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Culm Garden Village

Preliminary Flood Risk and Drainage Assessment

Draft Report

Lightwood Land

Project No: 60557390

December 2017

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
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1. Introduction

1.1 Commission

AECOM has been commissioned by Lightwood Land to undertake a Preliminary Flood Risk and Drainage Assessment to inform the masterplanning process for the new Culm Garden Village, located to the east of Cullompton in Mid Devon. It is understood that the new garden village will consist of approximately 5,000 homes and include land for employment, district/local centres, schools and supporting infrastructure.

1.2 Proposed Development

The Culm Garden Village masterplan covers an area of approximately 426 hectares (ha). The Garden Village will be developed over three phases with a cumulative total of ca. 5000 dwellings on completion. The number of dwellings for each phase will be:

- Phase 1: 680 dwellings
- Phase 2: 1800 dwellings;
- Phase 3: 2700 dwellings.
- Total: 5180 dwellings.

There will also be three primary schools, one secondary school, a district centre and 8 haof commercial land and a Country Park. Outline planning for the first phase is scheduled for Autumn 2018. The draft land budget plan provided by Pegasus Design (20th October 2017) is shown in Figure 1-1. The sketch masterplan and land budget plan is also provided in Appendix A.

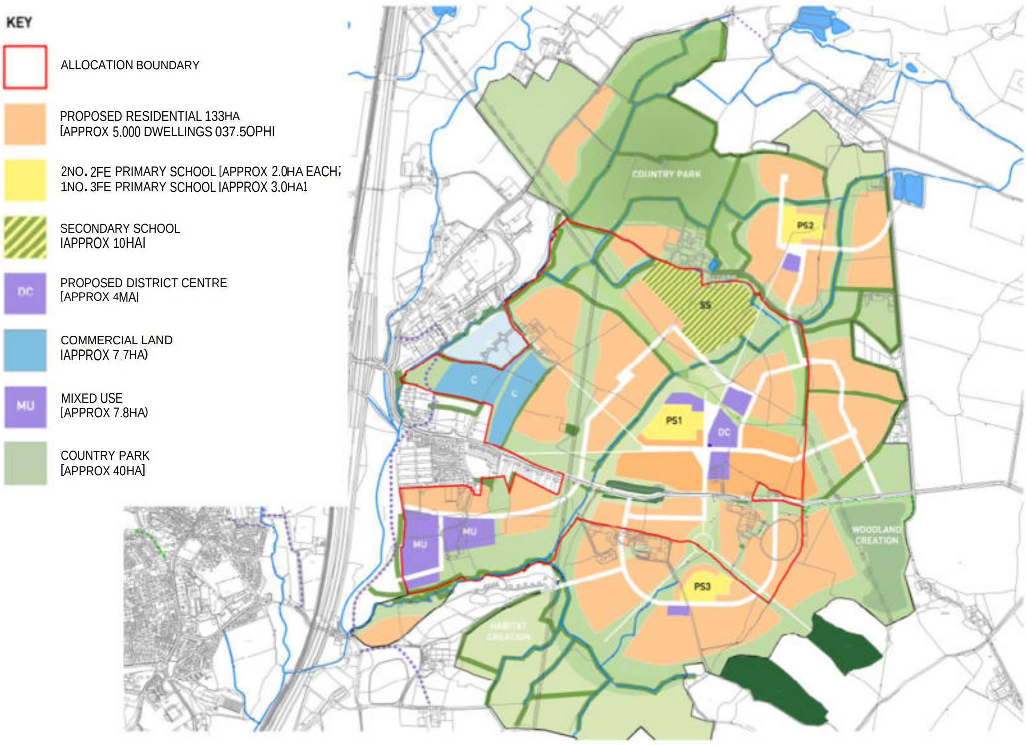


Figure 1-1: Draft Land Budget (courtesy of Pegasus Design)

1.3 Aim and Objectives

The aim of this preliminary assessment is to advise on a qualitative assessment of flood risk to the development and arising from the development. The following objectives will be met:

- Review of local and national planning policy and guidance relevant to flood risk and sustainable drainage, required to inform development of the Culm Garden Village masterplan;
- Review of relevant publicly available data from the Environment Agency, Mid Devon Council and Devon County Council and other online mapping (e.g. soil, geology, OS mapping);
- Undertake a site walkover to improve understanding of location and character of area, including observations of existing land-use, topography and drainage features;
- Identify existing blue corridors through the site (based on existing Environment Agency Flood Map for Planning and Risk of Flooding from Surface Water Map);
- Based on the above information provide high level assessment of existing flood risk onsite (from all sources) with reference to concept plan provided;
- Identify indicative sub-catchments across site based on existing topography and estimate greenfield runoff rates for each sub-catchment level using industry standard methods;
- Provide estimate of post development surface water attenuation requirements for each sub-catchment identified using the Micro Drainage Quick Storage Estimate tool;
- Based on the above, indicative locations and sizes (i.e. land-take) of surface water storage features required will be provided to inform masterplanning process;
- Liaison with South West Water to request information on capacity of existing foul drainage network and likely upgrade works required to accommodate additional foul flows.

2. Site Information

2.1 Site Location

The masterplan area is located to the east of Cullompton in Mid-Devon. The Ordnance Survey National Grid Reference (OSNGR) centred on the site is ST041076 whilst the closest postcode is EX15 1QQ. The M5 runs the entire length of the western boundary of the site in the vicinity of Junction 28. The village of Stoneyford, Kingsmill Industrial Estate and the Cummings Nursery site are also located along the western boundary.

Horn Road runs along the length of the eastern boundary. The northern boundary is loosely defined by Long Moor and Long Drag Roads. The southern boundary extends to Upton on the western side and Aller Wood on the eastern side. Existing residential properties and commercial land are located around the boundary of the site; however, the site is predominantly surrounded by fields and grassland.

The existing land-use within the site boundary is predominantly agricultural land. Existing buildings within the site boundary consist of farm houses and associated buildings. A number of field boundaries are bordered by trees and hedgerows, however as noted above the most prominent area of woodland is Aller Woods located on the southern boundary of the site.

The A373 (Honiton Road) which runs through the centre of the site will remain, however the majority of smaller farm access tracks are likely to be removed as part of the redevelopment. There are two listed buildings and many features of historic environmental interest located within the site boundary.

The indicative masterplan area and the detailed river network[1] local to the site are provided in Figure 2-1. The locations of photographs presented in Section 2.2 are also displayed.

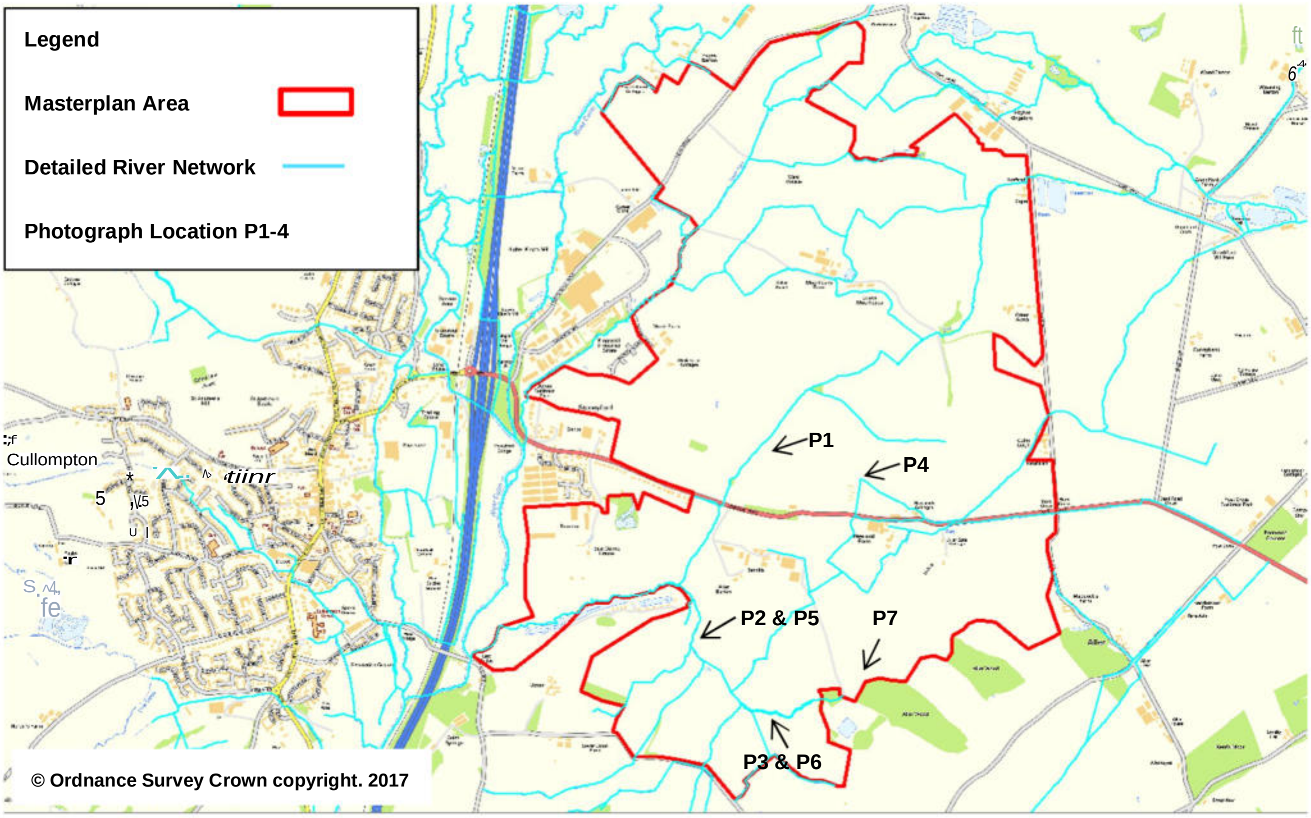


Figure 2-1: Site Location and Detailed River Network

[1] Downloaded from https://data.gov.uk/ (last accessed 24/10/2017)

2.2 River Catchments

The masterplan area is located within six sub-catchment areas (see Figure 2-2). The River Culm flows to the north of the site and along the western boundary following the M5 corridor. The north-western tip of the site is located within the immediate River Culm catchment, which has an upstream catchment area of approximately 125 km^2. However, the majority of the masterplan area is located within the River Ken catchment and associated sub-catchments.

The River Ken is a catchment which forms part of the larger River Culm catchment area. The River Ken discharges to the River Culm at two locations. The northern reach of the River Ken discharges to the River Culm immediately south of the A373, to the east of Junction 28 of the M5.

Based on a review of the Flood Estimation Handbook (FEH) catchment boundaries[2], together with site observations and conversations with local land owners, a preliminary sub-catchment map has been produced (see Figure 2-2). The northern River Ken catchment is considered to be the main channel with an upstream catchment area of 12.3 km^2. To the south there are three smaller sub-catchments (<2 km^2), which drain the masterplan area. The southern River Ken catchment is shown to discharge to the River Culm approximately 1 km south in the vicinity of Upton.

The detailed river network indicates some connectivity between the two River Ken catchments. Therefore, Figure 2-2 should be viewed as a preliminary overview of catchment delineation and subject to further investigation.

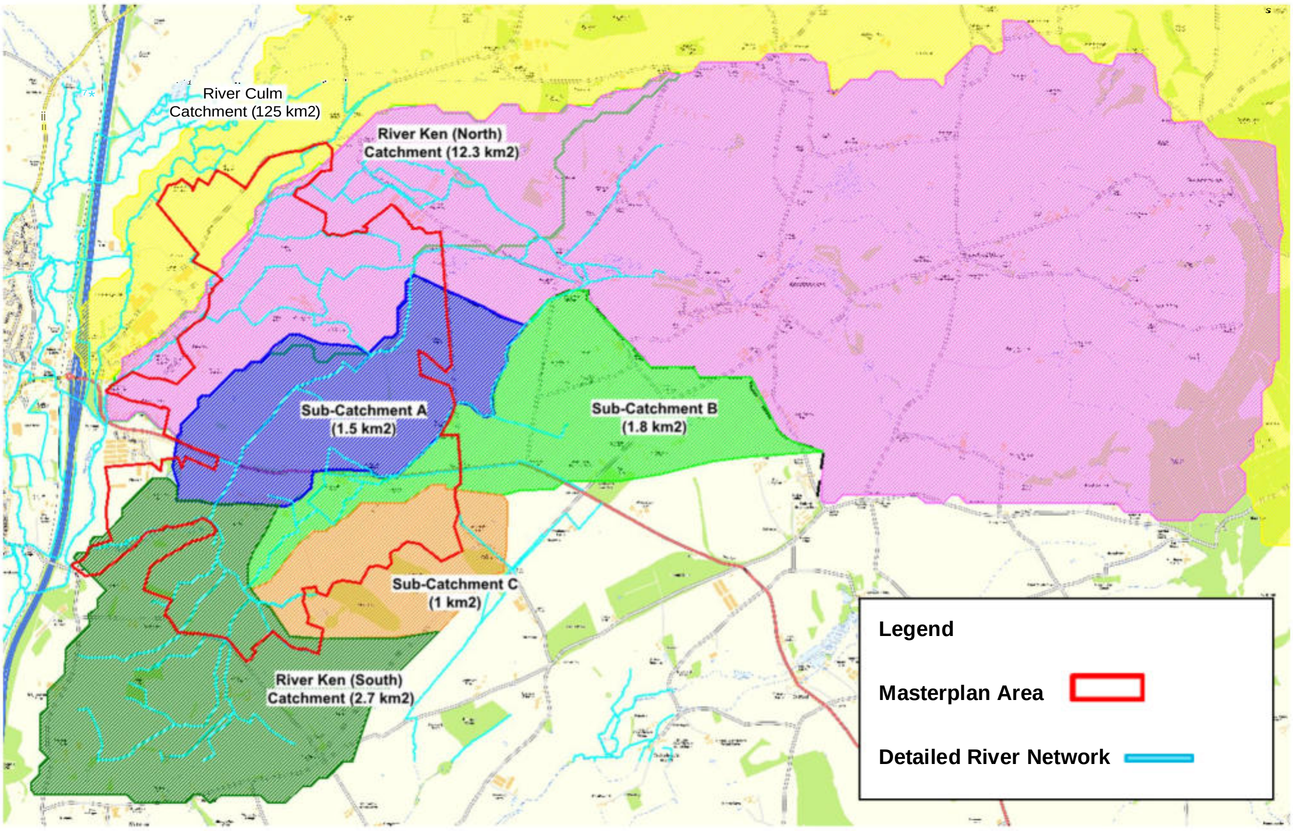


Figure 2-2: Site Location and Main Drainage Catchments

The River Culm and a short downstream section of the River Ken (to the south of Kingsmill Industrial Estate) are classified as Main River. The Environment Agency is responsible for carrying out maintenance, improvement or construction work on Main Rivers to manage flood risk. The majority of the watercourse and drainage ditches located within the masterplan area are classified as Ordinary Watercourses. Devon County Council in their role as Lead Local Flood Authority (LLFA) are responsible for activities related to Ordinary Watercourses.

[2] Downloaded from https://fehweb.ceh.ac.uk/ (last accessed 24/10/2018)

2.3 Drainage Regime

The site visit undertaken on the 2nd November 2017 confirmed the network of Ordinary Watercourses (consisting of drainage ditches) across the masterplan area. During the site walkover, conversations held with local land owners led the team to understand how during the 18th century off-take ditches from the main River Ken channel were made to irrigate local farmland. A review of historic OS maps (surveyed 1887) indicates the presence of these ditches.

These drainage ditch off-takes are shown on the detailed river network map (see Figure 2-1 and Figure 2-2). Conversations with local landowners identified that farmers have an active role in the maintenance of these drainage ditches, which are typically lined by trees and hedgerows. Responsibility for maintenance of the drainage ditches and watercourses within the masterplan area post development will need to be considered to make sure channels flow freely and flood risk is managed.

Typical examples of the drainage ditches observed during the site walkover are shown in Photographs 2-1 to 2-3. The general locations of these drainage ditches within the site boundary are shown on Figure 2-1. It should be noted that the majority of drainage ditches encountered were bordered by trees and hedgerows and were therefore not accessible or visible during the site walkover.

Photograph 2-1 (Phase1)

Photograph 2-2 (Phase 3)

Photograph 2-3 (Phase 3)

A typical example of other drainage features likely to be found within the site boundary is shown in Photograph 2-4. This photograph was taken towards the centre of the site on land to the north of the A373 adjacent to a solar farm and static caravans. At this location flow entering a pipe in the corner of the field was observed.

Photograph 2-4 (Phase 1)

Diagram 2-1

Anecdotal evidence from one landowner suggested that the pipe is laid across the field and discharges into the watercourse to the west (as shown by the blue line – Diagram 2-1). However, the detailed river network indicates that the pipe drains towards the south (as by the green line – Diagram 2-1). Further investigation is likely to be required to inform subsequent stages in the planning process.

Two fords have also been identified on site. One is located at the access to Aller Gate Cottage and the other is located on the access track to Moorhayes Farm and Lower Moorhayes.

Small areas of standing water and areas of saturated soils were observed during the site walkover towards the southern (lower) part of the site on land proposed for development as part of Phase 3. The site walkover was undertaken during a relatively dry period in November, thus indicating that these locations may often be prone to waterlogged soils. Photographs 2-5 to 2-7 provide examples of typical observations made.


Photograph 2-5 (Phase3)


Photograph 2-6 (Phase 3)


Photograph 2-7 (Phase 3)

Anecdotal evidence from local landowners suggests that the underlying soils are generally 'silt over clay' and therefore have low potential to infiltrate rainwater. This is therefore likely to result in higher rates of surface water runoff from the site and potential for standing water in flatter, low lying areas of the site.

Further anecdotal evidence from the landowner of the southern parts of the site indicates the presence of a below ground pipe adjacent to Aller Wood. This pipe is for land drainage as it is located within the base of a valley and likely to be located along a major surface water flow path. The pipe is understood to discharge into the upstream end of the local drainage ditch.

2.4 Topography

Typical ground levels across the masterplan area (based on LiDAR data[3]) are shown in Figure 2-3. Ground levels range from approximately 50 m AOD in the west up to 80 m AOD in the east. The northern and southern areas of the site associated with the downstream reaches of the River Ken are lower lying with approximate ground levels between 50 m AOD and 60 m AOD. The central eastern areas of the site have the highest ground levels ranging from between 70 m AOD and 80 m AOD. There is also a raised ridge orientated north-east to south-west to the north of the A373 Honiton Road, ground levels up to 67 m AOD are notable at this location.

Gradients down the contours can range between 1 in 100 and 1 in 20. The flatter parts of the site are typically within the lower areas with steep sections within the central eastern area of the site.

[3] Downloaded from http://environment.data.gov.uk/ds/survey/index.jsp#/survey (accessed 20/10/2017)

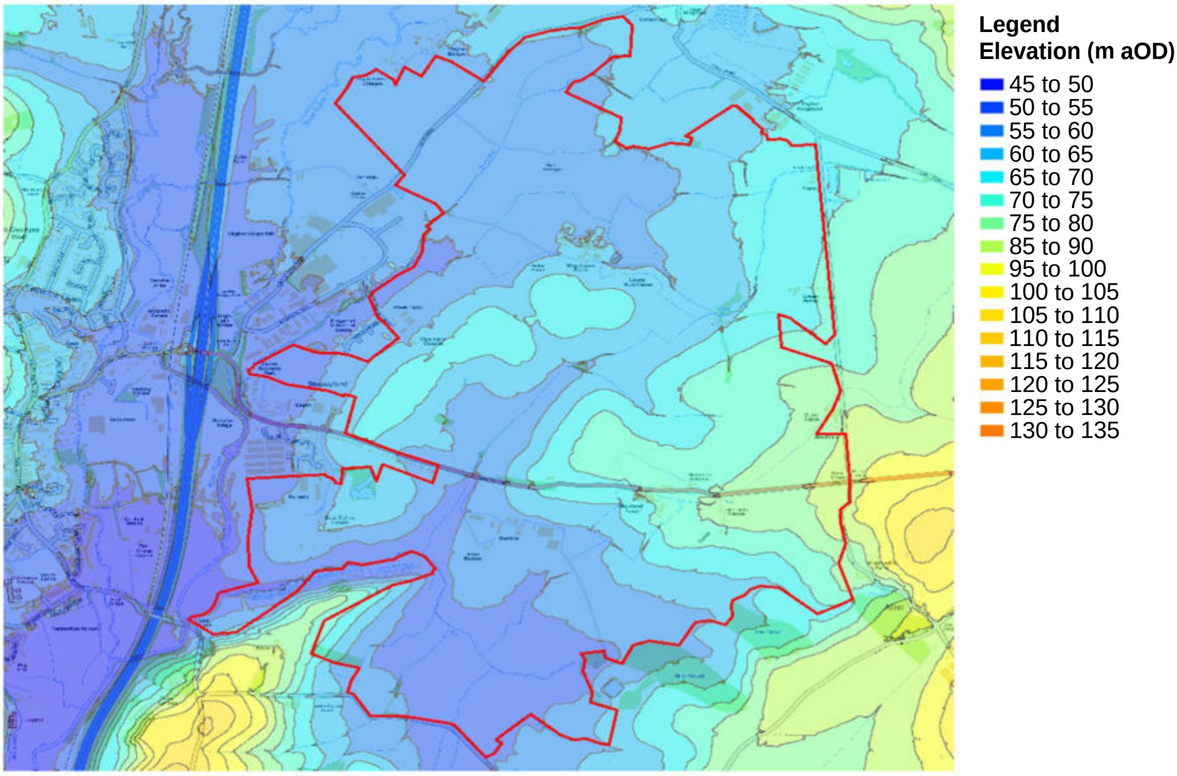


Figure 2-3: Local Topography

2.5 Soils and Geology

The preliminary assessment of soils and geology across the site is based on mapping sourced from the 'Soilscape' website[4] and the British Geological Survey[5] (BGS) respectively.

An excerpt map from the 'Soilscape' website is provided in Figure 2-4. The 'Soilscape' website indicates that soils across the site can generally be described as follows:

- Loamy soils with naturally high groundwater across northern site extents;
- A band of freely draining slightly acid loamy soils to the west of the site;
- Slightly acid loamy and clayey soils with impeded drainage central and eastern site;
- Slowly permeable seasonally wet, slightly acid but base rich loaming and clayey soils (with impeded drainage) to the south of the site;
- Loamy and clayey floodplain soils with naturally high groundwater (naturally wet drainage) to the far west and north-west of the site. The area of site impacted by this soil type is minimal.

The soil descriptions are generally consistent with observations and descriptions provided by the local land owners encountered during the site walkover. As described in Section 2.3, small areas of standing water and areas of saturated soils were observed during the site walkover towards the southern (lower) part of the site on land proposed for development as part of Phase 3. Waterlogged soils were not observed in northern areas of the site during the site walkover, although landowners description of soils were typically silt over clay.

[4] Available online: http://www.landis.org.uk/soilscapes/ Last accessed 12/10/2017
[5] Available online: http://mapapps.bgs.ac.uk/geologyofbritain/home.html. Last accessed 12/10/2017.

Figure 2-4: Soils across the Masterplan Area

According to the BGS map the bedrock beneath the site is Aylesbeare Mudstone Group - Mudstone. Sedimentary Bedrock formed during the Triassic Period where the local environment was previously dominated by lakes.

The superficial deposits are found along the river corridors of the River Culm and River Ken and also on the higher ground towards the eastern side of the masterplan area. Superficial deposits can be described as follows:

- River Culm and River Ken (north) lower river corridors – Alluvium - Clay, Silt and Sand. Superficial Deposits formed during the Quaternary Period. Local environment previously dominated by rivers;
- River Ken (south) river corridor – Colluvium - Diamicton. Superficial Deposits formed during the Quaternary Period. Local environment previously dominated by subaerial slopes;
- Higher eastern area - Head - Gravel. Superficial Deposits formed during the Quaternary Period. Local environment previously dominated by subaerial slopes.

Based on the soil and geological mapping the southern and central parts of the site are considered to be slowly permeable soils that may impede drainage. The loamy soils to the north and west may be more permeable, however this is unconfirmed. Note that the ground conditions should be investigated further at a later stage through ground investigations. This should include infiltration tests.

2.6 Hydrogeology

The Environment Agency classifies zones around potable groundwater abstraction points as Groundwater Source Protection Zones (SPZ) and these are designed to limit potential pollution activities. According to the Environment Agency website there is a small SPZ Inner Zone and Outer Zone in the vicinity of Aller Barton Farm (south-west of Stoneyford). The total diameter of the SPZ is approximately 500m across. The groundwater abstraction point associated with this SPZ is likely to serve a small local population, rather than a water supply for a major population. However, this has not been confirmed as part of this study.

The majority of the underlying bedrock is not classified as an aquifer. The bedrock underlying the far north is classified as a Secondary A aquifer. Secondary A Aquifers are permeable layers capable of supporting water supplies at a local level, and in some cases forming part of the base flow to rivers. All superficial deposits underlying the site are classified as Secondary B Aquifers, predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.

3. Policy and Guidance

3.1 National Planning Policy Framework

Section 10 of the National Planning Policy Framework (NPPF) and its Planning Practice Guide (PPG) provides the current guidance for planning with respect to flood risk. The NPPF advocates a sequential approach for the planning process in order to steer development to areas with the lowest possible risk of flooding. Table 2[6] of the PPG indicates that the development types such as residential and educational establishments such as schools would be classified as 'More Vulnerable'. Whereas buildings used for shops and general industry would be classified as 'Less Vulnerable'.

Subject to application of the Sequential Test, Table 3 of the PPG identifies that 'More Vulnerable' development is permitted within Flood Zone 1 and 2. However, the Exception Test is required for 'More Vulnerable' development proposed within Flood Zone 3a and development of this type is not permitted in Flood Zone 3b (Functional Floodplain). 'Less Vulnerable development is permitted within Flood Zone 1, 2 and 3a, but not permitted within Flood Zone 3b.

The NPPF and its PPG specify that planning applications for development proposals of 1 ha or greater located within Flood Zone 1 and all proposals for new development located in Flood Zones 2 and 3 should be accompanied by a Flood Risk Assessment (FRA). The FRA will need to demonstrate how flood risk from all sources of flooding to the development itself and flood risk to others will be managed and taking into account climate change.

3.2 Mid Devon Local Plan

The Mid Devon Local Plan Review (2013-2033) was submitted to the Planning Inspectorate on 31 March 2017 for examination. The Local Plan Review will guide development in the district over a 20 year period and aims to ensure that new homes, jobs and services required by communities are located in the most sustainable places. It will also help deliver the infrastructure, facilities and other developments needed to make this possible.

The following policies are relevant to the developing masterplan:

- Policy S1 – Sustainable Development Priorities, requires, at clause (j): '*meeting the challenges of climate change…. by managing flood risk';*
- Policy S9 – Environment, requires, at clause (c): '*The provision of measures to reduce the risk of flooding to life and property, requiring sustainable drainage systems including provisions for future maintenance, guiding development to locations of lowest flood risk by applying a sequential test where appropriate, and avoiding an increase in flood risk elsewhere';*
- Policy S11 – Cullompton, requires, at clause (g): '*Support measures to reduce flood risk within Cullompton and make provision for green infrastructure';*

Policy S11 supporting text states that:

'2.64 Critical Drainage Area (CDA) has been identified by the Environment Agency at Cullompton. The aim of this CDA is to ensure there is no increase in flood risk downstream as a result of development pressure. A Flood Risk Assessment will be required at the planning application stage for development proposed in the CDA to determine specific recommendations for mitigation. All new development will require additional water storage areas to be created within the site compared to the normal SUDs design thereby contributing to a reduction in flooding downstream. The Environment Agency (EA) is a statutory consultee on all developments in Critical Drainage Areas and flood zones 2 and 3, while the Lead Local Flood Authority (Devon County Council) will be a statutory consultee on all major development'.

As discussed below in Section 3.3 the masterplan area is not located within the Cullompton CDA. However, this policy has been included within this preliminary assessment for information.

[6] Available online: https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-2-Flood-Risk-Vulnerability-Classification

- Policy CU9 – East Cullompton Environmental Protection and Green Infrastructure, requires, at clause (f): '*Appropriate provision of a sewerage system to serve the development and a strategically designed, and phased, Sustainable Urban Drainage Scheme to deal with all surface water from the development and arrangements for future maintenance'*

Policy CU9 supporting text states that:

'3.107 There are various areas of narrow flood plains associated with watercourses running across the site. For some of the small watercourses, a flood risk assessment will need to consider the potential of flooding as the current extent is unknown. These watercourses do not take up a significant area but the layout of the development will need to take floodplains into account. Areas of floodplain should be retained as part of the strategic green infrastructure providing wildlife corridors to other areas.

The urbanisation of the area has the potential to increase surface water run-off elsewhere, through the loss of permeable surfaces. The inclusion of a sustainable urban drainage scheme approach for the entire development will ensure that there is no additional run-off from the site as a result of development. Sustainable urban drainage schemes usually involve the provision of ponds, swales and other soft areas which can serve as a dual use for public open space and can be incorporated into wildlife networks.

A strategy for dealing with surface water must be prepared as part of the masterplanning of the site to determine the number, size and location of the required SUDS features. The role of landscaping and tree-planting in flood prevention and carbon reduction should also be recognised in the development'.

This preliminary assessment considers references above regarding the need to take floodplains into account and the provision of SuDS features as part of the masterplaning process (see Section 5 and 6 respectively).

3.3 Cullompton Critical Drainage Area (May 2015)

As stated within Section 3.2 the masterplan area is not located within a CDA, however the catchments west of Cullompton, which include the Cole Brook, Crow Green Stream, and St Georges Well Stream have been designated as a CDA by the Environment Agency. These catchments are typically small, and respond quickly to rainfall, in particular short duration thunder storm events, as occurred in August 1997.

Future development within the CDA (which covers western and central areas of Cullompton) will need to meet more stringent SuDS requirements and contribute to schemes to reduce flooding to existing properties. The minimum drainage standards required for new development proposed within the CDA are as follows:

'All new developments will have to play their part in reducing current rainfall runoff rates. This requirement also applies to brownfield sites that will have to match the same standards. The surface water drainage hierarchy should be followed by using infiltration as far as is practicable. Further guidance on such systems can be found in the CIRIA SuDS Manual and in Lead Local Flood Authority guidance.

All off-site surface water discharges from developments should mimic greenfield performance up to a maximum 1 in 10 year discharge rate. On site all surface water should be safely managed up to the 1 in 100 plus climate change conditions. This will require additional water storage areas to be created thereby contributing to a reduction in flooding downstream.'

It is important to note that the Cullompton CDA has been designated to help mitigate flooding posed by the small, rapid response catchments to the west of Cullompton and does not cover the much larger River Culm catchment or tributaries to the east of Cullompton. Therefore, the masterplan area is located outside of the CDA.

3.4 Preliminary Flood Risk Assessment

The Devon PFRA (2011) was prepared to assist Devon County Council (DCC) with meeting their duties to manage local flood risk and deliver the requirements of the Flood Risk Regulations (2009). The report provides a high level overview of flood risk from local flood sources including surface water, groundwater, ordinary watercourses and canals.

According to the PFRA Cullompton is an area identified as being particularly at risk from groundwater flooding. No specific historic flood incidents have been identified across the masterplan area.

3.5 Strategic Flood Risk Assessment

Mid Devon District Council produced a Strategic Flood Risk Assessment (SFRA) in October 2014. The information contained within the SFRA will inform the preparation of policies relating to flooding, managing flood risk, land use and development allocations. The SFRA provides an overview of historic flooding within Cullompton. The 1997 thunderstorm that resulted in flooding to properties from Cole Brook, Crow Green Stream, and St Georges Well Stream and the 2012 flood event, where a number of properties in Cullompton were flooded from the River Culm are noted within the SFRA.

The Culm Garden Village masterplan area is referred to in the SFRA as the East Cullompton Urban Extension. The SFRA indicates that 0% of the site is located within the Environment Agency historic flood map. However, 10% of the site is located within Flood Zone 3 and a further 1% of the site located within Flood Zone 2.

Other information relevant to the masterplan area is that parts of Cullompton are included within a groundwater emergence zone (this is discussed further in Section 4.5).

The site is located within the River Exe Catchment Flood Management Plan (CFMP) area. Cullompton is located within Policy Unit 4, where the policy is 'take action to reduce flood risk (now and/or in the future).

3.6 Local Flood Risk Management Strategy

DCC has produced a Local Flood Risk Management Strategy (LFRMS). As the Lead Local Flood Authority for its area the strategy has been produced in line with the Flood and Water Management Act 2010.

The high level strategic outlines the responsibilities of the Risk Management Authorities in Devon and how they are working in partnership to coordinate local flood risk management. This covers everything from engaging with communities and preparing for floods, responding to flood events, collaborating on flood risk studies and investing in flood improvements.

DCC have also produced a SuDS guidance document, which should be used to guide the SuDS strategy proposed for the developing Masterplan. Further details of this document is provided in Section 5.

3.7 Flood Investigation Reports

Under Section 19 of the Flood and Water Management Act (2010) a number of flood investigation reports have been produced for Devon. Those that concern Cullompton include:

- Devon Floods, November 2012,
- Devon Floods, November 2016.

In each of these events residential properties were flooded however there were no incidents at, or within the vicinity, of the proposed masterplan area. Other Flood Investigation Reports covering flood incidents within Mid Devon have been prepared by Devon County Council, however, these reports do not cover the Cullompton area.

4. Flood Risk to the Development

4.1 Overview

The NPPF requires that all potential sources of flooding that could affect the proposed development are considered. This includes flooding from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems. Flooding from reservoirs and other artificial sources must also be considered. There should be demonstration of how these should be managed so that the development remains safe throughout its lifetime, taking into account climate change.

4.2 Tidal

Tidal flood sources include the sea and estuaries. The site is located approximately 24 km from the River Exe Estuary (closest tidal source) and minimum ground levels on site are approximately 50 m AOD. Therefore, the risk posed by tidal flooding is assessed as very low and not considered further within this assessment.

4.3 Fluvial

The majority of the masterplan area is located within Flood Zone 1 (i.e. land with less than 0.1% annual chance of fluvial flooding). However, there are areas of the site associated with the floodplain of the River Ken (and River Culm to a lesser extent), which are located within Flood Zones 2 and 3. Land in Flood Zone 2 is considered to have between a 1% and 0.1% annual chance of flooding, whereas land in Flood Zone 3 is considered to have greater than a 1% annual chance of flooding.

Flood Zones[7] across the masterplan area are shown in Figure 4-1. Figure 4-1 also highlights a number of locations within the masterplan area where proposed development parcels overlap Flood Zones 2 and 3.

A brief summary is provided below:

A. Flood Zone 3 extends approximately 15 m into this residential development parcel;

B. Flood Zone 2 extends approximately 8 m into this residential development parcel;

C. Flood Zone 3 extends approximately 10 m into this residential development parcel;

D. Flood Zone 2 extends approximately 20 m into this commercial development parcel;

E. Flood Zone 3 extends approximately 8 m into this district centre parcel;

F. Flood Zone 3 extends approximately 15 m into this residential development parcel. Flood Zone 3 at this location does not follow detailed river network or the watercourse shown on OS mapping;

G. Flood Zone 2 extends approximately 12 m into this mixed-use development parcel.

It is clear that the masterplanning process to date has been undertaken with consideration of Flood Zones 2 and 3, as the majority of the development has been sequentially located towards Flood Zone 1.

As the masterplan evolves, vulnerable parts of the development are recommended to be set back from the areas identified above (Bullets A to G). These areas form part of the wider green infrastructure zones or could be utilised as landscaping or car parking areas for the proposed development.

Flood Zone 3 associated with Area E could form part of the strategic SuDS network, as the upstream catchment area is small (~0.18 km^2) and will wholly form part of the Masterplan area post development.

[7] Downloaded from https://data.gov.uk/ (last accessed 24/10/2017)

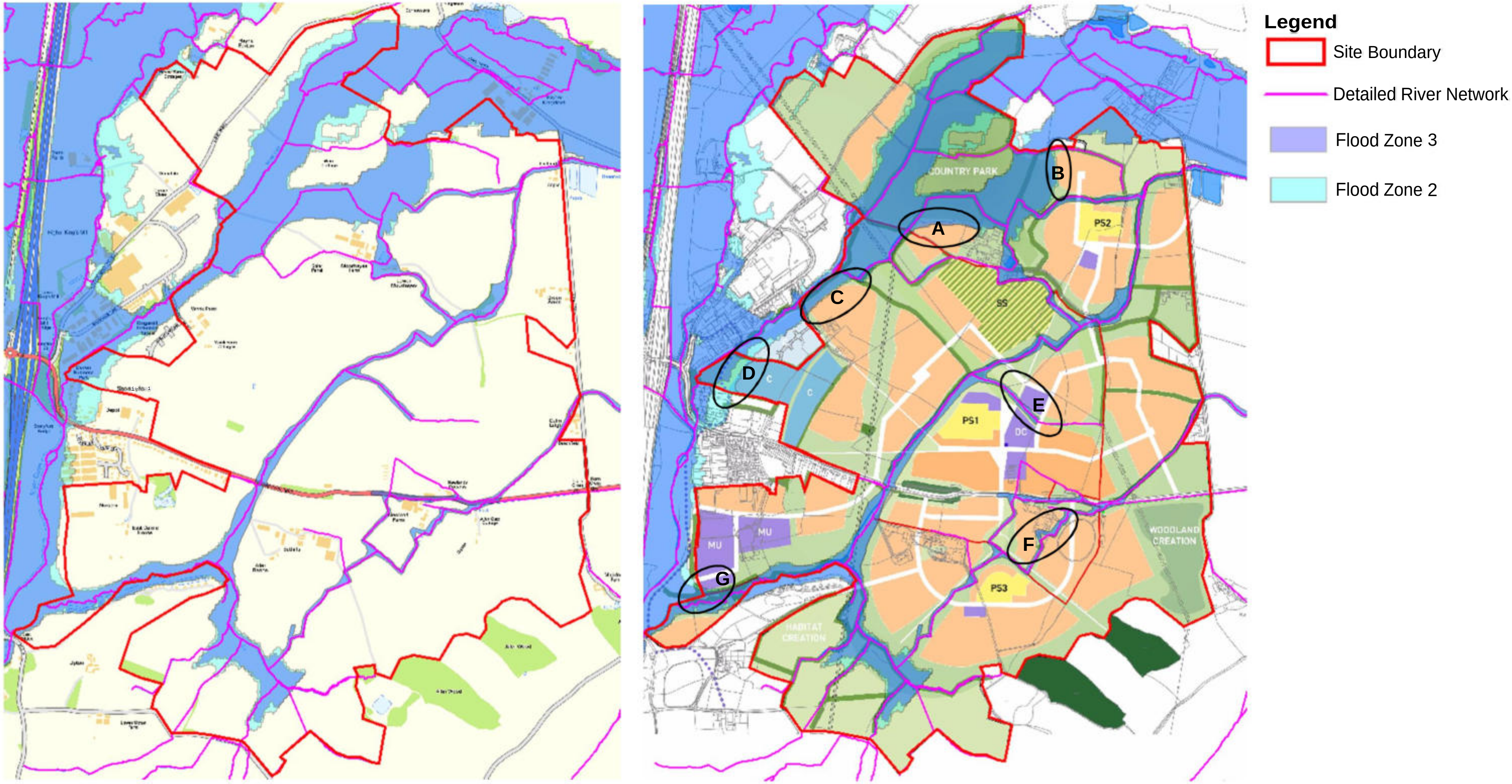


Figure 4-1: Flood Zones across the Masterplan Area (pre and post development)

4.4 Surface Water

Surface water flooding results from rainfall that fails to infiltrate the surface and travels over the ground; this is exacerbated where the permeability of the ground is low due to the type of soil and geology (such as clayey soils) or urban development. Surface water flow is also promoted in areas of steep topography which can rapidly convey water that has failed to penetrate the surface.

The Risk of Flooding from Surface Water dataset[8] (RoFfSW) provides an indication of areas across the masterplan area potentially susceptible to surface water flooding. The RoFfSW dataset is useful in identifying the floodplain associated with smaller watercourses not covered by Flood Zones 2 and 3 (see Section 4.3) and also overland surface water flow pathways prior to reaching the watercourses.

The majority of the masterplan area is located outside of the RoFfSW extents (i.e. land with less than 0.1% annual chance of surface water flooding). However, there are areas of land within the site located in areas with a risk of 3.3%, 1% and 0.1% annual chance of surface water flooding.

RoFfSW extents across the masterplan area are shown in Figure 4-2. Figure 4-2 highlights a number of locations within the masterplan area where proposed development parcels overlap the RoFfSW extents.

A. 3.3% annual chance of surface water flooding extent extends approximately 12 m into this residential development parcel;

B. A surface water flow pathway during the 0.1% annual chance of flooding event crosses this residential development parcel;

C. 3.3% annual chance of surface water flooding extent extends approximately 20 m into this secondary school development parcel;

D. A surface water flow pathway during the 0.1% annual chance of flooding event crosses the district centre development parcel and residential development parcel (to the east);

E. A surface water flow pathway during the 0.1% annual chance of flooding event passes within the southern boundary of this residential development parcel;

F. A surface water flow pathway during the 0.1% annual chance of flooding event passes within the southern boundary of this residential development parcel.

It is clear that the masterplanning process to date has been undertaken with consideration of the RoFfSW extents, as the majority of the development has been sequentially located to very low risk areas.

As the masterplan evolves the areas identified above (Bullets A to F), should be considered further and where possible vulnerable development should be set back from these areas. This is more important for areas identified as being within the 3.3% and 1% annual chance of flooding extent, but more flexibility should be allowed for areas of shallow flooding located within the 0.1% annual chance of flooding surface water extent.

The surface water flow pathway identified in Bullet B, C, D, E and F above could form part of the strategic SuDS network, as these are natural depressions where surface water is likely to be directed towards.

[8] Downloaded from http://environment.data.gov.uk/ds/partners/#/partners/login (accessed 24/10/2017)

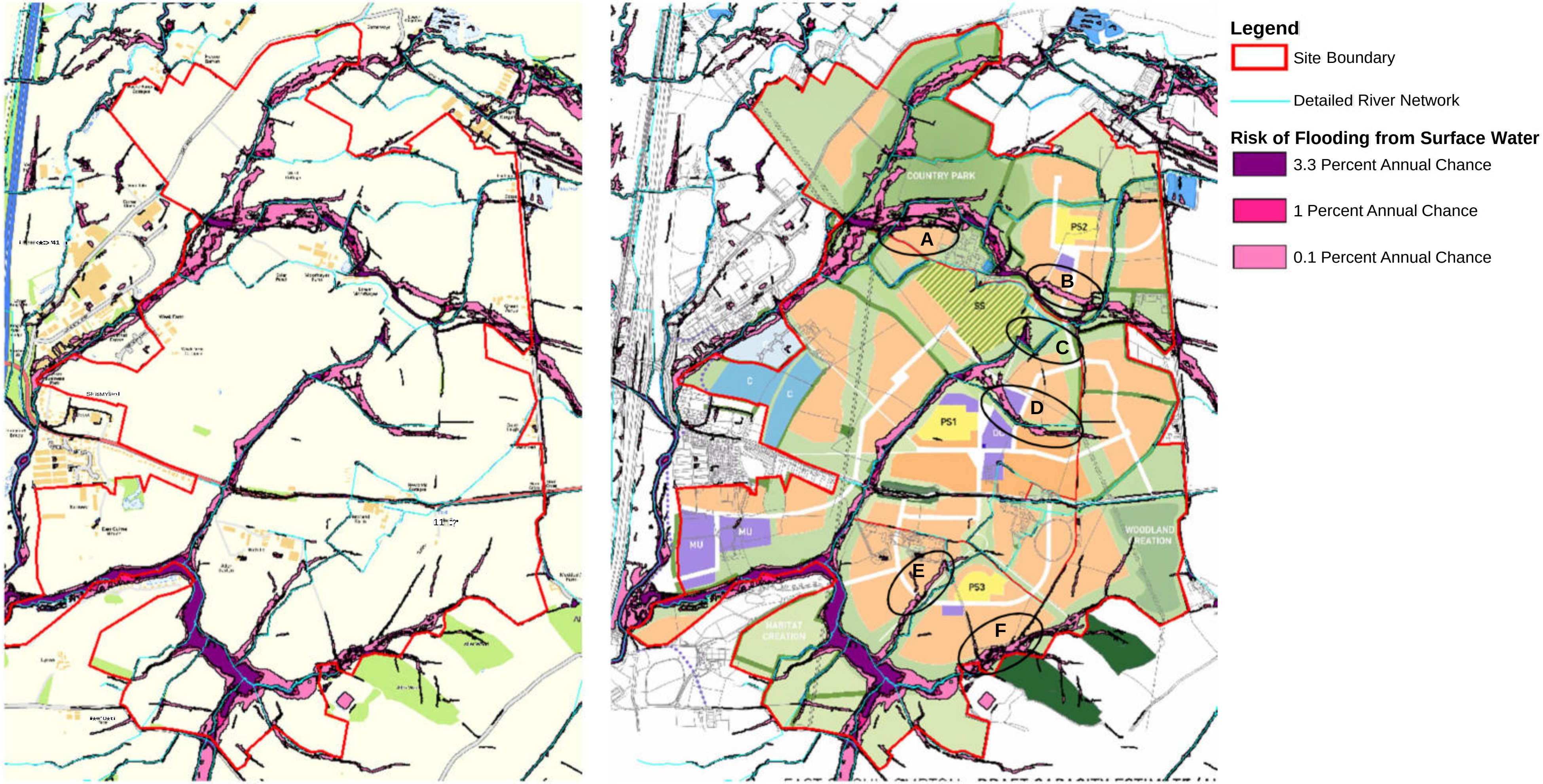


Figure 4-2: Risk of Surface Water Flooding across the Masterplan Area (pre and post development)

4.5 Groundwater

There is little information available on flood risk from groundwater. Figure 5-2 of the 2011 Devon County Council Preliminary Flood Risk Assessment (PFRA), shows the Environment Agency's Areas Susceptible to Groundwater Flooding (AStGWF) map for the Devon area. The AStGWF map is also shown within Appendix G of the Mid Devon Strategic Flood Risk Assessment (SFRA) prepared in 2014 for Mid Devon District Council.

The map indicates the proportion of each 1km grid square where the geological and hydrogeological condition show that groundwater might emerge (i.e. greater than 75%, 50% to 75%, 25% to 50% and less than 25%). It does not show the likelihood of groundwater flooding occurring.

The dataset indicates that the masterplan area includes 1 km grid squares where the proportion of land where groundwater flooding might emerge is less than 25% (generally in the south) up to 1 km grid squares where the proportion of land is greater than 75% (generally in the north and far south-west). This agrees with the soils map in Figure 2-3, which also suggests that soils towards the north have naturally high groundwater levels.

Section 4.6 of the Mid Devon SFRA also indicates that parts of Cullompton are located within a groundwater emergence zone, where groundwater levels could be expected to be at or close to the ground surface during exceptionally wet winters. However, the SFRA continues to note that being in a groundwater emergence zone does not necessarily mean that groundwater flooding will be a problem in these areas and only three reports of groundwater flooding have been recorded within Mid Devon (but the direct source not identified).

The AStGWF dataset provides a high level preliminary indication of the lands potential susceptibility to groundwater flooding. However, it should not be used as sole evidence for any specific flood risk management or land use planning decisions. The understanding of the potential for groundwater flooding to inform the masterplan should be improved by further liaison with landowners, site observations and groundwater investigation.

4.6 Sewer

Flooding can occur as a result of infrastructure failure e.g. blocked sewers or failed pumping stations. As the existing masterplan area is greenfield land existing sewer infrastructure is minimal. However, South West Water (SWW) Asset Plans indicate that public Combined Sewers do currently exist within the masterplan area. SWW Asset Plans are provided in Appendix B.

A review of historic sewer flooding records maintained by SWW indicates that five incidents of external flooding have been reported, but no internal flooding incidents. In summary:

- Two incidents were at Moorhays Farm, where sewer blockage was recorded as the cause of flooding;
- The other three incidents were associated with existing residential properties in the vicinity of A373 (Honiton Road); two were due to blockage and one was due to poor sewer condition.

Taking the above into account the risk of flooding posed by the existing sewer infrastructure is considered low.

4.7 Reservoir

The Environment Agency Risk of Flooding from Reservoirs Map indicates that the masterplan area is not located within a reservoir breach flood extent. The Risk of Flooding from Reservoir Map indicates that there are no reservoirs upstream of the River Culm or River Ken that present a potential flood risk to the site.

The nearest reservoir is Wimbleball Lake, which is located approximately 45 km to the north-west of Cullompton. In the event of a breach / failure floodwaters would be contained with the confines of the River Exe valley. Therefore, the risk from reservoir flooding is considered to be very low and not considered further in the report.

5. Surface Water Management

5.1 Overview

The proposed Culm Garden Village will result in an increase in impermeable surfaces across the existing greenfield site. If unmitigated the effect of this would be to increase both total and peak surface water flows, which could potentially contribute to flooding downstream of the site.

This preliminary assessment includes an initial exercise to consider where sustainable drainage systems (SuDS) can be located across the masterplan area. SuDS manage surface water on, or as is practicably close to, the ground surface, in a way that mimics natural hydrological processes.

Managing surface water in this way controls the rate and quantity of surface water runoff, which mitigates the potential adverse effects of the development on flood risk. SuDS can also improve the quality of surface water runoff, and also improve visual amenity and biodiversity at the site.

The supporting text for Policy CU9 of the Mid Devon Local Plan Review (2013-2033) (see Section 3.2) also states the requirement for use of SuDS such as swales and ponds to manage surface water generated across the masterplan area. Policy CU9 also requires that a strategy for dealing with surface water must be prepared as part of the masterplanning of the site to determine the number, size and location of the required SUDS features.

5.2 DCC SuDS Guidance

The Devon County Council (DDC) SuDS Guidance for Devon[9] document should be used to guide the SuDS strategy proposed for the developing Masterplan. DCC SuDS guidance requires all new surface water drainage management systems to provide a comprehensive SuDS Management Train, as follows:

- **Prevention:** good housekeeping and site design should be employed to manage and reduce surface water runoff and pollution;
- **Source control:** rainfall should be managed in above-ground SuDS components as close as possible to where it falls to the ground surface;
- **Site control:** residual flows from source control components should be managed in larger above-ground SuDS components;
- **Regional control:** surface water runoff from several sites can be managed downstream in large above-ground SuDS components.

This method ensures that natural hydrological processes are mimicked by managing surface water runoff at source (i.e. close to where the rain falls), with residual flows conveyed downstream to larger SuDS components.

DCC SuDS guidance favours the use of above ground SuDS components, which should be integrated into the green infrastructure by creating open green spaces which encourage habitat creation. Underground attenuation systems will only be permitted once robust evidence has been submitted which demonstrates that it is not viable to incorporate any above-ground SuDS components into the surface water drainage management plan.

The DCC technical requirements for SuDS in Devon have been considered to inform the initial preliminary assessment to identify indicative SuDS locations and sizes required across the masterplan area.

5.3 Blue Corridors

To inform the preliminary SuDS assessment blue corridors across the masterplan area have been identified. Blue corridors are areas where surface water runoff naturally flows toward and therefore these areas should be exploited for the positioning of SuDS components and wider green infrastructure.

The identification of blue corridors (and direction of overland flow) has been undertaken using the RoFfSW extent (0.1% annual chance of flooding). High level modelling undertaken using the MicroDrainage FloodFlow module,

[9] Available online: https://new.devon.gov.uk/floodriskmanagement/sustainable-drainage/ (lasted accessed 21/11/2017)

where 50 mm of rainfall was applied to a 5 m Digital Terrain Model (DTM), based on LiDAR data. The results of this exercise are shown in Figure 5-1.

It is important to note that the MicroDrainage FloodFlow modelling outputs have been provided to indicate the locations of blue corridors only and does not provide information on flood depths within the flow pathway extents. The FloodFlow modelling is based on existing ground levels and ground cover and therefore does not represent potential post development overland flow pathways where ground levels have been modified.

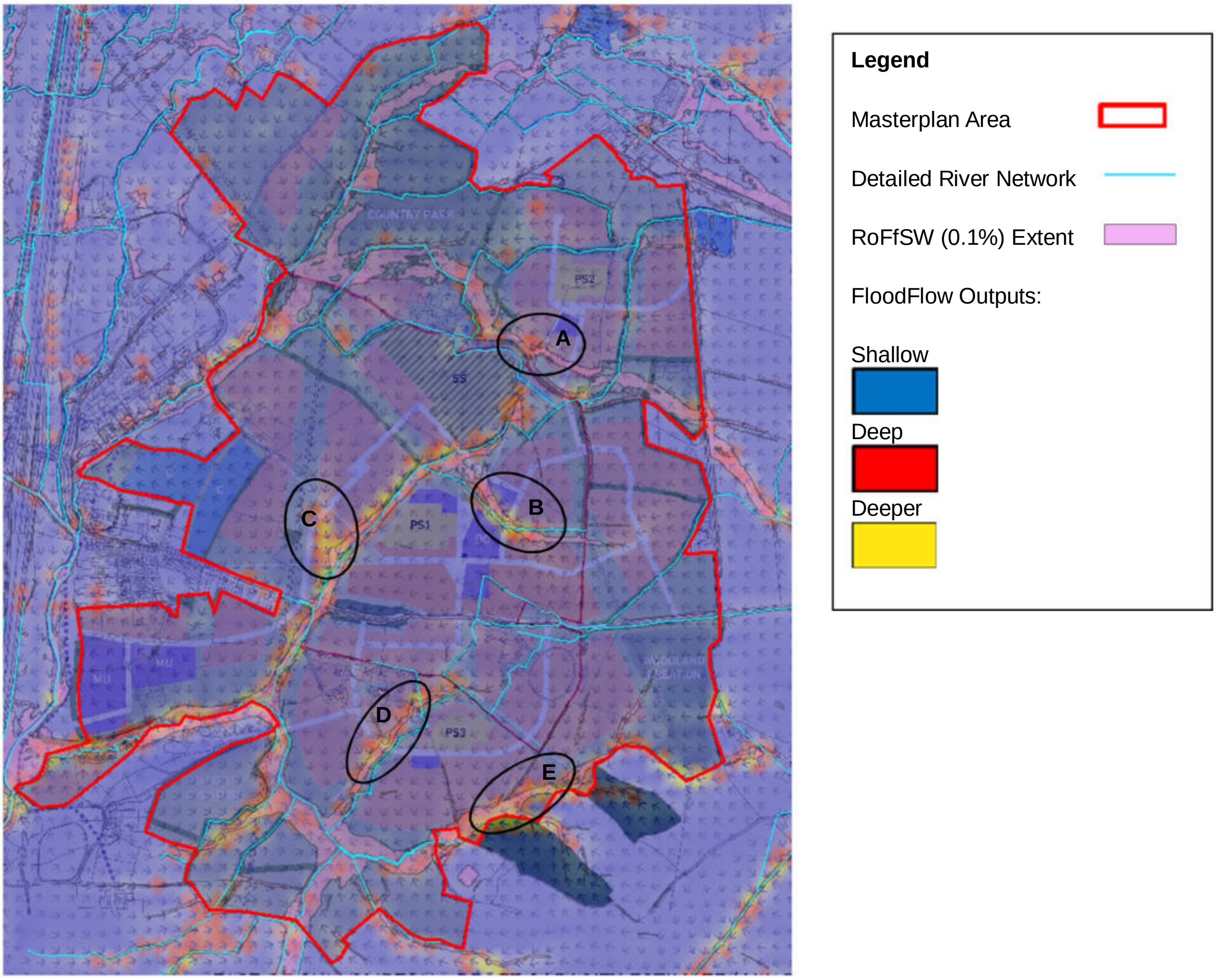


Figure 5-1: Blue Corridors and Direction of Overland Flow

Figure 5-1 indicates that the masterplan already accommodates the majority of the blue corridor areas by setting development back and creating green infrastructure corridors along river and drainage ditch corridors.

Additional areas that should be considered as potential blue corridors, which are currently indicated for development are shown in Figure 5-1 (Areas A to E). Area B within Phase 1 has been highlighted in previous sections as an area where an existing watercourse is located that could form part of the strategic SuDS network.

Anecdotal evidence from the landowner suggests that a land drainage pipe is currently located in the vicinity of Area E (Phase 3). Dependent on the upstream catchment this pipe could be opened up to form part of the strategic SuDS network.

The blue corridors and overland flow direction arrows shown in Figure 5-1 have been used to inform the location of SuDS swale and pond features within the masterplan area.

5.4 Peak Flow and Volume Control

The DCC SuDS Guidance for Devon states that where not collected for re-use, surface water runoff should be discharged as high up the hierarchy of discharge solutions as is practicable:

1. Discharge into the ground (infiltration);
2. Discharge to a surface water body (with written permission from the riparian owner);
3. Discharge to a surface water sewer, highway drain, or other drainage system (with written permission from South West Water Ltd., Devon County Council Highways, or the riparian owner, respectively);
4. Discharge to a combined sewer (with written permission from South West Water Ltd.).

Discharge into the ground (infiltration) must therefore be explored as the primary method of surface water disposal from the masterplan area. However, from this preliminary assessment, which has included a review of soil and geology maps, site observations and discussions with land owners, opportunities for widespread use of infiltration techniques across the site are limited.

Therefore, the preliminary consideration of the location and sizing of SuDS assumes that there will be no infiltration to ground via the sides and base of swales and ponds proposed.

Due to the network of watercourses across the masterplan area all SuDS features should be able to discharge to a surface waterbody. Greenfield runoff rates have been calculated to identify what the allowable discharge rate from the SuDS features to the surface waterbody is likely to be (subject to agreement with DCC).

Greenfield runoff rates in litres/second/hectare (l/s/ha) have been calculated using the ICP SuDS method (pro-rata version of the IH124 method). The ReFH2 rainfall runoff method has also been used to gain a comparison of QBAR. Greenfield runoff rates calculated for a range of return periods are shown in Table 5-1. The Standard Annual Average Rainfall (SAAR) and Soil Index Values applied are 888 mm and 0.47 respectively.

Table 5-1: Greenfield Runoff Rates (l/s/ha)

Method	Return Period (Years) (l/s/ha)			
	QBAR (1 in 2.3)	1 in 1	1 in 30	1 in 100
ICP SuDS	6.4	5	12.2	15.4
ReFH2	4.35	-	-	-
Mean	**5.37**	-	-	-

To meet volume control requirements set out in the DCC SuDS Guidance for Devon the additional volume (above the 1 in 100 year greenfield volume) should be discharged from SuDS components at 2 l/s/ha. The SuDS Manual (C753) provides an alternative option where runoff from the site for the 1 in 100 year event can be discharged at either 2 l/s/ha or the average annual peak flow rate (i.e. the mean annual flood, QBAR), whichever is greater.

Based on the results in Table 5-1 QBAR values are shown to be greater than 2 l/s/ha, therefore the mean QBAR value of 5.37 l/s/ha has been adopted as the maximum allowable discharge rate from SuDS components. This approach and maximum allowable discharge rate is considered suitable to inform this preliminary assessment, however rates and management of additional volumes are subject to agreement with DCC. Any subsequent increase in discharge rates will result in a reduction in SuDS attenuation volume requirements and vice versa.

5.5 Preliminary SuDS Strategy

Informed by the above sections a preliminary SuDS strategy has been developed for the masterplan area and is provided in Appendix C. The preliminary SuDS strategy provides a high level indication of potential SuDS locations, together with indicative sizings and outfall locations to watercourses.

This preliminary SuDS strategy is based on the use of strategic swales and ponds located within the blue/green corridors. It is currently assumed that surface water runoff associated with more frequent events (up to the 1 in 1 year rainfall event) will be managed via source control and/or streetscape SuDS features (e.g. rainwater harvesting systems, permeable paving, roadside swales / raingardens) within the development parcels.

It is assumed that residual flows will be collected via gullies and traditional piped network and discharge to swales, where surface water will be conveyed to larger ponds. The swales will also provide some attenuation.

It is important to note that this preliminary strategy should be viewed as a starting point to be developed further as the scheme progresses. No liaison with statutory consultees or riparian owners has been undertaken to date.

Tables 5-2 to 5-4 provides an overview of storage volume requirements within each surface water management zone and how the volume will be split between SuDS components. The swale and pond identification numbers (IDs) are shown on the preliminary SuDS strategy shown in Appendix C. A full breakdown of preliminary SuDS dimensions for each surface water management zone is provided in Appendix D.

Table 5-2: Phase 1 Source Control and Strategic SuDS Component Indicative Volume Requirements

Surface Water Management Zone	1 in 1 year Storage Volume Requirement (m^3) Source Control	1 in 100 year + 40% CC Storage Volume Requirement (m^3)	Strategic SuDS Storage Volume Requirement (m^3)	Storage Volume provided by Swale (m^3) (Swale ID)	Storage Volume provided by Pond (m^3) (Pond ID)
Phase 1A	647	4566	3919	300 m^3 (P1A-Swale)	3671 m^3 (P1A-Pond 1)
Phase 1B	1587	11202	9616	1066 m^3 (P1B-Swale 1) 88 m^3 (P1B-Swale 2)	4473 m^3 (P1B-Pond 1) 7940 (P1B-Pond 2)
Phase 1C	125	880	755	-	1165 m^3 (P1C-Pond)

Table 5-3: Phase 2 Source Control and Strategic SuDS Component Indicative Volume Requirements

Surface Water Management Zone	1 in 1 year Storage Volume Requirement (m^3) Source Control	1 in 100 year + 40% CC Storage Volume Requirement (m^3)	Strategic SuDS Storage Volume Requirement (m^3)	Storage Volume provided by Swale (m^3) (Swale ID)	Storage Volume provided by Pond (m^3) (Pond ID)
Phase 2A	224	1579	1356	1415 (P2A-Swale)	-
Phase 2B	514	3629	3115	205 (P2B-Swale)	6231 (P2B-Pond)
Phase 2C	375	2652	2277	176 (P2C-Swale)	6308 (P2C-Pond)
Phase 2D	208	1471	1263	189 (P2D-Swale)	5894 (P2D-Pond)
Phase 2E	680	4801	4122	662 (P2E-Swale)	3672 (P2E-Pond)
Phase 2F	400	2822	2422	226 (P2F-Swale)	4115 (P2F-Pond)
Phase 2G	267	2096	1799	174 (P2G-Swale 1) 241 (P2G-Swale 2) 92 (P2G-Swale 3)	4115 (P2G-Pond)
Phase 2H	524	3701	3177	153 (P2H-Swale 1) 93 (P2H-Swale 2)	1924 (P2H-Pond 1) 1457 (P2H-Pond 2)
Phase 2I	608	4294	3686	2622 (P2I-Swale)	1145 (P2I-Pond)
Phase 2J	165	1166	1001	142 (P2J-Swale)	1034 (P2J-Pond)

Surface Water Management Zone	1 in 1 year Storage Volume Requirement (m^3) Source Control	1 in 100 year + 40% CC Storage Volume Requirement (m^3)	Strategic SuDS Storage Volume Requirement (m^3)	Storage Volume provided by Swale (m^3) (Swale ID)	Storage Volume provided by Pond (m^3) (Pond ID)
Phase 2K	240	1692	1453	70 (P2K-Swale 1) 64 (P2K-Swale 2)	2420 (P2K-Pond)
Phase 2L	409	2883	2475	57 (P2L-Swale 1) 85 (P2L-Swale 2)	3376 (P2L-Pond 1) 2403 (P2L-Pond 2)
Phase 2M	714	5035	4322	419 (P2M-Swale)	4847 (P2M-Pond)
Phase 2N	174	1227.5	1054	35 (P2N-Swale 1) 46 (P2N-Swale 2)	3389 (P2N-Pond)
Phase 2O	1898	13399	11502	214 (P2O-Swale 1) 599 (P2O-Swale 2) 108 (P2O-Swale 3)	13176 (P2O-Pond)

Table 5-4: Phase 3 Source Control and Strategic SuDS Component Indicative Volume Requirements

Surface Water Management Zone	1 in 1 year Storage Volume Requirement (m^3) Source Control	1 in 100 year + 40% CC Storage Volume Requirement (m^3)	Strategic SuDS Storage Volume Requirement (m^3)	Storage Volume provided by Swale (m^3) (Swale ID)	Storage Volume provided by Pond (m^3) (Pond ID)
Phase 3A	380	2691	2301	74 (P3A-Swale)	4088 (P3A-Pond)
Phase 3B	118	1366	1247	98 (P3B-Swale)	3076 (P3B-Pond)
Phase 3C	118	1366	1247	156 (P3C-Swale)	3076 (P3C-Pond)
Phase 3D	793	5601	4808	223 (P3D-Swale)	2548 (P3D-Pond)
Phase 3E	256	1801	1546	99 (P3E-Swale)	2346 (P3E-Swale)
Phase 3F	262	1846	1585	322 (P3F-Swale)	2410 (P3F-Pond)
Phase 3G	131	920	790	-	1438 (P3G-Pond)

SuDS Strategy Criteria and Assumptions

The preliminary SuDS strategy provided in Appendix C is based on the following criteria/assumptions:

SuDS Storage Volume Identification

1. MicroDrainage FloodFlow module has been used to identify 25 surface water management zones across the masterplan area;
2. The MicroDrainage Quick Storage Estimate tool has been used to identify SuDS storage volumes for each zone during the 1 in 1 year event and 1 in 100 year event + 40% climate change;
3. The outflow from the SuDS component is restricted to QBAR (see Table 5-1);

4. 60% impermeable area has been assumed across each zone, this allows 40% permeable to account for private gardens, public open space, school playing fields (where applicable);
5. The 1 in 1 year event storage volume has been deducted from the 1 in 100 year event + 40% climate change storage volume, as it is assumed that runoff from more frequent rainfall events will be managed via source control or streetscape features (within development parcels) with residual flows managed by swales and ponds;

SuDS Locations

6. The swales and ponds have been located along the down slope perimeters of each surface water management zone within proposed green infrastructure corridors (where possible);
7. The timing of construction of each SuDS component has been considered in relation to the masterplan phases. For example, if a zone is split between Phase 2 and 3, the entire SuDS components for that zone will be constructed in Phase 2 to ensure that surface water can be managed appropriately;
8. SuDS features have been located outside of Flood Zone 3, but have been allowed in Flood Zone 2;
9. Farmers currently maintain existing channels to allow free flow of water to prevent flooding. A channel maintenance regime will need to continue post development. Therefore, an 8 m maintenance access strip has been included between the watercourse and SuDS components;

SuDS Dimensions

10. Depths of ponds and swales are limited to a maximum of 1.4 m (however, actual allowable depths may be influenced by constructability of inlets and outlets of SuDS features).
11. Side slopes of ponds and swales should be a maximum of 1 in 3;
12. An additional 2 m strip has been included in the overall swale width to allow for additional land take;
13. The longitudinal gradient along SuDS components has been observed to predominantly be shallower than a 1 in 100 gradient. However, a flat surface has been assumed for this preliminary strategy;

A limitation on steeper parts of the site is the assumption that SuDS components are located on a flat surface, as this could underestimate land-take requirements for SuDS to meet storage volume requirements. Both these assumptions will need to be investigated further to confirm feasibility of preliminary SuDS strategy.

5.6 Foul Drainage Strategy

To inform the preliminary foul drainage study, details of the likely on-site and off-site upgrade works required to meet the future demand of the new settlement have been requested from South West Water (SWW). Preliminary design flow rates for each phase of the new settlement, based on 4000 litres per dwelling per day (see Sewers for Adoption (7th Edition) were calculated and provided to SWW (see Table 5-5).

Table 5-5: Preliminary design flow rates for each phase of the new settlement

Phase	No. Dwellings	Peak Flow Rate (litres per dwelling, per day)	Peak Flow Rate (litres per phase, per day)	Peak Flow Rate (cubic metres per phase, per day)
Phase 1	680	4000	2720000	2,720
Phase 2	1800	4000	7200000	7,200
Phase 3	2700	4000	10800000	10,800
Total	5000	4000	20000000	20,000

Potential Options

SWW have responded by stating that the nearest public sewer network is to the west at Stoneyford where a public pumping station transfers flows across the M5 via the existing road bridge at Junction 28 to the main sewer network serving Cullompton. This pumping station, associated rising main and existing sewer network to which it discharges is not sufficient to support Phase 1 and neither is there scope to increase its capacity due to its location. Therefore, SWW have indicated two possible options for the overall Masterplan:

- **Cullompton Sewage Treatment Works (STW)** – Foul flows would be directed to Cullompton STW by means of a new onsite pumping station and offsite rising main which would have to cross the M5 Motorway, the River Culm and railway line by directional drilling;
- **Willand STW** – Foul flows would be directed north to Willand STW (approximately 3km away) via a new pumping station and rising main.

SWW has indicated that directing foul flows to Willand STW is likely to be their preferred option.

The foul drainage infrastructure required to for both the Cullompton STW and Willand STW option would be by means of Requisition. However, as of next April (see link below[10]) the financial mechanism for SWW to deliver new infrastructure is changing and yet to be finalised by OFWAT. Therefore, until April 2018 SWW are unable to inform developers on services charges for new developments.

Potential for New STW

The potential option of building a new STW for the Garden Village has also been raised with SWW. SWW have stated that if the developer would like to build a new STW and offer this for adoption under a Section 104 route then SWW would have to accept. However this is not SWW preferred option and the following points should be noted:

- The phased construction costs and the negotiation of easements and discharge permitting would all lie with the developer and this is likely to cost considerably more in both the short and medium term when compared to a sewer requisition option;
- Any new works would require construction to an agreed specification and to compliance with SWW technical standards and this would require their technical approval and an inspection fee being incurred.

If requested AECOM could obtain a plant cost for a standard specification 5000 population plant, however the installation, easement, compliance with required standard and Section 104 process could add considerable additional costs and these additional costs would be difficult to assess.

[10] Changes to Developer Services Charges: https://www.southwestwater.co.uk/developer-services/developer-services-charges/

6. Opportunities and Constraints

6.1 Potential Site Opportunities

A meeting was held with the client and a local land owner on the 23rd November 2017. The meeting provided an opportunity for the local landowner to provide an overview of the River Ken's drainage regime and how it has been modified over the years to supply water to landowners across the masterplan area.

The landowner confirmed that the main River Ken channel is the northern channel (see Figure 2-2) that flows through the area currently proposed as the Country Park within the draft masterplan. The two drainage ditches flowing towards the south through the masterplan area are off-takes from the main River Ken channel. Flow rates entering these off-take channels have been managed by local farmers over the years on an informal basis, with no 'modern' flow control structures currently installed (this has not been confirmed by AECOM).

During the meeting a number of potential water management options were discussed around the provision of flood storage to reduce flood risk either within or downstream of the development. These options, together with a view on whether they should be considered further are provided below. The locations of options discussed are shown in Figure 6-1.

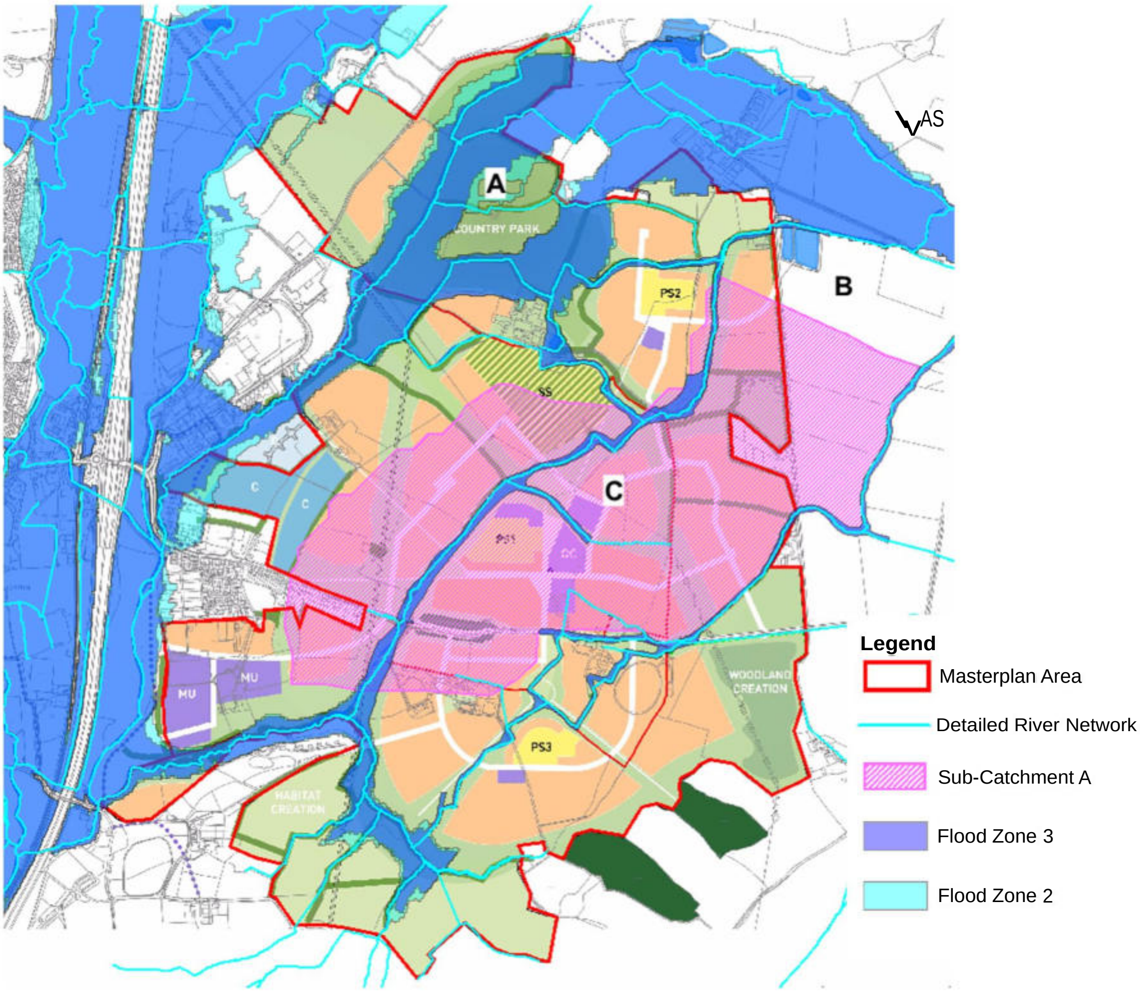


Figure 6-1: Water Management Options Considered

River Ken Flood Storage Areas

The use of the proposed Country Park and/or land to the east of Horn Road as potential flood storage areas to reduce flooding from the River Ken within the masterplan area and downstream was discussed (see Areas A and B on Figure 6-1).

During discussions it was noted that the floodplain of the River Ken downstream of the County Park narrows, affecting only a small number of existing properties before it merges with the larger River Culm floodplain. Therefore a flood storage area at this location would not have a significant beneficial effect on flood risk locally.

The land to the east of Horn Road is located slightly further upstream, however floodwaters do not naturally flow towards this land and therefore major earthworks and raised bunds would be required to create a flood storage area large enough to benefit flood risk in downstream areas.

In theory the construction of a flood storage area could be achieved through a combination of restricting flow across the floodplain through the use of bunds to hold back floodwater. The effect of this would be to increase flood levels (and therefore flood risk) upstream of the bund within the Country Park and adjacent development proposed on the masterplan. At this downstream location within the catchment it is likely that the bunded flood storage area would need to hold greater than 25,000 m^3 of water above ground level to provide any benefit and would therefore need to meet Environment Agency impounding reservoir operational requirements.

To avoid holding water above ground level a large area of excavation would be required. An initial review of online soil mapping (see Figure 2-3) indicates that soils have naturally high groundwater levels within this area and therefore is it likely that excavations would fill with groundwater removing volume intended for flood storage.

Incorporation of Central Off-take Channel within Strategic SuDS network

The potential to throttle the off-take channel (flowing north-east to south-west) through the centre of the development, for the purpose of reducing flood risk to downstream areas was also discussed. (see Area C on Figure 6-1).

The River Ken (south) floodplain is relatively narrow in the lower reaches of the site and is not shown to affect more than one or two existing properties before it merges with the larger River Culm floodplain. Therefore a flood storage area at this location would not have a significant beneficial effect on downstream flood risk within the River Ken, but would make a positive contribution to flood risk management within the wider area.

Therefore, the use of the central off-take channel draining Sub-catchment A (Area C on Figure 6-1) could potentially be used as the central spine for the conveyance and attenuation of surface water runoff generated from central parts of the masterplan area. The existing channel could potentially be re-profiled to become a swale type feature within the development with online (or offline) attenuation ponds at intervals along the route.

This would provide a more regional approach to surface water management where runoff from a number of sites could be managed within a strategic SuDS network (see Section 5.2). A constant low flow from the River Ken could be maintained by constructing a formal 'modern' flow control structure at the off-take point.

The above is simply a high level concept at this stage and requires significant further investigation to establish whether this approach to surface water management is feasible. One obvious constraint at this stage would be the likely requirement to remove large sections of existing hedgerow and established trees along the take-off channel and therefore the feasibility of this should be considered before the option is progressed further.

6.2 Potential Site Constraints

The following potential site SuDS constraints have been identified as part of this preliminary assessment, which will need to be investigated further as the SuDS strategy progresses:

High Groundwater Levels

Waterlogged soils were evident towards the south of the site (within Phase 3) during the site walkover. Where groundwater levels are within 1 m of the base of the SuDS component the SuDS Manual (CIRIA C753) identifies the following challenges which should be considered during the design process:

- The use of infiltration may not be suitable due to reduced hydraulic and treatment capacity;
- If SuDS are constructed below the maximum likely groundwater level, then groundwater can potentially enter the SuDS component and reduce the storage capacity;
- Flotation and structural risks to storage structures or impermeable liners can occur because of the extra loads imposed by the groundwater and the buoyancy of the tanks or liner.

Therefore, it is important to keep storage and conveyance systems above the maximum likely groundwater levels, wherever possible. This will avoid difficulties during construction caused by water flows into excavations and will make sure that the hydraulic and treatment capacity of the SuDS components is retained at all times.

Very Flat Areas

Very flat areas were also evident towards the south of the site (within Phase 3) during the site walkover. When designing a surface water management system for a very flat site, the SuDS Manual (CIRIA C753) identifies the following challenges which should be considered during the design process:

- Achieving sufficient gradients to drain runoff effectively;
- Difficulty in meeting outlet levels to existing watercourses or sewers;
- Impacts of downstream water levels on drainage performance.

On very flat sites, it is often not possible to construct piped drainage systems with sufficient falls to achieve minimum self-cleansing velocities. So using shallow SuDS components such as swales, pervious pavements or high capacity linear drainage channels is an advantage in these situations.

Even using shallow SuDS components, the end of the surface water drainage system may still end up below the minimum allowable outfall level. In such cases a pumping station may be necessary (as a last resort).

6.3 Maintenance and Adoption

At present the ponds and swales proposed as part of the strategic SuDS components are likely to be maintained by a private management company which will maintain the surface water management system alongside the site's general landscape maintenance regime.

Devon County Council , as the Highway Authority, may adopt parts of the surface water management system that receives highway runoff. However, the decision to adopt is made on a site-by-site basis.

South West Water will only adopt parts of the surface water management system, such as below ground sealed tanked or piped networks, which are designed to the 1 in 30 year rainfall event.

A separate surface water management system is therefore required to manage the surface water runoff generated from rainfall in excess of the 1 in 30 year rainfall event (up to the 1 in 100 year +40% allowance for climate change), and this system must prioritise the use of above-ground SuDS components.

Consequently, at present the adoption of surface water management systems is often piecemeal and complex, with no single authority/body responsible for adoption and maintenance. Therefore, early liaison between the developer, Highway Authority and SWW and is recommended to discuss options for SuDS adoption.

It is worth noting that Water UK is currently considering the role that sewerage undertakers (i.e. SWW) may have in adopting some SuDS components and are working on a framework and guidance to be included in Sewers for Adoption 8 (due mid 2018). This update may provide further options, which may be beneficial.

The DCC SuDS Guidance for Devon states that where surface water management systems are not proposed for adoption by the Highway Authority or SWW, an operation and maintenance plan must be submitted to explain:

- What needs maintaining, and the management aims for the site;
- Who will be responsible for maintaining each component part;
- How each component part will be accessed, and the scope of the activities required;
- When each component part needs maintaining.

7. Summary

AECOM has been commissioned by Lightwood Land to undertake a Preliminary Flood Risk and Drainage Assessment to inform the masterplanning process for the new Culm Garden Village, located to the east of Cullompton in Mid Devon. The new garden village will consist of approximately 5,000 homes and include land for employment, district/local centres, schools and supporting infrastructure. A summary is provided below:

Flood Risk to the Development

- The majority of proposed development parcels across the masterplan area have been sequentially located towards Flood Zone 1. On the whole development has been set back from Flood Zones 2 and 3, locating green infrastructure (including proposed country park) within floodplain corridors;
- Where development parcel boundaries overlap with fluvial or surface water flood risk zones, these areas have been identified as part of the preliminary assessment;
- There is little information available on groundwater flooding. However, the Environment Agency's Areas Susceptible to Groundwater Flooding dataset indicate that areas of the site to the north and far south-west may be susceptible to groundwater flooding. The Mid Devon SFRA also indicates that parts of Cullompton are located within a groundwater emergence zone, where groundwater levels could be expected to be at or close to the ground surface during exceptionally wet winters;
- The risk posed to the site from tidal, sewer and reservoir flooding is considered very low.

Surface Water Management

- A preliminary SuDS strategy has been developed to inform the masterplan process. The SuDS strategy provides a high level indication of potential strategic SuDS locations (based on direction of runoff), together with indicative sizings and outfall locations to watercourses;
- The preliminary SuDS strategy is based on discharging runoff from the strategic SuDS features at QBAR (mean annual flood) rates. This will provide significant betterment on existing greenfield runoff rates from the site, for storm events greater than approximately the 1 in 2 year storm event up to the 1 in 100 year + 40% climate change storm event;
- Subject to further investigation there is potential to incorporate the central off-take ditch into the strategic SuDS network with online (or offline ponds) at intervals along the route;
- Potential constraints to the proposed SuDS strategy have been identified, such as high groundwater levels and challenges of draining very flat areas;
- The preliminary assessment includes an overview of potential options for SuDS adoption and maintenance to be considered as the masterplan and planning process moves forward.

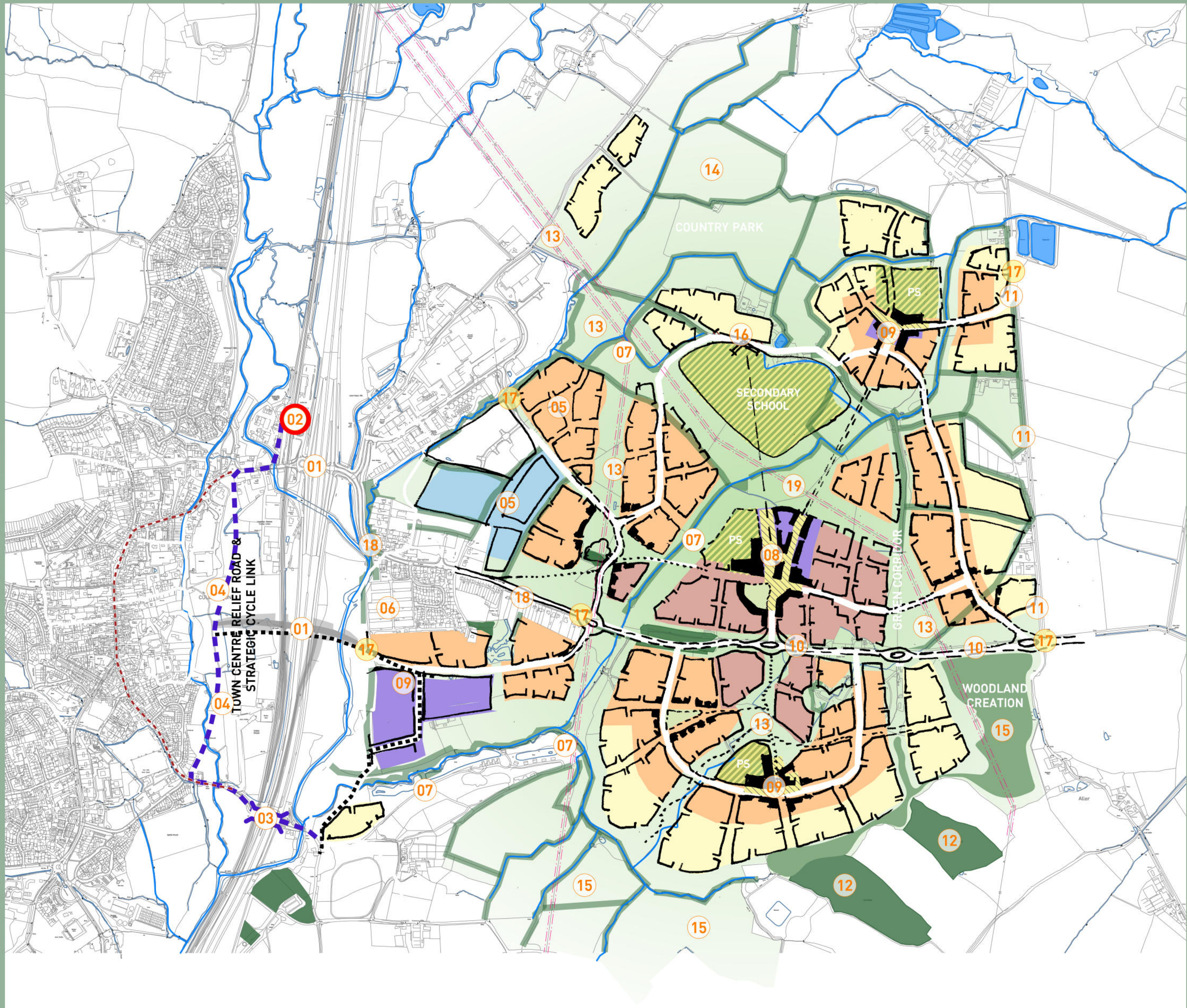
Foul Drainage Strategy

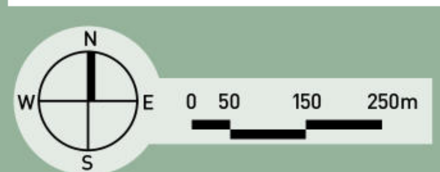
- South West Water has indicated that directing foul flows north to Willand STW (approximately 3km away) via a new pumping station and rising main would be their preferred option;

Next Steps

- **Fluvial / Surface Water Flooding** – Provide ongoing advice as the masterplan develops with regards to the masterplan development and flood risk;
- **Groundwater Flooding** – An improved understanding of the potential for groundwater flooding across the masterplan area is required. This could be achieved through further liaison with landowners, site observations and groundwater study/investigation;
- **Central off-take channel** – The feasibility of incorporating this central drainage channel into the strategic SuDS network requires further consideration/investigation;
- **Preliminary SuDS Strategy** – The SuDS strategy can be developed further as the masterplan evolves and to incorporate the central off-take channel if deemed feasible;
- **Foul Drainage Costs** – An estimate of likely construction costs for the required foul drainage based on current market rates, plus management percentage for water utility can be provided.

Appendix A – Draft Masterplan





1 NEW MOTORWAY JUNCTION DESIGNED TO BE ATTRACTIVE TO CYCLISTS AND PEDESTRIANS

2 REOPENING OF CULLOMPTON RAILWAY STATION

3 EXPLORE POTENTIAL TO RETAIN 'LAST BRIDGE' OR PROVIDE NEW CYCLE BRIDGE TO ALLOW NON CAR LINK TO HIGH STREET AND RAILWAY STATION. PROVIDES SUSTAINABLE CONNECTION TO SITE

4 DESIGN TOWN CENTRE RELIEF ROAD TO PROVIDE STRATEGIC CYCLE ROUTE

5 EMPLOYMENT ALLOCATION

6 HOUSING ALLOCATION

7 NEW STRATEGIC CYCLING AND WALKING ROUTE

8 NEW DISTRICT CENTRE LOCATED CENTRALLY WITHIN DEVELOPMENT

9 SMALLER LOCAL CENTRES WITH DIRECT CONNECTION TO DISTRICT CENTRE

10 NEW CROSSING POINTS ON HONITON ROAD AND CYCLING INFRASTRUCTURE

11 HORN ROAD DOWNGRADED TO BRIDLEWAY AND MAIN ROUTE DIVERTED THROUGH DEVELOPMENT

12 GREEN CORRIDORS THROUGH DEVELOPMENT TO ANCIENT WOODLAND TO SOUTH OF SITE

13 FORMAL SPORTS PROVISION LOCATED CENTRALLY WITHIN SITE AND NEAR CYCLE AND WALKING ROUTES

14 COUNTRY PARK TO THE NORTH OF THE SITE

15 NEW WILDLIFE HABITATS CREATED TO SOUTH OF SITE

16 LISTED BUILDINGS INTEGRATED INTO DEVELOPMENT AND OPEN LANDSCAPE CHARACTER FROM SOUTH RETAINED

17 LOCATIONS OF STRATEGIC VEHICULAR ACCESS

18 CYCLE INFRASTRUCTURE PROVIDED ALONG A373 HONITON ROAD WESTWARDS FROM SITE

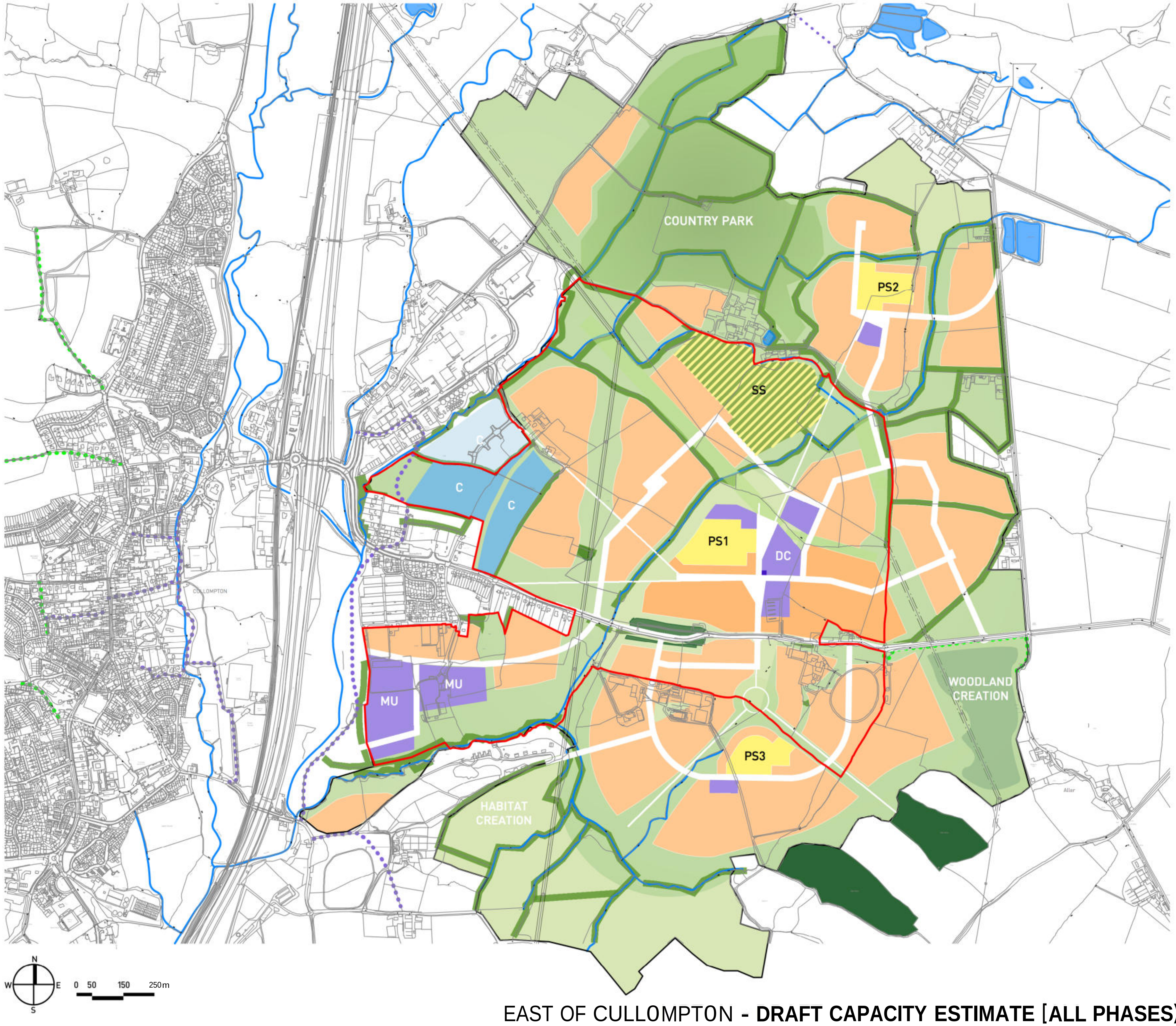
19 CENTRAL DESTINATION PLAY AREA

CULM GARDEN VILLAGE

CULM GARDEN VILLAGE - DRAFT SKETCH MASTERPLAN

Pegasus Design

PLANNING | DESIGN | ENVIRONMENT | ECONOMICS | WWW.PEGASUSPG.CO.UK | TEAM/DRAWN BY NFB/EJT | APPROVED BY P.M: EJT | DATE: 02/10/17 | SCALE: 1:10,000 @ A2 | DRWG: BRS.5955_35 SHEET NO: __ REV: B | CLIENT: LIGHTWOOD STRATEGIC |



KEY

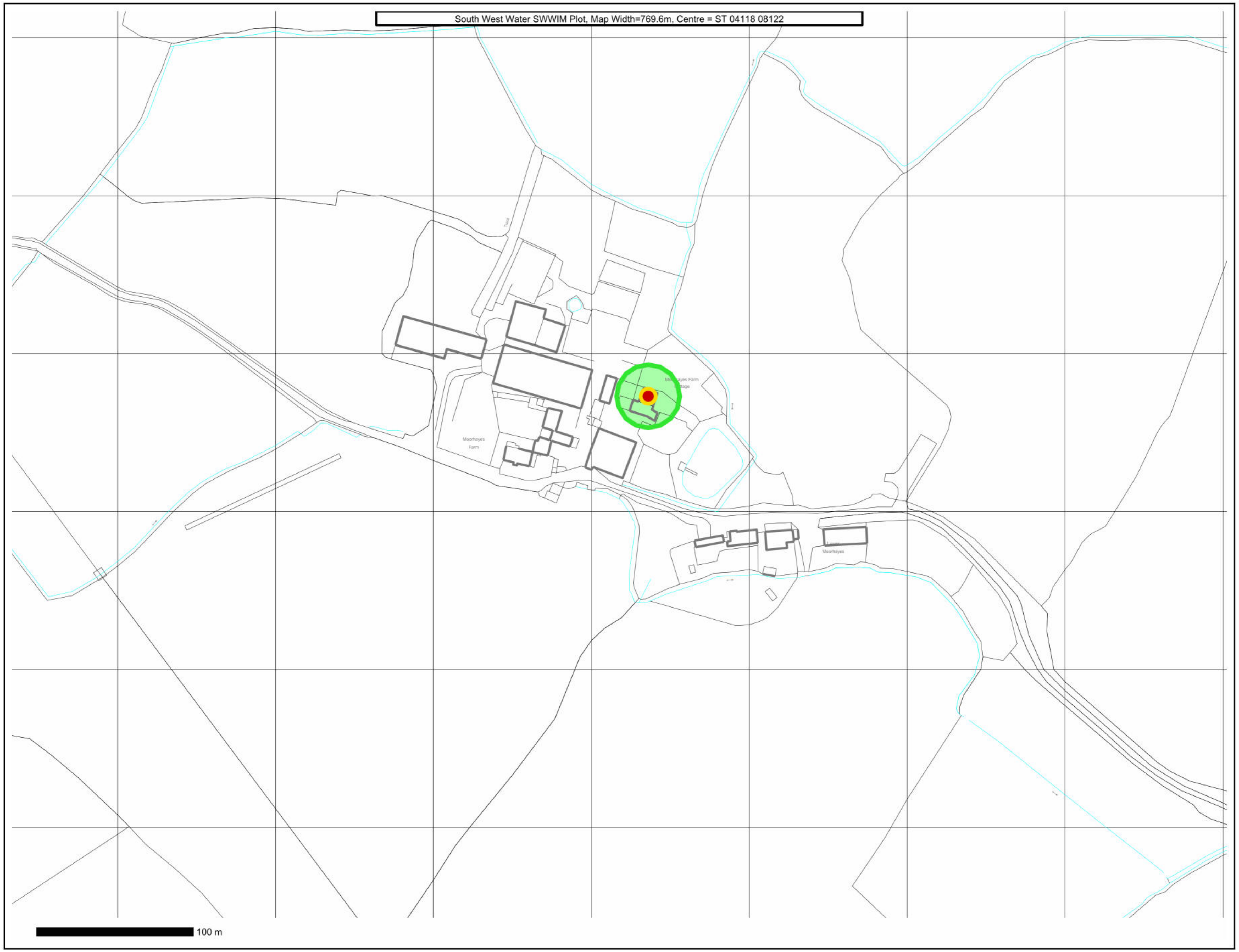
- ALLOCATION BOUNDARY
- PROPOSED RESIDENTIAL 133HA (APPROX 5,000 DWELLINGS @37.5DPH)
- 2NO. 2FE PRIMARY SCHOOL (APPROX 2.0HA EACH) 1NO. 3FE PRIMARY SCHOOL (APPROX 3.0HA)
- SECONDARY SCHOOL (APPROX 10HA)
- DC PROPOSED DISTRICT CENTRE (APPROX 4HA)
- COMMERCIAL LAND (APPROX 7.7HA)
- MU MIXED USE (APPROX 7.8HA)
- COUNTRY PARK (APPROX 40HA)

EAST OF CULLOMPTON - DRAFT CAPACITY ESTIMATE (ALL PHASES)

Pegasus Design

PLANNING | DESIGN | ENVIRONMENT | ECONOMICS | WWW.PEGASUSPG.CO.UK | TEAM/DRAWN BY ET/NFB | APPROVED BY P.M: ET | DATE: 19/10/17 | SCALE: 1:12,500 @ A3 | DRWG: BRS.5955_40-1 REV: A | CLIENT: LIGHTWOOD STRATEGIC |

Appendix B – SWW Asset Plans



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Culm Village, 1 of 2. Historical Flooding based on SWW data.

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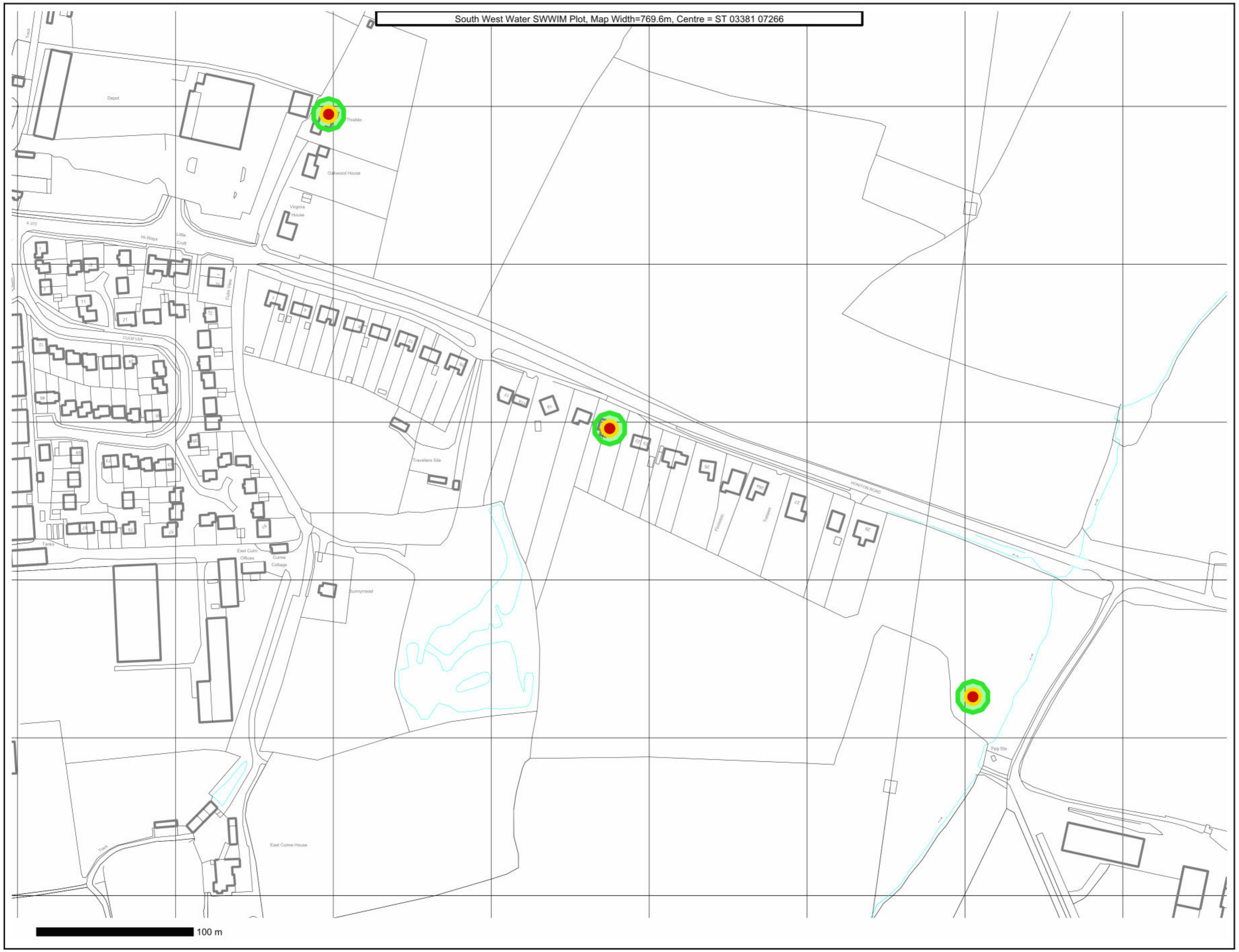
SOUTH WEST WATER



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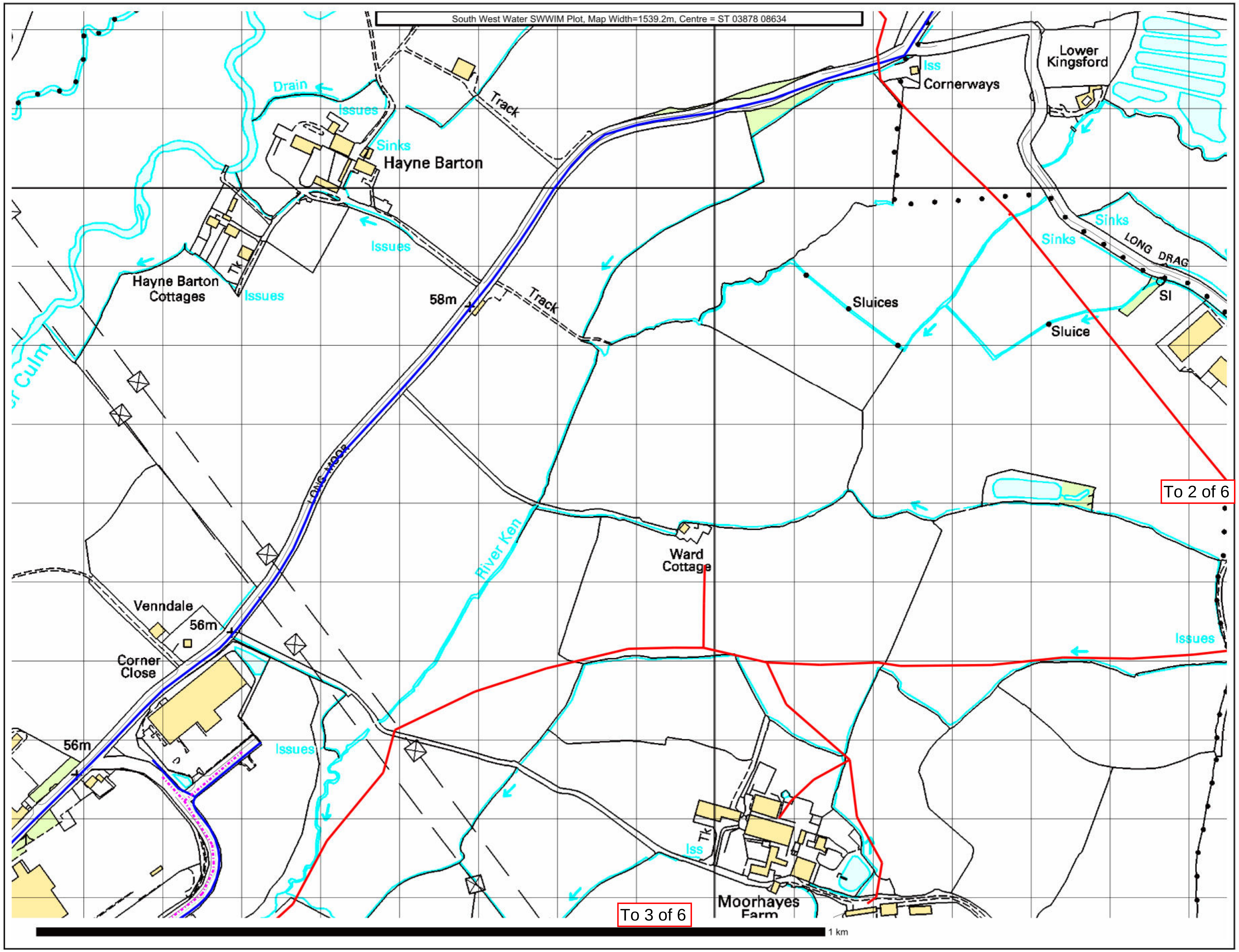

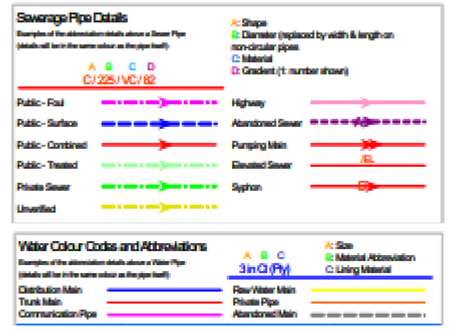

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Culm Village, 1 of 6.
SWW Network.

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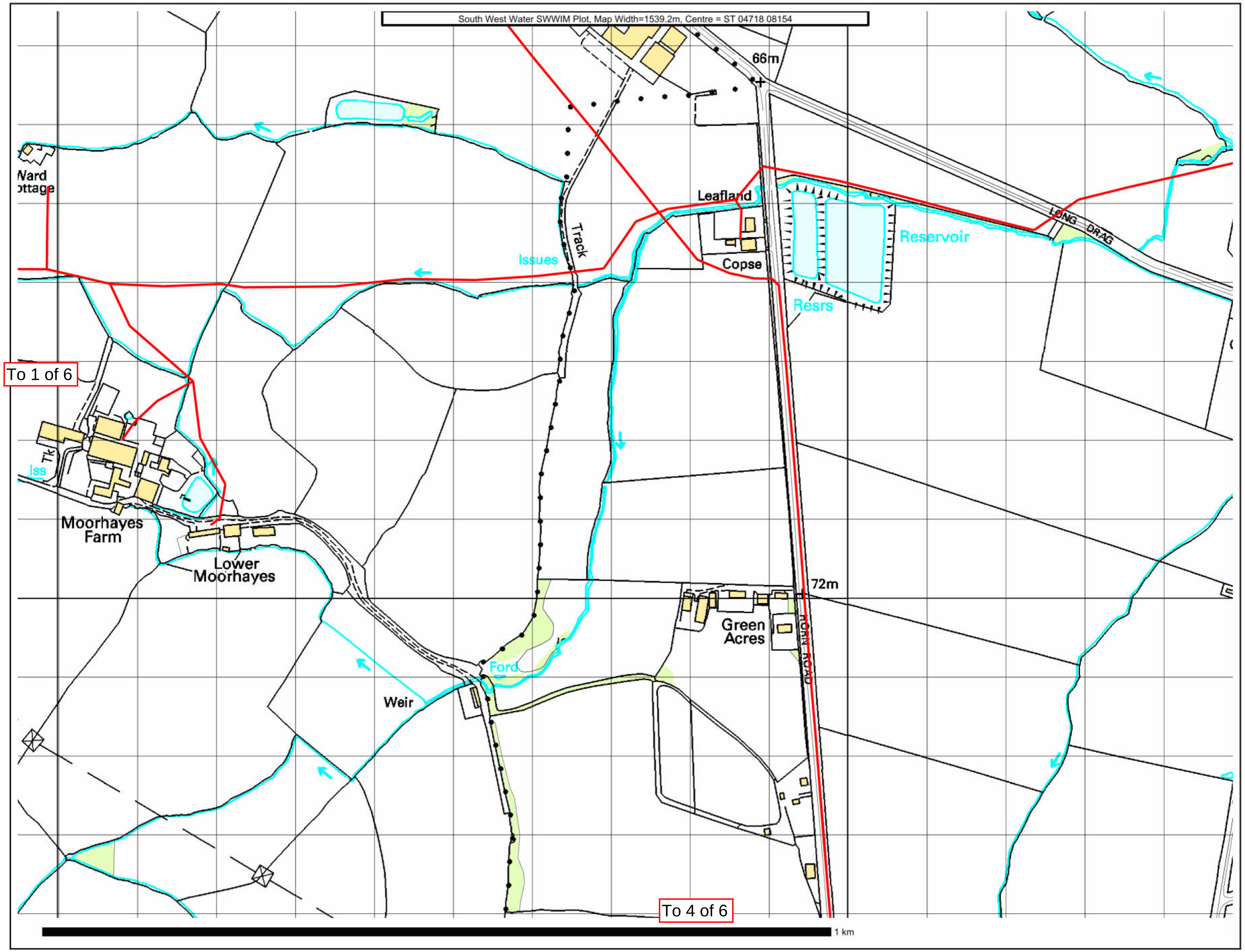

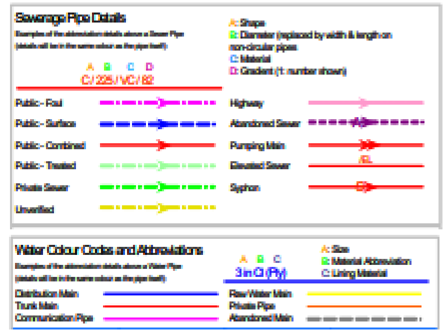

SOUTH WEST WATER

Drawing Title:

Culm Village, 2 of 6.
SWW Network.

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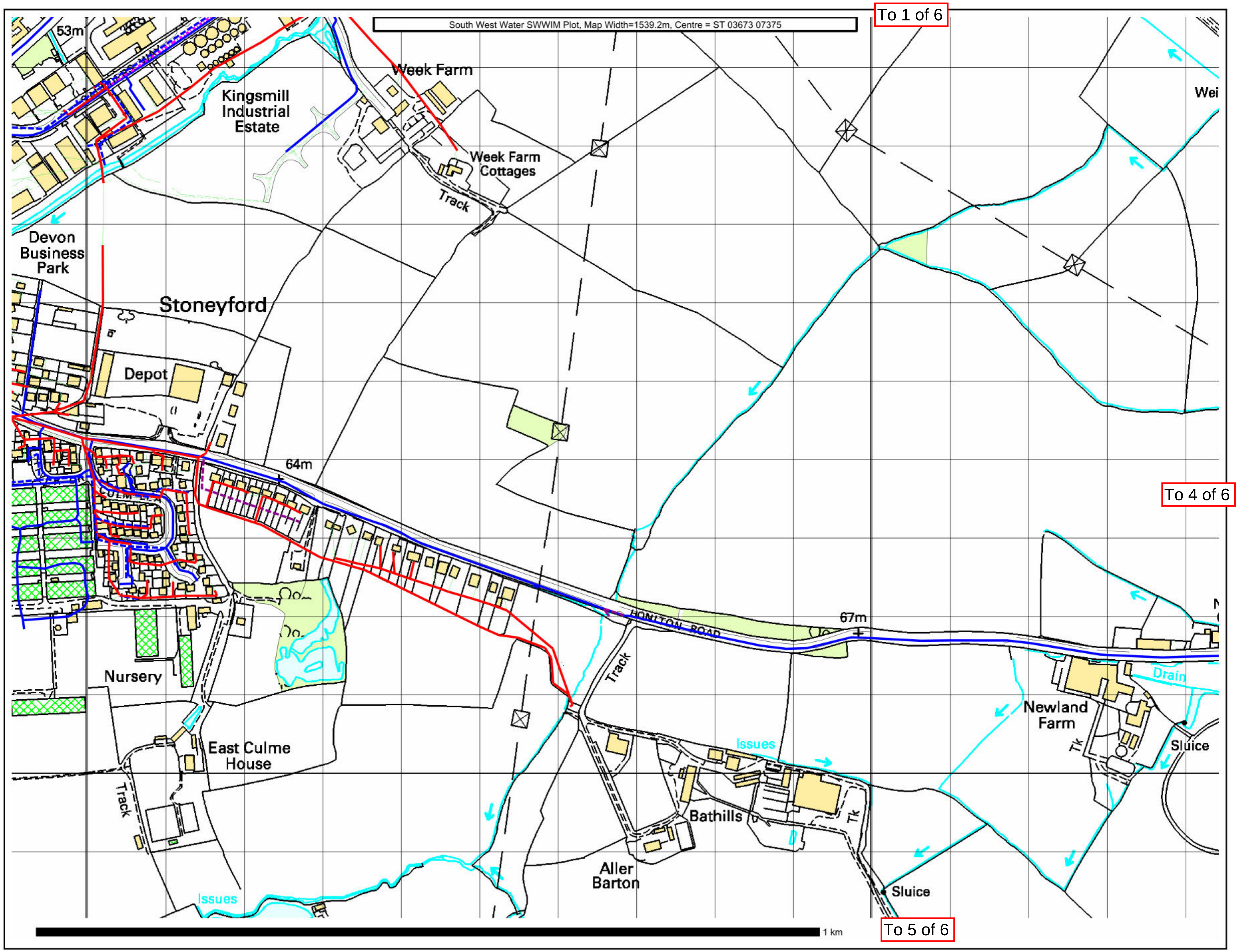

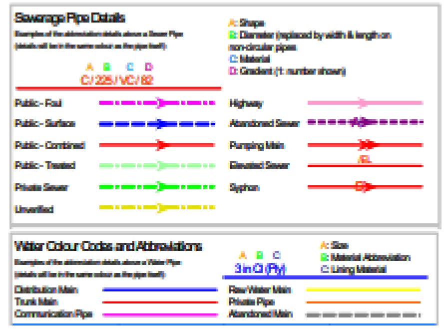

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Culm Village, 3 of 6. SWW Network.

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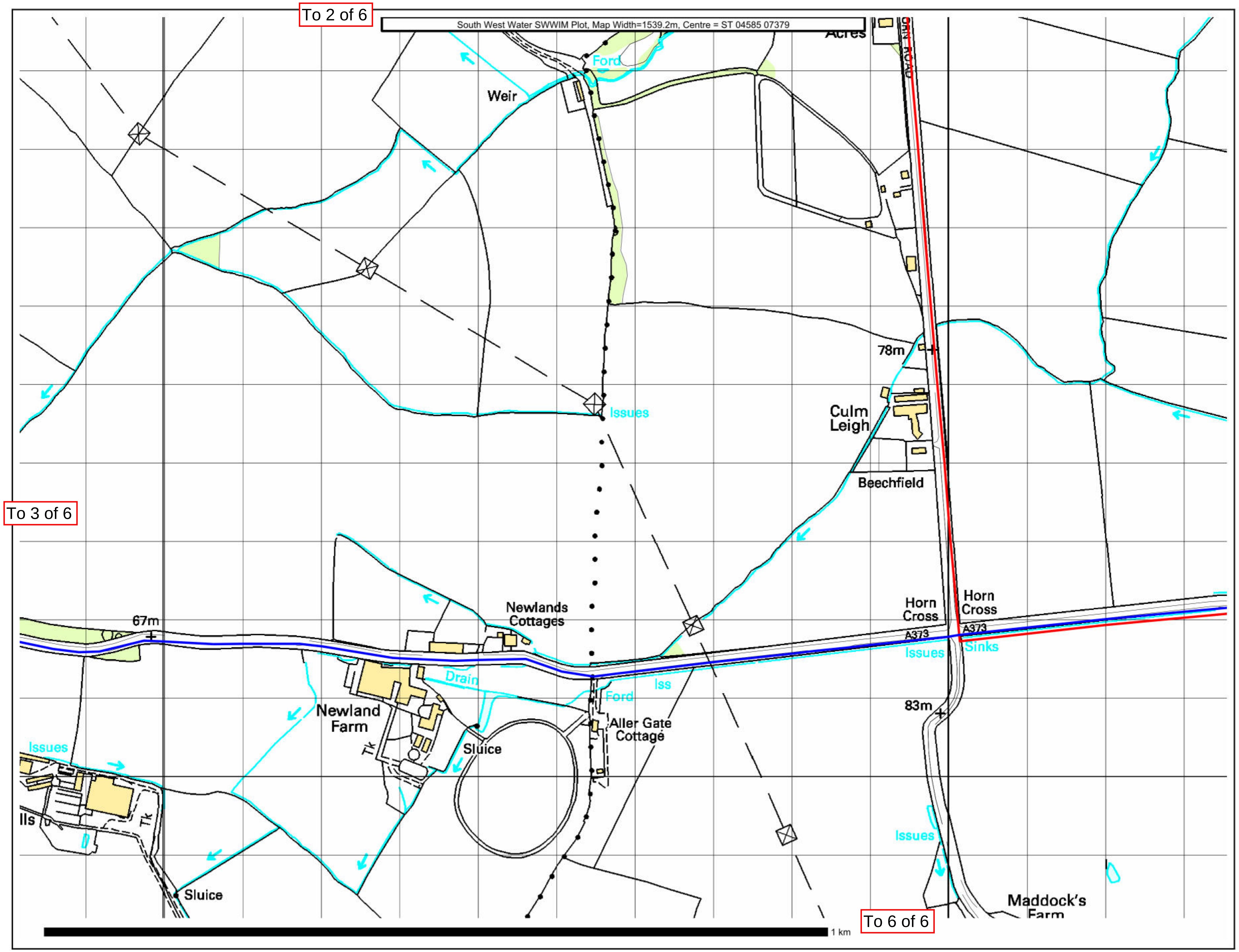
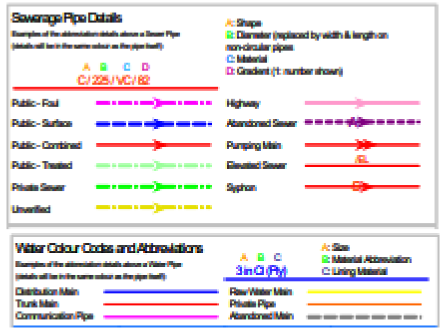
SOUTH WEST WATER





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Culm Village, 4 of 6.
SWW Network.

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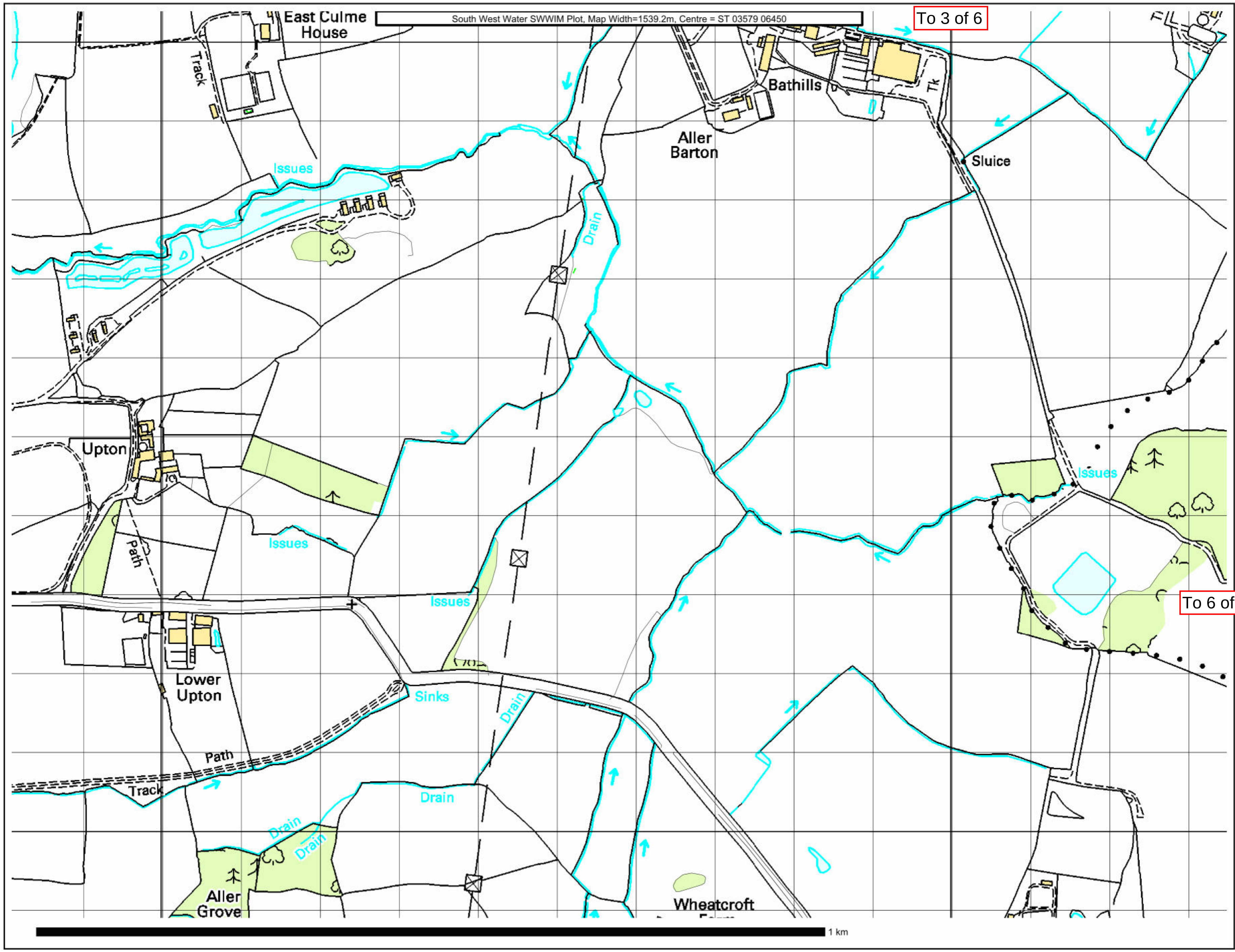

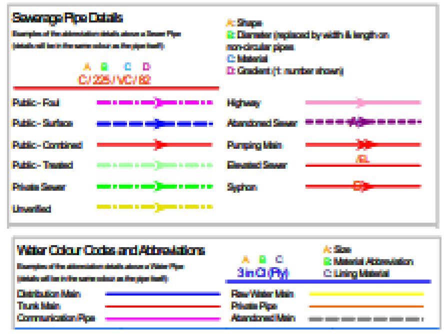

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Culm Village, 5 of 6.
SWW Network.

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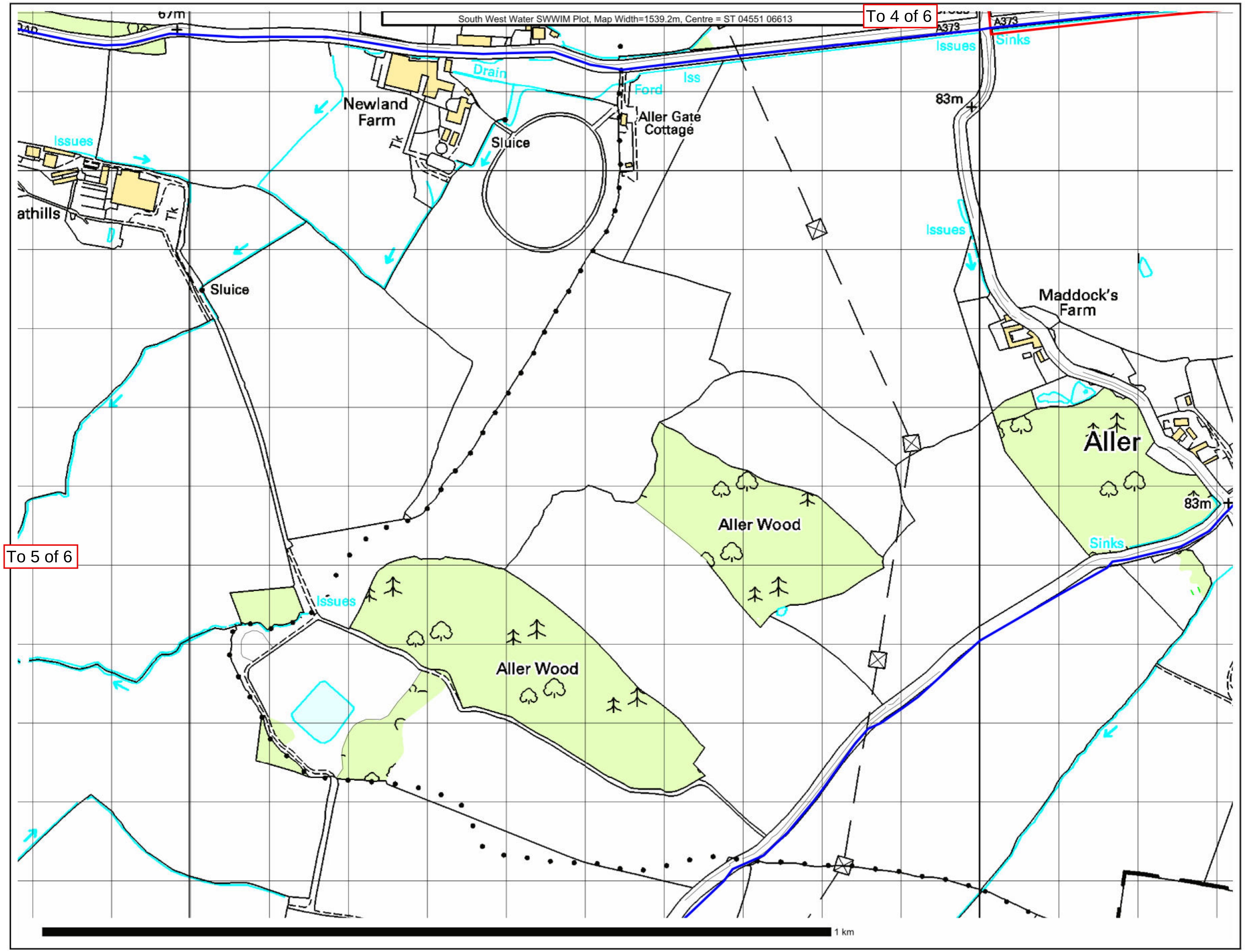

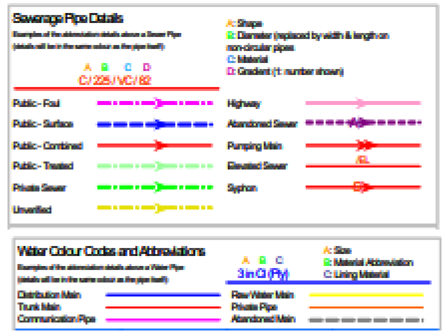

Drawing Title:

Culm Village, 6 of 6.
SWW Network.

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Appendix C – Preliminary SuDS Strategy

1

Notes:
Please read in conjunction with Section 5.5 and Appendix D of the Culm Garden Village Preliminary Report (AECOM, December 2017).

Date: **27/11/2017**

Title:
Preliminary Strategic SuDS Location Map

Project:
Culm Garden Village

AECOM

Appendix D – Preliminary SuDS Dimensions

Appendix D – Preliminary SuDS Dimensions

Phase 1

Zone 1A

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	3802	5329	4565.5
30YR	1608	2503	2055.5
1YR	435	858	646.5
5mm	299.46		
Strategic SuDS Vol			**3919**

Swale Dimension Summary	P1A-Swale
Side slopes (1 in n)	3.00
Depth (m)	0.5
Base Width (m)	0
Total Width with buffer (m)	5
Length (m)	399.82
Volume (m^3)	299.865
Longitudinal Slope (1 in n)	124

Pond Dimension Summary	P1A-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m2)	1966.896
Volume (m3)	3671.54

Zone 1B

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	9328	13076	11202
30YR	3945	6143	5044
1YR	1067	2106	1586.5
5mm	735		
Strategic SuDS Vol			9615.5

Swale Dimension Summary	P1B-Swale1	P1B-Swale2
Side slopes (1 in n)	3	3
Depth (m)	0.7	0.7
Base Width (m)	0	0
Total Width with buffer (m)	6.2	6.2
Length (m)	725.5	60.12
Volume (m^3)	1066.485	88.3764
Longitudinal Slope (1 in n)	50	547

Pond Dimension Summary	P1B-Pond1	P1B-Pond2
Slope (1 in n)	3.00	3.00
Depth (m)	1.4	1.4
Area (m^2)	2396.26	4253.318
Volume (m^3)	4473.02	7939.53

Zone 1C

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	733	1027	880
30YR	310	483	396.5
1YR	84	166	125
5mm	57.69		
Strategic SuDS Vol			755

Pond Dimension Summary	P1C-Pond
Slope (1 in n)	0.33
Depth (m)	1.4
Area (m^2)	623.9384
Volume (m^3)	1164.69

Phase 2

Zone 2A

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	1315	1843	1579
30YR	556	866	711
1YR	150	297	223.5
5mm	103.56		
Strategic SuDS Vol			1355.5

Swale Dimension Summary	P2A-Swale
Side slopes (1 in n)	3
Depth (m)	0.7
Base Width (m)	3.5
Total Width with buffer (m)	9.7
Length (m)	361.2
Volume (m^3)	1415.904
Longitudinal Slope (1 in n)	116

Zone 2B

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	3022	4236	3629
30YR	1276	1990	1633
1YR	346	682	514
5mm	238.05		
Strategic SuDS Vol			3115

Swale Dimension Summary	P2B-Swale
Side slopes (1 in n)	3.00
Depth (m)	0.5
Base Width (m)	0
Total Width with buffer (m)	5
Length (m)	273.2
Volume (m^3)	204.9
Longitudinal Slope (1 in n)	300

Pond Dimension Summary	P2B-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	3338.197
Volume (m^3)	6231.30

Zone 2C

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	2208	3096	2652
30YR	934	1454	1194
1YR	252	498	375
5mm	174.03		
Strategic SuDS Vol			2277

Swale Dimension Summary	P2C-Swale
Side slopes (1 in n)	3.00
Depth (m)	0.5
Base Width (m)	0
Total Width with buffer (m)	5
Length (m)	235.2
Volume (m^3)	176.4
Longitudinal Slope (1 in n)	102

Pond Dimension Summary	P2C-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	3379.142
Volume (m^3)	6307.73

Zone 2D

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	1225	1717	1471
30YR	518	807	662.5
1YR	140	276	208
5mm	96.57		
Strategic SuDS Vol			1263

Swale Dimension Summary	P2D-Swale
Side slopes (1 in n)	3.00
Depth (m)	0.5
Base Width (m)	0
Total Width with buffer (m)	5
Length (m)	252
Volume (m^3)	189
Longitudinal Slope (1 in n)	212

Pond Dimension Summary	P2D-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	3157.301
Volume (m^3)	5893.63

Zone 2E

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	3998	5604	4801
30YR	1691	2633	2162
1YR	457	902	679.5
5mm	315		
Strategic SuDS Vol			4121.5

Swale Dimension Summary	P2E-Swale
Side slopes (1 in n)	3.00
Depth (m)	0.7
Base Width (m)	0
Total Width with buffer (m)	6.2
Length (m)	450.4
Volume (m^3)	662.088
Longitudinal Slope (1 in n)	152

Pond Dimension Summary	P2E-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	1966.896
Volume (m^3)	3671.54

Zone 2F

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	2350	3294	2822
30YR	994	1548	1271
1YR	269	531	400
5mm	185.1		
Strategic SuDS Vol			2422

Swale Dimension Summary	P2F-Swale
Side slopes (1 in n)	3.00
Depth (m)	0.5
Base Width (m)	0
Total Width with buffer (m)	5
Length (m)	301.6
Volume (m^3)	226.2
Longitudinal Slope (1 in n)	301.6

Pond Dimension Summary	P2F-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	2204.28
Volume (m^3)	4114.66

Zone 2G

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	1745	2446	2095.5
30YR	738	1149	943.5
1YR	200	394	297
5mm	137.43		
Strategic SuDS Vol			1798.5

Swale Dimension Summary	P2G-Swale1	P2G-Swale2	P2G-Swale3
Side slopes (1 in n)	3.00	3.00	3.00
Depth (m)	0.5	0.5	0.5
Base Width (m)	1	1	1
Total Width with buffer (m)	6	6	6
Length (m)	138.9	192.5	73.62
Volume (m^3)	173.625	240.625	92.025
Longitudinal Slope (1 in n)	129	51	66

Pond Dimension Summary	P2G-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	2204.28
Volume (m^3)	4114.66

Zone 2H

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	3082	4320	3701
30YR	1303	2029	1666
1YR	352	696	524
5mm	242.85		
Strategic SuDS Vol			3177

Swale Dimension Summary	P1H-Swale1	P1H-Swale2
Side slopes (1 in n)	3	3
Depth (m)	0.5	0.5
Base Width (m)	0	0
Total Width with buffer (m)	5	5
Length (m)	203.7	123.6
Volume (m^3)	152.775	92.7
Longitudinal Slope (1 in n)	49	824

Pond Dimension Summary	P1H-Pond1	P1H-Pond2
Slope (1 in n)	3.00	3.00
Depth (m)	1.4	1.4
Area (m^2)	2886.169	2185.549
Volume (m^3)	1924.11	1457.03

Zone 2I

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	3575	5012	4293.5
30YR	1512	2354	1933
1YR	409	807	608
5mm	281.67		
Strategic SuDS Vol			3685.5

Swale Dimension Summary	P2I-Swale
Side slopes (1 in n)	3.00
Depth (m)	1.4
Base Width (m)	6
Total Width with buffer (m)	16.4
Length (m)	183.6
Volume (m^3)	2621.808
Longitudinal Slope (1 in n)	113

Pond Dimension Summary	P2I-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	613.6376
Volume (m^3)	1145.46

Zone 2J

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	971	1361	1166
30YR	411	639	525
1YR	111	219	165
5mm	76.5		
Strategic SuDS Vol			1001

Swale Dimension Summary	P2J-Swale
Side slopes (1 in n)	3.00
Depth (m)	0.5
Base Width (m)	0
Total Width with buffer (m)	5
Length (m)	189.6
Volume (m^3)	142.2
Longitudinal Slope (1 in n)	71

Pond Dimension Summary	P2J-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	553.896
Volume (m^3)	1033.94

Zone 2K

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	1409	1975	1692
30YR	596	928	762
1YR	161	318	239.5
5mm	111.03		
Strategic SuDS Vol			1452.5

Swale Dimension Summary	P1K-Swale1	P1K-Swale2
Side slopes (1 in n)	3	3
Depth (m)	0.5	0.5
Base Width (m)	0	0
Total Width with buffer (m)	5	5
Length (m)	93.83	85.34
Volume (m^3)	70.3725	64.005
Longitudinal Slope (1 in n)	117	44

Pond Dimension Summary	P2K-Pond
Slope (1 in n)	3.00
Depth (m)	0.5
Area (m^2)	3630.562
Volume (m^3)	2420.37

Zone 2L

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	2401	3365	2883
30YR	1015	1581	1298
1YR	275	542	408.5
5mm	189.21		
Strategic SuDS Vol			2474.5

Swale Dimension Summary	P2L-Swale1	P2L-Swale2
Side slopes (1 in n)	3	3
Depth (m)	0.5	0.5
Base Width (m)	0	0
Total Width with buffer (m)	5	5
Length (m)	75.7	113.54
Volume (m^3)	56.775	85.155
Longitudinal Slope (1 in n)	125	166

Pond Dimension Summary	P2L-Pond1	P2L-Pond2
Slope (1 in n)	3.00	3.00
Depth (m)	1.4	1.4
Area (m^2)	1808.673	1287.212
Volume (m^3)	3376.19	2402.79

Zone 2M

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	4193	5877	5035
30YR	1773	2761	2267
1YR	480	947	713.5
5mm	330.3		
Strategic SuDS Vol			4321.5

Swale Dimension Summary	P2M-Swale
Side slopes (1 in n)	3.00
Depth (m)	0.5
Base Width (m)	0
Total Width with buffer (m)	5
Length (m)	558
Volume (m^3)	418.5
Longitudinal Slope (1 in n)	117

Pond Dimension Summary	P2M-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	4846.904
Volume (m^3)	9047.55

Zone 2N

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	1022	1433	1227.5
30YR	432	673	552.5
1YR	117	231	174
5mm	80.34		
Strategic SuDS Vol			1053.5

Swale Dimension Summary	P2N-Swale1	P2N-Swale2
Side slopes (1 in n)	3	3
Depth (m)	0.5	0.5
Base Width (m)	0	0
Total Width with buffer (m)	5	5
Length (m)	47.3	60.77
Volume (m^3)	35.475	45.5775
Longitudinal Slope (1 in n)	29	26

Pond Dimension Summary	P2N-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	1815.548
Volume (m^3)	3389.02

Zone 2O

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	11158	15640	13399
30YR	4719	7348	6033.5
1YR	1276	2519	1897.5
5mm	879		
Strategic SuDS Vol			11501.5

Swale Dimension Summary	P2O-Swale1	P2O-Swale2	P2O-Swale3
Side slopes (1 in n)	3.00	3.00	3.00
Depth (m)	0.5	0.5	0.5
Base Width (m)	0	0	0
Total Width with buffer (m)	5	5	5
Length (m)	285.1	799	144
Volume (m^3)	213.825	599.25	108
Longitudinal Slope (1 in n)	77	71	182

Pond Dimension Summary	P2O-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	7058.406
Volume (m^3)	13175.69

Phase 3

Zone 3A

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	2232	3129	2680.5
30YR	944	1470	1207
1YR	255	504	379.5
5mm	175.74		
Strategic SuDS Vol			2301

Swale Dimension Summary	P3A-Swale
Side slopes (1 in n)	3.00
Depth (m)	0.5
Base Width (m)	0
Total Width with buffer (m)	5
Length (m)	98.41
Volume (m^3)	73.8075
Longitudinal Slope (1 in n)	54

Pond Dimension Summary	P3A-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	2190.15
Volume (m^3)	4088.28

Zone 3B

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	1137	1594	1365.5
30YR	481	749	615
1YR	130	106.5	118.25
5mm	89.595		
Strategic SuDS Vol			1247.25

Swale Dimension Summary	P3B-Swale
Side slopes (1 in n)	3.00
Depth (m)	0.5
Base Width (m)	0
Total Width with buffer (m)	5
Length (m)	130.3
Volume (m^3)	97.725
Longitudinal Slope (1 in n)	77

Pond Dimension Summary	P3B-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	1647.872
Volume (m^3)	3076.03

Zone 3C

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	1137	1594	1365.5
30YR	481	749	615
1YR	130	106.5	118.25
5mm	89.595		
Strategic SuDS Vol			1247.25

Swale Dimension Summary	P3C-Swale
Side slopes (1 in n)	3.00
Depth (m)	0.5
Base Width (m)	0
Total Width with buffer (m)	5
Length (m)	208.3
Volume (m^3)	156.225
Longitudinal Slope (1 in n)	123

Pond Dimension Summary	P3C-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	1647.872
Volume (m^3)	3076.03

Zone 3D

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	4664	6538	5601
30YR	1972	3071	2521.5
1YR	533	1053	793
5mm	367.5		
Strategic SuDS Vol			4808

Swale Dimension Summary	P3D-Swale
Side slopes (1 in n)	3.00
Depth (m)	0.5
Base Width (m)	0
Total Width with buffer (m)	5
Length (m)	297.5
Volume (m^3)	223.125
Longitudinal Slope (1 in n)	85

Pond Dimension Summary	P3D-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	2548.281
Volume (m^3)	4756.79

Zone 3E

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	1500	2102	1801
30YR	634	988	811
1YR	172	339	255.5
5mm	118.11		
Strategic SuDS Vol			1545.5

Swale Dimension Summary	P3E-Swale
Side slopes (1 in n)	3.00
Depth (m)	0.5
Base Width (m)	0
Total Width with buffer (m)	5
Length (m)	132.2
Volume (m^3)	99.15
Longitudinal Slope (1 in n)	134

Pond Dimension Summary	P3E-Pond
Slope (1 in n)	3.00
Depth (m)	1.4
Area (m^2)	1256.804
Volume (m^3)	2346.03

Zone 3F

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	1537	2155	1846
30YR	650	1012	831
1YR	176	347	261.5
5mm	121.14		
Strategic SuDS Vol			1584.5

Swale Dimension Summary	P3F-Swale
Side slopes (1 in n)	3.00
Depth (m)	0.5
Base Width (m)	0
Total Width with buffer (m)	5
Length (m)	429.8
Volume (m^3)	322.35
Longitudinal Slope (1 in n)	213

Pond Dimension Summary	P3F-Pond
Slope (1 in n)	3.00
Depth (m)	0.5
Area (m^2)	3614.266
Volume (m^3)	2409.51

Zone 3G

Event	Storage Volume (m3) (Discharge at QBAR rate)		
	Lower	Upper	Average
100YR+40%CC	766	1074	920
30YR	324	504	414
1YR	88	173	130.5
5mm	60.36		
Strategic SuDS Vol			789.5

Pond Dimension Summary	P3G-Pond
Slope (1 in n)	3.00
Depth (m)	0.5
Area (m^2)	770.2813
Volume (m^3)	1437.86

Appendix E – SWW Foul Drainage Correspondence

Crussell, Mark

From:	Developer Services Planning <DeveloperServicesPlanning@southwestwater.co.uk>
Sent:	09 November 2017 15:56
To:	Crussell, Mark
Subject:	RE: Culm Garden Village - Masterplan - Foul Drainage WR 2887073

Mark as of next April (see link below) the means by which we need to provide water services is to change meaning developers will not as such need to contribute directly to any capital improvement works although how this will be applied OFWAT have yet to determine fully.

If new drainage were to be laid directly to either Cullompton or Willand Sewage Treatment Works the latter being the most likely this would be by means of Requisition but the financial mechanism for delivering such has yet to be finalised.

I would suggest that you/your client wait until next April by which time it will have been established exactly how these charges will be applied

We can give a budget estimate based on a desk top study only for the full engineering costs for the provision of a p stn and off site sewer to either of the above works but clearly there will still be uncertainty of the funding mechanism for such?

Give me a ring if you want to discuss before taking this further.

Regards

Martyn Dunn Development Coordinator

South **West** Water

D: 01392 443702

Peninsula House, Rydon Lane, Exeter, EX2 7HR
www.southwestwater.co.uk

Please note that the Water Act 2014 has brought in changes that mean that all water companies are being asked to modify the way they charge customers for Developer Services related activities from April 2018.

PRICE PROMISE

From: Crussell, Mark [mailto:mark.crussell@aecom.com]
Sent: 09 November 2017 14:45
To: Developer Services Planning
Subject: RE: Culm Garden Village - Masterplan - Foul Drainage WR 2887073

Hi Martyn,

Thank you for your reply below. Please can you indicate high level 'ball-park' cost for undertaking the detailed evaluation to establish potential costs of works required. I think it will help guide my client as to whether an early evaluation is cost beneficial.

Regards,

Mark

From: Developer Services Planning [mailto:DeveloperServicesPlanning@southwestwater.co.uk]
Sent: 25 October 2017 11:02
To: Crussell, Mark; Developer Services Planning
Cc: Hunt, Lydia
Subject: RE: Culm Garden Village - Masterplan - Foul Drainage WR 2887073

Mark regarding this there are it seems 2 possible options for draining the proposal and we do need to consider the overall Masterplan as well as the initial phase.

The nearest public sewer network is to the west at Stoneyford where a public pumping station transfers flows across the M5 via the existing road bridge at Junction 28 to the main sewer network serving Cullompton.

This p station and associated rising main and existing sewer network to which it discharges is not sufficient to support phase 1 and neither is there scope to increase its capacity due to its location.

The first option would be to take flows by means of a new on site pumping station and off site rising main which would have to cross the M5/River Culm & Railway Line by directional drilling directly to the Cullompton sewage treatment works.

The second option and likely to be the preferred one would be to take flows via a new pumping station and rising main north to the Willand sewage treatment works(approximately 3km away).

Both of the above offer scope to deal with the initial phase and full development and would require detailed evaluation to establish potential costs which would in itself be expensive and the results only valid for a 9 month period. As outline planning is only anticipated to be submitted next September and development itself commencing some time thereafter it may not be in your financial interest to have such an evaluation undertaken at this time but rather base your foul drainage strategy on the options given here in outline?

Regards

Martyn Dunn Development Coordinator

South **West** Water

D: 01392 443702

Peninsula House, Rydon Lane, Exeter, EX2 7HR
www.southwestwater.co.uk

From: Crussell, Mark [mailto:mark.crussell@aecom.com]
Sent: 18 October 2017 11:57
To: Developer Services Planning
Cc: Hunt, Lydia
Subject: Culm Garden Village - Masterplan - Foul Drainage

Hi Martyn,

We are undertaking an preliminary flood risk and drainage study to inform the master planning process for the new Culm Garden Village located to east of the M5 at Cullompton (see working masterplan attached). The Garden Village will be developed over 3 phases with a cumulative total of 5000 dwellings on completion. No. of dwellings for each phase will be:

- Phase 1: 680 dwellings (outline planning scheduled for September 2018);
- Phase 2: 1800 dwellings;
- Phase 3: 2700 dwellings.
- Total: 5000 dwellings.

There will also be 3 Primary Schools, 1 Secondary School and district centre and 8 ha of commercial land.

To inform the foul drainage element of the study please can South West Water (SWW) provide details of the likely on-site and off-site upgrade works required to meet the future demand of the new settlement and also the first phase of 680 homes, district centre and primary school.

Based on Sewers for Adoption (7th Edition) design flow rates per dwelling (i.e. 4000 litres per dwelling per day), we can provide high level design flow rates for each phase of the new settlement:

Phase	No. Dwellings	Peak Flow Rate (litres per dwelling, per day)	Peak Flow Rate (litres per phase, per day)	Peak Flow Rate (cubic metres per phase, per day)
Phase 1	680	4000	2720000	2,720
Phase 2	1800	4000	7200000	7,200
Phase 3	2700	4000	10800000	10,800
Total	5000	4000	20000000	20,000

We feel that basing future demand on proposed dwelling numbers alone is a reasonable approach for this high level assessment stage.

Please can you indicate fee required for SWW to undertake this initial capacity assessment, together with likely timescales.

If you require any further information please contact me on the number below.

Kind regards,

Mark

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