Flood Risk Assessment and Drainage Strategy

Client: **The University of Lincoln**

Project : **Masterplan 2012 & 2020**
University of Lincoln

Job No. : 10/3921

Revision : B

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SCHEDULE OF REVISIONS

REVISION	ISSUE DATE	DESCRIPTION
First Issue	March 2010	
A	April 2010	Calculations amended using FEH rainfall data.
B	September 2011	Updated to suit revised architects masterplan and updated Lincoln SFRA.

1 Introduction

1.1 Background

Ward Cole Consulting Engineers were commissioned by the University of Lincoln to undertake a flood risk assessment on the South East Quadrant which forms part of the Lincoln University Masterplan 2012 & 2020.

1.2 Location

The site forms part of the main Brayford Campus of the University of Lincoln and is situated to the East of the High Street. Forming the Northern boundary of the site is the main railway, which divides the South East Quadrant from the main administrative building for the University, with pedestrian access being formed by footbridge. Vehicles access the site via the B1003 Ropewalk to the South, with the East and West boundaries formed by the Brayford Wharf East and Brayford Way roads respectively, with the River Witham running inside the Eastern Boundary before reaching Brayford Pool North of the railway. *(See Appendix A).*

1.3 Site Description & Current Usage

As existing, the 9.28 ha site is approximately 52% developed impermeable land and is home to some of the Brayford Campus University buildings, including the Lincoln School of Performing Arts, the Lincoln School of Architecture and the Sparkhouse Studios. The Western part of the site is dominated by the Delph balancing pond; this with its surrounding area accounts for approximately 65% of the total permeable area of the site. This pond is a relatively new addition to the site – just to the East is an area of made ground, just over 4000m², where an original pond has been backfilled to suit the development works. The North West corner of the site, adjacent to the railway, is home to the Science Centre and Lincoln School of Architecture, while the other educational buildings are concentrated to the East, with associated car parking and vehicular access, between the Ropewalk access and the Witham. A tarmac access road, just over 6m wide with block paved parking spaces either side, runs from the Ropewalk access along the Southern & Western boundaries and serves as vehicular access to the Science Centre.

The site as existing is fairly flat, with the existing buildings being set at between 6.20m AOD (Sparkhouse, South East corner), to 5.65m AOD (Science Centre, North West corner). The Delph pond water level is in the region of 2.7m AOD, with bank levels reaching 5.13m AOD and a substantial earth bund along its Southern extent, which reaches 1.9m in height. The highest levels on the site can be found in an area of earth fill / rubble, adjacent to the Ropewalk access, where the topographical survey shows levels up to 8.58m AOD. *(See Appendix B)*

1.4 Site Proposals

The university have drafted a masterplan for the future expansion of the university campus. The initial masterplan highlights buildings to be completed by 2012 which include the Engineering Hub and Arts Box. The overall masterplan which will be completed by 2020 will include the development of further educational buildings to be constructed around the Delph pond as shown on the masterplan drawing within Appendix B. Additionally, buildings to the north of the existing EMMTEC building and also directly west of the building on the other side of Brayford Way are proposed. To the west of the Brayford Way, directly south of the railway lines a proposed new building is to be situated near to the existing football pitch.

1.5 The Sequential Test

This risk-based test has the aim of steering new development to areas at the lowest probability of flooding in accordance with PPS25. It is broken down in to three tables as described below with appropriate results for this proposal.

Table D1 – Flood Zones

The first step is to identify, based on information found on the Environment Agency's Flood maps, what the probability of flooding is for the site. While the area North of the railway line (the North East Quadrant) has been recently downgraded to Zone 2 Medium Probability, the rest of the site would fall in to Flood Zone 3a High Probability. For the purpose of this assessment, the Zone 3a classification will be used. *(see Appendix C for the EA Flood Map)*

Table D2 – Flood Risk Vulnerability Classification

The result from this table is based on the proposed land use, in this case non-residential educational establishment, which would put the development in to the More Vulnerable category.

Table D3 – Flood Risk Vulnerability and Flood Zone 'Compatibility'

This table determines whether an Exception Test needs to be carried out. Based on the results from Tables D1 and D2 as outlined above, this proposal would require an Exception Test (see table below).

Table D3 – Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability classification (see Table D2)	Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone 1	✓	✓	✓	✓	✓
Flood Zone 2	✓	✓	Exception Test Required	✓	✓
Flood Zone 3a	Exception Test Required	✓	✗	Exception Test Required	✓
Flood Zone 3b 'Functional Floodplain,	Exception Test Required	✓	✗	✗	✗

A sequential test was passed and approved for the Masterplan 2012 (Refer to Appendix H – Environment Agency approval letter). A sequential and exception test for the Masterplan 2020 can be found in Appendix G).

2 Potential Sources of Flooding

2.1 River Witham

The River Witham flows northwards past the site upto a confluence at the Brayford Pool with the Fossdyke Navigation. The usual water level in the River Witham adjacent to the site and the Brayford Pool is 4.40m AOD with a design high water level of approximately 5.00m AOD based on a 1% probability event. The City of Lincoln benefits from the Washlands scheme comprising areas of land that are permitted to flood during severe storms; this along with a series of sluice gates, provides protection against the 1:100 year event and keeps the water level within the city between 4.36m & 5.7m AOD.

Flood levels for the Witham adjacent to the site have been given in the region of 5.59m AOD for the 1:100 year event, increasing to 5.64m AOD when climate change is factored in. These figures have been determined within the Upper Witham Lincoln Model, dated February 2007. *(See Appendix C)*

The site as existing benefits from man-made flood defences; along the South bank of Brayford Pool, these defences consist of timber / concrete piled walls, while along the Witham itself, there is a concrete flood wall. The Environment Agency have defined these defences as being in good condition and sufficient to defend against the 1:100 year event. Adjacent to the site, crest levels for these structures have been given as 5.69m AOD to the South and 5.64m AOD – as discussed above, these levels should be proof against the 1:100 year event, but with little or no available freeboard. However, it is understood that the Environment Agency inspect the defences throughout Lincoln on a regular basis, so any problems with these structures would be rectified as part of their general maintenance. Also, it is understood that either during recent redevelopment in the vicinity of the site the flood defences have been built up to approximately 5.80m AOD, which would give over 100mm of freeboard based on the flood levels provided.

2.2 Fossdyke Delph & Pond

As part of the infrastructure development works carried out on the site in the latter half of 2006, the original pond was filled in and relocated to the West. The original pond (and it's replacement) form one of two attenuation lagoons for the Fossdyke Delph, the other pond being situated some 450m to the West and being roughly 9,500m² in area. The Fossdyke Delph and associated ponds are the responsibility of the Upper Witham Internal Drainage Board (UW IDB), and discharge at Pyewipe Pumping Station, where the watercourse joins the Witham approximately 1.8km west of the site. The Fossdyke Delph has a design flood level of 3.3m AOD (assumed by the IDB). It is understood that most of the on-site surface water sewers discharge into this system as existing.

The new 2,400m² Delph Pond was designed and constructed in accordance with the Internal Drainage Board's requirements and is designed to have a normal water level of 2.7m AOD, which can rise to a level of 4.0m AOD (1:100 year) before affecting the 4.0m wide maintenance vehicle track. Based on a recorded pond edge boundary level in the region of 5.13m AOD, the water level within the pond would need to rise by some 2.4m before affecting the rest of the site. The pond also features an outfall in the South East corner, which is connected to an existing system of culverts relating to the pumping station at Coulson Road, some 700m to the South. The Upper Witham IDB believes that this system of culverts may well serve as a second point of discharge in to the Witham.

2.3 Historic Flood Event

The last major flood event to affect the site occurred in March 1947, where during a particularly harsh winter, parts of the River Trent (presumably including the River Witham) froze over, which was then followed by prolonged rainfall (which would have accelerated the thawing process), coupled with high spring tides. This sequence of events resulted in widespread flooding in the South of Lincoln City as well as other parts of the River Trent catchment.

During the flood, the only areas of the site to escape inundation were the present day locations of the Sparkhouse and the Library. Based on the Historic Flood Extent map provided by the Environment Agency *(See Appendix C)*, it can be assumed that water levels would have been in excess of 5.0m AOD, possibly reaching 5.5m AOD in the vicinity of the site. However, it is understood that the adjacent flood defences have been upgraded since this event, with crest levels reaching 5.64m to 5.69m AOD in the area, and due to recent development work, the topography of the site is likely to have changed, making full site-wide inundation less likely.

2.4 Strategic Flood Risk Assessment 2010

Published in March 2010 by JBA Consulting, the Strategic Flood Risk Assessment (SFRA) suggests that the main risk to the city is fluvial flooding from the Rivers Witham & Till, as well as from the man-made Fossdyke Canal. It also provides a series of maps illustrating parts of the city at greatest risk from overtopping and provides information relating to breach analysis at key points.

The River Witham 1000 year + CC (climate change) overtopping flood map within the SFRA (Map 4: Ref No. 3710-032) shows modelled depths of water across the site during the extreme event. According to the plan, the main part of the site would be covered with between 0.3 to 0.75m depth of water, however, a thin strip of land to the south of the railway and adjacent buildings could be inundated up to a depth in excess of 2m. The associated hazard map (Map 4: Ref 3710-050) within the SFRA shows that the 1:1000 year + CC overtopping event would lead to a hazard rating between 1.25 & 2.0, or 'danger to most' across the majority of the site. However, it also suggests that the majority of the city south of the railway & west of the River Witham during such an event would be at a similar risk.

The SFRA breach analysis has considered the effect of a breach at 3 No. locations in the vicinity of the development – one is close to EA modelled node UWA 999 adjacent to the road of Brayford Wharf East, the other appears to be in the vicinity of modelled node FD00487, under the Brayford Way bridge to the north-west of the site. The third is located to the north of the site at Brayford Pool.

The Lincoln breach flood depth (1:100 Year +CC) Map 6 (Ref: 3710-065) within the SFRA suggests a depth of water in the region of 1.5m across most of the site south of the railway during a 1:100 year plus climate change event breach and approximately 0.5m depth across most of the site north of the railway. Some isolated areas within the site are shown as having depths around 2 – 2,5m. This has been summarised as a 'danger for most' hazard rating for the majority of the site, with a band of 'danger for all' rating south of the building adjacent to the railway. Again, it is suggested that this is a worst case, as it is understood that the existing flood defences are currently in good condition and are monitored by the Environment Agency.

3 Existing Development

3.1 Existing Surface Water Drainage.

A topographical and drainage survey has been carried out detailing all existing surface water sewers on site. All surface water runoff currently drains to the existing Delph Pond which is controlled by the Upper Witham IDB. The Delph pond is one of a series of attenuation ponds which balance water during heavy and prolonged rainfall events. The normal water level is 2.7m AOD with a design flood level of 3.3m AOD and the 1:100 year flood level is 4.0m AOD.

There are currently two outfalls for the pond, which discharge in opposite directions. The main outfall is to the west of the pond, which discharges through a 1.5m box culvert into a small section of open drain then back to the box culvert leaving the site. The other outfall is located to the east, which is a 1.2m dia pipe and heads towards the River Witham below St. Marks Retail park.

All existing access roads and car park areas appear to discharge via petrol interceptors located across the site before discharging to the pond.

3.2 Existing Foul Water Drainage

The drainage survey also highlighted the existing foul sewer network serving the existing university buildings. There is a gravity network to the south of the railway which discharges to a private pump station. This is pumped underneath the railway into a gravity sewer to the north. The north side of the site is also served by a gravity network which takes pumped foul discharges from the south side and from the student residential village to the west of the site.

The entire foul sewage discharges to an adopted Anglian Water pump station located north of the existing Engine Shed building. The foul is then pumped to the existing public foul sewer within Brayford Wharf East via a 180mm rising main. We are advised by Anglian Water that the pump station capacity is 40 l/s which was designed to take the whole development and future expansion. At present, calculations show that approximately 20 l/s is currently discharging to the pump station.

4 Proposed Development

4.1 Summary of Proposals

The first phase of the university expansion will include the new Engineering Hub and Arts Box buildings to be completed by 2012. The overall masterplan which will be completed by 2020 will include the development of further buildings to be constructed around the Delph pond and also to the north of the existing EMMTEC building, and on the western side of the Brayford Way to the north and south of the railway lines.

4.2 Proposed Ground Levels

Any proposed buildings will be set at finished floor levels to match the existing / adjacent structures and likely to be in the range 5.6m AOD to 5.8m AOD, depending on ground levels.

4.3 SUDS

It is assumed at this stage that due to clay soils, the use of any infiltration devices will be limited. The use of rainwater harvesting or Green Roofs may be applicable and would need to be considered by the university during the detailed design stage. The landscape design does allow for a wetland area around the existing Delph pond to provide amenity for the new proposed buildings.

4.4 Proposed Surface Water Drainage

Preliminary meetings were attended by Ward Cole at the Environment Agency and Upper Witham IDB individually to agree a strategy for the disposal of surface water. The EA agreed that FFL's would be set where possible above the 1:100 year flood level. As the development only consists of educational establishments and no residential buildings then the EA would accept FFL's below the flood level if flood mitigating measures were to be introduced to the construction of ground floors.

The Upper Witham IDB controls the attenuation pond within the university and is therefore the approving authority for any proposed discharges to the pond. The IDB stated that there was currently no up to date model of their full drain network including all the attenuation ponds. This was an exercise that the IDB looked into appointing a consultant to carry out but established this would be difficult to model as well as time consuming and very expensive. Ward Cole carried out a Masterplan 2012 and 2020 drainage model in October 2010 to assess the ability of the Delph pond and downstream storage network to accept the surface water flows from the existing and proposed future development. It was found the pond can accept the flows whilst not exceeding the maximum pond level required by Upper Witham I.D.B.

It was agreed at the meeting that we would model the existing pond using MicroDrainage software for the following three scenarios:

- 2010 – Existing catchment area currently discharging to the pond.
- 2012 – Proposed catchment to include the addition of the Engineering Hub and Arts Box.
- 2020 – Proposed catchment for the full developed masterplan.

It was advised that the current 1:100 year flood level within the pond was 4.0m AOD. This would be 1.3m higher than the normal water level of 2.7m AOD. It was agreed that should any of the proposed future catchment areas increase the water level over and above the 4.0m flood level then the pond would need to be extended to ensure the flood level remains at 4.0m.

The future catchment areas would also need to include 20% for climate change. During the simulation the highest modelled water level for the 2020 catchment during the 1:100 year storm + 20% was calculated to be 3.751m AOD which would sit 249mm below the 4.0m flood level. The table below shows the results of the three simulated catchments and the full calculations can be found within Appendix F.

Existing Pond	Catchment Area = 5.16 Ha			
Storm Event	Max. Water level (m)	Depth (mm)	Max. Outflow L/s	Volume (m3)
1:2	2.946	246	100.8	565.4
1:30	3.167	467	313.3	1100
1:100	3.341	641	490.9	1535.5
1:100 + 20%	3.448	748	602.8	1812.5

2012 Pond	Catchment Area = 5.42 Ha			
Storm Event	Max. Water level (m)	Depth (mm)	Max. Outflow L/s	Volume (m3)
1:2	2.955	255	103.7	587.8
1:30	3.185	485	334.7	1145.5
1:100	3.365	665	513.3	1599.3
1:100 + 20%	3.479	779	644.5	1893.1

2020 Pond	Catchment Area = 7.575 Ha			
Storm Event	Max. Water level (m)	Depth (mm)	Max. Outflow L/s	Volume (m3)
1:2	3.033	333	178.3	771.5
1:30	3.347	647	490.9	1549.8
1:100	3.592	892	755.7	2192.4
1:100 + 20%	3.751	1051	868.8	2625.3

It was also agreed that a 4.0m maintenance easement to at least two sides along the pond is to be provided to ensure maintenance can be achieved to all areas of the pond. This will be discussed and agreed with UW IDB once the masterplan is more detailed.

It is also a proposal to culvert the open ditch section of the outfall between the two 1.5m box culverts to allow construction of the 2020 masterplan. Any storage volume within this open ditch would need to be accommodated within the main Delph pond.

The Masterplan 2012 and 2020 drainage model carried out in October 2010 was approved by the Upper Witham Internal Drainage Board, (refer to Appendix H for the approval letter dated 17.12.2011). The drainage model has been updated to suit the revised masterplan, which now shows additional development area to the west of Brayford Way to the north and also to the south of Campus Way / railway lines. The area to the north-west is already included in the network model and drains unbalanced to the Fossdyke Delph watercourse. The area to the south-west is already included in the model which drains to the smaller pond next to the football pitch south of the railway line, to the west of Brayford Way (referred to as Pond B in the drainage model report) and the network downstream. However, Pond B will require altering to suit the proposed building/development whilst maintaining the same capacity and connections to the downstream network.

4.5 Proposed Foul Water Drainage

A new network of gravity sewers will be designed to convey foul water from the Engineering Hub and Arts Box towards the private pump station to the south of the railway. It is assumed at this stage that the private pump station will have capacity to accommodate the low peak flow generated by the 2012 masterplan.

The Anglian Water adopted pump station on the north side of the railway has capacity for 40 l/s peak flow. The development peak flow for the 2012 and 2020 masterplan will be approximately 22.7 l/s and 38.95 l/s respectively (as shown on drawing 10-3921-1004 within Appendix D). Therefore the existing pump station has sufficient capacity. Although this has already been agreed with Anglian Water, an application for each additional discharge into the pump station will still need to be submitted for approval. Any peak flows above those estimated will need to be stored locally.

Both developments to the west of Brayford Way to the north and south of Campus Way will require pumping, either by utilising existing connections to the existing pump stations or else new pump station(s) will be needed subject to existing capacity checks and relevant approvals.

A schematic drainage drawing has not been updated for the 2020 masterplan at this stage.

6 **Conclusion**

The proposals include further development, consisting of new buildings for education and associated accesses, car parks & other amenities. It is likely that any new structures would have finished floor levels matching those of existing adjacent buildings (approximately 5.6m – 5.8m AOD). It is considered then, that any new structures would be at no more risk than the buildings already on site.

The development lies within Flood Risk Zone 3a 'high probability' to the south and Zone 2 'Medium Probability' to the north and would be classified as being 'more vulnerable' in nature. Based on the results of a Sequential Test carried out in accordance with PPS 25, further development work on this site would require an Exceptions Test to be passed.

The City of Lincoln SFRA prepared by JBA Consulting states that the city faces its greatest threat from fluvial flooding from the Rivers Witham, Till and the Fossdyke Canal. It also suggests that an overtopping scenario during an extreme 1:1000 year + climate change rainfall event would lead to a hazard rating of 'danger to most' across the majority of the site. A failure of flood defences due to breach could lead to a 'danger to most / all' hazard rating during a 1:100 plus climate change rainfall event. Therefore the flood defences are vital in keeping the site and surrounding areas of Lincoln protected from flooding.

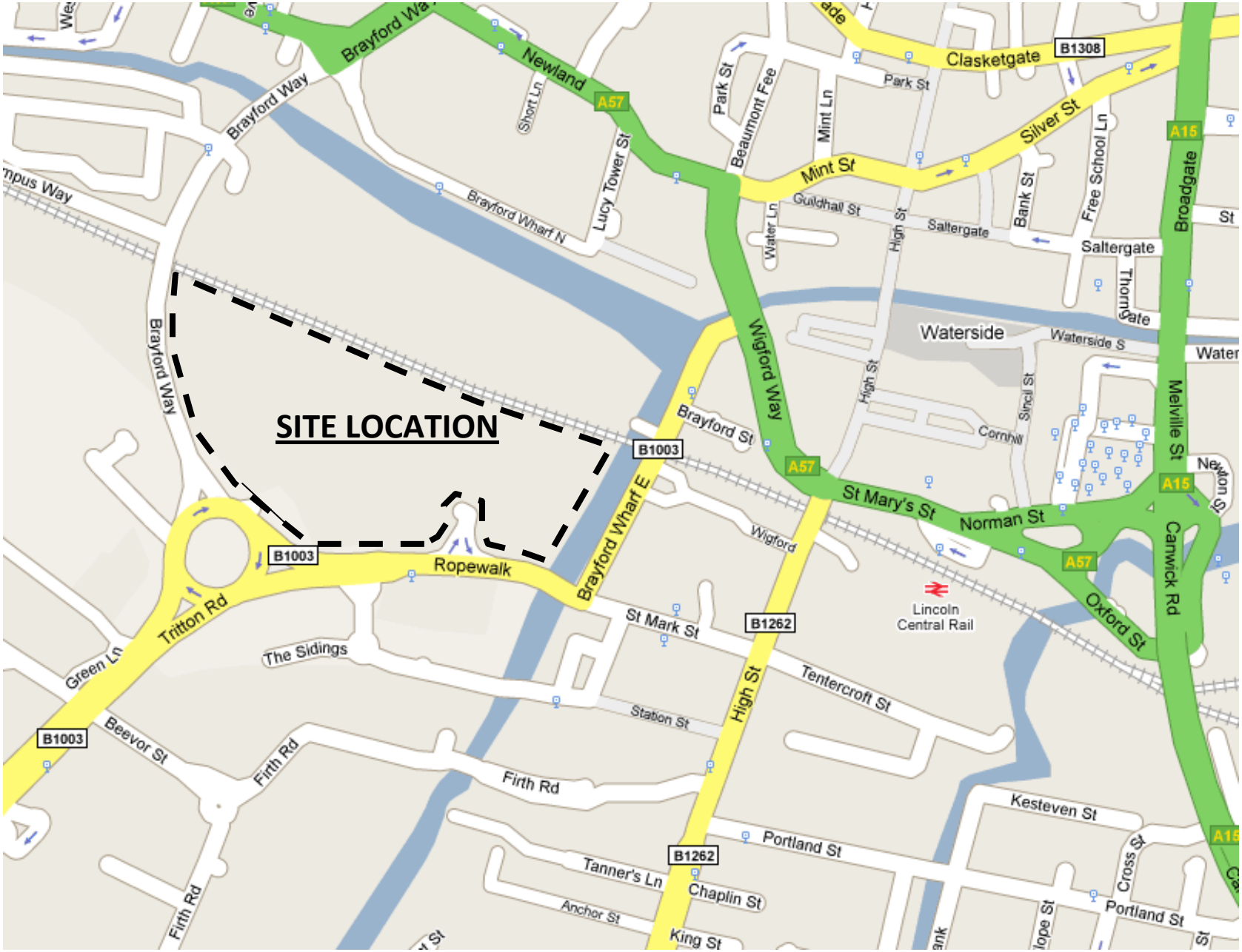
The proposed building footprint for the 2012 masterplan will be approximately 2800m^2. The loss of flood plain for 2800m^2 compared to the overall floodplain area would be very minimal and therefore would not result in any significant increase. Existing flood defences adjacent to the site have crest levels in the region of 5.64 – 5.69m AOD, are considered by the Environment Agency to be in good condition and are judged to be capable of defending against a 1:100 year flood event. However, once climate change is factored in, one part of the defences would have no freeboard when compared with the figures published in the 2007 Upper Witham Lincoln Model. It is understood that the defences adjacent to the site have been raised to 5.8m AOD during recent development works, which would give a freeboard in excess of 100mm against the projected 1:100 + climate change level of 5.64m AOD. It is also understood that these defences are regularly inspected by the Environment Agency as part of their maintenance works in the city, so any problems should be caught early.

Being an educational centre, it is believed that the site is already on the Environment Agency's emergency flood line which advises occupants of potential flood events. It is also considered likely that a flood procedure plan is in place, so that all occupants are aware of the evacuation plan / safe egress and refuge routes should flooding occur.

Based on the above the development can be considered as at risk from flooding but very well protected.

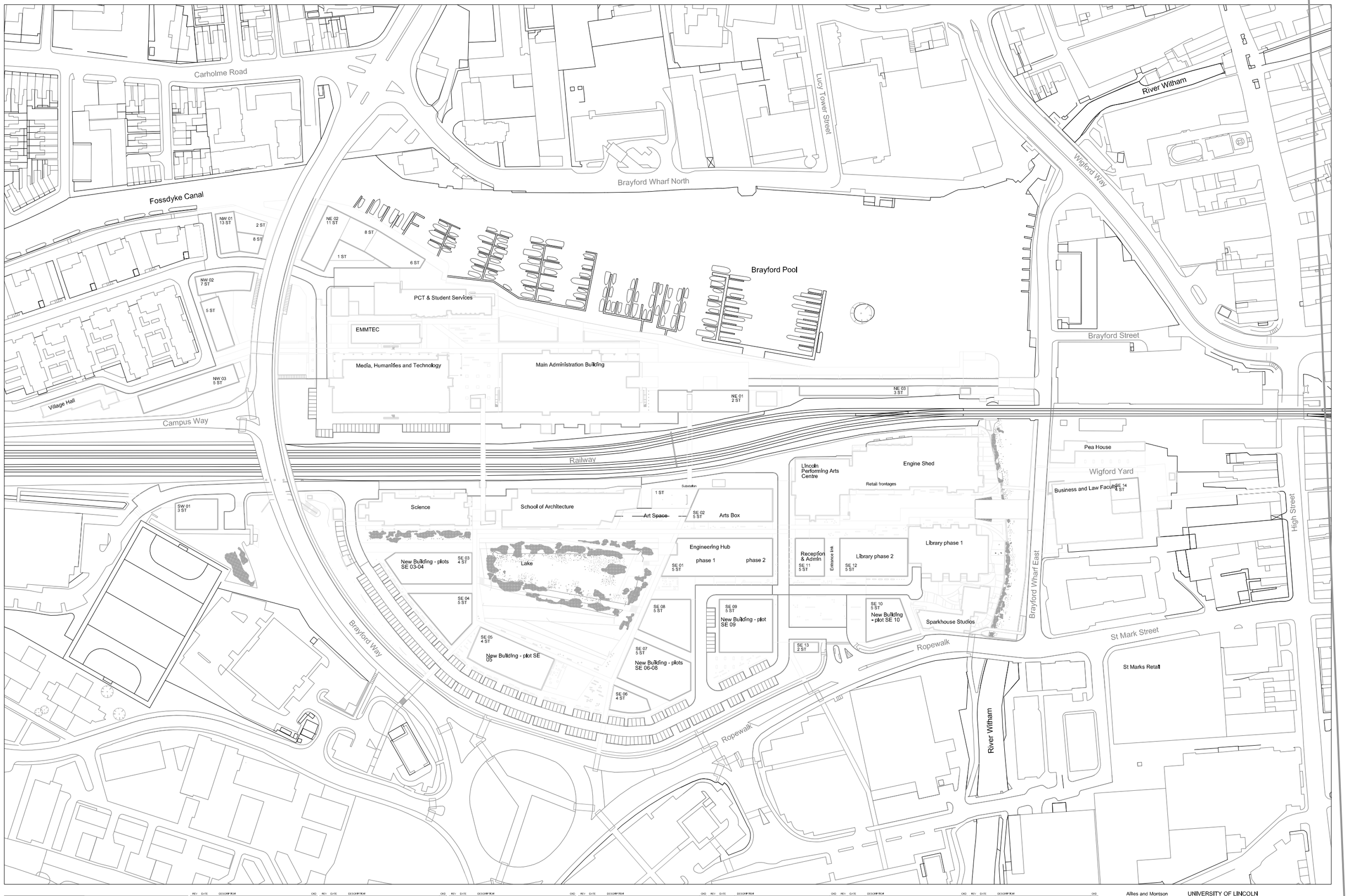
Appendix A

Site Location Plan


SITE LOCATION
Brayford Way
Newland
A57
Brayford Wharf N
Lucy Tower St
Short Ln
Park St
Beaumont Fee
Mint Ln
Clasketgate
B1308
Silver St
Mint St
Guildhall St
Water Ln
High St
Saltergate
Bank St
Free School Ln
Broadgate
A15
Thorngate
Waterside
Waterside S
Wigford Way
Brayford St
Brayford Wharf E
B1003
Sincil St
Cornhill
Melville St
St Mary's St
Norman St
Wigford
Ropewalk
Tritton Rd
Green Ln
The Sidings
St Mark St
B1262
Lincoln
Central Rail
Canwick Rd
Oxford St
Tentercroft St
Station St
Beevor St
Firth Rd
High St
Kesteven St
Portland St
Tanner's Ln
Chaplin St
Anchor St
King St
Cross St

Appendix B

University of Lincoln Masterplan



Do not scale from this drawing. Use figured dimensions only. Figured dimensions are in millimetres. All dimensions shall be verified by the contractor before proceeding with works. All levels are nominal, detailed topographical survey to be carried out to verify positions and level relationships in accordance with site features and ordnance survey. All levels are in metres. This drawing is for design intent only. This drawing is to be read in conjunction with other documentation from the architect, design team, main contractor and employer's agent. The architect must be notified of any discrepancies.

REV	DATE	DESCRIPTION	CKD
P1	091007	FOR INFORMATION	GW
P2	091104	FOR INFORMATION	GW
P3	091210	FOR INFORMATION	GW
P4	100211	FOR INFORMATION	GW
P5	100323	FOR INFORMATION	GW
P6	100429	FOR INFORMATION	GW
P7	101207	FOR INFORMATION	GW
P8	110204	FOR INFORMATION	GW

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UNIVERSITY OF LINCOLN

MASTERPLAN
GENERAL ARRANGEMENT
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P8
Revision

Appendix C

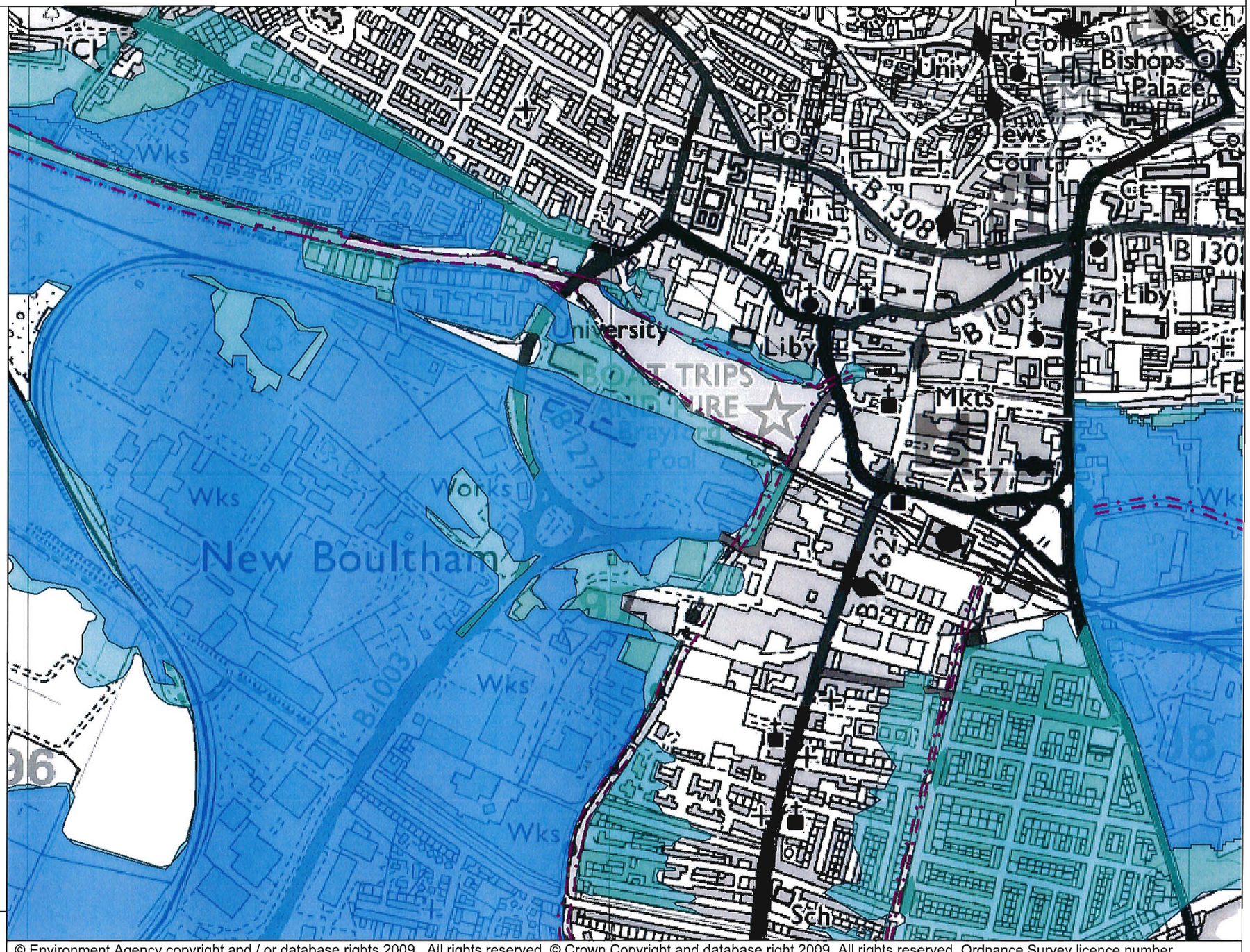
Environment Agency Flood Maps

Flood Map centred on The University of Lincoln created 29 October 2009

Environment Agency

Legend

- Flood Map - Defences
- Areas Benefiting from Flood Defences
- Flood Map - Flood Storage Areas
- Flood Map - Flood Zone 3
- Flood Map - Flood Zone 2



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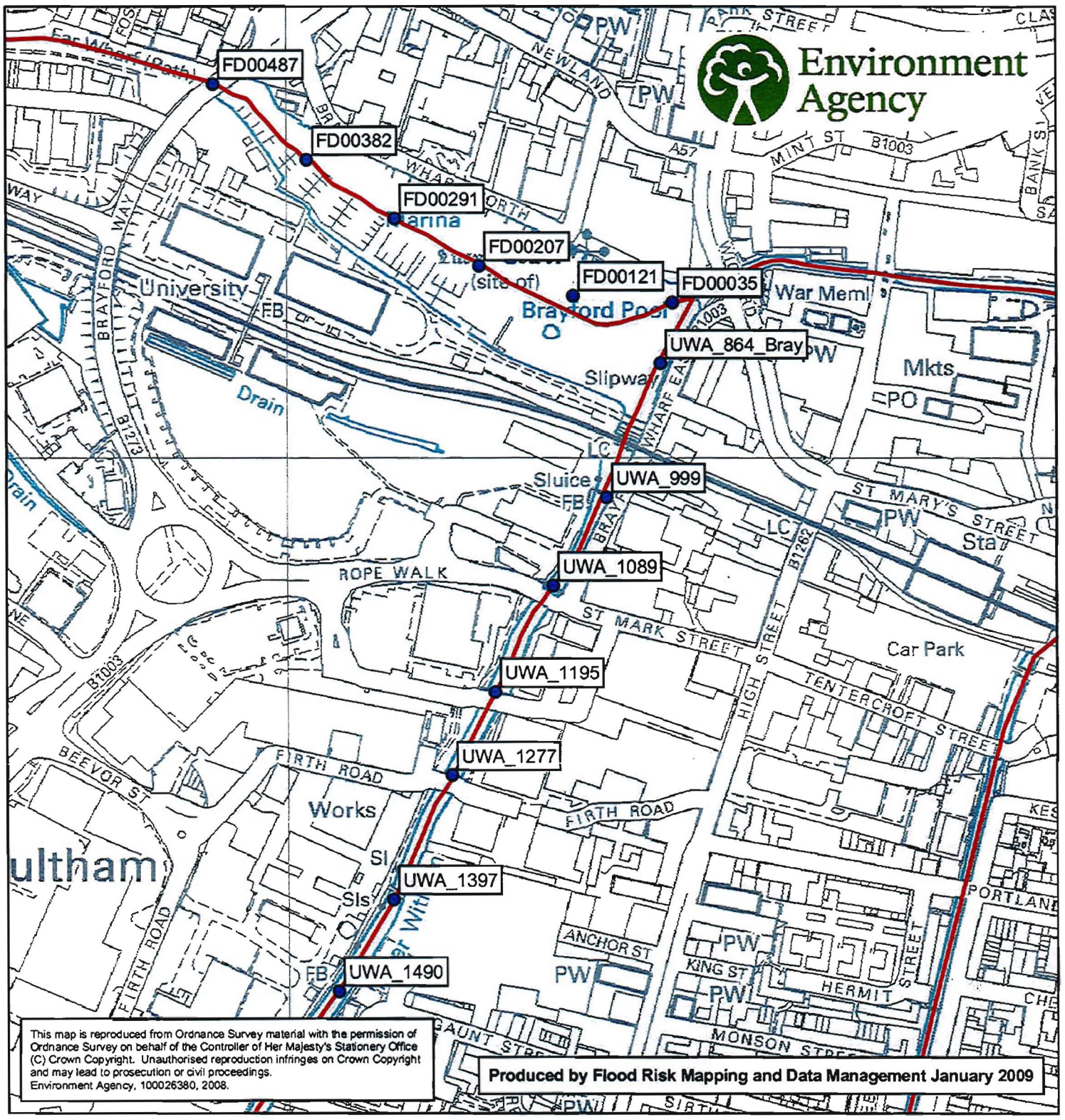
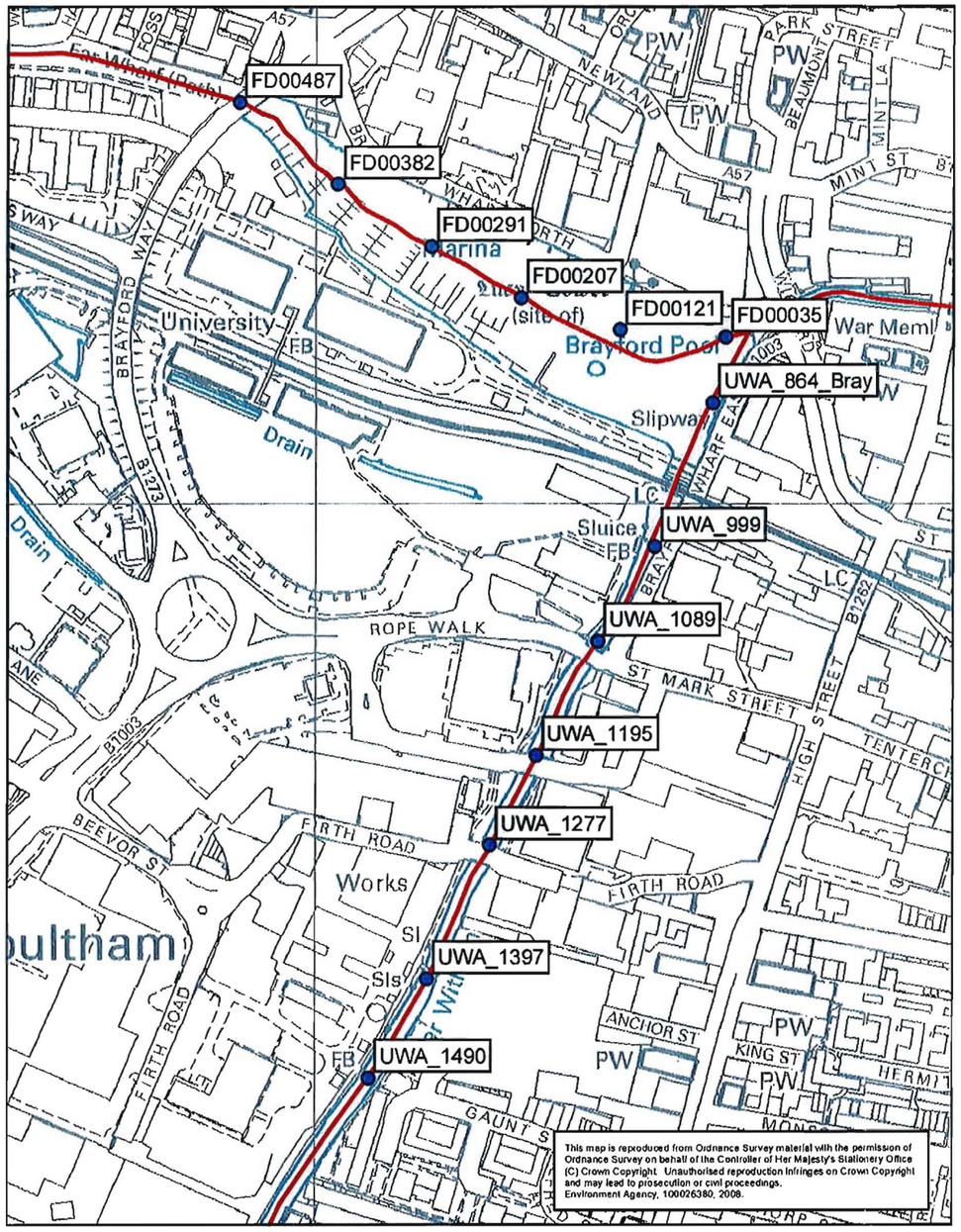


Levels mODN

Label	Easting	Northing	2yr	5yr	10yr	25yr	50yr	75yr	100yr	200yr	250yr	1000yr	100yr inc climate change	1000yr inc climate change
FD00487	496937	371325	5.06	5.21	5.26	5.38	5.45	5.46	5.54	5.57	0.00	5.65	5.58	5.67
FD00382	497018	371259	5.06	5.22	5.26	5.38	5.45	5.47	5.54	5.57	0.00	5.65	5.59	5.67
FD00291	497093	371208	5.06	5.22	5.26	5.38	5.45	5.47	5.54	5.57	0.00	5.65	5.59	5.67
FD00207	497166	371166	5.06	5.22	5.26	5.38	5.45	5.47	5.54	5.57	0.00	5.65	5.59	5.67
FD00121	497247	371140	5.06	5.22	5.26	5.38	5.45	5.47	5.54	5.57	0.00	5.65	5.59	5.67
FD00035	497333	371134	5.06	5.22	5.26	5.38	5.45	5.47	5.54	5.57	0.00	5.65	5.59	5.67
UWA_1490	497043	370534	5.10	5.26	5.30	5.46	5.54	5.55	5.64	5.68	0.00	5.76	5.70	5.78
UWA_1397	497091	370614	5.09	5.25	5.30	5.45	5.53	5.54	5.62	5.66	0.00	5.75	5.68	5.76
UWA_1277	497141	370723	5.09	5.24	5.29	5.44	5.52	5.53	5.62	5.65	0.00	5.74	5.67	5.75
UWA_1195	497179	370796	5.08	5.24	5.29	5.43	5.51	5.52	5.61	5.64	0.00	5.73	5.66	5.75
UWA_1089	497230	370888	5.08	5.23	5.28	5.42	5.50	5.51	5.59	5.63	0.00	5.71	5.65	5.73
UWA_999	497276	370965	5.07	5.23	5.28	5.42	5.49	5.51	5.59	5.62	0.00	5.71	5.64	5.73
UWA_864_Bray	497323	371081	5.06	5.22	5.26	5.38	5.45	5.47	5.54	5.57	0.00	5.65	5.59	5.67

Source: Upper Witham Lincoln Model February 2007
Issue date: 2 April 2009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Environment Agency
Crest Height mODN
Label Easting Northing Bed Level Left Bank Right Bank
FD00487 496937 371325 1.71 6.07 6.04
FD00382 497018 371259 1.88 5.41 5.12
FD00291 497093 371208 1.82 5.71 5.77
FD00207 497166 371166 1.59 5.64 5.77
FD00121 497247 371140 1.05 5.74 5.96
FD00035 497333 371134 1.25 5.68 6.15
UWA_1490 497043 370534 2.46 5.81 5.72
UWA_1397 497091 370614 2.56 5.88 5.96
UWA_1277 497141 370723 2.17 7.32 7.34
UWA_1195 497179 370796 2.44 6.61 6.75
UWA_1089 497230 370888 2.32 5.69 7.22
UWA_999 497276 370965 2.21 5.64 5.59
UWA_864_Bray 497323 371081 1.25 10.00 10.00
Source: Upper Witham Lincoln Model February 2007
Issue date: 2 April 2009
Produced by Flood Risk Mapping and Data Management
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Environment Agency

Historic Flood Extent

Legend

Main River

March 1947 on the River Witham in Lincoln

Floodline
0845 988 1188
ENVIRONMENT AGENCY

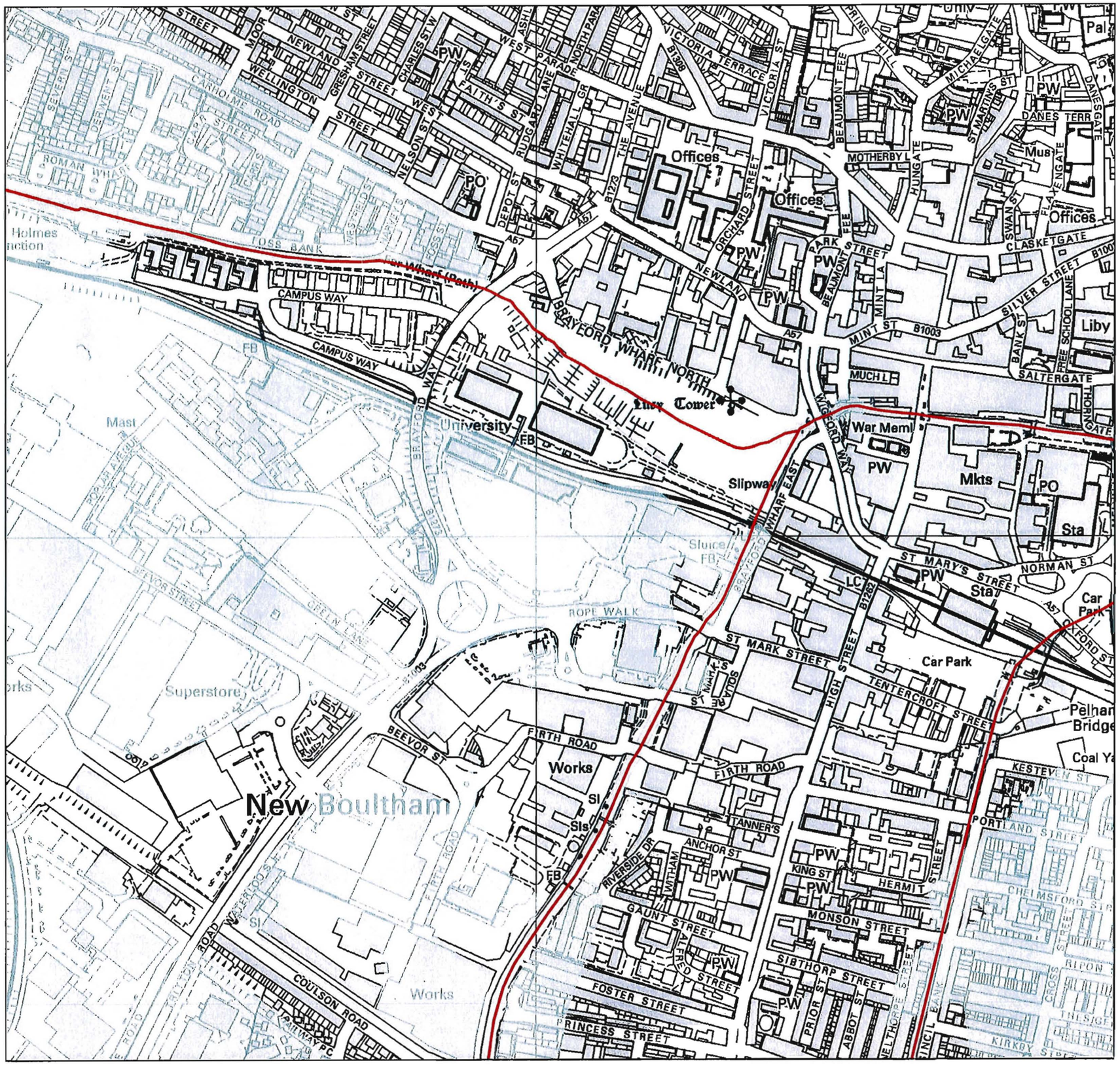
Environment Agency
Anglian Region Northern Area
Waterside House
Waterside North
Lincoln
LN2 5HA

Tel : 08708 506506

Scale: 1:5,000

April 2009

Produced by the Flood Risk Mapping and Data Management Team, Lincoln.



Appendix D

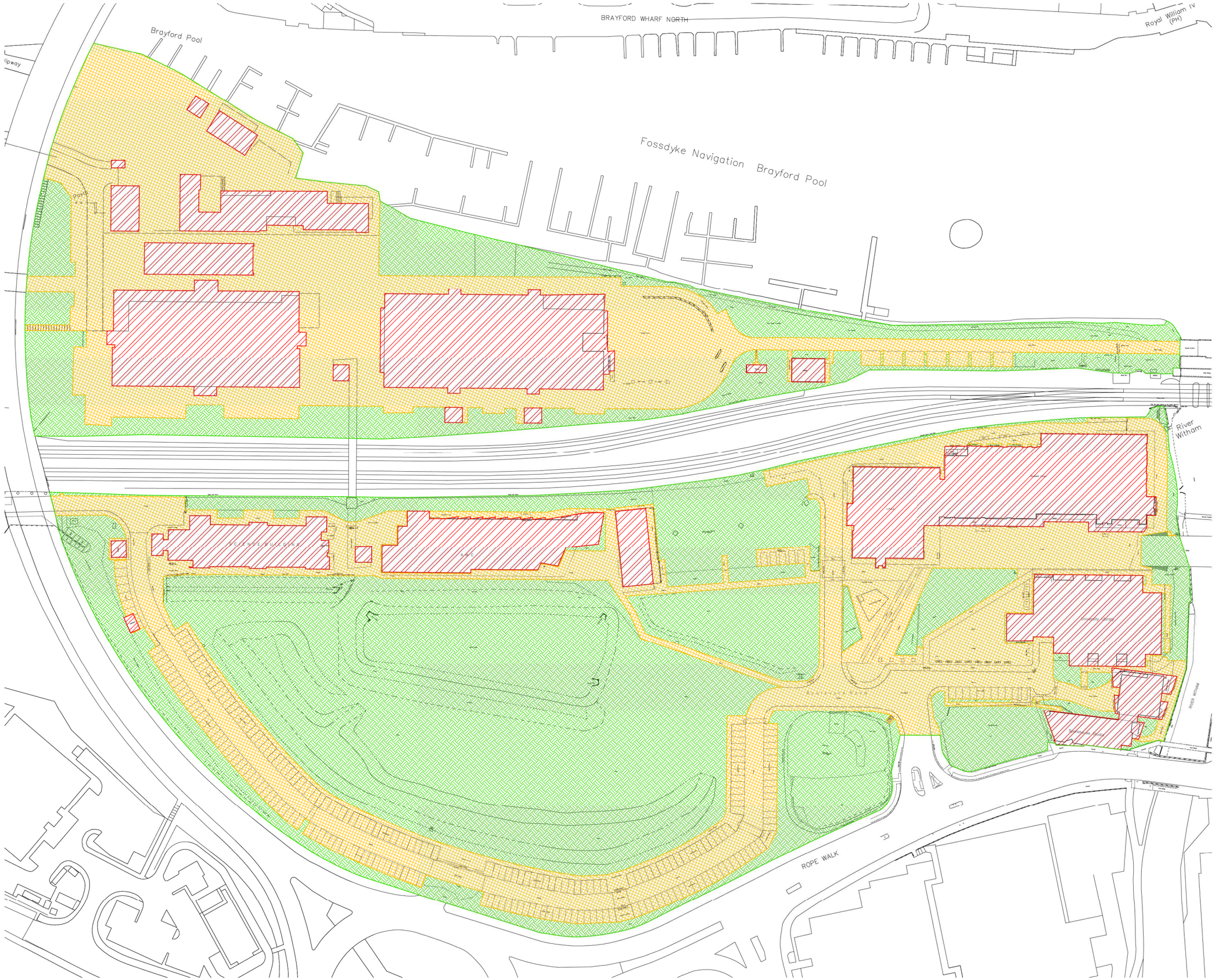
Ward Cole Drawings

EXISTING CATCHMENT AREAS

BUILDINGS = 18,334m²

IMPERMEABLE = 33,324m²

PERMEABLE = 41,181m²



rev.	date	description	drawn	chk.
	27/01/2012	First Issue	LM	RH

WARD COLE
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e-mail structures@wardcole-lincoln.co.uk

client:
University Of Lincoln

project:
Masterplan 2012

drawing title:
Existing Surface Water Catchment Areas

scale:	status:
1:500@A0	Tender

job number:	drawing number:	revision:
10/3921	1000	-

KEY

EXISTING SURFACE WATER SEWER

NOTES

1. SEWER LOCATIONS ON THIS DRAWING ARE BASED ON INITIAL SURVEYS DRAWING Nos. 6828-1 TO 6828-7, CARRIED OUT 15/11/2009. FOR AREAS NORTH OF THE RAILWAY LINE (NOT COVERED BY THE SURVEY), INFORMATION HAS BEEN TAKEN FROM VARIOUS RECORD & DESIGN DRAWINGS AND SEWER LOCATIONS ARE TO BE TAKEN AS APPROXIMATE ONLY.

ABBREVIATIONS

AWAP ALAN WOOD & PARTNERS DRAWINGS
BB BALFOUR BEATTY DRAWINGS
WC WARD COLE DRAWINGS

rev.	date	description	drawn.	chk.
-	15/01/2010	First Issue	LM	WEH

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client:
University Of Lincoln

project:
Masterplan 2012

drawing title:
Existing Surface Water Drainage

scale:	status:
1:500@A0	Tender

job number:	drawing number:	revision:
10/3921	1001	-

KEY

EXISTING GRAVITY FOUL WATER SEWER.

EXISTING PUMPED FOUL SEWER.

NOTES

1. SEWER LOCATIONS ON THIS DRAWING ARE BASED ON INITIAL SURVEYS DRAWING Nos. 6828-1 TO 6828-7, CARRIED OUT 11/11/2008. FOR AREAS NORTH OF THE RAILWAY LINE (NOT COVERED BY THE SURVEY), INFORMATION HAS BEEN TAKEN FROM VARIOUS RECORD & DESIGN DRAWINGS AND SEWER LOCATIONS ARE TO BE TAKEN AS APPROXIMATE ONLY.

ABBREVIATIONS

AW ANGLIAN WATER SERVICES DRAWINGS
BB BALFOUR BEATTY DRAWINGS
RNUM RNUM LONDON LTD DRAWINGS

rev.	date	description	drawn.	CHK.
-	15/01/2010	First Issue	LM	WEH

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client: University Of Lincoln

project: Masterplan 2012

drawing title: Existing Foul Water Drainage

scale:	status:	
1:500@A0	Tender	
job number: 10/3921	drawing number: 1002	revision: -

KEY

- EXISTING PUBLIC FOUL WATER SEWER.
- EXISTING PRIVATE FOUL WATER SEWER.
- EXISTING BUILDINGS.
- MASTERPLAN 2012 PROPOSED BUILDINGS.

EXISTING FOUL FLOWS
STUDENT VILLAGE UNITS 1 TO 5,
SERVICES BUILDING & LAUNDRY BUILDING
AVERAGE FLOW = 1.24l/s.
PEAK FLOW = 6.2l/s.

EXISTING FOUL FLOWS
STUDENT VILLAGE UNITS 6 TO 12
AVERAGE FLOW = 0.66l/s.
PEAK FLOW = 3.3l/s.

EXISTING FOUL FLOWS
EMMTEC BUILDING
AVERAGE FLOW = 0.015l/s.
PEAK FLOW = 0.1l/s.

EXISTING FOUL FLOWS
MARINA HEALTH CLUB
AVERAGE FLOW = 0.015l/s.
PEAK FLOW = 0.1l/s.

EXISTING FOUL FLOWS
STUDENT VILLAGE UNITS 13 TO 17,
BRIDGE HOUSE & VILLAGE HALL
AVERAGE FLOW = 1.13l/s.
PEAK FLOW = 5.65l/s.

EXISTING FOUL FLOWS
MAB BUILDING
AVERAGE FLOW = 0.3l/s.
PEAK FLOW = 1.5l/s.

EXISTING FOUL FLOWS
MHT BUILDING
AVERAGE FLOW = 0.25l/s.
PEAK FLOW = 1.25l/s.

EXISTING FOUL FLOWS FROM SOUTH OF RAILWAY SPORTS CENTRE, LPAC, SCIENCE, AMC & ENGINE SHED
AVERAGE FLOW = 0.42l/s.
PEAK FLOW = 2.1l/s.

EXISTING ADOPTED ANGLIAN WATER PUMPING STATION
CAPACITY = 40.0l/s.

TOTAL EXISTING FOUL FLOWS TO PUMPING STATION
AVERAGE FLOW = 4.03l/s.
PEAK FLOW = 20.2l/s.

EXISTING PRIVATE PUMP STATION
EXISTING FLOWS
AVERAGE FLOW = 0.42l/s.
PEAK FLOW = 2.10l/s.
FUTURE FLOWS
AVERAGE FLOW = 0.42+0.5 = 0.92l/s.
PEAK FLOW = 2.10+2.5 = 4.6l/s

FUTURE FOUL FLOWS
ART BOX
AVERAGE FLOW = 0.25l/s.
PEAK FLOW = 1.25l/s.

TOTAL FUTURE FOUL FLOWS TO PUMPING STATION FROM ART BOX & ENGINEERING HUB MASTERPLAN 2012
AVERAGE FLOW = 0.5l/s.
PEAK FLOW = 2.5l/s.

FUTURE FOUL FLOWS
ENGINEERING HUB PHASE 1 & 2
AVERAGE FLOW = 0.25l/s.
PEAK FLOW = 1.25l/s.

EXISTING FOUL SEWER FROM LIBRARY & SPARKHOUSE 1 & 2 TO EXISTING FOUL SEWER IN ROPEWALK

rev.	date	description	Drawn.	Chk.
–	15/01/2010	First Issue	MPS	WEH

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e-mail structures@wardcole-lincoln.co.uk

client:
University Of Lincoln

project:
Masterplan 2012

drawing title:
Existing and Proposed Foul Drainage For Masterplan Phase 1 (2012)

scale: 1:1250@A1 status: PRELIMINARY

Job number:	drawing number:	revision:
10/3921	1003	-

KEY

- EXISTING PUBLIC FOUL WATER SEWER.
- EXISTING PRIVATE FOUL WATER SEWER.
- EXISTING BUILDINGS.
- MASTERPLAN 2020 PROPOSED BUILDINGS.

POSSIBLE FUTURE CHANGE OF USE OF NE02 FROM ACADEMIC BUILDING TO HOTEL & CAFE, PEAK FLOWS TO REMAIN AS ACADEMIC BUILDING WITH ADDITIONAL PEAK FLOW STORED LOCALLY.

FUTURE FOUL FLOWS FROM PROPOSED ACADEMIC BUILDINGS AVERAGE FLOW = 0.25l/s. PEAK FLOW = 1.25l/s.

FUTURE FOUL FLOWS FROM PROPOSED ACADEMIC BUILDINGS AVERAGE FLOW = 0.25l/s. PEAK FLOW = 1.25l/s.

FUTURE FOUL FLOWS FROM PROPOSED ACADEMIC BUILDING AVERAGE FLOW = 0.25l/s. PEAK FLOW = 1.25l/s.

EXISTING FOUL FLOWS TO PRIVATE PUMP STATION (INC. 2012 BUILDINGS) AVERAGE FLOW = 0.92l/s. PEAK FLOW = 4.6l/s.

FUTURE FOUL FLOWS TO PRIVATE PUMP STATION FROM PROPOSED ACADEMIC BUILDINGS. AVERAGE FLOW = 9x0.25 = 2.25l/s. PEAK FLOW = 9x1.25 = 11.25l/s.

POSSIBLE FUTURE CHANGE OF USE OF SE04 FROM ACADEMIC BUILDING TO STUDENT RESIDENTIAL, PEAK FLOWS TO REMAIN AS ACADEMIC BUILDING WITH ADDITIONAL PEAK FLOW STORED LOCALLY.

EXISTING ADOPTED ANGLIAN WATER PUMPING STATION CAPACITY = 40.0l/s.

TOTAL EXISTING FOUL FLOWS TO PUMPING STATION INCLUDING 2012 BUILDINGS AVERAGE FLOW = 4.53l/s. PEAK FLOW = 22.7l/s.

TOTAL FUTURE FOUL FLOWS TO PUMPING STATION MASTERPLAN AVERAGE FLOW = 3.25l/s. PEAK FLOW = 16.25l/s.

rev.	date	description	Drawn.	Chk.
A	16/09/2011	Revised to suit updated architect layout.	IC	WEH
–	15/01/2010	First Issue	MPS	WEH

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client:
University Of Lincoln

project:
Masterplan

drawing title:
Proposed Future Foul Drainage For Masterplan Phase 2 (2020)

scale: 1:1250@A1
status: PRELIMINARY

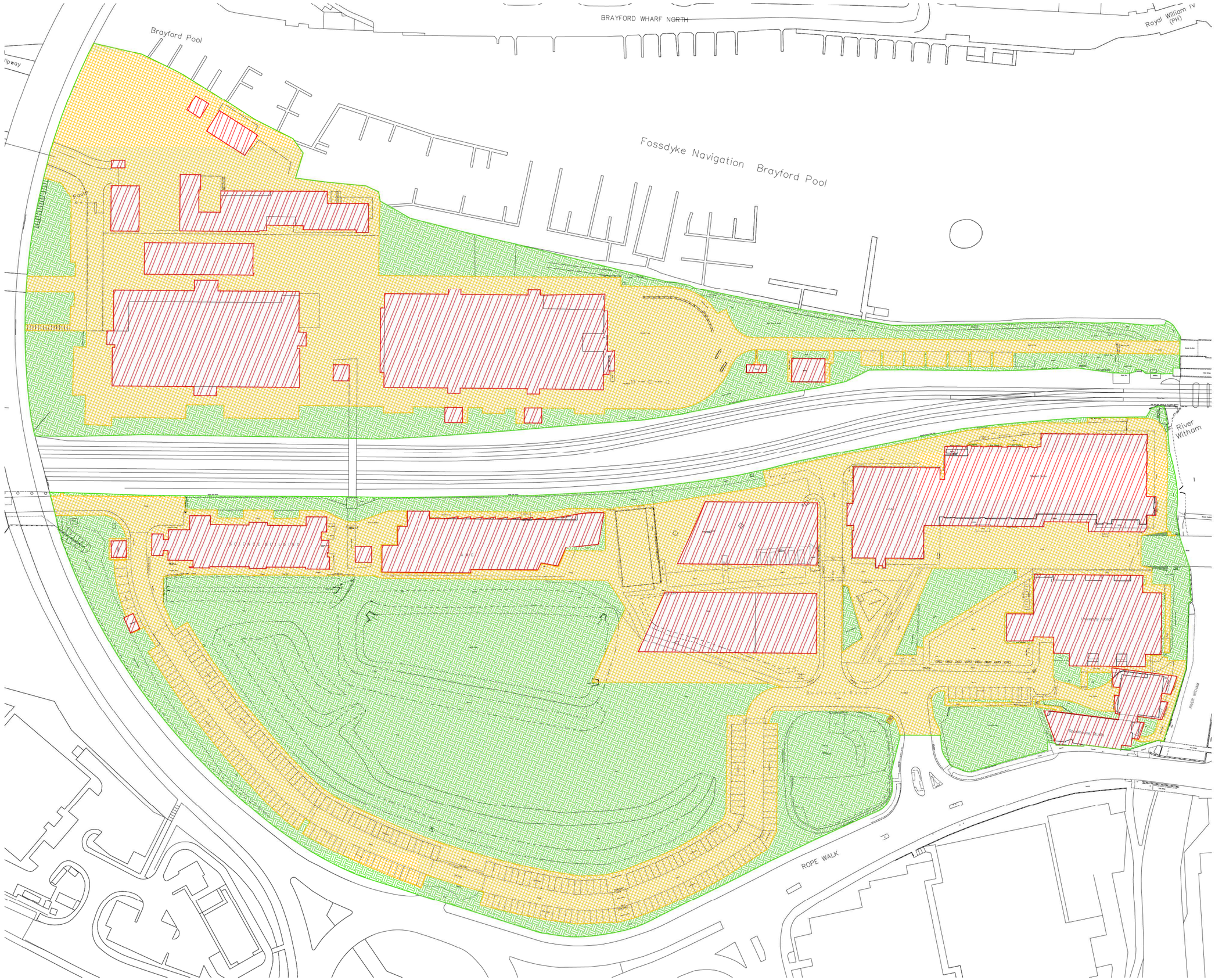
job number:	drawing number:	revision:
10/3921	1004	A

PROPOSED CATCHMENT AREAS

BUILDINGS = 20,891m²

IMPERMEABLE = 33,371m²

PERMEABLE = 38,577m²



rev.	date	description	drawn	chk.
	27/01/2010	First Issue	LM	RH

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client:
University Of Lincoln

project:
Masterplan 2012

drawing title:
Proposed Surface Water Catchment Areas Masterplan Phase 1 (2012)

scale:	status:
1:500@A0	Tender

job number:	drawing number:	revision:
10/3921	1005	-

Fossdyke Canal
Brayford Wharf North
Brayford Pool
Wigford Way
Brayford Street
Campus Way
Railway
Pea House
Wigford Yard
Business and Law Faculty
High Street
Brayford Wharf East
St Mark Street
Ropewalk
St Marks Retail
River Witham
Brayford Way

PROPOSED CATCHMENT AREAS

BUILDINGS = 32,227m²
IMPERMEABLE = 43,521m²
PERMEABLE = 17,897m²

rev.	date	description	Drawn.	Chk.
A	16/09/2011	Revised to suit latest masterplan.	LM	RH
_	15/01/2010	First Issue	LM	RH

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client:
University Of Lincoln

project:
Masterplan 2012

drawing title:
Proposed Surface Water Catchment Areas Masterplan Phase 2 (2020)

scale: 1:500@A0
status: Tender

job number:	drawing number:	revision:
10/3921	1009	A

KEY

- EXISTING SURFACE WATER SEWER
- INDICATIVE PROPOSED SURFACE WATER SEWER.
- EXISTING FOUL WATER SEWER (GRAVITY)
- EXISTING FOUL WATER SEWER (PUMPED)
- PROPOSED FOUL WATER SEWER.

NOTES

1. SEWER LOCATIONS ON THIS DRAWING ARE BASED ON INITIAL SURVEYS DRAWING Nos. 6828-1 TO 6828-7, CARRIED OUT 11/11/2009, FOR AREAS NORTH OF THE RAILWAY LINE (NOT COVERED BY THE SURVEY), INFORMATION HAS BEEN TAKEN FROM VARIOUS RECORD & DESIGN DRAWINGS AND SEWER LOCATIONS ARE TO BE TAKEN AS APPROXIMATE ONLY.
2. PROPOSED SEWERS SHOWN ON THIS PLAN ARE INDICATIVE ONLY AND ARE SUBJECT TO DETAILED DESIGN & APPROVAL BY THE RELEVANT STATUTORY AUTHORITIES.

ABBREVIATIONS

AWAP ALAN WOOD & PARTNERS DRAWINGS
BB BALFOUR BEATTY DRAWINGS
WC WARD COLE DRAWINGS

rev.	date	description	drawn.	chk.
-	12/03/2010	First Issue	LM	WEH

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e-mail structures@wardcole-lincoln.co.uk

client:
University Of Lincoln

project:
Masterplan 2012

drawing title:
Schematic Drainage Layout
Masterplan Phase 1 (2012)

scale:	status:	
1:500@A0	Tender	
job number: 10/3921	drawing number: 1010	revision: -

Appendix E
Upper Witham IDB Correspondence

UPPER WITHAM INTERNAL DRAINAGE BOARD

J1 THE POINT, WEAVER ROAD
LINCOLN LN6 3QN

C.J. ELKINGTON ESQ.
CHIEF EXECUTIVE AND
CLERK TO THE BOARD

K.J. PRATT, B.Sc. C.Eng. C.Env. MIWO MCIWEM
ENGINEER

Telephone (01522) 697123
Fax No. (01522) 697064

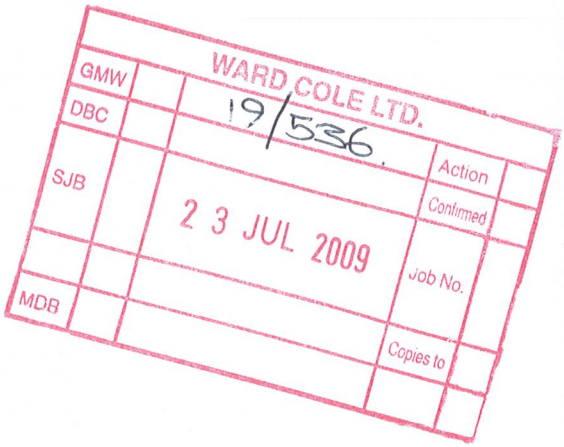
E mail. uwidb@vodabb.co.uk

www.uwidb.co.uk

OUR REF 375e09
6/4100
8/2/13

YOUR REF Luke Millis.

22nd July, 2009.



Ward Cole Consultancy,
Fosse House,
Roman Wharf,
Lincoln,
LN1 1SR.

Dear Sirs,

Flood Risk Assessment for South East Quadrant.
Lincoln University.

The Board currently maintain watercourses from the water body you name "Delph Pond" to the Pyewipe Pumping Station to the west including another attenuation lagoon. All of which are shown on the attached drawing.

The site lies in an area where flood regulation is a must and we wish to highlight the premis within PPS25 where developers, where possible, reduce flood risk overall (Paragraph 22) and that, as far a as practicable, surface water arising from a developed site should be managed in a sustainable manner to mimic the surface water flow arising from the site prior to the proposed development (Paragraph F6).

The site lies in an area where there is potential to be at risk of flooding and we advise contacting the Environment Agency in relation to the Flood Map and Flood Levels associated with the potential inundation from the Main River.

The Fossdyke Delph itself has the following assumed water levels:-

Normal water level - 2.7m A.O.D.
Design Flood level - 3.3m A.O.D.
Design 1 in 100 year flood level.
(no inflows from Main River) – approximately 4.0m A.O.D.

When considering floor levels you are obviously advised to consider the influence of the levels.

As the site lies adjacent to Fossdyke Delph, a watercourse under the control of this Board, I wish to draw you attention to the following:-

1) Under Section 23 of the Land Drainage Act 1991 any works affecting a watercourse requires the prior consent of the Board. Works in this instance will include outfalls, culverting etc. An Administration Fee of£50 is payable for all consents applied for under this section of the Land Drainage Act.
2) Under the Board's Byelaws any proposal to make a discharge to a watercourse requires their prior consent. This consent is in addition is in addition to any other consent required from the Environment Agency etc and is required even if the discharge is via an existing or proposed public or private sewer.
3) Under the Board's Byelaws, an undeveloped strip of 6 metres must be kept clear of all/any obstructions including fencing, walls, trees, hedges, etc. This area of land is required to enable the Board to gain access to the watercourse for maintenance and other purposes.

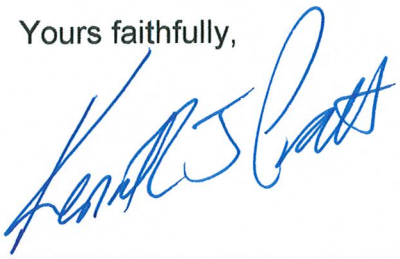
This development will be required to pass the sequential test which is decided by the Local Planning Authority. Any flood risk assessment undertaken must include reference to any infilling of flood plain.

It is believed that the area has the benefit of a second discharge point in to the River Witham that follows the line of an old culvert located somewhere below the St. Marks Retail park and runs parallel with the River Witham to outfall into the Boultham Pump Drain watercourse at Coulson Road.

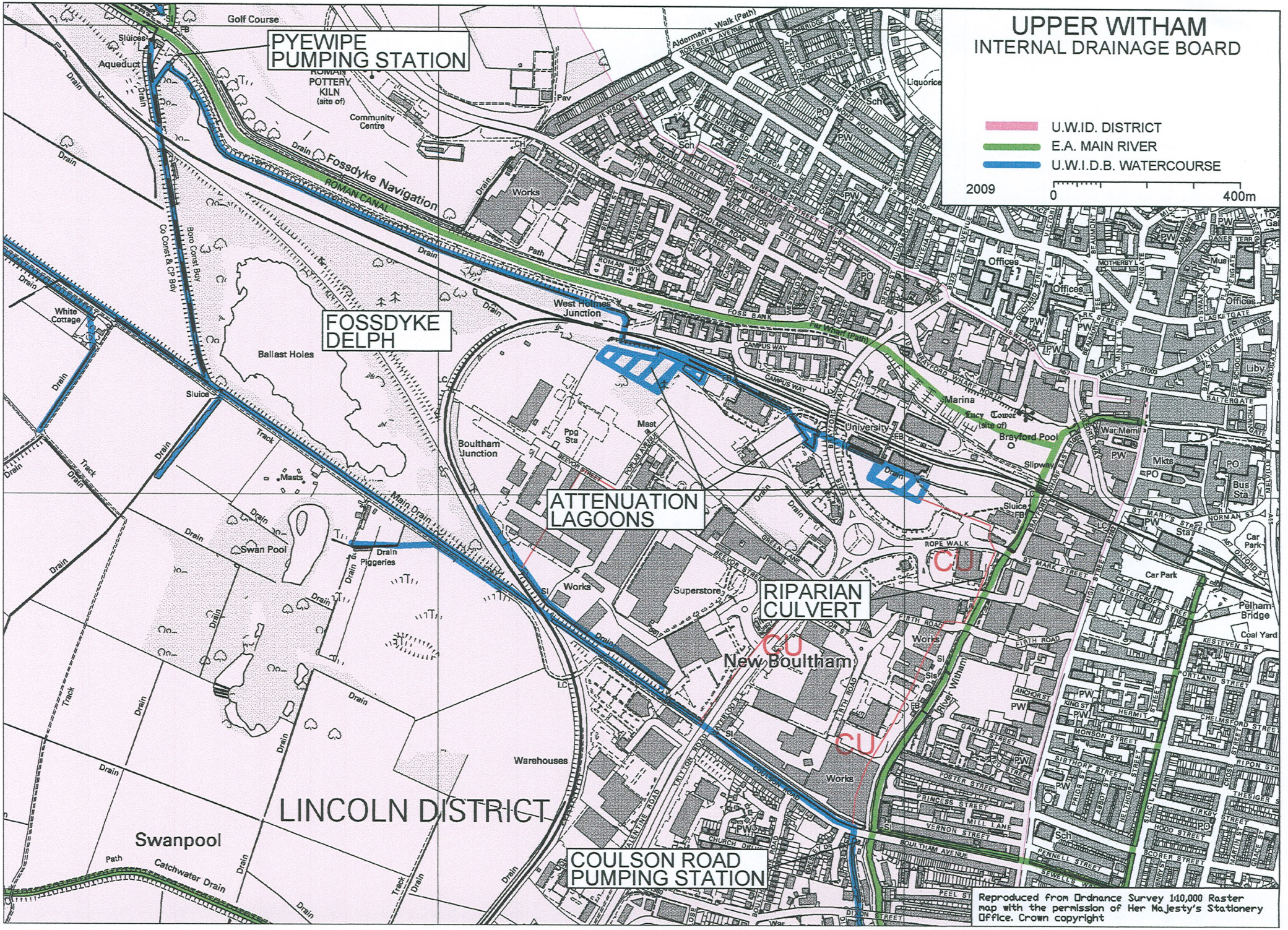
We believe that this culvert (375mm diameter outfall) is restricted near its outfall but it is not maintained by the Board and we have no records of its current condition.
In any event the Board will need to be satisfied that the discharge from your proposals can be accepted by the system into which it discharges and/or the attenuation lagoons or proposals on how the attenuation system will need to be amended.

The site is located within the Lincoln Policy Area which is covered by the Lincoln Urban Drainage Group. This Group, although non-statutory, is made up of many groups who have interests in the area and is a good opportunity to gain feedback to any proposed surface water management scheme that you may wish to suggest. More details about the group are available form Mr. P. Moon at the Environment Agency, Lincoln.

Yours faithfully,



K.J. Pratt.
Engineer.


UPPER WITHAM
INTERNAL DRAINAGE BOARD
U.W.ID. DISTRICT
E.A. MAIN RIVER
U.W.I.D.B. WATERCOURSE
2009
0
400m
PYEWIPE PUMPING STATION
FOSSDYKE DELPH
ATTENUATION LAGOONS
RIPARIAN CULVERT
COULSON ROAD PUMPING STATION
LINCOLN DISTRICT
Swanpool
New Boultham
Golf Course
Sluices
Aqueduct
ROMAN POTTERY KILN (site of)
Community Centre
Fossdyke Navigation
ROMAN CANAL
Works
Path
Drain
Boro Const Bdy
Co Const & CP Bdy
White Cottage
Ballast Holes
Sluice
Track
Masts
Swan Pool
Piggeries
Main Drain
Warehouses
Catchwater Drain
West Holmes Junction
Boultham Junction
Ppg Sta
Mast
Superstore
Offices
Marina
Lucy Tower (site of)
University
Brayford Pool
Slipway
War Mem
Mkts
PO
Bus Sta
Car Park
Pelham Bridge
Coal Yard
River Witham
Liquorice
Sch
Liby
Mus
Alderman's Walk (Path)
Far Ings (Path)
Foss Bank
Campus Way
Brayford Wharf North
Brayford Wharf East
Rope Walk
St Mark Street
High Street
Tentercroft Street
Firth Road
Coulson Road
Boultham Avenue
Valentine Road
Church Drive
Pennell Street
Sewells
Dixon Street
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Appendix F
Micro Drainage Calculations

Summary of Results for 2 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
15 Summer	48.0	48.0	2.8648	0.1647	375.4	O K
30 Summer	62.4	62.4	2.8917	0.1917	438.5	O K
60 Summer	76.5	76.5	2.9117	0.2117	484.6	O K
120 Summer	87.0	87.0	2.9267	0.2267	520.6	O K
180 Summer	90.9	90.9	2.9322	0.2322	532.5	O K
240 Summer	91.3	91.3	2.9327	0.2327	534.0	O K
360 Summer	88.4	88.4	2.9287	0.2287	524.6	O K
480 Summer	84.2	84.2	2.9227	0.2227	510.7	O K
600 Summer	78.9	78.9	2.9152	0.2152	493.0	O K
720 Summer	74.7	74.7	2.9093	0.2092	478.5	O K
960 Summer	65.2	65.2	2.8958	0.1957	448.0	O K
1440 Summer	52.6	52.6	2.8758	0.1758	400.7	O K
2160 Summer	42.9	42.9	2.8533	0.1533	348.4	O K
2880 Summer	35.8	35.8	2.8388	0.1388	315.2	O K
4320 Summer	29.5	29.5	2.8213	0.1213	275.0	O K
5760 Summer	24.1	24.1	2.8088	0.1088	245.5	O K
7200 Summer	19.3	19.3	2.7973	0.0973	220.4	O K
8640 Summer	15.2	15.2	2.7923	0.0923	208.6	O K
10080 Summer	14.5	14.5	2.7858	0.0858	194.1	O K
15 Winter	56.4	56.4	2.8833	0.1832	418.2	O K
30 Winter	77.2	77.2	2.9127	0.2127	486.9	O K
60 Winter	91.3	91.3	2.9342	0.2342	537.3	O K
120 Winter	100.8	100.8	2.9462	0.2462	565.7	O K
180 Winter	100.8	100.8	2.9462	0.2462	565.4	O K
240 Winter	97.9	97.9	2.9422	0.2422	556.2	O K
360 Winter	89.8	89.8	2.9307	0.2307	528.8	O K
480 Winter	79.9	79.9	2.9197	0.2197	503.7	O K
600 Winter	74.7	74.7	2.9092	0.2092	479.3	O K
720 Winter	68.4	68.4	2.9002	0.2002	458.3	O K
960 Winter	57.5	57.5	2.8848	0.1847	421.7	O K
1440 Winter	46.5	46.5	2.8613	0.1613	366.6	O K
2160 Winter	35.5	35.5	2.8353	0.1353	307.0	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	41.73	24
30 Summer	25.61	35
60 Summer	15.71	56
120 Summer	9.64	86
180 Summer	7.25	120
240 Summer	5.92	152
360 Summer	4.45	218
480 Summer	3.63	280
600 Summer	3.10	342
720 Summer	2.73	404
960 Summer	2.20	528
1440 Summer	1.62	774
2160 Summer	1.19	1132
2880 Summer	0.96	1504
4320 Summer	0.69	2240
5760 Summer	0.55	2928
7200 Summer	0.45	3688
8640 Summer	0.39	4424
10080 Summer	0.35	5136
15 Winter	41.73	24
30 Winter	25.61	35
60 Winter	15.71	56
120 Winter	9.64	92
180 Winter	7.25	126
240 Winter	5.92	162
360 Winter	4.45	228
480 Winter	3.63	294
600 Winter	3.10	356
720 Winter	2.73	420
960 Winter	2.20	548
1440 Winter	1.62	796
2160 Winter	1.19	1132

Summary of Results for 2 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
2880 Winter	29.5	29.5	2.8213	0.1213	275.4	O K
4320 Winter	19.3	19.3	2.8083	0.1083	244.7	O K
5760 Winter	19.3	19.3	2.7973	0.0973	220.1	O K
7200 Winter	14.5	14.5	2.7858	0.0858	193.4	O K
8640 Winter	11.8	11.8	2.7798	0.0798	180.1	O K
10080 Winter	10.4	10.4	2.7763	0.0763	172.2	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
2880 Winter	0.96	1488
4320 Winter	0.69	2348
5760 Winter	0.55	3080
7200 Winter	0.45	3576
8640 Winter	0.39	4416
10080 Winter	0.35	5144

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	2
Site Location	GB 497200 370850 SK 97200 70850
C (1km)	-0.021
D1 (1km)	0.310
D2 (1km)	0.263
D3 (1km)	0.196
E (1km)	0.308
F (1km)	2.541
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+0

Time / Area Diagram

Total Area (ha) = 5.160

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	1.720	4	8	1.720	8	12	1.720

Tank/Pond Details

Invert Level (m) 2.700 Ground Level (m) 4.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	2237.5	0.50	2484.0	1.00	2730.5	1.50	2878.5	2.00	2878.5	2.50	2878.5
0.10	2286.8	0.60	2533.3	1.10	2779.8	1.60	2878.5	2.10	2878.5		
0.20	2336.1	0.70	2582.6	1.20	2829.1	1.70	2878.5	2.20	2878.5		
0.30	2385.4	0.80	2631.9	1.30	2878.5	1.80	2878.5	2.30	2878.5		
0.40	2434.7	0.90	2681.2	1.40	2878.5	1.90	2878.5	2.40	2878.5		

Pipe Outflow Control

Pipe Diameter (m)	1.200	Roughness (mm)	0.600	Invert Level (m)	2.700
Slope (1:x)	1000.0	Entry Loss Coef	0.500		
Length (m)	88.000	Coef of Contraction	0.600		

Summary of Results for 30 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
15 Summer	213.7	213.7	3.0767	0.3767	877.5	O K
30 Summer	251.8	251.8	3.1112	0.4112	961.4	O K
60 Summer	271.8	271.8	3.1272	0.4272	1001.1	O K
120 Summer	271.8	271.8	3.1312	0.4312	1010.5	O K
180 Summer	251.8	251.8	3.1232	0.4232	991.2	O K
240 Summer	251.8	251.8	3.1082	0.4082	954.3	O K
360 Summer	213.7	213.7	3.0842	0.3842	895.8	O K
480 Summer	195.6	195.6	3.0607	0.3607	839.1	O K
600 Summer	178.3	178.3	3.0407	0.3407	790.7	O K
720 Summer	161.7	161.7	3.0257	0.3257	755.5	O K
960 Summer	145.9	145.9	2.9952	0.2952	681.9	O K
1440 Summer	110.8	110.8	2.9587	0.2587	595.4	O K
2160 Summer	84.6	84.6	2.9233	0.2232	511.9	O K
2880 Summer	68.4	68.4	2.9003	0.2003	458.2	O K
4320 Summer	49.0	49.0	2.8673	0.1673	381.4	O K
5760 Summer	40.5	40.5	2.8473	0.1473	334.1	O K
7200 Summer	34.8	34.8	2.8338	0.1338	303.1	O K
8640 Summer	29.6	29.6	2.8218	0.1218	276.3	O K
10080 Summer	24.1	24.1	2.8133	0.1133	256.3	O K
15 Winter	251.8	251.8	3.1167	0.4167	975.3	O K
30 Winter	292.3	292.3	3.1552	0.4552	1070.1	O K
60 Winter	313.3	313.3	3.1677	0.4677	1100.0	O K
120 Winter	292.3	292.3	3.1572	0.4572	1074.1	O K
180 Winter	271.8	271.8	3.1342	0.4342	1018.3	O K
240 Winter	251.8	251.8	3.1117	0.4117	963.1	O K
360 Winter	213.7	213.7	3.0732	0.3732	869.9	O K
480 Winter	178.3	178.3	3.0457	0.3457	803.5	O K
600 Winter	161.7	161.7	3.0197	0.3197	740.5	O K
720 Winter	145.9	145.9	3.0007	0.3007	694.7	O K
960 Winter	116.9	116.9	2.9727	0.2727	628.9	O K
1440 Winter	89.8	89.8	2.9308	0.2307	529.3	O K
2160 Winter	66.3	66.3	2.8973	0.1973	450.4	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	103.38	22
30 Summer	61.00	32
60 Summer	35.99	48
120 Summer	21.24	82
180 Summer	15.60	116
240 Summer	12.53	146
360 Summer	9.20	212
480 Summer	7.39	274
600 Summer	6.24	336
720 Summer	5.43	398
960 Summer	4.30	514
1440 Summer	3.10	760
2160 Summer	2.24	1124
2880 Summer	1.77	1484
4320 Summer	1.24	2212
5760 Summer	0.97	2992
7200 Summer	0.79	3640
8640 Summer	0.68	4336
10080 Summer	0.59	5144
15 Winter	103.38	22
30 Winter	61.00	32
60 Winter	35.99	52
120 Winter	21.24	86
180 Winter	15.60	122
240 Winter	12.53	154
360 Winter	9.20	218
480 Winter	7.39	286
600 Winter	6.24	346
720 Winter	5.43	406
960 Winter	4.30	538
1440 Winter	3.10	772
2160 Winter	2.24	1132

Summary of Results for 30 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
2880 Winter	52.6	52.6	2.8758	0.1758	400.5	O K
4320 Winter	35.8	35.8	2.8443	0.1443	328.2	O K
5760 Winter	29.6	29.6	2.8223	0.1223	276.7	O K
7200 Winter	24.1	24.1	2.8088	0.1088	246.6	O K
8640 Winter	24.1	24.1	2.8088	0.1088	245.6	O K
10080 Winter	19.3	19.3	2.7978	0.0978	220.6	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
2880 Winter	1.77	1504
4320 Winter	1.24	2300
5760 Winter	0.97	2840
7200 Winter	0.79	3680
8640 Winter	0.68	4608
10080 Winter	0.59	5048

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	30
Site Location	GB 497200 370850 SK 97200 70850
C (1km)	-0.021
D1 (1km)	0.310
D2 (1km)	0.263
D3 (1km)	0.196
E (1km)	0.308
F (1km)	2.541
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+0

Time / Area Diagram

Total Area (ha) = 5.160

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	1.720	4	8	1.720	8	12	1.720

Tank/Pond Details

Invert Level (m) 2.700 Ground Level (m) 4.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	2237.5	0.50	2484.0	1.00	2730.5	1.50	2878.5	2.00	2878.5	2.50	2878.5
0.10	2286.8	0.60	2533.3	1.10	2779.8	1.60	2878.5	2.10	2878.5		
0.20	2336.1	0.70	2582.6	1.20	2829.1	1.70	2878.5	2.20	2878.5		
0.30	2385.4	0.80	2631.9	1.30	2878.5	1.80	2878.5	2.30	2878.5		
0.40	2434.7	0.90	2681.2	1.40	2878.5	1.90	2878.5	2.40	2878.5		

Pipe Outflow Control

Pipe Diameter (m)	1.200	Roughness (mm)	0.600	Invert Level (m)	2.700
Slope (1:x)	1000.0	Entry Loss Coef	0.500		
Length (m)	88.000	Coef of Contraction	0.600		

Summary of Results for 100 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
15 Summer	378.5	378.5	3.2427	0.5427	1287.4	O K
30 Summer	423.2	423.2	3.2787	0.5787	1377.5	O K
60 Summer	423.2	423.2	3.2883	0.5882	1402.1	O K
120 Summer	423.2	423.2	3.2747	0.5747	1367.3	O K
180 Summer	400.8	400.8	3.2532	0.5532	1313.7	O K
240 Summer	378.5	378.5	3.2272	0.5272	1248.2	O K
360 Summer	334.7	334.7	3.1857	0.4857	1144.3	O K
480 Summer	292.3	292.3	3.1477	0.4477	1051.5	O K
600 Summer	251.8	251.8	3.1212	0.4212	986.7	O K
720 Summer	232.4	232.4	3.0972	0.3972	927.4	O K
960 Summer	195.6	195.6	3.0577	0.3577	832.5	O K
1440 Summer	145.9	145.9	3.0082	0.3082	713.5	O K
2160 Summer	114.2	114.2	2.9622	0.2622	603.2	O K
2880 Summer	91.3	91.3	2.9333	0.2333	535.8	O K
4320 Summer	65.6	65.6	2.8963	0.1963	448.4	O K
5760 Summer	50.5	50.5	2.8708	0.1708	389.7	O K
7200 Summer	42.2	42.2	2.8513	0.1513	344.5	O K
8640 Summer	35.8	35.8	2.8373	0.1373	312.0	O K
10080 Summer	29.6	29.6	2.8328	0.1328	301.9	O K
15 Winter	445.8	445.8	3.2998	0.5998	1430.2	O K
30 Winter	490.9	490.9	3.3388	0.6388	1529.2	O K
60 Winter	490.9	490.9	3.3413	0.6413	1535.5	O K
120 Winter	445.8	445.8	3.3053	0.6053	1444.4	O K
180 Winter	400.8	400.8	3.2662	0.5662	1345.7	O K
240 Winter	378.5	378.5	3.2277	0.5277	1249.4	O K
360 Winter	313.3	313.3	3.1667	0.4667	1098.3	O K
480 Winter	271.8	271.8	3.1247	0.4247	993.8	O K
600 Winter	232.4	232.4	3.0892	0.3892	908.2	O K
720 Winter	213.7	213.7	3.0657	0.3657	850.7	O K
960 Winter	161.7	161.7	3.0227	0.3227	747.4	O K
1440 Winter	124.9	124.9	2.9732	0.2732	629.4	O K
2160 Winter	88.1	88.1	2.9283	0.2282	523.9	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	155.76	22
30 Summer	90.29	31
60 Summer	52.34	48
120 Summer	30.34	82
180 Summer	22.06	114
240 Summer	17.59	146
360 Summer	12.79	208
480 Summer	10.20	270
600 Summer	8.56	334
720 Summer	7.41	394
960 Summer	5.83	516
1440 Summer	4.16	764
2160 Summer	2.97	1120
2880 Summer	2.33	1480
4320 Summer	1.62	2208
5760 Summer	1.25	2944
7200 Summer	1.02	3672
8640 Summer	0.87	4408
10080 Summer	0.76	5152
15 Winter	155.76	22
30 Winter	90.29	32
60 Winter	52.34	50
120 Winter	30.34	86
180 Winter	22.06	120
240 Winter	17.59	152
360 Winter	12.79	214
480 Winter	10.20	278
600 Winter	8.56	338
720 Winter	7.41	400
960 Winter	5.83	530
1440 Winter	4.16	758
2160 Winter	2.97	1132

Summary of Results for 100 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
2880 Winter	69.3	69.3	2.9028	0.2028	464.2	O K
4320 Winter	48.6	48.6	2.8663	0.1663	378.8	O K
5760 Winter	40.5	40.5	2.8473	0.1473	334.2	O K
7200 Winter	34.8	34.8	2.8338	0.1338	302.8	O K
8640 Winter	29.5	29.5	2.8213	0.1213	275.6	O K
10080 Winter	24.1	24.1	2.8088	0.1088	246.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
2880 Winter	2.33	1504
4320 Winter	1.62	2248
5760 Winter	1.25	3064
7200 Winter	1.02	3792
8640 Winter	0.87	4424
10080 Winter	0.76	5000

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	GB 497200 370850 SK 97200 70850
C (1km)	-0.021
D1 (1km)	0.310
D2 (1km)	0.263
D3 (1km)	0.196
E (1km)	0.308
F (1km)	2.541
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+0

Time / Area Diagram

Total Area (ha) = 5.160

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	1.720	4	8	1.720	8	12	1.720

Tank/Pond Details

Invert Level (m) 2.700 Ground Level (m) 4.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	2237.5	0.50	2484.0	1.00	2730.5	1.50	2878.5	2.00	2878.5	2.50	2878.5
0.10	2286.8	0.60	2533.3	1.10	2779.8	1.60	2878.5	2.10	2878.5		
0.20	2336.1	0.70	2582.6	1.20	2829.1	1.70	2878.5	2.20	2878.5		
0.30	2385.4	0.80	2631.9	1.30	2878.5	1.80	2878.5	2.30	2878.5		
0.40	2434.7	0.90	2681.2	1.40	2878.5	1.90	2878.5	2.40	2878.5		

Pipe Outflow Control

Pipe Diameter (m)	1.200	Roughness (mm)	0.600	Invert Level (m)	2.700
Slope (1:x)	1000.0	Entry Loss Coef	0.500		
Length (m)	88.000	Coef of Contraction	0.600		

Summary of Results for 100 year Return Period (+20%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	490.9	490.9	3.3373	0.6373	1526.5	O K
30 Summer	537.2	537.2	3.3783	0.6783	1631.0	O K
60 Summer	537.2	537.2	3.3878	0.6878	1655.7	O K
120 Summer	513.3	513.3	3.3698	0.6698	1608.7	O K
180 Summer	490.9	490.9	3.3383	0.6383	1528.3	O K
240 Summer	445.8	445.8	3.3083	0.6083	1452.7	O K
360 Summer	400.8	400.8	3.2537	0.5537	1314.3	O K
480 Summer	356.4	356.4	3.2092	0.5092	1202.8	O K
600 Summer	313.3	313.3	3.1752	0.4752	1118.6	O K
720 Summer	292.3	292.3	3.1472	0.4472	1049.7	O K
960 Summer	232.4	232.4	3.1032	0.4032	942.3	O K
1440 Summer	178.3	178.3	3.0432	0.3432	796.6	O K
2160 Summer	142.5	142.5	2.9912	0.2912	673.1	O K
2880 Summer	111.7	111.7	2.9598	0.2597	597.4	O K
4320 Summer	79.3	79.3	2.9158	0.2158	494.0	O K
5760 Summer	62.4	62.4	2.8918	0.1918	437.7	O K
7200 Summer	50.3	50.3	2.8703	0.1703	388.6	O K
8640 Summer	42.9	42.9	2.8538	0.1538	350.2	O K
10080 Summer	35.8	35.8	2.8463	0.1463	332.6	O K
15 Winter	559.4	559.4	3.4043	0.7043	1698.1	O K
30 Winter	602.8	602.8	3.4483	0.7483	1812.5	O K
60 Winter	602.8	602.8	3.4468	0.7468	1808.4	O K
120 Winter	559.4	559.4	3.3993	0.6993	1685.4	O K
180 Winter	490.9	490.9	3.3488	0.6488	1555.8	O K
240 Winter	445.8	445.8	3.3018	0.6018	1435.8	O K
360 Winter	378.5	378.5	3.2297	0.5297	1255.0	O K
480 Winter	313.3	313.3	3.1782	0.4782	1126.0	O K
600 Winter	271.8	271.8	3.1387	0.4387	1029.2	O K
720 Winter	251.8	251.8	3.1062	0.4062	949.6	O K
960 Winter	195.6	195.6	3.0597	0.3597	837.2	O K
1440 Winter	145.9	145.9	2.9982	0.2982	689.8	O K
2160 Winter	103.7	103.7	2.9552	0.2552	587.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	186.91	21
30 Summer	108.35	31
60 Summer	62.81	48
120 Summer	36.41	80
180 Summer	26.47	114
240 Summer	21.11	146
360 Summer	15.34	208
480 Summer	12.24	268
600 Summer	10.27	330
720 Summer	8.90	390
960 Summer	7.00	516
1440 Summer	4.99	760
2160 Summer	3.56	1128
2880 Summer	2.80	1476
4320 Summer	1.94	2208
5760 Summer	1.50	2936
7200 Summer	1.23	3672
8640 Summer	1.04	4408
10080 Summer	0.91	5152
15 Winter	186.91	22
30 Winter	108.35	32
60 Winter	62.81	50
120 Winter	36.41	86
180 Winter	26.47	120
240 Winter	21.11	152
360 Winter	15.34	214
480 Winter	12.24	278
600 Winter	10.27	342
720 Winter	8.90	396
960 Winter	7.00	528
1440 Winter	4.99	766
2160 Winter	3.56	1152

Summary of Results for 100 year Return Period (+20%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
2880 Winter	84.6	84.6	2.9233	0.2233	512.0	O K
4320 Winter	58.5	58.5	2.8863	0.1863	425.8	O K
5760 Winter	46.5	46.5	2.8613	0.1613	367.1	O K
7200 Winter	35.8	35.8	2.8458	0.1458	331.5	O K
8640 Winter	34.8	34.8	2.8338	0.1338	303.1	O K
10080 Winter	29.6	29.6	2.8218	0.1218	276.0	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
2880 Winter	2.80	1476
4320 Winter	1.94	2212
5760 Winter	1.50	2912
7200 Winter	1.23	3824
8640 Winter	1.04	4600
10080 Winter	0.91	5008

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	GB 497200 370850 SK 97200 70850
C (1km)	-0.021
D1 (1km)	0.310
D2 (1km)	0.263
D3 (1km)	0.196
E (1km)	0.308
F (1km)	2.541
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+20

Time / Area Diagram

Total Area (ha) = 5.160

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	1.720	4	8	1.720	8	12	1.720

Tank/Pond Details

Invert Level (m) 2.700 Ground Level (m) 4.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	2237.5	0.50	2484.0	1.00	2730.5	1.50	2878.5	2.00	2878.5	2.50	2878.5
0.10	2286.8	0.60	2533.3	1.10	2779.8	1.60	2878.5	2.10	2878.5		
0.20	2336.1	0.70	2582.6	1.20	2829.1	1.70	2878.5	2.20	2878.5		
0.30	2385.4	0.80	2631.9	1.30	2878.5	1.80	2878.5	2.30	2878.5		
0.40	2434.7	0.90	2681.2	1.40	2878.5	1.90	2878.5	2.40	2878.5		

Pipe Outflow Control

Pipe Diameter (m)	1.200	Roughness (mm)	0.600	Invert Level (m)	2.700
Slope (1:x)	1000.0	Entry Loss Coef	0.500		
Length (m)	88.000	Coef of Contraction	0.600		

Summary of Results for 2 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
15 Summer	50.8	50.8	2.8718	0.1717	391.5	O K
30 Summer	67.7	67.7	2.8992	0.1992	455.9	O K
60 Summer	79.9	79.9	2.9202	0.2202	504.8	O K
120 Summer	91.3	91.3	2.9357	0.2357	541.6	O K
180 Summer	96.9	96.9	2.9407	0.2407	553.3	O K
240 Summer	97.2	97.2	2.9412	0.2412	554.4	O K
360 Summer	91.3	91.3	2.9367	0.2367	543.5	O K
480 Summer	88.8	88.8	2.9292	0.2292	525.9	O K
600 Summer	84.2	84.2	2.9227	0.2227	510.4	O K
720 Summer	78.6	78.6	2.9147	0.2147	492.4	O K
960 Summer	69.1	69.1	2.9013	0.2012	460.6	O K
1440 Summer	55.0	55.0	2.8813	0.1813	413.1	O K
2160 Summer	42.9	42.9	2.8593	0.1593	362.1	O K
2880 Summer	35.8	35.8	2.8443	0.1443	328.2	O K
4320 Summer	29.6	29.6	2.8218	0.1218	276.2	O K
5760 Summer	24.1	24.1	2.8088	0.1088	245.8	O K
7200 Summer	19.3	19.3	2.7998	0.0998	225.4	O K
8640 Summer	19.3	19.3	2.7973	0.0973	220.2	O K
10080 Summer	15.1	15.1	2.7873	0.0873	197.1	O K
15 Winter	62.0	62.0	2.8912	0.1912	436.6	O K
30 Winter	79.9	79.9	2.9217	0.2217	507.7	O K
60 Winter	98.6	98.6	2.9432	0.2432	559.2	O K
120 Winter	103.7	103.7	2.9557	0.2557	587.8	O K
180 Winter	103.7	103.7	2.9552	0.2552	587.1	O K
240 Winter	103.6	103.6	2.9502	0.2502	574.9	O K
360 Winter	91.3	91.3	2.9387	0.2387	548.3	O K
480 Winter	86.3	86.3	2.9257	0.2257	518.0	O K
600 Winter	78.9	78.9	2.9152	0.2152	492.8	O K
720 Winter	73.0	73.0	2.9067	0.2067	472.8	O K
960 Winter	59.6	59.6	2.8903	0.1902	434.3	O K
1440 Winter	47.5	47.5	2.8638	0.1638	372.9	O K
2160 Winter	35.8	35.8	2.8393	0.1393	316.4	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	41.73	24
30 Summer	25.61	35
60 Summer	15.71	56
120 Summer	9.64	86
180 Summer	7.25	120
240 Summer	5.92	152
360 Summer	4.45	218
480 Summer	3.63	280
600 Summer	3.10	342
720 Summer	2.73	404
960 Summer	2.20	528
1440 Summer	1.62	774
2160 Summer	1.19	1148
2880 Summer	0.96	1508
4320 Summer	0.69	2208
5760 Summer	0.55	2976
7200 Summer	0.45	3680
8640 Summer	0.39	4440
10080 Summer	0.35	5136
15 Winter	41.73	23
30 Winter	25.61	35
60 Winter	15.71	56
120 Winter	9.64	92
180 Winter	7.25	128
240 Winter	5.92	160
360 Winter	4.45	230
480 Winter	3.63	292
600 Winter	3.10	354
720 Winter	2.73	416
960 Winter	2.20	548
1440 Winter	1.62	788
2160 Winter	1.19	1168

Summary of Results for 2 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
2880 Winter	29.6	29.6	2.8243	0.1243	281.3	O K
4320 Winter	24.1	24.1	2.8088	0.1088	245.7	O K
5760 Winter	19.3	19.3	2.7973	0.0973	220.3	O K
7200 Winter	14.5	14.5	2.7858	0.0858	193.8	O K
8640 Winter	14.5	14.5	2.7858	0.0858	193.0	O K
10080 Winter	11.1	11.1	2.7778	0.0778	174.9	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
2880 Winter	0.96	1528
4320 Winter	0.69	2176
5760 Winter	0.55	2888
7200 Winter	0.45	3672
8640 Winter	0.39	4528
10080 Winter	0.35	5112

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	2
Site Location	GB 497200 370850 SK 97200 70850
C (1km)	-0.021
D1 (1km)	0.310
D2 (1km)	0.263
D3 (1km)	0.196
E (1km)	0.308
F (1km)	2.541
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+0

Time / Area Diagram

Total Area (ha) = 5.400

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	1.800	4	8	1.800	8	12	1.800

Tank/Pond Details

Invert Level (m) 2.700 Ground Level (m) 4.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	2237.5	0.50	2484.0	1.00	2730.5	1.50	2878.5	2.00	2878.5	2.50	2878.5
0.10	2286.8	0.60	2533.3	1.10	2779.8	1.60	2878.5	2.10	2878.5		
0.20	2336.1	0.70	2582.6	1.20	2829.1	1.70	2878.5	2.20	2878.5		
0.30	2385.4	0.80	2631.9	1.30	2878.5	1.80	2878.5	2.30	2878.5		
0.40	2434.7	0.90	2681.2	1.40	2878.5	1.90	2878.5	2.40	2878.5		

Pipe Outflow Control

Pipe Diameter (m)	1.200	Roughness (mm)	0.600	Invert Level (m)	2.700
Slope (1:x)	1000.0	Entry Loss Coef	0.500		
Length (m)	88.000	Coef of Contraction	0.600		

Summary of Results for 30 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
15 Summer	232.4	232.4	3.0917	0.3917	914.4	O K
30 Summer	271.8	271.8	3.1277	0.4277	1002.7	O K
60 Summer	292.3	292.3	3.1447	0.4447	1044.2	O K
120 Summer	292.3	292.3	3.1482	0.4482	1052.6	O K
180 Summer	271.8	271.8	3.1377	0.4377	1026.5	O K
240 Summer	271.8	271.8	3.1247	0.4247	994.4	O K
360 Summer	232.4	232.4	3.0967	0.3967	926.0	O K
480 Summer	213.7	213.7	3.0707	0.3707	863.0	O K
600 Summer	195.6	195.6	3.0507	0.3507	814.7	O K
720 Summer	178.3	178.3	3.0327	0.3327	772.4	O K
960 Summer	145.9	145.9	3.0052	0.3052	706.2	O K
1440 Summer	116.6	116.6	2.9647	0.2647	610.2	O K
2160 Summer	88.4	88.4	2.9288	0.2287	524.4	O K
2880 Summer	73.0	73.0	2.9068	0.2068	473.0	O K
4320 Summer	50.8	50.8	2.8723	0.1723	392.8	O K
5760 Summer	41.4	41.4	2.8493	0.1493	339.6	O K
7200 Summer	35.0	35.0	2.8343	0.1343	304.3	O K
8640 Summer	29.6	29.6	2.8233	0.1233	279.1	O K
10080 Summer	24.1	24.1	2.8193	0.1193	270.7	O K
15 Winter	271.8	271.8	3.1342	0.4342	1017.6	O K
30 Winter	313.3	313.3	3.1732	0.4732	1113.8	O K
60 Winter	334.7	334.7	3.1857	0.4857	1145.5	O K
120 Winter	313.3	313.3	3.1742	0.4742	1116.0	O K
180 Winter	292.3	292.3	3.1492	0.4492	1054.4	O K
240 Winter	271.8	271.8	3.1257	0.4257	997.2	O K
360 Winter	232.4	232.4	3.0857	0.3857	899.2	O K
480 Winter	195.6	195.6	3.0527	0.3527	820.2	O K
600 Winter	178.3	178.3	3.0282	0.3282	761.2	O K
720 Winter	160.1	160.1	3.0092	0.3092	714.8	O K
960 Winter	128.4	128.4	2.9767	0.2767	637.7	O K
1440 Winter	91.3	91.3	2.9388	0.2387	548.7	O K
2160 Winter	69.1	69.1	2.9013	0.2013	460.7	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	103.38	22
30 Summer	61.00	32
60 Summer	35.99	48
120 Summer	21.24	82
180 Summer	15.60	114
240 Summer	12.53	146
360 Summer	9.20	210
480 Summer	7.39	272
600 Summer	6.24	332
720 Summer	5.43	394
960 Summer	4.30	520
1440 Summer	3.10	758
2160 Summer	2.24	1124
2880 Summer	1.77	1488
4320 Summer	1.24	2212
5760 Summer	0.97	2944
7200 Summer	0.79	3672
8640 Summer	0.68	4408
10080 Summer	0.59	5160
15 Winter	103.38	22
30 Winter	61.00	32
60 Winter	35.99	50
120 Winter	21.24	86
180 Winter	15.60	120
240 Winter	12.53	152
360 Winter	9.20	216
480 Winter	7.39	280
600 Winter	6.24	336
720 Winter	5.43	396
960 Winter	4.30	522
1440 Winter	3.10	786
2160 Winter	2.24	1136

Summary of Results for 30 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
2880 Winter	54.7	54.7	2.8808	0.1808	412.0	O K
4320 Winter	40.5	40.5	2.8473	0.1473	334.4	O K
5760 Winter	29.6	29.6	2.8278	0.1278	290.1	O K
7200 Winter	24.1	24.1	2.8183	0.1183	268.5	O K
8640 Winter	24.1	24.1	2.8088	0.1088	245.7	O K
10080 Winter	19.3	19.3	2.7978	0.0978	221.0	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
2880 Winter	1.77	1508
4320 Winter	1.24	2168
5760 Winter	0.97	3056
7200 Winter	0.79	3824
8640 Winter	0.68	4488
10080 Winter	0.59	5080

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	30
Site Location	GB 497200 370850 SK 97200 70850
C (1km)	-0.021
D1 (1km)	0.310
D2 (1km)	0.263
D3 (1km)	0.196
E (1km)	0.308
F (1km)	2.541
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+0

Time / Area Diagram

Total Area (ha) = 5.400

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	1.800	4	8	1.800	8	12	1.800

Tank/Pond Details

Invert Level (m) 2.700 Ground Level (m) 4.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	2237.5	0.50	2484.0	1.00	2730.5	1.50	2878.5	2.00	2878.5	2.50	2878.5
0.10	2286.8	0.60	2533.3	1.10	2779.8	1.60	2878.5	2.10	2878.5		
0.20	2336.1	0.70	2582.6	1.20	2829.1	1.70	2878.5	2.20	2878.5		
0.30	2385.4	0.80	2631.9	1.30	2878.5	1.80	2878.5	2.30	2878.5		
0.40	2434.7	0.90	2681.2	1.40	2878.5	1.90	2878.5	2.40	2878.5		

Pipe Outflow Control

Pipe Diameter (m)	1.200	Roughness (mm)	0.600	Invert Level (m)	2.700
Slope (1:x)	1000.0	Entry Loss Coef	0.500		
Length (m)	88.000	Coef of Contraction	0.600		

Summary of Results for 100 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	400.8	400.8	3.2652	0.5652	1343.5	O K
30 Summer	445.8	445.8	3.3023	0.6023	1436.8	O K
60 Summer	468.3	468.3	3.3108	0.6108	1458.8	O K
120 Summer	445.8	445.8	3.2973	0.5973	1424.9	O K
180 Summer	423.2	423.2	3.2742	0.5742	1365.6	O K
240 Summer	400.8	400.8	3.2477	0.5477	1298.8	O K
360 Summer	334.7	334.7	3.2002	0.5002	1181.5	O K
480 Summer	313.3	313.3	3.1652	0.4652	1092.9	O K
600 Summer	271.8	271.8	3.1337	0.4337	1017.0	O K
720 Summer	251.8	251.8	3.1087	0.4087	955.3	O K
960 Summer	213.7	213.7	3.0667	0.3667	854.0	O K
1440 Summer	161.7	161.7	3.0132	0.3132	724.6	O K
2160 Summer	116.9	116.9	2.9697	0.2697	621.3	O K
2880 Summer	96.5	96.5	2.9403	0.2403	551.4	O K
4320 Summer	68.7	68.7	2.9008	0.2008	459.1	O K
5760 Summer	52.8	52.8	2.8763	0.1763	402.6	O K
7200 Summer	42.9	42.9	2.8568	0.1568	357.3	O K
8640 Summer	35.8	35.8	2.8448	0.1448	328.6	O K
10080 Summer	34.8	34.8	2.8338	0.1338	303.6	O K
15 Winter	468.3	468.3	3.3238	0.6238	1492.1	O K
30 Winter	513.3	513.3	3.3653	0.6653	1597.1	O K
60 Winter	513.3	513.3	3.3658	0.6658	1599.3	O K
120 Winter	468.3	468.3	3.3273	0.6273	1500.6	O K
180 Winter	423.2	423.2	3.2843	0.5842	1391.4	O K
240 Winter	378.5	378.5	3.2452	0.5452	1293.6	O K
360 Winter	313.3	313.3	3.1832	0.4832	1138.8	O K
480 Winter	271.8	271.8	3.1367	0.4367	1024.0	O K
600 Winter	232.4	232.4	3.1042	0.4042	944.6	O K
720 Winter	213.7	213.7	3.0727	0.3727	868.7	O K
960 Winter	178.3	178.3	3.0287	0.3287	761.7	O K
1440 Winter	128.8	128.8	2.9772	0.2772	638.9	O K
2160 Winter	91.3	91.3	2.9348	0.2347	538.7	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	155.76	22
30 Summer	90.29	31
60 Summer	52.34	48
120 Summer	30.34	80
180 Summer	22.06	114
240 Summer	17.59	144
360 Summer	12.79	208
480 Summer	10.20	270
600 Summer	8.56	332
720 Summer	7.41	390
960 Summer	5.83	510
1440 Summer	4.16	754
2160 Summer	2.97	1128
2880 Summer	2.33	1476
4320 Summer	1.62	2208
5760 Summer	1.25	2944
7200 Summer	1.02	3680
8640 Summer	0.87	4416
10080 Summer	0.76	5120
15 Winter	155.76	22
30 Winter	90.29	32
60 Winter	52.34	50
120 Winter	30.34	86
180 Winter	22.06	120
240 Winter	17.59	152
360 Winter	12.79	218
480 Winter	10.20	280
600 Winter	8.56	346
720 Winter	7.41	402
960 Winter	5.83	514
1440 Winter	4.16	758
2160 Winter	2.97	1144

Summary of Results for 100 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
2880 Winter	73.7	73.7	2.9078	0.2078	475.1	O K
4320 Winter	50.7	50.7	2.8713	0.1713	390.7	O K
5760 Winter	40.5	40.5	2.8473	0.1473	335.0	O K
7200 Winter	34.8	34.8	2.8338	0.1338	303.1	O K
8640 Winter	29.6	29.6	2.8218	0.1218	276.0	O K
10080 Winter	24.1	24.1	2.8093	0.1093	246.8	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
2880 Winter	2.33	1476
4320 Winter	1.62	2248
5760 Winter	1.25	2904
7200 Winter	1.02	3632
8640 Winter	0.87	4280
10080 Winter	0.76	5136

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	GB 497200 370850 SK 97200 70850
C (1km)	-0.021
D1 (1km)	0.310
D2 (1km)	0.263
D3 (1km)	0.196
E (1km)	0.308
F (1km)	2.541
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+0

Time / Area Diagram

Total Area (ha) = 5.400

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	1.800	4	8	1.800	8	12	1.800

Tank/Pond Details

Invert Level (m) 2.700 Ground Level (m) 4.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	2237.5	0.50	2484.0	1.00	2730.5	1.50	2878.5	2.00	2878.5	2.50	2878.5
0.10	2286.8	0.60	2533.3	1.10	2779.8	1.60	2878.5	2.10	2878.5		
0.20	2336.1	0.70	2582.6	1.20	2829.1	1.70	2878.5	2.20	2878.5		
0.30	2385.4	0.80	2631.9	1.30	2878.5	1.80	2878.5	2.30	2878.5		
0.40	2434.7	0.90	2681.2	1.40	2878.5	1.90	2878.5	2.40	2878.5		

Pipe Outflow Control

Pipe Diameter (m)	1.200	Roughness (mm)	0.600	Invert Level (m)	2.700
Slope (1:x)	1000.0	Entry Loss Coef	0.500		
Length (m)	88.000	Coef of Contraction	0.600		

Summary of Results for 100 year Return Period (+20%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	513.3	513.3	3.3638	0.6638	1594.2	O K
30 Summer	559.4	559.4	3.4063	0.7063	1703.4	O K
60 Summer	559.4	559.4	3.4143	0.7143	1725.5	O K
120 Summer	559.4	559.4	3.3958	0.6958	1675.8	O K
180 Summer	513.3	513.3	3.3623	0.6623	1590.4	O K
240 Summer	468.3	468.3	3.3293	0.6293	1506.2	O K
360 Summer	423.2	423.2	3.2712	0.5712	1359.1	O K
480 Summer	378.5	378.5	3.2272	0.5272	1248.5	O K
600 Summer	334.7	334.7	3.1907	0.4907	1157.6	O K
720 Summer	292.3	292.3	3.1637	0.4637	1091.0	O K
960 Summer	251.8	251.8	3.1132	0.4132	966.8	O K
1440 Summer	195.6	195.6	3.0497	0.3497	812.5	O K
2160 Summer	145.9	145.9	2.9967	0.2967	685.5	O K
2880 Summer	116.9	116.9	2.9653	0.2652	611.0	O K
4320 Summer	84.2	84.2	2.9228	0.2228	510.6	O K
5760 Summer	64.9	64.9	2.8953	0.1953	446.0	O K
7200 Summer	52.8	52.8	2.8763	0.1763	402.2	O K
8640 Summer	46.5	46.5	2.8613	0.1613	367.0	O K
10080 Summer	40.5	40.5	2.8473	0.1473	335.1	O K
15 Winter	581.2	581.2	3.4338	0.7338	1774.2	O K
30 Winter	644.5	644.5	3.4793	0.7793	1893.1	O K
60 Winter	623.9	623.9	3.4748	0.7748	1881.1	O K
120 Winter	581.2	581.2	3.4268	0.7268	1756.2	O K
180 Winter	513.3	513.3	3.3718	0.6718	1614.2	O K
240 Winter	468.3	468.3	3.3228	0.6228	1489.1	O K
360 Winter	400.8	400.8	3.2477	0.5477	1300.1	O K
480 Winter	334.7	334.7	3.1922	0.4922	1160.8	O K
600 Winter	292.3	292.3	3.1502	0.4502	1058.0	O K
720 Winter	251.8	251.8	3.1217	0.4217	987.0	O K
960 Winter	213.7	213.7	3.0667	0.3667	853.5	O K
1440 Winter	160.1	160.1	3.0092	0.3092	715.3	O K
2160 Winter	111.7	111.7	2.9597	0.2597	597.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	186.91	21
30 Summer	108.35	31
60 Summer	62.81	48
120 Summer	36.41	80
180 Summer	26.47	114
240 Summer	21.11	146
360 Summer	15.34	206
480 Summer	12.24	270
600 Summer	10.27	330
720 Summer	8.90	394
960 Summer	7.00	512
1440 Summer	4.99	752
2160 Summer	3.56	1112
2880 Summer	2.80	1476
4320 Summer	1.94	2208
5760 Summer	1.50	2936
7200 Summer	1.23	3672
8640 Summer	1.04	4408
10080 Summer	0.91	5136
15 Winter	186.91	22
30 Winter	108.35	32
60 Winter	62.81	50
120 Winter	36.41	86
180 Winter	26.47	120
240 Winter	21.11	152
360 Winter	15.34	212
480 Winter	12.24	276
600 Winter	10.27	338
720 Winter	8.90	406
960 Winter	7.00	514
1440 Winter	4.99	750
2160 Winter	3.56	1124

Summary of Results for 100 year Return Period (+20%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
2880 Winter	88.1	88.1	2.9283	0.2283	523.0	O K
4320 Winter	62.1	62.1	2.8913	0.1913	436.9	O K
5760 Winter	47.5	47.5	2.8638	0.1638	372.8	O K
7200 Winter	40.5	40.5	2.8473	0.1473	334.7	O K
8640 Winter	34.8	34.8	2.8338	0.1338	303.5	O K
10080 Winter	29.6	29.6	2.8218	0.1218	276.6	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
2880 Winter	2.80	1480
4320 Winter	1.94	2192
5760 Winter	1.50	2944
7200 Winter	1.23	3624
8640 Winter	1.04	4352
10080 Winter	0.91	4976

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	GB 497200 370850 SK 97200 70850
C (1km)	-0.021
D1 (1km)	0.310
D2 (1km)	0.263
D3 (1km)	0.196
E (1km)	0.308
F (1km)	2.541
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+20

Time / Area Diagram

Total Area (ha) = 5.400

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	1.800	4	8	1.800	8	12	1.800

Tank/Pond Details

Invert Level (m) 2.700 Ground Level (m) 4.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	2237.5	0.50	2484.0	1.00	2730.5	1.50	2878.5	2.00	2878.5	2.50	2878.5
0.10	2286.8	0.60	2533.3	1.10	2779.8	1.60	2878.5	2.10	2878.5		
0.20	2336.1	0.70	2582.6	1.20	2829.1	1.70	2878.5	2.20	2878.5		
0.30	2385.4	0.80	2631.9	1.30	2878.5	1.80	2878.5	2.30	2878.5		
0.40	2434.7	0.90	2681.2	1.40	2878.5	1.90	2878.5	2.40	2878.5		

Pipe Outflow Control

Pipe Diameter (m)	1.200	Roughness (mm)	0.600	Invert Level (m)	2.700
Slope (1:x)	1000.0	Entry Loss Coef	0.500		
Length (m)	88.000	Coef of Contraction	0.600		

Summary of Results for 2 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	91.3	91.3	2.9347	0.2347	539.1	O K
30 Summer	116.9	116.9	2.9697	0.2697	621.2	O K
60 Summer	144.5	144.5	2.9932	0.2932	676.8	O K
120 Summer	161.1	161.1	3.0102	0.3102	717.9	O K
180 Summer	161.7	161.7	3.0127	0.3127	724.4	O K
240 Summer	161.6	161.6	3.0107	0.3107	718.9	O K
360 Summer	145.9	145.9	3.0002	0.3002	693.5	O K
480 Summer	131.0	131.0	2.9892	0.2892	668.4	O K
600 Summer	128.8	128.8	2.9772	0.2772	638.9	O K
720 Summer	116.9	116.9	2.9677	0.2677	616.5	O K
960 Summer	102.5	102.5	2.9487	0.2487	571.5	O K
1440 Summer	79.9	79.9	2.9218	0.2217	508.4	O K
2160 Summer	64.5	64.5	2.8948	0.1948	445.3	O K
2880 Summer	52.8	52.8	2.8763	0.1763	402.4	O K
4320 Summer	41.0	41.0	2.8483	0.1483	337.3	O K
5760 Summer	34.8	34.8	2.8338	0.1338	303.1	O K
7200 Summer	29.6	29.6	2.8218	0.1218	275.9	O K
8640 Summer	24.1	24.1	2.8088	0.1088	246.1	O K
10080 Summer	24.1	24.1	2.8088	0.1088	245.6	O K
15 Winter	112.7	112.7	2.9607	0.2607	599.6	O K
30 Winter	145.9	145.9	2.9977	0.2977	688.6	O K
60 Winter	161.7	161.7	3.0232	0.3232	748.5	O K
120 Winter	178.3	178.3	3.0327	0.3327	771.5	O K
180 Winter	178.2	178.2	3.0277	0.3277	759.5	O K
240 Winter	161.7	161.7	3.0177	0.3177	735.4	O K
360 Winter	145.9	145.9	2.9967	0.2967	685.5	O K
480 Winter	130.8	130.8	2.9792	0.2792	643.6	O K
600 Winter	116.6	116.6	2.9647	0.2647	609.6	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	41.73	23
30 Summer	25.61	34
60 Summer	15.71	50
120 Summer	9.64	84
180 Summer	7.25	116
240 Summer	5.92	148
360 Summer	4.45	214
480 Summer	3.63	278
600 Summer	3.10	336
720 Summer	2.73	400
960 Summer	2.20	520
1440 Summer	1.62	770
2160 Summer	1.19	1128
2880 Summer	0.96	1500
4320 Summer	0.69	2208
5760 Summer	0.55	2936
7200 Summer	0.45	3640
8640 Summer	0.39	4408
10080 Summer	0.35	5144
15 Winter	41.73	23
30 Winter	25.61	33
60 Winter	15.71	54
120 Winter	9.64	88
180 Winter	7.25	122
240 Winter	5.92	156
360 Winter	4.45	220
480 Winter	3.63	284
600 Winter	3.10	348

Summary of Results for 2 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
720 Winter	103.7	103.7	2.9527	0.2527	581.0	O K
960 Winter	88.8	88.8	2.9292	0.2292	525.9	O K
1440 Winter	68.0	68.0	2.8998	0.1998	457.1	O K
2160 Winter	50.8	50.8	2.8718	0.1718	391.2	O K
2880 Winter	42.0	42.0	2.8508	0.1508	343.0	O K
4320 Winter	29.6	29.6	2.8273	0.1273	288.3	O K
5760 Winter	24.1	24.1	2.8098	0.1098	248.9	O K
7200 Winter	19.3	19.3	2.8053	0.1053	238.7	O K
8640 Winter	19.3	19.3	2.7973	0.0973	220.4	O K
10080 Winter	15.2	15.2	2.7883	0.0883	199.7	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
720 Winter	2.73	414
960 Winter	2.20	534
1440 Winter	1.62	780
2160 Winter	1.19	1152
2880 Winter	0.96	1504
4320 Winter	0.69	2296
5760 Winter	0.55	2992
7200 Winter	0.45	3824
8640 Winter	0.39	4376
10080 Winter	0.35	5160

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	2
Site Location	GB 497200 370850 SK 97200 70850
C (1km)	-0.021
D1 (1km)	0.310
D2 (1km)	0.263
D3 (1km)	0.196
E (1km)	0.308
F (1km)	2.541
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+0

Time / Area Diagram

Total Area (ha) = 7.575

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	2.525	4	8	2.525	8	12	2.525

Tank/Pond Details

Invert Level (m) 2.700 Ground Level (m) 4.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	2237.5	0.60	2533.3	1.20	2829.1	1.80	2878.5	2.40	2878.5
0.10	2286.8	0.70	2582.6	1.30	2878.5	1.90	2878.5	2.50	2878.5
0.20	2336.1	0.80	2631.9	1.40	2878.5	2.00	2878.5		
0.30	2385.4	0.90	2681.2	1.50	2878.5	2.10	2878.5		
0.40	2434.7	1.00	2730.5	1.60	2878.5	2.20	2878.5		
0.50	2484.0	1.10	2779.8	1.70	2878.5	2.30	2878.5		

Pipe Outflow Control

Pipe Diameter (m)	1.200	Roughness (mm)	0.600	Invert Level (m)	2.700
Slope (1:x)	1000.0	Entry Loss Coef	0.500		
Length (m)	88.000	Coef of Contraction	0.600		

Summary of Results for 30 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	378.5	378.5	3.2292	0.5292	1253.8	O K
30 Summer	423.2	423.2	3.2752	0.5752	1368.3	O K
60 Summer	445.8	445.8	3.2933	0.5932	1414.1	O K
120 Summer	445.8	445.8	3.2898	0.5897	1405.2	O K
180 Summer	423.2	423.2	3.2692	0.5692	1353.8	O K
240 Summer	400.8	400.8	3.2477	0.5477	1299.7	O K
360 Summer	334.7	334.7	3.2047	0.5047	1192.7	O K
480 Summer	313.3	313.3	3.1682	0.4682	1102.0	O K
600 Summer	271.8	271.8	3.1417	0.4417	1036.1	O K
720 Summer	251.8	251.8	3.1162	0.4162	973.8	O K
960 Summer	213.7	213.7	3.0757	0.3757	875.5	O K
1440 Summer	161.7	161.7	3.0247	0.3247	752.5	O K
2160 Summer	128.4	128.4	2.9767	0.2767	638.1	O K
2880 Summer	102.2	102.2	2.9483	0.2483	571.1	O K
4320 Summer	74.4	74.4	2.9088	0.2088	478.2	O K
5760 Summer	57.8	57.8	2.8853	0.1853	423.2	O K
7200 Summer	48.2	48.2	2.8653	0.1653	376.3	O K
8640 Summer	41.4	41.4	2.8493	0.1493	340.0	O K
10080 Summer	35.8	35.8	2.8383	0.1383	314.2	O K
15 Winter	423.2	423.2	3.2857	0.5857	1395.2	O K
30 Winter	490.9	490.9	3.3343	0.6343	1517.8	O K
60 Winter	490.9	490.9	3.3468	0.6468	1549.8	O K
120 Winter	468.3	468.3	3.3188	0.6188	1479.2	O K
180 Winter	423.2	423.2	3.2797	0.5797	1379.9	O K
240 Winter	378.5	378.5	3.2447	0.5447	1292.2	O K
360 Winter	334.7	334.7	3.1857	0.4857	1144.8	O K
480 Winter	271.8	271.8	3.1437	0.4437	1041.0	O K
600 Winter	251.8	251.8	3.1062	0.4062	949.4	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	103.38	22
30 Summer	61.00	31
60 Summer	35.99	48
120 Summer	21.24	80
180 Summer	15.60	114
240 Summer	12.53	146
360 Summer	9.20	210
480 Summer	7.39	268
600 Summer	6.24	332
720 Summer	5.43	392
960 Summer	4.30	514
1440 Summer	3.10	760
2160 Summer	2.24	1112
2880 Summer	1.77	1480
4320 Summer	1.24	2208
5760 Summer	0.97	2944
7200 Summer	0.79	3672
8640 Summer	0.68	4408
10080 Summer	0.59	5144
15 Winter	103.38	22
30 Winter	61.00	32
60 Winter	35.99	50
120 Winter	21.24	86
180 Winter	15.60	120
240 Winter	12.53	152
360 Winter	9.20	214
480 Winter	7.39	282
600 Winter	6.24	336

Summary of Results for 30 year Return Period

Storm Duration (mins)		Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
720	Winter	213.7	213.7	3.0822	0.3822	891.8	O K
960	Winter	178.3	178.3	3.0362	0.3362	780.4	O K
1440	Winter	131.0	131.0	2.9857	0.2857	659.7	O K
2160	Winter	97.9	97.9	2.9423	0.2422	555.9	O K
2880	Winter	77.9	77.9	2.9138	0.2138	489.9	O K
4320	Winter	54.5	54.5	2.8803	0.1803	411.8	O K
5760	Winter	42.9	42.9	2.8528	0.1528	347.1	O K
7200	Winter	35.5	35.5	2.8353	0.1353	306.6	O K
8640	Winter	29.6	29.6	2.8258	0.1258	285.3	O K
10080	Winter	29.5	29.5	2.8213	0.1213	275.6	O K

Storm Duration (mins)		Rain (mm/hr)	Time-Peak (mins)
720	Winter	5.43	406
960	Winter	4.30	526
1440	Winter	3.10	776
2160	Winter	2.24	1128
2880	Winter	1.77	1500
4320	Winter	1.24	2248
5760	Winter	0.97	2944
7200	Winter	0.79	3680
8640	Winter	0.68	4504
10080	Winter	0.59	5104

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	30
Site Location	GB 497200 370850 SK 97200 70850
C (1km)	-0.021
D1 (1km)	0.310
D2 (1km)	0.263
D3 (1km)	0.196
E (1km)	0.308
F (1km)	2.541
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+0

Time / Area Diagram

Total Area (ha) = 7.575

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	2.525	4	8	2.525	8	12	2.525

Tank/Pond Details

Invert Level (m) 2.700 Ground Level (m) 4.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	2237.5	0.60	2533.3	1.20	2829.1	1.80	2878.5	2.40	2878.5
0.10	2286.8	0.70	2582.6	1.30	2878.5	1.90	2878.5	2.50	2878.5
0.20	2336.1	0.80	2631.9	1.40	2878.5	2.00	2878.5		
0.30	2385.4	0.90	2681.2	1.50	2878.5	2.10	2878.5		
0.40	2434.7	1.00	2730.5	1.60	2878.5	2.20	2878.5		
0.50	2484.0	1.10	2779.8	1.70	2878.5	2.30	2878.5		

Pipe Outflow Control

Pipe Diameter (m)	1.200	Roughness (mm)	0.600	Invert Level (m)	2.700
Slope (1:x)	1000.0	Entry Loss Coef	0.500		
Length (m)	88.000	Coef of Contraction	0.600		

Summary of Results for 100 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	623.9	623.9	3.4628	0.7628	1850.3	O K
30 Summer	664.6	664.6	3.5098	0.8098	1973.0	O K
60 Summer	684.2	684.2	3.5163	0.8163	1990.0	O K
120 Summer	644.5	644.5	3.4903	0.7903	1921.9	O K
180 Summer	602.8	602.8	3.4508	0.7508	1818.6	O K
240 Summer	559.4	559.4	3.4088	0.7088	1710.2	O K
360 Summer	490.9	490.9	3.3413	0.6413	1536.2	O K
480 Summer	445.8	445.8	3.2898	0.5897	1404.9	O K
600 Summer	400.8	400.8	3.2477	0.5477	1298.8	O K
720 Summer	356.4	356.4	3.2132	0.5132	1213.9	O K
960 Summer	292.3	292.3	3.1582	0.4582	1077.4	O K
1440 Summer	232.4	232.4	3.0862	0.3862	900.4	O K
2160 Summer	178.2	178.2	3.0277	0.3277	759.0	O K
2880 Summer	142.5	142.5	2.9912	0.2912	673.1	O K
4320 Summer	97.6	97.6	2.9418	0.2418	555.1	O K
5760 Summer	76.1	76.1	2.9113	0.2113	483.7	O K
7200 Summer	62.8	62.8	2.8923	0.1923	439.1	O K
8640 Summer	53.0	53.0	2.8768	0.1768	402.7	O K
10080 Summer	46.5	46.5	2.8613	0.1613	367.4	O K
15 Winter	703.1	703.1	3.5413	0.8413	2056.5	O K
30 Winter	755.7	755.7	3.5923	0.8923	2192.4	O K
60 Winter	738.9	738.9	3.5878	0.8878	2180.9	O K
120 Winter	684.2	684.2	3.5243	0.8243	2012.3	O K
180 Winter	623.9	623.9	3.4578	0.7578	1836.7	O K
240 Winter	559.4	559.4	3.3993	0.6993	1685.7	O K
360 Winter	468.3	468.3	3.3118	0.6118	1461.5	O K
480 Winter	400.8	400.8	3.2477	0.5477	1299.3	O K
600 Winter	334.7	334.7	3.2017	0.5017	1184.4	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	155.76	21
30 Summer	90.29	31
60 Summer	52.34	48
120 Summer	30.34	80
180 Summer	22.06	114
240 Summer	17.59	144
360 Summer	12.79	208
480 Summer	10.20	268
600 Summer	8.56	330
720 Summer	7.41	390
960 Summer	5.83	514
1440 Summer	4.16	750
2160 Summer	2.97	1124
2880 Summer	2.33	1480
4320 Summer	1.62	2208
5760 Summer	1.25	2936
7200 Summer	1.02	3672
8640 Summer	0.87	4408
10080 Summer	0.76	5136
15 Winter	155.76	22
30 Winter	90.29	32
60 Winter	52.34	50
120 Winter	30.34	86
180 Winter	22.06	118
240 Winter	17.59	150
360 Winter	12.79	212
480 Winter	10.20	274
600 Winter	8.56	342

Summary of Results for 100 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
720 Winter	313.3	313.3	3.1652	0.4652	1094.0	O K
960 Winter	251.8	251.8	3.1052	0.4052	946.9	O K
1440 Winter	178.3	178.3	3.0352	0.3352	778.4	O K
2160 Winter	130.8	130.8	2.9792	0.2792	644.0	O K
2880 Winter	102.9	102.9	2.9493	0.2492	572.5	O K
4320 Winter	73.0	73.0	2.9068	0.2068	473.2	O K
5760 Winter	55.4	55.4	2.8818	0.1818	415.2	O K
7200 Winter	46.5	46.5	2.8613	0.1613	367.0	O K
8640 Winter	40.5	40.5	2.8473	0.1473	334.5	O K
10080 Winter	34.8	34.8	2.8338	0.1338	303.7	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
720 Winter	7.41	398
960 Winter	5.83	510
1440 Winter	4.16	768
2160 Winter	2.97	1116
2880 Winter	2.33	1496
4320 Winter	1.62	2192
5760 Winter	1.25	2944
7200 Winter	1.02	3672
8640 Winter	0.87	4336
10080 Winter	0.76	4984

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	GB 497200 370850 SK 97200 70850
C (1km)	-0.021
D1 (1km)	0.310
D2 (1km)	0.263
D3 (1km)	0.196
E (1km)	0.308
F (1km)	2.541
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+0

Time / Area Diagram

Total Area (ha) = 7.575

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	2.525	4	8	2.525	8	12	2.525

Tank/Pond Details

Invert Level (m) 2.700 Ground Level (m) 4.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	2237.5	0.60	2533.3	1.20	2829.1	1.80	2878.5	2.40	2878.5
0.10	2286.8	0.70	2582.6	1.30	2878.5	1.90	2878.5	2.50	2878.5
0.20	2336.1	0.80	2631.9	1.40	2878.5	2.00	2878.5		
0.30	2385.4	0.90	2681.2	1.50	2878.5	2.10	2878.5		
0.40	2434.7	1.00	2730.5	1.60	2878.5	2.20	2878.5		
0.50	2484.0	1.10	2779.8	1.70	2878.5	2.30	2878.5		

Pipe Outflow Control

Pipe Diameter (m)	1.200	Roughness (mm)	0.600	Invert Level (m)	2.700
Slope (1:x)	1000.0	Entry Loss Coef	0.500		
Length (m)	88.000	Coef of Contraction	0.600		

Summary of Results for 100 year Return Period (+20%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	755.7	755.7	3.5958	0.8958	2202.3	O K
30 Summer	801.3	801.3	3.6508	0.9508	2349.9	O K
60 Summer	801.3	801.3	3.6568	0.9568	2365.8	O K
120 Summer	771.7	771.7	3.6228	0.9228	2274.6	O K
180 Summer	721.4	721.4	3.5703	0.8703	2133.3	O K
240 Summer	684.2	684.2	3.5183	0.8183	1996.3	O K
360 Summer	602.8	602.8	3.4358	0.7358	1779.4	O K
480 Summer	537.2	537.2	3.3733	0.6733	1617.5	O K
600 Summer	468.3	468.3	3.3223	0.6223	1487.5	O K
720 Summer	423.2	423.2	3.2832	0.5832	1388.9	O K
960 Summer	356.4	356.4	3.2167	0.5167	1222.5	O K
1440 Summer	271.8	271.8	3.1352	0.4352	1020.0	O K
2160 Summer	213.7	213.7	3.0657	0.3657	850.1	O K
2880 Summer	161.7	161.7	3.0197	0.3197	741.2	O K
4320 Summer	116.9	116.9	2.9663	0.2662	613.2	O K
5760 Summer	91.3	91.3	2.9328	0.2328	534.1	O K
7200 Summer	75.4	75.4	2.9103	0.2103	481.1	O K
8640 Summer	64.2	64.2	2.8943	0.1943	443.6	O K
10080 Summer	55.7	55.7	2.8823	0.1823	415.4	O K
15 Winter	827.4	827.4	3.6898	0.9898	2455.8	O K
30 Winter	868.8	868.8	3.7513	1.0513	2625.3	O K
60 Winter	868.8	868.8	3.7423	1.0423	2599.7	O K
120 Winter	814.8	814.8	3.6628	0.9628	2383.0	O K
180 Winter	738.9	738.9	3.5798	0.8798	2159.3	O K
240 Winter	664.6	664.6	3.5073	0.8073	1966.9	O K
360 Winter	559.4	559.4	3.3988	0.6988	1684.1	O K
480 Winter	468.3	468.3	3.3223	0.6223	1487.7	O K
600 Winter	423.2	423.2	3.2687	0.5687	1350.5	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	186.91	21
30 Summer	108.35	31
60 Summer	62.81	48
120 Summer	36.41	80
180 Summer	26.47	114
240 Summer	21.11	144
360 Summer	15.34	206
480 Summer	12.24	266
600 Summer	10.27	330
720 Summer	8.90	390
960 Summer	7.00	512
1440 Summer	4.99	754
2160 Summer	3.56	1128
2880 Summer	2.80	1480
4320 Summer	1.94	2208
5760 Summer	1.50	2936
7200 Summer	1.23	3672
8640 Summer	1.04	4400
10080 Summer	0.91	5136
15 Winter	186.91	22
30 Winter	108.35	32
60 Winter	62.81	50
120 Winter	36.41	86
180 Winter	26.47	118
240 Winter	21.11	152
360 Winter	15.34	214
480 Winter	12.24	276
600 Winter	10.27	336

Summary of Results for 100 year Return Period (+20%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
720 Winter	356.4	356.4	3.2257	0.5257	1244.3	O K
960 Winter	292.3	292.3	3.1562	0.4562	1071.6	O K
1440 Winter	213.7	213.7	3.0752	0.3752	874.3	O K
2160 Winter	160.1	160.1	3.0092	0.3092	715.3	O K
2880 Winter	124.9	124.9	2.9732	0.2732	629.8	O K
4320 Winter	86.3	86.3	2.9258	0.2258	518.1	O K
5760 Winter	67.0	67.0	2.8983	0.1983	452.8	O K
7200 Winter	54.5	54.5	2.8803	0.1803	411.3	O K
8640 Winter	46.5	46.5	2.8613	0.1613	367.5	O K
10080 Winter	40.5	40.5	2.8473	0.1473	335.0	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
720 Winter	8.90	404
960 Winter	7.00	522
1440 Winter	4.99	768
2160 Winter	3.56	1116
2880 Winter	2.80	1492
4320 Winter	1.94	2208
5760 Winter	1.50	2936
7200 Winter	1.23	3680
8640 Winter	1.04	4408
10080 Winter	0.91	4904

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	GB 497200 370850 SK 97200 70850
C (1km)	-0.021
D1 (1km)	0.310
D2 (1km)	0.263
D3 (1km)	0.196
E (1km)	0.308
F (1km)	2.541
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+20

Time / Area Diagram

Total Area (ha) = 7.575

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	2.525	4	8	2.525	8	12	2.525

Tank/Pond Details

Invert Level (m) 2.700 Ground Level (m) 4.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	2237.5	0.60	2533.3	1.20	2829.1	1.80	2878.5	2.40	2878.5
0.10	2286.8	0.70	2582.6	1.30	2878.5	1.90	2878.5	2.50	2878.5
0.20	2336.1	0.80	2631.9	1.40	2878.5	2.00	2878.5		
0.30	2385.4	0.90	2681.2	1.50	2878.5	2.10	2878.5		
0.40	2434.7	1.00	2730.5	1.60	2878.5	2.20	2878.5		
0.50	2484.0	1.10	2779.8	1.70	2878.5	2.30	2878.5		

Pipe Outflow Control

Pipe Diameter (m)	1.200	Roughness (mm)	0.600	Invert Level (m)	2.700
Slope (1:x)	1000.0	Entry Loss Coef	0.500		
Length (m)	88.000	Coef of Contraction	0.600		

Appendix G
Sequential and Exception Test

1 Sequential Test

1.0 Site Proposals

The university have drafted a masterplan for the future expansion of the university campus. The initial masterplan highlights buildings to be completed by 2012 which include the Engineering Hub and Arts Box. The overall masterplan which will be completed by 2020 will include the development of further educational buildings to be constructed around the Delph pond as shown on the masterplan drawing within Appendix B. Additionally, buildings to the north of the existing EMMTEC building and also directly west of the building on the other side of Brayford Way are proposed. To the west of the Brayford Way, directly south of the railway lines a proposed new building is to be situated near to the existing football pitch.

1.1 The Sequential Test

This risk-based test has the aim of steering new development to areas at the lowest probability of flooding in accordance with PPS25. It is broken down in to three tables as described below with appropriate results for this proposal.

The Environment Agency have stated that the area to be considered for the sequential would be the university campus only. The latest flood map shows the northern boundary above the railway to be within Flood Zone 2 'Medium Probability' whilst the southern boundary lies within Flood Zone 3a 'High Probability'.

The 2020 masterplan shows proposed buildings to be located within the northern and southern boundaries and also on the west of Brayford Way to the north and south of the railway line where developable previously-developed land is available. The sequential test aims to steer developments to the lower flood risk zone, however the northern boundary alone would not be able to accommodate all of the proposed university expansion.

Table D1 – Flood Zones

The first step is to identify, based on information found on the Environment Agency's Flood maps, what the probability of flooding is for the site. While the area North of the railway line (the North East Quadrant) has been recently downgraded to Zone 2 Medium Probability, the rest of the site would fall in to Flood Zone 3a High Probability. For the purpose of this assessment, the Zone 3a classification will be used.

Table D2 – Flood Risk Vulnerability Classification

The result from this table is based on the proposed land use, in this case non-residential educational establishment, which would put the development in to the More Vulnerable category.

Table D3 – Flood Risk Vulnerability and Flood Zone 'Compatibility'

This table determines whether an Exception Test needs to be carried out. Based on the results from Tables D1 and D2 as outlined above, this proposal would require an Exception Test (see table below).

Table D3 – Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability classification (see Table D2)	Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone 1	✓	✓	✓	✓	✓
Flood Zone 2	✓	✓	Exception Test Required	✓	✓
Flood Zone 3a	Exception Test Required	✓	✗	Exception Test Required	✓
Flood Zone 3b 'Functional Floodplain,	Exception Test Required	✓	✗	✗	✗

The proposed academic buildings have to be on the main university campus to give access to facilities and resources necessary for the student experience, including library, ICT support, student services, students union, catering, and other faculties where collaborative work is being undertaken (Art Architecture and Design, Computing). Positioning the building collegiate with other University buildings will allow the students to participate on the university campus by sharing their learning experience with other students thus intensifying knowledge transfer.

The alternative designated education sites, defined in the LPA, have been considered and determined less favourable because of either their equivalent flood risk and or their greater economic development cost. To position the academic buildings off the existing Brayford Pool Campus would require the construction of new university infrastructure and facilities because they cannot function in isolation. Positioning the buildings in their proposed locations on the Brayford Campus facilitates the sharing of hard services; ICT, utilities, car parking, security, roads, etc and soft facilities; shared learning spaces in adjacent buildings etc, thus reducing the development cost.

The continued development of the university campus by the construction of the proposed academic buildings on the Brayford Campus is in accordance with the Permissions granted to the University Project Company in 1993 & 1996 and the Endorsed Masterplan of 2002 & 2005.

2 Exceptions Test

2.1 Exception Test

In accordance with Paragraph D9 of PPS25 the exception test must demonstrate and pass the following criteria:

a) It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the 'submission' stage – see figure 4 of PPS12: *Local Development Frameworks* – the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal;

b) The development should be on developable should be on developable previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land; and

c) A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

The development is considered to address each of the three criteria in the Exception Test in the following way;

a) The project will provide key resources and expansion to the University of Lincoln. It will enable more students to study and a greater number of courses to increase the skills base within a number of sectors, in and around the city. This should play a significant role in the competitiveness and prosperity of the city and will enhance the future growth potential of businesses in the community.

   The project also allows the University to develop its provision in STEM subjects (science, technology, engineering and maths), which will continue to receive strategic support from the Higher Education Funding Council of England and Wales, so attracting greater levels of R&D activity and employer engagement with the University and city.

   The project as such will have a net positive impact on the skills base, and hence productivity, of local businesses, and the employment prospects of local students studying courses at the University.

b) The development will be constructed on previously developed land and therefore can be classed as brownfield.

c) The FRA and mitigation measures show that flood risk to the site can be adequately mitigated through the arrangement of finished levels on site and adequate flood warning measures. The development will have no adverse impacts on flood risk elsewhere.

Based on the above, it is therefore considered that the proposed development addresses the requirements of the Exceptions Test in accordance with PPS25.

Appendix H
Environment Agency approval letter dated 29.06.2010 and Upper Witham Internal Drainage Board approval letter dated 17.12.2010

City of Lincoln Council
Development Control
City Hall Beaumont Fee
Lincoln
Lincolnshire
LN1 1DF

Our ref: AN/2010/109563/01-L01

Your ref: 2010/0214/F

Date: 29 June 2010

FAO: Peter Harness

Dear Sir/Madam

Erection of a four storey school of engineering
Campus Way, Lincoln, Lincolnshire, LN6 7TS.

Thank you for referring the above application, which was initially received on 15 April 2010.

Environment Agency Position
We have assessed the Sequential Test document undertaken by Ward Cole Consulting Engineers (dated June 2010) and received confirmation from your Authority that you consider the site passes this Test. Based on the information submitted we consider that the process has been adequately undertaken.

We also consider that the Flood Risk Assessment (FRA) submitted with this application is compliant with Annex E of Planning Policy Statement 25 (PPS25).

Accordingly, we have no objection to the proposed development subject to the following condition being attached to any planning permission granted:

Condition
The development permitted by this planning permission shall only be carried out in accordance with the approved Flood Risk Assessment (FRA), ref: 10/3921 and the following mitigation measures detailed within the FRA:

- Flood resilient construction techniques.
- Finished floor levels are set no lower than 5.6 m above Ordnance Datum (AOD).

The applicant shall confirm completion of the approved scheme in writing within one month thereafter.

Reason
To reduce the risk and impact of flooding to the proposed development and future occupants.

Informative
The Upper Witham Internal Drainage Board should be consulted on the surface water arrangements for this application as it will drain into their system.

As you are aware the discharge of planning conditions rests with your Authority. It is, therefore, essential that you are satisfied that the proposed draft condition meets the requirements of Circular 11/95 'Use of Conditions in Planning Permission'. Please notify us immediately if you are unable to apply our suggested condition, as we may need to tailor our advice accordingly.

Please note that our advice has not considered the risk of flooding from other sources, such as ground water, drainage systems, reservoirs, canals or ordinary watercourses. Your Authority will therefore need to be satisfied that the proposed development is also in accordance with other requirements of PPS25.

Please forward a copy of the Decision Notice to us for the purpose of monitoring.

Should you require any additional information, or wish to discuss these matters further, please do not hesitate to contact me on the number below.

Yours faithfully

Laura Richardson
Planning Liaison Officer

Direct dial 01522 785938
Direct fax 01522 512927
Direct e-mail lauram.richardson@environment-agency.gov.uk

cc Richard Holmes, Ward Cole Consulting Engineers

End

UPPER WITHAM INTERNAL DRAINAGE BOARD

WITHAM HOUSE,
J1 THE POINT, WEAVER ROAD
LINCOLN LN6 3QN

C.J. ELKINGTON ESQ
CHIEF EXECUTIVE AND
CLERK TO THE BOARD

K.J. PRATT
B.Sc. C.Eng. C.Env. MIW MCIWEM MICE
ENGINEER TO THE BOARD

Telephone (01522) 697123
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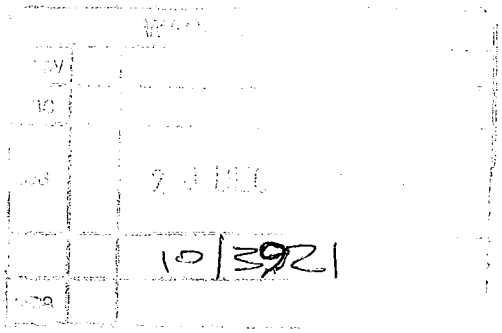
YOUR REF



17th December, 2010.

Attention of Richard Holmes.

Ward Cole,
Fosse House,
Roman Wharf,
Lincoln,
LN1 1SR.

Dear Sirs,

University of Lincoln.
Master Plan 2012 and 2020 Drainage – Network Model.

Thank you for your email dated 14th December, 2010 confirming that the points raised have been adequately dealt with.

The Board will therefore be happy to work with the University provided the development works are undertaken in accordance with the Model and all works required to the attenuation system are completed in such a manner as they are ahead of any development.

Yours sincerely,

K.J. Pratt.
Engineer.

c.c. Steve Coe, Environment Agency.