Proposed Development

Rail Central, Northamptonshire

Flood Risk Assessment, Hydraulic Modelling and Drainage Strategy Report (Part 2: J15a)

Draft Report

Ashfield Land Management Ltd

February 2018

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Issued by: Hydrock Consultants Limited
Over Court Barns
Over Lane
Almondsbury
Bristol
BS32 4DF

Tel: 01454 619533
Fax: 01454 614125
www.hydrock.com

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Issue Number:	**1**	**Name**	**Signature**
Prepared		Simon Mirams BSc, MCIWEM, C.WEM, CSci *Senior Flood Risk Consultant*	
Checked		David Lloyd BSc, PhD *Technical Director – Flood Risk*	
Approved		David Lloyd BSc, PhD *Technical Director – Flood Risk*	

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APPENDICES

1.0 INTRODUCTION

This report has been prepared by Hydrock Consultants Limited (Hydrock) on behalf of our client Ashfield Land Management Ltd in support of an application for Development Consent under the Planning Act 2008, to be submitted to the Examining Authority, for the proposed improvement works to junction 15a of the M1 in Northamptonshire. Also assessed within this report are a further 16 other minor highways works.

This report forms an appendix to the PEIR for the proposed development (**Appendix 14.1**).

The proposed improvement works to junction 15a (J15a) are located within the administrative area of South Northamptonshire. The further proposed highways works are situated at locations within South Northamptonshire and Northampton Borough, and are needed in order to mitigate relevant significant effects on the highway network arising for the development of the Main SRFI Site (FRA Part 1).

The Flood Risk Section of the National Networks National Policy Statement (NN NPS) has been reviewed and addressed within this report.

Local Planning Authorities are advised by the Government's *National Planning Policy Framework (NPPF)* to consult the Environment Agency (EA) on development proposals in areas at risk of flooding and/or for sites greater than 1ha in area.

This report has been prepared to satisfy any potential concerns the EA may have with the proposed development and to meet the requirements of NN NPS and NPPF through:

- Providing an assessment of whether the site is likely to be affected by flooding; and,
- Detailing the measures necessary to mitigate any flood risk identified, to ensure that the proposed development and end use would be safe, and that flood risk would not be increased elsewhere.

Only those requirements that are appropriate to a development of this nature have been considered in the compilation of this report and it has been prepared in accordance with current EA Policy and the requirements of the LLFA.

2.0 SITE INFORMATION

2.1 Existing Situation (J15a)

2.1.1 Location

Table.1: Site Referencing Information

Site Address	J15a Improvement Works, Rail Central, Northamptonshire
Grid Reference	472645, 257148 SP726571

2.1.2 Existing Land Use

Sections of the site are currently undeveloped and to agricultural use along with the Grand Union Canal which extends north to south through the site.

The site includes sections of the existing A43 road and M1 motorway. The M1 motorway runs west to east through the northern section of the red line boundary while the A43 runs north to south. Within the site is also Junction 15a of the M1 which links, via a number of roundabouts to the A43. Both of these roads are on embankments and are a minimum of around 2m above immediately surrounding ground levels.

The site is located to the north of Milton Malsor with Northampton being a short distance to the north east.

An Unnamed Watercourse is located within the site boundary for the proposed J15a improvements works. This watercourse enters the site on the western boundary and flows in a generally northerly direction, under the M1 Motorway through an existing culvert and then continues to flow parallel to the Grand Union Canal

2.2 Proposed Development

This part of the FRA (Part 2) considers the Junction 15a works and makes reference to other highway works which are also detailed below for information.

The J15a works include the following main elements:

- Pre-development works to facilitate widening/ reconfiguration (which will lead to some loss of vegetation in accordance with the draft landscape plan);
- Widening and signalisation of existing northern roundabout;
- Widening of A5123 approach; widening of M1 southbound off-slip approach;
- Widening of A43 northbound approach to northern roundabout;
- Reconfiguration of existing southern roundabout to provide signalised T-Junction;

- Provision of two lane free flow slip on A43 South Bound;
- Provision of new link road between southern junction to M1 northbound on and off slips;
- Widening of A43 northbound approach to southern junction; and
- Provision of environmental enhancement measures including new native tree and shrub planting, hedgerows, ponds and grass, wildflower and marshland areas.

The 'other' highways works relate to land at the following locations:

- Junction 16 of the M1 (M1/ A4500 (east to Northampton)/ A45 (west to Daventry));
- Junction 15 of the M1 (M1/ A45 (north to Northampton and Wellingborough)/ Saxon Avenue/ A508, Northampton Road (south to Milton Keynes));
- A4500, Weedon Road (east)/ Tollgate Way/ A4500, Weedon Road (west)/ A5076, Upton Way;
- A5076/ A5123/ Upton Way Roundabout (Pineham Park) (Dane Camp Way);
- A5076 (west)/ Hunsbury Hill Avenue/ Hunsbarrow Road/ A5076, Danes Camp Way/ Hunsbury Hill Road;
- Towcester Road/ A5076, Danes Camp Way/ A5123, Towcester Road/ Mere Way/ Tesco Access;
- A45, Nene Valley Way (south); A428, Bedford Road (west)/ A5095, Rushmere Road/ A45, Nene Valley Way (north)/ A428, Bedford Road (east);
- A45, Nene Valley Way (south); A43, Lumbertubs Way/ A45, Nene Valley Way (north)/ Ferris Row;
- Tove Roundabout (A43, Towcester Bypass (southwest)/ Towcester Road/ A5, (north)/ A43, (northeast)/ A5, Watling Street (southeast));
- Abthorpe Roundabout (Abthorpe Road/ A43, Towcester Bypass (north)/ Brackley Road/ A43, Towcester Bypass (south));
- A5076, Upton Way (south)/ Telford Way/ A5076, Upton Way (north)/ Walter Tull Way/ Dustan Mill Lane;
- A5076, Upton Way (south)/ High Street/ A5076, Upton Way (north)/ Dustan Mill (Stub);
- A45 (south)/ Eagle Drive/ A45 (north)/ Caswell Road; and
- A508, Harborough Road (south)/ A5199, Welford Road/ A508, Harborough Road (north)/ Cranford Road/ Kingsland Avenue.

- A43/St John's Road (signage and road surfacing scheme on the A43),
- A43 Northampton Road (signage scheme); and,
- Pedestrian/Cycle Way along Northampton Road and between Barn Lane to the junction of Collingtree Road (widening of existing footpaths, provision of new footpath and dropped kerbs, and realignment of the carriageway).

In order to effectively meet the demand which has been identified, it is necessary that that the DCO provides enough flexibility for the Applicant to accommodate changing occupier requirements and to give certainty to occupiers that they will be able to operate competitively without undue constraints imposed by the DCO during occupation.

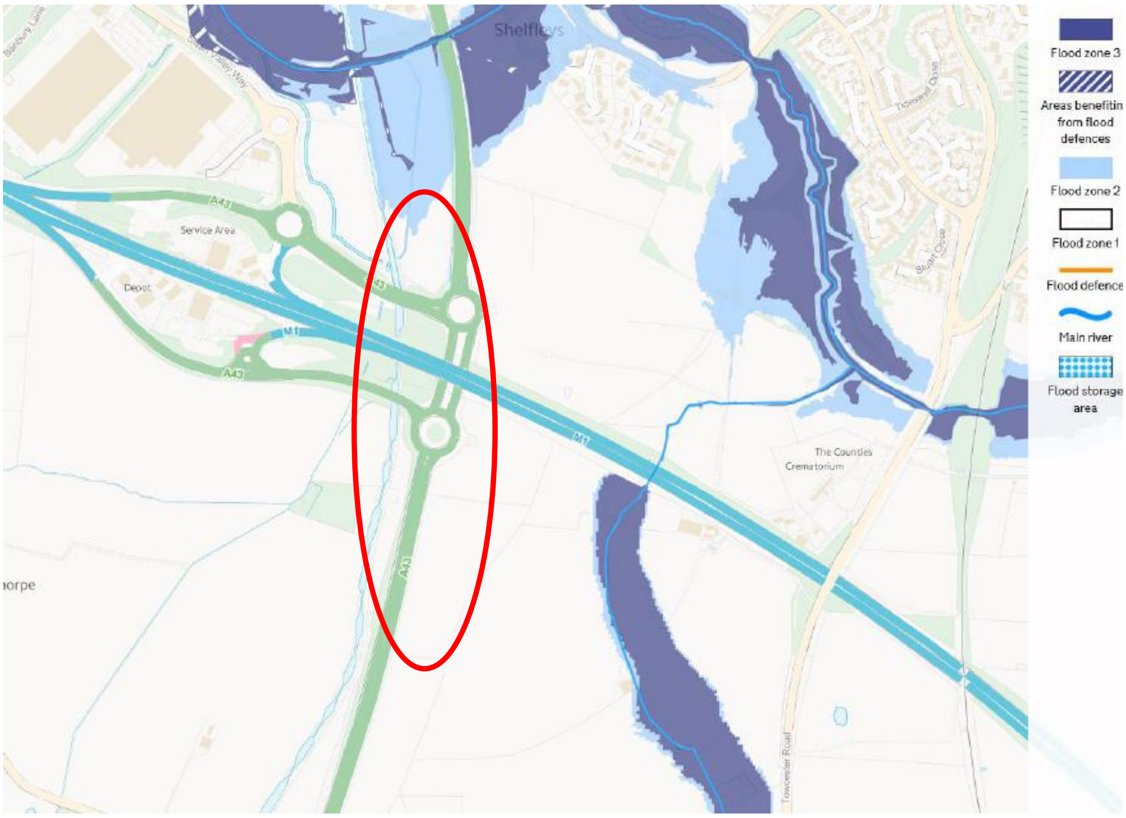
The assessment work in this FRA has been undertaken to assess the reasonable worst-case on the basis of the fixed parameters which set out the location, extent and scale of the Proposed Development for which consent is sought.

3.0 ASSESSMENT OF FLOOD RISK – JUNCTION 15A

3.1 Fluvial and Tidal Flooding

The Junction 15a site is shown by the EA's Flood Zone Mapping to be located within Flood Zone 1 (land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%)).

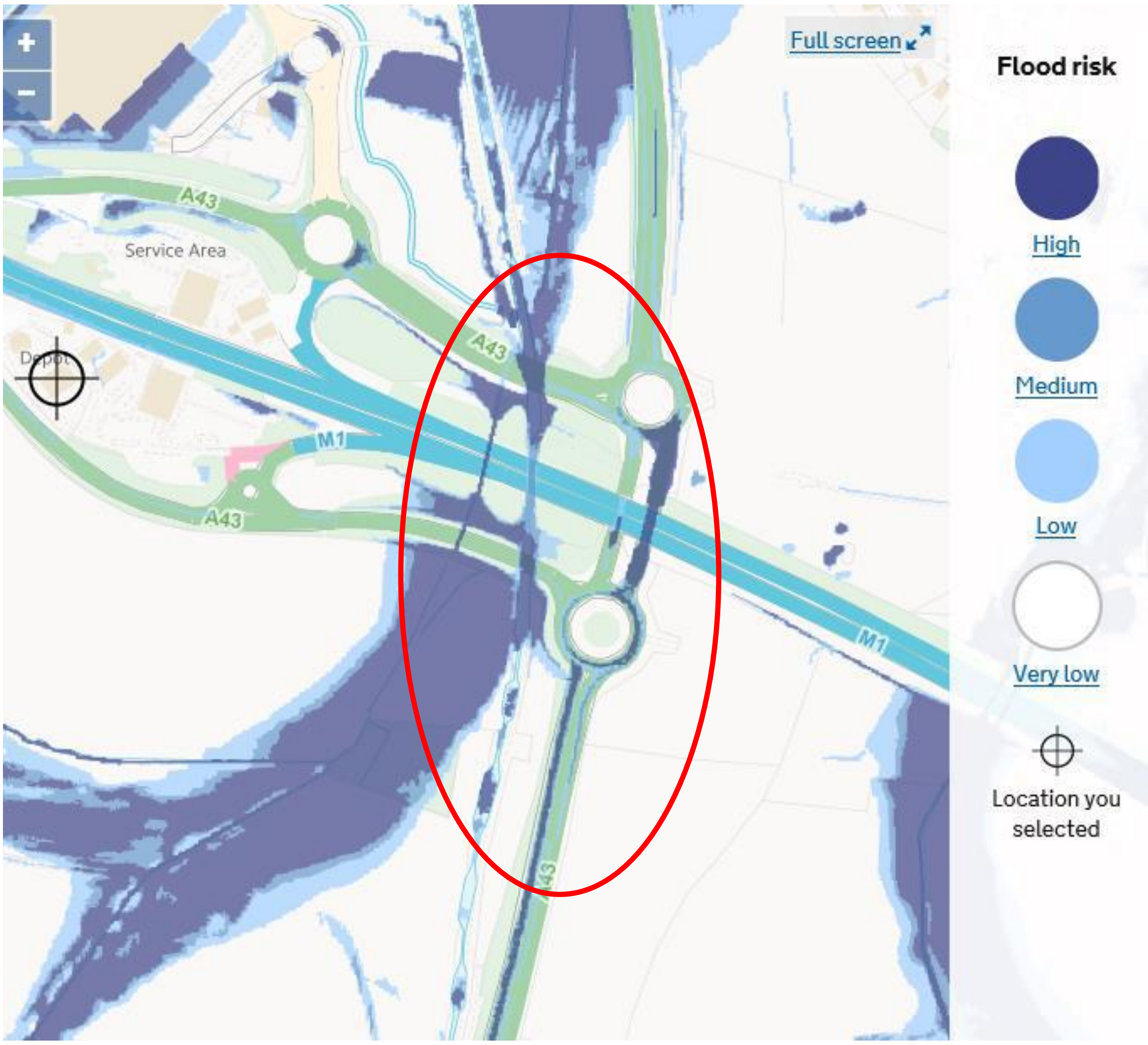
Figure 1: EA Flood Zone Mapping (approximate site location shown)



An unnamed watercourse enters the site at the western site boundary before turning and flowing in a northerly direction parallel to the Grand Union Canal, under the M1 Motorway before continuing beyond the site and draining into the River Nene (which is around 250m beyond the northern site boundary).

The Unnamed Watercourse has catchment area of less than 3km^2 and therefore has not been included within the EA's national assessment of flood risk. As such the EA's Flood Risk from Surface Water mapping (figure 2 below) has been used to provide an indication of the likely risk from the Unnamed Watercourse. It should be noted that the EA's flooding from surface water mapping does not make any detailed allowance for existing channel capacity (i.e. no channel cross sections) and only represents major culverts (such as where the Unnamed Watercourse flows under the M1 Motorway) and therefore is considered to provide a 'worst case' prediction of the potential fluvial risk from this source.

Figure 2: EA Flooding from Surface Water Mapping (approximate site location shown)



Whilst the Surface Water mapping shows that large areas of the site are likely to be at increased risk of flooding form the watercourse, as the A43 and M1 Motorways are raised they are considered to be at low risk from the unnamed watercourse.

Northamptonshire County Council's (the LLFA) Strategic Flood Risk Assessment also makes no reference to any recorded historic incidents of fluvial flooding to Junction 15a or the immediately surrounding area.

3.2 Surface Water Flooding

The Local Authority Strategic Flood Risk Assessment (SFRA) does not make reference to any known incidents of surface water flooding at Junction 15 or within the immediately surrounding area.

However, as noted above, the EA's Flooding from Surface Water mapping predicts areas at potential risk from this source that follow and extend along the route of the Unnamed

Watercourse. The predicted areas of flooding show that the existing culvert under the A43 and M1 Motorway may act as a restriction to flows, increasing the upstream risk and resulting in potential surface flows that could spill into the Grand Union Canal.

Whilst these flow routes appear to impact sections of both the A43 and M1 Motorway these locations are consistent with the existing crossings and are therefore representative of flows conveyed within the culverts and are not therefore considered to result in any increased flood risk to either carriageway.

A section of the A43 to the south of the southern roundabout is shown to be at potentially increased risk from this source. However, it should be noted that the EA's flooding from surface water mapping does not make any allowance for existing sewer networks or road drainage and therefore provides a 'worst case' prediction of risk from this source. As such, this location is concluded as being at low risk from surface water flooding provided the existing drainage system remains functional.

3.3 Groundwater Flooding

Groundwater flooding can occur when the water table rises after unusually prolonged rainfall. Such flooding is most likely to occur in low lying areas underlain by permeable rocks (aquifers).

The British Geological Survey mapping, indicates that the Site is predominantly underlain by the Dyrham Formation, the Whitby Mudstone formation, and the Marlstone Rock Formation. These are low in permeability. As such, and given the proximity of the Unnamed Watercourse and the Grand Union Canal, it is likely that groundwater levels would be in hydraulic connectivity with normal channel water levels but not to vary significantly over time. In order to adopt a conservative approach, the surface water mapping is considered as being representative of the 'worst case' groundwater flooding scenario and only the lower elevated sections of the Site (adjacent to both the Unnamed Watercourse and the Canal) are therefore considered to be at potential risk from this source.

3.4 Infrastructure Failure Flooding

The SFRA does not make reference to any previously recorded incidents of infrastructure flooding within the site or surrounding area.

The A43 and M1 Motorway through the site would be served by an engineered drainage system that would ultimately convey flows to neighbouring watercourses/ditches.

From the review of sewer records it is concluded that in the event of a failure (as a result of a blockage or collapse of the sewer) any generated overland flows would follow the existing topography and drain towards the watercourse or other land drainage features (field ditches, Grand Union Canal etc) within the site (i.e. field ditches). Any flooding as a result of an infrastructure failure would increase the flood risk but it is expected that this would only affect lower areas of the site before draining into existing land drainage features or watercourses. As such, any risk from infrastructure failure is concluded to be residual only.

3.5 Flooding from Artificial Sources

The EA's Flooding from Reservoir Mapping shows that the site is not within an area considered as being at risk from this source.

The Grand Union Canal runs through the approximate centre of the site. There is the potential in the event of a failure or breach of the Grand Union Canal for flows to be directed towards the Unnamed Watercourse but this is considered to pose a negligible risk to the existing A43 and M1 Motorway. The risk of such a failure is considered to be low owing to the level of ongoing inspections and maintenance undertaken by the Canal & River Trust. The risk for this source is therefore considered as minimal and residual only.

3.6 Summary

The EA's Flood Zone Mapping currently shows the entirety of the site as being at low risk from fluvial flooding and within Flood Zone 1. However, as this has not been modelled, the areas identified as being at an increased risk from surface water flooding are considered to be more representative of potential fluvial flooding. As the roads are elevated, these are not considered to be at risk from either fluvial or surface water flooding. The areas that are shown to be potentially at increased risk from surface water benefit from the positive road drainage and are therefore concluded as being at low risk from provided the existing drainage system remains functional.

Owing to the elevation of the existing roads in comparison to surrounding ground levels, and the drainage systems serving the hardstanding areas, the road network in the site is assessed as being at negligible risk from all remaining sources of flooding.

4.0 ASSESSMENT OF FLOOD RISK – OTHER MINOR HIGHWAYS WORKS

Owing to the number and location of the proposed Other Minor Highway works a detailed assessment of each has not been undertaken but below is a summary of the flood risks posed to each of the site.

Table. 2: Summary of risks to other minor highways work.

Site	Assessment of Flood Risk				
	Fluvial and Tidal	**Surface Water**	**Groundwater**	**Infrastructure Failure**	**Reservoir**
Junction 16 of the M1	Flood Zone 1	Predominantly Low but areas are at increased risk with medium and high areas predicted	Low	Low	Low
Junction 15 of the M1	Flood Zone 1	Low	Low	Low	Low
A4500, Weedon Road (east)/ Tollgate Way/ A4500, Weedon Road (west)/ A5076, Upton Way;	Flood Zone 1	Medium	Low	Low	Low
A5076/ A5123/ Upton Way Roundabout	Flood Zone 1	Mainly low but lower lying areas shown to be at medium	Low	Low	Low
A5076 (west)/ Hunsbury Hill Avenue/ Hunsbarrow Road/ A5076, Danes Camp Way/ Hunsbury Hill Road	Flood Zone 1	Low	Low	Low	Low
Towcester Road/ A5076, Danes Camp Way/ A5123, Towcester Road/ Mere Way/ Tesco Access	Flood Zone 1	Low	Low	Low	Low
A45, Nene Valley Way (south); A428,	Flood Zone 1	Low	Low	Low	Low

Bedford Road (west)/ A5095, Rushmere Road/ A45, Nene Valley Way (north)/ A428, Bedford Road (east);					
A45, Nene Valley Way (south); A43, Lumbertubs Way/ A45, Nene Valley Way (north)/ Ferris Row	Flood Zone 1	Low	Low	Low	Low
Tove Roundabout (A43, Towcester Bypass (southwest)/ Towcester Road/ A5, (north)/ A43, (northeast)/ A5, Watling Street (southeast))	Flood Zone 1	Low but areas of medium	Low	Low	Low
Abthorpe Roundabout (Abthorpe Road/ A43, Towcester Bypass (north)/ Brackley Road/ A43, Towcester Bypass (south))	Flood Zone 1	Low	Low	Low	Low
A5076, Upton Way (south)/ Telford Way/ A5076, Upton Way (north)/ Walter Tull Way/ Dustan Mill Lane	Flood Zone 1	Medium	Low	Low	Low
A5076, Upton Way (south)/ High Street/ A5076, Upton Way (north)/ Dustan Mill (Stub)	Flood Zone 1	Low but areas at medium risk	Low	Low	Low

A45 (south)/ Eagle Drive/ A45 (north)/ Caswell Road	Flood Zone 1	Low	Low	Low	Low
A508, Harborough Road (south)/ A5199, Welford Road/ A508, Harborough Road (north)/ Cranford Road/ Kingsland Avenue	Predominantly Flood Zone 1 but partially within Flood Zone 2.	Medium	Low	Low	Low
A43/St John's Road	Flood Zone 1	Low	Low	Low	Low
A43 Northampton Road	Flood Zone 1	Low	Low	Low	Low
Pedestrian/Cycle Way along Northampton Road	Predominantly Flood Zone 1	Low	Low	Low	Low

5.0 *NN NPS & NPPF* REQUIREMENTS

5.1 Sequential Test

The NN NPS Flood Risk Section provided guidance that mirrors that of the NPPF but is extended to include specific guidance on climate change. Both of these documents have been reviewed and used to inform this section of the report.

The EA's Flood Zone mapping classifies that the site is within Flood Zone 1 and therefore at low risk. However, this assessment has concluded that as a detailed assessment of the watercourse hasn't been undertaken the lower elevated sections of the site immediately adjacent to the Unnamed Watercourse would be at an increased risk. That said, both the A43 and M1 Motorway are shown as being suitably elevated to be at low risk from all potential sources.

The allocation of proposed uses to appropriate Flood Zones is considered to meet the requirements of the Sequential Test advocated within the *NPPF*. However, it is recommended that such an approach be confirmed to be acceptable by the EA and Local Authority in meeting the requirements of the Sequential Test.

5.2 Exception Test

Whilst an Exception Test is not explicitly required under the NPPF, assuming the site is accepted to pass the Sequential Test, the following section details any measures necessary to mitigate any residual flood risks, to ensure that the proposed development and occupants will be safe and that flood risk will not be increased elsewhere, akin to the requirements of second requirement of the Exception Test.

5.2.1 Resistance and Resilience of Site

The proposed development involves the reconfiguration of the existing junction and the provision of a new slip road to the south of the southern roundabout. As such, it would be recommended for this to be a clear span structure across the lower lying area shown to be at an increased risk of flooding. This approach would ensure that flows within the Unnamed Watercourse and the Grand Union Canal are not restricted and ensure the works result in no loss of floodplain storage. This recommendation ensures that there is no detrimental impact to third party land.

6.0 ***SURFACE WATER MANAGEMENT***

6.1 Pre-Development

The junction 15A interchange comprises four roundabouts linked via single and dual lengths of carriageway. Included within the area under consideration are areas of scrubland and open fields.

The highways are under the control of Highways England.

Rain falling on the undeveloped land will naturally infiltrate the ground until the capacity of the underlying soils is reached, after which runoff will shed off into the local ditches and watercourses.

A copy of the public sewer record plan for the area has been obtained from Anglian Water. This indicates that there are no public surface water sewers within the development area. A copy of this information is included in Appendix A.

Copies of historical highways drainage drawings have been obtained from Highways England which refer to previous improvement schemes in relation to junction 15A. This information has been combined with topographic survey work in order to prepare an overall existing drainage layout indicating how the carriageways are drained. Copies of the historical drawings are included in Appendix A.

The highway drainage system is formed of various combinations of the following features;

- Conventional pipe drainage;
- Filter drains;
- Combined kerb/drainage system (Beany Blocks);
- Open ditches;
- Conventional road gulleys;

The highway drainage runoff ultimately discharges to existing watercourses or the Grand Union Canal, as shown on the historic record plans.

In all of the above cases, it will be necessary for the post-development proposals to maintain existing flows across the site in order to ensure that no upstream third party areas are affected.

Drawing no. C151171-2001 showing the locations of existing sewers and drains is included in Appendix A.

6.2 Post-Development

The proposed improvements to the junction will result in both additional impermeable areas through new carriageways and the removal of existing impermeable areas where carriageways are replaced with landscaping. In most cases the total area draining to any outfall will be increased and therefore additional runoff generated will be managed through amendments to the infrastructure drainage systems such that there will be no detrimental impact to third parties downstream of the site.

In line with the NPPF, and other relevant guidance, initial consideration has been given to the use of Sustainable Drainage System (SUDS) methods of surface water disposal. The preferred hierarchy for dealing with surface water run-off is:

- Infiltration to ground via soakaways.
- Discharge to a watercourse.
- Discharge to a surface water sewer.

Soil conditions are unlikely to allow any meaningful ability to infiltrate surface water runoff to ground and therefore the proposed drainage will be via positive systems which will ultimately discharge to the existing ditches and drainage network.

Where possible, use will be made of the existing drainage network with new drainage provided where carriageway realignment dictates that existing drainage features cannot be retained. Where the impermeable area is significantly increased above the existing catchment, i.e +10%, attenuation will be provided with flows restricted to the equivalent greenfield QBAR rate.

An assessment has been made from the available information of the existing highway drainage catchment areas and where these catchments discharge to. At the time of writing, no level design has been carried out on the proposed junction works and therefore assumptions have been made regarding the likely directions of fall for new carriageway works and where new runoff will discharge to.

Drawing no. C151171-C2002 showing the impermeable catchment areas and their points of discharge is included in Appendix A.

The greenfield QBAR value has been calculated using the ICP SuDS Method within the industry standard Micro Drainage software. This indicates an undeveloped QBAR value of 3.9 litres/ha/sec which will be applied to the additional post-improvement impermeable areas in order to derive a maximum allowable discharge rate from the site.

In accordance with the requirements of the Design Manual for Road and Bridge Works, Volume 5, specifically HD33/16 – Design of Highway Drainage Systems, any new elements have been designed such that there is no flooding in the 1 in 5 year event with an allowance of +20% for climate change.

A summary of the catchments is set out below;

Area 'A'

New area of drained highway = 719m^2

Area of retained highway draining to new system = 1,102m^2

Therefore total area drained = 1,821m^2 = 0.182 hectares @ 3.9 l/s/ha = 0.71 l/s discharge rate, but minimum practical rate to avoid blockages is 2.0. l/s.

Provide 86m of 675mm dia pipe for storage.

Area 'B'

New area of drained highway = 696m^2

Area of retained highway draining to new system = 1,412m^2

Area of existing highway to be removed from system = 263m^2

Net increase in drained area = 433m^2 = 0.043 hectares @ 3.9 l/s/ha = 0.17 l/s discharge rate, but minimum practical rate to avoid blockages is 2.0. l/s.

Provide 2.4m diameter manhole for storage.

Area 'C'

New area of drained highway = 233m^2

However, this is offset by 1,102m^2 of retained highway being attenuated in Area 'A' therefore there is an overall betterment without any further attenuation.

Area 'D'

New area of drained highway = 563m^2

Area of retained highway draining to new system = 1,357m^2

Area of existing highway to be removed from system = 490m^2

Net increase in drained area = 73m^2 , as this is only 5% of the existing catchment area this is taken as a relatively insignificant increase and therefore no attenuation is proposed.

Area 'E'

New area of drained highway = 406m^2

Area of retained highway draining to new system = 1,691m^2

Area of existing highway to be removed from system = 282m^2

Net increase in drained area = 124m^2 , as this is only 7% of the existing catchment area this is taken as a relatively insignificant increase and therefore no attenuation is proposed.

Area 'F'

The area 'F' catchment comprises a mix of new, retained and reconfigured areas

The total existing impermeable area draining to point 'F' = 3,145m^2

The total post-development area draining to point 'F' = 3,180m^2

Net increase in drained area = 35m^2 , as this is only 1% of the existing catchment area this is taken a a relatively insignificant increase and therefore no attenuation is proposed.

Area 'G'

New area of drained highway = 1,306m^2

0.131 hectares @ 3.9 l/s/ha = 0.51 l/s discharge rate, but minimum practical rate to avoid blockages is 2.0. l/s.

Proposed attenuation basin with storage volume of 19m^3 to be provided.

Area 'H'

New area of drained highway = 793m^2

0.079 hectares @ 3.9 l/s/ha = 0.31 l/s discharge rate, but minimum practical rate to avoid blockages is 2.0. l/s.

Provide 15m of 900mm dia pipe for storage.

Area 'J'

No change to overall drained area.

Area 'K'

New area of drained highway = 3,490m^2

Area of existing highway to be removed from system = 501m^2

Net increase in drained area = 2,989m^2 which is equivalent to the new southbound leg of the southern roundabout therefore this section will be attenuated to offset the increase in area.

0.299 hectares @ 3.9 l/s/ha = 1.2 l/s discharge rate, but minimum practical rate to avoid blockages is 2.0. l/s.

Provide 85m of 900mm dia pipe for storage.

Area 'L'

New area of drained highway = 1,012m^2

0.101 hectares @ 3.9 l/s/ha = 0.4 l/s discharge rate, but minimum practical rate to avoid blockages is 2.0. l/s.

Provide 2.7m diameter manhole for storage.

The locations of the storage features and their respective sizes are shown on drawing no. C151171-C001 contained in Appendix A.

Where existing drainage outfall points are being retained, any existing petrol/oil interceptors will also be retained or replaced as appropriate. All new drainage systems with new outfall points will include a petrol/oil interceptor prior to discharge.

7.0 FOUL WATER MANAGEMENT

7.1 Pre-Development

A copy of the Anglian Water sewer record plans has been obtained and compared with the manholes shown on the topographic survey. A copy of the record plan is included in Appendix A.

There are no recorded foul sewers within the development boundary.

7.2 Post-Development

There are no foul proposals associated with the junction 15A works and therefore no foul water management proposals.

8.0 CONCLUSIONS

This report has considered the flood risk posed to the proposal site from a variety of sources of flooding, as defined by the *NPPF*.

The EA's Flood Zone Mapping currently shows the site as being at low risk from fluvial flooding and within Flood Zone 1. However, sections of the site that are adjacent to both the Unnamed Watercourse and Grand Union Canal are confirmed as potentially at an increased risk from both sources. Both the A43 and M1 Motorway are confirmed as being above the areas confirmed as potentially at risk from fluvial sources.

Owing to the elevation of the existing roads in comparison to surrounding ground levels, and the drainage systems serving the road network, the area is assessed as being at negligible risk from all remaining sources of flooding.

This report therefore demonstrates that, provided an approved SUDS is employed, and a clear span structure is employed, the proposed scheme will:

- Be safe and resilient to flooding in the critical design flood event with an acceptable level of residual risk.

- Not increase flood risk through loss of floodplain storage, impedance of flood flows or increase in surface water run-off.

As such, the proposed development is concluded to meet the flood risk requirements of the *NNNPS* and the *NPPF*.

Hydrock Consultants Limited

APPENDIX A – DRAINAGE STRATEGY

Reference	Title
254089-1 Wastewater Plan 1	Anglian Water Sewer Record Plan
TB/XVAJ/C/D/011E 15791/500/01E 1579/500/02E 4316/40/30D	Historic Highway Drainage Plans
C151171-C2001A	Existing Highway Drainage – Sheet 1
C151171-C2002A	Existing Highway Drainage – Sheet 2
C151171-C2003A	Drainage Areas
C151171-C2004A	Proposed Highway Drainage – Sheet 1
C151171-C2005A	Proposed Highway Drainage – Sheet 2
Greenfield Runoff	Existing Greenfield Runoff Calculations
AREA A .scrx	Area A Micro Drainage Storage Calculations
AREA B .scrx	Area B Micro Drainage Storage Calculations
AREA G .scrx	Area G Micro Drainage Storage Calculations
AREA H .scrx	Area H Micro Drainage Storage Calculations
AREA K .scrx	Area K Micro Drainage Storage Calculations
AREA L .scrx	Area l Micro Drainage Storage Calculations

 Date: 20/02/18 Scale: 1:1250 Map Centre: 472515,257237 Data updated: 04/01/18 Our Ref: 254089 - 1 Wastewater Plan A1

Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*

Outfall*
Inlet*
Manhole*

Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station

*(Colour denotes effluent type)

tracymartin@hydrock.com

M1 JUNCTION 15A

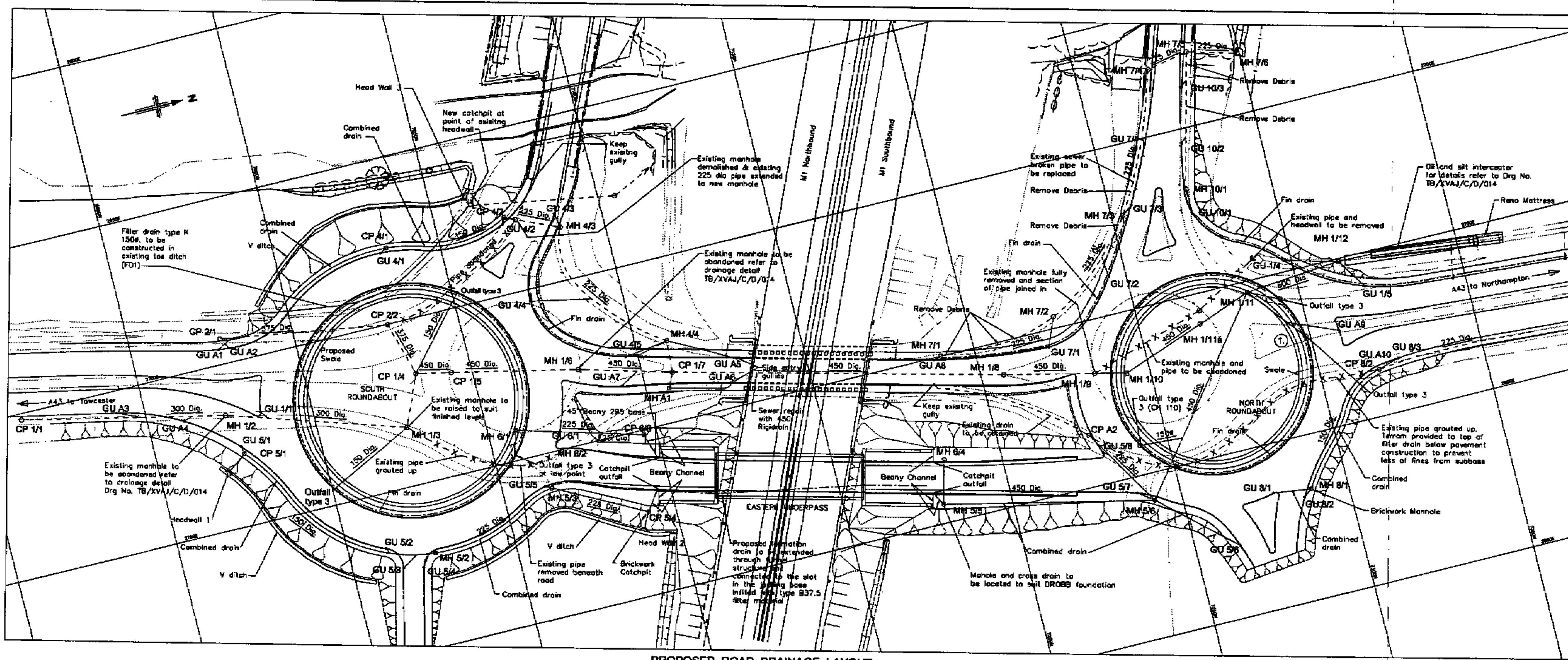
love every drop
anglianwater

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
2501	472231	257508	F	67.118	64.548	2.57
3501	472306	257558	F	65.866	-	-

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert



PROPOSED ROAD DRAINAGE LAYOUT

Scale 1:500

MANHOLE SCHEDULE (NEW)

Manhole Reference	Chamber Type	Chamber Dia. (mm)	Cover Type (D400)	Opening Size	Asbuilt Coords Centre of Chamber E	Asbuilt Coords Centre of Chamber N	Asbuilt Coords Centre of Opening E	Asbuilt Coords Centre of Opening N	Cover Level (mAOD)	Sump level (mAOD)	Outlet Pipe Ø	Outlet IL (mAOD)	Inlet Pipe Ø	Inlet IL (mAOD)	Inlet Pipe Ø	Inlet IL (mAOD)	Inlet Pipe Ø	Inlet IL (mAOD)	Inlet Pipe Ø	Inlet IL (mAOD)
MH A2	CP	1200	SOLID	600x600	2790.120	7227.424	2789.881	7227.881	72.807	70.767	225	71.141	225	71.141	150	71.487				
MH 1/10	MH	1350	SOLID	600x600	2789.283	7244.412	2789.283	7244.412	73.408	N/A	450	70.083	450	70.061	100	71.288	100	71.288		
MH 1/11	MH	1500	SOLID	600x600	2782.888	7288.875	2782.888	7288.875	73.052	N/A	600	69.218	450	69.300	450	69.225	150 150	70.851 70.237	100 100	70.288 70.288
MH 1/12	MH	1500	SOLID	1200x600	2790.871	7313.817	2790.871	7313.741	70.837	N/A	800	69.059	600	69.080	150	69.488	150	69.488		
MH 4/1	CP	1200	GRATING	600x600	2577.231	7033.274	2577.231	7033.274	74.810	72.423	150	72.820	150	73.740	150	73.290				
MH 4/2	CP	1200	GRATING	600x600	2579.041	7087.878	2579.041	7087.878	73.824	71.831	225	72.188	150	72.287	150	72.281	150	72.288		
MH 5/1	CP	1050	GRATING	600x600	2728.335	6978.887	2728.370	6978.837	74.817	73.084	150	73.409	150	73.659	150	73.784				
MH 5/2	MH	1200	SOLID	600x600	2771.717	7026.055	2771.808	7020.088	74.237	N/A	225	72.313	150	72.685						
MH 5/3	MH	1350	SOLID	600x600	2761.428	7061.808	2761.807	7061.887	73.285	N/A	225	71.884	225	71.886	150	71.880				
MH 5/4	CP	1200x675	SOLID	1200x600	2771.811	7088.802	2771.811	7088.802	72.738	71.380	BC	71.884	225	71.884						
MH 5/5	MH	1350	SOLID	600x600	2795.853	7178.773	2795.855	7178.773	71.503	N/A	450	69.871	225	70.222	225	70.222	150	70.222		
MH 5/6	MH	1350	SOLID	600x600	2805.871	7241.888	2805.888	7241.816	72.364	N/A	450	69.434	225	69.604	450	69.434	150 80	71.214 69.780	150 80	71.214 69.880
MH 6/1	MH	1350	SOLID	1200x600	2742.418	7086.884	2742.418	7086.854	73.879	N/A	225	71.780	150	71.780	100	71.780	100	71.780		
MH 6/3	CP	1350	SOLID	600x600	2751.133	7084.402	2750.885	7084.883	73.318	71.288	BC	71.814	225	71.814						
MH 6/4	MH	1350	SOLID	1200x600	2777.115	7183.883	2777.115	7183.885	71.737	N/A	225	70.392	225	70.392	150	70.487				
MH 8/1	MH	1200x675	SOLID	1200x600	2816.082	7288.817	2816.082	7288.817	72.800	N/A	150	71.810	150	71.810	150	71.810	150	71.616		
MH 8/2	CP	1200	GRATING	600x600	2788.885	7317.574	2788.877	7317.508	71.841	69.791	225	70.188	150	70.846	150	70.846				

MANHOLE SCHEDULE (EXISTING)

New Reference	Old Reference	Cover Level	Sump Level	Invert Level	Top of Pipe	New Cover Level
CP 1/3	6/22	74.03	73.48	72.78	73.025	77.089
CP 1/4	6/21	74.08	71.84	72.14	72.385	76.339
CP 1/5	6/23	74.18	71.77	72.07	72.815	77.813
CP 1/7	6/28	73.21	71.35	71.65	71.895	73.225
CP 1/8	6/29	72.89	70.58	70.88	71.108	72.633
CP 2/1	6/16	74.32	72.87	73.17	73.418	N/A
CP 2/2	6/20	74.03	72.38	72.68	72.905	77.388
MH 4/3	6/25	73.44	71.94	72.24	72.485	N/A
MH 4/4	6/26	73.14	71.88	71.88	72.225	N/A
MH A1	6/30	73.22	71.74	72.04	72.285	N/A
MH 7/1	6/31	73.08	71.57	71.87	72.115	N/A
MH 7/2	6/34	72.83	71.21	71.51	71.765	N/A
MH 7/3	6/35	72.87	70.89	71.19	71.435	N/A
MH 7/4	6/36	72.05	70.49	70.79	71.035	N/A
MH 7/6	6/40	72.02	70.30	70.60	70.845	N/A

FIN DRAIN AROUND STRING CC03.

CHAINAGE	IL (mAOD)
4	70.530
5	70.540
10	70.573
20	70.605
30	70.659
40	70.842
50	71.084
60	71.295
70	71.416
80	71.545
90	71.382
100	71.219
110	71.163
120	71.202
130	71.150
140	71.180
150	71.150
160	71.150
170	71.150
180	71.344
190	71.304
195	71.280
200	71.250
210	71.148
220	71.031
230	70.870
236	70.791
245	70.600
254	70.537

FIN DRAIN AROUND STRING CC12.

CHAINAGE	IL (mAOD)
0	71.800
10	71.798
20	71.808
30	72.087
40	72.374
50	72.611
60	72.794
70	72.923
80	73.011
90	73.102
100	73.184
110	73.275
120	73.365
130	73.461
140	73.541
150	73.610
160	73.644
170	73.618
180	73.580
190	73.458
200	73.341
210	73.222
220	73.103
230	72.870
240	72.846
250	72.690
260	72.477
270	72.288
280	71.884

V-DITCH TO HEADWALL 1

E	N	IL	
2730.324	6960.730	76.273	
2732.880	6965.742	76.280	HEADWALL
2738.827	6972.584	76.279	
2748.541	6977.781	76.295	
2758.276	6983.227	76.336	
2766.884	6990.774	76.344	
2773.406	6998.046	76.376	

V-DITCH TO HEADWALL 2

E	N	IL	
2781.020	7025.887	75.475	
2779.680	7034.889	75.378	
2777.214	7044.882	75.020	
2774.311	7062.546	74.714	
2770.889	7061.440	74.480	
2770.125	7069.089	74.330	
2774.818	7075.461	74.211	
2778.382	7084.463	74.088	HEADWALL
2781.159	7092.088	74.288	
2782.059	7098.615	74.480	

V-DITCH TO HEADWALL 3

E	N	IL	
2880.717	6990.522	71.183	
2873.835	6996.874	70.310	
2867.541	7006.825	69.320	
2863.780	7023.848	69.578	
2864.837	7039.187	69.309	
2860.253	7050.841	69.272	
2857.384	7057.187	69.160	HEADWALL
2852.537	7063.148	69.347	

FIN DRAIN AROUND STRING M103.

CHAINAGE	IL (mAOD)
0	71.850
20	71.700
45	71.613
50	71.475
65	71.363
82	71.160
Tie in MH 7/8	71.148

FIN DRAIN AROUND STRING M104.

CHAINAGE	IL (mAOD)
69	71.116
78	71.209
80	71.109
90	70.883
100	70.744
110	70.477
120	70.213

FIN DRAIN AROUND STRING M201.

CHAINAGE	IL (mAOD)
30	70.888
35	71.010
40	71.178
45	71.289
50	71.371
55	71.782
60	71.940

FIN DRAIN AROUND STRING M203.

CHAINAGE	IL (mAOD)
30	72.618
50	72.473
60	72.400
70	72.308
80	72.185
105	71.974
Tie in MH 4/4	71.888

NOTES:

1. All new manholes to be in accordance with SHW highway construction details, apart from Manholes 5/4, 6/3 & 6/4. Manholes 5/4, 6/3 & 6/4 shown on Drg No. TB/XVAJ/C/D/014
2. Motorway drainage to be re-instated to original levels
3. MH 6/3 and MH 5/4 to be located such that inlet pipes have 1.0m cover below earthworks outline

(1.) Co-ordinates
2767.200m East
7294.750m North

LEGEND:-

- - - - -	Existing sewers retained
O	Existing manholes
———	New sewers
□	New manholes
═══	V Ditch
———	New fin drain
- - - ———	New beany block drain
-x-x-x-	Pipes to be abandoned
MH	Manhole
CP	Catchpit

AS BUILT

Revision	By	Checked	Approved	Date	Description
E	[illegible]	[illegible]	[illegible]	[illegible]	AS BUILT [illegible]
D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
C	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
B	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Client: HIGHWAYS AGENCY

Contractor: Edmund Nuttall Limited, Civil Engineering Contractors — nuttall

Designers: John Hopkins Ltd, Consulting Civil Engineers — Halcrow

Project: SWAN VALLEY
M1 JUNCTION 15A ENHANCEMENT

DRAINAGE
LAYOUT
(AS BUILT)

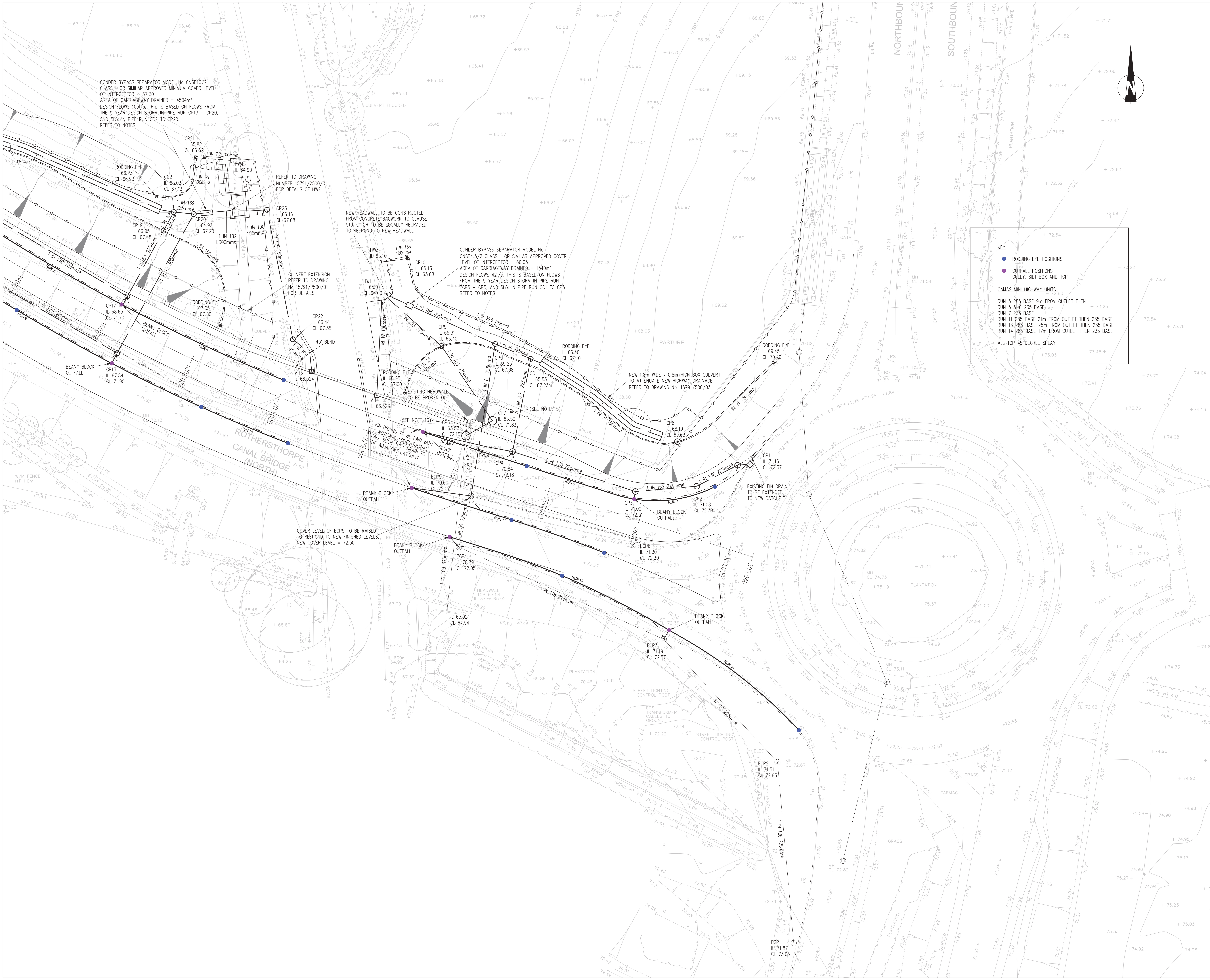
Drawn by	SR	Date	08/03/02
Checked by	DD	Date	16/04/02
Authorised by	JSW	Date	16/04/02

Drawing No. TB/XVAJ/C/D/011 — Revision E

Drawing Scale 1:500 AT A0

CAD Filename TB_XVAJ_C_D_011 — Plot Scale 1:1 AT A0

At A0 Scale = 1:500 — 10 0 10 20m



KEY

	EXISTING CARRIER DRAIN
	EXISTING FIN DRAIN
	EXISTING CARRIER DRAIN TO BE BROKEN OUT
	EXISTING FIN DRAIN TO BE BROKEN OUT
	EXISTING FILTER/CARRIER DRAIN
	NEW CARRIER DRAIN
	NEW FIN DRAIN
	NEW FILTER DRAIN
	NEW TRAPPED GULLY
	NEW COMBINED DRAINAGE & KERB SYSTEM CONNECTION
ECP1	EXISTING CATCH PIT CHAMBER
CP1	NEW CATCH PIT CHAMBER
CC1	ATTENUATION CONTROL CHAMBER
HW1	NEW HEADWALL
MH3	NEW CHAMBER ASSOCIATED WITH BACK OF ABUTMENT DRAINAGE. (REFER TO DRAWING 15791/1700/07).
	NEW BOX CULVERT
	COMBINED KERB AND DRAINAGE SYSTEM
	PROPOSED HIGHWAY BOUNDARY
	EXISTING HIGHWAY BOUNDARY

NOTES

1, THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH DRAWING No's 15791/500/01, 02 & 03 AND THE SERIES 500 APPENDICIES.

2, CHAMBER AND HEADWALL CONSTRUCTION DETAILS ARE SPECIFIED IN THE MANHOLE SCHEDULE IN APPENDIX 5/1.

3, THE CONTRACTOR SHALL UNDERTAKE A CCTV SURVEY OF THE EXISTING AND NEW HIGHWAY DRAINAGE AS SPECIFIED IN APPENDIX 5/1 AND AS REFERENCED IN CLAUSE 509.4 BOTH IN ADVANCE AND AFTER THE CONSTRUCTION WORKS.

4, THE CONTRACTOR SHALL CONFIRM THE LAYOUT, INVERT AND COVER LEVELS OF ALL EXISTING HIGHWAY DRAINAGE WITHIN THE VICINITY OF THE WORKS PRIOR TO UNDERTAKING ANY DRAINAGE WORKS. THIS INFORMATION SHALL BE FOWARDED TO THE PROJECT MANAGER AND THE DESIGN ORGANISATION A MINIMUM OF 2 WEEKS IN ADVANCE OF DRAINAGE WORKS COMMENCING.

5, ALL NEW CARRIER DRAINS TO BE INSTALLED IN ACCORDANCE WITH TRENCH AND BEDDING DETAILS SET OUT IN APPENDIX 5/1.

6, NEW 100mmø FIN DRAINS TO BE CONSTRUCTED TO HCD F18 AND F19 TYPE 6, AND AS SPECIFIED IN APPENDIX 5/4.

7, NEW FILTER DRAINS TO BE CONSTRUCTED TO DRAWING 15791/500/08. REFER ALSO TO APPENDIX 5/1.

8, COVER LEVELS AND INVERT LEVELS OF EXISTING CHAMBERS, ECP1, ECP2, ECP3, ECP4, ECP5, ECP6 HAVE BEEN TAKEN FROM SWAN VALLEY M1 JUNCTION 15A ENHANCEMENTS "AS BUILT" DRAINAGE LAYOUT – (DRAWING No. TB/XVA/C-D/011E).

9, COVER LEVELS AND INVERT LEVELS OF EXISTING CHAMBERS, ECP7, ECP8, ECP9, ECP10 & ECP11 HAVE BEEN OBTAINED BY BUCKINGHAM GROUP CONTRACTING LTD.

10, FOR DETAILS OF BOX CULVERT AND ASSOCIATED CONTROL CHAMBERS, REFER TO DRAWING No 15791/500/03.

11, ALL PIPES AND BEDDING HAVE BEEN DESIGNED FOR POST CONSTRUCTION LOADING ONLY IN ACCORDANCE WITH HA 40/01. THE CONTRACTOR SHOULD TAKE DUE ACCOUNT OF CONSTRUCTION LOADING ON THE PIPE AND BEDDING DURING CONSTRUCTION. REFER TO APPENDIX 5/1 FOR DETAILS OF PIPE BEDDING.

12, HEADWALLS HW1, HW3, HW4 AND HW5 TO BE CONCRETE BAG WORK TO CLAUSE 519. REFER TO DRAWING No 15791/2500/01 FOR DETAILS OF HW2.

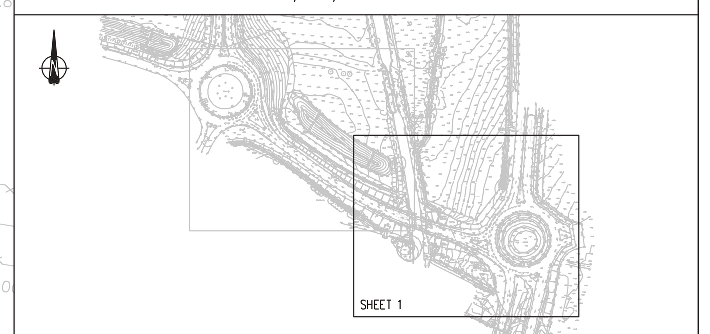
13, REFER TO DRAWING NUMBER 15791/500/07 FOR TRAPPED GULLY AND RODDING EYE DETAIL.

14, FOR DETAILS OF COMBINED KERB AND DRAINAGE SYSTEM, REFER TO DRAWINGS 15791/1100/01 AND 15791/500/07 FOR DETAILS. 185 MINI BEANY BASE UNITS SHALL BE USED EAST OF THE CANAL BRIDGE, AND 285 MINI BEANY BASE UNITS SHALL BE USED WEST OF THE CANAL BRIDGE

15, EARTHWORKS AROUND CP7 TO BE LOCALLY STEEPENED TO ACCOMMODATE CHAMBER COVER AND TO PROVIDE A 1m PLATEAU AROUND THE COVER TO ALLOW SAFE LIFTING OF THE LID. CONTRACTOR SHALL SUBMIT PROPOSALS TO THE DESIGN ORGANISATION AND PROJECT MANAGER FOR APPROVAL A MINIMUM OF TWO WEEKS IN ADVANCE OF THE PROPOSED WORKS.

16, CONTRACTOR TO CONSIDER THE COVER POSITION OF CP6 AND SHALL ENSURE THAT THE COVER AND ITS CONSTRUCTION DOES NOT CLASH WITH THE CONCRETE EDGING – REFER TO DRAWING 15791/1100/01.

17, REFER TO DRAWING No 15791/500/09 FOR DETAILS OF BYPASS SEPARATORS.



SITE LOCATION PLAN SCALE 1:5000

Mark	Revision	Drawn	Date	Chkd
E	REVISED DRAWING ISSUE STATUS	EJC	29/09/08	PJ
D	REVISED DRAWING ISSUE STATUS	EJC	12/12/07	PJ
C	REVISED DRAWING FOLLOWING URS COMMENTS	EJC	24/05/07	PJ
B	BACK OF ABUTMENT DRAINAGE ADDED	EJC	13/04/07	PJ
A	MINOR AMMENDEMENTS TO DRAINAGE LAYOUT	EJC	19/03/07	PJ

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.

UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

Drawing Issue Status

AS BUILT

PINEHAM DUALLING OF M1 J15A/A43 LINK ROAD
HIGHWAY DRAINAGE - GENERAL ARRANGEMENT
SHEET 1 OF 2

Client

PROLOGIS DEVELOPMENTS LTD

Date of 1st Issue: 12/02/07	Drawn by: EJC
A0 Scale: 1:250	Checked by: PJ
Drawing Number: 15791/500/01	Revision: E

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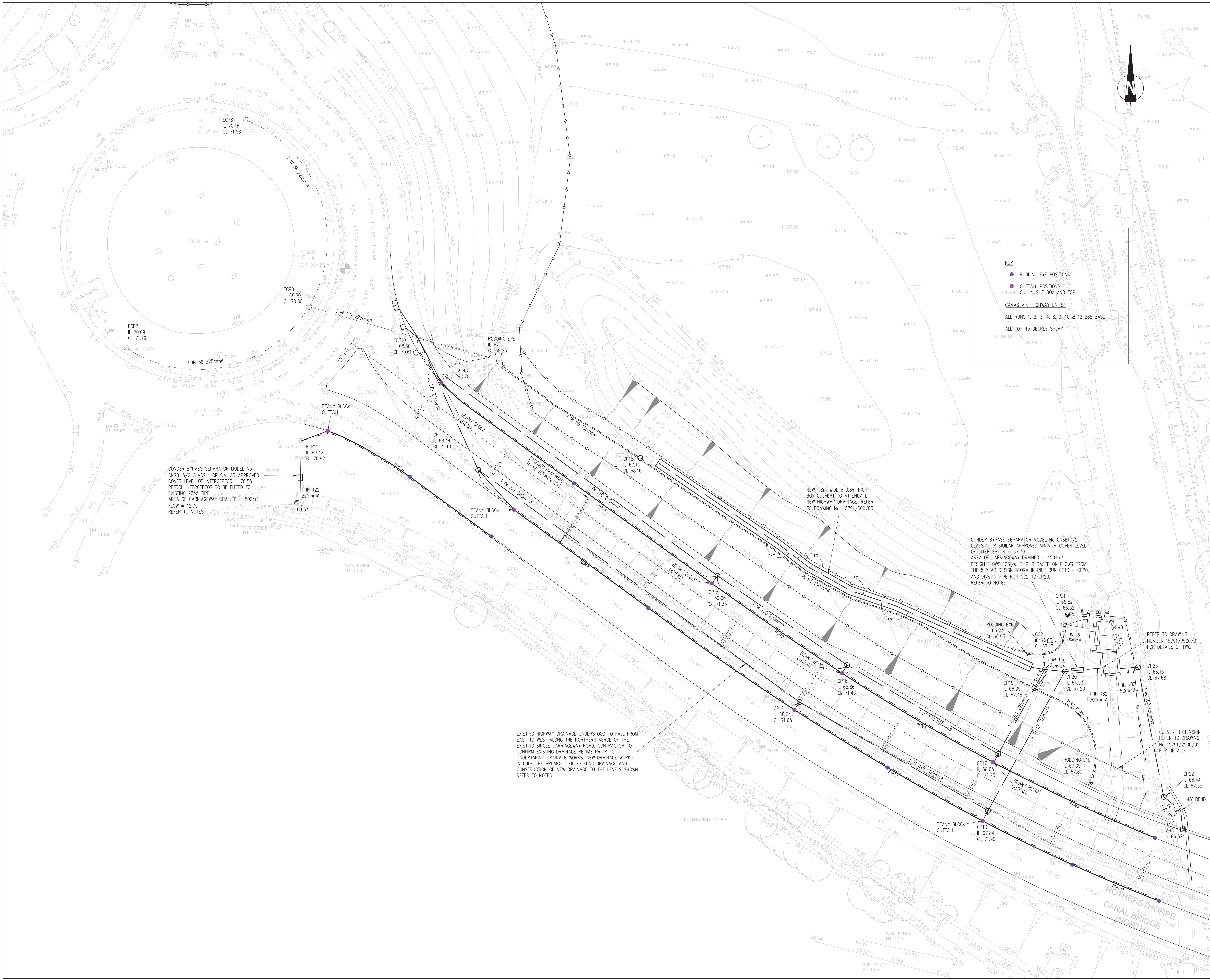

KEY

	EXISTING CARRIER DRAIN
	EXISTING FIN DRAIN
	EXISTING CARRIER DRAIN TO BE BROKEN OUT
	EXISTING FIN DRAIN TO BE BROKEN OUT
	EXISTING FILTER/CARRIER DRAIN
	NEW CARRIER DRAIN
	NEW FIN DRAIN
	NEW FILTER DRAIN
	NEW TRAPPED GULLY
	NEW COMBINED DRAINAGE & KERB SYSTEM CONNECTION
ECP1	EXISTING CATCH PIT CHAMBER
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	NEW BOX CULVERT
	COMBINED KERB AND DRAINAGE SYSTEM
	PROPOSED HIGHWAY BOUNDARY
	EXISTING HIGHWAY BOUNDARY

NOTES

1, THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH DRAWING No's 15791/500/01, 02 & 03 AND THE SERIES 500 APPENDICIES.

2, CHAMBER AND HEADWALL CONSTRUCTION DETAILS ARE SPECIFIED IN THE MANHOLE SCHEDULE IN APPENDIX 5/1.

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6, NEW 100mmø FIN DRAINS TO BE CONSTRUCTED TO HCD F18 AND F19 TYPE 6, AND AS SPECIFIED IN APPENDIX 5/4.

7, NEW FILTER DRAINS TO BE CONSTRUCTED TO DRAWING 15791/500/08. REFER ALSO TO APPENDIX 5/1.

8, COVER LEVELS AND INVERT LEVELS OF EXISTING CHAMBERS, ECP1, ECP2, ECP3, ECP4, ECP5, ECP6 HAVE BEEN TAKEN FROM SWAN VALLEY M1 JUNCTION 15A ENHANCEMENTS "AS BUILT" DRAINAGE LAYOUT - (DRAWING No. TB/XVA/C-D/011E).

9, COVER LEVELS AND INVERT LEVELS OF EXISTING CHAMBERS, ECP7, ECP8, ECP9, ECP10 & ECP11 HAVE BEEN OBTAINED BY BUCKINGHAM GROUP CONTRACTING LTD.

10, FOR DETAILS OF BOX CULVERT AND ASSOCIATED CONTROL CHAMBERS, REFER TO DRAWING No 15791/500/03.

11, ALL PIPES AND BEDDING HAVE BEEN DESIGNED FOR POST CONSTRUCTION LOADING ONLY IN ACCORDANCE WITH HA 40/01. THE CONTRACTOR SHOULD TAKE DUE ACCOUNT OF CONSTRUCTION LOADING ON THE PIPE AND BEDDING DURING CONSTRUCTION. REFER TO APPENDIX 5/1 FOR DETAILS OF PIPE BEDDING.

12, HEADWALLS HW1, HW3, HW4 AND HW5 TO BE CONCRETE BAG WORK TO CLAUSE 519. REFER TO DRAWING No 15791/2500/01 FOR DETAILS OF HW2.

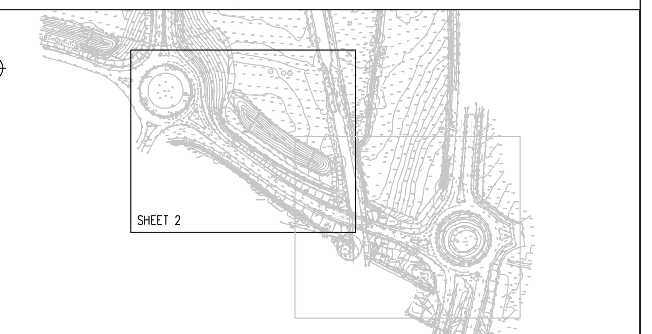
13, REFER TO DRAWING NUMBER 15791/500/07 FOR TRAPPED GULLY AND RODDING EYE DETAIL.

14, FOR DETAILS OF COMBINED KERB AND DRAINAGE SYSTEM, REFER TO DRAWINGS 15791/1100/01 AND 15791/500/07 FOR DETAILS. 185 MINI BEANY BASE UNITS SHALL BE USED EAST OF THE CANAL BRIDGE, AND 285 MINI BEANY BASE UNITS SHALL BE USED WEST OF THE CANAL BRIDGE

15, EARTHWORKS AROUND CP7 TO BE LOCALLY STEEPENED TO ACCOMMODATE CHAMBER COVER AND TO PROVIDE A 1m PLATEAU AROUND THE COVER TO ALLOW SAFE LIFTING OF THE LID. CONTRACTOR SHALL SUBMIT PROPOSALS TO THE DESIGN ORGANISATION AND PROJECT MANAGER FOR APPROVAL A MINIMUM OF TWO WEEKS IN ADVANCE OF THE PROPOSED WORKS.

16, CONTRACTOR TO CONSIDER THE COVER POSITION OF CP6 AND SHALL ENSURE THAT THE COVER AND ITS CONSTRUCTION DOES NOT CLASH WITH THE CONCRETE EDGING - REFER TO DRAWING 15791/1100/01.

17, REFER TO DRAWING No 15791/500/09 FOR DETAILS OF BYPASS SEPARATORS.



SITE LOCATION PLAN SCALE 1:5000

Mark	Revision	Drawn	Date	Chkd
E	REVISED DRAWING ISSUE STATUS	EJC	29/09/08	PJ
D	REVISED DRAWING ISSUE STATUS	EJC	12/12/07	PJ
C	REVISED DRAWING FOLLOWING URS COMMENTS	EJC	24/05/07	PJ
B	BACK OF ABUTMENT DRAINAGE ADDED	EJC	13/04/07	PJ
A	MINOR AMMENDEMENTS TO DRAINAGE LAYOUT	EJC	19/03/07	PJ

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Drawing Issue Status
AS BUILT

PINEHAM DUALLING OF M1 J15A/A43 LINK ROAD HIGHWAY DRAINAGE - GENERAL ARRANGEMENT SHEET 2 OF 2

Client
PROLOGIS DEVELOPMENTS LTD

Date of 1st Issue: 12/02/07	Drawn by: EJC
A0 Scale: 1:250	Checked by: PJ
Drawing Number: 15791/500/02	Revision: E

peterbrett
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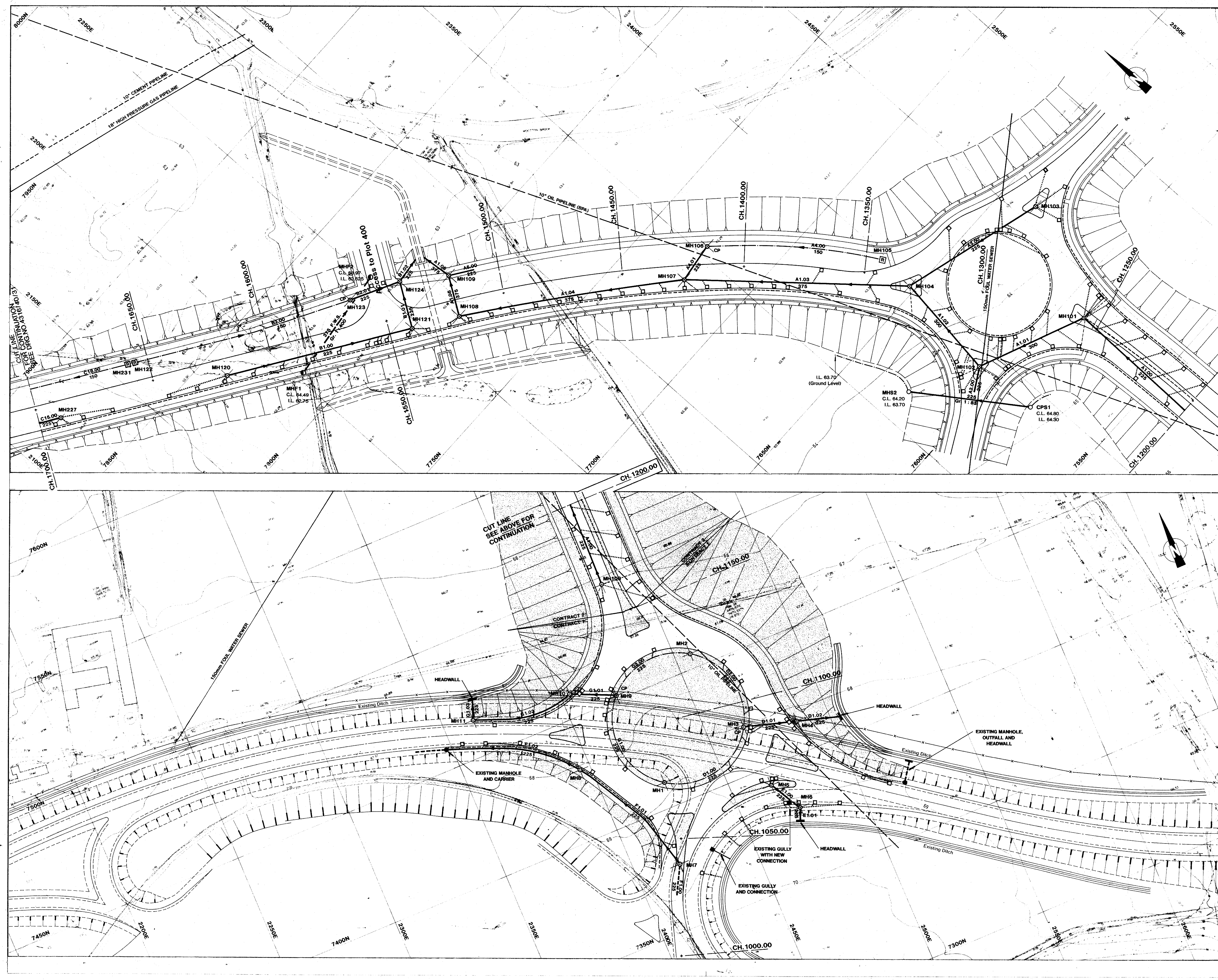


NOTES

1. All Service Ducts are shown on the Service Drawings 4316/46/120 and 121.

KEY

- Existing Manhole
- Manhole
- CP Catchpit
- Gully
- R Rodding Eye
- Existing Carrier Drain
- A1.00 / 375 Carrier Drain with Nom.Dia.in mm
- Narrow Filter Drain
- Fin/Narrow Filter Drain
- Gully Connection
- Foul Manhole

Mark	Revision	checked	Date	Drawn
D	Contract 1/2 boundary and Key for F.W.MH. added.		April 95	JTC.
C	Road drainage and numbering amended. S.104 FOUL DRAINAGE (F1–F2) added		Feb.1995	rhc
B	Fin Drain added, 2 No gully positions altered		Aug 94	jph
A	Fin drain connections amended		June 94	jph

SWAN VALLEY – Northampton
DRAINAGE
SHEET 1 OF 2

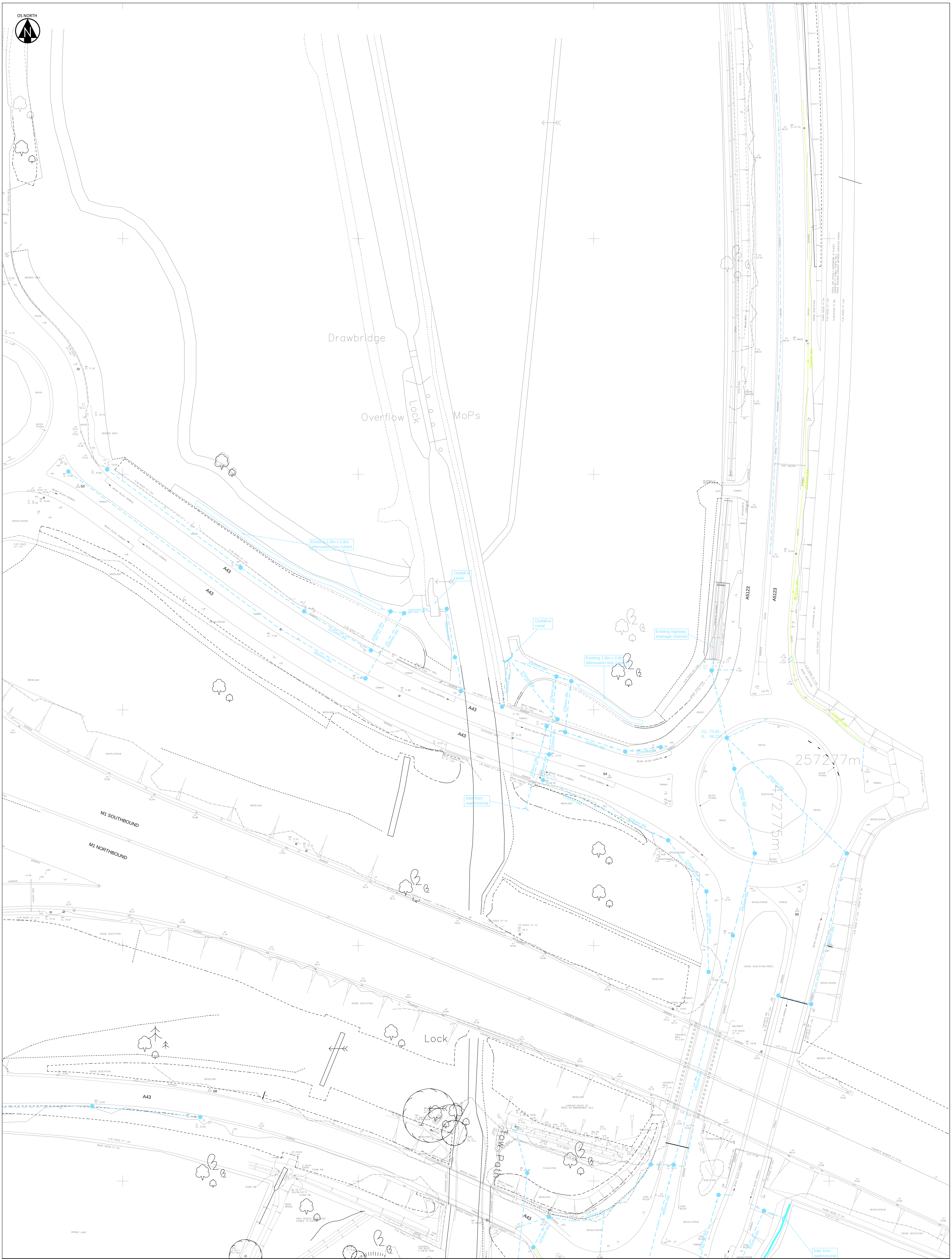
SWAN HILL DEVELOPMENTS

PETER BRETT ASSOCIATES

pba
24 BILLING ROAD NORTHAMPTON NN1 5AT TEL 0604 21270 FAX 0604 21182

Scales	1/500	Drawing No	4316/40/30 D
Date	March 1994	Drawn	rhc
Checked	AF	Passed	AF

MY 291757



KEY

- Existing highway drain
- Existing highway manhole
- Existing highway filter drain
- Existing highway V-ditch

NOTES

NOTES (continued)

KEY PLAN

SHEET 1

SHEET 2

REVISIONS

Rev	Date	Description	By	Ckd	App
A	21/02/18	First Issue.	RJH		

Hydrock
OVER COURT BARNS
OVER LANE
ALMONDSBURY
BRISTOL
BS32 4DF
t: +44 (0) 1454 619533
e: bristol@hydrock.com

CLIENT
ASHFIELD LAND MANAGEMENT LIMITED

PROJECT
RAIL CENTRAL NORTHAMPTONSHIRE

TITLE
M1 JUNCTION 15A
EXISTING HIGHWAY DRAINAGE
(SHEET 1 of 2)

HYDROCK PROJECT NO.	SCALE @ A0
C151171	1 : 500

STATUS DESCRIPTION	STATUS
INFORMATION	S2

DRAWING NO.	REVISION
C151171-C2001	A

KEY

- Existing highway drain
- Existing highway manhole
- Existing highway filter drain
- Existing highway V-ditch

NOTES

NOTES (continued)

KEY PLAN

SHEET 1

SHEET 2

REVISIONS

Rev	Date	Description	By	Ckd	App
A	21/02/18	First Issue.	RJH		

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BRISTOL
BS32 4DF
t: +44 (0) 1454 619533
e: bristol@hydrock.com

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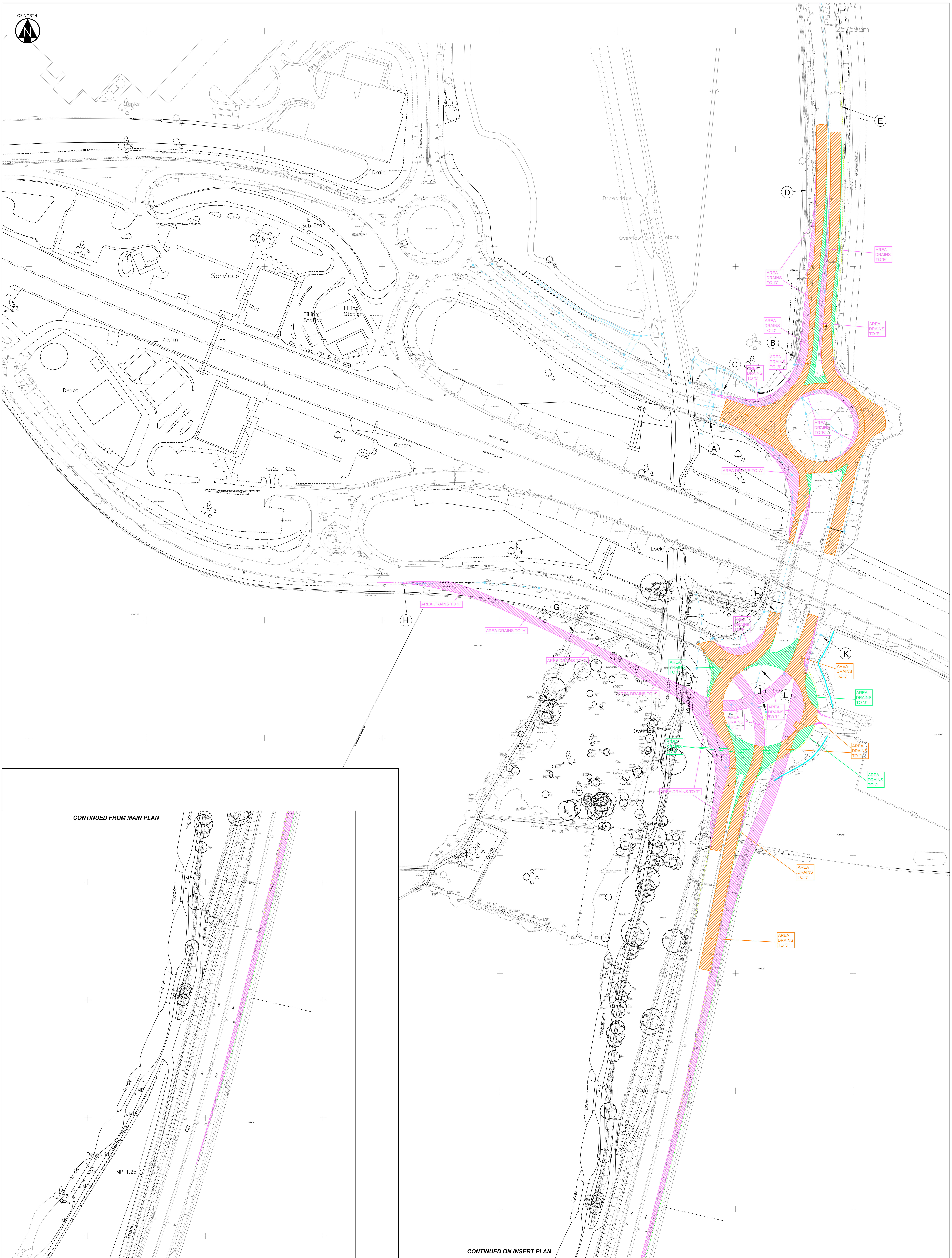
PROJECT
RAIL CENTRAL NORTHAMPTONSHIRE

TITLE
M1 JUNCTION 15A
EXISTING HIGHWAY DRAINAGE
(SHEET 2 of 2)

HYDROCK PROJECT NO.	SCALE @ A0
C151171	1 : 500

STATUS DESCRIPTION	STATUS
INFORMATION	S2

DRAWING NO.	REVISION
C151171-C2002	A



KEY

	Existing impermeable area to be removed
	Existing impermeable areas to be retained
	New impermeable areas to be drained
	Existing highway drain
	Existing highway manhole
	Existing highway filter drain
	Existing highway V-ditch

NOTES

NOTES (continued)

NOTES (continued)

REVISIONS

Rev	Date	Description	By	Ckd	App
A	21/02/18	First Issue.	RJH		

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OVER LANE
ALMONDSBURY
BRISTOL
BS32 4DF
t: +44 (0) 1454 619533
e: bristol@hydrock.com

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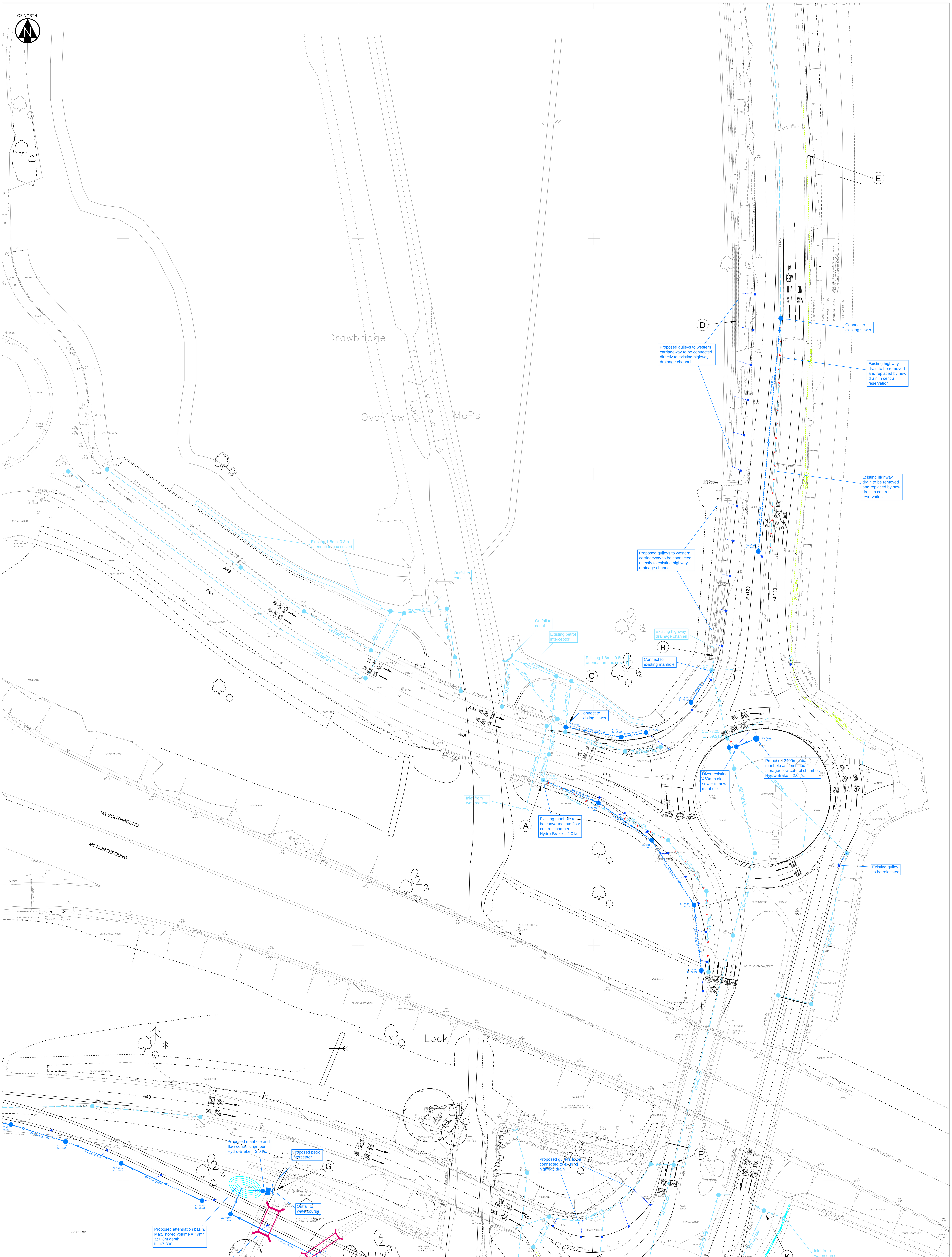
PROJECT
RAIL CENTRAL NORTHAMPTONSHIRE

TITLE
M1 JUNCTION 15A DRAINAGE AREAS

HYDROCK PROJECT NO.	SCALE @ A0
C151171	1 : 1,000

STATUS DESCRIPTION	STATUS
INFORMATION	S2

DRAWING NO.	REVISION
C151171-C2003	A



KEY

- Existing highway drain
- Existing highway manhole
- Existing highway filter drain
- Existing highway V-ditch
- Proposed highway drain
- Proposed combined kerb/channel drain
- Proposed highway filter drain
- Proposed road gulley and connection
- Extent of existing drain to be removed

NOTES

NOTES (continued)

KEY PLAN

SHEET 1

SHEET 2

REVISIONS

Rev	Date	Description	By	Ckd	App
A	21/02/18	First Issue.	RJH		

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ALMONDSBURY
BRISTOL
BS32 4DF
t: +44 (0) 1454 619533
e: bristol@hydrock.com

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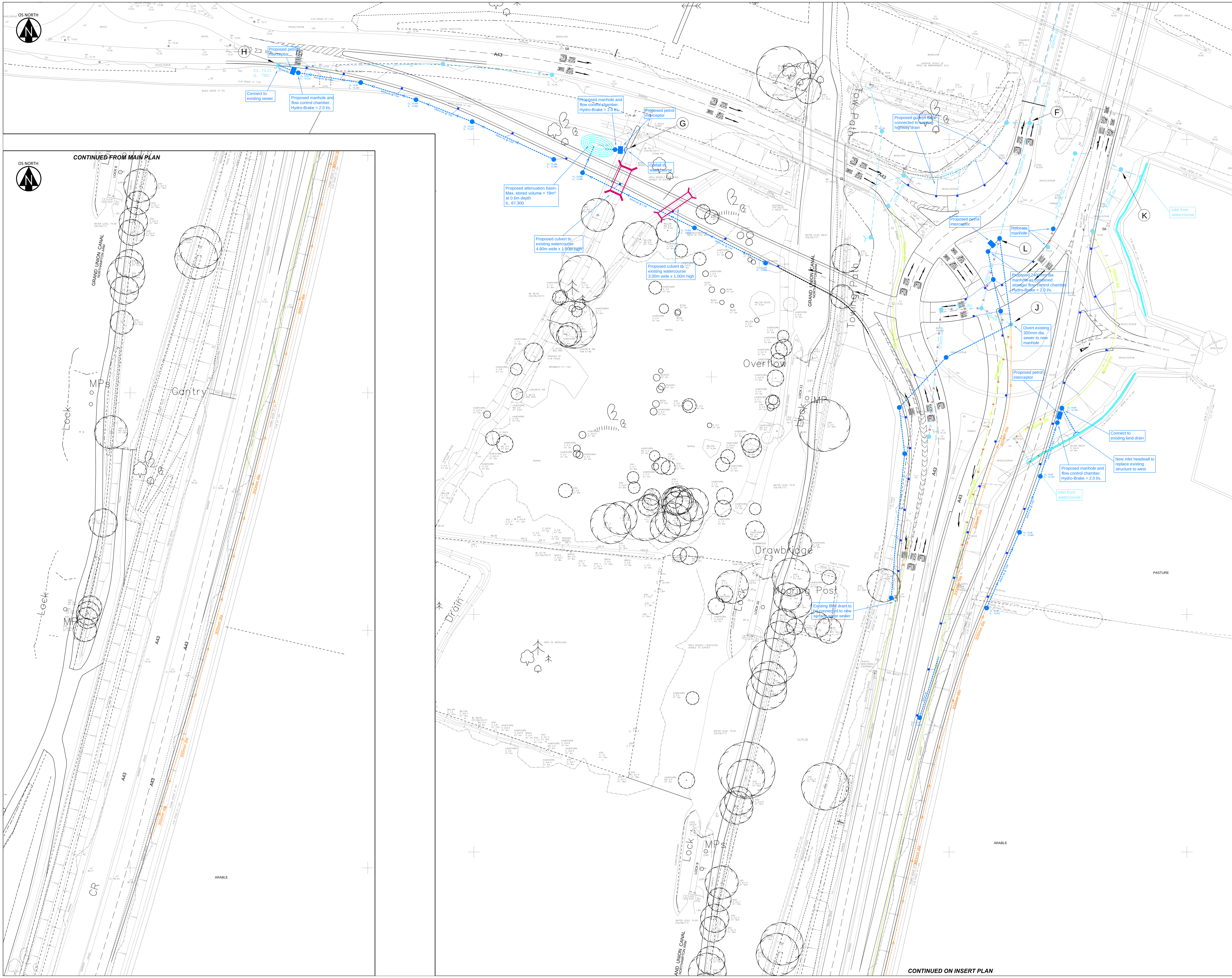
PROJECT
RAIL CENTRAL NORTHAMPTONSHIRE

TITLE
M1 JUNCTION 15A
PROPOSED HIGHWAY DRAINAGE
(SHEET 1 of 2)

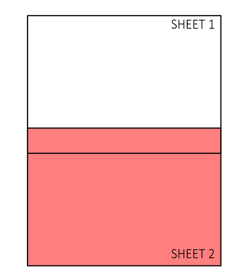
HYDROCK PROJECT NO.	SCALE @ A0
C151171	1 : 500

STATUS DESCRIPTION	STATUS
INFORMATION	S2

DRAWING NO.	REVISION
C151171-C2004	A



KEY PLAN



KEY

- Existing highway drain
- Existing highway manhole
- Existing highway filter drain
- Existing highway V-ditch
- Proposed highway drain
- Proposed combined kerb/channel drain
- Proposed highway filter drain
- Proposed road gulley and connection
- Extent of existing drain to be removed

REVISIONS

Rev	Date	Description	By	Ckd	App
A	21/02/18	First Issue.	RJH		

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BRISTOL
BS32 4DF
t: +44 (0) 1454 619533
e: bristol@hydrock.com

CLIENT
ASHFIELD LAND MANAGEMENT LIMITED

PROJECT
RAIL CENTRAL NORTHAMPTONSHIRE

TITLE
M1 JUNCTION 15A PROPOSED HIGHWAY DRAINAGE (SHEET 2 of 2)

HYDROCK PROJECT NO.	SCALE @ A0
C151171	1 : 500

STATUS DESCRIPTION	STATUS
FOR APPROVAL	S2

DRAWING NO.	REVISION
C151171-C2005	A

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	SAAR (mm)	635	Urban	0.000
Area (ha)	1.000	Soil	0.450	Region Number	Region 5

Results	**l/s**
QBAR Rural	3.9
QBAR Urban	3.9
Q100 years	14.0
Q1 year	3.4
Q30 years	9.4
Q100 years	14.0

Summary of Results for 5 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	71.283	0.493	1.8	18.6	O K
30 min Summer	71.344	0.554	1.8	22.0	O K
60 min Summer	71.403	0.613	1.8	25.1	O K
120 min Summer	71.437	0.647	1.8	26.8	O K
180 min Summer	71.431	0.641	1.8	26.5	O K
240 min Summer	71.421	0.631	1.8	26.0	O K
360 min Summer	71.399	0.609	1.8	25.0	O K
480 min Summer	71.376	0.586	1.8	23.8	O K
600 min Summer	71.349	0.559	1.8	22.3	O K
720 min Summer	71.322	0.532	1.8	20.8	O K
960 min Summer	71.266	0.476	1.8	17.6	O K
1440 min Summer	71.170	0.380	1.8	12.1	O K
2160 min Summer	71.060	0.270	1.8	6.2	O K
2880 min Summer	70.983	0.193	1.7	2.9	O K
4320 min Summer	70.884	0.094	1.5	0.6	O K
5760 min Summer	70.860	0.070	1.2	0.3	O K
7200 min Summer	70.849	0.059	1.0	0.2	O K
8640 min Summer	70.842	0.052	0.9	0.2	O K
10080 min Summer	70.838	0.048	0.8	0.1	O K
15 min Winter	71.328	0.538	1.8	21.2	O K
30 min Winter	71.404	0.614	1.8	25.2	O K
60 min Winter	71.490	0.700	1.8	28.9	O K
120 min Winter	71.595	0.805	1.8	31.2	O K
180 min Winter	71.595	0.805	1.8	31.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	62.143	0.0	21.2	28
30 min Summer	37.727	0.0	25.7	41
60 min Summer	22.904	0.0	31.3	68
120 min Summer	13.905	0.0	38.0	122
180 min Summer	10.384	0.0	42.5	166
240 min Summer	8.442	0.0	46.1	198
360 min Summer	6.304	0.0	51.6	266
480 min Summer	5.125	0.0	56.0	336
600 min Summer	4.364	0.0	59.6	402
720 min Summer	3.827	0.0	62.7	468
960 min Summer	3.094	0.0	67.6	596
1440 min Summer	2.293	0.0	75.1	842
2160 min Summer	1.699	0.0	83.5	1188
2880 min Summer	1.374	0.0	90.0	1512
4320 min Summer	0.995	0.0	97.8	2204
5760 min Summer	0.791	0.0	103.7	2872
7200 min Summer	0.663	0.0	108.5	3672
8640 min Summer	0.573	0.0	112.6	4384
10080 min Summer	0.507	0.0	116.2	5048
15 min Winter	62.143	0.0	23.8	28
30 min Winter	37.727	0.0	28.8	42
60 min Winter	22.904	0.0	35.0	68
120 min Winter	13.905	0.0	42.5	122
180 min Winter	10.384	0.0	47.6	176

Summary of Results for 5 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	71.548	0.758	1.8	30.5	O K
360 min Winter	71.494	0.704	1.8	29.0	O K
480 min Winter	71.448	0.658	1.8	27.3	O K
600 min Winter	71.405	0.615	1.8	25.2	O K
720 min Winter	71.358	0.568	1.8	22.8	O K
960 min Winter	71.260	0.470	1.8	17.3	O K
1440 min Winter	71.113	0.323	1.8	8.9	O K
2160 min Winter	70.963	0.173	1.7	2.2	O K
2880 min Winter	70.884	0.094	1.5	0.6	O K
4320 min Winter	70.854	0.064	1.1	0.2	O K
5760 min Winter	70.842	0.052	0.9	0.2	O K
7200 min Winter	70.836	0.046	0.7	0.1	O K
8640 min Winter	70.832	0.042	0.6	0.1	O K
10080 min Winter	70.829	0.039	0.6	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	8.442	0.0	51.6	208
360 min Winter	6.304	0.0	57.8	282
480 min Winter	5.125	0.0	62.7	360
600 min Winter	4.364	0.0	66.7	438
720 min Winter	3.827	0.0	70.2	514
960 min Winter	3.094	0.0	75.7	640
1440 min Winter	2.293	0.0	84.1	876
2160 min Winter	1.699	0.0	93.5	1176
2880 min Winter	1.374	0.0	100.8	1476
4320 min Winter	0.995	0.0	109.5	2156
5760 min Winter	0.791	0.0	116.1	2936
7200 min Winter	0.663	0.0	121.5	3616
8640 min Winter	0.573	0.0	126.2	4272
10080 min Winter	0.507	0.0	130.2	5008

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.243	Cv (Winter)	0.840
Return Period (years)	5	E (1km)	0.302	Shortest Storm (mins)	15
Site Location		F (1km)	2.496	Longest Storm (mins)	10080
C (1km)	-0.026	Summer Storms	Yes	Climate Change %	+20
D1 (1km)	0.319	Winter Storms	Yes		
D2 (1km)	0.300	Cv (Summer)	0.750		

Time Area Diagram

Total Area (ha) 0.182

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.046	4	8	0.046	8	12	0.045	12	16	0.045

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Model Details

Storage is Online Cover Level (m) 72.700

Pipe Structure

Diameter (m)	0.675	Length (m)	86.000
Slope (1:X)	400.000	Invert Level (m)	70.790

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0064-2000-1200-2000
Design Head (m)	1.200
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	64
Invert Level (m)	70.790
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.200	2.0	Kick-Flo®	0.573	1.4
Flush-Flo™	0.282	1.8	Mean Flow over Head Range	-	1.6

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	1.5	1.200	2.0	3.000	3.0	7.000	4.5
0.200	1.7	1.400	2.1	3.500	3.3	7.500	4.7
0.300	1.8	1.600	2.3	4.000	3.5	8.000	4.8
0.400	1.7	1.800	2.4	4.500	3.7	8.500	5.0
0.500	1.6	2.000	2.5	5.000	3.9	9.000	5.1
0.600	1.5	2.200	2.6	5.500	4.0	9.500	5.2
0.800	1.7	2.400	2.7	6.000	4.2		
1.000	1.8	2.600	2.8	6.500	4.4		

Summary of Results for 5 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	72.294	1.294	1.8	5.8	O K
30 min Summer	72.393	1.393	1.9	6.3	O K
60 min Summer	72.377	1.377	1.9	6.2	O K
120 min Summer	72.278	1.278	1.8	5.8	O K
180 min Summer	72.169	1.169	1.7	5.3	O K
240 min Summer	72.061	1.061	1.7	4.8	O K
360 min Summer	71.863	0.863	1.5	3.9	O K
480 min Summer	71.687	0.687	1.5	3.1	O K
600 min Summer	71.465	0.465	1.5	2.1	O K
720 min Summer	71.309	0.309	1.5	1.4	O K
960 min Summer	71.161	0.161	1.4	0.7	O K
1440 min Summer	71.080	0.080	1.2	0.4	O K
2160 min Summer	71.058	0.058	0.9	0.3	O K
2880 min Summer	71.048	0.048	0.7	0.2	O K
4320 min Summer	71.039	0.039	0.5	0.2	O K
5760 min Summer	71.034	0.034	0.4	0.2	O K
7200 min Summer	71.031	0.031	0.3	0.1	O K
8640 min Summer	71.028	0.028	0.3	0.1	O K
10080 min Summer	71.026	0.026	0.3	0.1	O K
15 min Winter	72.473	1.473	1.9	6.6	O K
30 min Winter	72.606	1.606	2.0	7.2	O K
60 min Winter	72.590	1.590	2.0	7.2	O K
120 min Winter	72.431	1.431	1.9	6.4	O K
180 min Winter	72.253	1.253	1.8	5.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	62.143	0.0	7.3	19
30 min Summer	37.727	0.0	8.9	30
60 min Summer	22.904	0.0	10.8	48
120 min Summer	13.905	0.0	13.1	82
180 min Summer	10.384	0.0	14.7	116
240 min Summer	8.442	0.0	16.0	150
360 min Summer	6.304	0.0	17.9	216
480 min Summer	5.125	0.0	19.4	282
600 min Summer	4.364	0.0	20.6	340
720 min Summer	3.827	0.0	21.7	390
960 min Summer	3.094	0.0	23.4	500
1440 min Summer	2.293	0.0	26.0	734
2160 min Summer	1.699	0.0	28.9	1080
2880 min Summer	1.374	0.0	31.2	1464
4320 min Summer	0.995	0.0	33.8	2180
5760 min Summer	0.791	0.0	35.9	2904
7200 min Summer	0.663	0.0	37.6	3576
8640 min Summer	0.573	0.0	39.0	4336
10080 min Summer	0.507	0.0	40.2	5104
15 min Winter	62.143	0.0	8.2	19
30 min Winter	37.727	0.0	10.0	31
60 min Winter	22.904	0.0	12.1	50
120 min Winter	13.905	0.0	14.7	88
180 min Winter	10.384	0.0	16.5	124

Summary of Results for 5 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	72.085	1.085	1.7	4.9	O K
360 min Winter	71.787	0.787	1.5	3.5	O K
480 min Winter	71.414	0.414	1.5	1.9	O K
600 min Winter	71.206	0.206	1.5	0.9	O K
720 min Winter	71.127	0.127	1.4	0.6	O K
960 min Winter	71.078	0.078	1.2	0.3	O K
1440 min Winter	71.057	0.057	0.9	0.3	O K
2160 min Winter	71.045	0.045	0.6	0.2	O K
2880 min Winter	71.039	0.039	0.5	0.2	O K
4320 min Winter	71.032	0.032	0.4	0.1	O K
5760 min Winter	71.028	0.028	0.3	0.1	O K
7200 min Winter	71.026	0.026	0.3	0.1	O K
8640 min Winter	71.024	0.024	0.2	0.1	O K
10080 min Winter	71.022	0.022	0.2	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	8.442	0.0	17.9	160
360 min Winter	6.304	0.0	20.0	230
480 min Winter	5.125	0.0	21.7	288
600 min Winter	4.364	0.0	23.1	332
720 min Winter	3.827	0.0	24.3	382
960 min Winter	3.094	0.0	26.2	488
1440 min Winter	2.293	0.0	29.1	736
2160 min Winter	1.699	0.0	32.4	1096
2880 min Winter	1.374	0.0	34.9	1468
4320 min Winter	0.995	0.0	37.9	2196
5760 min Winter	0.791	0.0	40.2	2984
7200 min Winter	0.663	0.0	42.1	3568
8640 min Winter	0.573	0.0	43.7	4312
10080 min Winter	0.507	0.0	45.1	5112

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.243	Cv (Winter)	0.840
Return Period (years)	5	E (1km)	0.302	Shortest Storm (mins)	15
Site Location		F (1km)	2.496	Longest Storm (mins)	10080
C (1km)	-0.026	Summer Storms	Yes	Climate Change %	+20
D1 (1km)	0.319	Winter Storms	Yes		
D2 (1km)	0.300	Cv (Summer)	0.750		

Time Area Diagram

Total Area (ha) 0.063

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.031	4	8	0.032

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 73.100

Tank or Pond Structure

Invert Level (m) 71.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4.5	1.400	4.5	2.800	0.0	4.200	0.0
0.200	4.5	1.600	4.5	3.000	0.0	4.400	0.0
0.400	4.5	1.800	4.5	3.200	0.0	4.600	0.0
0.600	4.5	2.000	0.0	3.400	0.0	4.800	0.0
0.800	4.5	2.200	0.0	3.600	0.0	5.000	0.0
1.000	4.5	2.400	0.0	3.800	0.0		
1.200	4.5	2.600	0.0	4.000	0.0		

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0060-2000-1600-2000
Design Head (m)	1.600
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	60
Invert Level (m)	71.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	2.0	Kick-Flo®	0.536	1.2
Flush-Flo™	0.263	1.5	Mean Flow over Head Range	-	1.5

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	1.3	1.200	1.8	3.000	2.7	7.000	4.0
0.200	1.5	1.400	1.9	3.500	2.9	7.500	4.1
0.300	1.5	1.600	2.0	4.000	3.0	8.000	4.2
0.400	1.5	1.800	2.1	4.500	3.2	8.500	4.3
0.500	1.3	2.000	2.2	5.000	3.4	9.000	4.4
0.600	1.3	2.200	2.3	5.500	3.5	9.500	4.6
0.800	1.5	2.400	2.4	6.000	3.7		
1.000	1.6	2.600	2.5	6.500	3.8		

Summary of Results for 5 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	67.668	0.468	2.0	13.2	O K
30 min Summer	67.706	0.506	2.0	15.2	Flood Risk
60 min Summer	67.728	0.528	2.0	16.5	Flood Risk
120 min Summer	67.724	0.524	2.0	16.3	Flood Risk
180 min Summer	67.715	0.515	2.0	15.8	Flood Risk
240 min Summer	67.705	0.505	2.0	15.2	Flood Risk
360 min Summer	67.680	0.480	2.0	13.8	O K
480 min Summer	67.652	0.452	2.0	12.5	O K
600 min Summer	67.622	0.422	2.0	11.0	O K
720 min Summer	67.584	0.384	2.0	9.4	O K
960 min Summer	67.504	0.304	2.0	6.3	O K
1440 min Summer	67.375	0.175	2.0	2.7	O K
2160 min Summer	67.290	0.090	1.8	1.1	O K
2880 min Summer	67.272	0.072	1.5	0.9	O K
4320 min Summer	67.256	0.056	1.1	0.6	O K
5760 min Summer	67.248	0.048	0.9	0.5	O K
7200 min Summer	67.243	0.043	0.7	0.5	O K
8640 min Summer	67.239	0.039	0.6	0.4	O K
10080 min Summer	67.237	0.037	0.6	0.4	O K
15 min Winter	67.702	0.502	2.0	15.0	Flood Risk
30 min Winter	67.744	0.544	2.0	17.4	Flood Risk
60 min Winter	67.772	0.572	2.0	19.1	Flood Risk
120 min Winter	67.770	0.570	2.0	19.0	Flood Risk
180 min Winter	67.758	0.558	2.0	18.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	62.143	0.0	15.4	24
30 min Summer	37.727	0.0	18.7	36
60 min Summer	22.904	0.0	22.7	62
120 min Summer	13.905	0.0	27.5	100
180 min Summer	10.384	0.0	30.8	132
240 min Summer	8.442	0.0	33.4	168
360 min Summer	6.304	0.0	37.4	236
480 min Summer	5.125	0.0	40.6	306
600 min Summer	4.364	0.0	43.2	372
720 min Summer	3.827	0.0	45.5	436
960 min Summer	3.094	0.0	49.0	550
1440 min Summer	2.293	0.0	54.5	768
2160 min Summer	1.699	0.0	60.6	1100
2880 min Summer	1.374	0.0	65.3	1468
4320 min Summer	0.995	0.0	70.9	2160
5760 min Summer	0.791	0.0	75.2	2872
7200 min Summer	0.663	0.0	78.7	3672
8640 min Summer	0.573	0.0	81.7	4304
10080 min Summer	0.507	0.0	84.3	5056
15 min Winter	62.143	0.0	17.2	24
30 min Winter	37.727	0.0	20.9	37
60 min Winter	22.904	0.0	25.4	62
120 min Winter	13.905	0.0	30.8	106
180 min Winter	10.384	0.0	34.5	142

Summary of Results for 5 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	67.742	0.542	2.0	17.3	Flood Risk
360 min Winter	67.704	0.504	2.0	15.1	Flood Risk
480 min Winter	67.660	0.460	2.0	12.8	O K
600 min Winter	67.608	0.408	2.0	10.4	O K
720 min Winter	67.538	0.338	2.0	7.5	O K
960 min Winter	67.408	0.208	2.0	3.5	O K
1440 min Winter	67.288	0.088	1.8	1.1	O K
2160 min Winter	67.265	0.065	1.3	0.8	O K
2880 min Winter	67.256	0.056	1.1	0.6	O K
4320 min Winter	67.245	0.045	0.8	0.5	O K
5760 min Winter	67.239	0.039	0.6	0.4	O K
7200 min Winter	67.236	0.036	0.5	0.4	O K
8640 min Winter	67.233	0.033	0.5	0.3	O K
10080 min Winter	67.231	0.031	0.4	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	8.442	0.0	37.4	182
360 min Winter	6.304	0.0	41.9	256
480 min Winter	5.125	0.0	45.5	330
600 min Winter	4.364	0.0	48.4	402
720 min Winter	3.827	0.0	50.9	456
960 min Winter	3.094	0.0	54.9	556
1440 min Winter	2.293	0.0	61.0	740
2160 min Winter	1.699	0.0	67.8	1080
2880 min Winter	1.374	0.0	73.1	1472
4320 min Winter	0.995	0.0	79.4	2160
5760 min Winter	0.791	0.0	84.2	2888
7200 min Winter	0.663	0.0	88.2	3656
8640 min Winter	0.573	0.0	91.5	4344
10080 min Winter	0.507	0.0	94.4	4984

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.243	Cv (Winter)	0.840
Return Period (years)	5	E (1km)	0.302	Shortest Storm (mins)	15
Site Location		F (1km)	2.496	Longest Storm (mins)	10080
C (1km)	-0.026	Summer Storms	Yes	Climate Change %	+20
D1 (1km)	0.319	Winter Storms	Yes		
D2 (1km)	0.300	Cv (Summer)	0.750		

Time Area Diagram

Total Area (ha) 0.132

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.044	4	8	0.044	8	12	0.044

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 68.000

Tank or Pond Structure

Invert Level (m) 67.200

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	9.7	1.400	93.5	2.800	93.5	4.200	93.5
0.200	24.6	1.600	93.5	3.000	93.5	4.400	93.5
0.400	43.5	1.800	93.5	3.200	93.5	4.600	93.5
0.600	66.5	2.000	93.5	3.400	93.5	4.800	93.5
0.800	93.5	2.200	93.5	3.600	93.5	5.000	93.5
1.000	93.5	2.400	93.5	3.800	93.5		
1.200	93.5	2.600	93.5	4.000	93.5		

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0073-2000-0600-2000
Design Head (m)	0.600
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	73
Invert Level (m)	67.200
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	2.0	Kick-Flo®	0.397	1.7
Flush-Flo™	0.177	2.0	Mean Flow over Head Range	-	1.7

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	1.9	1.200	2.7	3.000	4.2	7.000	6.3
0.200	2.0	1.400	2.9	3.500	4.5	7.500	6.5
0.300	1.9	1.600	3.1	4.000	4.8	8.000	6.7
0.400	1.7	1.800	3.3	4.500	5.1	8.500	6.9
0.500	1.8	2.000	3.5	5.000	5.3	9.000	7.1
0.600	2.0	2.200	3.6	5.500	5.6	9.500	7.3
0.800	2.3	2.400	3.8	6.000	5.8		
1.000	2.5	2.600	3.9	6.500	6.0		

Summary of Results for 5 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	71.493	0.593	2.0	7.1	O K
30 min Summer	71.554	0.654	2.0	7.9	O K
60 min Summer	71.556	0.656	2.0	7.9	O K
120 min Summer	71.515	0.615	2.0	7.4	O K
180 min Summer	71.468	0.568	2.0	6.7	O K
240 min Summer	71.416	0.516	2.0	6.0	O K
360 min Summer	71.301	0.401	2.0	4.3	O K
480 min Summer	71.211	0.311	2.0	3.0	O K
600 min Summer	71.140	0.240	2.0	2.1	O K
720 min Summer	71.087	0.187	2.0	1.5	O K
960 min Summer	71.019	0.119	1.8	0.7	O K
1440 min Summer	70.977	0.077	1.5	0.4	O K
2160 min Summer	70.959	0.059	1.1	0.2	O K
2880 min Summer	70.950	0.050	0.9	0.2	O K
4320 min Summer	70.941	0.041	0.6	0.1	O K
5760 min Summer	70.936	0.036	0.5	0.1	O K
7200 min Summer	70.933	0.033	0.4	0.1	O K
8640 min Summer	70.930	0.030	0.4	0.1	O K
10080 min Summer	70.928	0.028	0.3	0.1	O K
15 min Winter	71.571	0.671	2.0	8.1	O K
30 min Winter	71.652	0.752	2.0	9.1	O K
60 min Winter	71.665	0.765	2.0	9.3	O K
120 min Winter	71.593	0.693	2.0	8.4	O K
180 min Winter	71.513	0.613	2.0	7.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	62.143	0.0	9.2	22
30 min Summer	37.727	0.0	11.2	34
60 min Summer	22.904	0.0	13.6	54
120 min Summer	13.905	0.0	16.5	88
180 min Summer	10.384	0.0	18.5	122
240 min Summer	8.442	0.0	20.0	158
360 min Summer	6.304	0.0	22.4	218
480 min Summer	5.125	0.0	24.3	276
600 min Summer	4.364	0.0	25.9	332
720 min Summer	3.827	0.0	27.2	388
960 min Summer	3.094	0.0	29.3	500
1440 min Summer	2.293	0.0	32.6	736
2160 min Summer	1.699	0.0	36.2	1096
2880 min Summer	1.374	0.0	39.1	1456
4320 min Summer	0.995	0.0	42.4	2148
5760 min Summer	0.791	0.0	45.0	2920
7200 min Summer	0.663	0.0	47.1	3560
8640 min Summer	0.573	0.0	48.9	4384
10080 min Summer	0.507	0.0	50.5	5040
15 min Winter	62.143	0.0	10.3	23
30 min Winter	37.727	0.0	12.5	34
60 min Winter	22.904	0.0	15.2	56
120 min Winter	13.905	0.0	18.5	94
180 min Winter	10.384	0.0	20.7	132

Summary of Results for 5 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	71.428	0.528	2.0	6.2	O K
360 min Winter	71.243	0.343	2.0	3.5	O K
480 min Winter	71.117	0.217	2.0	1.8	O K
600 min Winter	71.039	0.139	1.9	0.9	O K
720 min Winter	70.997	0.097	1.7	0.5	O K
960 min Winter	70.975	0.075	1.4	0.4	O K
1440 min Winter	70.957	0.057	1.1	0.2	O K
2160 min Winter	70.947	0.047	0.8	0.2	O K
2880 min Winter	70.941	0.041	0.6	0.1	O K
4320 min Winter	70.934	0.034	0.5	0.1	O K
5760 min Winter	70.930	0.030	0.4	0.1	O K
7200 min Winter	70.927	0.027	0.3	0.1	O K
8640 min Winter	70.925	0.025	0.3	0.1	O K
10080 min Winter	70.924	0.024	0.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	8.442	0.0	22.4	170
360 min Winter	6.304	0.0	25.1	228
480 min Winter	5.125	0.0	27.2	280
600 min Winter	4.364	0.0	29.0	330
720 min Winter	3.827	0.0	30.5	380
960 min Winter	3.094	0.0	32.9	492
1440 min Winter	2.293	0.0	36.5	718
2160 min Winter	1.699	0.0	40.6	1092
2880 min Winter	1.374	0.0	43.8	1460
4320 min Winter	0.995	0.0	47.5	2164
5760 min Winter	0.791	0.0	50.4	2840
7200 min Winter	0.663	0.0	52.8	3584
8640 min Winter	0.573	0.0	54.8	4480
10080 min Winter	0.507	0.0	56.5	4872

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.243	Cv (Winter)	0.840
Return Period (years)	5	E (1km)	0.302	Shortest Storm (mins)	15
Site Location		F (1km)	2.496	Longest Storm (mins)	10080
C (1km)	-0.026	Summer Storms	Yes	Climate Change %	+20
D1 (1km)	0.319	Winter Storms	Yes		
D2 (1km)	0.300	Cv (Summer)	0.750		

Time Area Diagram

Total Area (ha) 0.079

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.026	4	8	0.026	8	12	0.027

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Model Details

Storage is Online Cover Level (m) 73.000

Pipe Structure

Diameter (m)	0.900	Length (m)	15.000
Slope (1:X)	500.000	Invert Level (m)	70.900

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0070-2000-0800-2000
Design Head (m)	0.800
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	70.900
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.800	2.0	Kick-Flo®	0.504	1.6
Flush-Flo™	0.240	2.0	Mean Flow over Head Range	-	1.7

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	1.8	1.200	2.4	3.000	3.7	7.000	5.5
0.200	2.0	1.400	2.6	3.500	3.9	7.500	5.6
0.300	2.0	1.600	2.7	4.000	4.2	8.000	5.8
0.400	1.9	1.800	2.9	4.500	4.4	8.500	6.0
0.500	1.6	2.000	3.0	5.000	4.7	9.000	6.2
0.600	1.8	2.200	3.2	5.500	4.9	9.500	6.3
0.800	2.0	2.400	3.3	6.000	5.1		
1.000	2.2	2.600	3.4	6.500	5.3		

Summary of Results for 5 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	73.092	0.592	2.0	31.9	O K
30 min Summer	73.172	0.672	2.0	37.9	O K
60 min Summer	73.256	0.756	2.0	43.9	O K
120 min Summer	73.327	0.827	2.0	48.4	O K
180 min Summer	73.345	0.845	2.0	49.3	O K
240 min Summer	73.339	0.839	2.0	49.0	O K
360 min Summer	73.323	0.823	2.0	48.1	O K
480 min Summer	73.307	0.807	2.0	47.1	O K
600 min Summer	73.290	0.790	2.0	46.1	O K
720 min Summer	73.272	0.772	2.0	44.9	O K
960 min Summer	73.229	0.729	2.0	42.1	O K
1440 min Summer	73.148	0.648	2.0	36.2	O K
2160 min Summer	73.032	0.532	2.0	27.3	O K
2880 min Summer	72.900	0.400	2.0	17.3	O K
4320 min Summer	72.720	0.220	2.0	5.5	O K
5760 min Summer	72.627	0.127	1.9	1.5	O K
7200 min Summer	72.586	0.086	1.6	0.6	O K
8640 min Summer	72.573	0.073	1.4	0.4	O K
10080 min Summer	72.565	0.065	1.2	0.3	O K
15 min Winter	73.147	0.647	2.0	36.1	O K
30 min Winter	73.243	0.743	2.0	43.0	O K
60 min Winter	73.357	0.857	2.1	50.0	O K
120 min Winter	74.034	1.534	2.7	55.6	O K
180 min Winter	74.592	2.092	3.1	56.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	62.143	0.0	34.8	29
30 min Summer	37.727	0.0	42.3	42
60 min Summer	22.904	0.0	51.4	70
120 min Summer	13.905	0.0	62.4	126
180 min Summer	10.384	0.0	69.9	182
240 min Summer	8.442	0.0	75.7	216
360 min Summer	6.304	0.0	84.8	282
480 min Summer	5.125	0.0	91.9	348
600 min Summer	4.364	0.0	97.9	418
720 min Summer	3.827	0.0	103.0	488
960 min Summer	3.094	0.0	111.0	628
1440 min Summer	2.293	0.0	123.4	904
2160 min Summer	1.699	0.0	137.2	1308
2880 min Summer	1.374	0.0	147.9	1648
4320 min Summer	0.995	0.0	160.6	2296
5760 min Summer	0.791	0.0	170.4	2944
7200 min Summer	0.663	0.0	178.3	3672
8640 min Summer	0.573	0.0	185.0	4328
10080 min Summer	0.507	0.0	191.0	5040
15 min Winter	62.143	0.0	39.0	29
30 min Winter	37.727	0.0	47.4	42
60 min Winter	22.904	0.0	57.5	70
120 min Winter	13.905	0.0	69.8	122
180 min Winter	10.384	0.0	78.2	170

Summary of Results for 5 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	74.566	2.066	3.1	56.1	Flood Risk
360 min Winter	74.126	1.626	2.8	55.7	O K
480 min Winter	73.501	1.001	2.2	54.8	O K
600 min Winter	73.428	0.928	2.1	53.1	O K
720 min Winter	73.382	0.882	2.1	51.3	O K
960 min Winter	73.300	0.800	2.0	46.7	O K
1440 min Winter	73.165	0.665	2.0	37.4	O K
2160 min Winter	72.956	0.456	2.0	21.5	O K
2880 min Winter	72.777	0.277	2.0	8.9	O K
4320 min Winter	72.597	0.097	1.7	0.8	O K
5760 min Winter	72.573	0.073	1.4	0.4	O K
7200 min Winter	72.562	0.062	1.2	0.3	O K
8640 min Winter	72.555	0.055	1.0	0.2	O K
10080 min Winter	72.551	0.051	0.9	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	8.442	0.0	84.8	196
360 min Winter	6.304	0.0	95.0	278
480 min Winter	5.125	0.0	103.0	370
600 min Winter	4.364	0.0	109.6	448
720 min Winter	3.827	0.0	115.4	526
960 min Winter	3.094	0.0	124.3	678
1440 min Winter	2.293	0.0	138.2	974
2160 min Winter	1.699	0.0	153.7	1372
2880 min Winter	1.374	0.0	165.6	1668
4320 min Winter	0.995	0.0	179.9	2208
5760 min Winter	0.791	0.0	190.8	2928
7200 min Winter	0.663	0.0	199.7	3648
8640 min Winter	0.573	0.0	207.3	4384
10080 min Winter	0.507	0.0	213.9	5016

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.243	Cv (Winter)	0.840
Return Period (years)	5	E (1km)	0.302	Shortest Storm (mins)	15
Site Location		F (1km)	2.496	Longest Storm (mins)	10080
C (1km)	-0.026	Summer Storms	Yes	Climate Change %	+20
D1 (1km)	0.319	Winter Storms	Yes		
D2 (1km)	0.300	Cv (Summer)	0.750		

Time Area Diagram

Total Area (ha) 0.299

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.075	4	8	0.075	8	12	0.075	12	16	0.074

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Model Details

Storage is Online Cover Level (m) 74.600

Pipe Structure

Diameter (m)	0.900	Length (m)	85.000
Slope (1:X)	500.000	Invert Level (m)	72.500

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0070-2000-0800-2000
Design Head (m)	0.800
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	72.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.800	2.0	Kick-Flo®	0.504	1.6
Flush-Flo™	0.240	2.0	Mean Flow over Head Range	-	1.7

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	1.8	1.200	2.4	3.000	3.7	7.000	5.5
0.200	2.0	1.400	2.6	3.500	3.9	7.500	5.6
0.300	2.0	1.600	2.7	4.000	4.2	8.000	5.8
0.400	1.9	1.800	2.9	4.500	4.4	8.500	6.0
0.500	1.6	2.000	3.0	5.000	4.7	9.000	6.2
0.600	1.8	2.200	3.2	5.500	4.9	9.500	6.3
0.800	2.0	2.400	3.3	6.000	5.1		
1.000	2.2	2.600	3.4	6.500	5.3		

Summary of Results for 5 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	71.753	1.753	2.1	10.0	O K
30 min Summer	71.958	1.958	2.2	11.2	O K
60 min Summer	72.023	2.023	2.2	11.5	O K
120 min Summer	71.968	1.968	2.2	11.2	O K
180 min Summer	71.880	1.880	2.1	10.7	O K
240 min Summer	71.787	1.787	2.1	10.2	O K
360 min Summer	71.601	1.601	2.0	9.1	O K
480 min Summer	71.426	1.426	1.9	8.1	O K
600 min Summer	71.268	1.268	1.8	7.2	O K
720 min Summer	71.126	1.126	1.7	6.4	O K
960 min Summer	70.874	0.874	1.5	5.0	O K
1440 min Summer	70.356	0.356	1.5	2.0	O K
2160 min Summer	70.121	0.121	1.4	0.7	O K
2880 min Summer	70.076	0.076	1.1	0.4	O K
4320 min Summer	70.055	0.055	0.8	0.3	O K
5760 min Summer	70.046	0.046	0.7	0.3	O K
7200 min Summer	70.041	0.041	0.6	0.2	O K
8640 min Summer	70.037	0.037	0.5	0.2	O K
10080 min Summer	70.035	0.035	0.4	0.2	O K
15 min Winter	71.987	1.987	2.2	11.3	O K
30 min Winter	72.240	2.240	2.3	12.8	O K
60 min Winter	72.341	2.341	2.4	13.3	O K
120 min Winter	72.260	2.260	2.3	12.9	O K
180 min Winter	72.111	2.111	2.3	12.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	62.143	0.0	11.8	20
30 min Summer	37.727	0.0	14.3	32
60 min Summer	22.904	0.0	17.3	52
120 min Summer	13.905	0.0	21.1	86
180 min Summer	10.384	0.0	23.6	120
240 min Summer	8.442	0.0	25.6	156
360 min Summer	6.304	0.0	28.7	222
480 min Summer	5.125	0.0	31.1	288
600 min Summer	4.364	0.0	33.1	354
720 min Summer	3.827	0.0	34.8	416
960 min Summer	3.094	0.0	37.5	544
1440 min Summer	2.293	0.0	41.7	770
2160 min Summer	1.699	0.0	46.3	1104
2880 min Summer	1.374	0.0	50.0	1468
4320 min Summer	0.995	0.0	54.3	2188
5760 min Summer	0.791	0.0	57.5	2848
7200 min Summer	0.663	0.0	60.2	3672
8640 min Summer	0.573	0.0	62.5	4296
10080 min Summer	0.507	0.0	64.5	5088
15 min Winter	62.143	0.0	13.2	20
30 min Winter	37.727	0.0	16.0	32
60 min Winter	22.904	0.0	19.4	56
120 min Winter	13.905	0.0	23.6	92
180 min Winter	10.384	0.0	26.4	130

Summary of Results for 5 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	71.956	1.956	2.2	11.1	O K
360 min Winter	71.662	1.662	2.0	9.5	O K
480 min Winter	71.404	1.404	1.9	8.0	O K
600 min Winter	71.182	1.182	1.7	6.7	O K
720 min Winter	70.988	0.988	1.6	5.6	O K
960 min Winter	70.596	0.596	1.5	3.4	O K
1440 min Winter	70.115	0.115	1.3	0.7	O K
2160 min Winter	70.067	0.067	1.0	0.4	O K
2880 min Winter	70.055	0.055	0.8	0.3	O K
4320 min Winter	70.043	0.043	0.6	0.2	O K
5760 min Winter	70.037	0.037	0.5	0.2	O K
7200 min Winter	70.033	0.033	0.4	0.2	O K
8640 min Winter	70.031	0.031	0.3	0.2	O K
10080 min Winter	70.029	0.029	0.3	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	8.442	0.0	28.6	166
360 min Winter	6.304	0.0	32.1	236
480 min Winter	5.125	0.0	34.8	306
600 min Winter	4.364	0.0	37.0	372
720 min Winter	3.827	0.0	39.0	440
960 min Winter	3.094	0.0	42.0	588
1440 min Winter	2.293	0.0	46.7	748
2160 min Winter	1.699	0.0	51.9	1096
2880 min Winter	1.374	0.0	55.9	1464
4320 min Winter	0.995	0.0	60.8	2152
5760 min Winter	0.791	0.0	64.4	2832
7200 min Winter	0.663	0.0	67.4	3640
8640 min Winter	0.573	0.0	70.0	4288
10080 min Winter	0.507	0.0	72.2	4984

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.243	Cv (Winter)	0.840
Return Period (years)	5	E (1km)	0.302	Shortest Storm (mins)	15
Site Location		F (1km)	2.496	Longest Storm (mins)	10080
C (1km)	-0.026	Summer Storms	Yes	Climate Change %	+20
D1 (1km)	0.319	Winter Storms	Yes		
D2 (1km)	0.300	Cv (Summer)	0.750		

Time Area Diagram

Total Area (ha) 0.101

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.050	4	8	0.051

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 73.200

Tank or Pond Structure

Invert Level (m) 70.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	5.7	1.400	5.7	2.800	5.7	4.200	5.7
0.200	5.7	1.600	5.7	3.000	5.7	4.400	5.7
0.400	5.7	1.800	5.7	3.200	5.7	4.600	5.7
0.600	5.7	2.000	5.7	3.400	5.7	4.800	5.7
0.800	5.7	2.200	5.7	3.600	5.7	5.000	5.7
1.000	5.7	2.400	5.7	3.800	5.7		
1.200	5.7	2.600	5.7	4.000	5.7		

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0060-2000-1600-2000
Design Head (m)	1.600
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	60
Invert Level (m)	70.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	2.0	Kick-Flo®	0.536	1.2
Flush-Flo™	0.263	1.5	Mean Flow over Head Range	-	1.5

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	1.3	1.200	1.8	3.000	2.7	7.000	4.0
0.200	1.5	1.400	1.9	3.500	2.9	7.500	4.1
0.300	1.5	1.600	2.0	4.000	3.0	8.000	4.2
0.400	1.5	1.800	2.1	4.500	3.2	8.500	4.3
0.500	1.3	2.000	2.2	5.000	3.4	9.000	4.4
0.600	1.3	2.200	2.3	5.500	3.5	9.500	4.6
0.800	1.5	2.400	2.4	6.000	3.7		
1.000	1.6	2.600	2.5	6.500	3.8		