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civil and structural engineering consultants

structural design
building surveyors
cdm co-ordinators
civil engineering
highway design

Drainage Assessment Report

Bradley Masterplannning

Bradley, Huddersfield

For

Kirklees COUNCIL

January 2016

13892L/AB/DAR

Mason Clark Associates
Unit E, Millshaw Business Living, Global Avenue, Beeston, Leeds LS11 8PR
t 0113 277 9542 f 0113 277 4738 e consultants@masonclark.co.uk

Hull Office
Church House, 44 Newland Park, Kingston upon Hull HU5 2DW
t 01482 345797 f 01482 345413 e consultants@masonclark.co.uk

www.masonclark.co.uk

Registered Office: 46 Newland Park, Hull HU5 2DW Registered in England No. 2537113

Prepared by:	Adam Branston	A Branston
Checked by:	Gavin Shepherd	

Revision	Comments	Date
-	Initial issue	25.01.2016
A	Planning consultant comments	29.01.2015

1. Introduction.

Mason Clark Associates have been commissioned by O'Neill Associates to carry out a high level flood risk assessment on behalf of Kirklees Council for a proposed development site in Bradley, Huddersfield, West Yorkshire. A location plan is presented in Appendix I.

This drainage assessment is carried out in accordance with the requirements of the National Planning Policy Guidance (NPPG) and the Environment Agency Guidance Note 3. As full details of the site are not available at this stage in the planning process, the assessment has been prepared using our best engineering judgement where full technical information is not available.

The object of the assessment is to demonstrate that a drainage solution exists for the site, not to produce a technical design.

2. General description of the Site.

The proposed development site covers mainly the existing Bradley Golf Course, near Huddersfield, but also incorporates some agricultural fields as well and buildings at Bradley Villa Farm.

The proposed site is bounded by the M62 motorway to the North West, a quarry to the North East and residential housing to the East, South and West.

Access to the site is available from either the existing golf club entrance on the A6107 Bradley Road, or from the farm access off the A641 Huddersfield road, there is also access from the end of Tithe House Way at the Eastern end of the site.

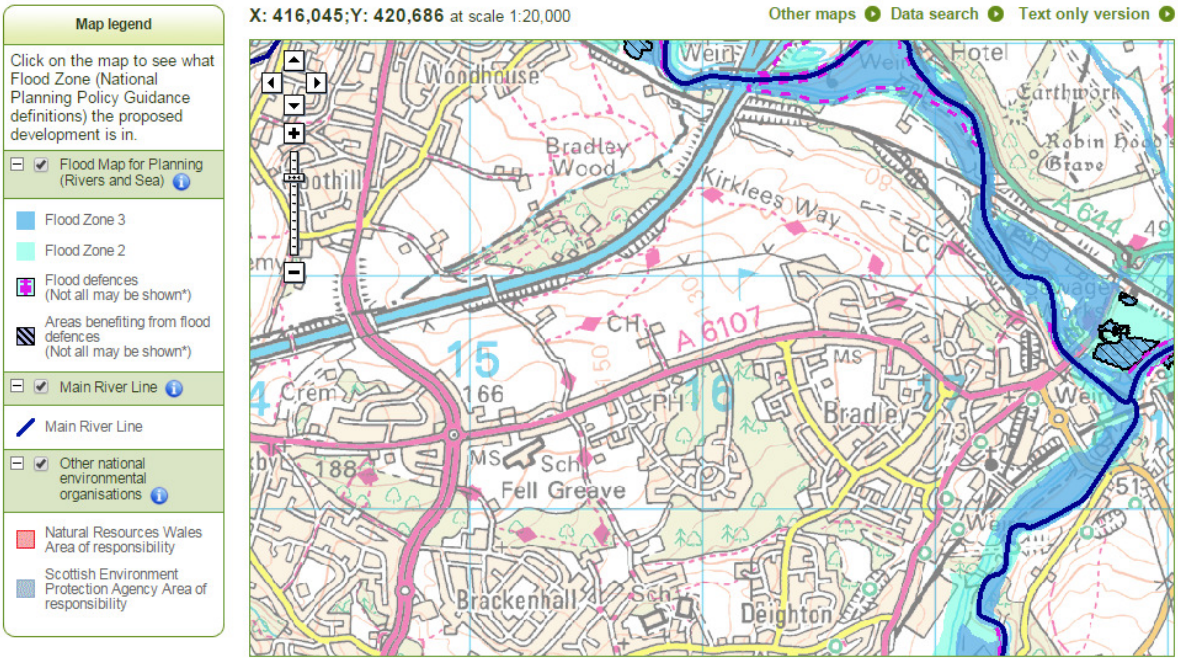
Lidar data has been used to establish the general topography of the site, which shows there is a general fall from southwest to northeast but this is undulating with local falls in all directions.

There is a significant level difference across the site with the high point being 167m AOD dropping to 93m AOD at the lowest point. Levels are based on LiDAR levels and have been taken at the eastern and western extremities of the site.

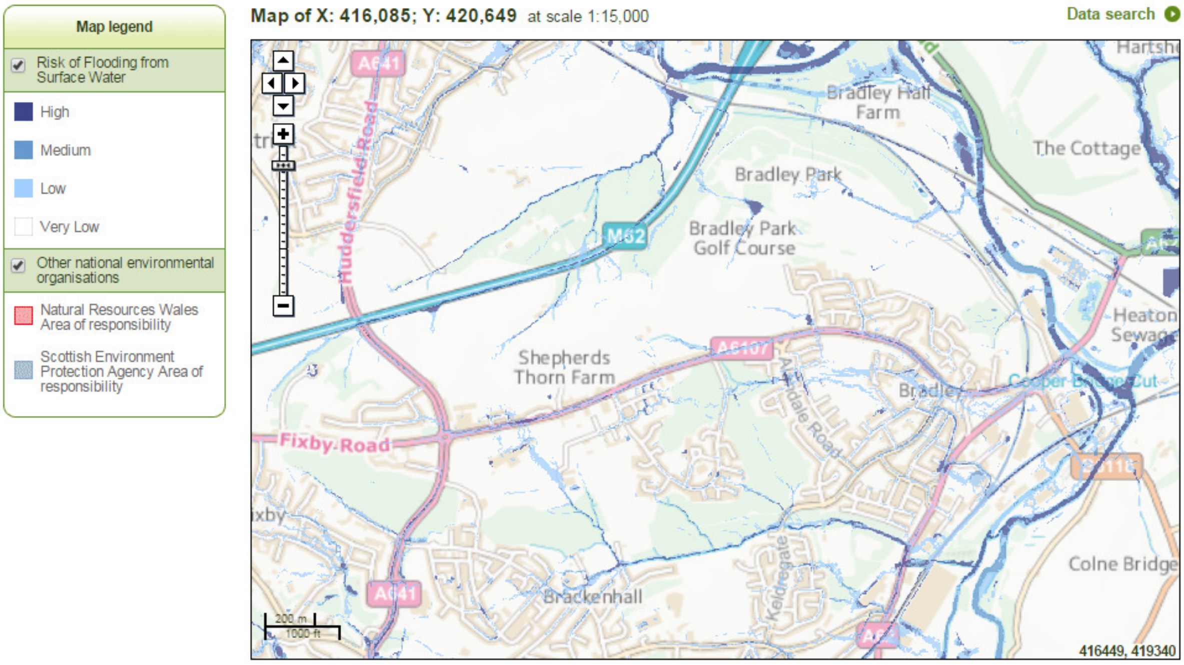
A plan showing existing 1m contours taken from Lidar can be found in Appendix II.

3. General observations.

By reference to the Environment Agency's Indicative Flood Map, the site is located in flood zone 1. Flood Zone 1 is defined in the National Planning Practice Guidance for Flood Risk and Coastal Change as a site with low annual probability of flooding. The zone comprises of land assessed as having less than 1 in 1,000 annual probability of river or sea flooding (<0.1%). As can be seen the Environment Agency flood map below:



The following Environment Agency map shows the areas at risk from surface water flooding and the flow paths to/from existing watercourses.



4. Surface Water Drainage Proposals.

Requirement H3 of the Building Regulations 2010 states that a hierarchy for surface water disposal should be considered, where priority should be given to soakaway/infiltration system, watercourse and as a last resort, sewers.

The Lead Local Flood Authority (LLFA) is keen for this development to be an exemplar site for sustainable drainage systems (SuDS). Therefore, Surface Water drainage systems serving the development should be designed with Suds in mind.

Sustainable drainage aims to mimic the natural surface water runoff by managing rainfall within close proximity to where it falls. SuDS systems can be designed to slow the runoff from developed areas to a more natural flow rate before infiltrating into the ground or entering into rivers and other watercourses. Above ground 'green' SuDS can be used to convey and store water in swales, ponds and detention basins, before allowing discharge to watercourse or infiltration into the ground. Below ground attenuation tanks can also be used to hold water before passing through a flow control device which will limit the flow to a predetermined rate.

Ground investigation and soakaway testing should take place across the site to determine whether the ground is suitable for infiltration. The development area covers a large expanse of land and it is possible that although the ground may be suitable for infiltration in one location it may not be possible in others. In this instance surface water should discharge to watercourses in the vicinity (discharge to watercourses will need to be approved by the LLFA or Environment Agency).

There are several inland watercourses that run from within the site, which can be seen on the plan found in Appendix II. Surface water drainage should be designed where infiltration is not possible to discharge to these, with prior agreement.

Direct connections with no further works may be possible to the watercourses that run from the northwest of the site beneath the M62 motorway and the watercourse that runs off site to southeast and beneath Bradley road. The watercourse shown running to a pond at the northeast of the site would require an engineered solution to create an outfall to the River Calder. This would involve the construction of a new overflow channel/watercourse to convey flows to the River Calder via the route shown on the EA surface water flood map shown in section 3 and on the plan found in Appendix II.

In order to determine discharge rates to the watercourses, liaison with the Environment Agency (EA), LLFA and/or the local Internal Drainage Board (IDB) should begin at the earliest stage possible. As the existing ground is practically 100% permeable, discharge to any watercourses is likely to be set at green field runoff rate of 1.4 l/s/ha.

Sufficient green space should be designed into the layout of the development for the implementation of SuDS techniques.

The use of swales that run alongside carriageways could be designed into the overall layout to convey surface runoff from highways and curtilage impermeable areas to ponds/detention basins. This could reduce the need for below ground surface water sewers.

Any above ground SuDS that are implemented would require a maintenance regime putting in place and/or adoption by the local authority. Any maintenance regime would require the approval of the local authority/approving body.

In the event that below ground sewers are required to convey surface runoff, these can be put forward for adoption by Yorkshire Water under S104 agreements. Public sewers are for domestic drainage only and as such highway runoff has no right to drain to public sewers. With this in mind any below ground sewers that do not take runoff from domestic properties would need to be adopted by the local highway authority.

Discharge to watercourses are to be controlled via the use of flow control devices such as Hydro-Brakes, weir walls, penstocks and orifice plates. The approving body will have the final say on the appropriateness of the device used at particular locations.

All below ground surface water drainage should be designed and constructed to the current adoptable standards. At the time of writing this is Sewers for Adoption 7th Edition.

Site Layout and Proposed Impermeable Areas

Several potential layouts for the development have been provided by the Architects, these can be found in Appendix III. From these, and using Micro-Drainage Source Control, we have estimated the details below:

Area of development = 56.44 ha (based on the Eco Boulevard option which is perceived as the worst case scenario in terms of potential developed impermeable area).

Discharge rate based on greenfield runoff rate – 1.4 l/s/ha.

Surface Water storage requirements based on impermeable percentage of developed land:

% of Impermeable Ground	Impermeable Area (ha)	Storage Required (m^3)	Approximate land required for above ground green SuDS @ 1m depth (m^2)*
100%	56.44	51,449	60,000
90%	50.80	46,325	55,000
80%	45.15	41,120	49,000
70%	39.51	36,086	43,000
60%	33.86	30,931	37,500
50%	28.22	25,642	32,000

Based on a 1:30 year storm event + 30% Climate change.

*Land requirement figures have been estimated assuming that all surface water storage would be above ground in open ponds/swales with 1:10 gradient side slopes.

<u>The figures shown in the above table are estimates only and should not be used for design purposes.</u>

Micro-Drainage Quick Storage Estimates can be found in Appendix IV.

The above storage estimates are overall site volumes and would require dividing up to provide adequate storage for each part of the development depending on future layout and topography.

The three other options put forward by the Architects have a potential developable area of 45.3ha (North Park) & 37 ha (Urban Fingers & Central Park). The Eco Boulevard option has been used to determine the above storage requirements as this has the largest developable area and therefore has potentially the most impermeable area. It is also the smallest in terms of density which could mean there is potentially more space available for SuDS options to be used.

Master Plan Option 1 – Central Park

This option offers opportunities to create fingers of woodland wildlife network running north south through the site. The housing has been designed in clusters between which bands of woodland and open green space connect Bradley Wood to the north with Screamer Wood to the south. These bands of open green space provides opportunities for surface water retention in the form of designed swales and semi-wetland habitats as well as open green recreational space for community leisure use.

As the existing ground falls significantly from Southwest to Northeast the proposed layout of the site should also follow this gradient. This option has areas of green space between areas of developed land. These have the potential to be used for locating surface water storage facilities that would take flows from the developed areas positioned higher up the hill. These can then discharge into the closest of the onsite watercourses.

Master Plan Option 2 – Urban Fingers

This option offers opportunities to create broader expanses of open green space between the housing blocks. These spaces can accommodate sports pitches, community orchards, ornamental planting and informal grassed areas. The housing has been designed on a grid system which promotes green corridors along the pedestrian networks through the housing, these green corridors would be able to incorporate grassed swales for conveyance of surface water from the highway and adjacent properties. The grid system also lends itself to connected roof gardens and green roofs which will enhance the wildlife value of the development, aid surface water run-off as part of the SUDs management train and will reduce the visual impact from the surrounding area. The northern green edge of the site offers opportunities for surface water retention in the form of designed swales and semi-wetland habitats which blend into the woodland edge.

As the existing ground falls significantly from Southwest to Northeast the proposed layout of the site should also follow this gradient. The Central Park and Urban Fingers options have areas of green space between areas of developed land. These have the potential to be used for locating surface water storage facilities that would take flows from the developed areas positioned higher up the hill. These can then discharge into the closest of the onsite watercourses.

Master Plan Option 3 – Eco Boulevard

This option offers a wide range of habitat types from formal avenue planting to the natural wetland habitat, which could be incorporated within the drainage philosophy.. Green corridors running east west through the housing clusters connect the main circulation routes to pocket parks created in each development block. Through the centre of the site running east west is an Eco Boulevard with designed swales, wetland planting, open green space, orchard tree planting and natural play opportunities. Again there is potential to make use of roof gardens and green roofs which will enhance the wildlife value of the development, aid surface water run-off as part of the SUDs management train and will reduce the visual impact from the surrounding area.

The Eco Boulevard option would need to use the areas of green space to the North, between the development and the M62 motorway, to store surface runoff above ground. However, these could be positioned in such a way that runoff from sections of the developed areas drain to swales and/or balancing ponds in lower lying areas before discharging into the nearest on site watercourse.

Master Plan Option 4 – North Park

This option combines the use of low rise and higher rise housing to enable a housing density of 30-35 homes per hectare while still providing extensive open green space. Green corridors run through the housing clusters providing designed landscape pedestrian networks throughout the development which connect to the main access points and to pockets parks, these corridors could also convey water should levels permit. A central east west parkland offers opportunities for swales, wetland habitats, natural play, orchard tree planting, pockets of woodland and informal open green space for recreational use. Roof gardens and green roofs enhance the wildlife value of the site whilst forming part of the SUDs treatment train philosophy.

As the existing ground falls significantly from Southwest to Northeast the proposed layout of the site should also follow this gradient. This option has areas of green space between areas of developed land. These have the potential to be used for locating surface water storage facilities that would take flows from the developed areas positioned higher up the hill. These can then discharge into the closest of the onsite watercourses.

General Observations

The four options as described above provided by the Architect do not show any actual layouts of streets, housing, civic and/or commercial buildings, so we have been unable to assess the actual surface drainage requirements for the individual options.

The current proposals are for 2,042 residential dwellings in the local plan period and 294 dwellings beyond the plan. With the current high level option plans (Appendix III) being high level it is not currently known how the site will be drained throughout. However all aspects of SUDs should be explored in order to reduce the impacts of run-off from impermeable surfaces.

Surface finishes will ultimately determine the overall impermeable area of the development i.e. roof areas, highways, car parks and playgrounds may be impermeable but some these could also be constructed using permeable paving systems. Public open spaces and gardens will reduced the overall impermeable area of the end developed site.

If the development is to be an exemplar SuDS scheme, sufficient land will have to be designed into the layout of the site or adjacent to the development in order for SuDS techniques to be a practical option.

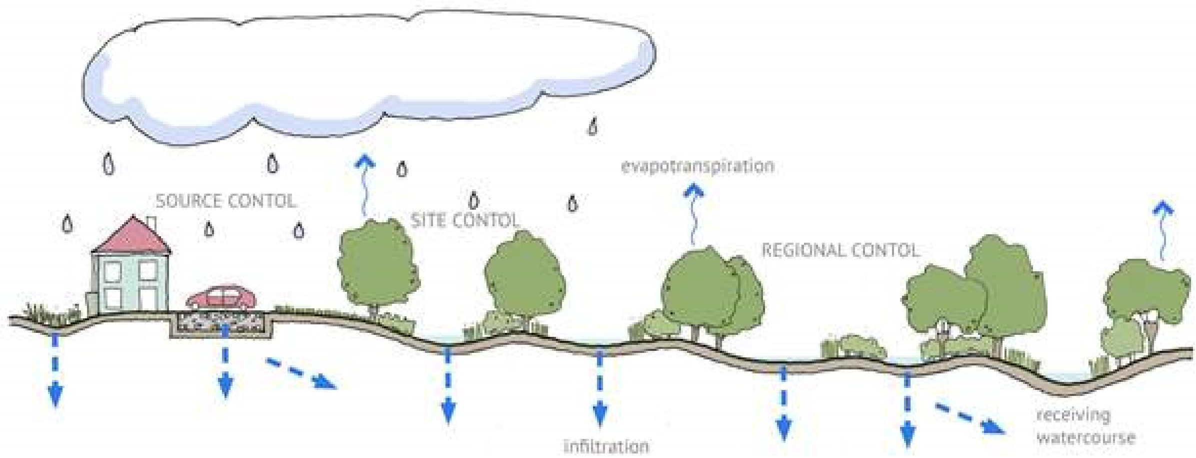
Below ground sewers could convey surface runoff to swales or balancing ponds but the site would need to be designed with the correct topography to ensure that they would not be unnecessarily deep. As the existing site has significant levels differences we do not envisage this to be problematic.

Suds Management Train

The preferred layout option will need to ensure that there is sufficient space to accommodate a variety of SuDS features which will make up the SuDS management train.

The management train concept promotes division of the area to be drained into sub catchments, with different characteristics and uses each within its own drainage strategy, which can be incorporated into different areas of the preferred layout option. End of pipe solutions where runoff is directly discharged to a wetland or pond should be avoided.

Dealing with the water locally not only reduces the quantity that has to be managed at any one point, but also reduces the need for conveying the water off site.



The options proposed have the ability to incorporate the philosophy of the SUDs management train. The philosophy starts with the overall site strategy including the design of residential areas, commercial and amenity spaces. The preferred option should consider green roofs, permeable paving, rain gardens, wetlands, swales, ponds, detention basins and watercourses.

Sustainable Drainage Systems (Overview)

Sustainable drainage

Drainage systems can contribute to sustainable development and improve urban design, by balancing the different issues that influence the development of communities. Approaches to manage surface water that take account of water quantity (flooding), water quality (pollution) and amenity issues are collectively referred to as Sustainable Drainage Systems (SuDS).

SuDS try to replicate natural systems that use cost effective solutions with low environmental impact to drain away dirty and surface water run-off through collection, storage, and cleaning before allowing it to be released slowly back into the environment, such as into water courses. This is to counter the effects of conventional drainage systems that often allow for flooding, pollution of the environment – with the resultant harm to wildlife – and contamination of groundwater sources used to provide drinking water. The many types of SuDS solutions should be that of a system that is easy to manage, requiring little or no energy input (except from environmental sources such as sunlight, etc.), resilient to use, and being environmentally as well as aesthetically attractive. Examples of this type of system are basins (shallow landscape depressions that are dry most of the time when it's not raining), rain-gardens (shallow landscape depressions with shrub or herbaceous planting), swales (shallow normally-dry, wide-based ditches), filter drains (gravel filled trench drain), bio-retention basins (shallow depressions with gravel and/or sand filtration layers beneath the growing medium), reed beds and other wetland habitats that collect, store, and filter dirty water along with providing a habitat for wildlife.

SUDS are technically regarded a sequence of management practices, control structures and strategies designed to efficiently and sustainably drain surface water, while minimising pollution and managing the impact on water quality of local water bodies.

SuDS are more sustainable than traditional drainage methods because they:

- Manage runoff volumes and flow rates from hard surfaces, reducing the impact of urbanisation on flooding
- Protect or enhance water quality (reducing pollution from runoff)
- Protect natural flow regimes in watercourses
- Are sympathetic to the environment and the needs of the local community
- Provide an attractive habitat for wildlife in urban watercourses
- Provide opportunities for evapotranspiration from vegetation and surface water
- Encourage natural groundwater/aquifer recharge (where appropriate)
- Create better places to live, work and play.

SuDS principles

Sustainable drainage is a departure from the traditional approach to draining sites. There are some key principles that influence the planning and design process enabling SuDS to mimic natural drainage by:

- storing runoff and releasing it slowly (attenuation)
- allowing water to soak into the ground (infiltration)
- Slowly transporting (conveying) water on the surface
- filtering out pollutants
- allowing sediments to settle out by controlling the flow of the water

The above was taken from www.susdrain.org

5. Foul Water Drainage Proposals.

Existing public combined sewers can be found running adjacent the site along the length of Bradley Road, and also in the roads surrounding Park Hill at the south eastern end of the development area. These sewers convey flows to the Yorkshire Water treatment works off Leeds Road in Huddersfield. Size, depth and capacity of these sewers is unknown at present. Further information on these should be obtained directly from Yorkshire Water.

Any discharge and/or connection to public sewers will require the approval of Yorkshire Water.

Where possible, foul water sewers from the proposed development should drain via gravity which could mean that some regrading of the site may be required. Alternatively pumping stations could be used to take flows from low level areas to gravity sewers.

The four options provided by the Architects show that the majority of the development would be along the line of Bradley Road behind the existing houses with green areas to be located towards the M62 corridor and in the lowest part of the site i.e. the Northeast corner. If this remains the general location for development then the need for pumping and/or regrading of the existing land would be significantly reduced.

Foul water sewers receiving flows from two or more properties and pumping stations could be offered for adoption by Yorkshire Water under S104 agreements. Yorkshire Water should be contacted at the earliest opportunity to agree connection points and/or discharge rates.

All below ground foul water drainage is to be designed and constructed to the current adoptable standards. At the time of writing this is Sewers for Adoption 7th Edition.

6. Conclusions.

The site is currently 100% permeable green field and has no positive surface water drainage. The Buildings regulations hierarchy of surface water disposal indicates that the first options to look at when designing a surface water scheme for a proposed development should be Infiltration.

The site is served by several inland watercourses which, following proof of negative percolation test and approval from the watercourse owner, could be used to drain surface runoff from the development. The masterplan options presented by the Architect show that following development there will be several locations of green public open space that could be used to implement SuDS techniques. Additionally SuDS techniques could be incorporated within the development areas, for example swales could form part of the highway network through the Eco Boulevard option.

As a last resort the option of discharge to the public sewer network would require approval from Yorkshire Water. This would also mean that, as there are only public sewers running along Bradley Road or in the roads within the housing to the Southeast end of the site, connection points would be minimal. This could mean that the majority of the storage requirement would need to be in one location.

The 4 options all have the opportunity to incorporate Sustainable Drainage Systems in one form or another. The site layouts when designed in detail should look to provide areas for surface water conveyance, attenuation and 'at source' retardation of surface water.

The density of housing will have an implication to the surface water run-off volumes but this can be managed within the site provided sufficient space is allocated for attenuation.

The bullet points below are a selection of points raised in the report that would require significant consideration prior to further design of the proposed development.

- Percolation tests should be carried out across the site to determine whether the existing ground is suitable for the use of soakaways.
- Following percolation testing, should some or all of these prove negative, surface water runoff should discharge to one or all of the watercourses that drain from the site at a rate to be determined by the watercourse owner. Assumed to be greenfield runoff rate, 1.4 l/s/ha.
- Surface water discharge to public sewer should only be considered as a last resort.
- SuDS techniques should be designed to accommodate surface water flows from the development. These could include the use of swales, ponds, detention basins, rain gardens, green roofs, permeable paving etc, and below ground storage. A combination of these features form the treatment train.
- Surface Water discharges are to be limited via flow control devices designed to a predetermined rate approved by the authority in control of the receiving watercourse and/or sewer.

- Proposed layouts should be designed to accommodate the implementation of green SuDS techniques.

- Foul Water should be designed, where possible to drain via gravity, and approval to discharge to one or more of the public sewers in the vicinity of the development should be sought from the local water authority.

- Proposed site levels should be designed to enable, where possible, gravity flows from both surface water and foul water systems to discharge points with holding features or receiving sewers.

7. Scope.

This report has been commissioned by Kirklees Council to assess the drainage proposals for proposed housing development.

This report shall be for the private and confidential use of Kirklees Council for whom the report is undertaken and their immediate advisors in connection with the proposed development. It shall not be reproduced in whole, or in part, or relied upon by third parties for any use whatsoever without the express written authority of Mason Clark Associates Limited.

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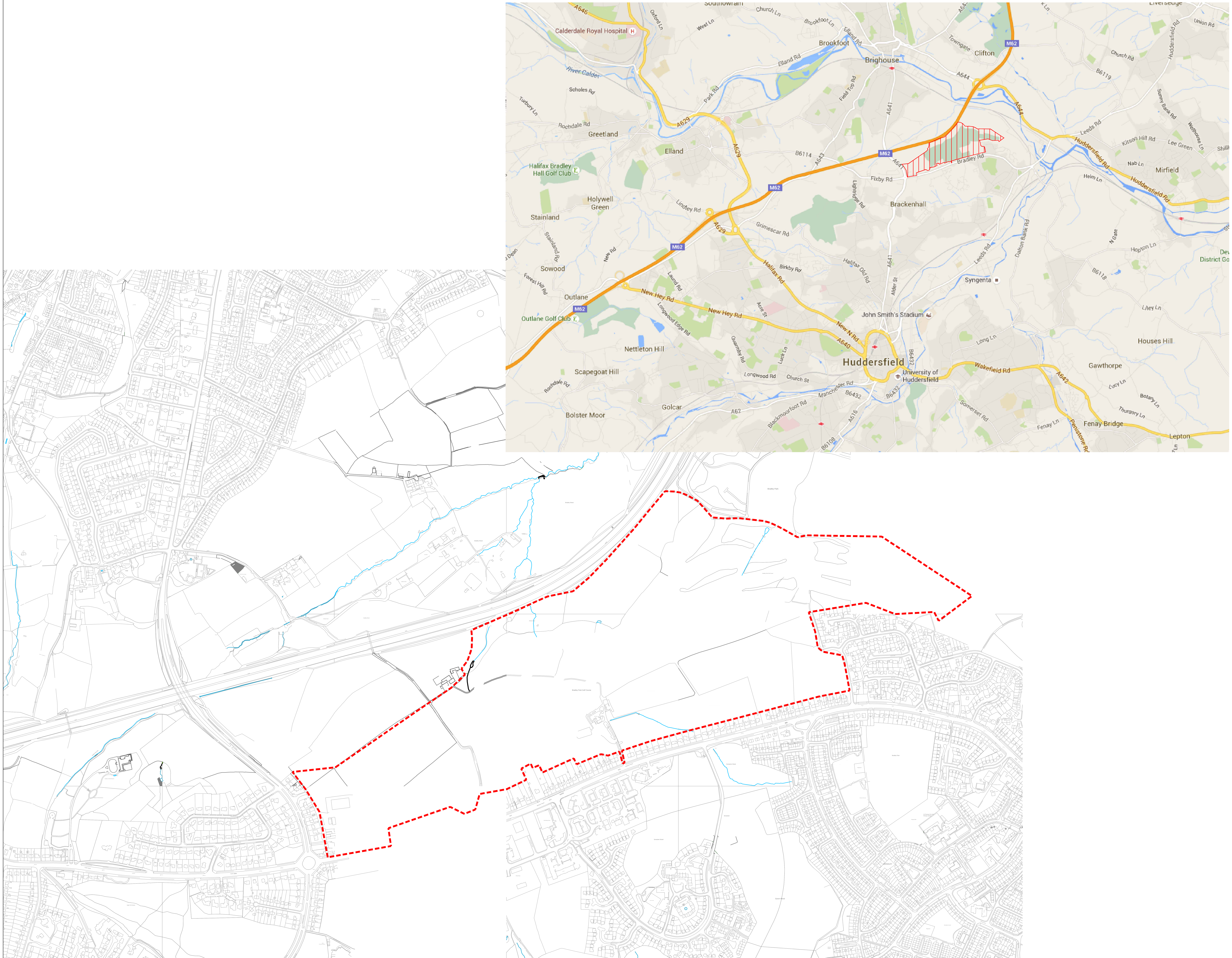
Appendix I

Location Plan.



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The contractor must ensure the overall stability of the works is adequate at all stages of the construction.

No allowance has been made for cutouts, holes, notches, etc. for services. All of these are to be agreed prior to the start of the works.

Rev	Details	By	Date

masonclarkassociates
civil and structural engineering consultants

Unit E, Millshaw Business Living
Global Avenue, Beeston,
Leeds, LS11 8PR
Tel: +44 (0) 113 277 9542
Fax: +44 (0) 113 277 4738

Client. Kirklees COUNCIL

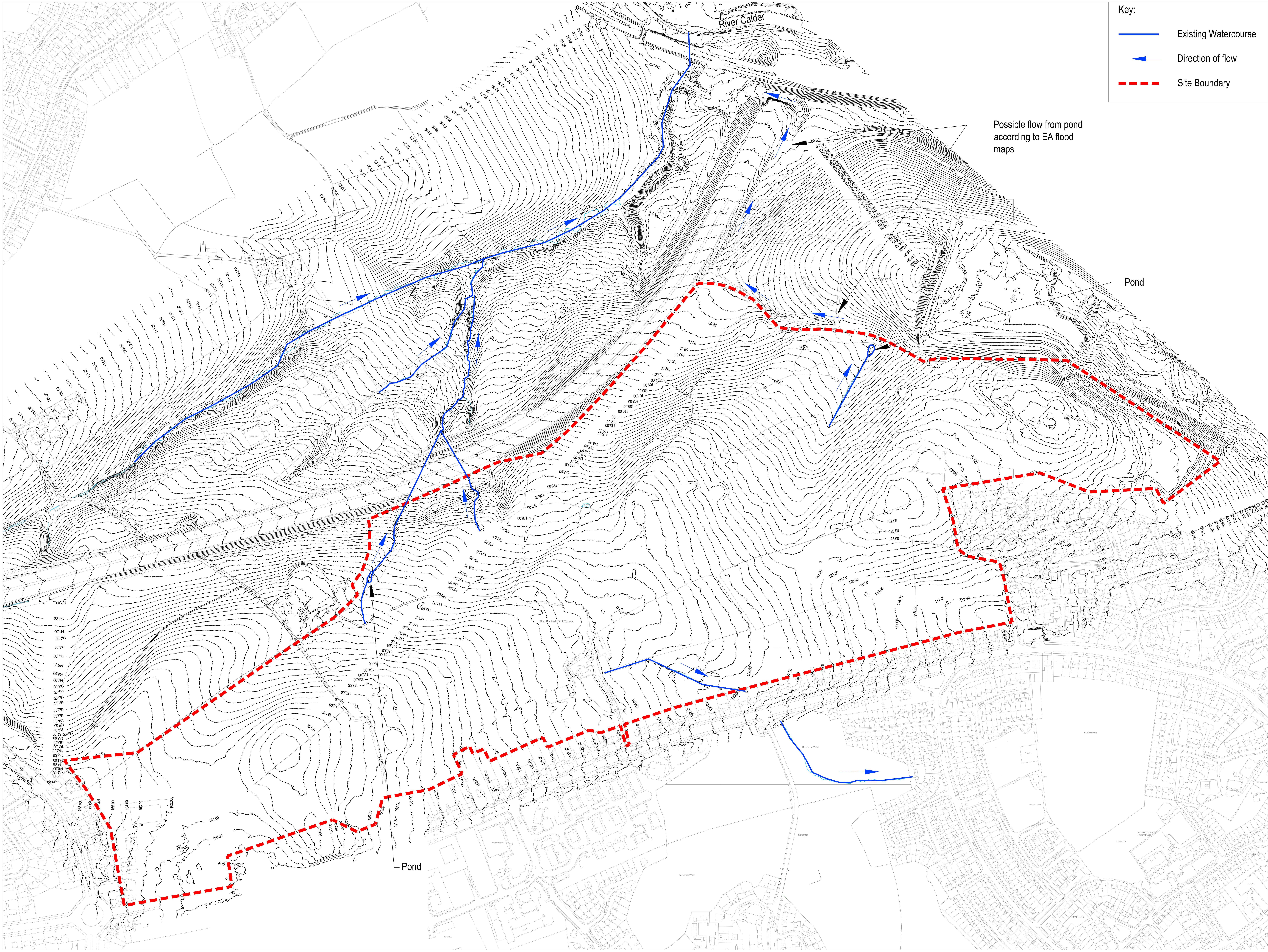
Project.
Masterplanning
Bradley, Huddersfield

Title.
Location Plan

Drawn: AB	Checked: GS	Date: Jan '16
Scale @ Size: 1:5000 @ A1		
Drawing No : 13892L-001		Rev: P1

Appendix II

1m Contour and Existing Watercourse Plan.



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Global Avenue, Beeston,
Leeds, LS11 8PR
Tel: +44 (0) 113 277 9542
Fax: +44 (0) 113 277 4738

Client. Kirklees Council

Project. Masterplanning
Bradley, Huddersfield

Title. 1m Contours from Lidar
& Existing Watercourses

Drawn: AB	Checked: GS	Date: Jan '16
Scale @ Size: 1:2000 @ A0		
Drawing No : 13892L-SK001		Rev: P1

Appendix III

Architects Layout Options.

NORTH PARK
G
V
F
Pri. Schl.
Sec. Schl.
West
2 mins
2 mins
West central
Central
East central
East
NORTH RARK
0 50 100 150 200

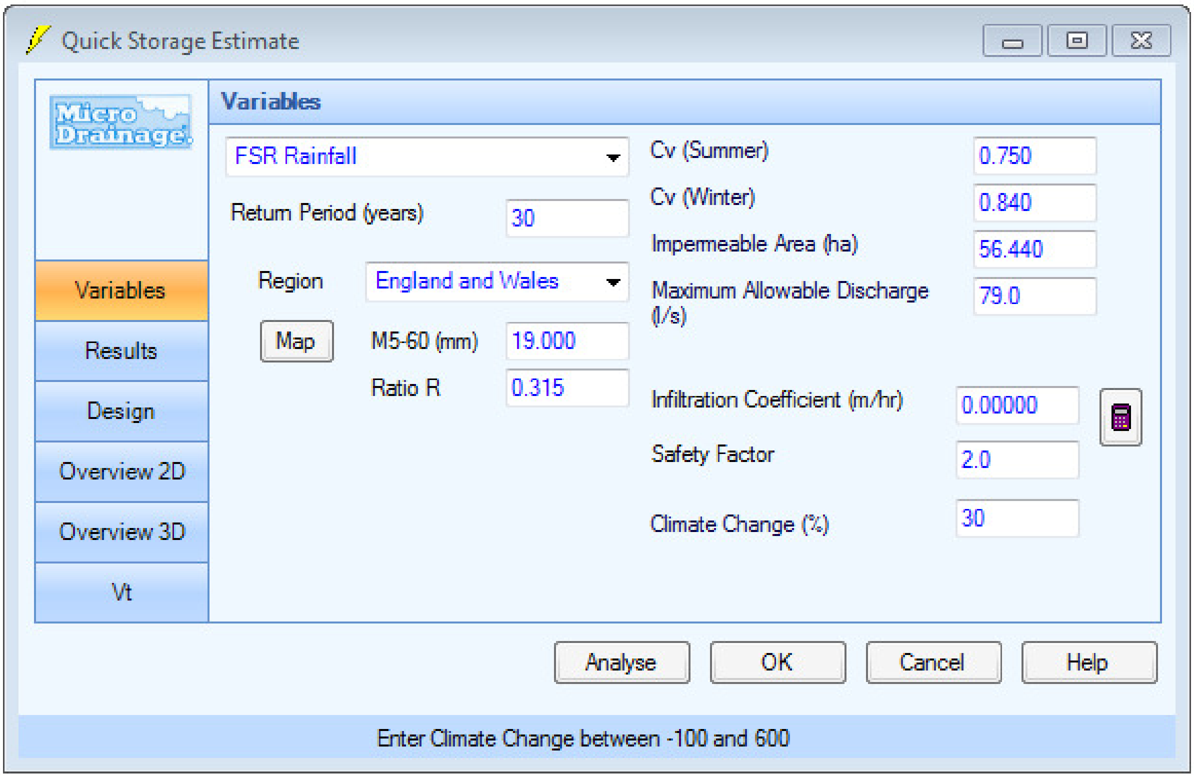

Lower East
com
Point
Juliet Green
Point
Romeo Green
Sec. Sch
Upper West

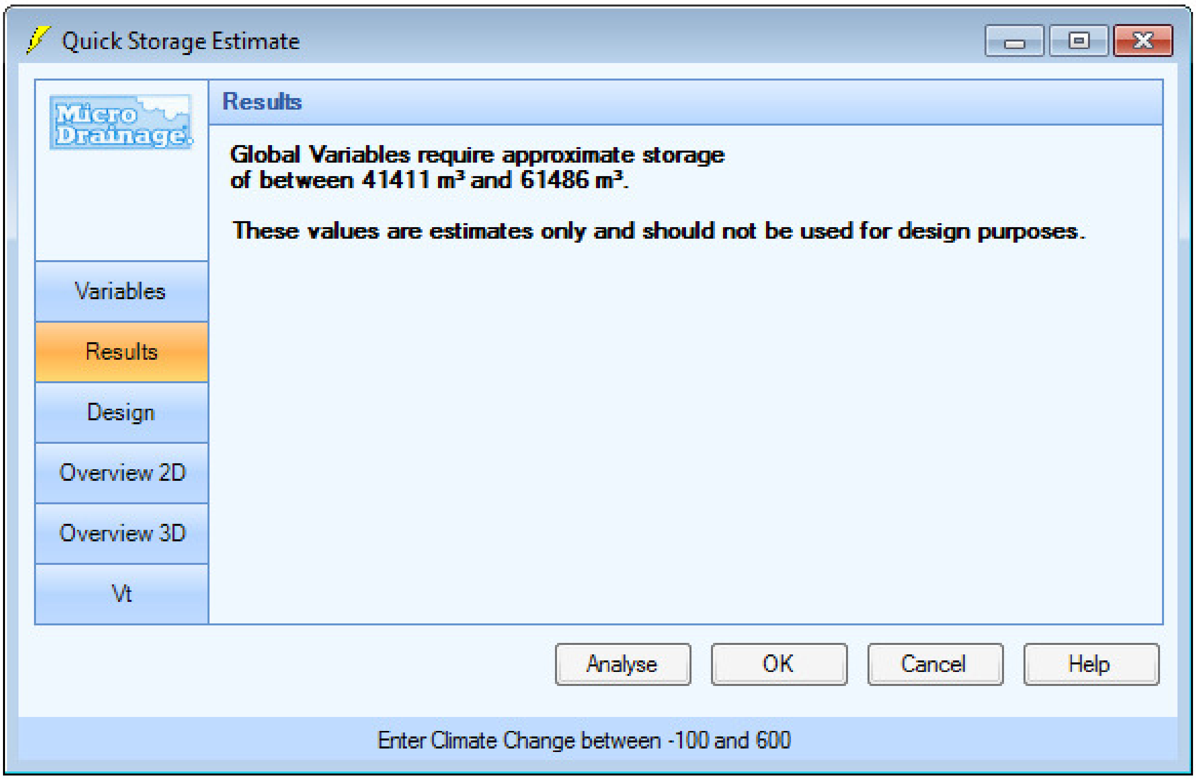

ECO BOULEVARD
Sch
Schl.
0 50 100 150 200

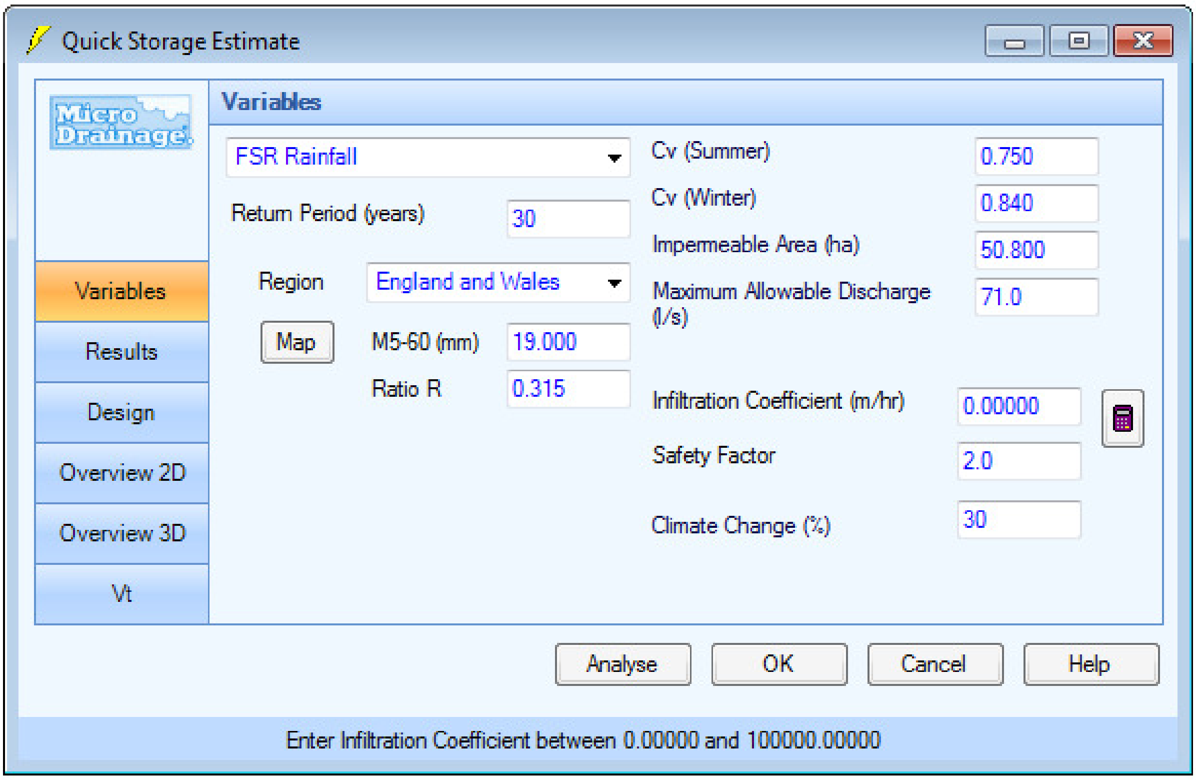

CENTRAL PARK
West side
central
East side
high
high
high
high
sch
sch
c
nr
0 50 100 150 200

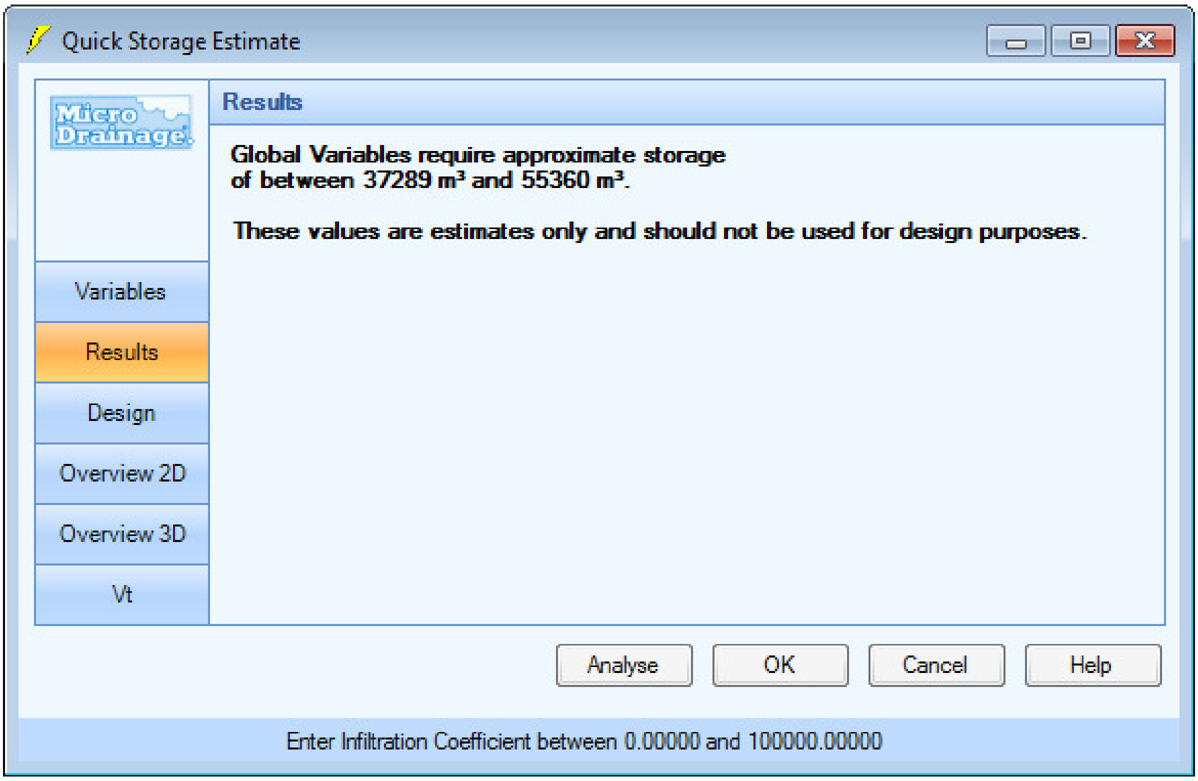
Appendix IV

Micro-Drainage Storage Estimates.


Quick Storage Estimate
Micro Drainage
Variables
FSR Rainfall
Return Period (years) 30
Region England and Wales
Map
M5-60 (mm) 19.000
Ratio R 0.315
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 56.440
Maximum Allowable Discharge (l/s) 79.0
Infiltration Coefficient (m/hr) 0.00000
Safety Factor 2.0
Climate Change (%) 30
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600


Quick Storage Estimate
Micro Drainage
Results
Global Variables require approximate storage of between 41411 m³ and 61486 m³.
These values are estimates only and should not be used for design purposes.
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600


Quick Storage Estimate
Micro Drainage
Variables
FSR Rainfall
Return Period (years)
30
Region
England and Wales
Map
M5-60 (mm)
19.000
Ratio R
0.315
Cv (Summer)
0.750
Cv (Winter)
0.840
Impermeable Area (ha)
50.800
Maximum Allowable Discharge (l/s)
71.0
Infiltration Coefficient (m/hr)
0.00000
Safety Factor
2.0
Climate Change (%)
30
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Infiltration Coefficient between 0.00000 and 100000.00000


Quick Storage Estimate
Micro Drainage
Results
Global Variables require approximate storage of between 37289 m³ and 55360 m³.
These values are estimates only and should not be used for design purposes.
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
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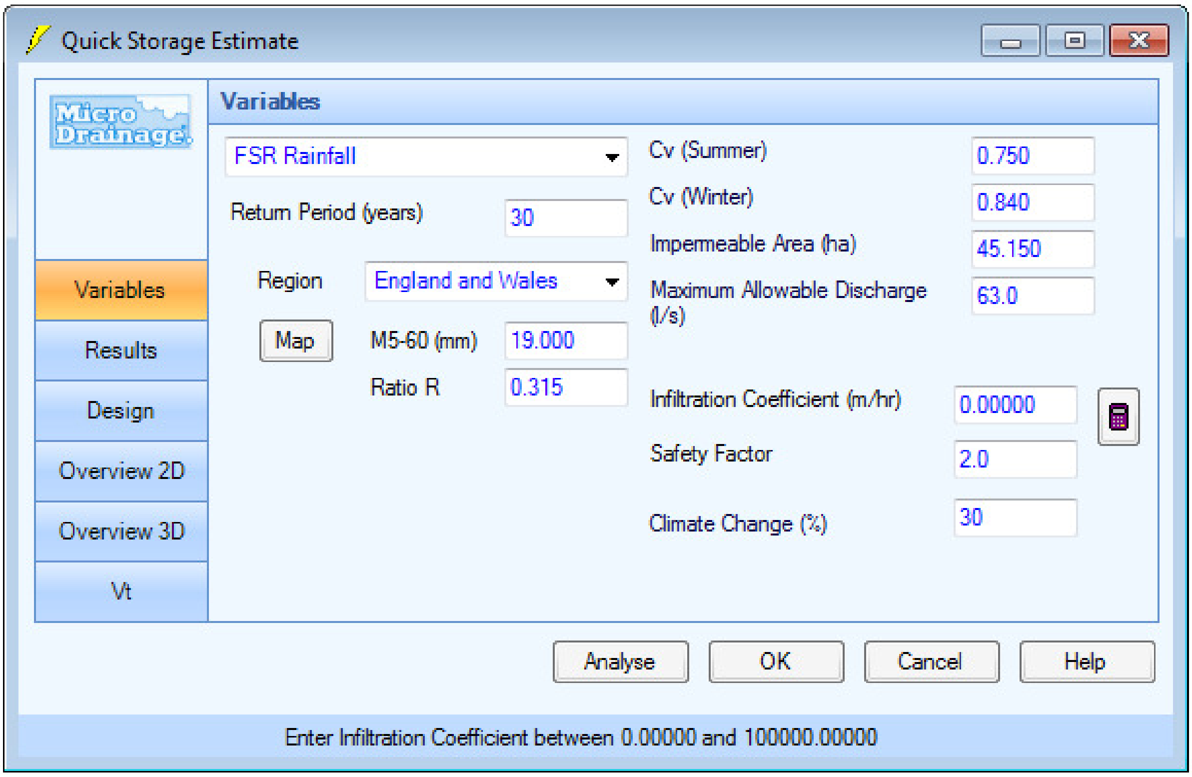
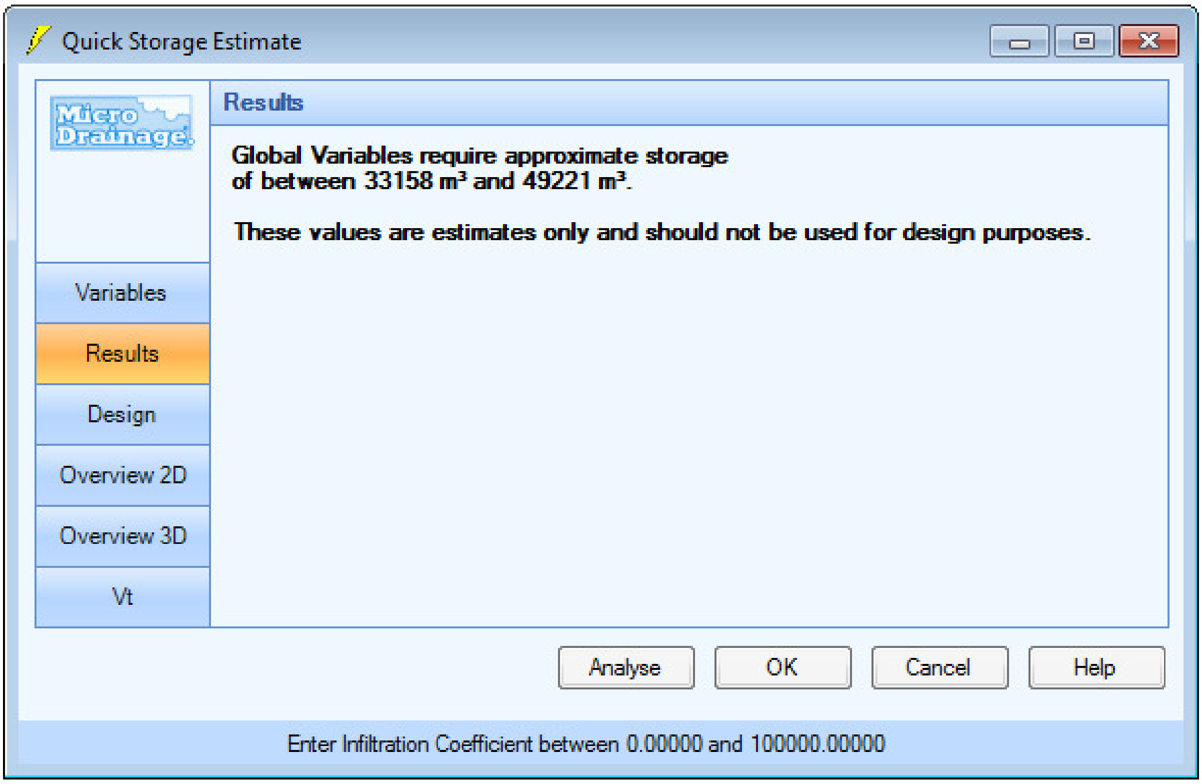
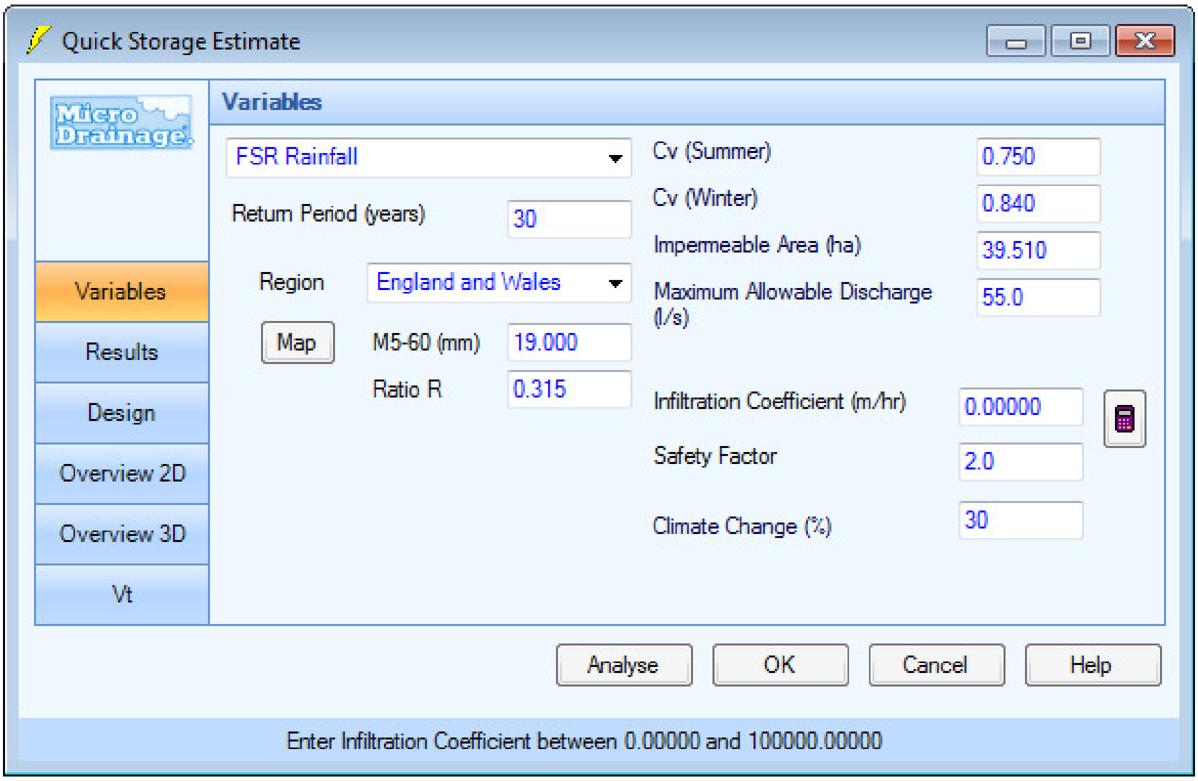
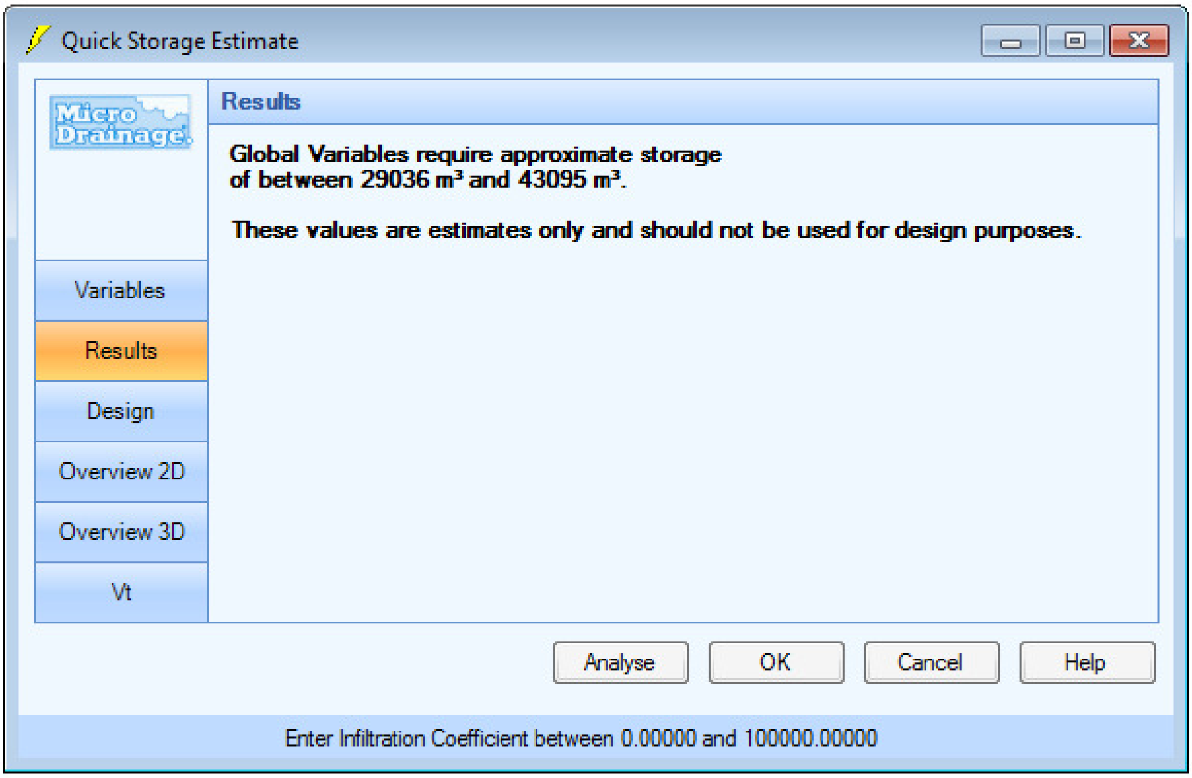
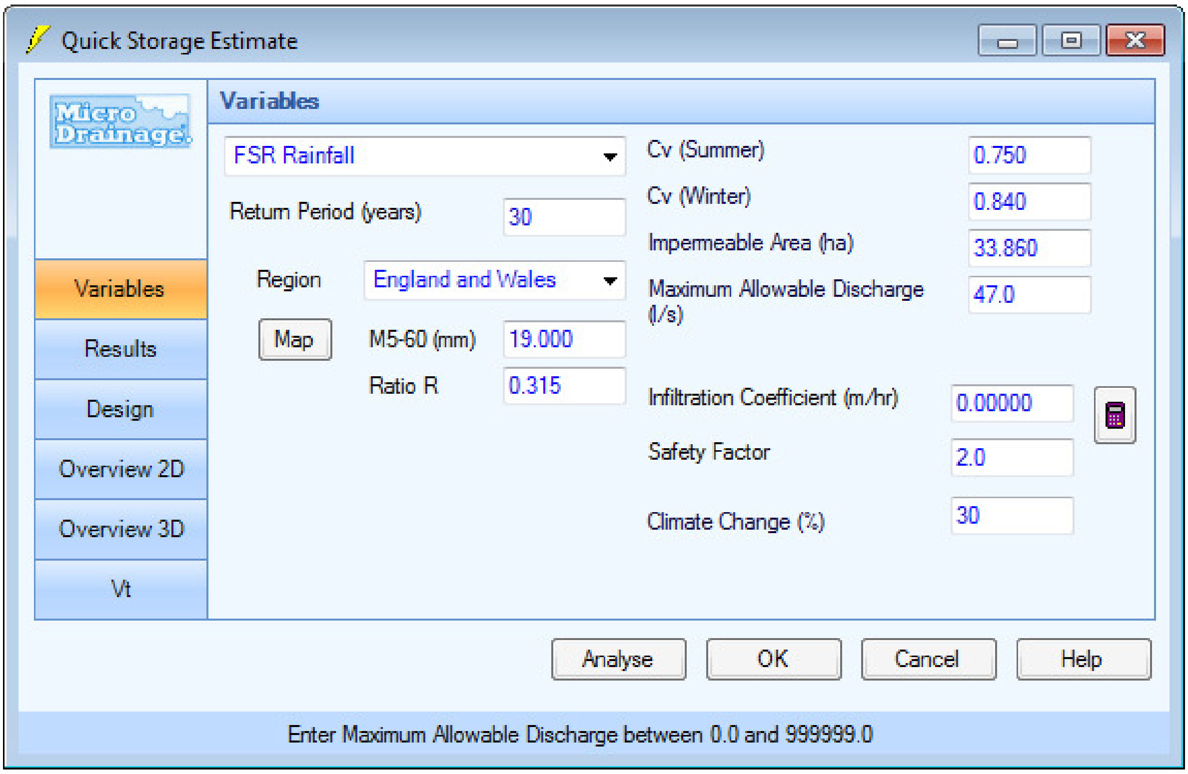
Help
Enter Infiltration Coefficient between 0.00000 and 100000.00000

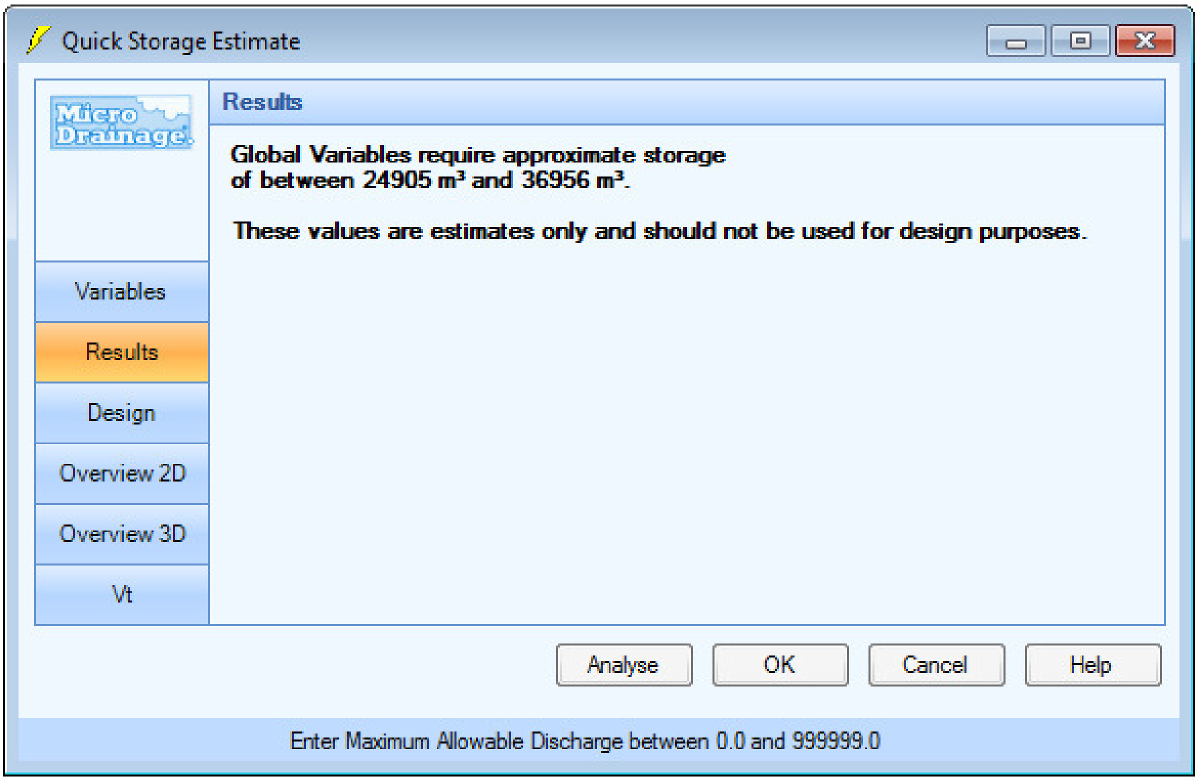

Quick Storage Estimate
Micro Drainage
Variables
FSR Rainfall
Return Period (years) 30
Region England and Wales
Map
M5-60 (mm) 19.000
Ratio R 0.315
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 45.150
Maximum Allowable Discharge (l/s) 63.0
Infiltration Coefficient (m/hr) 0.00000
Safety Factor 2.0
Climate Change (%) 30
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Infiltration Coefficient between 0.00000 and 100000.00000

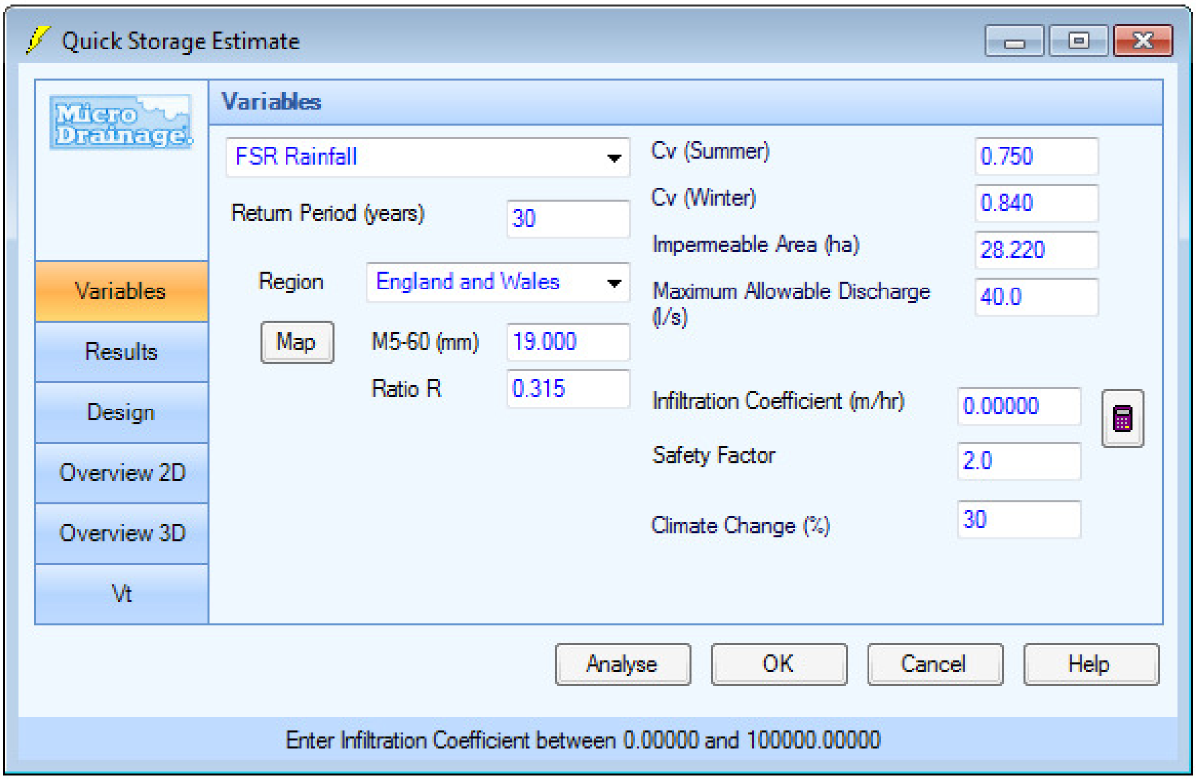

Quick Storage Estimate
Micro Drainage
Results
Global Variables require approximate storage of between 33158 m³ and 49221 m³.
These values are estimates only and should not be used for design purposes.
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Infiltration Coefficient between 0.00000 and 100000.00000

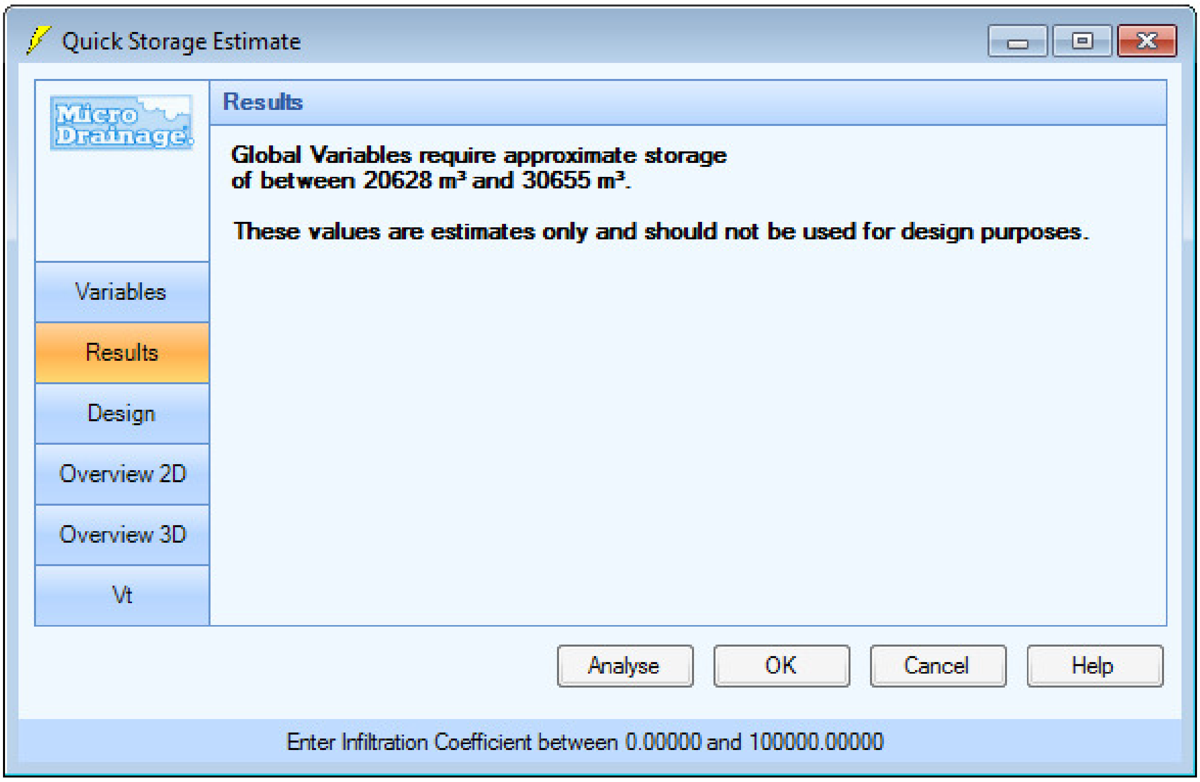

Quick Storage Estimate
Micro Drainage
Variables
FSR Rainfall
Return Period (years)
30
Region
England and Wales
Map
M5-60 (mm)
19.000
Ratio R
0.315
Cv (Summer)
0.750
Cv (Winter)
0.840
Impermeable Area (ha)
39.510
Maximum Allowable Discharge (l/s)
55.0
Infiltration Coefficient (m/hr)
0.00000
Safety Factor
2.0
Climate Change (%)
30
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Infiltration Coefficient between 0.00000 and 100000.00000


Quick Storage Estimate
Micro Drainage
Results
Global Variables require approximate storage
of between 29036 m³ and 43095 m³.
These values are estimates only and should not be used for design purposes.
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Infiltration Coefficient between 0.00000 and 100000.00000


Quick Storage Estimate
Micro Drainage
Variables
FSR Rainfall
Return Period (years) 30
Region England and Wales
Map
M5-60 (mm) 19.000
Ratio R 0.315
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 33.860
Maximum Allowable Discharge (l/s) 47.0
Infiltration Coefficient (m/hr) 0.00000
Safety Factor 2.0
Climate Change (%) 30
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Maximum Allowable Discharge between 0.0 and 999999.0


Quick Storage Estimate
Micro Drainage
Results
Global Variables require approximate storage
of between 24905 m³ and 36956 m³.
These values are estimates only and should not be used for design purposes.
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Maximum Allowable Discharge between 0.0 and 999999.0


Quick Storage Estimate
Micro Drainage
Variables
FSR Rainfall
Return Period (years)
30
Region
England and Wales
Map
M5-60 (mm)
19.000
Ratio R
0.315
Cv (Summer)
0.750
Cv (Winter)
0.840
Impermeable Area (ha)
28.220
Maximum Allowable Discharge (l/s)
40.0
Infiltration Coefficient (m/hr)
0.00000
Safety Factor
2.0
Climate Change (%)
30
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Infiltration Coefficient between 0.00000 and 100000.00000


Quick Storage Estimate
Micro Drainage
Results
Global Variables require approximate storage
of between 20628 m³ and 30655 m³.
These values are estimates only and should not be used for design purposes.
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Infiltration Coefficient between 0.00000 and 100000.00000