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FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

PROPOSED DEVELOPMENT, Haverton Hill Rd, Stockton on Tees.

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Executive Summary

This Flood Risk Assessment (FRA) has been prepared to support the planning application for the proposed development of the site located at Haverton Hill Rd, Stockton on Tees.

This report assesses existing flood risk issues at the site and proposes mitigation where necessary to reduce the risk of flooding to occupant's post-development with no increased risk of flooding off-site.

The site is currently predominantly greenfield with a small road within the site entry. The proposed development is for a single industrial / commercial unit and associated access, parking and hardstanding. (See Appendix A for development proposals)

The Environment Agency (EA) flood modelling has been obtained and is provided in Appendix E.

The development area of the site is located within the Environment Agency's (EA) flood zone 2 and 3 (medium-high risk).

The sources of flooding assessed and proposed mitigation measures are listed in the table below.

Source	**Risk Category (after mitigation)**	**Comments**
Fluvial (Rivers and Sea)	Low	Proposed finished floor levels of new build set more than 300mm above the 1 in 100-year plus climate change flood level.
Coastal and tidal	Negligible	Not near coast or tidal waterbody
Groundwater	Low	Proposed finished floor levels are a minimum 150mm above external ground levels
Surface water	Low	Low due to natural topography and presence of existing surface water drainage
Sewers	Very Low	Low due to natural topography and sewer location
Reservoirs	Very Low	Reservoir at low danger of failure

It is recommended that the management of the building prepare a flood evacuation plan.

The proposals for redevelopment of the land for mixed industrial and commercial use is classified as 'Less Vulnerable', as defined in PPG Table 2. According to PPG, this land use is appropriate for Flood Zones 2 and 3, subject to the application of the Sequential and Exception Test.

This report demonstrates that both the Sequential and Exception tests have been passed, hence the proposed redevelopment is appropriate, in flood risk terms.

It is proposed to set the floor level of the new build at least 300mm above the 1 in 100 year plus climate change flood level.

Safe access will be addressed through the provision of safe refuge within the new development and a safe route outside the flood extent. In the event of a flood, the road will be set above the flood level and can be accessed via foot from each of the proposed buildings, with a safe route through the site towards the private access road.

All businesses on site will be advised to sign up for the EA flood warning service which is available in this area.

The proposed drainage strategy presented in detail in this report aims to reduce the surface water discharge to greenfield rates in accordance with local guidelines and best practice.

Attenuation and reduced discharge (to greenfield rates) will be provided for all storm events up to and including the 1 in 100-year storm plus 20% allowance for climate change. Sustainable Drainage Systems (SuDS) shall be used, including attenuation tanks and silt traps.

In conclusion, the proposed development has an acceptable flood risk within the terms and requirements of the NPPF.

The comments stated above are based on information received from other consultees. The flood risk classification of this site has been based on the above observations and the recommendations stated. This report is intended for the use of the developer of the site in support of their planning application for this site only.

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1. Introduction

1.1 *Proposals*

1.1.1 Wallace Engineering have been commissioned to undertake a review of the existing Flood Risk Assessment (FRA) & Drainage Strategy in relation to a proposed mixed use development at the corner of a private road and Haverton Hill Rd, Stockton on Tees.

1.2 *Proposed Development*

1.2.1 The site currently is greenfield with a small road stub within the site entry. The proposed development is for a single industrial / commercial unit and associated access, parking and hardstanding.

1.2.2 Proposed development details are provided in Appendix A.

1.3 *Terms of Reference*

1.3.1 The National Planning Policy Framework (NPPF) states that when determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where informed by a site-specific FRA. This assessment is required for:

"Proposals of 1 hectare (ha) or greater in Flood Zone 1, all new development (including minor development and change of use) in Flood Zones 2 and 3 and an area within Flood Zone 1, which has critical drainage problems as notified to the local planning authority by the Environment Agency (EA)."

1.3.2 In accordance with the March 2014 Planning Practice Guidance (PPG), which supports the NPPF, the objectives of this FRA are to establish:

- *Whether a proposed development is likely to be affected by current or future flooding from any source;*
- *Whether it will increase flood risk elsewhere;*
- *Whether the measures proposed to deal with these effects and risks are appropriate.*

1.3.3 From April 2015, Stockton on tees Borough Council as a Lead Local Flood Authority (LLFA) is a statutory consultee for major planning applications in relation to surface water drainage, requiring that all planning applications are accompanied by a Sustainable Drainage Strategy. The aim of the Sustainable Drainage Strategy is to identify water management measures, including Sustainable Drainage Systems (SuDS), to provide surface water runoff reduction and treatment.

1.3.4 Local guidance documents including the Stockton on tees Borough Council Strategic Flood Risk Assessment (SFRA), the Stockton on tees Preliminary Flood Risk Assessment (PFRA) and the Tees Valley Authorities Local Standards For Sustainable Drainage have been reviewed for site specific information.

1.3.5 The EA have provided flood product 4 data for the site which is included in Appendix E.

2 Site Description

2.1 *Site*

2.1.1 The total site area is approximately 15,476 square metres. The site is bounded by the open land to the west, Haverton Hill rd to the north, a private road the east and further open land to the south with the River Tees approx. 100m to the south.

2.1.2 The site location information is as follows:

- Nearest Postcode: TS23 1PZ

2.2 *Topography*

Site Topography

2.2.1 An on-site topographic survey has been carried out and is provided in Appendix C. The site topography is irregular due to steep embankments and piled made ground within the site. The levels are generally between 4m AOD and 5m AOD and fall gently away towards the south and the River Tees.

2.3 *Hydrology*

2.3.1 The nearest surface water feature is the River Tees located approx. 100m to the south. As per the EA mapping, this river is classified as "Pending", so is assumed to be main river. See Appendix E for correspondence with the EA.

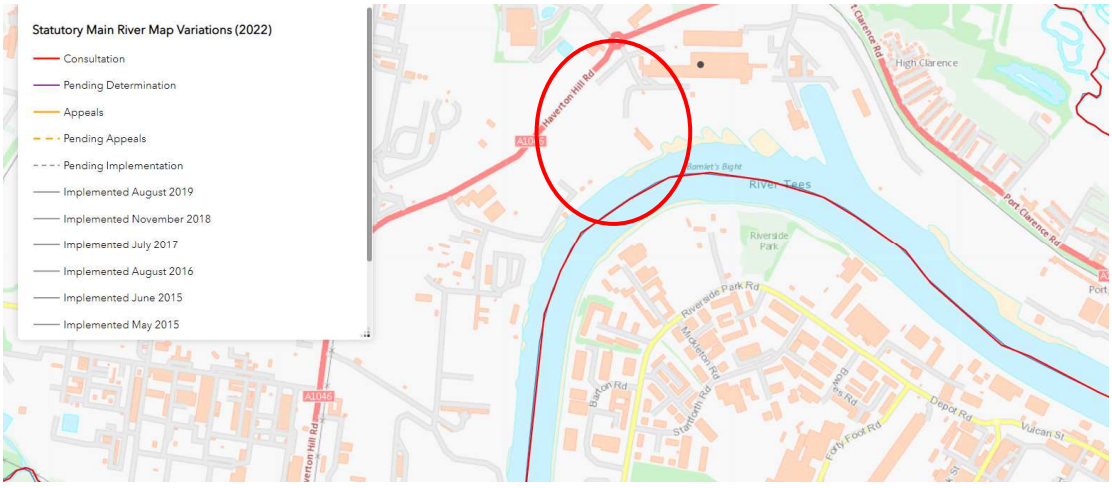


Figure 1: Local Waterways as per Environment Agency

2.4 *Geology and Hydrogeology*

2.4.1 Groundwater flooding occurs when the water table rises to the surface and is most likely to occur in low-lying areas underlain by permeable rocks.

2.4.2 Reference to the British Geological Survey online mapping (1:50,000 scale) indicates that the site is underlain by bedrock of Sherwood Sandstone Group - Sandstone. Sedimentary Bedrock formed approximately 237 to 272 million years ago in the Triassic and Permian Periods. Local environment previously dominated by rivers. Superficial deposits are Tidal Flat Deposits - Sand, Silt And Clay. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by shorelines (U).

2.4.3 MAGIC's online 'Groundwater Source Protection Zones' map indicates that the site is not located within a Groundwater Source Protection Zone.

2.4.4 The Aquifer Maps on the MAGIC map identifies the area as follows:

Bedrock –nothing of note

Superficial Drift –nothing of note

Groundwater Vulnerability – Medium - See the MAGIC Map in figure 2 below

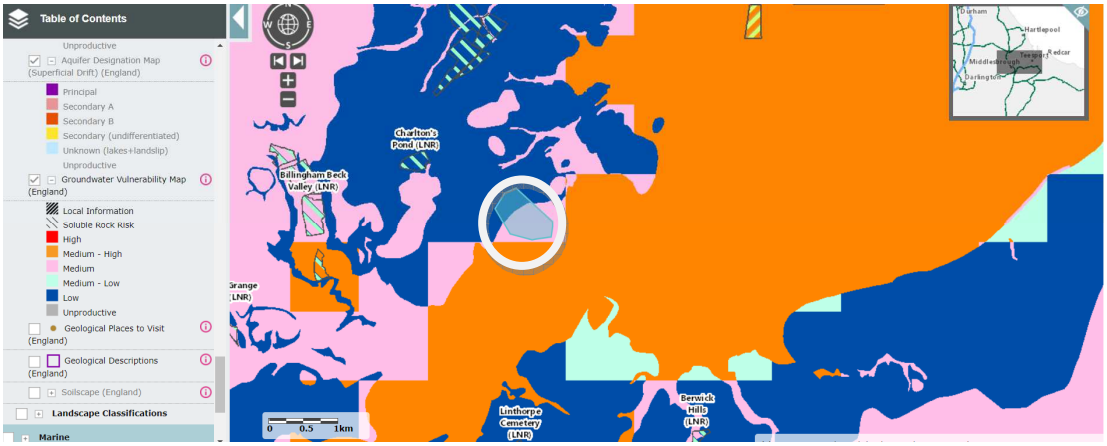


Figure 2: DEFRA Magic Map of Groundwater Vulnerability

3 Flood Risk Policy & Guidance

3.1 *Flood Risk Guidance*

3.1.1 The following resources have been reviewed to assist with the preparation of the FRA:

3.1.2 **Stockton on Tees Borough Council Strategic Flood Risk Assessment (SFRA), Levels 1 and 2, 2018**

3.1.3 **Stockton on Tees Preliminary Flood Risk Assessment (PFRA), 2017**

3.1.4 **Tees Valley Authorities Local Standards For Sustainable Drainage, 2015**

3.2 *National Planning Policy*

3.2.1 The PPG, which supports NPPF, defines three Flood Zones in relation to river flooding. These are defined as:

- Flood Zone 1 (Low Probability): This zone comprises land assessed as having less than a 1 in 1000 annual probability of river flooding;
- Flood Zone 2 (Medium Probability): This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding; and
- Flood Zone 3 (High Probability): This zone comprises land assessed as having greater than a 1 in 100 annual probability of river flooding.

3.2.2 The EA's Flood Map for Planning shows that the site is located in Flood Zones 2 and 3.

3.3 *Climate Change*

3.3.1 In line with PPG, a site-specific FRA must consider the following question:

"How is flood risk at the site likely to be affected by climate change?"

3.3.2 Commercial/Industrial development has an expected minimum lifetime of 50 years, so to demonstrate that the development is safe from the effects of flood risk through this lifetime, climate change must be considered. Based on the latest EA Guidance on climate change allowances a peak rainfall intensity increase of up to 20% should be considered. Thus it is proposed to use the modelled EA flood levels in the design of this site (see appendix E) as these flood levels include a suitable allowance for climate change.

3.4 *Sequential Test and Exception Test*

3.4.1 In accordance with the NPPF:

"The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding."

3.4.2 Where areas of lower risk are not available, the Exception Test, as set out in paragraph 102 of the NPPF can be applied, to ensure flood risk management for people and property meets the required level of standard.

3.4.3 The development area of the site is located in Flood Zones 2 and 3 (Figure 3 below). As the site is located in an area of medium-high flood risk, the exception test must be passed.

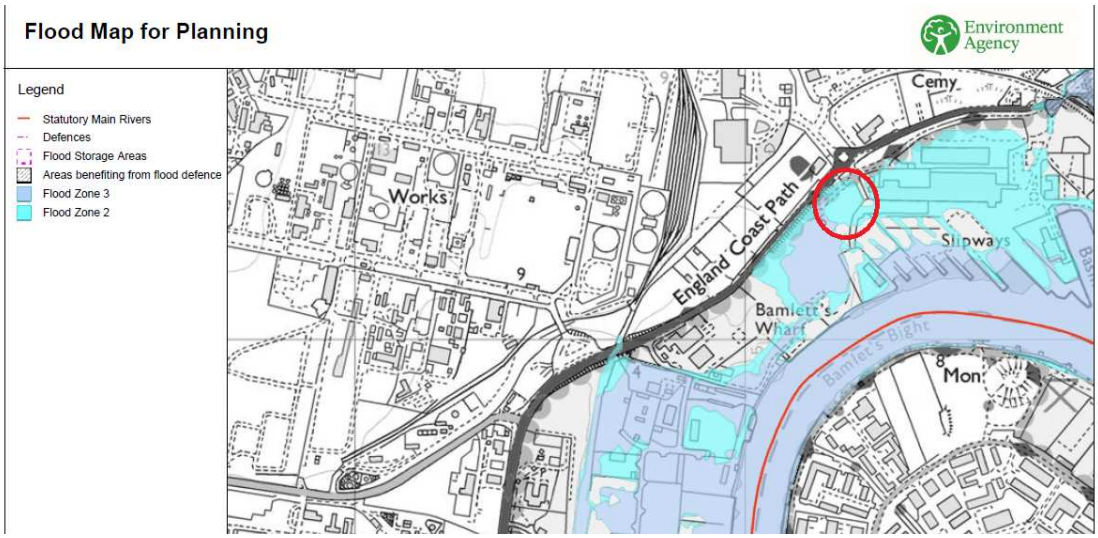


Figure 3: EA Flood Zone Map

4 Sources of Flooding and Assessment of Risk

4.1 *Flood Risk from Rivers (Fluvial)*

4.1.1 The River Tees is located just south of the site and is the main source of fluvial flooding for the area.

4.1.2 As the site is within a Flood Zones 2 and 3, it has between a 1 in 30 and 1 in 1000 annual probability of river flooding.

4.1.3 The EA flood modelling has been obtained and is provided in Appendix E.

4.1.4 A review of the flood levels and the topographic survey indicates that while the site is at some risk of flooding, the existing and proposed site levels are generally above the 100 year flood level and so the site is almost wholly within flood zone 2 and a small area within flood zone 3. See Appendix A for a plan of the modelled flood extent.

4.1.5 The modelled flood levels indicate that the 1 in 100 year flood level is approx. 3.927 and the 200 year flood level is 4.083m AOD. Based on this, for the purpose of this report, a worst case is assumed and it will be assumed that the 100 year plus climate change flood level is 4.083m AOD

4.1.6 Based on the above the flood risk from rivers is considered medium.

4.2 *Coastal and Tidal Flood Risk*

4.2.1 The site is located inland and is not near any tidally influenced watercourses; therefore, there is negligible risk of flooding from this source.

4.3 *Groundwater Flood Risk*

4.3.1 Groundwater flooding occurs when the water table rises to the surface and is most likely to occur in low-lying areas underlain by permeable rocks.

4.3.2 The SFRA does not contain any records of groundwater flooding at or in the immediate vicinity of the site.

4.3.3 The proposed development will be predominantly hardstanding and no basement levels are proposed. It can therefore be concluded that the risk of groundwater flooding is very low.

4.4 *Surface Water Flood Risk (Overland Flows)*

4.4.1 Surface water flooding occurs when the rainwater does not drain away through the normal drainage system or infiltrate the ground, but instead lies on or flows over the ground.

4.4.2 The EA produced a Risk of Flooding from Surface Water Map in December 2013. The maps were produced using 'direct rainfall' modelling. Although they consider local drainage capacity, non-surface water influences such as rivers, seas or groundwater are not considered. The map is based on LIDAR topographic data which is not suitable for site specific assessment and therefore, where available, topographic survey data should be used to provide a more accurate understanding of potential flow paths.

4.4.3 The map shows the entire country within four different risk categories, defined below in Table 1.

Table 1: EA Surface Water Flood Risk Categories

Risk Category	Definition
High	Each year, there is a chance of flooding of greater than 1 in 30 (3.3%)
Medium	Each year, there is a chance of flooding of between 1 in 30 (3.3%) and 1 in 100 (1%)
Low	Each year, there is a chance of flooding of between 1 in 100 (1%) and 1 in 1000 (0.1%)
Very Low	Each year, there is a chance of flooding of less than 1 in 1000 (0.1%)

4.4.4 An extract of the map, provided below, shows that there are some small pockets of the site susceptible to surface water flooding. However, a review of the topographic levels across the entire site indicate that the site falls gently away to the south and towards the river Tees. Thus it is unlikely that any flooding will occur as surface water would flow through the site to the waterway. It is also noted that there are no recorded instances of surface water/sewer flooding.

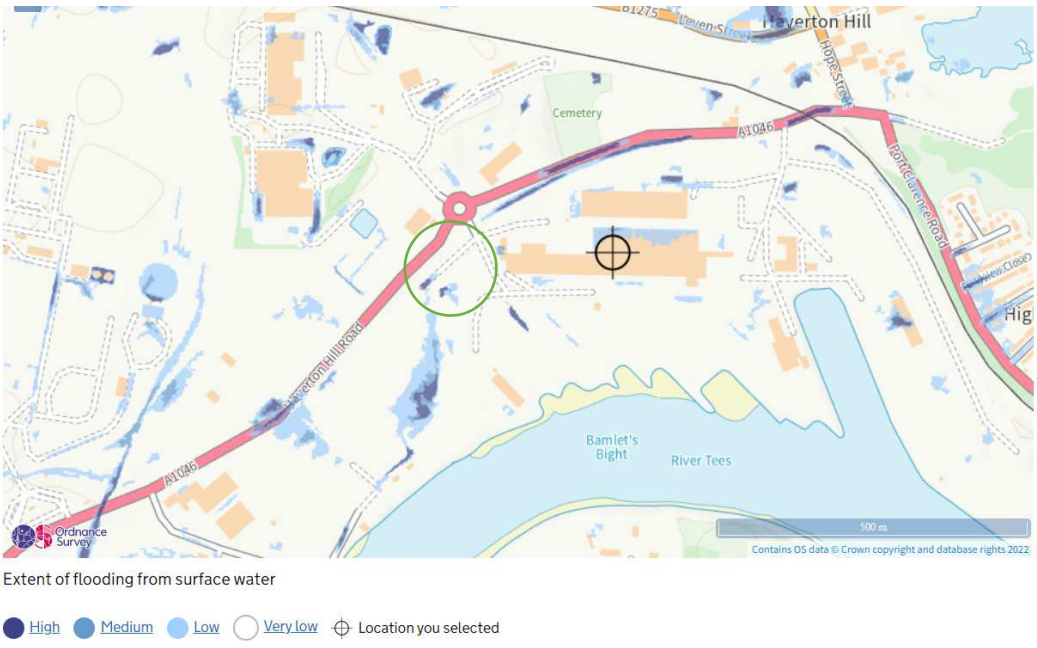


Figure 4: EA Flood Risk from Surface Water Map

4.4.5 There are no records within any LLFA document of any surface water flooding at the site.

4.4.6 Based on the EA's mapping, historical data and local topography, risk of surface water flooding to the site is considered to be low.

4.5 *Sewer/Drainage Flood Risk*

4.5.1 Sewer flooding is often caused by excess surface water entering the drainage system when there is insufficient sewer capacity to cope with this excess water, but also due to 'one off' events such as blockages.

4.5.2 Northumbrian Water are the sewer providers for the area, however there are no sewers near to the site (see sewer record plans in Appendix D).

4.5.3 On the basis there is considered to be a very low risk of sewer flooding to the site.

4.6 *Reservoir Flood Risk*

4.6.1 The EA has produced a Reservoir Flood Map that shows that the site is not at risk from reservoir flooding.

4.6.2 It should be emphasised that the risk of flooding from reservoir breach is very small since the EA is the enforcement authority for the Reservoirs Act (1975) and all large raised reservoirs are inspected and supervised by reservoir panel engineers.

4.6.3 On the basis there is considered to be a very low risk of reservoir flooding to the site.

4.7 *Summary of risk levels*

4.7.1 Pre-development, the risk of flooding is summarised below.

Table 2: Flood Risk Categories

Source	Risk Category
Fluvial (Rivers and Sea)	Medium
Coastal and tidal	Negligible
Groundwater	Very Low
Surface water	Low
Sewers	Very Low
Reservoirs	Very Low

5 Sequential and Exceptions Tests

5.1 *Flood Risk Vulnerability*

5.1.1 NPPF PPG 'Flood Risk and Coastal Change' Table 2 confirms the 'Flood risk vulnerability classification' of a site, depending upon the proposed usage. This classification is subsequently applied to PPG Table 3 to determine whether:

- The proposed development is suitable for the flood zone in which it is located, and;
- Whether an Exception Test is required for the proposed development.

5.1.2 The proposed development is classed as a 'Less Vulnerable' development.

5.1.3 The location of the proposed 'Less Vulnerable' development is in Flood Zones 2 and 3.

5.2 *NPPF Sequential Test*

5.2.1 The NPPF follows a sequential risk-based approach in determining the suitability of land for development in flood risk areas, with the intention of steering all new development to the lowest flood risk areas.

5.2.2 The NPPF requires the Local Authority to apply the Sequential Test in consideration of new development. The aim of the Test is to steer new development to areas at the lowest probability of flooding. The Sequential Test is based on the Environment Agency Flood Zones and information contained within the SFRA.

5.2.3 The flood zones as defined in the Strategic Flood Risk Assessment for the area provide the basis for applying the Test. The aim is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding). Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of river or sea flooding) be considered, considering the flood risk vulnerability of land uses and applying the Exception Test if required.

5.2.4 The methodology listed below is a general guide to the Sequential Test:

The application of the Sequential Test requires the identification of Flood Zones as defined in Table 1 of the NPPF Technical Guidance. Also, it will require LPAs to demonstrate that there are no reasonable available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed, by considering all forms of flooding based on a Level 1 SFRA.

5.2.5 Based on the above, the area is considered suitable for development should there be no properties available at lower risk of flooding, so in order to complete the

sequential test, a review of available properties in the area has been conducted and the following properties have been identified.

Land For Sale - Bagshaws - Belasis Point Greenwood Road, Billingham TS23 4AZ. This site is almost 10 times the size of this subject site and so too large.

Business Park for sale - Belasis Business Park, 2, 3 & 4 Belasis Court, Billingham TS23 4AZ. This site is an existing business park and too small for the proposals

5.2.6 Clearly, there are no more suitable areas large enough and with suitable access to the local industrial land in areas of lower flood risk within the area and thus the sequential test is considered to be passed.

5.3 *Flood Zone*

5.3.1 In accordance with Table 2 of the NPPG: Flood Risk and Coastal Change, industrial and commercial developments are considered to be less vulnerable'. Table 3 of the NPPG: Flood Risk and Coastal Change, states that 'less vulnerable' development is considered appropriate within Flood Zones 1, 2 and 3a. However, development should not be permitted in Flood Zone 3B. As the site is located mostly within flood zone 2 and partly within flood zone 3A it is assumed that the site is able to be developed.

5.4 *NPPF Exception Test*

5.4.1 The site is shown on the EA Flood Zone maps as falling within Flood Zone 3 'high probability'. The Exception Test has been carried out in accordance with the NPPF to demonstrate the significant benefits of the proposed development. The NPPF paragraph 102 states:

> *"...For the Exception Test to be passed:*
>
> *it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and*
>
> *a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall."*

5.4.2 The first part of the Exception Test is addressed by the significant benefits provided by the new development

- Provides important employment opportunities

- Develop an empty site close to a main road and not suitable for residential development
- No increase in surface water runoff as the proposed development limits all discharge to greenfield rates.

5.4.3 The details provided within this FRA address the second part of the Exception Test and demonstrate that the site is safe for its lifetime.

5.4.4 In conclusion, the provided information confirms that the Exception Test has been passed and the proposed redevelopment is appropriate, in flood risk terms.

6 Flood Risk Mitigation

6.1 *Introduction*

6.1.1 This chapter sets out how the risks identified in the previous chapter will be mitigated to minimise the risk to residents onsite, post development, without increasing the risk of flooding offsite.

6.2 *Floor Levels*

6.2.1 The modelled flood levels indicate that the worst case 1 in 100 year plus climate change flood level across the site is 4.083.

6.2.2 All proposed floor levels will be set at minimum of 5.00. This is more than 900mm above the expected flood level and will ensure the buildings are protected from any flooding and overland flows in an extreme rainfall event.

6.3 *Safe Access*

6.3.1 It is necessary to consider and incorporate safe access arrangements as part of the mitigation, to ensure the users/occupants of the development are safe in times of flooding.

6.3.2 The site and the proposed road are set at a level above the expected maximum flood event and so the requirement for safe access is provided.

6.4 *Flood Plain Compensation*

6.4.1 The site is partly identified and being located in Flood Zone 3. The EA modelled flood levels indicate that the site is actually mostly located above the 100 year flood level and so is not within flood zone 3. As the proposals generally do not increase ground levels there is no requirement for compensation.

6.5 *Flood Warning*

6.5.1 All businesses on site will be advised to sign up for the EA flood warning service which is available in this area.

6.5.2 The site management should prepare a flood plan to inform site users of the flood risk and to provide advice on what to do in the event of a flood. The flood plan should include details of a safe access / egress route to be used during a flood event.

6.5.3 It is also considered acceptable for site users to remain within the building and seek refuge at first floor level, where applicable. Site users should not evacuate the building into flood water unless instructed to do so otherwise by the emergency services.

7 Sustainable Drainage Systems (SuDS)

7.1.1 To maximise the potential use of SuDS at the site, a review has been undertaken as shown in Table 3 in accordance with the SuDS Hierarchy. This review highlights the components referenced in the SuDS Hierarchy and provides recommendations on whether the components could be incorporated into the development.

Table 3: SuDS Selection Based on the SuDS Hierarchy

Component	Recommendation
Green (living) roofs	Whilst the use of green roofs provides additional environmental benefits such as enhanced aesthetics and ecology, its exposure to wind and orientation must be considered. Access to undertake the construction and maintenance easily and safely is also a high priority. If feasible, depending on the roof design, a green roof will provide water quality, biodiversity and aesthetic benefits to the site. Additionally, the green roof/s will offer some attenuation for run-off, reducing volumes of run-off and in higher frequency events (i.e. 1in2 year storms) will result in no run-off for the building. The roofs are lightweight and not suitable for green roofs.
Basins and Ponds	Ponds and attenuation basins can provide overland storage of surface water whilst also providing additional biodiversity and aesthetic/amenity value. There are no ponds proposed for the site.
Filter Strips and Swales	Swales are linear vegetated drainage features, which provide overland conveyance and storage of surface water whilst trapping sediments and hydrocarbons within run-off. They also create biodiverse areas for planting and habitat. Swales are not considered suitable for this site due to the urban setting restricting the availability of space and suitability of swales.
Infiltration Devices	Infiltration devices are not suitable for this site in accordance with the recommendations of the section above.
Permeable Paving	Whilst incorporating attenuation storage, permeable paving also provides treatment through filtration of silt (and attached pollutants), settlement and retention of solids, adsorption of pollutants and biodegradation of organic pollutants, including petrol and diesel. Parking areas are to be hardstanding and not suitable for permeable paving

Component	Recommendation
Tanked Systems	This is the least sustainable option in terms of the SuDS Hierarchy. However, the use of tanked systems would still be of benefit compared to traditional drainage systems as it does allow run-off to be slowed down to an acceptable discharge rate. There are attenuation tanks proposed for the site with pollution managed via an oil interceptor.

8 Drainage Design

8.1 *Surface Water Drainage Design*

8.1.1 The site is currently greenfield and has an area of 15,476 square metres.

8.1.2 The Stockton-on-tees Borough Council use the Tees Valleys Authorities Local Standards for Sustainable Drainage. This guide states that *'These standards aim to limit the peak flow rates for a range of rainfall events and to return runoff rate to greenfield levels'*

8.2 *Existing Site Runoff*

8.2.1 The proposed development will result in an increase in impermeable area. Existing greenfield rates runoff rates have been estimated the Wallingford method and are summarised below (calcs can be seen in Appendix A).

Table 4: Existing Run-off Rates

Parameter	Existing (Greenfield) Discharge (l/s)	Proposed Discharge (l/s)
QBAR	6.13	NA
1 year	5.27	5
30 year	10.72	5
100 year	12.74	5
100 year +20%	NA	5

8.2.2 Site discharge should be as close to the greenfield rates as possible. This is achieved through attenuation and a hydrobrake to limit discharge from the site.

Attenuation Storage

8.2.3 In order to achieve the reduced discharge rates, surface water attenuation storage will be required. Storage estimates have been provided using FLOW and are included in Appendix A.

8.2.4 An estimated storage volume of 1200m³ will be required for the 1 in 100 year plus 20% Climate Change (CC) event.

8.2.5 The attenuation volumes are provided for indicative purposes only and should be verified at the detailed design stage.

8.3 *Exceedance Flooding and Overland Flow*

8.3.1 The drainage system has been designed to cater for the 1 in 100 year + 20% climate change storm. ie in this storm event all surface water will be collected on site and slowly released. Thus, the overland flow route will only be in use in the event of drainage network failure, storms in excess of the 1 in 100 year + 20% climate change storm or flows from offsite flowing through the site.

8.3.2 In the event of system failure all overland flow will move through the site and discharge into the River Tees. See overland flow drawing Appendix A.

8.4 *Consents, Offsite Works and Diversions*

8.4.1 The proposed surface water drainage strategy is accommodated mostly on-site, with the only requirement for off-site works being the connection to the River to EA approval or sewer to sewer owner approval.

8.5 *Maintenance*

8.5.1 A SuDS maintenance plan has been prepared to outline the management of the potential SuDS features. The maintenance plan is provided in Appendix F.

8.6 *Foul Drainage Design*

8.6.1 The foul drainage will connect to the existing sewers to the sewer owner approval.

8.7 *Flood Mitigation*

8.7.1 In order to minimise the impact of flooding during extreme storm events, the following should be applied where practical:

- Robust construction materials (engineering bricks)
- Raised electronic control units and sockets
- Use solid flooring (tiled, resin, concrete) at ground floor level
- Install smart air bricks or air brick covers
- Use non-hygroscopic renders, where applicable
- Use plastic and stainless steel fixtures and fittings.

9 Drainage during construction

9.1 *Construction Run-off Management*

9.1.1 Installing the surface water and foul drainage system, whilst managing temporary run-off, are key aspects of the construction works involved in any development. The information provided below is in accordance with the 'C698 Site handbook for the construction of SUDS' (CIRIA, 2007).

9.1.2 Please note that the measures recommended below are recommendations only and need to be confirmed at the construction stage by the client and the contractor.

9.2 *Management of Construction (Including Drainage)*

9.2.1 Drainage is typically an early activity in the construction stage of a development, taking form during the earthworks phase. However, final construction i.e. piped drainage system connections to the SuDS devices, should not take place until the end of site development work, unless a robust strategy for silt-removal is implemented prior to occupation of the site.

9.2.2 A plan for the management of construction (including phasing of works, details of any offsite works etc.) cannot be provided at this early stage, as construction work plans are not yet known. However, the following key points are general construction issues associated with SuDS which will be addressed when these plans are complete:

- Silt-laden waters from construction sites represent a common form of waterborne pollution;
- These silt-laden waters cannot enter SUDS drainage systems unless specifically designed to accept this as it can clog the systems and pollute receiving waters. Therefore, piped drainage systems should not be connected to the attenuation SuDS devices until the late stages of construction.
- Any gullies and piped systems should be capped off during construction and fully jetted and cleaned prior to connection to the attenuation SuDS devices.

9.3 *Temporary Drainage During Construction*

9.3.1 The three principal aspects of drainage control during construction are trapping sediment, conveying run-off, and controlling run-off.

9.3.2 Sediment traps and barriers can include basin traps and sediment fences (with any necessary boundary controls). The principal basins are to be installed after the construction site is accessed. Sediment fences and barriers will then be installed as needed during grading.

9.3.3 Conveyance of run-off can be achieved through small ditches/stream, storm drains, channels and sloped drains with sufficient inlet/outlet protection.

9.3.4 Slope stability needs to be considered when using any channels to convey run-off across the site into any basins etc.

9.3.5 Run-off control measures will need to be implemented in order not overwhelm the temporary system and cause flooding issues. Run-off rates from the site will be managed so they are no greater than pre-development or in keeping with the best practice guidance to minimise risk of blockage. Any additional conveyance measures are to be installed as needed during grading.

9.3.6 Run-off control to include provision of perimeter ditches or appropriate levels grading to direct any water from the construction site to remain on site.

9.3.7 Any necessary surface stabilisation measures are to be applied immediately on all disturbed areas where construction work is either delayed or incomplete.

9.3.8 Maintenance inspections are to be performed weekly, and maintenance repairs to be made immediately after periods of rainfall.

9.4 *Protection of Drainage Infrastructure during Construction*

9.4.1 All drainage infrastructure should be protected from damage by construction traffic and heavy machinery through the implementation of measures such as protective barriers, and storing construction materials away from the drainage infrastructure.

10 Residual Risk

10.1.1 It is difficult to completely guard against flooding since extreme events greater than the design standard event are always possible, however, it is practicable to minimise the risk by allowing a substantial freeboard (safety margin) and by using suitable construction and management techniques.

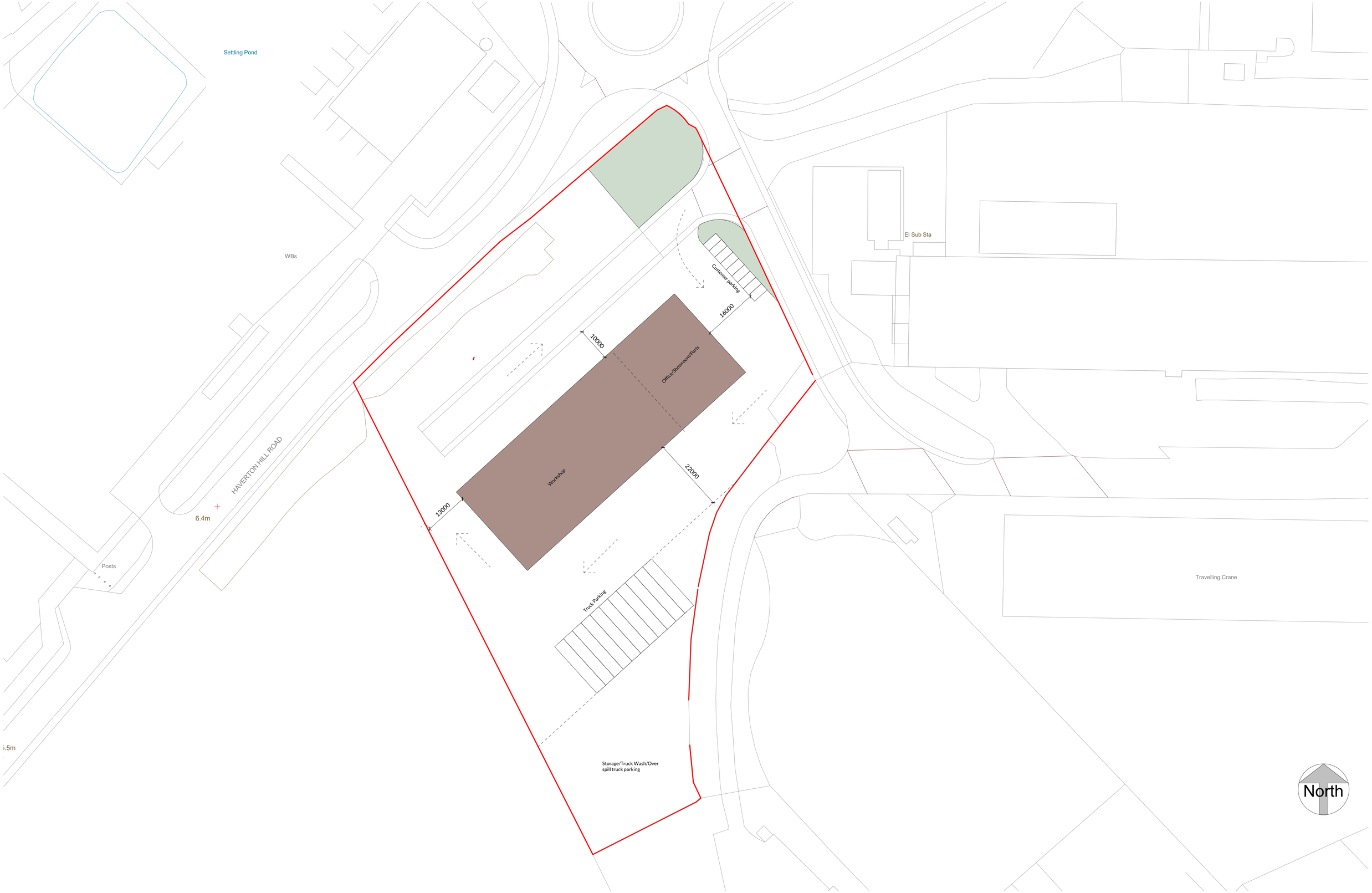
10.1.2 Finished floor levels will be set at least 300mm above the 1 in 100-year plus climate change flood level.

10.1.3 Safe access (Where possible dry access is preferred for such a route however a minimum standard of 'Low Hazard/Hazard for some' is acceptable) and egress routes for 'more vulnerable' users should be provided above the 1 in 1000-year breach flood level and lead to high ground outside the floodplain. The access road into the site will be set above the 1 in 100 year flood level and so safe access is provided.

10.1.4 As such, the residual risk is considered to be acceptable for the lifetime of the development.

Wallace Engineering
Consulting Engineers

Appendix A: Proposed Development Plans and calculations



NOTES:

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DO NOT SCALE - ALL DIMENSIONS TO BE VERIFIED ON SITE

REV	DESCRIPTION	BY	CHECK	DATE
P01	First Issue	BT	CB	28/10/2021

0m 10m 20m 30m 40m 50m

VISUAL SCALE 1:500 @ A1

STATUS: PRELIMINARY

PROJECT: Ford and Slater, DAF Haverton Hill Stockton

DESCRIPTION: Proposed Site Plan

AUTHOR: BT

SCALE - A1: 1 : 500

DATE: OCT 21

PROJECT NO. 29190

DRAWING NO. 1100

REV. P01

NORTH EAST STUDIO
Whickham, NE16 4PA
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YORKSHIRE STUDIO
Otley, LS21 3JP
0194 367 0003

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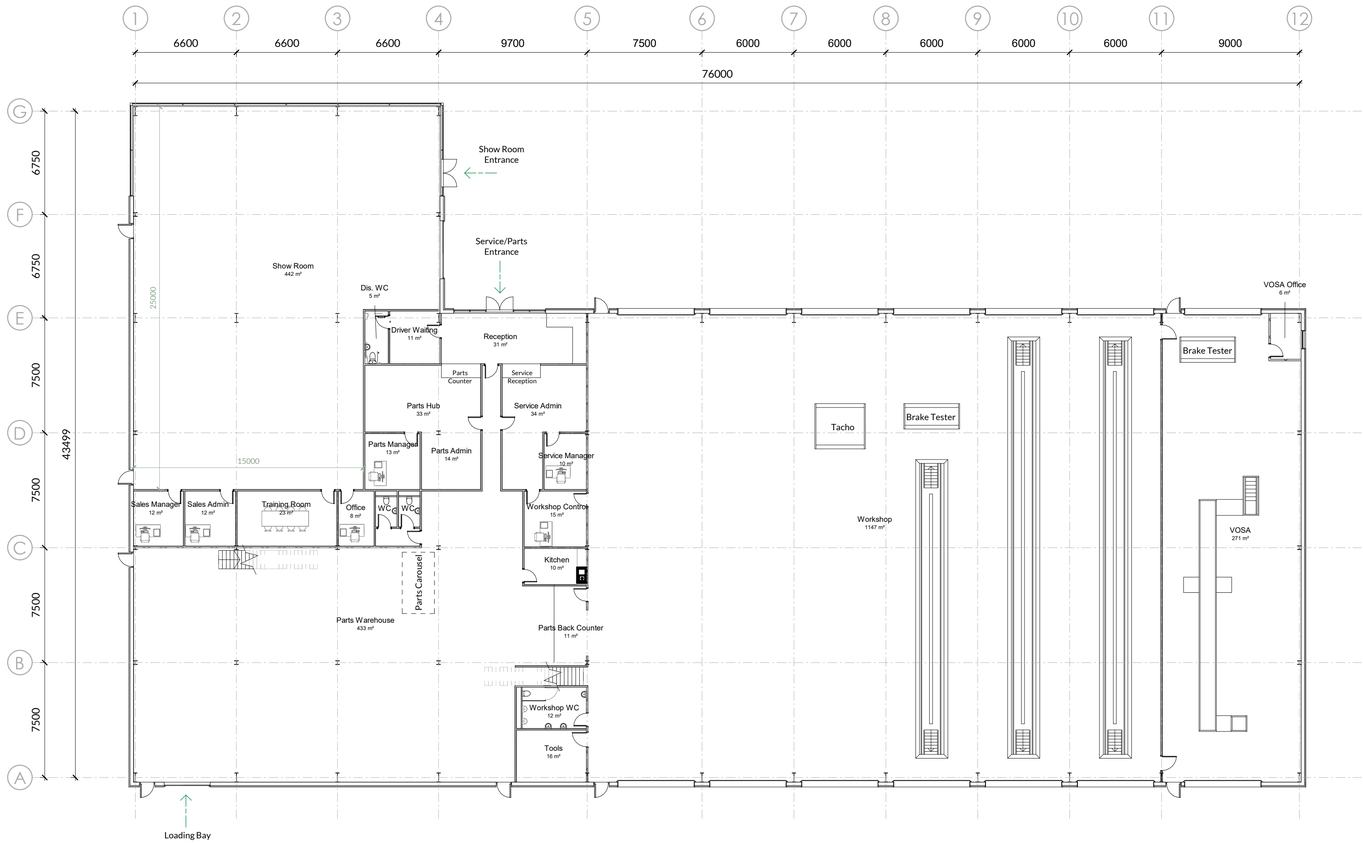
NICHOLSON NAIRN
ARCHITECTS



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DO NOT SCALE - ALL DIMENSIONS TO BE VERIFIED ON SITE

REV	DESCRIPTION	BY	CHECK	DATE
P01	First Issue	BT	CB	22/06/2021
P02	Revised following client comments	BT	CB	01/07/2021
P03	Layout amended to suit client comments	BT	CB	02/07/2021

0m 4m 8m 12m 16m 20m

VISUAL SCALE 1:200 @ A1

STATUS: PRELIMINARY

PROJECT: Ford and Slater, DAF

DESCRIPTION: Proposed Ground Floor Plan

AUTHOR: BT

SCALE - A1: 1 : 200

DATE: JUNE 21

PROJECT NO. 29190

DRAWING NO. 1110

REV. P03

NORTH EAST STUDIO
Whickham, NE16 4PA
0191 420 3090

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NICHOLSON NAIRN
ARCHITECTS

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	andrew wallace
Site name:	DAF
Site location:	Haverton Hill

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	54.59410° N
Longitude:	1.2546° W
Reference:	3211673598
Date:	Mar 30 2022 11:52

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 1.55

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics	Default	Edited
SAAR (mm):	590	590
Hydrological region:	3	3
Growth curve factor 1 year:	0.86	0.86
Growth curve factor 30 years:	1.75	1.75
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

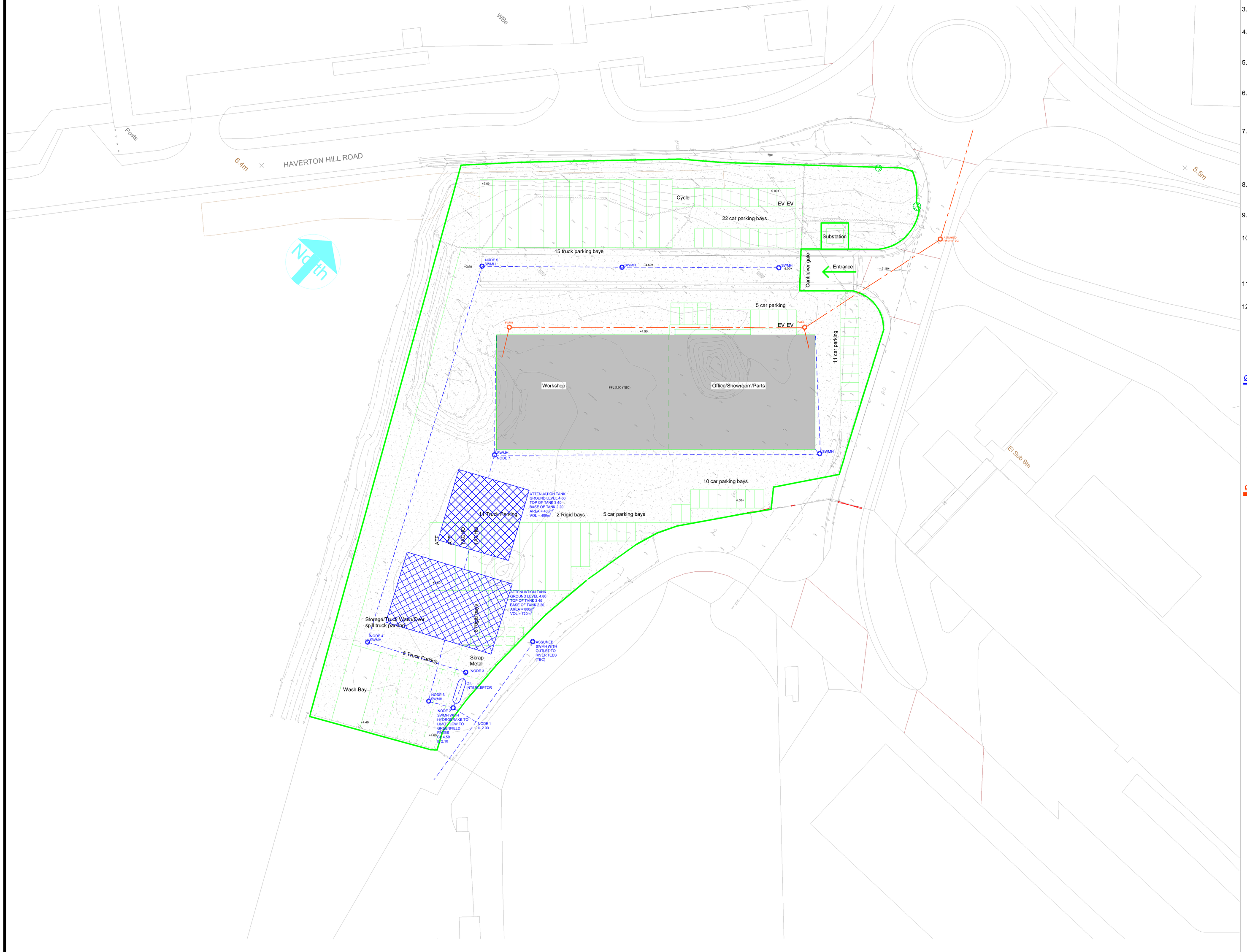
Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	6.13	6.13
1 in 1 year (l/s):	5.27	5.27
1 in 30 years (l/s):	10.72	10.72
1 in 100 year (l/s):	12.74	12.74
1 in 200 years (l/s):	14.52	14.52

ALL DIMENSIONS TO BE CHECKED BY CONTRACTOR



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4. ALL LEVELS, FINISHED FLOOR LEVELS (FFLS) AND FOUL AND SURFACE WATER DRAINAGE SHOWN ARE SUBJECT TO APPROVAL FROM THE ARCHAEOLOGIST
5. ANY DISCREPANCIES IN THE DETAILS SHOWN ARE TO BE REPORTED TO THE EMPLOYER'S REPRESENTATIVE/ENGINEER PRIOR TO CONSTRUCTION.
6. ALL EXISTING SERVICES ARE TO BE LOCATED PRIOR TO THE COMMENCEMENT OF ANY WORKS. THE CONTRACTOR MUST NOTIFY THE ENGINEER IMMEDIATELY OF ANY CONFLICT WITH THE PROPOSED WORKS.
7. THE GENERAL SPECIFICATION OF MATERIALS AND WORKMANSHIPS FOR THE CONSTRUCTION OF THE ACCESS ROAD, FOOTPATHS AND OTHER AREAS OF HARDSTANDING SHALL BE THE MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS, VOLUME 1, SPECIFICATION OF HIGHWAY WORKS (SHW) PUBLISHED BY THE STATIONARY OFFICE.
8. ALL RWP AND SVP SHOWN ARE INDICATIVE ONLY AND SUBJECT TO APPROVAL AND SETTING OUT BY THE ARCHITECT.
9. PIPES TO BE EXTRA STRENGTH VITRIFIED CLAYWARE TO BS EN 295 IN CLASS S BEDDING
10. MANHOLE COVERS TO BS EN 124
    ROADS/SERVICE YARDS - CLASS D400
    CARPARKS/KERBSIDE - CLASS C250
    FOOTWAYS/PEDESTRIAN AREAS - CLASS B125
    LANDSCAPING - CLASS A15
11. ALL PIPES TO BE LAID SOFFIT TO SOFFIT UNLESS STATED OTHERWISE.
12. UNLESS NOTED OTHERWISE, PIPES TO BE:
    FOUL PIPES UNDER BUILDING Ø100@1:40,
    FOUL PIPES EXTERNAL Ø100@1:80,
    SURFACE WATER PIPES Ø100@1:100

STORMWATER CONCEPT LEGEND

Ø100@1:100>	Stormwater Pipe - Diameter and fall
SWMH	Manhole type - SMH Surface Water
	Attenuation Tank
Ø150@1:100>	Foul Pipe - Diameter and fall
FWMH	Manhole type - FMH Foul Water
18.30x	Proposed Level
FFL 80.90	Finished floor level

Rev	Description			
A	PRELIMINARY	AW	AW	27.04.22

Engineer
Wallace Engineering
22 Park Rise
Harpenden

Developer
Ideal Design Solutions

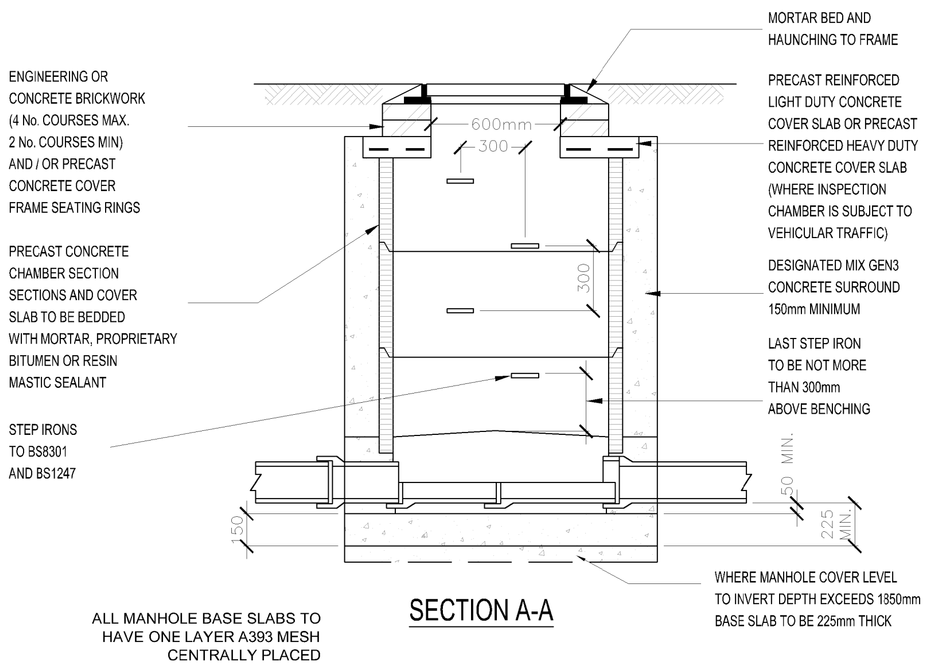
Project
Haverton Hill Rd,
Stockton on Tees

Title
CONCEPT DRAINAGE DESIGN AND FLOOD EXTENTS

Scale : A1	Drawn	Authorised
1:500	AW	FC

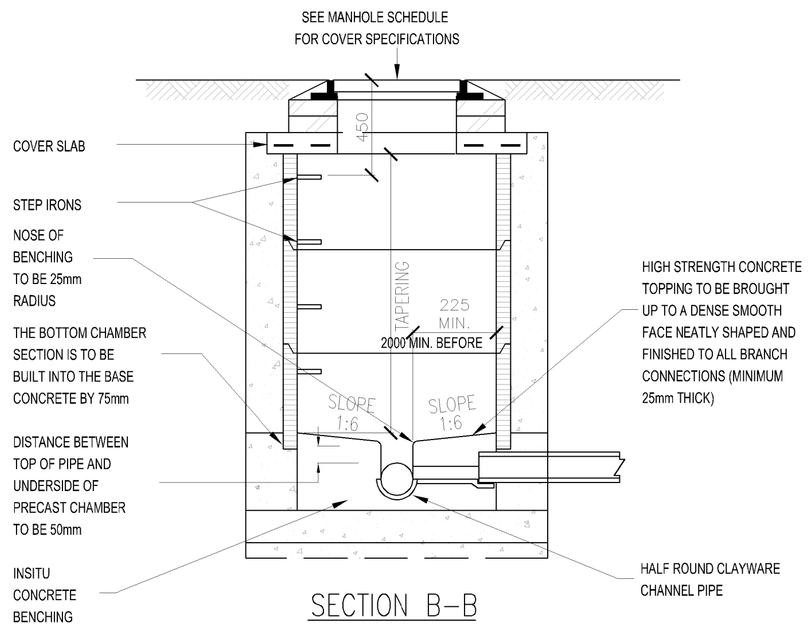
Job No	Drawing No	Revision
2373	C01	A

ALL DIMENSIONS TO BE CHECKED BY CONTRACTOR

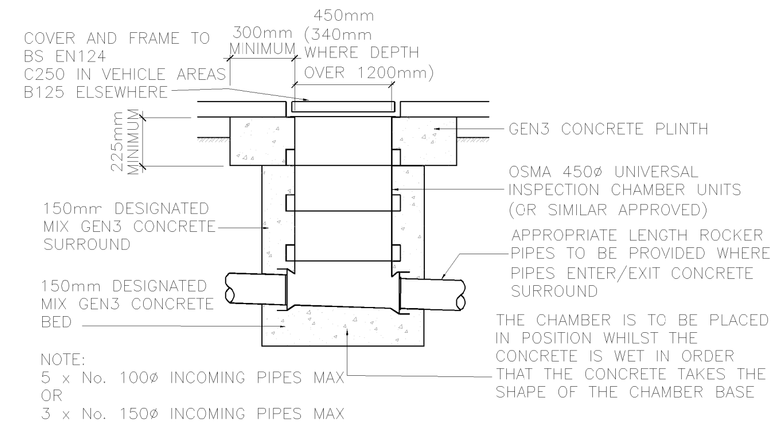


ALL MANHOLE BASE SLABS TO HAVE ONE LAYER A393 MESH CENTRALLY PLACED

SECTION A-A



SECTION B-B



EXTERNAL POLYPROPYLENE INSPECTION CHAMBER (PPIC)

MAXIMUM DEPTH TO INVERT OF CHAMBER TO BE 1200mm (3000mm FOR REDUCED ACCESS)

CUT TO INTERMEDIATE SIZES

SCALE 1:20

PRECAST CONCRETE MANHOLE TYPE B (PCC) IN EXTERNAL AREAS DETAIL

SCALE 1:20

NOTES

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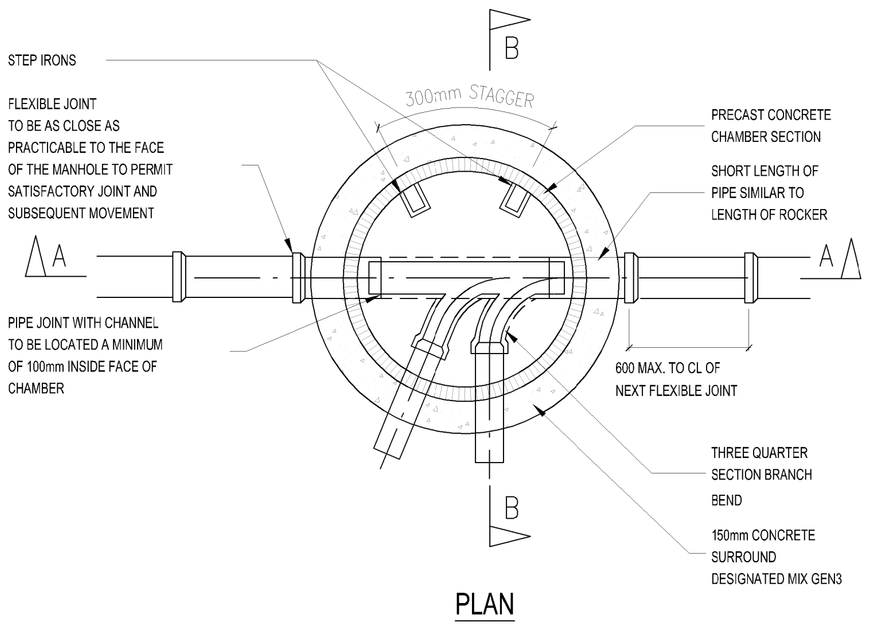
6. FOR GRAVITY SEWERS, ALL DRAINAGE AND FITTINGS ARE TO BE FLEXIBLY JOINTED UPVC TO BS EN 1401-1 OR CLAYWARE TO BS EN295 OR CONCRETE TO BS5911 PART 100
7. CHAMBER WALLS 225 THICK TO BE CONSTRUCTED IN CLASS B ENGINEERING BRICKS TO SHW SERIES 2400 IN DESIGNATION (i) MORTAR OR IN-SITU STRENGTH CLASS C16/20 CONCRETE TO CLAUSE 2602
8. CHAMBER WALLS AND COVER SLAB TO BE CONSTRUCTED IN PRECAST CONCRETE TO BS EN 1917 AND BS 5911-3.
9. CONCRETE MIXES INDICATED ON THIS DRAWING ARE DESIGNATED MIXES IN ACCORDANCE WITH BS8500-1:2006. ALL CONCRETE TO BE SULPHATE RESISTANT
10. BACKFILL TO ALL TRENCHES UNDER CARRIAGEWAYS TO BE TYPE 1 SUB-BASE MATERIAL, ELSEWHERE BACKFILL TO BE IN ACCORDANCE WITH THE SPECIFICATION, FREE DRAINING READILY COMPACTIBLE MATERIAL, FREE FROM RUBBISH AND ORGANIC MATTER, FROZEN SOIL CLAY LUMPS AND LARGE STONES. TO BE COMPACTED IN LAYERS NOT EXCEEDING 150mm THICK.
11. A FLEXIBLE JOINT SHALL BE PROVIDED AS CLOSE AS IS FEASIBLE TO OUTSIDE FACE OF ANY STRUCTURE INTO WHICH A PIPE IS BUILT, IN ACCORDANCE WITH THE DETAIL
12. THE GENERAL SPECIFICATION OF MATERIALS AND WORKMANSHIPS FOR THE CONSTRUCTION OF THE ACCESS ROAD, FOOTPATHS AND OTHER AREAS OF HARDSTANDING SHALL BE THE MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS, VOLUME 1. SPECIFICATION OF HIGHWAY WORKS (SHW) PUBLISHED BY THE STATIONARY OFFICE.
13. ALL PIPES TO BE LAID SOFFIT TO SOFFIT UNLESS NOTED OTHERWISE.
14. MANHOLE COVERS AND FRAMES SHALL COMPLY WITH BS EN124 AND SHALL BE OF A NON-ROCKING DESIGN WHICH DOES NOT RELY ON THE USE CF CUSHION INSERTS. CLASS D COVERS SHALL BE USED IN CARRIAGEWAYS, HARD SHOULDERS AND PARKING AREAS USED BY ALL TYPE OF ROAD VEHICLES. CLASS C SHALL BE USED IN FOOTWAYS, PEDESTRIAN AREAS AND ALL COMPARABLE LOCATIONS.

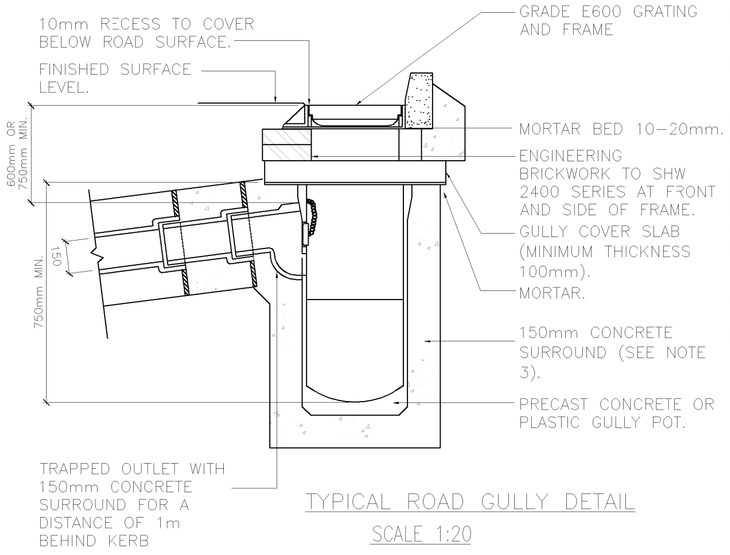


PLAN

NOTES:
CHAMBERS WITH OUTGOING PIPES GREATER THAN 500mm DIAMETER SHALL BE FITTED WITH GUARD BARS, SAFETY CHAINS OR OTHER SAFETY DEVICES. TOE HOLES TO BE PROVIDED IN BENCHING OF SEWERS GREATER THAN 450mm DIAMETER FOR ACCESS TO INVERT. WHERE INTERNAL HEIGHT EXCEEDS 1800mm MANHOLE MAY BE PROVIDED WITH REDUCING COVER AND SHAFT. SHAFT DIAMETER TO BE 600mm DIAMETER OR 900mm DIAMETER IF LONGER THAN 900mm.

PIPE DIAMETER	ROCKER PIPE * LENGTH
150mm-450mm	500mm-750mm
475mm-750mm	750mm-1000mm
OVER 750mm	1200mm

* OR LINTEL AND COMPRESSIBLE SEALANT IN ACCORDANCE WITH CLAUSE 689 OF THE SPECIFICATION.



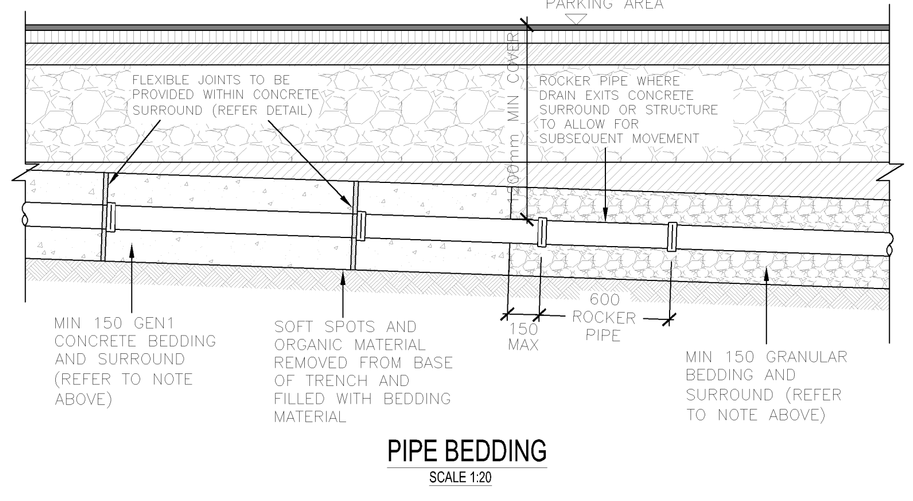
TYPICAL ROAD GULLY DETAIL

SCALE 1:20

NOTES:

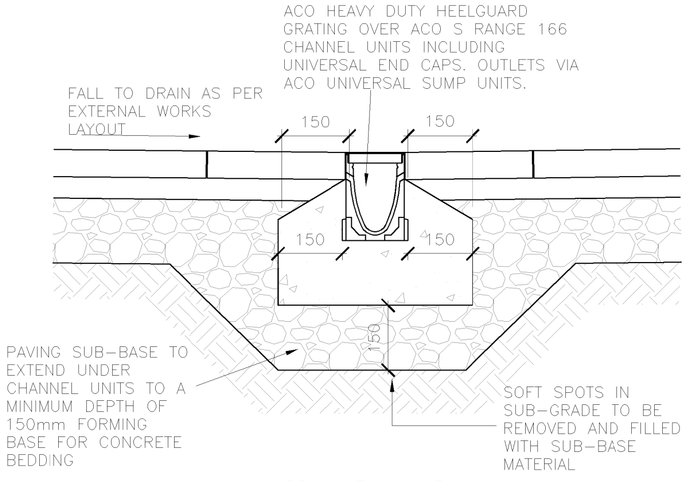
1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. THE MINIMUM DEPTH FROM THE TOP OF THE GRATING TO THE TOP OF THE GULLY OUTLET IS TO BE 750mm WHEN THE CONNECTING PIPE IS UNDER A CARRIAGEWAY, OR HARD SHOULDER AND 600mm ELSEWHERE.
3. PRECAST GULLY POTS SHOULD HAVE A BED AND SURROUNDING OF ST2 CONCRETE.

NOTE: A 150mm GEN1 CONCRETE SURROUND SHALL BE USED ON ALL PIPE WORK PASSING BELOW GROUND BEARING FOUNDATIONS (I.E. STRIP FOOTINGS FOR LANDSCAPING WALLS / PLANTERS). 150mm GEN1 CONCRETE SURROUND SHALL BE USED ON ALL PIPE WORK (EXCEPT LAND DRAINS) WHICH ARE LESS THAN 1200mm BELOW TRAFFICABLE PAVED AREAS AND LESS THAN 600mm IN ALL OTHER EXTERNAL AREAS. ALL PIPEWORK WITHIN BUILDING FOOTPRINT TO BE BEDDED ON GEN1 CONCRETE TO A DEPTH OF AT LEAST HALF THE PIPE DIAMETER



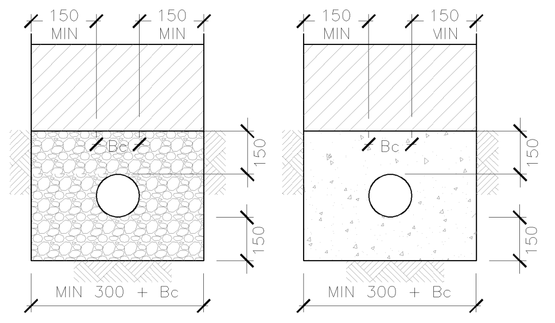
PIPE BEDDING

SCALE 1:20



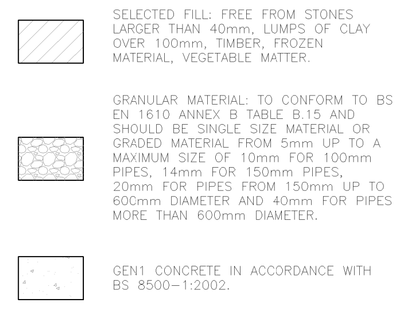
ACO DRAINAGE CHANNEL

SCALE 1:10



GENERAL PIPE BEDDING DETAIL

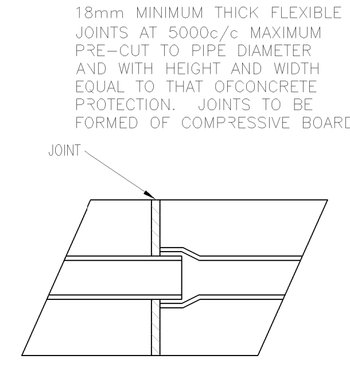
PIPE BEDDING DETAIL FOR ALL PIPES THAT PASS BELOW OR NEAR FOUNDATIONS. PIPES WITH LESS THAN 600mm COVER IN ALL EXTERNAL AREAS AND PIPES WITH LESS THAN 1200mm COVER BELOW ROADS AND DRIVEWAYS



NOTE:
PIPES LESS THAN 1200mm BELOW ROADS AND LESS THAN 600mm BELOW OTHER EXTERNAL AREAS SHALL HAVE A 150mm GEN1 CONCRETE SURROUND. OTHER THAN PIPES CAST WITHIN PILECAPS ALL PIPES BELOW SUSPENDED SLAB SHALL HAVE GRANULAR SURROUND AS SHOWN.

PIPE BEDDING DETAIL

SCALE 1:10



FLEXIBLE JOINTS IN CONCRETE PROTECTION

SCALE 1:10

Rev	Description

Engineer
Wallace Engineering
22 Park Rise
Harpenden

Developer
Ideal Design Solutions

Project
Haverton Hill Rd,
Stockton on Tees

Title
Construction Details 1 of 2

Scale : A1	Drawn	Authorised
NTS	AW	FC

Job No	Drawing No	Revision
2373	C02	-

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11. A FLEXIBLE JOINT SHALL BE PROVIDED AS CLOSE AS IS FEASIBLE TO OUTSIDE FACE OF ANY STRUCTURE INTO WHICH A PIPE IS BUILT, IN ACCORDANCE WITH THE DETAIL
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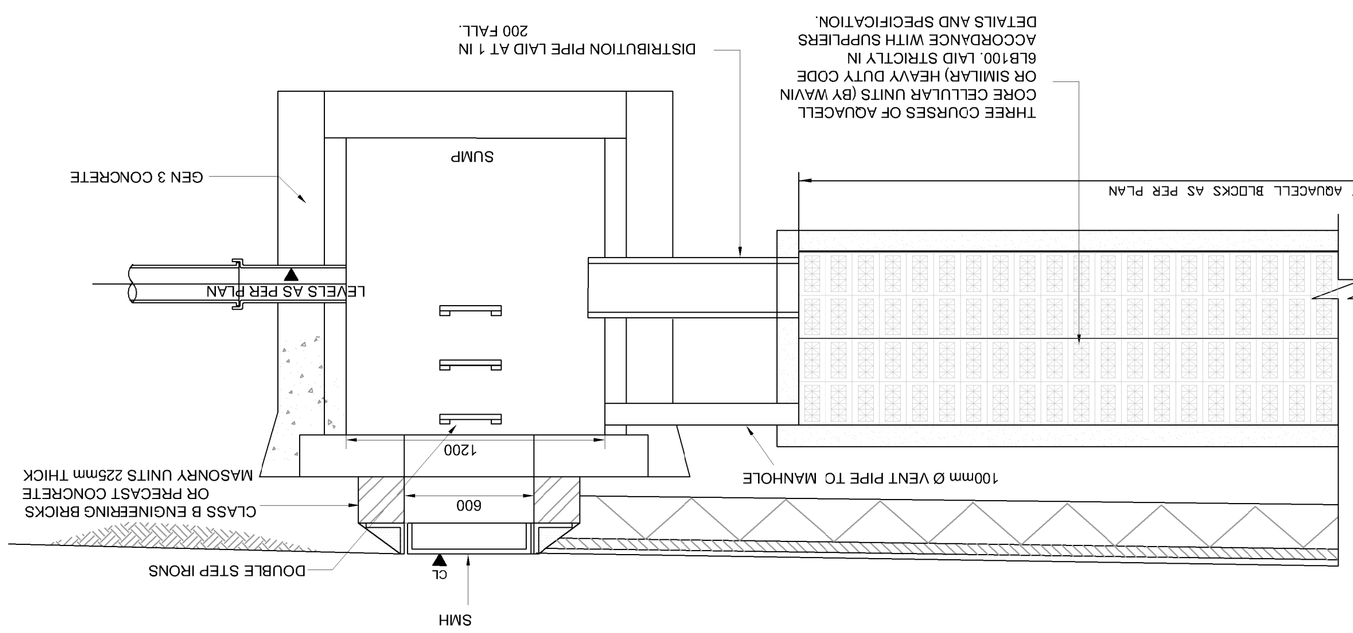
ATTENUATION TANK SYSTEM

SCALE 1:20



Rev	Description

Engineer

Wallace Engineering
22 Park Rise
Harpenden

Developer

Ideal Design Solutions

Project

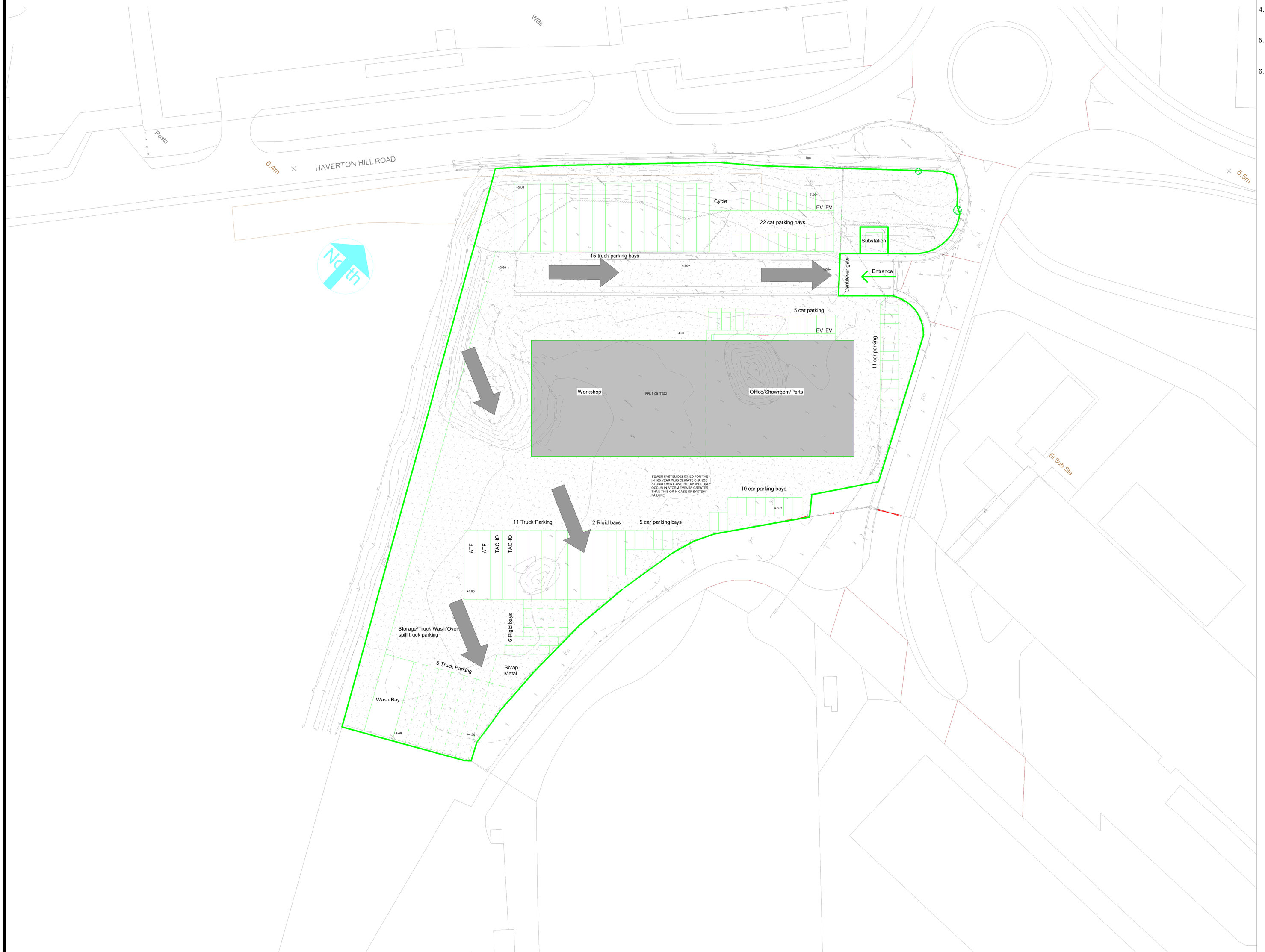
Haverton Hill Rd,
Stockton on Tees

Title

Construction Details 2 of 2

Scale : A1	Drawn	Authorised
NTS	AW	FC
Job No	Drawing No	Revision
2373	C03	-

ALL DIMENSIONS TO BE CHECKED BY CONTRACTOR



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STORMWATER CONCEPT LEGEND

18.30x	Proposed Level
FFL 80.90	Finished floor level
←	Overland flow

Rev	Description			
A	FOR APPROVAL	AW	AW	27.04.22

Engineer

Wallace Engineering
22 Park Rise
Harpenden

Developer

Ideal Design Solutions

Project

Haverton Hill Rd,
Stockton on Tees

Title

Overland Flow Plan

Scale : A1	Drawn	Authorised
1:500	AW	FC

Job No	Drawing No	Revision
2373	C04	A

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	40	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.000
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	2.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1			4.600	1800	50.000	50.000	2.600
2	0.250	2.00	4.500	1800	40.000	50.000	2.400
3	0.250	2.00	4.500	1800	40.000	60.000	2.000
4	0.250	2.00	4.600	1800	10.000	70.000	1.800
5	0.250	2.00	4.800	1800	30.000	160.000	1.500
6	0.300	2.00	4.800	1800	35.000	50.000	2.300
7	0.300	2.00	4.800	1800	40.000	90.000	1.800

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.003	2	1	10.000	0.600	2.100	2.000	0.100	100.0	300	3.22	50.0
1.002	3	2	10.000	0.600	2.500	2.100	0.400	25.0	600	3.11	50.0
1.001	4	3	31.623	0.600	2.800	2.500	0.300	105.4	600	3.08	50.0
1.000	5	4	92.195	0.600	3.300	2.800	0.500	184.4	600	2.86	50.0
2.001	6	2	5.000	0.600	2.500	2.100	0.400	12.5	600	2.26	50.0
2.000	7	6	40.311	0.600	3.000	2.500	0.500	80.6	600	2.25	50.0

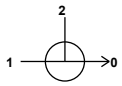
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.003	1.572	111.1	303.6	2.100	2.300	1.600	0.0
1.002	4.883	1380.6	142.3	1.400	1.800	0.750	0.0
1.001	2.371	670.5	94.9	1.200	1.400	0.500	0.0
1.000	1.790	506.0	47.4	0.900	1.200	0.250	0.0
2.001	6.911	1954.0	113.8	1.700	1.800	0.600	0.0
2.000	2.713	767.2	56.9	1.200	1.700	0.300	0.0

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.003	10.000	100.0	300	Circular	4.500	2.100	2.100	4.600	2.000	2.300
1.002	10.000	25.0	600	Circular	4.500	2.500	1.400	4.500	2.100	1.800
1.001	31.623	105.4	600	Circular	4.600	2.800	1.200	4.500	2.500	1.400
1.000	92.195	184.4	600	Circular	4.800	3.300	0.900	4.600	2.800	1.200
2.001	5.000	12.5	600	Circular	4.800	2.500	1.700	4.500	2.100	1.800
2.000	40.311	80.6	600	Circular	4.800	3.000	1.200	4.800	2.500	1.700

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.003	2	1800	Manhole	Adoptable	1	1800	Manhole	Adoptable
1.002	3	1800	Manhole	Adoptable	2	1800	Manhole	Adoptable
1.001	4	1800	Manhole	Adoptable	3	1800	Manhole	Adoptable
1.000	5	1800	Manhole	Adoptable	4	1800	Manhole	Adoptable
2.001	6	1800	Manhole	Adoptable	2	1800	Manhole	Adoptable
2.000	7	1800	Manhole	Adoptable	6	1800	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
1	50.000	50.000	4.600	2.600	1800		1	1.003	2.000	300
2	40.000	50.000	4.500	2.400	1800		1	2.001	2.100	600
							2	1.002	2.100	600
							0	1.003	2.100	300
3	40.000	60.000	4.500	2.000	1800		1	1.001	2.500	600
							0	1.002	2.500	600
4	10.000	70.000	4.600	1.800	1800		1	1.000	2.800	600
							0	1.001	2.800	600
5	30.000	160.000	4.800	1.500	1800		0	1.000	3.300	600
6	35.000	50.000	4.800	2.300	1800		1	2.000	2.500	600
							0	2.001	2.500	600
7	40.000	90.000	4.800	1.800	1800		0	2.000	3.000	600

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	✓
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
10	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Node 2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	2.100	Product Number	CTL-SHE-0098-5000-1500-5000
Design Depth (m)	1.500	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.0	Min Node Diameter (mm)	1200

Node 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.200
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1000.0	0.0	1.010	1.0	0.0	1.200	1000.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 97.14%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	1	2.000	0.000	4.6	0.0000	0.0000	OK
360 minute winter	2	352	2.530	0.430	41.5	264.8784	0.0000	SURCHARGED
15 minute summer	3	9	2.665	0.165	172.8	0.8333	0.0000	OK
15 minute summer	4	9	2.977	0.177	120.2	0.9412	0.0000	OK
15 minute summer	5	9	3.436	0.136	60.6	0.7998	0.0000	OK
15 minute summer	6	9	2.634	0.134	145.4	0.6902	0.0000	OK
15 minute summer	7	9	3.126	0.126	72.6	0.7408	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	2	Hydro-Brake®	1	4.9				160.4
15 minute summer	3	1.002	2	169.6	2.771	0.123	0.6258	
15 minute summer	4	1.001	3	112.2	1.792	0.167	2.0912	
15 minute summer	5	1.000	4	59.6	1.022	0.118	5.4008	
15 minute summer	6	2.001	2	146.3	2.828	0.075	0.2657	
15 minute summer	7	2.000	6	72.8	1.623	0.095	1.8087	

Results for 10 year Critical Storm Duration. Lowest mass balance: 97.14%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	1	2.000	0.000	4.8	0.0000	0.0000	OK
600 minute winter	2	585	2.823	0.723	62.3	413.4880	0.0000	SURCHARGED
600 minute winter	3	585	2.825	0.325	44.2	1.6379	0.0000	OK
15 minute summer	4	9	3.025	0.225	181.5	1.1973	0.0000	OK
15 minute summer	5	9	3.468	0.168	90.6	0.9893	0.0000	OK
600 minute winter	6	585	2.824	0.324	20.9	1.6704	0.0000	OK
15 minute summer	7	9	3.155	0.155	108.7	0.9111	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute winter	2	Hydro-Brake®	1	4.9				218.8
600 minute winter	3	1.002	2	-30.2	0.313	-0.022	2.1864	
15 minute summer	4	1.001	3	173.0	1.952	0.258	2.9494	
15 minute summer	5	1.000	4	90.9	1.133	0.180	7.4256	
600 minute winter	6	2.001	2	42.5	0.266	0.022	1.0925	
15 minute summer	7	2.000	6	108.8	1.745	0.142	2.5131	

Results for 30 year Critical Storm Duration. Lowest mass balance: 97.14%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	1	2.000	0.000	4.9	0.0000	0.0000	OK
720 minute winter	2	705	3.336	1.236	84.0	526.4177	0.0000	SURCHARGED
720 minute winter	3	705	3.336	0.836	39.8	4.2194	0.0000	SURCHARGED
720 minute winter	4	705	3.336	0.536	13.8	2.8546	0.0000	OK
15 minute summer	5	9	3.491	0.191	115.0	1.1223	0.0000	OK
720 minute winter	6	705	3.336	0.836	30.0	4.3097	0.0000	SURCHARGED
720 minute winter	7	705	3.336	0.336	8.2	1.9769	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
720 minute winter	2	Hydro-Brake®	1	4.9				243.8
720 minute winter	3	1.002	2	77.8	0.382	0.056	2.8168	
720 minute winter	4	1.001	3	13.7	1.048	0.020	8.6566	
15 minute summer	5	1.000	4	116.1	1.197	0.229	8.9716	
720 minute winter	6	2.001	2	54.7	0.392	0.028	1.4084	
720 minute winter	7	2.000	6	8.2	0.967	0.011	8.9532	

Results for 100 year Critical Storm Duration. Lowest mass balance: 97.14%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	1	2.000	0.000	4.9	0.0000	0.0000	OK
720 minute winter	2	705	3.545	1.445	95.7	715.5101	0.0000	SURCHARGED
720 minute winter	3	705	3.545	1.045	62.9	5.2722	0.0000	SURCHARGED
720 minute winter	4	705	3.545	0.745	17.6	3.9651	0.0000	SURCHARGED
720 minute winter	5	705	3.545	0.245	8.8	1.4403	0.0000	OK
720 minute winter	6	705	3.545	1.045	42.8	5.3850	0.0000	SURCHARGED
720 minute winter	7	705	3.545	0.545	10.6	3.2036	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
720 minute winter	2	Hydro-Brake®	1	4.9				258.1
720 minute winter	3	1.002	2	73.9	0.309	0.054	2.8168	
720 minute winter	4	1.001	3	17.6	1.088	0.026	8.9075	
720 minute winter	5	1.000	4	8.8	0.603	0.017	17.9705	
720 minute winter	6	2.001	2	19.8	0.227	0.010	1.4084	
720 minute winter	7	2.000	6	11.9	0.986	0.015	11.0971	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 97.14%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	1	2.000	0.000	4.9	0.0000	0.0000	OK
960 minute winter	2	945	3.932	1.832	180.0	1084.6840	0.0000	SURCHARGED
960 minute winter	3	945	3.932	1.432	50.1	7.2232	0.0000	SURCHARGED
960 minute winter	4	945	3.932	1.132	20.2	6.0231	0.0000	SURCHARGED
960 minute winter	5	945	3.932	0.632	9.8	3.7134	0.0000	SURCHARGED
960 minute winter	6	945	3.932	1.432	23.5	7.3778	0.0000	SURCHARGED
960 minute winter	7	945	3.932	0.932	11.8	5.4768	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute winter	2	Hydro-Brake®	1	5.5				347.9
960 minute winter	3	1.002	2	105.8	0.518	0.077	2.8168	
960 minute winter	4	1.001	3	20.9	1.030	0.031	8.9075	
960 minute winter	5	1.000	4	9.8	0.602	0.019	25.9692	
960 minute winter	6	2.001	2	65.9	0.364	0.034	1.4084	
960 minute winter	7	2.000	6	11.7	0.951	0.015	11.3547	

Appendix B: Location Plan

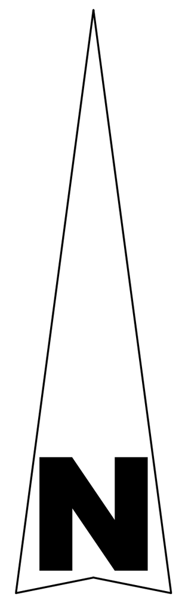
TS23 1PY

Stockton-on-Tees
Billingham
Postcode

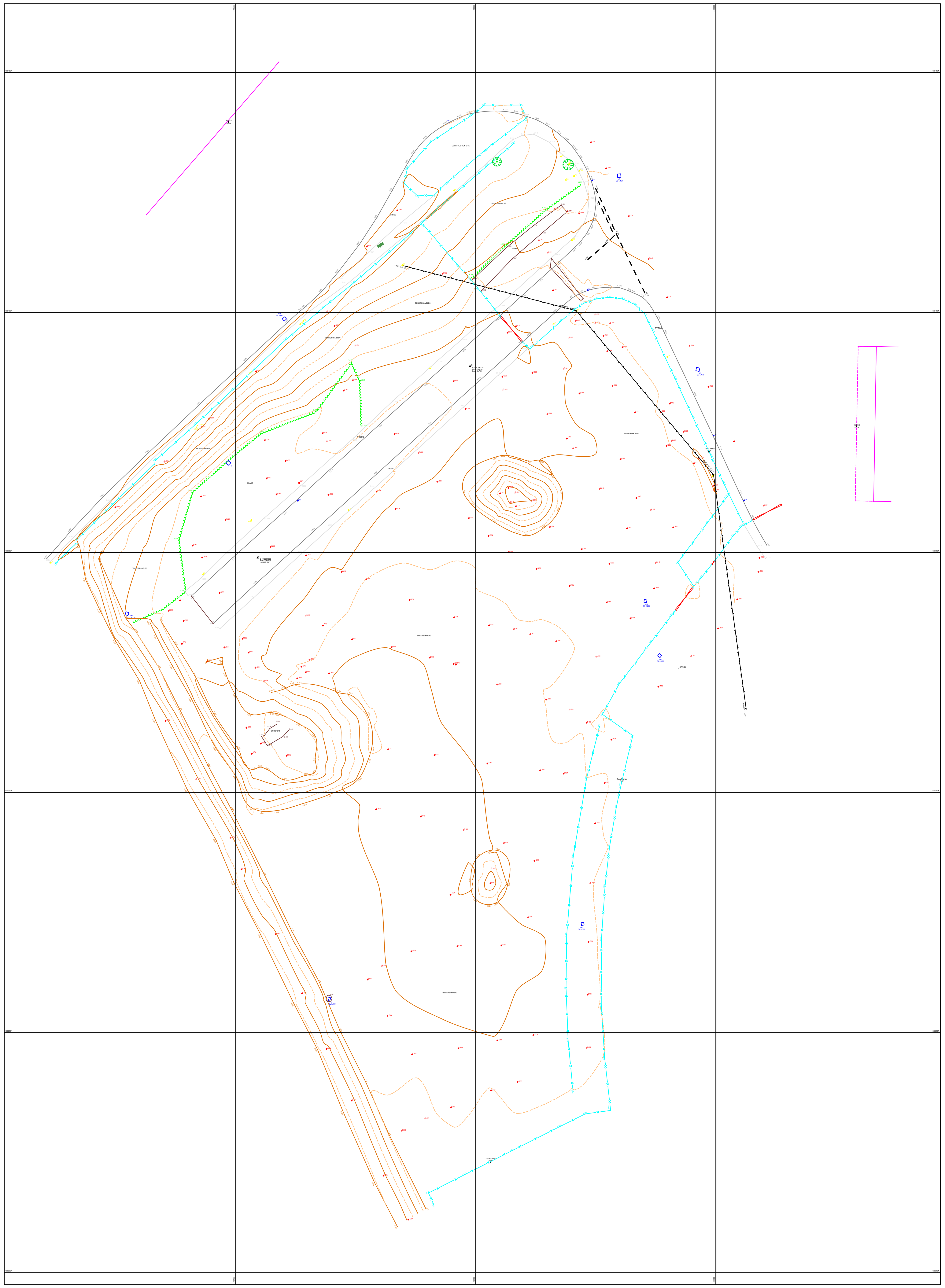
Haze · 9°C
12:54

Directions | Save | Nearby | Send to your phone | Share

Appendix C: Topographic Survey



APPROXIMATE NATIONAL GRID NORTH, BASED ON TRIMBLE OSTN15 SYSTEM



KEY

LINETYPES

- VERGE
- FENCE - CHAIN LINK
- FENCE - METAL
- FENCE - WOODEN
- FENCE - POST & RAIL
- HEDGE
- WALL
- BARRIER
- CHANNEL LINE
- CONCRETE EDGE
- FOOTPATH
- TRACK
- BUILDING
- TREE
- GATE
- SURVEY STATION
- EAVES

UTILITY KEY

LINETYPES

- BT BELOW GROUND
- BT ABOVE GROUND
- BT ASSUMED ROUTE
- CATV BELOW GROUND
- CATV ABOVE GROUND
- CATV ASSUMED ROUTE
- COMMS BELOW GROUND
- COMMS ABOVE GROUND
- COMMS ASSUMED ROUTE
- GAS BELOW GROUND
- GAS ABOVE GROUND
- GAS ASSUMED ROUTE
- ELECTRIC BELOW GROUND
- ELECTRIC ABOVE GROUND
- ELECTRIC ASSUMED ROUTE
- WATER BELOW GROUND
- WATER ABOVE GROUND
- WATER ASSUMED ROUTE
- UNKNOWN BELOW GROUND
- UNKNOWN ABOVE GROUND
- GPR BELOW GROUND
- COMBINED WATER SEWER
- ASSUMED COMBINED WATER SEWER ROUTE
- FOUL WATER SEWER
- ASSUMED FOUL WATER SEWER ROUTE
- STORM WATER SEWER
- ASSUMED STORM WATER SEWER ROUTE
- REINSTATEMENT SCAR
- SURVEY BOUNDARY

ABBREVIATIONS

(AC)	ASSUMED CONNECTION	INT	INTERCEPTOR
A/G	ABOVE GROUND	KV	KILO VOLT
(AR)	ASSUMED ROUTE	LD	LOOP DETECTOR
ASB	ASBESTOS CEMENT	LH	LAMP HOLE
AV	AIR VALVE	LP	LAMP POST
BB	BELISHA BEACON	LV	LOW VOLTAGE
BD	BACK DROP	MK	MARKER
BL	BASE LEVEL	MH	MANHOLE
BO	BOLLARD	MT	METER
BOL	BOLLARD LIGHT	M/WELL	MONITORING WELL
BT	BRITISH TELECOM	O/H	OVERHEAD
CATV	CABLE TELEVISION	PE	POLYETHYLENE
CB	CONTROL BOX	PTG	PIPE TO GROUND
CI	CAST IRON	PVC	POLYVINYL CHLORIDE
CL	COVER LEVEL	TFR	TAKEN FROM RECORDS
CR	CABLE RISER	RE	RODDING EYE
CWS	COMBINED WATER SEWER	RED	REDUNDANT SERVICE
d	DEPTH OF SERVICE	RWP	RAIN WATER PIPE
DCH	DRAINAGE CHANNEL	SC	STOP COCK
DI	DUCTILE IRON	SI	SPUN IRON
DIS	DISUSED	SOF	SOFFIT
EOT	END OF TRACE	SP	SOIL PIPE
EP	ELECTRIC POLE	SWS	SURFACE WATER SEWER
ER	EARTH ROD	SV	STOP VALVE
FFP	FUEL TANK FILL POINT	TL	TRAFFIC LIGHT
FH	FIRE HYDRANT	TLC	TRAFFIC LIGHT COVER
FWS	FOUL WATER SEWER	TP	TELECOM POLE
GPR	GROUND PENETRATING RADAR	UTL	UNABLE TO LIFT
GR	GAS RISER	UTS	UNABLE TO SURVEY
GV	GAS VALVE	UTT	UNABLE TO TRACE
GY	GULLY	VC	VITRIFIED CLAY
HV	HIGH VOLTAGE	VP	VENT PIPE
IC	INSPECTION COVER	WL	WATER LEVEL
Id	INVERT DEPTH	WO	WASH OUT
IL	INVERT LEVEL	WR	WATER RISER

DISCLAIMER

Unless otherwise stated, all services shown on this plan have been surveyed using approved detectors and the connections between manholes, if not traced, are assumed to be direct.

No guarantee can be given that all services have been shown.
In ideal conditions the depth accuracies for the underground utilities located is +/- 10% of depth.

Utilities traced using GPR techniques show depths approximately from ground level to the top of the utility. Utilities traced using Electromagnetic techniques provide an estimated depth which is measured from ground level to the centre of the utility. Drainage and pipes traced using Sonde Electromagnetic techniques show depths at approximately the Invert Level.

Where services are shown as 'Taken From Records' on the drawing we are not liable for any loss that may arise due to a lack of accuracy in that guided information.

Due to BT's policy we are not permitted to lift their inspection chamber covers.

Reference should be made to the methodology used on site as detailed within the latest version of SiteScan Procedures for Utility Location Surveys.

SiteScan recommend that all excavations are to be carried out in accordance with HSG 47 (Avoiding Danger from Underground Services).

Plan accuracies of the order of + or - 150mm may be achieved but this figure will depend on the depth of the service below ground level. Where similar services run in close proximity, separation may be impossible. Successful tracing of non-metallic pipes may be limited.

Existing record information showing underground services is often incomplete and of doubtful accuracy. It should be regarded only as an indication and cannot be guaranteed.

NOTES

REV	AMENDMENT	DRAWN	CHECKED
A	INITIAL RELEASE	NP	NG

SUITE 5 VITA HOUSE
FISH QUAY
NORTH SHIELDS
NE30 1JA
T: 0191 257 2911
www.sitescanltd.com

SiteScan
Information to build on

CLIENT: JJ DESIGN & BUILD

PROJECT TITLE: LAND OFF HAVERTON HILL ROAD STOCKON ON TEES

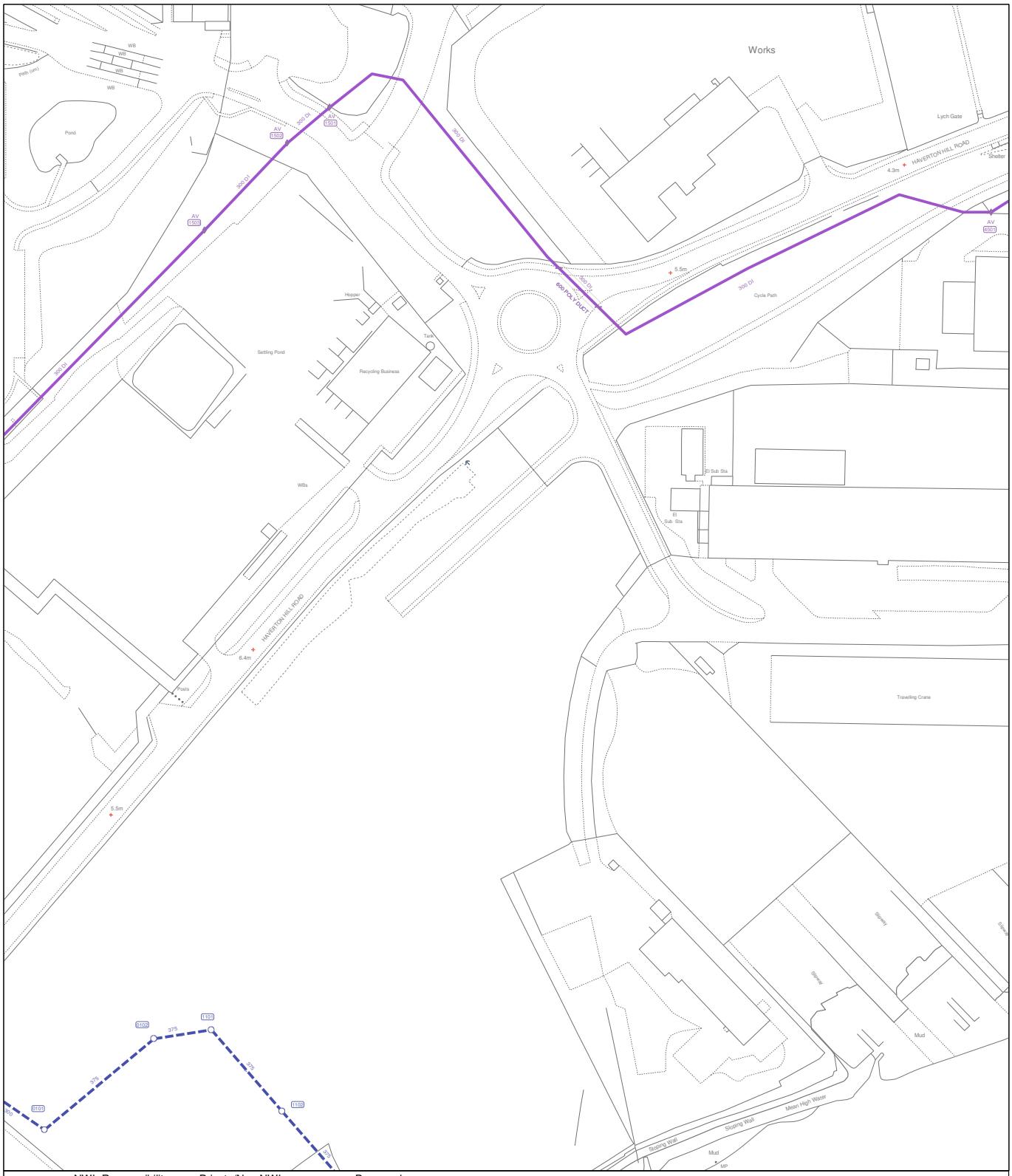
DRAWING TITLE: TOPOGRAPHICAL SURVEY

SCALE AT A1	DATE	GRID/DATUM
1:500 @ A1	21.03.22	OSTN15

SURVEYED BY	APPROVED
NP	NG

PROJECT No.	SHEET No.	REV
P22053	1/1	A

Appendix D: Sewer Records



NWL Responsibility

Combined	
Foul	
Surface	
Treated Eff	
Untreated Eff	
Overflow	

Private/Non NWL

Combined	
Foul	
Surface	
Treated Eff	
Trade Eff	
Watercourse	

Proposed

Combined	
Foul	
Surface	

Annotations

- Direction of flow
- Backdrop
- Abandoned
- Rising Main

Symbols

- Chambers
- Inlet/Outlet
- Treatment Works (STW)
- Pumping Station
- Capped End
- Balancing Pond
- Termination Node
- Rodding Eye
- Unknown End
- Attribute Change
- Air Valve
- Property Connection
- Lamp Hole
- Hatchbox
- Dual Usage Chamber

NORTHUMBRIAN WATER living water

User : DAWSJ1

Date : 01/04/2022

Title : 0000

Centre Point : 448243,522347

Map Sheet : NZ4822SW

25 m

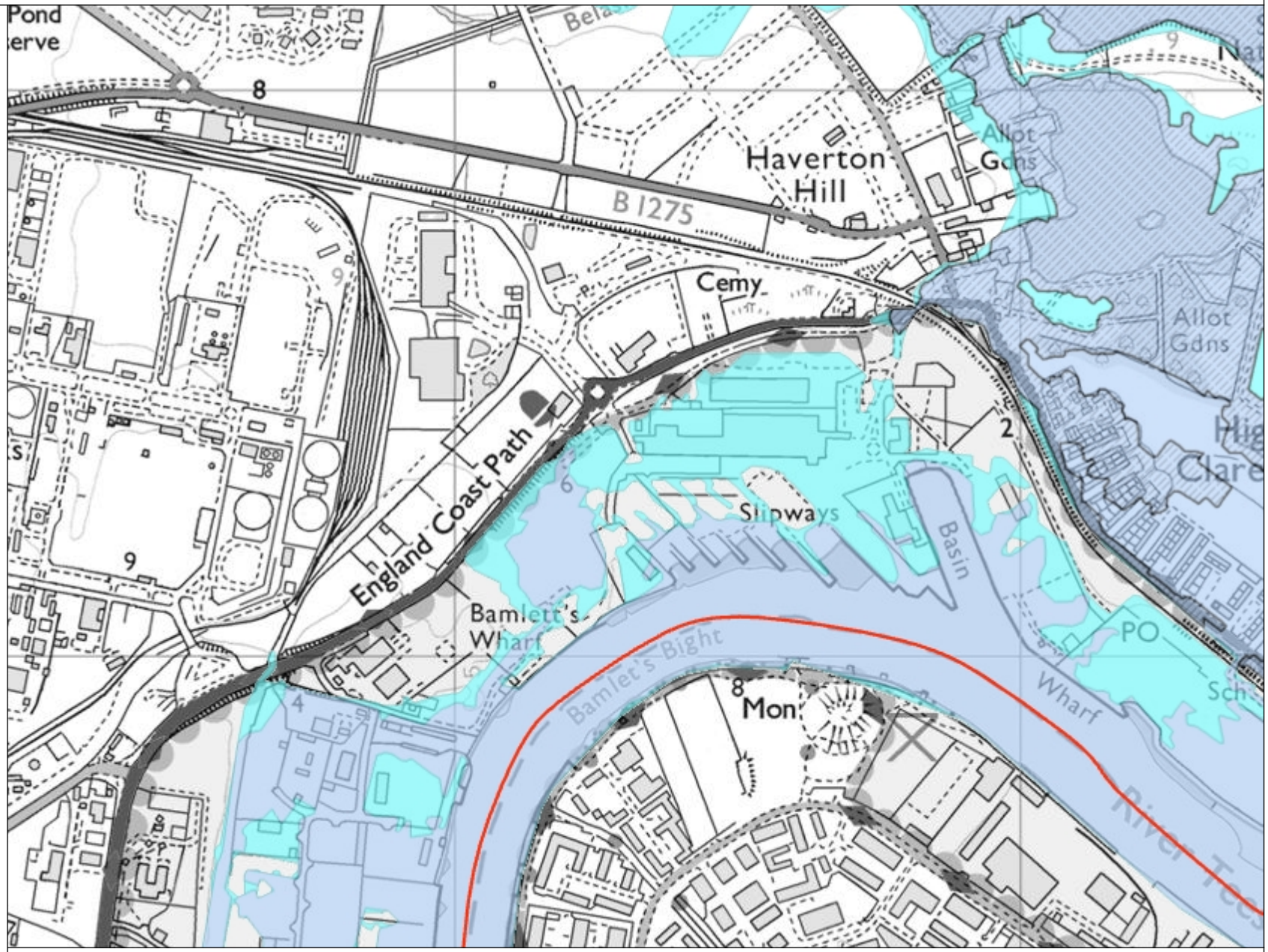
Appendix E: EA Mapping

Flood Map for Planning

Environment Agency

Legend

- Statutory Main Rivers
- Defences
- Flood Storage Areas
- Areas benefiting from flood defence
- Flood Zone 3
- Flood Zone 2



1: 10,000

0 250

Metres

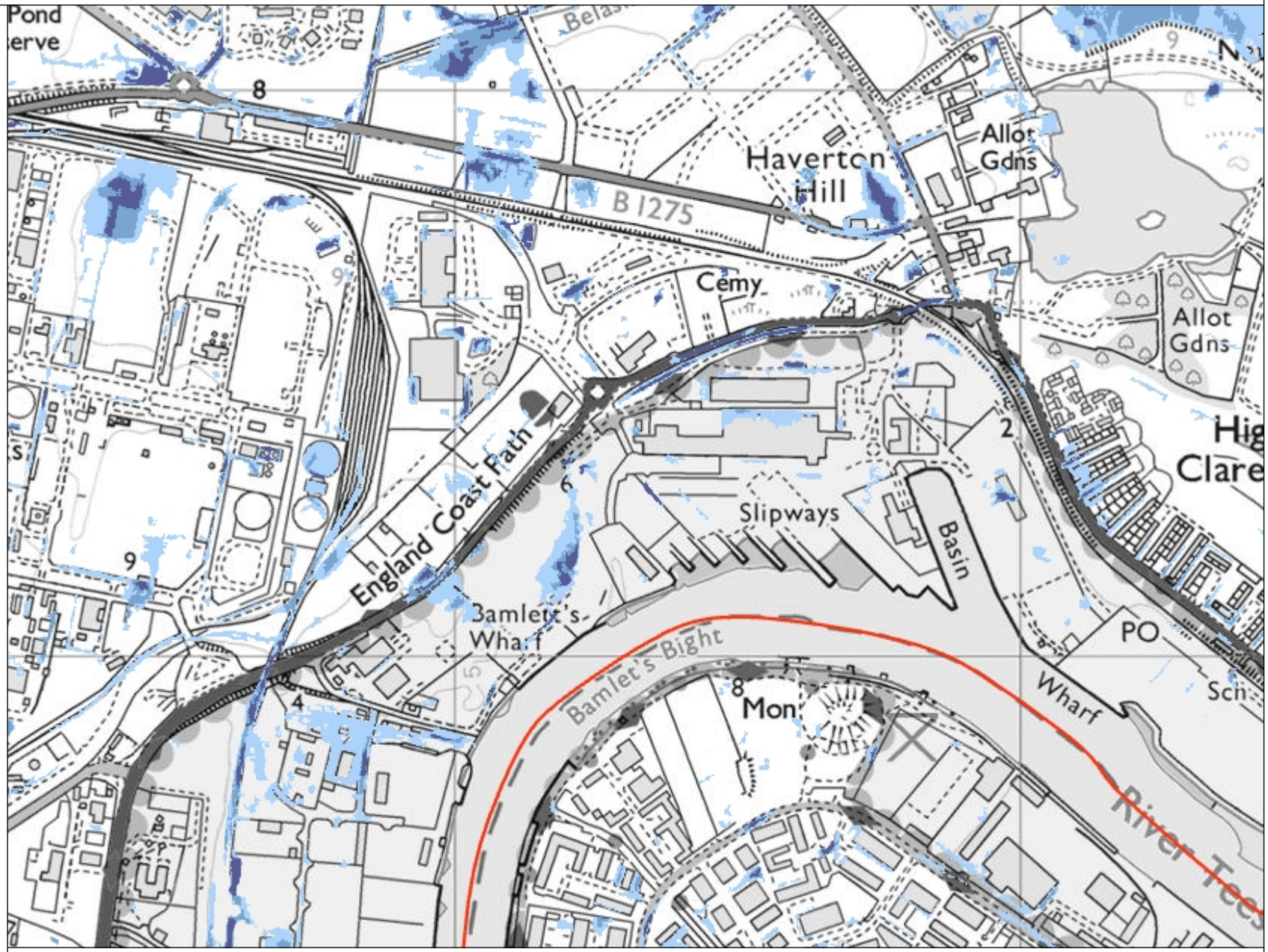
N W E S

Surface Water Flood Risk

Environment Agency

Legend

- Statutory Main Rivers
- Flood Extent 1 in 30
- Flood Extent 1 in 100
- Flood Extent 1 in 1000



1: 10,000

0 250

Metres

N W E S

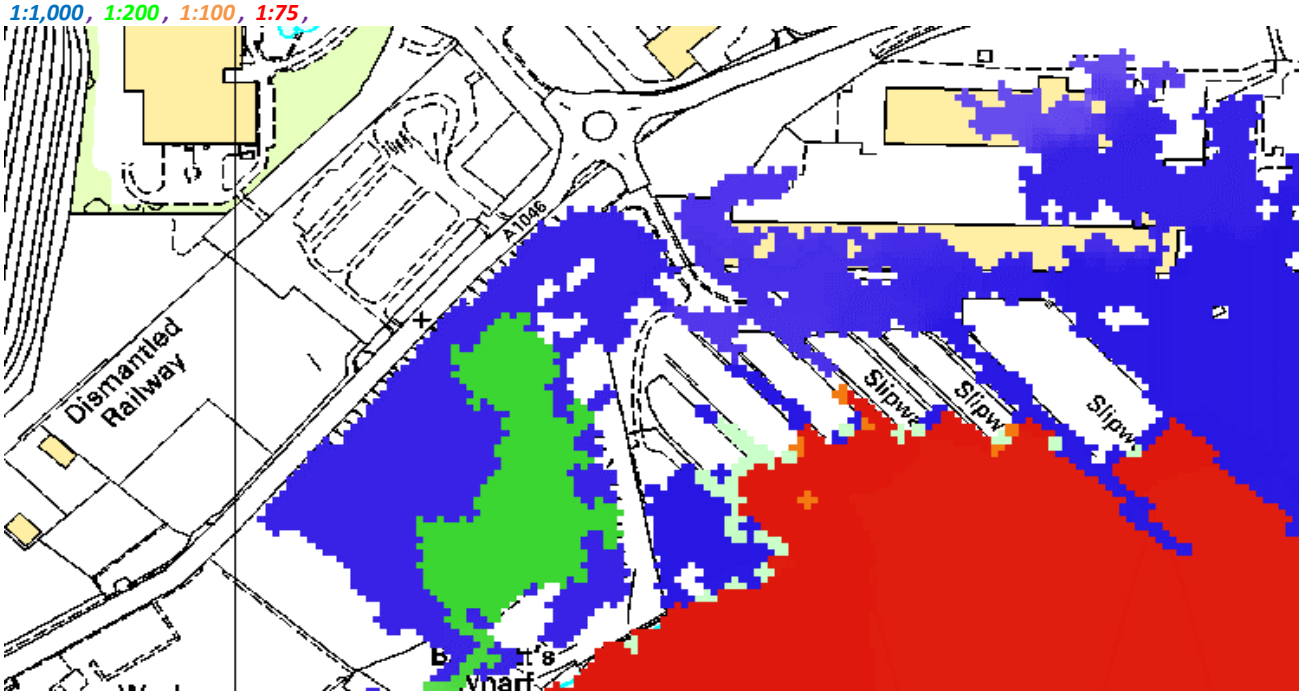
Tees Tidal Modelled Node Information

	Return Period (1:x years)	Levels (m aOD) at TS23 1PZ
Defended	2	0.000
	10	0.000
	20	0.000
	50	0.000
	75	0.000
	100	0.000
	200	2.967
	200 + CC (2030)	3.435
	200 + CC (2070)	4.664
	200 + CC (2100)	5.091
	1,000	4.319
Undefended	200 (FZ 3)	3.079
	1,000 (FZ 2)	4.324

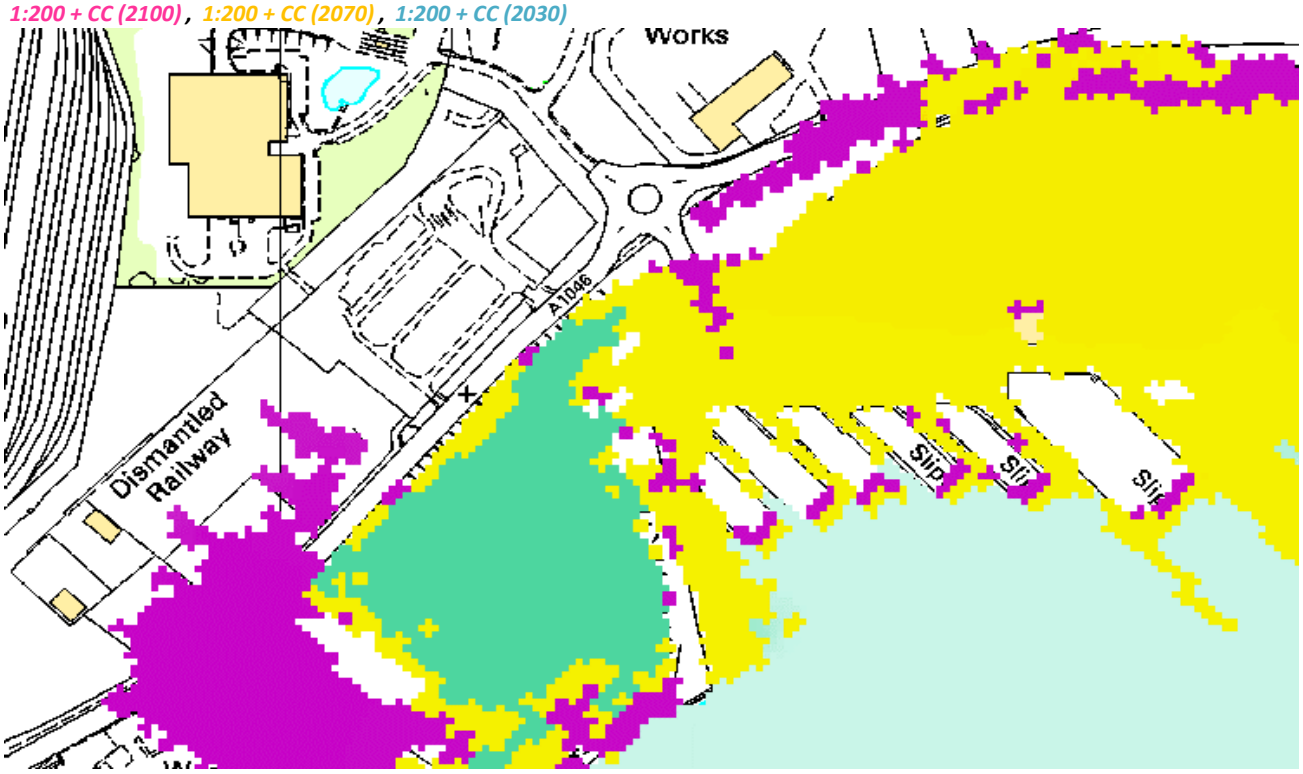
Model used for the results = Port Clarence 2020 TUFLOW Update

Defended

1:1,000, 1:200, 1:100, 1:75,



1:200 + CC (2100), *1:200 + CC (2070)*, *1:200 + CC (2030)*



Undefended

1:1,000, *1:200*

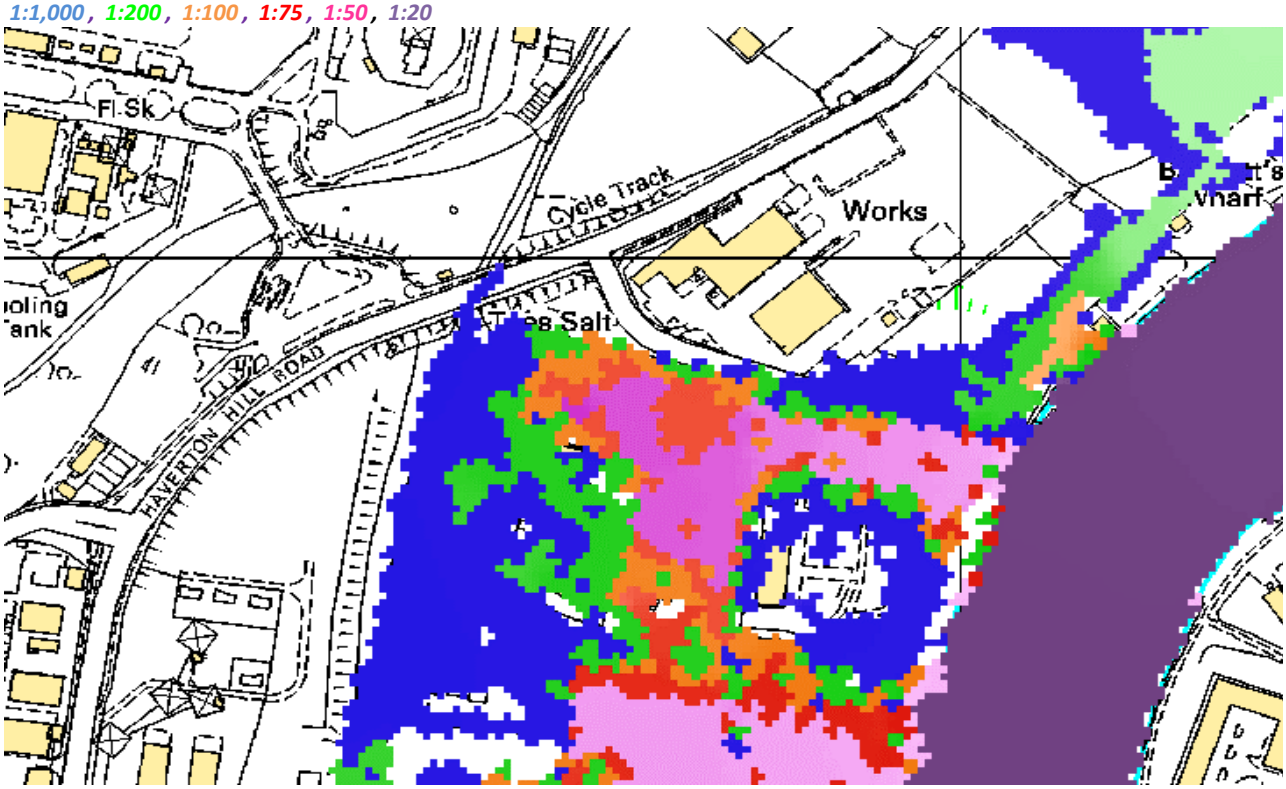
Tees Tidal Modelled Node Information

	Return Period (1:x years)	Levels (m aOD) at TS23 1PY
Defended	2	0.000
	10	0.000
	20	0.000
	50	3.629
	75	3.781
	100	3.927
	200	4.083
	200 + CC (2030)	4.166
	200 + CC (2070)	4.671
	200 + CC (2100)	5.113
	1,000	4.381
Undefended	200 (FZ 3)	4.117
	1,000 (FZ 2)	4.377

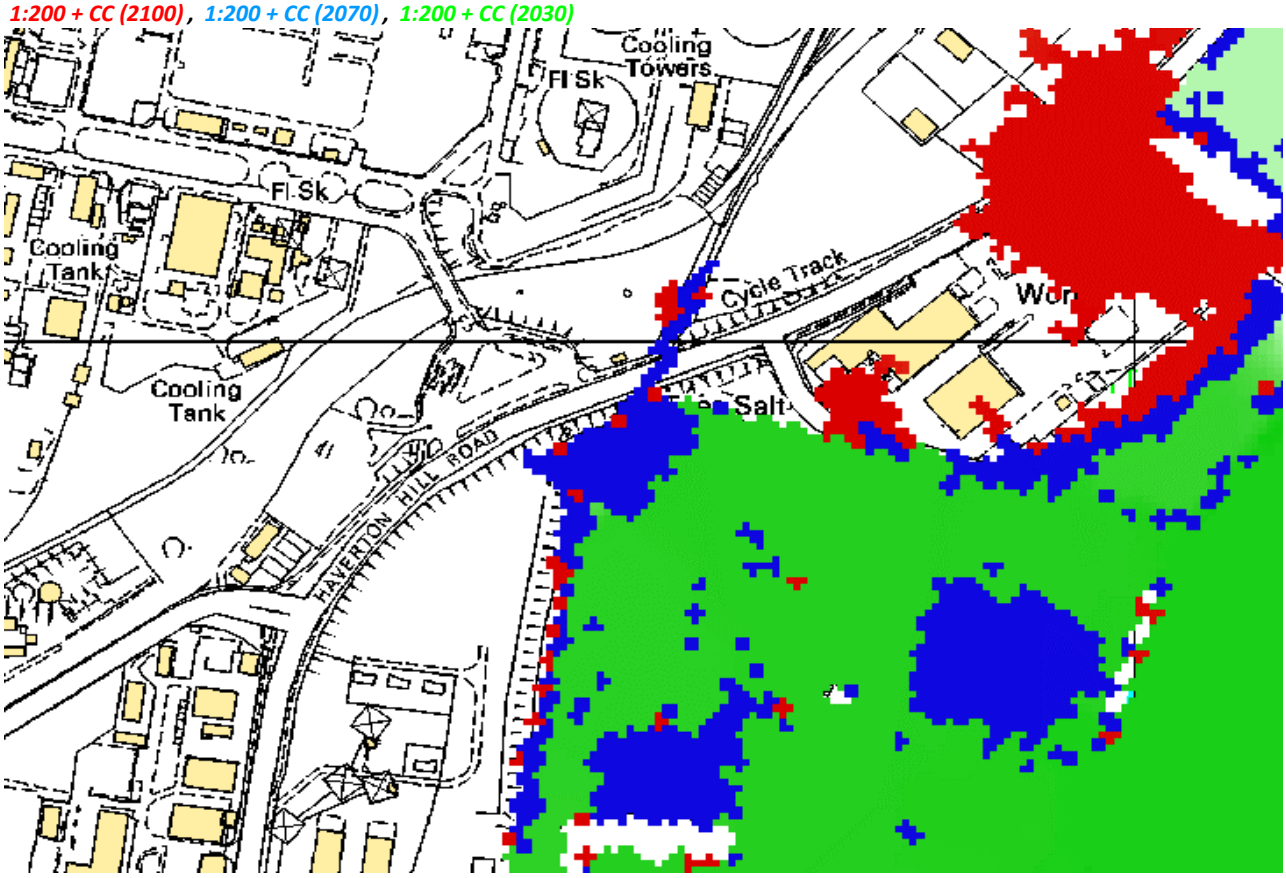
Model used for the results = Port Clarence 2020 TUFLOW Update

Defended

1:1,000, 1:200, 1:100, 1:75, 1:50, 1:20

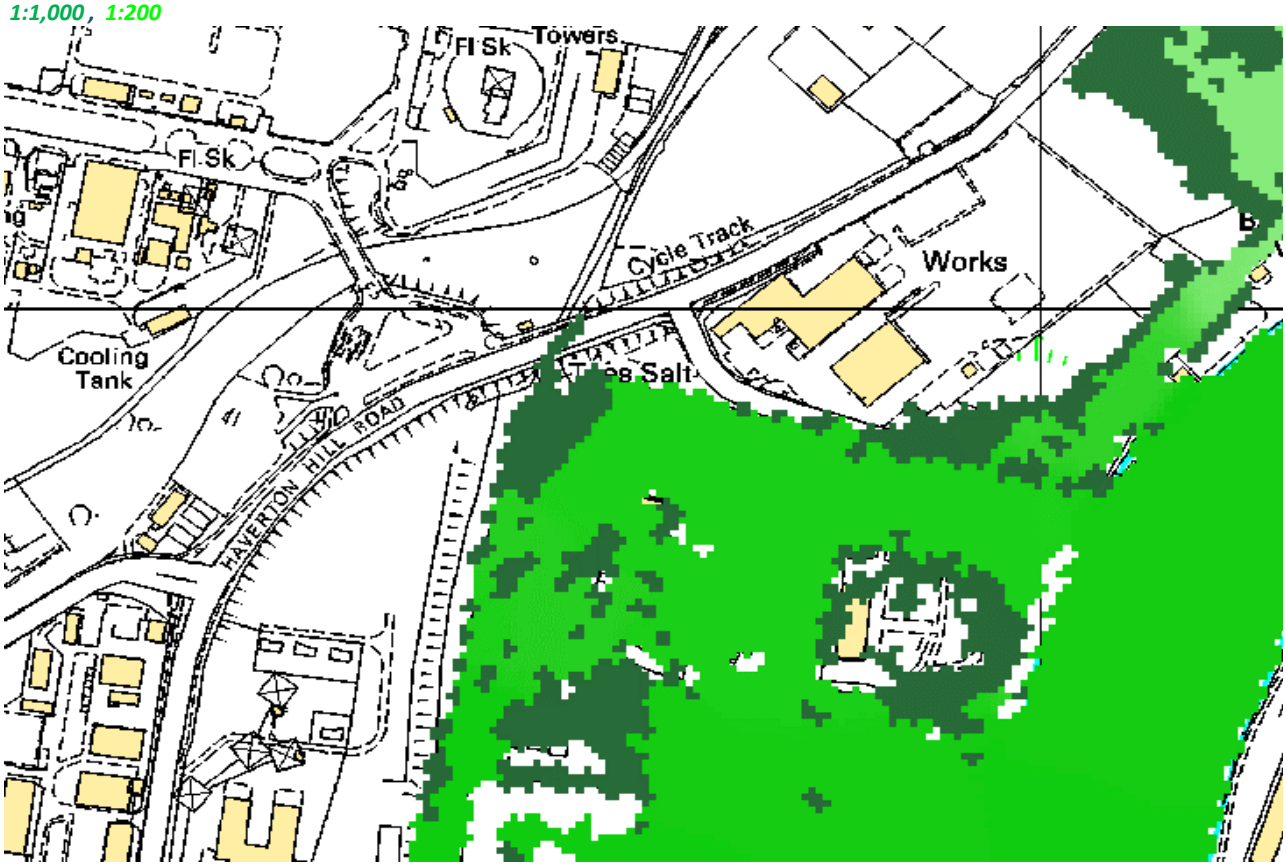


1:200 + CC (2100), 1:200 + CC (2070), 1:200 + CC (2030)



Undefended

1:1,000, 1:200



Wallace Engineering
Consulting Engineers

Appendix F: Maintenance Plan

Wallace Engineering
Consulting Engineers

DRAINAGE MAINTENANCE REPORT

PROPOSED DEVELOPMENT, Haverton Hill Rd, Stockton on Tees.

Prepared For: Ideal Design Solutions Ltd

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Report number 2373/02

Revision: - 13.04.22

1.0 General

1.1 Sustainable Drainage Systems (SuDS) are an environmentally friendly approach to managing rainfall. SuDS techniques use landscape features to deal with surface water with the aim to:

1.1.1 Control the flow, volume and frequency of water leaving a development.

1.1.2 Prevent pollution by intercepting silt and cleaning runoff from hard surfaces.

1.1.3 Provide attractive surroundings for the community.

1.2 The surface water drainage strategy for this development utilises an attenuation tank as the main SUDS feature. The following sections provides a brief description of these features and outlines the maintenance programme that should be adopted.

2.0 Cleaning of the Drainage System

2.1 Drainage systems should be inspected at regular intervals and where necessary, thoroughly cleaned out at the same time. Any defects discovered should be made good.

2.2 The following operations should be carried out during the periodic cleaning of a drainage system:-

Product Type	Period	Responsibility	Maintenance Methods
Silt Trap/Sump	As necessary and before wet season	Maintenance Company for communal areas	• Sediment and debris that accumulated during summer needs to be removed before the wet season. • Inspect and clean out routinely prior to inlet pipework to minimise debris reaching the tank. • Conduct inspections more frequently during the wet season for the area where sediment or trash accumulates more often. Clean and repair as needed.
Standard Manholes/ Inspection Chambers	As necessary	Site Owner for private areas. Maintenance Company for communal	• Remove and clean any soil and vegetation that covers the manhole cover to prevent blockage of the drainage system at the manhole.

Product Type	Period	Responsibility	Maintenance Methods
		areas	• Renew/replace any damaged/missing bolts and damaged/missing manhole covers.
Drainage Pipes	Six monthly interval	Site Owner for private areas. Maintenance Company for communal areas	• Inspect underground drainage pipes to ensure that the distribution pipework arrangement is operational and free from blockages. If required, take remedial action.
Hydrobrake Flow control	Annually	Maintenance Company for communal areas	• Renew any missing/broken items • Cleaning out • Check outlet spigot
Attenuation Tank	Monthly for 3 months	Maintenance Company for communal areas	• Inspect and identify any areas that are not operating correctly. If required, take remedial action.
	Monthly	Maintenance Company for communal areas	• Debris removal from catchment surface (where may cause risks to performance).
	Annually	Maintenance Company for communal areas	• Remove sediment from pre-treatment structures.
	As necessary	Maintenance Company for communal areas	• Repair/rehabilitation of inlets, outlet, overflows.

3.0 Sketches and Plans

3.1 The locations of the above features can be found by examining Drawing 2373-C01