BANNERS GATE

CIVIL, STRUCTURAL AND
TRANSPORTATION ENGINEERS

Signature New Homes

Land adjacent to New House Farm, Marden, Herefordshire

Flood Risk Assessment

January 2019

Prepared for:

Signature new homes

BANNERS GATE
CIVIL, STRUCTURAL AND TRANSPORTATION ENGINEERS

Revision Schedule

Land adjacent to New House Farm, Marden – Flood Risk Assessment
18070

Rev	Date	Details	Prepared by	Reviewed by	Approved by
00	24/09/2018	Draft	**Scott Marshall** BSc (Hons), MCIWEM	**John Byrne** Director	**Steve Foxall** Managing Director
01	12/11/2018	-	**Scott Marshall** BSc (Hons), MCIWEM	**John Byrne** Director	**Steve Foxall** Managing Director
02	11/12/2018	-	**Scott Marshall** BSc (Hons), MCIWEM	**David Allbright** Associate Director	**Steve Foxall** Managing Director
03	11/01/2019	-	**Scott Marshall** BSc (Hons), MCIWEM	**John Byrne** Director	**Steve Foxall** Managing Director

Banners Gate Ltd
Cavendish House
10-11 Birmingham Street
Halesowen
West Midlands
B63 3HN

Tel: 0121 687 1500
Fax: 0121 687 1501

Table of Contents

1 INTRODUCTION & BRIEF

1.1 Background Information

1.1.1 Banners Gate Limited was commissioned by Signature New Homes in August 2018 to prepare a Flood Risk Assessment to support a Reserved Matters Planning Application for a residential development in Marden, Herefordshire.

1.1.2 Outline Planning Permission[1] was granted in March 2017 for a "residential development of up to 90 dwellings, with the provision of a site for a community building and associated public open space".

1.1.3 A 'Preliminary Flood Risk Assessment'[2] dated April 2015 accompanied the Outline Planning Application.

1.1.4 This Revision 03 includes revised Schematic Drainage Strategy Plan.

1.2 Study Objectives and Methodology

1.2.1 The objectives of this Report are as follows:

- Determine likely sources of flooding,
- Assess the proposals in the context of the National Planning Policy Framework,
- Propose an appropriate drainage strategy, and
- Determine appropriate mitigation and / or protection measures.

1.2.2 The methodology followed in the preparation of this report included the following:

- Consideration of previous Flood Risk Assessments,
- Investigation of the flood risk within and external to the Site,
- Consideration of the pre-development and post-development storm water run-off and identification of a means of storm water disposal, and
- Consideration of storm events up to and including the 100 year return period storm, including climate change, and calculation of the required volume of attenuation storage, where applicable.

1.2.3 This Report deals with environmental issues as they are impacted by flooding, other impacts on the environment are not considered.

1.3 Policy Background

1.3.1 In accordance with the 'National Planning Policy Framework' (NPPF) a site-specific Flood Risk Assessment became a requirement for:

- Proposals of 1 hectare or greater in Flood Zone 1,
- All proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the Local Planning Authority by the Environment Agency),
- Where proposed development, or a change of use to a more vulnerable class, may be subject to other sources of flooding.

1.3.2 The site-specific Flood Risk Assessment should demonstrate how flood risk will be managed now and over the development's lifetime, taking climate change into account, and with regard to the vulnerability of its users.

1.3.3 The Department for Communities & Local Government publishes online Planning Practice Guidance to the NPPF, which is regularly updated, to provide additional guidance to ensure the effective implementation of the planning policy as set out in the NPPF.

1.4 Climate Change

1.4.1 Within the Hydro-Logic Preliminary Flood Risk Assessment a 30% peak rainfall intensity allowance was made however the Environment Agency subsequently updated its climate change allowances in February 2016.

1.4.2 The following Table shows current anticipated changes in extreme rainfall intensity in small and urban catchments.

Table 1.4: Peak rainfall intensity allowance in small and urban catchments

Applies across all of England	Total potential change anticipated		
	2010 to 2039	2040 to 2059	2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

1.4.3 For Flood Risk Assessments, and Strategic Flood Risk Assessments, both the Central and Upper end allowances are to be considered so that the range of the impact can be assessed.

1.4.4 The design horizon of the proposed development is beyond 2060 and therefore peak rainfall intensity has, where applicable, been increased by 20% and 40%.

1.5 Background to Report

1.5.1 The Report has been prepared using the following documents for guidance:

- The NPPF and Planning Practice Guidance,
- Environment Agency/DEFRA Flood Risk Assessment Standing Advice,
- Environment Agency/DEFRA Rainfall runoff for management for developments - Report-SC030219,
- DEFRA non-statutory Technical Standards for Sustainable Drainage Systems,
- CIRIA Report C624 – Development and Flood Risk – Guidance for the Construction Industry,
- CIRIA Report C753 – The SUDS manual,
- Strategic Flood Risk Assessment for Herefordshire, 3rd Edition,
- Herefordshire Council Sustainable Drainage Systems (SuDS) Handbook, June 2018
- Hydro-Logic 'Preliminary Flood Risk Assessment' Report Reference K0422/1 (Rev.1), dated April 2015.

1.6 Strategic Flood Risk Assessment

1.6.1 The primary aim of the Strategic Flood Risk Assessment (SFRA) is to determine whether planning policies or development land allocations will increase the risk of flooding, both within the development and the surrounding area, and to identify and promote measures that will minimise flood-risk and/or enhance flood resilience at all levels, particularly with regard to future development and existing critical infrastructure.

1.6.2 The following extracts from the SFRA are relevant:

[1] Hereford Council Application No: 150989
[2] Hydro-Logic Services LLP Report K0422/1 (Rev.1)

1.6.3 The Herefordshire situation is somewhat complex because the hydrological boundaries of the required study area extend across the Welsh border to the west and the Gloucestershire and Worcestershire borders to the east and north.

1.6.4 Flood risk within the County has been identified by the Council as a significant issue potentially affecting future housing development and employment opportunity.

1.6.5 Flood probabilities within Herefordshire are relatively high, due to undulating topography and reduced impermeability soils. Flood consequences are perhaps relatively lower than in some other areas of the West Midlands, but the towns of Hereford, Ross-on-Wye, Leominster and Ledbury have all encountered serious flooding on a local scale within the last 10 years.

1.6.6 The Old Red Sandstone geology which predominates over most of Herefordshire has low permeability, allowing limited drainage. However, there are significant local variations influenced by a range of soil types. The gravel aquifers around Hereford may provide a sub-surface route for flood waters. Moving southwards along the Wye from Hereford, the soils become increasingly permeable due to the influence of sandstone or limestone geology. The limestone geology in particular allows water to drain through the rocks, reducing surface run-off and the catchment's response to rainfall.

1.6.7 Herefordshire has encountered significant flood hazard in recent years. Of the 10 most major floods since 1795, five of these have occurred within the last 20 years (1990, 1998, 2000, 2004 and 2007).

1.6.8 Fluvial flooding is the largest single source of flooding within Herefordshire. However, land drainage also features strongly.

1.6.9 Groundwater and sewerage flooding are not thought to be significant issues within Herefordshire, but this may be due to the poor quality of reporting in past events.

1.6.10 Herefordshire is one of 45 locations in the country to be granted New Growth Point status by the government. New Growth Points will deliver a substantial number of new homes to help first time buyers onto the property ladder and to enable towns and cities to grow their economies by creating new jobs and encouraging business development.

1.6.11 The overall aim of decision-makers should be to steer new development to Flood Zone 1.

1.6.12 Projections of future climate change indicate that more frequent short-duration high intensity rainfall and more frequent periods of long-duration rainfall of the type for the widespread floods of 2000 can be expected.

1.6.13 The choice of SUDS system will depend on a number of factors such as:

- *The pollutants present in run-off*
- *The size of and drainage strategy for the catchment area*
- *The hydrology of the area and infiltration rate of the soil*
- *Groundwater Source Protection Zones or contaminated land*

1.6.14 Large-scale ponds and wetlands are general more appropriate for sites larger than 5ha. Infiltration trenches, swales, filter strips and porous pavements are suitable for both large and small sites.

1.7 Hydro-Logic Preliminary Flood Risk Assessment

1.7.1 The Hydro-Logic 'Preliminary Flood Risk Assessment' concluded that the Greenfield Site *"lies outside the 1:1,000 year flood zone of the River Lugg"* and the *"stream, close to the southern margin of the site"* is *"small and set well below most of the site"* and *"is not expected to pose a flood risk to the site, with the exception of a small, marginal strip adjacent to the stream".*

1.7.2 Surface water flooding was described as being unlikely to enter the site given it's surrounded on two sides by roads which would convey surface water away.

1.7.3 No records of historical flooding, within or near to the site, from any source were found.

1.7.4 A partially enclosed basin within the southern boundary of the site was described and noted as containing standing water during site visits on 22nd November 2013 and 9th January 2014.

Figure 1.7: Hydro-Logic Preliminary Flood Risk Assessment Figure 3-4 – *Low point viewed from the east on 9th January 2014, after a period of heavy rain*

1.7.5 Infiltration testing carried out in 2014 by Ludlow Drainage confirmed that runoff could be managed using infiltration. It was described that Ludlow Drainage had proposed concrete ring soakaways but an integrated holistic approach was favoured, as suggested by Churchman Landscape Architects, by Hydro-Logic. The approach was described as:

"The landscape proposals offer an integrated Sustainable Drainage Strategy that collects, transfers and treats the surface water run-off utilising the natural contours of the site. The proposals are intended to provide long term and attenuation storage for up to 1 in 100 year flood events with allowance for climate change. The strategy aims to mitigate the risk of flooding post-development by slowing the rate of flow, reducing the water volumes, and crucially improves water quality by removing pollutants through a treatment train. Water discharged into the ground or to nearby watercourses at the end of the designed treatment train and is controlled at greenfield rates".

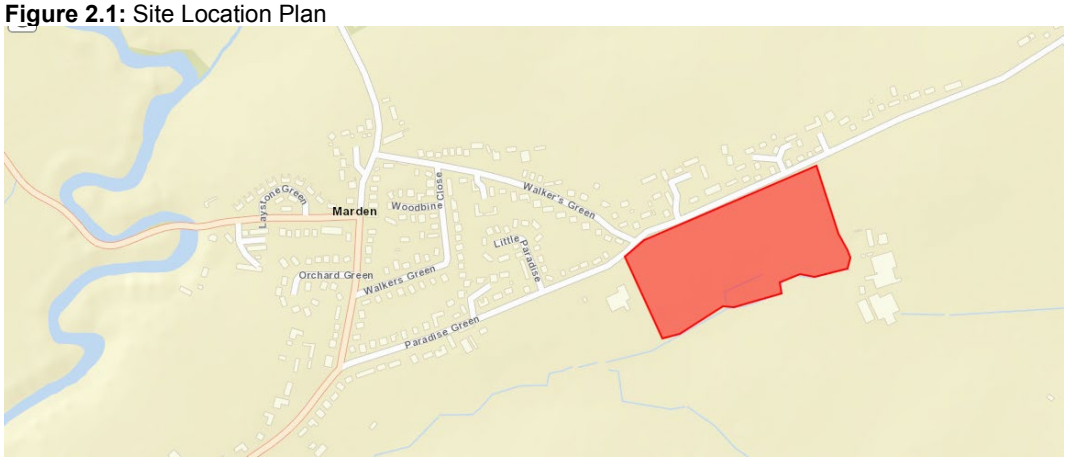
1.7.6 It was noted that the network of swales, detention basins and retention ponds would provide the same function as the concrete ring soakaways. It was recommended that the dimensions of the structures were calculated once the impermeable site areas become known.

2 EXISTING CONDITIONS

2.1 Site Location

2.1.1 The Site is located to the east of Marden in Herefordshire, at approximate National Grid Reference 352700, 247620 and post code HR1 3EW. The Site is shown outlined in red in Figure 2.1 below.

Figure 2.1: Site Location Plan



2.2 Site Description

2.2.1 The Greenfield Site has a total area of approximately 5.1 hectares.

2.2.2 The Site is bounded to the north by an unnamed road and beyond by residential dwellings, to the east by New House Farm, to the west by Marden Primary Academy and to the south by a tributary of the River Lugg.

2.2.3 Ground levels within the Site generally fall from northeast to southwest from approximately 67.5mAOD to 62.5mAOD. A Topographical Survey drawing[3] is presented in Appendix III.

2.3 Local Watercourses

2.3.1 The nearest watercourse is an unnamed tributary (an Ordinary Watercourse) of the River Lugg which flows along the southern Site boundary.

2.3.2 The River Lugg, at its closest, is approximately 0.7km to the west of the Site.

2.4 Underlying Geology

2.4.1 According to a Geoenvironmental Assessment Report[4] dated January 2018 topsoil, typically consisting of brown locally slightly silty, slightly gravelly sand and clay, was encountered across the Site to depths of between 0.15m and 0.7m below ground.

2.4.2 Predominantly granular River Terrace deposits were encountered beneath the topsoil to penetrated depths of between 1.0m and 4.0m below ground.

2.4.3 Clay materials were found to be more extensive at five locations, TP05, TP07, TP11, TP14 and TP16; refer to Appendix I for Exploratory Hole Location Plan[5].

[3] Alpine Land Surveyors Drawing Number: MARDEN 001/A
[4] Georisk Management Report Number: 17331/1
[5] Georisk Management Drawing Number: 17331/1

2.5 Groundwater

2.5.1 The River Terrace Deposits are classified as 'Secondary A' aquifers.

2.5.2 Groundwater was encountered during the excavation of ten of the seventeen Trial Pits at depths of between 1.7m and 3.8m below ground.

2.5.3 Groundwater monitoring standpipes were installed at the locations and whilst they remained dry during two of the three monitoring occasions, between 1st December 2017 and 3rd January 2018, it is noted that the boreholes terminated at 2m below ground. The final monitoring visit followed a period of heavy rainfall, with waterlogged ground conditions observed, thus the groundwater levels recorded on this occasion at between 0.3m and 1.9m below ground was attributed to surface inundation rather than being representative of groundwater levels.

2.5.4 The Site is not located within a Groundwater Source Protection Zone.

2.6 Existing Drainage

2.6.1 The Site is not thought to be served by any positive drainage systems. Any runoff from within the Site would be directed to the unnamed tributary of the River Lugg flowing along the southern Site boundary.

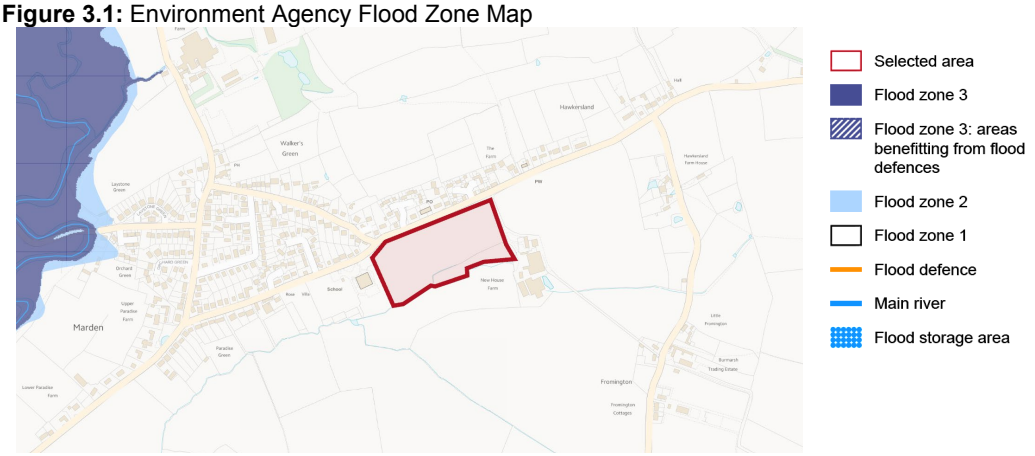
2.6.2 The Dwr Cymru Welsh Water Public Sewer Records, refer to Appendix I, show two surface water sewers serving Springfield Close entering the north-eastern corner of the Site. Further investigations must determine if the sewer records are accurate and establish if the sewers terminate in soakaways at the locations depicted or cross the site and outfall into the unnamed tributary of the River Lugg.

3 ASSESSMENT OF FLOOD RISK

3.1 Fluvial Flooding

3.1.1 The Environment Agency's Flood Zone Map for the Site is shown in Figure 3.1 below. The map shows that the Site is situated entirely within Flood Zone 1 – Low Probability.

Figure 3.1: Environment Agency Flood Zone Map



3.1.2 The definitions of each flood zone are as follows:

Table 3.1: Flood Zone Definitions

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. (Not separately distinguished from Zone 3a on the Flood Map.

3.1.3 The unnamed tributary of the River Lugg flowing along the southern Site boundary is shown without an associated floodplain suggesting the flood risk from this watercourse has not been assessed by the Environment Agency.

3.1.4 The Hydro-Logic Preliminary Flood Risk Assessment concluded that fluvial flooding from this watercourse is regarded as very unlikely following an assessment of its catchment characteristics, size and low-lying position. We concur with this assessment.

3.1.5 In addition to the findings of the earlier assessment ground levels to the south of the watercourse appear lower than those within the Site and thus any out of bank flows would be directed away from the Site.

3.2 Groundwater Flooding

3.2.1 British Geological Survey data indicates there is potential for groundwater flooding to occur at surface within the Site.

3.2.2 Proposed finished floor levels must be carefully considered during the detailed design stage with overland flow routes created to direct flows away from properties and towards the unnamed tributary of the River Lugg flowing along the southern Site boundary.

3.3 Pluvial Flooding

3.3.1 The Environment Agency's 'Flood Risk from Surface Water' map shows most of the Site to be at a 'Very Low' risk of flooding from surface water. The exception is the 'partially enclosed basin' located along the southern margin of the Site.

3.4 Reservoir Flooding

3.4.1 From inspection of the Environment Agency's Indicative Maps the site is not at risk from reservoir flooding.

4 THE DEVELOPMENT PROPOSALS

4.1 Proposed Layout

4.1.1 The proposed development comprises 90 residential dwellings and a Community Building as depicted on the Proposed Site Plan[6] drawing presented in Appendix III.

4.2 Proposed Levels

4.2.1 Proposed ground levels are anticipated to closely resemble existing levels to minimise the import and export of materials.

4.2.2 Generally finished floor levels should be set a minimum of 150mm above proposed adjacent ground levels however Plots 1 to 8 should be at least 300mm due to their proximity of the unnamed watercourse flowing along the southern Site boundary.

4.3 Area Take-off

4.3.1 The Site is Greenfield. Table 4.3 summarises the preliminary area take-off for the existing and proposed Sites.

Table 4.3: Preliminary Area Take-Off.

Category	Area Take-off	
	Existing (ha)	Site (ha)
Impermeable Area	0.0	1.4
Permeable Area	5.1	3.7
Site Area	5.1	5.1

4.3.2 The approximate existing and proposed percentage impermeable areas are 0% and 27% respectively.

4.3.3 In accordance with Herefordshire Councils Sustainable Drainage Systems (SuDS) Handbook an allowance for urban creep must be made. As the density of the development is less than 25 dwellings/hectare a 10% allowance is to be made.

[6] Zebra Architects Drawing Number: zeb1094-PL003

5 SURFACE WATER DRAINAGE

5.1 Introduction

5.1.1 This section relates to surface water run-off resulting from rainfall over the post-developed Site and the methods of disposing of that surface water. It is also concerned with the risk of flooding due to the capacity of the post-development internal drainage.

5.1.2 The drainage calculations attached to this Assessment including calculations of discharge rate, attenuation storage and the proposed methods of providing attenuation are for assessing the level of risk and general feasibility and are therefore indicative only.

5.2 Greenfield Runoff

5.2.1 Within the Hydro-Logic Preliminary Flood Risk Assessment the IoH124 calculation method was used to calculate Greenfield runoff rates and it is acknowledged that this was the most appropriate methodology at the time. However, Herefordshire Councils Sustainable Drainage Systems (SuDS) Handbook states runoff rates should be calculated using either the 'FEH' or 'ReFH' method.

5.2.2 Consequently, within this Assessment the ReFH2 method has been followed. The estimated Greenfield equivalent rates are summarised in the following table; calculations presented in Appendix II.

Table 5.2.1: Greenfield equivalent Runoff Rates – ReFH2 Method

Return Period (years)	Greenfield Rate of Runoff (l/s/ha)
1	1.9
Qbar	2.2*
30	5.2
100	7.3

*interpolated

5.2.3 The peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 and 1 in 100 year events should never exceed the greenfield runoff rate for the same event. In addition, Herefordshire Council reserve the right to insist on adherence to the 1 in 30 year event criteria also.

5.2.4 Where reasonably practicable the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100, 6 hour rainfall, event should never exceed the Greenfield runoff volume for the same event.

Table 5.2.2: Greenfield equivalent Runoff Volume – ReFH2 Method

Return Period	Greenfield Runoff Volume (m^3/ha)
100 year 6 hour duration	117.955

5.3 Disposal Options

5.3.1 In accordance with the requirements of Part H of the Building Regulations the disposal of surface water shall be to one of the following, listed in order of priority:

- Infiltration to the ground, or where that is not reasonably practicable,
- A watercourse, or where that is not reasonably practicable,
- A sewer.

5.3.2 Referring to the Georisk Management Geoenvironmental Assessment Report infiltration testing was undertaken at two locations, TP09 and TP10, in general accordance with BRE:365 (2016).

5.3.3 The recorded infiltration rates within the River Terrace Deposits were variable, ranging between $1x10^{-4}$m/s and $1x10^{-5}$m/s at depths of between approximately 1.2m and 1.9m below ground.

5.3.4 Consequently, the use of infiltration techniques is considered a viable drainage solution. However, given testing was only undertaken at two locations further testing, targeting the areas proposed for infiltration features, must be undertaken to inform the detailed design stage.

5.3.5 For any areas where the use of infiltration techniques is not considered appropriate a restricted discharge to the unnamed tributary of the River Lugg would be viable.

5.4 Sustainable Drainage Systems (SuDS)

5.4.1 In accordance with national and local guidance it is a requirement for any new development to include sustainable surface water drainage systems as a technique to manage surface water regimes sustainably.

5.4.2 The Environment Agency has published "A Practical Guide" to assist in the design of SuDS. The guide lists various SuDS techniques which are described as varying from the most to the least sustainable. It is worth noting that all of the techniques shown offer the benefit of flood reduction. The techniques offering benefits of Pollution Reduction and Wildlife Benefit determine those described as "Most Sustainable."

Table 5.4: SuDS Techniques

Most Sustainable ↑ / ↓ Least Sustainable	SuDS Technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit
	Living Roofs	✓	✓	✓
	Basins and Ponds - Constructed Wetlands - Balancing Ponds - Detention Basins - Retention Ponds	✓	✓	✓
	Filter strips and Swales	✓	✓	✓
	Infiltration Devices - Soakaways - Infiltration Trenches and Basins	✓	✓	✓
	Pervious surfaces and filter drains - Gravelled areas - Solid Paving Blocks - Porous Paviours	✓	✓	
	Tanked Systems - Over-sized pipes/tanks - Storm cells	✓		

5.4.3 The following techniques are considered suitable:

- Soakaways
- Infiltration Trenches
- Pervious Paving
- Swales
- Infiltration Basins

5.4.4 A Preliminary Schematic Drainage Strategy Layout Plan[7] is included within Appendix III.

5.5 Water Quality

5.5.1 In accordance with Table 26.2 of CIRIA Report C753 'The SuDS Manual' the pollution hazard level for the proposed residential development is 'Low' and therefore a simple index approach can be applied to ensure minimum water quality requirements are achieved.

5.5.2 The pollution hazard indices for the proposed development are summarised in Table 5.5

Land Use	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Roofs	0.2	0.2	0.05
Roads	0.5	0.4	0.4

Table 5.5: Pollution Hazard Indices (CIRIA Report C753 Table 26.2)

5.5.3 During the detailed design stage, it must be ensured that the proposed SuDS mitigation indices exceed the land pollution hazard to mitigate pollution risk.

5.6 Surface Water Exceedance Flow Routes

5.6.1 Overland flow corridors must be created to ensure flows resulting from a drainage network failure, or the system being overwhelmed during extreme events, are directed towards the unnamed tributary of the River Lugg flowing along the southern Site boundary.

5.7 SuDS Management

5.7.1 It is anticipated that the ownership and responsibility of all SuDS features will be transferred on completion to a Management Company who will provide long-term management and maintenance for an annual management charge.

[7] Banners Gate Drawing Number: 18070 – SK01

6 FOUL WATER DRAINAGE

6.1 The proposed development will produce a foul water effluent of a domestic nature only.

6.2 Dwr Cymru Welsh Water has advised[8] that foul water flows can be accommodated within the public sewerage at manhole SO52473501 located in Little Paradise.

6.3 Given the topography of the Site a Sewage Pumping Station will be required.

[8] Pre-Planning Enquiry Response letter dated 1st June 2018 Ref: PPA0003042

7 CONCLUSIONS

7.1 Based o the work carried out in the preparation of this Report the following conclusions are made:

7.2 A development of 90 residential dwellings and a Community Building is proposed on a Greenfield Site with an area of approximately 5.1ha in Marden, Herefordshire.

7.3 The Site is characterised as Flood Zone 1 'Low Probability' and is considered to be at a low risk of flooding from all sources.

7.4 The use of infiltration techniques, as a method to dispose of surface water runoff, is considered viable.

7.5 For areas where the use of infiltration techniques is not considered appropriate a restricted discharge to the unnamed tributary of the River Lugg flowing along the southern Site boundary is viable.

7.6 Foul water flows are to be directed via a Sewage Pumping Station to the public sewerage to the west of the Site.

7.7 The proposed drainage scheme will comply with current guidance and promote the use of sustainable drainage systems as far as is reasonably possible.

7.8 The proposed development will not impede flood flow, will not result in a net loss of floodplain and will not have an adverse impact on flood risk within or external to the Site.

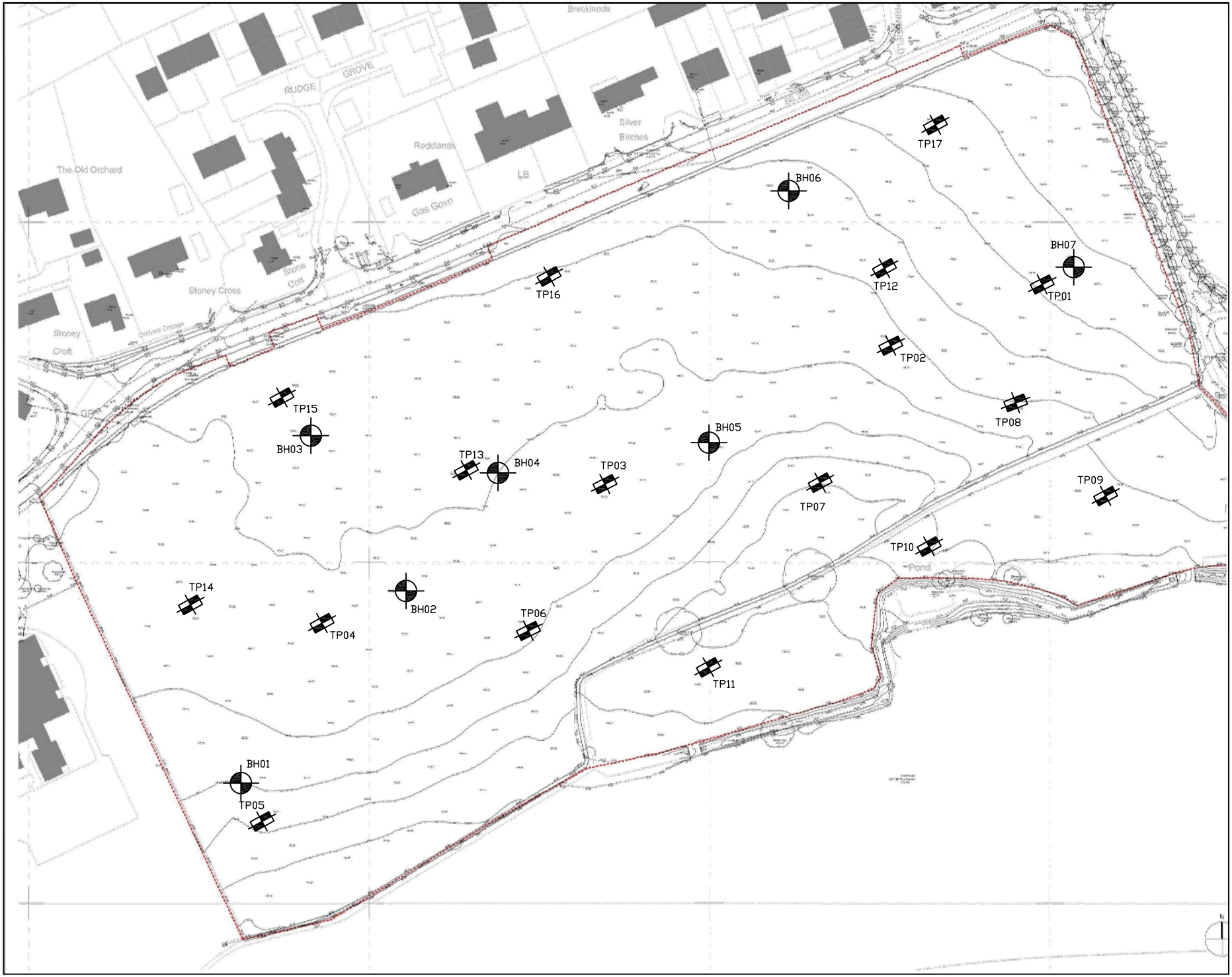
8 RECOMMENDATIONS

8.1 Based on the work carried out in the preparation of this report the following recommendations are made:

8.2 Further investigations must determine if the public sewer records which depict surface water sewers entering the north-eastern corner of the Site are accurate.

8.3 Targeted infiltration testing, in full accordance with BRE Digest 365, should be undertaken in the vicinity of any proposed infiltration features to inform the detailed design stage.

APPENDIX I – SUPPORTING INFORMATION



Notes

This drawing is to be read in conjunction with all development drawings, and designers risk assessments.

This drawing must not be scaled. Work to figured dimensions only.

KEY

TP01 Trial Pit Location

BH01 Borehole Location

Rev	Date	Description	Initials

Client

SIGNATURE NEW HOMES
AND THE
TRUSTEES OF THE DUDLEY PRICE
DISCRETIONARY SETTLEMENT

georisk MANAGEMENT

Summit Point, Summit Crescent, Smethwick, Birmingham B66 1BT
t. 0121 553 4044, f. 0121 553 1112
www.georisk-uk.com, email. enquiries@georisk-uk.com

Contract

LAND AT MARDEN
HEREFORD

Drawing Title

EXPLORATORY HOLE LOCATION PLAN

Drawing Status	DRAFT		
Drawn By	MJL	Date	15/11/17
Checked/Approved	MY	Date	15/11/17
Scale	NTS	Drawing Number	17331/1

Dŵr Cymru
Welsh Water

New House Farm, Marden, Herefordshire

N
W E
S

LEGEND(Representative of most common features)

Waste network:

	Foul chamber		Outfall
	Surface water chamber	LH	Lamphole
	Combined chamber		Storm Overflow
C O	Combined sewer overflow		Rising main
SPC	Special purpose chamber		Gravity sewer
	Treatment works	P	Private sewer
	Pumping station	S 104 P	Private sewer subject to Sect. 104 adoption agreement
		T	Private Sewer Transfer
		L	Lateral Drain
			Inspection Chamber

NB: Sewer symbol colour indicates the type.
RED - Combined
GREEN - Surface Water
BROWN - Foul
Purple - Former S24 sewers (for indicative purposes only)

Notes:

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be asbestos cement (AC) or Pitch Fibre (PF) . It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation

EXACT LOCATIONS OF ALL APPARATUS TO BE DETERMINED ON SITE.

Map Ref:	352673,247643
Map scale:	1:2500
Printed by:	Parker Amanda
Printed on:	25 Apr 2018

APPENDIX II – CALCULATIONS

ReFH2 Rural Runoff Peak Flows

Input

Return Period (Years)	2	Area (ha)	1.000
FEH Rainfall Version	2013	SAAR (mm)	659
Site Location	GB 352680 247673	BFIHOST	0.562
Data Type	Point	FARL	0.000
Season	Winter	SPRHOST	0.000
Country	England/Wales/Northern Ireland	URBEXT (2000)	0.0000

Results

Return Period (Years)	Rural (l/s)	Urban (l/s)
User	2.1	2.1
Q1	1.9	1.9
Q2	2.1	2.1
Q5	3.1	3.1
Q10	3.8	3.8
Q30	5.2	5.2
Q50	6.0	6.0
Q75	6.7	6.7
Q100	7.3	7.3
Q200	8.8	8.8
Q1000	13.0	13.0

ReFH2 Greenfield Runoff Volume

Input

Return Period (Years)	100	Area (ha)	1.000
Storm Duration (min)	360	SAAR (mm)	659
FEH Rainfall Version	2013	BFIHOST	0.562
Site Location	GB 352680 247673	FARL	0.000
Data Type	Point	SPRHOST	0.000
Season	Winter	URBEXT (2000)	0.0000
Country	England/Wales/Northern Ireland		

Results

Percentage Runoff (%)	25.52
Greenfield Runoff Volume (m^3)	117.955

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for 18070 - STORM NETWORK 1 2018.09.20.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model	
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 352680 247673
Data Type	Point
Maximum Rainfall (mm/hr)	100
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	0.000
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	0.75
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for 18070 - STORM NETWORK 1 2018.09.20.SWS

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	36.009	0.150	240.1	0.389	5.00	0.0	0.600	o	375	Pipe/Conduit	
S1.001	20.946	0.700	29.9	0.770	0.00	0.0	0.600	o	375	Pipe/Conduit	
S2.000	9.078	0.200	45.4	0.041	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	98.588	0.300	328.6	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	100.00	5.52	63.150	0.389	0.0	0.0	0.0	1.16	128.7	105.4
S1.001	100.00	5.62	63.150	1.159	0.0	0.0	0.0	3.32	367.0	313.9
S2.000	100.00	5.06	62.500	0.041	0.0	0.0	0.0	2.34	165.4	11.1
S1.002	100.00	7.27	62.300	1.200	0.0	0.0	0.0	0.99	109.8«	325.0

Network Design Table for 18070 - STORM NETWORK 1 2018.09.20.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S3.000	23.422	0.500	46.8	0.347	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	5.772	0.350	16.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S3.000	100.00	5.17	62.300	0.347	0.0	0.0	0.0	2.30	162.8	94.0
S1.003	100.00	7.31	62.000	1.547	0.0	0.0	0.0	2.49	44.1«	419.0

Manhole Schedules for 18070 - STORM NETWORK 1 2018.09.20.SWS

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdr (mm)
SHW	64.400	1.250	Open Manhole	1350	S1.000	63.150	375				
SBASIN 1	63.800	0.800	Open Manhole	1350	S1.001	63.150	375	S1.000	63.000	375	
SHW	63.525	1.025	Open Manhole	1200	S2.000	62.500	300				
SPIPE	63.302	1.002	Open Manhole	1350	S1.002	62.300	375	S1.001	62.450	375	15
								S2.000	62.300	300	
SHW	63.000	0.700	Open Manhole	1200	S3.000	62.300	300				
SBASIN 2	62.500	0.700	Open Manhole	1350	S1.003	62.000	150	S1.002	62.000	375	
								S3.000	61.800	300	
SHW	62.800	1.150	Open Manhole	0		OUTFALL		S1.003	61.650	150	

PIPELINE SCHEDULES for 18070 - STORM NETWORK 1 2018.09.20.SWS

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	375	SHW	64.400	63.150	0.875	Open Manhole	1350
S1.001	o	375	SBASIN 1	63.800	63.150	0.275	Open Manhole	1350
S2.000	o	300	SHW	63.525	62.500	0.725	Open Manhole	1200
S1.002	o	375	SPIPE	63.302	62.300	0.627	Open Manhole	1350
S3.000	o	300	SHW	63.000	62.300	0.400	Open Manhole	1200
S1.003	o	150	SBASIN 2	62.500	62.000	0.350	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	36.009	240.1	SBASIN 1	63.800	63.000	0.425	Open Manhole	1350
S1.001	20.946	29.9	SPIPE	63.302	62.450	0.477	Open Manhole	1350
S2.000	9.078	45.4	SPIPE	63.302	62.300	0.702	Open Manhole	1350
S1.002	98.588	328.6	SBASIN 2	62.500	62.000	0.125	Open Manhole	1350
S3.000	23.422	46.8	SBASIN 2	62.500	61.800	0.400	Open Manhole	1350
S1.003	5.772	16.5	SHW	62.800	61.650	1.000	Open Manhole	0

Free Flowing Outfall Details for 18070 - STORM NETWORK 1 2018.09.20.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.003	SHW	62.800	61.650	0.000	0	0

Simulation Criteria for 18070 - STORM NETWORK 1 2018.09.20.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0
Number of Online Controls 2 Number of Storage Structures 2

Simulation Criteria for 18070 - STORM NETWORK 1 2018.09.20.SWS

Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Summer Storms	Yes
Return Period (years)	30	Winter Storms	No
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 352680 247673	Cv (Winter)	0.840
Data Type	Point	Storm Duration (mins)	30

Online Controls for 18070 - STORM NETWORK 1 2018.09.20.SWS

Orifice Manhole: SBASIN 1, DS/PN: S1.001, Volume (m³): 4.8

Diameter (m) 0.051 Discharge Coefficient 0.600 Invert Level (m) 63.150

Orifice Manhole: SBASIN 2, DS/PN: S1.003, Volume (m³): 13.0

Diameter (m) 0.087 Discharge Coefficient 0.600 Invert Level (m) 62.000

Storage Structures for 18070 - STORM NETWORK 1 2018.09.20.SWS

Infiltration Basin Manhole: SBASIN 1, DS/PN: S1.001

Invert Level (m) 63.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.15372 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1370.0	0.700	1860.0	1.400	0.0	2.100	0.0
0.100	1440.0	0.800	1935.0	1.500	0.0	2.200	0.0
0.200	1510.0	0.900	0.0	1.600	0.0	2.300	0.0
0.300	1580.0	1.000	0.0	1.700	0.0	2.400	0.0
0.400	1650.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	1720.0	1.200	0.0	1.900	0.0		
0.600	1790.0	1.300	0.0	2.000	0.0		

Infiltration Basin Manhole: SBASIN 2, DS/PN: S1.003

Invert Level (m) 61.800 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.15372 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	160.0	0.700	674.0	1.400	0.0	2.100	0.0
0.100	184.0	0.800	0.0	1.500	0.0	2.200	0.0
0.200	330.0	0.900	0.0	1.600	0.0	2.300	0.0
0.300	390.0	1.000	0.0	1.700	0.0	2.400	0.0
0.400	460.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	530.0	1.200	0.0	1.900	0.0		
0.600	600.0	1.300	0.0	2.000	0.0		

Summary of Critical Results by Maximum Level (Rank 1) for 18070 - STORM NETWORK 1 2018.09.20.SWS

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FEH Data Type	Point
FEH Rainfall Version		2013 Cv (Summer)	0.750
Site Location	GB 352680 247673	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	2
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	SHW	60 Summer	2	+0%					63.290
S1.001	SBASIN 1	120 Winter	2	+0%					63.055
S2.000	SHW	60 Summer	2	+0%					62.535
S1.002	SPIPE	60 Summer	2	+0%					62.345
S3.000	SHW	60 Summer	2	+0%					62.394
S1.003	SBASIN 2	180 Winter	2	+0%					61.969

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SHW	-0.235	0.000	0.30		34.8	OK	
S1.001	SBASIN 1	-0.470	0.000	0.00		0.0	OK	
S2.000	SHW	-0.265	0.000	0.03		3.7	OK	
S1.002	SPIPE	-0.330	0.000	0.03		3.7	OK	
S3.000	SHW	-0.206	0.000	0.22		31.2	OK	
S1.003	SBASIN 2	-0.181	0.000	0.00		0.0	OK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for 18070 - STORM NETWORK 1 2018.09.20.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model	
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 352680 247673
Data Type	Point
Maximum Rainfall (mm/hr)	100
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	0.000
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	0.75
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for 18070 - STORM NETWORK 1 2018.09.20.SWS

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	36.009	0.150	240.1	0.389	5.00	0.0	0.600	o	375	Pipe/Conduit	
S1.001	20.946	0.700	29.9	0.770	0.00	0.0	0.600	o	375	Pipe/Conduit	
S2.000	9.078	0.200	45.4	0.041	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	98.588	0.300	328.6	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	100.00	5.52	63.150	0.389	0.0	0.0	0.0	1.16	128.7	105.4
S1.001	100.00	5.62	63.150	1.159	0.0	0.0	0.0	3.32	367.0	313.9
S2.000	100.00	5.06	62.500	0.041	0.0	0.0	0.0	2.34	165.4	11.1
S1.002	100.00	7.27	62.300	1.200	0.0	0.0	0.0	0.99	109.8«	325.0

Network Design Table for 18070 - STORM NETWORK 1 2018.09.20.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S3.000	23.422	0.500	46.8	0.347	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	5.772	0.350	16.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S3.000	100.00	5.17	62.300	0.347	0.0	0.0	0.0	2.30	162.8	94.0
S1.003	100.00	7.31	62.000	1.547	0.0	0.0	0.0	2.49	44.1«	419.0

Manhole Schedules for 18070 - STORM NETWORK 1 2018.09.20.SWS

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdr (mm)
SHW	64.400	1.250	Open Manhole	1350	S1.000	63.150	375				
SBASIN 1	63.800	0.800	Open Manhole	1350	S1.001	63.150	375	S1.000	63.000	375	
SHW	63.525	1.025	Open Manhole	1200	S2.000	62.500	300				
SPIPE	63.302	1.002	Open Manhole	1350	S1.002	62.300	375	S1.001	62.450	375	15
								S2.000	62.300	300	
SHW	63.000	0.700	Open Manhole	1200	S3.000	62.300	300				
SBASIN 2	62.500	0.700	Open Manhole	1350	S1.003	62.000	150	S1.002	62.000	375	
								S3.000	61.800	300	
SHW	62.800	1.150	Open Manhole	0		OUTFALL		S1.003	61.650	150	

PIPELINE SCHEDULES for 18070 - STORM NETWORK 1 2018.09.20.SWS

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	375	SHW	64.400	63.150	0.875	Open Manhole	1350
S1.001	o	375	SBASIN 1	63.800	63.150	0.275	Open Manhole	1350
S2.000	o	300	SHW	63.525	62.500	0.725	Open Manhole	1200
S1.002	o	375	SPIPE	63.302	62.300	0.627	Open Manhole	1350
S3.000	o	300	SHW	63.000	62.300	0.400	Open Manhole	1200
S1.003	o	150	SBASIN 2	62.500	62.000	0.350	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	36.009	240.1	SBASIN 1	63.800	63.000	0.425	Open Manhole	1350
S1.001	20.946	29.9	SPIPE	63.302	62.450	0.477	Open Manhole	1350
S2.000	9.078	45.4	SPIPE	63.302	62.300	0.702	Open Manhole	1350
S1.002	98.588	328.6	SBASIN 2	62.500	62.000	0.125	Open Manhole	1350
S3.000	23.422	46.8	SBASIN 2	62.500	61.800	0.400	Open Manhole	1350
S1.003	5.772	16.5	SHW	62.800	61.650	1.000	Open Manhole	0

Free Flowing Outfall Details for 18070 - STORM NETWORK 1 2018.09.20.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.003	SHW	62.800	61.650	0.000	0	0

Simulation Criteria for 18070 - STORM NETWORK 1 2018.09.20.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0
Number of Online Controls 2 Number of Storage Structures 2

Simulation Criteria for 18070 - STORM NETWORK 1 2018.09.20.SWS

Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Summer Storms	Yes
Return Period (years)	30	Winter Storms	No
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 352680 247673	Cv (Winter)	0.840
Data Type	Point	Storm Duration (mins)	30

Online Controls for 18070 - STORM NETWORK 1 2018.09.20.SWS

Orifice Manhole: SBASIN 1, DS/PN: S1.001, Volume (m³): 4.8

Diameter (m) 0.051 Discharge Coefficient 0.600 Invert Level (m) 63.150

Orifice Manhole: SBASIN 2, DS/PN: S1.003, Volume (m³): 13.0

Diameter (m) 0.087 Discharge Coefficient 0.600 Invert Level (m) 62.000

Storage Structures for 18070 - STORM NETWORK 1 2018.09.20.SWS

Infiltration Basin Manhole: SBASIN 1, DS/PN: S1.001

Invert Level (m) 63.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.15372 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1370.0	0.700	1860.0	1.400	0.0	2.100	0.0
0.100	1440.0	0.800	1935.0	1.500	0.0	2.200	0.0
0.200	1510.0	0.900	0.0	1.600	0.0	2.300	0.0
0.300	1580.0	1.000	0.0	1.700	0.0	2.400	0.0
0.400	1650.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	1720.0	1.200	0.0	1.900	0.0		
0.600	1790.0	1.300	0.0	2.000	0.0		

Infiltration Basin Manhole: SBASIN 2, DS/PN: S1.003

Invert Level (m) 61.800 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.15372 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	160.0	0.700	674.0	1.400	0.0	2.100	0.0
0.100	184.0	0.800	0.0	1.500	0.0	2.200	0.0
0.200	330.0	0.900	0.0	1.600	0.0	2.300	0.0
0.300	390.0	1.000	0.0	1.700	0.0	2.400	0.0
0.400	460.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	530.0	1.200	0.0	1.900	0.0		
0.600	600.0	1.300	0.0	2.000	0.0		

Summary of Critical Results by Maximum Level (Rank 1) for 18070 - STORM NETWORK 1 2018.09.20.SWS

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FEH Data Type	Point
FEH Rainfall Version		2013 Cv (Summer)	0.750
Site Location GB 352680 247673		Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	SHW	60 Summer	100	+20%	100/60 Summer			
S1.001	SBASIN 1	120 Winter	100	+20%				
S2.000	SHW	60 Summer	100	+20%				
S1.002	SPIPE	60 Summer	100	+20%				
S3.000	SHW	60 Summer	100	+20%				
S1.003	SBASIN 2	120 Winter	100	+20%	100/60 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SHW	63.640	0.115	0.000	1.36		157.2	SURCHARGED	
S1.001	SBASIN 1	63.313	-0.212	0.000	0.01		2.0	OK	
S2.000	SHW	62.577	-0.223	0.000	0.15		16.8	OK	
S1.002	SPIPE	62.400	-0.275	0.000	0.15		16.1	OK	
S3.000	SHW	62.558	-0.042	0.000	0.96		139.2	OK	
S1.003	SBASIN 2	62.260	0.110	0.000	0.20		7.3	FLOOD RISK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for 18070 - STORM NETWORK 1 2018.09.20.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model	
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 352680 247673
Data Type	Point
Maximum Rainfall (mm/hr)	100
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	0.000
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	0.75
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for 18070 - STORM NETWORK 1 2018.09.20.SWS

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	36.009	0.150	240.1	0.389	5.00	0.0	0.600	o	375	Pipe/Conduit	
S1.001	20.946	0.700	29.9	0.770	0.00	0.0	0.600	o	375	Pipe/Conduit	
S2.000	9.078	0.200	45.4	0.041	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	98.588	0.300	328.6	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	100.00	5.52	63.150	0.389	0.0	0.0	0.0	1.16	128.7	105.4
S1.001	100.00	5.62	63.150	1.159	0.0	0.0	0.0	3.32	367.0	313.9
S2.000	100.00	5.06	62.500	0.041	0.0	0.0	0.0	2.34	165.4	11.1
S1.002	100.00	7.27	62.300	1.200	0.0	0.0	0.0	0.99	109.8«	325.0

Network Design Table for 18070 - STORM NETWORK 1 2018.09.20.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S3.000	23.422	0.500	46.8	0.347	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	5.772	0.350	16.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S3.000	100.00	5.17	62.300	0.347	0.0	0.0	0.0	2.30	162.8	94.0
S1.003	100.00	7.31	62.000	1.547	0.0	0.0	0.0	2.49	44.1«	419.0

Manhole Schedules for 18070 - STORM NETWORK 1 2018.09.20.SWS

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdr (mm)
SHW	64.400	1.250	Open Manhole	1350	S1.000	63.150	375				
SBASIN 1	63.800	0.800	Open Manhole	1350	S1.001	63.150	375	S1.000	63.000	375	
SHW	63.525	1.025	Open Manhole	1200	S2.000	62.500	300				
SPIPE	63.302	1.002	Open Manhole	1350	S1.002	62.300	375	S1.001	62.450	375	15
								S2.000	62.300	300	
SHW	63.000	0.700	Open Manhole	1200	S3.000	62.300	300				
SBASIN 2	62.500	0.700	Open Manhole	1350	S1.003	62.000	150	S1.002	62.000	375	
								S3.000	61.800	300	
SHW	62.800	1.150	Open Manhole	0		OUTFALL		S1.003	61.650	150	

PIPELINE SCHEDULES for 18070 - STORM NETWORK 1 2018.09.20.SWS

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	375	SHW	64.400	63.150	0.875	Open Manhole	1350
S1.001	o	375	SBASIN 1	63.800	63.150	0.275	Open Manhole	1350
S2.000	o	300	SHW	63.525	62.500	0.725	Open Manhole	1200
S1.002	o	375	SPIPE	63.302	62.300	0.627	Open Manhole	1350
S3.000	o	300	SHW	63.000	62.300	0.400	Open Manhole	1200
S1.003	o	150	SBASIN 2	62.500	62.000	0.350	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	36.009	240.1	SBASIN 1	63.800	63.000	0.425	Open Manhole	1350
S1.001	20.946	29.9	SPIPE	63.302	62.450	0.477	Open Manhole	1350
S2.000	9.078	45.4	SPIPE	63.302	62.300	0.702	Open Manhole	1350
S1.002	98.588	328.6	SBASIN 2	62.500	62.000	0.125	Open Manhole	1350
S3.000	23.422	46.8	SBASIN 2	62.500	61.800	0.400	Open Manhole	1350
S1.003	5.772	16.5	SHW	62.800	61.650	1.000	Open Manhole	0

Free Flowing Outfall Details for 18070 - STORM NETWORK 1 2018.09.20.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.003	SHW	62.800	61.650	0.000	0	0

Simulation Criteria for 18070 - STORM NETWORK 1 2018.09.20.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0
Number of Online Controls 2 Number of Storage Structures 2

Simulation Criteria for 18070 - STORM NETWORK 1 2018.09.20.SWS

Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Summer Storms	Yes
Return Period (years)	30	Winter Storms	No
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 352680 247673	Cv (Winter)	0.840
Data Type	Point	Storm Duration (mins)	30

Online Controls for 18070 - STORM NETWORK 1 2018.09.20.SWS

Orifice Manhole: SBASIN 1, DS/PN: S1.001, Volume (m³): 4.8

Diameter (m) 0.051 Discharge Coefficient 0.600 Invert Level (m) 63.150

Orifice Manhole: SBASIN 2, DS/PN: S1.003, Volume (m³): 13.0

Diameter (m) 0.087 Discharge Coefficient 0.600 Invert Level (m) 62.000

Storage Structures for 18070 - STORM NETWORK 1 2018.09.20.SWS

Infiltration Basin Manhole: SBASIN 1, DS/PN: S1.001

Invert Level (m) 63.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.15372 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1370.0	0.700	1860.0	1.400	0.0	2.100	0.0
0.100	1440.0	0.800	1935.0	1.500	0.0	2.200	0.0
0.200	1510.0	0.900	0.0	1.600	0.0	2.300	0.0
0.300	1580.0	1.000	0.0	1.700	0.0	2.400	0.0
0.400	1650.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	1720.0	1.200	0.0	1.900	0.0		
0.600	1790.0	1.300	0.0	2.000	0.0		

Infiltration Basin Manhole: SBASIN 2, DS/PN: S1.003

Invert Level (m) 61.800 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.15372 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	160.0	0.700	674.0	1.400	0.0	2.100	0.0
0.100	184.0	0.800	0.0	1.500	0.0	2.200	0.0
0.200	330.0	0.900	0.0	1.600	0.0	2.300	0.0
0.300	390.0	1.000	0.0	1.700	0.0	2.400	0.0
0.400	460.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	530.0	1.200	0.0	1.900	0.0		
0.600	600.0	1.300	0.0	2.000	0.0		

Summary of Critical Results by Maximum Level (Rank 1) for 18070 - STORM NETWORK 1 2018.09.20.SWS

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FEH Data Type	Point
FEH Rainfall Version		2013 Cv (Summer)	0.750
Site Location	GB 352680 247673	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	SHW	60 Summer	100	+40%	100/60 Summer			
S1.001	SBASIN 1	120 Winter	100	+40%				
S2.000	SHW	60 Summer	100	+40%				
S1.002	SPIPE	60 Summer	100	+40%				
S3.000	SHW	60 Summer	100	+40%	100/60 Summer			
S1.003	SBASIN 2	120 Winter	100	+40%	100/60 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SHW	63.742	0.217	0.000	1.58		183.3	SURCHARGED	
S1.001	SBASIN 1	63.374	-0.151	0.000	0.01		2.4	OK	
S2.000	SHW	62.584	-0.216	0.000	0.18		19.6	OK	
S1.002	SPIPE	62.409	-0.266	0.000	0.18		18.7	OK	
S3.000	SHW	62.729	0.129	0.000	1.09		156.7	FLOOD RISK	
S1.003	SBASIN 2	62.313	0.163	0.000	0.22		8.2	FLOOD RISK	

APPENDIX III – DRAWINGS

Rev	Amendments	Date	By
A	Additional Survey Added.	16.01.15	JP

NOTES:

1. SITE GRID AND LEVELS ARE BASED UPON ORDNANCE SURVEY VIA THE ACTIVE GPS NETWORK.

Do not scale this drawing

KEY

TSB	TRAFFIC SIGNAL BOX
PHB	PHONE BOX
PB	POST BOX SQUARE
PB	POST BOX ROUND
GRILL	GRILL SQUARE
GRILL	GRILL ROUND
BL	BOLLARD
BN	BIN SQUARE
BN	BIN ROUND
SPOT	SPOT LEVEL
TAR	TARMAC
GR	GRASS
H/S	HARDSTANDING
BL	BOLLARD
BB	BELISHA BEACON
RS	ROAD SIGN
SIGN	SIGN
NP	STREET NAMEPLATE
TS	TRAFFIC SIGNAL
TSC	TRAFFIC SIGNAL CONTROLLER
IC	INSPECTION COVER
MH	MANHOLE
MH	MANHOLE
MP	MARKER POST
TP	TELEGRAPH POLE
LC	LIGHTING COLUMN
G	GULLY
WM	WATER METER
SV	SLUICE VALVE
ST	STOP TAP
FH	FIRE HYDRANT
BT	BRITISH TELECOM
CATV	CABLE TV
TV	CABLE TV
GV	GAS VALVE
1.00 BRK	BRICK WALL
1.00 BLK	BLOCK WALL
1.00 ST	STONE WALL
	HEDGEROW/TREE CANOPY
2.0 P+V	FENCE
DK	DROPPED KERB

APPROX N

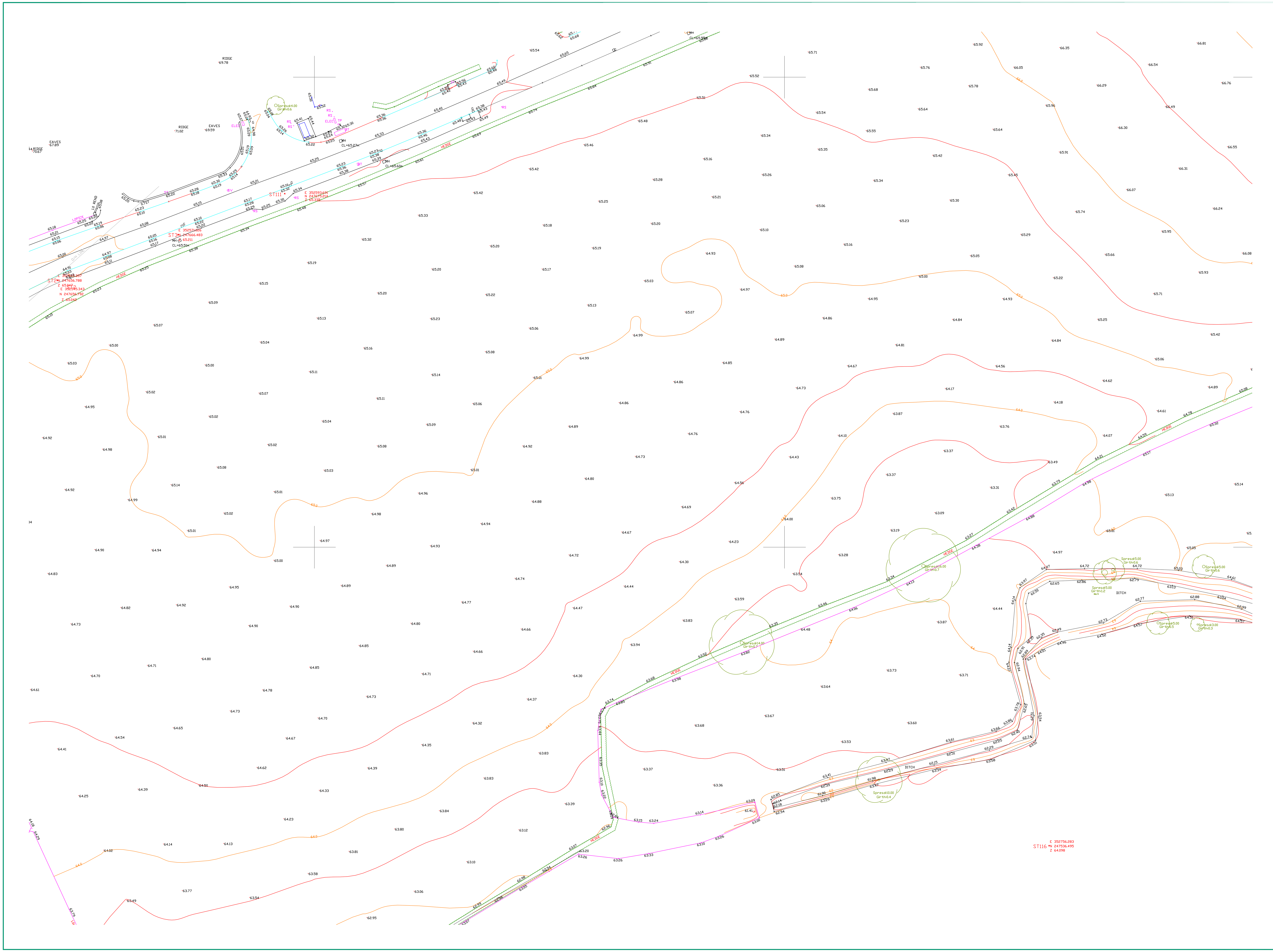
ALPINE LAND SURVEYORS
17 The Pines
Hewson Aberdare
South Wales
CF44 9QW
Tel/Fax: 01685 814007
Mobile: 07980 464 208

CLIENT
McCARTNEYS
LLP.

PROJECT
TOPOGRAPHICAL SURVEY
NEW HOUSE FARM,
MARDEN, HEREFORD.

Scales 1:250@A0	Date 04.11.14
Drawn MJH	Plot No. 01
Project Reference No.	MCC/MAR/01
Drawing Number	MARDEN 001/A

A0



Rev	Amendments	Date	By
A	Additional Survey Added.	16.01.15	JP

NOTES:

1. SITE GRID AND LEVELS ARE BASED UPON ORDNANCE SURVEY VIA THE ACTIVE GPS NETWORK.

Do not scale this drawing

KEY

TSB	TRAFFIC SIGNAL BOX
PHB	PHONE BOX
PB	POST BOX SQUARE
PB	POST BOX ROUND
GRILL	GRILL SQUARE
GRILL	GRILL ROUND
BL	BOLLARD
BIN	BIN SQUARE
BIN	BIN ROUND
38.32	SPOT LEVEL
TAR	TARMAC
GR	GRASS
H/S	HARDSTANDING
BL	BOLLARD
BB	BELISHA BEACON
RS	ROAD SIGN
SIGN	SIGN
NP	STREET NAMEPLATE
TS	TRAFFIC SIGNAL
TSC	TRAFFIC SIGNAL CONTROLLER
IC	INSPECTION COVER
MH	MANHOLE
MH	MANHOLE
MP	MARKER POST
TP	TELEGRAPH POLE
LC	LIGHTING COLUMN
G	GULLY
WM	WATER METER
SV	SLUICE VALVE
ST	STOP TAP
FH	FIRE HYDRANT
BT	BRITISH TELECOM
CATV	CABLE TV
TV	CABLE TV
GV	GAS VALVE
1.0BR	BRICK WALL
1.0BL	BLOCK WALL
1.0ST	STONE WALL
	HEDGEROW/TREE CANOPY
2.0 P+W	FENCE
DK	DROPPED KERB

APPROX N

ALPINE LAND SURVEYORS

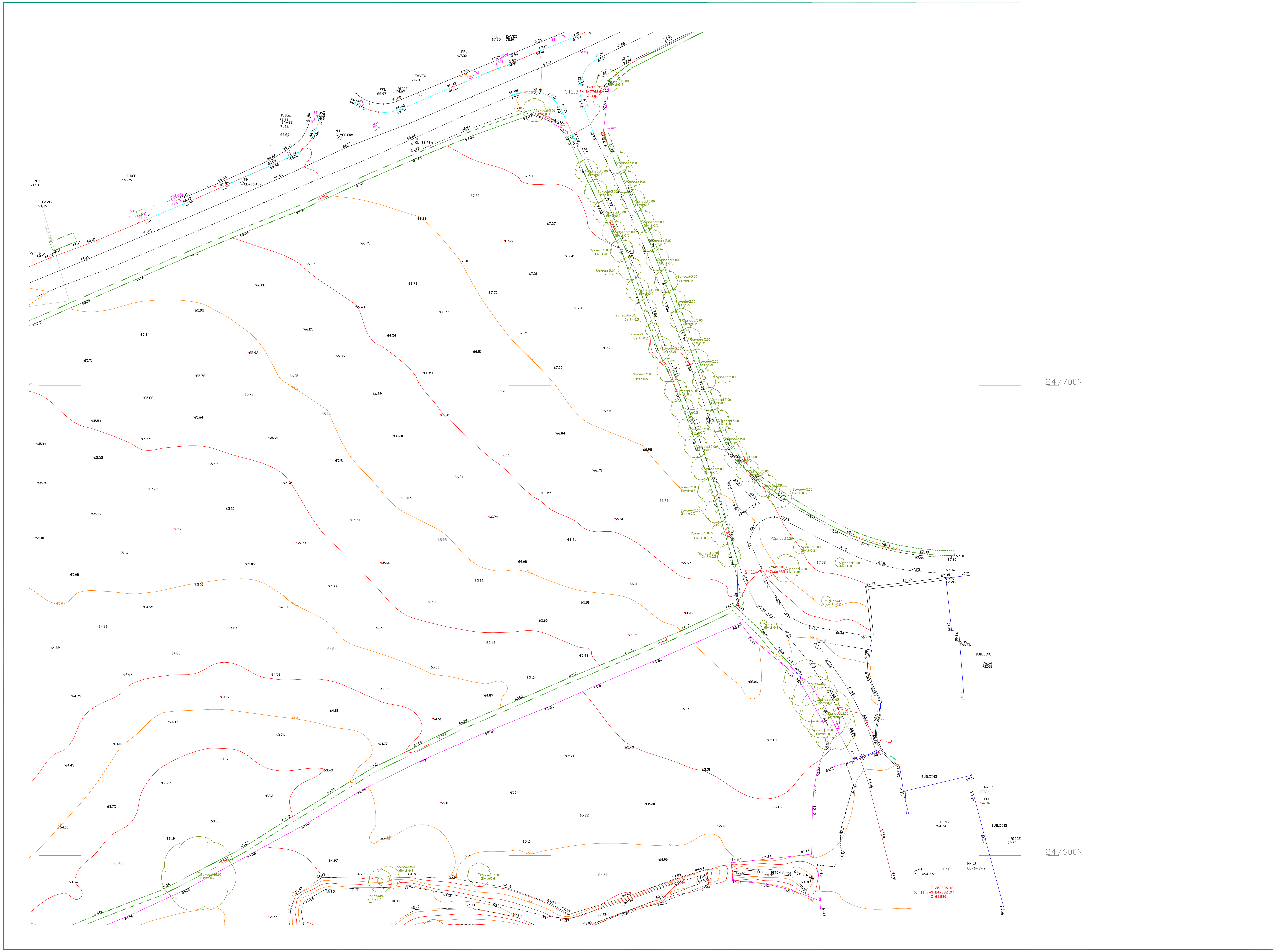
17 The Pines
Hirwaun, Aberdare
South Wales
CF44 9QW
Tel/Fax: 01685 814007
Mobile: 07980 404 208

CLIENT
McCARTNEYS LLP.

PROJECT
TOPOGRAPHICAL SURVEY
NEW HOUSE FARM,
MARDEN, HEREFORD.

Scales	1:250@A0	Date	04.11.14
Drawn	MJH	Plot No.	01
Project Reference No.	MCC/MAR/01		
Drawing Number	MARDEN 002/A		

A0



Rev	Amendments	Date	By
A	Additional Survey Added.	16.01.15	JP

NOTES:

1. SITE GRID AND LEVELS ARE BASED UPON ORDNANCE SURVEY VIA THE ACTIVE GPS NETWORK.

Do not scale this drawing

KEY

TSB	TRAFFIC SIGNAL BOX
PHB	PHONE BOX
PB	POST BOX SQUARE
PB	POST BOX ROUND
GRILL	GRILL SQUARE
GRILL	GRILL ROUND
BL	BOLLARD
BIN	BIN SQUARE
BIN	BIN ROUND
38.32	SPOT LEVEL
TAR	TARMAC
GR	GRASS
H/S	HARDSTANDING
BL	BOLLARD
BB	BELISHA BEACON
RS	ROAD SIGN
SIGN	SIGN
NP	STREET NAMEPLATE
TS	TRAFFIC SIGNAL
TSC	TRAFFIC SIGNAL CONTROLLER
IC	INSPECTION COVER
MH	MANHOLE
MH	MANHOLE
MP	MARKER POST
TP	TELEGRAPH POLE
LC	LIGHTING COLUMN
G	GULLY
WM	WATER METER
SV	SLUICE VALVE
ST	STOP TAP
FH	FIRE HYDRANT
BT	BRITISH TELECOM
CATV	CABLE TV
TV	CABLE TV
GV	GAS VALVE
1.0BR	BRICK WALL
1.0BL	BLOCK WALL
1.0ST	STONE WALL
	HEDGEROW/TREE CANOPY
2.0 P+W	FENCE
DK	DROPPED KERB

APPROX N

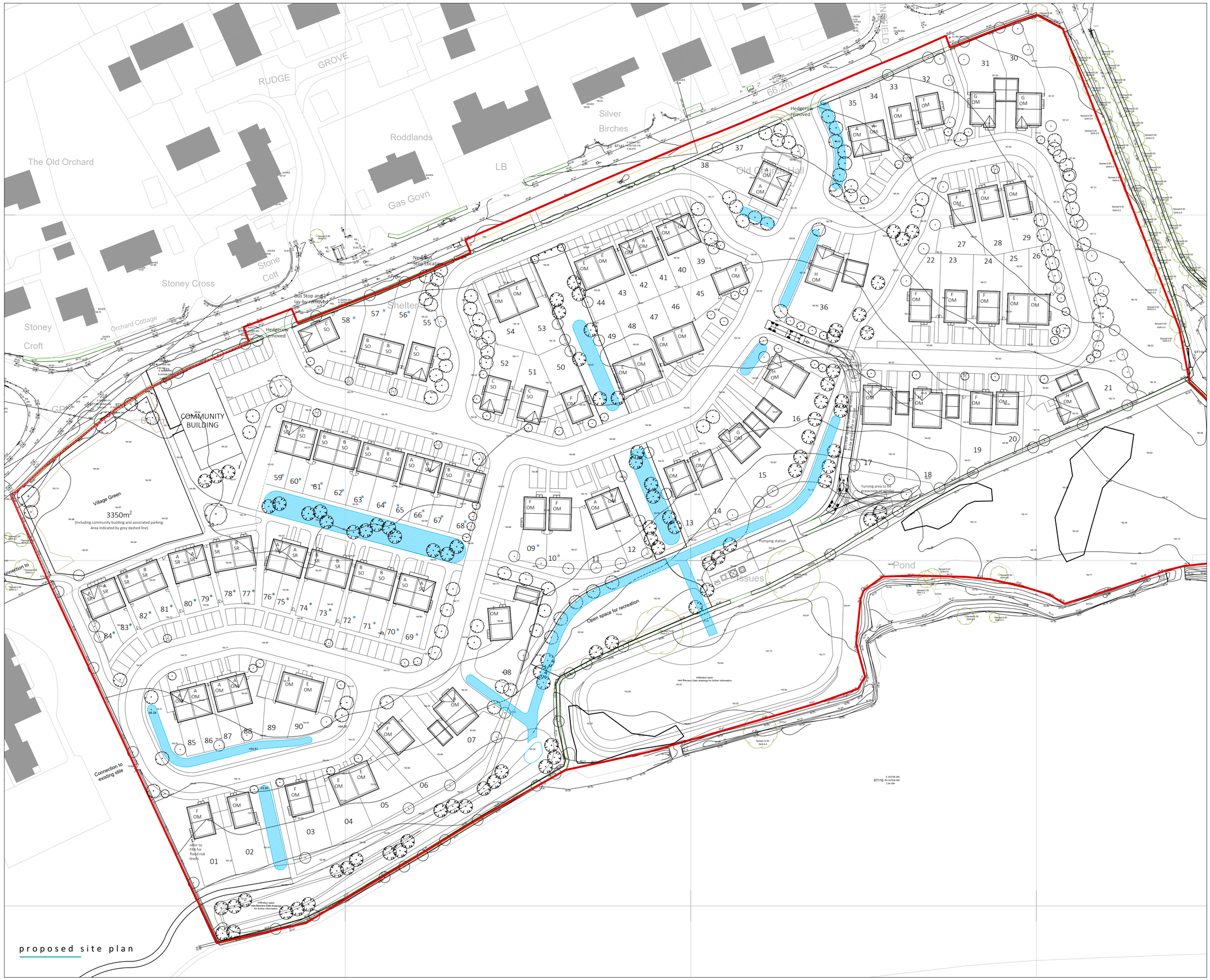
ALPINE LAND SURVEYORS
17 The Pines
Hirwaun, Aberdare
South Wales
CF44 9QW
Tel/Fax: 01685 814007
Mobile: 07980 404 208

CLIENT
McCARTNEYS LLP.

PROJECT
TOPOGRAPHICAL SURVEY
NEW HOUSE FARM,
MARDEN, HEREFORD.

Scales 1:250@A0	Date 04.11.14
Drawn MJH	Plot No. 01
Project Reference No.	MCC/MAR/01
Drawing Number	MARDEN 003/A

A0



proposed site plan

zebra ARCHITECTS

Signature new homes

zeb1094

Marden

Herefordshire

PL003

Proposed Site Plan

date	July 2018
status	information

rev **K**

A	Amended to client comments.	24/08/18
B	Amended to client comments.	07/09/18
C	Amended to Highway consultant comments.	18/09/18
D	Amended to incorporate drainage design.	28/09/18
E	Garage to plot 36 made larger.	05/11/18
F	Plot 17 amended to provide access to pumping station to rear	23/11/18
G	Pumping station area amended.	10/12/18
H	Amended to client comments.	02/01/18
J	Amended to client comments.	04/01/18
K	Pumping station position amended.	09/01/18

Accommodation schedule

Type	*	Ten.	Beds	Size	No.
A	*	SR	2B3P	74.4 (bw 75,6) m²	6
A		SO	2B3P	74.4 (bw 75,6) m²	6
A	*	OM	2B3P	74.4 (bw 75,6)m²	14
B	*	SR	3B5P	83m²	6
B	*	SO	3B5P	83m²	10
C		SO	4B6P	102.8 (bw 104.1)m²	4
E		OM	3B5P	85.4 (bw 86.7)m²	14
F		OM	3B6P	91.6 (bw 92.8)m²	21
G		OM	4B6P	111.6 (bw 112.8)m²	3
H		OM	4B7P	143.9 (bw 145)m²	6
TOTAL					90

SR	Social Rent	12
SO	Shared ownership	20
OM	Open Market	58

*bw house with bay window

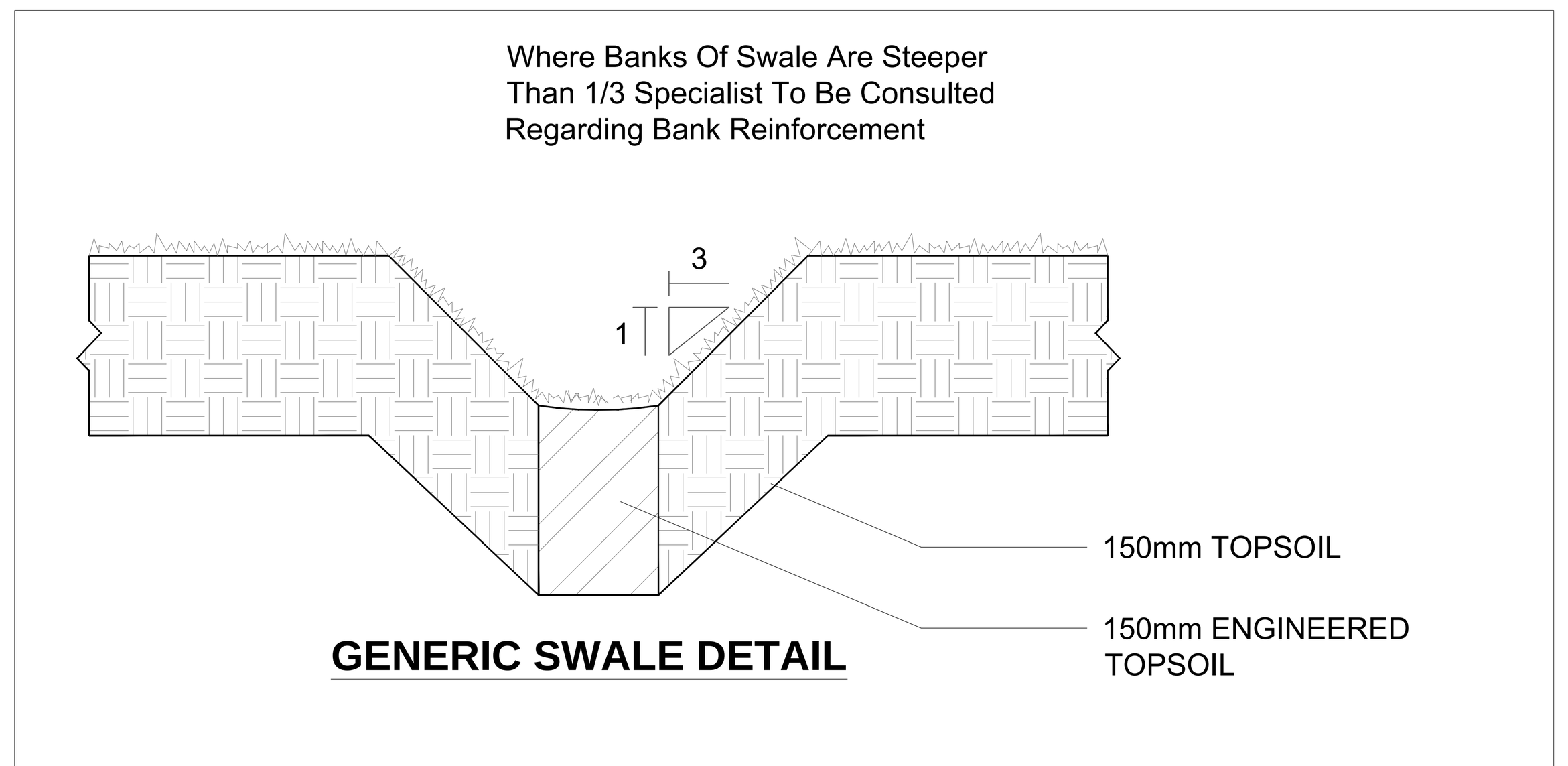
N

scale 1 : 500 @ A1

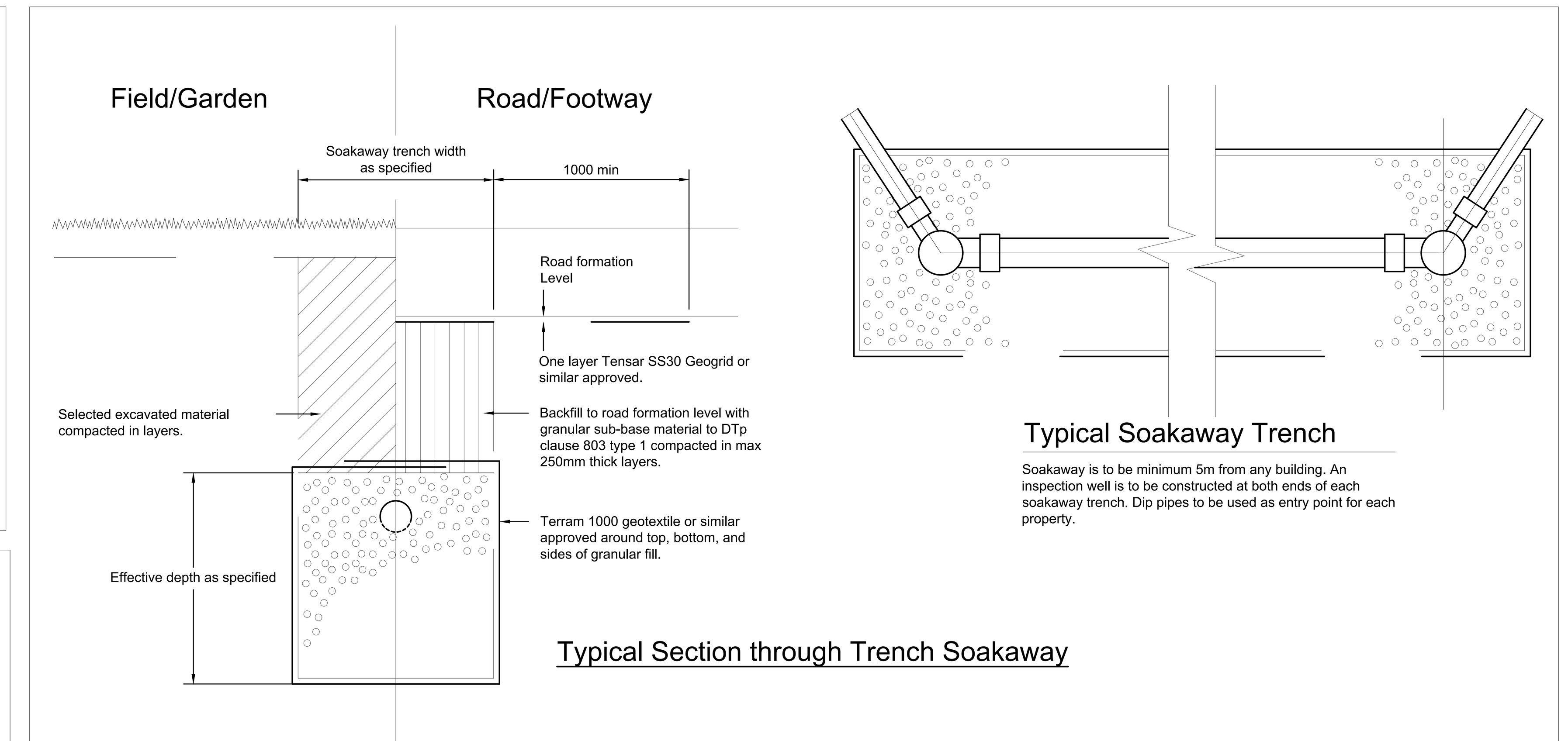
0 10 20 35 m

zebra architects ltd. is part of zebra group consulting ltd.

zebra architects ltd | c2 perdiswell park | worcester | wr3 7nw
hello@zebraarchitects.co.uk | 01905 351 472



Inset Scale 1:50

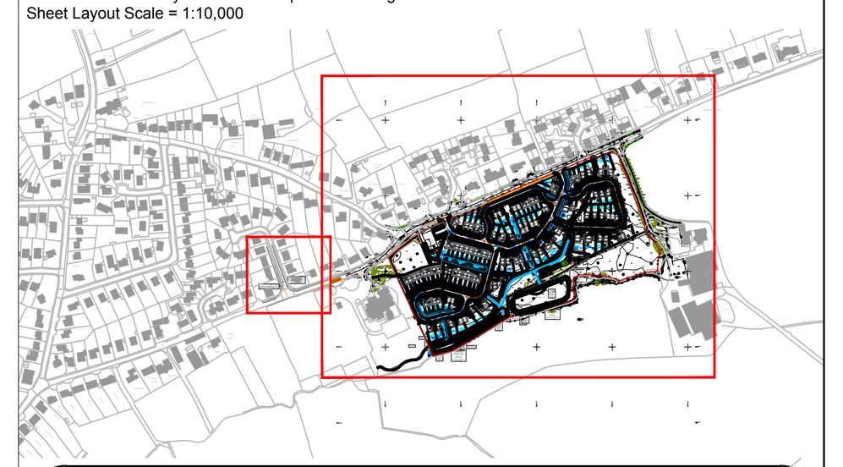


Inset Scale 1:20

Drainage Strategy Notes:.

- The storm highway run-off is proposed to flow through adopted highway sewers towards two privately maintained storage ponds which utilise infiltration (Assumed percolation value of 0.15372 m/hr). The private storm run-off is proposed to soakaway via infiltration trench's located 5m off rear building in back gardens where feasible (soakaways to be set minimum 1.0m above ground water level, soakaways not used where ground water table is high, levels taken from Trail Pit Logs provided by Georisk Management 15/11/2017). Soakaways have been sized to the 10yr storm event (In accordance with BRE 365), for storms up and above 10yr private run-off will overflow into storm inspection chambers which are routed through to swale SUDS features which is conveyed to the infiltration basins located at the bottom of the site.
- Discharge rate has been derived from ReFH rainfall methodology to calculate greenfield run-off rates of Q1= 1.9 l/s/ha & Q100 = 7.3 l/s/ha Total highways impermeable area = 1.112 ha, total private run-off area for extreme events = 0.292 ha. Discharge rates to be agreed with LLFA.
- FEH Rainfall data has been used to calculate initial storage pond requirements & have been sized to accommodate everything up to and including the 100year + 20% Storm event (site has sensitivity tested for 100year + 40%).
- Due to preliminary infiltration tests provided by Georisk Management (15/11/2017) an average value of (0.15372 m/hr) has been assumed and used to size schematic soakaway & basin sizes. Additional soakaways tests should be conducted prior to detailed design to accurately depict the use of soakaways across the entirety of the development.
- Foul drainage to drain via gravity towards adoptable pumping station located in the south eastern part of the site (other location specified on drawing). Foul is then pumped to a Welsh Water MH located within Little Paradise Ref:S052473501, total length of rising main=545m.
- All Section 38 highway drainage to be in accordance with Design Manual for Roads & Bridges DMRB.
- Certain plots (8-12 & 69-84) don't utilise individual plot soakaway trench's as per the trial pit logs provided by Georisk Management (15/11/2017) there is high ground water encountered at the trial pit logs by these locations.
- Swale SUDS features to include check dams where necessary.

Sheet Layout Scale



Rev.	Description	Date	By
C	Drawing revised to suit repositioned plots 83 & 84 and FPS.	11/01/2018	CS
B	FPS location amended. Strategy updated to suit.	11/12/2018	DA
A	Drainage strategy amended to suit revised layout.	11/11/2018	LJ
-	First Issue	21/09/2018	LJ

Drawing Status

PRELIMINARY

Please note while these drawings may be used for tender purposes, drawings are subject to Herefordshire Highways & Welsh Water approval as part of ongoing consultations and design checks. Amendments may therefore be requested.

Client: Signature New Homes

Project: Marden, Herefordshire

Title: Schematic Drainage Strategy Layout Plan

BANNERS GATE
Civil, Structural & Architectural Design Services
10-11 Birmingham Street, Halesowen, West Midlands B63 3HN
Tel: 0121 687 1500 Fax: 0121 687 1501
E-mail: mail@bannersgate.com

Scale	1:500 @ A0	Drawn	LJ
Date	September 2018	Checked	JB
File	18070/Dwgs/Civils/Current	Drawing	18070 - SK01 C