrastructure has also been considered in this chapter.

13.2 POTENTIAL EFFECTS

In respect of Hydrology and Water Resources there are a number of potential effects that should be taken into account when considering the proposed development. The following could have a potential effect on receptors in the hydrological, geological and drainage environments.

13.2.1 Site Clearance and Construction Phase

Construction of temporary or permanent access roads and hardstandings would require clearance of vegetation, excavation of topsoil, and placement of aggregates. Trenching for cable-laying and for the building foundations and potentially piling at the school site could require excavations, generate spoil and could potentially cause the pollution of groundwater by cementitious materials or superficial contaminants.

Excavation equipment and construction plant traffic, together with erosion from unprotected temporary surfaces or haul routes, may potentially lead to an increase in the volume of runoff and potentially increase the flood risk downstream. In addition, this could result in a significant silt load in surface water run off, which may be deposited in watercourses to the detriment of the prevailing ecological or hydromorphological regime. This potentially significant impact would be greatest where construction work adjoins watercourses, or where temporary or permanent crossings are to be formed.

Severing of land drains may lead to changes in soil moisture and drainage conditions and in addition work adjoining watercourses or where temporary or permanent crossings are formed may cause physical bank degradation.

The presence of plant and powered equipment on the site introduces the potential for spillages of contaminants such as diesel and other fuels, lubricants, coolants and hydraulic fluids to enter and contaminate watercourses via surface water runoff. Leaching of contaminants from spillages into groundwater bodies may also potentially occur due to the

permeable nature of the underlying geology. Contaminants entering the sub-soils may also be transported into watercourses via sub-surface lateral flow.
Wastewaters from site welfare facilities could be a source of pollution of surface waters if inappropriately discharged.

13.2.2 Operational Phase

The construction of impermeable surfaces, for example to form access roads or hardstandings, could potentially increase the quantity of runoff and decrease the time taken for this runoff to enter the natural drainage system. These effects could lead to an increase in the risk of flooding either within the proposed development or downstream in the absence of mitigation measures. These effects could also have an adverse impact upon the water environment including alteration of channel morphologies and aquatic habitats, and a potential reduction in groundwater recharge.

Hydrocarbons and suspended solids within runoff from access roads and hardstandings could lead to pollution of the watercourses.

Installation of deep foundations, including potentially piling, or penetrative ground improvement, could cause alteration of the groundwater recharge regime or introduce pathways for pollution by superficial contaminants.

Organic matter, nutrients, fertilisers, pesticides, herbicides and de-icing materials from management of landscaped areas or roads and paving could lead to pollution of the ditches and watercourses or groundwater. These pollutants may enter watercourses via spray-drift or runoff.

Accidental spillages of chemicals, oils or fuels stored on the site or used in cleaning or maintenance of the equipment could lead to pollution of the ditches and watercourses or groundwater.

If land drains are severed and not reinstated or diverted, this may lead to changes in soil moisture and drainage conditions locally. Local groundwater abstractions could potentially be affected if patterns of groundwater recharge were to be significantly altered by the development of the site.

Additional flows to the foul drainage system could arise as a result of the development, which may have an adverse effect upon the capacity of the local sewerage network, and will increase demand on treatment facilities and their process products. In addition, demand for potable water could arise as a result of the development, which may have an adverse effect upon the capacity of the local supply network, and will increase demand on water resources.

13.2.3 Water resources and foul drainage

The proposed development will place additional demand on the existing water supply and distribution network, including the resource from which the supply is drawn. Where there are insufficient water resources and/or distribution infrastructure, this can place a significant constraint on new development.

In considering the effect of the development on wastewater, both the foul drainage infrastructure and wastewater treatment capacity has to be considered. Urban extensions

can require upgrading of the foul drainage infrastructure to enable the increased flows to be conveyed to the treatment works. This can be both disruptive and may result in off-site environmental impacts.

If there is insufficient capacity at the treatment works, an upgrade may be required. Lack of treatment capacity can be a significant constraint to development as there may not be the land available to extend the works, or there may not be sufficient environmental 'capacity' in the receiving watercourse to enable an increase in discharge. In extreme cases, increased effluent discharge to a watercourse can increase the flood risk downstream.

13.3 ASSESSMENT METHODOLOGY

The methodology for assessment of the impacts of the proposed development is as follows:

- Establish a baseline hydrological, geological and drainage environment involving desk study, liaison with interested parties, a walkover survey, and review of published information.

- Identification and evaluation of potential impacts on receptors in the hydrological, geological and drainage environments arising from the proposed development.

- Identification of measures to mitigate potentially significant adverse impacts that may arise from construction or operation of the proposed development, and evaluation of the residual impact with those measures in place.

The significance of effects upon the identified receptors is evaluated qualitatively and described using the terminology set out at Chapter 2, Section 2.3 Determining the Significance of Environmental Impacts.

13.3.1 Information Reviewed

The information reviewed for developing the baseline hydrological, geological and drainage environment has included the following:

- Topographic information for the proposed development site obtained from the 1:25,000 plan published by Ordnance Survey.

- Geological information obtained from the 1:50,000 scale geological map Sheet 221 'Hitchen' (Solid and Drift Edition) published by the British Geological Survey (BGS). Reference was also made to the Bureau Veritas Site Investigation completed on 4 September 2009.

- Reference has been made, as appropriate, to the Scoping Opinions for the Environmental Impact Assessment provided by the Environment Agency in their letter dated 19th June 2007.

- Reference has been made, as appropriate, to the Scoping Opinions for the Environmental Impact Assessment provided by North Hertfordshire District Council in their letter dated 6th July 2007.

- Reference has been made, as appropriate, to the Pollution Protection Guidelines published by the Environment Agency, notably PPG5 'Works In, Near or Liable to Affect Watercourses' and PPG6 'Working at Construction or Demolition Sites', for assessment of mitigation measures.

- Reference has been made, as appropriate, to the Luton & South Bedfordshire Water Cycle Strategy Phase 1 – Outline Strategy Technical Report, December 2008 prepared by Halcrow Group Limited on behalf of the Luton and South Bedfordshire Joint Committee.

13.3.2 Site Walkover

A site walkover survey was completed on 20 August 2009 to visually assess the principal surface features in the vicinity of the proposed development site.

13.3.3 Consultations

Consultations have been made with the following with regard to hydrology and drainage issues:

- North Hertfordshire District Council
  Bob Meadows, Assistant Network Manager - DC (North/East)

- The Environment Agency
  Karen Foster, Planning Liaison Officer
  Anna Stevens, Planning Liaison Officer
  Ally Riley, Groundwater and Contaminated Land Officer
  Helen Stafford Groundwater and Contaminated Land Officer
  Daniel Bicknell, Sustainable Development Principal Officer

- Three Valleys Water
  Julie Picarel, Three Valleys Water
  John Ellis, Veolia Water
  James Owen, Veolia Water

- Thames Water
  Mark Dickenson, Thames Water Utilities Limited
  Richard Dean, Thames Water Utilities Limited

For further information on consultee response please refer to the Flood Risk Assessment and Surface Water Runoff and Drainage Strategy in Appendices J1 and J2.

13.4 BASELINE CONDITIONS

13.4.1 Land Use

The site is dominated by agricultural use, predominantly for arable crops, although an area towards the south-east of the site is occupied by a golf course and driving range. There are a number of farm buildings and the club house to the golf course located just outside of the site boundary. Within the site boundary there appears to be a number of buildings towards the north of the site. There is a large wooded area to the south east of Brick Kiln Lane (Brick Kiln Wood) which forms the boundary of the site. A number of hedgerows form field boundaries throughout the site.

13.4.2 Topography

The site slopes in a number of directions from a maximum elevation of approximately 160m above Ordnance Datum (AOD) at the north-east corner of the site. There is a relatively steep valley feature that encroaches into the north-eastern boundary of the site, sloping towards the north-east. The majority of the southern part of the site is situated on the eastern flank of a gentler valley feature that falls in a south-easterly direction.

13.4.3 Geology Desk Study

The 1:50,000 geological map for this area published by the British Geological Survey indicates that the site is immediately underlain predominantly by Quaternary drift deposits of Clay with Flints, with a small finger of Head deposits encroaching into the south-eastern boundary. The solid geology beneath is dominated by Lewes Nodular Chalk, with Chalk Rock Member and Holywell Nodular Chalk being found on the north-eastern flank of the valley that forms the southern area of the site.

The general geology of the site is illustrated by Figures DS2 and DS3 enclosed at Appendix J2.

The site investigation confirmed that the majority of the site is underlain by Clay with Flints that exceeded 3m in depth (the maximum depth to which the trial pits could be excavated) and was relatively impermeable. Where the Upper Chalk was located in a trial pit in the base of the valley along the western boundary of the site, it was significantly degraded.

There are no sites within the vicinity designated by the Joint Nature Conservation Committee within the Geological Conservation Review (www.jncc.gov.uk/earthheritage), and the provisions of PPS9 are thus not applicable.

No geological Sites of Special Scientific Interest lie within the vicinity.

13.4.4 Hydrogeology Site Study

The site lies within a water abstraction management area and the total catchment of a groundwater abstraction to the north of Beachwood Green. The groundwater source

protection zones in the vicinity of the site are illustrated by Figure DS5 enclosed at Appendix J2.

With reference to the hydrogeological map of the area between Cambridge and Maidenhead, published by the British Geological Survey, the groundwater table is shown to be at an elevation of approximately 110m above ordnance datum, some 30m below the lowest point on the site. An extract of the hydrogeological map is shown by Figure DS6 enclosed at Appendix J2.

13.4.5 Hydrology

A walkover survey was completed on 20 August 2009 to establish the principal hydrological features of the site and its surroundings.

There were no significant hydrological features identified within the site boundary, and none within the immediate vicinity outside of the site boundary.

No evidence was seen of land drainage systems serving the site.

The flood maps published on the Environment Agency's web site indicate that the site lies entirely within Flood Zone 1 and is at low risk of fluvial flooding. The annual probability of fluvial flooding is shown to be less than 0.1%. The Environment Agency also confirmed that there has been no history of flooding at the site.

A Flood Risk Assessment has been completed for the proposed development and is enclosed at Appendix J1. The report includes an assessment of runoff from the proposed development and means of managing potential impacts within and beyond the site.

13.4.6 Local Drainage and Water Supply Infrastructure

The site lies to the east of the eastern fringe of Luton. As such, the site is effectively at the head of the foul drainage network that drains ultimately to the Luton (East Hyde) Wastewater Treatment Works to the south of Luton on the River Lee, operated by Thames Water.

As the site is largely undeveloped, there is no significant existing surface water drainage infrastructure.

Similarly, there is no significant water distribution infrastructure within the site.

13.5 MITIGATION MEASURES

Proposed mitigation measures are identified below and the significance of the related residual impacts is set out in Section 13.6.

13.5.1 Site Clearance and Construction Phase

It is proposed that throughout the site works construction related impacts would be mitigated by adopting site management controls in accordance with recognised industry good practice, notably following EA Pollution Prevention Guidelines No 6 (PPG 6) 'Working at Construction or Demolition Sites'. A Draft Code of Construction Practice (CoCP) is included at Appendix A3. Specific mitigation measures relevant to hydrology and water resources are detailed below.

The control of silt load in discharges via surface water runoff would be achieved by suitable timing and sequences of earthmoving operations, using buffer strips where necessary, containment of runoff, and provision of settlement facilities where appropriate, prior to discharge.

Severing of land drains will be mitigated by reinstating or diverting land drains wherever they are encountered.

Spillage of construction chemicals and plant-related fluids will be mitigated by provision of secure bunded storage areas and containment at refuelling and maintenance facilities in accordance with EA Pollution Prevention Guidelines No 6 (PPG 6) 'Working at Construction or Demolition Sites', and by ensuring containment of runoff and provision of decontamination facilities where appropriate, prior to discharge. These measures would ensure that leaching or infiltration of contaminants, and discharge to groundwater or via sub-surface lateral flow, is minimised.

The proposed development comprises 2 to 3 storey dwellings together with a school, local shops and a community centre. Based on the results of the preliminary site investigation that informed the drainage strategy, it is anticipated that the development would largely be founded on strip footings wholly within the depth of the clay overburden to the Chalk. The only exception might be where a large span structure is required such as sports hall to the school or the community centre. Overall, therefore, the use of piled foundations and hence the risk of creating pathways into the underlying chalk is considered low and would be mitigated appropriate design measures.

It is proposed that all wastewaters from site welfare facilities would be contained for disposal to a licensed reception facility off-site, and none would be discharged to the ground or to watercourses.

Mitigation of impacts resulting from increased runoff rate or volume due to compaction of surfaces would be achieved by suitable timing and sequence of earthmoving operations, together with suitable plant use, and the provision of containment and attenuation of runoff where needed.

13.5.2 Operational Phase

Surface water is to be disposed to the underlying permeable (Chalk) strata and therefore flood-related impacts within and beyond the site resulting from increased runoff rates or volumes due to the reduction in permeability of surfaces are expected to be minimal.

Due to the depth of the superficial deposits overlying the chalk, it is proposed that deep bored soakaways will be constructed together with attenuation ponds. This has the added

benefit of providing an opportunity to enhance the bio-diversity of the site by introducing wetland and aquatic habitat.

Where appropriate, swales will be used to convey surface water runoff to the point of discharge to improve the quality of surface water runoff. The attenuation ponds will be designed both to balance the peak inflow with the capacity of the deep bored soakaways and provide sufficient 'residence' time to allow potential pollutants to settle out of the inflow. Groundwater will further be protected by ensuring that a minimum 10m unsaturated zone is maintained beneath the borehole.

Details of the proposed drainage strategy are enclosed at Appendix J2.

The principal residual risk that will remain after the implementation of the measures to control flood risk is the failure or blockage of the surface water management system. However, this has been considered as part of the surface water drainage strategy, which has five separate catchments so that a single blockage would not result in a catastrophic increase in surface water run-off.

A risk-based approach to the maintenance of the critical elements surface water drainage system will be adopted that would for instance provide for the inspection of the system after leaf fall or following particular severe storm that might deposit debris in the system.

Impacts on groundwater bodies arising from the installation of any piled foundations that may be required are likely to be localised, and it is therefore unlikely that significant pathways for contaminants would be introduced. The disturbance of the ground will be restricted to the timescale of the piling (if required) and other excavation works and the Site is underlain principally by Clay and Flints drift deposits that overlay the Chalk and may therefore afford a significant amount of protection to the groundwater beneath.

Impacts from the application of organic matter, nutrients, fertilisers, pesticides or herbicides in landscaped areas would be minimal given the present agricultural use. Such impacts would be mitigated by adopting land management controls in accordance with recognised industry good practice. These include provision of untreated buffer strips and stockpiling mowings and composting materials away from the proposed ponds.

Storage of fuels, lubricants or chemicals on site is not expected. impacts due to storage, or to cleaning or maintenance of equipment, would be mitigated by provision of secure bunded storage, and by adopting land management controls such as ensuring containment of runoff and provision of decontamination facilities where appropriate prior to discharge.

Through consultation with Three Valleys Water, it has been established that there are sufficient available potable water resources to serve the proposed development and a high level strategy for the supply to the proposed development has been identified.

Demand management will be implemented as part of the design of the scheme and will be required to achieve the appropriate level set by prevailing Building Regulations. It is anticipated that this will include the water efficiency measures set out in the draft amended Part G of the Building Regulations. This is, for example, likely to include the installation of water-efficient fixtures and fittings and for domestic properties the provision of water butts for garden irrigation. Rainwater harvesting to provide a non-potable supply for the proposed commercial (local centre) will also be considered as part of the design development of the scheme.

Thames Water Developer Services (TWDS) were consulted with respect to the disposal of foul drainage from the site. The lack of capacity in the existing drainage network serving the eastern fringe of Luton was identified as a significant issue and therefore to avoid a significant and potentially disruptive programme of works to increase network capacity, TWDS have agreed in principal to a proposed solution where foul drainage is stored on site and discharges to the existing network at period of low flow, i.e. overnight. It is anticipated that a storage tank with a volume of between 3,000m^3 and 4,000m^3 would be required at the southern extremity of the site such that a connection can be made to the existing manhole immediately upstream of Wandon End Sewage Pumping Station. It is anticipated that this tank would be constructed below ground and would be adopted by Thames Water.

It is of note that this option was not considered as part of the Luton & South Bedfordshire Water Cycle Strategy Phase 1 – Outline Strategy Technical Report when considering the issue of connecting the proposed development to the East Hyde Wastewater Treatment Works at Paragraph 5.12.20 of the report.

Thames Water has confirmed that there is sufficient capacity at the East Hyde Wastewater Treatment Works to accommodate the proposed development. Paragraph 5.11.4 of the Luton & South Bedfordshire Water Cycle Strategy Phase 1 – Outline Strategy Technical Report concludes that there is capacity at the works for an additional 7,070 dwellings before the works would have to be upgraded.

13.6 ASSESSMENT OF IMPACTS

13.6.1 Residual Impacts – Construction Phase

The site is predominately agricultural land and therefore a potential impact on surface waters may arise from silt discharged from the site. However, there are no significant watercourses in the vicinity of the site and through the mitigation measures outlined at Section 13.5 it is considered the development would lead to a direct, short term, minor adverse impact.

Construction will require excavations for various foundations, structures and services, which may require dewatering should they become inundated during inclement weather. The use of excavation equipment and trafficking by construction plant, together with erosion from unprotected temporary surfaces or haul routes, will potentially lead to a significant silt load in surface water run off. Accumulations of silt deposited in surface water drainage systems may lead to blockages and local flooding, and to the potential detriment of the prevailing ecological or hydromorphological regime in downstream watercourses. However, there are no significant watercourses or surface water drainage systems in the vicinity of the site and through the mitigation measures outlined at Section 13.5 it is considered the development would lead to a direct, short term, minor adverse impact.

It is unlikely that significant piled foundations will be required and as such the potential for an indirect, long term, major adverse impact to the deep groundwater in the underlying major chalk aquifer, by creating preferential pathways for the migration of contamination is considered low. This is reinforced by the limited site investigation that revealed a significant depth of impermeable clay overlying the Chalk over the majority of the site. Where a potential risk is identified, mitigation measures such as the type of piling system are available that would at worst result in a direct, short term and minor adverse impact.

The presence of plant and powered equipment on the site introduces the potential for spillages of contaminants such as diesel and other fuels, lubricants, coolants and hydraulic fluids to enter and contaminate the surface water drainage systems and downstream watercourses via surface water run-off. However, there are no significant watercourses or surface water drainage systems in the vicinity of the site and through the mitigation measures outlined at Section 13.5 it is considered the development would lead to a direct, short term, minor adverse impact.

Spillages of construction materials such as concrete, chemicals, washdown wastes, and cleaning materials may lead to contamination of the surface water drainage systems and downstream watercourses via runoff. Removal or alterations to the electrical substation and disused tanks or pipelines may give rise to such spillages. However, there are no significant watercourses surface water drainage systems in the vicinity of the site and through the mitigation measures outlined at Section 13.5 it is considered the development would lead to a direct, short term, minor adverse impact.

Wastewaters from site welfare facilities may be a source of pollution of surface waters if inappropriately discharged. Following the implementation of appropriate mitigation measures, the potential effects of discharge of wastewaters are assessed as direct, short term, minor adverse impact.

13.6.2 Residual Impacts - Operational Phase

The impermeable area of the site will be significantly increased as a result of the development and therefore without mitigation the discharge of surface water from the development could potentially significantly increase.

The proposed mitigation strategy set out in the Drainage Strategy enclosed at Appendix J2 will in water resources terms lead to a direct, long-term, moderate, beneficial impact due to the direct recharge of an over-abstracted aquifer. There is a risk that the discharge of surface water to the Chalk may have an adverse impact on groundwater quality, however, following implementation of the mitigation measures described in the Drainage Strategy enclosed at Appendix J2, the potential impact is considered negligible.

If there were to be a failure of the surface water management measures, there may be an increased risk to others. However, based on the location of the proposed attenuation ponds that are most likely to be the point of any significant failure, there are no vulnerable properties immediately down-slope and hence the increase in flood risk is considered to be negligible.

Three Valleys Water has confirmed that there are sufficient water resources to serve the proposed development and a high level strategy for infrastructure improvements has been identified. Water efficiency measures and where appropriate, rainwater harvesting, will be implemented as part of the development and therefore the effect on water resources will be long-term, minor adverse. In regional terms, this may be offset by the recharge of the underlying aquifer through the implementation of the proposed drainage strategy.

There is sufficient capacity at the East Hyde Wastewater Treatment Works to accommodate the proposed development and a means of utilising the existing foul drainage infrastructure has been identified by Thames Water. Assuming that the Wastewater Treatment Works continues to operate within its consented limits, it is considered the development would not have an appreciable impact.

13.7 SUMMARY

Potential effects on receptors in the hydrological, geological and drainage environments have been identified and mitigation measures will be provided.

Effects on the water environment during site clearance and construction of the development, include potential discharges of silt or contaminants via surface water runoff have been considered. Through the implementation of appropriate mitigation measures these effects are assessed to be no more than direct, short term, minor adverse impacts.

Effects on the water environment during the lifetime of the development have been assessed. The Drainage Strategy will ensure that surface water will not result in increased flood risk downstream, will assist in the recharge of groundwater, protect groundwater quality and the proposed attenuation ponds will bring additional biodiversity benefits. The drainage strategy has taken into account both the present conditions and included an allowance for the future effects of climate change. Through the implementation of appropriate mitigation measures these effects are assessed to be Negligible.

There are sufficient potable water and wastewater treatment resources to serve the site and a means has been identified to convey foul flows generated by the proposed development without the need for disruptive infrastructure improvements. With the implementation of water efficiency and demand measures, and where appropriate rainwater harvesting, the effect on water resources will be long-term, minor adverse.