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## Flood Risk & Surface Water Drainage Assessment

and

Land North of Impington Lane, Histon, Cambridgeshire, CB24 9AL  
September 2013



Land North of Impington Lane, Histon, Cambridgeshire  
September 2013

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## Quality Assurance

Site name: Land North of Impington Lane, Histon, Cambridgeshire

Client name:

Type of report: Flood Risk & Surface Water Drainage Assessment

Prepared by: Richard Martin IEng MICE

Signed

Date September 2013

Reviewed by: Glenn Gammons BEng (Hons) CEng MIStructE MCIWEM

Signed

Date September 2013

Rev	Date	Details	Prepared by	Checked by
Version 1	September 2012	Issued for site allocation	RSM	GG
Version 2	August 2013	Issued for internal comments	RSM	GG
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Version 4	October 2013	Updated Proposed Development Layout – Appendix C	RSM	GG
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## 1 **Executive Summary**

- 1.1 Bidwells (Consulting Engineers) have been commissioned by [REDACTED] [REDACTED] to prepare a Flood Risk and Surface Water Drainage Assessment in accordance with the National Planning Policy Framework (NPPF), the NPPF Technical Guidance document and the Companion Practice Guide to Planning Policy Statement (PPS) 25. This report will form part of the supporting information submitted with regard to representations made in support of the allocation of site reference H/1:d, land north of Impington Lane, Histon & Impington, for proposed residential development to South Cambridgeshire District Council.
- 1.2 The allocation site is located to the north of Impington Lane within the village of Histon, Cambridgeshire. The site currently comprises of open grassland and vegetation. Access to the parcel of land to east is via a private tarmac road leading off Impington Lane between plots 83 and 87 while access to the west parcel of land is also off Impington Lane between plots 51 and 67. Ground levels within the site fall in a northerly direction towards the watercourse (Award Drain 165).
- 1.3 The proposed development comprises of 74 residential dwellings and associated infrastructure including adoptable highways, private drives and public open space.
- 1.4 The allocation site is considered to be at a low risk of flooding from all sources except fluvial and sewer flooding.
- Fluvial flooding is considered to be a medium risk due to the site's proximity to Award Drain 165 to the north;
  - Sewer flooding is also considered to be a medium risk due to the increased impermeable area of the proposed development layout.
- 1.5 No development should be located below the existing ground level of 10.05m AOD. This level denotes the worst known historic flood level recorded during September 2005.
- 1.6 Any raising of land to be carried out below the level of 10.35m AOD (10.05m AOD + 300mm freeboard) should be compensated elsewhere within the allocation site at a level for level basis.
- 1.7 The Finished Floor Level of all dwellings should be set at a minimum level of 10.80m AOD which is 750mm above the historic flood level.
- 1.8 Infiltration drainage has been considered during the early stages of the developments drainage strategy. The BGS (British Geological Survey) digital geological map of Great Britain (1:50,000 scale) has identifies the site geology as small pockets of Superficial Deposits comprising of Sand & Gravel and a Bedrock Geology comprising of Mudstone. Based on the geology description and

the SuDS Infiltration Feasibility Plan included as part of the Strategic Flood Risk Assessment, the permeability of the soil is considered to be poor and not suitable to drain the proposed development.

- 1.9 This assessment was further reinforced following a conversation with the site manager supervising the construction of the adjacent residential development. He confirmed that the results of several percolation tests demonstrated poor permeability of the soil throughout their site. Therefore the drainage strategy for the adjacent development comprised of a restricted discharge to Award Drain 165 and the public sewer located in Impington Lane with on-site storage provided within underground attenuation tanks.
- 1.10 When infiltration drainage is not a viable surface water drainage solution then a restricted discharge to an adjacent watercourse would be the next preferred method of surface water disposal. Award Drain 165 runs in a westerly direction along the northern boundary of the site and a restricted discharge equal to the Greenfield runoff rate is proposed with on-site attenuation provided to accommodate the critical 100 year plus climate change storm event.
- 1.11 The surface water discharge from the development will be restricted using a vortex flow control (hydro-brake) or similar.
- 1.12 The type of attenuation is unknown at this stage and could comprise of one or several of the methods listed below:
- Storage Lagoon;
  - Swales;
  - Large Diameter Pipes;
  - Geo-cellular/Concrete Tanks;
  - Permeable Paving;
  - Rainwater Harvesting;
  - Green Roofs.
- 1.13 The report demonstrates that the proposed allocation site:
- 1) is located outside of the historical flood extent.
  - 2) is not subject to the sequential and exception tests during the planning process.
  - 3) is at a low risk of flooding from all sources subject to onsite mitigation measures.
  - 4) will provide a suitable sustainable surface water drainage strategy to drain the site.

- 1.14 Therefore, the proposed development is considered appropriate from a flood risk and drainage perspective subject to the implementation of the recommended mitigation measures put forward as part of this report.

## 2 **Introduction**

- 2.1 Bidwells (Consulting Engineers) have been commissioned by [REDACTED] to prepare a Flood Risk and Surface Water Drainage Assessment in accordance with the National Planning Policy Framework (NPPF), the NPPF Technical Guidance document and the Companion Practice Guide to Planning Policy Statement (PPS) 25. This report will form part of the supporting information submitted with regard to representations made in support of the allocation of site reference H/1:d, land north of Impington Lane, Histon & Impington, for proposed residential development to South Cambridgeshire District Council.
- 2.2 The purpose of this report is to provide site specific information on the flood risks associates with the proposed allocation site and present appropriate mitigation measures for the proposed development. This is to enable the site to obtain allocation for residential development by South Cambridgeshire District Council without an objection from the Local Planning Authority or their consultees and so that the site, its occupants and the surrounding development is at the minimum risk of flooding.

### 3 Development Description and Location

#### Location

- 3.1 The allocation site is located to the north of Impington Lane within the village of Histon, Cambridgeshire CB24 9AL. The site boundary is shown in Figures 3.1 and 3.2 below and is centred on grid reference TL 444 635.

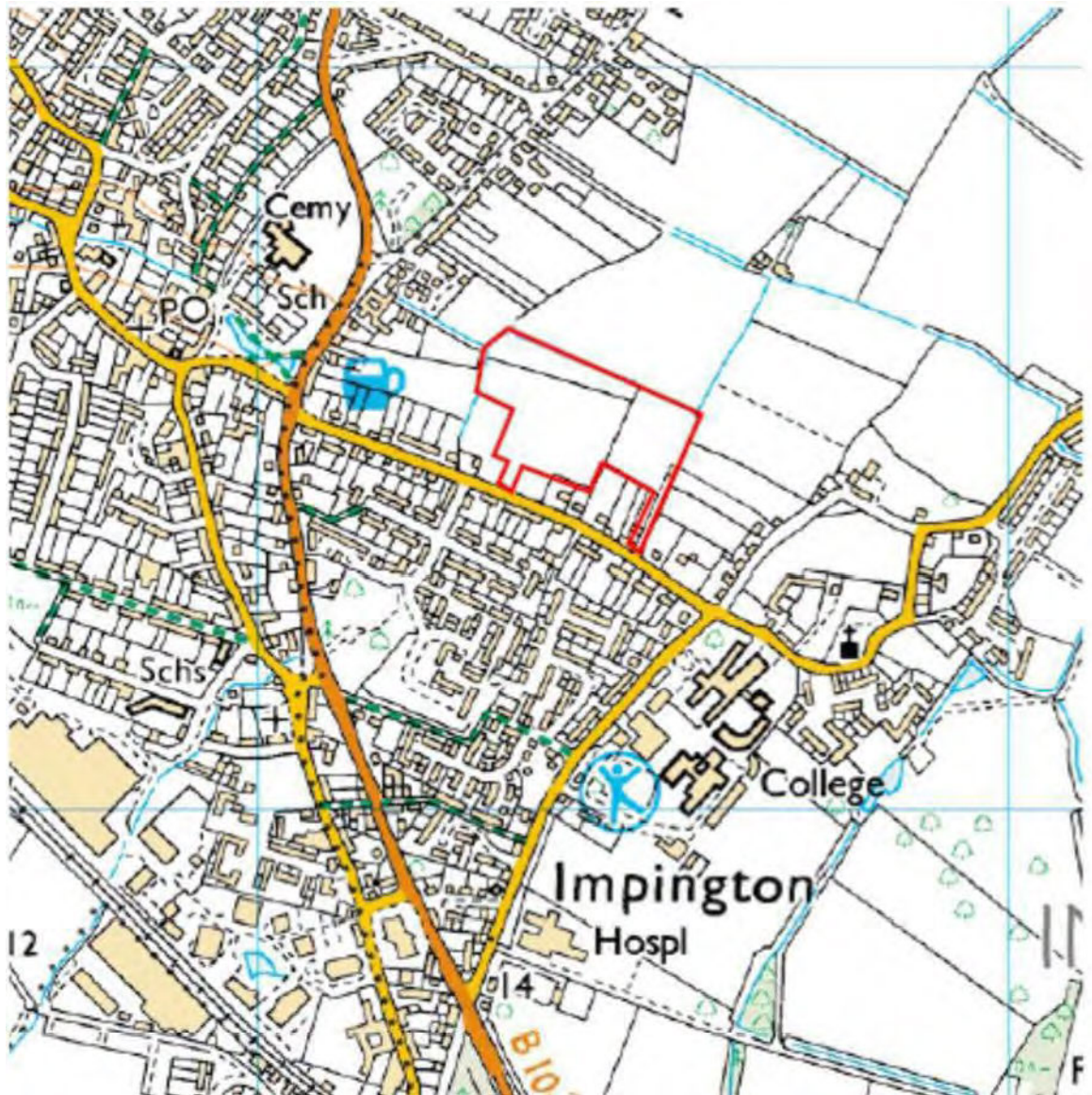


Figure 3.1: Location plan of the site



**Figure 3.2: Aerial Photo**

### **Existing Site Layout**

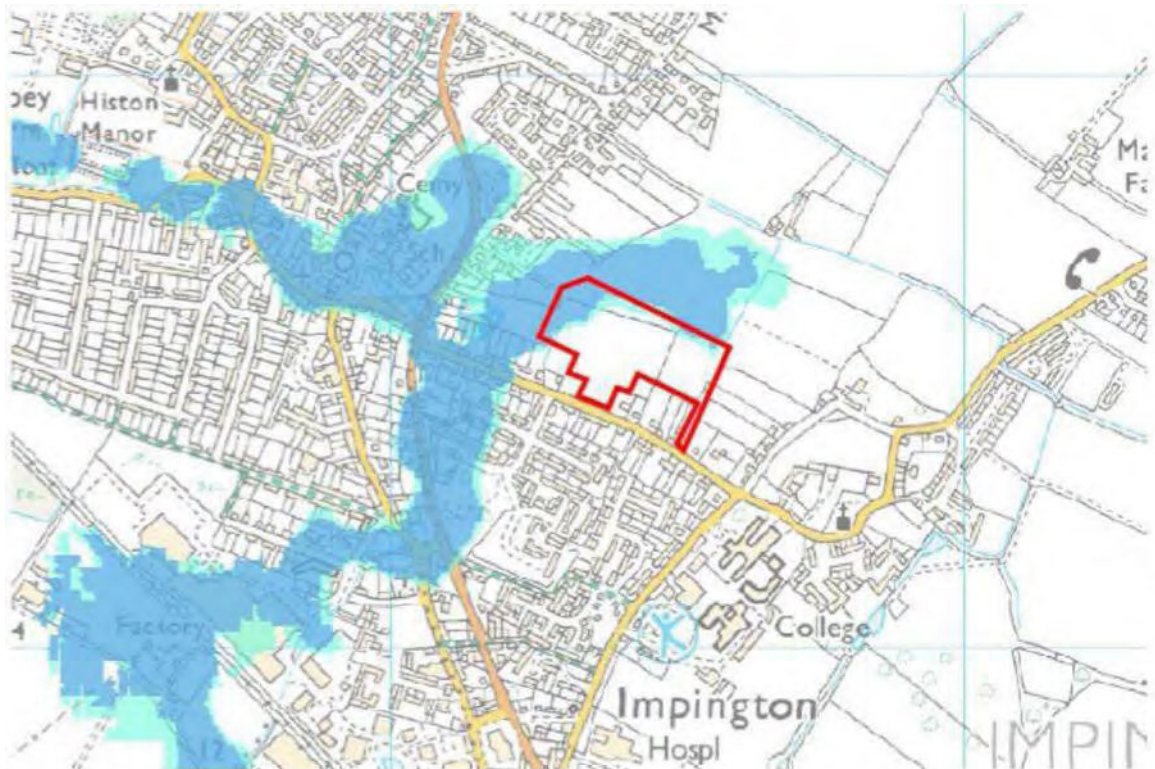
- 3.2 The development boundary as identified in Figure 3.2 above encloses an area of approximately 3.30 ha and is defined by a watercourse (Award Drain 165) to the north; Impington Lane and residential development to the south and residential development to the east and west.
- 3.3 A topographical survey of the existing site layout has been undertaken to GPS datum as shown in Appendix A. The site currently comprises of open grassland which is separated into three distinct areas of land via trees and thick vegetation. Dense vegetation from north to south splits the site into east and west land parcels. Dense vegetation from east to west (parallel to the watercourse) also splits the west area of land again into north and south land parcels. Access to the parcel of land to east is via a private tarmac road leading off Impington Lane between plots 83 and 87 while access to the west parcel of land is also off Impington Lane between plots 51 and 67.
- 3.4 Ground levels within the site fall in a northerly direction towards the watercourse (Award Drain 165). The watercourse is approximately 1.5m deep and flows in a westerly direction toward Histon Pond where it joins Award Drain 164. The existing site layout has no significant impermeable area and is not serve by a positive drainage system, therefore the site discharge its surface water runoff into the Award Drain 165 to the north at the natural greenfield runoff rate.
- 3.5 See Appendix B for site photos.

### **Proposed Development**

- 3.6 The proposed development comprises of 74 residential dwellings and associated infrastructure including adoptable highways, private drives and public open space as shown on the outline development proposal within Appendix C.
- 3.7 The application site has been put forward for residential allocation to South Cambridgeshire District Council and therefore the exact impermeable area of the proposed development is unknown at this stage. However using the outline development plan within Appendix C it has been calculated to be approximately 1.50 ha.

### **Flood Zone Delineation**

- 3.8 The Environment Agency's (EA) indicative flood maps as shown in Figure 3.3 below demonstrates that the proposed development is located within Flood Zones 1, 2 and 3.



**Figure 3.3 Environment Agency Indicative Flood Mapping**

- 3.9 The indicative flood mapping shown in Figure 3.3 above is based on course modelling techniques (J-Flow) and should be used for guidance purposes only. Therefore a Product 4 data requested was submitted to the EA to accurately define the flood extent within the site.

- 3.10 The watercourse to the north of the allocation site is known as Award Drain 165 and is under the jurisdiction of South Cambridge District Council (SCDC). The EA and SCDC have not commissioned a detailed hydraulic modelling study of the watercourses and therefore modelled flood level data is not available.
- 3.11 A residential development that bounds the site to the west has recently been given planning permission after much consultation regarding flood risk. The consultation used the highest known historical flood level which was observed at Histon Pond and detailed in Table 3.1 below.

Storm Event	Flood Level Data (m AOD)
September 2005	10.05

**Table 3.1 Historical Flood Level Data**

- 3.12 Therefore the historic flood level of 10.05m AOD has also been used to define the flood plain within the proposed allocation site. The majority of the site is above the 10.05m AOD flood level apart from a small section of land to the north-west. This small area of land has been excluded from the boundary that defines the proposed allocation site and therefore the entire site is located outside of the flood plain and will not displace flood water which may cause flooding elsewhere.
- 3.13 The Finished Floor Level (FFL) of all the proposed dwellings shall be set no lower than 10.80m AOD which provides a 750mm freeboard above the historical flood level of 10.05m AOD. The 750mm freeboard is considered an appropriate allowance for any discrepancies with the surveyed flood data, the potential effects of climate change over the life time of the development and the residual risk of blockages occurring within the watercourse.
- 3.14 See Appendix D for the complete range of flood level data and relevant site details provided by the Environment Agency.

**Vulnerability Classification**

- 3.15 Table 2 of the NPPF Technical Guidance Document provides a detailed list of which types of development fall into the vulnerability classifications also defined within the NPPF. This list is recognised as not being exclusive and provides guidance on the various uses and their subsequent Flood Risk Vulnerability Classification.
- 3.16 The allocation site is intended for residential development and therefore, the flood risk classification indicates that this falls within the “**More Vulnerable**” classification.

### **Sequential and Exception Tests**

- 3.17 The proposed development is classified as More Vulnerable development and is located outside of the historic flood plain, as was the adjacent development to the west which recently received planning approval. Therefore in accordance with the NPPF Technical Guidance Document, the Sequential and Exception Tests is not required to be undertaken by the Local Planning Authority as part of the planning process.

### **Geology and Hydrogeology**

- 3.18 The BGS (British Geological Survey) digital geological map of Great Britain at 1:50,000 scale, indicates that the site geology comprises of:
- Superficial Deposits – Small pockets within the site comprising of Sand & Gravel (River Terrace Deposits).
  - Bedrock Geology – comprises of Mudstone (Gault Formation).
- 3.19 The site is located outside the Source Protection Zone (SPZ) and is also situated outside the principal aquifer for superficial and bedrock designation.

## **4 Flood Hazards**

### **Source of Flooding**

#### **Fluvial**

- 4.1 Fluvial flooding is flooding caused by rivers and occurs when the river channel capacity is exceeded by the flow. Most rivers have a natural floodplain which in built up areas is sometimes encroached upon by development.

#### **Tidal**

- 4.2 Tidal flooding from the sea occurs when high tides and storm surges raise the level of tidal waters above the level of the shore or river bank. They can be sudden and severe, but are dependent upon a number of factors.

#### **Overland Flow**

- 4.3 Within a highly dense urban area where there are large areas of impermeable surfacing e.g. roof areas, car parking and roads, it is possible for high intensity rainfall storms to not be able to soak into the ground or enter the man-made drainage system at a quick enough rate to cope with the volume of water. Where this occurs, the excess water can flow across land and potentially cause flooding.

#### **Groundwater**

- 4.4 In areas where the level of groundwater is high, rainfall that soaks into the ground can raise it to a level where structures within the ground are at risk of flooding. Structures such as basements or detention ponds can be at risk, although this is dependent upon the ground conditions of the site.

#### **Sewers**

- 4.5 Flooding from sewers occurs when the quantity of water flowing into the sewers exceeds the capacity of the sewer and backs up to an extent where it floods out of manholes or gullies. Alternatively and more commonly, sewers flood when a blockage occurs in a pipe. This is more likely on private sewers, but is usually less severe than flooding from larger public sewers which can cause extensive flooding due to the greater quantity of surface area which they drain.

#### **Artificial Sources**

- 4.6 Non-natural or artificial sources of flooding can include reservoirs, canals and lakes where water is retained above the natural ground level and flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure. The potential effects of flood risk management infrastructure such as pumping station failure should also be considered.

### **Description of Flooding**

- 4.7 The allocation site is considered to be at a low risk of flooding from all sources except fluvial and sewer flooding.
- Fluvial flooding is considered to be a medium risk due to the site's proximity to Award Drain 165 to the north;
  - Sewer flooding is also considered to be a medium risk due to the increased impermeable area of the proposed development layout.
- 4.8 Therefore the focus of this report will be to mitigate the fluvial and sewer flood risks, however flood risk from the other sources will not be overlooked and mitigation measures put forward where appropriate.

### **Strategic Flood Risk Assessment**

- 4.9 A review of South Cambridgeshire and Cambridge City Strategic Flood Risk Assessment (SFRA) (Level 1) did not raise any site specific comments, however the following general comments and observations listed below were identified as part of the SFRA report and its supporting appendices:
- Historical fluvial and pluvial (09 September 2012) flooding has been identified within the close vicinity of the site (Impington Lane). The exact extent of the flooding for these events have not been defined as part of the historical mapping exercise;
  - Historical sewer (21 October 2012) flooding has been identified within the close vicinity of the site (Impington Lane). The exact extent of the flooding for this event has not been defined as part of the historical mapping exercise;
  - The surface water flood maps for the area closely follows the EA's indicative fluvial flood mapping for the area. The surface water flood maps are based on course modelling techniques and exclude the underground drainage systems, smaller overground drainage systems and buildings;
  - The SuDS Infiltration Feasibility Plan indicates the site as having a low potential for infiltration;
  - The groundwater source protection zone maps indicate the site is situated outside of the source protection zone.

### **Access and Egress**

- 4.10 In accordance with the NPPF and the NPPF Technical Guidance Document, access and egress to the site during a range of storm events should be considered with preference being given over dry land,

however where this is not possible evacuation should fall within the white cells as classified within Table 13.1 of FD2320\_TR2.

- 4.11 The proposed development is located outside of the historic floodplain and therefore access and egress conditions to the site during equivalent storm events have been classified as safe (over dry land) and will not require the assistance of the emergency services.
- 4.12 The proposed FFL's for the development will be set at a minimum of 750mm above the historic flood level and within certain areas of the site this will require landscaping of the surrounding land to tie into the existing ground levels. Therefore the careful layout and level design of the development will also provide safe (over dry land) access and egress conditions during storm events significantly greater than the historic event.

## **5 Flood Risk Management Measures**

5.1 To enable the allocation site to be considered in line with the NPPF, the NPPF Technical Guidance document and the Companion Practice Guide to PPS 25, appropriate flood mitigation measures need to be set in place. The measures laid out below, are put forward as those that will be incorporated within the detailed design and operation of the proposed development.

### **Level Regime**

5.2 No development should be located below the existing ground level of 10.05m AOD. This level denotes the worst known historic flood level recorded during September 2005.

5.3 Any raising of land to be carried out below the level of 10.35m AOD (10.05m AOD + 300mm freeboard) should be compensated elsewhere within the allocation site at a level for level basis. The preliminary land re-profiling requirements base on the outline development layout has been shown within Appendix G.

5.4 The Finished Floor Level of all dwellings should be set at a minimum level of 10.80m AOD which is 750mm above the historic flood level.

5.5 The careful layout and level design of the development will provide safe (over dry land) access and egress conditions during storm events significantly greater than the September 2005 historic flood event.

5.6 All external hardstanding areas should be designed to fall away from the proposed dwellings so that in the event of a sewer surcharging or overland flow flood event, the flood water will not enter the dwelling, but will instead flood any external areas.

### **Maintenance Strip**

5.7 A minimum 5.0m maintenance strip should remain undeveloped adjacent to the watercourse (Award Drain 165) located to the north of the site. The 5.0m strip of land will provide sufficient working space for SNDC to undertake necessary maintenance works and gain access to the watercourse.

5.8 Access to the maintenance strip should be provided as part of the development layout to ensure the 5.0m maintenance strip does not become land locked by the development.

### **Surface Water Drainage Strategy**

5.9 The surface water drainage strategy for the proposed development will be carried out in accordance with Section 6 of this report.

### **Detailed Design**

- 5.10 It is proposed that the mitigation measures set out above are controlled by conditions to the planning consent which will be approved by the LPA and their consultees.

## 6 Surface Water Drainage Strategy

### Surface Water Run-off Rate

6.1 The existing site layout consists of permeable farm/grass land with a surface water discharge equal to the natural greenfield run-off rate as shown in Table 6.1 below (with and without the effects of climate change). The flow rates have been calculated using the IH 124 method taking into account the existing site conditions.

Return Period	Existing Discharge Rate	Existing Discharge Rate (+30%)
1 in 1 year	4.4 l/s	5.7 l/s
1 in 30 year	12.0 l/s	15.6 l/s
1 in 100 year	17.8 l/s	23.1 l/s

**Table 6.1 Existing Site Run-off Rates**

6.2 The proposed development has an impermeable area of approximately 1.50 ha (based on the outline development plan) and prior to any mitigation measures being implemented into the drainage strategy the proposed development would produce unrestricted flow rates as shown within Table 6.2 below (with and without the effects of climate change).

6.3 The flow rates have been calculated using the Micro-Drainage design software (Colebrook-White Method) incorporating the FSR rainfall parameters for the site during a 15 minute winter event.

Return Period	Proposed Discharge Rate	Proposed Discharge Rate (+30%)
1 in 1 year	224.3 l/s	291.6 l/s
1 in 30 year	549.5 l/s	714.4 l/s
1 in 100 year	713.1 l/s	927.0 l/s

**Table 6.2 Potential Site Run-off Rates**

6.4 To ensure the proposed development does not exceed the existing discharge rate as stated within Table 6.1 above, adequate mitigation measures will be required as part of the proposed surface water drainage strategy.

### **Climate Change**

- 6.5 There is one element of climate change that will affect flood risk at the site which is the peak rainfall intensity. In accordance with Tables 4 & 5 of the NPPF Technical Guidance document, climate change is dependent upon the life span of the development. For a site intended for residential use, it is considered to take the range of 2085 – 2115 which equates to a design life of 72 – 102 years.
- 6.6 This will result in an increase to the peak rainfall intensity of 30% which has been incorporated into the Surface Water Drainage Strategy detailed below.

### **Proposed Surface Water Drainage Strategy**

- 6.7 The development will incorporate a Sustainable Drainage System (SuDS) that suits the site conditions and location. However all sites have constraining factors which mean that certain SuDS solutions may be restricted.

### **Infiltration Drainage**

- 6.8 In accordance with the NPPF, the NPPF Technical Guidance document and the Companion Practice Guide to PPS25, infiltration drainage has been considered during the early stages of the development's drainage strategy. The BGS (British Geological Survey) digital geological map of Great Britain at 1:50,000 scale, indicates that the site geology comprises of:
- Superficial Deposits – Small pockets within the site comprising of Sand & Gravel (River Terrace Deposits).
  - Bedrock Geology – comprises of Mudstone (Gault Formation).
- 6.9 Based on the above geology description and the SuDS Infiltration Feasibility Plan included as part of the Strategic Flood Risk Assessment, the permeability of the soil is considered to be poor. This assessment was further reinforced following a conversation with the site manager supervising the construction of the adjacent residential development. He confirmed that the results of several percolation tests demonstrated poor permeability of the soil throughout their site. Therefore the drainage strategy for the adjacent development comprised of a restricted discharge to Award Drain 165 and the public sewer located in Impington Lane with on-site storage provided within underground attenuation tanks.
- 6.10 When infiltration drainage techniques are unsuitable to drain a proposed development for reasons such as poor infiltration, high water table or contamination then an alternative surface water drainage strategy will be required to drain the site as detailed below.

**Attenuation (Restricted Discharge)**

- 6.11 In line with the NPPF, the NPPF Technical Guidance document and the Companion Practice Guide to PPS25, if infiltration drainage is not a viable surface water drainage solution then a restricted discharge to an adjacent watercourse would be the next preferred method of surface water disposal. Award Drain 165 runs in a westerly direction along the northern boundary of the site and a restricted discharge equal to the Greenfield runoff rate is proposed with on-site attenuation provided to accommodate the critical 100 year plus climate change storm event.
- 6.12 The surface water discharge from the development will be restricted using a vortex flow control (hydro-brake) or similar and base on an impermeable area of 1.50 ha will produce a restricted discharge into the watercourse similar to those shown within Table 6.3 below (subject to detail design):

Return Period	Existing Discharge Rate (Refer: Table 6.1)	Proposed Restricted Discharge Rate
1 in 1 year	4.4 l/s	4.4 l/s
1 in 30 year	12.0 l/s	6.5 l/s
1 in 100 year	17.8 l/s	6.8 l/s
1 in 100 year (+30%)	23.1 l/s	7.5 l/s

**Table 6.3 Proposed Restricted Run-off Rates**

- 6.13 On-site attenuation will be provided to accommodate the critical 100 year plus climate change storm event. The type of attenuation is unknown at this stage and could comprise of one or several of the methods listed below:
- Storage Lagoon;
  - Swales;
  - Large Diameter Pipes;
  - Geo-cellular/Concrete Tanks;
  - Permeable Paving;
  - Rainwater Harvesting;
  - Green Roofs.

- 6.14 The above list is not considered to be exhaustive and where possible infiltration should still be incorporated into the design even if soil percolation rates are poor.
- 6.15 The preliminary surface water drainage layout and corresponding surface water calculations are shown within Appendix E and F respectively (subject to detail design). For the purpose of this report the attenuation will be provided within an underground tank to accommodate the critical 30 year storm event and could potentially be offered for adoption to Anglian Water. Additional storage will be provided within an attenuation lagoon/depression which will be utilised during storm events between the 30 year and 100 year plus climate change events. Therefore the attenuation lagoon/depression will remain dry the majority of the time and could be utilised as part of the public open space.
- 6.16 The surface water sewer network discharging to the attenuation facility should be designed to ensure no surcharging of the network occurs during the critical 1 in 1 year storm event and no flooding of the network occurs during the critical 1 in 30 year storm event. For storm events up to and including the 1 in 100 year plus climate change event careful flood routing towards the attenuation facility should be undertaken or alternatively the design of the proposed drainage network should be upgraded accordingly.

#### **Pollution Control**

- 6.17 Pollution control measures should be put in place during the detail design in accordance with CIRIA 697 to reduce the risk of contaminants entering the watercourse or ground water table. The private roads/drives and adoptable highway will present the highest pollution risk from this source and some of the pollution control measures for these area could include the use of:
- catchpit gullies;
  - catchpit manholes;
  - T-shaped outlet pipes on the final manholes prior to discharging into the soakaway or attenuation facility;
  - oil separators.
- 6.18 The pollution control measures listed above form part of the positive drainage network that will drain the proposed development. Further pollution control measure could also be implemented in to the drainage strategy with the careful selection of SuDS techniques such as filter strips, storage lagoons, swales and permeable paving etc.

## 7 **Off Site Impacts**

### **Impact of Development on Hydrological Morphology**

- 7.1 The proposed allocation site is sequentially placed outside of the extents of the worst recorded historical flood event and therefore the proposed development is considered not to be located within the fluvial flow path of any watercourse and will not occupy any critical floodplain storage.
- 7.2 Therefore the development will have no major impact on the hydrological morphology of the surrounding area.

### **Impact of Surface Water Drainage**

- 7.3 The proposed surface water drainage strategy as detailed within Section 6 of this report will include a restricted discharge equal to the Greenfield runoff rate into the adjacent watercourse (Award Drain 165) and the provision of on-site attenuation up to the critical 1 in 100 year plus climate change storm event in accordance with the NPPF and the NPPF Technical Guidance Document.
- 7.4 Therefore there will be no increased risk of surface water flooding to the site, its occupants or existing surrounding development.

## 8 **Residual Risks**

### **Remaining Flood Risks**

- 8.1 The main residual flood risks to be considered is that from the possible blockage/surcharging of sewers, both private and public which surround and cross the site. Should the maintenance of these structures not be undertaken then there is an increased risk that they could cause flooding.

### **Risk Management Responsibility**

- 8.2 The maintenance and repair of the existing public sewer network surrounding the site is the responsibility of Anglian Water and/or the Highways Authority and is outside the control of the developer.
- 8.3 The maintenance and ownership of the proposed surface water drainage network should be established during the early stages of detailed design process. Where it is possible the system should be offered for adoption to a responsible authority such as Anglian Water or Cambridgeshire County Council as part of their role as the Lead Local Flood Authority (LLFA) to ensure it's effective and long term use.
- 8.4 The adopting authority will have an impact on the final design parameter of the surface water drainage system such as the type of attenuation i.e. Anglian Water will only adopt large diameter pipes/culvert or concrete attenuation tanks. Therefore as stated above it is vital that the adoption of the surface water drainage system is identified early during the detailed design process.

## 9 **Overview**

- 9.1 This Flood Risk and Drainage Assessment has been prepared in accordance with the National Planning Policy Framework (NPPF), the NPPF Technical Guidance document and the Companion Practice Guide to Planning Policy Statement (PPS25).
- 9.2 The report demonstrates that the proposed allocation site:
- 1) is located outside of the historical flood extent.
  - 2) is not subject to the sequential and exception tests during the planning process.
  - 3) is at a low risk of flooding from all sources subject to onsite mitigation measures.
  - 4) will provide a suitable sustainable surface water drainage strategy to drain the site.
- 9.3 Therefore, the proposed development is considered appropriate from a flood risk and drainage perspective subject to the implementation of the recommended mitigation measures put forward as part of this report.

Land North of Impington Lane, Histon, Cambridgeshire  
September 2013

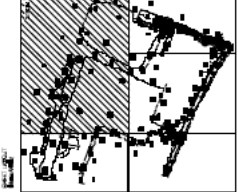
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# Appendix A

Topographical Survey (Existing Site Layout)

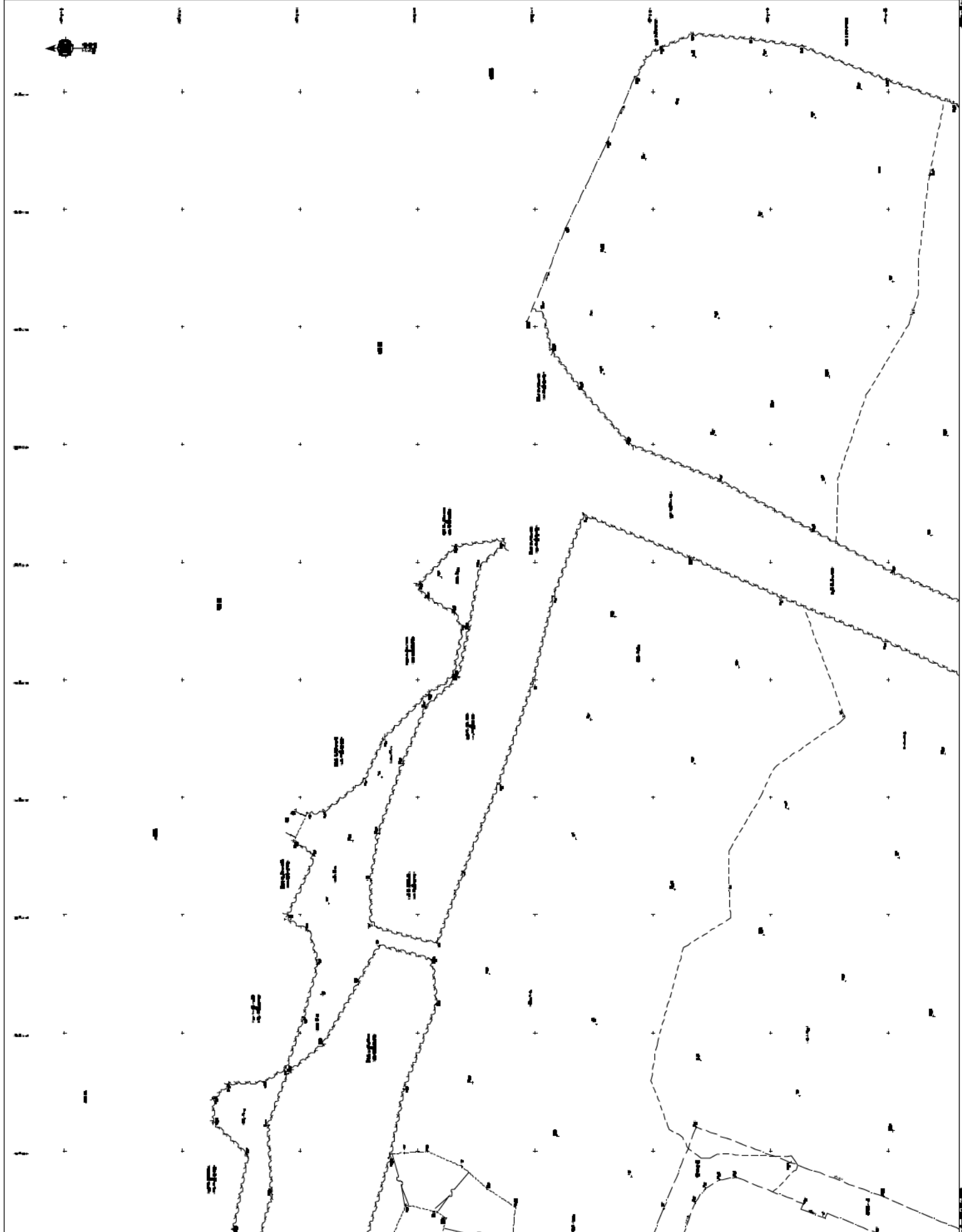


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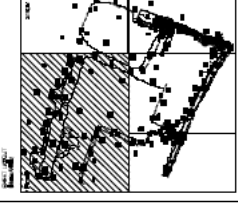


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 4. The survey was conducted in accordance with the ...  
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 6. The survey was conducted in accordance with the ...  
 7. The survey was conducted in accordance with the ...  
 8. The survey was conducted in accordance with the ...  
 9. The survey was conducted in accordance with the ...  
 10. The survey was conducted in accordance with the ...

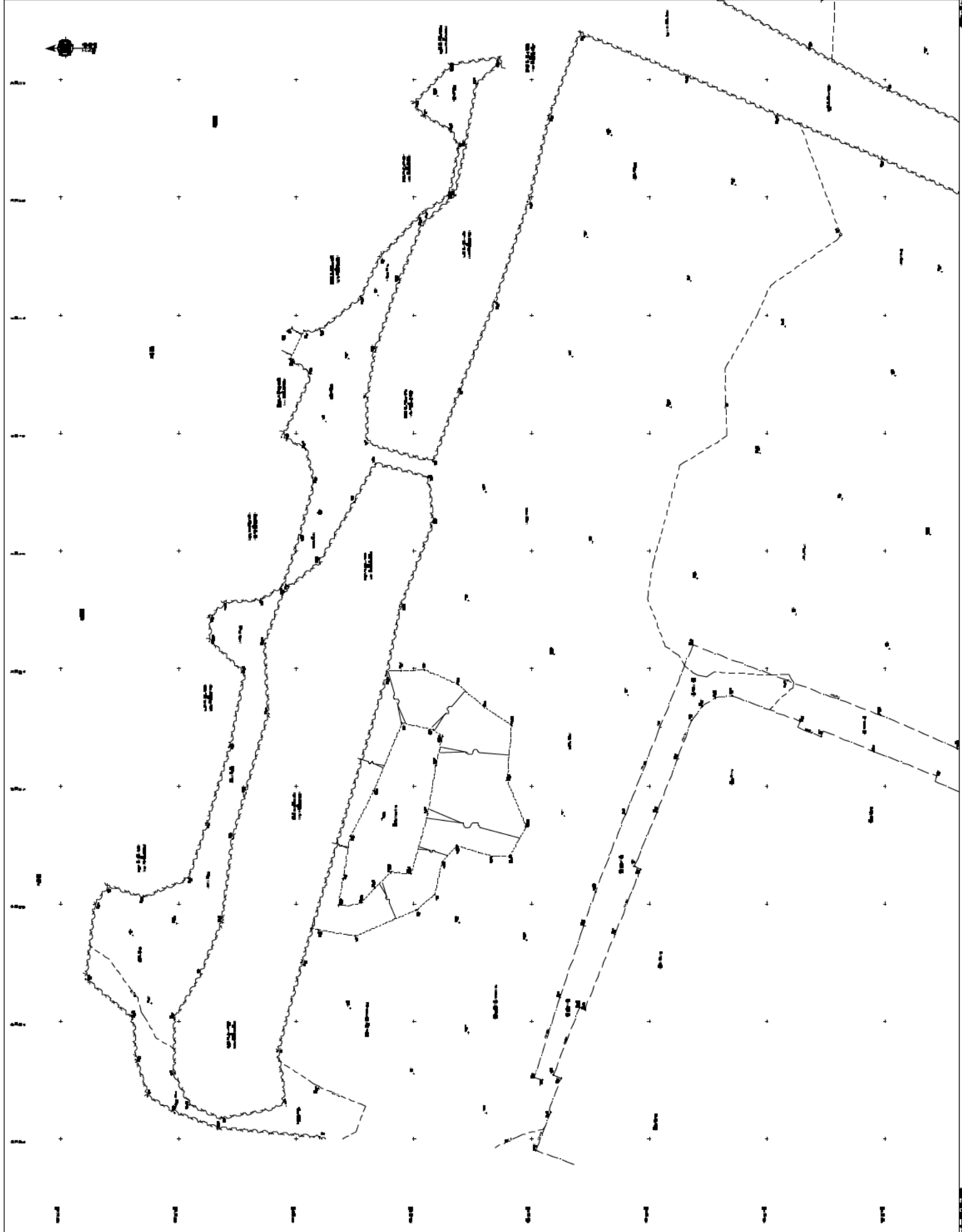


1. The survey was conducted on the 15th day of the month of ...  
 2. The area surveyed is situated in the ...  
 3. The survey was conducted by ...  
 4. The survey was conducted in accordance with the ...  
 5. The survey was conducted in accordance with the ...  
 6. The survey was conducted in accordance with the ...  
 7. The survey was conducted in accordance with the ...  
 8. The survey was conducted in accordance with the ...  
 9. The survey was conducted in accordance with the ...  
 10. The survey was conducted in accordance with the ...



1. The survey was conducted on the 15th day of the month of ...  
 2. The area surveyed is situated in the ...  
 3. The survey was conducted by ...  
 4. The survey was conducted in accordance with the ...  
 5. The survey was conducted in accordance with the ...  
 6. The survey was conducted in accordance with the ...  
 7. The survey was conducted in accordance with the ...  
 8. The survey was conducted in accordance with the ...  
 9. The survey was conducted in accordance with the ...  
 10. The survey was conducted in accordance with the ...

**SURVEY**  
 1. The survey was conducted on the 15th day of the month of ...  
 2. The area surveyed is situated in the ...  
 3. The survey was conducted by ...  
 4. The survey was conducted in accordance with the ...  
 5. The survey was conducted in accordance with the ...  
 6. The survey was conducted in accordance with the ...  
 7. The survey was conducted in accordance with the ...  
 8. The survey was conducted in accordance with the ...  
 9. The survey was conducted in accordance with the ...  
 10. The survey was conducted in accordance with the ...



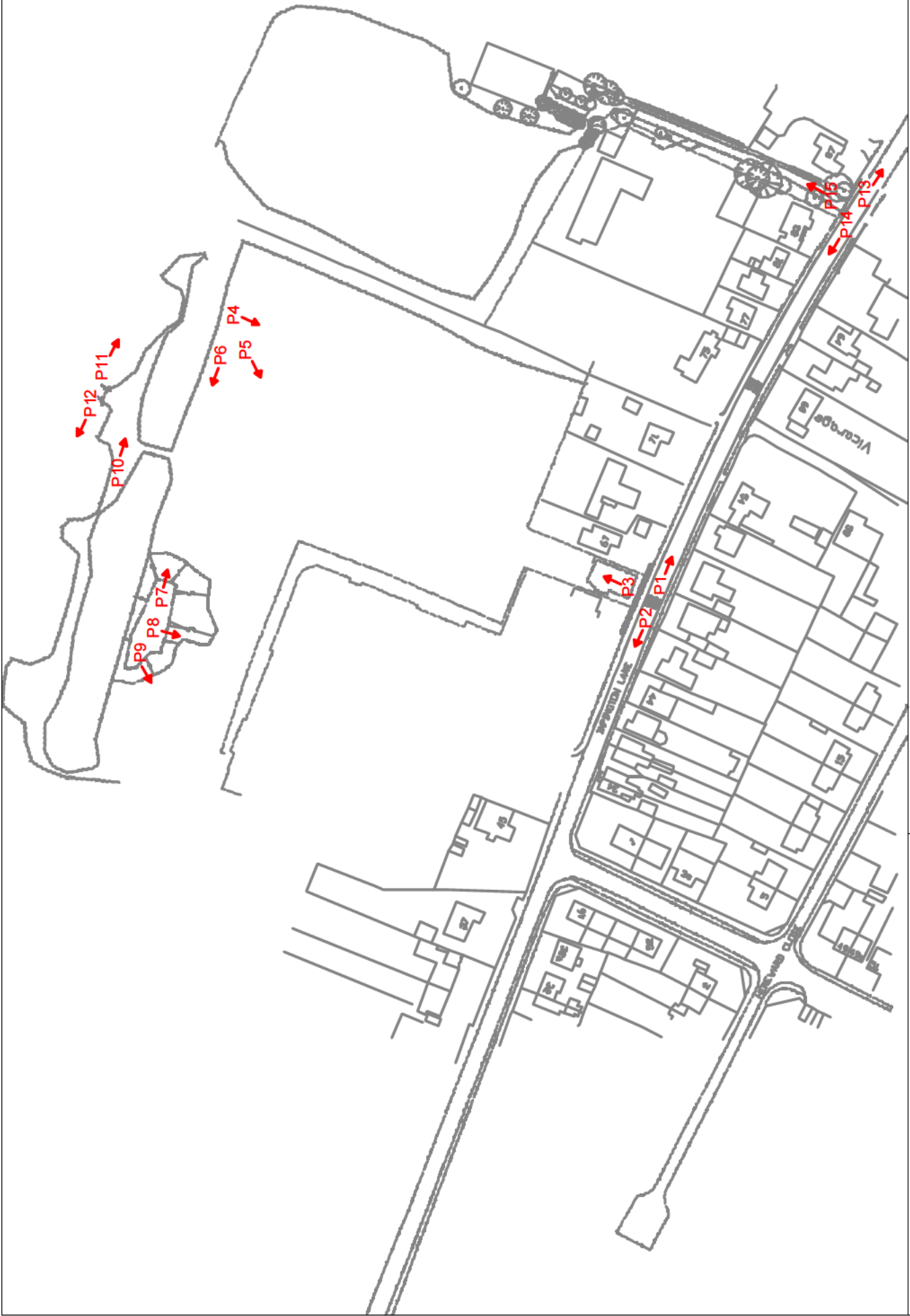


Land North of Impington Lane, Histon, Cambridgeshire  
September 2013

**BIDWELLS**

# Appendix B

Site Photos



building consultancy		16 Upper King Street, Norwich, Norfolk NR1 1TH		01603760000	
client	W J UrwinEPLAF and Messes Biggs	file	Photo Location Plan	date	25/09/12
project	Land North of Impington Lane, Histon	author	FRA Purposes Only	drawn by	RSM
discipline	Consulting Engineers	report no.	W050300001	scale	1:1250
		sheet no.	Appendix B	total sheets	0

**NOTES**

Do not use a from this drawing, use figured dimensions only.  
 All dimensions to be checked on site.  
 All drawings to be used in conjunction with other contract documents.  
 Any discrepancy due to be reported to the Contract Administrator before any work commences.  
 © Copyright Bidwell LLP

rev.	date	description	dn	dwg

Land North of Impington Lane, Histon, Cambridgeshire  
September 2012



Land North of Impington Lane, Histon, Cambridgeshire  
September 2012



Land North of Impington Lane, Histon, Cambridgeshire  
September 2012



Land North of Impington Lane, Histon, Cambridgeshire  
September 2013

**BIDWELLS**

# Appendix C

Proposed Development Layout



Land North of Impington Lane, Histon, Cambridgeshire  
September 2013

**BIDWELLS**

# Appendix D

Environment Agency Product 4 Data

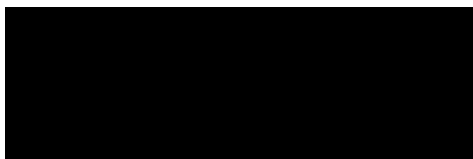


Laura

Laura Holmes  
External Relations Officer  
Central Area, Anglian

t:  
e: \_\_\_\_\_

Have your say on how we can work together to improve the water environment through our **Working Together consultation**. You can view and respond to the consultation here <https://consult.environment-agency.gov.uk/portal/ho/wfd/working/together2012>.



CC/2012/16859

Click [here](#) to report this email as spam.

Dear Sir/Madam

Could you please provide a quotation to provide **Product 4 Data** for the site detailed below and shown on the attached site location plans.

Land to the rear of 67 Impington Lane  
Histon  
Cambridgeshire  
CB24 9AL

Grid Ref: TL 444 634

I understand from discussions with your colleagues and the LPA that flood data and flow data is available for the adjacent watercourse (as detailed within an FRA undertaken for an adjacent development). If this is a higher product data code than the one I have requested above then please adjust your quotation accordingly.

If you would like to discuss the above or require further clarification then please contact me or in my absence Jon Frith on the number below.

Kind Regards,

**Richard Martin**  
Senior Civil Engineer  
Consulting Engineers

Bidwells 16 Upper King Street Norwich, Norfolk, NR3 1HA

t: \_\_\_\_\_  
dd: \_\_\_\_\_  
m: \_\_\_\_\_



[www.bidwells.co.uk](http://www.bidwells.co.uk)

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Land North of Impington Lane, Histon, Cambridgeshire  
September 2013

**BIDWELLS**

# Appendix E

Surface Water Drainage Layout



Land North of Impington Lane, Histon, Cambridgeshire  
September 2013

**BIDWELLS**

# Appendix F

Surface Water Drainage Calculations

Stonecross  
Trumpington High Street  
Cambridge CB2 9SU

Residential Development  
Impington Lane  
Histon\_Cambs



Date August 2013  
File

Designed by RSM  
Checked by

Elstree Computing Ltd

Source Control W.12.6

ICP SUDS Mean Annual Flood

Input

Return Period (years) 1 SAAR (mm) 553 Urban 0.000  
Area (ha) 1.500 Soil 0.450 Region Number Region 5

**Results 1/s**

QBAR Rural 5.0  
QBAR Urban 5.0

Q1 year 4.4

Q1 year 4.4

Q30 years 12.0

Q100 years 17.8

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.228	0.128	2.5	0.0	2.5	85.7	O K
30 min Summer	9.265	0.165	3.1	0.0	3.1	110.5	O K
60 min Summer	9.304	0.204	3.5	0.0	3.5	136.9	O K
120 min Summer	9.343	0.243	3.8	0.0	3.8	163.2	O K
180 min Summer	9.365	0.265	3.9	0.0	3.9	177.4	O K
240 min Summer	9.378	0.278	4.0	0.0	4.0	186.1	O K
360 min Summer	9.390	0.290	4.1	0.0	4.1	194.1	O K
480 min Summer	9.396	0.296	4.1	0.0	4.1	198.4	O K
600 min Summer	9.400	0.300	4.2	0.0	4.2	201.2	O K
720 min Summer	9.403	0.303	4.2	0.0	4.2	202.9	O K
960 min Summer	9.404	0.304	4.2	0.0	4.2	204.1	O K
1440 min Summer	9.400	0.300	4.2	0.0	4.2	201.2	O K
2160 min Summer	9.386	0.286	4.1	0.0	4.1	191.7	O K
2880 min Summer	9.369	0.269	4.0	0.0	4.0	180.3	O K
4320 min Summer	9.337	0.237	3.7	0.0	3.7	158.6	O K
5760 min Summer	9.310	0.210	3.5	0.0	3.5	140.6	O K
7200 min Summer	9.288	0.188	3.3	0.0	3.3	126.4	O K
8640 min Summer	9.272	0.172	3.2	0.0	3.2	115.1	O K
10080 min Summer	9.258	0.158	3.0	0.0	3.0	105.9	O K
15 min Winter	9.243	0.143	2.8	0.0	2.8	96.0	O K
30 min Winter	9.285	0.185	3.3	0.0	3.3	123.9	O K
60 min Winter	9.329	0.229	3.7	0.0	3.7	153.8	O K
120 min Winter	9.374	0.274	4.0	0.0	4.0	183.9	O K
180 min Winter	9.399	0.299	4.1	0.0	4.1	200.4	O K
240 min Winter	9.415	0.315	4.2	0.0	4.2	210.9	O K
360 min Winter	9.430	0.330	4.3	0.0	4.3	221.3	O K
Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)				
15 min Summer	30.991	0.0	19				
30 min Summer	20.215	0.0	33				
60 min Summer	12.800	0.0	62				
120 min Summer	7.942	0.0	122				
180 min Summer	5.979	0.0	182				
240 min Summer	4.882	0.0	240				
360 min Summer	3.646	0.0	334				
480 min Summer	2.956	0.0	390				
600 min Summer	2.511	0.0	452				
720 min Summer	2.199	0.0	518				
960 min Summer	1.782	0.0	654				
1440 min Summer	1.326	0.0	926				
2160 min Summer	0.988	0.0	1340				
2880 min Summer	0.800	0.0	1732				
4320 min Summer	0.595	0.0	2508				
5760 min Summer	0.483	0.0	3232				
7200 min Summer	0.410	0.0	3968				
8640 min Summer	0.359	0.0	4672				
10080 min Summer	0.322	0.0	5440				
15 min Winter	30.991	0.0	19				
30 min Winter	20.215	0.0	33				
60 min Winter	12.800	0.0	62				
120 min Winter	7.942	0.0	120				
180 min Winter	5.979	0.0	178				
240 min Winter	4.882	0.0	234				
360 min Winter	3.646	0.0	344				

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
480 min Winter	9.435	0.335	4.4	0.0	4.4	224.8	O K
600 min Winter	9.438	0.338	4.4	0.0	4.4	226.8	O K
720 min Winter	9.440	0.340	4.4	0.0	4.4	228.0	O K
960 min Winter	9.439	0.339	4.4	0.0	4.4	227.3	O K
1440 min Winter	9.427	0.327	4.3	0.0	4.3	219.4	O K
2160 min Winter	9.401	0.301	4.2	0.0	4.2	202.0	O K
2880 min Winter	9.374	0.274	4.0	0.0	4.0	183.7	O K
4320 min Winter	9.327	0.227	3.7	0.0	3.7	151.9	O K
5760 min Winter	9.291	0.191	3.4	0.0	3.4	127.8	O K
7200 min Winter	9.265	0.165	3.1	0.0	3.1	110.6	O K
8640 min Winter	9.246	0.146	2.8	0.0	2.8	98.2	O K
10080 min Winter	9.232	0.132	2.6	0.0	2.6	88.7	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m <sup>3</sup> )	Time-Peak (mins)
480 min Winter	2.956	0.0	444
600 min Winter	2.511	0.0	476
720 min Winter	2.199	0.0	552
960 min Winter	1.782	0.0	706
1440 min Winter	1.326	0.0	1010
2160 min Winter	0.988	0.0	1432
2880 min Winter	0.800	0.0	1848
4320 min Winter	0.595	0.0	2636
5760 min Winter	0.483	0.0	3352
7200 min Winter	0.410	0.0	4104
8640 min Winter	0.359	0.0	4832
10080 min Winter	0.322	0.0	5544

Stonecross  
 Trumpington High Street  
 Cambridge CB2 9SU

Residential Development  
 Impington Lane  
 Histon\_Cambs



Date August 2013  
 File M1\_Storage.srcx

Designed by RSM  
 Checked by

Elstree Computing Ltd

Source Control W.12.6

### Rainfall Details


Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

### Time / Area Diagram

Total Area (ha) 1.500

Time (mins)	Area (ha)
----------------	--------------

0-4	1.500
-----	-------

Bidwells		Page 5
Stonecross Trumpington High Street Cambridge CB2 9SU	Residential Development Impington Lane Histon_Cambs	
Date August 2013 File M1_Storage.srcx	Designed by RSM Checked by	
Elstree Computing Ltd		Source Control W.12.6

Model Details

Storage is Online Cover Level (m) 10.200

Tank or Pond Structure

Invert Level (m) 9.100

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	670.5	0.600	670.5	1.200	0.0	1.800	0.0	2.400	0.0
0.100	670.5	0.700	670.5	1.300	0.0	1.900	0.0	2.500	0.0
0.200	670.5	0.800	670.5	1.400	0.0	2.000	0.0		
0.300	670.5	0.900	0.0	1.500	0.0	2.100	0.0		
0.400	670.5	1.000	0.0	1.600	0.0	2.200	0.0		
0.500	670.5	1.100	0.0	1.700	0.0	2.300	0.0		

Hydro-Brake® Outflow Control

Design Head (m) 0.800 Hydro-Brake® Type Md8 Invert Level (m) 9.100  
Design Flow (l/s) 6.6 Diameter (mm) 109

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0	0.800	6.5	2.000	10.3	4.000	14.5	7.000	19.2
0.200	3.4	1.000	7.3	2.200	10.8	4.500	15.4	7.500	19.9
0.300	4.2	1.200	8.0	2.400	11.3	5.000	16.3	8.000	20.6
0.400	4.7	1.400	8.6	2.600	11.7	5.500	17.1	8.500	21.2
0.500	5.2	1.600	9.2	3.000	12.6	6.000	17.8	9.000	21.8
0.600	5.7	1.800	9.8	3.500	13.6	6.500	18.5	9.500	22.4

Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.200 Invert Level (m) 9.900

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.415	0.315	4.2	0.0	4.2	211.2	O K
30 min Summer	9.507	0.407	4.7	0.0	4.7	272.9	O K
60 min Summer	9.599	0.499	5.2	0.0	5.2	334.9	O K
120 min Summer	9.687	0.587	5.6	0.0	5.6	393.9	O K
180 min Summer	9.733	0.633	5.8	0.0	5.8	424.2	O K
240 min Summer	9.759	0.659	5.9	0.0	5.9	441.9	O K
360 min Summer	9.787	0.687	6.1	0.0	6.1	460.7	O K
480 min Summer	9.798	0.698	6.1	0.0	6.1	467.9	O K
600 min Summer	9.800	0.700	6.1	0.0	6.1	469.2	O K
720 min Summer	9.800	0.700	6.1	0.0	6.1	469.7	O K
960 min Summer	9.798	0.698	6.1	0.0	6.1	468.0	O K
1440 min Summer	9.784	0.684	6.0	0.0	6.0	458.8	O K
2160 min Summer	9.752	0.652	5.9	0.0	5.9	437.0	O K
2880 min Summer	9.716	0.616	5.7	0.0	5.7	412.8	O K
4320 min Summer	9.646	0.546	5.4	0.0	5.4	365.8	O K
5760 min Summer	9.585	0.485	5.1	0.0	5.1	325.0	O K
7200 min Summer	9.533	0.433	4.9	0.0	4.9	290.1	O K
8640 min Summer	9.488	0.388	4.6	0.0	4.6	260.4	O K
10080 min Summer	9.451	0.351	4.4	0.0	4.4	235.2	O K
15 min Winter	9.453	0.353	4.5	0.0	4.5	236.6	O K
30 min Winter	9.556	0.456	5.0	0.0	5.0	306.0	O K
60 min Winter	9.661	0.561	5.5	0.0	5.5	375.8	O K
120 min Winter	9.760	0.660	5.9	0.0	5.9	442.8	O K
180 min Winter	9.813	0.713	6.2	0.0	6.2	477.8	O K
240 min Winter	9.844	0.744	6.3	0.0	6.3	498.7	O K
360 min Winter	9.879	0.779	6.4	0.0	6.4	522.1	O K
Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)				
15 min Summer	76.035	0.0	19				
30 min Summer	49.499	0.0	34				
60 min Summer	30.811	0.0	64				
120 min Summer	18.615	0.0	122				
180 min Summer	13.715	0.0	182				
240 min Summer	10.995	0.0	242				
360 min Summer	8.034	0.0	360				
480 min Summer	6.428	0.0	480				
600 min Summer	5.404	0.0	550				
720 min Summer	4.687	0.0	606				
960 min Summer	3.743	0.0	724				
1440 min Summer	2.723	0.0	994				
2160 min Summer	1.979	0.0	1404				
2880 min Summer	1.577	0.0	1816				
4320 min Summer	1.143	0.0	2632				
5760 min Summer	0.910	0.0	3400				
7200 min Summer	0.762	0.0	4176				
8640 min Summer	0.659	0.0	4920				
10080 min Summer	0.583	0.0	5648				
15 min Winter	76.035	0.0	19				
30 min Winter	49.499	0.0	33				
60 min Winter	30.811	0.0	62				
120 min Winter	18.615	0.0	120				
180 min Winter	13.715	0.0	180				
240 min Winter	10.995	0.0	238				
360 min Winter	8.034	0.0	352				

Stonecross  
 Trumpington High Street  
 Cambridge CB2 9SU

Residential Development  
 Impington Lane  
 Histon\_Cambs



Date August 2013  
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Elstree Computing Ltd

Source Control W.12.6

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
480 min Winter	9.895	0.795	6.5	0.0	6.5	532.8	O K
600 min Winter	9.900	0.800	6.5	0.0	6.5	536.2	O K
720 min Winter	9.898	0.798	6.5	0.0	6.5	535.3	O K
960 min Winter	9.891	0.791	6.5	0.0	6.5	530.1	O K
1440 min Winter	9.868	0.768	6.4	0.0	6.4	515.2	O K
2160 min Winter	9.818	0.718	6.2	0.0	6.2	481.4	O K
2880 min Winter	9.764	0.664	6.0	0.0	6.0	444.9	O K
4320 min Winter	9.662	0.562	5.5	0.0	5.5	376.7	O K
5760 min Winter	9.576	0.476	5.1	0.0	5.1	319.5	O K
7200 min Winter	9.506	0.406	4.7	0.0	4.7	272.4	O K
8640 min Winter	9.449	0.349	4.4	0.0	4.4	234.0	O K
10080 min Winter	9.402	0.302	4.2	0.0	4.2	202.6	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
480 min Winter	6.428	0.0	464
600 min Winter	5.404	0.0	572
720 min Winter	4.687	0.0	674
960 min Winter	3.743	0.0	762
1440 min Winter	2.723	0.0	1068
2160 min Winter	1.979	0.0	1516
2880 min Winter	1.577	0.0	1960
4320 min Winter	1.143	0.0	2808
5760 min Winter	0.910	0.0	3584
7200 min Winter	0.762	0.0	4392
8640 min Winter	0.659	0.0	5104
10080 min Winter	0.583	0.0	5848

Stonecross  
 Trumpington High Street  
 Cambridge CB2 9SU

Residential Development  
 Impington Lane  
 Histon\_Cambs



Date August 2013  
 File M30\_Storage.srcx

Designed by RSM  
 Checked by

Elstree Computing Ltd

Source Control W.12.6

### Rainfall Details


Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

### Time / Area Diagram

Total Area (ha) 1.500

Time (mins)	Area (ha)
----------------	--------------

0-4	1.500
-----	-------

Bidwells		Page 9
Stonecross Trumpington High Street Cambridge CB2 9SU	Residential Development Impington Lane Histon_Cambs	
Date August 2013 File M30_Storage.srcx	Designed by RSM Checked by	
Elstree Computing Ltd		Source Control W.12.6

Model Details

Storage is Online Cover Level (m) 10.200

Tank or Pond Structure

Invert Level (m) 9.100

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	670.5	0.600	670.5	1.200	0.0	1.800	0.0	2.400	0.0
0.100	670.5	0.700	670.5	1.300	0.0	1.900	0.0	2.500	0.0
0.200	670.5	0.800	670.5	1.400	0.0	2.000	0.0		
0.300	670.5	0.900	0.0	1.500	0.0	2.100	0.0		
0.400	670.5	1.000	0.0	1.600	0.0	2.200	0.0		
0.500	670.5	1.100	0.0	1.700	0.0	2.300	0.0		

Hydro-Brake® Outflow Control

Design Head (m) 0.800 Hydro-Brake® Type Md8 Invert Level (m) 9.100  
Design Flow (l/s) 6.6 Diameter (mm) 109

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0	0.800	6.5	2.000	10.3	4.000	14.5	7.000	19.2
0.200	3.4	1.000	7.3	2.200	10.8	4.500	15.4	7.500	19.9
0.300	4.2	1.200	8.0	2.400	11.3	5.000	16.3	8.000	20.6
0.400	4.7	1.400	8.6	2.600	11.7	5.500	17.1	8.500	21.2
0.500	5.2	1.600	9.2	3.000	12.6	6.000	17.8	9.000	21.8
0.600	5.7	1.800	9.8	3.500	13.6	6.500	18.5	9.500	22.4


Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.200 Invert Level (m) 9.900

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.509	0.409	4.8	0.0	4.8	274.4	O K
30 min Summer	9.634	0.534	5.4	0.0	5.4	358.0	O K
60 min Summer	9.759	0.659	5.9	0.0	5.9	442.1	O K
120 min Summer	9.877	0.777	6.4	0.0	6.4	521.3	O K
180 min Summer	9.927	0.827	6.6	9.2	15.8	552.1	O K
240 min Summer	9.930	0.830	6.6	10.5	17.1	553.4	O K
360 min Summer	9.933	0.833	6.7	12.4	19.0	555.1	O K
480 min Summer	9.937	0.837	6.7	14.7	21.4	556.6	O K
600 min Summer	9.939	0.839	6.7	15.6	22.3	557.2	O K
720 min Summer	9.939	0.839	6.7	15.6	22.3	557.3	O K
960 min Summer	9.936	0.836	6.7	14.1	20.8	556.3	O K
1440 min Summer	9.929	0.829	6.6	10.2	16.9	553.1	O K
2160 min Summer	9.919	0.819	6.6	5.2	11.8	547.7	O K
2880 min Summer	9.906	0.806	6.5	0.9	7.4	540.0	O K
4320 min Summer	9.820	0.720	6.2	0.0	6.2	482.7	O K
5760 min Summer	9.742	0.642	5.9	0.0	5.9	430.5	O K
7200 min Summer	9.675	0.575	5.6	0.0	5.6	385.7	O K
8640 min Summer	9.618	0.518	5.3	0.0	5.3	347.3	O K
10080 min Summer	9.569	0.469	5.1	0.0	5.1	314.1	O K
15 min Winter	9.559	0.459	5.0	0.0	5.0	307.5	O K
30 min Winter	9.699	0.599	5.7	0.0	5.7	401.4	O K
60 min Winter	9.840	0.740	6.3	0.0	6.3	496.0	O K
120 min Winter	9.953	0.853	6.7	24.8	31.5	562.5	O K
180 min Winter	9.962	0.862	6.8	31.4	38.1	565.1	O K
240 min Winter	9.972	0.872	6.8	39.3	46.1	567.2	O K
360 min Winter	9.973	0.873	6.8	40.1	46.9	567.4	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	98.681	0.0	19
30 min Summer	64.789	0.0	34
60 min Summer	40.510	0.0	64
120 min Summer	24.461	0.0	122
180 min Summer	17.964	14.2	180
240 min Summer	14.342	37.4	212
360 min Summer	10.418	65.4	262
480 min Summer	8.302	79.6	322
600 min Summer	6.956	85.3	388
720 min Summer	6.017	85.8	456
960 min Summer	4.784	80.9	590
1440 min Summer	3.456	65.6	868
2160 min Summer	2.493	35.8	1316
2880 min Summer	1.975	4.1	1812
4320 min Summer	1.421	0.0	2640
5760 min Summer	1.124	0.0	3456
7200 min Summer	0.936	0.0	4184
8640 min Summer	0.806	0.0	4936
10080 min Summer	0.710	0.0	5744
15 min Winter	98.681	0.0	19
30 min Winter	64.789	0.0	33
60 min Winter	40.510	0.0	62
120 min Winter	24.461	36.5	114
180 min Winter	17.964	83.9	138
240 min Winter	14.342	112.7	170
360 min Winter	10.418	147.3	238

Bidwells		Page 11
Stonecross Trumpington High Street Cambridge CB2 9SU	Residential Development Impington Lane Histon_Cams	
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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
480 min Winter	9.968	0.868	6.8	36.5	43.2	566.6	O K
600 min Winter	9.964	0.864	6.8	32.9	39.7	565.5	O K
720 min Winter	9.959	0.859	6.7	29.1	35.9	564.2	O K
960 min Winter	9.951	0.851	6.7	23.4	30.1	561.8	O K
1440 min Winter	9.939	0.839	6.7	15.9	22.6	557.6	O K
2160 min Winter	9.928	0.828	6.6	9.5	16.1	552.4	O K
2880 min Winter	9.918	0.818	6.6	5.0	11.6	547.5	O K
4320 min Winter	9.856	0.756	6.3	0.0	6.3	506.8	O K
5760 min Winter	9.747	0.647	5.9	0.0	5.9	433.9	O K
7200 min Winter	9.657	0.557	5.5	0.0	5.5	373.3	O K
8640 min Winter	9.582	0.482	5.1	0.0	5.1	322.9	O K
10080 min Winter	9.519	0.419	4.8	0.0	4.8	280.8	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
480 min Winter	8.302	166.2	306
600 min Winter	6.956	175.4	374
720 min Winter	6.017	178.5	442
960 min Winter	4.784	173.4	580
1440 min Winter	3.456	149.2	864
2160 min Winter	2.493	105.7	1296
2880 min Winter	1.975	57.1	1764
4320 min Winter	1.421	0.0	2852
5760 min Winter	1.124	0.0	3640
7200 min Winter	0.936	0.0	4464
8640 min Winter	0.806	0.0	5192
10080 min Winter	0.710	0.0	5952

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Residential Development  
 Impington Lane  
 Histon\_Cambs



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Source Control W.12.6

### Rainfall Details


Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

### Time / Area Diagram

Total Area (ha) 1.500

Time (mins)	Area (ha)
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0-4	1.500
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Stonecross Trumpington High Street Cambridge CB2 9SU	Residential Development Impington Lane Histon_Cambs	
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Model Details

Storage is Online Cover Level (m) 10.200

Tank or Pond Structure

Invert Level (m) 9.100

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	670.5	0.600	670.5	1.200	0.0	1.800	0.0	2.400	0.0
0.100	670.5	0.700	670.5	1.300	0.0	1.900	0.0	2.500	0.0
0.200	670.5	0.800	670.5	1.400	0.0	2.000	0.0		
0.300	670.5	0.900	0.0	1.500	0.0	2.100	0.0		
0.400	670.5	1.000	0.0	1.600	0.0	2.200	0.0		
0.500	670.5	1.100	0.0	1.700	0.0	2.300	0.0		

Hydro-Brake® Outflow Control

Design Head (m) 0.800 Hydro-Brake® Type Md8 Invert Level (m) 9.100  
Design Flow (l/s) 6.6 Diameter (mm) 109

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0	0.800	6.5	2.000	10.3	4.000	14.5	7.000	19.2
0.200	3.4	1.000	7.3	2.200	10.8	4.500	15.4	7.500	19.9
0.300	4.2	1.200	8.0	2.400	11.3	5.000	16.3	8.000	20.6
0.400	4.7	1.400	8.6	2.600	11.7	5.500	17.1	8.500	21.2
0.500	5.2	1.600	9.2	3.000	12.6	6.000	17.8	9.000	21.8
0.600	5.7	1.800	9.8	3.500	13.6	6.500	18.5	9.500	22.4

Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.200 Invert Level (m) 9.900

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.633	0.533	5.4	0.0	5.4	357.2	O K
30 min Summer	9.796	0.696	6.1	0.0	6.1	466.4	O K
60 min Summer	9.961	0.861	6.8	30.6	37.4	564.7	O K
120 min Summer	10.018	0.918	7.0	83.1	90.1	569.9	O K
180 min Summer	10.085	0.985	7.2	163.0	170.2	569.9	O K
240 min Summer	10.055	0.955	7.1	124.5	131.6	569.9	O K
360 min Summer	10.058	0.958	7.1	128.7	135.8	569.9	O K
480 min Summer	10.045	0.945	7.1	112.6	119.7	569.9	O K
600 min Summer	10.019	0.919	7.0	84.2	91.2	569.9	O K
720 min Summer	10.005	0.905	6.9	69.8	76.7	569.9	O K
960 min Summer	9.988	0.888	6.9	53.1	60.0	569.9	O K
1440 min Summer	9.970	0.870	6.8	38.1	44.9	566.9	O K
2160 min Summer	9.954	0.854	6.7	25.5	32.2	562.8	O K
2880 min Summer	9.943	0.843	6.7	18.4	25.1	559.1	O K
4320 min Summer	9.929	0.829	6.6	10.2	16.9	553.1	O K
5760 min Summer	9.919	0.819	6.6	5.2	11.8	547.8	O K
7200 min Summer	9.908	0.808	6.5	1.4	7.9	541.3	O K
8640 min Summer	9.849	0.749	6.3	0.0	6.3	502.0	O K
10080 min Summer	9.784	0.684	6.0	0.0	6.0	458.9	O K
15 min Winter	9.697	0.597	5.7	0.0	5.7	400.3	O K
30 min Winter	9.880	0.780	6.4	0.0	6.4	522.8	O K
60 min Winter	10.054	0.954	7.1	123.3	130.4	569.9	O K
120 min Winter	10.153	1.053	7.5	259.8	267.3	569.9	O K
180 min Winter	10.081	0.981	7.2	157.8	165.0	569.9	O K
240 min Winter	10.108	1.008	7.3	193.6	200.9	569.9	O K
360 min Winter	10.067	0.967	7.2	139.2	146.4	569.9	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	128.285	0.0	19
30 min Summer	84.226	0.0	34
60 min Summer	52.662	26.2	62
120 min Summer	31.800	132.6	86
180 min Summer	23.353	189.3	110
240 min Summer	18.644	224.3	140
360 min Summer	13.543	267.6	210
480 min Summer	10.792	292.6	280
600 min Summer	9.043	306.5	338
720 min Summer	7.823	313.1	392
960 min Summer	6.219	313.0	512
1440 min Summer	4.493	295.0	764
2160 min Summer	3.241	261.1	1144
2880 min Summer	2.568	223.0	1528
4320 min Summer	1.847	145.7	2332
5760 min Summer	1.461	74.7	3176
7200 min Summer	1.217	13.5	4144
8640 min Summer	1.048	0.0	5016
10080 min Summer	0.923	0.0	5760
15 min Winter	128.285	0.0	19
30 min Winter	84.226	0.0	33
60 min Winter	52.662	96.2	52
120 min Winter	31.800	217.6	78
180 min Winter	23.353	282.8	120
240 min Winter	18.644	323.5	162
360 min Winter	13.543	375.3	226

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
480 min Winter	10.032	0.932	7.0	98.3	105.4	569.9	O K
600 min Winter	10.006	0.906	6.9	70.8	77.7	569.9	O K
720 min Winter	9.996	0.896	6.9	60.6	67.5	569.9	O K
960 min Winter	9.980	0.880	6.8	46.5	53.3	568.6	O K
1440 min Winter	9.962	0.862	6.8	31.8	38.5	565.2	O K
2160 min Winter	9.947	0.847	6.7	21.0	27.7	560.7	O K
2880 min Winter	9.938	0.838	6.7	15.3	22.0	557.1	O K
4320 min Winter	9.926	0.826	6.6	8.7	15.3	551.6	O K
5760 min Winter	9.917	0.817	6.6	4.6	11.2	546.9	O K
7200 min Winter	9.907	0.807	6.5	1.1	7.7	540.6	O K
8640 min Winter	9.823	0.723	6.2	0.0	6.2	484.6	O K
10080 min Winter	9.739	0.639	5.8	0.0	5.8	428.6	O K

Storm Event	Rain (mm/hr)	Overflow Volume (m <sup>3</sup> )	Time-Peak (mins)
480 min Winter	10.792	406.5	278
600 min Winter	9.043	425.3	332
720 min Winter	7.823	436.0	380
960 min Winter	6.219	441.8	508
1440 min Winter	4.493	420.3	754
2160 min Winter	3.241	372.8	1144
2880 min Winter	2.568	319.5	1524
4320 min Winter	1.847	206.5	2332
5760 min Winter	1.461	101.6	3232
7200 min Winter	1.217	13.4	4392
8640 min Winter	1.048	0.0	5280
10080 min Winter	0.923	0.0	6056

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Elstree Computing Ltd

Source Control W.12.6

### Rainfall Details


Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

### Time / Area Diagram

Total Area (ha) 1.500

Time (mins)	Area (ha)
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0-4	1.500
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Bidwells		Page 17
Stonecross Trumpington High Street Cambridge CB2 9SU	Residential Development Impington Lane Histon_Cambs	
Date August 2013 File M100+CC_Storage.srcx	Designed by RSM Checked by	
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Model Details

Storage is Online Cover Level (m) 10.200

Tank or Pond Structure

Invert Level (m) 9.100

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	670.5	0.600	670.5	1.200	0.0	1.800	0.0	2.400	0.0
0.100	670.5	0.700	670.5	1.300	0.0	1.900	0.0	2.500	0.0
0.200	670.5	0.800	670.5	1.400	0.0	2.000	0.0		
0.300	670.5	0.900	0.0	1.500	0.0	2.100	0.0		
0.400	670.5	1.000	0.0	1.600	0.0	2.200	0.0		
0.500	670.5	1.100	0.0	1.700	0.0	2.300	0.0		

Hydro-Brake® Outflow Control

Design Head (m) 0.800 Hydro-Brake® Type Md8 Invert Level (m) 9.100  
Design Flow (l/s) 6.6 Diameter (mm) 109

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0	0.800	6.5	2.000	10.3	4.000	14.5	7.000	19.2
0.200	3.4	1.000	7.3	2.200	10.8	4.500	15.4	7.500	19.9
0.300	4.2	1.200	8.0	2.400	11.3	5.000	16.3	8.000	20.6
0.400	4.7	1.400	8.6	2.600	11.7	5.500	17.1	8.500	21.2
0.500	5.2	1.600	9.2	3.000	12.6	6.000	17.8	9.000	21.8
0.600	5.7	1.800	9.8	3.500	13.6	6.500	18.5	9.500	22.4

Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.200 Invert Level (m) 9.900

Land North of Impington Lane, Histon, Cambridgeshire  
September 2013

**BIDWELLS**

# Appendix G

Preliminary Land Re-profiling Proposal

MAGENTA HATCH INDICATES AREA OF LAND TO PROVIDE COMPENSATION STORAGE.

GREEN HATCH INDICATES AREA OF OUTLINE DEVELOPMENT PROPOSAL LOCATED BELOW 10.35M AOD AND REQUIRING LAND RAISING.

Drain



**building consultancy** | humpington road, cambridge, cb2 3ld | 01223 841641

client: [REDACTED] | title: PRELIMINARY GROUND REPROFILING PROPOSAL | date: 10/10/13

project: IMPINGTON LANE, HISTON | status: PRELIMINARY | scale: @ 1:50

drawn: RSM | checked: RSM | project no.: W779500003 | sheet no.: SK101

drawn: RSM | checked: RSM | project no.: W779500003 | sheet no.: SK101

drawn: RSM | checked: RSM | project no.: W779500003 | sheet no.: SK101

**NOTES**

Do not scale from this drawing, use figured dimensions only.

All dimensions to be checked onsite.

All drawings to be read in conjunction with other contract documentation.

Any discrepancies to be reported to the Contract Administrator before any work commences.

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P1	10/10/13	First Issue	RSM	dm	chkd

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