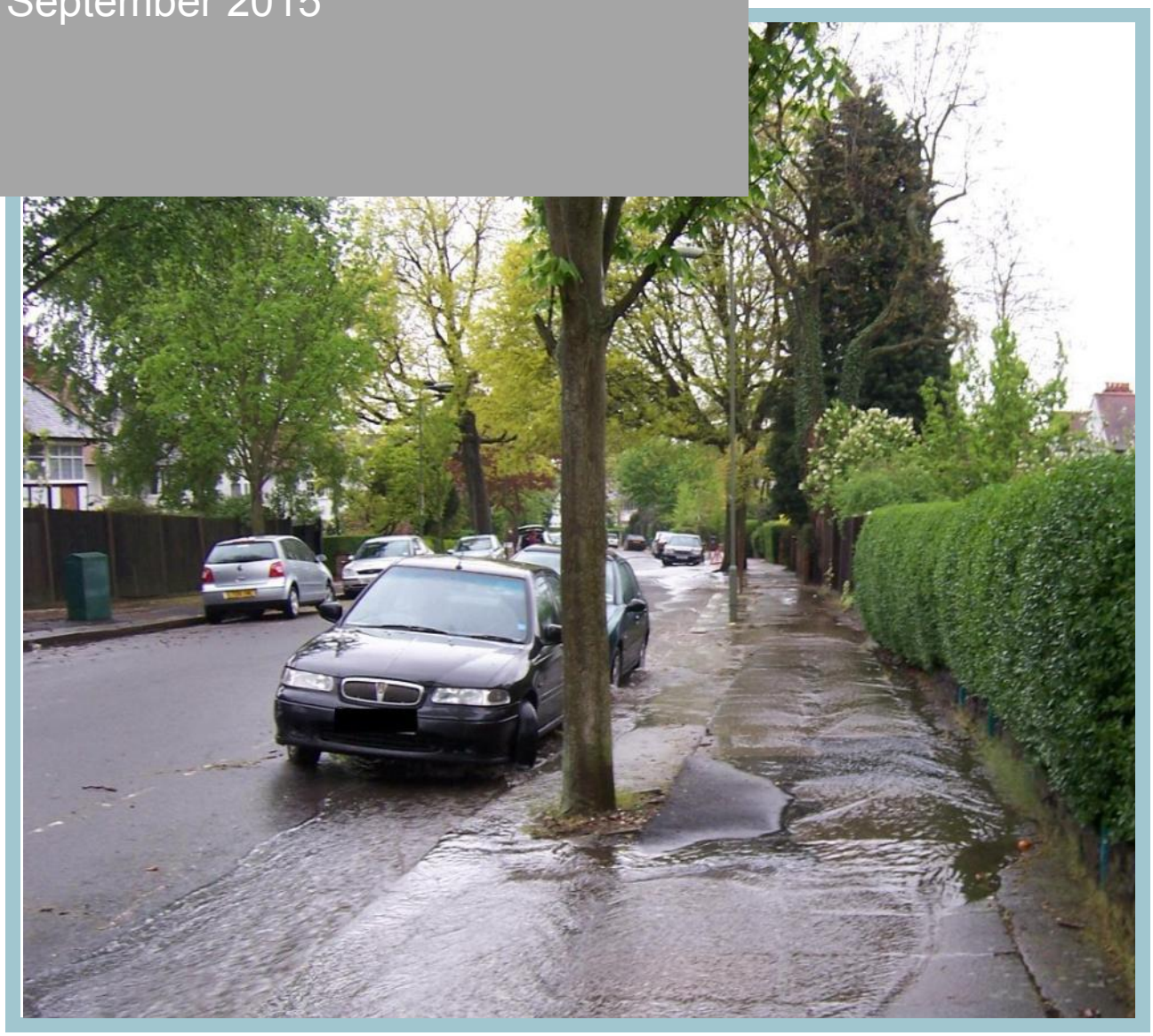
LUTON BOROUGH COUNCIL

Flood Risk and Water Management

Luton Water Cycle Strategy

September 2015



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Quality Management

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Contents

Appendices

Glossary of Terms

Term	Description
AMP	Asset Management Plan
AfW	Affinity Water (formerly Veolia Water Central Limited)
AWS	Anglian Water Services
AOD	Above Ordinance Datum
BAP	Biodiversity Action Plan
BAT	Best Available Technology
BOD	Biochemical Oxygen Demand
CAMS	Catchment Abstraction Management Strategy
CFMP	Catchment Flood Management Plan
CSH	Code for Sustainable Homes
CSO	Combined Sewer Overflow
CWS	County Wildlife Site
Defra	Department of Environment, Food and Rural Affairs
DTI	Department of Trade & Industry
DWF	Dry Weather Flow – the minimum or baseflow in a sewer network in dry weather conditions
EA	The Environment Agency of England
FEH	Flood Estimation Handbook
FFT	Flow to Full Treatment (at a wastewater treatment works)
Flood risk	The percentage probability of a flood occurring which causes significant damage or disruption within a given year
Flood zones	Areas defined by the Environment Agency as being at risk of flooding. Zone 2 has a flood risk probability of between 1 in 100 and 1 in 1,000 (1% - 0.1%). Zone 3 has a probability of greater than 1 in 100 (1%)
FRA	Flood Risk Assessment
FRMP	Flood Risk Management Plans
GI	Green Infrastructure
IDB	Internal Drainage Board
IUD	Integrated Urban Drainage
JTU	Joint Technical Unit
LBC	Luton Borough Council
LDF	Local Development Framework
LFRMS	Luton Flood Risk Management Strategy (EA)
LLFRMS	Luton Local Flood Risk Management Strategy (LBC)
LNR	Local Nature Reserve
LPA	Local Planning Authority
MKSM SRS	Milton Keynes South Midlands Sub-Regional Strategy
Ofwat	Office of Water Services (The Water Services Regulation Authority)
ONS	Office of National Statistics

Term	Description
PFRA	Preliminary Flood Risk Assessment
pcc	Per Capita Consumption (litres per head per day)
NPPF	National Planning Policy Framework
PZ	Water resources Planning Zone (smaller area units within WRZ)
dRBMP	draft River Basin Management Plan
RE1	River Ecosystem 1
RQO	River Quality Objectives
RSA	Restoring Sustainable Abstraction
East of England Plan	Regional Spatial Strategy for the East of England. The East of England Plan was formally revoked by Government in January 2013.
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SHLAA	Strategic Housing Land Availability Assessment
SIMCAT	Environment Agency's modelling software for water quality assessment
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
Standard of protection	The probability of a flood occurring which causes the existing flood defences to be overtopped or fail
SUDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
TSS	Total Suspended Solids
TWUL	Thames Water Utilities Limited
UKTAG	United Kingdom Technical Advisory Group
UWWTD	Urban Wastewater Treatment Directive
VWC	Veolia Water Central Limited (formerly Three Valleys Water)
WAT1 / WAT2 etc.	RSS East of England Plan water-related policies
WCS	Water Cycle Strategy
WFD	Water Framework Directive
WHO	World Health Organisation
WRMP	Water Resource Management Plan
WRMU	Water Resources Management Unit
WRZ	Water Resource Zone
WSI	Water Services Infrastructure
WTW	Water Treatment Works
WwTW	Wastewater Treatment Works

1. Introduction

1.1.1 The need for additional housing in the South and East of England is well documented. A Water Cycle Strategy (WCS) identifies tensions between growth proposals and the environmental requirements, providing details of the water cycle related actions and infrastructure needed to facilitate planned growth.

1.1.2 Capita AECOM were commissioned in September 2012 to revise the Luton and Southern Central Bedfordshire Phase 1 (2008) and Phase 2 (2010) Water Cycle Strategy (WCS) documents. The updated WCS concentrates on the Luton Borough Council (LBC) Administrative Area; however the study area also includes some parts of Bedfordshire and North Hertfordshire to encompass potential development sites, water company supply zones and wastewater treatment works' catchments.

1.1.3 The previous Phase 2 WCS built directly on the Phase 1 WCS, providing a more detailed investigation; as such, much of the information contained in the Phase 2 report supersedes that in Phase 1. Therefore, in updating the documents have been combined into a single Water Cycle Strategy document for Luton.

1.1.4 The Luton Water Cycle Strategy addresses the key areas of: water efficiency; wastewater treatment; environmental water quality; water resources; water supply; wastewater drainage; flood risk and surface water as well as the ecological constraints and opportunities relating to these aspects of the water cycle. The output of this Strategy is the high level specification of technically feasible Water Services Infrastructure (WSI) solutions which will enable potential developments to be served without detriment to the water cycle.

1.1.5 A summary table of the water services actions and infrastructure associated with potential development is provided below, referenced to the appropriate sections of the report for further detail on each item.

1.1.6 It is recommended that this WCS is reviewed on a regular basis to ensure that progress is monitored and that the Strategy contained herein is updated if necessary following any significant changes in the development proposals for the Borough. The stakeholder group should maintain contact to discuss issues arising relating to the delivery of water services infrastructure.

TABLE 1-1: SUMMARY OF REQUIRED WATER CYCLE ACTIONS AND INFRASTRUCTURE

Water Cycle Aspect	Estimated Timescale[1]	Infrastructure Requirements	Responsibility	Report Reference
Water resources	Policy action required prior to development; other measures according to timeline provided	Council to implement CSH level 3/4 for all new domestic properties through planning policy – developers to comply. Programme of measures recommended for achieving reduced water consumption across the Borough.	AfW, Luton BC, Developer(s)	Paragraph 6.8.48
Sewerage	Prior to development	Detailed modelling where required to confirm whether (and how much of) initial development on new sites can drain to existing networks.	AWS,TWUL	Paragraph 5.3.1
Flood Risk & Surface Water	Prior to planning approval	Undertake further regional and site-specific studies as recommended in Table 10.2.	Developer(s), TWUL, Luton BC, AWS, EA	Table 10.2
Wastewater & water quality	Ongoing	Development of a policy that requires developers to ensure that surface water drainage systems are designed to deliver water quality improvements in the receiving watercourse or aquifer to meet the objectives of the WFD.	Luton BC, EA, AWS, TWUL	Paragraph 10.2.3
Ecology	During planning negotiations for each site and as development progresses	Pursue opportunities for wetland habitat creation and enhancement of existing wetland features, and linking habitats through extensive Green Infrastructure to surrounding countryside.	Developer(s), Luton BC	Paragraph 9.6.24 to 9.6.36
Ecology	Prior to planning approval for each site	Identify opportunities for wetland habitat creation associated with SUDS strategy.	Developer(s)	Paragraph 9.6.24 to 9.6.36
Ecology	Not yet defined	Consider wetland habitat creation as part of any flood risk attenuation proposals for WwTW.	AWS, TWUL	Paragraph 9.6.25

[1] Timescales are approximate based on planning trajectory provided by LBC and set out in section 4 of this WCS. A plan led approach has been taken to ensure that long term, strategic infrastructure requirements are identified and planned for to support new development and protect against associated impacts on the urban water cycle. This strategic infrastructure requires long lead in times and must be progressed in alignment with long term growth plans to ensure that it can be provided in time to support development as it comes forward. Non-strategic infrastructure (such as local network upgrades, booster stations, etc) has also been identified to facilitate strategic planning; however, it is accepted that these will be more closely linked to the short term market conditions because once identified, their delivery is triggered by development and does not require long lead in times.

2. Background

2.1 Introduction

2.1.1 This Strategy forms a key part of the strategic planning process for Luton Borough, and will be used to inform the Local Plan (2011-2031) which is currently under development.

2.1.2 In April 2009 South Bedfordshire merged with Mid Bedfordshire to form the new unitary authority, Central Bedfordshire. In the 2010 WCS, the part of the previous study area comprising the former district of South Bedfordshire was referred to as Southern Central Bedfordshire. Where wording relates to other prior studies for the area, these remain as South Bedfordshire for the local authority and Southern Central Bedfordshire for the South Bedfordshire local authority administrative area respectively. These terms will be used throughout this report for continuity, although it must be noted that the updated study is for Luton Borough Council alone.

2.1.3 The Luton and South Bedfordshire Joint Committee and the Joint Technical Unit (JTU) referred to in the previous WCS are no longer in existence; therefore, references to the Joint Committee and JTU are made in a historical context only.

2.2 Project History

2.2.1 The original Phase 1 WCS assisted in identifying preferred development sites from thirteen potential options identified within the Core Strategy Issues and Options Paper, by assessment of potential impacts of growth on flood risk, water supply and resource, wastewater treatment and foul network. The Phase 2 WCS detailed the water cycle related actions and infrastructure needed to facilitate growth at the preferred sites identified in Phase 1.

2.2.2 Key findings of Luton and South Bedfordshire Phase 1 WCS (2008) are provided in Table 2.1.

TABLE 2-1: KEY OUTCOMS OF LUTON AND SOUTH BEDFORDSHIRE PHASE 1 WATER CYCLE STRATEGY (2008)

Water Service Aspect	Major Findings
Flood Risk	The high-level flood risk assessment undertaken in the previous Phase 1 WCS (2008) indicated that a number of potential development sites had potential flood risk issues and constraints, however these were not considered to be a significant restriction to development in the region
Wastewater and Treatment	Dunstable and Chalton WwTW, owned and operated by Anglian Water Services (AWS), have potential capacity to accept some growth although a permit revision might be required for all Wastewater Treatment Works
Ecological Constraints and Opportunities	Sites bordering Luton to its north and north-west were identified as Sites of Special Scientific Interest (SSSI) - Fancott Woods, Meadows and Flitwick Moor SSSI . Increased flows from Chalton WwTW were identified as having possible impacts on these SSSIs. A detailed ecological assessment of constraints and opportunities associated with the potential development sites was recommended, along with a gap analysis and if necessary a field survey.
Water Supply and Resources	AfW has adequately identified provision of water to the Borough, however there is limited capacity within the network and upgrades are required.

2.2.3 A number of legislative changes have taken place since the Phase 2 Water Cycle Strategy (2010), along with changes to the administrative authorities in the region. Consequently, Capita AECOM have been commissioned to update the WCS for the area administered by Luton Borough Council.

2.2.4 Planning policies for England were reformed in March 2012 and the National Planning Policy Framework (NPPF) introduced. The NPPF and accompanying Planning Practice Guidance (PPG) aim to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth. This strategy will make reference to the NPPF.

2.2.5 A Surface Water Management Plan (SWMP) was developed for Luton Borough Council by Capita between October 2010 and November 2011. The SWMP outlines the preferred surface water management strategy for the study area, covering flooding from sewers, drains, groundwater, runoff from land, and ordinary watercourses occurring as a result of heavy rainfall.

2.2.6 Preliminary analysis showed that at most sites, increases in runoff could be mitigated using infiltration SUDS. The SWMP further investigated the potential for strategic flood mitigation measures that offer the opportunity to reduce flood risk to existing development in addition to providing mitigation for new developments, with due consideration to local ecological and green infrastructure goals. This WCS takes into account findings from the SWMP and considers the interrelationship between new development and legacy flooding in existing development, as well as identifying potential opportunities for new development to provide betterment for existing communities.

2.3 The WCS partners

The key stakeholders in the delivery of growth and associated Water Services Infrastructure are as follows:

- Luton Borough Council
- The Environment Agency (EA)
- Anglian Water Services Ltd (AWS)
- Thames Water Utilities Ltd (TWUL)
- Affinity Water (AfW)
- Central Bedfordshire Council (CBC)
- North Hertfordshire District Council (NHDC)
- Luton Airport

2.3.1 TWUL, AfW and AWS are the incumbent water companies jointly responsible for providing water supply, foul sewerage and wastewater treatment services for the study area. The Environment Agency is responsible for provision of a framework to comply with environmental standards and government policy to safeguard water resources, water quality and ecological status; as defined in the Water Framework Directive for which the Environment Agency is the lead in England and Wales. The Environment Agency also has wide-ranging statutory responsibilities for managing flood risk, detailed in Section 3.

2.3.2 The WCS partners worked collaboratively to develop the project objectives for the previous WCS, and to define the relevant parameters within which to develop the direction for Water Services Infrastructure in Luton.

2.3.3 The general water-related catchments that need to be considered are:

- River basin catchments
- Water resource zones
- Wastewater treatment works drainage catchments

2.3.4 Other, more specific cross catchment issues associated with this WCS relate to:

- Water supply for potential development sites that are located on and around the boundaries between the AWS and AfW catchments
- Foul sewerage and wastewater treatment for the potential development sites that are located on and around the boundaries between the AWS and TWUL catchments

2.4 Water Cycle Strategy Guidance

2.4.1 According to the Environment Agency's Water Cycle Study Guidance, a detailed water cycle study is to be undertaken alongside the latter stages of the Luton Local Plan process, and should:

- Identify what water cycle systems are needed, and where;
- Identify who is responsible for providing the systems, and by what deadline;
- Guide the local authorities and developers on site specific requirements (for example SUDS requirements).

2.4.2 Luton Borough Council has identified a number of potential sites for development within Luton. This strategy takes into account these potential development options, as well as potential development sites that lie outside of the Luton administrative boundary area, which may impact water services within Luton.

2.5 Objectives and Scope for Update

2.5.1 Luton Borough Council is currently in the process of updating its evidence base to support the production of the Submission Version of the Local Plan. This WCS will be an important part of the evidence base that will help to identify sites with potential for development over the period 2011 to 2031.

2.5.2 The WCS will help Luton Borough Council determine the most appropriate locations for development (with respect to water infrastructure and the water environment) to be identified in the Local Plan, whether in the form of strategic sites allocated within the Spatial Development Strategy, or as other sites to be allocated in a future Site Allocations Development Plan Document.

2.5.3 The objective of the WCS update is to identify any constraints on planned housing growth that may be imposed by the water cycle. The WCS then identifies how these can be resolved, for example by ensuring that appropriate Water Services Infrastructure (WSI) can be provided to support the proposed development. Furthermore, it should provide a strategic approach to the management and use of water which ensures that the sustainability of the water environment in the Borough is not compromised.

2.5.4 The outcome is the development of a water cycle strategy for the Borough which informs site specific and other DPDs of the water environment and WSI issues. This will need to be considered in bringing growth forward at various sites, including guidance for developers in conforming to the requirements of the strategy.

2.5.5 The key objectives of the WCS update for Luton Borough Council are as follows:

- Determine if solutions to wastewater treatment for each growth location are required and how this might impact phasing of development within (and around) each growth location;
- Determine whether any Habitats Directive designated ecological sites have the potential to be impacted by the wastewater treatment strategy via a screening process;
- Determine whether additional water resources are required to support growth;
- Determine upgrades required to water supply infrastructure relative to potential options for growth;
- Consider whether growth can be delivered and achieve a ‘neutral water use’ condition. Provide a pathway to achievement of water neutrality;
- Determine impact of infrastructure and mitigation provision on housing delivery phasing;
- Determine the risks to groundwater;
- Assess flood risk within Luton from all sources including surface water, fluvial, sewer and groundwater, taking into account the findings of the Surface Water Management Plan (2011) and updated Level 1 Strategic Flood Risk Assessment (2012);
- Provide recommendations for management of flood risk through the development planning process;
- Provide guidance on mitigating the impacts of development on flood risk;
- Identify potential opportunities for developers, local planning authorities and the Environment Agency to work together in providing strategic solutions that benefit the catchment as a whole; and
- Provide policy recommendations.

3. Relevant Policy and Guidance

3.1 Introduction

3.1.1 This section presents a review of the key planning and economic development policies at national, regional and local levels for the Luton area. Where appropriate we identify where these policies make specific reference to water infrastructure and water issues. These policy documents provide the framework which will shape future growth patterns. It is important to understand the spatial distribution of future growth in housing, employment, social/community facilities and other development in order to ensure that water infrastructure is provided in a timely manner and to ensure there is no damage to the water environment. An overview of these policies is provided below along with the role and responsibilities of key stakeholders.

3.2 European Union (EU) Policies

EU Water Framework Directive

3.2.1 The Water Framework Directive (2000/60/EC) is a framework to protect the water environment and to improve the quality of surface coastal and inland water bodies, groundwater, and associated wetlands.

3.2.2 The Environment Agency is the competent authority for implementation of the Water Framework Directive in England and Wales. This involves use of the Agency's regulatory powers as well as collaboration with other delivery agencies and local and regional government to deliver the intended outcomes.

Objectives

3.2.3 By taking an inclusive approach to managing water as it flows through catchments from lakes, rivers and groundwater to estuaries and the sea, the Water Framework Directive aims to:

- Improve the ecological health of inland and coastal waters and prevent further deterioration, especially by protecting against diffuse pollution in urban and rural areas through better land management;
- Drive wiser, more sustainable use of water as a natural resource;
- Create better habitats for wildlife in and around water;
- Progressively reduce or phase out discharges, emissions and losses of priority substances and priority hazardous substances;
- Progressively reduce the pollution of groundwater; and
- Contribute to mitigating the effects of floods and droughts.

3.2.4 The Water Framework Directive recognises the potential impacts on water bodies from new development as a pressure that must be addressed. The Environment Agency may, for example, work through the planning system and advise developers and local authorities to:

- Restore river margins to a natural state wherever possible through new development and redevelopment of previously developed land;
- Use Sustainable Drainage Systems where they are suitable to control peak flows in rivers and streams and help prevent urban pollution;

- Ensure that new water infrastructure is designed and located to improve the quality of local watercourses, and is resilient to the effects of climate change, especially the impact of higher peak flows;
- Plan, in partnership with water companies, so that new water infrastructure capacity is available in time to meet the demand from new development, and
- Ensure that inappropriate new development does not occur in places that are at risk of flooding, or where it increases the risk of flooding elsewhere.

The Environment Agency will do this by commenting on development plans, environmental assessments and planning applications. The EA also has powers under the Environmental Permitting Regulations to control discharges of treated effluent to surface water and to ground.

River Basin Management Plans (RBMP)

3.2.5 In England River Basin Management Plans identify what needs to be done by the Environment Agency and others to implement a Programme of Measures to achieve 'good status' (ecological, chemical and physical for surface water bodies, chemical and quantitative status for groundwater bodies) in designated water bodies. The first RBMPs were published in 2009. Second reports are to be published in 2015 and every six years after that until 2027.

3.2.6 River Basin Management Plans identify water bodies and appraise their baseline condition (2008). Standards for good status of water bodies are assessed under UKTAG Water Framework Directive guidance. Where water bodies do not meet the required standard the Programme of Measures will identify action needed to achieve it.

3.2.7 The RBMP process is currently in the implementation phase and progress reporting was completed in December 2012. The following phase from January 2013 to December 2015 will continue implementation of the Programme of Measures and complete a review of the first cycle of implementation. The consultation period run from the 10th of October 2014 to the 10th of April 2015. Luton falls within the Thames RBMP[2]. The RBMP document should be referred to for further detail, but condition assessment of water bodies in the Luton area is summarised below:

- River Lea - Poor Ecological Potential and Fails to Achieve Good Chemical Status.
- Groundwater – Generally 'poor' chemical status with some 'good' areas to the northern edge of the study area.

The area north of Houghton Regis (which falls within the study area) is covered by the Anglian RBMP. The Anglian River Basin Management Plan (December 2009)[3] identifies Luton as one of the three largest Growth Area which will see a substantial amount of new development in the next 15-20 years, particularly in areas identified for growth or regeneration. Pressures from the cumulative impacts of planned development, especially those on water resources and water quality mean that actions will be required to achieve good ecological status and ensure that there is no deterioration. Refer to the RBMP document for more details.

There are three WFD groundwater bodies in Luton: the Upper Lee Chalk (includes most of Luton), the Upper Bedford Ouse Chalk (northern area) and the Mid-Chilterns Chalk (in the southwest). There are three Groundwater SgZs in Luton: one is for nitrate from urban sources and includes most

[2] Thames River Basin Management Plan available from: http://www.environment-agency.gov.uk/research/planning/125035.aspx

[3] Environment Agency River Basin Management Plan, Anglian River Basin District available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/309814/River_Basin_Management_Plan.pdf

of central Luton, the other two, which are for boron and nitrate overlap with Luton to the west and east respectively.

Flood Risk Management Plans (FRMP)

3.2.8 Flood Risk Management Plans (FRMPs) highlight the hazards and risks of flooding from rivers, the sea, surface water, groundwater and reservoirs, and set out how Risk Management Authorities (RMAs) work together with communities to manage flood risk.

3.2.9 Flood Risk Management Plans must include:

- A map showing the boundaries of the Flood Risk Area;
- The conclusions drawn from the flood hazard and risk maps;
- Objectives for the purpose of managing the flood risk;
- Proposed measures for achieving those objectives;
- A description of the proposed timing and manner of implementing the measures including details of who is responsible for implementation;
- A description of the way implementation of the measures will be monitored;
- A report of the consultation, and
- Where appropriate, information about how the implementation of measures under the FRMP and RBMP area will be co-ordinated.

3.2.10 FRMP is currently out for consultation. The consultation period closes at the 2nd of June 2015.

3.3 National Policies

Future Water (2008)

3.3.1 Future Water (published February 2008) sets out the Government's vision for water in England in 2030. The strategy sets out an integrated approach to the sustainable management of all aspects of the water cycle, from rainfall and drainage, through to treatment and discharge. The strategy focuses on practical ways to achieve the vision to ensure sustainable use of water from the perspective of people, businesses and the environment. Specific aspects of the water sector considered in Future Water are:

- Water demand;
- Water supply;
- Water quality, and
- Flooding (river, coastal, surface water and groundwater flooding).

3.3.2 The strategy also sets out the vision to cut greenhouse gas emissions, and discusses the regulatory framework for the water industry.

3.3.3 It looks at the adaptability of our water environment to climate change and other pressures on the water cycle. The aim is to ensure sustainable delivery of water supplies, and help improve the water environment for future generations.

Water for Life (2011)

3.3.4 Water for Life, commonly referred to as the Water White Paper, was published by the Department for Environment, Food and Rural Affairs (Defra) in December 2011. The White Paper sets out objectives for delivering future water management under the potential pressures of climate change and population growth. The White Paper focuses on future challenges facing the water sector, including maintaining water supplies for people, agriculture and business, while recognising the need for protection of watercourses and the importance of water supply and sewerage infrastructure.

3.3.5 The Environment Agency published two documents in support of this known as the "Case for change". "Current and future water availability" presents potential impacts of climate change and population growth on supply and demand, and "Reforming water abstraction management in England", written in collaboration with Ofwat, includes an assessment of the current regulatory regime and whether it is fit for purpose in the longer term.

Flood and Water Management Act (2010)

3.3.6 Combined with the Flood Risk Regulations 2009, (which enact the EU Floods Directive in England and Wales) the Flood and Water Management Act 2010 places significantly greater responsibility on Local Authorities to manage and lead on local flooding issues. The Act and Regulations together set out the requirements and targets Local Authorities need to meet, including:

- Playing an active role leading flood risk management;
- Development of Local Flood Risk Management Strategies (LFRMS);
- Preparation of preliminary flood risk assessments, flood hazard maps, flood risk maps and flood risk management plans;
- Development and implementation of drainage and flood risk management strategies; and
- Responsibility for approval, followed by adoption, management and maintenance of Sustainable Drainage System (SUDS).

3.3.7 The Flood and Water Management Act also clarifies three key areas that influence development:

- Sustainable drainage (SUDS) - the Act makes provision for a national standard to be prepared on SUDS. Developers will be required to obtain local authority approval for the SUDS in accordance with the standards, likely with conditions. When are designed and constructed robustly, local authorities will be required to adopt and maintain the SUDS.
- Flood risk management structures - the Act enables the EA and local authorities to designate structures such as flood defences or embankments owned by third parties for protection if they affect flooding or coastal erosion. A developer or landowner will not be able to alter, remove or replace a designated structure or feature without first obtaining consent from the designating authority..
- Permitted flooding of third party land - The EA and local authorities have the power to carry out work which may cause flooding to third party land where the works are deemed to be in the interest of nature conservation, the preservation of cultural heritage or people's enjoyment of the environment or of cultural heritage.

Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities (2011)

3.3.8 This 2011 advice[4] replaces Defra's Supplementary Note to Operating Authorities – Climate Change Impacts, October 2006. The advice is based on Governments policy for climate change adaption, and is specifically intended for projects or strategies seeking Government Flood Defence Grant in Aid (FDGiA). The purpose of this advice is to ensure that an economically credible appraisal taking account of the uncertainties associated with climate change can be made to support Government investment decisions. The guidance uses the latest guidance from UKCP09 to provide projections of rainfall and sea level rise through the century.

3.3.9 This guidance should be used by Luton Borough Council if and when it requests FDGiA or it may be used in developing plans for making Flood and Coastal Erosion Risk Management Appraisal (FCERM-AG) investment decisions.

3.3.10 Note the projections contained in the advice should not be used to inform FRAs and development design. The guidance contained within DEFRA's document 'Flood and Coastal Defence Appraisal Guidance FCDPAG3 Economic Appraisal' published in October 2006 should be used[5].

National Planning Policy Framework (2012)

3.3.11 The National Planning Policy Framework[6] (NPPF) was issued in March 2012 and outlines the national policy including development and flood risk assessment. This replaced with immediate effect national policy including all Planning Policy Statements. In the context of water cycle management, the NPPF addresses several key areas:

- Supporting a prosperous rural economy;
- Requiring good design;
- Protecting Green Belt land;
- Meeting the challenge of climate change, flooding and coastal change; and
- Conserving and enhancing the natural environment.

3.3.12 The Ministerial Statement issued in December 2014 obliged the Local Planning Authorities to require SUDS in all major developments from April 2015 and to formally consult with the Lead Local Flood Authorities on surface water flood risk and sustainable drainage.

3.3.13 Water Act (2014) The Water Act received Royal Assent on 14th May 2014. The provisions of the Act cover four main areas:

- Making water supplies more resilient to natural hazards such as drought and floods,
- Creating a national water supply network,
- Ensuring access to affordable flood insurance, and
- Increasing competition in the water industry.

[4] Environment Agency, 2011, Adapting to Climate Change Advice for Flood and Coastal Erosion Risk Management Authorities, Environment Agency Bristol

[5] http://webarchive.nationalarchives.gov.uk/20130822084033/http://www.defra.gov.uk/environ/fcd/pubs/pagn/climatechangeupdate.pdf

[6] National Planning Policy Framework (DCLG, 2012)

3.4 Local Policies

Strategic Flood Risk Assessment (SFRA)

3.4.1 The aim of the LBC Level 1 SFRA was to present sufficient information to enable the LPA to apply the Sequential Test (as defined by the NPPF) to site allocations and to assist in identifying if application of the Exception Test will be necessary. In addition the SFRA forms a reference document for use by development control officers for advising and determining decisions on windfall and allocated sites.

LBC Local Plan 2011-2031

3.4.2 The Local Plan sets out the Council's detailed policies and specific proposals for the development and use of land. The Draft Local Plan (2011-2031) has undergone consultation and, at the time of writing, consultation comments are being reviewed to inform the next draft of the Local Plan. The Draft Local Plan sets out guidelines for minimising the risk and impact of flooding through application of a sequential, risk based approach to development based on the NPPF and PPG.

Surface Water Management Plan

3.4.3 Capita were commissioned in 2010 to undertake the Surface Water Management Plan (SWMP) on behalf of Luton Borough Council. The plan outlines the preferred surface water management strategy for the borough and for the part of the catchment that lies within Central Bedfordshire. The work involved a four phase approach, collection and review, risk assessment, option assessment and the development of a long term action plan for Luton Borough Council.

3.4.4 Within the study area 17 Critical Drainage Areas (CDAs) were identified. For each of the CDAs identified within the study area, site-specific measures were identified that could be considered to help alleviate surface water flooding. Analysis of the number of properties at risk of flooding was undertaken for the rainfall event with a 1 in 100 probability of occurrence in any given year. A review of the results demonstrate that 6,085 properties in the study area could be at risk of surface water flooding of a depth greater than 0.1m during a 100 year rainfall event (above an assumed 0.1m building threshold).

Preliminary Flood Risk Assessment (PFRA)

3.4.5 A Preliminary Flood Risk Assessment (PFRA) was prepared by Capita for Luton Borough Council in June 2011. The report was prepared to ensure Luton Borough Council meet their duties to manage local flood risk under the Flood and Water Management Act 2010 and deliver the requirements of the Flood Risk Regulations (2009). Luton Borough Council is defined as a Lead Local Flood Authority (LLFA) under the Act.

3.4.6 The PFRA is aimed at providing high level overview of flood risk from all sources of flooding within the local area, including consideration of surface water, groundwater, ordinary watercourses and canals.

3.4.7 The geographic area covered by Luton Borough Council was not identified as an 'Indicative Flood Risk Area' by the national assessment undertaken by the EA and Defra. Similarly, locally collected information does not suggest that Luton should be classified as a 'Flood Risk Area' and hence is not required to have a FRMP (see section 3.2.10 to 3.2.11).

3.5 Environment Agency Policies

Catchment Flood Management Plan (CFMP)

3.5.1 Catchment Flood Management Plans (CFMPs) are the Environment Agency's high level strategic plans for the sustainable management of flood risk at a river catchment scale. The documents seek to identify those factors that influence flooding in an area and through liaison with key decision makers identify broad policies for the long term management of flood risk in a sustainable manner.

3.5.2 The LBC WCS study area is covered by one CFMP the catchment of the Upper River Lea that is discussed in the Thames Catchment Flood Management Plan (Environment Agency, January 2007). This section identifies the key issues and polices from this document.

Thames Catchment Flood Management Plan

3.5.3 The Thames CFMP identifies the characteristics of Luton to be:

- Typically an area of heavily developed floodplain with concrete river channels.
- An area where structural flood defence schemes are unlikely to be built to protect properties in the near future.

3.5.4 The Thames CFMP also identifies the key flooding characteristics of Luton to be:

- Flood risk will increase as a result of urbanisation and climate change.
- Existing flood defence assets are deteriorating.

3.5.5 Flooding in the area occurs from or is exacerbated by the:

- Overtopping of river banks and the channel.
- Overflow of surface water drains.
- Inundation of sewers.
- Rapid runoff from urban expansion.
- In-channel blockages and constrictions.
- Groundwater flooding.

3.5.6 Currently the flood risk management measures employed in Luton involve the rapid conveyance of flood waters in concrete channels, with the aim of transferring flood waters out of the town as fast as is possible. However the poor condition of many structures and/or blockage by fly-tipped waste and debris significantly reduces the effectiveness of this approach.

3.5.7 To alleviate flood risks to current development in Luton the Environment Agency advocates:

- Use of the Sequential Test to locate new development in areas of lowest flood risk
- Where development in the floodplain must take place seek opportunities to reduce risk through consideration of development vulnerability, reduction in development footprint, replacement of existing buildings with development on stilts.
- Incorporating flood resilience into a site's design (e.g. flood-proofing, raised floor levels).

3.5.8 In terms of riverside development the CFMP seeks to ensure that:

- Developments are set back from rivers, seeking an 8 metre wide undeveloped buffer strip. Where development has already occurred on one bank (and if these are not to be demolished) then the other bank needs to account for the set back distance lost in the opposite bank.
- The condition of existing river walls is assessed and renewed/repaired so that the lifetime of the river wall is commensurate with the lifetime of the development. At present river wall restoration is undertaken on a piecemeal basis, making future upgrades difficult. The Environment Agency would prefer LBC to produce a river wall replacement strategy for the centre of Luton to address this issue. This should include those sections of culverted watercourse which are also in a poor state of repair/at risk of collapse. However, this is difficult to achieve given the current financial climate and the Council's resources.
- Riparian developments look at opportunities for river restoration/enhancement as part of a development to make space for water.
- Culverting and building over of culverts is prevented. Furthermore all new developments with culverts running through their site should seek to de-culvert rivers for flood risk management and conservation benefit. However, this is subject to national policy on development viability so other technological approaches (i.e. culverting) will still need to be an option.

3.5.9 Flood Alleviation Schemes:

- The remaining greenfield areas throughout Luton are its single greatest flood risk management asset. These should be protected from future development in order that Luton continues to be provided with some flood water storage capacity.
- Whilst recent strategic flood risk mapping undertaken by the Environment Agency has identified a flood alleviation scheme that would benefit several areas of Luton, it also indicates that due to economic, environmental and technical constraints it is unlikely that any flood defence schemes will take place in the foreseeable future. Whilst implementation of this scheme cannot currently be justified, the land required to bring this scheme online in the future should be protected from future development to enable development in the future.
- Allied to strategic flood mitigation schemes, local authorities should seek opportunities to identify sites where developer contributions could be used to fund future flood risk management schemes.
- Look at opportunities to make space for water to accommodate climate change.

4. Proposed Growth

4.1 Preferred Growth Strategy

4.1.1 Luton Borough Council has identified the future expected developments (per year by development site) in Luton up to 2031. The Council's Administrative Boundary is shown in Figure 4-1.

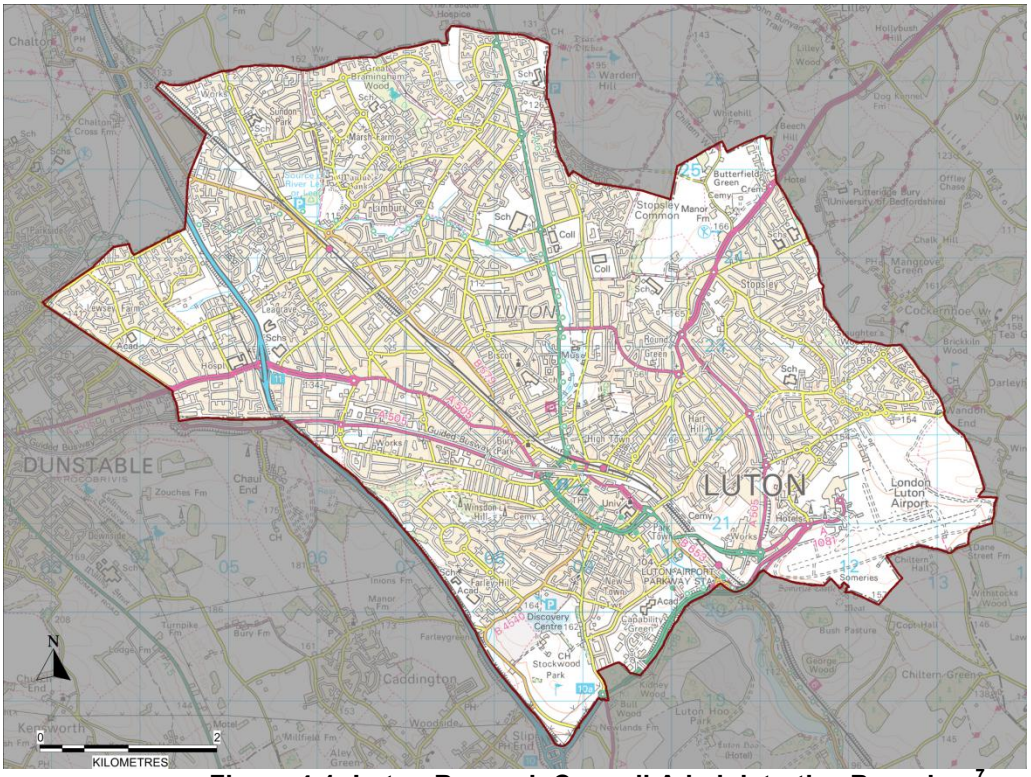


Figure 4-1: Luton Borough Council Administrative Boundary[7]

4.1.2 The purpose of the Water Cycle Strategy update is to assess the potential impact of an increase in planned housing numbers upon Luton Borough's water environment and WSI, including flood risk, surface water drainage, water resources, wastewater infrastructure and water quality and ecological issues. Luton Borough Council's revised spatial approach of future expected development is detailed in their 2011-2031 Local Plan and Spatial Development Strategy, which was in consultation stage as part of the development of the Council's Local Plan at the time of undertaking this WCS. This WCS update is based on figures for: homes already built since 2011; committed allocations; additional allocations; and the three strategic sites located within neighbouring local authorities administrative areas, which are:

- Houghton Regis North Strategic Allocation (Central Bedfordshire);
- North of Luton Strategic Allocation (Central Bedfordshire); and

[7] Reproduced from Ordnance Survey digital map data © Crown copyright 2014. All rights reserved. License number 0100031673.

- East of Luton (North Hertfordshire).

4.1.3 The focus of this study is on wastewater treatment infrastructure and the impact of wastewater treatment on water quality and ecology within the Borough and more widely.

4.2 Housing

4.2.1 This WCS update incorporates development in all settlement areas within the Borough, including Power Court, Napier Park, High Town, Marsh Farm and the Creative Quarter. The objectively assessed housing need for the Borough is 17,800 additional dwellings and 30,000 additional dwellings in the Luton Housing Market Area over the plan period (2011 - 2031)[8]. Despite this housing need, there is only capacity for 5,993 to 7,500 net additional dwellings within the Borough boundaries over the plan period, which accounts to a shortfall of between 10,000 and 12,000 dwellings.

4.2.2 Three proposed growth scenarios have been assessed to account for the potential number of dwellings which could be built within the Borough during the plan period (2011 – 2031)[9]. The scenarios include;

a) **Scenario A** – 5,993 dwellings within the Borough boundaries,
b) **Scenario B** – 7,000 dwellings within the Borough boundaries, and
c) **Scenario C** – 7,500 dwellings within the Borough boundaries.

4.2.3 Three strategic sites have been put forward in the neighbouring local authorities of Central Bedfordshire and North Hertfordshire. The proposed strategic sites could provide a greater number of houses than the 12,000 requirement in the long term, therefore this WCS has assessed the greatest possible housing development for each strategic site. Table 4-1 provides a summary of the housing figures to be assessed for each scenario.

TABLE 4-1: SUMMARY OF HOUSING FIGURES

	SHLAA (Luton)	Additional (Luton)	Extra up to Scenario	Strategic Allocations (outside of Luton)	Total
Scenario A	4,384	618	0	10,988	15,990
Scenario B	4,384	618	1157	10,988	17,147
Scenario C	4,384	618	1657	10,988	17,647

4.2.4 The three strategic sites put forward comprise of North Luton, North of Houghton Regis and East of Luton. Table 4-2 provides a breakdown of the strategic site allocations between the neighbouring local authorities.

[8] Luton & Central Bedfordshire Strategic Housing Market Assessment Refresh (2014).
[9] The number of dwellings completed to date (built since 2011) is 841 dwellings. This number has been subtracted from the scenario dwelling numbers as it is assumed these dwellings are now connected to the wastewater network and are now accommodated for.

TABLE 4-2: SUMMARY OF STRATEGIC SITE ALLOCATIONS			
Local Authority	**Strategic Site**	**Site Name**	**Total Dwellings**
Central Bedfordshire	North Luton	North of Luton	3200
	North of Houghton Regis	North of Houghton Regis Site 1	2,800
		Bellcross Site, East of Houghton Park Road	300
		Nursery Site, Sundon Road	30
		Bedford Road Site	196
		North of Houghton Regis Site 2	1500
North Hertfordshire	East Luton	Wandon Park	1,050
		Land east of Brickkiln Lane	350
		Land west of Cockernhoe	700
		Land north east of Luton	800
	-	Former Allotments, Luton Road[10]	62
TOTAL			**10988**

4.3 Employment

4.3.1 This WCS update also takes account of proposed increase in employment throughout the plan period; a total of approximately 22,250 new jobs by 2031[11] to be provided within the Borough boundaries. Table 4-3 provides a summary of the employment figures within the Borough to be assessed.

TABLE 4-3: SUMMARY OF EMPLOYMENT FIGURES	
Site Name	**Jobs**
Butterfield Technology Park	4,800
Land south of Stockwood Park	1,728
Century Park	1,882
Napier Park	6,514
Luton Airport	5,050

[10] Development falls within East Hyde WwTW catchment, but is not part of the additional Luton allocation.
[11] Luton Borough Council Employment Land Review (2013).

TABLE 4-3: SUMMARY OF EMPLOYMENT FIGURES	
Site Name	**Jobs**
Creative Quarter	200
Power Court	2,074

4.3.2 In addition, employment outside of the Borough boundaries but within the WwTW catchments of Chalton, Dunstable and East Hyde has been assessed; a total of approximately 5,775 new jobs. Table 4-4 provides a summary of the employment figures outside the Borough to be assessed.

TABLE 4-4: SUMMARY OF EMPLOYMENT FIGURES OUTSIDE OF LUTON	
Site Name	**Jobs**
Sundon RFI	2000
North of Luton	650
North of Houghton Regis Site 1	2500
North of Houghton Regis Site 2	625

4.4 London Luton Airport

4.4.1 Planning consent has been granted to expand London Luton Airport which is estimated to increase annual passenger capacity from approximately 12 million passengers to 18 million passengers by 2031, and create an additional 5,050 new jobs. This in-situ increase in passengers and jobs across the planning period is being considered as part of Luton Borough Council's Local Plan and therefore has been taken into account within this WCS. Consultation with Luton Airport is suggested in order to agree drainage design that prevents any increased risk of bird strike.

5. Wastewater Treatment Assessment

5.1 Wastewater Treatment Assessment Approach

5.1.1 Increases in residential and employment growth results in an increase in wastewater flows generated within an area and hence it is essential to consider:

- Whether there is sufficient capacity within existing treatment facilities (WwTWs) to treat the additional wastewater;
- What new infrastructure is required to provide for the additional wastewater treatment; and
- Whether waterbodies receiving the treated flow can cope with the additional flow without affecting water quality.

5.1.2 There are therefore two elements to the assessment of existing capacity (and any solutions required) with respect to wastewater treatment:

- The capacity of the infrastructure itself to treat the wastewater (infrastructure capacity); and
- The capacity of the environment to sustain additional discharges of treated wastewater (environmental capacity).

Wastewater Treatment in Luton

5.1.3 Wastewater treatment in Luton is provided by:

- Chalton WwTW (Anglian Water) situated to the north of Luton;
- Dunstable WwTW[12] (Anglian Water) situated to the west of Luton; and
- East Hyde WwTW (Thames Water) situated to the south of Luton.

5.1.4 Each of these WwTWs is fed by a network of wastewater pipes (the sewerage system) which drains wastewater generated by properties to the treatment works; this is defined as the WwTW's 'catchment'.

5.1.5 Table 5-1 provides a summary of the housing figures to be assessed for each WwTW, including a breakdown of the additional dwellings proposed in scenarios A, B and C. It has been assumed that the additional dwellings will most likely be in-fill development within the Borough, and have therefore been assumed to fall within the East Hyde WwTW catchment only.

[12] Currently does not serve Luton, but will serve some of Luton's Houghton Regis North strategic site.

TABLE 5-1: SUMMARY OF HOUSING FIGURES PER WWTW				
WwTW Catchment	**Allocations**			
	SHLAA (Luton)	**Additional (Luton)**	**Strategic Allocations (outside of Luton)**	**Total**
Chalton	429	137	3,704	4,270
Dunstable	0	0	4,322	4,322
East Hyde Scenario's				
East Hyde *(Scenario A)*	3,955	481	2,962	7,398
East Hyde *(Scenario B)*	3,955	1,638	2,962	8,555
East Hyde *(Scenario C)*	3,955	2,138	2,962	9,055
TOTAL	**4,384**	**A = 618** **B = 1,775** **C = 2,275**	**10,988**	**A = 15,990** **B = 17,147** **C = 17,647**

5.1.6 Table 5-2 provides a summary of the employment figures to be assessed per each WwTW. No other proposed growth scenarios for employment, other than that which is provided below in Table 5-2 have been assessed.

TABLE 5-2: SUMMARY OF EMPLOYMENT FIGURES PER WWTW			
WwTW Catchment	**Inside or Outside of Luton**	**Site Name**	**Jobs**
Chalton	Outside	Sundon RFI	2000
		North of Luton	650
		North of Houghton Regis Site 1	2500
Dunstable	Outside	North of Houghton Regis Site 2	625
East Hyde	Inside	Century Park	1,882
		Butterfield Technology Park	4,800
		Land south of Stockwood Park	1,728
		Napier Park	6,514

TABLE 5-2: SUMMARY OF EMPLOYMENT FIGURES PER WWTW			
WwTW Catchment	**Inside or Outside of Luton**	**Site Name**	**Jobs**
		Luton Airport	5,050
		Creative Quarter	200
		Power Court	2,074

Management of WwTW Discharges

5.1.7 All WwTWs are issued with a permit to discharge by the Environment Agency, which sets out conditions on the maximum volume of treated flow that it can discharge and also limits on the quality of the treated flow. These limits are set in order to protect the water quality and ecology of the receiving waterbody. They also dictate how much flow can be received by each WwTW, as well as the type of treatment processes to be used at the WwTWs.

5.1.8 The volume element of the discharge permit determines the maximum number of properties that can be connected to a WwTW catchment. When discharge permits are issued for the first time, they are generally set with a volume 'freeboard', which acknowledges that allowance needs to be made for additional connections. This allowance is termed 'permitted headroom'. The quality conditions applied to the discharge permit are derived to ensure that the water quality of the receiving waterbody is not adversely affected, even when the maximum amount of flow is discharged. For the purposes of this WCS, a simplified assumption is applied that the permitted headroom is usable[13] and would not affect downstream water quality. This headroom therefore determines how many properties can be connected to the WwTW before a new discharge permit would need to be issued (and hence how many properties can connect without significant changes to the treatment infrastructure).

5.1.9 When a new discharge permit is required, an assessment needs to be undertaken to determine what new quality conditions would need to be applied to the discharge. If the quality conditions remained unchanged, the increase in flow would result in an increase in total load of some substances being discharged to the receiving waterbody. This may have the effect of deteriorating water quality and hence in most cases, an increase in permitted discharge flow results in more stringent (or tighter) conditions on the quality of the discharge. The requirement to treat to a higher level may result in an increase in the intensity of treatment processes at the WwTWs which may also require improvements or upgrades to be made to the WwTW to allow the new conditions to be met.

5.1.10 In some cases, it may be possible that the quality conditions required to protect water quality and ecology are beyond that which can be achieved with conventional treatment processes and as a result, this WCS assumes that a new solution would be required in this situation to allow growth to proceed.

[13] In some cases, there is a hydraulic restriction on flow within a WwTWs which would limit full use of the maximum permitted headroom

5.1.11 The primary legislative driver which determines the quality conditions of any new permit to discharge are the Water Framework Directive (WFD) and the Habitats Directive (HD) as described in the following subsections.

WFD Compliance

5.1.12 The WFD is the most significant piece of water legislation since the creation of the EU. The overall requirement of the directive is that all waterbodies in the UK must achieve "Good Status". The definition of a waterbody's 'status' is a complex assessment that combines standards for water quality with standards for hydromorphology (i.e. habitat and flow quality) and ecological requirements.

5.1.13 The two key aspects of the WFD relevant to the wastewater assessment in this WCS are the policy requirements that:

- Development must not cause a deterioration in the current status of a waterbody[14]; and
- Development must not prevent future attainment of 'good status', hence it is not acceptable to allow an impact to occur just because other impacts are causing the status of a water body to already be less than good.

5.1.14 Where permitted headroom at a WwTW would be exceeded by proposed levels of growth, a water quality modelling assessment has been undertaken to determine the quality conditions that would need to be applied to the new permit to ensure the two policy requirements of the WFD are met.

Habitats Directive

5.1.15 The Habitats Directive and the Habitats Regulations has designated some sites as areas that require protection in order to maintain or enhance the rare ecological species or habitat associated with them. A retrospective review process has been on-going since the translation of the Habitats Directive into the UK Habitats Regulations called the Review of Consents (RoC). The RoC process requires the Environment Agency to consider the impact of the abstraction licenses and discharge permits it has previously issued on sites which became protected (and hence designated) under the Habitats Regulations.

5.1.16 If the RoC process identifies that an existing license or permit cannot be ruled out as having an impact on a designated site, then the Environment Agency are required to either revoke or alter the license or permit. As a result of this process, restrictions on some discharge permits have been introduced to ensure that any identified impact on downstream sites is mitigated. Although the Habitats Directive does not directly stipulate conditions on discharge, the Habitats Regulations can, by the requirement to ensure no detrimental impact on designated sites, require restrictions on discharges to (or abstractions from) water dependent habitats that could be impacted by anthropogenic manipulation of the water environment.

[14] i.e. a reduction High Status to Good Status as a result of a discharge would not be acceptable, even though the overall target of good status as required under the WFD is still maintained

Assessment Methodology Summary

5.1.17 A stepped assessment approach has been developed for the WCS to determine the impact of the proposed growth on wastewater treatment capacity and the environmental capacity of the receiving watercourse. The assessment steps are outlined below:

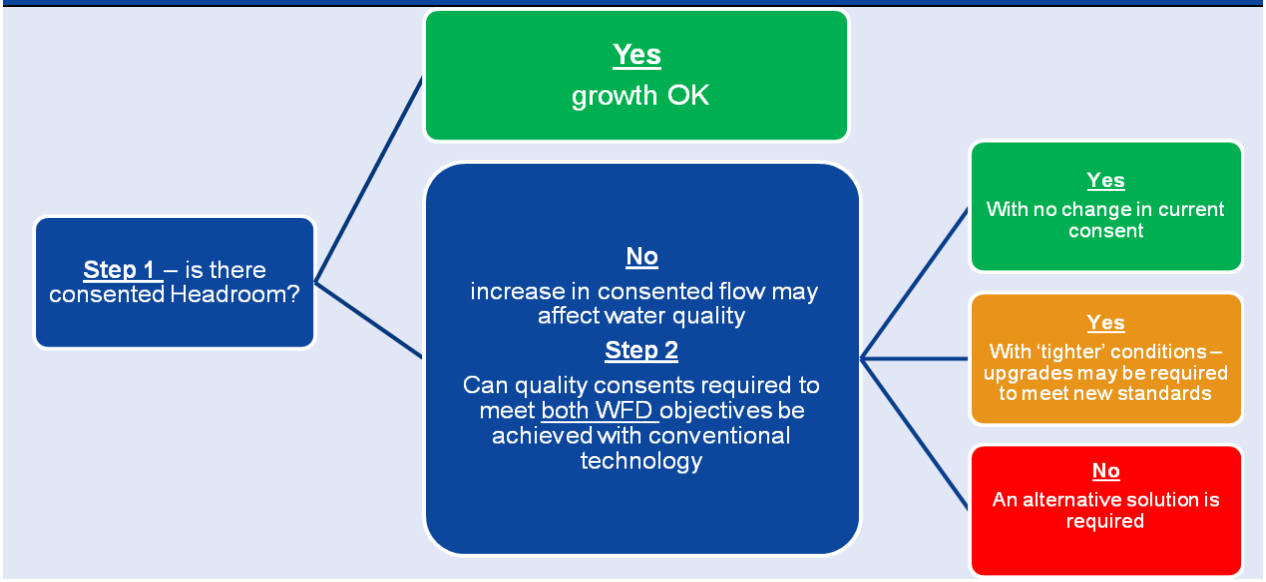
- Determine the amount of growth draining to each WwTW and calculate the additional flow generated;
- Calculate available headroom at each WwTW;
- Determine whether the growth can be accommodated within existing headroom;
- For those WwTWs where headroom is exceeded, calculate what quality conditions need to be put in place to meet the two key objectives of the WFD to ensure:
- No deterioration in receiving watercourse from its current WFD status;
- Future Good Status is not compromised by growth;
- Determine whether any quality conditions required to meet WFD objectives would be beyond the limits of conventional treatment for WwTWs;
- Where the conditions are achievable, indicate where infrastructure upgrades are required to be undertaken by the Water Company to meet the new permit conditions and phasing implications of these upgrades; and
- Where the conditions are not achievable, indicate where there are alternative solutions for treatment in that catchment which would need to be perused by the Water Company.

Assessment Results Overview

5.1.18 The results for each WwTW are presented in a Red/Amber/Green (RAG) Assessment for ease of planning reference. The RAG code refers broadly to the following categories and the process is set out in Figure 5-1.

- Green – Growth can be accepted with no changes to the permit required. There may be a need for improvements to the WwTW infrastructure following assessment of biological capacity. WFD objectives will not be adversely affected.
- Amber – Changes to the discharge permit are required in order to meet WFD objectives and/or upgrades may be required to WwTW infrastructure which may have phasing implications.
- Red - in order to meet WFD objectives changes to the discharge permit are required which are beyond the limits of what can be achieved with conventional treatment. An alternative solution needs to be sought.

FIGURE 5-1: RAG ASSESSMENT PROCESS DIAGRAM FOR WASTEWATER TREATMENT CAPACITY



5.2 Wastewater Treatment Assessment – Results

WwTW with Permitted Headroom

5.2.1 The volume of wastewater generated from growth in each WwTW catchment was calculated for the proposed growth locations under each of the three growth scenarios and compared to the treatment capacity at each WwTW.

5.2.2 Table 5-3 details the results of these calculations, and demonstrates that all the WwTW serving Luton have existing permitted headroom sufficient to accommodate all three proposed growth scenarios. Detailed assessment of biological capacity for each WwTW would still need to be completed by AWS and TWU to determine if infrastructure upgrades are required to deliver the proposed growth levels in the Borough within the existing consent limits. However, assuming process capacity can be provided by fture investment, growth in the Borough would not deteriorate water quality (i.e. deterioration in WFD status), or increase flood risk and hence there is no barrier to delivering the proposed growth levels.

5.2.3 Table 5-3 also includes information on how many additional homes could be connected for each growth scenario before the headroom would be exceeded, to inform any potential future variations to the spatial strategy.

TABLE 5-3: WWTW WITH PERMITTED HEADROOM					
Relevant WwTW	Scenario	Current Permitted DWF (m^3/d)	Future 2031 DWF after Growth (m^3/d)	Headroom Assessment	
				2031 Headroom Capacity (m^3/d)	Approximate Residual Housing Capacity after Growth (2031)[15]
Chalton	A, B and C	15,000	14,587	413	1,416
Dunstable	A, B and C	17,000	13,895	3,105	8,808
East Hyde	A	44,418	36,759	7,659	24,188
	B		37,168	7,250	23,031
	C		37,345	7,073	22,531

5.2.4 The following growth has been accounted for:

- Growth intended to meet the housing and employment needs for Luton Borough within the Borough boundaries,
- Growth intended to meet the housing and employment needs for Luton Borough, but is located outside the Borough boundaries,
- Expansion of London Luton Airport, and
- Growth proposed to meet the housing and employment needs in the neighbouring LPAs which only falls within the WwTW catchment of either Chalton, Dunstable or East Hyde WwTW (Central Bedfordshire or North Hertfordshire).

[15] Based on an Occupancy rate of 2.7 and consumption rate of 131 l/h/d

WFD Compliance

5.2.5 The assessment of permitted headroom at Chalton, Dunstable and East Hyde WwTWs determined that there is sufficient volumetric headroom under their current permits to accommodate expected wastewater flows (also the case for East Hyde WwTW across all three growth scenarios assessed). Growth is therefore assigned a 'green' coding using the RAG method presented in Figure 5-1.

5.2.6 However, as part of this WCS, an additional water quality assessment has been undertaken for all three WwTWs. This aimed to determine whether increasing wastewater discharges as a result of growth could impact on the objectives of the WFD, even though the additional volumetric discharge is within existing permitted conditions.

5.2.7 For East Hyde WwTW, modelling has been undertaken for the Scenario C, representing the highest level of growth. Detailed results are provided in Appendix D. A summary of the results is provided below.

East Hyde WwTW

No deterioration assessment

5.2.8 Modelling has shown that in order to maintain the current WFD status of the River Lea with current discharge volumes (from existing connections), the permit conditions on discharge quality should theoretically be tighter than they currently are. The calculations show that the permit conditions should be set at a 5mg/l 95 percentile limit for Biochemical Oxygen Demand (BOD)[16], a 1mg/l 95 percentile limit for ammonia[17] and a 1mg/l mean limit for Phosphate[18]. These theoretical conditions are at the limits of conventional treatment, but would potentially be achievable.

5.2.9 This analysis suggests that East Hyde WwTW is currently treating discharge to a higher standard than the current discharge permit conditions. If it was performing more frequently at, or closer to, the limits of the current permit conditions (i.e. a lower standard of treatment), the statistical based modelling undertaken suggests that the current WFD status of the physico-chemical sub-elements would have deteriorated from their current status.

5.2.10 Modelling was subsequently undertaken with increased wastewater flows from the maximum growth level proposed in Scenario C. This showed that, taking account of growth, the quality conditions stated above in section 5.2.8 for current flows would ensure current WFD status is maintained downstream in the River Lea[19]. This analysis suggests growth will not affect long-term compliance with the WFD no-deterioration objective.

Preventing future Good Status

5.2.11 As well as considering deterioration in current status, it was also important to consider whether growth could affect attainment of the future target status for the River Lea. In physico-chemical terms, this relates to a target of either Moderate or Good for Phosphate. BOD (High status) and Ammonia (Good status) would remain at the required level with the permit limit required for no deterioration.

[16] Currently at 8mg/l in the existing permit
[17] Currently at 2mg/l in the existing permit
[18] Currently no permit condition
[19] 5mg/l BOD, 1mg/l Ammonia and 1mg/l Phosphate

5.2.12 The modelling has shown that future Moderate or Good Status for Phosphate cannot be achieved with the current discharge quality, unless a Phosphate condition was applied beyond the levels of conventional treatment (0.08mg/l for Good Status and 0.21mg/l for Moderate Status). Assessment of growth shows that a similar Phosphate condition would need to be applied beyond the limits of conventional treatment to achieve Moderate or Good Status, and as such, growth itself would not prevent future Moderate or Good status for Phosphate from being achieved.

Chalton WwTW

No deterioration assessment

5.2.13 Modelling has shown that in order to maintain the current WFD status of the River Flit with current discharge volumes (from existing connections), the permit conditions on discharge quality should theoretically be tighter than they currently are. The calculations show that the permit conditions should be set at less than 5mg/l 95 percentile limit BOD[20], less than 1mg/l 95 percentile limit for ammonia[21] and a 1mg/l mean limit for Phosphate[22].

5.2.14 Chalton WwTW is located in the headwaters of the River Flit, and as a consequence, has significantly limited dilution potential, hence the very tight permit conditions outlined above.

5.2.15 The theoretical conditions for both BOD and ammonia are considered to be beyond the limits of conventional treatment. The Environment Agency have stated that this is as a result of the WFD sample point being located several kilometres downstream of the WwTW and so setting of the permit conditions for BOD and Ammonia to achieve 'High' status immediately downstream of the WwTW is over protective. Natural purification and breakdown will occur before the downstream sample point, where 'High' status should be achieved and therefore a permit condition of 5mg/l 95 percentile limit for BOD and 1mg/l 95 percentile limit for ammonia is recommended.

5.2.16 This analysis suggests that Chalton WwTW is currently treating discharge to a higher standard than the current discharge permit conditions. If it was performing more frequently at, or closer to, the limits of the current permit conditions (i.e. a lower standard of treatment), the statistical based modelling undertaken suggests that the current WFD status of the physico-chemical sub-elements would have deteriorated from their current status.

5.2.17 Further modelling has been undertaken, with increased wastewater flows from the growth predicted within the WwTW catchment over the plan period. This showed that the permit conditions recommended above for current flows would ensure current WFD status is maintained downstream in the River Flit[23]. This suggests wastewater flows from growth would not affect compliance with the WFD no deterioration assessment.

Preventing future Good Status

5.2.18 The modelling has shown that future Moderate or Good Status for Phosphate cannot be achieved with the current discharge quality, unless a Phosphate condition was applied beyond the levels of conventional treatment (0.08mg/l for Good Status and 0.13mg/l for Moderate Status). Assessment of growth shows that a similar Phosphate condition would need to be applied beyond the limits of conventional treatment to achieve Good Status or 0.19mg/l for Moderate Status. As such, growth itself would not prevent future Moderate or Good status for Phosphate from being achieved.

[20] Currently at 12mg/l in the existing permit
[21] Currently at 5mg/l in the existing permit
[22] Currently at 2mg/l in the existing permit
[23] 5mg/l BOD, 1mg/l Ammonia and 1mg/l Phosphate

Dunstable WwTW

No deterioration assessment

5.2.19 Modelling has shown that in order to maintain the current WFD status of the Ouzel Brook with current discharge volumes (from existing connections), the permit conditions on discharge quality should theoretically be tighter than they currently are. The calculations show that the permit conditions should be set at 5mg/l 95 percentile limit for BOD[24], less than 1mg/l 95 percentile limit for ammonia[25] and a 1mg/l mean limit for Phosphate[26].

5.2.20 The theoretical condition for ammonia is considered to be beyond the limits of conventional treatment. Following consultation with the Environment Agency, this is as a result of the location of the WwTW in the headwaters of the Ouzel Brook where the dilution capacity is severely limited. The Environment Agency has indicated through monitoring results that the WwTW over performs in terms of ammonia discharge quality and they have stated that a permit condition of 1mg/l 95 percentile limit for ammonia should ensure no deterioration of the current WFD status, as actual discharge quality is likely to be significantly better.

5.2.21 This analysis suggests that Dunstable WwTW is currently treating discharge to a higher standard than the current discharge permit conditions. If it was performing more frequently at, or closer to, the limits of the current permit conditions (i.e. a lower standard of treatment), the statistical based modelling undertaken suggests that the current WFD status of the physico-chemical sub-elements would have deteriorated from their current status.

5.2.22 Further modelling has been undertaken with increased wastewater flows from the growth predicted to occur within the WwTW catchment over the plan period. This showed that the permit conditions recommended above for current flows would ensure current WFD status is maintained downstream in the Ouzel Brook [27]. This suggests wastewater flows from growth would not affect compliance with the WFD no deterioration assessment.

Preventing future Good Status

5.2.23 The modelling has shown that future Moderate or Good Status for Phosphate cannot be achieved with the current discharge quality, unless a Phosphate condition was applied beyond the levels of conventional treatment (0.08mg/l for Good Status and 0.21mg/l for Moderate Status). Assessment of growth shows that a similar Phosphate condition would need to be applied beyond the limits of conventional treatment to achieve Moderate or Good Status, and as such, growth itself would not prevent future Moderate or Good status for Phosphate from being achieved.

5.3 Wastewater Network

5.3.1 The wastewater strategy to cater for growth requires an assessment of the capacity of the wastewater network (sewer system) to accept and transmit wastewater flows from the new development to the WwTW for treatment.

5.3.2 An assumption has been applied that it is preferential from a cost and phasing perspective to use capacity within the existing sewer network first, before new sewers are built and commissioned.

[24] Currently at 12mg/l in the existing permit
[25] Currently at 4mg/l in the existing permit
[26] Currently at 2mg/l in the existing permit
[27] 5mg/l BOD, 1mg/l Ammonia and 1mg/l Phosphate

5.3.3 The capacity of the existing sewer network is an important consideration for growth, as in some cases the existing system is already at, or over its design capacity. Further additions of wastewater from growth can result in sewer flooding in the system (affecting property or infrastructure) or can increase the frequency with which overflows to river systems occur, resulting in ecological impact and deterioration in water quality.

Allocations within Luton

5.3.4 It is assumed that all site allocations within Luton Borough will drain into the existing sewer network, either to East Hyde WwTW or Chalton WwTW, depending on the WwTW catchment each site falls in. Figures in Table 5-1 include the likely increased flow from London Luton Airport as a result of the predicted increase in passengers throughout the plan period.

5.3.5 Detailed network modelling may be required by AWS or TW, but it is likely that the relatively small number of allocations within Luton can be accommodated by the existing sewer infrastructure.

London Luton Airport

5.3.6 To take account of the increase in annual passenger capacity of 18 million passengers by 2031, the following assumptions have been made:

- The airport will drain to East Hyde WwTW;
- There is a consistent increase in annual passenger numbers each year from 9,710,771 passengers per year (2013)[28] to 18,000,000 by 2031, an increase of 460,513 each year; and
- The airport's most recently published water consumption, 10.5l per passenger (2012)[29], remains constant throughout the plan period.
- Applying these assumptions, the airports calculated annual water consumption in 2031 is estimated to be 189 Ml (518 m^3 per day). This is approximately equivalent to 1,500 dwellings[30].

Strategic Allocations outside Luton

5.3.7 The majority of planned growth will be situated outside of Luton Borough at the three strategic sites. Where the proposed development sites border the existing urban area, there is scope to drain all or part of the development into the existing sewer infrastructure, subject to capacity being available.

East of Luton

5.3.8 The preferred option would be to drain the site via a new dedicated main to East Hyde WwTW. Upgrades are likely to be required for the existing sewer infrastructure to accommodate additional flows, and this could cause significant disruption to the community within the urban area.

Houghton Regis North

5.3.9 Under recommendations made within the Luton and Southern Central Bedfordshire Phase 2 WCS, the majority of the Houghton Regis North Strategic Allocation site should be drained to Dunstable WwTW via a combination of gravity and pumping main. The eastern part of the site falls within the

[28] London Luton Airport (2013) Annual Monitoring Report. Available at http://www.london-luton.co.uk/en/content/8/243/annual-monitoring-report.html Accessed 1st September 2014.

[29] London Luton Airport (2012) Community Engagement Annual Report. Available at http://www.london-lutoninthecommunity.co.uk/content/1/4/publications.html Accessed 1st September 2014.

[30] Assuming an occupancy rate of 2.7 and consumption rate of 0.131 m^3/h/d

Chalton WwTW catchment and it is recommended this portion of the site is drained by gravity to Chalton WwTW.

5.3.10 Approximately 18% of the site falls within the Chalton WwTW catchment, which equates to approximately 780 dwellings out of the total 4322 dwellings allocated to the site.

5.3.11 As demonstrated in Table 5-1, Chalton WwTW has a residual housing capacity of 1,416, meaning that even if this recommendation was to be applied, Chalton WwTW will be able to accept the additional 780 dwellings and still have remaining capacity.

North of Luton

5.3.12 This site falls entirely within the Chalton WwTW catchment, and should be drained by connection to the existing local system or by provision of a new system to serve the development only.

5.3.13 The optimum solution cannot be established until a full survey of the local system has been undertaken and the layout of the development has been established. Upgrading of the existing outfall trunk sewer may be necessary towards the end of the development to accommodate the increased flow. This could prove costly and would require a long lead in time as approvals would be required from the National Rail and Highways authorities. There should a requirement that this is undertaken at the master planning stage.

Luton Integrated Catchment Model

5.3.14 It is understood that TWU is currently in the early phases of an Integrated Catchment Model for Luton to assess the role of their discharges on WFD water quality compliance in the River Lea catchment, taking into account non-urban catchment runoff, Combined Sewer Overflows (CSOs), Surface Water Outfalls (SWOs), and discharges from WwTWs and storm tanks.

5.3.15 This WCS should be updated in light of the findings and outputs from the Integrated Catchment Model, due to be completed in 2016.

6. Water Supply Strategy

6.1 Introduction

6.1.1 Water supply for the majority of the Luton Borough Council area is provided by Affinity Water (AfW). The Outline Luton and South Bedfordshire WCS[31] included an assessment of the existing environmental baseline with respect to locally available resources in the aquifers and the main river systems. The outline assessment was based on the Environment Agency's Catchment Abstraction Management Strategies (CAMS), Luton falls within two CAMS:

- The Upper Lee CAMS– covers all of Luton, including East of Luton, North of Luton and a small part of Houghton Regis North strategic sites, and
- The Upper Ouse and Bedford Ouse CAMS – which covers the majority of the Houghton Regis North strategic site.

6.1.2 The process of describing catchment resources is not repeated in this WCS update. Instead, this WCS has used the final version of Affinity Water's Water Resources Management Plan (WRMP)[32] to determine available water supply against predicted demand and has considered how water efficiency can be further promoted and delivered for new homes beyond that which is planned for delivery in AfW's WRMP.

6.2 Water Resource Planning

6.2.1 Water companies have historically undertaken medium to long term planning of water resources in order to demonstrate that a there is a long-term plan for delivering sustainable water supply within their operational area to meet existing and future demand.

6.2.2 As of 2007, it became a statutory requirement for water companies to prepare and maintain WRMPs which demonstrate how water companies are managing the balance between available supply and future demand over a 25 year plan. These plans are subject to consultation and approval by secretary of state every five years, but must be updated on a yearly basis.

6.2.3 WRMPs are a key document for a WCS as they set out how demand for water from growth within a water company's supply area can be met, taking into account the need to for the environment to be protected. As part of the statutory approval process, the plans must be approved by both the Environment Agency and Natural England (as well as other regulators) and hence the outcomes of the plans can be used directly to inform whether growth levels being assessed within a WCS can be supplied with a sustainable source of water supply.

[31] Luton and South Bedfordshire Phase 1 – Outline Study, Luton and South Bedfordshire Joint Committee, Halcrow, 2008.
[32] Affinity Water Final WRMP (2014). Available at https://stakeholder.affinitywater.co.uk/water-resources.aspx Accessed 1st September 2014.

6.2.4 Water companies manage available water resources within key zones, called Water Resource Zones (WRZ). These are broadly integrated areas in which customers are supplied by common a pipe network from a number of local water sources. WRZ are used to facilitate the assessment of the supply / demand balance. As such the customers within these zones share the same security of water when it is freely available; but also share the same risk of supply failure when water is not as freely available during dry periods (i.e. deficit of supply). Water companies undertake resource modelling to calculate if there is likely to be a surplus of available water or a deficit in each WRZ by 2040, once additional demand from growth and other factors such as climate change are taken into account.

6.2.5 In formulating the statutory 2014 final WRMP, AfW used targets as discussed with Local Planning Authorities (as well as other sources).

6.2.6 Prior to use of the findings of the WRMP, it was essential to ensure that the growth being assessed for the Borough within this WCS was comparable to the growth assumptions used by AfW in formulating the final WRMP.

Demand for Water

6.2.7 Likely increases in demand in the Borough have been calculated for two different scenarios, using six different water demand projections based on different rates of water use for new homes that could be implemented through potential future policy. The first scenario takes into account water demand from houses and employment, whilst the second scenario takes into account houses, employment and proposed passenger number increases at Luton Airport.

The projections were derived as outlined below, with projections 3 to 5 previously based on the Code for Sustainable Homes (CSH) water efficiency ratings:

- **Projection 1 – Average Affinity Water metered consumption –** New homes would use 131 l/h/d, this reflects the planning consumption used to maintain security of supply;
- **Projection 2a** – **Building Regulations –** New homes would conform to (and not use more than) Part G of the Building Regulations requirement of 125 l/h/d;
- **Projection 2b – Building Regulations Optional Requirement –** Only applies where a condition that the new home should meet the optional requirement is imposed as part of the process of granting planning permission. Where it applies, new homes would conform to (and not use more than) Part G of the Building Regulations optional requirement of 110 l/h/d.
- **Projection 3** – **Low Efficiency Scenario –** New homes would achieve 120 l/h/d (previously based on CSH Level 1/2)
- **Projection 4** – **Medium Efficiency Scenario –** New homes would achieve 105 l/h/d (previously based on CSH Level 3/4) ;
- **Projection 5** – **High Efficiency Scenario –** New homes would achieve 80 l/h/d (previously based on CSH Level 5/6); and
- **Projection 6** – **Very High Efficiency Scenario –** New homes would include both greywater recycling and rainwater harvesting reducing water use to a minimum of 62 l/h/d.

6.2.8 Using these projections, the increase in demand for water by 2031, could range between the following:

- Scenario 1 – houses and employment – 3.32 and 6.60 Ml/d (Figure 6-1); and
- Scenario 2 – houses, employment and airport –3.32 and 6.61 Ml/d (Figure 6-1)

FIGURE 6-1: RANGE OF WATER DEMANDS ACROSS PLAN PERIOD IN LUTON DEPENDING ON EFFICIENCY LEVELS OF NEW HOMES – SCENARIO 1

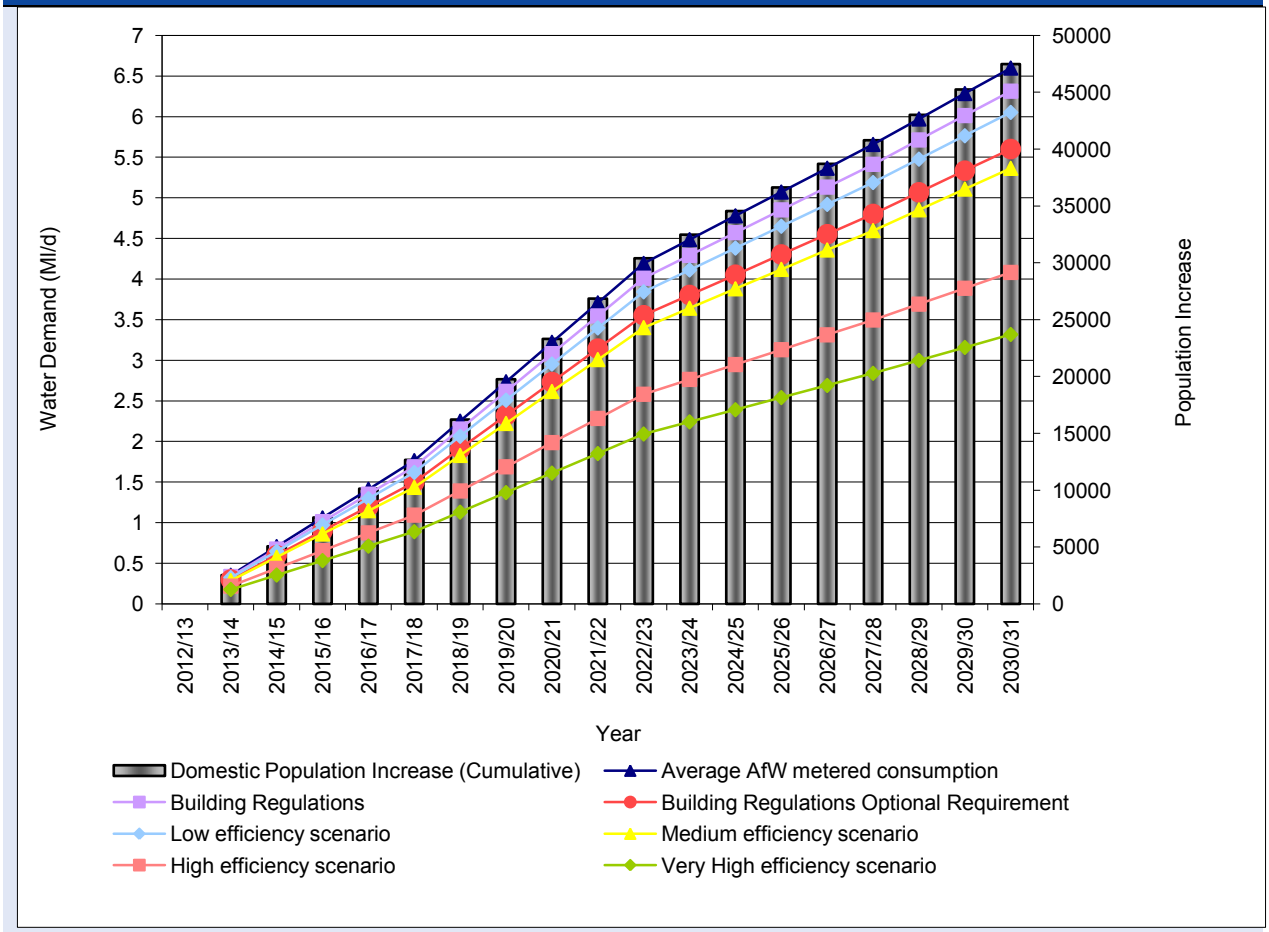
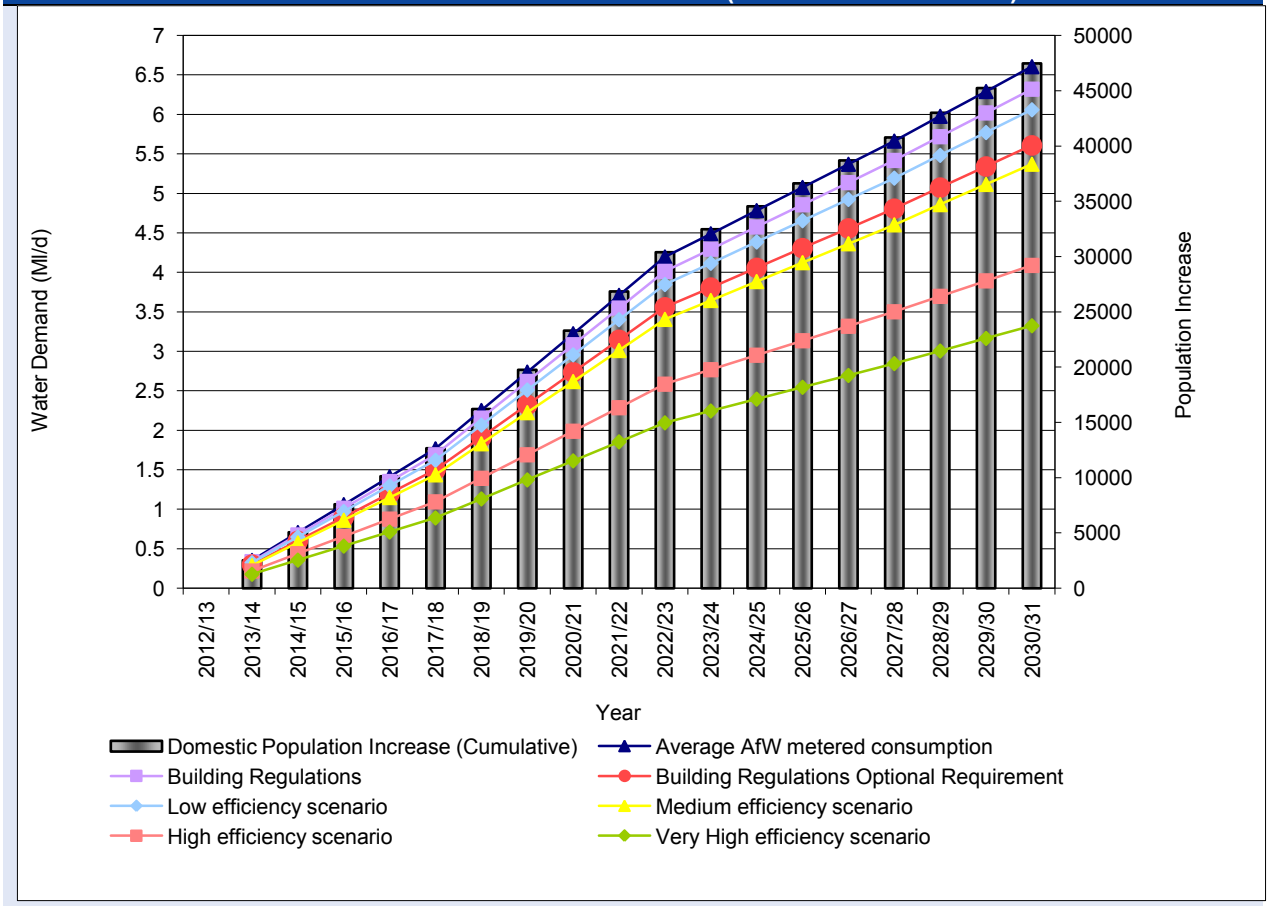


FIGURE 6-2: RANGE OF WATER DEMANDS ACROSS PLAN PERIOD IN LUTON DEPENDING ON EFFICIENCY LEVELS OF NEW HOMES – SCENARIO 2 (INCLUDING AIRPORT)



6.3 Planned Water Availability Summary – Affinity Water

6.3.1 AfW's WRMP has been used to summarise water availability to meet the projected demand for Luton Borough Council covering the planning period to 2040.

6.3.2 Luton Borough is located within the Lee Water Resource Zone (WRZ). Small portions of the North of Luton and Houghton Regis North strategic sites fall within Anglian Water's Ruthamford South RZ, however, it has been assumed in this WCS that these small areas will be included within the Lee WRZ.

6.3.3 AfW shares a resource with Anglian Water to the north of the Lee WRZ. AfW are entitled to a bulk transfer of 91 Ml/d on average from this resource under the terms of the Great Ouse Water Act (GOWA). The availability of the shared resource is considered to be of critical importance to AfW's WRMP. The combination of significant sustainability reductions[33] in the Lee WRZ and the forecast increase in population is likely to result in increased utilisation by AfW of this shared resource within the conditions set out in the GOWA.

[33] Water companies are implementing sustainable reductions to bring water abstraction levels back to sustainable levels.

6.3.4 The Lee WRZ includes two main abstraction catchments covering the Borough, the Upper Lee CAMS and the Upper Ouse and Bedford Ouse CAMS. There are water resource issues affecting both groundwater and surface water, whereby most abstraction licenses are for the abstraction of groundwater for public water supply.

6.3.5 There is a forecasted supply-demand risk within the Lee WRZ, which worsens over the planning period. An average deficit of 1 – 10 Ml/d has been forecast in 2020, which remains negative and is estimated to be >10 Ml/d in 2040. Across all three AfW regions (Central, East and South East), without measures to manage supply and demand, AfW predicts a total supply-demand deficit of 170.04 Ml/d by the end of the planning period, but this would only occur if AfW did not plan and deliver any interventions to reduce this.

Preferred Plan Options

6.3.6 As part of AfW's Preferred Plan, a number of options have been identified that will help to reduce the supply-demand deficit specifically within the Lee WRZ which will be implemented over the next 5 years. The options include:

- Community integrated Automated Meter Reading and Water Efficiency (expected in Luton by 2020);
- Commercial water efficiency audits;
- Leakage reduction;
- Peak license scheme in Hertford;
- Additional Water Efficiency for households;
- Replacement borehole in Hertford;
- Dual flush toilets for households;
- Peak license scheme in west Luton (Greensand);
- Source optimisation in south east Royston;
- Third party license in Luton; and
- London Luton Airport water efficiency.

6.3.7 These options are in addition to the existing bulk transfer from Anglian Water, and ensure that AfW maintains a headroom surplus throughout the planning period.

6.4 Water Efficiency Plan

6.4.1 AfW's Preferred Plan implements a series of demand management measures and improvements to existing resources. With the successful implementation of a range of supply and demand options, AfW is predicting a supply surplus of available water in 2040 within the Lee WRZ, which would provide sufficient water supply to support the levels of growth within the Borough through the plan period.

6.4.2 However, there are several key drivers for ensuring that water use in the development plan period is minimised as far as possible. In addition, the impact of the proposed growth within and on the boundaries of the Borough can be minimised with more water efficient development. This WCS therefore includes an assessment of the feasibility of achieving a 'water neutral' position after growth across the Borough.

6.4.3 As is the case for all sustainable use of resources, the three 'R's of reduce, reuse and recycle are key to maximising the sustainability and reduce is the first and arguably most important element of sustainable water use to consider.

6.5 Drivers and Justification for Water Efficiency

6.5.1 Luton Borough lies within an area of serious water stress[34]. Any growth and increase in population will further exacerbate this issue. In order to ensure surplus raw water supply for growth in and around the Borough, AfW's Preferred Plan over the next 25 years is reliant on more efficient use of existing resources and demand reduction from customers. The proposals and opportunities for new resources within the area are limited, in the main due to the limitation on available new resources locally, which means that looking beyond the next 25 years, further new resources would likely need to be transferred into the area to cater for further increases in population and hence water demand. This creates a very strong driver for new homes in the next 25 years to be made as efficient as economically possible in order to safeguard future resources.

6.5.2 Luton Borough Council is aspiring to promote sustainable development within the Borough, as such higher levels of efficiency should be considered as part of this WCS and its recommendations for the Local Plan more widely.

6.5.3 AfW have to consider new measures to address supply and demand deficits within the Lee WRZ serving Luton. Therefore, measures should be taken to reduce demand from new property as far as possible.

[34] As classified by the Environment Agency https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf

6.6 Policy and Legislation Drivers

6.6.1 Future Water, the Government's water strategy for England[35] was published in February 2008 and lays out the Government's policies for the future management of water in England. Part of its vision is for water efficiency to play a prominent role in achieving a sustainable supply and demand balance.

6.6.2 For relevance to the aspiration of water neutrality, Future Water specifically aims to reduce water consumption in existing homes to 130 or 120 l/h/d by 2030. This will require the retrofitting of water efficient measures in existing homes and business and behavioural change in the use of water and understanding of where it comes from.

6.7 Climate Change and Sustainability Reduction Impacts

6.7.1 It is predicted that climate change will further reduce the available water resources in Luton as rainfall patterns change to less frequent, but more extreme, rainfall events in the summer months, and winter rainfall patterns become more frequent and intense. This could lead to sustainability reductions of abstraction licenses.

6.7.2 In planning for future water resources availability, AfW have accounted for the impacts of climate change within their calculations of available raw water for use and forecast demand. AfW has used assumptions on climate change impacts based on the UKCP09 scenarios, the information on sustainability reductions provided at the time by the Environment Agency and the Environment Agency's Water Resources Plan guideline.

6.7.3 AfW have assessed the impacts of climate change and sustainability reductions on both supply and demand. The main findings from these, as included in their final WRMP, are summarised below.

Impact on Supplies

6.7.4 AfW have undertaken analysis of the impacts of climate change on the future availability of their water resources, forecasting a range of impacts on groundwater levels, and incorporating these results into their assessment of deployable output. AfW predict that by 2035, their deployable output in the Lee WRZ will be reduced by 4.61 Ml/d as a result of climate change.

Impact on Demand

6.7.5 The main impact of climate change on demand is related to periods of extremely hot and dry weather that will increase the peak demand for water. AfW have accounted for the impact on the peak demand and the longer duration effect of a dry year through applying factors to the household and non-household water consumption rate in their supply-demand modelling.

6.7.6 Only a small increase in demand is expected as a result of climate change which largely applies to garden watering.

[35] Future Water, the Government's water strategy for England, DEFRA, 2008

6.7.7 Although AfW have planned for the anticipated impacts of climate change, the view of AfW and other water companies is that, in order to manage the effects of climate change effectively, the single most cost effective step in water resources climate change resilience is to manage demand downwards. The reduction in demand will also help to reduce carbon emissions which aids in reducing impacts of climate change.

What is Water Neutrality?

6.7.8 Water neutrality is a concept whereby the total demand for water within a planning area after development has taken place is the same (or less) than it was before development took place[36]. If this can be achieved, the overall balance for water demand is 'neutral', and there is considered to be no net increase in demand as a result of development. In order to achieve this, new development needs to be subject to planning policy which aims to ensure that where possible, houses and businesses are built to high standards of water efficiency through the use of water efficient fixtures and fittings, and in some cases rainwater harvesting and greywater recycling.

6.7.9 It is theoretically possible that neutrality can be achieved within a new development area, through the complete management of the water cycle within that development area. In addition to water demand being limited to a minimum, it requires:

- All wastewater to be treated and re-used for potable consumption rather than discharged to the environment;
- Maximisation of rainwater harvesting (in some cases complete capture of rainfall falling within the development) for use in the home; and
- Abstraction of local groundwater or river flow storage for treatment and potable supply.

6.7.10 Achieving 'total' water neutrality within a development remains an aspirational concept and is usually only considered for an eco-town or eco-village type development, due to the requirement for specific catchment conditions to supply raw water for treatment and significant capital expenditure. It also requires specialist operational input to maintain the systems such as wastewater re-use on a community scale. Total neutrality for a single development site is yet to be achieved in the UK.

6.7.11 For the majority of new development, in order for the water neutrality concept to work, the additional demand created by new development needs to be offset by reducing the demand from existing population and employment. Therefore, a 'planning area' needs to be considered where measures are taken to reduce existing or current water demand from the current housing and employment stock. The planning area in this case is considered to be Luton Borough Council and its strategic development sites.

Twin-Track Approach

6.7.12 Attainment of water neutrality requires a 'twin track' approach whereby water demand in new development is minimised as far as possible, whilst at the same time taking measures, such as retrofitting of water efficient devices on existing homes and business to reduce water use in existing development.

[36] Water Neutrality is defined more fully in the Environment Agency report 'Towards water neutrality in the Thames Gateway' (2007)

6.7.13 In order to reduce water consumption and manage demand for the limited water resources within the Borough, a number of measures and devices are available[37]. Generally, these measures fall into two categories due to cost and space constraints, as those that should be installed in new developments and those which could be retrofitted. Appendix C provides more detail on the different types of device or system along with the range of efficiency savings they could lead to.

Achieving Total Neutrality – is it feasible?

6.7.14 When considering neutrality within an existing planning area, it is recognised by the Environment Agency[38] that achievement of total water neutrality (100%) for new development is often not possible, as the levels of water savings required in existing stock may not be possible for the level of growth proposed. A lower percentage of neutrality may therefore be a realistic target, for example 50% neutrality.

6.7.15 This WCS therefore considers four water neutrality targets and sets out a 'pathway' for how the most likely target (or level of neutrality) can be achieved. The pathway concept is discussed in more detail in Appendix C, and highlights the importance of developing local policy in Luton Borough for delivering aspirations like water neutrality as well as understanding the additional steps required beyond 'business as usual' required to achieve it.

Water Neutrality Scenarios

6.7.16 Four water neutrality targets have been proposed and assessed. Each target moves beyond the Business as Usual scenario, which is considered to be:

- 125 l/h/d for all new homes[39];
- No mandatory efficiency target for non-domestic property; and
- Continued meter installation in existing homes as planned in AfW's WRMP up to 2040.

6.7.17 The existing level of metering within the AfW Central region is 42%. AfW's future target for meter penetration[40] on domestic water meters in the Central region is 90% by 2025. The WRMP assumes the current rate of meter penetration will continue to the target of 90% of customers metered by 2025.

6.7.18 The water neutrality scenarios have been developed based on the following generic assumptions. For clarity, Luton Borough has been considered as a whole when assessing the scenarios.

6.7.19 The water demand from London Luton Airport has also been included in the calculations. It is likely that water efficiency measures will be included within the expansion plans at the airport.

<u>Very High Scenario</u>

[37] Water Efficiency in the South East of England, Environment Agency, April 2007.
[38] Environment Agency (2009) *Water Neutrality, an improved and expanded water management definition*
[39] Building regulations Part G Requirement
[40] proportion of properties within the AfW supply area which have a water meter installed

6.7.20 The scenario has been developed as a context to demonstrate what is required to achieve the full aspiration of water neutrality. In reality, achieving 100% meter penetration across the Borough is unlikely, due to a proportion of existing properties which either have complicated plumbing or whose water is supplied by bulk (i.e. flats), making it difficult for meter installation.

6.7.21 The key assumptions for this scenario are that water neutrality is achieved; however it is considered as aspirational only as it is unlikely to be feasible based on:

- Existing research into financial viability of such high levels of water efficiency measures in new homes; and
- Uptake of retrofitting water efficiency measures considered to be at the maximum achievable (35%) in the Borough.

6.7.22 It would require:

- A significant funding pool and a specific joint partnership 'delivery plan' to deliver the extremely high percentage of retrofitting measures required;
- Strong local policy within the Local Plan on restriction of water use in new homes on a Borough scale which is currently unprecedented in the UK; and
- All new development to include water recycling facilities across the Borough which is currently limited to small scale development in the UK.

<u>High Scenario</u>

6.7.23 The key assumptions for this scenario are that a high water neutrality percentage[41] is achieved but requires significant funding and partnership working, and adoption of new local policy which is currently unprecedented in the UK.

6.7.24 It would require:

- Uptake of retrofitting water efficiency measures to be very high (25%) in relation to studies undertaken across the UK; and
- A significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures required.

6.7.25 It is considered that, despite being at the upper scale of percentage uptake of retrofitting measures, it is technically and politically feasible to obtain this level of neutrality if a fully funded joint partnership approach could be developed.

[41] WN percentage refers to the percentage of water use savings made by various measures against the total new demand if the business as usual demand were to continue

Medium Scenario

6.7.26 The key assumptions for this scenario are that the water neutrality percentage[42] achieved is at least 50% of the total neutrality target and would require funding and partnership working, and adoption of new local policy which has only been adopted in a minimal number of Local Plans in the UK.

6.7.27 It would require:

- Uptake of retrofitting water efficiency measures to be reasonably high (20%) in the Borough; and
- A significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures required.

6.7.28 It is considered that it is technically and politically feasible to obtain this level with a relatively modest funded joint partnership approach and with new developers contributing relatively standard, but high spec water efficient homes.

Low Scenario

6.7.29 The key assumptions for this scenario are that the water neutrality percentage[43] achieved is low but would require small scale level of funding and partnership working, and adoption of new local policy which is likely to be easily justified and straightforward for developers to implement.

6.7.30 It would require:

- Uptake of retrofitting water efficiency measures to be fairly low (10%); and
- A relatively small funding pool and a partnership working not moving too far beyond 'business as usual' for stakeholders.

6.7.31 It is considered that it is technically and politically straightforward to obtain this level with a small funded joint partnership approach and with new developers contributing standard, but water efficient homes with a relative low capital expenditure.

[42] WN percentage refers to the percentage of water use savings made by various measures against the total new demand if the business as usual demand were to continue

[43] WN percentage refers to the percentage of water use savings made by various measures against the total new demand if the business as usual demand were to continue

Neutrality Scenario Assessment Results

6.7.32 For each neutrality scenario, an outline of the required water efficiency specification was developed for new houses, combined with an estimate of the savings that could be achieved through metering and further savings that could be achieved via retrofitting of water efficient fixtures and fittings in existing property. This has been undertaken utilising research undertaken by groups and organisations such as Waterwise East, UKWIR[44], the Environment Agency and Ofwat to determine realistic and feasible efficiency savings as part of developer design of properties, and standards for non-residential properties (see Appendix C).

6.7.33 To achieve total neutrality, the demand post growth must be the same as, or less than existing demand. Based on estimates of population size, existing demand in Luton was calculated to be 26 Ml/d. Demand post growth therefore needs to be below 26Ml/d for water neutrality to be achieved.

6.7.34 For each neutrality scenario, total demand was then calculated at three separate stages for housing and employment as follows:

- Stage 1 – total demand post growth without any assumed water efficiency retrofitting for the differing levels of water efficiency in new homes;
- Stage 2 – total demand post growth with effect of metering applied for the differing levels of water efficiency in new homes; and
- Stage 3 – total demand post growth with metering and water efficient retrofitting applied to existing homes for the differing levels of water efficiency in new homes.

6.7.35 The results are shown in Table 6-1. If neutrality is achieved (total demand after metering and water efficient fixtures and fittings is less than or equal to 26Ml/d), the result is displayed as green. If it is not, but within 20%, it is displayed as amber, and red if not achieved. The percentage of total neutrality achieved per scenario is also provided.

TABLE 6-1: RESULTS OF THE NEUTRALITY SCENARIO ASSESSMENTS

New Homes & Employment Demand Projections	Demand from Growth (Ml/d)	Total demand post growth* (Ml/d)	Total demand after metering effect (Ml/d)	Total demand after metering & WE F&F (Ml/d)	% Neutrality Achieved
Baseline Assumption	6.60	32.88	31.68	31.68	-
Building Regulations	6.31	32.59	31.40	31.40	19%
Building Regulations Optional Requirement	5.60	31.88	30.68	30.68	30%
Low WN Scenario	6.05	32.33	31.13	30.94	26%
Medium WN Scenario	5.36	31.64	30.45	29.27	53%
High WN Scenario	4.08	30.36	29.16	26.74	93%
Very High WN Scenario	3.32	29.59	28.15	24.76	124%

[44] UKWIR – The United Kingdom Water Industry Research group, attended and part funded by all major UK water companies

* prior to demand management for existing stock

The results show that total neutrality is only achieved by applying the very high scenario, whilst the high neutrality scenario gives 93% neutral water use, and the medium neutrality scenario gives 53% neutral water use.

Delivery Requirements – Technological

6.7.36 The details of what is required technologically from each scenario in terms of new build are included in Table 6-2.

TABLE 6-2: DETAILS OF NEW BUILD SPECIFICATION REQUIRED TO MEET EACH WATER USE TARGET

Component	150 l/h/d Standard Home	Business as usual	Low (120 l/h/d)	Medium (105 l/h/d)	High (80 l/h/d)	Very High
Toilet flushing	28.8	19.2 [b]	19.2 [b]	16.8 [d]	16.8 [d]	16.8 [d]
Taps	42.3 [a]	31.8 [a]	31.8 [a]	24.9 [a]	18 [a]	18 [a]
Shower	30	30	24	18	18	18
Bath	28.8 [c]	25.6 [c]	25.6 [c]	25.6 [c]	22.4 [f]	22.4 [f]
Washing Machine	16.7	15.3	15.3	15.3	15.3	15.3
Dishwasher	3.9	3.9	3.6	3.6	3.6	3.6
Recycled water					-16.1 [e]	-32.2 [g]
Total per head	150.5	125.8	119.5	104.2	78	61.9
Total per household	325.08	271.728	258.12	225.072	168.48	133.704

- a Combines kitchen sink and wash hand basin
- b 6/3 litre dual-flush toilet (f) recycled water
- c 160 litre bath filled to 40% capacity, frequency of use 0.4/day
- d 4.5/3 litre dual flush toilet
- e Rainwater harvesting
- f 120 litre bath
- g Rainwater/greywater harvesting for toilet and washing machine

More detail on the specific measures required under each scenario can be found in Appendix C.

Financial Cost Considerations

6.7.37 There are detailed financial and sustainability issues to consider in deciding whether to adopt a policy for water neutrality. Whilst being water efficient is a consideration of this study, reaching neutrality should not be at the expense of increasing energy use and potential increasing the carbon footprint of development.

6.7.38 It is also important to consider that through using less water, more water efficient homes require less energy to heat water, hence there are energy savings. These elements are broken down in more detail in Appendix C.

6.7.39 The estimated financial cost of delivering the technological requirements of each neutrality scenario has been calculated from available research and published documents. Summary tables below should be reviewed with Appendix C for supporting information.

Neutrality scenario costs

6.7.40 Using the information compiled, the financial costs per scenario has been calculated and are included in Table 6-3. It should be noted that these are only estimated costs.

TABLE 6-3: ESTIMATED COST OF NEUTRALITY SCENARIOS										
Neutrality Scenario	Outstanding Homes		Existing Properties					Costs Summary		
	Numbers	Cost	No. to be metered (10% existing)	Metering cost	Retrofit %	No. to retrofit	Retrofit cost	Developer	Non developer	Total
Low	17,585	-	7,429	£3,714,650	10	7429	£371,465	-	£4,086,115	£4,086,115
Medium	17,585	£2,198,125	7,429	£3,714,650	20	14859	£2,451,669	£2,198,125	£6,166,319	£8,364,444
High (RWH)	17,585	£46,512,325	7,429	£3,714,650	25	18573	£4,086,115	£46,512,325	£7,800,765	£54,313,090
Very High (RWH & GWR)	17,585	£70,427,925	7,429	£3,714,650	35	26003	£5,720,561	£70,427,925	£9,435,211	£79,863,136

Carbon Cost Considerations

6.7.41 As described in this section, there are sustainability issues to take into account when considering a policy for promotion of water efficiency and water neutrality. Reaching the very highest levels of efficiency requires the use of recycling technology (either through rainwater harvesting and treatment or greywater recycling) which requires additional energy both embedded in the physical structures required and also in the treatment process required to make the water usable. More detail is provided in Appendix C on the methodology used to calculate carbon equivalents of energy used.

6.7.42 The WRMP Direction 2007[45] and WRP Guideline[46] require details of the greenhouse gas emissions that are likely to arise through the delivery of a water company's proposed WRMP. AfW estimated these from calculation of greenhouse gases as tonnes of carbon dioxide equivalent (tCO2e) for the base year 2013-14 of 111,000 tCO2e for drinking water treatment and distribution across the AfW region. For subsequent years the value of 0.55 tCO2e/Ml[47] has been used with the forecast demand to give the mass of CO2e likely to be emitted on the basis of current technologies. In order to calculate the carbon costs of achieving water efficiency for the proposed growth in Luton, the value of 0.55 tCO2e/Ml has been used.

Results

6.7.43 The information was used along with estimates of energy used in recycling technology[48] to provide a carbon cost for each of the WN scenarios for Luton. The results are presented in Table 6-4.

The following assumptions have been applied:

- Under the 'High' and 'Very high' scenarios, consideration must be taken of carbon use in rainwater harvesting as well as water use;
- A basic assumption that each new home is a 90m^2 2-storey house with a small biological system; and
- Insufficient information was available to differentiate between energy used in a building regulations standard home at 125l/h/d and a low WN (120l/h/d) home. Therefore, energy used per home is the same for 'business as usual' (i.e. building regulations) and the low WN scenario.

[45] WRMP Regulations Statutory Instrument 2007 No. 727, WRMP Direction 2007, WRMP (No.2) Direction 2007, WRMP (No.2) (Amendment) Direction 2007, WRMP Direction 2008

[46] Water resources planning guideline, Environment Agency, November 2008, http://www.environment-agency.gov.uk/business/sectors/39687.aspx

[47] Veolia Water (2011) Responsible Business Review 2011

[48] Environment Agency (2010) Energy and carbon implications of rainwater harvesting and greywater recycling

TABLE 6-4: CARBON COSTS OF WATER NEUTRALITY SCENARIOS						
WN Scenario	**Water Use Reductions from retrofit pre WN Scenario (Ml/d)**	**Carbon reduction per WN scenario (tCO2e/d)**	**Carbon use per New Home (kg/y)**	**Carbon use per New Home (kg/d)**	**Total Carbon use for New Homes in EC (tCO2e/d)**	**Total (tCO2e/d)**
Business as Usual (Building Regs Only)	0.00	0.00	681.00	1.87	17.21	17.21
Low	0.19	-0.11	681.00	1.87	17.21	17.10
Medium	1.18	-0.65	582.00	1.59	14.70	14.06
High	2.42	-1.33	578.00	1.58	14.60	13.27
Very High	3.39	-1.87	614.90	1.68	15.54	13.67

6.7.44 The results show that there are significant CO_2 savings to be made by homes being built to a higher water efficiency level and from the effect of existing homes using less energy to heat water through retrofitting of water efficient devices.

6.7.45 The additional energy used per house for RWH in the high scenario is offset by the savings made in using less water in line with the very high scenario; however the additional energy required for greywater recycling in the very high scenario makes this scenario higher in CO2 emissions than the high WN scenario. This suggests that in order to meet total neutrality there will be an increase in CO2 emissions over less intensive WN scenarios and hence there are concerns over the long term sustainability of pursuing such a strategy.

Preferred Strategy – Delivery Pathway

6.7.46 The assessment of water neutrality in this WCS has been undertaken to demonstrate whether moving towards neutrality is feasible and what the cost, and technological implications might be to get as close to neutrality as possible.

6.7.47 To achieve any level of neutrality, a series of policies, partnership approaches and funding sources would need to be developed. This WCS has assumed a 'medium' scenario would be favoured and sets out what would be required to support this strategy. The 'medium' WN scenario could allow a WN target of 53% to be reached, but would require funding and partnership working.

6.7.48 It is considered that it is technically and politically possible to obtain this level with a relatively modest funded joint partnership approach and with new developers contributing standard, but high spec, water efficient homes.

6.7.49 Depending on the success of the first step to neutrality, higher WN scenarios could be aspired to by further developing policies and partnership working to deliver greater efficiencies.

Delivery Requirements – Policy

6.7.50 In order to meet the 'medium' WN scenario, the following measures are suggested to support its delivery. Planning policy should seek to achieve the following:

- Ensure all housing is water efficient, new housing development would need to go beyond Building Regulations (equivalent to reaching Code for Sustainable Homes Level 3/4).

- Ensure all non-residential development is water efficient and goes beyond Building Regulations and as a minimum reach Good BREEAM status.

- Carry out a programme of retrofitting and water audits of existing dwellings and non-domestic buildings. Aim to move towards delivery of 20% of the existing housing stock with easy fit water saving devices.

- Establish a programme of water efficiency promotion and consumer education, with the aim of behavioral change with regards to water use.

6.7.51 When considering planning applications for new development (regardless of size), the planning authority and statutory consultees should consider whether the proposed design of the development has incorporated water efficiency measures, including (but not necessarily limited to) garden water butts, low flush toilets, low volume baths, aerated taps, and water efficient appliances sufficient to meet 105l/h/d.

6.7.52 Undertaking retrofitting and water audits must work in parallel with the promotion and education programme. Further recommendations on how to achieve it are included in the sections below, including recommended funding mechanisms.

Delivery Requirements – Partnership Approaches

6.7.53 Housing association partners should be targeted with a programme of retrofitting water efficient devices, to showcase the policy and promote the benefits. This should be a collaborative scheme between Luton Borough Council, AfW and Waterwise. In addition, RWH/GWR schemes could be implemented into larger council owned and maintained buildings.

6.7.54 The retrofitting scheme should then be extended to non-Council owned properties, via the promotion and education programme.

6.7.55 A programme of water audits should be carried out in existing domestic and non-domestic buildings, again showcased by Council owned properties, to establish water usage and to make recommendations for improving water efficiency measures. The water audits should be followed up by retrofitting water efficient measures in these buildings, as discussed above. In private non-domestic buildings water audits and retrofitting should be funded by the asset owner, the cost of this could be offset by the financial savings resulting from the implementation of water efficient measures. In order to ensure the uptake of retrofitting water efficient devices for non-council properties, Luton Borough should implement an awareness and education campaign, which could include the points listed below. It should be noted that, under the latest WRMP, AfW intend to implement a water saving program, a retrofit program (which will include homes and commercial properties) a schools program and high footfall events.

- Continue to work with AfW to help with its water efficiency initiative, which has seen leaflets distributed directly to customers and at events across the region each year[49];

- A media campaign, with adverts/articles in local papers and features on a local news programme;

- A media campaign could be supplemented by promotional material, ranging from those that directly affect water use e.g. free cistern displacement devices, to products which will raise awareness e.g. fridge magnets with a water saving message;

- Encouraging developers to provide new residents with ‘welcome packs’, explaining the importance of water efficiency and the steps that they can take to reduce water use;

[49] https://www.affinitywater.co.uk/mediapublications.aspx

- Working with retailers to promote water efficient products, possibly with financial incentives as were undertaken as part of the Preston Water Initiative[50];

- Carrying out educational visits to schools and colleges, to raise awareness of water efficiency amongst children and young adults;

- Working with neighbourhood trusts, community groups and local interest groups to raise awareness of water efficiency; and

- Carrying out home visits to householders to explain the benefits of saving water, this may not be possible for the general population of Luton Borough, but rather should be used to support a targeted scheme aimed at a specific residential group, as was carried out for the Preston Water Initiative.

Responsibility

6.7.56 The recommendations above are targeted at Luton Borough and AfW, as these are the major stakeholders, although the Environment Agency and other statutory consultees can also influence future development to ensure the water neutrality target is achieved.

6.7.57 It is therefore suggested that responsibility for implementing water efficiency policies be shared as follows:

- Responsibility for ensuring planning applications are compliant with the recommended policies lies with Luton Borough Council and Environment Agency (and other statutory consultees as appropriate);

- Responsibility for fitting water efficient devices in accordance with the policy lies with the developer, but this should be guided and if necessary enforced by Luton Borough Council through the planning application process (as above);

- Responsibility to ensure continuing increases in the level of water meter penetration lies with AfW;

- Responsibility for retrofitting devices lies with property owners, but with facilitation and funding support from Luton Borough Council (potentially through CIL infrastructure list) for privately owned housing stock;

- Responsibility for promoting water audits lies with Luton Borough. It is suggested that the Council sets targets for the numbers of businesses that have water audits carried out and that a specific individual or team within the Council is responsible for promoting and water audits and ensuring the targets are met. The same team or individual could also act as a community liaison for households (council and privately owned) and businesses where water efficient devices are to be retrofitted, to ensure the occupants of the affected properties understand the need and mechanisms for water efficiency; and

- Responsibility for education and awareness of water efficiency should be shared between Luton Borough, AfW and energy companies, as a partnership managed by the Council.

6.7.58 However it should be noted that a major aim of the education and awareness programme, as outlined by Policy Recommendation 2, is to change peoples' attitude to water use and water saving and to make the general population understand that it is everybody's responsibility to reduce water use. Studies have shown that the water efficiencies in existing housing stock achieved by

[50] Preston Water Efficiency Report, Waterwise, March 2009, www.waterwise.org.uk

behavioural changes, such as turning off the tap while brushing teeth or reducing shower time, can be as important as the installation of water efficient devices.

Retrofitting funding options

6.7.59 In addition to possible resistance from existing householders, the biggest obstacle to retrofitting is the funding mechanism.

6.7.60 Water companies are embarking on retrofit as part of their response to meeting Ofwat's mandatory water efficiency targets. These programmes are funded out of operational expenditure. If a company has, or is forecasting, a supply-demand deficit over the planning period, water efficiency programmes can form part of a preferred option(s) set to overcome the deficit. However, these options are identified as part of the companies' water resource management plans and will have to undergo a cost-benefit analysis.

6.7.61 Luton Borough could consider developer contributions to the Community Infrastructure Levy (CIL) or through S106 agreements.

6.7.62 Part 11 of the Planning Act 2008[51] (c. 29) ("the Act") provides for the imposition of a charge to be known as Community Infrastructure Levy (CIL). This is a new local levy that authorities can choose to introduce to help fund infrastructure in their area. CIL will help pay for the infrastructure required to serve new development, and although CIL should not be used to remedy pre-existing deficiencies, if the new development makes the deficiency more severe (as is the case with water resources in the Luton area) then the use of CIL is appropriate.

6.7.63 Section 106 (S106) of the Town and Country Planning Act 1990[52] allows a local planning authority (LPA) to enter into a legally-binding agreement or planning obligation with a landowner in association with the granting of planning permission, known as a Section 106 Agreement. These agreements are a way of delivering or addressing matters that are necessary to make a development acceptable in planning terms. They are increasingly used to support the provision of services and infrastructure, such as highways, recreational facilities, education, health and affordable housing.

6.7.64 However, there are considerable existing demands on developer contributions and it is unlikely that all of the retrofitting required in Luton could be funded through these mechanisms; Luton Borough therefore needs to look beyond developer contributions, possibly to the water companies, for further funding sources. Some councils offer council tax rebates to residents who install energy efficient measures (rebates jointly funded by the Council and Energy Company). Luton Borough Council should consider a similar scheme, although this would require the agreement of AfW.

6.7.65 There are two possible European funding mechanisms available for the promotion of water efficiencies:

- European Investment Bank; and
- European Regional Development Funds.

6.7.66 The European Investment Bank's lending policy[53] sets out how they will support water efficiency measures by water service providers and grant loans to promote water efficiency in buildings. This could be a possible funding route for a widespread retrofitting programme.

6.7.67 European Regional Development Funds are more limited, as funds are often preferentially directed towards energy efficiency projects, with the aim of reducing carbon emissions to achieve European targets. Allocated funding for the current programming period (2007 to 2013 are mainly allocated to

[51] http://www.legislation.gov.uk/ukpga/2008/29/contents
[52] http://www.legislation.gov.uk/ukpga/1990/8/contents

such projects[54], although the possibility for funding water efficiency project post-2013 should be investigated.

Retrofitting monitoring

6.7.68 During delivery stage, it will be important to ensure sufficient monitoring is in place to track the effects of retrofitting on reducing demand from existing housing stock. The latest research shows that retrofitting can have a significant beneficial effect and can be a cost effective way of managing the water supply-demand balance[55]. However, it is acknowledged that savings from retrofitting measures do diminish with time. This means that a long-term communication strategy is also needed to accompany any retrofit programme taken forward and this needs to be supported by monitoring so that messages can be targeted and water savings maintained in the longer-term. The communication and monitoring message also applies to new builds to maintain continued use of water efficient fixtures and fittings.

[53] http://www.eib.org/attachments/strategies/water_sector_lending_policy_2008_en.pdf
[54] Ensuring Water for All, Scoping Study Final Report, Environment Agency, 2010
[55] Waterwise (2011): Evidence base for large-scale water efficiency, Phase II Final report

7. Flood Risk and Surface Water Drainage

7.1 Introduction

7.1.1 There is a need for development to be managed through the planning process in order to avoid construction in high flood risk areas, to prevent any increase in flood risk to existing properties, and to identify strategic measures for managing surface water run-off. Throughout the planning process, opportunities for reducing flood risk should be fully investigated.

7.1.2 The previous Phase 1 and Phase 2 Water Cycle Strategies investigated the causes of flooding, assessed the risk of flooding at a number of potential development sites, indicated what drainage system types might be suitable for mitigating any increase in surface water run-off from sites, and identified potential opportunities for a strategic and integrated approach to flood risk management. Options that reduce flood risk and provide multiple benefits were also evaluated, and areas where development may restrict future opportunities for reducing flood risk identified. SUDS suitable for limiting surface water runoff from proposed development sites to greenfield rates were also identified.

7.1.3 This study differs from the previous WCSs in that the Luton area is being studied more generally, rather than looking at specific development sites. In addition, studies completed since 2009 have provided more detailed information relating to local flood risk. These include:

- The Surface Water Management Plan (SWMP) completed in 2012, which investigated surface water flooding in Luton; and
- The updated Level 1 Strategic Flood Risk Assessment for Luton (2012).

7.1.4 This approach supports the aims of the NPPF which requires that flood risk and the potential effects of climate change are taken into account at all stages in the planning process. However, the Water Cycle Strategy is not intended to replace site-specific flood risk assessments by developers. Instead, it identifies the potential for developers, local planning authorities and the Environment Agency (EA) to work together in providing strategic solutions that benefit the catchment as a whole.

7.2 Overview of Study Area

7.2.1 The Luton study area lies at the top of the River Thames drainage basin. The hydrological boundary is formed by wide ridges running to the north, east and west of the Luton urban area (see Figure 2-1 in Appendix B). The River Lea and its tributaries (Houghton Brook, Cat Brook, Lewsey Brook and Riddy Brook) drain the Luton catchment towards the south east. The catchment is characterised by highly developed floodplains with little open space and modified river channels. Apart from the urban areas of Luton and Dunstable, the upper catchment is predominantly used for arable farming on unconfined chalky soils. Luton and Dunstable are major urban areas within the catchment; the M1 and London-Luton airport are major transport links that also fall within the catchment. Some water from the Upper Lea catchment is transferred to the River Ouzel via the Dunstable Sewage Treatment Works.

7.2.2 The geology of the study area consists of Chalk with the Lambeth Group along the north east and south west sides of the borough and Glaciofluvial Deposits along the River Lea (Appendix B Figure 5-2-1 and Figure 5-2-2). Due to the local geology the study area has extensive aquifers, many being used for potable and/or industrial water supply. In addition, most of the watercourses in the area are spring-fed, indicating groundwater levels are at or very close to the ground surface in some locations throughout the study area. Groundwater-fed rivers are particularly sensitive to changes in rainfall-runoff and infiltration patterns due to development, as the increase in impermeable surfaces can result in much lower baseflows and flashier responses to rainfall.

7.2.3 There is a history of surface water and fluvial flooding in Luton. However, despite the high permeability of the bedrock, there are few records of groundwater flooding. Instead, in Luton, flood risk is predominantly from surface water sources, as a consequence of rapid development in the 1960s without concurrent upgrading of the sewer system[56].

7.2.4 Throughout this section, standards of flood protection are referred to according to the probability of flooding occurring in a location in one year. A standard of protection to the 1 in 100 year event means that the location has a 1% chance (1 in 100) of flooding in any year. This does not mean that if the location floods one year, it will definitely not flood again for the next 99 years, nor that if it has not flooded for the previous 99 years, it will definitely flood this year.

7.3 Policy Context

Regional Policies and Studies

7.3.1 At the regional scale, policies for 'Main River' watercourses are set by the EA regional districts. The Luton study area is within the EA South East administrative region. Through regional byelaws, the EA has permissive powers to maintain and improve Main Rivers for efficient passage of flood flows and the management of water levels. The byelaw of particular relevance to development is that regarding the width of undeveloped buffer strips to be left adjacent to Main Rivers:

- In the Thames Region, an 8 m undeveloped buffer strip must be left adjacent to the river bank (whether open watercourse or culverted).

7.3.2 River Basin Management Plans (RBMPs) identify long-term policies for water environment management at the regional scale, to meet the requirements of the Water Framework Directive. RBMPs consider the ecological, chemical and hydrological quality of all water bodies and set objectives to improve standards. The Luton study area is within the Thames RBMP study area, for which the RBMP was approved by the Secretary of State for the Department for Environment, Food and Rural Affairs in December 2009. The proposed actions for the Thames study area include the following suggestions relevant for planning and flood risk:

- Promotion of wide-scale use of sustainable drainage schemes for flood risk, to reduce risks of flooding and impact on surface water quality at times of high rainfall.
- Promotion of national guidance for spatial planners and other professions on the integration of water planning and development planning to reduce the risk of pollution and flow issues arising in water bodies caused by new development.

[56] This document does not consider groundwater infiltration to sewers. The state of the existing sewerage system may need to be investigated prior to development and assurances need to be given that there are no sewer infiltration problems in the sewer.

- Development of WFD compliant strategies for green infrastructure delivery as an integral element of the development process, to use natural processes to meet the objectives of the WFD, to allow better access for watercourse maintenance, to attenuate flood waters etc.
- Improved management of surface water drainage by use of sustainable drainage systems and development and implementation of Surface Water Management Plans where appropriate, to reduce risk of diffuse pollution due to flooding.

7.3.3 Catchment Flood Management Plans (CFMPs) are a non-statutory planning tool used by the EA to identify long-term policies for sustainable flood risk management at the regional scale. The Luton region is covered by the Thames Region CFMP. The Thames Region CFMP (EA, 2007) covers the River Lea. A specific policy unit is included for Luton for which the recommendation is: Take further action to sustain the current level of flood risk into the future (responding to potential increases in risk from urban development, land use change and climate change). To deliver this policy, a number of actions are identified, which are summarised in Table 7.1. These actions are currently being addressed, for example, the Environment Agency is currently developing an 'opt-out' flood warning service (Lu7).

TABLE 7-1: THAMES CATCHMENT FLOOD MANAGEMENT PLAN MANAGEMENT POLICIES FOR LUTON

Lu1: Land use planning – Short term planning actions	The short to medium term priority actions in line with NPPF to create safe and sustainable development that positively reduces flood risk in Luton are: • Agree a Strategic Flood Risk Assessment and use the information to reduce flood risk through influencing Local Development Framework documents, Regional Spatial Strategies, planning applications and emergency and evacuation plans. • Seek commitments in land use planning documents to retain the remaining floodplain for flood risk management compatible uses. • Identify opportunities to recreate river corridors and wetland habitats in urban areas. Encourage new development and any redevelopment of these areas to acknowledge these opportunities in their site layouts and set development back, allowing space for water, habitat, wildlife and recreation. • Removing obstructions to flow and naturalising watercourses so there is a reduced risk of blockages. • Encourage safeguarding of areas needed for flood risk management as identified in the finalised Luton Strategy. Encourage the Local Authority to adopt and apply policies that ensure that all new properties built in the floodplain are resistant and resilient to flooding.
Lu2: Land use planning – Long term adaptation of the urban environment to be more flood resilient.	The priority actions to achieve long-term adaptation of urban river corridors in Luton, linked to the redevelopment of these areas, are: • Encourage refurbishment of existing buildings to increase resilience and resistance to flooding. • Increase the available storage within the river corridor. • Encourage partners to assess the viability of future land swapping opportunities in those areas where there is a risk of flooding. This will need to recognize both flood risk management objectives and the wider objectives of the Planning Authority and seek a net reduction in flood risk.

TABLE 7-1: THAMES CATCHMENT FLOOD MANAGEMENT PLAN MANAGEMENT POLICIES FOR LUTON	
Lu3: Flood Risk Management Strategy	Complete the Luton Flood Risk Management Strategy to identify in detail the most effective and sustainable options for managing flood risk.
Lu4: Surface water drainage	Consider the impact of other sources of flooding by assisting in the development of a Surface Water Management Plan (or within the Luton Strategy) for those areas of Luton that are most vulnerable to this source of flooding. This plan should investigate risk from surface water and sewer flooding. This plan should consider increased risk to the drainage system from future development and climate change.
Lu5: Optimising attenuation and conveyance within the catchment in the long term.	It is a priority to set out a clear vision for the future management of the flow of water in the catchment. This is necessary because the current management relies heavily on conveyance, which is not sustainable. The outcomes being sought are: • Conveyance maintained where necessary, but in a more natural state. • Greater attenuation in the catchment. • Re-establishment and enhancement of river corridors. • Reduced future legacy costs by identification of redundant asset structures. The Luton Strategy will assess the viability of attenuation options.
Lu6: Short-term management of assets	The approach for short-term management of assets is: • Maintain the existing level of conveyance through Luton by keeping existing channels clear and free from obstruction. Where regeneration is likely in the foreseeable future (including beyond the current Plan period), manage those assets to avoid the need for replacement until regeneration occurs.
Lu7: Flood warning, flood awareness and emergency planning.	An important element of flood risk management is to prepare for and to address the consequences of flooding. The priority actions are: • Participation in Local Resilience Forums and the development of Multi-Agency Emergency Response Plans with our partners. • Work with partners to identify critical infrastructure at risk of flooding and encourage appropriate action. • Work with partners, including the media, to ensure that effective communication plans are in place before, during and in the recovery phase of a flooding incident. • Increase public awareness including encouraging people to sign up for the free Flood Line Warnings Direct service. • Identify those places where an adequate flood warning is not currently provided. Investigate whether this situation can be improved and where possible do so, e.g. through the installation of river level monitoring. • Encourage communities to work together with parish councils to produce community flood plans that will: • Identify flood risks to the community and take action to reduce them. • Identify vulnerable people in the community and develop plans to assist/protect them. • Identify resources in the community available to assist during an emergency.

TABLE 7-1: THAMES CATCHMENT FLOOD MANAGEMENT PLAN MANAGEMENT POLICIES FOR LUTON	
	Provide key contact details for the Emergency Management Team, key community resources, the emergency services and local authorities.

Local Policies and Studies

7.3.4 At the local scale, policies for 'non-Main River / Ordinary' watercourses are set by the relevant Operating Authority. In the study area, Luton Borough Council is the Operating Authority for ordinary watercourses. The powers and responsibilities of local authorities with respect to drainage have been enhanced through the Flood and Water Management Act (2010), as discussed in Section 3. The local authority is not the sole party with an interest in watercourses outside the IDB area of operation. Under the Flood and Water Management Act, the Lead Local Flood Authority has powers to consent works that may impede or obstruct flow within any ordinary watercourse. The LLFA also has certain powers of enforcement over activities on ordinary watercourses.

7.3.5 Strategic Flood Risk Assessments (SFRAs) support NPPF by providing a reference document for use by the Local Planning Authority (LPA) in their strategic land use planning. SFRAs are usually prepared in two stages: a Level 1 SFRA supplies information needed for the Sequential Test to be applied, while a Level 2 SFRA supplies information needed for the Exception Test to be applied. The status of the SFRA for Luton is as follows:

7.3.6 The Level 1 SFRA for Luton and Southern Central Bedfordshire was completed in August 2008 and mapped flood risk from all sources at the time of writing and in 2115 using available data. An updated Level 1 SFRA for Luton was completed in October 2012, the results of which have informed this WCS.

7.3.7 Flood risk and mitigation options for the Upper Lea catchment (Luton to Wheathampstead) have been investigated through the Upper Lea Flood Risk Management Strategy (2007). A strategy appraisal report (SAR) has been prepared by the EA evaluated mitigation options and economic viability, known as the Luton Flood Risk Management Strategy (LFRMS). A summary of the LFRMS is given below.

<u>The Luton Flood Risk Management Strategy (EA)</u>

7.3.8 The Environment Agency has developed a strategy for managing flood risk within the Luton and Dunstable area of the upper River Lea catchment. A number of studies of the flooding characteristics of this catchment have been carried out between 2002 and 2007 and have identified the problems and key issues related to the flood risk in the catchment. They have also set out conclusions as to which flood defence options were viable and not viable, and recommended a flood defence option combination to be carried forward for further study in order to establish the general arrangement of the works.

7.3.9 The Luton Flood Risk Management Strategy (LFRMS),produced in July 2012,has the following elements and objectives:

- Appraise flood storage solutions, conveyance solutions and a limited number of combinations of options, in addition to the storage sites identified in the 2002 Flood Defence Strategy Study;

- Investigate the likely impacts on flood risk of proposed new urban development;
- Undertake Strategic Environmental Assessment (SEA) scoping and preliminary options appraisal;
- Identify key land ownership issues at potential storage solution sites;
- Select preferred option / combination of options;
- Complete a full SEA for the preferred option / combination of options, and identify the optimum design standard. Identify specific sites for environmental gain (e.g. potential new Biodiversity Action Plan habitat);
- Resolve land ownership issues at all potential sites for storage solutions and habitat creation;
- Finalise economic assessment and set out full business case, including investment needs to 2019;
- Develop and test appropriate non-structural options for the catchment such as: operation and maintenance initiatives, future studies on flood risk, measures relating to flood warning, environmental, planning and land-use management;
- Carry out an economic assessment of all viable non-structural options;
- Consider the need for improvements in flood risk management in these areas over the next 100 years and the means by which these might be achieved; and
- Whilst the strategy will focus on the upper River Lea catchment for modelling purposes (to establish the flood risk, damages and benefits of options on assets within that catchment), the final assessment of options will also have regard for downstream impacts on strategically significant assets (i.e. those of regional importance and above).

Surface Water Management Plan

7.3.10 A Surface Water Management Plan for Luton was completed in 2012. Surface Water Management Plans (SWMPs) offer one method for local partners to work together to investigate and manage surface water flood risk. SWMPs were a key recommendation of the Pitt Review of the summer 2007 floods, and are being promoted by Defra through their Future Water strategy and the Flood and Water Management Act (2010). The Luton SWMP provides the following information:

- Detailed mapping of surface water flood risk for a range of rainfall events (including the impact of climate change);
- Proposes management and mitigation options for flood risk; and
- An action plan to be delivered by LBC to manage and reduce surface water flood risk.

Luton Local Flood Risk Management Strategy (LBC)

7.3.11 Luton Local Flood Risk Management Strategy (LLFRMS) is currently been produced by Luton Borough Council. The overarching aim of the strategy is to enable the management and communication of the risks and consequences of flooding arising from rivers, surface water runoff and groundwater in the borough of Luton. As required by the Flood and Water Management Act 2010, the strategy covers:

- the risk management authorities in Luton;
- the flood risk management functions that may be exercised by those authorities in Luton;
- the objectives for managing flood risk;
- the measures proposed to achieve the objectives;
- how and when the measures are expected to be implemented;
- the costs and benefits of those measures and how they are to be paid for;
- the assessment of local flood risk for the purpose of this strategy;
- how and when the strategy is to be reviewed, and
- how the strategy contributes to the achievement of wider environmental benefits.

8. Flood Risk to Development Sites

8.1 Introduction

8.1.1 The Sequential Test described by the NPPF requires that development is directed first to areas of lowest flood risk, according to the vulnerability of the development. The Water Cycle Strategy aims to support the application of NPPF by examining flood risk to each proposed site at an overview level. The Water Cycle Strategy is not designed to replace site-specific flood risk assessments by developers.

8.1.2 Flooding can occur from a range of sources, including rivers, the sea and tidal estuaries, groundwater, overland flow, sewers, reservoirs, canals and lakes. Available data should be used to re-evaluate whether there is no, low, medium, or high constraint to development as a result of flood risk from each source of flooding. The data used is summarised in Table 8.1 and site specific assessments should be undertaken as required.

TABLE 8-1: DATA TO BE USED TO ASSESS FLOOD RISK FROM EACH SOURCE

Sea and Tidal	Risk not considered due to distance inland.
Fluvial (rivers) ,	EA flood zone maps (Figure 5-6). SFRA flood maps. Historic flood maps (Figure 5-9). Ordnance survey mapping of minor watercourses.
Groundwater	BGS mapping of Areas Susceptible to Groundwater Flooding (LLFRMS Map 4) Borehole Flood Risk Factors (Figure 5-10)
Surface Water	Detailed modelling completed as part of the Surface Water Management Plan (Figure 5-11) EA Updated flood map for surface water (LLFRMS Map 3).
Sewers ,	SWMP mapping of sewer flooding reported to TWUL and AWS (Figure 5-12). SWMP mapping of Luton Borough Council database of highways flooding. SWMP mapping of Luton Fire and Rescue Service reported call-outs for flooding, 2004-2008 (Figure 5-14).
Artificial (reservoirs, canals, pumped quarries)	EA reservoir inundation mapping
Residual risks	SFRA mapping of flood defences (Figure 5-13). SFRA indications of future planned flood defences.

8.1.3 Developers must prepare a site-specific flood risk assessment that investigates the flood risks to the site in more detail to satisfy LBC and the EA that the development will be safe.

Surface Water Flood Risk in Luton

8.1.4 Previous studies have indicated that surface water flood risk is a particular problem in Luton for the areas surrounding Lewsey Brook, Houghton Brook and Cat Brook, including Lewsey Farm, Parkside and Limbury. This is thought to be due to the rapid expansion of the town to the north in the 1950s and 1960s without upgrade of the town centre sewer system downstream. The problem is further compounded by the local topography, which routes surface water into the town centre, and some reliance on pumped drainage which becomes overwhelmed in heavy rain or during fluvial flooding.

8.2 Mitigating the Impacts of Development

8.2.1 NPPF requires that developments have no adverse impact on flood risk elsewhere and, where possible, result in an overall decrease in flood risk. Development can negatively impact flood risk in a number of ways:

- Loss of access to watercourses for maintenance or in an emergency situation. An undeveloped buffer strip must be incorporated alongside all 'Main River' and IDB-managed watercourses; in the Thames region this must be 8 m wide. It is recommended that buffer strips are also required as a planning condition for all ordinary watercourses. In the Thames Region, an 8 m undeveloped buffer strip must be left adjacent to the river bank (whether open watercourse or culverted).
- Loss of floodplain storage on the development. Assessment of the need for compensatory floodplain storage requires a detailed examination of site topography and proposed layouts and is therefore beyond the strategic focus of this Water Cycle Strategy. These calculations should be included in site-specific flood risk assessments by the developer accompanying individual planning applications.
- Increased production of wastewater from new development can result in increased discharge from wastewater treatment works (WWTWs), leading to increased flood risk downstream.
- Increased impermeable area leading to increased rate and volume of surface water run-off. This impact can be mitigated through the use of Sustainable Drainage Systems (SUDS) that mimic the natural site drainage. The potential SUDS measures that could be applied for each site are considered further in Section 8.2.4.

Sustainable Drainage Solutions

8.2.2 NPPF requires that surface water run-off from developments should be restricted to predevelopment rates and volumes. This should be achieved wherever possible using Sustainable Drainage Systems (SUDS) and especially in major development (see paragraph 3.3.12). SUDS solutions may achieve many environmental objectives including:

- Flood risk mitigation through managing run-off arising from development.
- On-site pollution control arising from surface water run-off.
- Reducing pollutant infiltration into groundwater.

- Maintaining recharge to groundwater.
- Providing natural amenity and green spaces within development.
- Maintaining or restoring natural flow regimes of a receiving watercourse.

8.2.3 SUDS may also be implemented at a number of scales to form a management train. Source control elements such as rainwater harvesting may be introduced at the house or street level to manage the generation of run-off. At the site level, features such as storage ponds can effectively attenuate run-off to greenfield rates and volumes. At the regional level, masterplanning of drainage for many sites allows more effective management of run-off and maintenance. Each element plays a role in conveying and managing surface water so that it limits flood risk locally and at downstream locations. It is recommended in the CIRIA SUDS Manual[57] that sites larger than 2 ha do not drain to a single component, but include several smaller features draining to a final site or regional control.

8.2.4 The type of SUDS selected for each site will depend on the following factors:

- **Land use characteristics**. Different types of development will require different SUDS to manage their runoff characteristics, particularly with regards to pollution. The following recommendations are made for different types of land use:
  i. Residential land use will generally require only one treatment stage with appropriate pre-treatment.
  ii. B1 land uses (business offices and light industrial) will generally require two stages of treatment. Three stages may be required depending on the receiving watercourse sensitivity. Both infiltration and attenuation SUDS are suitable.
  iii. B2 land uses (general industrial) and B8 land uses (storage and distribution) will generally require at least three treatment stages, including containment systems to control spills in high risk areas. Some areas such as permanent skip areas, yard and delivery areas at risk of spillage, pressure washing areas and fuelling areas should be connected to the foul sewer system. These areas should be limited to prevent any increase in flood risk downstream due to increased discharge from wastewater treatment works. Infiltration methods should not be used within the treatment sequence, but may be used as a final method for discharging treated runoff to groundwater.
- **Site characteristics**. These include the soil permeability and slope. The CIRIA SUDS manual states that infiltration methods require at least 1 m of soil depth between the base of the unit and the maximum expected groundwater level (the 1% probability annual groundwater level should be used), although the Environment Agency recommend that a minimum freeboard of 2 m is allowed. Infiltration methods are also limited to gentle slopes and should be located at the base of slopes to prevent instability or re-emergence of runoff down slope. The site area will determine the availability of space for methods which require more land-take.
- **Catchment characteristics**. These include sensitive features that may preclude the use of certain SUDS measures. For example, where a site overlies a source protection zone for groundwater used as public water supply, infiltration techniques may be limited by the need to prevent pollution, but at the same time the rate of recharge will need to be retained.

[57]The SuDS Manual, CIRIA C697, London 2007

- **Quantity and quality performance requirements**. These include hydraulic requirements regarding rate and volume of runoff, and water quality requirements such as suspended solids removal, nutrient removal, heavy metals removal, bacterial removal and treatment of fine suspended sediments and dissolved pollutants. A combination of techniques may be needed to meet all requirements.
- **Community, amenity and environmental requirements**. These include aspects such as maintenance regime, community acceptability, cost, public safety and habitat creation. These requirements should be determined by the local authority in agreement with community stakeholders such as Groundwork Luton.
- **Potential adoption bodies**. Any SUDS device that serves more than one property will need to be adopted by LBC following the enactment of the relevant section of the Flood and Water Management Act (2010) – this is expected in 2015.

8.2.5 Further guidance on the design of the suggested SUDS measures is given in Appendix2 of the Luton Local flood Risk Management Strategy (LLFRMS). The section is intended to supplement the Non-statutory Technical Standards for Sustainable Drainage Systems published by Defra in March 2015. .

SUDS, Groundwater Recharge and Groundwater Flood Risk

8.2.6 For permeable sites, the majority of rainfall will infiltrate to groundwater at present and there will be low rates of surface water runoff. Some of the infiltrated water will be taken up by vegetation roots and returned to the atmosphere by evapotranspiration. The remaining water will percolate downwards to recharge groundwater stored in aquifers. The groundwater store provides a minimum baseflow to nearby rivers and may also be used as a source for water supply. It is therefore important that the rate of recharge is maintained at a suitable agreed level to ensure the security of future water supplies and also to prevent any decrease in river baseflow which would have detrimental ecological impacts.

8.2.7 Conversely, high levels of groundwater may cause flood risk due to the re-emergence of springs and dry rivers. Groundwater flooding is typically long-lasting and difficult to prevent or manage. There is therefore a risk that increased rates of recharge to groundwater may increase groundwater flooding elsewhere. These effects may be felt some distance away from the infiltration source zones, due to the large sizes of aquifers.

8.2.8 It is therefore recommended that developers aim to maintain the current recharge volumes. These should be estimated using infiltration tests across each site in accordance with BRE Digest 365, coupled with estimates of losses to evapotranspiration based on the current vegetation of the site. While source control SUDS such as green roofs, water butts and rainwater harvesting are still recommended, it should be ensured that the net effect of these measures is not to reduce groundwater recharge volumes. Likewise, infiltration basins with large surface areas may increase evaporation rates and reduce groundwater recharge compared to pre-development conditions.

8.2.9 At present, the groundwater dynamics in the Luton area are poorly understood. It is recommended that a new groundwater model for the area be undertaken that could be used to investigate groundwater recharge paths, areas at risk of groundwater flooding, and the potential impacts of development.

Infill Sites

8.2.10 The infill development sites are predominantly located on brownfield locations. For these locations, NPPF requires that there is no increase in flood risk downstream and therefore at minimum surface water runoff rates and volumes should be restricted to their current brownfield conditions (including an appropriate allowance for climate change). However, it is recommended that run-off rates are reduced to greenfield equivalent for all brownfield developments due to the rapid response times of the catchment, in line with the recommendations of the Level 1 SFRA for Luton. It is recommended that for these brownfield infill sites, the following approaches to surface water drainage are adopted, in order of preference:

- (Most preferable): New SUDS drainage measures are installed to reduce run-off rates and volumes to greenfield equivalent. A SUDS train should be used to manage and improve water quality, according to site use. This will provide maximum benefit to flood risk downstream, but may not be possible at all sites due to storage volumes required.
- New SUDS drainage measures are installed to reduce run-off rates and volumes below the existing brownfield rates and volumes. This will provide some benefit to flood risk downstream. A SUDS train should be used to manage and improve water quality, according to site use. This option should only be permissible if it has been shown that it is not technically feasible to attenuate to greenfield runoff rates and volumes on-site.
- (Least preferable): Run-off rates and volumes are maintained at their present brownfield rates and volumes. Water quality SUDS treatment stages must still be included to manage and improve run-off quality, according to site use. This option should only be permissible if it had been shown that the above two more preferable options are not technically possible in the site.

8.2.11 It should be noted that discharge of surface water to any foul sewers will not be permissible. This may require the development of new surface water drainage systems beyond the development site boundaries.

8.2.12 Where a number of infill sites are located in close proximity, it is recommended that developers work together to design a cost-effective drainage strategy that may also have amenity and ecological benefits (e.g. through creation of one larger permanently wet pond, compared to smaller subsurface attenuation storage).

8.3 Summary and Conclusions

Flood Risk to Potential Development Sites

8.3.1 This report has updated the analysis of flood risk carried out in the previous Phase 1 and Phase 2 Water Cycle Strategies, using data from the updated Luton SFRA (Stage 1), SWMP and the recently completed Luton Local Flood Risk Management Strategy

8.3.2 The results show that it is possible for flood risk to be reduced and managed on-site through careful layout and planning. Where selected development sites lie within the Flood Zones, the Local Planning Authority should normally prepare a Level 2 SFRA to examine flood risk and flood hazard across each site in more detail. In this case LBC considers that it is not necessary to prepare a Level 2 SFRA because the Council intends to integrate the detailed information about the extent of flooding from the SWMP into the master planning process and, in addition, developers will be required to submit a site-specific flood risk assessment for all development sites to investigate flood risk to the sites from all sources to satisfy the EA that the development will be safe.

A Strategy for Flood Risk Management and SUDS

8.3.3 A strategy has been proposed for managing the impacts of development on flood risk, consisting of the following elements:

- An assessment of the impact of increased discharge from WwTWs on flood risk and a high-level estimate of the volume of storage needed to compensate for these effects.
- Recommendations for a SUDS strategy, including ball-park run-off rates and storage volumes required, source control SUDS, pathway control SUDS, site control SUDS and management of residual risk, regional control SUDS, opportunities for betterment downstream, and consideration of cumulative impacts of development.
- Guidance on the design, maintenance and adoption of SUDS applicable to all development sites.

8.3.4 Developers will be responsible for producing a drainage strategy that meets with the Local Authority and EA's vision for sustainable management of surface water in the area. Where several sites drain to the same watercourse or could contribute to larger flood risk benefit schemes, it is recommended that a surface water management group is formed to allow design, maintenance and adoption arrangements to be agreed by all parties.

9. Ecological Opportunities and Constraints

9.1 Introduction

9.1.1 A key objective of a water cycle strategy (WCS) is to ensure that the planning process makes best use of environmental capacity, adapts to environmental constraints and identifies environmental opportunities relating to the water environment. Key to this is the consideration of potential constraints, opportunities, risks and benefits relating to nature conservation and biodiversity.

9.1.2 This chapter considers the potential changes in the water cycle that may arise from planned development in Luton, and presents a high-level appraisal of the related constraints, opportunities, risks and benefits associated with the key water and wetland ecological features of the area.

9.1.3 The primary objectives of this appraisal are to:

- Describe the key water and wetland ecological features sensitive to potential changes in the water environment that could constrain or be affected (positively or negatively) by the implementation of actions recommended by this WCS.
- Identify the risks, benefits and opportunities relating to these key water and wetland features arising from the conclusions and recommendations of this WCS.

9.2 Approach

Scope of this appraisal

9.2.1 This ecological appraisal is designed to identify potential constraints, opportunities, and risks associated with key water and wetland ecological features within the study area as a result of the proposed changes to the water cycle.

9.2.2 The appraisal has both informed and considered the conclusions and recommendations of the following aspects of this WCS:

- Drainage and flood risk management requirements to manage surface water run-off (see Chapter 7)
- Water resources exploitation and protection to meet an increased demand for potable water (see Chapter 6)
- Water quality protection related to an increased demand for wastewater treatment and disposal (Chapter 5)
- Significant new water supply infrastructure (Chapter 6)
- Significant new sewerage infrastructure (Chapters 5 & 10)

9.2.3 There is no statutory basis for this ecological appraisal. It is intended to complement, but not replace, the full consideration of ecological issues required during the statutory environmental assessment of proposals arising from the Local Plan review process – including Strategic Environmental Assessments (SEA), Sustainability Appraisals (SA) and any 'Appropriate Assessment' requirements under the Conservation (Natural Habitats &c.) Regulations 1994, as amended – and any subsequent, more detailed, Environmental Impact Assessments (EIA) required for specific developments.

9.2.4 In addition, this appraisal has been informed by, but does not replace, statutory ecological assessments undertaken by external parties in support of various aspects of the water cycle, for example the Environment Agency's the Upper Lea CAMS and consented discharges and abstractions.

9.2.5 All internationally or nationally significant water / wetland ecological sites have been identified. Additional focus on locally significant features – Local Nature Reserves (LNR), County Wildlife Sites (CWS) and protected and notable species associated with water and wetland features - has been made for the development footprints and the River Lea and its tributaries.

9.2.6 The appraisal was undertaken in parallel with the other aspects of the WCS and involved the following process:

- Review of all water and wetland features present within the study area and identification of those relevant to this ecological appraisal –the 'key water and wetland features'. Details of designated sites (international, national and regional/local) within the study area were reviewed to determine the presence of significant water and wetland features. Sites identified as not having significant water or wetland features within them were not considered further.
- Determination of the importance of the key water and wetland features as international, national or local based on: presence of nature conservation designations; qualification under the UK Biodiversity Action Plan (BAP); and/or wildlife conservation legislation (e.g. EU Habitats Directive, EU Freshwater Fisheries Directive, Wildlife & Countryside Act 1981, as amended).
- Display of the collated information for the key water and wetland features on a GIS mapping platform – see Figure 8-1 in Appendix B.
- Identification of policy and legislative requirements relevant to the water and wetland ecology of the study area, for example, likely improvements in the ecological status of rivers and lakes under the EU Water Framework Directive.
- Assessment of the sensitivity of the key water and wetland features to potential hazards resulting from changes to the water cycle and identification of relevant constraints on the implementation of these changes.
- Identification of the likely risks to the key water and wetland features resulting from changes to relevant aspects of the water cycle (e.g. change to hydrology, decrease in water quality) and, where relevant, recommendations on how these might be managed and mitigated.
- Identification of opportunities for improvement of the key water and wetland features resulting from changes to relevant aspects of the water cycle and, where relevant, recommendations on taking these forward.
- Informal consultation with relevant stakeholders including Natural England and Environment Agency regarding the likely risks to, and opportunities for, the key water and wetland features resulting from changes to relevant aspects of the water cycle.
- Identification of high level principles for future water and wetland nature conservation protection and enhancement to ultimately support a developer's ecological design guide.

Information sources and mapping

9.2.7 The information used for the ecological appraisal was compiled from the published and web-based information sources shown in Table 9.1.

TABLE 9-1: INFORMATION SOURCES FOR ECOLOGICAL APPRAISAL	
Ecological data	• Environment Agency • Bedfordshire and Luton Biodiversity Recording and Monitoring Centre • Bedfordshire, Cambridgeshire, Northamptonshire and Peterborough Wildlife Trust • Natural England • UK BAP website: • MAGIC (Multi-Agency Geographic Information for the Countryside) website: • Bedfordshire Wet Woodlands Working Group: Bedfordshire Wet Woodland Strategy • Lawrence, R.: The Otter Survey of Bedfordshire 2008/09 • Proud, A. and McCarrick, M.(2005) Bedfordshire Water Vole Monitoring
Related plans	• Water Framework Directive (WFD) objectives and measures under the Anglian and Thames River Basin District Management Plans • Environment Agency Upper Lea CAMS • UK Biodiversity Action Plan (BAP) • Bedfordshire and Luton BAP • Water and Wetlands BAP (Bedfordshire and Luton) • NPPF • Bedfordshire and Luton Strategic Green Infrastructure Plan (2007) • Luton and South Bedfordshire Green Infrastructure Plan (2009) • Luton and South Bedfordshire Greenspace Strategy: Consultation Draft (2008) • Environmental Sensitivity Assessment: South Bedfordshire Growth Area (2008) • Luton and South Bedfordshire Core Strategy Preferred Option Report (2009)

9.2.8 The collated information for the identified key water and wetland features was entered into a GIS mapping platform. To ensure clarity on the GIS maps, the following decisions were made:

- Designated sites (international, national and local) without water and wetland features were not displayed.
- Due to the large number of local designated sites, the mapping shows only those that are within 1km of the River Lea and its tributaries and also within 1km of the development areas. Potential development sites in Luton are generally small and widespread throughout the borough.
- Where conservation designations overlap, e.g. local, national and international, only the highest rank was displayed on the maps.
- No GIS information was available for ditch and pond habitats so these have not been mapped.
- Key areas of species distributions are identified on Figure 8-1 in Appendix B. Where the distribution of species are scattered these are detailed in Appendix E of the current 2015 WCS.

9.2.9 Data on habitat and species distributions will be dependent on the surveys undertaken; therefore there may be relevant water and wetland features present which are not displayed on the mapping.

9.3 The Study Area

Context

9.3.1 The study lies within the boundaries of three Natural Areas[58]; West Anglian Plain, Bedfordshire Greensand Ridge, and Chilterns. Arable land and agriculturally improved pasture make up the majority of the habitats present. They comprise features such as hedgerows, mature trees, ponds, small watercourses and rough grassland. Key wetland and water habitats in these Natural Areas and present across the study area include:

- Standing and flowing open waters;
- Swamp;
- Mires;
- Marsh;
- Wet woodland; and
- Flood meadow.

9.3.2 Although there are no ecological sites of national importance within Luton there is a Site of Special Scientific Interest (SSSI) at Galley and Warden Hills on the north-eastern edge of the town. Appendix B Figure 8-1 shows that there are a large number of County and District Wildlife Sites within Luton and the wider study area. The river corridor and wetland habitats are particularly important with regard to the water cycle:

- County Wildlife Sites - Leagrave Common, Cowslip Meadow, Fallowfield, Croda Colloids, Riverside Walk and the River Lea (part)
- District Wildlife Sites - Lewsey Park and the River Lea (part).

[58] Natural Areas are biogeographic zones that allow for the identification of habitats and species that are both important nationally and distinctive locally, and for appropriate nature conservation objectives to be set.www.naturalareas.naturalengland.org.uk [Accessed 19th October 2012]

9.3.3 In addition, the chalk grassland sites at Dallow Downs and Winsdon Hill form an important area where water percolates down to the aquifer. These sites are part of the calcareous hills that are an important feature of how the water cycle functions around the town.

9.3.4 Conservation objectives for these habitats and their associated species have been set within the Natural Area profiles. Habitat objectives cover the restoration and maintenance of water quality and quantity, appropriate management of habitats adjacent to open water, traditional management of marshes, flood meadows and mires, and the re-establishment of natural river dynamics. Species objectives include the assessment and maintenance of white-clawed crayfish *Austropotamobius pallipes* distribution, and watercourse management to support otter *Lutra lutra*, and water vole *Arvicolla terrestris*.

9.3.5 In the study area there are numerous designated sites covering two levels of conservation importance (i.e. there are no internationally designated sites):

- National: Sites of Special Scientific Interest (SSSIs) – designated under the Wildlife and Countryside Act 1981 (as amended). National Nature Reserves (NNR) – designated under the National Parks and Access to the Countryside Act 1949 or the Wildlife and Countryside Act 1981 (as amended). Details of designated sites with water and wetland features present are given in Appendix E.
- Local/Regional: County Wildlife Sites (CWS) – designated by principal local authorities and receive protection under planning policy. Local Nature Reserves (LNR) - designated by principal local authorities under Section 21 of the National Parks and Access to the Countryside Act 1949. Details of designated sites with water and wetland features present are given in Appendix N of the 2010 WCS.

9.3.6 In addition to designated sites, there are habitats and species within the study area which are targeted for action under the UK Biodiversity Action Plan (BAP). BAPs identify key 'priority' species and habitats that are considered to be under threat, either on a local or national basis, and set out a plan of action to protect and enhance them. BAPs are set at both a national and local level. UK BAP priority habitats present within the study area and relevant to the WCS include:

- Floodplain grazing marsh;
- Wet woodland;
- Fens;
- Mires;
- Rivers,
- Ponds,
- Standing open water bodies, some of which may qualify as UK BAP priority habitat type "oligotrophic and dystrophic lakes", "mesotrophic lakes" or "eutrophic standing waters";
- Purple moor rush grassland; and
- Reed beds.

9.3.7 Relevant UK BAP priority species within the study area include: water vole; otter and the great crested newt *Triturus cristatus*, Appendix B Figure 8-1 illustrate the known distribution of the UK BAP habitats and key populations of species across the study area.

Related policies, plans and proposals

9.3.8 There are seven key drivers for policies/plans/proposals relating to maintaining and enhancing water habitats and species, and the creation of new habitats and waterways.

9.3.9 Water Framework Directive (WFD) (2000/60/EC): sets environmental objectives for rivers and other types of water bodies such as lakes and groundwater to achieve good ecological status (which requires appropriate ecological, chemical and physical conditions for surface water bodies and chemical and quantitative conditions for groundwater bodies) by 2015. The objectives and measures for the study area are outlined in the Thames River Basin Management Plan. The WFD will be the main driver to place tighter constraints on levels of ammonia and phosphate in discharge from treatment works to reduce levels in the receiving water courses.

9.3.10 Freshwater Fisheries Directive (78/659/EEC) adopted in 1978 and updated in 2006 (2006/44/EC)[59]: The Directive is concerned with the protection and improvement of fresh waters in order to sustain fish life. Designated stretches are divided into two categories of water: those suitable for salmonids (salmon, trout and grayling); and those suitable for cyprinids (carp, tench, bream, roach, chub and minnows). For designated waters the Directive sets physical and chemical water quality objectives. Within the study area there is a diverse range of fisheries habitats, with stretches of the River Lea being designated under the Directive as suitable for cyprinid species (see Appendix F)

9.3.11 Habitats Directive (92/43/EEC): The Directive aims to promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species at a favourable conservation status, introducing robust protection for those habitats and species of European importance. The Habitats Directive introduces for the first time for protected areas, the precautionary principle; that is that projects can only be permitted after ascertaining no adverse effect on the integrity of any designated site. Projects may still be permitted if there are no alternatives, and there are imperative reasons of overriding public interest. In such cases compensation measures are required to ensure the overall integrity of the network of sites. In the UK, the Directive has been transposed into UK law by means of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended).

9.3.12 Urban Waste Water Directive (91/271/EEC) (as amended): The Directive aims to protect the water environment from the adverse effects of discharges of urban waste water and some industrial discharges. The Directive requires Member States to designate areas which are 'sensitive', as follows:

- Natural freshwaters, other freshwater bodies, estuaries and coastal waters which have a high level of nitrates. These can cause a high growth of algae and other plants which can affect species living in the water, and the quality of the water overall. These lakes are called eutrophic. This also covers areas which could become eutrophic if no action is taken. These are designated Sensitive Areas (Eutrophic).

[59] In 2013, the Water Framework Directive had subsumed the Freshwater Fisheries Directive. However, sites designated under the Freshwater Fisheries Directive will continue to receive protection.

- Surface freshwaters used for drinking water that could contain more nitrates than allowed by EC directives 75/440/EEC of 16 June 1975. These are designated as Sensitive Areas (Nitrate).

9.3.13 Where WwTW discharge into areas that are designated as sensitive, they require extra treatment before discharge (Dunstable WwTW and Chalton WwTW do not discharge into sensitive areas).

9.3.14 Environment Agency Upper Lea CAMS: Water demands in the CAMS area include surface water abstractions for public water supply, industry, agriculture, golf course irrigation, public amenities and fish farms. The Environment Agency classifies the River Lea as "over abstracted" for surface water and groundwater resources. The River Lea is Chalk based and is dependent on groundwater for flow. The main groundwater abstractions are from an unconfined Chalk aquifer.

9.3.15 Environment Agency Colne CAMS: Water demands in the CAMS area include abstractions for public water supply, agriculture, energy generation, quarrying, and water bottling. The Environment Agency classifies the Colne Catchment as "over abstracted" for surface water, and groundwater resources. The main groundwater abstractions are from unconfined and confined chalk aquifers throughout the catchment. This CAMS relates to a small part of the study area to the south west of Luton in the M1 and Caddington area.

9.3.16 The Bedford and Luton Strategic Green Infrastructure Plan: The Bedford and Luton Strategic Green Infrastructure Plan identifies key areas for wetland habitat enhancement and creation along the River Lea. These identified areas are part of the strategic opportunity mapping which has the aim of creating a biodiversity rich tapestry within the Luton area.

9.3.17 Luton and South Bedfordshire Green Infrastructure Plan: The Luton and South Bedfordshire Green Infrastructure Plan identifies key areas for wetland habitat enhancement and creation including, for example, along the River Lea.

9.3.18 Adopted Luton Local Plan 2001-2011: The purpose of the Local Plan is to guide development and the use of land in Luton over the next 10 years. Its policies and proposals for land use and transportation are used to give planning advice and provide the primary basis for determining planning applications. The Plan references Policy ENV5 "Protection and enhancement of nature conservation" which provides guidance on development proposals and biodiversity.

9.3.19 In addition adjoining plans such as the Central Bedfordshire and the North Hertfordshire District Plan should be reviewed for policies/plans/proposals relating to maintaining and enhancing water habitats and species.

Features considered in the appraisal

9.3.20 As noted in Section 9.3.1 the study area includes a number of different water and wetland habitats which are considered to be sensitive to potential changes in the water cycle.

9.3.21 The specific features considered in the appraisal (see Appendix B Figure 8-1 for their distribution) included:

- The River Lea (and its minor tributaries), which rises in Leagrave Park, Luton and flows through Luton in a south-easterly direction, and to London where it joins the River Thames;
- Standing open water bodies within the study area (including disused quarry pits);
- Wetland areas (in particular floodplain wetlands);
- Wet woodland;

- Ditches (scattered distribution);
- Ponds (scattered distribution);
- Species associated with these habitats (e.g. water vole, otter, white-clawed crayfish, eel, sea trout, and wading birds).

9.3.22 The water and wetland features listed above have varying levels of conservation importance; some or part of the features may be within a designated site boundary, and some qualify as a priority habitat or species under the UK BAP. See Appendix E.

9.4 Key Conclusions from the proposed water cycle changes

Water resources

9.4.1 For growth in Luton, demand can be served within existing licensed abstractions assuming water efficiency measures are put in place.

9.4.2 As of 2014, Affinity Water did not predict the need to increase licensed abstraction with growth.

Surface water flow and flood risk management

9.4.3 NPPF requires that developments have no adverse impact on flood risk elsewhere and, where possible, result in an overall decrease in flood risk. For all of the development areas any flood risk can be mitigated through the use of Sustainable Drainage Systems (SUDS) that mimic the natural site drainage. The potential SUDS measures that could be applied for each site are considered further in Flood Risk Management Section 8.2.2 onwards.

9.4.4 This analysis has shown that there are a number of opportunities for larger scale schemes (such as Land North of Lewsey and between Houghton Regis and the M1) which incorporate flood mitigation needs for potential development sites or which will provide flood mitigation benefits elsewhere.

9.4.5 Increased production of wastewater from new development can result in increased discharge from WwTW leading to increased base flow of receiving watercourses. This situation can lead to increased flood risk because the receiving watercourses have a decreased capacity to retain additional surface water from flood events. Flood risk is considered further in Section 10.4, and the key conclusions from the water cycle strategy are outlined below.

- Chalton WwTW – high risk of flooding because the River Flit receiving watercourse has a limited capacity in this location. Recommendations from the WCS is that the IDB, Developers in relevant areas and Chalton WwTW undertake further work to determine exact details of flood risk and possible mitigation options;
- Dunstable WwTW – high risk of flooding due to capacity of receiving Ouzel Brook watercourse. A constriction of Ouzel Brook at A5 Thorn Road leads to increased flooding risk upstream of this location. Recommendation from the WCS is that a storage area is created upstream of A5 Thorn Road to attenuate water flows during a flood event. The IDB, Developers and Dunstable WwTW need to determine options for creating a flood storage area;
- East Hyde WwTW (outside of the study area) – medium risk of flooding of East Hyde due to constriction of the River Lea at a minor road in East Hyde. Recommendation from the WCS is that a storage area is created downstream of East Hyde WwTW (upstream of the constriction location) to attenuate flows during a flood event;

Wastewater discharge (including surface water discharge and foul sewer discharge)

9.4.6 Three WwTWs (Luton East Hyde, Chalton and Dunstable) are most likely to be affected by the potential growth (see Chapter 5). These WwTWs discharge into numerous rivers including the River Ouzel, River Lea, Ouzel Brook and River Flit.

9.4.7 Even with increased development and subsequent increase in volume of treated water, all three WwTWs have the capacity to discharge within their permitted standards during this plan period. This should therefore mean that any decrease in current water quality will not be in breach of the WFD.

9.4.8 To ensure the River Lea does not deteriorate in quality, discharges from East Hyde WwTW should be regulated with a revised permit stipulating quality conditions of 5mg/l for BOD, 1mg/l for Ammonia and 1mg/l for Phosphate, and that these conditions would need to be applied irrespective of the levels of additional growth to 2031.

9.4.9 East Hyde WwTW currently has a less stringent set of permit conditions than outlined above, but because the WwTW is treating to a higher standard than the permit, the River Lea does not deteriorate in quality downstream of the discharge. Formalising the permit to a tighter set of conditions would provide regulatory assurance that downstream water quality would continue to be protected (so long as the WwTW continued to operate within the limits of the revised permit). The assessment undertaken for this WCS has shown that the highest levels of proposed growth (Scenario C) could theoretically be treated at the WwTW with the revised permit quality conditions and still ensure no downstream deterioration.

Network infrastructure

9.4.10 Upgrades to the water supply network and additional infrastructure are likely to be needed to meet the demands of potential future developments across the study area.

9.5 Water and wetland features and their sensitivity to water cycle hazards

Change in hydrology e.g. changes to ground, surface and flood water levels

9.5.1 All features are considered to be sensitive to changes in hydrology as they are dependent on water to maintain the quality of the habitats for their associated species.

9.5.2 Rivers and streams are sensitive to reductions in river flow or levels through surface or groundwater abstraction as well as localised hydrology changes from development footprints which have the potential to impact on BAP habitat quality, water voles, and fish.

9.5.3 Increased flood water levels and increased frequency of flooding of rivers has the potential to impact water vole populations through increased flooding of their river habitats. Water voles are particularly vulnerable to disturbance during the breeding season.

9.5.4 Change in flooding regime e.g. change in season, frequency and magnitude of flooding resulting in increased flooding of habitats such as floodplain grazing marsh has the potential to disturb bird populations during the breeding season as nesting habitats would be flooded.

Decrease in water quality e.g. increased nutrient levels, contamination

9.5.5 A decrease in water quality from WwTW or separate urban runoff (especially storm flows) has the potential to impact certain riverine species directly (including sea trout, and white-clawed crayfish) or indirectly, e.g. by impacting the food sources of species such as water voles.

Physical habitat loss e.g. direct loss from the footprint of proposed development areas

9.5.6 More relevant to sites outside of Luton but habitats such as ponds, ditches and floodplain grazing marsh, and the species they support, will be vulnerable if present within the proposed footprints of the development areas and associated infrastructure, including compensatory flood storage sites.

Change in channel morphology e.g. erosion from additional flows, flood defence structures

9.5.7 Changes in channel morphology from flood risk management proposals and increased flows from waste water treatment discharges have the potential to impact river channel morphology. This could potentially result in impacts on BAP habitats and aquatic vegetation through erosion and on fish populations through the prevention of fish passage through flow control structures.

Disturbance to sensitive species from public access e.g. through development of areas adjacent to wetland habitats

9.5.8 Development of areas adjacent to local wildlife sites and SSSIs leading to increased public access and increased disturbance to sensitive species such as otters and birds.

9.6 Risks and Opportunities

Overview

9.6.1 The risks and opportunities related to key water and wetland feature are assessed below, based on their sensitivity to water cycle hazards and the probability of the hazard occurring.

Assumptions made:

Assumption 1 Water resources

9.6.2 It is assumed that existing abstraction licences consented by the Environment Agency take account of ecological risks, and providing the abstraction levels are maintained within their consented levels there will be no significant risk to habitats and species associated with these locations.

9.6.3 As growth in the Luton area occurs, the Bedford Ouse WTW will need up-rating, i.e. an increase in abstraction. This will lead to a progressive increase in flow in the upper reaches of the Bedford Ouse. Up-rating will occur as flow in the Bedford Ouse progressively increases, and as such the overall flow in the Bedford Ouse will remain the same. In addition, any increase in abstraction required will be regulated by the Environment Agency.

9.6.4 As a result of the above assumptions, it is anticipated that the above proposed measures will not result in a risk to ecological features and as such have not been assessed further.

9.6.5 There is currently not enough information detailing what works will be required to up-rate Bedford Ouse WTW to assess the potential ecological risks and opportunities. As a result, this has not been assessed.

Assumption 2 Wastewater discharge (including surface water discharge and foul sewer discharge)

9.6.6 Increased development is likely to lead to an increase in the volume of treated water that will be discharged from the existing WwTWs into watercourses. It has been assumed as part of this appraisal that all of the WwTWs will be required to discharge within their permitted water quality standards as well as their permitted water discharge volumes. It is considered that there will not be a decrease in water quality compared with existing as any increased flow will still be subject to permit by the EA, and this combined with improvements in wastewater quality as required to meet the water quality requirements of the WFD should ensure that the future discharges will not cause decreases in water quality.

Assumption 3 Network infrastructure

9.6.7 As only the general network infrastructure locations are known, rather than specific locations, only risk to particularly sensitive areas such as local or nationally designated sites were assessed during this risk assessment. It is assumed that risks at a more detailed level will be considered by AWS and TWUL through the EIA process.

Risks to ecologically sensitive features from water cycle hazards

9.6.8 Risks discussed in this section are related to the effect of the proposed water cycle changes upon the water and wetland features and associated habitats and species within the study area.

Surface water and flood risk management

9.6.9 Increased production of wastewater from new developments can result in increased discharge from WwTW leading to increased base flow of receiving watercourses. This situation can lead to increased flood risk downstream of the WwTWs because the receiving watercourses have a decreased capacity to retain additional surface water.

9.6.10 Increased discharge from Dunstable WwTW would lead to an increase in baseflow of Ouzel Brook and the potential for increased flooding upstream of the WwTW due to a constriction downstream at the A5, Thorn Road. Increased flooding has the potential to: impact water voles through increased flooding of their river habitats, particularly sensitive during breeding season; displace fish such as stone loach; and displace amphibians in nearby ponds. Increased flooding in the locality of Thorn Spring CWS, of local importance, upstream of Dunstable WwTW, may pose a risk to the water quality of the spring.

9.6.11 Increased discharge from Chalton WwTW would lead to an increase in baseflow of the River Flit and the potential for increased flooding downstream of the WwTW (outside the Luton study area). Fancott Woods and Meadows SSSI and Flitwick Moor SSSI, which are of national importance, and River Flit CWS, which is of local importance, lie downstream of Chalton WwTW in Central Bedfordshire. Depending on the duration and extent of flooding, there is a risk of loss of habitats within these designated sites including BAP priority habitats such as fen. High water levels for long periods of inundation could lead to the loss of habitats. Nutrient enrichment which could also change the plant species composition of the fen habitat which is groundwater fed. Increased flooding has the potential to: impact water voles through increased flooding of their river habitats, particularly sensitive during breeding season; displace fish such as bullhead, carp and rudd; and displace amphibians in nearby ponds (for example ponds in the River Flit CWS).

9.6.12 Increased discharge from East Hyde WwTW would lead to an increase in baseflow of the River Lea and the potential for increased flooding downstream of the WwTW (outside the Luton study area). East Hyde Riverside CWS and the River Lea CWS, both of which are of local importance, lie downstream of the WwTW. Depending on the duration and extent of flooding, there is a risk of loss of habitats within these designated sites, for example, wet grassland. Increased flooding has the potential to: displace fish such as eel, bullhead and stone loach; and displace amphibians in nearby ponds/ditches.

9.6.13 Increased flashiness in flooding characteristics also has the potential to impact bird species (such UK Priority BAP species reed bunting, curlew and lapwing) on the margins of the River Lea by decreasing available nesting habitat and destroying nests should future flood events coincide with the breeding season. Habitat for invertebrate feeding wading birds may also be reduced by extensive flooding of their feeding areas.

Wastewater discharge risks (including surface water discharge and foul sewer discharge)

9.6.14 The receiving watercourse of the identified WwTWs most likely to have increased demand from proposed development is the River Lea.

9.6.15 The River Lea, within the study area, is classified as having “moderate” ecological status and “fail” chemical status. The main water quality issue for this catchment concerns eutrophication and nutrient loading of phosphorous.

9.6.16 The Waterways and Wetland Action Plan, Bedford and Luton LBAP has highlighted eutrophication as an issue and outlines a target for reducing eutrophication of river waters by introducing phosphorous stripping at Dunstable WwTW. The section of the River Lea between Luton and the River Thames is designated as a Eutrophic Sensitive Area under the Urban Wastewater Directive. Under the Sensitive Area designations, Dunstable WwTW is identified as needing to reduce phosphate and nitrate levels, and Chalton and Luton East Hyde to reduce phosphate levels.

9.6.17 East Hyde WwTW has been identified as having capacity within its permitted water discharge volume to deal with a certain amount of increased demand from potential development. It is considered that the existing permits combined with nutrient control measures that are already required, ensure that the future discharges will not cause decreases in water quality that will be in breach of the WFD. However, formalising a permit to a tighter set of conditions would provide regulatory assurance that downstream water quality would continue to be protected (so long as the WwTW continued to operate within the limits of the revised permit). The assessment undertaken for this WCS has shown that the highest levels of proposed growth (Scenario C) could theoretically be treated at the WwTW with the revised permit quality conditions and still ensure no downstream deterioration.

9.6.18 Two WwTWs (Dunstable and Chalton WwTW outside the study area) have been identified as likely to need to increase their permitted water discharge volumes in the future (post 2031) in response to the demand from increased development. These increases in discharge volumes without improvements in water treatment have the potential to effect water quality in the receiving watercourses through increased eutrophication.

Development footprint risk

9.6.19 The footprints of possible developments have the potential for direct loss of open water, river, stream, marginal, reedbed and fen habitats, (all UK BAP or UK BAP Priority habitats) and species associated with these habitats such as water voles, aquatic invertebrates, fish (including bullhead and stone loach) and breeding/wintering waterbirds. Other habitats such as ditches and ponds may also be present within the footprints of any of development areas. The potential loss of pond and ditch habitats may lead to subsequent risks to aquatic invertebrates, fish, and amphibians, including great crested newts.

Potential ecological opportunities/benefits arising from the water cycle strategy

9.6.20 Opportunities discussed in this section are aimed at either increasing the quality and extent of existing habitats or the creation of wetland and aquatic habitats where the changes in the water cycle may create suitable conditions. These opportunities reflect UK BAP targets for priority water and wetland features, and the conservation objectives outlined in the Natural Area profiles for the study area.

Opportunity 1 Wastewater treatment

9.6.21 The increase in discharges from WwTW into the River Lea has the potential to increase summer flows and water levels, helping to alleviate reduced flow concerns. This would have benefits to associated habitats and species such as flow sensitive invertebrates including mayflies and fish including bullhead.

Opportunity 2 Development footprint

9.6.22 Collectively, open water, river, stream, marginal, reed bed, pond, ditch and fen habitats are likely to be located within the footprints of developments areas. Careful design of the development areas and the management of water should be used to increase the quality and extent of these habitats where they are present. Increasing the quality and extent of these habitats will also benefit species associated with these habitats such as otters, water voles, amphibians and invertebrates.

9.6.23 Houghton Brook would benefit from river restoration opportunities, such as removal of flood structures, which will return the river to historical natural flows. This would allow unrestricted fish passage within the river systems for fish and otters. Additionally, enhancement of floodplain habitats along these watercourses should be undertaken to increase the quality of exiting habitats and to benefit species associated with them. Where possible, measures should be made to contribute to programmes which reduce the populations of signal crayfish, which are known to be present in Houghton Brook.

Opportunity 3 Surface water flow and flood risk management

9.6.24 Where it is recommended by the water cycle strategy that flood storage areas are used to attenuate increases in flow (detailed in Section 9.4.5) within the River Lea (Luton East Hyde WwTWs), wetland habitat creation opportunities should be incorporated into these proposals to help increase the extent of wetland BAP habitats. This will also increase the population and range of species that utilise these habitats. Watercourse enhancements could also be incorporated in any proposals for the River Lea including the creation of fish refuges for fish to utilise during flood events. These regions fall within the Central Bedfordshire administrative area.

9.6.25 Where details of possible options for attenuating increases in flows are not known at this stage, e.g. at Dunstable WwTW and for River Flit at Chalton WwTW (outside the Luton study area), wetland habitat creation opportunities should be included in future attenuation proposals in Central Bedfordshire. Creation of floodplain grazing marsh could be incorporated into proposals to attenuate water downstream of Chalton WwTW along the River Flit.

9.6.26 Within all development areas flood risk management measures should be used as an opportunity for habitat creation and enhancement. Where wetland habitats exist they should be included in flood risk management plans and extended where possible. Habitats should include BAP habitats such as ponds, marshy grassland, reed beds, ditches and wet woodlands. Diverting or repositioning rivers away from natural valley floors should be avoided, since this presents a risk of channel leakage, exacerbating problems of low flow and habitat fragmentation.

9.6.27 This is particularly relevant for development sites located in areas of Chalk geology. Such sites may also present opportunities for restoring river bed integrity where historic diversion has resulted in leaky channels, e.g. on the Houghton Brook. Bedfordshire and Luton Green Infrastructure Plan states that “Proposals should contribute to maintaining and enhancing biodiversity through habitat enhancement, linkage and creation in areas where BAP habitat and species targets can be best met”. This would support Bedford and Luton BAP habitat creation and restoration targets which include the restoration of 0.6ha of wet woodland, 2.6ha of floodplain grazing marsh and 30 ponds as well as the creation of a further 30 ponds. Specific flood risk management measures and possible habitat creation opportunities associated with the SUDS design are given in Chapter 8. Combining wetland habitat creation and enhancement with flood risk management measures through SUDS will benefit a range of associated species including amphibians, birds, fish, water voles and otters.

9.6.28 Any habitat creation should use native plant species and where possible planted/seeded before development commences as this will give the habitats more time to establish, reducing habitat loss impacts to associated species.

9.6.29 Habitats such as reed beds and wet woodland should be incorporated into SUDS options to be used as a method to improve water quality where possible.

9.6.30 Soft engineering options should be incorporated into SUDS options as well as keeping watercourses open by avoiding the use of culverts. Open channels should be profiled in a manner which encourages marginal vegetation such as a stepped bank profile and creation of ‘low flow’ channels within newly created watercourses.

9.6.31 The Luton Flood Risk Management Strategy (Environment Agency, 2011) proposes wetland habitat creation as part of the proposed flood storage area located to the north-west, just outside the Luton Borough Council administrative region. Habitat proposals include the enhancement of Houghton Brook (outside of Luton Borough Council boundary but within the study area) and associated habitats within the river corridor as well as creation of areas of semi-permanent wetlands within the proposed constructed flood storage area. Any development in this area could contribute to the recommendations detailed in the Luton Strategy, thus mitigating flood risk associated with the development whilst at the same time resulting in larger areas of wetland habitat creation.

9.6.32 The restoration and creation of habitats, including enhancing watercourses, is supported by the Bedfordshire and Luton Green Infrastructure Plan and the Environmental Sensitivity Assessment of the South Bedfordshire Growth Area. It is important that existing habitats and created habitats are connected throughout the whole of any developments as a network of habitats so that linkages between water and wetland features exist. This ensures movement of species between habitats and minimises habitat fragmentation. It allows habitats to function as a larger 'system' which will increase its overall conservation importance. This habitat network can be designed to give recreation and amenity benefits to the community, creating 'Green Infrastructure' throughout the development area. Green Infrastructure is defined in the Bedfordshire and Luton Green Infrastructure Plan as "A strategically planned and managed network of green spaces, access routes, wildlife habitats, landscapes and historic features which meet the needs of existing and new communities by providing:

- An essential environmental foundation and support system;
- A healthy and diverse environment;
- Attractive places to live and visit and a good quality of life; and
- A sustainable future

9.6.33 Green infrastructure should be managed to avoid conflicts between public access and wildlife to increase overall conservation of habitats and species. This can be achieved by including measures such as ensuring public access is strategically planned and restricted in certain areas to retain some water and wetland features as undisturbed habitats for wildlife.

9.6.34 The Bedfordshire and Luton Green Infrastructure Plan states that "New development and land use changes should support the strategic Green Infrastructure Network" and that "All major new built development should have green infrastructure provision at its heart, and as such relevant elements of the Green Infrastructure Network outlined in this Plan should be delivered as an initial earliest stage of any such development". It states that areas identified in the plan give "strategic importance to the areas with the greatest potential to achieve a coherent network of wildlife rich habitat which could form a more robust and resilient ecologically functional landscape".

Potential ecological opportunities/benefits arising from regional proposals

9.6.35 The Green Infrastructure network within a development area needs to tie into the wider countryside to ensure that habitats are integrated with wider habitats beyond the site boundary. This ensures a robust and resilient ecologically functional landscape (Bedfordshire and Luton Green Infrastructure Plan). This will give benefits such as ensuring the long-term integrity of these habitats as well as allowing greater movement of species. To help ensure the best possible provision of green infrastructure Luton and South Beds Greenspace Strategy states that "provision [of green corridors] is planned in advance of development, particularly in relation to new growth area developments."

9.6.36 Bedfordshire and Luton Strategic Green Infrastructure Plan (2009) and Luton and South Bedfordshire Green Infrastructure Plan both identify opportunity areas where there is "strategic importance to the areas with the greatest potential to achieve a coherent network of wildlife rich habitat which could form a more robust and resilient ecologically functional landscape" and include habitat restoration, habitat creation and watercourse enhancement targets. The River Lea corridor is part of the Strategic Green Infrastructure Network.

9.7 Ecological Appraisal Conclusions and Recommendations

9.7.1 Table 9.2 summarises where potential risks to water and wetland features and opportunities for the features have been identified (for further details see Appendix E). The risks and opportunities identified were based upon the assumptions made in Section 9.6.

TABLE 9-2: SUMMARY OF RISKS (R) AND OPPORTUNITIES (O) ON WATER AND WETLAND FEATURES ARISING FROM THE WATER CYCLE STRATEGY

	Surface flow and flood risk management	Waste water treatment	Development footprint	Network infrastructure
Standing open water –lakes and margins	O	No risks/ opportunities	R O	No risks/ opportunities
Rivers and Streams	R O	R O O		No risks/ opportunities
Wet Woodland	O	R	O	No risks/ opportunities
Marshy grassland	O	No risks/ opportunities	No risks/ opportunities	No risks/ opportunities
Reed bed and swamp	O	R R O		R
Ditches	R O	No risks/ opportunities	O	R
Fen	No risks/ opportunities	R R O		R
Ponds	R O	No risks/ opportunities	O R	R
Purple Moor Rush Grassland and Rush Pastures	No risks/ opportunities	No risks/ opportunities	No risks/ opportunities	No risks/ opportunities

9.7.2 It is recommended that:

- Where ecological risks and opportunities resulting from proposed water cycle changes have been identified, these are considered within the relevant flood risk and surface water management proposals. These opportunities and the reduction of identified risks can be incorporated into the detailed design of the developments and local green infrastructure plans.
- During the progression of the designs for the developments, designers consult with organisations such as the Environment Agency, Natural England, Lead Local Flood Authority and local groups to further develop the opportunities identified here.
- The cumulative effect of increased abstraction from other development proposals in the Luton area and neighbouring areas is considered.

10. Conclusions and Recommendations

10.1 Introduction

10.1.1 It is recommended that a series of policies be developed by Luton Borough Council to ensure that the Local Plan considers potential limitations (and opportunities) presented by the water environment and water infrastructure on growth, and phasing of growth.

10.2 Recommendations for Policy Development

Water Supply

WS1 – Water Efficiency in New Homes and Buildings

10.2.1 In order to move towards a more 'water neutral position' and to enhance sustainability of development coming forward, a policy should be developed that ensures all housing is as water efficient as possible, and that new housing development should go beyond Building Regulations and as a minimum reach Code for Sustainable Homes Level 3/4. Non-domestic building should as a minimum reach 'Good' BREEAM status.

WS2 – Water Efficiency Retrofitting

10.2.2 In order to move towards a more 'water neutral position', a policy could be developed to carry out a programme of retrofitting and water audits of existing dwellings and non-domestic buildings with the aim to move towards delivery of 20% of the existing housing stock with easy fit water savings devices.

WS3 – Water Efficiency Promotion

In order to move towards a more 'water neutral position', a policy could be developed to establish a programme of water efficiency promotion and consumer education, with the aim of behavioural change with regards to water use.

Surface Water Management and Flood Risk

10.2.3 **SWM1 – SUDS and Water Efficiency**

In order to move towards a more 'water neutral position' and to enhance sustainability of development coming forward, a policy should be developed which encourages developers to seek linkage of SUDS to water efficiency measures, including rainwater harvesting.

SWM2 – Linkages to SWMP, SFRA and LLFRMS

To ensure appropriate design, adoption and maintenance of SUDS, a policy should be developed that requires developers to ensure that SuDS design supports the findings and recommendations of the Luton Borough Council Surface Water Management Plan (SWMP), the CIRIA SUDS Manual and Luton Borough Council's SFRA and LLFRMS.

SWM3 – Water Quality Improvements

A policy should be developed that requires developers to ensure (where possible) that discharges of surface water are designed to deliver water quality improvements in the receiving watercourse or aquifer where possible to help meet the objectives of the WFD.

10.3 Recommendations for infrastructure

10.3.1 A collaboration between the EA, the World Wide Fund for Nature, and others has developed a web based sustainability checklist which covers Climate Change and Energy (including water resources and efficiency, and site infrastructure), Ecology, and Place Making. This resource provides comprehensive information for sustainable development, and should be referred to by developers and planners. The checklist may be found at http://www.environment-agency.gov.uk/research/planning/33368.aspx

10.3.2 Timescales for infrastructure delivery are approximate, based on planning trajectory provided by LBC and set out in Chapter 4 of this WCS. A plan led approach has been taken to ensure that long term, strategic infrastructure requirements are identified and planned for to support new development and protect against associated impacts on the urban water cycle. This strategic infrastructure requires long lead in times and must be progressed in alignment with long term growth plans to ensure that it can be provided in time to support development as it comes forward. Non-strategic infrastructure (such as local network upgrades, booster stations, etc) has also been identified to facilitate strategic planning; however, it is accepted that these will be more closely linked to the short term market conditions because once identified, their delivery is triggered by development and does not require long lead in times.

Summary of WCS Infrastructure Requirements for Potential Development Sites

TABLE 10-1: SUMMARY OF WCS INFRASTRUCTURE REQUIREMENTS FOR POTENTIAL DEVELOPMENT SITES

Water Cycle Aspect	Estimated Timescale	Infrastructure Requirements	Responsibility	Report Reference
Water resources	Policy action required prior to development; other measures according to timeline provided	Council to implement CSH level 3/4 for all new domestic properties through planning policy – developers to comply. Programme of measures recommended for achieving reduced water consumption across the study area.	Luton BC, Developer(s)	Paragraph 6.8.47
Sewerage	Prior to development	Detailed modelling where required to confirm whether (and how much of) initial development on new sites can drain to existing networks.	AWS, TWUL	Paragraph 5.3.1
Flood Risk & Surface Water	Prior to planning approval	Undertake further regional and site-specific studies as recommended in Table 10.2.	Developer(s), TWUL, Luton BC, AWS, EA	Table 10.2
Wastewater & water quality	Ongoing	Development of a policy that requires developers to ensure (where possible) that discharges of surface water are designed to deliver water quality improvements in the receiving watercourse or aquifer where possible to help meet the objectives of the WFD.	Luton BC, EA, AWS, TWUL	Paragraph 5.1.13
Ecology	During planning negotiations for each site and as development progresses	Pursue opportunities for wetland habitat creation and enhancement of existing wetland features, and linking habitats through extensive Green Infrastructure to surrounding countryside.	Developer(s), Luton BC	Paragraph 9.6.24 to 9.6.34
Ecology	Prior to planning approval for each site	Identify opportunities for wetland habitat creation associated with SUDS strategy.	Developer(s)	Paragraph 9.6.24 to 9.6.34
Ecology	Not yet defined	Consider wetland habitat creation as part of any flood risk attenuation proposals for WwTW.	AWS, TWUL	Paragraph 9.6.25
Ecology	Prior to planning approval	Investigate opportunities to contribute to local Green Infrastructure objectives	Developer (s)	Paragraph 9.6.35 to 9.6.36

10.3.3 Other Recommendations

The following are additional recommendations to be considered:

- Encourage pre-application discussions on relevant planning applications;
- Require the submission of holistic or site specific water cycle studies with every major planning application (greater than 100 dwellings). This would ensure that an adequate evidence base has been provided and suitable consideration has been given to water level/flood risk management; and
- Water Neutrality should be extended to non-domestic properties.

10.4 Flood Risk

10.4.1 The analysis of flood risk has shown that there are risks of flooding from a variety of sources (e.g. fluvial, overland, sewer and groundwater) to all the potential development sites. However, in all cases, the risks may be reduced and managed on-site through careful site layout planning.

10.4.2 Information on existing surface water flooding problems in Luton has been collated and analysed, showing that surface water flooding issues are widespread across the town and there is no single problem location. However, if any development takes place upstream of problem areas, particular care should be taken that there is no detriment to the existing surface water flooding issues downstream and if possible betterment should be provided. A Surface Water Management Plan was prepared for Luton (2012) due to the extent of surface water flooding across Luton and lack of co-ordination of improvement schemes between stakeholders. The types of SUDS required to mitigate the impacts of development on flood risk through increased run-off have been assessed. Many of the sites overlie permeable bedrock and therefore infiltration SUDS measures are preferred to maintain groundwater levels for public water supply and low river levels. Pollution control measures will be needed to ensure no detriment to water quality. At present, the groundwater dynamics in the Luton area are poorly understood and it is recommended that a new groundwater model of the area be undertaken to investigate groundwater recharge and groundwater flood risk.

10.4.3 Opportunities for development sites to contribute to larger regional scale flood mitigation facilities should be investigated prior to development and site specific flood risk and surface water management strategies should be used by the Local Planning Authority to inform planning conditions.

10.4.4 It is recommended that discussions should be held between planners from LBC and its neighbouring authorities to agree works and S106 and Community Infrastructure Levy contributions to determine an appropriate policy for identifying locations where mitigation measures would be beneficial and suitable methods for mitigation. Additional mitigation may also be required where expansion of the WwTW occurs in the functional flood plain.

10.4.5 A summary of flood risk and surface water recommendations is provided in Table 10.2.

TABLE 10-1: SUMMARY OF FLOOD RISK RECOMMENDATIONS

Context	Ref.	Action	Responsibility	Reference in WCS
Regional planning	1	Consider flood risk to sites when preparing Allocated Sites Development Planning Document, using information available in WCS, SWMP and SFRA.	LPA in consultation with EA.	Paragraph 8.3.2
	2	Agree policy for identifying locations where mitigation measures are necessary and suitable methods for mitigation.	Agreement is needed between TWUL, AWS and EA	Paragraph 8.2.1
	3	Undertake groundwater modelling to improve understanding of groundwater recharge paths, areas at risk of groundwater flooding, and the potential impacts of development.	EA in partnership with major developers.	Paragraph 8.2.9

Development of individual sites and WwTW	4	Prepare site-specific flood risk assessments to satisfy requirements of NPPF. The information available in the WCS, SWMP,SFRAs and LLFRMS should be used as an initial guide to potential flood risks and suitable mitigation measures, but further detailed site investigations will be required.	Developers in consultation with LPA, LLFA, local authority, EA and relevant water companies (AWS or TWUL).	Paragraph 8.1.3
	5	For permeable sites, consult with EA regarding groundwater flood risk and groundwater recharge requirements (rates, volumes and water quality requirements).	All developers in consultation with EA	Paragraph 8.2.6
	6	For brownfield sites in Luton, aim to reduce surface water run-off rates and volumes to greenfield equivalent.	All developers in consultation with EA	Paragraph 8.2.10
	7	Prepare a joint strategy for flood risk and surface water management for areas draining to Houghton Brook.	Developers of any sites in relevant area in consultation with EA and Highways Agency (motorway development), potentially through the formation of a Surface Waters Group.	Paragraph 9.6.26
	8	Investigate opportunities to reduce surface water discharge below greenfield rates to reduce risk of surface water flooding in Luton.	Developers of relevant areas in consultation with EA and LBC, through involvement in the Luton SWMP.	Paragraph 8.2.3
	9	Consult with Luton Airport to agree drainage design that prevents any increased risk of bird strike.	Developers of relevant area in consultation with EA and Luton Airport.	Paragraph 4.4.1

	10	Agree any requirement for mitigation at East Hyde WwTW, and develop a solution.	Developers of relevant area in consultation with TWUL and the EA.	Paragraph 9.4.9
	11	Agree policy for identifying locations where mitigation measures are necessary, and suitable methods for mitigation	Discussion is needed between LBC & neighbouring authorities to agree works and S106 & CIL contributions to develop policy and mitigations	Paragraph 10.4.4.

10.5 Ecology

10.5.1 The analysis undertaken within this report has identified key ecological risks and opportunities associated with the potential development sites. A detailed summary table is provided in AppendixE.

10.5.2 It is recommended that:

- Where ecological risks and opportunities resulting from proposed water cycle changes have been identified, these are considered within the relevant flood risk and surface water management proposals. These opportunities and the reduction of identified risks can be incorporated into the detailed design of the developments and local green infrastructure plans.
- During the progression of the designs for the developments, designers consult with organisations such as the Environment Agency, Natural England and local groups to further develop the opportunities identified here.
- The cumulative effect of increased abstraction from other development proposals in the Luton area and neighbouring areas is considered.

10.6 Future review of the WCS

10.6.1 As timescales provided within a WCS are indicative only and specifically linked to the planned progression of development, these will need to be reviewed following any future changes in the trajectory. The detailed technical analysis will need to be reviewed following significant changes to: the overall level of development; the land use budgets, or the site footprints.

10.6.2 It is recommended that a regular review of the WCS be undertaken to assess progress and identify any areas of change. An annual review by the core stakeholder group is suggested for this purpose. Any issues with delivery of sites or infrastructure arising in the interim should be brought to the attention of the stakeholder group for discussion as soon as possible to ensure the strategy is not compromised.

10.6.3 In addition, the WCS should be reviewed following future changes to the Local Plan, to ensure that it is kept up to date.

10.6.4 The WCS should remain a living document, and (ideally) be reviewed on an annual basis as development progresses and changes are made to the various studies and plans that support it; these include:

- Five yearly reviews of AfW's WRMP (next full review in 2019, although interim reviews are undertaken annually);
- Second round of RBMP updates due by the end of 2015; and
- Climate change impact assessment milestones (see Table 10-3).

TABLE 10-3: WATER AND CLIMATE CHANGE RELATED PLANNING DOCUMENTS

Document	Produced By	Date for Review
AfW Water Resource Management Plan	AfW	2019 (though plan is reviewed annually)
Thames River Basin Management Plan	Environment Agency	December 2015
Catchment Abstraction Management Strategies	Environment Agency	Yearly updates provided. Date of next full review unknown
UKCP09 Projections and Impacts	UKCIP	On-going – check website for further research and case studies for mitigation / adaption (http://www.ukcip.org.uk/)

Appendix A Flood Risk Assessment Methods

The Sequential Test of NPPF requires that development is directed first to areas of lowest flood risk, according to the vulnerability of the development. The Water Cycle Strategy aims to support the application of NPPF by providing an overview of the flood risk to each potential development site. The Water Cycle Strategy is not designed to replace site-specific flood risk assessments by developers. Flooding can occur from a range of sources, including rivers, the sea and tidal estuaries, groundwater, overland flow, sewers, reservoirs, canals and lakes.

Sea and Tidal Flooding
This source of flooding is not a risk to the study area which is located inland, and is not considered further in the assessment.

Fluvial Flood Risk

Information on fluvial flood risk was obtained from three main sources:

(a) EA Flood Zone Maps. These classify land into the four flood zones listed in Table A-1. The flood zone maps show flood risk excluding the effects of any existing flood defences (see Figure 5-6 in Appendix B). It should be noted that the EA flood zones have only been mapped for catchments greater than 3 km^2. Therefore there may be areas that are within flood zones but do not appear to be so based on the EA maps.

(b) Strategic Flood Risk Assessment (SFRA) Flood Maps. The SFRA flood maps take into account the presence of any existing flood defences and may map flood risk for watercourses smaller than those included in the EA Flood Zone Maps

(c) Historic Flood Maps. These were provided by the EA and show the observed flood extents of recent large floods. It is assumed the outlines represent fluvial flooding events.

The potential effects of climate change are predicted to include an increase in peak river flow, due to an increase in both long-duration rainfall and short-duration high intensity rainfall. The magnitude of these effects is unknown, but NPPF recommends that an additional 20% is added to peak river flow as an uncertainty allowance for these changes over the next 100 years. The flood maps produced for the SFRA assume a 20% increase in peak flow due to climate change and therefore these have been used in this assessment to ensure uncertainty in climate change is allowed for.

TABLE A-1: FLOOD ZONE BASED ON TABLE 1 OF NPPF	
Zone 1: Low Probability	< 1 in 1000 (<0.1%) annual probability of river or sea flooding.
Zone 2: Medium Probability	1 in 100 to 1 in 1000 (1% to 0.1%) annual probability of river flooding; or 1 in 200 to 1 in 1000 (0.5% to 0.1%) annual probability of sea flooding
Zone 3: High Probability	> 1 in 100 (>1%) annual probability of river flooding; or > 1 in 200 (>0.5%) annual probability of sea flooding.
Zone 3b: Functional Floodplain	Land where water has to flow or be stored in times of flood: >1 in 20 (>5%) annual probability of flooding, or another probability agreed between the LPA and EA, including water conveyance routes.

The flood zones refer to the probability of river and sea flooding, ignoring the presence of defences

Groundwater Flood Risk

Groundwater flooding occurs when water levels in underlying permeable rocks (aquifers) rise above the surface ground levels. The bedrock and surface geology for the study area are shown in Appendix B Figure 5-2-1 and Figure 5-2-2. Reference should be made to the areas susceptible to groundwater flooding within the SWMP and LLFRMS.

Surface Water flooding

Overland flooding occurs when the rate of rainfall exceeds the rate of infiltration into the soil, and water flows overland to the river. This is particularly a risk at the base of steep slopes with impermeable soils where water flowing downhill can rapidly coalesce. The SWMP for Luton and recently completed LLFRMS should be referred to assess the risk from surface water flooding across the borough.

Artificial Sources of Flood Risk

Artificial sources of flooding can include reservoirs, canals and lakes where water is retained above natural ground level. There are no lakes above ground level within the study area but there are underground reservoirs at Hart Hill and Butterfield Green Road and a water tower at Hampshire Way within the Borough and an underground reservoir at Sundon outside the Borough, all of which could affect the areas of the Borough in the event of structural failure.

In 2009 the Environment Agency produced a series of reservoir inundation flood maps. Only large reservoirs that hold over 25,000 cubic meters of water were assessed. Maps of the maximum flood extent are available on the Environment Agency's website.

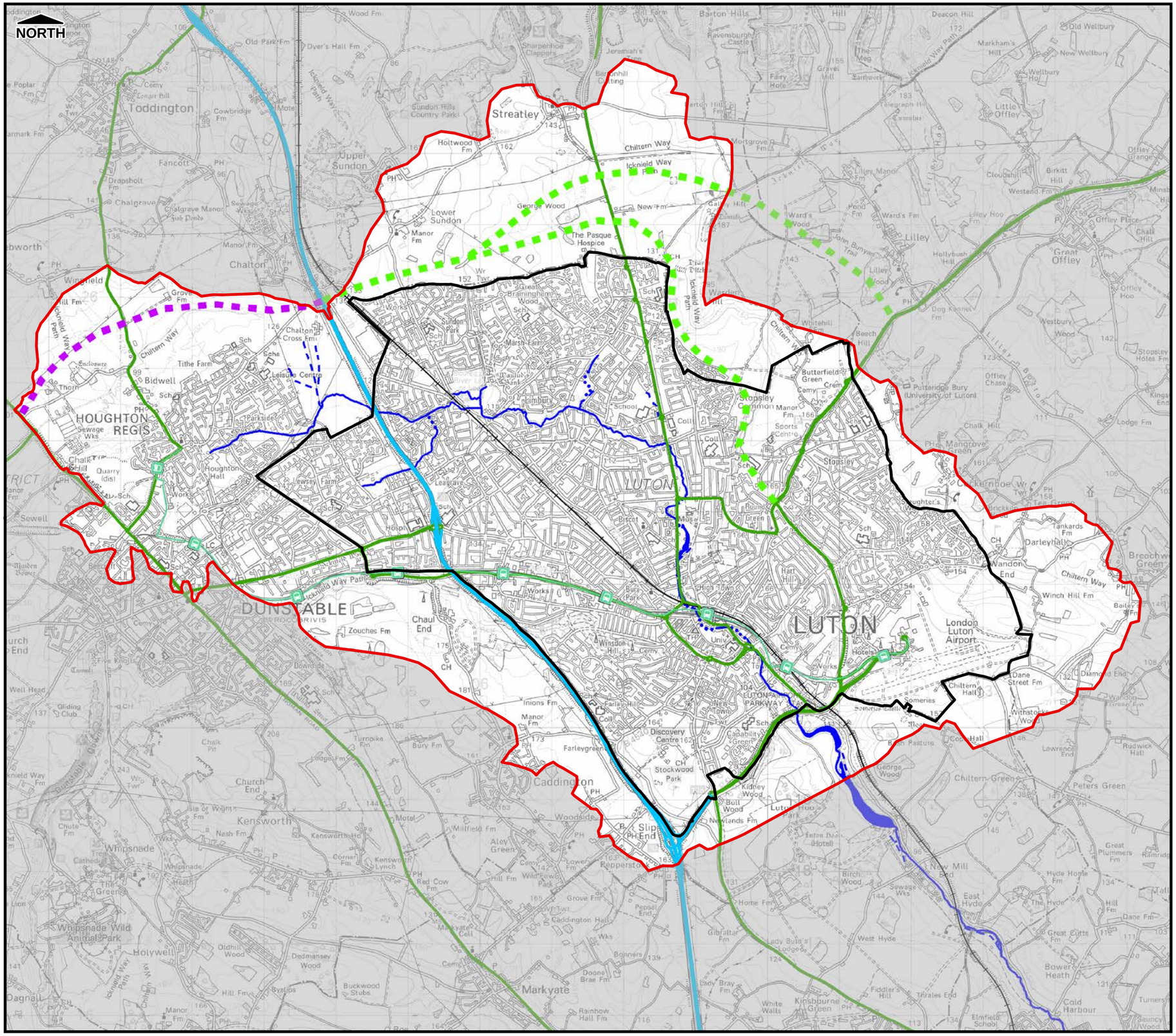
Sundon Reservoir is owned and maintained by Anglian Water Services Ltd and is located at NGR 506255 228275, just outside the Luton Borough boundary at Streatley. The path for floodwater from a reservoir failure at Sundon Reservoir would head south towards Luton, where is could impact properties on Quantock Rise / Holford Way and Whitehorse Vale. Flood extents are not predicted to extend any further south than the junction of Icknield Way and Bramingham Road. The probability of reservoir failure is low and there has not been a loss of life in the UK since 1925. Although the probability of failure is very low, the consequences of a failure are potentially high.

The active management and regular maintenance of these structures mean that there is a low to very low probability of failure, however, the extent of areas shown to be potentially at risk is large and the consequences of flooding if it were to occur are likely to be very high. This assessment therefore concludes that there is a medium risk of flooding from this source.

Residual Flood Risk

In the course of discussion with the Environment Agency's Thames Region a number of vulnerable watercourses or flood risk management structures have been identified. These are defined in more detail in Luton SFRA and presented with Figure 13 of the SFRA (refer also to Appendix B of the 2015 Luton WCS).

Appendix B Figures



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Luton Borough Council Boundary
- Study Area
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Existing Infrastructure

- Motorway
- Railway Lines
- Guided_Busway
- Railway Stations
- Main Roads

Proposed Infrastructure

- Proposed A5-M1 Link (funding committed)
- Proposed M1-A6-A505 Bypass - 2 options (no funding committed)

Notes

Luton Borough Council

LUTON BOROUGH COUNCIL

Luton Water Cycle Strategy

Scale at A3	Date	Drawn by	Approved by
1:55,000	March 2013	R.EABRY	M.ARTHUR

Study Area

Consultant

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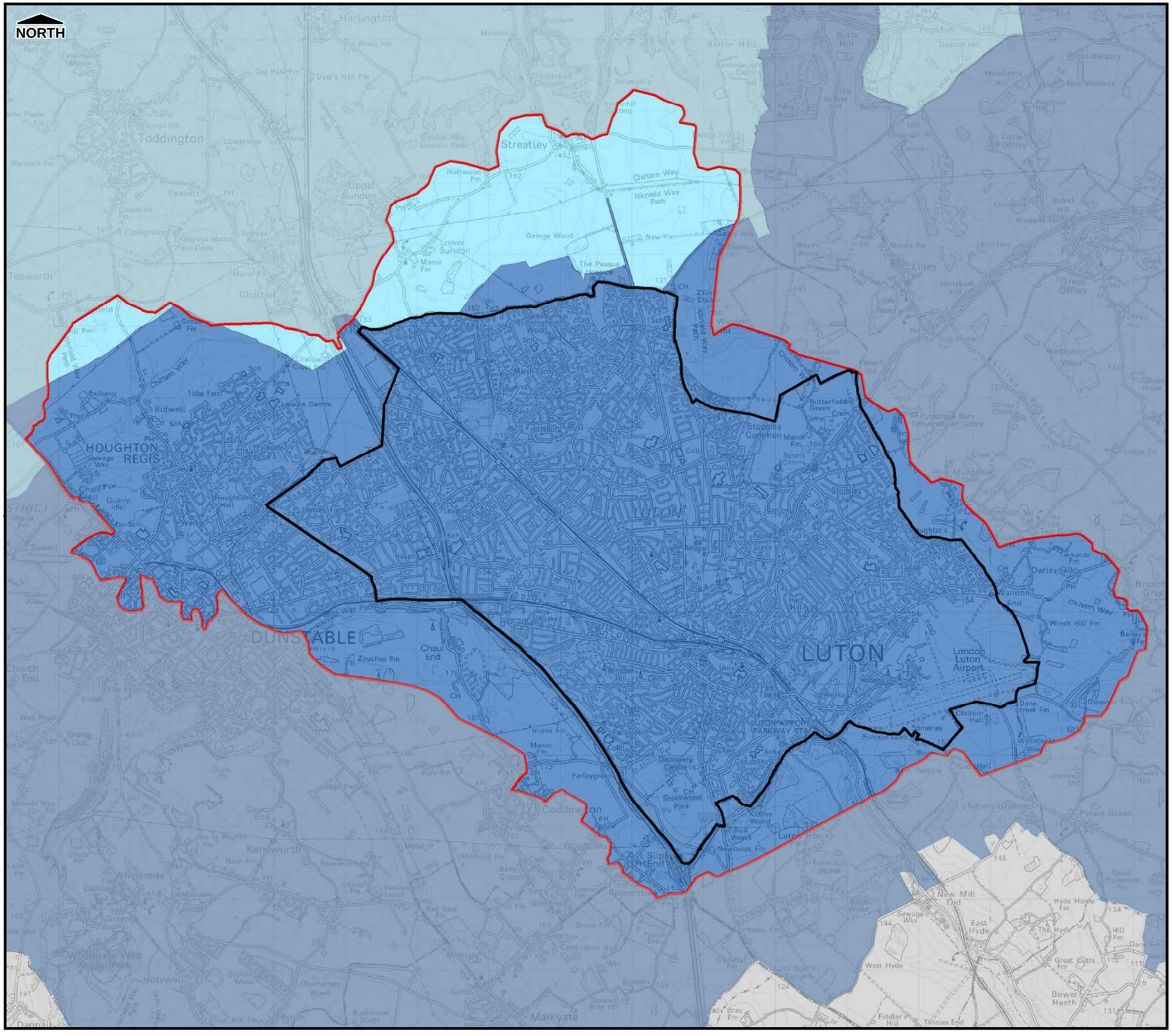
Capita
65 Gresham Street
London
EC2V 7NQ

FIGURE 2-1



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Legend

- Luton Borough Council Boundary
- Study Area

Water Resources Zones

- Affinity Water
- Anglian Water

Notes

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Luton Water Cycle Strategy

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Water Resources Catchment Boundaries

Consultant

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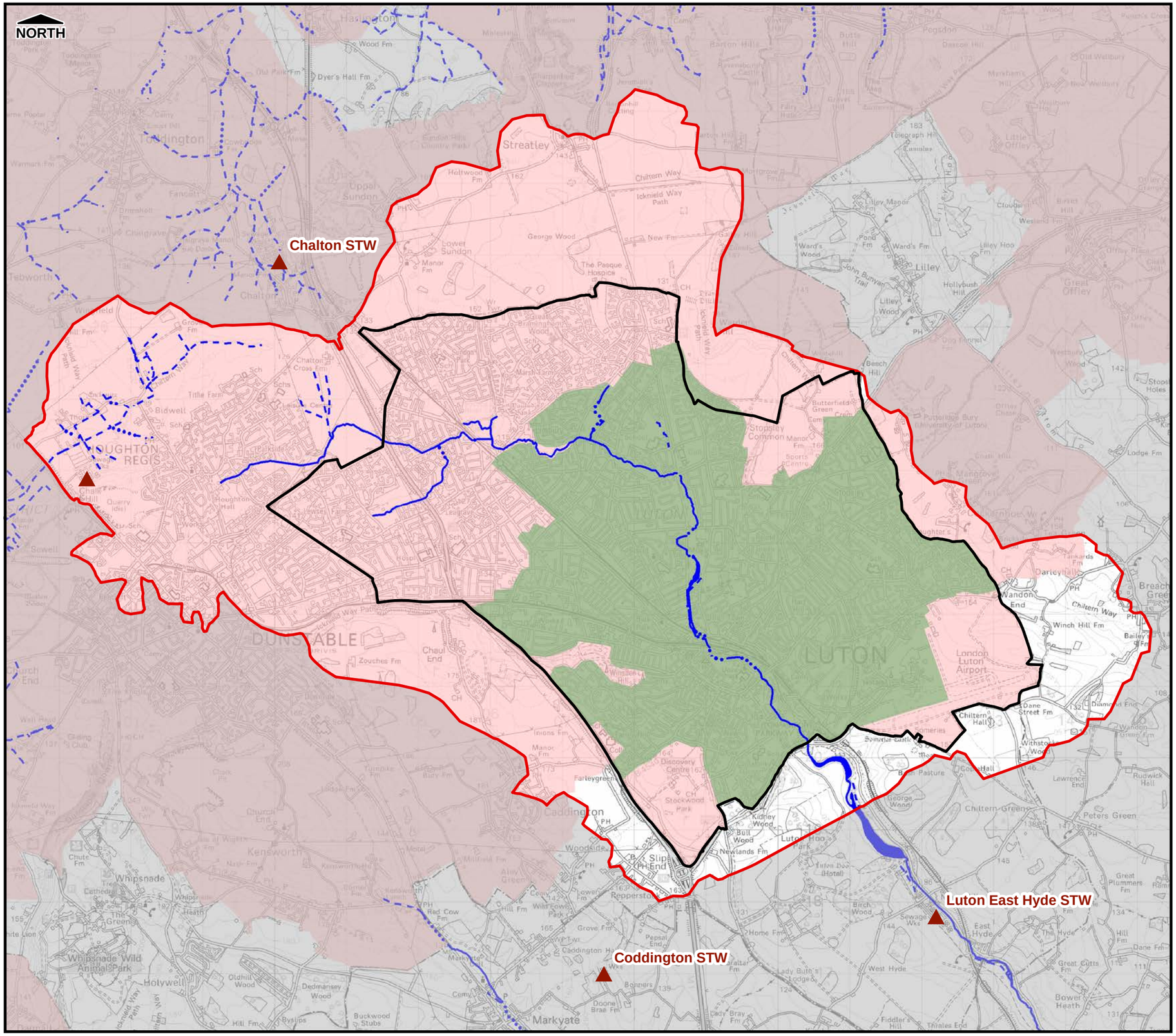
FIGURE 2-2



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Luton Borough Council Boundary
- Study Area
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Wastewater catchments

- Thames Water
- Anglian Water
- Wastewater Treatment Works Stations

Notes

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Luton Water Cycle Strategy

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Wastewater Catchments

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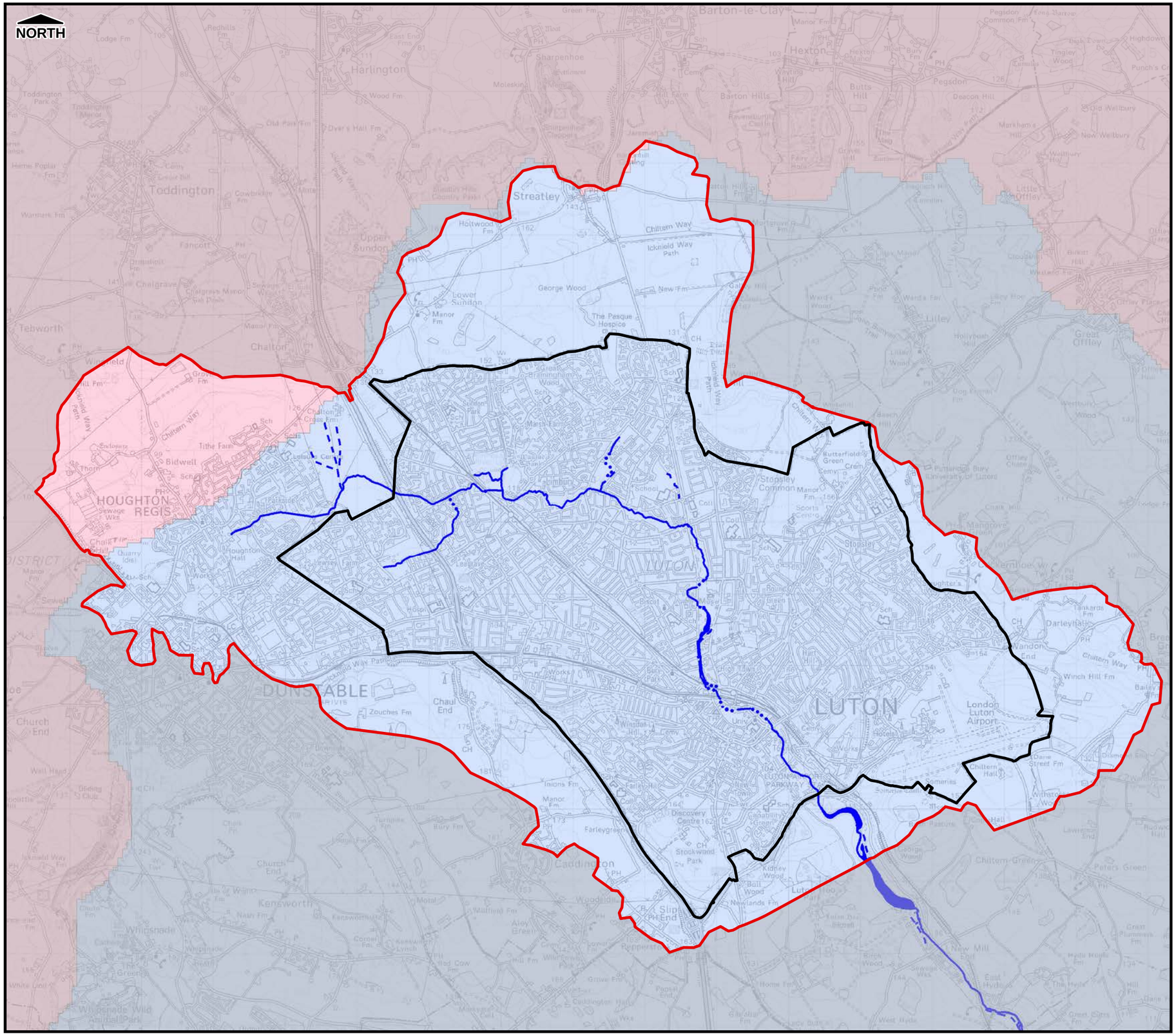
FIGURE 2-3



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Legend

- Luton Borough Council Boundary
- Study Area
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Environment Agency Regions

- Anglian
- Thames

Notes

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Luton Water Cycle Strategy

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Environment Agency Regions

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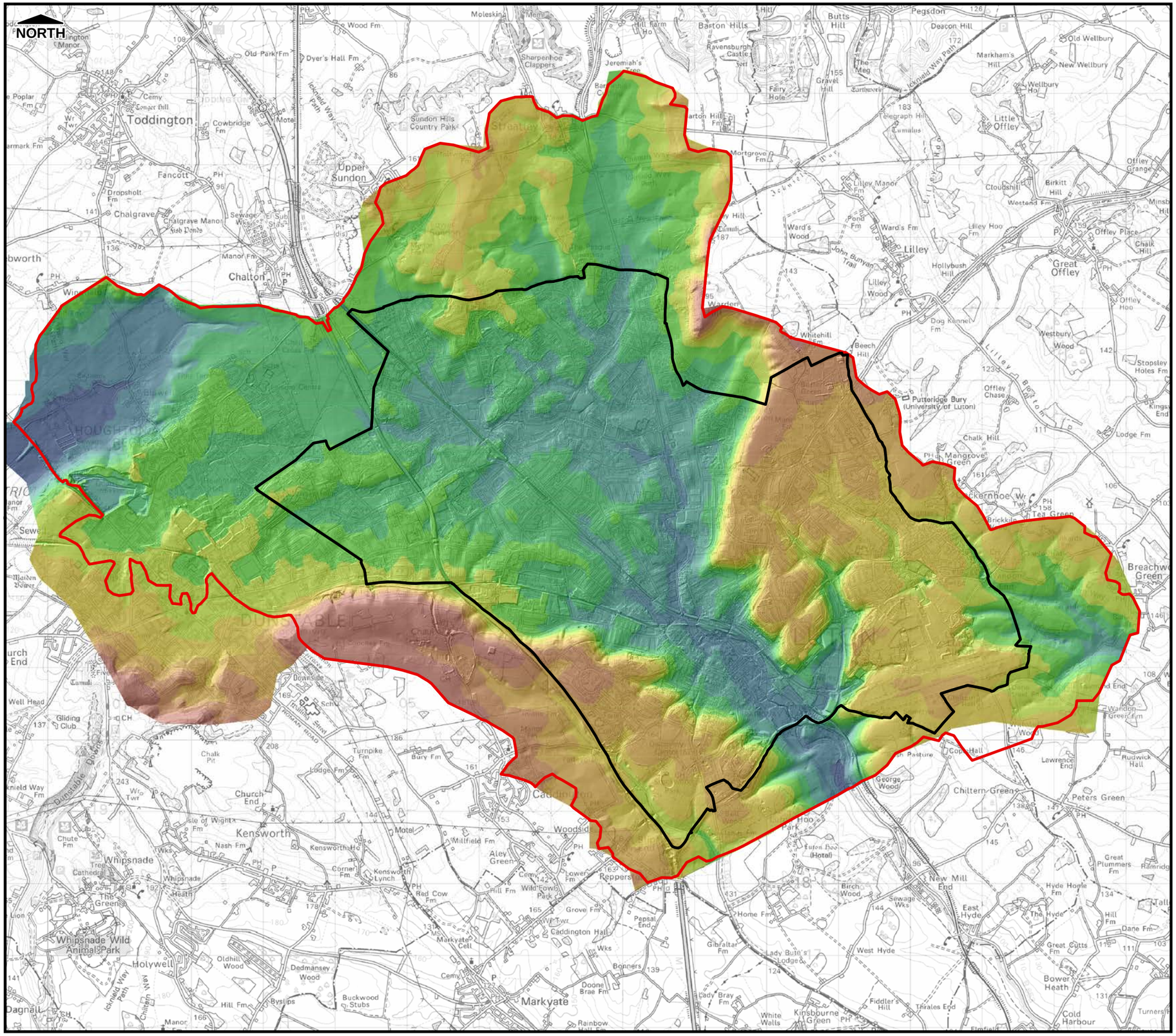
FIGURE 2-4



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Luton Borough Council Boundary
- Study Area

Elevation (mAOD)

- < 100
- 100 - 110
- 110 - 120
- 120 - 130
- 130 - 140
- 140 - 150
- 150 - 160
- 160 - 170
- 170 - 180
- > 190

Notes

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Luton Water Cycle Strategy

Scale at A3	Date	Drawn by	Approved by
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Topographic Data (Lidar)

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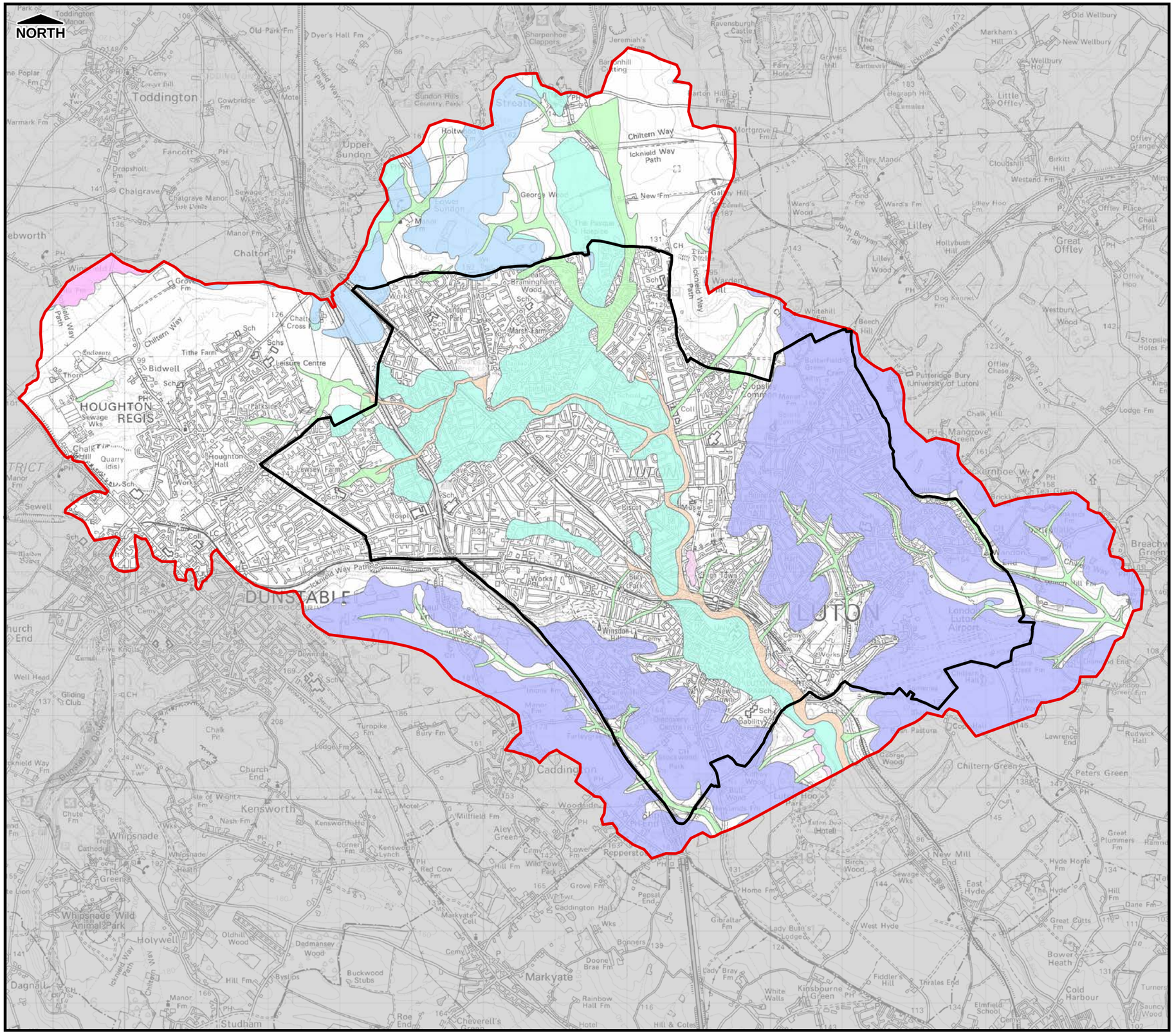
FIGURE 5-1



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Luton Borough Council Boundary
- Study Area

Drift Geology

- Alluvium
- Clay with Flints
- Glaciofluvial Deposits
- Head
- Lowestoft Formation
- River Terrace Deposits
- Till

Notes

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Luton Water Cycle Strategy

Scale at A3	Date	Drawn by	Approved by
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Drift Geology

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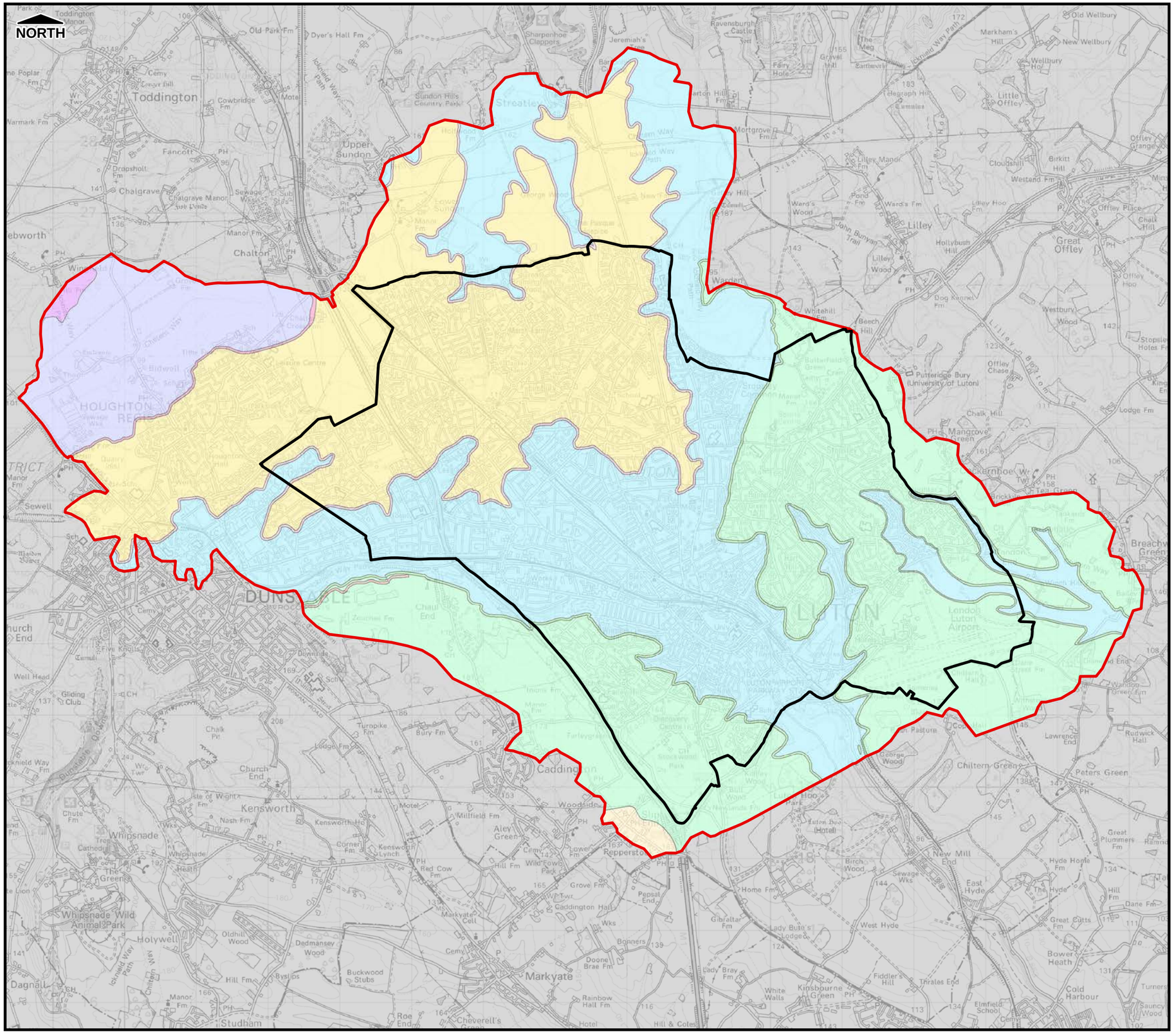
FIGURE 5-2-1



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Legend

- Luton Borough Council Boundary
- Study Area

Solid Geology

- Chalk Rock Member
- Gault Formation
- Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated)
- Lambeth Group
- Lewes Nodular Chalk Formation and Seaford Chalk Formation (Undifferentiated)
- Melbourne Rock Member
- Top Rock Bed
- Totternhoe Stone Member
- West Melbury Marly Chalk Formation
- Zig Zag Chalk Formation

Notes

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Luton Water Cycle Strategy

Scale at A3	Date	Drawn by	Approved by
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Solid Geology

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FIGURE 5-2-2

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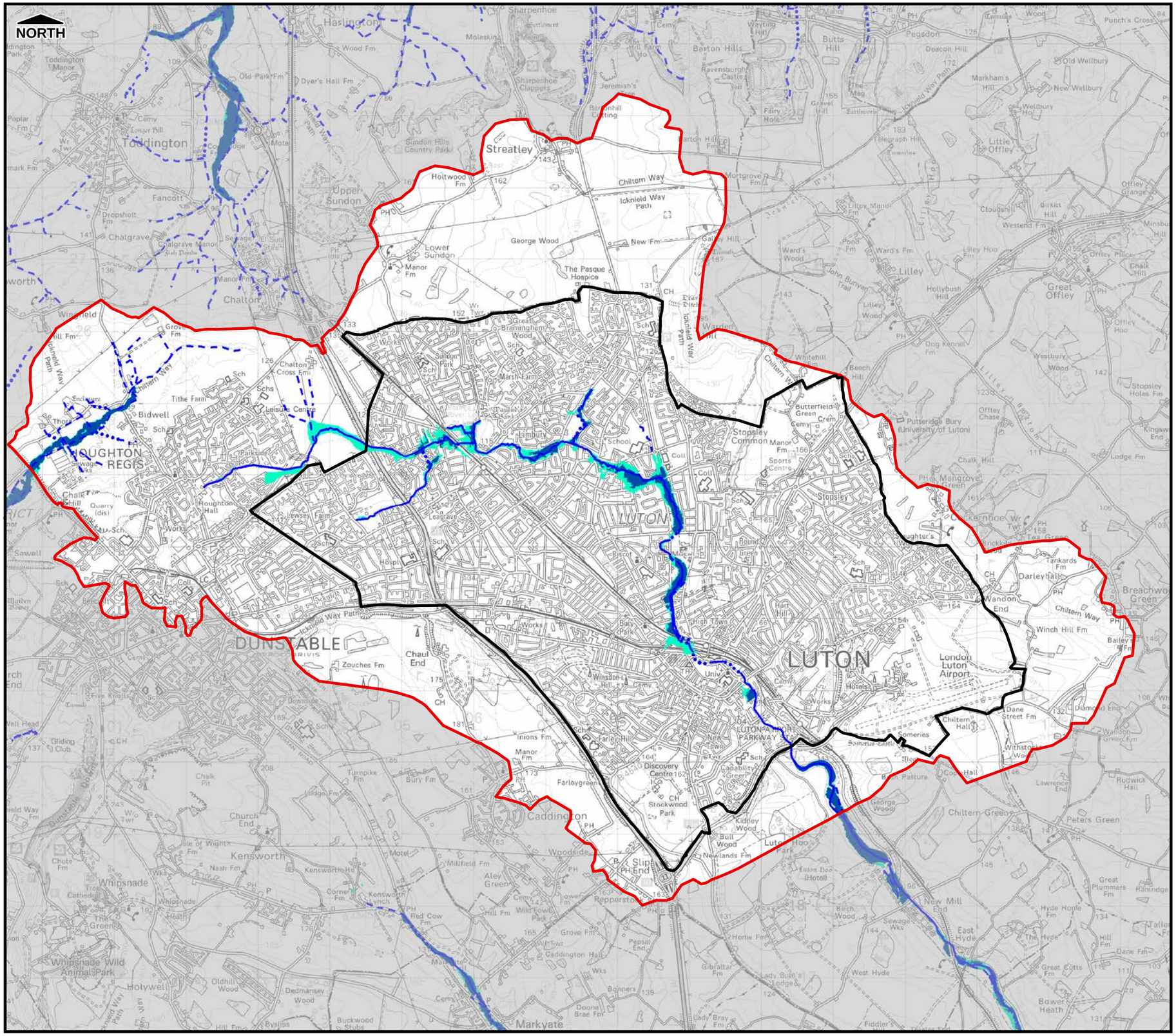

Legend

- Luton Borough Council Boundary
- Study Area
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Environment Agency Flood Zone 3
- Environment Agency Flood Zone 2

Notes

Luton Borough Council

LUTON BOROUGH COUNCIL

Luton Water Cycle Strategy

Scale at A3	Date	Drawn by	Approved by
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Environment Agency Flood Zones

Consultant

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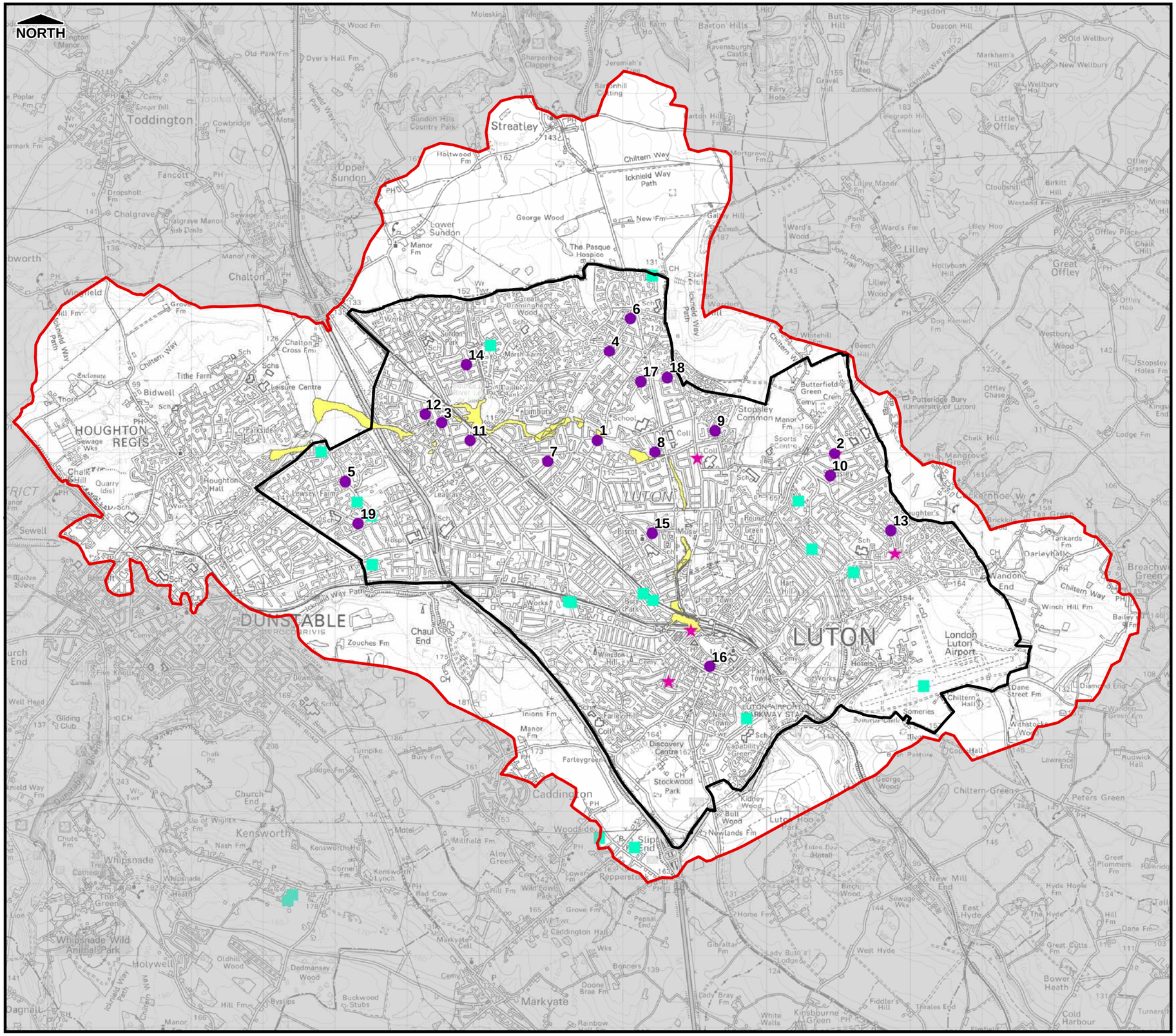
FIGURE 5-6



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Legend

- Luton Borough Council Boundary
- Study Area
- Luton Borough Council - Known Flood Sites (Unresolved)
- Luton Borough Council - July/August 1980 Flood Incidents
- Bedfordshire Fire Brigade - Callouts for 'Weather Related Flooding'
- Environment Agency Historical Flood Outlines

Notes

Luton Borough Council

LUTON BOROUGH COUNCIL

Luton Water Cycle Strategy

Scale at A3	Date	Drawn by	Approved by
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Historic Fluvial Flood Outlines

Consultant

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Capita
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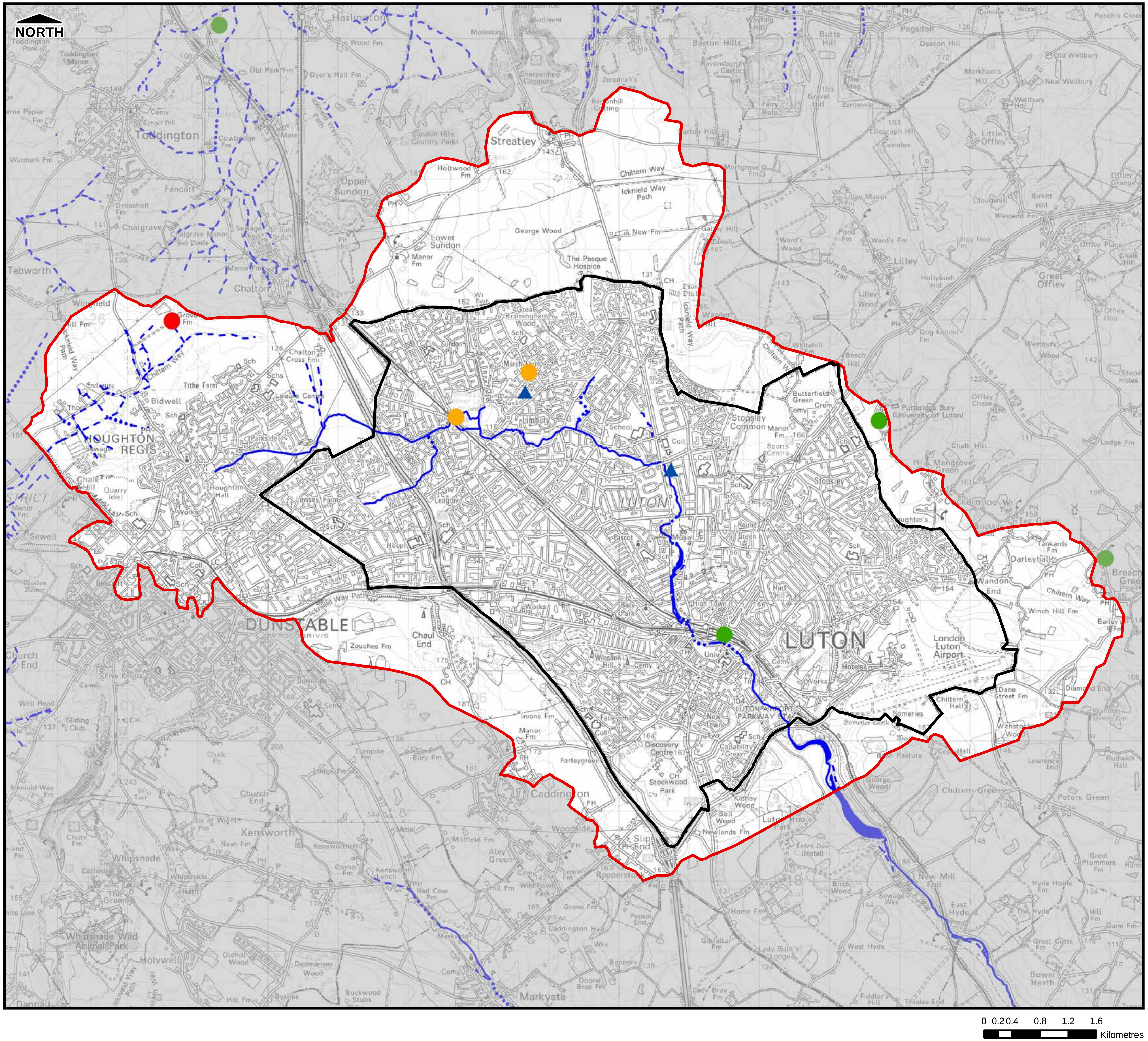
FIGURE 5-9



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Luton Borough Council Boundary
- Study Area
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Reported groundwater flooding incidents from SFRA

Borehole flood risk factors

- Low risk
- Medium risk
- High risk

Notes

Luton Borough Council

LUTON
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Luton Water Cycle Strategy

Scale at A3	Date	Drawn by	Approved by
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Indicators of groundwater flood risk

Consultant

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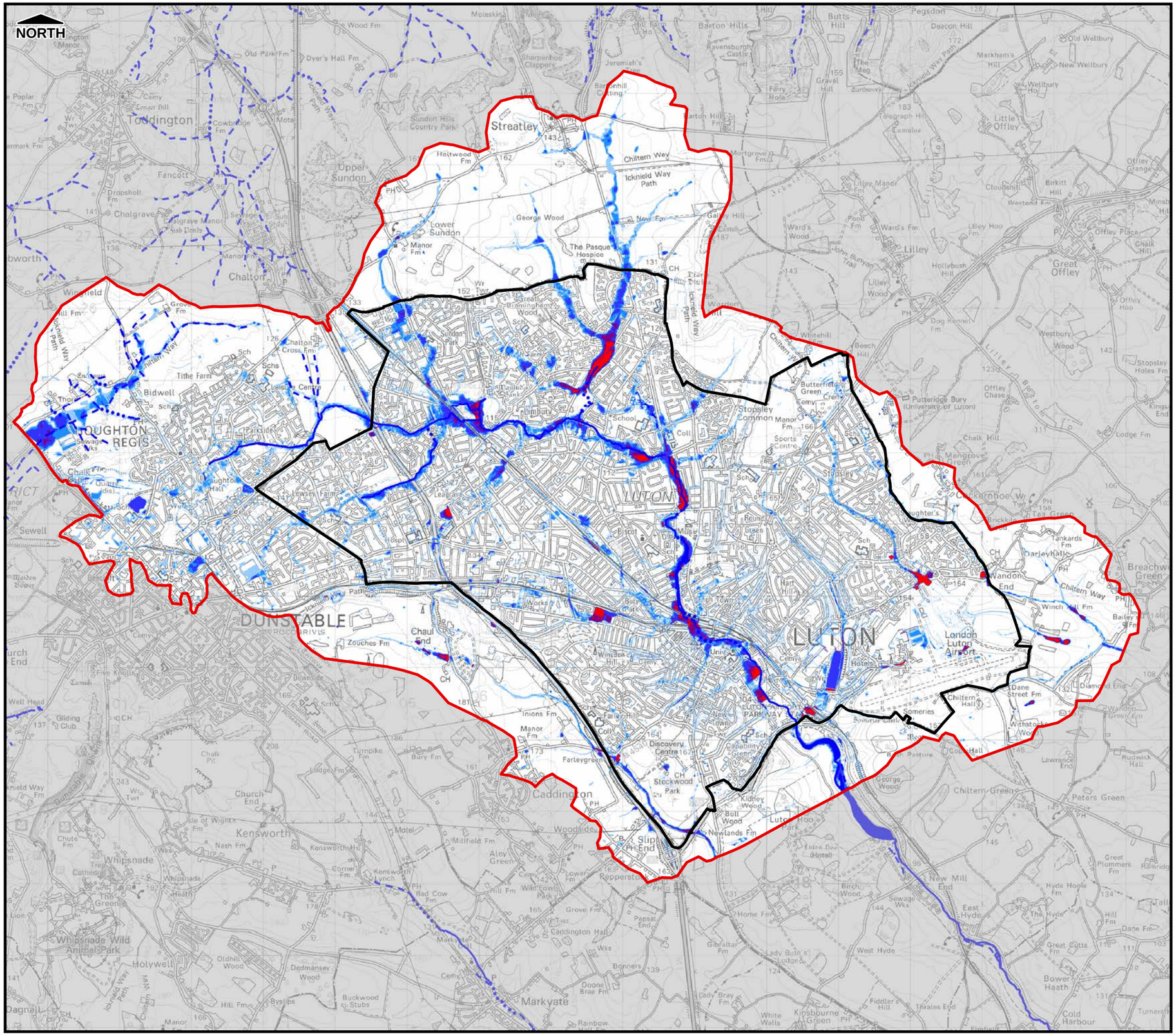
FIGURE 5-10



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Luton Borough Council Boundary
- Study Area
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Flood Depth (m)

- < 0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- > 1.5m

Notes

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Luton Water Cycle Strategy

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Surface Water Flood Depth 1 in 100yr CC, 3hr duration

Consultant

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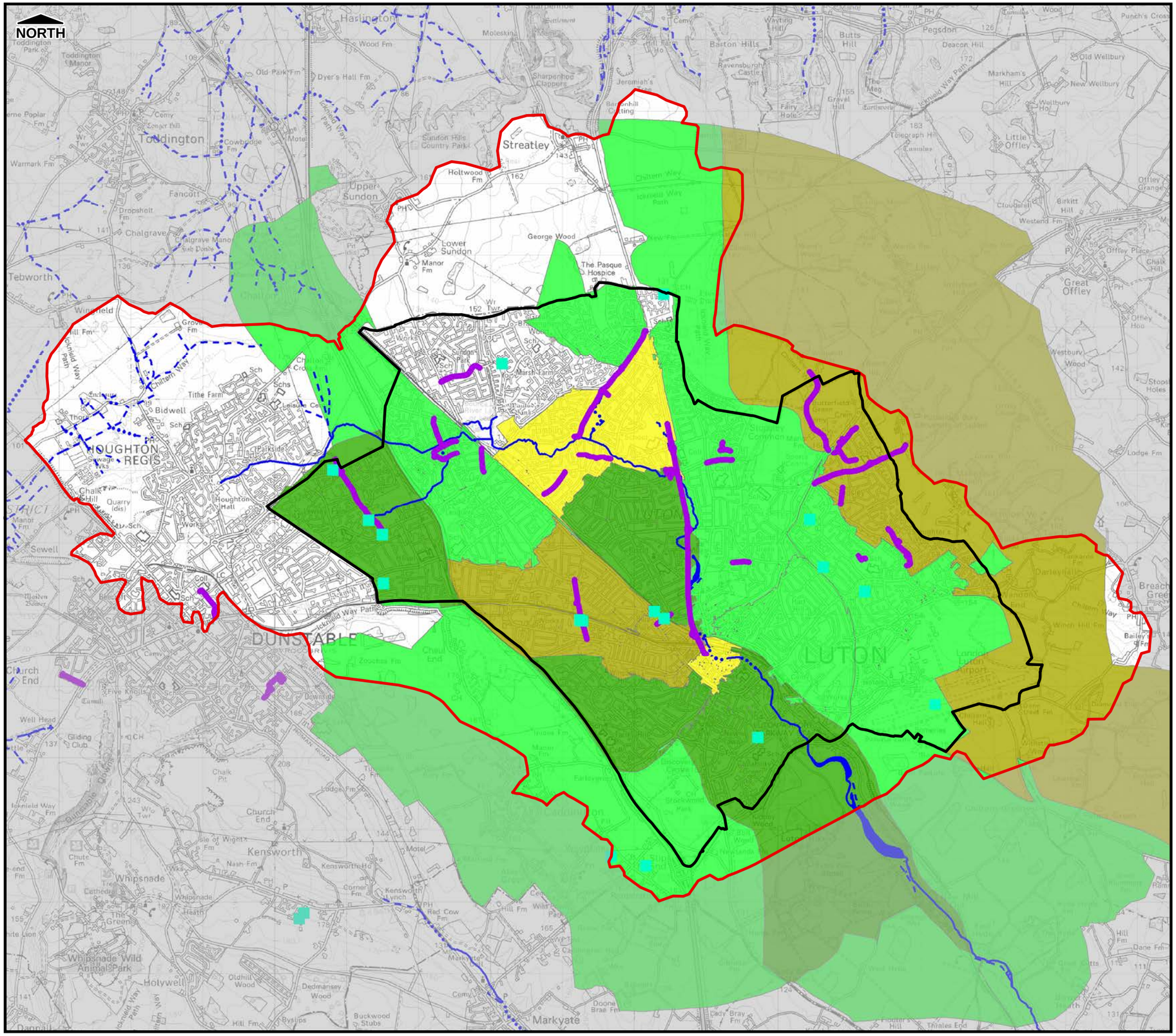
FIGURE 5-11



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Legend

- Luton Borough Council Boundary
- Study Area
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Known Road Flooding
- Bedfordshire Fire Brigade - Callouts for 'Weather Related Flooding'

Sewer Flooding Records

- 0
- 1 - 5
- 6 - 10
- 11- 20
- 21- 25

Notes

Luton Borough Council

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Luton Water Cycle Strategy

Scale at A3	Date	Drawn by	Approved by
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Sewer Flooding

Consultant

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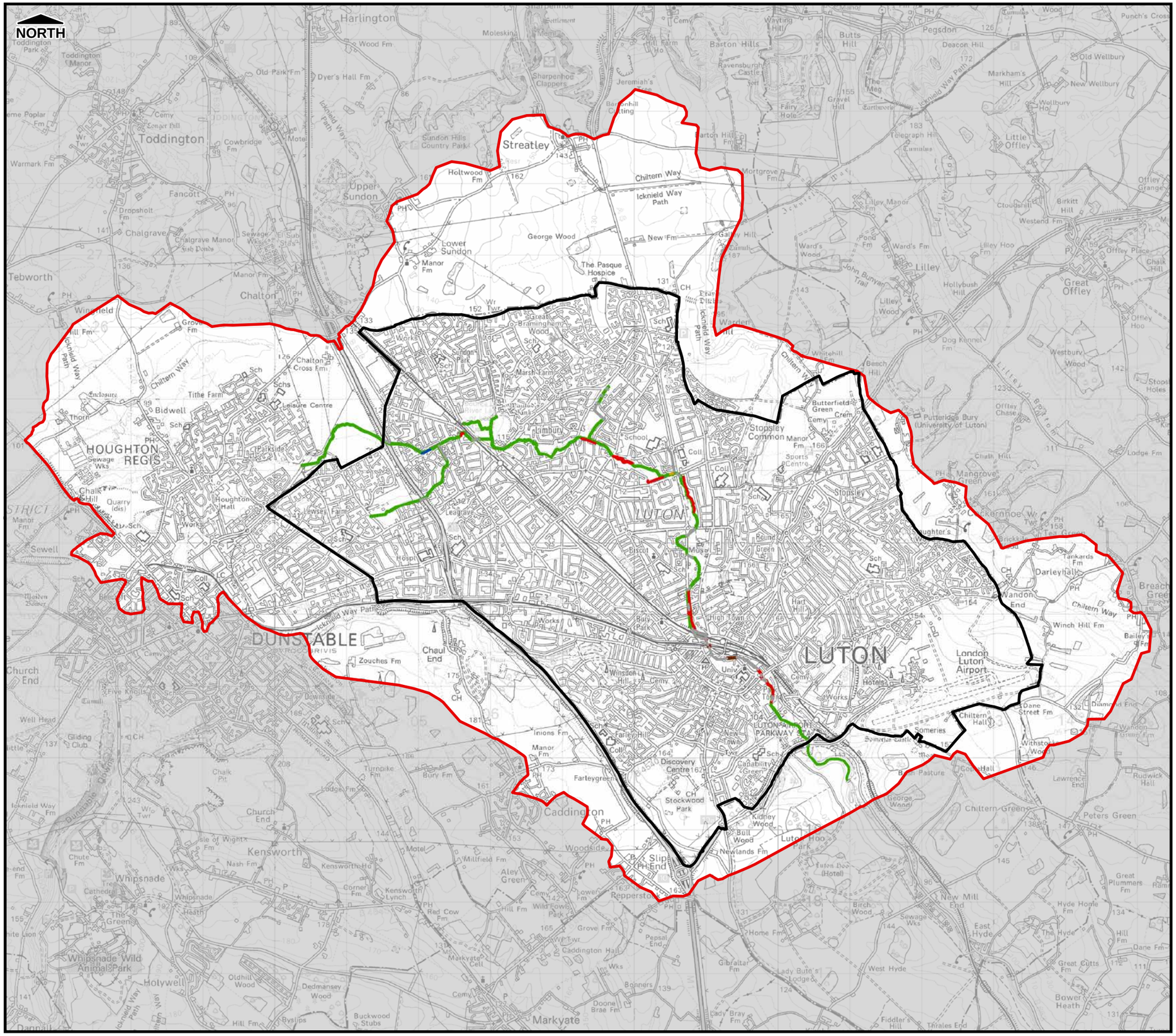
FIGURE 5-12



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Study Area

Flood Defence Type

- Flood Defence Structure
- Maintained Channel
- Raised Defence (man-made)
- Raised Defence (natural)
- Culverted Channel
- Natural Channel

Notes

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Luton Water Cycle Strategy

Scale at A3	Date	Drawn by	Approved by
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Flood defence locations

Consultant

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Capita
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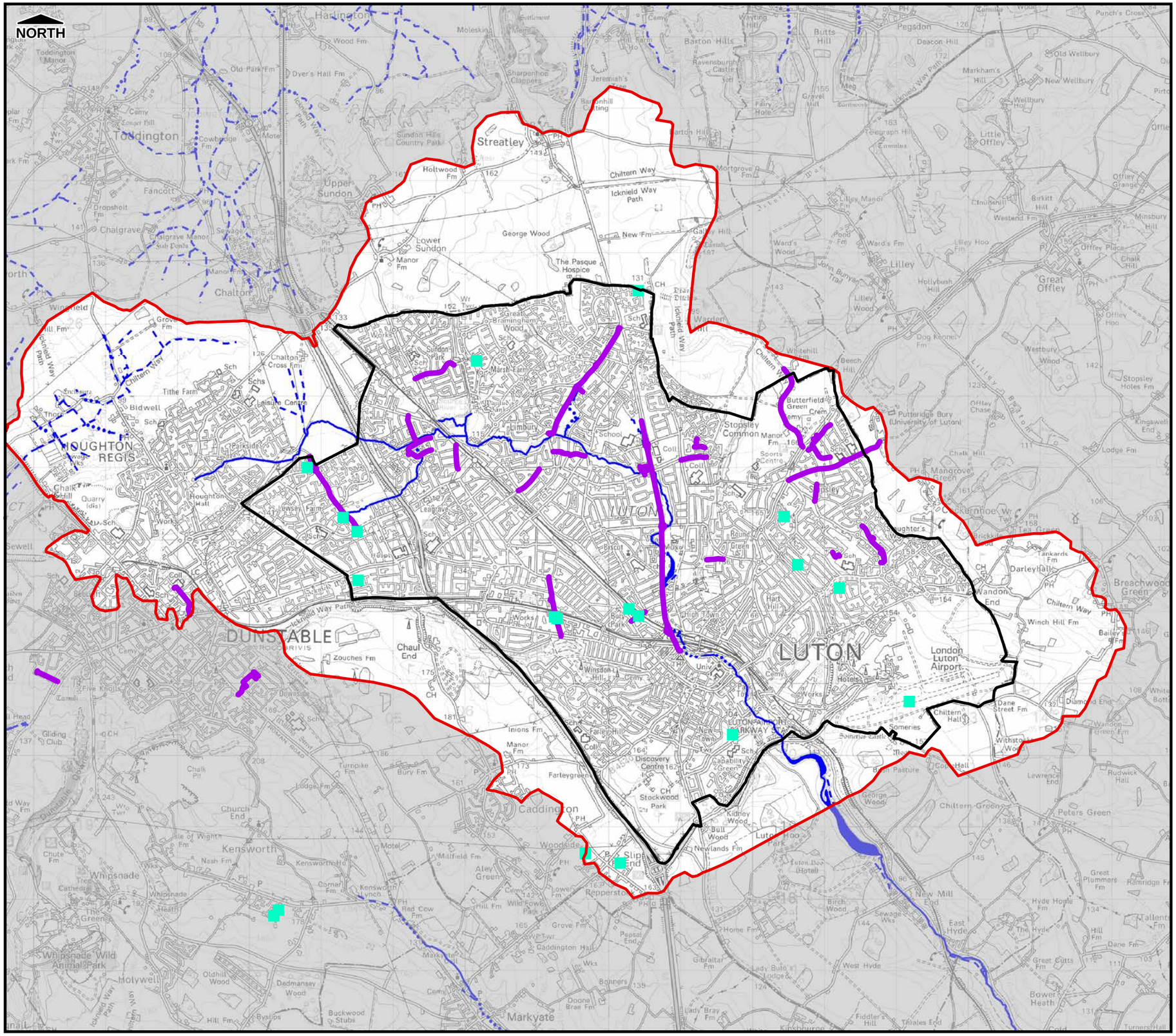
FIGURE 5-13



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Luton Borough Council Boundary
- Study Area
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Known Road Flooding
- Bedfordshire Fire Brigade - Callouts for 'Weather Related Flooding'

Notes

Luton Borough Council

LUTON BOROUGH COUNCIL

Luton Water Cycle Strategy

Scale at A3	Date	Drawn by	Approved by
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Sewer flood risk in Luton

Consultant

CAPITA | AECOM

Capita
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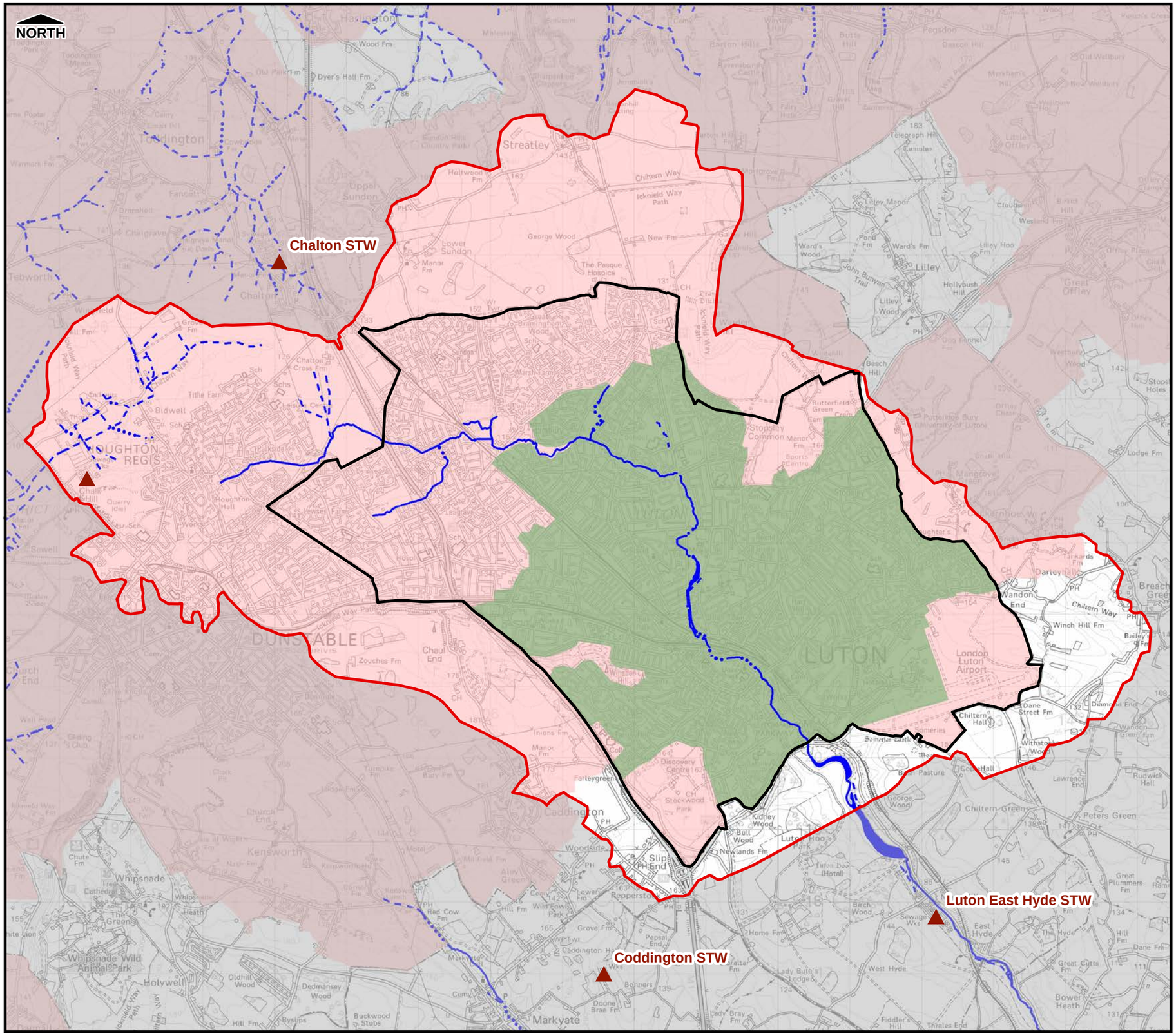
London
EC2V 7NQ

FIGURE 5-14



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Luton Borough Council Boundary
- Study Area
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Wastewater catchments

- Thames Water
- Anglian Water
- Wastewater Treatment Works Stations

Notes

Luton East SUE will fall in TWUL statutory area.

Luton Borough Council

LUTON BOROUGH COUNCIL

Luton Water Cycle Strategy Final

Scale at A3	Date	Drawn by	Approved by
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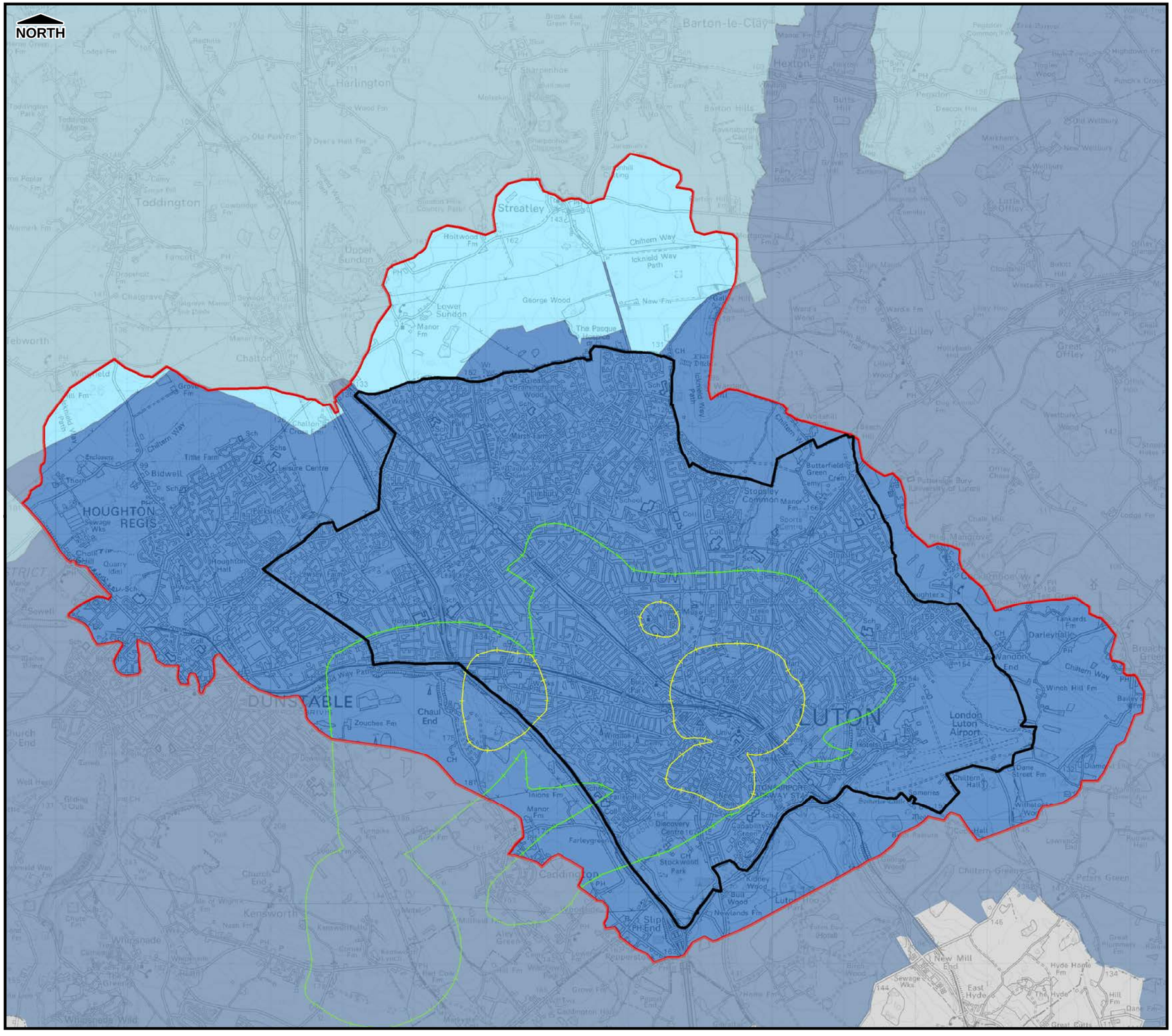
Wastewater Catchments

Consultant

CAPITA | AECOM

Capita
65 Gresham Street
London
EC2V 7NQ

FIGURE 6-1



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Luton Borough Council Boundary
- Study Area

EA Groundwater Source Protection Zone

- Inner Zone
- Outer Zone

Water Resources Zones

- Anglian Water
- Affinity Water

Notes

Luton Borough Council

LUTON BOROUGH COUNCIL

Luton Water Cycle Strategy

Scale at A3	Date	Drawn by	Approved by
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Water Resource and Source Protection Zones

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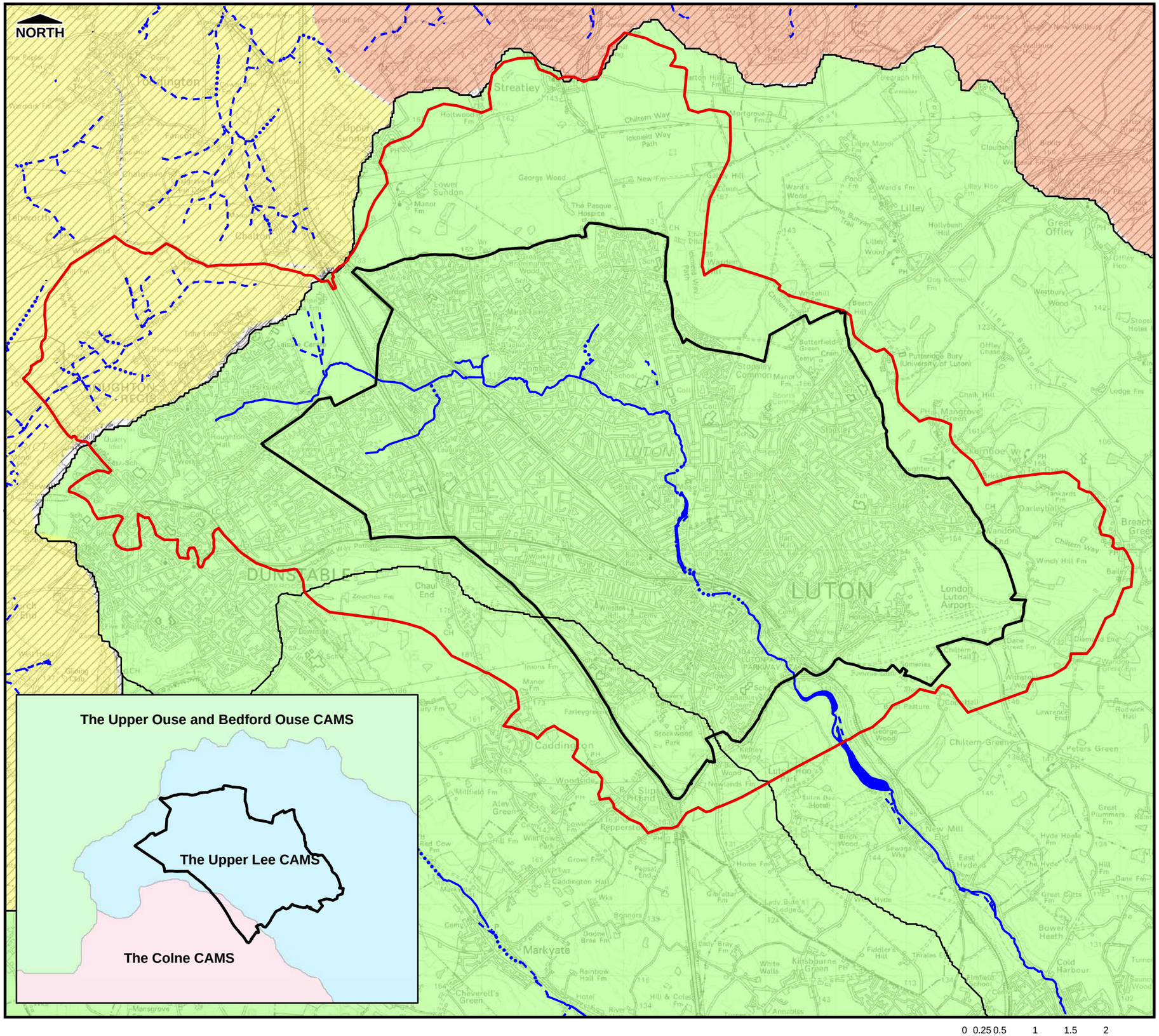
EC2V 7NQ

FIGURE 7-1



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Luton Borough Council Boundary
- Study Area
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Catchment Abstraction Management Strategy Water Availability Status

Surface Water

- No Water Available
- Over Abstracted
- Over Licensed

Ground Water

- No Water Available

Notes

Luton Borough Council

LUTON BOROUGH COUNCIL

Luton Water Cycle Strategy

Scale at A3	Date	Drawn by	Approved by
1:55,000	June 2013	R.EABRY	M.ARTHUR

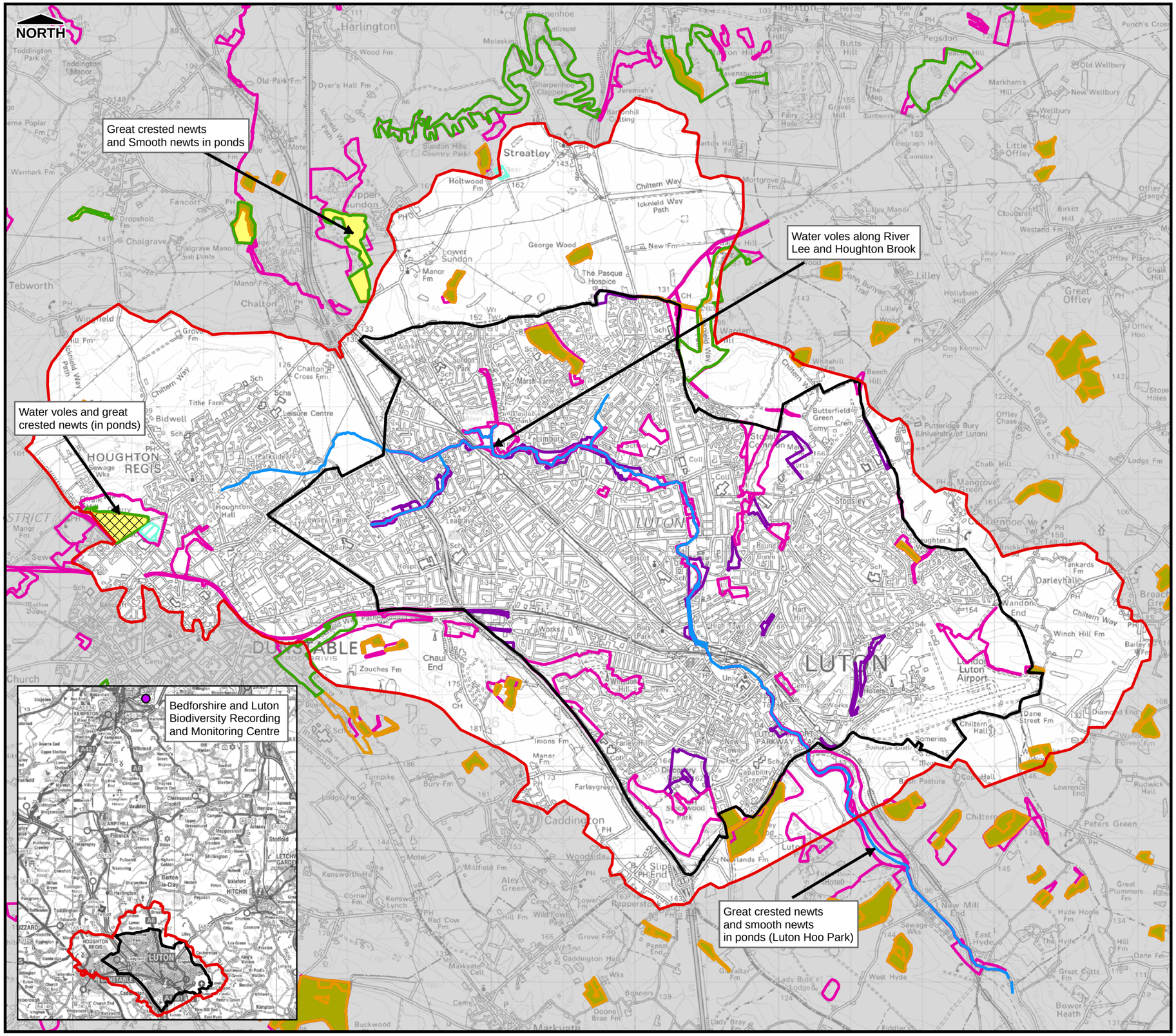
Catchment Abstraction Management Strategy (CAMS)

Consultant

CAPITA | AECOM

Capita
65 Gresham Street
London
EC2V 7NQ

FIGURE 7-2



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Legend

- Study Area
- Luton Borough Council Boundary
- Main River
- Water Bodies

Sites of Nature Conservation Importance

- National
- Local

Wildlife Sites

- County
- District

BAP Habitats

- Reedbed
- Ancient Woodland
- Fens

Notes

Luton Borough Council

LUTON BOROUGH COUNCIL

Luton Water Cycle Strategy

Scale at A3	Date	Drawn by	Approved by
1:55,000	June 2013	R.EABRY	M.ARTHUR

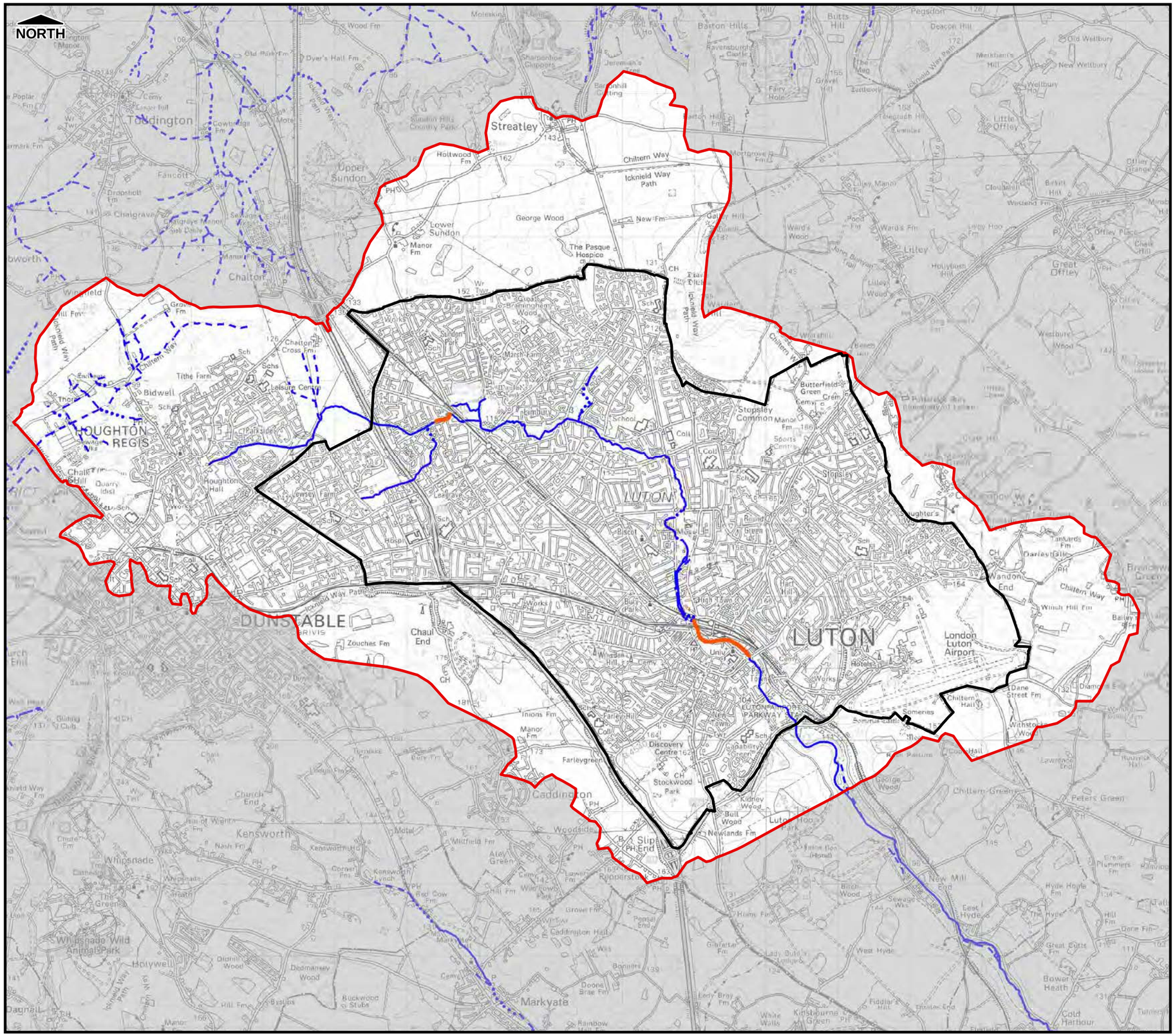
Ecology

Consultant

CAPITA | AECOM

Capita
65 Gresham Street
London
EC2V 7NQ

FIGURE 8-1



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Luton Borough Council Boundary
- Study Area
- Vulnerable Watercourses
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Notes

Luton Borough Council

LUTON BOROUGH COUNCIL

Strategic Flood Risk Assessment Level 1

Scale at A3	Date	Drawn by	Approved by
1:55,000	19/10/2012	R.EABRY	M.ARTHUR

Development Constraints Map/ Vulnerable Watercourses

Consultant

CAPITA SYMONDS
Flood Risk Management

Capita Symonds
Level Seven,
52 Grosvenor Gardens,
Belgravia,
London
SW1W 0AU

FIGURE 13

Filepath: G:\environment\ZWETCS060431_Luton_SFRA_WCS_Update\GIS\ARCmxds\SWMP_Luton_WCS_Phase1_Template.mxd

Appendix C Water Neutrality

Water Neutrality is defined in Chapter 6. This appendix provides supplementary information and guidance to the processes followed.

Twin-Track Approach

Attainment of water neutrality requires a 'twin track' approach whereby water demand in new development is minimised as far as possible, whilst at the same time taking measures to reduce water use in existing development, such as retrofitting of water efficient devices on existing homes and business.

In order to reduce water consumption and manage demand for the limited water resources within the Borough, a number of measures and devices are available[60], including:

- cistern displacement devices;
- flow regulation;
- greywater recycling;
- low or variable flush replacement toilets;
- low flow showers;
- metering;
- point of use water heaters;
- pressure control;
- rainwater harvesting;
- variable tariffs;
- low flows taps;
- water audits;
- water butts;
- water efficient garden irrigation; and
- water efficiency promotion and education.

The varying costs and space and design constraints of the above mean that they can be divided into two categories, measures that should be installed for new developments and those which can be retrofitted into existing properties. For example, due to economies of scale, to install a rainwater harvesting system is more cost effective when carried out on a large scale and it is therefore often incorporated into new build schools, hotels or other similar buildings. Rainwater harvesting is less well advanced as part of domestic new builds, as the payback periods are longer for smaller systems and there are maintenance

[60] Source: Water Efficiency in the South East of England, Environment Agency, April 2007.

issues. To retrofit a rainwater harvesting system can have very high installation costs, which reduces the feasibility of it.

However, there are a number of the measures listed above that can be easily and cheaply installed into existing properties, particularly if part of a large campaign targeted at a number of properties. Examples of these include the fitting of dual-flush toilets and low flow showers heads to social housing stock, as was successfully carried out in Preston by Reigate and Banstead Council in conjunction with Sutton and East Surrey Water and Waterwise[61].

The Pathway Concept

The term 'pathway' is used here as it is acknowledged that, to achieve any level of neutrality, a series of steps are required in order to go beyond the minimum starting point for water efficiency which is currently mandatory for new development under current and planned national planning policy and legislation.

There is no statutory requirements for new housing to have a low water use specification as previous government proposals to make different levels compulsory have been postponed pending government review. For non-domestic development, there is no statutory requirement to have a sustainability rating with the Building Research Establishment Environmental Assessment Method (BREEAM), only being mandatory where specified by a public body in England such as:

- Local Authorities incorporating environmental standards as part of supplementary planning guidance;
- Department of Health for new healthcare buildings and refurbishments;
- Department for Education for all projects valued at over £500K (primary schools) and £2million (secondary schools);
- English Partnerships (now incorporated into the Homes and Communities Agency) for all new developments involving their land; and
- Office of Government Commerce for all new buildings;

Therefore, other than potential local policies delivered through the Local Plan, the only water efficiency requirements for new development are through the Building Regulations[62] where new homes must be built to specification to restrict water use to 125l/h/d. However, the key aim of the Localism Act is to decentralise power away from central government towards local authorities and the communities they serve. It therefore creates a stronger driver for local authorities such as Luton to propose local policy to address specific local concerns. New local level policy is therefore key to delivering aspirations such as water neutrality and the Localism Act provides the legislative mechanism to achieve this in Luton.

In addition to the steps required in new local policy, the use of a pathway to describe the process of achieving water neutrality is also relevant to the other elements required to deliver it, as it describes the additional steps required beyond 'business as usual' that both developers and stakeholders with a role (or interest) in delivering water neutrality would need to take, for example:

- the steps required to deliver higher water efficiency levels on the ground (for the developers themselves); and
- The partnership initiative that would be required beyond that normally undertaken by local authorities and water companies in order to minimise existing water use from the current housing and business stock.

[61] Preston Water Efficiency Report, Waterwise, March 2009, www.waterwise.org.uk

[62] Part G of the Building Regulations

Therefore, the pathway to neutrality described in this section of the WCS requires a series of steps covering:

- technological inputs in terms of physically delivering water efficiency measures on the ground;
- local planning policies which go beyond national guidance; and
- partnership initiatives and partnership working.

The following sections outline the types of water efficiency measures which have been considered in developing the technological pathway for the water neutrality target scenarios.

Improving Efficiency in Existing Development

Metering

The installation of water meters in existing housing stock has the potential to generate significant water use reductions because it gives customers a financial incentive to reduce their water consumption. Being on a meter also encourages the installation and use of other water saving products, by introducing a financial incentive and introducing a price signal against which the payback time of new water efficiency measures can be assessed. Metering typically results in a 5-10 per cent reduction from unmetered supply, which equates to water savings of approximately 12.41l/h/d or 33.5l per household per day, assuming an occupancy rate of 2.7[63] for existing properties.

In 2009, DEFRA instructed Anna Walker (the Chair of the Office of Rail Regulation) to carry out an independent review of charging for household water and sewerage services (the Walker Review)[64]. The typical savings in water bills of metered and unmetered households were compared by the Walker review, which gives an indication of the levels of water saving that can be expected (see Table C-1).

TABLE C-1: CHANGE IN TYPICAL METERED AND UNMETERED HOUSEHOLD BILLS

2009-10 Metered	2009-10 Unmetered	2014-15 Metered	2014-15 Unmetered	% change Metered	% change Unmetered
348	470	336	533	-3	13

Low or Variable Flush Toilets

Toilets use about 30 per cent of the total water used in a household[65]. An old style single flush toilet can use up to 13 litres of water in one flush. New, more water-efficient dual-flush toilets can use as little as 2.6 litres[66] per flush. A study carried out in 2000 by Southern Water and the Environment Agency[67] on 33 domestic properties in Sussex showed that the average dual flush saving observed during the trial was 27 per cent, equivalent to a volumetric saving of around 2.6 litres per flush. The study suggested that replacing existing toilets with low or variable flush alternatives could reduce the volume of water used for toilet flushing by approximately 27 per cent on average.

[63] 2.7 is used for existing properties and new properties. This figure was agreed with LBC prior to the assessment.

[64] Independent Walker Review of Charging and Metering for Water and Sewerage services, DEFRA, 2009, http://www.defra.gov.uk/environment/quality/water/industry/walkerreview/

[65] http://www.waterwise.org.uk/reducing_water_wastage_in_the_uk/house_and_garden/toilet_flushing.html

[66] http://www.lecico.co.uk/

[67] The Water Efficiency of Retrofit Dual Flush Toilets, Southern Water/Environment Agency, December 2000

Cistern Displacement Devices

These are simple devices which are placed in the toilet cistern by the user, which displace water and therefore reduce the volume that is used with each flush. These can be easily installed by householders and are very cheap to produce and supply. Water companies and environmental organisations often provide these for free.

Depending on the type of device used (which can vary from a custom made device, such bag filled with material that expands on contact with water, to a household brick) the water savings can be up to 3 litres per flush.

Low Flow Taps and Showers

Flow reducing aerating taps and shower heads restrict the flow of water without reducing water pressure. Thames Water estimates that an aerating shower head can cut water use by 60 per cent with no loss of performance[68].

Pressure Control

Reducing pressure within the water supply network can be an effective method of reducing the volume of water supplied to customers. However, many modern appliances, such as Combi boilers, point of use water heaters and electric showers require a minimum water pressure to function. Careful monitoring of pressure is therefore required to ensure that a minimum water pressure is maintained. For areas which already experience low pressure (such as those areas with properties that are included on a water company's DG2 Register), this is not suitable. Limited data is available on the water savings that can be achieved from this method.

Variable tariffs

Variable tariffs can provide different incentives to customers and distribute a water company's costs across customers in different ways.

The Walker review assessed variable tariffs for water, including:

- a rising block tariff;
- a declining block tariff;
- a seasonal tariff; and
- a time of day tariff.

A rising block tariff increases charges for each subsequent block of water used. This can raise the price of water to very high levels for customers whose water consumption is high, which gives a financial incentive to not to consume additional water (for discretionary use, for example) while still giving people access to low price water for essential use.

A declining block tariff decreases charges for each subsequent block of water used. This reflects the fact that the initial costs of supply are high, while additional supply has a marginal additional cost. This is designed to reduce bills for very high users and although it weakens incentives for them to reduce discretionary water use, in commercial tariffs it can reflect the economies of scale from bulk supplies.

A seasonal tariff reflects the additional costs of summer water supply and the fact that fixed costs are driven largely by the peak demand placed on the system, which is likely to be in the summer.

[68] http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/9047.htm

Time-of-day tariffs have a variable cost per unit supply according to the time of the day when the water is used; this requires smart meters. This type of charging reflects the cost of water supply and may reduce an individual household's bill; however, it may not reduce overall water use for a customer.

Water Efficient Appliances

Washing machines and dishwashers have become much more water efficient over the past twenty years. An old washing machine may use up to 150 litres per cycle, whereas modern, efficient machines may use as little as 35 litres per cycle. An old dishwasher could use up to 50 litres per cycle, whereas modern models can use as little as 10 litres. However, this is partially offset by the increased frequency with which these are now used. It has been estimated[69] that dishwashers, together with the kitchen tap, account for about 8-14 per cent of water used in the home.

The Water Efficient Product Labelling Scheme provides information on the water efficiency of a product (such as a washing machine) and allows the consumer to compare products and select the most efficient product. The water savings from installation of water efficient appliances vary depending on the type of machine used.

Non-Domestic Properties

There is also the potential for considerable water savings in non-domestic properties. Depending on the nature of a business, water consumption may be high, for example food processing businesses. Even in businesses where water use is not high, such as B1 Business or B8 Storage and Distribution, there is still the potential for water savings using the retrofitting measures listed above. Water audits are useful methods of identifying potential savings and implementation of measures and installation of water saving devices could be funded by the asset owner; this could be justified by significant financial savings which can be achieved through implementation of water efficient measures. Non-domestic buildings such as warehouses and large scale commercial (e.g. supermarkets) property have significant scope for rainwater harvesting on large roof areas.

Water Efficiency in New Development

The use of efficient fixtures and fittings as described above also apply to the specification of water use in the building of new homes. The simplest way of demonstrating the reductions that use of efficient fixtures and fitting has in new builds is to consider what is required in terms of installation of the fixtures and fittings at different ranges of specification to ensure attainment of water use requirements under the Building Regulations or the optional requirement. The Cambridge WCS[70] gave a summary of water use savings that can be achieved by the use of efficient fixtures and fittings, as shown below in Table C-2.

TABLE C-2: SUMMARY OF WATER SAVINGS BORNE BY WATER EFFICIENCY FIXTURES AND FITTINGS

Component	150 l/h/d Standard Home	130 l/h/d	120 l/h/d CSH Level 1/2	115 l/h/d	105 l/h/d CSH Level 3/4	80 l/h/d CSH Level 5/6
Toilet flushing	28.8	19.2b	19.2 b	16.8d	16.8 d	8.4 + 8.4 f
Taps	42.3 a	42.3 a	31.8 a	31.8 a	24.9 a	18 a
Shower	30	24	24	22	18	18
Bath	28.8	25.6c	25.6 c	25.6 c	25.6 c	22.4 e

[69] Water Efficiency Retrofitting: A Best Practice Guide, Waterwise, 2009, www.waterwise.org.uk

[70] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2010

Washing machine	16.7	15.3	15.3	15.3	15.3	7.65 + 7.65 f
Dishwasher	3.9	3.6	3.6	3.6	3.6	3.6
Recycled water	-	-	-	-	-	-16.1
Total per head	150.5	130	119.5	115.1	104.2	78
Outdoor	11.5	11.5	11.5	11.5	11.5	11.5
TOTAL PER HOUSEHOLD	**366.68**	**319.3**	**293.52**	**284.14**	**257.41**	**195.58**

-
- a Combines kitchen sink and wash hand basin
- b 6/3 litre dual-flush toilet (f) recycled water
- c 160 litre bath filled to 40% capacity, frequency of use 0.4/day
- d 4.5/3 litre dual flush toilet
- e 120 litre bath
- f rainwater/greywater harvesting
- g Assumed garden use

Table C-2 highlights that in order to achieve water use around 80 l/h/d, water re-use technology (rainwater harvesting and/or greywater recycling) needs to be incorporated into the development.

In using the BRE Water Demand Calculator[71], the experience of AECOM BREEAM/CHS assessors is that it is theoretically possible to get close to 80l/h/d through the use of fixture and fittings, but that this requires extremely high specification efficiency devices which are unlikely to be acceptable to the user and will either affect the saleability of new homes or result in the immediate replacement of the fixtures and fittings upon habitation. This includes baths at capacity below 120 litres, and shower heads with aeration which reduces the pressure sensation of the user. For this reason, it is not considered practical to suggest that 80l/h/d can be reached without some form of water recycling.

Rainwater Harvesting

Rainwater harvesting (RWH) is the capture and storage of rain water that lands on the roof of a property. This can have the dual advantage of both reducing the volume of water leaving a site, thereby reducing surface water management requirements and potential flooding issues, and be a direct source of water, thereby reducing the amount of water that needs to be supplied to a property from the mains water system.

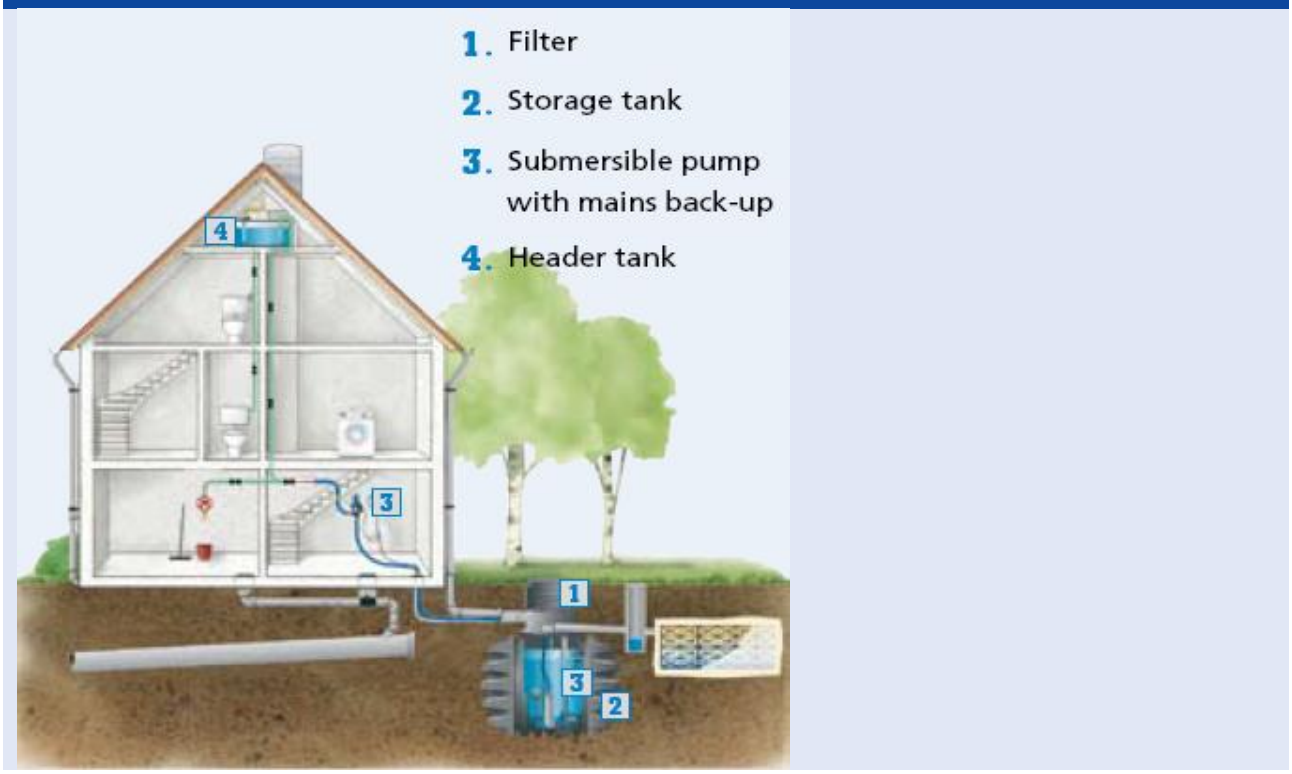
RWH systems typically consist of a collection area (usually a rooftop), a method of conveying the water to the storage tank (gutters, down spouts and pipes), a filtration and treatment system, a storage tank and a method of conveying the water from the storage container to the taps (pipes with pumped or gravity flow). A treatment system may be included, depending on the rainwater quality desired and the source. Figure C-1 below gives a diagrammatic representation of a typical domestic system[72].

[71] http://www.thewatercalculator.org.uk/faq.asp

[72] Source: Aquality Intelligent Water management, www.aqua-lity.co.uk

The level to which the rainwater is treated depends on the source of the rainwater and the purpose for which it has been collected. Rainwater is usually first filtered to remove larger debris such as leaves and grit. A second stage may also be incorporated into the holding tank; some systems contain biological treatment within the holding tank, or flow calming devices on the inlet and outlets will that allow heavier particles to sink to the bottom, with lighter debris and oils floating to the surface of the water. A floating extraction system can then allow the clean rainwater to be extracted from between these two layers[73].

FIGURE C-1: A TYPICAL DOMESTIC RAINWATER HARVESTING SYSTEM



A recent sustainable water management strategy carried out for a proposed EcoTown development at Northstowe[74], approximately 10 km to the north west of Cambridge, calculated the size of rainwater storage that may be required for different occupant numbers, as shown below in Table C-3.

[73] Aquality Rainwater Harvesting brochure, 2008

[74] Sustainable water management strategy for Northstowe, WSP, December 2007

TABLE C-3: RWH SYSTEMS SIZING					
Number of occupants	**Total water consumption**	**Roof area (m^2)**	**Required storage tank (m^3)**	**Potable water saving per head (l/d)**	**Water consumption with RWH (l/h/d)**
1	110	13	0.44	15.4	94.6
1	110	10	0.44	12.1	97.9
1	110	25	0.88	30.8	79.2
1	110	50	1.32	57.2	52.8
2	220	25	0.88	15.4	94.6
2	220	50	1.76	30.8	79.2
3	330	25	1.32	9.9	100.1
3	330	50	1.32	19.8	90.2
4	440	25	1.76	7.7	102.3
4	440	50	1.76	15.4	94.6

A family of four, with an assumed roof area of $50m^3$, could therefore expect to save 61.6 litres per day if a RWH system was installed.

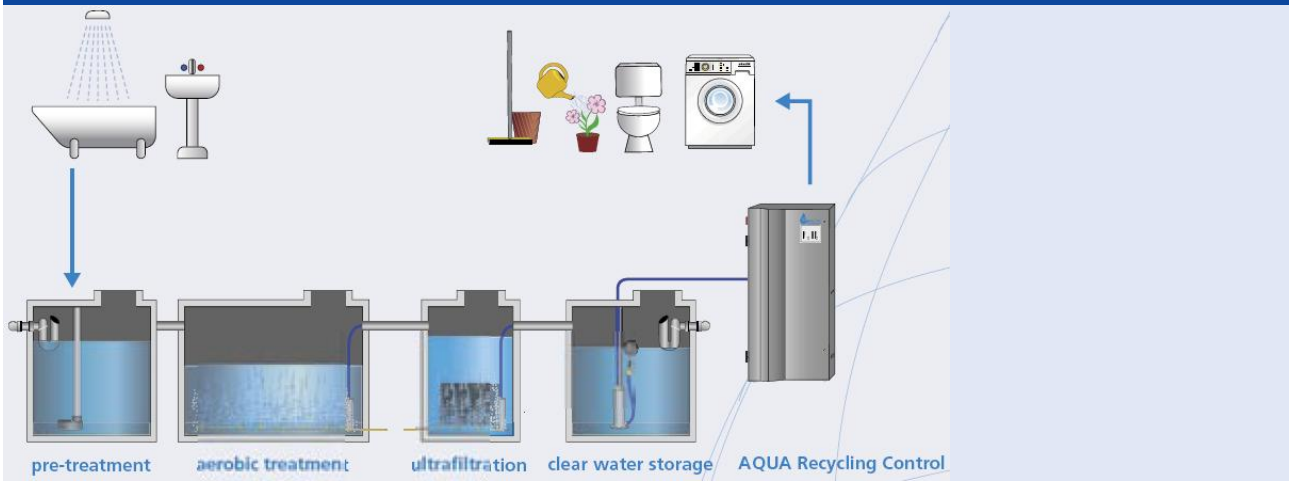
Greywater Recycling

Greywater recycling (GWR) is the treatment and re-use of wastewater from shower, bath and sinks for use again within a property where potable quality water is not essential e.g. toilet flushing. Recycled greywater is not suitable for human consumption or for irrigating plants or crops that are intended for human consumption. The source of greywater should be selected by available volumes and pollution levels, which often rules out the use of kitchen and clothes washing waste water as these tend to be most highly polluted. However, in larger system virtually all non-toilet sources can be used, subject to appropriate treatment.

The storage volumes required for GWR are usually smaller than those required for rainwater harvesting as the supply of greywater is more reliable than rainfall. In domestic situations, greywater production often exceeds demand and a correctly designed system can therefore cope with high demand application and irregular use, such as garden irrigation. Figure C-2 below gives a diagrammatic representation of a typical domestic system[75].

[75] Source: Aquality Intelligent Water management, www.aqua-lity.co.uk

FIGURE C-2: A TYPICAL DOMESTIC GREYWATER RECYCLING SYSTEM



Combined rainwater harvesting and greywater recycling systems can be particularly effective, with the use of rainwater supplementing greywater flows at peak demand times (e.g. morning and evenings).

The Northstowe sustainable water management strategy calculated the volumes of water that could be made available from the use GWR. These were assessed against water demand calculated using the BRE Water Demand Calculator[76].

Table C-4 demonstrates the water savings that can be achieved by GWR. If the toilet and washing machine are connected to the GWR system a saving of 37 litres per person per day can be achieved.

TABLE C-4: POTENTIAL WATER SAVINGS FROM GWR

Appliance	Demand with Efficiencies (l/h/day)	Potential Source	Greywater Required (l/h/day)	Out As	Greywater available (80% efficiency) (l/h/day)	Consumptions with GWR (l/h/day)
Toilet	15	Grey	15	Sewage	0	0
Wash hand basin	9	Potable	0	Grey	7	9
Shower	23	Potable	0	Grey	18	23
Bath	15	Potable	0	Grey	12	15
Kitchen Sink	21	Potable	0	Sewage	0	21
Washing Machine	17	Grey	17	Sewage	0	0
Dishwasher	4	Potable	0	Sewage	0	4
TOTAL	103		31		37	72

The treatment requirements of the GWR system will vary, as water which is to be used for flushing the toilet does not need to be treated to the same standard as that which is to be used for the washing machine. The source of the greywater also greatly affects the type of treatment required. Greywater from

[76] http://www.thewatercalculator.org.uk/faq.asp

a washing machine may contain suspended solids, organic matter, oils and grease, detergents (including nitrates and phosphates) and bleach. Greywater from a dishwasher could have a similar composition, although the proportion of fats, oils and grease is likely to be higher; similarly for wastewater from a kitchen sink. Wastewater from a bath or shower will contain suspended solids, organic matter (hair and skin), soap and detergents. All wastewater will contain bacteria, although the risk of infection from this is considered to be low[77].Treatment systems for GWR are usually of the following four types:

- basic (e.g. coarse filtration and disinfection);
- chemical (e.g. flocculation);
- physical (e.g. sand filters or membrane filtration and reverse osmosis); and
- biological (e.g. aerated filters or membrane bioreactors).

Table C-5 below gives further detail on the measures required in new builds and from retrofitting, including assumptions on the predicted uptake of retrofitting from the existing housing and commercial building use.

[77] Centre for the Built Environment, www.cbe.org.uk

TABLE C-5: WATER NEUTRALITY SCENARIOS – SPECIFIC REQUIREMENTS FOR EACH SCENARIO

WN Scenario	New development requirement				Retrofitting existing development	
	New development Water use target (l/h/d)	Relevant CSH target	Water Efficient Fixtures and Fittings	Water Recycling technology	Metering Penetration assumption (a)	Water Efficient Fixtures and Fittings (b)
Business as usual	125	Building Regs only	- 3-6 litre dual flush toilet; - Low aeration taps; - 160 litre capacity bath; - High efficiency washing machine	None	90%	None
Low	120	Level 1/2	- 3-6 litre dual flush toilet; - Low spec aeration taps; - 160 litre capacity bath; - Low spec low flow shower head - High efficiency dishwasher - High efficiency washing machine	None	100%	- 3-6 litre dual flush toilet or cistern device fitted; - 10% take up across the Borough
Medium	105	Level 3/4	- 3-4.5 litre dual flush toilet; - Medium spec aeration taps; - High spec low flow shower head; - 160 litre capacity bath; - High spec low flow shower head - High efficiency dishwasher - High efficiency washing machine	None	100%	- 3-4.5 litre dual flush toilet or cistern device fitted; - medium spec aerated taps fitted - 20% take up across the Borough
High	78	Level 5/6	- 3-4.5litre dual flush toilet; - High spec aeration taps;	Rainwater harvesting	100%	- 3-4.5 litre dual flush toilet or cistern device fitted; - high spec aerated taps fitted

TABLE C-5: WATER NEUTRALITY SCENARIOS – SPECIFIC REQUIREMENTS FOR EACH SCENARIO

WN Scenario	New development requirement				Retrofitting existing development	
	New development Water use target (l/h/d)	Relevant CSH target	Water Efficient Fixtures and Fittings	Water Recycling technology	Metering Penetration assumption (a)	Water Efficient Fixtures and Fittings (b)
			- High spec low flow shower head; - 120 litre capacity bath; - High spec low flow shower head - High efficiency dishwasher - High efficiency washing machine			- high spec low flow shower head fitted - 25% take up across the Borough
Very High	62	Level 5/6	- 3-4.5 litre dual flush toilet; - High spec aeration taps; - High spec low flow shower head; - 120 litre capacity bath; - High spec low flow shower head - High efficiency dishwasher - High efficiency washing machine	Rainwater harvesting and Greywater recycling	100%	- 3-4.5 litre dual flush toilet or cistern device fitted; - high spec aerated taps fitted - high spec low flow shower head fitted - 35% take up across the Borough

Financial Cost Considerations for Water Neutrality scenarios

The financial cost of delivering the technological requirements of each neutrality scenario have been calculated from available research and published documents.

New Build Costs

Costs for water efficiency in new property have been provided based on homes achieving different code levels under the CSH based on the cost analysis undertaken by DCLG[78] and as set out in Table C-6.

TABLE C-6: CSH SPECIFICATIONS AND COSTS

Code Level	Estimated water consumption (l/h/d)	Specification	Cost	
			Additional Cost (£)	Cumulative Cost (£)
1 and 2	120	2 x 6/4 litre flush toilets 4 x taps with flow regulators (2.5 l/m) 1 x shower 6 litres/min 1 x standard bath (90 litres per use) 1 x standard washing machine* 1 x standard dishwasher*	£0	£0
3 and 4	105	As Level 1 and 2, except: 2x4/2.5 litre flush toilets 1x smaller shaped bath	£125	£125
5 and 6	80	Houses As Level 3 and 4, except: Rainwater harvesting 2 x 6/4 litre flush toilets	£2,520	£2,645
		Apartments As Level 3 and 4, except: Rainwater harvesting 2 x 6/4 litre flush toilets	£680	£805
Notes:	*Additional cost of washing machine and dishwasher is assumed to be zero as these fittings are 'standard' industry performance. Therefore, if they are typically installed by house builder there would be no additional cost over their current specifications.			

An additional cost was required for the 'very high' neutrality scenario that included greywater recycling as well as rainwater harvesting and this is detailed in the following section.

Water Recycling

Research into the financial costs of installing and operating GWR systems gives a range of values, as shown in Table C-7.

TABLE C-7: COSTS OF GWR SYSTEMS

Cost	Cost	Comments
Installation cost	£1,750	Cost of reaching Code Level 5/6 for water consumption in a 2-bed flat[79]
	£2,000	For a single dwelling[80]
	£800	Cost per house for a communal system[81]
	£2,650	Cost of reaching Code Level 3/4 for water consumption in a 3-bed semi-detached house[82]

[78] DCLG (2008) Cost Analysis of the Code for Sustainable Homes

Operation of GWR	£30 per annum[83]	
Replacement costs	£3,000 to replace[23]	It is assumed a replacement system will be required every 25 years

There is less research and evidence relating to the cost of community scale systems compared to individual household systems, but it is thought that economies of scale will mean than larger scale systems will be cheaper to install than those for individual properties. As shown above, the Cost review of the Code for Sustainable Homes indicated that the cost of installing a GWR system in flats is less than the cost for a semi-detached house. Similarly, the Water Efficient Buildings website estimates the cost of installing a GWR system to be £2,000 for a single dwelling and £800 per property for a share of a communal system.

As it is not possible to determine how many of the outstanding housing developments in Luton will be of a size large enough to consider communal recycling facilities, an approximation has been made of an average per house cost (£1,400) using the cost of a single dwelling (at £2,000) and cost for communal (at £800). This has been used for the assessment of cost for a greywater system in a new property required for the 'very high' neutrality scenario.

Installing a Meter

The cost of installing a water meter has been assumed to be £500 per property[84]. It is assumed that the replacement costs will be the same as the installation costs (£500), and that meters would need to be replaced every 15 years[85].

Retrofitting of Water Efficient Devices

Findings from the Environment Agency report Water Efficiency in the South East of England[86], costs have been used as a guide to potential costs of retrofitting of water efficient fixtures and fittings and are presented in Table C-8 below.

TABLE C-8: WATER SAVING METHODS

Water Saving Method	Approximate Cost per House (£)	Comments/Uncertainty
Variable flush retrofit toilets	£50 - £140	Low cost for 3-6 litre system and high cost for 3-4.5 litre system. Needs incentive to replace old toilets with low flush toilets.
Low flow shower head scheme	£15 - £50	Low cost for low spec shower head; high costs for high spec. Cannot be used with electric, power or low pressure gravity fed systems.
Aerating taps	£10 - £20	Low cost is med spec, high cost is high spec.

Toilet cistern displacement devices are often supplied free of charge by water companies and this is therefore also not considered to be an additional cost.

[79] Code for Sustainable Homes: A Cost Review, Department for Communities and Local Government, 2008
[80] http://www.water-efficient-buildings.org.uk/?page_id=1056
[81] http://www.water-efficient-buildings.org.uk/?page_id=1056
[82] Code for Sustainable Homes: A Cost Review, Communities and Local Government, 2008
[83] Environment Agency Publication - Science Report – SC070010, Greenhouse Gas Emissions of Water Supply and Demand Management Options, 2008
[84] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2010
[85] Environment Agency Publication - Science Report – SC070010: Greenhouse Gas Emissions of Water Supply and Demand Management Options, 2008
[86] Environment Agency (2007) Water Efficiency in the South East of England

Neutrality scenario costs

Using the above information, the financial costs per scenario have been calculated and are included in Table C-9.

TABLE C-9: ESTIMATED COST OF NEUTRALITY SCENARIOS

Neutrality Scenario	Costs Summary		
	Developer	Non developer	Total
Low	-	£4,086,115	£4,086,115
Medium	£2,198,125	£6,166,319	£8,364,444
High (RWH)	£46,512,325	£7,800,765	£54,313,090
Very High (RWH & GWR)	£70,427,925	£9,435,211	£79,863,136

Carbon Cost Considerations

As described in this section, there are sustainability issues to consider when deciding on a policy for promotion of water neutrality. Reaching the very highest levels of efficiency requires the use of recycling technology (either through rainwater harvesting and treatment or greywater recycling) which requires additional energy both embedded in the physical structures required and also in the treatment process required to make the water usable.

Whilst being water efficient is a key consideration of this study, due to the wider vision for sustainable growth, reaching neutrality should not be at the expense of increasing energy use and potential increasing the carbon footprint of development.

It is also important to consider that through using less water, more water efficient homes require less energy to heat water, hence there are energy savings.

In order to give an overview of the likely sustainability of each of the WN scenarios, a 'carbon cost' has been applied to each of the scenarios based on the water efficiency measures proposed for new homes, and the retrofitting of existing.

Methodology

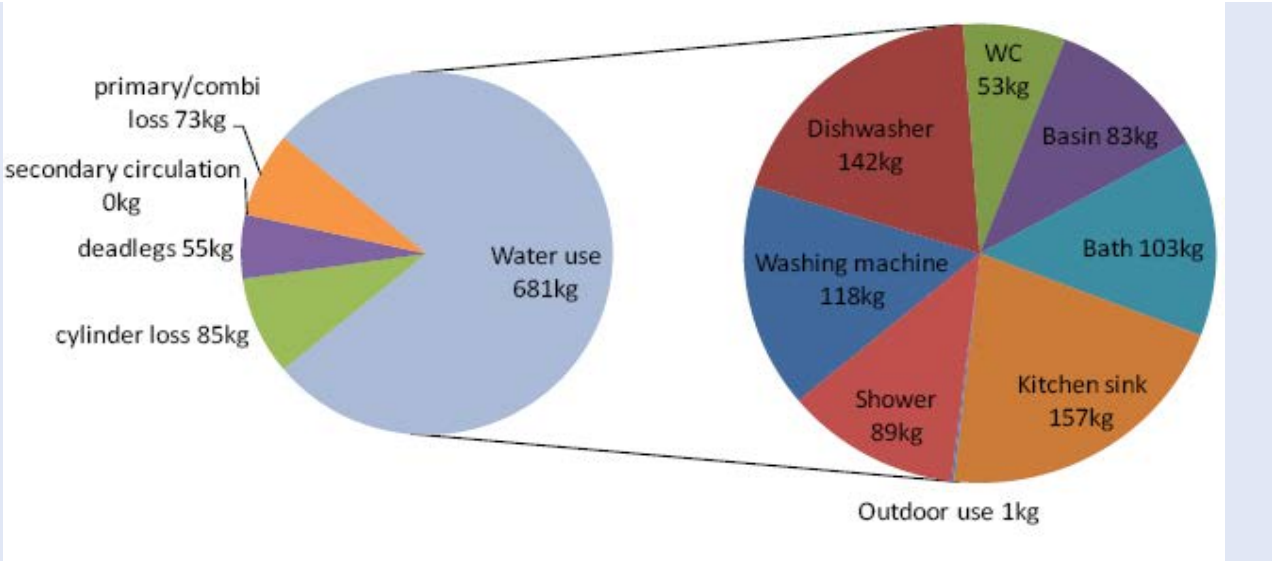
A joint study by the Environment Agency and the Energy Saving Trust[87] assessed the energy and carbon implications of the installation of water saving devices (Table C-10). The report initially calculated a baseline water consumption figure for existing housing stock, using the following assumptions:

[87] Quantifying the energy and carbon effects of water saving, Full technical report, Environment Agency and the Energy Saving Trust, 2009

TABLE C-10: BASELINE ENERGY CONSUMPTION ASSUMPTIONS		
Device	**Volume of water per use (litres)**	**Frequency of use (per person per day)**
Toilet	9.4	4.66
Kitchen Taps	59	Taps taken as volume/day, 40% cold
Basin taps hot	42	Taps taken as volume/day, 30% cold
Bath	70	0.21
Washing machine	50	0.34
Shower	25.7	0.59
Dishwasher	21.3	0.29

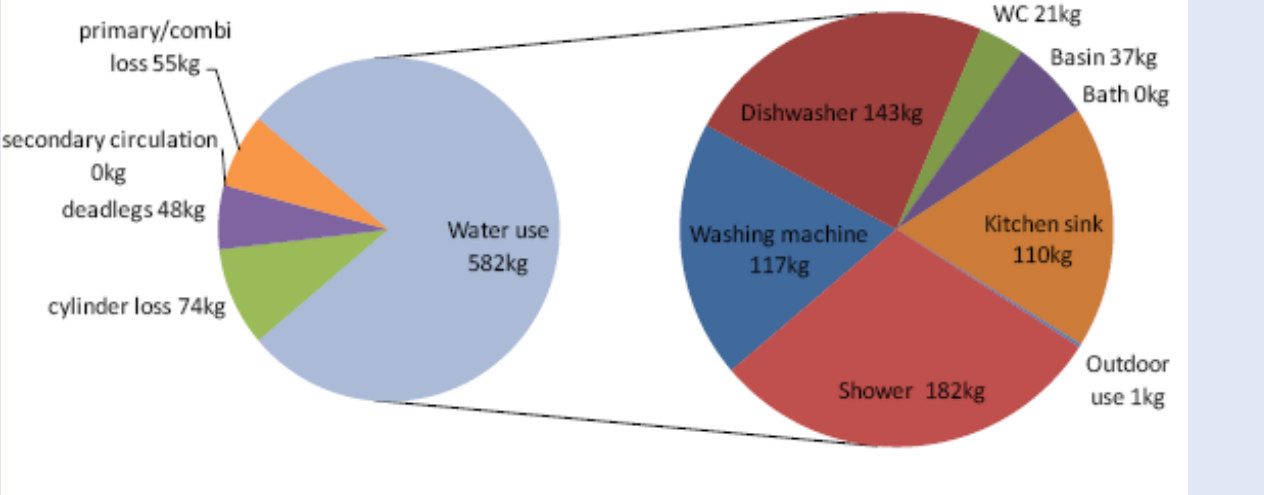
The study then modelled the CO_2 emissions from this 'standard' existing dwelling, as shown below in Figure C-3. Appliances requiring hot water using appliances dominate, but water use for toilet flushing produces 53kg of CO_2 emissions per year (approximately 50 per cent from water company emissions and 50 per cent due to heat loss as cold mains water in the toilet cistern heats to room temperature).

FIGURE C-3: CO_2 EMISSIONS FROM A 'STANDARD' EXISTING DWELLING



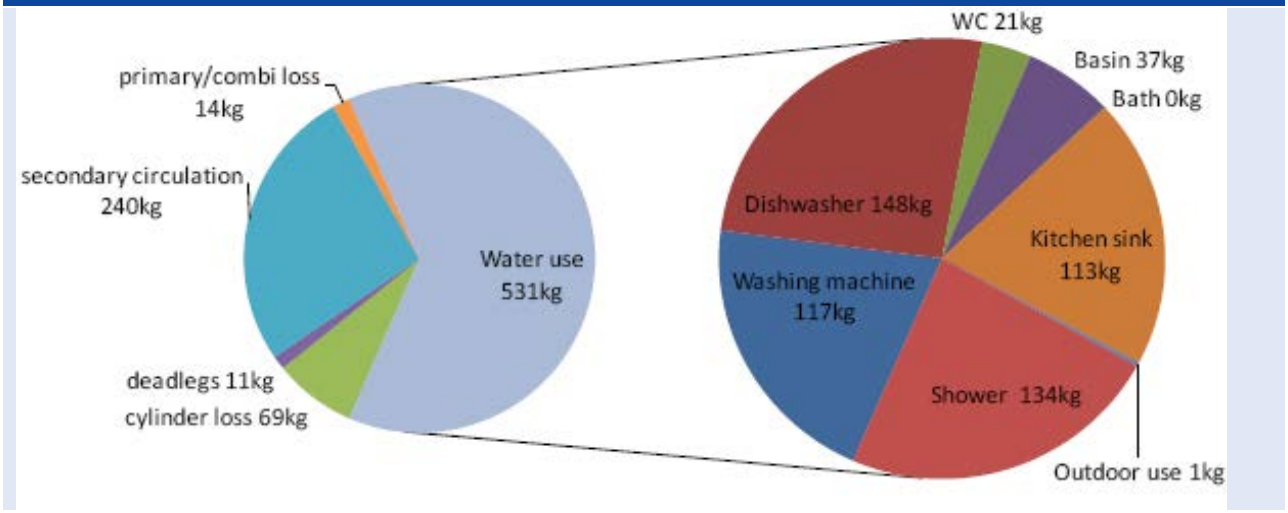
The study then assessed the impacts on this baseline figure of 681 kg CO_2 for water use from a home which has water use compliant with CSH level 3/4 (Figure C-4).

FIGURE C-4: CO_2 EMISSIONS FROM A CSH LEVEL 3/4 DWELLING



The study then assessed the impacts of a home which has water use compliant with CSH level 5/6 (Figure C-5).

FIGURE C-5: CO_2 EMISSIONS FROM A CSH LEVEL 5/6 DWELLING



It can therefore be seen that the carbon cost of achieving Levels 3/4 and 5/6 compares favourably to the baseline scenario of current average water use of 681kg/CO_2. CSH level 3/4 represents a carbon saving of 99 kg/CO_2 and CSH Level 5/6 represents a carbon saving of 150 kg/CO_2.

The energy savings from water efficiency measures within the home would be offset to a certain degree by increased energy demands of RWH or GWR systems, which have been shown to be required to meet CSH Level 5/6. Energy savings for AfW from not treating additional water to potable standard, as with the conventional mains water supply, can be thought of to be simply a transfer of energy consumption away from the AfW to the individual householders. While AfW will benefit from this reduction in energy demand, which will assist with meeting its Carbon Reduction Commitment (CRC) (as laid down in 2007's Energy Reduction White Paper[88]), the expense will be passed to householders.

For households with the GWR/RWH required for CSH Levels 5/6, any financial benefits to householders experienced through a reduction in water bills (for metered properties) will be offset by the increased expense of energy bills for pumping and treating water in GWR and RWH systems.

[88] Meeting the Energy Challenge - A White Paper on Energy, May 2007, Department of Trade and Industry

Appendix D WwTW Capacity Assessment Results

Modelling Assumptions and Input Data

Several key assumptions have been used in the water quality and permit modelling as follows:

- The wastewater generation per new household is based on an assumed Occupancy Rate (OR) of 2.7 people per house and an average consumption of 131 l/h/d (as set out in Section 5.2). The 131 l/h/d figure makes an allowance for commercial use and use in schools and hospitals etc. considered to represent increases in non-domestic use across the study area;

- WwTW current flows were taken as the current permitted dry weather flow (DWF). Future 2031 flows were calculated by adding the volume of additional wastewater generated by new dwellings (using an OR of 2.7, a consumption value of 131l/h/d and allowance for an increase in infiltration) to the current permitted DWF value;

- River flow data for the RQP modelling has been provided by the Environment Agency based on flow gauging data from the Environment Agency gauging station at Luton East Hyde (4641TH) on the River Lea. The mean flow and Q95[89] values were calculated from the raw data;

- Raw water quality data for modelling has been provided by Environment Agency water quality planners. The WFD 'no deterioration' target for East Hyde WwTW is the downstream status, for each water quality element, based on river monitoring data collected between 2009 and 2014. Actual data was used in preference over the published status in the RBMP. The mean value and standard deviation was calculated, using this raw data for BOD, Ammonia and Phosphate for both the upstream (of the WwTW) and downstream (the discharge) inputs.

For the purposes of this study, the limits of conventionally applied treatment processes are considered to be:

- 5 mg/l for BOD;

- 1 mg/l for Ammoniacal-N; and

- 1 mg/l for Phosphate.

Assessment Techniques

Modelling of the quality permits required to meet the two WFD requirements has been undertaken, using RQP 2.5 (River Quality Planning), the Environment Agency's software for calculating permit conditions. The software is a monte-carlo based statistical tool that determines what statistical quality is required from discharges in order to meet defined downstream targets, or to determine the impact of a discharge on downstream water quality compliance statistics.

The first stage of the modelling exercise was to establish the discharge permit standards that would be required to meet 'No Deterioration'; this would be the discharge permit limit that would need to be imposed on TWU at the time the growth causes the flow permit to be exceeded. No deterioration is an absolute requirement of the WFD and any development must not result in a decrease in quality downstream from the current status.

The second stage was to establish the discharge permit standards that would be required to meet future Good Status under the WFD in the downstream waterbody. This assessment is only carried out where the current status is less than Good (i.e. currently Moderate, Poor or Bad). This would be the discharge permit standard that may need to be applied in the future, subject to the assessments of 'technical feasibility' and

[89] Defined as the flow value exceeded 95% of the time i.e. a representation of low flows

'disproportionate cost'. Such assessments would be carried out as part of the formal Periodic Review process overseen by OFWAT in order to confirm that the proposed improvement scheme is acceptable.

Step 1 – 'No Deterioration'

A calculation was undertaken to determine if the receiving watercourse can maintain 'No Deterioration' downstream from the current quality with the proposed growth within limits of conventional treatment technology, and what permit limits would be required. If 'No Deterioration' could be achieved, then a proposed discharge permit standard was calculated which will be needed as soon as the growth causes the WwTW flow permit to be exceeded, see Table D2-1.

Step 2 – Meeting Future 'Good' Status

For WwTW where the current downstream quality of the receiving watercourse *is less than good*, a calculation was undertaken to determine if the receiving watercourse could achieve future 'Good Status' with the proposed growth within limits of conventional treatment technology and what permit limits would be required to achieve this.

The assessment of attainment of future 'Good Status' assumed that other measures will be put in place to ensure 'Good Status' upstream so the modelling assumed upstream water quality is at the mid-point of the 'Good Status' for each element and set the downstream target as the lower boundary of the 'Good Status' for each element.

If 'Good' could be achieved with growth with permits achievable within the limits of conventional treatment, then a proposed discharge permit standard which may be needed in the future has been given in Table D2-2.

TABLE D2-1: 'NO DETERIORATION' ASSESSMENT									
	Easy Hyde WwTW			Dunstable WwTW			Chalton WwTW		
	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate
River Downstream of Discharge									
No Deterioration Target	High	Good	Poor	High	High	Poor	High	High	Poor
Designated Salmonid Fishery?	No			No			No		
River Quality Target (mg/l) (90%ile or AA)	4.0	0.6	1.0	4.0	0.3	1.0	4.0	0.3	1.0
Current Permit									
Current DWF (m^3/day)	33246			12356			12989		
Permit Limits (mg/l) (95%ile or AA)	8	2	-	12	4 (3 mg/l by 2018)	2	12	5 (1 mg/l by 2018)	2
Current effluent quality required (95%ile or AA)	**5.11**	**1.08**	**1.14**	**4.98**	**0.38***	**1.20**	**4.74**	**0.39****	**1.09**
Discharge Quality Required									
Future DWF (m^3/day)	37313			13895			14619		
Effluent Quality Required (95%ile or AA)	**5.08**	**1.06**	**1.13**	**4.98**	**0.38***	**1.18**	**4.72**	**0.39****	**1.08**
Will Growth prevent WFD 'No Deterioration' being achieved?	**No**			**No**			**No**		

TABLE D2-2: EAST HYDE WWTW IMPROVEMENT TO 'GOOD STATUS' ASSESSMENT												
	Easy Hyde WwTW				Dunstable WwTW				Chalton WwTW			
	BOD	Ammonia	Phosphate		BOD	Ammonia	Phosphate		BOD	Ammonia	Phosphate	
River Downstream of Discharge												
Future Status target	High	Good	Good	Moderate	High	High	Good	Moderate	High	High	Good	Moderate
River Quality Target (90%ile or AA)	-	-	0.075	0.185	-	-	0.075	0.185	-	-	0.075	0.185
Current Permit												
Current DWF (m^3/day)	33246				12356				12989			
Permit Limits (95%ile or AA)	-	-	**0.08**	**0.21**	**-**	**-**	**0.08**	**0.21**	**-**	**-**	**0.08**	**0.13**
Discharge Quality Required												
Future DWF (m^3/day)	37313											
Effluent Quality Required (95%ile or AA)	-	-	**0.08**	**0.20**	**-**	**-**	**0.08**	**0.20**	**-**	**-**	**0.08**	**0.19**
Will Growth prevent WFD 'No Deterioration' being achieved?	**No**				**No**				**No**			

Key: Green Value – No change to current permit required, Amber Value – Permit tightening required, but within limits of conventionally applied treatment processes, Red Value – Not achievable within limits of conventionally applied treatment processes

* Note provided by the Environment Agency: Calculated ammonia permit limit is below the limit of conventional technology due to the lack of dilution in the Ouzel Brook. Past experience of over performance at this WwTW suggests that setting the ammonia permit limit at 1mg/l will be enough to ensure no deterioration from the 'High' status for ammonia, as actual effluent quality is likely to be significantly better than 1mg/l.

** Note provided by the Environment Agency: Proposed ammonia permit limit is beyond that achievable by conventional treatment. WFD Sample point is several kilometres downstream, so setting permit to achieve High status immediately downstream is over-protective as natural purification will readily occur before sample point. Recommend setting the ammonia permit limit at the current effluent quality.

Appendix E Detailed Summary of Ecological Risks and Opportunities

	Feature habitat & associated species	Distribution	Protected sites: Site name	Protected sites: Importance: International, European, National, Local *	Related Policies & Legislation	Sensitivity to WCS hazards	Surface water flow and flood risk management	Waste water discharge	Development footprint (direct)	Network Infrastructure	Risk	Opportunities
Context							Each development area needs to prevent more water leaving site than green runoff rates. Increased production of wastewater from new development can result in increased discharge from wastewater treatment works (WwTW) leading to increased base flow of receiving watercourses. This situation can lead to increased flood risk downstream of the WwTWs because the receiving watercourses have a decreased capacity to retain additional surface water from flood events.	Even with increased development and subsequent increase in volume of treated water, the WwTWs have the capacity to discharge within their consented water quality standards. This should therefore mean there is no decrease in current water quality. However, the following discharge consents will need to be revised in the future because the quantity of discharge is likely to increase: • Dunstable WwTW – after 2031 • Chalton WwTW – after 2031 • Stanbridgeford WwTW - before end 2010 Additionally, tightening of the discharge consents is likely to be required beyond the year 2015 in order to meet the future water quality requirements of the Water Framework Directive. In some cases these indicative water quality consents (as outlined in Section 6), in particular those for phosphate levels, are beyond current best available technology (Chapter 6.5).	The area covered by each development footprint in relation to ecological features can be seen on Figure 8-1.	Upgrades to the water supply network and additional infrastructure will be needed to meet the demands of future developments across the study area. Schematic layout of the proposed network infrastructure is shown in Figure8-1.		
Standing open water - lakes & margins	Standing open water - lakes & margins habitat	Luton Hoo Lakes	Houghton Regis Chalk Pits CWS, King and Barbers Wood and Heaths CWS, Stockgrove Country Park CWS, Tiddenfoot Park CWS, Sundon Chalk Quarry SSSI, Sundon Chalk Pits CWS, Houghton Regis Marl Lakes SSSI, Luton Hoo Park CWS, Leagrave Common CWS, Rushmere Park CWS , Rackley Hill Pit CWS, East Hyde Riverside CWS, River Lea CWS, Wigmore Park CWS, Riverside Walk CWS	N	UK BAP habitat; LBAP habitat	**Change in hydrology e.g. reduction in ground water & surface levels from abstraction activities.**	Enhancement of Lake from SUDS at Development F for Houghton Regis Marl Lake SSSI Development L - potential to tie into Luton Hoo Lakes Enhancement of existing habitats and habitat creation for flood risk management for all dev areas where ground conditions suitable. Habitats include lakes, ponds, ditches, reedbeds and wet woodland. Potential for wetland habitat creation as part of the flood storage proposals for the River Lee and Ouzel Brook.		Development C and D - lakes within development footprint. Development F - lake within development footprint. Possible loss of terrestrial and marginal habitat. Lakes within Houghton Regis Marl Lakes SSSI. Water voles within development footprint within SSSI/CWS Development G - lakes within development footprint Development I - lakes within footprint of development Development L - lakes within footprint of development. Wigmore Park CWS, within the southern corner of development L has pools and skylarks.	Development F - lake within development footprint. Possible loss of terrestrial and marginal habitat. Lakes within Houghton Regis Marl Lakes SSSI. Water voles within development footprint within SSSI/CWS Development L - Wigmore Park CWS, within the southern corner of development L has pools	<u>Development footprint</u> Loss of marginal and terrestrial habitat, and associated impact on species present. <u>Infrastructure Network</u> Loss of marginal and terrestrial habitat, and associated impact on species present.	<u>Surface flow and flood risk management</u> Enhancement of Lake from SUDS at Development F for Houghton Regis Marl Lake SSSI Development L - potential to tie into Luton Hoo Lakes Potential for wetland habitat creation as part of the flood storage proposals for the River Lee and Ouzel Brook. <u>Development footprint</u> Development F - Opportunity for habitat enhancement Development C and D and G and I - maintain and enhance existing lakes for amphibians, flora, invertebrates etc. Development 2 - adjacent to Sundon Chalk Pits CWS and Sundon Chalk Quarry SSSI so opportunity to create habitats and connect to habitats that already exist in designated sites such as fen, lakes, ponds mire and bog. Would also increase range of amphibians in area such as great crested newts and smooth newts.
	Fish	Luton Hoo Lakes (crucian carp, bullhead, carp, three spined stickleback, gudgeon, orfe, perch, minnow, roach, rudd, tench)	Houghton Regis Chalk Pits CWS, King and Barbers Wood and Heaths CWS, Stockgrove Country Park CWS, Tiddenfoot Park CWS, Rackley Hill Pit CWS	I	Habitats Directive	**Decrease in water quality e.g. link between river & lake during a flood event.**						
	Invertebrates	Scarce blue-tailed damselfly:one site in East Anglia (Sundon Pit)	Sundon Chalk Pit CWS	L	LBAP species	**Change in channel morphology e.g. erosion from additional flows, flood defence structures. Decrease in water quality e.g. nutrient enrichment, change in water chemistry, contamination. Change in hydrology e.g. reduction in surface or ground water levels.**						
	Water vole		Houghton Regis Chalk Pit CWS	L	LBAP species							
	Birds	Birds (e.g.black tern, black headed gull, common greenshank, pochard, shelduck, common tern, curlew, oystercatcher, teal, gadwall, great cormorant, great crested grebe, grey heron, herring gull, lesser black backed gull, little egret, little gull, little ringed plover, mute swan, northern pintail, northern shoveler, tufted duck, water rail, whimbrel)		N	Wildlife and Countryside Act 1981 (as amended); Priority UK BAP species (herring gull)	**Disturbance to fauna e.g bird populations.**						

	Feature habitat & associated species	Distribution	Protected sites: Site name	Protected sites: Importance: International, European, National, Local *	Related Policies & Legislation	Sensitivity to WCS hazards	Surface water flow and flood risk management	Waste water discharge	Development footprint (direct)	Network Infrastructure	Risk	Opportunities
Context							Each development area needs to prevent more water leaving site than green runoff rates. Increased production of wastewater from new development can result in increased discharge from wastewater treatment works (WwTW) leading to increased base flow of receiving watercourses. This situation can lead to increased flood risk downstream of the WwTWs because the receiving watercourses have a decreased capacity to retain additional surface water from flood events.	Even with increased development and subsequent increase in volume of treated water, the WwTWs have the capacity to discharge within their consented water quality standards. This should therefore mean there is no decrease in current water quality. However, the following discharge consents will need to be revised in the future because the quantity of discharge is likely to increase: • Dunstable WwTW – after 2031 • Chalton WwTW – after 2031 • Stanbridgeford WwTW - before end 2010 Additionally, tightening of the discharge consents is likely to be required beyond the year 2015 in order to meet the future water quality requirements of the Water Framework Directive. In some cases these indicative water quality consents (as outlined in Section 6), in particular those for phosphate levels, are beyond current best available technology (Chapter 6.5).	The area covered by each development footprint in relation to ecological features can be seen on Figure 8-1.	Upgrades to the water supply network and additional infrastructure will be needed to meet the demands of future developments across the study area. Schematic layout of the proposed network infrastructure is shown in Figure8-1.		
Rivers & Streams	Rivers & Streams habitat	River Ouzel, River Flit, River Gade, River Lea (or Lee) is classified as a chalk river by the Environment Agency, River Mimram, Clipstone Brook, Houghton Brook, Lewsey Brook, Cats Brook	River Lea (or Lee) CWS, River Ouzel CWS, Clipstone Brook CWS, Fancott Woods and Meadows CWS, Poplars Nursery CWS, Church Meadows CWS, Croda Colloids CWS, East Hyde Riverside CWS, Fallowfield CWS, Luton Hoo Park CWS, Tebworth Marsh SSSI, Eggington Fields CWS, Leagrave Common CWS, Cowslip Meadow CWS, Ouzel Valley CWS	N	Priority UK BAP habitat (Rivers); LBAP habitat (Rivers and streams)	**Change in channel morphology e.g. erosion from additional flows, flood defence structures. Decrease in water quality e.g. nutrient enrichment, change in water chemistry, contamination. Change in hydrology e.g. reduction in surface or ground water levels. Physical loss of habitat e.g. from development footprint**	Development L - potential to tie into the River Lea Valley Biodiversity Opportunity Area which has potential to buffer and link wetland and woodland habitat. Developments C and D - potential to tie into the Ouzel Valley Biodiversity Opportunity Area and Ouzel Valley Corridor area and contribute to enhancement targets for Clipstone Brook. Development 2, F and G - potential for wetland creation Development G - potential to contribute to the ecological targets of the Luton Flood Risk Management Strategy through enhancement of Houghton Brook and associated habitats in the river corridor. Enhancement of existing habitats and habitat creation for flood risk management for all dev areas where ground conditions suitable. Habitats include ditches, reedbeds and wet woodland. Increased flooding has the potential to impact water voles through increased flooding of their river habitats, displace fish such as stone loach and amphibians. In addition, increased flooding has the potential to impact associated bird species (such as mute swan, and tufted duck) on the margins of the water should the flood event with the breeding season by decre available nesting habitat and wash Habitat for river and feeding birds reduced. Enhancement of exisiting habitats proposed flood storage proposals River Lee and Ouzel Brook. Poten to create fish refuges as part of th enhancement.	Three WwTW (Dunstable, Chalton and Stanbridgeford) have been identified as needing to increase their consented water discharge volumes in the future in response to the demand from increased development. These increases in discharge volumes without improvements in water quality have the potential to affect water quality in the receiving watercourses through increased eutrophication. A decrease in water quality in Ouzel Brook (Dunstable WwTW and Stanbridgeford WwTW) may be a risk to sensitive fish species such as bullhead and stone loach, and sensitive invertebrates including mayfly and caddisfly species. A decrease in water quality in the River Flit (Chalton WwTW) may be a risk to sensitive species sensitive such as bullhead and sensitive invertebrates, including caddisfly species, and plant diversity within designated sites downstream of Chalton WwTW including the River Flit CWS, Fancott Woods and Meadows SSSI and CWS, and Flitick Moor SSSI. There is also the potential for a risk to Eutrophic Sensitive Areas including Grafham Water as a result of the potential for cumulative impacts with ot A decrease in water quality may pose a risk t the Water Framework Directive. Water voles and otters along Ouzel Brook ar by a change in water quality due to a risk to t water quality may affect fish populations whic The increase in discharges from WwTW into Lee have the potential to increase summer fl reduced flow concerns (Upper Ouse and Bed	Development C - fish in Clipstone Brook (Stone Loach, Bullhead, pike, minnow), invertebrates including caddisflies and mayflies Development D - watercourse through middle of development area and south of development area (both unnamed) Development G - Houghton Brook runs through south of development footprint. Inverts include caddisflies, banded demoiselle and beautiful demoiselle which are indicators of healthy aquatic system for Houghton Brook. Fish in Houghton Brook include bullhead and stone loach Development F - Ouzel Brook runs through development footprint - otters, water voles, fish.		<u>Surface flow and flood risk management</u> Increased flooding has the potential to impact water voles through increased flooding of their river habitats, displace fish such as stone loach and amphibians. In addition, increased flooding has the potential to impact associated bird species (such as mute swan, and tufted duck) on the margins of the water should the flood event coincide with the breeding season by decreasing available nesting habitat and washing out nests. Habitat for river and feeding birds may also be reduced. <u>Waste water discharge</u> Increases in discharge volumes without improvements in water quality have the potential to affect water quality in the receiving watercourses. Ouzel Brook (Dunstable WwTW and Stanbridgeford WwTW) - risk to sensitive fish species such as bullhead and stone loach, and sensitive invertebrates including mayfly and caddisfly species. Risk to water voles, otters, and species that rely on fish and inverterbates present. River Flit (Chalton WwTW) - risk to sensitive species sensitive such as bullhead and sensitive invertebrates ir A decrease in water quality may pose	<u>Surface flow and flood risk management</u> Development L - potential to tie into Luton Hoo and the River Lea Valley Biodiversity Opportunity Area rwhich has potential to buffer and link wetland and woodland habitat. Developments C and D - potential to tie into the Ouzel Valley Biodiversity Opportunity Area and Ouzel Valley Corridor area and contribute to enhancement targets for Clipstone Brook. Development 2, F and G - potential for wetland creation Development G - potential to contribute to the ecological targets of the Luton Flood Risk Management Strategy through enhancement of Houghton Brook and associated habitats in the river corridor. Enhancement of existing habitats and habitat creation for flood risk management for all dev areas where ground conditions suitable. Habitats include ditches, reedbeds and wet woodland. Enhancement of exisiting habitats during the proposed flood storage proposals on the River Lee and Ouzel Brook. Potential to create fish refuges as part of this enhancement. <u>Waste water discharge</u> The increase in discharges from WwTW into t <u>Development footprint</u> Development C - Clipstone Brook - river resto and enhancement of adjacent floodplain habitat. Potential to implement a programme to control signal crayfish which are present in the area. Development D - restoration of watercourses associated habitats Development G - restoration of Houghton Bro surrounding habitat to encourage water voles present downstream to increase their range. Potential to implement a programme to control signal crayfish which are present in the area. Development F - restoration and enhancemer Ouzel Brook and adjacent floodplain habitat
	Mammals	Otter: Records on the River Ouzel at Linslade, Ouzel Brook at and near to Dunstable STW, River Flit at Chalton STW, River Lee at East Hyde, Grand Union Canal at Linslade. Otters present along the whole of the Ouse in Bedfordshire as well as its tributaries the Ivel, Elstow Brook and Rhee, and on the River Flit.	River Flit CWS, Ouzel Valley CWS, East Hyde Riverside CWS	I	Habitats Directive; Wildlife and Countryside Act 1981 (as amended); Priority UK BAP Species; LBAP Species							
		Water vole: Records on the River Flit at Chalton STW and Fancott Woods and Meadows SSSI, Ouzel Brook at Dunstable STW, near Ouzel Brook at Houghton Regis Chalk Pit CWS, Houghton Brook and River Lee (or Lea), Cats Brook and Wardown Park, Luton. Also, survey work in 2005 confirmed populations at Leagrave Marsh, along Houghton Brook and Lewsey Brook and the section of the River Lea (or Lee) where these two tributaries join. It also confirmed population in Luton at Cowslip Meadow CWS, on the Lea between Kingsdown Avenue and Stockingstone Road, and through Limbry.	Fancott Woods and Meadows SSSI, River Lea (or Lee) CWS, Leagrave Common CWS, Fallowfield CWS, Houghton Regis Chalk Pit CWS, Cowslip Measow CWS	I	Habitats Directive; Wildlife and Countryside Act 1981 (as amended); Priority UK BAP Species; LBAP Species							
		Water shrew: Records on River Ouzel at Leighton Buzzard, Little Billington, Billington, and Dunstable STW, and on the Grand Union Canal at Grove Lock, Leighton Buzzard and Linslade.	River Ouzel CWS	N	Wildlife & Countryside Act 1981 (as amended)							
	Fish	Stretches of the River Ouzel (extenstion to source, Stanbridgeford STW, Billington to Eaton Leys), the River Flit from extension to source, the River Lee (from East Hyde Bridge to Wheathamstead) are designated as Cyprinid Fisheries under the Freshwater Fish Directive. Stretches of the River Gade (extension to source) and River Mimram (extension to source, Kings Walden to Digswell) are designated as Salmonid Fisheries under the Freshwater Fish Directive. Grand Union Canal (stone loach, bream, silverbream, bullhead, carp, three spined stickleback, gudgeon, ruffe, perch, roach, rudd, wels). River Lea (or Lee) (stone loach, eel, chub, barbel, carp, three spined stickleback, gudgeon, perch, minnow, ten spined stickleback, roach).	River Lea (or Lee) CWS, River Ouzel CWS, Clipstone Brook CWS	I	Habitats Directive; Priority UK BAP Species (sea trout, and eel only), Freshwater Fisheries Directive							

	Feature habitat & associated species	Distribution	Protected sites Site name	Protected sites Importance: International, European, National, Local *	Related Policies & Legislation	Sensitivity to WCS hazards	Surface water flow and flood risk management	Waste water discharge	Development footprint (direct)	Network Infrastructure	Risk	Opportunities
Context							Each development area needs to prevent more water leaving site than green runoff rates. Increased production of wastewater from new development can result in increased discharge from wastewater treatment works (WwTW) leading to increased base flow of receiving watercourses. This situation can lead to increased flood risk downstream of the WwTWs because the receiving watercourses have a decreased capacity to retain additional surface water from flood events.	Even with increased development and subsequent increase in volume of treated water, the WwTWs have the capacity to discharge within their consented water quality standards. This should therefore mean there is no decrease in current water quality. However, the following discharge consents will need to be revised in the future because the quantity of discharge is likely to increase: • Dunstable WwTW – after 2031 • Chalton WwTW – after 2031 • Stanbridgeford WwTW - before end 2010 Additionally, tightening of the discharge consents is likely to be required beyond the year 2015 in order to meet the future water quality requirements of the Water Framework Directive. In some cases these indicative water quality consents (as outlined in Section 6), in particular those for phosphate levels, are beyond current best available technology (Chapter 6.5).	The area covered by each development footprint in relation to ecological features can be seen on Figure 8-1.	Upgrades to the water supply network and additional infrastructure will be needed to meet the demands of future developments across the study area. Schematic layout of the proposed network infrastructure is shown in Figure8-1.		
		River Ouzel (stone loach, sea trout, bullhead, carp, three spined stickleback, pike, gudgeon, chub, dace, perch, minnow, roach, rudd, tench, bleak, tench, bream, ruffe). Clipstone Brook (stone loach, bullhead, pike, three spined stickleback, minnow). Houghton Brook (bullhead and stoneloach) River Flit (bullhead, carp, three spined stickleback, rudd). Ouzel Brook (Tilsworth) (stone loach, ten spined stickleback, three spined stickleback, carp, bullhead).									
	Invertebrates	White clawed crayfish: Records on River Lea downstream of Luton Hoo Lakes, and on the Grand Union Canal. However, these records are dated 1980 and 1960 respectively and as such may no longer be relevant. Caddisfly that score 10 on BMWP: Phryganeidae (Ouzel Brook, Clipstone Brook, River Ouzel), Leptoceridae (Ouzel Brook, Clipstone Brook, River Ouzel, Fancott Brook, River Flit, River Lee, Houghton Brook), Goeridae (Ouzel Brook, Clipstone Brook, River Ouzel, River Lee), Ephmerellidae (River Lee), Molanidae (River Ouzel) Mayfly that score 10 on BMWP: Leptophlebiidae (Ouzel Brook, Clipstone Brook, River Ouzel), Emphemeridae (Ouzel Brook, River Lee) Banded demoiselle and Beautiful demoiselle (Houghton Brook)	River Lea CWS	I	Habitats Directive; Wildlife and Countryside Act 1981 (as amended); Priority UK BAP Species (white clawed crayfish)						
	Birds	Birds (kingfisher, gadwall, great cormorant, green sandpiper, grey wagtail, grey heron, little egret, sand martin, tufted duck)		N	Wildlife and Countryside Act 1981 (as amended); Kingfisher - Schedule 1 species under the Wildlife and Countryside Act 1981 (as amended)						
	Flora	River Lea CWS: Blunt leaved pondweed (locally rare)	River Lea CWS	L							

	Feature habitat & associated species	Distribution	Protected sites: Site name	Protected sites: Importance: International, European, National, Local *	Related Policies & Legislation	Sensitivity to WCS hazards	Surface water flow and flood risk management	Waste water discharge	Development footprint (direct)	Network Infrastructure	Risk	Opportunities
Context							Each development area needs to prevent more water leaving site than green runoff rates. Increased production of wastewater from new development can result in increased discharge from wastewater treatment works (WwTW) leading to increased base flow of receiving watercourses. This situation can lead to increased flood risk downstream of the WwTWs because the receiving watercourses have a decreased capacity to retain additional surface water from flood events.	Even with increased development and subsequent increase in volume of treated water, the WwTWs have the capacity to discharge within their consented water quality standards. This should therefore mean there is no decrease in current water quality. However, the following discharge consents will need to be revised in the future because the quantity of discharge is likely to increase: • Dunstable WwTW – after 2031 • Chalton WwTW – after 2031 • Stanbridgeford WwTW - before end 2010 Additionally, tightening of the discharge consents is likely to be required beyond the year 2015 in order to meet the future water quality requirements of the Water Framework Directive. In some cases these indicative water quality consents (as outlined in Section 6), in particular those for phosphate levels, are beyond current best available technology (Chapter 6.5).	The area covered by each development footprint in relation to ecological features can be seen on Figure 8-1.	Upgrades to the water supply network and additional infrastructure will be needed to meet the demands of future developments across the study area. Schematic layout of the proposed network infrastructure is shown in Figure8-1.		
Wet Woodland (including wet ash-maple woodland)	Wet Woodland habitat	Along the River Flit at Chalton STW, areas close to Development Area I, and near Ouzel Brook.	Fancott Woods and Meadows SSSI and CWS, Woodcok Wood CWS, Hipsey Spinney Woods CWS, Sundan Woods CWS. Holt Wood CWS, Bramingham Wood CWS, Sharpenhoe Grove CWS, Stanbridge and Blackgrove Woods CWS, Leagrave Common (former SSSI), Eggington Fields CWS, River Flit CWS	N	Priority UK BAP habitat; LBAP habitat	**Change in hydrology** e.g. reduction in surface, flood or ground water levels. **Decrease in water quality** e.g. contamination. **Flood defence** works with no integrated flood management. **Physical loss of habitat** e.g. from development footprint	Enhancement of existing habitats and habitat creation for flood risk management for all development areas where ground conditions suitable.		Development I - adjacent to wet woodland habitat in Sundon Wood CWS but not within development footprint		Waste water discharge A decrease in water quality in the River Flit may pose a risk to plant diversity within the wet woodland in Fancott Woods and Meadows SSSI and CWS.	Surface flow and flood risk management Enhancement of existing habitats and habitat creation for flood risk management for all development areas where ground conditions suitable. Development footprint Development I adjacent to wet woodland in Sundon Wood CWS; opportunity to create wet woodland within footprint and connect to existing wet woodland.
Marshy grassland (floodplain grazing marsh)	Marshy grassland (floodplain grazing marsh) habitat and marsh habitat	Between River Ouzel and Grand Union Canal from Linslade to Leighton Buzzard, River Ouzel at Leighton Buzzard, River Ouzel at Stanbridge STW	Nares Gladley Marsh SSSI, Ouzel Valley CWS, River Ouzel CWS, Rackley Pit CWS, Church Meadows CWS, Leagrave Common (former SSSI), Kings and Baker's Wood and Heaths CWS, Tebworth Marsh SSSI, Dropshort Marsh SSSI, Cowslip Meadow CWS, Eggington Fields CWS, East Hyde Riverside CWS	N	Priority UK BAP habitat; LBAP habitat	**Change in hydrology** e.g. reduction in ground, surface or flood water levels. **Flood defence** works preventing seasonal flooding. **Physical loss of habitat** e.g. from development footprint. **Disturbance to fauna** e.g. to bird populations.	Enhancement of existing habitats and habitat creation for flood risk management for all development areas where ground conditions suitable. Potential to increase exisiting floodplain grazing marsh as part of the Stanbridgeford WwTW flood storage proposals on the Ouzel Brook. Creation of floodplain grazing marsh could be incorporated to attentuate flood water downstream of Chalton WwTW along the River Flit.					Surface flow and flood risk management Enhancement of existing habitats and habitat creation for flood risk management for all development areas where ground conditions suitable. Creation of floodplain grazing marsh could be incorporated to attentuate flood water downstream of Chalton WwTW along the River Flit.
	Birds	Birds (e.g. common snipe, curlew, oystercatcher, wigeon, green sandpiper, grey heron, little egret, lapwing, reed bunting, yellow wagtail)		N	Wildlife and Countryside Act 1981 (as amended); Priority UK BAP species (lapwing, curlew, and reed bunting)							
Reed bed and swamp	Reed bed and swamp habitat	Under footprint of development area F	Houghton Regis Marl Lakes SSSI, Houghton Regis Chalk Pits CWS, Kings and Baker's Wood and Heaths CWS, Flitwick Moor SSSI, East Hyde Riverside CWS, Leagrave Common CWS, Rackley Hill Pit CWS, River Flit CWS, Riverside Walk CWS, Tiddenfoot Park CWS	N	Priority UK BAP habitats; LBAP habitats	**Change in hydrology** e.g. reduction in surface, flood or ground water levels. **Decrease in water quality** e.g. contamination; flood defence works with no integrated flood management. **Excessive flooding** leading to habitat loss. **Physical loss of habitat** e.g. from development footprint.	Enhancement of existing habitats and habitat creation for flood risk management for all development areas where ground conditions suitable.	A decrease in water quality in the River Flit may pose a risk to plant diversity within reed bed and swamp habitat in the River Flit CWS.	Development F - reedbed within development footprint (Houghton Regis Chalk Pit CWS and Houghton Regis Marl Lakes SSSI)	Dev F - reedbed within development footprint (Houghton Regis Chalk Pit CWS and Houghton Regis Marl Lakes SSSI)	Waste water discharge A decrease in water quality in the River Flit may pose a risk to plant diversity within reed bed and swamp habitat in the River Flit CWS. Development footprint Risk to reedbed habitat within footprint of Development F Infrastructure Network Risk to reedbed habitat within footprint of Development F	Surface flow and flood risk management Enhancement of existing habitats and habitat creation for flood risk management for all dev areas where ground conditions suitable. Development footprint Development F - Opportunity to maintain and enhance reedbed habitat.
	Birds	Birds (e.g. teal, grey heron, little grebe, reed bunting, water rail)		N	Wildlife and Countryside Act 1981 (as amended); Priority UK BAP species (reed bunting)							
	Ditch habitat	Scattered distribution	Church Meadows CWS, Eggington Fields	I		**Change in**	Enhancement of existing habitats		Development I - ditch system in	Development I - ditch system in	Development footprint	Surface flow and flood risk management

	Feature habitat & associated species	Distribution	Protected sites: Site name	Protected sites: Importance: International, European, National, Local *	Related Policies & Legislation	Sensitivity to WCS hazards	Surface water flow and flood risk management	Waste water discharge	Development footprint (direct)	Network Infrastructure	Risk	Opportunities
Context							Each development area needs to prevent more water leaving site than green runoff rates. Increased production of wastewater from new development can result in increased discharge from wastewater treatment works (WwTW) leading to increased base flow of receiving watercourses. This situation can lead to increased flood risk downstream of the WwTWs because the receiving watercourses have a decreased capacity to retain additional surface water from flood events.	Even with increased development and subsequent increase in volume of treated water, the WwTWs have the capacity to discharge within their consented water quality standards. This should therefore mean there is no decrease in current water quality. However, the following discharge consents will need to be revised in the future because the quantity of discharge is likely to increase: • Dunstable WwTW – after 2031 • Chalton WwTW – after 2031 • Stanbridgeford WwTW - before end 2010 Additionally, tightening of the discharge consents is likely to be required beyond the year 2015 in order to meet the future water quality requirements of the Water Framework Directive. In some cases these indicative water quality consents (as outlined in Section 6), in particular those for phosphate levels, are beyond current best available technology (Chapter 6.5).	The area covered by each development footprint in relation to ecological features can be seen on Figure 8-1.	Upgrades to the water supply network and additional infrastructure will be needed to meet the demands of future developments across the study area. Schematic layout of the proposed network infrastructure is shown in Figure8-1.		
Ditches	Ditch habitat	Scattered distribution	Church Meadows CWS, Eggington Fields CWS, Icknield Way CWS, River Flit CWS, Stanbridge and Blackgrove Woods CWS, Ouzel Valley CWS	L		**Change in hydrology** e.g. reduction in surface and ground water levels. **Physical loss of habitat** e.g. from development footprint.	Enhancement of existing habitats and habitat creation for flood risk management for all development areas where ground conditions suitable. Increased flooding has the potential to displace fish such as stone loach and amphibians in ditches. There is also the potential for flooding to cause		Development F - ditch system in Icknield Way CWS at eastern dip of development area	Development F - ditch system in Icknield Way CWS at eastern dip of development area	Development footprint Risk to ditch habitat within footprint of Development I Infrastructure Network Risk to ditch habitat within footprint of Development I	Surface flow and flood risk management Enhancement of existing habitats and habitat creation for flood risk management for all development areas where ground conditions suitable. Development footprint Development I - Opportunity to retain and enhance existing ditch systems
Fen	Fen habitat	Footprint of development area F, adjacent to development area 2, along the River Flit at Chalton STW	Houghton Regis Mark Lakes SSSI, Houghton Regis Chalk Pits CWS, Dropshort Marsh SSSI, Fancott Woods and Meadows SSSI and CWS, Sundon Chalk Quarry SSSI, Sundon Chalk Pits CWS, Flitwick Moor SSSI	N	Priority UK BAP habitat	**Change in hydrology** e.g. reduction in surface, flood or ground water levels. **Physical loss of habitat** e.g. from development footprint.		A decrease in water quality in the River Flit may pose a risk to plant diversity within fen habitat in Fancott Woods and Meadows SSSI and CWS.	Development F - base rich fen within development footprint (Houghton Regis Chalk Pit CWS and Houghton Regis Marl Lake SSSI). At risk of water quality issues and loss of habitat Development 2 - adjacent to Sundon Chalk Pits CWS and Sundon Chalk Quarry SSSI		Waste water discharge A decrease in water quality in the River Flit may pose a risk to plant diversity within fen habitat in Fancott Woods and Meadows SSSI and CWS. Development footprint Risk to fen habitat within footprint	Development footprint Development F - opportunity to maintain and enhance fen habitat, and to improve water availability which could contribute to increasing condition of SSSI Development 2 - opportunity to create new habitats and connect to habitats within designated sites such as fen, lakes, ponds mire and bog. In doing this there is the potential to increase the range of amphibians such as great crested newts and smooth newts.
Ponds	Pond habitat	Scattered distribution	Sundon Quarry SSSI, Sundon Chalk Pit CWS, Houghton Regis Chalk Pit SSSI, Double Arches Pit SSSI, Leagrave Common (former SSSI); Kings and Baker's Wood and Heaths SSSI, Fancott Woods and Meadows SSSI, Eggington Fields CWS, Pedley Hill CWS, River Flit CWS, Stanbridge and Blackgrove Woods CWS, Sundon Wood CWS, Ouzel Valley CWS	N	Priority UK BAP habitats; LBAP habitats	**Change in hydrology** e.g. reduction in surface, flood or ground water levels. **Decrease in water quality** e.g. nutrient enrichment, change in water chemistry, contamination. **Physical loss of habitat** e.g. from development footprint.	Enhancement of existing habitats and habitat creation for flood risk management for all development areas where ground conditions suitable. Increased flooding has the potential to displace fish such as stone loach and amphibians in ponds. There is also the potential for flooding to cause decreased water quality in ponds.		There is the potential for all Development areas to have ponds withing their footprints, these should be assessed during the EIA process. Development F - ponds, great crested newts and smooth newts with dev footprint (within Houghton Regis Marl Lakes SSSI and Houghton Regis Chalk Pit CWS) Development I - ponds, great crested newts and smooth newts in area so likely to be in any ponds within development area footprints Development 2 - ponds, great crested newts and smooth newts in area so likely to be in any ponds within development area footprints		Surface flow and flood risk management Increased flooding has the potential to displace fish such as stone loach and amphibians in ponds. There is also the potential for flooding to cause decreased water quality in ponds. Development footprint Risk to pond habitat within development footprints, and the associated risk to species including protected species such as great crested newts.	Surface flow and flood risk management Enhancement of existing habitats and habitat creation for flood risk management for all dev areas where ground conditions suitable. Development footprint Development C, D, F, I, 2 - maintain and enhance existing and ponds for amphibians, flora, invertebrates etc. Development 2 - opportunity to create new habitats and connect to habitats within designated sites such as fen, lakes, ponds mire and bog. In doing this there is the potential to increase the range of amphibians such as great crested newts and smooth newts. Opportunity to create and enhance pond habitat within development footprints
	Great crested newt	Ponds across study area, Luton Hoo Park	Sundon Quarry SSSI, Sundon Chalk Pit CWS, Houghton Regis Chalk Pit SSSI, Double Arches Pit SSSI	I	Habitats Directive, Wildlife and Countryside Act 1981 (as amended); Priority UK BAP species; LBAP species							
	Smooth newt	Ponds across study area	Sundon Quarry SSSI, Sundon Chalk Pit CWS	L								
	Common toad	Ponds across study area	Sundon Quarry SSSI, Sundon Chalk Pit CWS	N	Priority UK BAP species							
	Common frog	Ponds across study area	Sundon Quarry SSSI, Sundon Chalk Pit CWS	L								
Purple Moor Rush Grassland and Rush Pastures	Purple Moor Rush Grassland and Rush Pastures habitat	River Ouzel at Linslade	River Ouzel CWS, Nares Gladley Marsh SSSI	N	Priority UK BAP species							

Key

I	International Importance
N	National Importance
R	Regional Importance
L	Local Importance

* National BAP Priority habitats and species have been allocated National Importance subject to more detailed investigation into geographical frame of reference

Appendix F Salmonid/Cyprinid River Stretches

Salmonid/Cyprinid River Stretches

Salmonid/Cyprinid stretches within the study area

Watercourse	Stretch	Designation under the Freshwater Fisheries Directive	STA_NGR	END_NGR
Lee	Sundon Pk - Leagrave	Cyprinid	TL06072474	TL06152429
Lee	Leagrave - Luton Hoo Lakes	Cyprinid	TL06152429	TL10442111
Lee	Luton Hoo Lakes - Luton STW	Cyprinid	TL10442111	TL12301820
Lee	Luton STW - East Hyde Br	Cyprinid	TL12301820	TL12851720
Ouzel	Confluence with Broughton Brook to Birc	Cyprinid	SP8870041700	SP8810044000
Ouzel	The A421 road bridge to confluence with	Cyprinid	SP8850037500	SP8870041700
Ouzel	Eaton Leys Farm to the A421 road bridge	Cyprinid	SP8840033200	SP8850037500
Flit	Chicksands Priory to Shefford	Cyprinid	TL1190038900	TL1450039300
Flit	Beadlow to Chicksands Priory	Cyprinid	TL1070038400	TL1190038900
Flit	Hall End to Beadlow	Cyprinid	TL0750037400	TL1070038400

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