The Thames Region Catchment Flood Management Plan (CFMP) is a high level strategic flood risk management tool. It is used to develop flood risk management strategies at a catchment level over the next 25 to 50 years. The aims of the CFMP are to provide flood risk management policies which; reduce flood risk to people and the built environment; maximise opportunities to work with the natural environment; contribute towards sustainable development and sustainable flood management practice; support implementation of EU directive and Government policies and targets; and to support planning policies statutory land use plans and implementation of the Water Framework Directive. The CFMP is complete and is available at http://www.environment-agency.gov.uk/research/planning/114391.aspx.

Oxford falls into the category of *"Large urban areas with no major built flood defences"* and the messages are:

- The most sustainable way of reducing the flood risk will be through floodplain management. It is essential that partners have a shared vision for future land use that meets a wide range of objectives if this is to happen.
- Through re-development, there can be a net reduction in flood risk whilst meeting wider community needs.
- Where they can, the Environment Agency will progress options to reduce flood risk that are most effective and sustainable in the long-term. Options to manage the consequences of flooding may be more sustainable than defences in many cases.

The specific objectives for the Oxford Policy Unit are:

- *"That Local Authorities and the Environment Agency have a common understanding and shared vision of future land use within the floodplain. That this vision is sufficiently well developed so that there can be a net reduction in flood risk from redevelopment, whilst at the same time recognising the wider pressures on land use within the city. The Strategic Flood Risk Assessments (or future revisions) can be one mechanism for coming to this understanding.*
- *Based on this shared vision, that there is a net reduction in flood risk from development at a scale agreed between the Local Authority and Environment Agency. Layout (for example, set back) and design (for example, flood resistant buildings) will be key components.*
- *Reduce the consequences of flooding through continued action to raise public awareness of flooding, tailoring the advice and approach (e.g. community based) to ensure those "at risk" take appropriate action to respond to flooding.*
- *Continue to reduce the impact of low order flooding (up to a 10% to 20% AEP flood - 1 in 10 to 1 in 5 year return period) by maintaining conveyance where it is both effective and sustainable to do so (for example on the Thames tributaries). Continue to maintain the capacity and function of the undeveloped natural floodplain within the city (for example on Port Meadow) and upstream to retain water so that it can continue to reduce the impact of low order flood events to people and property and maintain floodplain habitats.*
- *Safeguard the existing undeveloped natural floodplain through the appropriate application of the sequential test within PPS25.*
- *Where it is most effective, progress options to reduce flood risk in the long-term. This could be to manage the probability of flooding (for example through defences), or to manage the consequences (for example through resilience). Option selection should be based on what is the most effective and sustainable and not short-term factors (for example, the ease of capital funding streams) and will be addressed within the Oxford Strategy."*

The Oxford Flood Risk Management Study was completed in 2010. This study included review of existing detailed hydraulic models to incorporate more information and calibrate it against the flood events in 2000 and 2003. The study provided a detailed assessment of the causes of flood risk in the Oxford area and made recommendations for viable flood management options to reduce the level of flood risk in Oxford City. The study concluded that the most viable approach to managing flood risk within the Oxford area is to increase the volume of water that can be carried through the western side of the River Thames floodplain thus bypassing Oxford City.

The Strategy assessed each of the options identified with regard to their impact upon the natural and human environment, and their potential benefits to Oxford. The study assessed the interdependencies between groundwater and surface water flooding and made recommendations for mitigation options. The Oxford Flood Risk Management Study made recommendations for flood management improvements for Oxford City.

The Environment Agency has undertaken a Flood Forecasting Model for the Thames including the Cherwell confluence completed November 2006. Following the flooding in July 2007 a review of the ratings within the flood forecasting model has been undertaken.

2.4 Historic Flood Events

Oxford is located at the confluence of the Rivers Thames and Cherwell and as such is at risk of flooding by both watercourses.

Records of historic flood risk events are documented by the Environment Agency in the form of reports, photographs and maps. Flood extent data is available for nine separate flood events dating back to the Spring of 1947 with the most recent events being recorded in Winter 2003 and Summer 2007. Table 3 lists the events for which flood extent data is available.

Table 3: Historic Flood Events in Oxford

Date of Flood Event
Spring 1947
Summer 1977
Winter 1979
Autumn 1992
Autumn 1993
Easter 1998
Winter 2000
New Year 2003
Summer 2007

Appendix C shows the mapped flood extents for these events, which are recognised as the largest events on record. Significant flooding occurred on the Thames and Cherwell floodplain and in the areas surrounding the Cherwell/Thames confluence. It can be seen that the largest events on record occurred in 1947, 1977, 1979 and 2003. The remaining events were smaller, but still sufficient to cause flooding in the city.

A flood outline of the Summer 2007 event and flood incident report show that the main areas that experienced flooding during this event were; the area surrounding Botley Road, between New Osney and Botley and the area surrounding Abingdon Road through New Hinksey. Botley Road and Abingdon Road are closed during most flood events.

The Thames has flooded a number of areas, one of which is Wolvercote, in the North-West of the catchment, which is shown to have flooded in the 1947 floods only. Wolvercote is not shown to have flooded since this date on the historic outlines available, however, there are reports of surface water flood related issues during periods of high rainfall although these reports are unsubstantiated at this time.

The area between Wolvercote and the city centre shows regular inundation through all of the events. This area is largely farmland and recreational land, so there is a smaller cost implication associated with its inundation.

Around the A420 (Botley Road), a number of houses, roads and gardens have been inundated during some of the recorded events. Properties not directly affected by flood waters have been impacted by access difficulties caused by high flood waters to roads.

Historically, the area surrounding the confluence between the Cherwell and the Thames and the area directly downstream, has experienced the greatest flooding to property. The largest flood extents were observed during the Spring 1947 and New Year 2003 events.

Along the Cherwell, very few properties have been flooded by the listed events. The 1947 event has inundated the greatest area; however the properties that are located within this flood extent are predominantly sporting facilities. It is suspected that these properties were not built in 1947 and the finished floor levels have been set above the 1947 flood level. This would explain why they have largely not been affected by subsequent flooding, including the similarly sized 2003 event. In addition, in 1998 roads around Oxford were flooded from the River Cherwell.

Table 4 provides a narrative of a number of historic events within the River Thames from Eynsham Lock to Sandford Lock Flood Warning Area. The Environment Agency document titled 'Local Flood Warning Plan -The County of Oxfordshire Local Authority Area' has provided the information for the 1947, 1979, 2000 and 2003 events. Information for the 2007 event was provided by the council.

It should be noted that the Environment Agency use historic data to calibrate, check and review the design event outlines developed as part of flood risk mapping exercises. This does not mean the design events will totally contain the historical floods, but that the historical events have contributed to the development process. Each flood is a unique event and reflects the conditions of the watercourse at that time; therefore they cannot be used to definitively define the extent of future flooding, but can provide a useful indication.

Table 4: Narration of Historic Events in Oxford

Year	Month/ Period	Area Affected
1947	March	Areas/roads affected: Bullstake Close, Folly Bridge, Abingdon Road, Botley Road, Marlborough Court, Binsey Lane, Duke Street, Bridge Street, South Street, West Street, Osney Mead Industrial Estate, John Towle Close and Lamarsh Road in Oxford and Rosamund Road, Home Close, Elmthorpe Road and Goodstow Road in Wolvercote.
1979	Not Known	Areas/roads affected: Kennington Road in Kennington, Fox Crescent, Canning Crescent, Dale Close, Weirs Lane, Sadler Walk, Sunningwell Road, Trinity Street, John Towle Close, Abingdon Road, Folly Bridge, Abbey Road, Port Meadow, Wytham Street and Riverside Road.
2000	December	Areas/roads affected: Folly Bridge, Jubilee Terrace, Marlborough Road, Weirs Lane, Watermans Reach, Binsey, Binsey Lane, Port Meadow, Botley Road, Stone Meadow, Coxes Ground and Bullstake Close in Oxford and Dunstead Lane in Wytham.
2003	January	Areas/roads affected: Sandford Lane, Kennington, Manor Road, South Hinksey, Rose Island, Littlemoor, Botley Road, Wytham Street, Marlborough Road, Abingdon Road, Sunningwell Road, Weirs Lane, Peel Place, Fox Crescent, Chatham Street, Port Meadow and Bullstak Close
2007	July	Areas/roads affected in North Hinksey include: A420 Botley Road, Binsey Lane, Helen Road, Alexandra Road, Oatlands Road, Harley Road, Duke Street, Earl Street, Lamarsh Road. Area/roads affected in New Hinksey include: A4144 Abingdon Road, Chatham Road, North Road, Lake Street, Gordon Street, Vicarage Road, Green Place, Norreys Avenue, Sunningwell Road, Lincoln Road, Monmouth Road, Northampton Road and Oswestry Road.

2.5 Existing Flood Defences

2.5.1 Definition of Flood Defences

Information on flood defences is required to indicate areas where there is protection from fluvial flood risk, the level of protection provided by the defence and the predicted life of the defence.

Flood defences are raised structures which prevent floodwater from flooding surrounding areas by altering the natural flood flow paths from a watercourse or retaining flood water. Flood defences are categorised as ‘formal’ defences or ‘informal’ defences. A ‘formal’ defence is a structure that was built specifically to defend land or property from flooding and is maintained for this purpose by the Environment Agency, Local Authority, or a riparian landowner. An ‘informal’ defence is a structure that has not been specifically built to retain floodwater and is not maintained for this specific purpose but may afford some protection against flooding. ‘Informal’ defences include boundary walls, industrial buildings and railway and road embankments.

The extent, condition and standard of protection of the defences owned and maintained by the Environment Agency are recorded within the National Flood and Coastal Defence Database (NFCDD).

To determine the standard of protection provided by the defence, the following information is essential:

- Location of defence
- Defence crest Level
- Probability of water level reaching crest level

Where available the following information was also collated;

- Condition of the defence (based on the NFCDD scale and measured between 1 and 5 Good – Poor)
- Residual life
- Type of defence

2.5.2 Formal Flood Defences

Consultation with the Environment Agency has revealed there to be no formal, permanent, flood defences for which the Agency is responsible for performance and maintenance within Oxford. The Agency do own and deploy demountable flood defences at Osney Island and New Hinksey, these defences are erected as required during high water events.

There is an Agency controlled 0.6m wide sluice gate (penstock) and 8 no. x 300mm diameter overflow pipes set in a stone headwall either side of an earth bank walkway, upstream of Hythe Bridge Street. This water level control is operated by the lock keeper at Osney.

Through consultations with the Oxford City Council it has been confirmed that Oxford has no formal flood defences maintained by the council or riparian landowners.

2.5.3 Informal Flood Defences

The Environment Agency supplied a mapping table that locates a number of informal flood defences within the city limits, however, on review of this information in conjunction with the Environment Agency it was agreed that none of these informal defences provide protection relevant to the SFRA. The reasons for this are that the defences identified either provide a standard of protection less than the 4.0% annual probability (1 in 25 year) event or are discontinuous in their defended line, therefore, it is felt that the level of protection is not relevant to this SFRA.

The major problem with private river defences is that they are constructed to protect individual properties and this is often at the expense of others. Often these informal defences simply increase flooding on the opposite bank, or increase the water levels downstream. This can only be avoided by creating a planned scheme for the whole area, for which this report is the first step.

In addition, there are structures and assets that provide some form of flood defence but were never designed to do so. This group of defences includes structures such as buildings, garden walls, railway and road embankments.

Within Oxford City, after consultation with the Environment Agency, it has been identified that there is a railway embankment which runs in a north-south direction through the city, a small section of defence which provides protection to a number of properties at Manor Place on Hollywell Mill Stream and Worcester car park which provides flood alleviation. There are plans to redevelop Worcester car park as a canal basin which may improve flood risk in the area.

2.6 Flood Warning

The Environment Agency issue Flood Warnings for fluvial flooding. The aim is to issue a Flood Alert 2 hours prior to the start of flooding and Flood Warnings 2 hours prior to the start of property flooding. Flood Warnings apply to flooding caused by rivers and streams, not to flooding from other sources, such as sewer and surface water flooding, burst water mains, impounding, etc. For fast responding catchments (particularly in urban areas) it may be necessary to issue Flood Warnings (or even Severe Flood Warnings) directly without issuing a Flood Alert first.

2.6.1 Lead Time Analysis

Application of the Flood Estimation Handbook to the Thames and Cherwell catchments has identified that each catchment is slow to respond to rainfall, there is potentially a lead time of approximately 20 hours from peak rainfall in the upstream parts of the catchment to peak water levels through Oxford City. This is a significant amount of time which contributes to the successful delivery of flood warning services through Oxford.

2.6.2 Existing Flood Warning Areas

Oxford City is currently covered by 5 Flood Warning Areas these are :

- 061FWF23Wlvrcote - River Thames and tributaries at Wolvercote in Oxford.
- 061FWF23BnsyOsny - River Thames and tributaries in the Binsey, Osney and Osney Island areas in Oxford.
- 061FWF23NwBotley - River Thames and tributaries at New Botley, New and North Hinksey and Grandpont in Oxford.
- 061FWF14CherOxfd - River Cherwell at Oxford from Cherwell Bridge to the Thames confluence north of New Hinksey, including parts of Summertown, New Marston and Magdalen Bridge areas.
- 061FWF23Keningtn - River Thames and tributaries at Kennington near Oxford

Flood Warning areas are drawn to the extent of Flood Zone 2 and will cover all properties that fall within this boundary. The River Cherwell Flood Warning Area (FWA) covers the Cherwell Valley and is inclusive of the villages of Enslow, Kirtlington and Kidlington.

The River Thames FWA covers the River Thames channel through Oxford City including the West End. The area of the West End that is included within this FWA is the same as the Environment Agency Flood Zone 3. This is essentially an area of the left bank of the River Thames, inclusive of areas surrounding Friars Wharf, Dale Close, Thames Street and Cromwell Street, and a channel through the West End following the path of Castle Mill Stream.

The Environment Agency recommends everyone sign up to the Environment Agency's flood warning system, Floodline Warnings Direct (FWD). FWD is a multimedia flood warning system that is used to issue flood warnings to specific areas by telephone, mobile, fax or pager. The aim of this service is to increase awareness of the risk of flooding and provide advice on how people can limit the damage that flooding can cause. This is a free service and people are encouraged to register to receive flood warning messages if they are at risk of flooding. Environment Agency monitoring continues throughout the year. Please contact the Floodline service to register for a flood warning and for further information on 0845 988 1188.

2.7 Potential Development Sites and Flood Warning

The information on land allocations used within this SFRA study to assess the appropriateness of proposed land uses have originated from Oxford City Council's Planning Department. These sites are split into two separate groups. The first group includes the 3 large potential strategic locations for development within Oxford and the second group includes 24 sites identified within the West End of Oxford. Appendix D contains plans of the potential strategic locations for development and those within the West End.

Of these sites, two of the potential strategic locations for development, Barton and Summertown, have some part within the Cherwell FWA. Of the 24 separate sites within the West End, 8 are, to varying degrees, identified to have some part within the Thames FWA. Table 5 identifies those sites deemed to be located in full or part within the FWA.

Table 5: Potential Development Sites Within Flood Warning Areas

Site Ref.	Potential Sites
4	Island site (Park End St/Hythe Bridge St)
5	Worcester Street Car Park
9	Ocean and Collins, Hythe Bridge Street
11	Cooper Callas Site, Paradise Street
17	Oxpens
19	Oxford and Cherwell Valley College
20	Westgate Shopping Centre
23	Telephone Exchange, Speedwell Street

It should be noted that this list of sites is likely to change as further sites will be allocated in the future. The comparison above is for information only and future sites should be assessed against Flood Zones when considering appropriate locations and intended land use.

2.8 Emergency Plans

The Pitt Review (The Cabinet Office, June 2008) assessed the lessons to be learnt following the summer floods of 2007. The report highlighted the need for local authorities to be better prepared for flooding, to better serve people affected by flooding. A significant element of this preparation is the development of emergency plans that can be followed in times of flood.

Consultations have been undertaken with representatives of the Environment Agency, Oxford City Council and Oxfordshire County Council to determine whether there are any emergency plans in place for Oxford City.

The Environment Agency has a local Flood Warning Plan for Oxfordshire and they are working with Oxfordshire County Council and Oxford City Council on emergency response. Oxford City has a plan to distribute sandbags to various locations to deploy temporary defences in Bulstake Close and to evacuate people to Kassam Stadium.

Oxford City Council is in the process of developing Flood Action Plans for areas of the city. The plan for West Oxford is currently being developed and is unavailable at the time of developing this SFRA. Plans for Oxford City Homes and City Works have been produced, but they have not been brought together to form a coordinated response. This work will continue, so that a comprehensive, city wide plan can be developed. It is recommended that when these plans are complete, they are reviewed against the SFRA and where appropriate references to the document included.

BAYNHAM MEIKLE
Consulting Civil and Structural Engineers

Appendix C – Proposed Information

C.1 Proposed Site Plan

C.2 Proposed Drainage Strategy

C.3 Proposed Levels Strategy

C.4 Proposed External Construction Surface Layout

FREDERICK ROAD

PROPOSED FOUL SEWER TO DISCHARGE INTO EXISTING FOUL WATER SEWER. SUBJECT TO SECTION 106 APPROVAL. LINE AND LEVEL OF FOUL SEWER TO BE CONFIRMED PRIOR TO CONSTRUCTION.

Service Easement

FOUL OUTFALL
CL: 71.340
IL: 69.570

RE02
CL:71.300
IL:69.960

RE03
CL:71.400
IL:69.940

RE01
CL:71.545
IL:69.975

CP8
CL:71.650
IL:69.755

CP5
CL:71.735
IL:69.735

CP4
CL:71.550
IL:69.955

CP3
CL:71.605
IL:69.980

CP2
CL:71.675
IL:70.070

CP1
CL:71.715
IL:70.155

MH01 (1200Ø)
CL: 71.745
IL: 69.660

MH02 (1200Ø)
CL: 71.545
IL: 69.410

MH03 (1200Ø)
CL: 71.930
IL: 69.840

MH04 (1200Ø)
CL: 71.870
IL: 69.595

MH05 (1200Ø)
CL: 71.740
IL: 69.490

MH06 (1200Ø)
CL: 71.545
IL: 69.290

FMH OUTFALL (BD)
CL: 71.025
IL: 67.855

EXSMH12 OUTFALL
CL: 71.430
IL: 69.212

FMHX (1200 Ø)
CL: 71.525
IL: 70.155

FMHX (1200 Ø)
CL: 71.025
IL: 69.880

FMHX (1200 Ø)
CL: 71.540
IL: 69.965

FMHX (1200 Ø)
CL: 71.670
IL: 70.135

FMHX (1200 Ø)
CL: 71.800
IL: 70.075

FMHX (1200 Ø)
CL: 71.780
IL: 69.925

FMHX (1200 Ø)
CL: 71.820
IL: 70.185

FMHX (600 Ø)
CL: 71.775
IL: 70.740

FMHX (600 Ø)
CL: 71.860
IL: 70.815

FMHX (600 Ø)
CL: 71.860
IL: 70.970

Geo-cellular Storage
Surface Area - 50.00m2
Height - 1.22m
Volume - 57.00m3
BOC - 69.535 AOD
TOC - 70.800 AOD

Geo-cellular Storage
Surface Area - 50.000m2
Height - 1.22m
Volume - 57.000m3
BOC - 69.385 AOD
TOC - 71.100 AOD

Hydrobrake (1200Ø)
Design Head: 1.0m
Flow: 4.7l/s
CL: 71.630
IL: 69.265

FFL 71.870

FFL 71.870

Office / Lead Space

Core

Reception

Transformer

LV Switchroom

Fire Escape Stair

Cycle Store

Gas Store

Goods Lift

GAS STORE

MOTORCYCLE PARKING

GENERATOR

HV SWITCH ROOM

PROPOSED SURFACE WATER SEWER TO DISCHARGE INTO EXISTING PRIVATE SURFACE WATER SEWER. LINE AND LEVEL OF PRIVATE SURFACE WATER SEWER TO BE CONFIRMED PRIOR TO CONSTRUCTION.

JOHN SMITH DRIVE

Business Park South

Spires

1 : 200
0m 2m 4m 6m 8m 10m 12m 14m 16m 18m 20m
5 mm 10 mm 20 mm 30 mm 40 mm 50 mm 60 mm 70 mm 80 mm 90 mm 100 mm
CHECK: For the plan to be in scale, the above scale bar must measure correct, i.e. 100mm when printed.

Notes

A0

1. Do not scale from this drawing. All dimensions must be checked & verified on-site. If in doubt ask.
2. The Contractor is to check & verify all dimensions & levels before any work is started on-site.
3. Existing site survey works have been carried out by others & no guarantee can be given by Baynham Meikle for their accuracy.
4. Any discrepancies noted on-site are to be reported to Baynham Meikle immediately.
5. This drawing is to be read in conjunction with all relevant Architects', Engineers' and other Specialists' drawings & specifications.
6. For existing ground conditions, refer to Site Investigation reports.
7. The drainage installation is to be compliant with Building Regs. (Part H).
8. All adoptable drainage works shall comply with "Water UK - Design and Construction Guide".
9. The following pipe strengths shall be adopted (unless noted otherwise):
   - Pipes up to and including 150mm Ø to be PVC-U to BS-EN 1329, or Clayware to BS-EN 295 Class 160.
   - Pipes 150mm Ø up to and including 225mm Ø to be Clayware to BS-EN 295 Class 160.
   - Pipes 300mm Ø to be Clay to BS-EN 295 Class 160 or Concrete to BS 5911 Class M.
   - Pipes over 300mm Ø to be Concrete to BS 5911 Class M.
10. All pipe runs to be laid with flexible joints.
11. All pipes entering and exiting manholes are to be connected to pipe soffits level unless noted otherwise.
12. Pipe Bedding and surround to be as follows:

Location:	Cover to Soffit:		Pipe Bedding:
	Clay / Conc	Flexible	
Roads.	>1.2m	>0.9m	Class S
	<1.2m	<0.9m	Class Z
Hard and Soft Landscaping.	>0.6m		Class S
	<0.6m		Class Z

13. The following Conc. mixes are to be used (in accordance with BS 8500):

Location:	Mix Reference:
Concrete Surround to Pipes	ST4
Concrete Base and Surround to Manholes	ST4

14. All precast-concrete products (i.e. pipes, manhole rings, etc.) shall be of suitable Concrete mix to cater for Class 2 Sulphates.
15. Pre-formed channels are to be used in manholes where applicable.
16. Granolithic Concrete benching to be steel trowelled to a dense smooth face neatly shaped and finished to all branch connections and laid in accordance with the Specification.
17. All connections to be turned in direction of flow using pipe bends.
18. Manhole covers and frames to be Ductile Iron Medium Duty grade B125 rectangular to BS-EN 124 positions outside vehicular-trafficked areas, and Heavy Duty grade D400 in vehicular-trafficked areas.
19. Manhole covers and frames to be Ductile Iron Medium Duty grade A15 covers in Soft Landscaping.
20. First flexible joint in pipes adjacent to a manhole shall be a maximum of 600mm from inside face of manhole, connecting to rocker pipe.
21. The length of Rocker Pipe is as follows:

Pipe Diameter:	Length of Rocker Pipe:
150mm - 600mm	600mm
675mm - 750mm	1000mm
825mm & Over	1250mm

22. Manholes with outgoing pipes greater than 600mm Ø shall be fitted with guard bars, safety chains or other safety devices.
23. The Principle Contractor shall be responsible for checking the existing line and invert levels of any connection points for both the Foul and Surface Water systems, prior to undertaking installation of any new drainage works. Any deviation to the levels and positions indicated on the drawing should be brought to the attention of the Engineer.
24. All invert levels specified are outgoing (except Backdrop connections).
25. All Foul connections to be 150mm Ø laid at a minimum gradient of 1/40 unless noted otherwise. Surface Water pipe sizes are as indicated.
26. Foul pipes to be externally vented (SVP) at head of run.
27. For location of internal SVP, SS, etc., refer to Architect's latest layouts.
28. Internal Foul drainage connections / positions and setting-out information to be confirmed by the M&E Consultant / Architect.
29. This drawing is subject to detailed design and for planning purposes only.

KEY

- PROPOSED STORM DRAINAGE
- PROPOSED FOUL DRAINAGE
- PROPOSED VULCATHENE FOUL DRAINAGE
- PROPOSED GULLY
- PROPOSED STORM MANHOLE
- PROPOSED FOUL MANHOLE
- PROPOSED VULCATHENE FOUL MANHOLE
- PROPOSED CATCHPIT
- PROPOSED RODDING EYE
- PROPOSED SVP CONNECTION
- PROPOSED DRAINAGE CHANNEL
- PROPOSED PERFORATED PIPE
- PROPOSED GRASSCRETE
- PROPOSED CONCRETE TRENCH
- PROPOSED LINED PERMEABLE SURFACE SYSTEM
- PROPOSED CELLULAR STORAGE
- PROPOSED GREEN ROOF

Rev	Date	Description	By	Chkd
B	29/01/2024	Drainage updated to suit latest layout	M.R.	N.S.B.
A	10/08/2023	First Issue	M.R.	N.S.B.

Revision Schedule

Drawing Status: **For Planning**

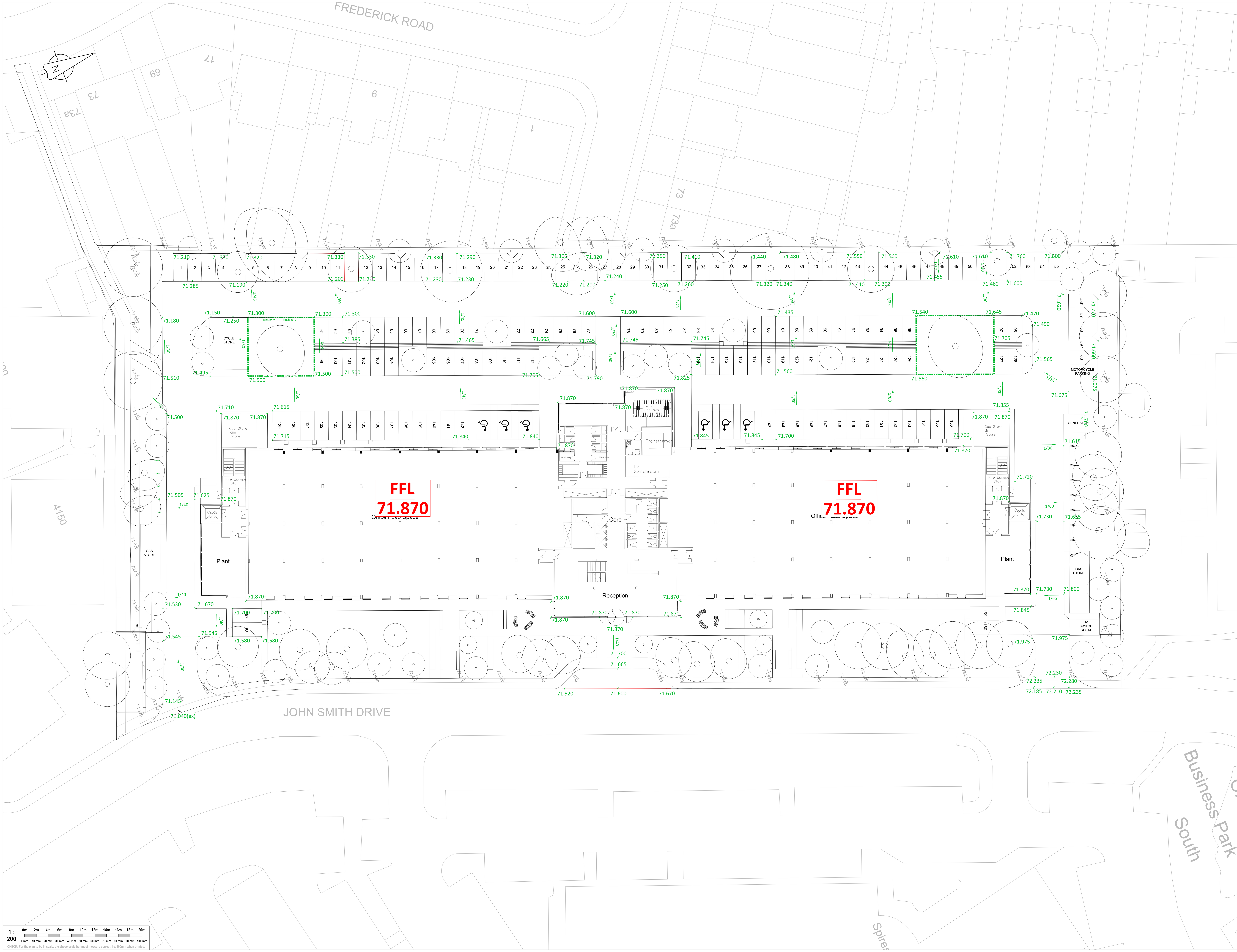
Project Title: **ARC Oxford - Plot 4200**

Drawing Title: **Proposed Drainage Plan**

Drawing Number	Revision
13520_200	B

BM Ref	Scale @ A0	Drawn by	Checked by	Project Eng
13520	1 : 200	M.R.	J.H.	N.S.B.

BAYNHAM MEIKLE
Consulting Civil & Structural Engineers
0121 434 4000
admin@baynhammeikle.co.uk
www.baynhammeikle.co.uk



Notes — A0

1. Topographical Survey carried out by **Macgregor Smith**, Drawing No.:
   - **05879 4200 - Topographical Survey Plan** (Dated **19/05/2023**).
2. Do not scale from this drawing. All dimensions must be checked & verified on-site. If in doubt ask.
3. The Contractor is to check & verify all dimensions & levels before any work is started on-site.
4. Existing site survey works have been carried out by others & no guarantee can be given by Baynham Meikle for their accuracy.
5. Any discrepancies noted on-site are to be reported to Baynham Meikle immediately.
6. This drawing is to be read in conjunction with all relevant Architects', Engineers' and other Specialists' drawings & specifications.
7. For existing ground conditions, refer to Site Investigation reports.

KEY

PROPOSED SITE BOUNDARY
PROPOSED FFL
PROPOSED RETAINING FEATURE
PROPOSED LEVEL
EXISTING LEVELS
ROOT PROTECTION AREA

Rev	Date	Description	By	Chkd
D	02/02/2024	Architect's Proposed Layout updated. Proposed Levels updated.	K.M.	N.S.B.
C	27/11/2023	Landscape Architect's Proposed Layout updated. Proposed Levels updated.	K.M.	N.S.B.
B	08/11/2023	Level Amended to suit Landscape Co-ordination	N.S.B	N.S.B.
A	10/08/2023	First Issue.	M.R.	N.S.B.

Revision Schedule

Drawing Status

For Information

Project Title

ARC Oxford - Plot 4200

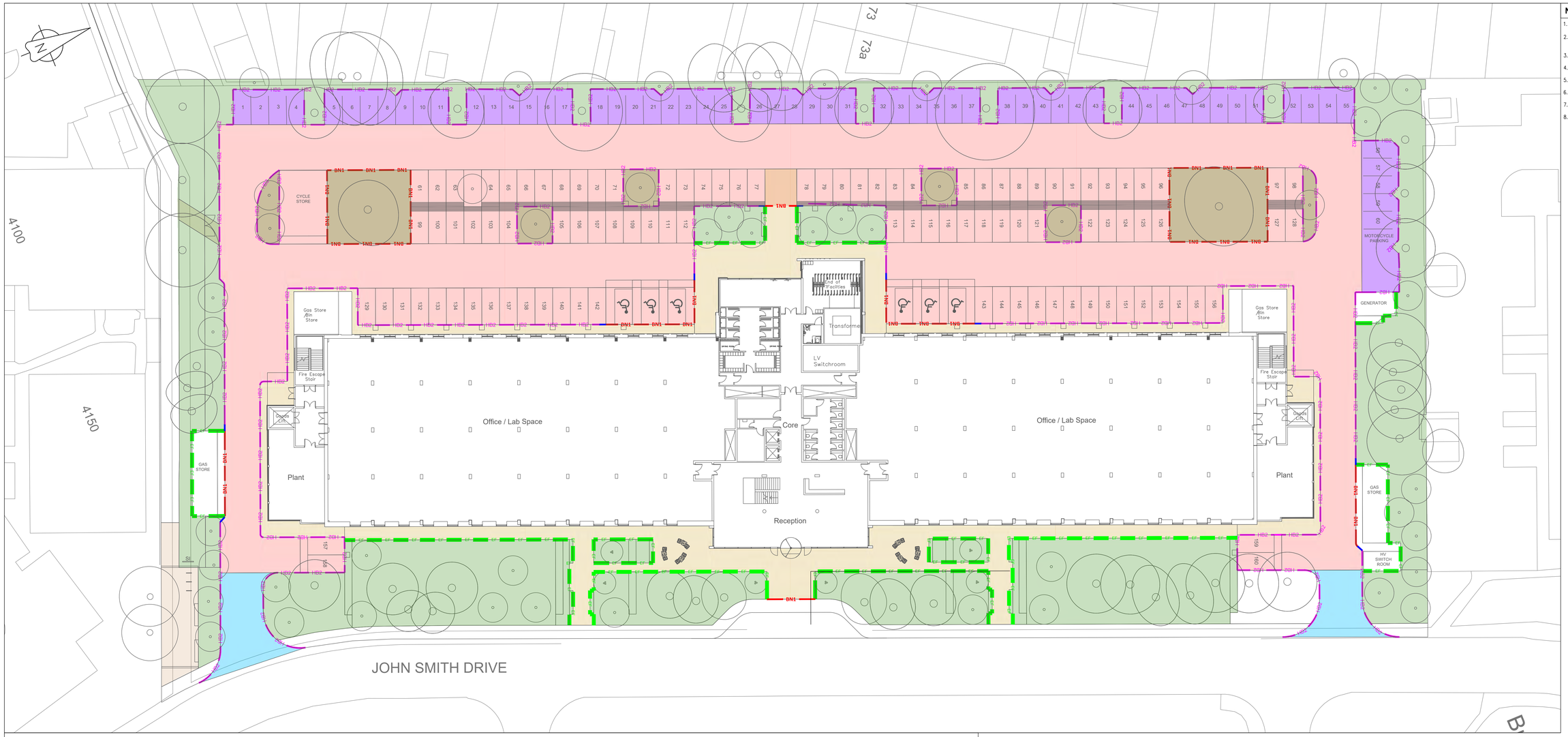
Drawing Title

Proposed Levels Strategy Plan

Drawing Number: **13520-201** — Revision: **D**

BM Ref	Scale @ A0	Drawn by	Checked by	Project Eng
13520	1 : 200	M.R.	J.H.	N.S.B.

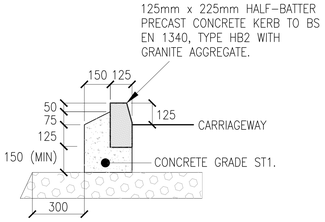
BAYNHAM MEIKLE
Consulting Civil & Structural Engineers
0121 434 4100
admin@baynhammeikle.co.uk
www.baynhammeikle.co.uk



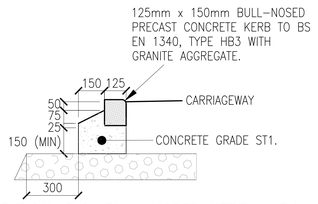
Notes

A0

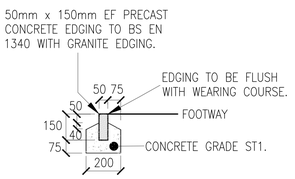
1. DO NOT SCALE THIS DRAWING. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE. IF IN DOUBT ASK.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALISTS DRAWINGS AND SPECIFICATIONS.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE. ALL LEVELS IN METRES UNLESS NOTED OTHERWISE.
4. ANY DISCREPANCIES NOTED ON SITE ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
5. THIS DRAWING IS TO BE READ INCONJUNCTION WITH THE NBS SPECIFICATION DOCUMENT.
6. FOR DETAILS OF GROUND CONDITIONS REFER TO THE GROUND INVESTIGATION REPORT.
7. THIS DRAWING IS SUBJECT TO DETAILED DESIGN AND RECEIPT OF FULL SITE INVESTIGATION INFORMATION REPORT.
8. THIS DRAWING IS SUBJECT TO DETAILED DESIGN.



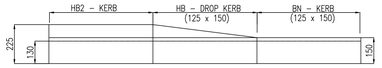
TYPICAL P.C. KERB H.B.2.
SCALE 1:20



TYPICAL P.C. BULL-NOSED KERB – B.N.
SCALE 1:20



TYPICAL P.C. EDGING E.F.
SCALE 1:20



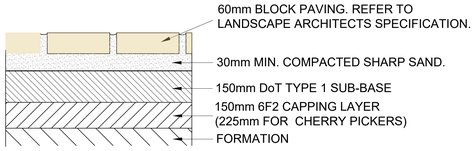
DROP KERB DETAIL
SCALE 1:20

CBR TABLE 1
SCALE 1:20

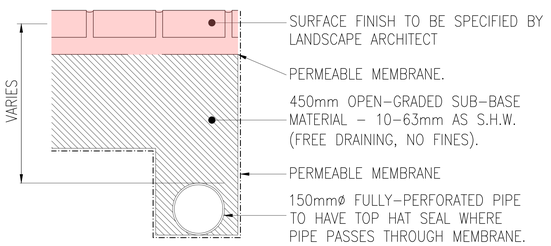
MEASURED CBR (%)	SUB-BASE + (mm)	CAPPING (mm)	SUB-BASE ONLY (mm)
<2	150	600	N/A
2–3	150	450	N/A
3.1–4	150	350	325
4.1–5.4	150	300	275
5.5–10	150	250	225
10–14.9	150	200	175
>15	150	0	150

KEY

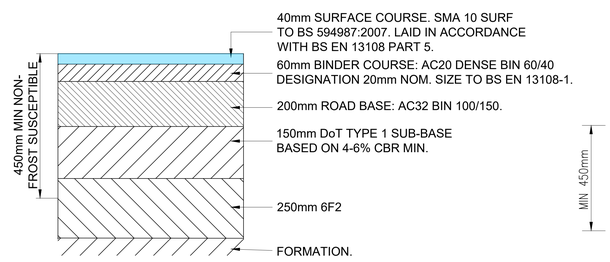
- PROPOSED SITE BOUNDARY
- PROPOSED PERMEABLE CAR PARKING (BLOCKS)
- PROPOSED REDUCED DEPTH POROUS CAR PARKING (BLOCKS)
- PROPOSED ACCESS ROAD (MACADAM).
- PROPOSED FOOTPATH (BLOCKS).
- PROPOSED HB2 KERB
- PROPOSED EF FLAT TOP EDGING
- PROPOSED BN1 BULLNOSE KERB
- PROPOSED HB HALF BATTERED TRANSITION KERB



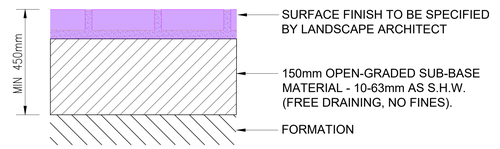
BLOCK-PAVED FOOTPATH CONSTRUCTION
SCALE 1:20



TYPICAL PERMEABLE BLOCK-PAVING CONSTRUCTION
SCALE 1:25



MACADAM ACCESS ROAD CONSTRUCTION DETAIL
SCALE 1:20



TYPICAL POROUS BLOCK PAVING PARKING BAYS
SCALE 1:20

1 : 200
0m 2m 4m 6m 8m 10m 12m 14m 16m 18m 20m
0 mm 10 mm 20 mm 30 mm 40 mm 50 mm 60 mm 70 mm 80 mm 90 mm 100 mm
CHECK: For the plan to be in scale, the above scale bar must measure correct, i.e. 100mm when printed.

Rev	Date	Description	By	Chkd
B	31/01/2024	Updated to suit latest layout	M.R.	N.S.B.
A	09/11/2023	First Issue.	M.R.	N.S.B.

Revision Schedule

Drawing Status: **For Information**

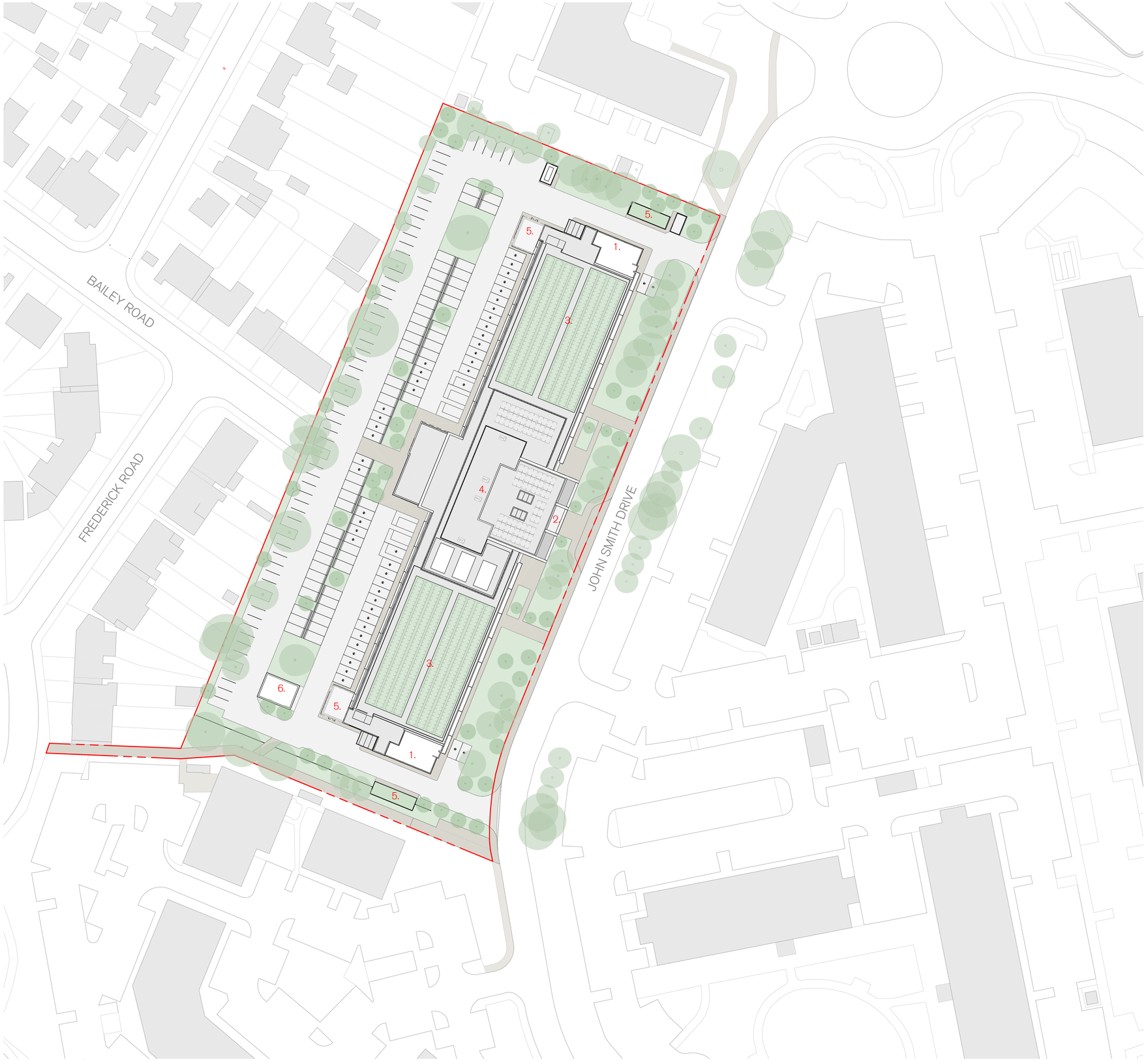
Project Title: **NASH COURT REDEVELOPMENT**

Drawing Title: **External Construction Surface Layout**

Drawing Number	Revision
13520_205	B

BM Ref	Scale @ A0	Drawn by	Checked by	Project Eng
13520	1 : 200	M.R.	J.H.	N.S.B.

BAYNHAM MEIKLE
Consulting Civil & Structural Engineers
0121 434 4000
admin@baynhammeikle.co.uk
www.baynhammeikle.co.uk



GENERAL NOTES

All architectural drawings should be read in conjunction with reports by other consultants submitted along with the application.

All proposed internal layouts are indicative and approximate.

Any dimensions or datum levels are subject to further detail design development.

Key
1. Stacked Plant Core
2. Roof Terrace
3. Biodiverse Roof & PV Cells
4. Future Tenant Flues
5. Lab Gas / Bin Store
6. Covered External Cycle Store

1:500
0 5 10 20 30 50m

N

SPRATLEY & PARTNERS
7 CENTENARY BUSINESS PARK, STATION ROAD, HENLEY-ON-THAMES, OXFORDSHIRE RG9 1DS . 01491 411277

REV.	ISSUED	DESCRIPTION	DRAWN	CHECKED
P01	01/02/24	Issued to Carter Jonas for Planning Submission	MC	SG

PROJECT: Nash Court, ARC Oxford
DESCRIPTION: PL - Proposed Site Plan - Roof
CLIENT: ARC - Advanced Research Clusters
DRAWING NO: NCO - SP - ZZ - RF - DR - A - 0011
(PROJECT - ORIGINATOR - ZONE - LEVEL - TYPE - ROLE - NUMBER)

DATE	SCALE AT A1	JOB NO
Feb 2024	1 : 500	23.036

STATUS	SUITABILITY
PLANNING	S3

REV	DRAWN	CHECKED
P01	MC	SG

S & P

BAYNHAM MEIKLE
Consulting Civil and Structural Engineers

Appendix D - Calculations

D.1 Surface Water Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	21.550	0.085	253.5	0.060	6.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	22.389	0.090	248.8	0.020	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	6.882	0.025	275.3	0.050	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	52.441	0.220	238.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	52.441	0.220	238.4	0.080	6.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	49.587	0.205	241.9	0.070	6.00	0.0	0.600	o	300	Pipe/Conduit	
2.001	5.522	0.020	276.1	0.060	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	48.97	6.37	70.155	0.060	0.0	0.0	0.0	0.98	69.5	8.0
1.001	47.62	6.74	70.070	0.080	0.0	0.0	0.0	0.99	70.1	10.3
1.002	47.20	6.86	69.980	0.130	0.0	0.0	0.0	0.94	66.6	16.6
1.003	44.46	7.73	69.955	0.130	0.0	0.0	0.0	1.01	71.7	16.6
2.000	47.20	6.86	69.975	0.080	0.0	0.0	0.0	1.01	71.7	10.2
3.000	47.34	6.82	69.960	0.070	0.0	0.0	0.0	1.01	71.1	9.0
2.001	46.87	6.96	69.755	0.210	0.0	0.0	0.0	0.94	66.5	26.7

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
4.000	49.587	0.205	241.9	0.100	6.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	6.681	0.025	267.2	0.200	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	13.058	0.050	261.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	29.057	0.125	232.5	0.050	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	29.643	0.125	237.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.008	34.226	0.145	236.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.000	58.800	0.245	240.0	0.080	6.00	0.0	0.600	o	300	Pipe/Conduit	
5.001	26.577	0.105	253.1	0.050	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.002	24.587	0.105	234.2	0.090	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.003	21.991	0.095	231.5	0.040	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.004	6.008	0.025	240.3	0.020	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.009	8.092	0.053	152.7	0.040	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
4.000	47.34	6.82	69.940	0.100	0.0	0.0	0.0	1.01	71.1	12.8
1.004	44.11	7.84	69.735	0.640	0.0	0.0	0.0	0.96	67.6«	76.5
1.005	43.47	8.07	69.710	0.640	0.0	0.0	0.0	0.97	68.4«	76.5
1.006	42.18	8.54	69.660	0.690	0.0	0.0	0.0	1.03	72.6«	78.8
1.007	40.97	9.02	69.535	0.690	0.0	0.0	0.0	1.02	71.9«	78.8
1.008	39.72	9.58	69.410	0.690	0.0	0.0	0.0	1.02	72.0«	78.8
5.000	46.84	6.97	69.840	0.080	0.0	0.0	0.0	1.01	71.4	10.1
5.001	45.38	7.42	69.595	0.130	0.0	0.0	0.0	0.98	69.5	16.0
5.002	44.17	7.82	69.490	0.220	0.0	0.0	0.0	1.02	72.3	26.3
5.003	43.16	8.18	69.385	0.260	0.0	0.0	0.0	1.03	72.7	30.4
5.004	42.88	8.28	69.290	0.280	0.0	0.0	0.0	1.01	71.4	32.5
1.009	39.49	9.69	69.265	1.010	0.0	0.0	0.0	1.27	89.8«	108.0

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdro (mm)
CP1	71.715	1.560	Open Manhole	1200	1.000	70.155	300				
CP2	71.675	1.605	Open Manhole	1200	1.001	70.070	300	1.000	70.070	300	
CP3	71.605	1.625	Open Manhole	1200	1.002	69.980	300	1.001	69.980	300	
CP4	71.550	1.595	Open Manhole	1200	1.003	69.955	300	1.002	69.955	300	
CP7	71.545	1.570	Open Manhole	1200	2.000	69.975	300				
CP9	71.300	1.340	Open Manhole	1200	3.000	69.960	300				
CP8	71.650	1.895	Open Manhole	1200	2.001	69.755	300	2.000	69.755	300	
								3.000	69.755	300	
CP10	71.400	1.460	Open Manhole	1200	4.000	69.940	300				
CP5	71.735	2.000	Open Manhole	1200	1.004	69.735	300	1.003	69.735	300	
								2.001	69.735	300	
								4.000	69.735	300	
CP6	71.835	2.125	Open Manhole	1200	1.005	69.710	300	1.004	69.710	300	
MH01	71.745	2.085	Open Manhole	1200	1.006	69.660	300	1.005	69.660	300	
Tank 1	71.600	2.065	Open Manhole	1200	1.007	69.535	300	1.006	69.535	300	
MH02	71.545	2.135	Open Manhole	1200	1.008	69.410	300	1.007	69.410	300	
MH03	71.930	2.090	Open Manhole	1200	5.000	69.840	300				
MH04	71.870	2.275	Open Manhole	1200	5.001	69.595	300	5.000	69.595	300	
MH05	71.740	2.250	Open Manhole	1200	5.002	69.490	300	5.001	69.490	300	
Tank 2	71.700	2.315	Open Manhole	1200	5.003	69.385	300	5.002	69.385	300	
MH06	71.545	2.255	Open Manhole	1200	5.004	69.290	300	5.003	69.290	300	
Hydrobrake	71.630	2.365	Open Manhole	1200	1.009	69.265	300	1.008	69.265	300	
								5.004	69.265	300	
Outfall	71.430	2.218	Open Manhole	0		OUTFALL		1.009	69.212	300	

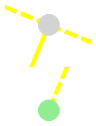
MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
CP1	454776.468	203847.966	454776.468	203847.966	Required	
CP2	454756.506	203856.084	454756.506	203856.084	Required	
CP3	454748.134	203835.319	454748.134	203835.319	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
CP4	454741.758	203837.909	454741.758	203837.909	Required	
CP7	454736.643	203839.987	454736.643	203839.987	Required	
CP9	454698.246	203745.459	454698.246	203745.459	Required	
CP8	454716.907	203791.401	454716.907	203791.401	Required	
CP10	454703.362	203743.381	454703.362	203743.381	Required	
CP5	454722.023	203789.323	454722.023	203789.323	Required	
CP6	454728.213	203786.808	454728.213	203786.808	Required	
MH01	454723.301	203774.709	454723.301	203774.709	Required	
Tank 1	454712.268	203747.828	454712.268	203747.828	Required	
MH02	454701.159	203720.345	454701.159	203720.345	Required	
MH03	454788.021	203827.401	454788.021	203827.401	Required	
MH04	454765.936	203772.906	454765.936	203772.906	Required	
MH05	454755.928	203748.285	454755.928	203748.285	Required	
Tank 2	454746.127	203725.737	454746.127	203725.737	Required	
MH06	454738.411	203705.143	454738.411	203705.143	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
Hydrobrake	454732.854	203707.428	454732.854	203707.428	Required	
Outfall	454729.777	203699.944			No Entry	



PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	300	CP1	71.715	70.155	1.260	Open Manhole	1200
1.001	o	300	CP2	71.675	70.070	1.305	Open Manhole	1200
1.002	o	300	CP3	71.605	69.980	1.325	Open Manhole	1200
1.003	o	300	CP4	71.550	69.955	1.295	Open Manhole	1200
2.000	o	300	CP7	71.545	69.975	1.270	Open Manhole	1200
3.000	o	300	CP9	71.300	69.960	1.040	Open Manhole	1200
2.001	o	300	CP8	71.650	69.755	1.595	Open Manhole	1200
4.000	o	300	CP10	71.400	69.940	1.160	Open Manhole	1200
1.004	o	300	CP5	71.735	69.735	1.700	Open Manhole	1200
1.005	o	300	CP6	71.835	69.710	1.825	Open Manhole	1200
1.006	o	300	MH01	71.745	69.660	1.785	Open Manhole	1200
1.007	o	300	Tank 1	71.600	69.535	1.765	Open Manhole	1200
1.008	o	300	MH02	71.545	69.410	1.835	Open Manhole	1200
5.000	o	300	MH03	71.930	69.840	1.790	Open Manhole	1200
5.001	o	300	MH04	71.870	69.595	1.975	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	21.550	253.5	CP2	71.675	70.070	1.305	Open Manhole	1200
1.001	22.389	248.8	CP3	71.605	69.980	1.325	Open Manhole	1200
1.002	6.882	275.3	CP4	71.550	69.955	1.295	Open Manhole	1200
1.003	52.441	238.4	CP5	71.735	69.735	1.700	Open Manhole	1200
2.000	52.441	238.4	CP8	71.650	69.755	1.595	Open Manhole	1200
3.000	49.587	241.9	CP8	71.650	69.755	1.595	Open Manhole	1200
2.001	5.522	276.1	CP5	71.735	69.735	1.700	Open Manhole	1200
4.000	49.587	241.9	CP5	71.735	69.735	1.700	Open Manhole	1200
1.004	6.681	267.2	CP6	71.835	69.710	1.825	Open Manhole	1200
1.005	13.058	261.2	MH01	71.745	69.660	1.785	Open Manhole	1200
1.006	29.057	232.5	Tank 1	71.600	69.535	1.765	Open Manhole	1200
1.007	29.643	237.1	MH02	71.545	69.410	1.835	Open Manhole	1200
1.008	34.226	236.0	Hydrobrake	71.630	69.265	2.065	Open Manhole	1200
5.000	58.800	240.0	MH04	71.870	69.595	1.975	Open Manhole	1200
5.001	26.577	253.1	MH05	71.740	69.490	1.950	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
5.002	o	300	MH05	71.740	69.490	1.950	Open Manhole	1200
5.003	o	300	Tank 2	71.700	69.385	2.015	Open Manhole	1200
5.004	o	300	MH06	71.545	69.290	1.955	Open Manhole	1200
1.009	o	300	Hydrobrake	71.630	69.265	2.065	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
5.002	24.587	234.2	Tank 2	71.700	69.385	2.015	Open Manhole	1200
5.003	21.991	231.5	MH06	71.545	69.290	1.955	Open Manhole	1200
5.004	6.008	240.3	Hydrobrake	71.630	69.265	2.065	Open Manhole	1200
1.009	8.092	152.7	Outfall	71.430	69.212	1.918	Open Manhole	0

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	CP1	300	1.260	1.305	Unclassified	1200	0	1.260	Unclassified
1.001	CP2	300	1.305	1.325	Unclassified	1200	0	1.305	Unclassified
1.002	CP3	300	1.295	1.325	Unclassified	1200	0	1.325	Unclassified
1.003	CP4	300	1.295	1.700	Unclassified	1200	0	1.295	Unclassified
2.000	CP7	300	1.270	1.595	Unclassified	1200	0	1.270	Unclassified
3.000	CP9	300	1.040	1.595	Unclassified	1200	0	1.040	Unclassified
2.001	CP8	300	1.595	1.700	Unclassified	1200	0	1.595	Unclassified
4.000	CP10	300	1.160	1.700	Unclassified	1200	0	1.160	Unclassified
1.004	CP5	300	1.700	1.825	Unclassified	1200	0	1.700	Unclassified
1.005	CP6	300	1.785	1.825	Unclassified	1200	0	1.825	Unclassified
1.006	MH01	300	1.765	1.785	Unclassified	1200	0	1.785	Unclassified
1.007	Tank 1	300	1.765	1.835	Unclassified	1200	0	1.765	Unclassified
1.008	MH02	300	1.835	2.065	Unclassified	1200	0	1.835	Unclassified
5.000	MH03	300	1.790	1.975	Unclassified	1200	0	1.790	Unclassified
5.001	MH04	300	1.950	1.975	Unclassified	1200	0	1.975	Unclassified
5.002	MH05	300	1.950	2.015	Unclassified	1200	0	1.950	Unclassified
5.003	Tank 2	300	1.955	2.015	Unclassified	1200	0	2.015	Unclassified
5.004	MH06	300	1.955	2.065	Unclassified	1200	0	1.955	Unclassified
1.009	Hydrobrake	300	1.918	2.065	Unclassified	1200	0	2.065	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.009	Outfall	71.430	69.212	69.212	0	0

Online Controls for Storm

Hydro-Brake® Optimum Manhole: Hydrobrake, DS/PN: 1.009, Volume (m³): 5.3

Unit Reference	MD-SHE-0102-4700-1000-4700
Design Head (m)	1.000
Design Flow (l/s)	4.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	102
Invert Level (m)	69.265
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.7
Flush-Flo™	0.299	4.7
Kick-Flo®	0.640	3.8
Mean Flow over Head Range	-	4.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	1.200	5.1	3.000	7.9	7.000	11.7
0.200	4.6	1.400	5.5	3.500	8.4	7.500	12.1
0.300	4.7	1.600	5.8	4.000	9.0	8.000	12.5
0.400	4.6	1.800	6.2	4.500	9.5	8.500	12.9
0.500	4.5	2.000	6.5	5.000	10.0	9.000	13.2
0.600	4.1	2.200	6.8	5.500	10.5	9.500	13.6
0.800	4.2	2.400	7.1	6.000	10.9		
1.000	4.7	2.600	7.3	6.500	11.3		

Storage Structures for Storm

Porous Car Park Manhole: CP7, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	7.70000	Width (m)	60.0
Membrane Percolation (mm/hr)	1000	Length (m)	15.0
Max Percolation (l/s)	250.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	70.945	Cap Volume Depth (m)	0.450

Porous Car Park Manhole: CP9, DS/PN: 3.000

Infiltration Coefficient Base (m/hr)	7.70000	Width (m)	60.0
Membrane Percolation (mm/hr)	1000	Length (m)	15.0
Max Percolation (l/s)	250.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	70.700	Cap Volume Depth (m)	0.450

Cellular Storage Manhole: Tank 1, DS/PN: 1.007

Invert Level (m)	69.535	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	7.70000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	50.0	50.0	1.201	0.0	86.0
1.200	50.0	86.0			

Cellular Storage Manhole: Tank 2, DS/PN: 5.003

Invert Level (m)	69.385	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	7.70000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	50.0	50.0	1.201	0.0	86.0
1.200	50.0	86.0			

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	CP1	15 Winter	1	+0%	30/15 Summer			
1.001	CP2	15 Winter	1	+0%	30/15 Summer			
1.002	CP3	15 Winter	1	+0%	30/15 Summer			
1.003	CP4	15 Winter	1	+0%	30/15 Summer			
2.000	CP7	30 Winter	1	+0%	30/15 Summer			
3.000	CP9	30 Winter	1	+0%	30/15 Summer			
2.001	CP8	15 Winter	1	+0%	30/15 Summer			
4.000	CP10	15 Winter	1	+0%	30/15 Summer			
1.004	CP5	15 Winter	1	+0%	30/15 Summer			
1.005	CP6	15 Winter	1	+0%	30/15 Summer			
1.006	MH01	15 Winter	1	+0%	30/15 Summer			
1.007	Tank 1	15 Winter	1	+0%	30/15 Winter			
1.008	MH02	15 Winter	1	+0%	30/15 Summer			
5.000	MH03	15 Winter	1	+0%	100/15 Summer			
5.001	MH04	15 Winter	1	+0%	100/15 Summer			
5.002	MH05	15 Winter	1	+0%	100/15 Summer			
5.003	Tank 2	15 Winter	1	+0%	100/15 Summer			
5.004	MH06	30 Winter	1	+0%	30/15 Summer			
1.009	Hydrobrake	30 Winter	1	+0%	30/15 Summer			

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	CP1	70.225	-0.230	0.000	0.13			7.7	OK
1.001	CP2	70.153	-0.217	0.000	0.16			9.8	OK
1.002	CP3	70.097	-0.183	0.000	0.32			15.4	OK
1.003	CP4	70.052	-0.203	0.000	0.22			15.0	OK
2.000	CP7	70.038	-0.237	0.000	0.08		8	5.3	OK
3.000	CP9	70.014	-0.246	0.000	0.05		9	3.4	OK
2.001	CP8	69.973	-0.082	0.000	0.24			11.1	OK
4.000	CP10	70.029	-0.211	0.000	0.19			12.4	OK
1.004	CP5	69.971	-0.064	0.000	0.97			47.0	OK
1.005	CP6	69.921	-0.089	0.000	0.84			47.0	OK
1.006	MH01	69.860	-0.100	0.000	0.77			50.8	OK
1.007	Tank 1	69.579	-0.256	0.000	0.05		7	3.4	OK
1.008	MH02	69.471	-0.239	0.000	0.05			3.3	OK
5.000	MH03	69.917	-0.223	0.000	0.15			9.9	OK
5.001	MH04	69.696	-0.199	0.000	0.25			15.4	OK
5.002	MH05	69.620	-0.170	0.000	0.39			25.1	OK
5.003	Tank 2	69.412	-0.273	0.000	0.01		7	0.4	OK
5.004	MH06	69.452	-0.138	0.000	0.03			1.3	OK
1.009	Hydrobrake	69.452	-0.113	0.000	0.07			4.5	OK

PN	US/MH Name	Level Exceeded
1.000	CP1	
1.001	CP2	
1.002	CP3	
1.003	CP4	
2.000	CP7	
3.000	CP9	
2.001	CP8	
4.000	CP10	
1.004	CP5	
1.005	CP6	
1.006	MH01	
1.007	Tank 1	
1.008	MH02	
5.000	MH03	
5.001	MH04	
5.002	MH05	
5.003	Tank 2	
5.004	MH06	
1.009	Hydrobrake	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	CP1	15 Winter	30	+0%	30/15 Summer			
1.001	CP2	15 Winter	30	+0%	30/15 Summer			
1.002	CP3	15 Winter	30	+0%	30/15 Summer			
1.003	CP4	15 Winter	30	+0%	30/15 Summer			
2.000	CP7	15 Winter	30	+0%	30/15 Summer			
3.000	CP9	15 Winter	30	+0%	30/15 Summer			
2.001	CP8	15 Winter	30	+0%	30/15 Summer			
4.000	CP10	15 Winter	30	+0%	30/15 Summer			
1.004	CP5	15 Winter	30	+0%	30/15 Summer			
1.005	CP6	15 Winter	30	+0%	30/15 Summer			
1.006	MH01	15 Winter	30	+0%	30/15 Summer			
1.007	Tank 1	30 Winter	30	+0%	30/15 Winter			
1.008	MH02	30 Winter	30	+0%	30/15 Summer			
5.000	MH03	15 Winter	30	+0%	100/15 Summer			
5.001	MH04	15 Winter	30	+0%	100/15 Summer			
5.002	MH05	15 Winter	30	+0%	100/15 Summer			
5.003	Tank 2	30 Winter	30	+0%	100/15 Summer			
5.004	MH06	30 Winter	30	+0%	30/15 Summer			
1.009	Hydrobrake	30 Winter	30	+0%	30/15 Summer			

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	CP1	70.795	0.340	0.000	0.26			15.9	SURCHARGED
1.001	CP2	70.780	0.410	0.000	0.30			18.6	SURCHARGED
1.002	CP3	70.761	0.481	0.000	0.64			30.8	SURCHARGED
1.003	CP4	70.747	0.492	0.000	0.37			25.2	SURCHARGED
2.000	CP7	70.782	0.507	0.000	0.29		6	19.8	SURCHARGED
3.000	CP9	70.701	0.441	0.000	0.18		5	12.0	SURCHARGED
2.001	CP8	70.708	0.653	0.000	0.80			36.1	SURCHARGED
4.000	CP10	70.766	0.526	0.000	0.37			24.9	SURCHARGED
1.004	CP5	70.690	0.655	0.000	2.33			112.6	SURCHARGED
1.005	CP6	70.473	0.463	0.000	2.02			113.3	SURCHARGED
1.006	MH01	70.261	0.301	0.000	1.85			121.5	SURCHARGED
1.007	Tank 1	69.917	0.082	0.000	0.73		9	47.5	SURCHARGED
1.008	MH02	69.977	0.267	0.000	0.56			37.3	SURCHARGED
5.000	MH03	69.966	-0.174	0.000	0.36			24.2	OK
5.001	MH04	69.800	-0.095	0.000	0.63			39.2	OK
5.002	MH05	69.755	-0.035	0.000	1.00			64.5	OK
5.003	Tank 2	69.621	-0.064	0.000	0.01		8	0.4	OK
5.004	MH06	69.843	0.253	0.000	0.03			1.3	SURCHARGED
1.009	Hydrobrake	69.917	0.352	0.000	0.08			4.7	SURCHARGED

PN	US/MH Name	Level Exceeded
1.000	CP1	
1.001	CP2	
1.002	CP3	
1.003	CP4	
2.000	CP7	
3.000	CP9	
2.001	CP8	
4.000	CP10	
1.004	CP5	
1.005	CP6	
1.006	MH01	
1.007	Tank 1	
1.008	MH02	
5.000	MH03	
5.001	MH04	
5.002	MH05	
5.003	Tank 2	
5.004	MH06	
1.009	Hydrobrake	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	CP1	15 Winter	100	+40%	30/15 Summer			
1.001	CP2	15 Winter	100	+40%	30/15 Summer			
1.002	CP3	15 Winter	100	+40%	30/15 Summer			
1.003	CP4	15 Winter	100	+40%	30/15 Summer			
2.000	CP7	15 Summer	100	+40%	30/15 Summer			
3.000	CP9	15 Winter	100	+40%	30/15 Summer			
2.001	CP8	15 Winter	100	+40%	30/15 Summer			
4.000	CP10	15 Winter	100	+40%	30/15 Summer			
1.004	CP5	15 Winter	100	+40%	30/15 Summer			
1.005	CP6	15 Summer	100	+40%	30/15 Summer			
1.006	MH01	15 Summer	100	+40%	30/15 Summer			
1.007	Tank 1	60 Winter	100	+40%	30/15 Winter			
1.008	MH02	30 Winter	100	+40%	30/15 Summer			
5.000	MH03	30 Winter	100	+40%	100/15 Summer			
5.001	MH04	30 Winter	100	+40%	100/15 Summer			
5.002	MH05	30 Winter	100	+40%	100/15 Summer			
5.003	Tank 2	30 Winter	100	+40%	100/15 Summer			
5.004	MH06	30 Winter	100	+40%	30/15 Summer			
1.009	Hydrobrake	30 Winter	100	+40%	30/15 Summer			

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	CP1	71.610	1.155	0.000	0.55			33.3	FLOOD RISK
1.001	CP2	71.513	1.143	0.000	0.70			43.4	FLOOD RISK
1.002	CP3	71.436	1.156	0.000	1.41			67.6	FLOOD RISK
1.003	CP4	71.361	1.106	0.000	0.97			65.5	FLOOD RISK
2.000	CP7	70.950	0.675	0.000	0.35		4	24.0	SURCHARGED
3.000	CP9	70.707	0.447	0.000	0.09		7	5.8	SURCHARGED
2.001	CP8	71.126	1.071	0.000	0.41			18.7	SURCHARGED
4.000	CP10	71.343	1.103	0.000	0.84			56.5	FLOOD RISK
1.004	CP5	71.191	1.156	0.000	2.80			135.5	SURCHARGED
1.005	CP6	70.915	0.905	0.000	2.35			132.1	SURCHARGED
1.006	MH01	70.634	0.674	0.000	2.45			160.8	SURCHARGED
1.007	Tank 1	70.422	0.587	0.000	0.84		21	54.5	SURCHARGED
1.008	MH02	70.671	0.961	0.000	0.50			33.3	SURCHARGED
5.000	MH03	70.367	0.227	0.000	0.52			35.2	SURCHARGED
5.001	MH04	70.344	0.449	0.000	0.78			48.8	SURCHARGED
5.002	MH05	70.297	0.507	0.000	1.37			88.1	SURCHARGED
5.003	Tank 2	70.226	0.541	0.000	0.16		17	10.2	SURCHARGED
5.004	MH06	70.581	0.991	0.000	0.03			1.6	SURCHARGED
1.009	Hydrobrake	70.670	1.105	0.000	0.08			5.0	SURCHARGED

PN	US/MH Name	Level Exceeded
1.000	CP1	
1.001	CP2	
1.002	CP3	
1.003	CP4	
2.000	CP7	
3.000	CP9	
2.001	CP8	
4.000	CP10	
1.004	CP5	
1.005	CP6	
1.006	MH01	
1.007	Tank 1	
1.008	MH02	
5.000	MH03	
5.001	MH04	
5.002	MH05	
5.003	Tank 2	
5.004	MH06	
1.009	Hydrobrake	

BAYNHAM MEIKLE
Consulting Civil and Structural Engineers

Appendix E – Other Supporting Information

E.1 Phase 1 Desk Study

E.2 Phase 2 Intrusive Ground Investigation