Consulting Civil, Structural & Geo-Environmental Engineers

Flood Risk Assessment

Site Address:

Residential Development
Dodworth Road
Barnsley

Paul Waite Associates Ltd
Summit House
Riparian Way
The Crossing
Cross Hills
BD20 7BW

info@pwaite.co.uk
www.pwaite.co.uk

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Summary Report Status Details

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STATUS:	*FINAL*	*27 August 2010*

Paul Waite Associates were instructed by Bellway Homes to provide a Drainage Impact and Flood Risk Assessment to support a planning application for a residential development off Dodworth Road in Barnsley.

Clients Details

Bellway Homes Ltd
2 Deighton Close
Wetherby
West Yorkshire
LS22 7GZ

Documents Revision Status

ISSUE:	***DATE***	***COMMENTS***
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Contents

Tables

Figures

Appendices

Executive Summary

Paul Waite Associates has been commissioned to undertake a Flood Risk and Drainage Impact Assessment in accordance with PPS25 to support a planning application involving the redevelopment of the former Polar Ford site located off Dodworth Road in Barnsley, to provide residential development.

Proposals for the development involve the construction of 59No residential units.

The site is approximately 1.6 Hectares in size and previously comprised commercial development.

The development sites are situated within Flood Zone 1 of the Environment Agency Flood Map (version 2.8.2), being the zone with risk of less than 1 in 1,000 year (<0.1% AEP) for river flooding or tidal/coastal flooding.

The primary flood risk to the former Polar Ford site at the Dodworth Road site has been identified as surface water flooding.

The sewer record plans obtained from Yorkshire Water along with a survey of the existing drainage indicate that former development was positively drained, with the foul and some surface water flows being directed to an outfall into the public sewer network within Dodworth Road.

A second outfall has been identified which allows discharge of surface water from the site to an existing 675mm diameter public surface water sewer, which discharges to a pond/local watercourse situated adjacent to the north boundary of the site.
The proposed drainage strategy for the development involves the maintenance of suitable outfalls to the into the existing public sewer network.

As such, surface water runoff from the development will need to be managed to minimise any impact on the development and the surrounding environment.

Using the Modified Rational Method, a summary table indicating the storage volumes for the 1 in 2 year, 30 year, 100 year and 100 year plus 20% climate change events at both Easel 1 and Easel 2 is provided below:

Summary Table: Indicative Balance Volumes

Return Period	Outfall 1 – 300mm diameter combined sewer (m^3)	Outfall 2 – 675mm diameter surface water sewer (m^3)
1 in 2 year	0	0
1 in 30 year	74	4
1 in 100 year	144	29
1 in 100 year + 30% climate change	215	66

Yorkshire Water and Barnsley MBC usually requires that surface water runoff is controlled as near to its source as possible, through a sustainable drainage approach to surface water management (SUDS).

Therefore it is recommended that the adoptable drainage strategy for the site incorporates attenuation in the form of large diameter pipework at both sites. Flow into the existing public sewer is to be controlled via Hydrobrake or similar flow control device.

It is concluded that there is a low risk of flooding at the Polar Ford site and implementation of mitigation measures as described within this report will ensure that any risk of flooding at the proposed development sites may be reduced to an acceptable level.

1.0 Introduction

Paul Waite Associates has been commissioned to undertake a Flood Risk and Drainage Impact Assessment in accordance with PPS25 to support a planning application planning application involving the redevelopment of the former Polar Ford site located off Dodworth Road in Barnsley.

The proposed development covers an area approximating 1.6 Hectares.

Proposals for the site involve the provision of 59No new residential dwellings.

The development is situated within Flood Zone 1 of the Environment Agency Flood Map (version 2.8.2), being the zone with risk of less than 1 in 1,000 year (<0.1% AEP) for river flooding or tidal/coastal flooding.

The primary source of flood risk to the proposed development site has been identified to be from surface water runoff from the development, however other sources of flooding have been considered within this assessment.

The existing development previously accommodated commercial development in the form of a used car sales facility, known as Polar Ford, and comprised 2No large commercial buildings. The area surrounding the buildings was predominantly paved to provide car parking.

It is usual for the Environment Agency to raise an objection to development applications within the functional floodplain or Zone 2 or 3 of the flood map until the question of flood risk has been properly evaluated. The Agency will also object to developments where the total site area is in excess of 1 Hectare until suitable consideration has been given to surface water runoff.

2.0 Approach to the Flood Risk Assessment

2.1 Approach

A topographical survey of the site was carried out by Latitude Surveys in May 2010. The survey has been orientated to OSNG (Ordnance Survey National Grid), with positions fixed by GPS Active Network to OS projection. Survey levels have been calibrated to OSGM02, and therefore the resulting site levels have been used within this report.

The requirements for flood risk assessments are generally as set out in Annex E of PPS25. The detail and complexity of the study required should be appropriate to the scale and potential impact of the development. For the purposes of this study, the following have been considered:-

- Available information on historical flooding in the area.
- Site level information.
- Details of structures, which may influence hydraulics of the watercourse and consideration of the effect of blockage of structures.
- Estimates of design levels, equivalent to a 200-year (coastal/tidal) and a 100-year (fluvial) return period flood event.
- Allowances for increased flows resulting from the effects of climate change.
- Allowances for sea level rise resulting from the effects of climate change.
- Assess the existing runoff characteristics and the potential impact the proposed development will have on the runoff.

Further guidance is also provided in the CIRIA Research Project 624 "Development and Flood Risk: Guidance for the Construction Industry".

2.2 Application of the Sequential and Exceptions Test

The risk based sequential test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding, within zone 1. The flood zones are the starting point for the sequential approach.

The development is situated within Flood Zone 1 of the Environment Agency Flood Map (version 2.8.2), being the zone with risk of less than 1 in 1,000 year (<0.1% AEP) for river flooding or tidal/coastal flooding.

The proposed development comprises a residential development. As such Table D2 of Annex D within PPS25 indicates that the development is classified as 'less vulnerable'.

Utilising the Flood Risk Vulnerability Table as shown overleaf, it is considered that the proposed development is suitable for the site.

Table 1: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability Classification		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b	Exception Test required	✓	×	×	×

✓ Development is appropriate
× Development should not be permitted

3.0 Site Details

3.1 Location

The site is centred on ordnance survey grid reference SE 330 063.

An Ordnance Survey plan, indicating the location of the development is presented below.

Figure 1: Location Plan – Polar Ford Development, Dodworth Road

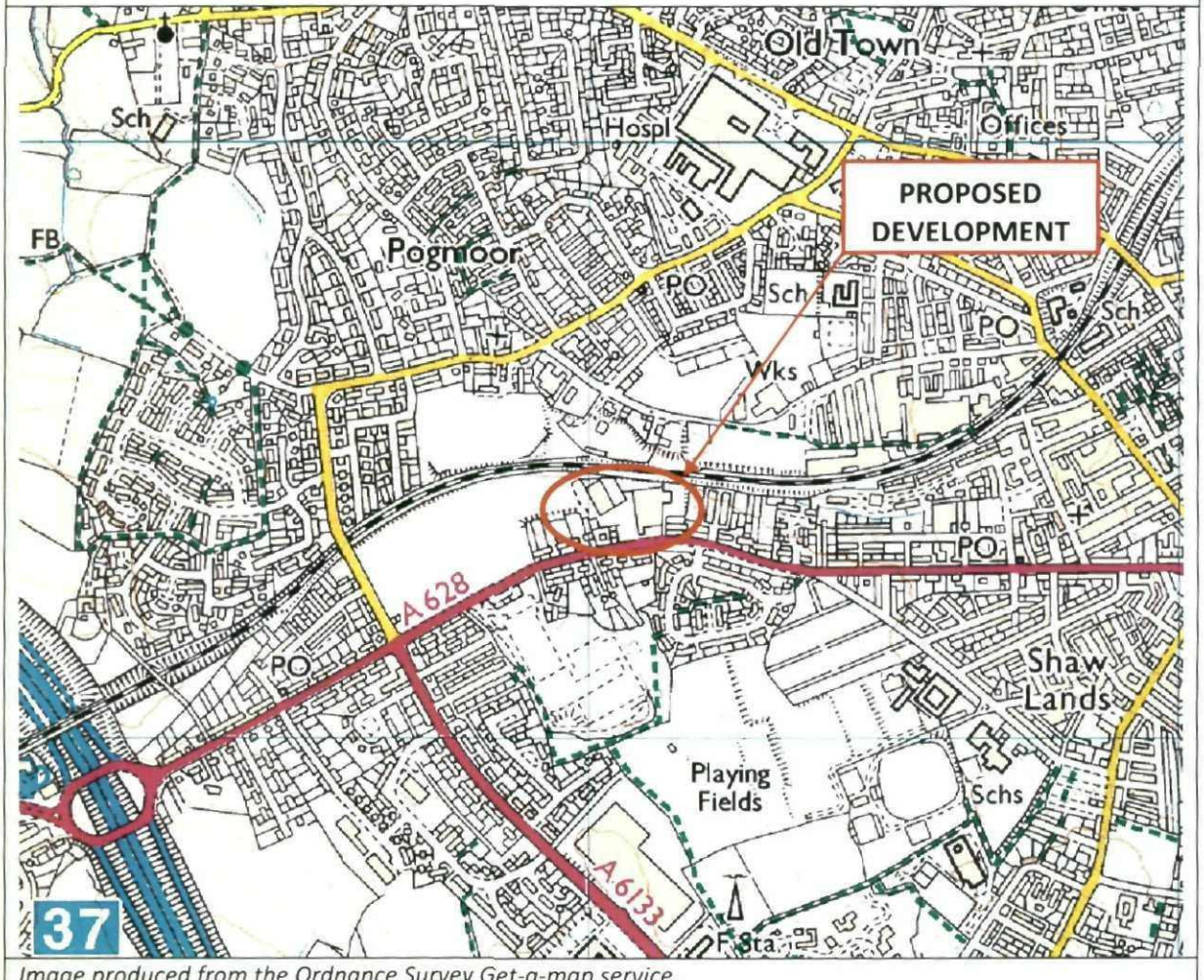


Image produced from the Ordnance Survey Get-a-map service.
Image reproduced with kind permission of Ordnance Survey and Ordnance Survey of Northern Ireland.

3.2 Current/Former Use

Polar Ford have recently relocated to alternative premises at Wakefield Road in Barnsley, and so the Dodworth Road site is currently unoccupied.

The site previously comprised 2No large commercial buildings; however it is understood that some demolition works have been undertaken at the site. Photographs of the development indicate that one of the existing buildings has recently been demolished.

Figure 2: Existing Site Viewed North West from Dodworth Road

Image produced from Google Earth

Figure 3: Existing Site Viewed North East from Dodworth Road

Image produced from Google Earth

3.3 Proposals

Proposals for the site involve the provision of residential development comprising 59No new residential units.

The proposed layout produced by QAD Architects is provided in Appendix C of this report.

3.4 Boundaries

The development is located to the north of Dodworth Road, within the area between Pogmoor and Shaw Lands near to the western fringe of Barnsley.

The site is situated within an area comprising predominantly of existing residential development and is located approximately 1.5 kilometres to the west of Barnsley town centre.

The village of Dodworth is situated to the west of the M1 motorway, almost 2 kilometres to the south west of the site. Beyond Dodworth the landscape is largely rural, and comprises agricultural farmland.

The Barnsley-Penistone railway line is situated immediately to the north of the development, with a mixture of existing commercial and residential development lying to the north of the existing railway line.

The proposed development is accessed directly off Dodworth Road.

3.5 Topography

The development site is considered to be fairly flat in nature, with a shallow gradient falling towards the east boundary of the site.

Ground levels extracted from the topographical survey of the development are shown to lie at an average level of 133.5mAOD.

The lowest level within the site is shown to be 132.75mAOD and is positioned at the north east corner of the site.

The highest level within the development area is at around 137.00mAOD and is located along the western boundary of the site.

3.6 Drainage

3.6.1 Public Sewer System

Details from Yorkshire Water indicate that there is a 300mm diameter public combined sewer situated within Dodworth Road; and a 375mm diameter public combined sewer situated between the north boundary of the site and the existing railway line.

The sewer record plans also indicate the location of a 675mm diameter public surface water sewer, which is shown to traverse the development within the western part of the site. Yorkshire Water require a 5 metre easement either side of this sewer to be incorporated into the redevelopment plan.

This public sewer is shown to outfall into a pond immediately to the north of the site boundary. It is understood that the pond feeds water into a local watercourse, which flows eastwards along the north boundary of the proposed development, and ultimately discharging into the River Dearne to the east side of Barnsley.

The sewer record plans and associated correspondence received from Yorkshire Water are provided within Appendix D of the report.

3.6.2 On-Site Drainage

Until recently the site was used as a car sales facility, known as Polar Ford. Details of the existing layout indicate that the site roof and paved areas cover an area approximating to 1.07 Hectares, hence 67% of the total site area.

A drainage survey of the existing site has been undertaken by Bellway Homes and indicates that both foul flows and a large proportion of surface water flows from the site were directed towards the 300mm diameter public combined sewer within Dodworth Road.

Surface water flows from the paved areas to the north and west of commercial buildings appear to be directed to a petrol/oil interceptor. During the survey, the outlet from the interceptor unit could not be located, however owing to proximity; it is believed that surface water from this area was directed into the 675mm diameter public surface water sewer.

An extract indicating the findings of the drainage survey are provided in Appendix B.

Following completion of the redevelopment works, it is considered that foul flows from the site will be increased; however in contrast, due to the reduction in roof and other hardstanding areas surface water flows from the site will be reduced.

Therefore, consideration of changes to surface water runoff; the requirement of surface water attenuation; and incorporation of sustainable drainage techniques within the proposed drainage strategy has been investigated further within this report.

3.7 History of Flooding

A search on the British Hydrological Society Chronology of British Hydrological Events website (http://www.dundee.ac.uk/geography/cbhe) indicates numerous incidents of historical flooding within the Barnsley area. However, no records relating to flooding within the immediate vicinity of the proposed development at Dodworth Road was highlighted.

Undertaking an internet based search for flooding indicated that Barnsley was seriously affected by the floods of 2007, when homes in Darton, Hoyland, Thurnscoe, Bolton, Grimethorpe, Wosbrough, Burton Grange and Silkstone were inundate by flood water.

No further information relating to historical flooding within the vicinity of the proposed development was found.

4.0 Flooding Mechanisms

Table 2: Sources of Flooding

Source/Pathway	Significant?	Comment/Reason
Fluvial	Yes	Local watercourse.
Tidal/Coastal	No	
Canal	No	
Pluvial (urban drainage)	Yes	Existing site is positively drained.
Groundwater	No	Site is situated over a minor aquifer.
Overland flow	No	No elevated ground within the vicinity of the site.
Blockage	No	
Infrastructure failure	No	
Rainfall Ponding	No	

4.1 Local Watercourse

The Yorkshire Water sewer records and the Environment Agency Flood Map indicate the presence of an open watercourse along the north boundary of the development site.

The watercourse is a tributary of the River Dearne and is intermittently culverted along its route eastwards towards its confluence with the Dearne at to the east of Barnsley town centre.

The upper reach of the stream is predominantly open channel, is classified as ordinary watercourse.

The ordinary watercourse flows eastwards along the north boundary of the site. At Farrar Street, approximately 700 metres downstream of the development, the watercourse becomes 'Main River'.

The Environment Agency Flood Map, along with an internet search of historic flooding within the area of Barnsley upstream of Farrar Road has not provided any indication of flooding caused by overtopping of the local watercourse.

As such it is considered that the local watercourse presents a low risk of flooding to the development.

4.2 Surface Water Runoff

4.2.1 Existing Site

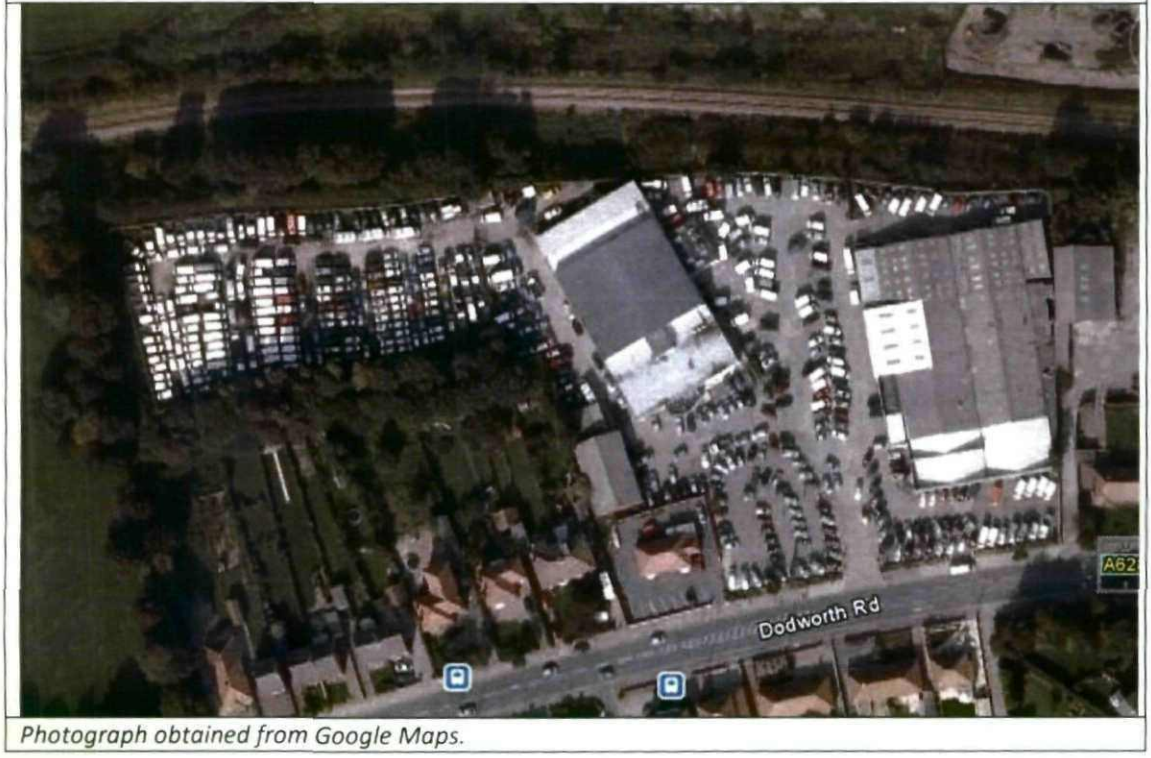
The existing site covers an area approximating 1.6Ha. A survey of the existing drainage network within the site has been undertaken and provides evidence of a positive drainage system.

The survey indicates the arrangement of existing yard gullies and inspection chambers serving the development. A copy of this survey is available within Appendix B of the report.

The drainage survey has identified that foul and some surface water flows from the existing site are directed towards the 300mm diameter public combined sewer situated within Dodworth Road.

However some surface water from the site, is directed towards the 675mm diameter surface water sewer which traverses northwards through the development.

Figure 4: Aerial Photograph of the Existing Site.



Photograph obtained from Google Maps.

4.2.2 Estimation of Existing Surface Water Runoff

Outfall to Dodworth Road

From the topographic survey, it is estimated that roof and hard paved areas within the existing site, which are directed towards the combined sewer within Dodworth Road cover 1.07 Hectares, hence 6% of the total site area.

In accordance with PPS25, surface water runoff from the proposed development which is to be discharged to a local sewer network or nearby watercourse should be restricted to the existing 1 in 2 year peak runoff rate incorporating a 30% reduction to accommodate climate change over the lifetime of the proposed development.

However should ground conditions within the development prove to be suitable to accommodate disposal of surface water runoff via infiltration methods, then this restriction is not applicable.

As such, the proposed 1 in 2 year runoff should be maintained within the drainage system and the 1 in 30 year event should not be allowed to flood the surface; hence the water must remain within the pipes, manholes, and storage systems.

The 1 in 100 year plus 30% climate change event is usually allowed to flood the surface but flood water will not be permitted to enter any of the buildings within the site. In addition, the 1 in 100 year plus climate change flood must be limited to the development boundary and must not be allowed to migrate to adjacent properties.

In order to estimate the existing 1 in 2 year runoff rate from the development area, the Wallingford Procedure Modified Rational Method is considered to be appropriate.

Surface Water Flow Q = 2.78Ai

Where 2.78 = constant coefficient

A = Impermeable Area within the Existing Site = 1.07 Hectares

i = Rainfall intensity = 50mm/hour

Therefore Flow Q = 2.78 x 1.07 x 50 = **148.73l/s**

In conclusion surface water flow from the existing development is estimated to be 148.73 l/s.

In order to meet the requirements laid out by Yorkshire Water and Barnsley MBC, all brownfield development proposals are to provide a reduction in surface water runoff of 30% to accommodate climate change over the lifetime of the proposed development.

As such, applying this reduction to the calculated flows for the Polar Ford site at Dodworth Road indicates that surface water discharge from the new development to the existing sewer connection to the south of the site should be restricted to a maximum of **104l/s**.

Following development it is anticipated that there will be an overall reduction in roof and paved areas, due to the inclusion of generously sized gardens. Therefore in general terms, it is considered that this will contribute to a decrease in surface water runoff from the site.

Flows in excess of 104l/s are required to be attenuated within the site.

Outfall to Surface Water Sewer

Surface water discharge to the existing 675mm diameter public sewer will need to be restricted to a greenfield runoff rate of 5l/s/ha.

As such, existing surface water flow is estimated as follows:

Surface Water Flow Q = 5l/s/ha x A

Where A = Site Area = 1.6 Hectares

Therefore Flow Q = 5 x 1.6 = **8l/s**

In conclusion surface water flow from the existing development discharged into the local watercourse via the existing 675mm diameter public surface water sewer is estimated to be 8 l/s.

Flows in excess of 8l/s are required to be attenuated within the site.

4.2.3 `Proposed Surface Water Attenuation

Outfall to Dodworth Road

The proposed residential development will involve the construction of estate roads, footpaths and driveways to access the residential units, the total impermeable area within the site will be increased.

However due to the increased area provided for gardens and planting it is considered that surface water runoff from the site will decrease following development.

QAD Architects have produced a development layout, which indicates that the impermeable area within the site, which is to be discharged to the public sewer within Dodworth Road, following development will be approximately 47% of the total site area, hence 0.75 Hectares.

Using the Wallingford Procedure, Modified Rational Method the volume to be attenuated has been calculated for the 1 in 2 year, 30 year, 100 year and 100 year plus 30% climate change events.

The peak discharge for all four return period events was set at the 104l/s. Reference should be made to Appendix E where the spreadsheets used to calculate the volumes to be stored for each return period are provided.

The required attenuation volumes have been tabulated below.

Table 3: Indicative Volumes for Attenuation – Dodworth Road Outfall

Return Period	Balance Volumes: Total Development Area (m^3)
1 in 2 year	0
1 in 30 year	74
1 in 100 year	144
1 in 100 year + 30% climate change	215

Outfall to Surface Water Sewer

The proposed residential development will involve the construction of estate roads, footpaths and driveways to access the residential units, the total impermeable area within the site will be increased.

However due to the increased area provided for gardens and planting it is considered that surface water runoff from the site will decrease following development.

QAD Architects have produced a development layout, which indicates that the impermeable area within the site, which is to be discharged to public surface water, following development will be approximately 10% of the total site area, hence 0.16 Hectares.

Using the Wallingford Procedure, Modified Rational Method the volume to be attenuated has been calculated for the 1 in 2 year, 30 year, 100 year and 100 year plus 30% climate change events.

The peak discharge for all four return period events was set at the 8l/s. Reference should be made to Appendix E where the spreadsheets used to calculate the volumes to be stored for each return period are provided.

The required attenuation volumes have been tabulated overleaf.

Table 4: Indicative Volumes for Attenuation – Outfall to Surface Water Sewer

Return Period	Balance Volumes: Total Development Area (m^3)
1 in 2 year	4
1 in 30 year	29
1 in 100 year	47
1 in 100 year + 30% climate change	66

It is normal practice to ensure that the 1 in 30 year event is maintained below the ground in the form of storage. Flows in excess of this are usually permitted to flood the surface as long as it can be demonstrated that there is no flooding to buildings.

Any flood volume must not be allowed to migrate to adjacent property, hence contained within the site boundary i.e. within the car park areas and access roads throughout the proposed development area.

It is highlighted that the volume balance requirements should be established to a greater accuracy during the detailed design stage to reflect the actual development proposal, the extent of impermeable areas and associated runoff generated. Preliminary calculations have made no allowance for any additional storage available in the storm water sewer network & manholes, hence providing a 'worst case' scenario.

4.3 Groundwater

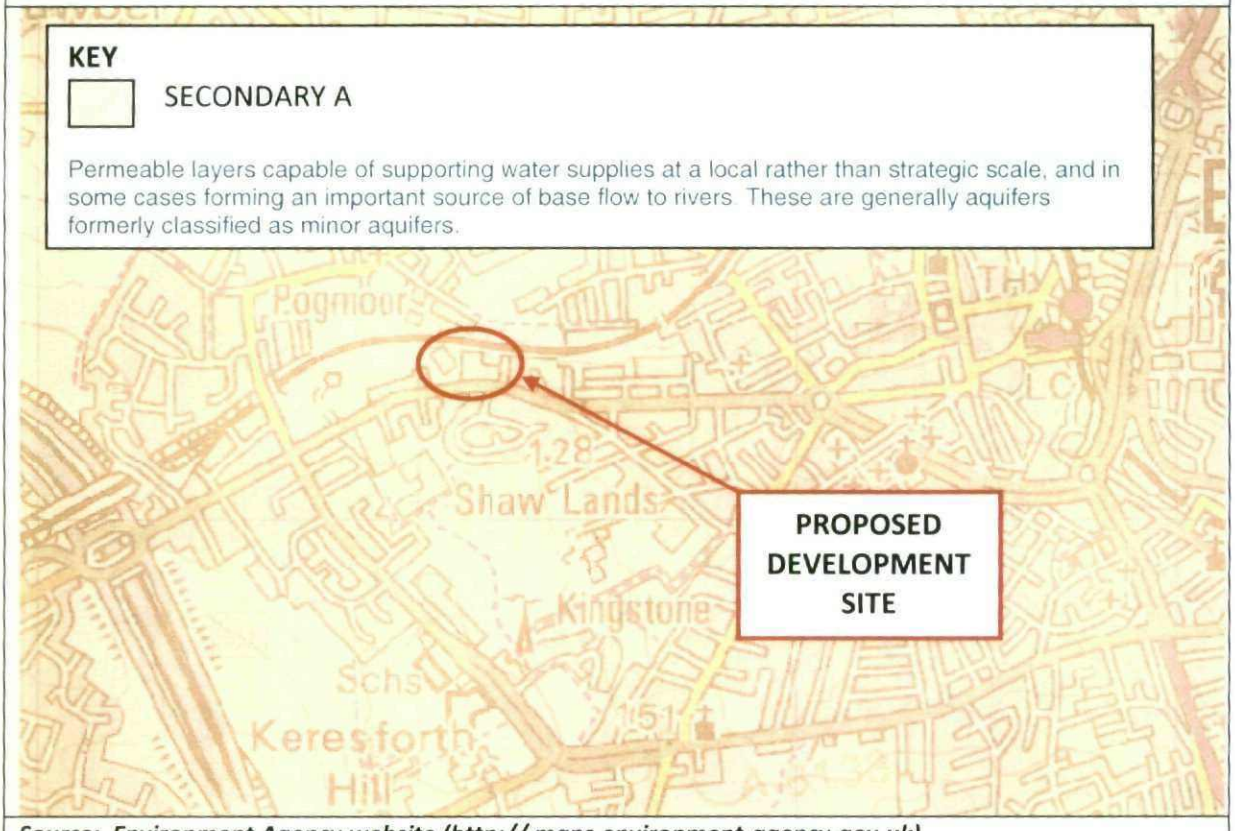
A site specific ground investigation has not been made available at this stage and therefore the presence and depth of groundwater within the development is currently unknown.

Information obtained from the Environment Agency website indicates that the development area is underlain by a minor aquifer, as illustrated in Figure 5 overleaf.

No information has been sourced which indicates that the Dodworth Road area of Barnsley is susceptible to groundwater flooding.

At this stage therefore it is considered that groundwater presents a low risk of flooding to the site.

Figure 5: Identification of Groundwater and Aquifers



Source: Environment Agency website (http:// maps.environment-agency.gov.uk)

5.0 Material Consideration In Respect of PPS25

5.1 Climatic Change

Annex A of PPS25 suggests that winters will become wetter over the whole of the UK, by as much as 20% by the year 2050. In making an assessment of the impact of climatic change, flooding from rivers and land will give a peak flow allowance of up to 20% increase in rainfall for a given return period by 2050 and 30% by 2110. These considerations will provide an appropriate precautionary assessment for climatic change impact on flood flows and rainfall intensities.

The areas surrounding the site comprise existing development and therefore in terms of climatic change, only rainfall falling within the site will be considered.

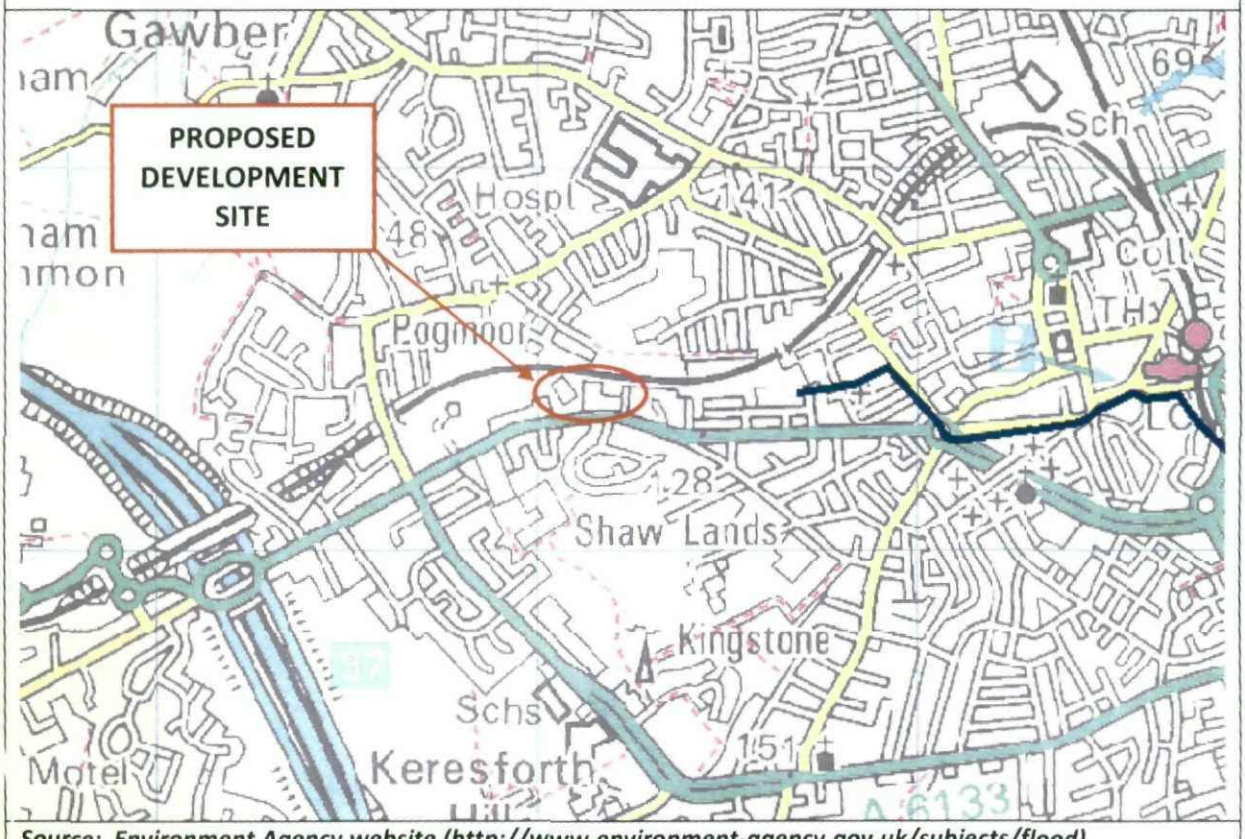
The latest identified figures in Annex B of PPS25 identifies that increases in rainfall of around 30% are anticipated for developments extending beyond the year 2050. It will be necessary, therefore, to make allowance for this increased rainfall in any positive drainage system assumed on the site.

5.2 Environment Agency Flood Maps

The Environment Agency flood zone map indicates that the site lies within Flood Zone 1, of the Environment Agency Flood Map (version 2.8.2), being the zone with risk of less than 1 in 1,000 year (<0.1% AEP) for river flooding or tidal/coastal flooding.

An extract of the Environment Agency flood map at the development site is provided in Figure 6 overleaf.

Figure 6: Environment Agency Flood Map



Source: Environment Agency website (http://www.environment-agency.gov.uk/subjects/flood)

5.3 Proposed Finished Floor Levels

The proposed development located along the north side of Dodworth Road, within the western part of Barnsley. The site is situated within Flood Zone 1 of the Environment Agency Map and as such it is considered that land raising will not be required as a direct result of flood risk.

Paul Waite Associates have undertaken an initial design to determine external levels throughout the proposed development. Finished floor levels are designed ranging from 132.90mAOD up to 137.15mAOD respectively within the north east and north west parts of the site.

Due to the possibility of localised flooding caused by heavy rainfall, it is also recommended that the internal ground floor level is elevated a minimum of 150mm above the adjacent external finished ground levels.

5.4 Emergency Access and Egress during Times of Flood

It is a requirement under Planning Policy Statement PPS25 that occupants should be able to gain access or egress to any building during times of flood, without being trapped by flood conditions.

The development is shown to lie completely within Flood Zone 1. As such, it is considered that safe access and egress from the site will be possible at all times.

5.5 Surface Water

It is a requirement of any new development to ensure that surface water run-off from any has a negligible consequence on downstream areas as a result of sewer capacity; discharge to watercourse; or groundwater recharge via infiltration methods.

It is proposed that the drainage strategy for the development will incorporate a number of different methods in order to reduce the volume of surface water leaving the site. The suitability of such methods is investigated further in Section 5.6 below.

5.6 Sustainable Urban Drainage (SUDS)

The impermeable area within the site is shown to be reduced following development. The existing site is developed and is drained via a positive system to 2No outfalls into the public sewer system. One outfall directs flow to the 300mm diameter combined public sewer located within Dodworth Road, with the second outfall allowing discharge to an existing 675mm diameter surface water sewer which traverses the site.

Surface water outflow from the existing development to the sewer within Dodworth Road is estimated to be 148.73l/s. Incorporating a 30% reduction to existing surface water flows in accordance with the requirements of Yorkshire Water and Barnsley MBC, surface water discharge from the new development to this outfall should be restricted to a maximum of 104l/s.

In contrast surface water flows discharging to the local watercourse via the 675mm diameter surface water sewer should be restricted to a greenfield runoff rate of 5l/s/ha, hence 8l/s.

Flows generated by the proposed development, which are in excess of the estimated discharge rates should be attenuated within the site.

To reduce the impact of surface water runoff from the development in accordance with the requirements of PPS25; Yorkshire Water and Barnsley MBC, the employment of SUDS techniques to limit runoff volumes and rates from the site are recommended. SUDS techniques can also be used to provide an appropriate level of treatment to the runoff.

It is normal practice to ensure that the 1 in 30 year event is maintained within the drainage system and the 1 in 100 year is permitted to flood the surface as long as there is no flooding to buildings and the flood volume is contained within the site boundary in specific areas proposed for this purpose.

The following section provides an indication of the possible SUDS techniques which could be employed on the site to balance flows within the proposed development. SUDS techniques are also able to provide treatment to the runoff to remove a proportion of the pollution and protect the quality of the downstream watercourses. Following guidance from CIRIA Report C522 the following levels of treatment will be provided:

- Roofs – 1 level
- Driveways – 1 level
- Roads and communal parking areas – 2 levels.

The level of treatment indicates the number of SUDS techniques that will be used to treat pollution. For example if two levels are required the runoff may enter a filter drain that leads to a basin or pond before outfall.

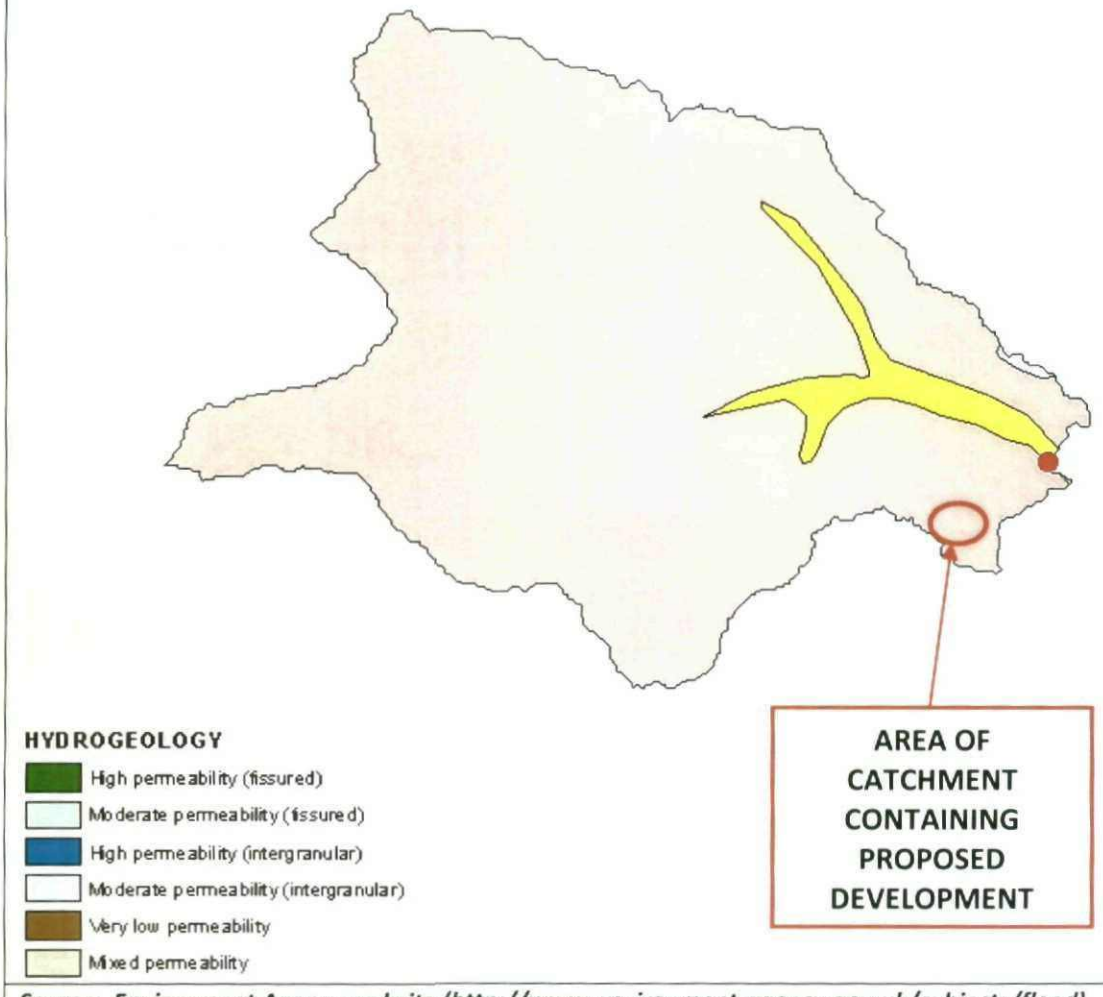
Yorkshire Water and Barnsley MBC recommend the use of source control techniques within the drainage strategy for any development. In practice there will be little outflow from these techniques for a 1 in 2 year storm as most of the rainfall will be held within the system and will disperse via evapotranspiration. Further detail of the potential to use SUDS within this site it provided within Table 3. The precise combination of methods used will be dependent upon the site constraints identified at the final design stage.

With regards to the potential for infiltration methods to dispose of surface water from the development, the following information has been taken from hydrogeological and drift data for the catchment area containing the development site obtained from the Centre for Ecology and Hydrology website.

The information obtained indicates that the development is located within an area exhibiting ground conditions with a mixed permeability. A map illustrating the geological features of the area surrounding the proposed development is provided within Figure 7 overleaf.

As such, it is highly recommended that a site specific ground investigation is carried out in order to determine if this method of surface water disposal is suitable for the proposed development.

Figure 7: Hydrogeological and Drift Deposits Map



Source: Environment Agency website (http://www.environment-agency.gov.uk/subjects/flood)

Table 5: SUDS Techniques and Suitability of Use

Method	Description	Potential for use at site
Filter drains	Drainage trench filled with gravel and provided with a pipe	Possible use to be established following infiltration testing.
Swales	Shallow grass ditch	May be utilised around the development boundary to prevent surface water migrating from the site.
Permeable surfaces	Pavement surfaces that allow water to pass through into underlying storage in sub base e.g. permeable concrete block paving or porous asphalt	May be considered suitable for use within the car park and hard paved areas in order to remove the need for on-line attenuation.
Ponds and basins	Open areas that are used to store and treat rainwater. Ponds are permanent bodies of water and basins are generally dry and occasionally store water	Limited availability of open space within the site precludes the suitability of this option within the drainage strategy for the development.
Green roofs	Roof system that is vegetated with plants (note sedum plants rather than grass so no mowing is required)	Dependant upon Architects proposals for the building design.
Infiltration devices	Methods that allow rainwater to soak into the ground, e.g. soakaways	Possible use to be established following infiltration testing.
Storage tanks	Underground tanks that temporarily store water in the drainage system	Online attenuation in the form of oversized sewer sections.

6.0 Conclusions and Recommendations

6.1 The development known Polar Ford, off Dodworth Road in Barnsley is located within Flood Zone 1 of the Environment Agency's Flood Map.

6.2 Surface water runoff has been identified as the primary flood risk to the development area.

6.3 Proposal for the development incorporates the construction of 59No residential properties.

6.4 Following development the impermeable area within the site will be reduced and hence the impact of surface water on the local environment downstream from the development will also be reduced.

6.5 Yorkshire Water and Barnsley MBC requires that allowable surface water discharge rates from development proposals on Brownfield sites, are to be restricted to existing rates with an additional 30% reduction to accommodate climate change over the lifetime of the developmement; or restricted to a greenfield runoff rate of 5l/s/ha for undeveloped land.

6.6 The existing site I positively drained with surface water being discharged to 2No outfalls; a combined sewer within Dodworth Road; and surface water sewer which discharges to a pond and local watercourse to the north of the site.

6.7 It is calculated that discharge to the surface water sewer should be restricted to a maximum rate of 8l/s; with a maximum of 104l/s allowed to discharge to the existing sewer at Dodworth Road.

6.8 It is estimated that the volume of attenuation required for the 1 in 30 year plus 30% climate change event for the area of development discharging to the surface water sewer site is approximately 29m^3.

6.9 The volume of attenuation required for the development area discharging surface water to the combined sewer during the 1 in 30 year plus 30% climate change event is estimated to be 74m^3.

6.10 The drainage strategy for both parts of the Polar Ford development involves the conveyance of surface water runoff via a piped network to an oversized pipe situated within the estate road. It is proposed that surface water discharge rates will be controlled using a Hydrobrake or similar arrangement.

6.11 Details pertaining to the ground conditions within the development are not currently available. However, owing to the location of the site over a minor aquifer; along with the hydrogeological information obtained for the local catchment area, it is considered reasonable that disposal of surfaced water via infiltration methods may not be feasible.

APPENDIX A

EXISTING SITE

SYMBOL LEGEND

- Borehole
- Benchmark
- Bollard
- Bus Stop
- Electric Box
- Electricity Pole
- Fence Post
- Gas Stop Valve
- Gate Post
- Gas Marker
- Gully
- Gas Well
- Kerb Outlet
- Litter Bin
- Manhole Chamber
- Lamp Post
- Manhole Point
- MH Triangular
- Wooden Peg
- Ground Marker
- Marker Post
- Pylon
- Rodding Eye
- Sample Point
- Sign Post
- Spot Height
- Servs Level
- Ridge Level
- Strip
- Survey Station
- Traffic Camera
- Telephone Box
- Trial Pit
- Telegraph Pole
- Deciduous Tree
- Road Sign
- Valve
- Vent
- Water Meter
- Letter Box
- MH Circular
- Knockout Pot

MANHOLE LEGEND

MHCT	Cable Television
MHEL	Electricity
MHGA	Gas
MHSW	Surface Water
MHFW	Foul Water
MHBT	British Telecom
MHWT	Water

LINETYPE LEGEND

- Bridge
- Bottom of Bank
- Building
- Canopy Ridge
- Concrete Ridge
- Ditch
- Drop Kerb
- Overhead Cable
- Fence
- Gate
- Kerb
- Path
- Pipe Line
- River
- Surface Water Drain
- Railway Line
- Road Centre Line
- Tarmac Edge
- Top of Bank
- Track
- Wall
- Verge
- Flagstone Paving
- Stone
- Hedgerow
- Grass Edge

ABBREVIATIONS

LP.	Lamp Post
TP.	Telegraph Pole
EP.	Electricity Pole
SP.	Sign Post
TS.	Traffic Sign
BS.	Bus Stop
GM.	Gas Marker Monument
MH.	Manhole
GLL	Gully
FH.	Fire Hydrant
CATV.	Cable Television Point
WM.	Water Meter
WSV.	Water Stop Valve
GSV.	Gas Stop Valve
RE.	Rodding Eye

SURVEY IS ORIENTED TO ORDNANCE SURVEY NATIONAL GRID. POSITIONS FIXED BY GPS ACTIVE NETWORK TO OS PROJECTION. LEVELS TO OSGM02. SCALE FACTOR FOR SURVEY 1.0000

THIS SURVEY SHOWS PHYSICAL SITE BOUNDARIES ONLY. CONFIRMATION OF LEGAL OWNERSHIP BOUNDARIES SHOULD BE OBTAINED BY REFERENCE TO THE H.M. LAND REGISTRY TITLE PLAN

THE PLAN SCALE IS FOR GUIDANCE ONLY.
DO NOT SCALE DIRECTLY.
IF IN DOUBT, CONSULT LATITUDE SURVEYS

REV.	DESCRIPTION	DATE

LATITUDE SURVEYS Chartered Land Surveyors

RICS The mark of property professionals worldwide

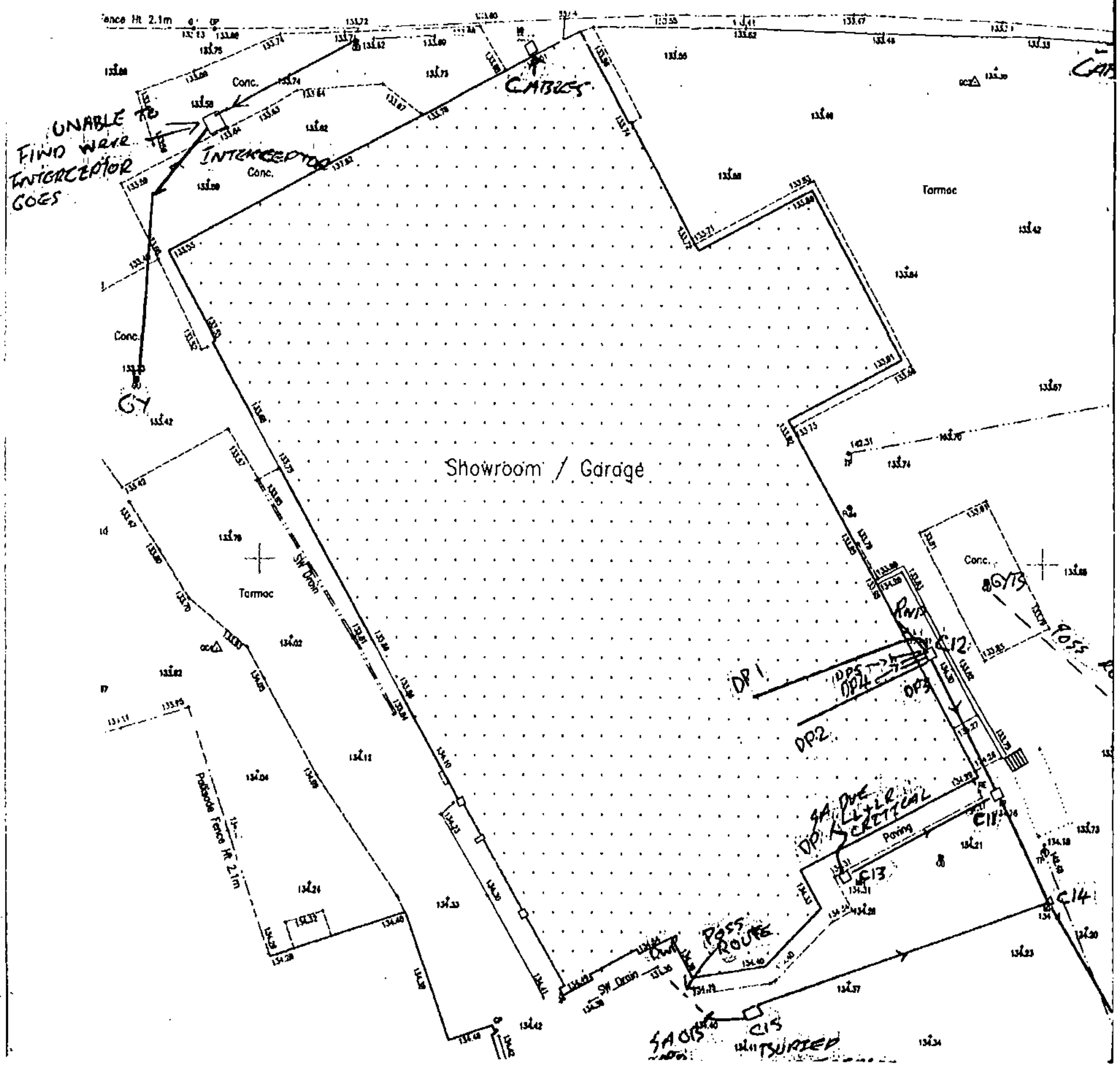
POLAR FORD
DODDWORTH ROAD
BARNSLEY

DETAILED
TOPOGRAPHIC SURVEY

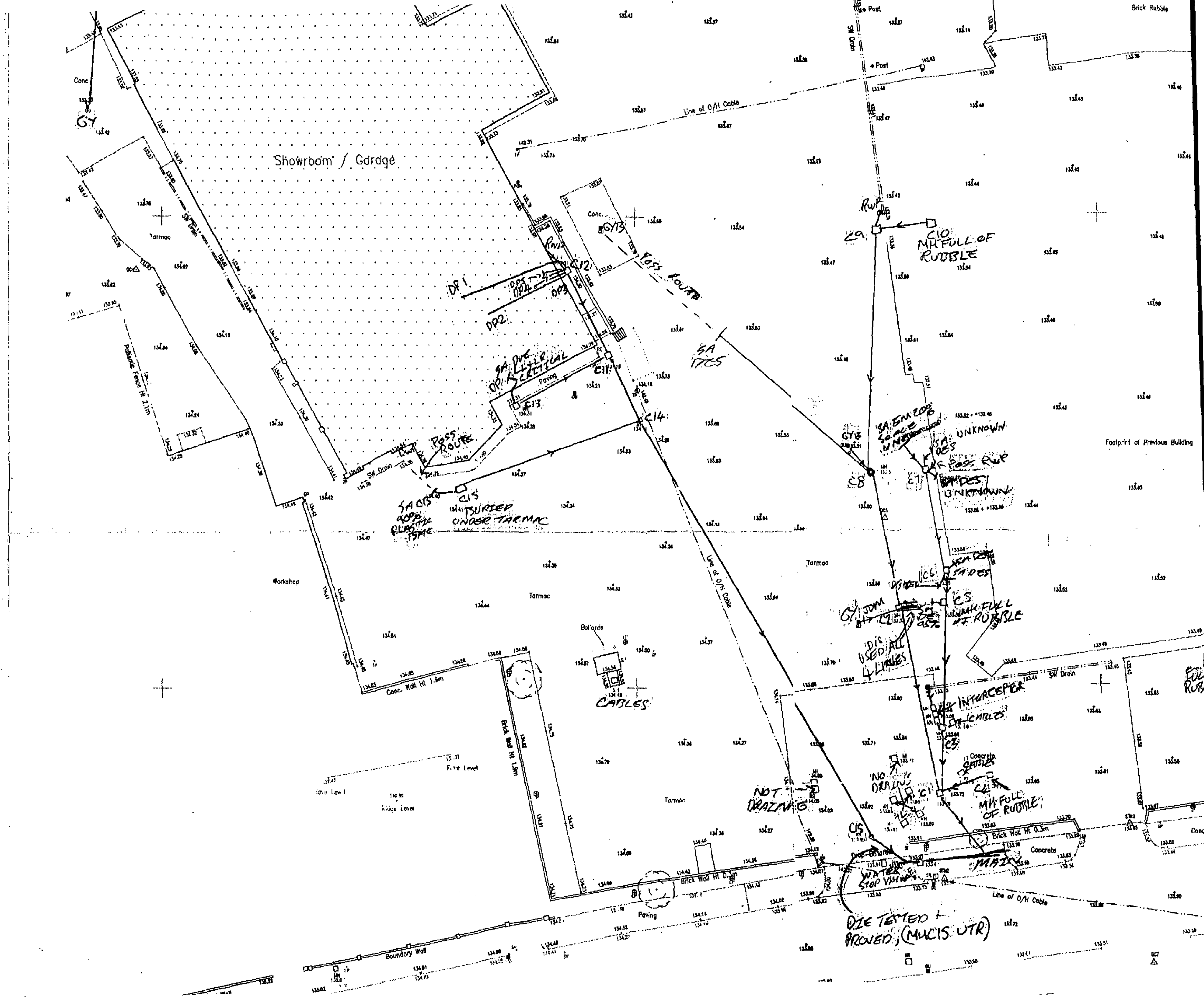
DRAWN GC	SIGNATURE	DATE 17/05/10	STATUS FOR COMMENT ☐ FOR APPROVAL ☐ DRAFT ☐ FINAL ☒
APPROVED CC	SIGNATURE	DATE 17/05/10	
SCALE 1:500	SIZE A1	DRAWING NO. BL1005/001	REVISION -

APPENDIX B

DRAINAGE SURVEY



Showroom / Garage
Tarmac
Conc.
SW Drain
Paving
Palisade Fence Ht 2.1m
Fence Ht 2.1m
CABLES
INTERCEPTOR
UNABLE TO FIND WERE INTERCEPTOR GOES
GY
C11
C12
C13
C14
C15
DP1
DP2
DP3
DP4
DP5
POSS ROUTE


Showroom / Garage
Tarmac
Workshop
Footprint of Previous Building
Line of O/H Cable
SW Drain
Conc. Wall Ht 1.9m
Brick Wall Ht 1.5m
Brick Wall Ht 0.5m
Boundary Wall
Paving
Bollards
Concrete
Brick Rubble
Palisade Fence Ht 2.1m
Eave Level
Ridge Level
Post
GY
DP1
DP2
C12
C13
C14
C15
C9
C10 MH FULL OF RUBBLE
C8
C7
C6
C5
C3
C1
RWP
POSS ROUTE
CABLES
INTERCEPTOR
NOT DRAINING
MAIN
WATER STOP VALVE
DIE TESTED + PROVED (MUCIS UTR)
BURIED UNDER TARMAC
UNKNOWN

APPENDIX C

PROPOSED DEVELOPMENT

PLANS

Note:
Contractors must verify all dimensions on site before commencing any work or shop drawings. This drawing is not to be scaled. Used figured dimensions only. If in doubt, please call QAD.

Schedule of Accommodation : Dodworth Road Option 1

Unit Types	No. of Units	Unit Floor Area sq m	Unit Floor Area sq ft	Total Floor Area sq m	Total Floor Area sq ft
Mi - Milton - 2 Bed Mews house	7	59.6	642	417.5	4494
G - Greenwhich - 3 Bed Semi	5	66.3	714	331.7	3570
D - Derwin - 3 Bed Semi	2	76.4	822	152.7	1644
D - Derwin - 3 Bed Detached	10	76.4	822	763.7	8220
M - Millpeck - 4 Bed Detached	8	99.0	1066	891.3	9594
B - Brampton - 4 Bed Detached	11	110.0	1184	1210.3	13024
S - Sovereign - 4 Bed Detached	9	122.3	1318	1102.9	11862
Ch - Chatsworth - 4 Bed Detached	6	135.9	1458	812.7	8748
TOTAL FLOOR AREA (GROSS INTERNAL)	69			5681.8	61158

Rev	Notes	Revised	Checked

Status
PRELIMINARY

Project
Dodworth Road, Barnsley
BELLWAY

Drawing Title
Site Layout

Drawing Size A2

Job No	Drawing No.	Scale	Revision
10-024	SK01	1:500	

Reviewed by IB | Drawn by CC | Date June 2010

QAD ARCHITECTS
Studio 2 - Ideas House
98 Bradford Road
Wakefield - WF3 2JL
Email - info@q-ad.co.uk
Web - www.q-ad.co.uk
T - 01924 872 101
F - 01924 872 102

APPENDIX D

YORKSHIRE WATER CORRESPONDENCE

& SEWER RECORDS

YorkshireWater

Yorkshire Water
Developer Services Team
Western House
Halifax Road
PO Box 500
Bradford
BD6 2SZ

Tel: 0845 120 8482
Fax: (01274) 372 834

Email:
Planning.Sewerage@yorkshirewater.co.uk

For telephone enquiries ring:

Kashif Khan on (0845)120 8482

Bellway Homes Yorkshire
2 Deighton Close
Wetherby Business Park
Wetherby
West Yorkshire
LS22 7GZ

For the attention of Chris Clingo

Your Ref: Polar Ford, Dodsworth
Our Ref: L003152

1st June 2010

Dear Sir,

Polar Ford, Dodworth Road, Barnsley - Pre Planning Sewerage Enquiry

Thank you for your enquiry received 13th May 2010. Our charge of £60.00 (plus VAT) will be added to your account with us, reference BWY015. You will receive an invoice for your account in due course.

Please find enclosed a complimentary extract from the Statutory Sewer Map. This indicates the recorded position of the public sewers. The following comments reflect our view, with regard to the public sewer network only, based on a 'desk top' study of the site:

There is a 675/680 mm diameter public surface water sewer recorded crossing the site. No buildings are to be erected within 5 (five) metres, nor trees planted within 5 (five) metres of this public sewer. It may not be acceptable to raise or lower ground levels over the sewer, nor to restrict access to the manholes on the sewer. If you wish to have this sewer diverted under Section 185 of the Water Industry Act 1991 an application should be made in writing. To discuss this matter, please telephone 0845 120 84 82.

Development of the site should take place with separate systems for foul and surface water drainage. The separate system should extend to the public sewer.

Foul water should discharge to the 375 mm diameter public combined sewer recorded adjacent to the north of the site.

From the information supplied, it is not possible to determine if the whole site will drain by gravity to the public sewer network. If the site, or part of it, will not drain by gravity, then it is likely that a sewage pumping station will be required to facilitate connection to the public sewer network. If sewage pumping is required foul water discharge must not exceed 6 (six) litres per second.

The developer's attention is drawn to Requirement H3 of the Building Regulations 2000. This establishes a preferred hierarchy for surface water disposal. Consideration should firstly be given to discharge to soakaway, infiltration system and watercourse in that priority order.

Sustainable Drainage Systems (SUDS), for example the use of soakaways and/or permeable hardstanding etc., may be a suitable solution for surface water disposal appropriate in this situation. You are advised to seek comments on the suitability of SUDS in this instance from the appropriate authorities.

Where appropriate, soakaways, swales and infiltration trenches (SUDS) may be adopted as part of the public sewer network. For general conditions for the adoption of SUDS please see the attached sheet. Further information may be seen in the DEFRA publication 'Interim Code of Practice for Sustainable Drainage Systems' (ISBN 0-86017-904-4). If the developer is considering adoption of SUDS they should contact our Developer Services Team on 0845 120 84 82.

The local public sewer network does not have capacity to accept any discharge of surface water from the proposal site. The developer is advised to contact the Environment Agency/local Land Drainage Authority with a view to establishing a suitable watercourse for discharge.

It is understood that a watercourse is located to the north of the site. This appears to be the obvious place for surface water disposal.

Please note further restrictions on surface water disposal from the site may be imposed by other parties. You are strongly advised to seek advice/comments from the Environment Agency/Land Drainage Authority/Internal Drainage Board, with regard to surface water disposal from the site.

Prospectively adoptable sewers and pumping stations must be designed and constructed in accordance with the WRc publication "Sewers for Adoption - a design and construction guide for developers" 6th Edition as supplemented by Yorkshire Water's requirements, pursuant to an agreement under Section 104 of the Water Industry Act 1991. An application to enter into a Section 104 agreement must be made in writing prior to any works commencing on site. Please contact our Developer Services Team (telephone 0845 120 84 82) for further information.

The public sewer network is for domestic sewage purposes. This generally means foul water for domestic purposes and, where a suitable surface water or combined sewer is available, surface water from the roofs of buildings together with surface water from paved areas of land appurtenant to those buildings. Land and highway drainage have no right of connection to the public sewer network. Land drainage will not be allowed into a public sewer. Highway drainage, however, may be accepted under certain circumstances; for instance, if SUDS are not a viable option and there is no highway drain available and if capacity is available within the public sewer network. In this event, a formal agreement for highway drainage discharge to public sewer, under Services under Section 115 Water Industry Act 1991, will be required.

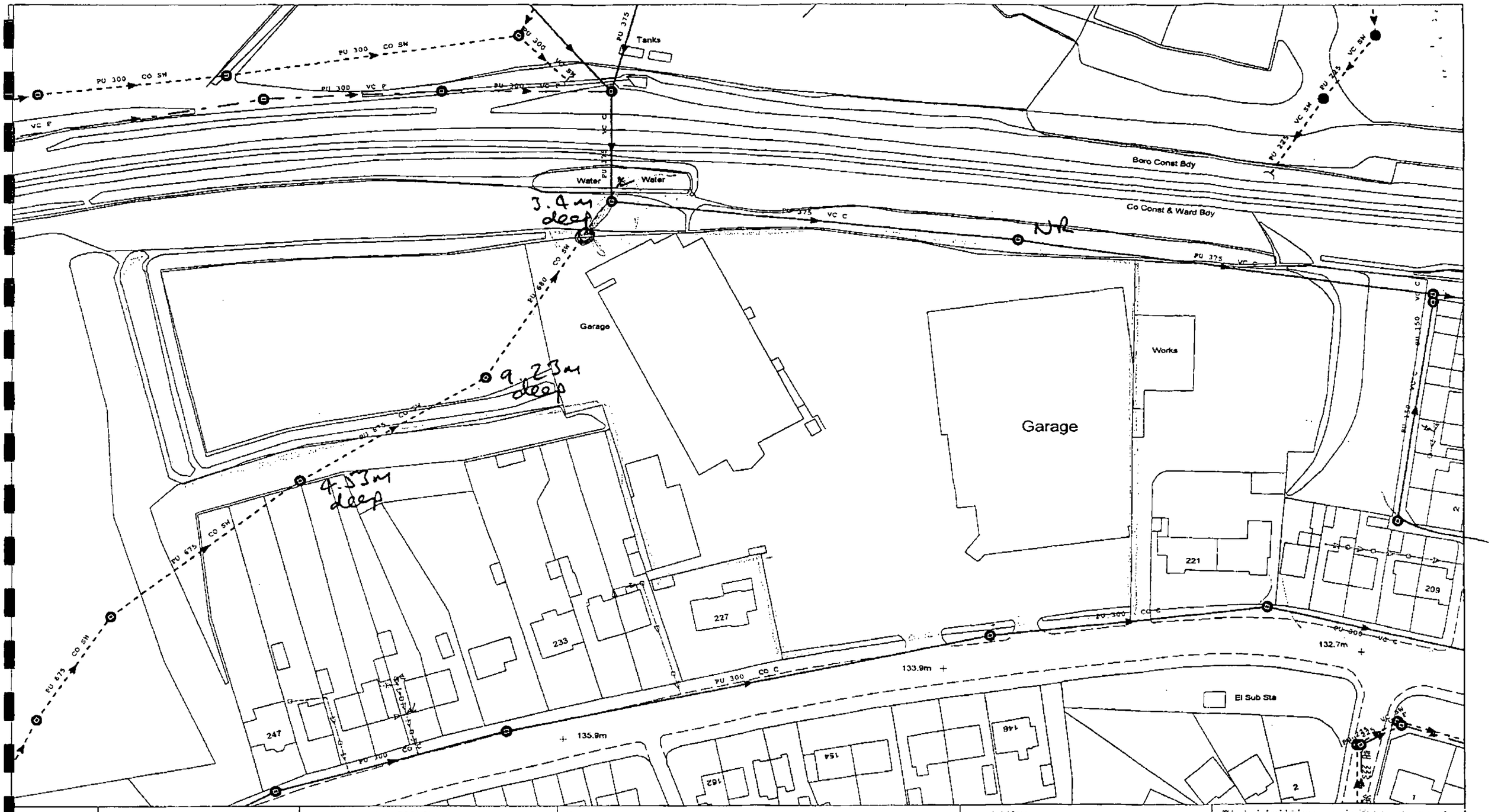
No land drainage to be connected/discharged to public sewer.

Any new connection to an existing public sewer will require the approval of Yorkshire Water. You may obtain an application form from our website (www.yorkshirewater.com) or by telephoning 0845 120 84 82.

All the above comments are based upon the information and records available at the present time. The information contained in this letter together with that shown on any extract from the Statutory Sewer Map that may be enclosed is believed to be correct and is supplied in good faith. Please note that capacity in the public sewer network is not reserved for specific future development. It is used up on a 'first come, first served' basis. You should visit the site and establish the line and level of any public sewers affecting your proposals before the commencement of any design work.

Yours faithfully

Developer Services Team



432834 : 406265	Map Name : SE3206SE	Title	Partial Key
Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : K KHAN Contact Tel :		Notes NR = No Recorded depth.	Foul Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Separate = PS
YorkshireWater		(Ody) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO © Crown copyright and database 2004. All rights reserved Ordnance Survey Licence number 100019559	This plan is furnished as a general guide only and no warranty as to its correctness is given or implied. This plan must not be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connection
		Date Req : 01/06/2010, 11:09:51	Date Gen : 01/06/2010, 11:09:53
		Source : Sewer Network Enquiry	

UPN: Undefined Originator: K KHAN, New Development - Waste Water,

APPENDIX E

ATTENUATION VOLUME

CALCULATIONS

Modified Rational Method

Length (m)	60	m
Area (ha)	0.749	Ha
Max Height	131.5	mAOD
Min Height	131.1	mAOD
DeltaH	0.3	
Slope (%)	0.55	
Te (mins)	15.11	mins
ARF	0.998	
SAAR	689.000	mm
UCWI	63	mm
PIMP	100.0	%
SOIL	0.39	
Percentage Runoff PR	76.86	
DEEPSTOR	0.95	

Cv	0.76864	
Cr	1.3	
allowable outflow		
2 year	0.104	m^3/s

Storage	RT years	Storage m3
	2	-43

Post Development — Return Period flood 2 years — Rainfall 2 years — OUTFALL 1: COMBINED SEWER AT DODWORTH ROAD

Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)	RUN-OFF FLOW (m^3)	RUN-OFF RAIN (m^3)	Allowable Outflow (m^3)	Difference (m^3)
0.25	0.010	6.77	6.8	27.1	56.3	75.2	51	51	93.60	-43
0.5	0.021	8.83	8.8	17.7	36.7	49.1	66	66	187.20	-121
0.75	0.031	10.29	10.3	13.7	28.5	38.1	77	77	280.80	-204
1	0.042	11.47	11.5	11.5	23.9	31.9	86	86	374.40	-289
1.25	0.052	12.47	12.5	10.0	20.8	27.7	93	93	468.00	-375
1.5	0.063	13.35	13.3	8.9	18.5	24.7	100	100	561.60	-462
1.75	0.073	14.15	14.1	8.1	16.8	22.5	106	106	655.20	-549
2	0.083	14.87	14.9	7.4	15.5	20.7	111	111	748.80	-638
2.25	0.094	15.54	15.5	6.9	14.4	19.2	116	116	842.40	-726
2.5	0.104	16.16	16.1	6.5	13.4	18.0	121	121	936.00	-815
2.75	0.115	16.74	16.7	6.1	12.7	16.9	125	125	1029.60	-904
3	0.125	17.29	17.3	5.8	12.0	16.0	130	129	1123.20	-994
3.25	0.135	17.82	17.8	5.5	11.4	15.2	133	133	1216.80	-1083
3.5	0.146	18.31	18.3	5.2	10.9	14.5	137	137	1310.40	-1173
3.75	0.156	18.79	18.8	5.0	10.4	13.9	141	141	1404.00	-1263
4	0.167	19.24	19.2	4.8	10.0	13.4	144	144	1497.60	-1354
4.25	0.177	19.68	19.7	4.6	9.6	12.9	147	147	1591.20	-1444
4.5	0.188	20.1	20.1	4.5	9.3	12.4	151	150	1684.80	-1534
4.75	0.198	20.51	20.5	4.3	9.0	12.0	154	154	1778.40	-1625
5	0.208	20.9	20.9	4.2	8.7	11.6	157	156	1872.00	-1716
5.25	0.219	21.28	21.3	4.1	8.4	11.3	159	159	1965.60	-1806
5.5	0.229	21.65	21.6	3.9	8.2	10.9	162	162	2059.20	-1897
5.75	0.240	22.01	22.0	3.8	8.0	10.6	165	165	2152.80	-1988
6	0.250	22.36	22.3	3.7	7.8	10.4	167	167	2246.40	-2079
6.25	0.260	22.7	22.7	3.6	7.6	10.1	170	170	2340.00	-2170
6.5	0.271	23.03	23.0	3.5	7.4	9.8	173	172	2433.60	-2261
6.75	0.281	23.36	23.3	3.5	7.2	9.6	175	175	2527.20	-2352
7	0.292	23.67	23.7	3.4	7.0	9.4	177	177	2620.80	-2444
7.25	0.302	23.98	24.0	3.3	6.9	9.2	180	179	2714.40	-2535
7.5	0.313	24.28	24.3	3.2	6.7	9.0	182	182	2808.00	-2626
7.75	0.323	24.58	24.6	3.2	6.6	8.8	184	184	2901.60	-2718
8	0.333	24.87	24.9	3.1	6.5	8.6	186	186	2995.20	-2809
8.25	0.344	25.15	25.1	3.0	6.3	8.5	188	188	3088.80	-2901
8.5	0.354	25.43	25.4	3.0	6.2	8.3	190	190	3182.40	-2992
8.75	0.365	25.7	25.7	2.9	6.1	8.2	192	192	3276.00	-3084
9	0.375	25.97	26.0	2.9	6.0	8.0	195	194	3369.60	-3175
9.25	0.385	26.24	26.2	2.8	5.9	7.9	197	196	3463.20	-3267
9.5	0.396	26.5	26.5	2.8	5.8	7.7	198	198	3556.80	-3358
9.75	0.406	26.75	26.7	2.7	5.7	7.6	200	200	3650.40	-3450
10	0.417	27	27.0	2.7	5.6	7.5	202	202	3744.00	-3542

Modified Rational Method

Length (m)	60	m
Area (ha)	0.749	Ha
Max Height	131.5	mAOD
Min Height	131.1	mAOD
DeltaH	0.3	
Slope (%)	0.55	
Te (mins)	15.11	mins
ARF	0.998	
SAAR	689.000	mm
UCWI	63	mm
PIMP	100.0	%
SOIL	0.39	
Percentage Runoff PR	76.86	
DEEPSTOR	0.95	

Cv	0.76864	
Cr	1.3	
allowable outflow		
30 year	0.104	m^3/s

m3

Storage	RT years	Storage
	30	74

Return Period flood 30 years

Post Development Rainfall 50 years

OUTFALL 1: COMBINED SEWER AT DODWORTH ROAD

Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)	RUN-OFF FLOW (m^3)	RUN-OFF RAIN (m^3)	Allowable Outflow (m^3)	Difference (m^3)
0.25	0.010	22.37	22.4	89.5	186.2	248.6	168	167	93.60	74
0.5	0.021	27.35	27.3	54.7	113.8	151.9	205	205	187.20	17
0.75	0.031	30.73	30.7	41.0	85.2	113.8	230	230	280.80	-51
1	0.042	33.35	33.3	33.4	69.4	92.6	250	250	374.40	-125
1.25	0.052	35.53	35.5	28.4	59.1	79.0	266	266	468.00	-202
1.5	0.063	37.41	37.4	24.9	51.9	69.3	280	280	561.60	-282
1.75	0.073	39.07	39.0	22.3	46.5	62.0	293	292	655.20	-363
2	0.083	40.57	40.5	20.3	42.2	56.3	304	304	748.80	-445
2.25	0.094	41.94	41.9	18.6	38.8	51.8	314	314	842.40	-529
2.5	0.104	43.19	43.2	17.3	35.9	48.0	324	323	936.00	-613
2.75	0.115	44.36	44.3	16.1	33.6	44.8	332	332	1029.60	-698
3	0.125	45.46	45.4	15.2	31.5	42.1	341	340	1123.20	-783
3.25	0.135	46.49	46.5	14.3	29.8	39.7	348	348	1216.80	-869
3.5	0.146	47.46	47.4	13.6	28.2	37.7	355	355	1310.40	-955
3.75	0.156	48.38	48.3	12.9	26.8	35.8	362	362	1404.00	-1042
4	0.167	49.26	49.2	12.3	25.6	34.2	369	369	1497.60	-1129
4.25	0.177	50.1	50.1	11.8	24.5	32.7	375	375	1591.20	-1216
4.5	0.188	50.91	50.9	11.3	23.5	31.4	381	381	1684.80	-1304
4.75	0.198	51.68	51.6	10.9	22.6	30.2	387	387	1778.40	-1392
5	0.208	52.42	52.4	10.5	21.8	29.1	393	392	1872.00	-1480
5.25	0.219	53.14	53.1	10.1	21.1	28.1	398	398	1965.60	-1568
5.5	0.229	53.83	53.8	9.8	20.4	27.2	403	403	2059.20	-1656
5.75	0.240	54.5	54.5	9.5	19.7	26.3	408	408	2152.80	-1745
6	0.250	55.15	55.1	9.2	19.1	25.5	413	413	2246.40	-1834
6.25	0.260	55.78	55.7	8.9	18.6	24.8	418	417	2340.00	-1923
6.5	0.271	56.39	56.3	8.7	18.1	24.1	422	422	2433.60	-2012
6.75	0.281	56.98	56.9	8.4	17.6	23.4	427	426	2527.20	-2101
7	0.292	57.56	57.5	8.2	17.1	22.8	431	431	2620.80	-2190
7.25	0.302	58.13	58.1	8.0	16.7	22.3	435	435	2714.40	-2279
7.5	0.313	58.67	58.6	7.8	16.3	21.7	439	439	2808.00	-2369
7.75	0.323	59.21	59.2	7.6	15.9	21.2	443	443	2901.60	-2458
8	0.333	59.73	59.7	7.5	15.5	20.7	447	447	2995.20	-2548
8.25	0.344	60.25	60.2	7.3	15.2	20.3	451	451	3088.80	-2638
8.5	0.354	60.75	60.7	7.1	14.9	19.9	455	455	3182.40	-2728
8.75	0.365	61.24	61.2	7.0	14.6	19.4	459	458	3276.00	-2818
9	0.375	61.72	61.7	6.9	14.3	19.0	462	462	3369.60	-2908
9.25	0.385	62.19	62.1	6.7	14.0	18.7	466	465	3463.20	-2998
9.5	0.396	62.65	62.6	6.6	13.7	18.3	469	469	3556.80	-3088
9.75	0.406	63.1	63.1	6.5	13.5	18.0	473	472	3650.40	-3178
10	0.417	63.54	63.5	6.4	13.2	17.7	476	476	3744.00	-3268

Modified Rational Method

Length (m)	60	m
Area (ha)	0.749	Ha
Max Height	131.5	mAOD
Min Height	131.1	mAOD
DeltaH	0.3	
Slope (%)	0.55	
Te (mins)	15.11	mins
ARF	0.998	
SAAR	689.000	mm
UCWI	63	mm
PIMP	100.0	%
SOIL	0.39	
Percentage Runoff PR	76.86	
DEEPSTOR	0.41	

Cv	0.76864	
Cr	1.3	
allowable outflow		
100 year	0.104	m^3/s

Storage	RT years	Storage
		m3
	100	144

Return Period flood 100 years

Post Development Rainfall 140 years

OUTFALL 1: COMBINED SEWER AT DODWORTH ROAD

Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)	RUN-OFF FLOW (m^3)	RUN-OFF RAIN (m^3)	Allowable Outflow (m^3)	Difference (m^3)
0.25	0.010	31.74	31.7	127.0	264.2	352.7	238	238	93.60	144
0.5	0.021	38.11	38.1	76.2	158.6	211.7	285	285	187.20	98
0.75	0.031	42.34	42.3	56.5	117.5	156.8	317	317	280.80	36
1	0.042	45.6	45.6	45.6	94.9	126.7	342	341	374.40	-33
1.25	0.052	48.29	48.3	38.6	80.4	107.3	362	361	468.00	-107
1.5	0.063	50.6	50.6	33.7	70.2	93.7	379	379	561.60	-183
1.75	0.073	52.63	52.6	30.1	62.6	83.5	394	394	655.20	-261
2	0.083	54.45	54.4	27.2	56.6	75.6	408	408	748.80	-341
2.25	0.094	56.1	56.1	24.9	51.9	69.3	420	420	842.40	-423
2.5	0.104	57.62	57.6	23.0	48.0	64.0	432	431	936.00	-505
2.75	0.115	59.03	59.0	21.5	44.7	59.6	442	442	1029.60	-588
3	0.125	60.34	60.3	20.1	41.8	55.9	452	452	1123.20	-672
3.25	0.135	61.57	61.5	18.9	39.4	52.6	461	461	1216.80	-756
3.5	0.146	62.74	62.7	17.9	37.3	49.8	470	470	1310.40	-841
3.75	0.156	63.84	63.8	17.0	35.4	47.3	478	478	1404.00	-926
4	0.167	64.89	64.8	16.2	33.8	45.1	486	486	1497.60	-1012
4.25	0.177	65.89	65.8	15.5	32.3	43.1	494	493	1591.20	-1098
4.5	0.188	66.84	66.8	14.9	30.9	41.3	501	500	1684.80	-1185
4.75	0.198	67.76	67.7	14.3	29.7	39.6	508	507	1778.40	-1271
5	0.208	68.64	68.6	13.7	28.6	38.1	514	514	1872.00	-1358
5.25	0.219	69.48	69.4	13.2	27.5	36.8	520	520	1965.60	-1446
5.5	0.229	70.3	70.2	12.8	26.6	35.5	527	526	2059.20	-1533
5.75	0.240	71.09	71.0	12.4	25.7	34.3	532	532	2152.80	-1621
6	0.250	71.85	71.8	12.0	24.9	33.3	538	538	2246.40	-1709
6.25	0.260	72.59	72.5	11.6	24.2	32.3	544	543	2340.00	-1797
6.5	0.271	73.31	73.3	11.3	23.5	31.3	549	549	2433.60	-1885
6.75	0.281	74.01	74.0	11.0	22.8	30.5	554	554	2527.20	-1973
7	0.292	74.69	74.6	10.7	22.2	29.6	559	559	2620.80	-2062
7.25	0.302	75.34	75.3	10.4	21.6	28.9	564	564	2714.40	-2151
7.5	0.313	75.99	75.9	10.1	21.1	28.1	569	569	2808.00	-2239
7.75	0.323	76.61	76.6	9.9	20.6	27.5	574	573	2901.60	-2328
8	0.333	77.23	77.2	9.7	20.1	26.8	578	578	2995.20	-2417
8.25	0.344	77.82	77.8	9.4	19.6	26.2	583	582	3088.80	-2506
8.5	0.354	78.41	78.3	9.2	19.2	25.6	587	587	3182.40	-2596
8.75	0.365	78.98	78.9	9.0	18.8	25.1	592	591	3276.00	-2685
9	0.375	79.53	79.5	8.8	18.4	24.5	596	595	3369.60	-2774
9.25	0.385	80.08	80.0	8.7	18.0	24.0	600	599	3463.20	-2864
9.5	0.396	80.62	80.6	8.5	17.7	23.6	604	603	3556.80	-2953
9.75	0.406	81.14	81.1	8.3	17.3	23.1	608	607	3650.40	-3043
10	0.417	81.66	81.6	8.2	17.0	22.7	612	611	3744.00	-3133

Modified Rational Method

Length (m)	60	m
Area (ha)	0.910	Ha
Max Height	131.5	mAOD
Min Height	131.1	mAOD
DeltaH	0.3	
Slope (%)	0.55	
Te (mins)	15.11	mins
ARF	0.998	
SAAR	689.000	mm
UCWI	63	mm
PIMP	100.0	%
SOIL	0.39	
Percentage Runoff PR	76.86	
DEEPSTOR	0.95	

Cv	0.76864	
Cr	1.3	
allowable outflow		
100 year + 30% cc	0.104	m³/s

m3

Storage	RT years	Storage
	100	282

Return Period flood 100+cc years

Post Development Rainfall 140 years

OUTFALL 1: COMBINED SEWER AT DODWORTH ROAD

Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	30% increase	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)	RUN-OFF FLOW (m³)	RUN-OFF RAIN (m³)	Allowable Outflow (m³)	Difference (m³)
0.25	0.010	31.74	41.262	41.2	127.0	320.9	352.7	289	375	93.60	282
0.5	0.021	38.11	49.543	49.5	76.2	192.7	211.7	347	450	187.20	263
0.75	0.031	42.34	55.042	55.0	56.5	142.7	156.8	385	500	280.80	220
1	0.042	45.6	59.28	59.2	45.6	115.3	126.7	415	539	374.40	165
1.25	0.052	48.29	62.777	62.7	38.6	97.7	107.3	439	571	468.00	103
1.5	0.063	50.6	65.78	65.7	33.7	85.3	93.7	460	598	561.60	37
1.75	0.073	52.63	68.419	68.4	30.1	76.0	83.5	479	622	655.20	-33
2	0.083	54.45	70.785	70.7	27.2	68.8	75.6	496	644	748.80	-105
2.25	0.094	56.1	72.93	72.9	24.9	63.0	69.3	511	663	842.40	-179
2.5	0.104	57.62	74.906	74.8	23.0	58.3	64.0	524	681	936.00	-255
2.75	0.115	59.03	76.739	76.7	21.5	54.3	59.6	537	698	1029.60	-332
3	0.125	60.34	78.442	78.4	20.1	50.8	55.9	549	713	1123.20	-410
3.25	0.135	61.57	80.041	80.0	18.9	47.9	52.6	560	728	1216.80	-489
3.5	0.146	62.74	81.562	81.5	17.9	45.3	49.8	571	742	1310.40	-569
3.75	0.156	63.84	82.992	82.9	17.0	43.0	47.3	581	755	1404.00	-649
4	0.167	64.89	84.357	84.3	16.2	41.0	45.1	591	767	1497.60	-731
4.25	0.177	65.89	85.657	85.6	15.5	39.2	43.1	600	779	1591.20	-812
4.5	0.188	66.84	86.892	86.8	14.9	37.5	41.3	608	790	1684.80	-895
4.75	0.198	67.76	88.088	88.0	14.3	36.1	39.6	617	801	1778.40	-977
5	0.208	68.64	89.232	89.2	13.7	34.7	38.1	625	811	1872.00	-1061
5.25	0.219	69.48	90.324	90.3	13.2	33.5	36.8	632	821	1965.60	-1144
5.5	0.229	70.3	91.39	91.3	12.8	32.3	35.5	640	831	2059.20	-1228
5.75	0.240	71.09	92.417	92.3	12.4	31.3	34.3	647	840	2152.80	-1312
6	0.250	71.85	93.405	93.3	12.0	30.3	33.3	654	849	2246.40	-1397
6.25	0.260	72.59	94.367	94.3	11.6	29.4	32.3	661	858	2340.00	-1482
6.5	0.271	73.31	95.303	95.2	11.3	28.5	31.3	667	867	2433.60	-1567
6.75	0.281	74.01	96.213	96.1	11.0	27.7	30.5	674	875	2527.20	-1652
7	0.292	74.69	97.097	97.0	10.7	27.0	29.6	680	883	2620.80	-1738
7.25	0.302	75.34	97.942	97.9	10.4	26.3	28.9	686	891	2714.40	-1824
7.5	0.313	75.99	98.787	98.7	10.1	25.6	28.1	692	898	2808.00	-1910
7.75	0.323	76.61	99.593	99.5	9.9	25.0	27.5	697	906	2901.60	-1996
8	0.333	77.23	100.399	100.3	9.7	24.4	26.8	703	913	2995.20	-2082
8.25	0.344	77.82	101.166	101.1	9.4	23.8	26.2	708	920	3088.80	-2169
8.5	0.354	78.41	101.933	101.9	9.2	23.3	25.6	714	927	3182.40	-2256
8.75	0.365	78.98	102.674	102.6	9.0	22.8	25.1	719	934	3276.00	-2342
9	0.375	79.53	103.389	103.3	8.8	22.3	24.5	724	940	3369.60	-2429
9.25	0.385	80.08	104.104	104.0	8.7	21.9	24.0	729	947	3463.20	-2517
9.5	0.396	80.62	104.806	104.7	8.5	21.5	23.6	734	953	3556.80	-2604
9.75	0.406	81.14	105.482	105.4	8.3	21.0	23.1	738	959	3650.40	-2691
10	0.417	81.66	106.158	106.1	8.2	20.6	22.7	743	965	3744.00	-2779

Modified Rational Method

Length (m)	135	m
Area (ha)	0.160	Ha
Max Height	135.7	mAOD
Min Height	129.6	mAOD
DeltaH	6.1	
Slope (%)	4 52	
Te (mins)	9 45	mins
ARF	0 999	
SAAR	689.000	mm
UCWI	63	mm
PIMP	100.0	%
SOIL	0.39	
Percentage Runoff PR	76 86	
DEEPSTOR	0 34	

Cv	0 76864	
Cr	1.3	
allowable outflow		
2 year	0.008	m^3/s

Storage	RT years	Storage m3
	2	4

Return Period flood 2 years — OUTFALL 2: SURFACE WATER SEWER

Post Development Rainfall 2 years

Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)	RUN-OFF FLOW (m^3)	RUN-OFF RAIN (m^3)	Allowable Outflow (m^3)	Difference (m^3)
0.25	0.010	6.77	6.8	27.1	12.0	75.2	11	11	7.20	4
0.5	0.021	8.83	8.8	17.7	7.8	49.1	14	14	14.40	0
0.75	0.031	10.29	10.3	13.7	6.1	38.1	16	16	21.60	-5
1	0.042	11.47	11.5	11.5	5.1	31.9	18	18	28.80	-10
1.25	0.052	12.47	12.5	10.0	4.4	27.7	20	20	36.00	-16
1.5	0.063	13.35	13.3	8.9	4.0	24.7	21	21	43.20	-22
1.75	0.073	14.15	14.1	8.1	3.6	22.5	23	23	50.40	-28
2	0.083	14.87	14.9	7.4	3.3	20.7	24	24	57.60	-34
2.25	0.094	15.54	15.5	6.9	3.1	19.2	25	25	64.80	-40
2.5	0.104	16.16	16.1	6.5	2.9	18.0	26	26	72.00	-46
2.75	0.115	16.74	16.7	6.1	2.7	16.9	27	27	79.20	-52
3	0.125	17.29	17.3	5.8	2.6	16.0	28	28	86.40	-59
3.25	0.135	17.82	17.8	5.5	2.4	15.2	29	28	93.60	-65
3.5	0.146	18.31	18.3	5.2	2.3	14.5	29	29	100.80	-72
3.75	0.156	18.79	18.8	5.0	2.2	13.9	30	30	108.00	-78
4	0.167	19.24	19.2	4.8	2.1	13.4	31	31	115.20	-84
4.25	0.177	19.68	19.7	4.6	2.1	12.9	31	31	122.40	-91
4.5	0.188	20.1	20.1	4.5	2.0	12.4	32	32	129.60	-97
4.75	0.198	20.51	20.5	4.3	1.9	12.0	33	33	136.80	-104
5	0.208	20.9	20.9	4.2	1.9	11.6	33	33	144.00	-111
5.25	0.219	21.28	21.3	4.1	1.8	11.3	34	34	151.20	-117
5.5	0.229	21.65	21.6	3.9	1.7	10.9	35	35	158.40	-124
5.75	0.240	22.01	22.0	3.8	1.7	10.6	35	35	165.60	-130
6	0.250	22.36	22.3	3.7	1.7	10.4	36	36	172.80	-137
6.25	0.260	22.7	22.7	3.6	1.6	10.1	36	36	180.00	-144
6.5	0.271	23.03	23.0	3.5	1.6	9.8	37	37	187.20	-150
6.75	0.281	23.36	23.3	3.5	1.5	9.6	37	37	194.40	-157
7	0.292	23.67	23.7	3.4	1.5	9.4	38	38	201.60	-164
7.25	0.302	23.98	24.0	3.3	1.5	9.2	38	38	208.80	-170
7.5	0.313	24.28	24.3	3.2	1.4	9.0	39	39	216.00	-177
7.75	0.323	24.58	24.6	3.2	1.4	8.8	39	39	223.20	-184
8	0.333	24.87	24.9	3.1	1.4	8.6	40	40	230.40	-191
8.25	0.344	25.15	25.1	3.0	1.4	8.5	40	40	237.60	-197
8.5	0.354	25.43	25.4	3.0	1.3	8.3	41	41	244.80	-204
8.75	0.365	25.7	25.7	2.9	1.3	8.2	41	41	252.00	-211
9	0.375	25.97	26.0	2.9	1.3	8.0	42	42	259.20	-218
9.25	0.385	26.24	26.2	2.8	1.3	7.9	42	42	266.40	-224
9.5	0.396	26.5	26.5	2.8	1.2	7.7	42	42	273.60	-231
9.75	0.406	26.75	26.7	2.7	1.2	7.6	43	43	280.80	-238
10	0.417	27	27.0	2.7	1.2	7.5	43	43	288.00	-245

Modified Rational Method

Length (m)	135	m
Area (ha)	0.160	Ha
Max Height	135.7	mAOD
Min Height	129.6	mAOD
DeltaH	6.1	
Slope (%)	4.52	
Te (mins)	9.45	mins
ARF	0.999	
SAAR	689.000	mm
UCWI	63	mm
PIMP	100.0	%
SOIL	0.39	
Percentage Runoff PR	76.86	
DEEPSTOR	0.34	

Cv	0.76864	
Cr	1.3	
allowable outflow		
30 year	0.008	m^3/s

Storage	RT years	Storage m3
	30	29

Return Period flood 30 years

Post Development Rainfall 50 years

OUTFALL 2: SURFACE WATER SEWER

Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)	RUN-OFF FLOW (m^3)	RUN-OFF RAIN (m^3)	Allowable Outflow (m^3)	Difference (m^3)
0.25	0.010	22.37	22.4	89.5	39.8	248.6	36	36	7.20	29
0.5	0.021	27.35	27.3	54.7	24.3	151.9	44	44	14.40	29
0.75	0.031	30.73	30.7	41.0	18.2	113.8	49	49	21.60	28
1	0.042	33.35	33.3	33.4	14.8	92.6	53	53	28.80	25
1.25	0.052	35.53	35.5	28.4	12.6	79.0	57	57	36.00	21
1.5	0.063	37.41	37.4	24.9	11.1	69.3	60	60	43.20	17
1.75	0.073	39.07	39.0	22.3	9.9	62.0	63	62	50.40	12
2	0.083	40.57	40.5	20.3	9.0	56.3	65	65	57.60	7
2.25	0.094	41.94	41.9	18.6	8.3	51.8	67	67	64.80	2
2.5	0.104	43.19	43.2	17.3	7.7	48.0	69	69	72.00	-3
2.75	0.115	44.36	44.3	16.1	7.2	44.8	71	71	79.20	-8
3	0.125	45.46	45.4	15.2	6.7	42.1	73	73	86.40	-14
3.25	0.135	46.49	46.5	14.3	6.4	39.7	74	74	93.60	-19
3.5	0.146	47.46	47.4	13.6	6.0	37.7	76	76	100.80	-25
3.75	0.156	48.38	48.3	12.9	5.7	35.8	77	77	108.00	-31
4	0.167	49.26	49.2	12.3	5.5	34.2	79	79	115.20	-36
4.25	0.177	50.1	50.1	11.8	5.2	32.7	80	80	122.40	-42
4.5	0.188	50.91	50.9	11.3	5.0	31.4	81	81	129.60	-48
4.75	0.198	51.68	51.6	10.9	4.8	30.2	83	83	136.80	-54
5	0.208	52.42	52.4	10.5	4.7	29.1	84	84	144.00	-60
5.25	0.219	53.14	53.1	10.1	4.5	28.1	85	85	151.20	-66
5.5	0.229	53.83	53.8	9.8	4.4	27.2	86	86	158.40	-72
5.75	0.240	54.5	54.5	9.5	4.2	26.3	87	87	165.60	-78
6	0.250	55.15	55.1	9.2	4.1	25.5	88	88	172.80	-85
6.25	0.260	55.78	55.7	8.9	4.0	24.8	89	89	180.00	-91
6.5	0.271	56.39	56.3	8.7	3.9	24.1	90	90	187.20	-97
6.75	0.281	56.98	56.9	8.4	3.8	23.4	91	91	194.40	-103
7	0.292	57.56	57.5	8.2	3.7	22.8	92	92	201.60	-110
7.25	0.302	58.13	58.1	8.0	3.6	22.3	93	93	208.80	-116
7.5	0.313	58.67	58.6	7.8	3.5	21.7	94	94	216.00	-122
7.75	0.323	59.21	59.2	7.6	3.4	21.2	95	95	223.20	-129
8	0.333	59.73	59.7	7.5	3.3	20.7	96	95	230.40	-135
8.25	0.344	60.25	60.2	7.3	3.2	20.3	96	96	237.60	-141
8.5	0.354	60.75	60.7	7.1	3.2	19.9	97	97	244.80	-148
8.75	0.365	61.24	61.2	7.0	3.1	19.4	98	98	252.00	-154
9	0.375	61.72	61.7	6.9	3.0	19.0	99	99	259.20	-161
9.25	0.385	62.19	62.1	6.7	3.0	18.7	100	99	266.40	-167
9.5	0.396	62.65	62.6	6.6	2.9	18.3	100	100	273.60	-173
9.75	0.406	63.1	63.1	6.5	2.9	18.0	101	101	280.80	-180
10	0.417	63.54	63.5	6.4	2.8	17.7	102	102	288.00	-186

Modified Rational Method

Length (m)	135	m
Area (ha)	0.160	Ha
Max Height	135.7	mAOD
Min Height	129.6	mAOD
DeltaH	6.1	
Slope (%)	4.52	
Te (mins)	9.45	mins
ARF	0.999	
SAAR	689.000	mm
UCWI	63	mm
PIMP	100.0	%
SOIL	0.39	
Percentage Runoff PR	76.86	
DEEPSTOR	0.34	

Cv	0.76864	
Cr	1.3	
allowable outflow		
100 year +30% cc	0.008	m^3/s

m3

Storage	RT years	Storage
	100	66

Return Period: flood 100+cc years

Post Development: Rainfall 140 years

OUTFALL 2: SURFACE WATER SEWER

Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	30% increase	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)	RUN-OFF FLOW (m³)	RUN-OFF RAIN (m³)	Allowable Outflow (m³)	Difference (m³)
0.25	0.010	31.74	41.262	41.2	127.0	56.4	352.7	51	66	7.20	59
0.5	0.021	38.11	49.543	49.5	76.2	33.9	211.7	61	79	14.40	65
0.75	0.031	42.34	55.042	55.0	56.5	25.1	156.8	68	88	21.60	66
1	0.042	45.6	59.28	59.2	45.6	20.3	126.7	73	95	28.80	66
1.25	0.052	48.29	62.777	62.7	38.6	17.2	107.3	77	100	36.00	64
1.5	0.063	50.6	65.78	65.7	33.7	15.0	93.7	81	105	43.20	62
1.75	0.073	52.63	68.419	68.4	30.1	13.4	83.5	84	109	50.40	59
2	0.083	54.45	70.785	70.7	27.2	12.1	75.6	87	113	57.60	56
2.25	0.094	56.1	72.93	72.9	24.9	11.1	69.3	90	117	64.80	52
2.5	0.104	57.62	74.906	74.8	23.0	10.2	64.0	92	120	72.00	48
2.75	0.115	59.03	76.739	76.7	21.5	9.5	59.6	94	123	79.20	43
3	0.125	60.34	78.442	78.4	20.1	8.9	55.9	97	125	86.40	39
3.25	0.135	61.57	80.041	80.0	18.9	8.4	52.6	99	128	93.60	34
3.5	0.146	62.74	81.562	81.5	17.9	8.0	49.8	100	130	100.80	30
3.75	0.156	63.84	82.992	82.9	17.0	7.6	47.3	102	133	108.00	25
4	0.167	64.89	84.357	84.3	16.2	7.2	45.1	104	135	115.20	20
4.25	0.177	65.89	85.657	85.6	15.5	6.9	43.1	105	137	122.40	15
4.5	0.188	66.84	86.892	86.8	14.9	6.6	41.3	107	139	129.60	9
4.75	0.198	67.76	88.088	88.0	14.3	6.3	39.6	108	141	136.80	4
5	0.208	68.64	89.232	89.2	13.7	6.1	38.1	110	143	144.00	-1
5.25	0.219	69.48	90.324	90.3	13.2	5.9	36.8	111	144	151.20	-7
5.5	0.229	70.3	91.39	91.3	12.8	5.7	35.5	112	146	158.40	-12
5.75	0.240	71.09	92.417	92.3	12.4	5.5	34.3	114	148	165.60	-18
6	0.250	71.85	93.405	93.3	12.0	5.3	33.3	115	149	172.80	-23
6.25	0.260	72.59	94.367	94.3	11.6	5.2	32.3	116	151	180.00	-29
6.5	0.271	73.31	95.303	95.2	11.3	5.0	31.3	117	152	187.20	-35
6.75	0.281	74.01	96.213	96.1	11.0	4.9	30.5	118	154	194.40	-41
7	0.292	74.69	97.097	97.0	10.7	4.7	29.6	120	155	201.60	-46
7.25	0.302	75.34	97.942	97.9	10.4	4.6	28.9	121	157	208.80	-52
7.5	0.313	75.99	98.787	98.7	10.1	4.5	28.1	122	158	216.00	-58
7.75	0.323	76.61	99.593	99.5	9.9	4.4	27.5	123	159	223.20	-64
8	0.333	77.23	100.399	100.3	9.7	4.3	26.8	124	161	230.40	-70
8.25	0.344	77.82	101.166	101.1	9.4	4.2	26.2	125	162	237.60	-76
8.5	0.354	78.41	101.933	101.9	9.2	4.1	25.6	125	163	244.80	-82
8.75	0.365	78.98	102.674	102.6	9.0	4.0	25.1	126	164	252.00	-88
9	0.375	79.53	103.389	103.3	8.8	3.9	24.5	127	165	259.20	-94
9.25	0.385	80.08	104.104	104.0	8.7	3.8	24.0	128	166	266.40	-100
9.5	0.396	80.62	104.806	104.7	8.5	3.8	23.6	129	168	273.60	-106
9.75	0.406	81.14	105.482	105.4	8.3	3.7	23.1	130	169	280.80	-112
10	0.417	81.66	106.158	106.1	8.2	3.6	22.7	131	170	288.00	-118

Modified Rational Method

Length (m)	135	m
Area (ha)	0.160	Ha
Max Height	135.7	mAOD
Min Height	129.6	mAOD
DeltaH	6.1	
Slope (%)	4.52	
Te (mins)	9.45	mins
ARF	0.999	
SAAR	689.000	mm
UCWI	63	mm
PIMP	100.0	%
SOIL	0.39	
Percentage Runoff PR	76.86	
DEEPSTOR	0.41	

Cv	0.76864	
Cr	1.3	
allowable outflow		
100 year	0.008	m^3/s

Storage	RT years	Storage
		m3
	100	47

Return Period flood 100 years — OUTFALL 2: SURFACE WATER SEWER

Post Development Rainfall 140 years

Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)	RUN-OFF FLOW (m^3)	RUN-OFF RAIN (m^3)	Allowable Outflow (m^3)	Difference (m^3)
0.25	0.010	31.74	31.7	127.0	56.4	352.7	51	51	7.20	44
0.5	0.021	38.11	38.1	76.2	33.9	211.7	61	61	14.40	47
0.75	0.031	42.34	42.3	56.5	25.1	156.8	68	68	21.60	46
1	0.042	45.6	45.6	45.6	20.3	126.7	73	73	28.80	44
1.25	0.052	48.29	48.3	38.6	17.2	107.3	77	77	36.00	41
1.5	0.063	50.6	50.6	33.7	15.0	93.7	81	81	43.20	38
1.75	0.073	52.63	52.6	30.1	13.4	83.5	84	84	50.40	34
2	0.083	54.45	54.4	27.2	12.1	75.6	87	87	57.60	29
2.25	0.094	56.1	56.1	24.9	11.1	69.3	90	90	64.80	25
2.5	0.104	57.62	57.6	23.0	10.2	64.0	92	92	72.00	20
2.75	0.115	59.03	59.0	21.5	9.5	59.6	94	94	79.20	15
3	0.125	60.34	60.3	20.1	8.9	55.9	97	96	86.40	10
3.25	0.135	61.57	61.5	18.9	8.4	52.6	99	98	93.60	5
3.5	0.146	62.74	62.7	17.9	8.0	49.8	100	100	100.80	0
3.75	0.156	63.84	63.8	17.0	7.6	47.3	102	102	108.00	-6
4	0.167	64.89	64.8	16.2	7.2	45.1	104	104	115.20	-11
4.25	0.177	65.89	65.8	15.5	6.9	43.1	105	105	122.40	-17
4.5	0.188	66.84	66.8	14.9	6.6	41.3	107	107	129.60	-23
4.75	0.198	67.76	67.7	14.3	6.3	39.6	108	108	136.80	-28
5	0.208	68.64	68.6	13.7	6.1	38.1	110	110	144.00	-34
5.25	0.219	69.48	69.4	13.2	5.9	36.8	111	111	151.20	-40
5.5	0.229	70.3	70.2	12.8	5.7	35.5	112	112	158.40	-46
5.75	0.240	71.09	71.0	12.4	5.5	34.3	114	114	165.60	-52
6	0.250	71.85	71.8	12.0	5.3	33.3	115	115	172.80	-58
6.25	0.260	72.59	72.5	11.6	5.2	32.3	116	116	180.00	-64
6.5	0.271	73.31	73.3	11.3	5.0	31.3	117	117	187.20	-70
6.75	0.281	74.01	74.0	11.0	4.9	30.5	118	118	194.40	-76
7	0.292	74.69	74.6	10.7	4.7	29.6	120	119	201.60	-82
7.25	0.302	75.34	75.3	10.4	4.6	28.9	121	120	208.80	-88
7.5	0.313	75.99	75.9	10.1	4.5	28.1	122	121	216.00	-95
7.75	0.323	76.61	76.6	9.9	4.4	27.5	123	122	223.20	-101
8	0.333	77.23	77.2	9.7	4.3	26.8	124	123	230.40	-107
8.25	0.344	77.82	77.8	9.4	4.2	26.2	125	124	237.60	-113
8.5	0.354	78.41	78.3	9.2	4.1	25.6	125	125	244.80	-119
8.75	0.365	78.98	78.9	9.0	4.0	25.1	126	126	252.00	-126
9	0.375	79.53	79.5	8.8	3.9	24.5	127	127	259.20	-132
9.25	0.385	80.08	80.0	8.7	3.8	24.0	128	128	266.40	-138
9.5	0.396	80.62	80.6	8.5	3.8	23.6	129	129	273.60	-145
9.75	0.406	81.14	81.1	8.3	3.7	23.1	130	130	280.80	-151
10	0.417	81.66	81.6	8.2	3.6	22.7	131	131	288.00	-157

D - Dunkirk - 3 Bed Detached	10	79.4	822	793.7	8228		
M - Millbrook - 4 Bed Detached	9	88.9	1000	891.3	9994		
S - Stonepillow - 4 Bed Detached	11	146.9	1584	1290.9	13934		
S - Sevenings - 4 Bed Detached	9	122.4	1318	1120.9	12062		
CH - Chesterwith - 4 Bed Detached	6	135.3	1456	812.7	8740		
TOTAL FLOOR AREA (GROSS INTERNAL)	49			4908.5	52158		

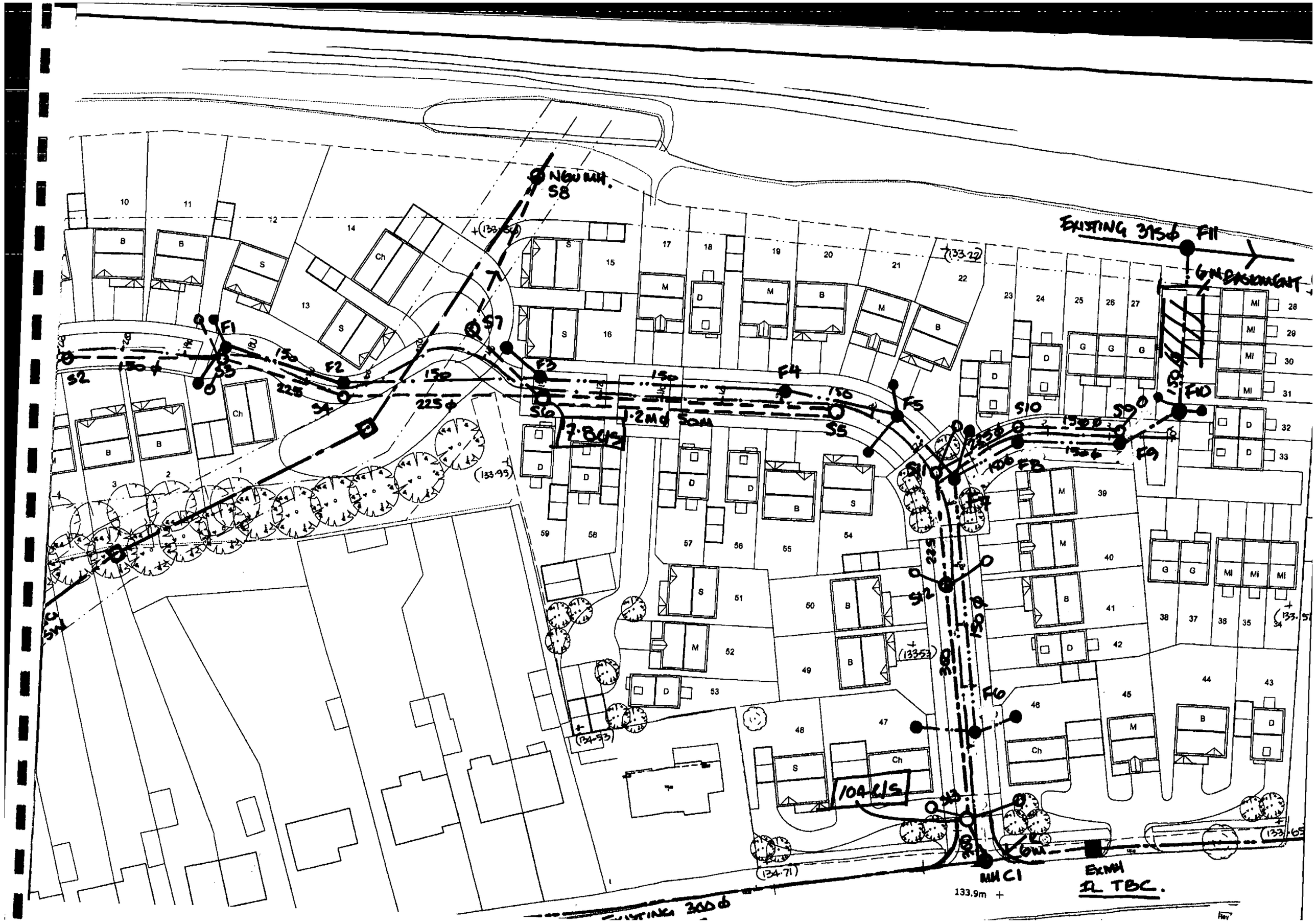
MH SCHEDULE FOUL WATER

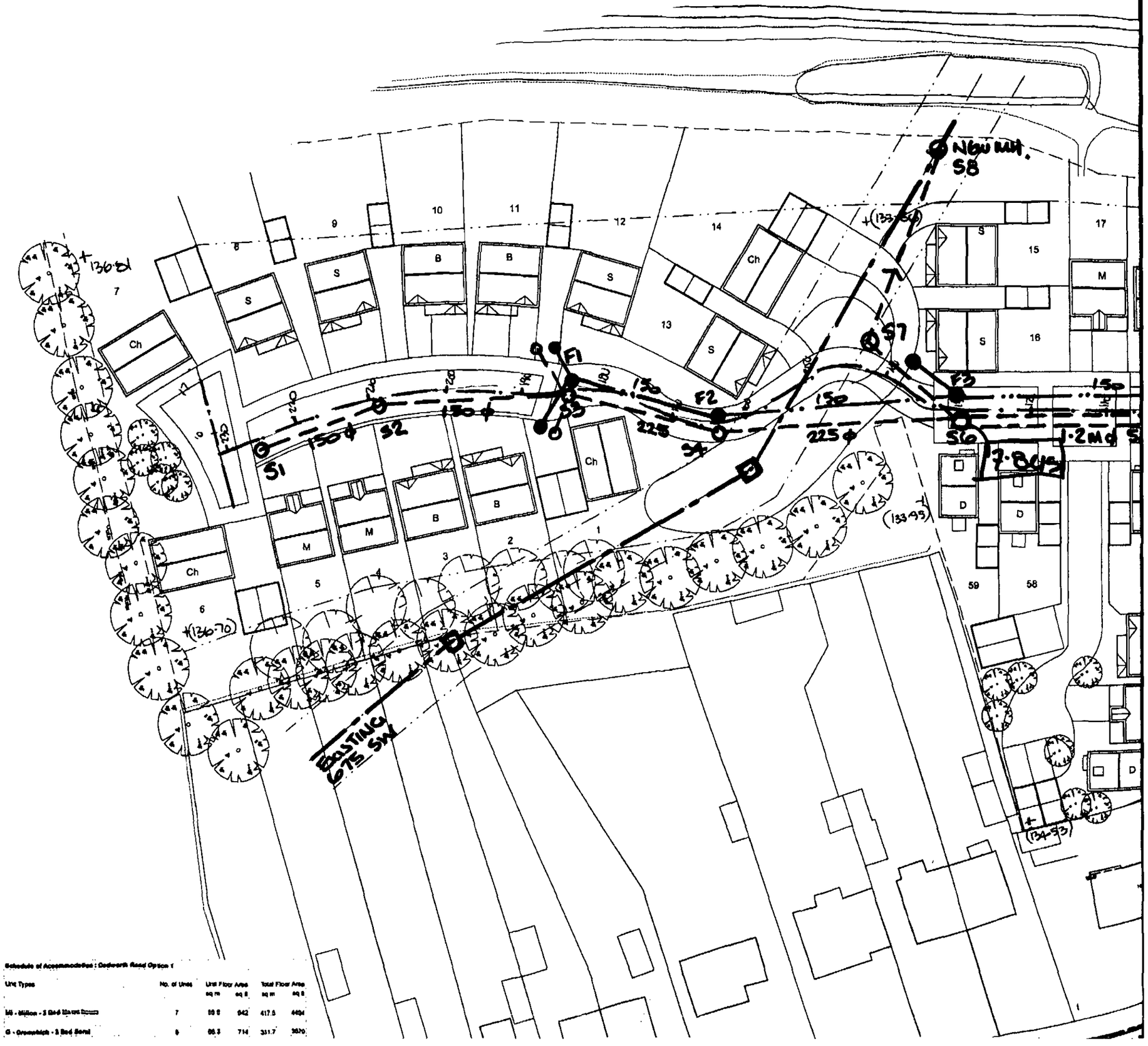
RtC	Cover lvl	Invert	LVL	RING ⌀		CL	IL
F1	135.45	134.25		1200	F11	130.00 CAPPIOX	128.50
F2	134.7	133.93		1200			
F3	134.0	132.50		1200			
F4	133.6	132.100		1200			
F5	133.65	131.97		1200			
F6	133.600		132.100	1200			
F7	133.500		131.680	1200			
F8	133.25		131.600	1200			
F9	133.00		131.480	1200			
F10	133.00		131.400				

MH SCHEDULE: SURFACE WATER

	REF	COVER LEVEL	INVERT LEVEL	RING Ø
IL	S1	136.7	135.7	1200
128.50	S2	136.3	135.1	1200
	S3	135.45	134.05	1200
	S4	134.7	133.05	1200
	S5	133.6	131.20	2.1 Ø
	S6	134.00	131.10	2.1 Ø HYDROBRAKE
	S7	134.00	131.00	
	S8	133.00	129.6	1200 Ø (IL TBC)
	S9	133.00	131.80	1200 Ø
	S10	133.25	131.63	1200 Ø

REF	COVER LVL
S11	133.6
S12	133.60
S13	133.80
C1	133.9


NEW MH.
S8
S7
S6
S5
S4
S3
S2
S1
S10
S9
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
F11
1·2MØ SOM
7·8 l/s
104 l/s
225Ø
150Ø
100 FB
EXISTING 315Ø
GW EASEMENT
EXISTING 300Ø
MH C1
133.9m +
EXMH
@ TBC.
(133·99)
(133·22)
(134·53)
(134·71)
(133·53)



Schedule of Accommodation : Cedworth Road Option 1

Unit Types	No. of Units	Unit Floor Area sq m	sq ft	Total Floor Area sq m	sq ft
M - Milton - 3 Bed Mews House	7	88.8	942	417.5	4494
G - Greenleigh - 3 Bed Semi	6	66.3	714	331.7	3570