11 Water resources, flooding and drainage

Introduction

11.1 This chapter has been prepared by WSP Environmental and assesses the effect of the proposed development on drainage, flooding and water resources. In particular, it considers the potential effects on surface and foul drainage systems, potable water demand, water bodies and flood risk on site, in the vicinity of and downstream of the site during the construction phase and the post-construction phase of the proposed development.

11.2 Where appropriate, mitigation measures to prevent, minimise or control the potential adverse effects are presented and residual effects following the adoption of those measures are assessed.

11.3 Potentially significant effects to groundwater and degradation to surface water quality due to chemical contamination are addressed within chapter 10: geology, hydrogeology and contamination.

Legislation and policy

Legislative framework

11.4 The applicable legislative framework is summarised as follows:

- Environmental Protection Act (EPA) 1990 (ref. 11.1 in table 11.1) - Part IIA of the Environmental Protection Act 1990 describes a regulatory role for local authorities in dealing with contaminated land
- Water Industry Act, 1991 (ref. 11.2) - consolidates enactments relating to the supply of water and the provision of sewerage services
- The Water Resources Act 1991 (ref. 11.3) - sets out the regulatory controls and restrictions that provide protection to the water environment through controls on abstraction, impounding and discharges, as well as identifying water quality and drought provisions
- Land Drainage Act 1991 (ref. 11.4) - consolidates enactments relating to internal drainage boards and the functions of these boards and of local authorities in relation to land drainage. Internal Drainage Boards (IDB) exercise a general supervision over all matters relating to the drainage of land within their district and they have powers to perform duties imposed on them within the Act
- Land Drainage Act 1994 (ref. 11.5) - adds new environmental duties to the Land Drainage Act 1991. It places a duty on the IDB and local authorities to further the conservation and enhancement of natural beauty and the conservation of flora, fauna and geological or physiographical features of special interest; and to take into account any effect that the proposed development would have on the beauty or amenity of any rural or urban area or on any such flora, fauna or features

- The Environment Act 1995 (ref. 11.6) - sets out the responsibilities of the Environment Agency (EA) in relation to water pollution, resource management, flood defence and fisheries
- The Water Framework Directive (2000/60/EC) (WFD) (ref. 11.7) - transposed into UK law in 2003 (The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003), and is designed to improve and integrate the way water bodies are managed throughout Europe. The WFD requires all inland and coastal waters to reach "good" chemical and ecological status in inland and coastal waters by 2015
- Water Act 2003 (ref. 11.8) - amends the Water Resources Act 1991 and the Water Industry Act 1991 to formalise the Government's commitment to the sustainable management and use of water resources
- Building Regulations (Part G), draft amendments May 2009 (ref. 11.9) - changes have been made to these regulations to include targets for reducing water consumption

Planning policy

11.5 Planning policy at the national, regional, county and local level, including the scheme's compliance with policy requirements, is discussed in the Planning Supporting Statement.

National planning policy

11.6 National planning policy relating to this chapter includes:

- PPS 1 – Delivering Sustainable Development (2005) confirms that good planning should deliver the right development in the right place and time, and protect the environment. A supplement to PPS1 (2007) requires that planning should help shape new homes, jobs and infrastructure to be resilient to climate change (e.g. changes in flood risk)
- PPS 23 – Planning and Pollution Control (2004). Annex 1 'Pollution Control, Air and Water Quality' and Annex 2 'Development on Land Affected by Contamination' set out policies for pollution control to be followed at all stages of planning
- PPS 25 – Development and Flood Risk (March 2010) ensures that the Government's policies on avoiding flood risk and accommodating the impacts of climate change in relation to drainage are implemented in the planning process
- Draft National Planning Policy Framework (July 2011) sets out emerging policy on climate change and flooding and states that the planning system should aim to minimise vulnerability and provide resilience to impacts arising from climate change; and avoid inappropriate development in areas at risk of flooding

Regional and local planning policy

11.7 The Localism Bill was enacted in November 2011, thereafter becoming the Localism Act. Different parts of the Act will, however, come into effect at different times over the coming months. The Act enables Regional Spatial Strategies, including the East of England Plan, to be abolished, but this will be undertaken by statutory order by the government in due course (it is currently understood that this will be around March / April 2012), subject to consultation. Whilst the East of England Plan remains part of the development plan until it is formally abolished, the government has advised that the proposed abolition of Regional Spatial Strategies should be regarded as a material consideration by local planning authorities when deciding planning applications. It should therefore be afforded limited weight in the determination of this planning application.

11.8 Relevant local planning policies contained within South Cambridgeshire District Council Local Development Framework (LDF) Development Control Policies, adopted July 2007 include the following:

- Policy DP/1 Sustainable Development - pertinent points include the following
  - Incorporate water conservation measures
  - Minimise flood risk
  - Use SuDS where practicable
  - Mitigate impacts of climate change through location, form and design of buildings
  - Ensure no unacceptable adverse impact in land, air and water
- Policy NE/9: Water and Drainage Infrastructure - planning permission will not be granted where there is inadequate water supply, sewerage or land drainage systems (including water sources, water and sewage treatment works) available to meet the demands of the development
- Policy NE/11: Flood Risk - in relation to flood risk, applications for planning permission will be judged against national policy (currently in PPS 25)
- Policy NE/12: Water Conservation – development must incorporate all practicable water conservation measures. Submission of a Water Conservation Strategy is required

11.9 Relevant local planning policies contained within Northstowe Area Action Plan (NAAP), adopted July 2007 include the following:

- Policy NS/21: Land Drainage, Water Conservation, Foul Drainage and Sewage Disposal, which states the following
  - Surface water drainage is to be by means of a Sustainable Drainage System (SuDS)
  - Neither the development of Northstowe as a whole, nor any phase of the development, will result in harm in the form of untreated sewage discharge or increased flood risk from treated waste water

- All water bodies and water courses required to serve the development will be maintained and managed by one or more publicly accountable bodies to ensure a comprehensive and integrated approach to surface water drainage
- All flood mitigation measures should make allowance for the forecast effects of climate change
- All development in Northstowe will incorporate water conservation measures

Guidance

11.10 The following Pollution Prevention Guidelines (PPG) issued by the EA are considered to be relevant to this assessment:

- EA, pre 2007. PPG1 *General Guidance to the Prevention of Pollution* (ref. 11.10)
- EA, October 2007. PPG5 *Works or Maintenance in or Near Water* (ref. 11.11)
- EA, pre 2007. PPG6 *Working at Construction and Demolition Sites* (ref. 11.12)
- EA, March 2009. PPG21 *Incident Response Planning* (ref. 11.13)

11.11 Other guidance documents considered to be relevant to this assessment include the following:

- Construction Industry Research and Information Association (CIRIA), 2007. *CIRIA 697: The SuDS Manual* (ref. 11.14)
- CIRIA, 2001. Guidance *C532 – Control of Pollution from Construction Sites* (ref. 11.15)
- EA, 2009. Flood Risk Standing Advice for England (ref. 11.16) - This advice reflects the policy contained in PPS 25 and provides standard information on whether a development is suitable with regards to flood risk

Methodology

Scope of the assessment

11.12 The scope of this chapter includes a review of the available baseline information on the site's setting, with specific regards to current drainage, flooding conditions and water resources.

11.13 A Scoping Report was issued to SCDC in July 2011. This document identified the effects that the proposed development will potentially have on surface and foul water drainage, flooding, physical surface water quality and water demand during the construction and post-construction stages.

11.14 These included the following potentially significant effects:

- Effects on surface water quality due to increased sediment loading during construction
- Effects on surface water quality due to increased sediment loading post-construction
- Effects on the hydrology and associated flood risk of surrounding watercourses due to increased surface water runoff post-construction
- Effects on groundwater from reduced recharge rates associated with the increased impermeable area on site post construction
- Effects arising from the increased demand for potable water and wastewater treatment and the associated upgrade works required post construction

11.15 This chapter assesses the potential degradation to surface water quality due to physical contamination (i.e. sedimentation). Impacts due to chemical contamination are addressed within chapter 10: geology, hydrogeology and contamination.

Extent of the study area

11.16 The study area for water resources, flooding and drainage encompasses the site and sensitive receptors within the influence of the site. These include surface water courses within the Swavesey Drain / Longstanton Brook catchment and the Cottenham Lode catchment (including Beck Brook, Oakington Brook and Reynolds Drain), ponds and unnamed drains on site and in proximity, the underlying groundwater and the catchment area for foul water drainage and potable water supply.

Method of baseline data collection

11.17 This chapter comprises a desk study that draws on the relevant findings of a number of documents and through correspondence with the consultees. Other sources of desk study information are referred to throughout this chapter where relevant and a full list of references is presented in table 11.1. The most pertinent documents are as follows:

- WSP UK, December 2011. Northstowe Phase 1: Water Conservation Strategy (ref. 11.17)
- WSP UK, December 2011. Northstowe Phase 1: PPS25 Flood Risk Assessment (technical appendix H)
- WSP Environmental, December 2011. Geoenvironmental Assessment – Factual Report, Northstowe Phase 1 (technical appendix G)
- WSP Environmental, December 2011. Geoenvironmental Assessment – Interpretive Report, Northstowe Phase 1 (technical appendix G)
- WSP UK, December 2011. Northstowe: Strategic Utility Report and Foul Drainage Issues (ref. 11.18)

Table 11.1: References	
No.	**Reference**
11.1	HMSO (1990). *Environmental Protection Act (EPA).*
11.2	HMSO (1991). *Water Industry Act.*
11.3	HMSO (1991). *Water Resources Act.*
11.4	HMSO (1991). *Land Drainage Act.*
11.5	HMSO (1994). *Land Drainage Act.*
11.6	HMSO (1995). *Environment Act.*
11.7	HMSO (2003). *The Water Environment (Water Framework Directive) (England & Wales) Regulations.*
11.8	HMSO (2003). *Water Act 2003.*
11.9	HMSO (2009). *Building Regulations (Part G), draft amendments.*
11.10	EA (pre 2007). *PPG1 General guidance to the prevention of Pollution.*
11.11	EA (October 2007). *PPG5 Works or Maintenance in or Near Water.*
11.12	EA (pre 2007). *PPG6 Working at Construction and Demolition Sites.*
11.13	EA (March 2009). *PPG21 Incident Response Planning.*
11.14	Construction Industry Research and Information Association (CIRIA) (2007). *CIRIA 697: The SuDS Manual.*
11.15	CIRIA (2001). *Guidance C532 – Control of Pollution from Construction Sites.*
11.16	EA (2009). *Flood Risk Standing Advice for England.*
11.17	WSP (December 2011). *Northstowe Phase 1: Water Conservation Strategy*
11.18	WSP (December 2011). *Northstowe: Strategic Utility Report and Foul Drainage Issues.*
11.19	EA (March 2007). *The Cam and Ely Ouse Catchment Abstraction Management Strategy (CAMS).*
11.20	DEFRA (February 2008). *Future Water, the Government's water strategy for England Plan.*
11.21	EA (2008). *Water Resources in England and Wales – Current State and Future Pressures.*
11.22	Cambridge Water Company (January 2010). *Final Water Resources Management Plan.*
11.23	WSP (September 2007). *Uttons Drove Stage 1 Baseline Modelling Report.*
11.24	WSP (April 2010). *Uttons Drove Stage 2 Modelling Report.*
11.25	Communities and Local Government (December 2006). *Code for Sustainable Homes; A step change in sustainable home building practice.*

Significance criteria

11.18 The assessment of potential effects as a result of the proposed development has taken into account both the construction and post-construction stages. The degree attributed to each effect has been assessed based on the magnitude of change due to the proposed development and the sensitivity of the affected receptor / receiving environment to change (figure 11.1) and the magnitude of change due to the proposed development (figure 11.2).

11.19 Effect significance has been determined by combining the receptor sensitivity with the impact magnitude to derive the degree of the effect, using the matrix in figure 11.3. Effects that are moderate or above are considered to be significant.

Baseline

Land use and surface cover

11.20 The primary development site currently supports predominantly pastoral and arable agricultural land on the south eastern and northern parts of the site, and a golf course through the centre, which includes a club house and associated buildings and infrastructure. Station Road (B1050) crosses the north western corner of the site.

11.21 Brookfield Farm is located immediately adjacent to the south of the primary development site, off Rampton Road. A second farm and residential properties are also located off the southern boundary of the site along Rampton Road. The village of Longstanton lies to the west of the site, with farmland, some residential development, nurseries and commercial premises to the north. Land to the east beyond the Cambridgeshire Guided Busway (CGB) is predominantly agricultural. The former Oakington Airfield and Barracks is present to the south of Rampton Road, as well as a small residential development known as Rampton Drift.

11.22 The land use on the Hatton's Road attenuation ponds area is predominantly arable farming.

Topography

11.23 The overall topography of the primary development site is of gently falling ground, with levels ranging from approximately 9.5 m AOD in the west of the site, to approximately 5.5 m AOD to the east towards the CGB route.

11.24 The existing ground levels in the Hatton's Road attenuation ponds area are between approximately 10.2 m to 11.8 m AOD and 13.0 m to 14.6 m AOD for the downstream and upstream attenuation areas respectively (technical appendix H, section 6).

Geology

11.25 Chapter 10: geology, hydrogeology and contamination presents the published geology for the site and ground and groundwater conditions encountered during the ground investigation. The following geology, hydrogeology and hydrology sections present a summary of the pertinent findings.

Primary development site

11.26 The natural strata underlying the primary development site comprise River Terrace Deposits (to a depth of 0.4 m – 8.0 m below ground level, bgl) overlying Ampthill Clay (unproven depth).

11.27 The Ampthill Clay outcrops (i.e. the River Terrace Deposits are not present) in the east of the primary development site and generally comprises a fissured firm to hard clay with rare bands of siltstone.

11.28 Based on the geological mapping and strata encountered in proximity, the Ampthill Clay will be underlain by Kimmeridge Clay.

11.29 The River Terrace Deposits are drift deposits comprising sands and gravel with variable clay content. Some areas of the central and southern portion of the primary development site exhibited River Terrace Deposits channelised into the underlying solid geology. The River Terrace Deposits generally get thinner from the west towards the centre of the primary development site.

11.30 Made Ground was also encountered overlying the natural strata in localised areas within the western area of the primary development site.

Hatton's Road attenuation ponds area

11.31 The natural strata underlying the Hatton's Road attenuation ponds area were found to be consistent with the geological map information, comprising River Terrace Deposits underlain by Ampthill Clay (in the north) or Kimmeridge Clay (in the south). The lithologies of the two clays were generally similar, comprising firm to hard grey or blue clay, occasionally mottled brown or orange brown.

11.32 Generally thin superficial River Terrace Deposits were encountered above the solid strata. They predominantly comprised sandy clay, with irregular granular deposits often channelised into the underlying solid strata.

Hydrogeology

11.33 Neither the primary development site nor the Hatton's Road attenuation ponds area is located within an EA designated groundwater source protection zone and there are no source protection zones in the study area. The groundwater quantitative and chemical quality is not currently assessed by the EA as part of its River Basin Management Plans, either for the groundwater below the primary development site or the Hatton's Road attenuation ponds area.

Primary development site

11.34 Groundwater was predominantly encountered in exploratory holes across the western part of the site. The monitored groundwater levels were recorded between 0.3 m and 2.0 m bgl within the River Terrace Deposits and between 0 m bgl and 6.9 m bgl in the Ampthill Clay.

11.35 The River Terrace Deposits are classified by the EA as a Secondary A Aquifer and the Ampthill and Kimmeridge Clays are classified as Unproductive Strata.

11.36 Groundwater level monitoring has confirmed that the groundwater flow direction is to the north within the River Terrace Deposits, corresponding with the general flow direction of local surface water features and the elongated depositional shape of the permeable River Terrace Deposits towards the north.

11.37 It is considered that surface water features on the site, such as ponds and lakes, are in hydraulic continuity with groundwater. The principal groundwater receptor is considered to be the River Terrace Deposits Secondary A Aquifer beneath the western part of the primary development site.

11.38 Permeability testing (reported within technical appendix G) indicated hydraulic conductivities between 0.09 m/day and 16.15 m/day within the clay strata. The upper end was recorded in a location at which fissuring was observed. The lower end is considered to be more typical for the primary porosity (matrix) flow within similar clay deposits.

11.39 Permeability testing within the granular River Terrace Deposits recorded hydraulic conductivities between 7.94 m/day and 12.18 m/day.

11.40 One groundwater abstraction is currently located on the primary development site and is licensed to abstract groundwater for direct spray irrigation purposes. This will be terminated during construction.

11.41 Two regulated abstractions are located within 1 km to the south of the site (up gradient) licensed to a nursery for general agriculture and spray irrigation. It is not considered that these will be impacted by the proposed development as they are located up gradient. One regulated abstraction has been identified 315 m north (down gradient) of the site licenced for general farming and domestic.

11.42 Further abstractions were identified historically to the north within 1 km of the site and are now classified as 'revoked'. However, this may mean they remain active but have been deregulated by the EA if they abstract less than 20 m^3 per year.

Hatton's Road attenuation ponds area

11.43 Groundwater was encountered in exploratory holes predominantly within the River Terrace Deposits during drilling. The majority of monitoring wells were installed within the Ampthill / Kimmeridge Clay due to the thin depths of River Terrace Deposits encountered.

11.44 Groundwater elevations within the Ampthill / Kimmeridge Clay were recorded during monitoring between 0 m bgl and 4.3 m bgl. The direction of groundwater flow in the Ampthill / Kimmeridge Clay beneath the Hatton's Road attenuation ponds area is to the north or north west.

11.45 Groundwater flow appears to be influenced by the flow direction of local surface water features, with flows parallel to the open surface drains and Longstanton Brook that flows through the site.

11.46 Several groundwater abstractions have been identified within 1 km of the Hatton's Road attenuation ponds area, although not all of these may still be in use. All the abstractions identified are located to the south and east of the site (up hydraulic gradient), and are therefore unlikely to be impacted by the site.

Abstractions on and immediately around the primary development site are over 1 km from the Hatton's Road attenuation ponds area.

Hydrology

11.47 The area surrounding the site, including the existing settlement of Longstanton, is drained by two main catchments: Swavesey Drain / Longstanton Brook catchment and the Cottenham Lode catchment, including the Beck Brook and Oakington Brook (and Reynolds Drain). The existing surface water features are presented on figure 5 of technical appendix G.

Primary development site

11.48 Notable surface water features on or in the vicinity of the primary development site are identified in table 11.2 and are presented on figure 11.4.

Table 11.2: Surface water features, primary development site

Surface water feature	Distance from site	Direction from site	Quality*
Unnamed drains	On site	-	NA
Unnamed ponds	On site	-	NA
Unnamed drain	Adjacent	South west	NA
Reynolds Drain / Ditch (flowing into Cottenham Lode)	Adjacent	East	NA
Nethergrove Lake	110 m	South	NA
Longstanton Brook (flows into Swavesey Drain)	240 m	South west	NA
Cottenham Lode	900 m	East	
Beck Brook (flows into Cottenham Lode)	1 km	South east	Current and predicted ecological quality 'moderate' for Cottenham Lode. The chemical quality has not been assessed.
Oakington Brook (flows into Beck Brook)	2.6 km	South	
Burgess Drain	1 km	East	NA
Swavesey Drain	1.3 km	North west	Current and predicted ecological quality 'good'. The chemical quality has not been assessed.
Old West River (River Great Ouse)	5.3 km	North east	Current and predicted ecological quality 'moderate'. Current and predicted chemical quality 'good'.

* The EA's River Basin Management Plans have been referred to with regards to the current and predicted ecological and chemical quality. NA – 'not requiring assessment' under the Environment Agency River Basin Management Plan for the region.

11.49 There are no significant watercourses within the primary development site; however, a number of drainage ditches are present across the site that are the responsibility of their riparian owners, SCDC and the Old West Internal Drainage Board. These ditches flow from south west to north east across the primary development site to the tributaries of the Cottenham Lode / Beck Brook.

11.50 The main surface water bodies in the vicinity of the site generally flow south to north, with drainage generally west to east, linking with the primary surface water bodies.

11.51 Oakington Brook originates to the south of Bar Hill and generally flows in a north easterly direction through the village of Bar Hill, beneath the existing A14, parallel to the Dry Drayton Road and past Oakington village prior to discharging in to the Beck Brook to the south east of the primary development site.

11.52 Beck Brook originates to the west of Girton and generally flows in a north easterly direction. To the north of Girton the brook flows in a generally northerly direction to the east of Oakington, prior to discharging in to the Cottenham Lode to the east of the primary development site. A number of drainage ditches from the former barracks and Oakington Airfield outfall into Beck Brook. To the south of the A14, Beck Brook is identified as Callow Brook.

11.53 Cottenham Lode generally flows in a north easterly direction to the north of Cottenham, prior to discharging into the Old West River (River Great Ouse) to the north east of the primary development site.

11.54 Reynolds Drain originates adjacent to the east of the site and three main drainage ditches outfall into Reynolds Drain from the golf course and Brookfield Farm via culverts beneath the disused railway. Reynolds Drain drains towards the east. Reynolds Drain eventually flows into Cottenham Lode or Burgess Drain to the east, depending on flow conditions within the Cottenham Lode.

11.55 Burgess Drain flows in a north-north east direction to the north west of Cottenham (to the north east of the site), before discharging to the Left Wing Drain at a location to the north of Cottenham and to the east of Willingham. The Right Wing Drain joins the Left Wing Drain prior to discharging to the Old West River (River Great Ouse).

11.56 Longstanton Brook originates to the south west of Bar Hill and generally flows in a north easterly direction to the west of Bar Hill towards Longstanton. It flows to the west of Longstanton, continuing in a northerly direction prior to becoming Swavesey Drain at Gravel Bridge.

11.57 Swavesey Drain generally flows to the north west between the villages of Over and Swavesey, before eventually discharging to the River Great Ouse via the Webbs Hole Sluice.

11.58 There are several manmade ponds on the golf course of varying sizes; the main pond, located in the west, is to be retained as part of the proposed development. There are also a number of ponds within close proximity to the site boundary, predominantly within the village of Longstanton. The largest pond within Longstanton is Nethergrove Lake, which is currently utilised by a private members fishing club.

11.59 There are a number of other drains across the golf course that predominantly discharge to the two main drains on site, and ultimately to Reynolds Drain.

11.60 A surface water abstraction for 'construction: dust suppression' is located immediately north of the primary development site. It relates to the Edmund Nuthall Ltd Cambridgeshire Guided Busway site and, given that the busway is now complete, is unlikely to be further utilised.

11.61 Despite being managed over the years, both the Oakington and Longstanton Brooks are valuable wildlife habitat for a range of species, including water vole. Otter have also previously been recorded. The brooks also provide foraging areas for protected species such as bats. More detailed information relating to the ecological value of the watercourses in the vicinity of the site is discussed in chapter 6: natural heritage.

11.62 The presence of numerous species of fish and aquatic invertebrates within many of these surface water features provides an indication of water quality. Although the fish species identified are not of particular conservation importance in a UK context, their presence indicates that water quality is relatively good.

11.63 Overall, the surface water quality in the Cam and Ely Ouse catchment can be considered to be good (ref. 11.19).

Hatton's Road attenuation ponds area

11.64 Notable surface water features on or in the vicinity of the Hatton's Road attenuation ponds area are identified in table 11.3.

Table 11.3: Surface water features, Hatton's Road attenuation ponds area

Surface water feature	Distance from site	Direction from site	Quality
Longstanton Brook	On site	On site	NA
Unnamed drains	On site	On site	NA
Balancing Ponds (32 and 34, to control surface water runoff associated with the A14)	800 m	South west	NA

NA – 'not requiring assessment' under the Environment Agency River Basin Management Plan for the region.

11.65 Longstanton Brook flows through the Hatton's Road attenuation ponds area from south to north. Other notable surface water features in the vicinity are limited to unnamed surface water drains.

11.66 The existing bed levels of the Longstanton Brook along the reach adjacent to Hatton's Road in the location of the Hatton's Road attenuation ponds area range between approximately 8.68 m AOD (downstream) to 11.75 m AOD (upstream) (technical appendix H, section 6).

Foul water drainage

11.67 Anglian Water (AW) is the Sewerage Undertaker for the area. It is responsible for the existing and proposed surface and foul water sewerage systems, as well as the sewage treatment facilities in the area (ref. 11.18).

11.68 The current foul sewerage network is located on Station Road, which crosses through the north west of the primary development site. The existing foul flow from Longstanton, Oakington and the surrounding area is pumped to Over or Uttons Drove Sewage Treatment Works (STW) (ref. 11.18).

11.69 The Over STW discharges directly to the Great Ouse, whilst the Uttons Drove STW discharges into the Swavesey Drain system. Historically, the IDB and EA have raised concerns regarding the impact of final effluent discharges on existing flood risks within the Swavesey Drain system.

11.70 The current foul drainage volume is unknown; however, it is considered to be negligible as the sole on site use is assumed to comprise the existing golf club, for facilities within the clubhouse.

Surface water drainage

11.71 The primary development site is split into a number of existing drainage catchments, as indicated on figure 3 within the FRA (technical appendix H). These primarily drain towards the CGB and then to the Reynolds Drain to the east. However, a small parcel of land to the north of Station Road (B1050) drains towards Willingham along the highway.

11.72 There are no known existing public surface water sewers crossing the site. The ditches on the primary development site are either the responsibility of SCDC, as they are award drains, the Old West IDB, or the responsibility of the riparian owner.

11.73 Surface water on the Hatton's Road attenuation ponds area drains, either directly or via unnamed drains, into Longstanton Brook, which flows through the centre of the area.

Fluvial flood risk

11.74 The majority of the baseline fluvial flood risk information was sourced from the FRA (technical appendix H, sections 7 and 8), unless otherwise stated.

Flood risk classification

11.75 The EA's Flood Map for the Beck Brook shows that the primary development site is primarily located within flood zone 1 (low probability of flooding), with some areas closest to the CGB falling within flood zone 3 (high probability of flooding). However, the flood zone 3 extent is an undefended scenario and, as such, this 1 in 100 year flooding extent would only be likely if existing defences (the CGB embankment and the restrictive nature of the culverts) were not present. There is therefore an existing residual risk of flooding in the 1 in 100 year event if defences in this area were to fail.

11.76 The area shown as flood zone 3 is located in the south east of the site, to the north of Rampton Road and west of the CGB. It covers approximately 30% of the primary development site. Site knowledge and anecdotal evidence suggests

that this estimated 1 in 100 year floodplain is conservative and over-predicts flood levels, and that the actual 1 in 100 year floodplain is not as extensive as that predicted.

11.77 The Hatton's Road attenuation ponds area is crossed by the Longstanton Brook, which has a small area of flood plain associated with it.

11.78 Longstanton is located to the west of phase 1, situated on the edge of the fens. The village is affected by flooding, primarily as a result of insufficient capacity of the culverts through the urbanised area. The flood plain expands in the village and a number of properties are at risk of flooding.

11.79 Downstream of the primary development site, both the Beck Brook (north east) and the Swavesey Drain (north west) will flow through flood embankments where they enter the flat fen land. The watercourses draining away from the site are currently at capacity.

Historical records of flooding

11.80 Despite several flooding occasions in the vicinity of the site over the last 40-50 years, the site is not known to have flooded in the past, except to a shallow level at the lowest part of the site nearest Reynolds Drain.

11.81 The Webbs Hole Sluice is located in the Longstanton Brook / Swavesey Drain catchment, to the north west of the primary development site. The key function of Webbs Hole Sluice is to discharge flows to the Great River Ouse as quickly as possible; however, during high water level conditions in the Great River Ouse the sluice can become tide-locked. During these conditions the resulting flows can back up within the Swavesey Drain, leading to potential flooding problems.

11.82 Parts of the villages of Oakington and Longstanton flooded during the October 2001 event (technical appendix H, section 7). The Oakington flooding came from Cottenham Lode, the 8th Public drain and Oakington Brook, while the flooding in Longstanton came from Longstanton Brook.

11.83 Rampton experienced flooding in October 2001, partly due to a breach on the Cottenham Lode and the failure of a small balancing facility within the village.

11.84 The principal cause of flooding in Longstanton is the Longstanton Brook because culverts throughout the village have insufficient capacity to pass the flood flows for extreme events over a 1 in 25 year event. The lack of capacity has been exacerbated historically by a lack of maintenance.

Existing flood defences

11.85 The level of protection against flooding for the primary development site and the wider surrounding areas was increased significantly when the EA undertook flood alleviation works on the Oakington Brook in 1985. These

works involved the clearance, widening and dredging of 6.34 km of award drains and the widening of 8 km of main river. In addition, the twin arch Rampton Road Bridge was replaced with a clear span deck.

11.86 Works were also undertaken in the Swavesey Drain area to form a separate high level carrier drainage system across the Swavesey IDB. The works involved the construction of a replacement outfall sluice with greater discharge capacity, channel improvement works to Swavesey Drain, Church End Drain and Uttons Drove Drain, and a short length of new cut to divert another high level carrier drain to the new system.

11.87 A culvert is located downstream (north east) of the primary development site, connecting the Reynolds Drain / Reynolds Ditch to the Cottenham Lode. This is a 1050 mm pipe with flap valve to prevent flows from the Cottenham Lode entering the Reynolds Drain / Reynolds Ditch in times of high flow within the Cottenham Lode.

11.88 Oakington, Longstanton and Rampton villages have no other known flood protection measures.

Secondary existing flood defences

11.89 The Cottenham Lode (east of the primary development site) is protected by flood bunds; these flood bunds protect the majority of land between the CGB and the River Great Ouse and help to protect the villages of Rampton and Cottenham and the surrounding farm land.

11.90 The CGB route has been built on the historical mineral railway route, which acts as an informal secondary flood defence. The crest level of the CGB embankment is located above the predicted flood levels, and therefore the flooding mechanism from the Beck Brook into the primary development site is likely to be as a result of flood waters backing up and entering the site via the culverts located along the eastern boundary, under the CGB embankment.

11.91 The Beck Brook has flood banks along part of its length to east of the CGB route (disused railway line), but these are not designed to a high standard. Overtopping has minimal impact on the primary development site. The exact level of protection is unknown, but is likely to be approximately a 1 in 100 year event. For events that overtop the defences, the flood water flows down either side of the Lode and outfalls eventually to the Old West River. This is the flooding mechanism that was observed in the October 2001 flood.

Pluvial flood risk

11.92 The site lies at the top of a natural catchment for the Beck Brook / Cottenham Lode watercourse and therefore flooding from overland flow does not pose a significant flood risk to the site (technical appendix H, section 7).

Foul drainage flood risk

11.93 AW's sewerage network in the villages of Longstanton and Oakington is at capacity and there are existing flooding problems from the foul drainage system in Longstanton (ref. 11.18).

Groundwater flood risk

11.94 Parts of the phase 1 area have shallow groundwater levels, particularly during the winter months. However, there are no historical records of groundwater flooding.

Water supply

11.95 Cambridge Water (CW) supplies the potable water for the area around Northstowe (including Oakington and Longstanton) from the Cherry Hinton reservoir to the southeast of Cambridge. Water is transferred from there to the Coton and Madingley reservoirs to the west of Cambridge. Madingley Reservoir feeds trunk mains that pass northwards to the west of Oakington and Longstanton to supply areas to the north of Over. Villages on each side, including Oakington and Longstanton, are supplied by branch mains from these trunk mains (ref. 11.18). The current distribution main is located on Station Road, which crosses through the north west of the primary development site.

11.96 It is estimated that average water use in England is about 150 litres per person per day (l/p/d) (ref.11.20). Based on standard fittings and appliances, typically found in Cambridge properties, the average demand in the area is also assumed to be 150 l/p/d (ref. 11.17). Almost all of this is delivered to premises as a drinking standard, even though the vast majority is used for washing, toilet flushing and watering the garden.

11.97 The baseline conditions against which the proposed development will be assessed in this chapter comprise the current water usage at the site. The exact volume is unknown; however, it is considered to be negligible as the sole on site current use is anticipated to be the golf club for facilities in the club house. Spray irrigation of the golf course is supplied from a current groundwater abstraction onsite.

11.98 The east of England receives the lowest level of rainfall in the country. The Cam and Ely Ouse Catchment receives approximately 600 mm to 650 mm per year (ref. 11.19).

11.99 In *Water Resources in England and Wales – Current State and Future Pressures* (ref. 11.20), the EA advises which areas of the UK they consider to be seriously water stressed by assessing where current and future household demand for water is a high proportion of the available freshwater resources. The site is located in an area classified as 'serious' water stress.

11.100 The initial water resource availability of the surface Water Resource Management Unit that the site is located within is classified as 'no water available at low flows'. However, this has been reduced to 'no water available' to ensure that additional abstraction does not impact downstream units. There is no groundwater resource associated with this unit (ref. 11.19). This means that limited water may be available only at times of high flow.

11.101 The potable water supply for the primary development site will be provided either by CW or AW.

11.102 The Water Act, 2003 (ref. 11.8) requires water companies to produce 'Water Resources Management Plans (WRMP)', which provide a realistic strategic plan for managing water resources and indicate how a water company intends to maintain the balance between supply and demand for water over the next 25 years. CW has produced one for its supply area (ref. 11.22).

11.103 Demand for water in the Cambridge area is likely to grow over the next 15 years, due to a proposed significant growth in housing numbers. However, the WRMP states that the company has a current healthy supply-demand balance, and anticipates being able to meet demand until at least 2035 (including allowances for an increased rate of housing growth and climate change), with no plans for major investment in additional resources required.

11.104 It aims to maintain the balance through a twin track approach of maximising the amount of water available for use, within current licensing and aquifer constraints; and regulating distribution input through a combination of active leakage control and demand management.

11.105 CW expects that the demand for water in new dwellings will decrease through a combination of adoption of the Code for Sustainable Homes and the incorporation of grey water recycling.

Potential sensitive receptors

11.106 The following sensitive receptors have been identified in relation to impacts from water resources, flooding and drainage:

- Neighbouring villages (i.e. Oakington, Longstanton, Swavesey, Willingham, Cottenham etc.) - these potential receptors are considered to be of high sensitivity due the possible severity that an impact could have on human health if potential risks are not appropriately managed
- Surface water features (river, drains, brooks and ponds) - the available EA data indicate that the water quality is moderate to good within the relevant catchments, and despite these watercourses having been managed over the years they are valuable wildlife habitats for a range of species, including water vole. They also provide foraging areas for protected species such as bats. However, there are no major surface water abstractions in proximity of the site, and there are no statutory ecological designations in proximity. On this basis, the watercourses identified within the vicinity of the site are conservatively considered

to be of medium sensitivity due to the proximity of construction works to some of the features

- Groundwater abstractions from the River Terrace Deposits to the north (down gradient) of the primary development site – these receptors are considered to be of medium sensitivity as only one regulated abstraction was identified within 1 km and does not have an associated groundwater source protection zone
- Potable water supply resources - the East Anglian region is known to be a water deprived area; however, CW has confirmed that it can meet demand in the area for at least the next 25 years. On this basis potable resources are considered to be of medium sensitivity
- Utilities infrastructure - two public STW are located in the surrounding area; Over and Utton Drove. AW has advised that Uttons Drove STW is the preferred STW and the capacity of this facility will be sufficient providing upgrading is undertaken. This receptor is therefore considered to be of medium sensitivity
- Construction workers - these potential receptors are considered to be of high sensitivity due to the possible severity that an impact could have on human health if potential risks are not appropriately managed
- Future site residents - these potential receptors are considered to be of high sensitivity due to the possible severity that an impact could have on human health if potential risks are not appropriately managed

Regulatory enquiries

11.107 Table 11.4 provides an overview of the consultation undertaken with respect to the topics covered in this chapter.

Table 11.4: Overview of consultation

Organisation / body	Name / contact	Date of communication	Brief summary of consultation
1) Anglian Water (AW)	Denise Harding (Planning and Equivalence Team)	11.08.11	AW confirm that it can accommodate the proposals for Northstowe Phase 1 with regards to drainage.
2) Swavesey Internal Drainage Board	Clerk to the Board	29.07.11	The Swavesey drain is at capacity and is 'tide looked' at Webbs Hole Sluice at times of high flow in the River Great Ouse. Therefore, it should not be assumed that capacity will be available within the drain to take additional flows and adequate provision should be ensured for times when the sluice is closed. The IDB raised concerns regarding the flood risk to its area potentially created by surface water and treated effluent discharge.
3) Old West Drainage Board	Andrew Newton (engineer)	12.08.11	The board's surface water receiving system has no residual capacity to accept increased flows therefore adequate surface water accommodation works need to be put in place and will need to maintained in perpetuity.
4) Girton Parish Council	Brian Bromwich	03.08.11	The surface water drainage catchments in the area of the site discharge to the River Great Ouse either by gravity or pumping depending on the downstream water levels (dependent on tides or rainfall). The Parish comments on the proposed drainage features and has concern in the event that the mitigation measures did not perform in accordance with the design.
5) Cottenham Parish Council	Julie Groves (clerk)	15.08.11	The Parish has concerns that the discharge of runoff water from the site into the Cottenham Lode system has not been fully considered.
6) Anglian Water	Sue Bull (Planning Liaison Manager)	16.08.11	AW provide confirmation that it can provide sewage treatment for phase 1. The correspondence is attached within the Strategic Utility Report (ref. 11.18).

11.108 Correspondence items numbered 1 to 5 are contained within technical appendix A (scoping).

Future baseline

11.109 With no development, it is considered that the future baseline conditions in relation to drainage, flooding and water resources would remain relatively unchanged, particularly if the current land uses remained the same (i.e. golf club and agriculture).

11.110 There may be some deterioration of the foul and surface water drainage network if maintenance was not undertaken.

11.111 As the potable water usage is confined to the golf club, it is not anticipated that potable water demand would change.

11.112 In the longer term, the risk of flooding at the site may increase with the effects of climate change due to increased frequency of extreme rainfall events.

Effects during construction

Effects on surface water quality from pollution due to increased sediment loading during construction

11.113 Key potential surface water receptors include on site drains (draining to Reynolds Drain), Reynolds Drain adjacent to the eastern boundary, Longstanton Brook (on site – Hatton's Road attenuation ponds area), and ultimately the down gradient larger watercourses (including Cottenham Lode, Swavesey Drain and the Old West River). They also include the on site pond that is being retained as part of the proposed development (the remaining ponds will be infilled and will no longer comprise receptors). The ponds off site are considered unlikely to be affected due to their distance from the site and the unlikely presence of viable surface water runoff pathways.

11.114 During the site preparation, demolition, earthworks and remediation phase of the primary development site, there will be a number of activities that could reduce surface water quality with respect to physical contaminants (sedimentation). These include:

- Demolition of existing buildings / structures (including internal / external stripping) and associated site clearance (confined to the golf club buildings on the primary development area)
- Movement and use of static and mobile plant / construction vehicles such as excavators, dumper trucks, hydraulic breakers, haulage trucks, crushing and screening equipment
- Breaking out of existing hardstanding (including ground slabs and foundations relating to the golf club)
- Processing of aggregates from demolition rubble and arisings for reuse or removal from site (including crushing and screening)
- Materials handling, storage, stockpiling, spillage and disposal
- Bulk earthworks to ground formation levels
- Excavation and foundation construction within the site and site preparation
- Installation of temporary and permanent infrastructure and roads and haul routes
- Construction of proposed buildings
- Construction of drainage runs and utilities duct runs
- Formation of public spaces, public realm and associated restoration and landscaping
- Installation of infrastructure and roads and haul routes

11.115 As a result of the proposed Hatton's Road attenuation ponds within the vicinity of Longstanton Brook, sections of this brook will be permanently diverted around the attenuation features. These activities could result in a direct impact on water quality from the associated earthworks and silt-laden runoff.

11.116 The site preparation, demolition, earthworks and construction activities may lead to the disturbance and mobilisation of physical contaminants (i.e. dust, sediments, and muds). In particular, during periods of heavy rainfall, vehicle movements resulting in damage to soil structure may generate increased sedimentation within surface runoff. In addition, during periods of dry, windy weather, wind-blown dusts generated by the demolition of buildings and excavation of soils have the potential to directly reduce the quality of surface water features.

11.117 These activities may result in sediments directly (e.g. wind-blown) or indirectly (e.g. via surface water runoff) entering surface water features, impacting on the physical quality of the surface water receptors on site and in the surrounding area.

11.118 This has the potential to also subsequently impact the chemical and biological quality of surface water receptors. The chemical water quality is discussed in chapter 10: geology, hydrogeology and contamination. The biological quality could be impacted indirectly through sediment smothering feeding and breeding grounds and physically altering the habitat.

11.119 This is likely to be a change of medium magnitude on a receptor of medium sensitivity without mitigation, leading to a short term, adverse, moderate, significant effect.

Effects on construction workers and construction activities from increased surface water runoff, drainage and / or groundwater flooding during construction

11.120 Any overland flow that did flow into or out of the site would currently follow the line of least resistance and follow natural topography; however, the topography is likely to change to some extent during the construction phase.

11.121 Any flows resulting from surcharging of the drainage or sewer system during extreme rainfall events would be short term, relatively shallow in depth and would pass through the site following the natural topography.

11.122 Surface cover at the site currently predominantly comprises permeable farmland or golf course land. During the construction phase, the extent of hardstanding surface cover is likely to vary, and potentially will increase at various stages of the construction phase due to the creation of impermeable areas for plant. Therefore the rate of rainfall infiltration and volume of surface water runoff will also vary.

11.123 Surface water and drainage flooding, especially after extreme rainfall events, has the potential to harm construction workers on site if it is received in large volumes, particularly if they are working in excavations that have the potential to fill with water.

11.124 Areas of the primary development site currently are located within flood zone 3. However, secondary flood defences are present, including flood bunds along Cottenham Lode and flood banks along Beck Brook. The route of the CGB, which has been built on the historical mineral railway route, is considered to act as an informal flood defence. These defences will provide protection to construction workers during construction.

11.125 Although no records of groundwater flooding have been recorded at the site, shallow groundwater elevations have been recorded on site. Shallow groundwater has the potential to ingress excavations at any location on the site during construction, creating health and safety risks to workers and activities.

11.126 This is likely to be a change of medium magnitude on a receptor of high sensitivity without mitigation, leading to a short term, adverse, substantial, significant effect.

Effects post-construction

Effects on surface water quality from pollution due to increased sediment loading post-construction

11.127 As discussed in the construction phase section, the key potential surface water receptors on the primary development site include drains that are to be retained (draining to Reynolds Drain), Reynolds Drain adjacent to the eastern boundary, Longstanton Brook, and ultimately the down gradient larger watercourses (including Cottenham Lode, Swavesey Drain and the Old West River). They also include the on site pond that is being retained as part of the proposed development (the remaining ponds will be infilled and will no longer comprise receptors). The ponds off site are considered unlikely to be affected due to their distance from the site and the unlikely presence of viable surface water runoff pathways.

11.128 Post-construction, the potential for sediment entrainment in surface water runoff is anticipated to decrease on site from that anticipated in the construction phase. As it will be a controlled amenity and residential area, there is anticipated to be a low volume of physical contaminants (sediment) that could potentially be entrained in surface water runoff over hardstanding and landscaping areas and discharged to surface water receptors, reducing the physical, chemical and biological quality.

11.129 However, there is the potential that increased traffic will result in increases in the generation of dust and other fine particulates off site. These particles may be mobilised within surface water runoff, particularly during periods of heavy

rainfall, and without mitigation could result in the deterioration of surface water quality (i.e. increased suspended solids).

11.130 This is likely to be a change of small magnitude on a receptor of medium sensitivity without mitigation, leading to a short term, adverse, slight to moderate significant effect.

11.131 Post-construction, the potential for sediment entrainment within the Hatton's Road attenuation ponds area is unlikely to increase above current levels, as the surface cover surrounding the surface water features will remain vegetated. The presence of vegetation will serve to stabilise the soil and minimise the entrainment of loose sediment in surface water runoff.

Effects on the hydrology and associated flood risk of surrounding watercourses due to increased surface water runoff

Primary development site

Baseline summary and development risks

11.132 The primary development site is primarily located within flood zone 1, with some areas closest to the CGB falling within flood zone 3 due to flood risk from Beck Brook / Cottenham Lode. However, the flood zone 3 extent is an undefended scenario and, as such, this 1 in 100 year flooding extent would only be likely if existing defences were not present. Existing flood defences include flood bunds along Cottenham Lode, flood banks along Beck Brook and the route of the CGB, which has been built on the historical mineral railway route and acts as an informal flood defence.

11.133 The proposed development will result in the modification of the existing natural catchment behaviour within the development area. The phase 1 area is predominantly undeveloped. The scale of the proposed development will result in areas of agricultural land and golf course being replaced by built development, including impermeable roof areas, hardstanding and highways that will lead to increased rates and volumes of runoff being generated from the site. This could therefore lead to an increase in flood risk down gradient of the primary development site.

11.134 As part of the site is outside the defended 1 in 100 year plus climate change flood plain, the proposed development can only be affected by extreme flood events in excess of the 1 in 100 year plus climate change flood level or through failure of the local flood defences.

Proposed drainage strategy

11.135 Following redevelopment, the primary development site will naturally drain away from the existing villages and into the Cottenham Lode catchment, via both the Reynolds Drain / Reynolds Ditch and the Beck Brook through existing culverts under the CGB, maintaining the existing catchments where they do not drain through Longstanton and Willingham.

11.136 The increased runoff generated from the phase 1 area will be managed through a series of SuDS measures provided both at source and regional control level. However, the performance of these techniques is limited and cannot be guaranteed in perpetuity, and a failsafe measure for controlling runoff from the site in the form of a water park feature will be provided to store all runoff during storm conditions within the surrounding areas.

11.137 The proposed distribution of land uses within the phase 1 site has been developed following a sequential approach, with more vulnerable development located away from sources of flood risk, and less vulnerable development such as the water park located in the higher flood risk areas.

11.138 The drainage strategy for the primary development site comprises drainage of surface water via greenways (open channels cut into the ground) initially to a water park located within the low section that is parallel along the north eastern / eastern boundary of the primary development site adjacent to the CGB route.

11.139 The on site drainage strategy will hold runoff for the 1 in 100 year plus climate change (30%) rainfall event without any discharge to the receiving watercourses. The surface water will then be pumped off site at a rate and time that minimises the risk of flooding to areas downstream of the site. This will therefore reduce the risk to downstream properties.

11.140 Part of the water park will be constructed as part of the phase 1 application and will comprise two strategic attenuation areas connected by an open channel. Each attenuated area will contain a pumping station. The full details of the strategy, including drawings, are presented in technical appendix H.

11.141 The water park will consist of one attenuation area containing two ponds that will be designed as permanent water features to provide a site level SuDS feature and to manage runoff quantity and quality and achieve biodiversity gain. The surface water runoff generated from the site will be conveyed to the ponds by gravity via a combination of a conventional piped systems and arterial greenways running west to east that discharge into the main flood attenuation ponds.

11.142 The proposed water park itself creates an increased residual flood risk to the primary development site. However, this risk is considered to be very low (technical appendix H, section 8).

11.143 The key principle and constraint of the drainage strategy involves a zero discharge from the site when the nearby Beck Brook and Cottenham Lode are in flood (this may be up to 48 hours). This will be achieved by storing all on site surface water runoff in the proposed attenuation ponds within the development area. The water would then be pumped (at restricted rates) from the ponds once the flood conditions in the downstream watercourses had receded sufficiently. Due to off site flooding mechanisms, the runoff within

the development will need to be stored for up to one to two days with a zero discharge during the 1 in 200 year plus climate change event.

11.144 Flood mitigation will be provided to the catchments downstream of the site by the implementation of the water park and the proposed control mechanisms.

11.145 The proposed development includes the creation of a new flood bund between the water park and the CGB. This will form a reservoir on site, ensuring the runoff from the site can be managed to reduce the risk downstream but also to prevent the external flood risk affecting the site.

11.146 The site, including access and egress routes, will be located above the 1 in 100 year plus climate change (20%) flood level. Therefore, residents will remain safe with safe dry access and egress available at all times, in the event that the primary and secondary defences are breached during a 1 in 100 year plus climate change event.

11.147 The proposed on site attenuation has been designed to accommodate all the runoff from the development area from the 1 in 200 year event (plus climate change; 30%) without discharging. The relative levels of the water park area have been designed so that if a storm occurred in excess of the 1 in 200 year event (plus climate change) the volume of water could be stored without discharge from the primary development site or placing the development at risk. Therefore, although during extreme events there may be overtopping of the attenuation ponds and flooding of the water park area, there will be no flood risk to the developed areas / properties on site and significant benefit to downstream properties.

11.148 The site will therefore provide the first phase of the water park, providing ecological and social benefits at the outset of the scheme as well as ensuring there is no increase in flood risk as a result of the scheme.

11.149 The existing outfalls under the CGB route are the only hydraulic structures that could produce a flood risk to the site area. Surface water runoff will be stored within the attenuation ponds in the water park prior to discharging by pumping into the existing culverts under the CGB and then into Beck Brook and / or Reynolds Drain. Therefore, it is not anticipated that these culverts would cause a flood risk, even if they became blocked, due to the significant capacity of the ponds.

11.150 Sewers have also been sized to ensure that no surface water flooding occurs for events up to and including the 1 in 30 year design storm event. The pipe diameters within the sewer networks have been designed to accommodate the 1 in 2 year storm event at full bore and avoid surface flooding for a 1 in 30 year storm event.

Hatton's Road attenuation ponds area

11.151 The flooding mechanisms within Longstanton are primarily caused by a lack of hydraulic capacity within the culverted sections of the Longstanton Brook

as it flows through Longstanton village and a lack of maintenance at Bar Hill ponds.

11.152 As part of the 2007 site wide application for the Northstowe development, mitigation works to reduce flood risk in the existing villages of Longstanton and Oakington were proposed. As part of the phase 1 proposed development the flood mitigation for Longstanton will be delivered.

11.153 To mitigate the flood risk to Longstanton, two attenuation areas are proposed. These areas are located between Bar Hill and Longstanton villages adjacent to the Longstanton Brook, south of the B1050 (Hatton's Road) and are included within the phase 1 application area.

11.154 The attenuation areas are to have off-line connections to the Longstanton Brook, and have been designed to reduce peak flow in the brook. The scheme will utilise adjustable side inlet weirs to channel some of the existing flood flow into the attenuation area, with culverts to allow the water to drain out once flood flows have passed. This means that normal flows will by-pass the attenuation areas but will divert flood flows in extreme events, reducing flood flows through Longstanton. The brook will be locally diverted around these areas so they can to be integrated into the landscape whilst reducing the extent of earthworks required.

11.155 The benefit of these attenuation features will be to reduce the 1 in 100 year flow through Longstanton village to less than the existing 1 in 20 year event peak flows, therefore reducing both the frequency and severity of flood events.

Overall effect

11.156 The site is not considered to be at flood risk following development and will not displace any flood water. Additionally, the drainage strategy provides a tangible benefit to the existing catchment by the retention of flows on site for the 1 in 200 year event (plus climate change). Therefore, there is likely to be a change of small magnitude on a receptor of high sensitivity, leading to a long term, moderate, significant beneficial effect.

Effects on groundwater from reduced recharge rates associated with the increased impermeable area on site

11.157 The following provides a qualitative assessment of the effects on groundwater from reduced recharge rates. The solid stratum underlying the site comprises the Ampthill Clay. As this is classified as non-productive strata, effects to this stratum will not be assessed here.

11.158 Superficial deposits comprising River Terrace Deposits underlie the west of the primary development site only, and get thinner towards the centre. They are not present within the east of the site. Therefore, permeable areas with the potential for permitting significant infiltration and subsequent groundwater recharge are only considered to be present across approximately half the

primary development site, and are of reduced thickness within some areas (in the centre).

11.159 Groundwater flow direction within the River Terrace Deposits is towards the north. The River Terrace Deposits are classified as a Secondary A Aquifer. However, the groundwater quantitative and chemical status below the site was not assessed as part of the EA's River Basin Management Plans and therefore it is considered to have been regarded as of relatively low priority.

11.160 One regulated groundwater abstraction and potentially further deregulated groundwater abstractions are located towards the north of the primary development site, and two regulated abstractions are located to the south. One regulated abstraction is currently located on site and will be terminated during construction.

11.161 The abstractions to the south will not be assessed here as they are located up gradient of the primary development site and therefore should not be affected by the development. The groundwater abstractions to the north are considered to be the main sensitive receptors to any decrease in groundwater recharge rates.

11.162 The termination of the current on site groundwater abstraction borehole will aid in reducing the impact to groundwater recharge rates through increased impermeable surfacing.

11.163 Surface water runoff from the primary development site is currently drained by a network of drainage ditches that drain to the surface water features in the wider area. The drainage strategy following development will remain relatively similar, with surface water runoff discharging to the main ditches, which will be retained. The main existing pond located in the west will also be retained, providing an ongoing source of rainfall / surface water runoff capture and infiltration within the permeable area.

11.164 Although the proposed development will reduce the permeable areas on the primary development site, the actual reduction is anticipated to be relatively small. The proposed master plan shows that the west of the primary development site will comprise open vegetated areas, including formal recreation / sports pitches, allotments, informal open space, landscape and habitats. The remaining area includes a proposed school, which will likely contain sports pitches, and residential areas which will contain garden and landscaped areas.

11.165 Only small localised areas within the north of the western section (a proposed residential area and part of the school area) will incorporate an element of cohesive fill with regards to earthworks (thus potentially decreasing infiltration rates). Based on the proposed earthworks, these will comprise a maximum of 1 m fill, with the majority at less than 0.5 m.

11.166 Therefore, qualitatively the decrease in groundwater recharge rates on the primary development site through increased impermeable surfacing is

anticipated to be small, and the current on site groundwater abstraction will be terminated. Based on this assessment, there is likely to be a change of small magnitude on receptors of medium sensitivity without mitigation, leading to a long term slight adverse effect that will not be significant.

11.167 No impermeable areas are proposed to be constructed in the Hatton's Road attenuation pond area and the ponds will not be lined. Therefore, there should not be a reduction in groundwater recharge in this area.

Effects arising from the increased demand for potable water and wastewater treatment and the associated upgrade works required

Potable water supply

11.168 It should be noted that this assessment considers impacts in relation to the availability of potable water supply only, and within only the primary development site.

11.169 The current distribution main is located on Station Road, which crosses through the north west of the primary development site. The area around the site is currently supplied by CW; however, the sole on site use of mains water supply is currently the golf club. Therefore, the current water usage rate is considered to be relatively low. The site is located in an area classified as 'serious' water stress by the EA and it is located within an area of relatively low rainfall.

11.170 The development of 1,500 new dwellings will create a demand on water resources at a local scale. At this stage, the dwelling types have not been confirmed. Therefore, using an average of two occupants per dwelling and assuming the 33% reduction in potable water usage below a baseline of 150 l/p/day is met, the approximate total residential potable water consumption for the development would be 0.3 Ml/day.

11.171 CW and AW have confirmed that they both have adequate water resources to serve the Northstowe development and that this can be delivered with the planned reinforcements (ref 11.18). For phase 1, reinforcements will comprise a new 300 mm diameter branch main that will be constructed from the trunk mains to the north of Longstanton, following the route of the new bypass.

11.172 CW produces company specific housing growth forecasts in order to ensure a continued level of supply now and in the future. These forecasts utilise best available information from a national, regional and local scale. CW states that it has a current healthy supply-demand balance, and anticipates being able to meet demand in its supply area until at least 2035 (including allowances for an increased rate of housing growth and climate change), with no plans for major investment in additional resources required. CW also expects that the demand for water in new dwellings will decrease through a combination of adoption of the Code for Sustainable Homes and the incorporation of grey water recycling.

11.173 Therefore, there is likely to be a change of small to medium magnitude on receptors of medium sensitivity without mitigation, leading to a long term, moderate, adverse, significant effect.

Wastewater treatment

11.174 AW is the sewerage undertaker for the area. It is responsible for the existing and proposed surface and foul water sewerage systems, as well as the sewage treatment facilities in the area. The current foul sewerage network is located on Station Road, which crosses through the north west of the primary development site. The existing foul flow from Longstanton, Oakington and the surrounding area is pumped to Over or Uttons Drove Sewage Treatment Works (STW). The Over STW discharges directly to the River Great Ouse, whilst the Uttons Drove STW discharges into the Swavesey Drain system. The current foul drainage volume is unknown; however, it is considered to be low as the sole on site user comprises the existing golf club.

11.175 Due to the size and nature of the proposed development, there will be a significant increase in the volume of foul discharge from the site, which could have an impact on utility infrastructure and downstream flood risk at the point of discharge from the STW on the Swavesey Drain Catchment.

11.176 The Uttons Drove STW, where capacity exists, is located 5.6 km to the west of the site and was identified by AW as the treatment facility best suited for improvement in order to receive the increased effluent associated with any new development in this area (technical appendix H, section 10). AW has confirmed that it can provide capacity for the development though implementation of its upgrade plans.

11.177 The area served by Uttons Drove STW, which discharges into the Uttons Drove drain, has been identified as a growth area in the local development framework and has seen new development in recent years, such as at Cambourne, with more development expected in the medium to long term, such as at Northstowe.

11.178 The discharge of treated sewage from Uttons Drove STW in the Swavesey Drain Catchment is the subject of a number of technical studies and designs (Uttons Drove Modelling Reports, ref. 11.23 and ref. 11.24) to ensure that any increase to the flow does not increase the flood risk to downstream properties. The STW discharges to a series of land drains that flow to Webbs Hole Sluice. When the River Great Ouse is in flood, the sluice closes and the additional treated effluent cannot be discharged into the River Great Ouse and therefore may increase the flood risk.

11.179 A land drainage scheme has been proposed and agreed in principle with the Swavesey Internal Drainage Board, the Environment Agency, AW, South Cambridgeshire District Council, the developers at Cambourne and the promoters of Northstowe. This solution will be delivered in two phases, with stage 1 of the scheme due to be completed before summer 2013:

- Stage 1 – increase land drainage capacity within the watercourses between the Uttons Drove STW and Webbs Hole Sluice
- Stage 2 – install a 1 m^3/sec pumping station at Webbs Hole Sluice to pump the water into the River Great Ouse when the sluice is closed

11.180 The modelling undertaken by the EA has demonstrated that the scheme can accommodate the additional 950 dwellings at Cambourne plus 1,500 dwellings at Northstowe. It is anticipated that the entire development of Northstowe will utilise one terminal pumping station, to be constructed at the northern end of the proposed development site, to discharge effluent from the site. The drainage for phase 1 will be sized to serve both phase 1 and to convey flows from the later phases to the terminal pumping station.

11.181 Phase 1 foul drainage will drain to the terminal pumping station generally by gravity, with local lifting stations as necessary to prevent excessive sewer depth. The individual pumping stations will be designed in accordance with AW's requirements for storage at the detailed design stage and therefore will reduce flood risk.

11.182 Due to receipt of capacity confirmation from AW (providing the relevant upgrades are undertaken), there is likely to be a change of small magnitude on a receptor of medium sensitivity without mitigation, leading to a long term, adverse, slight (and therefore not significant) effect.

Mitigation

Effects on surface water quality from pollution due to increased sediment loading during construction

11.183 At no stage during the construction process will surface water runoff from the construction site be permitted to discharge in an uncontrolled manner into any watercourses or the sewer system.

11.184 Prior to the commencement of the construction phase, site runoff will be controlled to mitigate both flood risk and sediment loading. At this time, the proposed drainage strategy for the construction stage has not been developed. This will be addressed during the detailed design stage in agreement with the EA.

11.185 It is assumed that site runoff will be collected and directed through the temporary drainage system and attenuated on site, prior to discharge ensuring the protection of water quality in receiving waterbodies on site and off site from an increased sediment load. Additional temporary stilling ponds may be required to deal with construction based solids in suspension.

11.186 A variety of good environmental site practices will be implemented to avoid or minimise effects at the source. Such measures will include, but are not limited to, the following:

- Working areas shall be clearly defined to ensure the disturbance of soils is minimised, where possible
- Haul routes and accesses shall be clearly defined to minimise the risk of accidents
- Implementation of a phased temporary drainage network in line with construction phasing to prevent sediment laden surface runoff from leaving the site or entering surface water features
- The cleaning of vehicle wheels prior to leaving site
- Controlled and covered waste storage areas
- Dust suppression (i.e. damping down)
- Provision of environmental awareness training for site workers
- Where necessary, all site works will be undertaken in accordance with the EA's Pollution Prevention Guidelines, in particular:
    - PPG1 *General Guide to the Prevention of Water Pollution* (ref. 11.10)
    - PPG5 *Works in, near or Liable to Affect Watercourses* (ref. 11.11)
    - PPG6 *Working at Construction and Demolition Sites* (ref. 11.12)
- Installation of systems such as silt traps, including adequate maintenance and monitoring of these to ensure effectiveness, particularly after adverse weather conditions
- The position and extent of working areas shall reflect the sensitivity of surrounding areas and works being carried out. The contractor shall appraise the suitability of such working areas in this respect as part of working method statements

11.187 Earthworks and construction activities will also be undertaken in accordance with CIRIA guidance *C532 – Control of Pollution from Construction Sites* (ref. 11.15). All site works and ground works will be undertaken in accordance with the Considerate Contractors Scheme to help ensure a well-managed operation that minimises environmental risks.

11.188 Best practice recommendations for the prevention of contamination will be outlined in more detail in a Construction Environment Management Plan (CEMP) or equivalent, which will be developed prior to the site construction phase commencing.

11.189 Any dewatering that will be carried out as part of the construction process will be stored, attenuated and discharged at appropriate rates to the public combined sewer. Discharge consents will be obtained from the EA as appropriate.

11.190 The above mitigation measures will reduce the magnitude of change to negligible and therefore the degree of effect to negligible. The effect will no longer be significant.

Effects on construction workers and construction activities from increased surface water runoff, drainage flooding and / or groundwater flooding during construction

11.191 Prior to the commencement of the construction phase, site surface runoff will be controlled to mitigate flood risks as discussed in the sediment loading section above. The proposed drainage strategy for the construction phase of the proposed development has not yet been developed. This will be addressed during the detailed design stage.

11.192 Groundwater levels should be monitored during all excavations. Dewatering measures should be employed if necessary. Should dewatering be required, abstraction and discharge licences will be sought from the EA under the terms of the Water Resources Act 1991.

11.193 Construction workers on site should be made aware of risks during the construction phase. Contingency and evacuation plans for any risk will be prepared and the information provided to all workers on site.

11.194 The above mitigation measures will reduce the magnitude of change to negligible and therefore the degree of effect to negligible. The effect will no longer be significant.

Effects on surface water quality from pollution due to increased sediment loading post-construction

11.195 Site surface water drainage (including roads) will be designed in accordance with best practice to prevent pollution from surface water runoff.

11.196 A network of positive drainage systems will direct surface water runoff to on site attenuation ponds (i.e. the water park) prior to discharge. In addition, a series of local SuDS options will be utilised throughout the development that will ensure water quality is maintained prior to discharge from the site. This will include the use of swales, ditches, and permeable surfaces / pavements that will prevent sediments from reaching watercourses and / or enable sediments to settle out of suspension prior to discharge.

11.197 In order to mitigate the potential impact to retained surface water features, interceptors will be utilised at appropriate locations to enable sediments and other contaminants to be removed from the surface water runoff prior to entering the retained drainage ditches.

11.198 The surface water features within the locality are unlikely to be affected by significant amounts of sedimentation, as sediments that arise as a result of the proposed development will ultimately fall out of suspension within the attenuation features prior to discharge.

11.199 It is acknowledged that over time, if not appropriately managed, the potential build up of sediments within the attenuation features has the potential to result in the accidental release of physical contaminants to sensitive surface water

receptors. To mitigate this potential impact, a commitment is made to ensure that the attenuation features and drainage infrastructure are appropriately managed and maintained throughout the duration of the operational phase of the development. It is understood that the detail of how these features are to be managed and maintained has not yet been agreed, but is currently being investigated and considered by the relevant stakeholders. This will be further developed during the detailed design stages.

11.200 To ensure that physical contaminants associated with the storage of materials on-site do not adversely impact sensitive surface watercourses, future tenants of light industrial / commercial units etc. will be required to ensure that the appropriate storage of materials is in general accordance with the EA PPGs, in particular:

- PPG1 *General Guide to the Prevention of Water Pollution*
- PPG5 *Works in, near or Liable to Affect Watercourses*

11.201 For further detail on appropriate storage of chemicals refer to chapter 10: geology, hydrogeology and contamination.

11.202 The above mitigation measures will reduce the magnitude of change to negligible and therefore the degree of effect to negligible. The effect will no longer be significant.

Effects on the hydrology and associated flood risk of surrounding watercourses due to increased surface water runoff post-construction

11.203 There will be substantial freeboard (over 1 m) from the top flood water level during the 1 in 200 year event (including an allowance for climate change), and the proposed minimum finished floor levels of built development will be set at higher levels to the water park area. This will provide a substantial amount of storage if a second storm occurred whilst the water park was draining down. The exact volume required in this area, and therefore its final capacity, will be confirmed as part of the detailed design. Owing to the land raising and the provision of the bund along the edge of the water park, the risk of a failure in terms of defences is minimal.

11.204 Discharge to the Beck Brook and Cottenham Lode from the water park will be pumped at a time when the Cottenham Lode is not in flood and therefore not increase the flood risk downstream.

11.205 The flood flow and levels in the Beck Brook and Cottenham Lode will be monitored following the development using a telemetry system linked to a number of sensors. These systems will be integrated into both the pump control systems on the site and the stakeholders' monitoring systems to allow discharge from the site to be regulated in response to dry weather and storm conditions within the catchment. The proposed development will therefore have a wider benefit to the surrounding communities by ensuring that surface water runoff from the development does not exacerbate existing flood risks to downstream settlements, and enabling riparian base flows to be maintained. It

is proposed to link the monitoring points for the stations with the EA's flood warning network, thereby providing the opportunity to improve emergency planning within areas of existing development prone to flooding.

11.206 A range of SuDS options will be considered at the next stage in the planning process and included into the design codes, depending on the development type and location. The exact form of SuDS will depend on the specific local constraints associated with individual areas of the site. These will also help to reduce local flood risk.

11.207 The classification of the water park as a reservoir requires an inspection and maintenance programme for the future. An agreed programme by a Reservoirs Panel Engineer will be produced in accordance with legal requirements set out within the Reservoirs Act 1975. This programme is in line with what would be expected for a new town of this size.

11.208 The site is known to have fluctuating shallow groundwater levels. Ground levels will be raised for on site drainage reasons; however, this will also result in reducing groundwater flood risk post development. Given the high groundwater levels, no basement construction will be permitted.

11.209 Inclusion of the above mitigation measures, along with those proposed as part of the application will contribute to a positive effect on the hydrology and associated flood risk due to surface water runoff post-construction. The magnitude of change will be small on a receptor of high sensitivity, therefore leading to a long term, positive, moderate, significant effect.

Effects on groundwater from reduced recharge rates associated with the increased impermeable area on site post-construction

11.210 As set out above, the increased runoff generated from the phase 1 area will be managed through a series of SuDS measures provided both at source and regional control level. A range of SuDS options will be used on site and will be considered at the detailed design stage, depending on the development type and location. The exact form of SuDS will depend on the specific local constraints associated with individual areas of the site. The opportunities for integrating source control measures at plot scale include the use of swales, porous paving and infiltration devices.

11.211 The SuDS techniques will attenuate flows and promote infiltration where ground conditions allow, thus recharging the underlying aquifer and completing the natural water cycle.

11.212 Although the SUDS mitigation measures will aid in increasing groundwater recharge rates, overall it is anticipated that the infiltration rates will still decrease, albeit to a relatively small effect. Therefore, the magnitude of change will remain small and the degree of effect will remain long term, adverse, slight and will not be significant.

Effects arising from the increased demand for potable water and wastewater treatment and the associated upgrade works required post-construction

Potable water supply

11.213 The NAAP Policy NS/21 section 6 states: "All development in Northstowe will incorporate water conservation measures, including water saving devices, rainwater harvesting and grey water recycling whilst managing the recycling of water in order to achieve between 33% and 50% reductions on mains water use compared with conventional housing".

11.214 The importance of reducing consumption is recognised within the Code for Sustainable Homes (ref. 11.25), where water usage is set as a mandatory standard for levels 1 and 2 at 120 l/p/d, levels 3 and 4 at 105 l/p/d, and levels 5 and 6 at 80 l/p/d.

11.215 The developers aim to achieve a Code for Sustainable Homes (ref. 11.25) 3 credit rating for water demand (WAT1) for residential properties, which equates to a demand of 105 l/p/d or less. WAT1 awards credits based on reducing the calculated internal water demand of residents by either minimisation of demand, reuse or recycling.

11.216 The Water Conservation Strategy (ref. 11.17) sets out plans on how to achieve a water demand figure of 99 l/p/d, a level equivalent to three credits under Code for Sustainable Homes (ref. 11.25) and 33% less than a typical demand of 150 l/p/d.

11.217 The strategy for commercial buildings is also to provide a 33% to 50% reduction in demand over typical industry baseline figures, in line with domestic demand reduction requirements set out within the NAAP. The school will be the responsibility of the Cambridgeshire County Council and would have its own water minimisation strategy produced at the time of design. However, targets should be keep in-line with the minimum policy 33% reduction over typical school demand.

11.218 It is anticipated that a decrease of 33% in potable water demand below typical demand will be achieved across the site through the implementation of demand reduction (low flow taps, dual flush WCs and low consumption / water free urinals) and rainwater harvesting. In addition, the viability of grey water reuse will be assessed.

11.219 Providing water conservation and demand reduction measures are installed in the development as discussed above, the magnitude of change will be small and the degree of effect will be slight and not significant.

Wastewater treatment

11.220 The on site strategy will utilise the topography and the layout to minimise the depth of sewers, whilst at the same time minimising the number of pumping stations to reduce the long term maintenance requirements.

11.221 The detailed foul drainage system for the primary development site has not been finalised to date and it is understood that this will be addressed during the detailed design stage in collaboration with AW. It is anticipated that this will include measures for minimising foul drainage in combination with measures for minimising water use.

11.222 It is considered that the magnitude of change will remain small and the degree of effect will remain long term, slight, adverse and will not be significant.

Residual effects

11.223 The significant residual effects are summarised in table 11.5.

Table 11.5: Significant residual effects

Topic	Significant residual effect	Sensitivity of receptor	Magnitude of change	Duration	Nature	Degree of effect	Level of certainty
Water resources, flooding and drainage	Reduction in existing flood risk post-construction on site and in Longstanton	High	Small	Long term	Beneficial	Moderate	Reasonable