



- 13.5.19 The modelled water levels from the River Crane, located within the Site boundary were provided by the EA (2014) and show the 1 in 1000 year defended flood extent across the College playing field to range from 8.66 m AOD to 8.77 m AOD. The average elevation of the College playing field within the flood outline is between 8.40 mAOD to 8.50 mAOD. Therefore the playing field will be submerged to average depths of 26 cm-27 cm for a 1 in 1000 year flood event.
- 13.5.20 The risk of pluvial flooding has been assessed using results from JBA surface water flooding maps (see **Appendix 13.1**). The maps shows small patches of low to moderate pluvial risk associated with impermeable surfaces and poor drainage. The areas associated with the high pluvial flood risk are small and associated with small parts of the grass sports pitch in the northern section. This is believed to be caused by local depressions and impermeable soils.
- 13.5.21 The BGS susceptibility map identifies the Site as having 'potential for groundwater flooding at surface' (GroundSure, 2014). However based on a risk assessment the site is considered at negligible risk of groundwater flooding according to the ESI groundwater flood risk map (ESI, 2014 referenced in the outline Sustainable Drainage Assessment in **Appendix 13.2** for the 1 in 100 year event. Deep subterranean structures and basements would potentially be at risk of groundwater ingress, but are not proposed as part of the REEC development.
- 13.5.22 The sand and gravels below the Site are most likely in hydraulic continuity with the River Thames. The groundwater response, to a river flood event, could exceed the ground level in the vicinity of the river, even if river bank defences are not overtopped, however the impact is unlikely to extend beneath the main site.
- 13.5.23 The Site is not located within an area identified as being at risk of flooding due to the event of a reservoir failure (Groundsure, 2014).
- 13.5.24 The flooding records held by Thames Water indicate that there have been no incidents of flooding in the area as a result of surcharging public sewers (Thames Water, 2014).
- 13.5.25 The Local Council is aware of localised flooding issues within 1.5 km of the Site but all of these flooding events occurred further than 500m from the Site and no incidents have been reported on the Site itself. According to Groundsure (2014), no historical flooding has been recorded within 250m of the Site.

Future Baseline

13.5.26 The Environment Agency is planning to carry out a programme of river restoration works in the Crane Catchment, which may involve changing the balance of flows



between the Duke of Northumberland's River and the River Crane, naturalising the river banks and providing a 2 stage channel to improve the river's ecological potential. The programme for these works is not yet defined and will be subject to a prior feasibility study to identify the most appropriate set of measures from the River Basin Management Plan to apply.

Baseline Limitations

13.5.27 The ground investigation of the Site undertaken by Soiltechnics in 2008 (described in the outline Sustainable Drainage Strategy, **Appendix 13.2**) which encountered groundwater at between 1.1-3.5 mbgl, would need to be updated at reserved matters stage to precisely map groundwater levels across the Site. This baseline information, in conjunction with the detailed development layout, will be required to confirm the location of potential infiltration SuDS measures within the Site for the detailed design.

13.6 SENSITIVE RECEPTORS

13.6.1 The baseline description has been used to characterise each feature of the study area.The sensitive receptors are summarised in Table 13.5, a brief commentary is provided regarding the level of importance/value assigned to each receptor.



Table 13.5Summary of Water Resource and Flood Risk SensitiveReceptors

Feature	Receptor	Value/	Commentary
		Importance/ Sensitivity	
Water Supply	Local water supply network	Low-Medium*	Existing supply from Thames Water network to east of site
Surface Water	Existing		Discharge to Thames Water
and Foul	foul/combined sewer	Low-Medium*	combined sewer on Craneford Way
Drainage	network		and Egerton Road
Groundwater	Kempton Park gravels (principal aquifer)	Medium	Low sensitivity (less than good WFD status in RBMP1 and RMBP2 update). High importance as principal aquifer. Site is not in a Source Protection Zone, and nearest abstraction (not for public
			consumption) is 1.5km away
Surface Water	River Crane	Medium	Low sensitivity (less than Good WFD status, high degree of modification and subsequent low vulnerability to changes in hydrology, water quality and hydromorphology) and medium importance (relative proximity of non-statutory designated sites and recreational use of the watercourse)
	Duke of Northumberland's River	Medium	Low sensitivity (less than Good WFD status, high degree of modification and subsequent low vulnerability to changes in hydrology, water quality and hydromorphology) and medium importance (based on Borough level designation and recreational use of the watercourse).
Flooding	People and infrastructure affected by flooding	Low	Low sensitivity/vulnerability to flooding as majority of Site is in Flood Zone 1 with low probability of flooding; playing fields at south of the Site in Flood Zone 2 with medium probability with low risk to people and infrastructure. No other major flood risk on the Site.

*Preliminary value - subject to further consultation with Thames Water

13.7 IMPACT ASSESSMENT

- 13.7.1 This section presents the water resources impact assessment for potential receptors during construction and operational phases.
- 13.7.2 The significance of effects (Table 2.5) is based on the character of the receptors in terms of their value/importance/sensitivity (Table 13.4) and the nature of the effect in terms of magnitude, probability, reversibility, duration and direction (Tables 13. 2 and 13.3). The nature of the effects at both the construction and operational phases of the redevelopment is described in the following sections for infrastructure, potable



water supply, foul water drainage capacity, hydrology, water quality and hydromorphology. Flood risk is also summarised within this section; further details can be found in the FRA report presented in **Appendix 13.1**.

Site Enabling, Demolition and Construction Impacts

Introduction

- 13.7.3 Enabling works, demolition and construction associated with the redevelopment have the potential to disturb sub-surface infrastructure or existing drainage systems. Ground disturbance could also mobilise contaminants or materials in the soil such as fuel, dirt, cement, concrete and other debris which could enter the River Crane or the Duke of Northumberland's River. The watercourses could experience increases in turbidity and decreases in water quality as a result. Construction activities (e.g. heavy vehicles movement) could have some impact on soil structure (i.e. compaction) which may reduce soil permeability.
- 13.7.4 In terms of flood risk, the Site, and therefore construction workers, are at risk of flooding from two main sources:
 - A large-scale catchment wide flooding event of the River Crane which may cause riverine flooding (limited to the south section of the Site); and
 - Surface water flooding on the Site due to more localised heavy rainfall events exceeding the capacity of ground infiltration and drainage facilities.
- 13.7.5 During the construction phase (and in operation) works may impact the volume of surface water runoff generated on site due to changes in impermeable areas. Any green space or landscaping has the potential to reduce surface water runoff leaving the site.
- 13.7.6 Other direct effects during the construction phase may include those relating to the water supply network, additional water demand and additional wastewater generation.

Water Supply and Drainage Network

13.7.7 Accidental damage during construction to the water supply network could lead to pressure issues and the interruption to water supply to surrounding buildings. Damage to the existing surface or foul drainage network on-site could increase the likelihood of pollutants being released with the potential to contaminate the surface waters or the underlying aquifer. Pathways include infiltration, vertical and lateral preferential pathways, surface water runoff and the surface water drainage network. As the construction works are phased, only parts of the site will be undergoing demolition and construction at a time, which reduces the risk. Without mitigation, it



is anticipated that the effect would be localised, temporary and of **minor adverse** significance.

13.7.8 The phasing strategy for the REEC development allows the early installation of temporary drainage measures, and subsequently permanent drainage systems for each development zone in turn. Interim surface water drainage systems for each construction phase have been identified in the outline Sustainable Drainage Assessment (Appendix 13.2) to prevent surface water runoff from the site, hence there will be no adverse effects on the drainage network during the construction phase.

Water Supply

13.7.9 Water demand for construction processes may represent a medium-term increase in supply volumes to the Site. It is expected that water supply to the Site during the construction phase will be provided via the existing Thames Water network and an application to use an existing water supply for building purposes may be required to be made to Thames Water. The effect on water resources would be expected to be **negligible**.

Foul Drainage

- 13.7.10 Wastewater generation on construction sites includes effluent from sanitary facilities provided on-site and sediment laden water from washing down and wheel wash facilities. It is expected that foul water generated at the Site will be drained via the existing Thames Water combined sewers at the west and east of the Site. The construction activities may result in an increase in the volumes of wastewater generated. An increase in wastewater volumes generated can increase pressure on the local sewer network capacity and increase flood risk.
- 13.7.11 The phasing strategy for the development and utilities has been planned to enable the early re-routing and installing of the permanent foul drainage network to maintain an operational system. However, the rate at which the Site can discharge to the Thames Water sewer network is restricted by the size of the existing sewer connections (for which automatic connection is accepted). New connections would be subject to a Section 106 agreement that sets out the requirement to enter into an agreement with Thames Water, prior to construction under the Flood and Water Management Act. If no additional connections to the sewer network are obtained, then the maximum discharge into the sewer network cannot exceed the existing situation. If Thames Water determines that there is insufficient capacity within the local sewer network or existing connections, then it will be necessary to store more wastewater on site, either in existing tanks or additional temporary storage, and pump it into the sewer on



Craneford Way at a rate no greater than the existing discharge. This would avoid surcharging the sewers and effects will therefore be **negligible**.

Groundwater

- 13.7.12 The construction of basements has the potential to permanently interrupt shallow groundwater flow. However, the REEC development will not have large infrastructure located below ground such as basements and underground parking. Temporary dewatering during excavations may be necessary given high groundwater levels. If dewatering is required during excavations, then abstracted water would be discharged to the Thames Water foul sewer, following treatment such as sediment removal. This will require consultation with and permission from Thames Water.
- 13.7.13 Small areas of the site are subject to historical contamination as described in Chapter 11 – Ground Conditions. The contamination hotspots are within the residential development zone and will be remediated during the construction phase, hence there will be no effect on groundwater quality. There is a risk of groundwater quality being affected by spillage or leakage of fuels, oils, lubricants and other materials on site during the demolition and construction works. Without mitigation, this is assessed as a low magnitude, low probability, short-term effect of **minor adverse** significance.

Flood Risk

13.7.14 During construction, flood risk from fluvial sources is limited to the College playing fields development zone on the southern part of the Site. Works in this zone comprise removal of existing hardstanding, installation of fenced pitches and upgrading of the footpath. No loss of floodplain flood storage is anticipated. However, a temporary bund along the southern boundary of this zone is proposed to defend this zone from flooding during construction and to avoid any silt and sediment transfer into the River Crane. Construction of the pitches is programmed in Phase 2a from autumn 2017 to summer 2018; excavation for the all weather pitch should be timed in summer when there is a lower risk of flooding. Therefore, the likely effect on flood risk is **negligible**.

Surface Water

13.7.15 The phased demolition and construction works will result in changes in hardstanding areas, a potential increase in surface water run-off, changes in flood risk and associated contaminant transfer from onsite activities. The construction area in each phase has been considered to be impermeable for the duration of the construction in order to evaluate potential effects on surface water and flood risk and provide mitigation measures required. The outline Sustainable Drainage Assessment



(**Appendix 13.2**) sets out a series of actions in each phase to protect and utilise the existing site soakaways, new soakaways and temporary surface water attenuation ponds, sized and located for each of the three phases of construction within the development zones.

13.7.16 This Site drainage is intended to capture all overland flow within the construction areas in each development zone, with no intentional discharges of runoff to surrounding surface watercourses. However, there is risk that site drainage could be overloaded or fail. It is also possible during major earthworks on the Site that low spots will be created where localised ponding may occur during rainfall events. This could affect the flow in the drainage network or surface watercourses receiving runoff. Without mitigation, this could have a low magnitude, medium probability, reversible and short-term effect of **minor adverse** significance.

Water Quality

- 13.7.17 The potential hydrological impacts of the redevelopment demolition and construction works listed above could potentially lead to soil exposure and contaminant transfer from onsite activities. Short-term runoff to local watercourses from local stockpiling, demolition, construction works and drainage improvement works could convey debris, sediment and contaminants into the River Crane and Duke of Northumberland's River. Contaminants could include highly alkaline sediments from concreting works, organic material, nutrients and pollutants such as hydrocarbons; which could result in reduced dissolved oxygen levels in the watercourses or toxicity to fish and other aquatic organisms.
- 13.7.18 The Duke of Northumberland's River is unlikely to be affected by construction works on the main college site due to distance and topography, but could be affected by the junction improvement works at the junction of Langhorn Drive and the A316, where an at grade, signalised crossing is being installed and a left turn slip lane into Langhorn Drive is being lengthened slightly. The river north of the A316 is protected by a raised footpath, and south of the A316 by kerbs around parking areas which would help to prevent runoff entering the watercourse.
- 13.7.19 The River Crane could be affected by the installation of the artificial pitch on the College playing fields and widening and upgrading of the existing footpath. However, in the area closest to the river, 'no dig' technology is proposed for the pitch installation in order to protect the root zones of trees along the river bank. This will reduce the potential for runoff of soil and discharge to the river. Runoff containing silt and other pollutants could have a low magnitude, medium probability, reversible and short-term adverse effect on water quality in the receiving watercourses. Therefore, without mitigation, potential effects on the River Crane and Duke of



Northumberland's River are considered likely to be of **minor adverse** significance.

Hydromorphology

13.7.20 The predicted pollutant transfer from onsite activities listed above could include fine sediments and colloidal materials. Relevant reaches are those where direct runoff is possible. Dependent on the material transfer, there is risk of increased sedimentation or increased turbidity in the River Crane and Duke of Northumberland's River. This could have low magnitude, medium probability, reversible and short-term adverse effects on hydromorphology in the receiving watercourses. Without mitigation, potential effects on the River Crane and Duke of Northumberland's River are considered to be of **minor adverse** significance.

Mitigation Measures

- 13.7.21 Proposed mitigation measures will be implemented through the site-wide outline Construction Environmental Management Plan (CEMP) (**Appendix 6.1**). All site works will be carried out in accordance with best environmental working practices, such as Environment Agency Pollution Prevention Guidelines, which are referenced in the CEMP. Generic pollution control measures are also included in the outline Construction Logistics Plan (**Appendix 6.3**). The CEMP provides the means to ensure that environmental mitigation measures identified in the ES are fully implemented and that their effectiveness is monitored on an ongoing basis by the contractor(s).
- 13.7.22 Measures to reduce the possibility of disturbing or damaging the existing drainage systems and water supply network will include:
 - Utilisation of signs to warn of the presence of utility infrastructure;
 - Immediate repair of any damage to the drainage network; and
 - Preparation of an emergency response plan to ensure that spillages and leakages are immediately contained.
- 13.7.23 Water saving measures will be adopted where possible, thereby reducing the magnitude of effect on the water supply network; including:
 - Selection and specification of equipment to reduce the amount of water required;
 - Implementation of staff-based initiatives such as turning off taps, plant and equipment when not in use both on-site and within Site offices; and
 - Use of a grey water recycling water systems where possible such as wheel washes.



- 13.7.24 Mitigation measures required in relation to flood risk and surface water drainage include:
 - Installation of sustainable drainage systems at the commencement of each construction phase, as recommended in the outline Sustainable Drainage Assessment (**Appendix 13.2**);
 - Protection of any new SuDS features for long term operation and in particular from being compromised by demolition and construction activities in other construction phases;
 - Collection and diversion of surface water through temporary or permanent SuDs to prevent surface water flooding during each construction phase;
 - Provision of a temporary bund along the southern boundary of the College playing field development zone to prevent flooding during construction and to avoid any silt and sediment transfer into the River Crane; and
 - All necessary measures, actions and permits to deal with dewatering of excavation during construction (if required).
- 13.7.25 Additional mitigation measures to control site activities with potential to affect hydrology, flood risk, water quality and hydromorphology of surface waters will include:
 - Application of standard good practice such as those published by the Environment Agency A (e.g. Pollution Prevention Guidance series) or CIRIA publications;
 - Development of a Water Management Plan to accompany the CEMP, which describes the water pollution management measures and controls that the contractor will implement during the construction process, and details of all drainage systems including flow direction and outlet, pollution sources, methods of pollution prevention and potential receptors (e.g. watercourses and ground);
 - Colour coding of clean and foul drainage to minimise the risk of pollution;
 - General site controls including measures for bootwash, vehicle and plant cleaning, spill kits and storage of solvents and chemicals on site;
 - The storage of oils and fuels away from all watercourses with refuelling carried out in a designated bunded area. Any fuel oil tanks will be located within a secondary containment system and / or bunded, with a minimum bund capacity of 110% of the capacity of the tank. All tanks, pipework bunds and pollution prevention equipment will be checked regularly (including for build up of any liquids in bunds);
 - Provision of a low bund around tanker delivery hardstandings, within which tankers can park whilst offloading fuel. The hard standing will be large enough



to accommodate the full length of the tanker. Installation of a system to prevent any fuel spillages discharging into the drainage system, without suitable containment or treatment;

- Daily inspection of the Site works to identify any potential run-off from the Site works. The watercourses adjacent to the Site will be protected to ensure that no runoff from the works can enter them. Where risks are identified, a range of settlement options and barriers such as settlement lagoons and French drains will be deployed to prevent silt and fine sediments from entering watercourses;
- Prevention of surface runoff onto sediment generating surfaces such as excavation areas or exposed ground, by utilising the existing drainage system on other parts of the Site, by using or creating temporary drainage systems or cut-off ditches to divert water away, thus minimising the need for settlement and filtration;
- Minimisation of areas of exposed earthworks and disturbed/compacted and loose soil, and covering of exposed ground and stockpiles, for example with geotextiles, to prevent rainwater generating sediment laden runoff. Stockpile sites will whenever possible be located away from the site boundary, sensitive receptors and surface drains, and will have a self-contained drainage system to prevent untreated water release;
- Where groundwater is encountered in excavations, use of all necessary temporary works to ensure this does not cause surface water flooding. Appropriate measures will be adopted to undertake dewatering at each phase of construction. No discharge of any kind to watercourses or sewers will be permitted without the prior written consent of the appropriate authority and compliance with all their requirements;
- Provision of all necessary measures, including suitable pumps, machinery and equipment for temporary works, to enable surface water runoff to be controlled in both dry weather and wet weather conditions, and prevent flooding;
- Plant and road controls to prevent silt pollution, including wash out facilities for concrete wagons with adequate pollution prevention measures. Regular inspections will be carried out to ensure access roads edges and pathways are swept and damped down to prevent contaminant transfer. Regular removal of dust and mud from Site roads, plants and vehicles;
- Clear labelling of tanks describing their contents. Prompt removal of empty containers from the Site with appropriate disposal;
- Mixing and storage of cement in a contained area away from pathways, receptors and surface watercourses. Use of appropriate rapid setting concrete near drains and watercourses. Washing of concrete mixing equipment or lorries will be undertaken with cleaning equipment that uses a re-circulating system to avoid discharge of contaminated water;



- Provision and maintenance of spillage kits, typically containing oil-absorbent granules, floating booms, absorbent mats, polythene sheeting and polythene sacks, on Site with suitably trained persons appointed to deal with any spillages which may occur. Any spillage of diesel or petrol will be confined and removed as quickly as possible. All staff should receive spill procedure training at induction;
- Storage of spill kits should be stored in marked bag or wheelie bins in wellsignposted locations. Spill kits will be located adjacent to the fuel storage area, waste compound and fuel bowser. Buckets of sand, earth, straw bales or rags will also be provided for cleaning up small spillages; and
- Development of a contingency plan for the management of pollution incidents before construction commences.

Residual Effects

- 13.7.26 A summary of the significance of the potential residual effects is provided in Table13.6. Mitigation measures, relevant to each activity associated with a potentially significant adverse effect, are also set out from the outline CEMP (Appendix 6.1).
- 13.7.27 Incorporation of the mitigation measures identified above will result in a reduction in the magnitude and / or probability of adverse impacts on sensitive receptor reaches such that the residual effects on water resources are not considered to be significant.

Monitoring

13.7.28 As outlined in the CEMP (**Appendix 6.1**), regular visual inspection of River Crane and the Duke of Northumberland River should be undertaken when works are in proximity, and water quality sampling undertaken in the event of any accidental discharge to surface waters.

Operation

Introduction

13.7.29 Key issues in the operational phase are potential increases in demand for water and wastewater disposal due to the increased numbers of people on the Site, and the potential effects of the changes in land use on surface water drainage and flood risk within and outside the Site.

Water Supply

13.7.30 An indication of the proposed water demand for the REEC development has been



made. CIRIA Guidance C657⁸ has been used to estimate water demand for the students, employees and staff of the College and schools, assuming the use of water efficient fixtures and fittings in line with the aspiration to achieve a BREEAM 'very good' rating for the educational element of the development. Demand from the new housing is estimated based on the London Plan and London Housing Design Guide requirement that residential schemes should be designed to meet a water consumption rate of 105 litres or less per person per day. Using these data, the total water use for the development is estimated to be approximately 70,900 litres / day.

- 13.7.31 Estimates made using available billing information based on metered water use by the College indicates an annual average consumption of 9765m³. Assuming 200 working days per year, this equates to 48,825 litres / day. The REEC development would therefore result in an increase in demand of approximately 22,000 litres/day over the existing estimated usage of48,825 litres / day. Note that these are indicative figures only for the outline design and will be confirmed at detailed design stage. Further water efficiency measures such as rainwater harvesting will also be considered at detailed design stage to reduce the requirement for mains water. The outline Sustainable Drainage Strategy (**Appendix 13.2**) includes use of green roofs on parts of the development to attenuate runoff, but some roof areas could be used to collect rainwater, which would be stored in tanks and used for irrigating landscaped areas and gardens and for toilet flushing.
- 13.7.32 Thames Water has a duty under the Water Industry Act 1991 to provide supplies to premises in their area and make supplies available to persons who demand them. To inform the detailed design stage, Thames Water may need to carry out flow and pressure tests for daily demand estimations. This will assess the available capacity in the local supply network and determine whether any additional mains infrastructure is necessary to support the proposed development. Preliminary assessment suggests that additional storage of water may be able to be provided at the College to provide for peak demand, with booster pumps to increase the water pressure in case of fire. Further assessment will be undertaken in consultation with Thames Water at the detailed design stage.
- 13.7.33 The impact of the development on the overall water supply capacity would be minimal. With Thames Water's long-term strategy aiming to achieve a surplus in target headroom, the long-term effects of the development on water supply are expected to be **negligible**.

⁸ Water Key Performance Indicators and benchmarks for offices and hotels, CIRIA C657, 2006.



Foul Drainage

- 13.7.34 Foul water from inside the buildings would be discharged to the existing combined sewer system with approval from Thames Water. If total foul water flow is equivalent to water supply (as is indicated in metered water bills for the existing site) there is likely to be a proportional increase in foul flows in line with the increase in water supply estimated above. Preliminary assessments suggest foul water discharge flow rates of approximately 15 litres/second from the College, 10 litres / second from the schools and 26 litres/second from the residential development.
- 13.7.35 Further consultation with Thames Water will be undertaken during the detailed design stage to confirm whether peak flows could be accommodated within this combined sewer network. It is likely that Thames Water would undertake a capacity check on their network to determine this. If the sewer system is at capacity, storage tanks will be provided on Site to reduce the pumped flows to sewer at peak times to existing rates, hence effects would be expected to be **negligible**.

Groundwater

13.7.36 Any tanked basements or underground car parking would have the potential to permanently interrupt shallow groundwater flow. However, there are no basements or underground car parking proposed for the REEC development, hence there will be no effects on groundwater flow.

Flood Risk

- 13.7.37 The FRA (**Appendix 13.1**) provides full details regarding the flood risk from all potential sources. No fluvial flood risk affecting the Site was identified in the FRA with the exception of the open pitches on the College playing fields south of Craneford Way. This area of the Site remains as open pitches at the same ground level, and no significant change in flood flow route and/or floodplain storage at this location is predicted.
- 13.7.38 Of all flood risk sources assessed during the operational phase, only surface water flooding will be affected, for which an outline Sustainable Drainage Strategy (Appendix 13.2) has been prepared. Therefore the predicted effect of the operational REEC development on flood risk is negligible.

Surface Water

13.7.39 The outline Sustainable Drainage Assessment (**Appendix 13.2**) assesses the potential change in volumes and rate of surface water runoff. Based on the likely surfacing set out in the Illustrative Masterplan, the permeable area of the



development zones will increase by 19.5% while the impermeable area will decrease by 23% after development. The report identifies that there are at least 15 existing soakaways in the Site and that as there is no record of historical flooding at the Site, the soakaways are likely to provide the site drainage. However, the existing system of soakaways cannot be retained as the proposed building zones overlap with the location of the soakaways.

- 13.7.40 It is proposed to maintain all surface water runoff generated during a 100-year rainfall event, including climate change impact, on the Site using SuDS. The surface water runoff from the Site will be attenuated and stored using a combination of green roofs, permeable paving on roads and car parking areas, and soakaways. The green roofs and permeable pavement will be designed to ensure they can intercept rainfall and site runoff to their fullest capacity before discharging to the soakaways. The SuDS proposals are set out in detail in **Appendix 13.2**.
- 13.7.41 The site has five development zones, each contributing to one specific soakaway. While indicative locations of proposed soakaways have been provided, the design and placement of soakaways in each zone will be subject to a detailed ground condition investigation (e.g. infiltration and water level) at the detailed design stage. The Utility Statement (Appendix 13.3) confirms the presence of a gravity connection to combined Thames Water manholes serving the eastern portion of the Site. The detailed site investigation should therefore also confirm whether surface water could be drained to Thames Water's network if a soakaway option at a particular location in the Site is found to be infeasible.
- 13.7.42 During an extreme event or an event greater than the design event for the drainage facilities, the College playing fields to the south of the Site could be used as a surface water storage area and to attenuate excess surface water runoff.
- 13.7.43 Therefore the predicted effects of the REEC Development in operation on surface waters and surface water drainage would be **negligible**.

Water Quality

- 13.7.44 The changes to land use may result in potential pollution sources arising from the operational use of the proposed development which could affect surface water and groundwater quality. Typical surface water quality issues associated with flows from hard surface areas are suspended solids, hydrocarbons and pollutants resulting from accidental spillages. The proposed drainage strategy will limit the effect of these on groundwater and river water quality.
- 13.7.45 A key requirement of any SuDS system is pollution prevention, which can be effectively managed by an appropriate "train" or sequence of SuDS components that



are connected in series. The operational phase of the REEC development is associated with low hazard (roof water) and medium hazard (runoff from carpark and road). Given the presence of a Principal Aquifer under the Site, the minimum number of treatment stages is 3, using National Standards for Sustainable Drainage Systems. Subject to proper design, the proposed SuDS, including green roofs, permeable pavements and soakaways, would provide the minimum number of treatment stages required (e.g. storage/attenuation, filtration through sub-base and filtration through unsaturated soil zone).

13.7.46 The mitigation measures already incorporated into the design of the development described above will ensure that the residual effect on the quality of receiving water bodies will be of **negligible** significance. In practice, replacement of ageing soakways subject to siltation with new SuDS features is likely to provide a long term minor beneficial effect on receiving water quality.

Hydromorphology

13.7.47 The mitigation measures already incorporated into the design of the development described above with respect to hydrology and water quality, will ensure that hydromorphological effects (such as siltation) on the River Crane and Duke of Northumberland's River will be of **negligible** significance.

Mitigation Measures

- 13.7.48 Mitigation by design has been included in the form of the outline Sustainable Drainage Strategy for the Site. The SuDs is proposed to maintain 100% of surface water runoff generated during 100-year rainfall event, including the impact of climate change, on site. Green roofs, permeable pavements on roads and car parking and soakaways have been proposed to attenuate, store and infiltrate post development surface waters. All proposed SuDS, subject to proper design, would offer the minimum number of treatment stages as required by National Standards for Sustainable Drainage Systems.
- 13.7.49 In addition to mitigation measures identified above, the College playing fields to the south of the Site may be used as a surface water storage area during an extreme event or an event greater than the design event for the drainage facilities.
- 13.7.50 If Thames Water determine that there is not capacity within the local water supply or sewer network to serve the proposed development, then it will be necessary for works to be undertaken to upgrade the network or to provide additional water storage on site prior to the REEC development commencing, and any residual effect on flood risk and water resources will be **negligible**.



Residual Effects

13.7.51 The residual effects on water resources and flood risk during operation are all negligible, and are not considered significant.

Monitoring

- 13.7.52 The following monitoring plan will be required during the operation phase of the development:
 - Develop and implement a monitoring plan to assess the performance of the SuDS proposed in order to develop and implement a maintenance regime or implement supplementary and corrective measures.



13.8 SUMMARY OF RESIDUAL EFFECTS

13.8.1 A summary of residual effects on water resources and flood risk is provided in **Table** 13.6 below.

Table 13.6	Summary of Residual Effects
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Issue	Likely Significant Effect	Mitigation Measures	Likely Residual Effect
Site Enabling, Demol	ition and Constructio	n	
Existing Drainage Systems and Water Supply Network	Minor adverse	Sustainable Drainage Strategy, measures in CMP and CEMP	Negligible
Water Supply (demand)	Negligible	N/A	Negligible
Foul Water Drainage Capacity	Negligible	N/A	Negligible
Groundwater	Minor adverse	Measures in CEMP	Negligible
Surface Water – Rivers	Minor adverse	Measures in CEMP	Negligible
Flood Risk	Negligible	Sustainable Drainage Strategy	Negligible
Water Quality	Minor adverse	Measures in CMP and CEMP	Negligible
Hydromorphology	Minor adverse	Measures in CMP and CEMP	Negligible
Operation			
Water Supply (demand)	Negligible	N/A	Negligible
Foul Water Drainage Capacity	Negligible	N/A	Negligible
Groundwater flow	N/A	N/A	N/A
Surface Water – Rivers	Negligible	N/A	Negligible
Flood Risk	Negligible	Sustainable Drainage Strategy, use of College playing fields as emergency storage	Negligible
Water Quality	Negligible	N/A	Negligible
Hydromorphology	Negligible	N/A	Negligible



13.9 CUMULATIVE EFFECTS ASSESSMENT

13.9.1 Three cumulative schemes have been identified, as described in Chapter 2 – EIA Methodology.

Surface Water

13.9.2 Further development may increase the amount of impermeable surfacing and therefore increase the amount of storm water run-off to be discharged to the sewer network. It has been proposed that the 100% surface water runoff from the Site will be maintained on the Site with no reliance on the external drainage systems. Policy drivers and Thames Water and Environment Agency requirements should ensure storm water run-off from cumulative schemes is not increased from the current rates through the use of various SuDS techniques and therefore the effects would be **negligible**.

Foul Drainage

13.9.3 Cumulative schemes are likely to increase foul water discharges to the system in the area. The operational effects outlined above would therefore be cumulative and would further reduce the available capacity in the sewers causing increased risk of sewer flooding. It is the responsibility of Thames Water to assess the existing network capacity to determine whether any additional infrastructure is necessary to cope with anticipated discharges of foul water in the area. Provided the foul drainage system is upgraded, if required, the effects are expected to be **negligible**.

Groundwater

13.9.4 The Environment Agency licensing process would ensure that any groundwater dewatering effects from cumulative developments are managed in an appropriate manner, therefore the effects on the upper and lower aquifer are considered **negligible**.

Water Quality

- 13.9.5 The outline Sustainable Drainage Strategy for the proposed development as described in this chapter would not adversely affect the water quality in the River Crane. Other cumulative schemes would need to adopt a similar SuDS strategy, with agreement from the Environment Agency, with **negligible** effect on the River Crane quality.
- 13.9.6 Increased discharges to the sewer network from cumulative schemes could lead to increased frequency of sewer flooding. This may result in pollutants entering water courses and having an indirect, long-term permanent, minor adverse effect on water



quality. Provided the foul drainage system is upgraded to provide capacity for increased foul discharge from cumulative developments, if required, the effects are expected to be **negligible**.

Flood Risk

13.9.7 NPPF guidance states that flood risk to the proposed development must not be increased from the existing situation, and that flood risk to the surrounding area must not be increased due to the proposed development. Developers of cumulative schemes must therefore ensure that flood risk for their development is addressed and as such there would be a **negligible** cumulative effect to people and infrastructure for flood risk.

13.10 SUMMARY AND CONCLUSION

13.10.1 With the implementation of the outline Sustainable Drainage Strategy (Appendix 13.2) and CEMP (Appendix 6.1) during construction, and subject to further consultation with Thames Water on network capacity, the effect of the REEC development on water resources and flood risk is expected to be negligible.



14 DAYLIGHT, SUNLIGHT AND OVERSHADOWING

14.1 INTRODUCTION AND KEY ISSUES

- 14.1.1 This chapter describes the likely daylight, sunlight and shadow effects of the proposed Richmond Education and Enterprise Campus (REEC) development at Richmond upon Thames College (RuTC) in Twickenham, within the London Borough of Richmond upon Thames (LBRuT).
- 14.1.2 The chapter considers the impacts of the proposed development on residential receptors on Craneford Way, Egerton Road, Heathfield South and the Challenge Court residential complex. It also considers the levels of sunlight and overshadowing that will be experienced within neighbouring gardens and amenity spaces (sun on ground analysis).
- 14.1.3 The chapter provides an assessment of the levels of natural light that will be received within the proposed residential accommodation within the residential component of the development and the proportionate levels of sunlight and shadow that will be experienced within gardens and open spaces in the development.
- 14.1.4 The quantitative assessment has been undertaken in accordance with the guidance set out in the report "*Site Layout Planning for Daylight and Sunlight: A Guide to Good Practice*" (BR209, 2011).
- 14.1.5 The chapter considers the impacts of the development in terms of daylight, sunlight and overshadowing. It does not address rights to light, which is a legal matter rather than a planning consideration.
- 14.1.6 The assessment has been carried out using the following information:
 - Ordnance Survey Superplan digital mapping
 - Aerial photography of the site and surroundings
 - Drawings of maximum development parameters for the outline application (PL-05).
 - Illustrative Masterplan for the Residential Development Zone (see **Figure 5.1** in Chapter 5).
 - Photogrammetric model of the site and surroundings
 - Topographical survey information
 - Detailed site observations
- 14.1.7 The assessment has been based on the maximum development parameters illustrated in the above drawing. If the development subsequently extends beyond these parameters then its daylight and sunlight effects will need to be reassessed in due



course.

14.1.8 The chapter is supported by a series of appendices (**Appendices 14.1-14.8**) containing images of the assessment model, plans showing the neighbouring receptors (residential dwellings and gardens/amenity space) and detailed results tables.

14.2 CONSULTATION

- 14.2.1 The Scoping Opinion received from the LBRuT confirmed that the proposed approach to the daylight, sunlight and shadow assessment was acceptable.
- 14.2.2 A preliminary daylight and sunlight appraisal was undertaken to analyse the effects of an early iteration of the development (see Chapter 4 – Alternatives and Design Evolution) on neighbouring properties and gardens. The results of the appraisal demonstrated that the development would have a negligible effect on all neighbouring properties. This formed the basis of discussions regarding the development's daylight and sunlight impacts at the Community Forum held on 12 January 2015 and resulted in scheme amendments. The revised scheme and initial assessment results were presented at the Community Forum held on 13 April 2015.

14.3 LEGISLATION AND PLANNING POLICY

14.3.1 The statutory development plan covering the proposal site is formed by the London Plan and the LBRuT Local Plan (Core Strategy, 2006; and Development Management Plan, 2011). The latter is accompanied by a series of SPDs of which the Residential Development Standards SPD is of relevance. Guidance from LBRuT is also found in the Crane Valley Planning Guidelines (2005) which provides supplementary planning guidance for the RuTC site.

Regional Policy

London Plan – The Spatial Development Strategy for London consolidated with Alterations since 2011 (2015)

14.3.2 The London Plan addresses the residential amenity effects of development. Policy 7.6 states that proposals for buildings should, amongst other things, "not cause unacceptable harm to the amenity of surrounding land and buildings, particularly residential buildings, in relation to privacy, overshadowing, wind and microclimate". Amenity in this case is considered to include access to adequate daylight and sunlight.

Local Policy

14.3.3 Within the LBRuT Core Strategy, Policy CP7 seeks to maintain and improve the local



environment. It states that new development will be required to maintain appropriate levels of amenity. Again, amenity is considered to include access to adequate daylight and sunlight.

14.3.4 The Development Management Plan provides further detail regarding the amenity impacts of new development. Policy DM DC5 addresses neighbourliness, sunlight and daylight. It states that:

> "The Council will generally seek to ensure that the design and layout of buildings enables sufficient sunlight and daylight to penetrate into and between buildings, and that adjoining land or properties are protected from overshadowing in accordance with established standards."

- 14.3.5 The accompanying text confirms that the Council will be guided in its consideration of daylight and sunlight matters by the BRE guidance. The BRE methodology and guidance has formed the basis for this assessment.
- 14.3.6 The Residential Development Standards SPD contains further guidance on daylight and sunlighting. Section 3.1 confirms that providing a development causes no substantial loss of sunlight or daylight to adjoining dwellings and gardens, the development will generally be acceptable. It states that new development should create good living conditions and should not cause any significant loss of daylight or sunlight to habitable rooms or gardens in neighbouring properties. The SPD again notes that the BRE guide forms the appropriate basis for assessment.
- 14.3.7 The LBRuT Crane Valley Planning Guidelines SPG (2005) also contains guidance for this area of the borough. The urban design principles set out in the SPG require development to protect local amenity conditions in terms of daylight, sunlight and shadow in the context of the BRE guidance.



14.4 ASSESSMENT METHODOLOGY

Evaluation of Effects

14.4.1 This section of the chapter outlines the BRE methodology and guide levels utilised in the assessment of daylight, sunlight and overshadowing.

Daylight Analysis

- 14.4.2 The daylight analysis for neighbouring receptors is based on the assessment of vertical sky component (VSC) which forms the primary means of assessing the daylight received by neighbouring properties under the BRE guidance. While the BRE guidance also indicates that daylight distribution (No Sky Line) analyses can provide an additional means of assessing the effects of development on the daylight conditions of neighbouring properties, this is reliant on room layouts being known for the neighbouring properties assessed. Given that room layouts for the majority of the neighbouring properties assessed are, in this case, unavailable, the accuracy and reliability of this method of assessment is limited and has not been applied here.
- 14.4.3 The internal daylight analysis for the proposed residential accommodation is based on Average Daylight Factor (ADF).
- 14.4.4 These methods of assessment are described below.

Vertical Sky Component

- 14.4.5 The level of ambient daylight received by a window is quantified in terms of its VSC, which represents the amount of vertical skylight falling on a vertical window. The daylight assessment has been based on three dimensional AutoCAD models constructed for the site and surroundings as existing and with the proposed development in place. The heights (above ground level) and locations of the surrounding buildings and the proposed development have been taken from survey information, Z mapping models, Ordnance Survey digital plan data, site observations, aerial photography and the application drawings.
- 14.4.6 The VSC level at each of the windows requiring assessment has been quantified using Waldram Tools daylight and sunlight software (MBS Software Ltd).
- 14.4.7 The BRE good practice guide outlines numerical guidelines that represent flexible targets for new developments in relation to the vertical sky component at nearby reference points. The document states that:

"If the vertical sky component, *with the new development in place, is both less than 27%* **and** *less than 0.8 times its former value, then the loss of light is likely to be noticeable." (our emphasis)*



14.4.8 The guidelines therefore require that **either** the VSC target **or** the degree of change in daylighting are met (i.e. if the 27% target is adhered to, there is no requirement under the BRE guidelines for the resultant VSC level to remain at 0.8 times the former VSC level).

Average Daylight Factor (ADF)

- 14.4.9 ADF is defined as the average internal illuminance as a percentage of the unobstructed external illuminance under standard overcast conditions. The calculation of ADF provides a detailed assessment of the level of daylight received within a room as it also considers the size and transmittance of a window and the size and reflectance of the room it serves, as well as the VSC level received at the window(s).
- 14.4.10 ADF is calculated using the following formula:

$$df = \frac{TA_W\theta}{A(1-R^2)} \%$$

Where:

- T is the diffuse visible transmittance of the glazing;
- A_w is the net glazed area of the window (m²);
- θ is the angle of visible sky in degrees;
- A is the total area of the room surfaces: ceiling, floor, walls and windows (m²); and,
- R is the average reflectance.
- 14.4.11 In relation to interior daylighting, the BRE guidelines state that:

"If a predominately daylit appearance is required, then df [Average Daylight Factor] should be 5% or more if there is no supplementary electric lighting, or 2% or more if supplementary electric lighting is provided. There are additional recommendations for dwellings, of 2% for kitchens, 1.5% for living rooms and 1% for bedrooms. These last are minimum values of average daylight factor, which should be attained even if a predominately daylit appearance is not required".

14.4.12 The proposed residential units considered in the internal daylight analysis have been assessed in terms of ADF.

Sunlight Analysis

14.4.13 The levels of sunlight availability at a window reference points assessed have been



calculated based on the three dimensional AutoCAD models of the site and surroundings as existing and with the development in place, using the Waldram Tools daylight and sunlight software. The calculations provide the percentage year round sunlight availability and the percentage of sunlight availability received during the winter months.

14.4.14 The BRE good practice guide states that the sunlighting of an existing dwelling may be adversely affected by a development

"...if the centre *of the window:*

receives less than 25% of annual probable sunlight hours, or less than 5% of annual probable sunlight hours between 21 September and 21 March and

receives less than 0.8 times its former sunlight hours during either period and

has a reduction in sunlight received over the whole year greater than 4% of annual probable sunlight hours"

14.4.15 As with daylighting, the guidelines require that either the sunlight availability targets or the degree of change in sunlighting or a reduction less than 4% of APSH are achieved (i.e. if the 25%/5% targets are adhered to, there is no requirement under the BRE guidelines for the resultant sunlight levels to remain at 0.8 times the former levels).

Overshadowing

14.4.16 The BRE 'test' for a development's overshadowing impacts relates to the area of an amenity space that receives more than two hours of sunlight on 21 March (the Spring Equinox). The guide states:

"...for it to appear adequately sunlit throughout the year, at least half of a garden or amenity area should receive at least two hours of sunlight on 21 March. If, as a result of new development, an existing garden or amenity area does not meet the above, and the area which can receive two hours of sun on 21 march is less than 0.8 times its former value, then the loss of sunlight is likely to be noticeable".

14.4.17 The assessment has therefore considered the area of amenity the gardens and amenity spaces assessed that can receive more than two hours of direct sunlight on this date.



Significance of Effects

- 14.4.18 The significance criteria used in the daylight, sunlight and overshadowing analyses are summarised below:
- 14.4.19 The guide levels set out in the BRE guidance have been used as a basis for establishing the significance criteria for the assessment. The level of compliance with the guidance with each of the aforementioned residential properties has been established. The significance of the environmental effects has then been described using the following standardised EIA terminology on the basis of professional judgement:
 - Major beneficial effect;
 - Moderate beneficial effect;
 - Minor beneficial effect;
 - Negligible effect;
 - Minor adverse effect;
 - Moderate adverse effect; and
 - Major adverse effect.
- 14.4.20 Due to the scale of the development and the extensive scope of the assessment, the significance of the development's effects on neighbouring properties and the internal levels of daylight and sunlighting have been described on a building by building basis.
- 14.4.21 The categorisation of a development's daylight and sunlight effects is based on professional judgement. The environmental effects are a function of the absolute light levels with the scheme in place, the degree of change against the existing baseline position and the proportionate compliance across the windows serving each property. They are also affected by a site's location and context. The BRE guide is clear in its introduction that its guide levels should be applied flexibly and do not form a set of exacting, universally applicable standards. This is particularly relevant in urban environments where expectations of natural light are very different to those within the suburban locations which form the basis of the guide levels.
- 14.4.22 On this basis, the effects of the REEC development on the daylight and sunlight levels experienced by neighbouring properties can be classified based on the following categories of impact:
 - **Beneficial effect:** Enhancement of natural light conditions.
 - **Negligible effect**: Compliant with BRE daylight distribution/VSC or annual/winter sunlight availability guide levels.
 - Minor adverse/marginal effect: Retained daylight distribution/VSC or



annual/winter sunlight availability level within 20% of BRE guide levels (or the effects are predominantly attributable to balconies),

- **Moderate adverse**: Retained daylight distribution/VSC or annual/winter sunlight availability level within 50% of BRE guide levels.
- **Major adverse:** Retained daylight distribution/VSC or annual/winter sunlight availability level more than 50% below BRE guide levels.

Limitations of Assessment

- 14.4.23 The assessment of neighbouring receptors' baseline natural light conditions is based on topographic and elevational survey drawings so is of a high level of accuracy. In certain instances, where survey information is partially incomplete assumptions have been made regarding windows requiring assessment, window positions and heights of garden boundaries. Where the nature of rooms served by windows is unclear, they have been included in the assessment for completeness.
- 14.4.24 As with all daylight and sunlight assessments, trees and vegetation cannot be accurately modelled and have not been included in the assessment.
- 14.4.25 These matters will not materially alter the results of the assessment or the conclusions outlined in this chapter.

14.5 BASELINE AND SENSITIVE RECEPTORS

Scope of Assessment

- 14.5.1 This following outlines the neighbouring receptors (residential dwellings and gardens / amenity space) considered in the daylight, sunlight and overshadowing analyses. It also set out the notional residential accommodation and open spaces considered in the internal analysis of daylight, sunlight and shadow conditions within the development.
- 14.5.2 The assessment of effects on neighbouring properties and their gardens is based on the maximum development parameters illustrated in drawing PL-05. The internal assessment of the proposed residential accommodation is based on the Illustrative Masterplan (see **Figure 5.1** in Chapter 5).
- 14.5.3 The assessment model and properties / windows assessed are illustrated in **Appendices 14.1** and **14.2** respectively.

Daylight and Sunlight: Neighbouring Properties

14.5.4 As set out at Section 14.1, the assessment has focused on the effects of the development on properties on Craneford Way, Egerton Road, Heathfield South, Court Way, Talma Gardens, Tayben Avenue and the Challenge Court Apartments. All



other neighbouring properties are situated a sufficient distance from the site to be unaffected in terms of daylight and sunlighting.

14.5.5 The neighbouring properties assessed are listed in **Table 14.1**.

Table 14.1 Neighbouring Properties Assessed

Address	No. Windows Assessed		
Address	Daylight	Sunlight	
150 Craneford Way	4 windows		
146-148 Craneford Way	4 windows		
142-144 Craneford Way	6 windows		
138-140 Craneford Way	4 windows		
134-136 Craneford Way	6 windows		
130-132 Craneford Way	4 windows		
126-128 Craneford Way	4 windows		
122-124 Craneford Way	6 windows		
118-120 Craneford Way	6 windows		
114-116 Craneford Way	4 windows		
110-112 Craneford Way	6 windows		
106-108 Craneford Way	6 windows		
102-104 Craneford Way	6 windows		
98-100 Craneford Way	6 windows		
94-96 Craneford Way	6 windows		
90-92 Craneford Way	6 windows		
86-88 Craneford Way	6 windows		
82-84 Craneford Way	6 windows		
78-80 Craneford Way	6 windows		
74-76 Craneford Way	6 windows		
70-72 Craneford Way	6 windows		
16 Egerton Road	8 windows	6 windows	
94 Heathfield South	1 window	1 window	
3A & 3B Egerton Road	4 windows	4 windows	
3 Egerton Road	8 windows	8 windows	
5 Egerton Road	7 windows	7 windows	
7 Egerton Road	8 windows	8 windows	
9 Egerton Road	8 windows	8 windows	
11 Egerton Road	5 windows	5 windows	
13 Egerton Road	5 windows	5 windows	
15 Egerton Road	7 windows	7 windows	
17 Egerton Road	7 windows	7 windows	
19 Egerton Road	6 windows	6 windows	
21 Egerton Road	6 windows	6 windows	
23 Egerton Road	5 windows	5 windows	
25 Egerton Road	8 windows	8 windows	
27 Egerton Road	3 windows	3 windows	
29 Egerton Road	5 windows	5 windows	
31 Egerton Road	4 windows	4 windows	
33 Egerton Road	6 windows	6 windows	
28-36 Egerton Road	1 window	1 window	
96 Court Way	3 windows	3 windows	
28 Talma Gardens	2 windows	2 windows	
31 Talma Gardens	1 window	1 window	
16 Tayben Avenue	1 window	1 window	
Challenge Court Apartments 1-43	12 windows	12 windows	
Total	245 windows	129 windows	

14.5.6 Overall, the assessment has considered the effects of the proposed development on 245 windows serving these neighbouring residential properties in terms of daylight.



Of these, 129 windows are orientated within 90 degrees of due south and also require analysis in terms of sunlight availability.

14.5.7 The locations of the window reference points assessed are illustrated in the plans attached at **Appendix 14.2**.

Overshadowing: Neighbouring Gardens and Open Spaces

14.5.8 The neighbouring gardens and areas of amenity space assessed in terms of sunlight on ground are listed in **Table 14.2**.

Table 14.2 Neighbouring Gardens Assessed

Address	Garden/ Amenity Space Assessed
3A & 3B Egerton Road– rear garden	Private rear garden
3 Egerton Road– rear garden	Private rear garden
5 Egerton Road– rear garden	Private rear garden
7 Egerton Road– rear garden	Private rear garden
9 Egerton Road– rear garden	Private rear garden
11 Egerton Road– rear garden	Private rear garden
13 Egerton Road– rear garden	Private rear garden
15 Egerton Road– rear garden	Private rear garden
17 Egerton Road– rear garden	Private rear garden
19 Egerton Road– rear garden	Private rear garden
21 Egerton Road– rear garden	Private rear garden
23 Egerton Road– rear garden	Private rear garden
25 Egerton Road– rear garden	Private rear garden
27 Egerton Road– rear garden	Private rear garden
29 Egerton Road– rear garden	Private rear garden
31 Egerton Road– rear garden	Private rear garden
33 Egerton Road– rear garden	Private rear garden
28 Talma Gardens – rear garden	Private rear garden
Amenity space adjacent to 28 Talma Gardens	Amenity space
Amenity space adjacent to 25-27 Talma Gardens	Amenity space
Amenity space adjacent to 29 Talma Gardens	Amenity space
Amenity space adjacent to 31 Talma Gardens	Amenity space
Amenity space adjacent to 33-35 Talma Gardens	Amenity space
Communal amenity space adjacent to 37-75 Talma	Amenity space
16 Tayben Avenue– rear garden	Private rear garden
Amenity space adjacent to 16 Tayben Avenue	Amenity space
97 Heathfield South – rear garden	Private rear garden
Amenity space adjacent to 97 Heathfield South	Amenity space
Amenity space adjacent to 94 Heathfield South	Amenity space
94 Heathfield South – rear garden	Private rear garden
Amenity space adjacent to 96 Court Way	Amenity space
Public space adjacent to Challenge Court Apartments	Public space
Total	32 gardens/ amenity spaces

The assessment has considered the effects of the proposed development on these 32 gardens and areas of amenity space in terms of the BRE two-hour sunlight contour analysis.



Daylight and Sunlight: Proposed Residential Accommodation

- 14.5.9 The proposed residential accommodation within the Residential Development Zone of the outline development proposals has been considered in the assessment. A series of notional window reference points and main habitable rooms have been assessed for the lowest residential floor of these buildings.
- 14.5.10 In the case of each of the residential buildings in the Illustrative Masterplan (see **Figure 5.1**), windows have been positioned at ground floor level at the midpoint of the facades facing another element of the development and at other sensitive points of the façade close to obstructions to natural light. The locations of these windows are illustrated at **Appendix 14.2**.
- 14.5.11 In each case it has been assumed that the notional window serves a living room/kitchen with a standard layout and floor to ceiling height (based on typical rooms derived from London Housing Design Guide standards). It has been assumed that each room is served by a window with a glazed area of 3.4sqm (based on a typical window arrangement for a "living" room/kitchen within other comparable developments.).
- 14.5.12 This notional exercise has been undertaken to demonstrate that the amended outline elements of the development can accommodate residential units that will achieve good levels of internal daylight and sunlight.
- 14.5.13 The notional windows and rooms assessed are listed in **Table 14.3** and the locations of this notional accommodation are illustrated in **Figure 14.1**.

Building/ Plot	Floor	No. Rooms Assessed - Daylight	No. Windows Assessed – Sunlight
North western residential building	Ground	1 rooms	1 window
South western residential building	Ground	3 rooms	1 window
South eastern residential building	Ground	1 rooms	o windows
South eastern houses	Ground	8 rooms	o windows
North eastern houses	Ground	3 rooms	3 windows
Total		16 rooms	5 windows

Table 14.3 Notional Accommodation Assessed within the ResidentialElement of the Development

14.5.14 The daylight levels within these notional main rooms have been assessed and the notional windows facing within 90 degrees of due south have also been assessed in terms of annual and winter sunlight availability.





Overshadowing: Internal analysis

- 14.5.15 The gardens and amenity spaces serving the residential blocks within the development have been assessed in terms of overshadowing. Similarly, the open space proposed within the new college / schools development has been considered in terms of sunlight and shadow.
- 14.5.16 The following eight areas of proposed open / amenity space, based on the Illustrative Masterplan (see **Figure 5.1** in Chapter 5) have been assessed in terms of the BRE two-hour sunlight contour analysis.
 - Private gardens serving south western building;
 - Communal amenity space adjacent to south western building
 - Private gardens serving north western building
 - Private gardens serving south eastern building
 - Private gardens serving north eastern houses
 - Central communal space between north west and south east Blocks
 - Rear gardens serving southern houses
 - Central open space within college/schools development
- 14.5.17 The locations of these areas of open / amenity space are illustrated in **Figure 14.2**.

Current Baseline

14.5.18 This section of the chapter sets out the existing (baseline) daylight (VSC) and sunlight availability (APSH/WPSH) levels experienced within the existing neighbouring residential properties requiring assessment.

Daylight: Baseline Levels

14.5.19 A summary of the existing VSC levels at the window reference points assessed is provided in **Table 14.4**. The VSC results for neighbouring properties are provided in **Appendix 14.3**.



Areas of Open / Amenity Space Within Residential Development Used in Overshadowing Assessment





Table 14.4: Baseline VSC Levels at N	Neighbouring Properties
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Address	No. Windows	No. (%) windows with VSC
150 Craneford Way	4 windows	4 windows (100%)
146-148 Craneford Way	4 windows	4 windows (100%)
142-144 Craneford Way	6 windows	6 windows (100%)
138-140 Craneford Way	4 windows	4 windows (100%)
134-136 Craneford Way	6 windows	6 windows (100%)
130-132 Craneford Way	4 windows	4 windows (100%)
126-128 Craneford Way	4 windows	4 windows (100%)
122-124 Craneford Way	6 windows	6 windows (100%)
118-120 Craneford Way	6 windows	6 windows (100%)
114-116 Craneford Way	4 windows	4 windows (100%)
110-112 Craneford Way	6 windows	6 windows (100%)
106-108 Craneford Way	6 windows	4 windows (100%)
102-104 Craneford Way	6 windows	6 windows (100%)
98-100 Craneford Way	6 windows	6 windows (100%)
94-96 Craneford Way	6 windows	6 windows (100%)
90-92 Craneford Way	6 windows	6 windows (100%)
86-88 Craneford Way	6 windows	6 windows (100%)
82-84 Craneford Way	6 windows	6 windows (100%)
78-80 Craneford Way	6 windows	6 windows (100%)
74-76 Craneford Way	6 windows	6 windows (100%)
70-72 Craneford Way	6 windows	6 windows (100%)
16 Egerton Road	8 windows	7 windows (87.5%)
94 Heathfield South	1 window	1 windows (100%)
3A & 3B Egerton Road	4 windows	3 windows (75%)
3 Egerton Road	8 windows	6 windows (75%)
5 Egerton Road	7 windows	7 windows (100%)
7 Egerton Road	8 windows	6 windows (75%)
9 Egerton Road	8 windows	7 windows (87.5%)
11 Egerton Road	5 windows	5 windows (100%)
13 Egerton Road	5 windows	5 windows (100%)
15 Egerton Road	7 windows	7 windows (100%)
17 Egerton Road	7 windows	7 windows (100%)
19 Egerton Road	6 windows	6 windows (100%)
21 Egerton Road	6 windows	6 windows (100%)
23 Egerton Road	5 windows	5 windows (100%)
25 Egerton Road	8 windows	7 windows (87.5%)
27 Egerton Road	3 windows	3 windows (100%)
29 Egerton Road	5 windows	5 windows (100%)
31 Egerton Road	4 windows	4 windows (100%)
33 Egerton Road	6 windows	6 windows (100%)
28-36 Egerton Road	1 window	1 window (100%)
96 Court Way	3 windows	2 windows (66.7%)
28 Talma Gardens	2 windows	2 windows (100%)
31 Talma Gardens	1 window	1 window (100%)
16 Tayben Avenue	1 window	1 window (100%)
Challenge Court	12 windows	11 windows (91.7%)
Total	245 windows	233 windows (95.1%)

14.5.20 The results of the baseline study demonstrate that the majority of neighbouring properties requiring assessment currently receive VSC levels above the BRE guide levels of 27% for good diffuse daylighting. Of the 245 windows assessed serving neighbouring properties, 233 windows (95.1%) currently receive VSC levels above the



BRE target level of 27%.

14.5.21 The baseline results show that certain windows within existing properties on Egerton Road already experience daylight levels marginally below the BRE guide levels. These lower baseline levels within certain neighbouring properties need to be taken into account in the subsequent assessment of the REEC development's effects. Clearly, where existing VSC levels are below the BRE guidelines, the effects of the development need to be assessed in terms of the degree of change arising. The BRE sets a threshold of 0.8 times the baseline level for 'noticeable' change in VSC level (and sunlight availability).

Sunlight: Baseline Levels

14.5.22 **Table 14.5** provides a summary of the baseline annual and winter sunlight levels at the window reference points assessed. The full sunlight availability results for neighbouring properties are provided in **Appendix 14.4**.


Table 14.5: Baseline Sunlight Levels at Neighbouring Properties

Address	No.	Existing Sunlight above BRE Guide Level	
	Windows	Annual Sunlight (25%)	Winter Sunlight
150 Craneford Way	o windows	n/a	n/a
146-148 Craneford Way	o windows	n/a	n/a
142-144 Craneford Way	o windows	n/a	n/a
138-140 Craneford Way	o windows	n/a	n/a
134-136 Craneford Way	o windows	n/a	n/a
130-132 Craneford Way	o windows	n/a	n/a
126-128 Craneford Way	o windows	n/a	n/a
122-124 Craneford Way	o windows	n/a	n/a
118-120 Craneford Way	o windows	n/a	n/a
114-116 Craneford Way	o windows	n/a	n/a
110-112 Craneford Way	o windows	n/a	n/a
106-108 Craneford Way	o windows	n/a	n/a
102-104 Craneford Way	o windows	n/a	n/a
98-100 Craneford Way	o windows	n/a	n/a
94-96 Craneford Way	o windows	n/a	n/a
90-92 Craneford Way	o windows	n/a	n/a
86-88 Craneford Way	o windows	n/a	n/a
82-84 Craneford Way	o windows	n/a	n/a
78-80 Craneford Way	o windows	n/a	n/a
74-76 Craneford Way	o windows	n/a	n/a
70-72 Craneford Way	o windows	n/a	n/a
16 Egerton Road	6 windows	6 windows (100%)	6 windows (100%)
94 Heathfield South	1 window	1 window (100%)	1 window (100%)
3A & 3B Egerton Road	4 windows	3 windows (75%)	2 windows (50%)
3 Egerton Road	8 windows	8 windows (100%)	6 windows (75%)
5 Egerton Road	7 windows	7 windows (100%)	7 windows (100%)
7 Egerton Road	8 windows	7 windows (87.5%)	6 windows (75%)
9 Egerton Road	8 windows	8 windows (100%)	8 windows (100%)
11 Egerton Road	5 windows	5 windows (100%)	4 windows (80%)
13 Egerton Road	5 windows	5 windows (100%)	5 windows (100%)
15 Egerton Road	7 windows	7 windows (100%)	6 windows (85.7%)
17 Egerton Road	7 windows	7 windows (100%)	7 windows (100%)
19 Egerton Road	6 windows	6 windows (100%)	6 windows (100%)
21 Egerton Road	6 windows	6 windows (100%)	6 windows (100%)
23 Egerton Road	5 windows	5 windows (100%)	5 windows (100%)
25 Egerton Road	8 windows	8 windows (100%)	8 windows (100%)
27 Egerton Road	3 windows	3 windows (100%)	3 windows (100%)
29 Egerton Road	5 windows	5 windows (100%)	5 windows (100%)
31 Egerton Road	4 windows	4 windows (100%)	4 windows (100%)
33 Egerton Road	6 windows	6 windows (100%)	6 windows (100%)
28-36 Egerton Road	1 window	1 window (100%)	1 window (100%)
96 Court Way	3 windows	3 windows (100%)	3 windows (100%)
28 Talma Gardens	2 windows	2 windows (100%)	2 windows (100%)
31 Talma Gardens	1 window	1 window (100%)	1 window (100%)
16 Tayben Avenue	1 window	1 window (100%)	1 window (100%)
Challenge Court	4 windows	4 windows (100%)	4 windows (100%)
Total	129 windows	127 windows (98.4%)	123 windows (95.3%)



14.5.23 The results of the baseline sunlight assessment show that the majority of the south facing windows assessed within existing neighbouring properties currently receive levels of annual and winter sunlight above the BRE target levels of 25% and 5%. As with daylighting, certain windows serving properties on Egerton Road currently receive annual and winter sunlight levels below the BRE guide levels.

Overshadowing: Baseline Levels

- 14.5.24 The existing buildings at the site result in a negligible level of overshadowing of nearby amenity space or landscape resources.
- 14.5.25 Overall the baseline overshadowing levels arising as a result of the buildings occupying the site are negligible throughout the year.

14.6 IMPACT ASSESSMENT

Site Enabling, Demolition and Construction – Neighbouring Receptors

- 14.6.1 During the phased construction, there will be an incremental increase in the development's effects on neighbouring properties' daylight and sunlight levels as the development on the site increases. The effects throughout the development's construction phases will be less than the effects arising from the overall development based on the maximum parameters. Consequently, the quantitative analysis of the development's effects on natural light has been based on the effects arising from the maximum parameters across the development as a whole (a worst case scenario has been assessed).
- 14.6.2 There will be negligible effects from scaffolding, hording, crane(s) and construction plant. Elements of these construction structures (tower cranes) may be taller than the development / parameters; however they will be light weight and unlikely to significantly obstruct daylight or sunlight. These effects will also be temporary and transitory.
- 14.6.3 There are unlikely to be any significant daylight and sunlight effects on neighbouring properties as a result of the construction process.

Operation – Neighbouring Receptors

Introduction

14.6.4 The effects of the REEC development on the levels of daylight and sunlight experienced within existing neighbouring properties have been assessed in the context of the 2011 BRE guidelines. An assessment has also been made of the levels of overshadowing of existing amenity space in the vicinity of the site.



Predicted Effects- Neighbouring Receptors

Effects on Neighbouring Properties: Daylight

14.6.5 A summary of the effects of the development on the VSC levels experienced at the neighbouring window reference points assessed is presented in **Table 14.6**. The VSC results are set out in full in **Appendix 14.3**.

	No. Windows	No. (%) windows with VSC
Address	Assessed	currently above BRE target (27%)
150 Craneford Way	4 windows	4 windows (100%)
146-148 Craneford Way	4 windows	4 windows (100%)
142-144 Craneford Way	6 windows	6 windows (100%)
138-140 Craneford Way	4 windows	4 windows (100%)
134-136 Craneford Way	6 windows	6 windows (100%)
130-132 Craneford Way	4 windows	4 windows (100%)
126-128 Craneford Way	4 windows	4 windows (100%)
122-124 Craneford Way	6 windows	6 windows (100%)
118-120 Craneford Way	6 windows	6 windows (100%)
114-116 Craneford Way	4 windows	4 windows (100%)
110-112 Craneford Way	6 windows	6 windows (100%)
106-108 Craneford Way	6 windows	4 windows (100%)
102-104 Craneford Way	6 windows	6 windows (100%)
98-100 Craneford Way	6 windows	6 windows (100%)
94-96 Craneford Way	6 windows	6 windows (100%)
90-92 Craneford Way	6 windows	6 windows (100%)
86-88 Craneford Way	6 windows	6 windows (100%)
82-84 Craneford Way	6 windows	6 windows (100%)
78-80 Craneford Way	6 windows	6 windows (100%)
74-76 Craneford Way	6 windows	6 windows (100%)
70-72 Craneford Way	6 windows	6 windows (100%)
16 Egerton Road	8 windows	8 windows (100%)
94 Heathfield South	1 window	1 window (100%)
3A & 3B Egerton Road	4 windows	4 windows (100%)
3 Egerton Road	8 windows	8 windows (100%)
5 Egerton Road	7 windows	7 windows (100%)
7 Egerton Road	8 windows	8 windows (100%)
9 Egerton Road	8 windows	8 windows (100%)
11 Egerton Road	5 windows	5 windows (100%)
13 Egerton Road	5 windows	5 windows (100%)
15 Egerton Road	7 windows	7 windows (100%)
17 Egerton Road	7 windows	7 windows (100%)
19 Egerton Road	6 windows	6 windows (100%)
21 Egerton Road	6 windows	6 windows (100%)
23 Egerton Road	5 windows	5 windows (100%)
25 Egerton Road	8 windows	8 windows (100%)
27 Egerton Road	3 windows	3 windows (100%)
29 Egerton Road	5 windows	5 windows (100%)
31 Egerton Road	4 windows	4 windows (100%)
33 Egerton Road	6 windows	6 windows (100%)
28-36 Egerton Road	1 window	1 window (100%)
96 Court Way	3 windows	3 windows (100%)
28 Talma Gardens	2 windows	2 windows (100%)
31 Talma Gardens	1 window	1 window (100%)
16 Tayben Avenue	1 window	1 window (100%)
Challenge Court Apartments 1-43	12 windows	12 windows (100%)
Total	245 windows	245 windows (100%)

Table 14.6 VSC Results for Neighbouring Properties



- 14.6.6 The results of the assessment demonstrate that all of the 245 windows assessed serving neighbouring houses and apartments will comply with the BRE guide levels with the development in place (i.e. 100% are compliant). These properties and the windows assessed represent the most sensitive neighbouring properties in relation to the development. As such, other less sensitive neighbours will similarly comply with the BRE guidance.
- 14.6.7 On this basis, the effect of the REEC development on the daylight conditions experienced at all neighbouring properties can be categorised as **negligible**.

Effects on Neighbouring Properties: Sunlight

14.6.8 A summary of the effects of the development on the sunlight availability levels experienced at the neighbouring window reference points assessed is presented in Table 14.7. The sunlight results are set out in full in Appendix 14.4.



Table 14.7 Sunlight Results for Neighbouring Properties

Address	No. Windows	indows Sunlight Results above BRE Guide Leve	
	Assessed	Annual Sunlight	Winter Sunlight
150 Craneford Way	0 windows	n/a	n/a
146-148 Craneford Way	o windows	n/a	n/a
142-144 Craneford Way	o windows	n/a	n/a
138-140 Craneford Way	o windows	n/a	n/a
134-136 Craneford Way	o windows	n/a	n/a
130-132 Craneford Way	0 windows	n/a	n/a
126-128 Craneford Way	0 windows	n/a	n/a
122-124 Craneford Way	0 windows	n/a	n/a
118-120 Craneford Way	0 windows	n/a	n/a
114-116 Craneford Way	0 windows	n/a	n/a
110-112 Craneford Way	0 windows	n/a	n/a
106-108 Craneford Way	0 windows	n/a	n/a
102-104 Craneford Way	0 windows	n/a	n/a
98-100 Craneford Way	0 windows	n/a	n/a
94-96 Craneford Way	0 windows	n/a	n/a
90-92 Craneford Way	o windows	n/a	n/a
86-88 Craneford Way	o windows	n/a	n/a
82-84 Craneford Way	o windows	n/a	n/a
78-80 Craneford Way	o windows	n/a	n/a
74-76 Craneford Way	o windows	n/a	n/a
70-72 Craneford Way	o windows	n/a	n/a
16 Egerton Road	6 windows	6 windows (100%)	6 windows (100%)
94 Heathfield South	1 window	1 window (100%)	1 window (100%)
3A & 3B Egerton Road	4 windows	4 windows (100%)	4 windows (100%)
3 Egerton Road	8 windows	8 windows (100%)	8 windows (100%)
5 Egerton Road	7 windows	7 windows (100%)	7 windows (100%)
7 Egerton Road	8 windows	8 windows (100%)	8 windows (100%)
9 Egerton Road	8 windows	8 windows (100%)	8 windows (100%)
11 Egerton Road	5 windows	5 windows (100%)	5 windows (100%)
13 Egerton Road	5 windows	5 windows (100%)	5 windows (100%)
15 Egerton Road	7 windows	7 windows (100%)	6 windows (85.7%)
17 Egerton Road	7 windows	7 windows (100%)	7 windows (100%)
19 Egerton Road	6 windows	6 windows (100%)	4 windows (66.7%)
21 Egerton Road	6 windows	6 windows (100%)	6 windows (100%)
23 Egerton Road	5 windows	5 windows (100%)	5 windows (100%)
25 Egerton Road	8 windows	8 windows (100%)	8 windows (100%)
27 Egerton Road	3 windows	3 windows (100%)	3 windows (100%)
29 Egerton Road	5 windows	5 windows (100%)	5 windows (100%)
31 Egerton Road	4 windows	4 windows (100%)	4 windows (100%)
33 Egerton Road	6 windows	6 windows (100%)	6 windows (100%)
28-36 Egerton Road	1 window	1 window (100%)	1 window (100%)
96 Court Way	3 windows	3 windows (100%)	3 windows (100%)
28 Talma Gardens	2 windows	2 windows (100%)	2 windows (100%)
31 Talma Gardens	1 window	1 window (100%)	1 window (100%)
16 Tayben Avenue	1 window	1 window (100%)	1 window (100%)
Challenge Court	4 windows	4 windows (100%)	4 windows (100%)
Total	129 windows	129 windows (100%)	126 windows (97.7%)



- 14.6.9 As with daylighting, the results of the assessment demonstrate that all of the 129 neighbouring windows requiring assessment in terms of sunlight availability comply with the BRE guide levels for annual sunlight with the development in place (i.e. 100% are compliant). Again, these windows represent the most sensitive neighbouring properties in relation to the development's effects on sunlighting. As such, other less sensitive neighbours will similarly comply with the BRE guidance for annual sunlight.
- 14.6.10 The effect of the development on the annual sunlight levels experienced at all neighbouring properties can, therefore, be categorised as **negligible**.
- 14.6.11 The results for winter sunlighting show that 126 of the 129 neighbouring windows requiring assessment in terms of sunlight availability will comply with the BRE guide levels for winter sunlight with the development in place (97.7% compliance). Three isolated windows within Nos. 15 and 19 Egerton Road will experience winter sunlight levels marginally below the guide levels. These windows are fully compliant with the guidance for annual sunlight which forms the primary measure of sunlighting. As such the impacts are considered to be acceptable.
- 14.6.12 The effect of the development on the winter sunlight levels experienced at all neighbouring properties on Craneford Way, Heathfield South, Court Way, Talma Gardens, the Challenge Court Apartments and Nos. 3, 3a, 3b, 5, 7, 9, 11, 13, 17, 21, 23, 25, 27, 29, 31 and 28-36 Egerton Road can be categorised as **negligible**.
- 14.6.13 The effects on Nos. 15 and 19 Egerton Road are extremely marginal but are categorised as **minor adverse**.

Effects on Neighbouring Amenity Space: Overshadowing

14.6.14 A summary of the results of the overshadowing assessment for the neighbouring gardens and areas of amenity space is presented in **Table 14.8**. The results are presented in full in **Appendix 14.5**).



Address	Amonity Chase	Above/ Below
Address	Amenity Space Private rear	Above
2 Egerton Road	Private rear garden	Above
5 Egerton Road	Private rear garden	Above
7 Egerton Road	Private rear garden	Above
o Egerton Road	Private rear garden	Above
11 Egerton Road	Private rear garden	Above
13 Egerton Road	Private rear garden	Above
15 Egerton Road	Private rear garden	Above
17 Egerton Road	Private rear garden	Above
19 Egerton Road	Private rear garden	Above
21 Egerton Road	Private rear garden	Above
23 Egerton Road	Private rear garden	Above
25 Egerton Road	Private rear garden	Above
27 Egerton Road	Private rear garden	Above
29 Egerton Road	Private rear garden	Above
31 Egerton Road	Private rear garden	Above
33 Egerton Road	Private rear garden	Above
Amenity space adjacent to 28 Talma Gardens	Amenity space	Above
Amenity space adjacent to 25-27 Talma Gardens	Amenity space	Above
Amenity space adjacent to 29 Talma Gardens	Amenity space	Above
Amenity space adjacent to 31 Talma Gardens	Amenity space	Above
Amenity space adjacent to 33-35 Talma Gardens	Amenity space	Above
Communal amenity space adjacent to 37-75 Talma	Amenity space	Above
16 Tayben Avenue– rear garden	Private rear garden	Above
Amenity space adjacent to 16 Tayben Avenue	Amenity space	Above
97 Heathfield South – rear garden	Private rear garden	Above
Amenity space adjacent to 97 Heathfield South	Amenity space	Above
Amenity space adjacent to 94 Heathfield South	Amenity space	Above
94 Heathfield South – rear garden	Private rear garden	Above
Amenity space adjacent to 96 Court Way	Amenity space	Above
Public space adjacent to Challenge Court Apartments	Public space	Above

Table 14.8 Summary of Overshadowing Analysis for NeighbouringGardens/Amenity Space

14.6.15 The results of the overshadowing analysis show that the REEC development will comply fully with the BRE guidance for overshadowing in relation to all of the existing neighbouring gardens/amenity spaces assessed in the vicinity of the site. The effects of the development in this regard will again be **negligible**.

Operation – Internal Receptors

Introduction

14.6.16 As discussed at Section 14.2, a series of notional window reference points and 'main' habitable rooms have been assessed for the residential accommodation within the residential buildings based on the Illustrative Masterplan. This notional exercise has been undertaken to demonstrate that the outline elements of the development can accommodate residential units which will achieve good levels of internal daylight and



sunlight.

14.6.17 The windows and rooms have been assessed in terms of ADF and Sunlight Availability. The internal daylight and sunlight results are discussed below.

Predicted Effects- Internal Receptors

Internal Daylight – Outline Blocks

14.6.18 A summary of the ADF results for the notional rooms in the outline blocks within the Residential Development Zone is presented in **Table 14.9**. The results for these notional rooms are presented in full in **Appendix 14.6**.

Table 14.9 Summary of ADF Results for Notional Rooms within OutlineResidential Blocks

Building	Floor	Internal Daylight		
		No. rooms assessed	No. (%) compliant	
North western residential building	Ground	1 room	1 (100%)	
South western residential building	Ground	3 rooms	3 (100%)	
South eastern residential building	Ground	1 rooms	1 (100%)	
South eastern houses	Ground	8 rooms	8 (100%)	
North eastern houses	Ground	3 rooms	3 (100%)	
Total		16 rooms	16 (100%)	

- 14.6.19 The results of the assessment for the notional ground floor level rooms analysed within the outline residential buildings in the development demonstrate that all of the indicative living rooms/kitchens assessed would comply with the BS/BRE guide levels for ADF on the basis of the typical window/room parameters used in the analysis. The notional rooms considered are situated at ground floor level and comparable rooms in the floors above would all receive superior ADF levels.
- 14.6.20 On this basis, it is reasonable to conclude that the illustrative outline proposals provide an acceptable basis from which to deliver high quality residential accommodation providing a good environment in interior daylight terms. The accommodation will be designed in detail at the reserved matters stages.

Sunlight Availability – Outline Blocks

14.6.21 A summary of the sunlight results for the notional windows within the outline



element of the scheme is presented in **Table 14.10**. The results for these notional windows are presented in full in **Appendix 14.7**.

Building	Floor	Annual Sunlight	
		No. windows assessed	No. (%) compliant
North western residential building	Ground	1 window	1 (100%)
South western residential building	Ground	1 window	1 (100%)
South eastern residential building	Ground	o windows	n/a
South eastern houses	Ground	o windows	n/a
North eastern houses	Ground	3 windows	3 (100%)
Total		5 windows	5 (100%)

Table 14.10: Summary of Sunlight Results for Notional Rooms withinOutline Residential Blocks

- 14.6.22 The results of the sunlight analysis for the notional ground floor level windows assessed again demonstrate that all of the notional south facing windows within the residential element of the development would receive levels of annual sunlighting in accordance with the BRE guide levels. As with daylighting, accommodation in the floors above ground floor level would experience better levels of sunlight and would similarly comply with the BRE guidance.
- 14.6.23 Overall, it is considered that the residential element of the development provides an appropriate basis to deliver high quality residential accommodation providing a good environment in sunlight terms.

Overshadowing: Internal Analysis

14.6.24 The areas of open space and gardens/amenity space within the development have been assessed in terms of overshadowing. The results are summarised in the Table 14.11 and contained in full at Appendix 14.8.



Address	Amenity Space	Above/ Below BRE
Private gardens serving		Guidance
south western building;	Private rear gardens	Below (marginal)
Communal amenity space adjacent to south western building	Communal landscaped space	Above
Private gardens serving north western building	Private rear gardens	Above
Private gardens serving south eastern building	Private rear gardens	Below
Private gardens serving north eastern houses	Private rear gardens	Above
Central communal space between north west and south east Blocks	Communal landscaped space	Above
Egerton Road communal space	Landscaped communal space	Above
Rear gardens serving southern houses	Private rear gardens	Above
Central open space within college/schools development	Landscaped open space (non residential)	Above

Table 14.11Summary of Overshadowing Analysis for ProposedGardens/Amenity Space

- 14.6.25 The results of the overshadowing analysis for the proposed areas of amenity space show that the majority of the gardens and open spaces within the development will comply with the BRE guide levels in terms of sunlight and shadow. This includes all communal areas of amenity space within the residential element of the development, the rear gardens serving the north western building, the north eastern houses and the southern houses, and the open space within the college/schools development.
- 14.6.26 The gardens serving the ground floor units within the south eastern block and the south western block will experience areas of sunlight below the BRE guide levels. This reflects the fact that these gardens are enclosed on their southern sides by the proposed residential buildings. These gardens will still receive direct sunlight at the March Equinox and the 'lit area' of the south western building will be only very marginally below the guide levels. Subject to appropriate landscaping and planting, these spaces will provide good quality useable amenity space for residents. Importantly, the spaces have been assessed at the March Equinox and will receive much higher levels of sunlight during the summer months when they will be most frequently used.
- 14.6.27 Overall, the development's open spaces will together provide a good range of high quality, well lit amenity spaces. Collectively these spaces will achieve good levels of natural light (c.94% of the open/amenity space across the development will receive more than two hours sunlight at the March Equinox; well in excess of the 50% set out by the BRE).



- 14.6.28 It is important to recognise that the BRE guidance is flexible and based on a suburban scale of development. The overshadowing analysis is difficult to achieve in the case of urban courtyard developments as the 'test' is effectively derived from expectations of sunlight/shadow within a suburban garden.
- 14.6.29 For these reasons, it is considered that the REEC development will not result in any materially unacceptable effects in terms of the overshadowing levels experienced within open spaces in the development.

14.7 MITIGATION MEASURES

- 14.7.1 The daylight, sunlight and overshadowing analyses undertaken as part of the EIA process have fed into and informed the design process for the development. Alterations have been made to maximise the development's compliance with the BRE Guide targets.
- 14.7.2 It is not considered that any further mitigation of impacts is required in relation to daylight and sunlight effects.

14.8 SUMMARY OF RESIDUAL EFFECTS

14.8.1 As outlined in the preceding section of the assessment, the mitigation of potential daylight and sunlight effects has been integral to the development's design process. No residual adverse effects on the daylight, sunlight or overshadowing levels at neighbouring receptors are predicted to occur as a result of the REEC development's maximum parameters. **Table 14.12** below provides a summary of the development's daylight and sunlight effects.



Issue	Likely Significant Effect	Mitigation Measures	Likely Residual Effect
Site Enabling, Demo	lition and Constructio	n	
None	N/A	N/A	N/A
Operation			
Neighbouring properties' daylight	Negligible	None required	Negligible
Neighbouring properties' annual sunlight	Negligible	None required	Negligible
Neighbouring properties' winter sunlight – all properties except No. 15 and No. 19 Egerton Road	Negligible	None	Negligible
Neighbouring properties' winter sunlight –No. 15 and No. 19 Egerton Road	Minor adverse	None	Minor adverse
Overshadowing of neighbouring gardens	Negligible	None	Negligible

Table 14.12Summary of Daylight and Sunlight Impacts

14.9 CUMULATIVE IMPACTS

- 14.9.1 There are no emerging developments in the immediate vicinity of the site that could give rise to cumulative effects or interactions in terms of daylight, sunlight and shadow effects. The cumulative developments identified in Chapter 2 are a sufficient distance from the site to ensure there are no interactions or collective effects arising.
- 14.9.2 As such, there is no requirement to undertake a separate assessment of cumulative effects in this case.

14.10 SUMMARY AND CONCLUSIONS

14.10.1 This chapter considers the effects of the Richmond Education and Enterprise Campus development on the daylight and sunlight levels received by neighbouring residential properties and the levels of sunlight and shadow that will be received within neighbouring amenity space. The assessment has been carried out in accordance with BRE guidelines relating to the analysis of daylight, sunlight and overshadowing.



- 14.10.2 The assessment considers the scheme's effects on the levels of daylight and sunlight received by 245 windows and 129 windows respectively serving residential properties on Craneford Way, Egerton Road, Heathfield South, Court Way, Talma Gardens, Tayben Avenue and the Challenge Court Apartments. The chapter also considers the effects of the development on the levels of overshadowing experienced within 32 neighbouring gardens and areas of amenity space.
- 14.10.3 The following conclusions can be drawn from the daylight, sunlight and shadow assessment:
 - All of the 245 windows requiring assessment within neighbouring properties will comply fully with the BRE guide levels in terms of daylight (Vertical Sky Component). The effect of the development on the daylight conditions experienced at all neighbouring properties can be categorised as negligible.
 - Similarly, all of the 129 windows serving neighbouring properties that require assessment in terms of sunlight availability will comply fully with the BRE guide levels for annual sunlight with the development in place. The effect of the development on the annual sunlight levels experienced at all neighbouring properties can be categorised as negligible.
 - The results for winter sunlighting show that 126 of the 129 neighbouring windows requiring assessment in terms of sunlight availability will comply with the BRE guide levels for winter sunlight with the development in place (97.7% compliance). Three windows serving two neighbouring properties will experience a very isolated and marginal impact in terms of winter sunlight. The effects of the development on the majority of neighbouring properties (40 of the 42 neighbouring buildings assessed) in terms of winter sunlight are negligible. Two neighbouring properties (Nos. 15 and 19 Egerton Road) will experience a minor adverse effect, though the magnitude of this effect is highly isolated and extremely marginal.
 - The results of the overshadowing analysis show that the development will comply with the BRE guidance for all of the existing neighbouring gardens/amenity spaces assessed in the vicinity of the site. The effects of the development in this regard will again be negligible.
 - An internal analysis has been undertaken for notional residential accommodation within the outline development proposals and the gardens and open spaces within the development. This exercise has demonstrated that the outline proposals provide a good basis from which to deliver residential accommodation and open spaces that will experience good levels of interior daylight, sunlight availability and sunlight on ground in the context of the BRE guidance.

14.10.4 Overall, the development's full (100%) compliance with the BRE guide levels for VSC,



annual sunlight availability and sunlight on ground in relation to neighbouring properties is exceptional for an urban development project and the level of compliance with the guide levels for winter sunlight is very high.

The analysis has also shown that the proposed residential accommodation and open/amenity spaces within the development would achieve good levels of natural light (subject to detailed design and landscaping at the reserved matters stage).

14.10.5 It is, therefore, concluded that the proposed development will not give rise to any materially unacceptable environmental impacts in terms of daylight, sunlight and overshadowing in the context of the BRE guidelines and relevant planning policy.



15 ECOLOGY

15.1 INTRODUCTION AND KEY ISSUES

- 15.1.1 This chapter describes the likely ecology effects of the proposed Richmond Education and Enterprise Campus (REEC) development at Richmond upon Thames College (RuTC) in Twickenham, within the London Borough of Richmond upon Thames (LBRuT).
- 15.1.2 The potential ecology and nature conservation issues are considered to be:
 - Impacts on the River Crane and the Duke of Northumberland's river and associated designated sites as a result of construction activities and increased recreational use;
 - Loss of and disturbance to vegetation affecting bird (nesting) and bat (commuting and foraging) activity, particularly on the College playing fields by the A316 and south of Craneford Way; and
 - Potential for species enhancements through habitat provision within the outline design.

15.2 CONSULTATION

- 15.2.1 The Scoping Opinion received from LBRuT and subsequent correspondence with Tasha Hunter, LBRuT Ecology Policy and Planning Officer, specified the requirement for targeted reptile surveys to be undertaken in support of the scheme. However, it was subsequently clarified that the area of concern where reptiles may be present is Craneford Way West playing fields, which lie outside the proposed development boundary. Therefore, it was agreed with Tasha Hunter that no reptile surveys were required to be undertaken in support of the REEC development, and that only if the proposals were revised in the future to include this area, would targeted reptile surveys be required.
- 15.2.2 Meetings with the Friends of the River Crane (FORCE) centred on potential enhancements that the REEC development could provide, in line with the Crane Valley Guidelines¹. Restoration of the reach of the River Crane bordering the College's landholding (along the College playing fields) could be undertaken as part of the scheme but after discussion with both FORCE and the Environment Agency, it was considered that it would be more appropriate for REEC to provide a contribution to support the Environment Agency's planned programme of improvement works within the Crane catchment, as set out in the River Basin Management Plan. This was because any works to the river would affect the existing flood defences, could be

¹ Crane Valley Planning Guidelines SPG April 2005



superseded by the forthcoming restoration programme, and could therefore be redundant. A contribution could be used by the Environment Agency to undertake feasibility studies on the optimum restoration programme and could also attract match funding. This is discussed further in Chapter 18 - Socio-economics.

15.2.3 Discussions were also held with FORCE on ecological enhancements that the scheme could provide and those included within the REEC development are described in the 'Mitigation Measures' sub-sections in Section 15.7.

15.3 LEGISLATION AND PLANNING POLICY

International/European

EU Habitats (92/43/EEC) and Birds (2009/147/EC) Directives

15.3.1 These Directives are enacted in the UK through The Conservation of Habitats and Species Regulations (2010) as amended², including the Conservation of Habitats and Species (Amendment) Regulations (2012). They provide protection for sites, habitats and species that are of conservation importance at the European or international level and provide the framework for the designation and protection of 'European sites', including Special Protection Areas and Special Areas of Conservation. The Regulations also provide legislative protection to species, identified as 'European Protected Species' identified in Schedule 2 of the Regulations. The level of protection and presence of European Protected Species on the Site is documented in the Extended Phase 1 Habitat survey and species survey reports (see **Appendices 15.1** to **15.3**).

National

The Wildlife and Countryside Act (1981), as amended

15.3.2 The Act provides the principal means by which wildlife is protected at a national level. The Act enables the identification and protection of Sites of Special Scientific Interest, provides protection to all wild birds (with additional protection to certain species of birds) and protection to certain species of animal and plants identified in the Schedules of the Act. The level of protection afforded to specific species of animal and plant, and their distribution on the Site, is documented in the Extended Phase 1 Habitat survey and species survey reports (see **Appendices 15.1** to **15.3**).

The Natural Environment and Rural Communities (NERC) Act (2006)

15.3.3 The Act places a duty on public bodies and statutory undertakers to ensure due

 $^{^{2}}$ The Conservation of Habitats and Species Regulations 2010 (as amended) transpose Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.



regard is given to the conservation of biodiversity. Section 41 of the Act also requires the Secretary of State to identify a list of habitats and species which are considered to be of principal importance for the conservation of biodiversity in England. These lists have been derived largely from the earlier UK BAP habitats and species lists.

The Countryside and Rights of Way (CRoW) Act (2000)

15.3.4 The Act strengthened the Wildlife and Countryside Act 1981 (as amended) in relation to the protection afforded to Sites of Special Scientific Interest and placed an obligation for protection of threatened species.

National Planning Policy Framework (NPPF) (2012)

- 15.3.5 National planning policy guidance in relation to ecology and nature conservation is provided through NPPF³, with planning practice guidance provided by the Department for Communities and Local Government⁴. The NPPF sets out the Government's planning policies on the conservation and enhancement of the natural environment.
- 15.3.6 Chapter 11 Conserving and enhancing the natural environment, paragraph 109, page 25 states:

'the planning system should contribute to and enhance the natural and local environment by:

- *recognising the* wider *benefits of ecosystem services*
- minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures'.
- 15.3.7 Chapter 11 Conserving and enhancing the natural environment, paragraph 111, page 26 states:

'planning policies and decisions should encourage the effective use of land by reusing land that has been previously developed (brownfield land), provided that it is not of high environmental value'.

15.3.8 In the determination of planning applications, the NPPF requires local planning authorities to aim for the conservation and enhancement of biodiversity and not just avoidance of impact. Chapter 11 Conserving and enhancing the natural environment,

³ Department for Communities and Local Government (2012) National Planning Policy Framework.

⁴ Department for Communities and Local Government (2014) *Planning Practice Guidance - Natural Environment, Biodiversity, Ecosystems and Green Infrastructure.* Accessed through http://planningguidance.planningportal.gov.uk on 01/10/2014.



paragraph 118, page 27 states:

- 'if significant harm resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused;
- opportunities to incorporate biodiversity in and around developments should be encouraged⁵;
- planning permission should be refused for development resulting in the loss or deterioration of irreplaceable habitats, including ancient woodland and the loss of aged or veteran trees found outside ancient woodland, unless the need for, and benefits of, the development in that location clearly outweigh the loss.'

UK Post-2010 Biodiversity Framework

15.3.9 The UK Post-2010 Biodiversity Framework was published on 17 July 2012. This addresses the changes in the strategic thinking of the Convention on Biological Diversity's Strategic Plan for Biodiversity 2011-2020. The Framework includes new priorities for UK-level work for the Convention on Biological Diversity and provides a broad structure to enable action across the UK between 2012 and 2020. The framework identifies the activities required to complement the country biodiversity strategies, and where work in the country strategies contributes to international obligations. The Framework replaces the previous UK Biodiversity Action Plan (UK BAP), though the lists of priority species and habitats agreed under UK BAP still form the basis of much biodiversity work in the UK6 and informed the lists of species and habitats of principal importance found in the NERC Act Section 41.

Other Legislation

15.3.10 Environmental Damage (Prevention and Remediation) Regulations (2009):

The regulations 'impose obligations on operators of economic activities requiring them to prevent, limit or remediate environmental damage caused by their operations'.

15.3.11 Water Environment (Water Framework Directive) (England and Wales) Regulations (2003):

UK Regulations enacting the Water Framework Directive (WFD) which commits

⁵ Biodiversity enhancements are identified in the planning practice guidance as comprising habitat restoration, re-creation and expansion, improvement to links between existing sites, buffering of existing important sites, creation of new biodiversity features within a development and securing management for long-term enhancement.

⁶ Natural England (2014) *Habitats and species of principal importance in England*. Accessed through www.naturalengland.org.uk on 01/10/2014.



EU member states to achieve good qualitative and quantitative status of all water bodies (including marine waters up to one nautical mile from shore) by 2015.

Regional

The London Plan - Spatial Development Strategy for London Consolidated with Alterations since 2011 (2015)

- 15.3.12 The key policies from the adopted London Plan of relevance to ecology for the development are detailed below.
- 15.3.13 Policy 2.18 Green infrastructure: the multi-functional network of green and open spaces, page 94-97 states:

'the Mayor will work with all relevant strategic partners to protect, promote, expand and manage the extent and quantity of, and access to, London's network of green infrastructure'. To achieve this, development proposals are required to 'incorporate appropriate elements of green infrastructure that are integrated into the wider network'; and 'encourage the linkage of green infrastructure including the Blue Ribbon Network, to the wider public realm to improve accessibility for all and develop new links utilising green chains, street trees, and other components of urban greening'

15.3.14 Policy 5.10 Urban Greening, page 202 states:

'the Mayor will promote and support urban greening, such as new planting in the public realm (including streets, squares and plazas) and multifunctional green infrastructure, to contribute to the adaptation to, and reduction of, the effects of climate change'. To achieve this, development proposals should integrate green infrastructure from the outset, which can include tree planting, green roofs and walls, and soft landscaping.

15.3.15 Policy 5.11 Green roofs and development site environs, page 203 states:

'major development proposals should be designed to include roof, wall and site planting, especially green roofs and walls where feasible, to deliver..' a number of objectives relating to climate change resilience/adaptation, sustainable urban drainage, enhancement of biodiversity and visual appearance among others.

15.3.16 Policy 5.13 Sustainable drainage, page 205 states:

'development should utilise sustainable urban drainage systems (SuDS), unless there are practical reasons for not doing so'. Although biodiversity is not a principal objective relating to the use of SuDS, the policy identifies that they should be delivered in such a way that contributes to biodiversity objectives in the London Plan.



15.3.17 Policy 7.19 Biodiversity and access to nature, page 306 – 309 states:

'wherever possible, make a positive contribution to the protection and enhancement, of biodiversity.....prioritise assisting in achieving targets in BAPs.....and/or improving access to nature in areas deficient in accessible wildlife sites.....not adversely affect the integrity of European sites and be resisted where they have significant adverse impact on European or nationally designated sites or on the population or conservation status of a protected species or a priority species or habitat identified in a UK, London or appropriate regional BAP or borough BAP'.

15.3.18 With regards to Sites of Importance for Nature Conservation, development proposals are required to:

'give strong protection to sites of metropolitan importance for nature conservation (SMIs). These are sites jointly identified by the Mayor and boroughs as having strategic nature conservation importance; and.....give sites of borough and local importance for nature conservation the level of protection commensurate with their importance'.

- 15.3.19 The policy identifies the hierarchy as set out below when a development could affect directly, indirectly or cumulatively a site of recognised nature conservation interest:
 - '1 avoid adverse impact to the biodiversity interest;
 - *2 minimise impact and seek mitigation; and*
 - 3 only in exceptional cases where the benefits of the proposal clearly outweigh the biodiversity impacts, seek appropriate compensation.'
- 15.3.20 Policy 7.21 Trees and woodlands, page 310 states:

'trees and woodlands should be protected, maintained and enhanced, following the guidance of the London Tree and Woodland Framework'.

- 15.3.21 To achieve this, existing trees of value should be retained and any loss as the result of development should be replaced following the principle of 'right place, right tree' and the planting of additional trees should be incorporated where appropriate.
- 15.3.22 In addition to these protective policies, the London Plan includes policies that have the potential to protect or require an increase in features of ecological or nature conservation value. These are discussed above.



The London Biodiversity Action Plan (BAP)

15.3.23 The London BAP provides a framework for the conservation and enhancement of biodiversity features across Greater London. The BAP provides important information as it identifies the ecological resources within the region that require consideration to protect or recover their conservation status. Details of the habitats and species included in the London BAP, and those present on the Site, are identified in the Extended Phase 1 Habitat survey (see **Appendix 15.1**).

Local

15.3.24 Local planning policy for the site is provided in the London Borough of Richmond upon Thames Local Development Framework Core Strategy⁷ and Development Management Plan⁸, which provides more detailed policies that build on those of the Core Strategy. The site falls outside the Twickenham Area Action Plan, which provides a framework for the revitalisation of the commercial town centre.

London Borough of Richmond upon Thames Core Strategy (2009)

15.3.25 Chapter 8.1.4, Core Policy 4 Biodiversity, page 64 states:

'the Borough's biodiversity including the SSSIs and other Sites of Nature Importance will be safeguarded and enhanced. Biodiversity enhancements will be encouraged particularly in areas of deficiency (parts of Twickenham), in areas of new development and along wildlife corridors and green chains such as the River Thames and River Crane corridors'

- 15.3.26 The policy also identifies that 'weighted priority in terms of importance will be afforded to protected species and priority species and habitats in the UK, regional and Richmond upon Thames Biodiversity Action Plans'.
- 15.3.27 The Core Strategy includes two further policies that identify the requirement to safeguard and enhance areas with biodiversity forming part of the consideration.
- 15.3.28 Chapter 8.2.4, Core Policy 10 Open Land and Parks, page 92 states:

'the open environment will be protected and enhanced.....'green chains and corridors will be safeguarded and improved for biodiversity, sport and recreation and heritage, and for visual reasons'

15.3.29 Chapter 8.2.6, Core Policy 12 River Crane Corridor, page 99 states:

⁷ London Borough of Richmond upon Thames (2009) London Borough of Richmond upon Thames Local Development Framework Core Strategy.

⁸ London Borough of Richmond upon Thames (2011) London Borough of Richmond upon Thames Local Development Framework Development Management Plan.



'the Council will improve the strategic corridor to provide an attractive open space with improvements to the biodiversity'. The policy identifies an intention to improve the habitat linkage along the River Crane between Hounslow Heath and Twickenham Station to form the Crane Riverside Park.

London Borough of Richmond upon Thames Development Management Plan (2011)

- 15.3.30 The plan sets out the key principles that should be considered in new development proposals.
- 15.3.31 Policy DM OS 5, page 42 states:

'preserve and where possible enhance existing habitats including river corridors and biodiversity features, including trees.....enhance existing and incorporate new biodiversity features and habitats into the design of buildings themselves as well as in appropriate design and landscaping schemes with the aim to attract wildlife and promote biodiversity, where possible;.....use native species in the design of new habitats and biodiversity features and incorporate consideration of adaptability to the likely effects of climate change;.....and;.....incorporate habitats and biodiversity features that make a positive contribution to and integration and link to the wider green and blue infrastructure network, including de-culverting rivers, where possible'. The Development Management Plan includes additional policies that are of relevance to ecology and nature conservation.

15.3.32 Policy DM SD 5, page 20 states:

'Living roofs should be incorporated into new developments where technically feasible and subject to considerations of visual impact. The onus is on the applicant/developer for proposals with roof plate areas of 100sqm or more to provide evidence and justification if a living roof cannot be incorporated. The aim should be to use at least 70% of any potential roof plate area as a living roof.

15.3.33 Policy DM DC 4, page 120 states:

'The boroughs trees and landscape will be protected and enhanced by....the use of Tree Preservation Orders....planting and encouraging others to plant....continuing to maintain trees in streets and public open spaces....require landscape proposals in submissions for new development'.

London Borough of Richmond upon Thames Supplementary Planning Guidance: Nature Conservation and Development

15.3.34 This provides guidance on the retention of existing site features (e.g. trees and



hedges) and advice on design of new planting and maintenance plans.

Crane Valley Planning Guidelines (2005)

15.3.35 This provides guidance for developers at four sites in the Crane Valley, including the College. The Guidelines state that the quality of the open spaces and rivers, including the West London Green Chain, should be improved and nature conservation interest and biodiversity enhanced.

Richmond Upon Thames Biodiversity Action Plan (2014)

15.3.36 This identifies the ecological resources within the Borough that require consideration to protect or recover their conservation status.

15.4 ASSESSMENT METHODOLOGY

15.4.1 This chapter has been completed with principal reference to the Chartered Institute of Ecology and Environmental Management (CIEEM) guidelines on Ecological Impact Assessment (EcIA)⁹. CIEEM is currently reviewing and updating its EcIA guidelines, however as there is no estimated date for completion, and until the revised version has been published, the current guidelines remain valid and have therefore been used for this assessment.

Evaluation of Effects

Determining Ecological Value

- 15.4.2 Guidance provided by CIEEM has been used to determine the ecological value of the Site and ecological receptors identified. When assigning value to an ecological feature or resource, the following considerations have been taken into account:
 - Geographical context of the site, for example international, UK, national, regional, metropolitan, borough and local;
 - Designated sites and features, such as Sites of Importance for Nature Conservation, Tree Preservation Orders (TPOs), important hedgerows, National and Local Nature Reserves (NNRs and LNRs);
 - Biodiversity value, BAPs, including Habitat and Species Action Plans, rare or uncommon species, endemic species, notably large populations considered uncommon or threatened in a wider context, habitat diversity and connectivity;
 - Potential value of a feature. For example, if targets are in place for a Site of Special Scientific Interest to meet 'favourable conditions' this should be the benchmark against which impacts are assessed. Similarly, for BAPs, Habitat

⁹ Institute of Ecology and Environmental Management (2006) *Guidelines for Ecological Impact Assessment in the United Kingdom* (version 7 July 2006).



Action Plans and Species Action Plans, if a detailed management plan is in place and the chance of failure is low, the site should be valued as if the intended resource already exists;

- Secondary or supporting value of the feature, i.e. they may not be of any particular ecological interest but they may perform an ecological function. For example, an area of scrub may be included in a Site of Special Scientific Interest (SSSI) for calcareous grassland because it provides a buffer between agricultural spraying on adjacent farmland;
- Social value of the feature which is used and enjoyed by many people, e.g. sites that provide the only visual and/or physically accessible area of semi-natural greenspace for a local community;
- Economic value of the feature such as the profit made from visits to a bird hide and angling; and
- Legal protection for both sites and species.
- 15.4.3 It is important to distinguish between the *biodiversity value* of a receptor and its *legal* status. Features of high *biodiversity value* may not necessarily attract *legal protection* and vice versa. For example, a viable area of ancient woodland is likely to be considered of high biodiversity value even if it does not receive any formal statutory designation.
- 15.4.4 In accordance with CIEEM guidelines, each biodiversity feature is assessed as valuable, or potentially valuable, based on the following geographic frame of reference. Some examples of ecological receptors that may be potentially valuable at each geographic scale are presented in **Table 15.1**.
- 15.4.5 It should be noted that this method of assigning value is relatively straightforward for sites/habitats formally designated at each geographical level. However, the assigning of values to non-designated habitats and species is more challenging and requires a greater degree of subjective professional judgement, using the limited available data on that receptor's conservation status (e.g. distribution, rarity, trends) at each scale. Some reliance on national and local consensus in the form of agreed lists of biodiversity priorities (e.g. NERC Act Section 41 and local BAPs) is made in order to reflect such consensus and current policies.
- 15.4.6 In addition to determining value, in line with CIEEM guidelines, where it is appropriate to consider the social/community or economic value of a receptor, an appropriate level of value will be attributed within the identified geographical scale.



Value	Example Criteria
International	An internationally designated site or candidate site, i.e. a Special Protection Area (SPA), proposed SPA (pSPA), Special Area of Conservation (SAC), candidate SAC (cSAC), Ramsar site, or an area which would meet the published selection criteria for such designation.
	Other significant areas of Annex I priority habitats listed in the Habitats Directive, the loss of which would significantly change the overall range and area at the European scale in the long term.
	Internationally significant populations of European Protected Species, Annexe II (Habitats Directive) species, or species otherwise formally deemed to be globally rare and threatened (e.g. IUCN 'red-listed'), the loss of which would significantly change the species' overall conservation status (i.e. range, abundance, population trend) at the European scale.
	A nationally designated site, i.e. SSSI, NNR or discrete area which would meet the published selection criteria for national designation (e.g. SSSI selection guidelines).
National (England)	A significant area of a non-designated habitat identified in the NERC Act 2006, Section 41 as being of principal importance for the conservation of biodiversity in England, the loss of which would significantly change the overall range and area of that habitat at the national scale in the long term. Such habitat should be a major component of areas that are at near-equivalence to SSSIs, meeting most of the published SSSI selection criteria.
	Nationally significant populations of species identified in the NERC Act 2006 Section 41 as being of principal importance for the conservation of biodiversity in England, or otherwise formally deemed to be nationally rare and threatened (e.g. 'red-listed'), the loss of which would significantly change the species' overall conservation status (i.e. range, abundance, population trend) at the national scale.
Regional (South East)	A significant area of a non-designated habitat identified in the NERC Act 2006, Section 41 as being of principal importance for the conservation of biodiversity in England, the loss of which would significantly change the overall range and area of that habitat at the regional scale in the long term. Significant areas of semi-natural ancient woodland that do not meet the 'National' value criteria (above) should be considered at this regional scale due to the irreplaceable nature of such habitat.
	Regionally significant populations of species identified in the NERC Act 2006 Section 41 as being of principal importance for the conservation of biodiversity in England, or otherwise formally deemed to be nationally rare and threatened (e.g. 'red-listed'), the loss of which would significantly change the species' overall conservation status (i.e. range, abundance, population trend) at the regional scale.

Table 15.1 Criteria for Assessing Ecological Value



Value	Example Criteria
Metropolitan/ County (Greater London)	Sites formally recognised by local authorities, e.g. Sites of Metropolitan Importance for Nature Conservation (SMINC), or considered to meet published ecological selection criteria for such designation.
	A significant area of a non-designated habitat identified in the NERC Act 2006, Section 41 as being of principal importance for the conservation of biodiversity in England, the loss of which would significantly change the overall range and area of that habitat at the greater metropolitan scale in the long term. A significant area of key habitat identified in the London BAP.
	Significant populations of species identified in the NERC Act 2006 Section 41 as being of principal importance for the conservation of biodiversity in England, or otherwise formally deemed to be nationally rare and threatened (e.g. 'red-listed'), the loss of which would significantly change the species' overall conservation status (i.e. range, abundance, population trend) at the metropolitan scale. Significant and viable populations of other species identified as metropolitan priorities in the London BAP.
	Sites formally recognised by local authorities, e.g. Sites of Borough Importance for Nature Conservation (Borough/Local SINC), LNRs, or considered to meet published ecological selection criteria for such designation.
Borough/ District (Richmond upon Thames)	A significant area of a non-designated habitat identified in the NERC Act 2006, Section 41 as being of principal importance for the conservation of biodiversity in England, the loss of which would significantly change the overall range and area of that habitat at the greater district/borough scale in the long term. A significant and viable area of habitat identified in the District BAP.
	Significant populations of species identified in the NERC Act 2006 Section 41 as being of principal importance for the conservation of biodiversity in England, or otherwise formally deemed to be nationally rare and threatened (e.g. 'red-listed'), the loss of which would significantly change the species' overall conservation status (i.e. range, abundance, population trend) at the district/borough scale. Significant and viable populations of other species identified in the LBRuT BAP.
Local/Parish	A small area of a non-designated habitat identified in the NERC Act 2006, Section 41 as being of principal importance for the conservation of biodiversity in England, the loss of which would change the overall range and area of that habitat only at the local/parish scale in the long term.
	Species identified in the NERC Act 2006 Section 41 as being of principal importance for the conservation of biodiversity in England, or otherwise formally deemed to be nationally rare and threatened (e.g. 'red-listed'), the loss of which would significantly change the species' overall conservation status (i.e. range, abundance, population trend) only at the local/parish scale.
	Other areas of semi-natural vegetation able to support a range of species, but which due to their size or quality are not considered to meet higher valuation criteria.
Within the immediate survey area only	Areas of habitats and/or species populations of limited ecological importance due to their size, species composition or lack of threat/rarity. Where the loss of such a feature would have no discernible impact on the species'/habitat's overall range and conservation status at any administrative scale in the long term.

Table source: CIEEM Ecological Impact Assessment Guidelines (2006).

Threshold for Receptor Inclusion

15.4.7 The starting point for any impact assessment is to determine which ecological features are of sufficient value to be included in the assessment, with CIEEM guidelines recommending this approach to ensure attention is focussed on those receptors that are susceptible to impact. Therefore, the thresholds for inclusion



within the impact assessment are defined as:

- Any sites, habitats or species that are considered of at least local biodiversity value; and
- Sites, habitats and/or species that receive legal protection.

Predicting and Characterising Ecological Impact

- 15.4.8 Once values have been assigned to ecological features and those of sufficient value for inclusion have been identified, an assessment of the impacts likely to affect the features is undertaken. The identification of impacts refers to ecological structure and function and the impacts are assessed in the context of the predicted baseline conditions during the lifetime of the development. The characterisation of impacts is completed with reference to the following criteria:
 - Positive or negative;
 - Magnitude the 'size' or 'amount' of an impact expressed in quantitative terms where possible;
 - Extent the area over which an impact may occur;
 - Duration the time for which an impact is expected to last;
 - Reversibility whether effects are permanent or temporary. A permanent impact is one that is irreversible within a reasonable timescale or for which there is no reasonable chance of action being taken to reverse it. A temporary impact is one from which short-term recovery is possible; and
 - Timing and frequency whether impacts are constant and on-going, separated but recurrent or single events and whether they occur during critical seasons of life-stages of flora and fauna.
- 15.4.9 The likelihood that an effect and its resultant changes to the ecological feature will occur as predicted and the degree of confidence in the assessment of the effect on ecological structure and function is assessed using the four-point scale identified in CIEEM guidelines:
 - *Certain/near certain:* probability estimated at 95% chance or higher
 - *Probable*: probability estimated above 50% but below 95%
 - *Unlikely:* probability estimated above 5% but below 50%
 - *Extremely unlikely*: probability estimated at less than 5%.

Significance of Effects

15.4.10 The ecological significance of the effect is defined by CIEEM guidelines as 'an effect (positive or negative) on the 'integrity' of a defined site or ecosystem and/or the conservation status of habitats and species within a given geographical area'.

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15.4.11 *'Integrity*' is defined in the Government Circular: Biodiversity and Geological Conservation as:

'The integrity of a site is the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or levels of populations of the species for which it was classified'.

- 15.4.12 *'Conservation status'* is defined by CIEEM (2006) using a modified version of the Habitats Directive Article 1 definition as follows. For a habitat, conservation status is determined by the sum of influences that may affect its long-term distribution, structure and functions as well as the survival of its typical species within a given geographical area. For a species, conservation status is determined by the sum of influences that may affect its long-term distribution and abundance of populations within a given geographical area.
- 15.4.13 The biodiversity value of each feature is used to inform the geographical scale at which the effect could be significant. Potential effects are considered on the basis of how they will affect a receptor and at what scale the impact is likely to occur. An effect can therefore be assessed as significant at a lower scale than the receptor's biodiversity value.
- 15.4.14 The CIEEM methodology therefore departs from other standard EIA methods in that it does not require the significance to be categorised as 'Major', 'Moderate' or 'Minor'. All that is recommended is that the impact is assessed as either significant or not significant at the geographical scale which it has been valued (or in some cases lower). This then allows decision-makers to consider such impacts in relation to policy set at the relevant geographical scale.
- 15.4.15 This departure from other standard EIA methods of impact categorisation can make comparison between topics difficult, therefore **Table 15.2** provides a means of translating the CIEEM impact categories into more traditional EIA categories.
- 15.4.16 Although CIEEM's EcIA guidelines do not recommend such approach for assessment, it has been included to provide a guide as to how the scale of effect compares to effects identified in other chapters of the ES. The table has been used as a guideline, with professional judgement applied to ensure an appropriate impact significance is described.



Table 15.2 Significance Categories

EcIA Impact Significance (CIEEM 2006)	Equivalent EIA Effect Significance
International significance	Major
National significance	Major
Regional significance	Major
Metropolitan significance	Moderate
Borough/District significance	Moderate
Local/Parish significance	Minor
Significant only within immediate survey area	Negligible

Limitations of Assessment

- 15.4.17 Due to the outline nature of the application, full detailed design information is not available. The Primary Control Documents (set out in Chapter 5 The Proposed Development) for the OPA have been used to enable assessment of impacts on ecological features, primarily the Parameter Plans which set out the maximum limits of development (**Appendix 5.1**). The assessment presented in this chapter has therefore been undertaken on a worst-case basis.
- 15.4.18 Parameter Plans PL-03 and PL-04 (**Appendix 5.1**) identify the proposed development zones and building zones, from which the likely impacts such as land take associated with the development works have been identified. Parameter Plan PL-02 provides information on the proposed access routes, as do Detailed Access Plans (**30713/AC/038; 30713/AC/040; 30713/AC/041; 30713/AC/042**) and these form the basis on which impacts associated with operational lighting have been considered. Parameter Plan PL-16 sets out the extent of the proposals for the College playing fields south of Craneford Way. The phasing plans (**Appendix 6.1**) were used in the assessment of construction impact.
- 15.4.19 The Illustrative Masterplan (Figure 5.1 in Chapter 5) and Illustrative Landscape Plan (Figures 5.2 and 5.3 in Chapter 5) were also considered in the assessment. They provide further detail with regards to the potential for ecological mitigation measures such as living roofs and landscaping, as discussed in 'Mitigation Measures' sub-sections in Section 15.7. There is a limitation in that these plans are illustrative only, but they serve to demonstrate how the ecological mitigation and enhancement measures identified in this chapter could be incorporated into the as built scheme. Ecological input into the development of the scheme design, which is captured in these plans, is described in Chapter 4 Alternatives and Design Evolution.



15.5 BASELINE

Introduction

- 15.5.1 The ecological baseline has been established through the collation of desk-based information and completion of field surveys, including an Extended Phase 1 Habitat survey and detailed species surveys for breeding birds, bats and terrestrial invertebrates. An initial baseline for the Site is presented in the Extended Phase 1 Habitat survey report (**Appendix 15.1**), which also presents the findings of an initial desk-based study and background data request from Greenspace Information for Greater London (GIGL). Additional baseline information from targeted species surveys are presented in the individual species reports (**Appendix 15.2** for breeding birds and bats and **Appendix 15.3** for terrestrial invertebrates).
- 15.5.2 The extent of the study area has been determined using professional judgement to ensure all potential effects likely to arise from the development are considered. A standard 2km study area surrounding the development site has been used for the desk-based identification of statutory and non-statutory designated sites, important habitats and records of legally protected and ecologically significant species. The field survey areas sit within this study area and include areas within and immediately adjacent to the Application Site boundary.

Current Baseline

Designated Sites

15.5.3 Five non-statutory designated sites in the potential zone of influence of the scheme were identified as requiring consideration as part of the Ecological Impact Assessment, as identified in **Table 15.3** and **Figure 15.1**. A number of additional statutory and non-statutory designated sites were identified within the study area, as identified in the Extended Phase 1 Habitat survey report (**Appendix 15.1**), however, these were scoped out of the assessment as no pathways for impacts were identified at the Scoping stage of the EIA, and therefore, these sites have not been taken forward for further assessment in the ES.



Non-Statutory	Proximity to	Designation Criteria
Designated Site	Site (m)	
Crane Corridor SMINC Metropolitan biodiversity value	450m south- west	Along its 5km length, the River Crane is bordered by habitats of remarkable diversity including woodland, dry pastures, water meadows, and areas of open water. The river is one of the most natural in London and a stronghold for uncommon wetland plants, as well as supporting willow-alder woodland in the riparian habitat in several places. The site supports a rich breeding bird community and water voles inhabit parts of the watercourse.
Duke of Northumberland's River north of Kneller Road Borough I SINC Borough biodiversity value	150m north	The site supports excellent aquatic and diverse marginal vegetation. The watercourse has improved significantly in recent years for wildlife, with increases in vegetation cover providing habitat opportunities for birds, fish and invertebrates.
Duke of Northumberland's River south of Kneller Road Borough II SINC Borough biodiversity value	30m west	The site supports important marginal vegetation including uncommon species for London. Kingfishers are commonly seen, feeding on the abundant fish population present.
River Crane at St. Margarets Borough II SINCs Borough biodiversity value	200m north-east	The site includes the River Crane, which is divided into two channels lined with trees and shrubs. The watercourse in this location frequently supports kingfisher.
Twickenham Junction Rough Local SINC Borough biodiversity value	10m south- east	The site comprises an island of undisturbed habitat in between railway lines, with a mixture of rough grassland, tall herbs, scrub and young woodland present. On the north side of the railway, opposite the island, is an area of mature woodland and old brick walls that support an interesting fern community that includes three species scarce in London.

Table 15.3 Designated Nature Conservation Sites in the Study Area





Duke of Northumberland's River

15.5.4 The Duke of Northumberland's River also provides a wildlife corridor, running to the west of the development site just beyond the site boundary. Although the watercourse is characterised by its urban context, with a straight plan-form and modified bank profiles, it has greater biodiversity value than the River Crane. The river has areas of natural bank substrate and supports a greater depth of water across its length, resulting in improved habitat provision for aquatic flora and fauna. The improved conditions are reflected in the designation of this reach and downstream as Borough SINCs. Therefore, the watercourse is considered to be of biodiversity value at the **borough scale**.

Twickenham Junction Rough

- 15.5.5 The habitat on the opposite side of the River Crane comprises part of the Twickenham Junction Rough SLINC, with the habitats present identified as part of the ecological assessment of a separate planning application (13/1147/FUL)¹⁰.
- 15.5.6 The habitat to the western end of this area is predominantly comprised of dense scrub and trees, in particular associated with the site margins and boundary fencing, with bramble thicket and tall herb vegetation extensively present. The habitats present are not considered to be of particular interest botanically, are common habitats locally and nationally and are not considered to comprise part of any BAP habitat. However, the ecological function of the habitats contribute to the SLINC designation of the area (and are therefore considered as part of this designation), and provide an area of undisturbed semi-natural habitats which are considered to hold value at the **borough scale**. At present these habitats are not easily accessible because the footpath proposed as part of the separate planning application for Twickenham Rough is not yet in place.

Habitats

- 15.5.7 The habitats on site were assessed following the Extended Phase 1 Habitat survey methodology¹¹, with the survey completed in suitable weather conditions on 15 April 2014 by an experienced ecological surveyor holding full membership of CIEEM (MCIEEM).
- 15.5.8 The Site is dominated by the existing College buildings and associated facilities, including amenity and recreational areas. Although typically of lower value, the

¹⁰ Aspect Ecology (2013) Land to the West of the former Royal Mail Sorting Office, Twickenham, Ecological Assessment. June 2013.

¹¹ Joint Nature Conservation Committee (2007) *Handbook for Phase 1 Habitat survey - A Technique for Environmental Audit.* Peterborough, UK.



grassland and scrub habitats within the College grounds have the potential to provide supporting value to a number of faunal species, whilst the River Crane at the southern boundary of the site provides a wildlife corridor that links semi-natural habitats upstream to the River Thames downstream. The following section summarises the habitats found on site along with an assessment of their value. Full details of the habitats recorded by the survey are provided within the Extended Phase 1 Habitat survey (see **Appendix 15.1**) and are presented in **Figure 15.2**.

15.5.9 The habitats on the Site are not considered likely to change before commencement of the development. The semi-natural habitats are either well developed, for example the broadleaved woodland alongside the River Crane, or regularly managed, for example the poor semi-improved and amenity grassland habitats.

River Crane

- 15.5.10 A non-designated section of the River Crane runs along the southern boundary of the site and is typical of an urban river which has undergone significant modification for flood risk and drainage purposes, with over-deepening and straightening of the watercourse. The channel is a concrete open culvert with vertical concrete walls (that form flood defences) and it is devoid of vegetation with the exception of filamentous algae. The over-deepening of the reach has created a disconnect between the river and the riparian habitat, whilst the over-widening has resulted in a shallow base-flow water depth that is considered likely to be unsuitable for many species of fish. While there are some minor weirs which are unlikely to affect fish movement, the watercourse itself has little potential for supporting the movement of fish species along the watercourse. The watercourse does, however, provide a wildlife corridor for birds and small mammals and is part of a habitat type (rivers) listed under Section 41 of the NERC Act.
- 15.5.11 Therefore, within the survey area the river is considered to hold biodiversity value at the **local scale**. It is however noted that, despite the low value of habitat in the immediate vicinity, the river in the wider area does hold greater biodiversity value and supports a varied and diverse community, for example Kneller Gardens on the River Crane upstream of the College site.







Amenity Grassland

15.5.12 The amenity grassland is not considered to be ecologically valuable beyond the survey area, due to its poor species composition and limited biodiversity value. These areas are managed for public access but are not considered to comprise part of the metropolitan and local Urban Greenspace BAP habitat. Currently this habitat is considered to hold value **within the immediate survey area only**.

Broadleaved Semi-natural Woodland

15.5.13 Broadleaved semi-natural woodland is present in one small copse at the south west boundary of the Site alongside the River Crane and Craneford Way West playing field. The woodland is very small in extent, and may have been plantation originally; however the habitat has developed a more semi-natural appearance with a tall ruderal vegetation understorey for the most part. Although a relatively common habitat type and despite the small extent, it is considered to hold biodiversity value at the **local scale** as it provides supporting habitat in the urban context and is included in the local BAP.

Poor Semi-improved Grassland

15.5.14 A small area of poor semi-improved grassland was identified outside the western boundary of the Site at Challenge Court. The area of grassland is not mown and as a result has developed a greater floral diversity than the surrounding amenity grassland. The habitat is considered to contribute to the metropolitan and local Urban Greenspace BAP, and therefore is considered to hold biodiversity value at the **local scale**.

Scattered Trees

15.5.15 Scattered trees are present throughout the Site, principally along the boundaries of the College grounds and within amenity areas. Although scattered trees are typically of amenity value, mature species could hold significance for wildlife or landscape features as identified in the LBRuT BAP for parkland and veteran trees. As a result, the mature scattered trees along the northern and southern boundaries of the development area and those surrounding Challenge Court beyond the western boundary of the site are considered to comprise part of the LBRuT BAP habitat and are considered to hold value at the **local scale**.

Species

<u>Notable Flora</u>

15.5.16 Wall cotoneaster Cotoneaster horizontalis was identified as present during the


Extended Phase 1 Habitat survey and noted in the GIGL data request. The species, listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended), is an invasive non-native species, and was identified throughout the survey area as part of the landscape planting within the College grounds and adjacent car parking. Further survey of the species was not considered necessary and, as an invasive species, it is considered to hold **negligible** biodiversity value. However, due to its invasive non-native species status, it has been considered further within this chapter.

15.5.17 No other notable flora is likely within the scheme's zone of influence due to the relatively common habitats present.

<u>Birds</u>

- 15.5.18 As part of the desk-based assessment, the Friends of the River Crane Environment provided a list of bird species that are commonly present along the River Crane corridor, including many species protected under Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) or referenced in local, regional or national policy (see Table A15.2 in Appendix 15.1). GIGL also returned a number of legally protected bird species present within the study area (see Table A15.3 in Appendix 15.1).
- A breeding bird survey was completed on the Site over three repeat visits in June and 15.5.19 July 2014. The survey was completed following a standardised breeding bird survey methodology¹², with a survey route planned to come within at least 25m, and typically 5m or less, of all tree, woodland and scrub habitats on the site. The location of the survey route to open habitats, such as grassland, was considered to be less critical as bird species utilising these habitats are more easily visible. Furthermore, during the breeding season bird species are more often associated with woodland and scrub vegetation. The survey route was walked slowly, with frequent stops, during the main activity period of the day and all species seen and heard identified and recorded on field maps using the BTO two-letter code nomenclature. The approach is detailed, along with the results, in the breeding bird survey report (see Appendix 15.3). The main areas of value for breeding birds comprise the peripheral vegetation around and adjacent to the Site, notably the grassland area of Challenge Court, mature tree line along the western boundary of the College site and the semi-natural habitat bordering the playing fields and watercourses (see Figure 15.3). These areas were utilised by the majority of species.

¹² Gilbert, G., Gibbons, D. W. and Evans, J. (1998) *Bird Monitoring Methods: a manual of techniques for key UK species*. RSPB, Sandy, Bedfordshire.