

## Drainage Strategy & Design

Proposed Residential Development, Harras Dyke Farm,  
Whitehaven

Washington Homes

Ref: K40340.DS/001A

Version	Date	Prepared By	Checked By	Approved By
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## GLOSSARY OF TERMS

AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
BGL	Below Ground Level
BGS	British Geological Society
CC	Climate Change
DSM	Digital Surface Model
DTM	Digital Terrain Model
EA	Environment Agency
FEH	Flood Estimation Handbook
FFL	Finished Floor Level
FRA	Flood Risk Assessment
GIS	Geographical Information System
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
OS	Ordnance Survey
RGP	RG Parkins & Partners Ltd
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage System
UU	United Utilities

## 1. INTRODUCTION

### 1.1 BACKGROUND

This report has been prepared by R. G. Parkins & Partners Ltd (RGP) for Washington Homes in support of proposals for a residential development at Harras Dyke Farm, Whitehaven, in accordance with the National Planning Policy Framework <sup>[1][2]</sup>.

Copeland District Council issued planning permission for Phase 1 (4/16/2416/001) for 5 no. proposed dwellings and Phase 2 (4/16/2415/001) for 85 no. dwellings in November 2016. The following report and associated drainage layout are to discharge the following drainage related planning conditions.

- 4/16/2415/001

Condition 15 Foul and surface water drainage design

Condition 16 Surface water drainage design, SuDS Operation and Management

Condition 17 Foul water drainage design

- 4/16/2416/001

Condition 11 Foul and surface water drainage design

Condition 12 Surface water drainage design, SuDS Operation and Management

Condition 13 Foul water drainage design

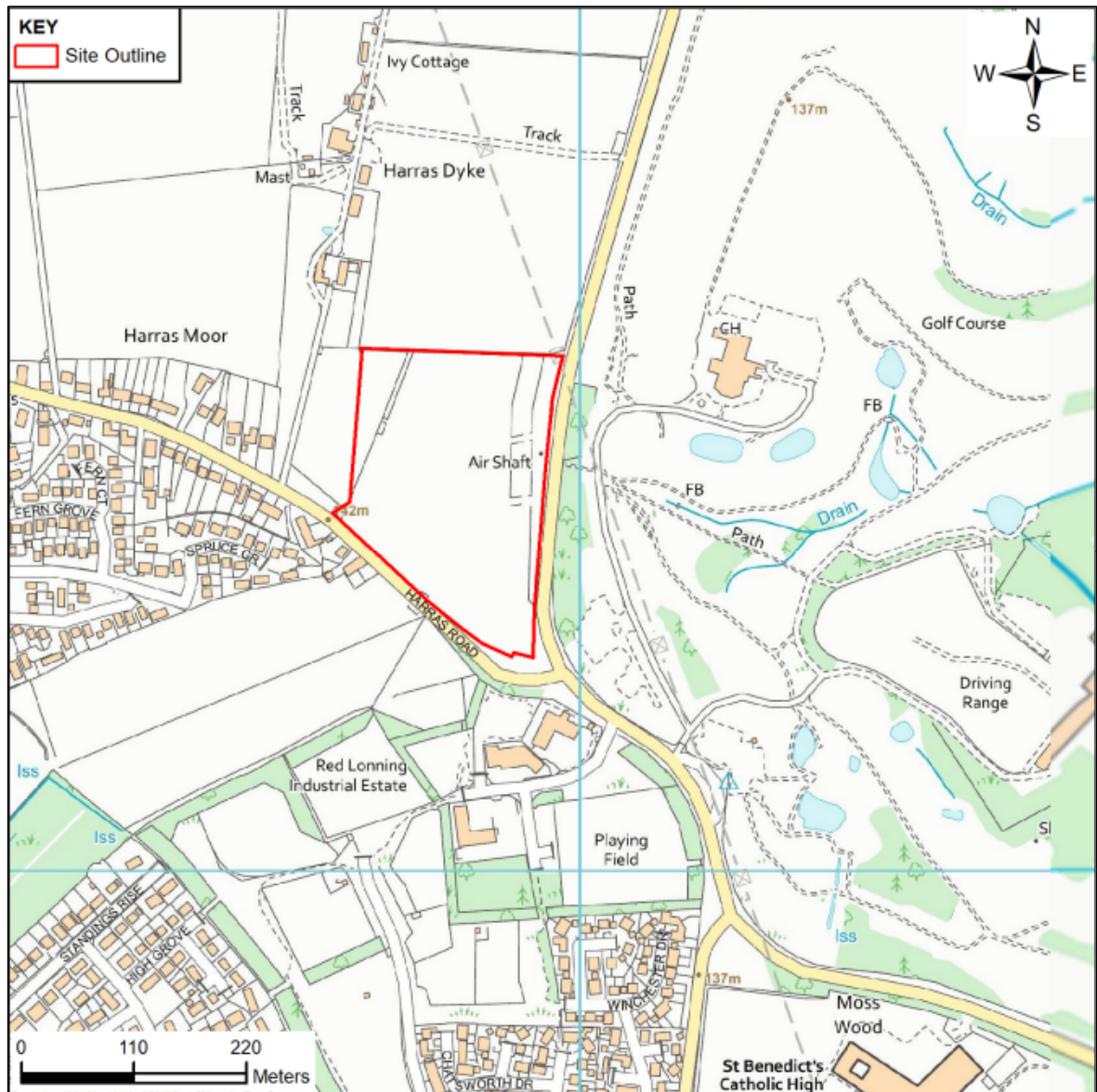
The latest development proposals by Manning Elliott (drawing no. 4/21/2196/OR1) shows a combined total of 90 no. plots. The drawing can be found in Appendix A for reference.

Due to the proposed site layout, it will be necessary to serve both phases of the development via a single surface water drainage network and foul water drainage network; the Phase 1 and Phase 2 sites will thereby be referred to as 'the site' hereon in.

## 2. SITE CHARACTERISATION

### 2.1 SITE LOCATION

The site is located c. 1.4 m east of Whitehaven in Harras Moor on a plot of land located north of Harras Lane and west of Red Lonning. The National Grid Co-Ordinates to the centre of the site are 298845E 518430N (Figure 2.1).



**Figure 2.1 Site Location**

### 2.2 SITE DESCRIPTION

The site covers an area of approximately 4.624 ha (46,242 m<sup>2</sup>), and at present is utilised as grazing pasture. The site is bounded to the south by Harras Road, agricultural land lies to the west with an access track serving Harras Dyke Farm further west. Red Lonning highway lies to the east with agricultural land to the north.

Topographically, the majority of the site falls from the north to the south east corner of the site, with levels ranging between ~144.400 mAOD and ~140.250 mAOD. The north west corner of the site drains to the south west corner (144.40 mAOD to 140.40 mAOD).

Access to the site is from Harras Road.

## 2.3 SITE HISTORY

The site has been identified that part of the site was formerly a large opencast coal mine, which has subsequently been restored.

In 1980, the site was shown as being included in the Moresby and Keekle Opencast Coal site operated by British Coal. It operated until the late 1980s.

## 2.4 GEOLOGY & HYDROGEOLOGY

British Geological Survey (BGS) <sup>[3]</sup> and Land Information Systems (LandIS) <sup>[4]</sup> mapping indicates the site is underlain by the geological sequences outlined in Table 2.1. The Defra Magic Maps <sup>[5]</sup> indicates the nearest Source Protection Zone is located c. 5.30 km to the south (Zone III Total Catchment).

The site is not located within a drinking water protected area or drinking water safeguard zone for surface water or groundwater.

The development site overlies a major aquifer with 'Medium-High' vulnerability.

**Table 2.1 Site Geological Summary**

Geological Unit	Classification	Description	Aquifer Classification
Soil	Soilscape 6	Freely draining slightly acid loamy soils	N/A
Drift	Till, Devensian	Diamicton – clay, silt, sands and gravel	Summary: Secondary (undifferentiated)
Solid (edge of site)	Whitehaven Sandstone Formation	Sandstone	Summary: Secondary A
Solid (centre of site)	Pennine Middle Coal Measures Formation	Mudstone, siltstone and sandstone	Summary: Secondary A

## 2.5 HYDROLOGY

Reference to OS Mapping indicates the nearest main river, Midgley Gill lies c. 830 m south of the site.

The nearest open watercourse lies 290 m to the south east. It is culverted within a 375 mm dia. concrete pipe under the highway and golf course, at depths varying between 1.58 and 2.30 m deep. This culvert was subject to a CCTV survey undertaken by Lanes Group PLC in April 2018 <sup>[6]</sup>. A review



of the survey report shows there are numerous displaced joints and cracks / holes within the pipework.

Lanes Group Plc returned to site in May 2018 to undertake a CCTV drainage survey of the outfall within the golf course and the upstream pipework <sup>[7]</sup>. It was found that the 375 mm dia. concrete pipe within the highway at the junction of Harras Road and Red Lonning was found to have numerous structural defects involving holes and fractures.

A further survey, also undertaken by Lanes for Drains in August 2023, again confirmed blockages within the pipework and the displaced joints with the 375 mm dia. concrete pipe.

## 2.6 EXISTING LAND DRAINAGE NETWORK

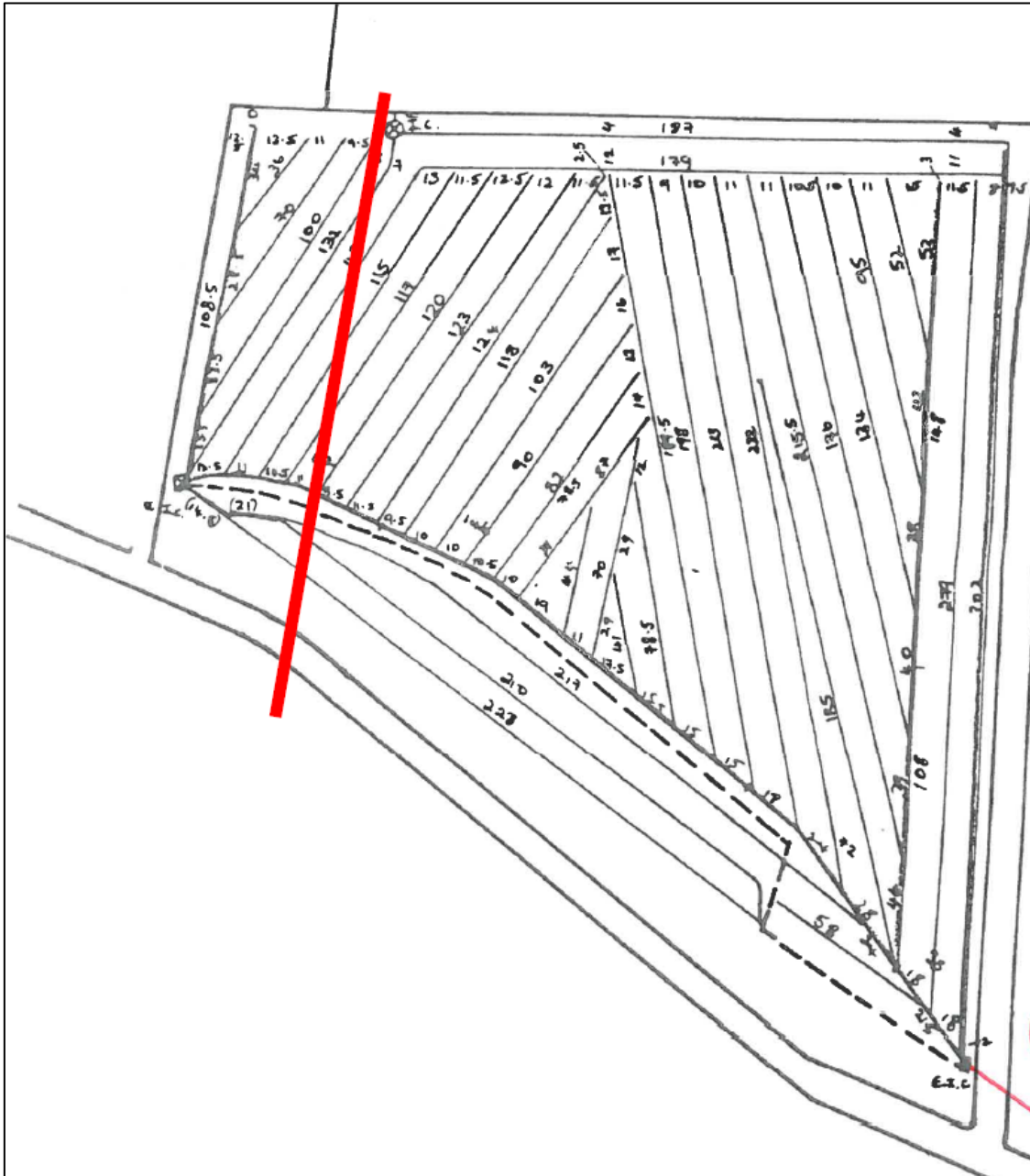
The site is served by a complex land drainage system conveying flows from predominantly the north to south east corner (Figure 2.2). This land drainage sketch was provided within a historic report by ADAS, the date of which is unknown. The drainage system also conveys flows from the field upslope. The land drainage network culminates in a single carrier drain crossing the lower section of the site from west to south east, ultimately discharging to the woodlands within the golf course, east of the site, via an existing 375 mm dia. culvert.

This culvert is designated as 'Ordinary Watercourse' and is therefore maintained by riparian ownership, responsibility therefore lies with Cumberland Borough Council Highways where it runs under the highway and the owners of the golf course, where it runs through the golf course.

Numerous CCTV surveys have been undertaken at the site, these are listed below for reference:

- Lanes for Drains - April 2018 (report no. PJ293289)
- Lane for Drains – May 2018 (report no. PJ297981)
- Lanes for Drains – August 2023 (report no. LSO00019310)
- Atlantic Geomatics – November 2023 (utility survey and manhole inspection – drawing no. 3184-P-12 to 17)
- SK Drainage Solutions Ltd – October 2023 (report no. SK-S 161-2023)

The surveys confirmed the land drainage network is in poor condition, with some sections unable to be surveyed due to damaged pipework or blockages. As part of the proposals the main carrier land drain will be replaced and diverted. In addition to this, there is a section of the 375 mm dia. culvert near the junction of Harras Road and Red Lonning that will need to be replaced as part of the works.



**Figure 2.2 Land Drainage Plan**

## 2.7 EXISTING SEWERS

Reference to the United Utilities sewer records indicates there is a 225 mm dia. combined sewer in Harras Road. It flows in a north westerly direction serving Harras Moor. Reference to the latest development proposals indicate UU MH 7303 is located at the site entrance. According to UU records this manhole is 1.4 m deep.

The records also show the presence of a UU public 150 mm dia. foul sewer in the Red Lonning Industrial Estate. The nearest possible connecting manhole is UU MH 9003.

The CCTV drainage surveys listed above also surveyed the combined network within Harras Road along with the land drainage network. The surveys all confirmed the existing combined network is

in reasonable condition and a gravity connection from the site will be possible. The foul drainage network in Red Lonning was however not surveyed.

## 2.8 EXISTING UTILITIES

Reference to the UU water records show there are 3 no. water mains crossing the site. There are 2 no. water mains running parallel to Harras Road within the site boundary (400 mm and 14" pipes), and a 560 mm pipe along the eastern boundary, crossing the site in the north and exiting the site in the south / south east corner. The pipes are classified as Distribution mains and trunk mains.

There are easements associated with these water mains, which are shown on RGP drawings K40340-20-25.

## 2.9 GROUND INVESTIGATION

There has been a significant number of Geotechnical investigations undertaken at the site in recent years due to the historical opencast mine.

The most recent intrusive ground investigations were undertaken at the site in December 2019 by GEO Environmental Engineering Ltd<sup>[6]</sup>. GEO were commissioned to carry out soil infiltration tests to determine whether the underlying ground conditions were suitable for infiltration based SuDS. The below information regarding ground conditions are taken from the 2019 GEO report.

Ground conditions outside the former opencast mine comprised of topsoil at varying depths between 0.20 m and 0.40 mBGL. The topsoil was described as dark grey, brown clayey sand with gravelly loam.

Made ground was encountered to depths of between c. 1.50 m and c. 1.80 mBGL, within some trial holes, all of which were located in the south western part of the site. This is likely to be a result of opencast capping material extending beyond the highwall.

Outside of the former opencast, weathered bedrock was encountered at depths between 0.80 m and 3.20 mBGL.

The exploratory holes were typically dry except for occasional ingress from field drainage and minor seepages from the made ground at a depth of c. 1.60 mBGL.

Ground conditions within the former opencast mine comprised topsoil to depths of between c. 0.20 m and 0.46 mBGL. The topsoil was described as dark grey, brown clay.

Made ground was encountered at the base of every exploratory holes within the former opencast mine which typically comprised a cap of stiff brown slightly sandy very gravelly clay. The cap material was generally encountered to depths of between c 1.00 m and 1.90 mBGL. The material appeared very similar to the natural drift deposits encountered outside of the former opencast area and comprised reworked natural drift deposits.

Based on a review of mine abandonment plans show the deepest area of coal appears to have been extracted at c. 96.00 mAOD. Therefore, based on current topographic survey data, the opencast backfill may be up to 48m.

Bedrock was not encountered within the former opencast area during the ground investigation.

The report concluded that the site is underlain by glacial till overlying solid strata of the Middle Coal Measures Formation. The report also identified coal seams that are conjectured as potentially sub cropping on site.

The report identified a potential for shallow unrecorded mine workings beneath areas of the site which have not been excavated during the opencast coal mining operations on site.

For further details refer to Geo Environmental Engineering Report No. GEO2022-5231.

Sirius have subsequently been appointed to undertake additional work at the site, that will review the key geotechnical constraints at the site, including foundation design, settlements (total and differential) and highway location and profile related to the former site use as an opencast mine.

Possible additional works include inundation settlement testing, along with the consideration of the opencast highwall profile and geometry. The assumed highwall location is shown on the RGP drainage layout plan included in Appendix A for reference.

## 2.10 COAL MINING

The Coal Authority Coal Mining Report indicated that the site is within the likely zone of influence of workings in two seams of coal at depths of between 130 mBGL and 200 mBGL, with the latest date of workings being 1961. The report states that these workings are not considered to pose a significant risk to the proposed development site <sup>[9]</sup>.

The report also identified a former mine shaft in the eastern part of the site which is also identified on historical and current map extracts. A concrete marker post was identified in this location near the eastern boundary.

Due to the former opencast mine, the report noted a potential for deep and extensive made ground on site. The report also indicated a low risk of ground contamination and a very low risk of ground gas due to the site history and the potential for significant made ground. The risk to the controlled waters and surrounding land was considered negligible as significant contamination sources were not encountered.

## 3. SURFACE WATER DRAINAGE STRATEGY & DESIGN

### 3.1 INTRODUCTION

The principal aim of the following drainage strategy is to design the development to avoid, reduce and delay the discharge of rainfall to public sewers and watercourses in order to protect watercourses and reduce the risk of localised flooding, pollution and other environmental damage.

In order to satisfy these criteria this surface water runoff assessment and drainage design has been undertaken in accordance with the following reports and guidance documents:

- SuDS Manual, CIRIA Report C753, 2015 <sup>[10]</sup>
- Code of Practice for Surface Water Management, BS8582:2013, November 2013<sup>[11]</sup>
- Rainfall Runoff Management for Developments, Defra/EA, SC030219, October 2013<sup>[12]</sup>
- Designing for Exceedance in Urban Drainage – Good Practice, CIRIA Report C635, 2006<sup>[13]</sup>
- Flood Estimation Handbook (FEH)<sup>[14]</sup>
- Flood Studies Report (FSR), Volume 1, Hydrological Studies, 1993<sup>[15]</sup>
- Flood Studies Supplementary Report No 14 (FSSR14), Review of Regional Growth Curves, 1983<sup>[16]</sup>
- Flood Estimation for Small Catchments, Marshall & Bayliss, Institute of Hydrology, Report No. 124 (IoH 124), 1994<sup>[17]</sup>

The following drainage strategy is based on the latest site layout plan by Manning Elliott Partnership (drawing no. 4/21/2196/OR1), which is included in Appendix A for reference. Any alterations to the site plan resulting in changes to impermeable areas will require the drainage strategy to be revisited.

### 3.2 PRE-DEVELOPMENT RUNOFF ASSESSMENT

As the site covers an area of less than 200 ha the Greenfield calculations have been undertaken in accordance with methodology described in IoH 124<sup>[17]</sup>. For catchments of less than 50 ha the Greenfield runoff rate is scaled according to the size of the catchment in relation to a 50-hectare site. The calculation has been based on the entire site area of 4.624 ha.

Full details of the calculations and the methodology for deriving the Peak Rate of Runoff are included in Appendix B, and a summary included in Table 3.1.

**Table 3.1 Pre-Development Greenfield Runoff Rates**

Rate of Runoff (l/s)	
Event	Greenfield
Q1	33.5
QBAR	38.4
Q10	53.1
Q30	65.4
Q100	80.0
Q100 + 50% CC	120.0

### 3.3 SITE AREAS

To support the exploration of options for site drainage, the spatial extent of different types of proposed land cover on the site have been measured. Table 3.2 shows the measured proposed land cover areas. The highest percentage is garden and landscaped areas at 53%, access road and footways at 20%, roof areas at 14%, parking and paved areas at 7%, and basin / swale areas at 5%.

**Table 3.2 Land Cover Areas**

Land Cover	Area		Percentage of total site area
	m <sup>2</sup>	Ha	
Total Roof Area	6607	0.661	14%
Basin Area	2250	0.225	5%
Total Access Road & Footway	9464	0.946	20%
Total Parking & Paved Area	3370	0.337	7%
Gardens & Landscaped Areas	24550	2.445	53%

To develop the detailed drainage design, only certain surfaces and areas will be positively drained into the surface water network. Positively drained areas include roof areas, car parking, access road and footways. All other areas (principally gardens, landscaping and patios) will either have a permeable surface or will have no positive drainage (i.e. patios will run-off to landscaped or garden areas). Table 3.3 summarises this and shows that positively drained areas will cover 53% of the site and permeable areas 47%.

**Table 3.3 Summary of drained and undrained areas into surface water drainage system**

Land Cover	Area		Percentage of total site area
	m <sup>2</sup>	Ha	
Total Positively Drained Area	21690	2.169	47%
Remaining Undrained Area	24550	2.455	53%

### 3.4 RUNOFF CONTRIBUTION FROM PERMEABLE AREAS

A 40% contribution from pervious / permeable areas should be allowed for within the calculations. Guidance by HR Wallingford stipulates 30% is the proposed default factor, the inclusion of this uplift will result in highly conservative design.

## 3.5 SURFACE WATER DRAINAGE DESIGN PARAMETERS

The surface water drainage system has been designed on the following basis using the modified rational method and a generated rainfall profile:

### 3.5.1 CLIMATE CHANGE

Projections of future climate change indicate that more frequent short-duration, high intensity rainfall and more frequent periods of long-duration rainfall are likely to occur over the next few decades in the UK. These future changes will have implications for river flooding and for local flash flooding. These factors will lead to increased and new risks of flooding within the lifetime of planned developments.

The EA have provided a peak rainfall online map showing the anticipated changes in peak rainfall intensity across the UK. Climate change allowances are now provided on a catchment by catchment basis. The site falls within the South West Lakes catchment. Table 3.4 outlines the EA guidance for this catchment, for the anticipated design life of the proposed development.

In line with current guidance and for conservative design, a 50% allowance shall be used within this assessment.

**Table 3.4 South West Lakes Management Catchment Peak Rainfall Allowances (1.0 AEP)**

South West Lakes (1.0%AEP)	Central Allowance (%)	Upper End Allowance (%)
2050s	30	45
2070s	35	50

### 3.5.2 URBAN CREEP

BS 8582:2013<sup>[11]</sup> outlines best practice with regard to Urban Creep. Although not a statutory requirement, future increase in impermeable area due to extensions and introduction of impervious positively drained areas has been considered. An uplift of 10% on impermeable areas associated with plots only has been applied to the contributing area used for surface water drainage design.

### 3.5.3 PERCENTAGE IMPERMEABILITY (PIMP)

The percentage impermeability (PIMP) for all impermeable areas is modelled as 100%. The entirety of the impermeable areas is to be positively drained.

### 3.5.4 VOLUMETRIC RUNOFF COEFFICIENT (CV)

The volumetric runoff coefficient describes the volume of surface water which runs off an impermeable surface following losses due to infiltration, depression storage, initial wetting and evaporation. The coefficient is dimensionless. Default industry standard volumetric runoff coefficients are 0.75 for summer and 0.84 for winter and are used for design.

## 3.5.5 RAINFALL MODEL

The calculations use the REFH2 unit hydrograph methodology in line with best practice as outlined in the SuDS Manual<sup>[10]</sup>. The calculations use the most up to date available catchment descriptors (2022) provided by the Centre for Ecology and Hydrology Flood Estimation Handbook web service.

## 3.6 LLFA CORRESPONDENCE

RGP held a meeting with LLFA Highways officers from Cumberland Council in September 2023 to discuss proposals for the site. It was agreed during this meeting that:

- The site is served by an existing land drainage / culvert system. The offsite culvert is a 375 mm dia. pipe that runs under the highway and into the golf course, prior to discharge into an existing surface water feature.
- There is a section of this culvert within the highway that has settled (See section 2.5) and will need to be repaired / replaced as part of the development proposals.
- There have been some recorded flooding issues with the section of land drain/culvert that runs through the neighbouring parcel of land to the west. Recent CCTV survey was abandoned due to silt build up. The main carrier land drain is to be retained/diverted/remediated as part of the development proposals, thereby retaining the existing flows from the north. All existing lateral land drains within the development site will be removed as part of the proposals. No development run-off will discharge directly into the existing land drainage network.
- Infiltration-based SuDS is not suitable due to the risk of inundation settlement of the Made Ground within the infilled opencast mine. Elsewhere the underlying ground conditions are not suitable for infiltration based SuDS. The proposed drainage strategy will therefore comprise a combination of attenuation based SuDS. These will include below ground over-sized pipes and above ground features, primarily a single SuDS detention basin located in the south-east corner of the site. The size and extent of the basin will be constrained by existing UU water pipes and associated 10m wide easements. Consideration of other SuDS components, such as swales, filter drains and gravel margins to be considered as part of the drainage strategy. The SuDS detention basin will provide the principle form of treatment. The intention is to get both the surface and foul water sewers adopted under a S104 Agreement, either with UU or a NAV.
- It was agreed that the Greenfield run off rate for the whole site (38.4 l/s) would be acceptable, due to the extensive land drainage network currently serving the site. It was also agreed a 40% contribution from pervious / permeable areas should be allowed for. Guidance by HR Wallingford stipulates 30% is the proposed default factor, the inclusion of this uplift will result in highly conservative design.

## 3.7 SURFACE WATER DISPOSAL

Surface water disposal has been considered in line with the hierarchy outlined in the SuDS Manual<sup>[10]</sup>. The approach considers infiltration drainage in preference to disposal to watercourse, in preference to discharge to sewer.



Infiltration testing undertaken at the site by GEO Environmental Engineering confirmed that the ground is not suitably permeable to facilitate soakaway drainage. For further information refer to Section 2.6. The site was also formerly an open cast mine, and as such an infiltration drainage strategy is not considered appropriate.

The site naturally falls towards an existing low point in the south east corner of the site, where there is a connecting manhole to the culverted ordinary watercourse within Harras Road. As part of the strategy, this manhole will be retained, connecting the new surface water drainage system to the existing culvert.

### 3.8 SURFACE WATER DRAINAGE DESIGN

The proposed surface water drainage network serving the entire developable area of the site has been modelled using Causeway Flow (results are included in Appendix B).

The drainage design has been sized to store a future 1% AEP event of critical duration without any flooding. Future climate change (50%) and urban creep (10% to housing roof areas only) and 40% uplift for green spaces is accounted for within the calculations.

It is proposed that all impermeable site areas i.e. roof, driveway and road areas will ultimately drain via gravity through a network of pipes and chambers into a shared detention basin located in the natural respective low point of the site.

The new detention basin will be formed as a permanent feature in an area designated as open space and will be designed to incorporate shallow, grassed slopes (1:3 gradient) to provide important amenity and biodiversity benefits to the development. The basin will provide 967 m<sup>3</sup> of attenuation.

A flow control chamber incorporating a Hydrobrake will be located downstream of the detention basin restricting discharge to the greenfield runoff rate (QBAR) of 38.4 l/s, prior to discharge into the existing culverted watercourse within Harras Road, via an existing connection.

Additional storage will be provided upstream of the detention basin, and this will be in the form of a series of conveyance swales / shallow basins in sequence, with interconnecting pipework, along the site's eastern boundary. Flow controls and a 150 dia. pipe will be used to throttle the flow within the conveyance swales, allowing the storage features to be utilised to their maximum capacity. The swales will provide a total of 985 m<sup>3</sup> of storage.

In the west of the site, additional attenuation volume will be provided within a series of oversized pipes within a manifold arrangement (3 no. pipes at 1800 dia.), providing 420 m<sup>3</sup> of storage. This will discharge into the surface water network within the access road, upstream of the detention basin.

The access road and car parking areas will be constructed using conventional surfacing in the form of asphalt. The access road will be drained via a series of highway gullies into the proposed surface water drainage network.

It is proposed the existing land drainage across the site, which is in poor condition, will be replaced with a new 375 dia. pipe along the southern site boundary. The land drainage currently discharges unattenuated into the culverted watercourse via an existing connection. This connection shall be retained.

Due to the sites former use, it is proposed that all pipe work will be laid in geogrid mechanically stabilised pipe bedding, installed on top of a ground improvement solution to limit differential settlement. This ground improvement solution will be designed and specified by the geotechnical specialists, Sirius.

Full details of the drainage proposals are included on RGP drawings K40340-20-25, included in Appendix A.

### 3.9 OTHER BENEFITS OF DEVELOPMENT

The development site in its current agricultural form is sparse grazing pasture on sloping land, underlain by relatively impermeable soil, provides little in the way of natural flood defence or attenuation to overland flows and stormwater runoff. The land in its current form also lacks any meaningful biodiversity or amenity value and provides limited benefits to the surrounding community.

The proposed development site will tie into the existing topography via careful design. Slopes, gardens and open space areas will be carefully landscaped using a variety of plants, shrubs and trees, providing a net gain in biodiversity and enhanced storage/protection against overland flows.

As such the existing hydraulic regime of the site will be modified whereby overland and subsurface flows will be intercepted, attenuated, and re-directed by below ground structures, positive drainage and service trenches.

Hydraulic gradients and velocities will be reduced, and the risk of downstream flooding would not be increased. Any surface emergence of any groundwater on-site will be intercepted by land drainage systems and directed away from existing dwellings.

### 3.10 DESIGNING FOR LOCAL DRAINAGE SYSTEM FAILURE

In accordance with the general principles discussed in CIRIA Report C635 – Designing for Exceedance in Urban Drainage <sup>[13]</sup> the proposed surface water drainage, where practical, should be designed to ensure there is no increased risk of flooding to the proposed dwellings on the site or elsewhere as a result of extreme rainfall, lack of maintenance, blockages or other causes. These measures are discussed below.

#### 3.10.1 BLOCKAGE & EXCEEDANCE

The sustainable drainage system has been designed to attenuate a 100-year design storm including a 50% allowance for climate change, with no flooding. The drainage system will also provide capacity for lower probability (greater design storm events) which are not critical duration.

The crest level of the detention basin will be locally lowered by 100mm to create a spillway for any exceedance flows and these will be channelled into the green area in the south west corner of the site. This area is set lower than the neighbouring highway (Harras Road) and should not increase flood risk downstream.

Should flooding occur within any of the flow control devices, manholes or silt traps, exceedance flows would follow the road gradients, entering the network via the highway gullies. Any further exceedance flows will follow the topographic gradients and discharge into the detention basin in the south east corner of the site, where the flow control will restrict flows to the Greenfield Qbar.

### 3.10.2 SURFACE STORAGE & EXTERNAL LEVELS

The site levels have been designed to offer additional surface water storage volume and conveyance of flood water should the SuDS and drainage system fail, flood or exceed capacity. Where appropriate, the kerb lines have been raised to channel surface water runoff back into the drainage system or onto the existing highway.

### 3.10.3 BUILDING LAYOUT & DETAIL

The finished floor levels to the new dwellings have been designed and situated to ensure that they are not at risk of flooding from overland flow. Finished floor levels have been set 150mm above external paved areas (whilst providing level access where needed). External footpaths typically fall away from the thresholds, ensuring that any flood water runs away from, rather than towards the dwellings.

## 3.11 SURFACE WATER TREATMENT

The treatment of surface water is not a statutory requirement. Water quality remains a material consideration but there are no prescriptive standards to be imposed in terms of treatment train management. In the absence of a design standard, the SuDS manual has been used which outlines best practice.

Pollutants such as suspended solids, heavy metals and organic pollutants may be present in surface water runoff, the quantity and composition of the runoff is highly dependent upon site use. For housing developments, the pollutant load is very low. The SuDS Manual<sup>[10]</sup> outlines best practice with regards to treatment of surface water by SuDS components prior to discharge to the environment. SuDS components can be effective in reducing the amount of pollutants within the surface water discharged and therefore environmental impact of the development. SuDS components may be installed in series to form a treatment train to treat the runoff.

For the three categories of runoff areas served by the drainage system, roof areas, residential parking and residential roads, treatment is proposed by directing all surface water runoff via a final detention basin before discharge off site. Tables 3.5 -3.7 summarise the pollution hazard and mitigation indices for this type of runoff and show that adequate treatment of surface water runoff is provided by the use of the detention basin.

This approach is however highly conservative, as additional treatment will be provided for the areas of roofs, driveways and access roads, also served by the conveyance swales prior to discharge into

the basin. The below calculations therefore present a worst case scenario in terms of treatment, and it is concluded sufficient treatment is provided across the site. Table 3.8 shows the levels of treatment provided for those areas of highway served by both swale and detention basin, for completeness.

A silt trap will also be located upstream of the detention basin to capture and solids before discharge into this storage feature.

**Table 3.5 Pollution Hazard & Mitigation Indices - Roof Areas**

Indices	Suspended Solids	Metals	Hydrocarbons
Pollution Hazard	0.20	0.20	0.05
Pollution Mitigation	0.50	0.50	0.60
Treatment Suitability	Adequate	Adequate	Adequate

**Table 3.6 Pollution Hazard & Mitigation Indices - Parking Areas**

Indices	Suspended Solids	Metals	Hydrocarbons
Pollution Hazard	0.50	0.40	0.40
Pollution Mitigation	0.50	0.50	0.60
Treatment Suitability	Adequate	Adequate	Adequate

**Table 3.7 Pollution Hazard & Mitigation Indices - Road Areas**

Indices	Suspended Solids	Metals	Hydrocarbons
Pollution Hazard	0.50	0.40	0.40
Pollution Mitigation	0.50	0.50	0.60
Treatment Suitability	Adequate	Adequate	Adequate

**Table 3.8 Pollution Hazard & Mitigation Indices - Road Areas Swale & Detention Basin**

Indices	Suspended Solids	Metals	Hydrocarbons
Pollution Hazard	0.50	0.40	0.40
Pollution Mitigation	0.75	0.85	0.90
Treatment Suitability	Adequate	Adequate	Adequate

### 3.12 OPERATIONS & MAINTENANCE RESPONSIBILITY

All underground pipework will be offered for adoption under a S104 Agreement with UU or a NAV. This pipework will include oversized pipes, up to the headwalls of the basins and swales and the flow control devices. All interconnecting pipework between the swales will also be offered for adoption.

It is proposed the detention basin and swales will be privately maintained by a third party management company. An 'Operations & Maintenance Plan' (K40340.OM/002) has been prepared by RGP detailing the requirements for future maintenance of the drainage system.

All diverted land drainage will remain private.

## 4. FOUL WATER DRAINAGE STRATEGY

It is proposed that foul water from the new development shall be drained via gravity within the site. Due to the topography, there will be a requirements for 2 no. connections into the UU public foul network. The north and eastern portion of the site (33 no. plots) will discharge to UU MH 7303 in Harras Road, with the remaining 57 no. plots discharging into UU MH 9003. UU MH9003 lies within the Red Lonning industrial estate, it will therefore be necessary to lay a 150 dia. pipe within the highway (Harras Road), across a highways verge and into the industrial estate to enable a gravity connection.

A number of CCTV drainage surveys, and a review of the detailed UU sewer records have confirmed that the sewers are sufficiently deep to enable conventional gravity connections.

The new connections will be subject to formal application to UU under S106 agreements. Foul water discharge calculations have been undertaken for the 90 no. dwelling, and subdivided into their respective discharge points, in accordance with the Design and Construction Guidance for Foul and Surface Water Sewers <sup>[20]</sup>, as shown in Table 4.1.

A pre development enquiry has been submitted to UU, who have confirmed the proposed foul connections are acceptable in principle. Full correspondence can be found in Appendix C.

**Table 4.1 Peak Foul Flow Rates**

Sewerage Sector Design & Construction Guidance Clause B3.1	
Total Peak Load based on Number of Dwellings, 90 no. units @ 4000 l/day	360,000
Peak Flow Rate from Site (l/s)	4.17
Peak Flow Rate into UU MH 7303 (33 no. plots)	1.53
Peak Flow Rate into UU MH 9003 (57 no. plots)	2.64

The estimated total peak foul flow rate for the development is 4.17 lit/sec. For further details, refer to the Drainage Layout Plan included in Appendix A (K40340-20).

## 5. CONCLUSIONS AND RECOMMENDATIONS

The proposed Drainage Strategy can be summarised as follows:

- The site was previously in use as an opencast mine but has subsequently been infilled and compacted. The only remnants on site of its previous history are a former mine shaft, marked with a concrete marker post in the east of the site.
- Ground investigation undertaken on December 2019 by GEO Environmental Engineering Ltd concluded that the site is not suitable for infiltration-based SuDS drainage and an off-site surface water drainage solution is required.
- It is proposed that surface water runoff from the site will be attenuated within a combination of SuDS features, ranging from a manifold oversized pipe arrangement, oversized pipes, conveyance swales and a detention basin, thereby providing ~2370m<sup>3</sup> of storage within the site.
- A flow control chamber incorporating a Hydrobrake will be located downstream of the detention basin restricting discharge to the greenfield development QBAR runoff rate of 38.4 lit/sec.
- The drainage has been designed to attenuate a Q100 + 50% climate change design event, with an uplift of 10% on roof areas for urban creep, and a 40% uplift in pervious areas, resulting in a highly conservative drainage design, as per discussions with the LLFA.
- The access road and driveways will be constructed using conventional surfacing in the form of asphalt and block paving respectively. The access road will drain via. highway gullies and convey flows towards the detention basin and swales.
- Attenuated discharge from the site shall be to the existing culverted ordinary watercourse, utilising a connecting manhole on site. The culvert crosses under Harras Road and Red Lonning before discharging to a surface water feature within the golf course, east of the site. This culverted watercourse is under riparian ownership, so will be maintained by Cumberland Council Highways and the owners of the golf course.
- Due to the sites former use, it is proposed that all pipe work will be laid in geogrid mechanically stabilised pipe bedding, installed on top of a ground improvement solution. This solution will be designed by geotechnical specialists, Sirius.
- Treatment of surface water is proposed by the detention basin and conveyance swales.
- It is proposed foul water drainage shall discharge via gravity connections into the existing public 150 mm dia. foul water sewers. Due to the topography of the site, and to enable a gravity connection for all dwellings, 33 no. dwellings will discharge into UUMH 7303. The peak flow rate for these plots is 1.53 l/s. The remaining 57 no. plots will discharge into UU MH 9003 in Red Lonning industrial estate south of the site, at a peak flow rate of 2.64 l/s.

- A pre development enquiry has been submitted to UU, who have confirmed the foul connection points are acceptable in principle.

## 6. REFERENCES

- [1] Ministry of Housing, Communities and Local Government, National Planning Policy Framework, December 2023.
- [2] Ministry of Housing, Communities and Local Government, Planning Practice Guidance to the National Planning Policy Framework, August 2023
- [3] British Geological Survey, April 2024 Geoindex.  
<http://mapapps2.bgs.ac.uk/geoindex/home.html>
- [4] Land Information System (LANDIS)- Soilscales viewer, April 2024  
<http://www.landis.org.uk/soilscales>
- [5] Defra Magic Maps, 2024  
<https://magic.defra.gov.uk/MagicMap.aspx>.
- [6] Lanes Group Plc, Thomas Armstong Limited, Whitehaven PJ293289, April 2018
- [7] Lanes group Plc, Thomas Armstong Limited, Harras Moor, Whitehaven PJ297981, May 2018
- [8] GEO Environmental Engineering Ltd, December 2019. Phase II: Ground Investigation Report Proposed Residential Development of Land at Harras Dyke Farm, Harras Moor, Whitehaven. Cumbria. Report no. 2019-3889.
- [9] Elliott Environmental Surveyors, Coal Mining Risk Assessment Report for land at Harras Moor, Whitehaven, Cumbria, Report No. EES16-199, December 2016
- [10] CIRIA, The SuDS Manual, Report C753, 2015.
- [11] BS8582:2013, Code of Practice for Surface Water Management, November 2013.
- [12] DEFRA/EA, Rainfall Runoff Management for Developments, SC030219, October 2013.
- [13] CIRIA, Designing for Exceedance in Urban Drainage – Good Practice, Report C635, London, 2006.
- [14] Centre for Ecology and Hydrology, Flood Estimation Handbook, Vols. 1 – 5 & FEH CD-ROM 3, 2009.
- [15] Institute of Hydrology, Flood Studies Report, Volume 1, Hydrological Studies, 1993.
- [16] Institute of Hydrology, Flood Studies Supplementary Report No 14 – Review of Regional Growth Curves, August 1983.
- [17] Marshall & Bayliss, 1994. Flood Estimation for Small Catchments, Report No. 124 (IoH 124), Institute of Hydrology.
- [18] Department for Environment, Food and Rural Affairs, Non-Statutory Technical Standards for Sustainable Drainage Systems, March 2015
- [19] Innovyze, 2022, Micro Drainage Source Control
- [20] Water UK, Design and Construction Guidance for Foul & Surface Water Sewers Offered for Adoption Under the Code for Adoption Agreements for Water and Sewage Companies Operating Wholly or Mainly in England, Approved Version 10, October 2019



## APPENDIX A

### DRAWINGS



Unit Schedule										Proposed Application Mix					
Type (ref)	No of beds	Style	Plot No's							No of dwelling s	ft2 (each)	ft2 (total)			
Ab	2-bed	Semi	85	86							2	741	1482		
Al	3-bed	End link	82	84							2	880	1760		
Al	3-bed	Mid link	83								1	880	880		
Ba	3-bed	Mid link	2	9	40	43	55				5	955	4775		
Ba	3-bed	End link	3	39	42	54					4	955	3820		
Ba	3-bed	End link	8								1	956	956		
Ba	3-bed	Semi	13	45	64	87	88	89	90		7	955	6685		
Ca	3-bed	Semi	11	12	20	21	57	58	65	66	74	75	10	1043	10430
Ca	3-bed	Det	17	28	68								3	1043	3129
Di	3-bed	End link	1	10	41	44	46	56					6	1057	6342
Di	3-bed	Semi	14	63									2	1057	2114
Ex	3-bed	Semi	4	5	6	7							4	1083	4332
Ex	3-bed	Semi	52	53									2	1083	2166
Fa	4-bed	Det	50	59	80								3	1157	3471
Ga	4-bed	Det	18	23	33	51	67	81					6	1200	7200
Ha	4-bed	Det	19	29	35	47	70	76	77				7	1199	8393
In	4-bed	Det	16	22	25	30	36	49	61	71	78		9	1335	12015
Ke	4-bed	Det	32	37	48	60	69	72	79				7	1425	9975
La	4-bed	Det	24	27	31	73							4	1506	6024
Ma	5-bed	Det	15	26	34	38	62						5	1589	7945
													90		103894

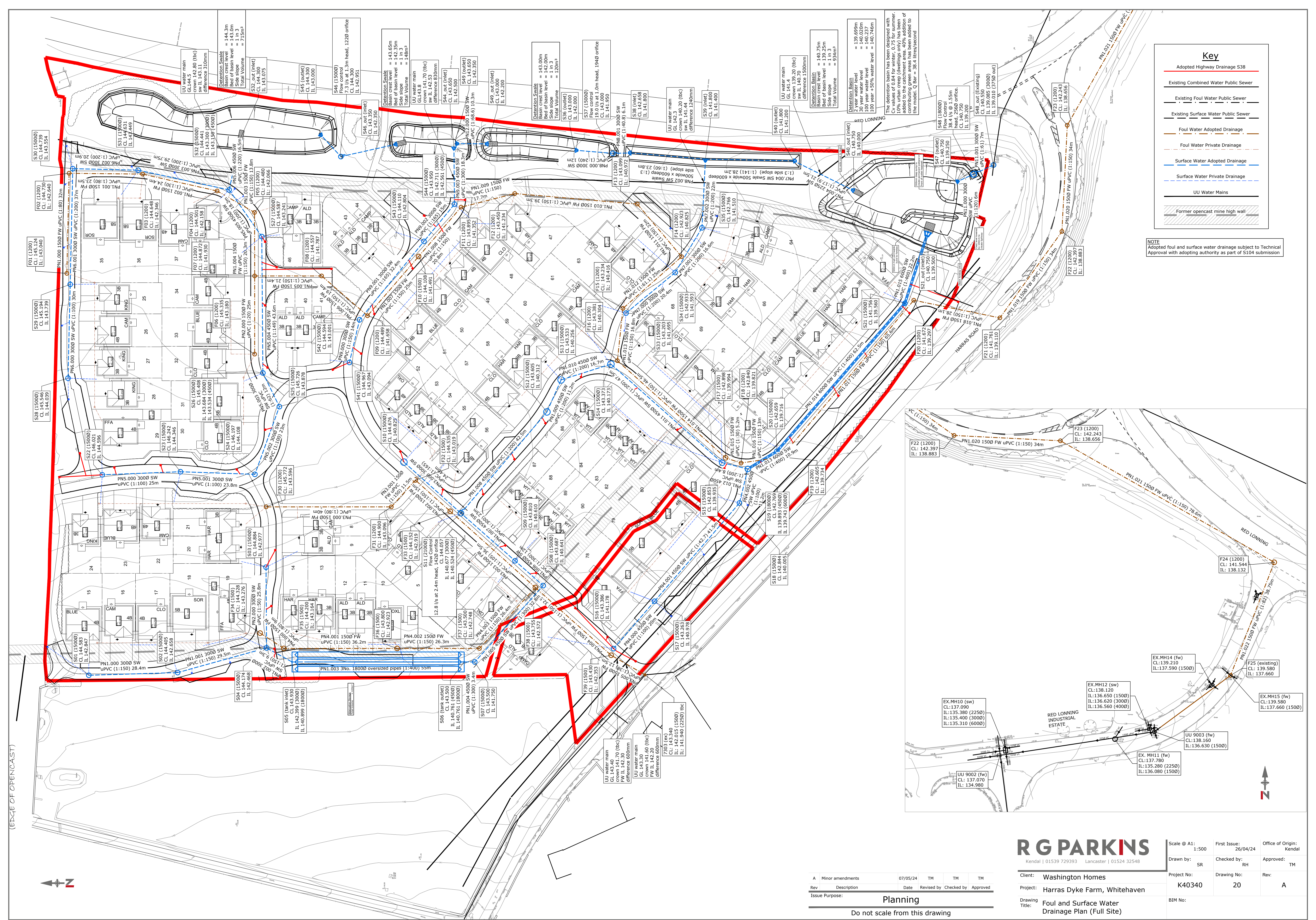
	Mid lin	End Lin	Semi	Det	TOTAL
2-bed			2		2
3-bed	6	13	25	3	47
4-bed				36	36
5-bed				5	5
	6	13	27	44	90



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project title:  
Proposed Housing Development  
Land at Harras Dyke Farm  
Whitehaven  
drawing title:  
Site Layout Plan as Proposed  
issue stage:  
PLANNING ISSUE  
date:  
APR 21  
drawn:  
MH/CS  
scale @ A1:  
1:500  
drawing number:  
1931-PL210  
revision:  
E





Key

Adopted Highway Drainage S38

Existing Combined Water Public Sewer

Existing Foul Water Public Sewer

Existing Surface Water Public Sewer

Foul Water Adopted Drainage

Foul Water Private Drainage

Surface Water Adopted Drainage

Surface Water Private Drainage

UU Water Mains

Former opencast mine high wall

NOTE

Adopted foul and surface water drainage subject to Technical Approval with adopting authority as part of S104 submission

R G PARKINS

Kendal | 01539 729393 | Lancaster | 01524 32548

Client: Washington Homes

Project: Harras Dyke Farm, Whitehaven

Drawing Title: Foul and Surface Water Drainage Plan (Full Site)

Scale @ A1: 1:500

First Issue: 26/04/24

Office of Origin: Kendal

Drawn by: SR

Checked by: RH

Approved: TM

Project No: K40340

Drawing No: 20

Rev: A

BIM No:

A	Minor amendments	07/05/24	TM	TM	TM
Rev	Description	Date	Revised by	Checked by	Approved
Issue Purpose: Planning					
Do not scale from this drawing					



## APPENDIX B

### CALCULATIONS

## DESIGN BASIS MEMORANDUM - PEAK RATE OF RUN-OFF CALCULATION

### Design Brief

The following peak rate of run-off calculations have been undertaken to determine changes in peak flow resulting from the development of a greenfield or brownfield site. These calculations are for the **Peak Rate of Run-Off** requirements only.

### Background Information & References

The site area is **less than** 200ha and the Greenfield (pre-development) calculation has been undertaken in accordance with methodology described by Marshall & Bayliss, Institute of Hydrology, Report No. 124, Flood Estimation for Small Catchments, 1994 (IoH 124).

In addition, the following references have been used in the preparation of these calculations:

- Interim Code of Practice for Sustainable Drainage Systems (SUDS), CIRIA, 2004
- CIRIA, The SUDS Manual, Report C753, 2015
- Designing for Exceedance in Urban Drainage - good practice, CIRIA Report C635, 2006
- Flood Estimation Handbook (FEH)
- Flood Studies Report (FSR), Volume 1, Hydrological Studies, 1993
- Flood Studies Supplementary Report No 2 (FSSR2), The Estimation of Low Return Period Floods
- Flood Studies Supplementary Report No 14 (FSSR14), Review of Regional Growth Curves, 1983
- Planning Practice guidance of the National Planning Policy Framework, Recommended national precautionary sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights.

### Proposed Land Use Changes

Changes to the existing site are as follows:

Brownfield Site to Brownfield Site (Reduced Impermeable Area)

### Results Summary

Rate of Run-Off (l/s)			
Event	Greenfield	Pre-Development Brownfield	Post-Development
Q1	33.5	182.1	182.1
QBAR	38.4	266.6	266.6
Q10	53.1	364.2	364.2
Q30	65.4	444.8	444.8
Q100	80.0	570.2	570.2
Q100 + 50% CC	120.0	855.3	855.3

## SITE AREAS (LAND COVER AREAS)

### Existing Impermeable & Permeable Land Cover

Total Site Area: **4.6242** ha **46242** m<sup>2</sup>

### Existing Impermeable & Permeable Land Cover

Land Cover	Area		Percentage of total site area
	m <sup>2</sup>	ha	
Total impermeable area	46242.0	4.624	100%
Remaining permeable area	0.0	0.000	0%

### Proposed Land Cover Areas

Land Cover	Area		Percentage of total site area
	m <sup>2</sup>	ha	
Total roof area	6607.0	0.661	14%
Basin Area	2250.0	0.225	5%
Total Highway	9464.0	0.946	20%
Total parking and paved area	3370.0	0.337	7%
Garden & landscaped areas	24551.0	2.455	53%

### Proposed Impermeable & Permeable Land Cover

Land Cover	Area		Percentage of total site area
	m <sup>2</sup>	ha	
Total impermeable area	21691.0	2.169	47%
Remaining permeable area	24551.0	2.455	53%

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Calc by RH	Check by 0
Date 24/04/2024	Revised -

### ESTIMATION OF QBAR (RURAL) (GREENFIELD RUNOFF RATE)

IoH 124 based on research on small catchments < 25 km<sup>2</sup>

Method is based on regression analysis of response times using catchments from 0.9 to 22.9 km<sup>2</sup>

QBAR<sub>rural</sub> is mean annual flood on rural catchment

QBAR<sub>rural</sub> depends on SOIL, SAAR and AREA most significantly

$$QBAR_{rural} = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$$

For SOIL refer to FSR Vol 1, Section 4.2.3 and 4.2.6 and IoH 124

Contributing watershed area

Area, A	=	500000	m <sup>2</sup>	insert 50 ha for EA
	=	0.500	km <sup>2</sup>	small catchment method
	=	50.000	ha	

SAAR	=	1114	mm	From FEH Web Service (point data)
------	---	------	----	-----------------------------------

Soil index based on soil type, SOIL

$$= \frac{(0.1S1 + 0.3S2 + 0.37S3 + 0.47S4 + 0.53S5)}{(S1 + S2 + S3 + S4 + S5)}$$

Where:	S1	=		%
	S2	=		%
	S3	=		%
	S4	=	100	%
	S5	=		%
			100	%

So,	SOIL	=	0.47
-----	------	---	------

Note: for very small catchments it is far better to rely on local site investigation information.

QBAR <sub>rural</sub>	=	0.416	m <sup>3</sup> /s
	=	415.7	l/s

### Small rural catchments less than 50 ha

The Environment Agency recommends that this method should be used for development sizes from 0 to 50 ha and should linearly interpolate the formula to 50 ha.

So, catchment size	=	46242	m <sup>2</sup>	Excluding significant open space which would remain disconnected from the positive drainage system during flood events.
	=	0.046	km <sup>2</sup>	
	=	4.624	ha	

QBAR <sub>rural site</sub>	=	0.03845	m <sup>3</sup> /s
	=	38.45	l/s

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Calc by RH	Check by 0
Date 24/04/2024	Revised -

Harras Road  
Whitehaven

### GREENFIELD RETURN PERIOD ORDINATES

QBAR can be factored by the UK FSR regional growth curves for return periods <2 years and for all other return periods to obtain peak flow estimates for required return periods.

These regional growth curves are constant throughout a region, whatever the catchment type and size.

See Table 2.39 for region curve ordinates  
Use FSSR2 Growth Curves to estimate Qbar

Reference- Pg 173-FSR V.1, ch 2.6.2

Region

= 10

Use Figure A1.1 to determine region

### GREENFIELD RETURN PERIOD FLOW RATES

Return Period	Ordinate	Q (l/s)
1	0.87	33.45
2	0.93	35.76
5	1.19	45.75
10	1.38	53.06
25	1.64	63.06
30	1.7	65.36
50	1.85	71.13
100	2.08	79.97
200	2.32	89.20
500	2.73	104.96
1000	3.04	116.88

Ordinate from FSSR2

Interpolation taken from Figure 24.2 (pg 515) SuDS Manual



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Calc by RH	Check by 0
Date 24/04/2024	Revised -

Harras Road  
Whitehaven

### ESTIMATE OF BROWNFIELD RUNOFF

Total site impermeable area, A = **21691** m<sup>2</sup>

M5-60 rainfall depth **17** mm  
Ratio M5-60/M5-2Day, r **0.30**

[Flood Studies Report (NERC, 1975)]  
[The Wallingford Proceedure - V4  
Modified Rational Method, Fig A.2  
(Hydraulics Research, 1983)]

Storm Duration **15** mins

Anticipated critical duration for the site -  
usually 15 minutes

Duration factor, Z1 0.59

[The Wallingford Proceedure - V4  
Modified Rational Method, Fig A.3b  
(Hydraulics Research, 1983)]

M5-15 rainfall depth = 10.0 mm

#### Return period ratio, Z2

M1-15	0.61
M10-15	1.22
M30-15	1.49
M100-15	1.91

[The Wallingford Proceedure - V4  
Modified Rational Method, Table A1  
(Hydraulics Research, 1983)]

#### Rainfall

	Depth (mm)	Intensity, i (mm/hr)
<b>M1-15</b>	6.1	24
<b>M10-15</b>	12.2	49
<b>M30-15</b>	14.9	60
<b>M100-15</b>	19.2	77

Peak discharge, Qp = Cv Cr i A

Where:

Cv = Volumetric Runoff Coefficient  
Cr = Routing Coefficient  
i = Rainfall intensity (mm/hour)

Cv = **0.95**  
Cr = **1.3**

#### Peak Runoff

	l/s
Q1	182.1
Q10	364.2
Q30	444.8
Q100	570.2

### ESTIMATION OF QBAR (BROWNFIELD RUNOFF RATE)

See Table 2.39 for region curve ordinates

Use FSSR2 Growth Curves to estimate Qbar

Region = 10

Return Period	Ordinate
1	0.87
2	0.93
5	1.19
10	1.38
25	1.64
30	1.70
50	1.85
100	2.08
200	2.32
500	2.73
1000	3.04

#### Qbar

Ordinate used	l/s
10 year	263.9
30 year	261.7
100 year	274.1

Proposed Brownfield Runoff, Qbar = 266.58 l/s

Reference- Pg 173-FSR V.1, ch 2.6.2

Use Figure A1.1 to determine region

Ordinate from FSSR2

Interpolation taken from Figure 24.2 (pg 515) SuDS Manual

Using the average Qbar derived from three ordinates.



Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
40_OUT	0.000		140.750		298942.647	518251.537	1.467
41	0.075	5.00	144.967	1500	298887.750	518412.748	1.873
42	0.047	5.00	144.595	1500	298901.374	518409.525	1.594
43	0.056	5.00	144.110	1500	298926.450	518388.942	1.306
44	0.103	5.00	143.950	1500	298938.321	518379.198	1.389
44_OUT	0.000		143.650		298956.621	518379.374	1.281
45	0.071	5.00	144.300		298960.739	518422.151	1.300
46	0.000		144.300	1800	298953.552	518415.491	1.349
46_OUT	0.000		143.650		298958.170	518397.875	1.281
47	0.064	5.00	140.750		298945.464	518218.771	1.500
48	0.000		140.750	1800	298947.931	518213.302	1.550
48_OUT			140.550	1500	298950.874	518206.921	1.465
49	0.019	5.00	143.650		298957.697	518378.738	1.300
49_OUT	0.000		143.000		298957.623	518368.446	0.972

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)
1.000	1	2	28.400	0.600	142.847	142.658	0.189	150.0	300	5.37	50.0
1.001	2	4	29.501	0.600	142.658	142.461	0.197	150.0	300	5.75	50.0
2.000	3	4	25.801	0.600	142.977	142.461	0.516	50.0	300	5.19	50.0
1.002	4	5	9.298	0.600	142.461	142.399	0.062	150.0	300	5.87	50.0
1.003	5	6	55.002	0.600	140.899	140.761	0.138	400.0	1800	6.26	50.0
1.004	6	7	3.371	0.600	140.761	140.750	0.011	300.0	450	6.31	50.0
1.005	7	8	32.787	0.600	140.750	140.641	0.109	300.0	450	6.77	50.0
1.006	8	9	12.000	0.600	140.641	140.601	0.040	300.0	450	6.94	50.0
1.007	9	11	23.011	0.600	140.601	140.524	0.077	300.0	450	7.27	50.0
3.000	10	11	24.480	0.600	140.825	140.677	0.148	165.0	300	5.33	50.0
1.008	11	12	42.453	0.600	140.524	140.312	0.212	200.0	450	7.77	50.0
1.009	12	13	11.211	0.600	140.312	140.256	0.056	200.0	450	7.90	50.0
1.010	13	14	16.699	0.600	140.256	140.173	0.083	200.0	450	8.09	50.0
1.011	14	15	47.501	0.600	140.173	139.935	0.238	200.0	450	8.64	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)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.281	90.6	6.5	1.435	1.447	0.036	0.0	54	0.752
1.001	1.281	90.6	17.7	1.447	1.413	0.098	0.0	89	0.999
2.000	2.228	157.5	15.0	1.607	1.413	0.083	0.0	62	1.417
1.002	1.281	90.6	42.3	1.413	1.231	0.234	0.0	144	1.259
1.003	2.390	18248.9	47.2	1.231	0.939	0.261	0.0	65	0.538
1.004	1.168	185.8	61.8	2.289	2.300	0.342	0.0	178	1.054
1.005	1.168	185.8	61.8	2.300	2.608	0.342	0.0	178	1.054
1.006	1.168	185.8	83.5	2.608	2.759	0.462	0.0	211	1.138
1.007	1.168	185.8	83.5	2.759	3.083	0.462	0.0	211	1.138
3.000	1.221	86.3	14.8	3.551	3.080	0.082	0.0	83	0.918
1.008	1.434	228.0	113.8	3.083	2.843	0.630	0.0	225	1.433
1.009	1.434	228.0	113.8	2.843	2.827	0.630	0.0	225	1.433
1.010	1.434	228.0	125.0	2.827	2.750	0.692	0.0	238	1.465
1.011	1.434	228.0	134.4	2.750	2.468	0.744	0.0	249	1.491

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)
1.012	15	19	8.434	0.600	139.935	139.893	0.042	200.0	450	8.74	50.0
4.000	16	17	20.011	0.600	141.178	140.978	0.200	100.0	450	5.16	50.0
4.001	17	18	41.500	0.600	140.978	140.005	0.973	42.7	450	5.39	50.0
4.002	18	19	11.225	0.600	140.005	139.893	0.112	100.0	450	5.48	50.0
1.013	19	20	10.900	0.600	139.743	139.716	0.027	400.0	600	8.89	50.0
1.014	20	21	62.499	0.600	139.716	139.560	0.156	400.0	600	9.75	50.0
1.015	21	21_OUT	24.000	0.600	139.560	139.500	0.060	400.0	600	10.08	50.0
5.000	22	23	25.000	0.600	144.596	144.346	0.250	100.0	300	5.27	50.0
5.001	23	24	23.800	0.600	144.346	144.108	0.238	100.0	300	5.52	50.0
5.002	24	25	23.000	0.600	144.108	143.878	0.230	100.0	300	5.76	50.0
5.003	25	26	12.000	0.600	143.878	143.684	0.194	61.9	300	5.86	50.0
5.004	26	27	43.600	0.600	143.534	143.241	0.293	148.8	450	6.30	50.0
5.005	27	32	18.199	0.600	143.241	143.150	0.091	200.0	450	6.51	50.0
6.000	28	29	30.000	0.600	144.039	143.739	0.300	100.0	300	5.32	50.0
6.001	29	30	37.000	0.600	143.739	143.554	0.185	200.0	300	5.87	50.0
6.002	30	31	20.900	0.600	143.554	143.450	0.104	200.0	300	6.19	50.0
6.003	31	32	29.750	0.600	143.450	143.301	0.149	200.0	300	6.64	50.0
5.006	32	32_OUT	16.501	0.600	143.150	143.075	0.075	220.0	450	6.84	50.0
7.000	33	34	20.401	0.600	141.695	141.593	0.102	200.0	300	5.31	50.0
7.001	34	35	16.649	0.600	141.593	141.510	0.083	200.0	300	5.56	50.0
7.002	35	39	22.000	0.600	141.510	141.400	0.110	200.0	300	5.89	50.0
8.000	36	37	12.043	0.600	142.000	141.950	0.050	240.9	300	5.20	50.0
8.001	37	38	5.857	0.600	141.950	141.800	0.150	39.0	300	5.24	50.0
8.002	38	39	23.821	0.600	141.800	141.400	0.400	59.6	600	5.32	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)	Pro Depth (mm)	Pro Velocity (m/s)
1.012	1.434	228.0	154.5	2.468	2.426	0.855	0.0	272	1.535
4.000	2.033	323.3	12.3	1.758	1.835	0.068	0.0	59	0.997
4.001	3.119	496.1	20.2	1.835	2.389	0.112	0.0	61	1.561
4.002	2.033	323.3	32.7	2.389	2.426	0.181	0.0	95	1.320
1.013	1.211	342.4	190.1	2.426	2.343	1.052	0.0	320	1.241
1.014	1.211	342.4	200.4	2.343	1.596	1.109	0.0	330	1.256
1.015	1.211	342.4	225.3	1.596	0.650	1.247	0.0	356	1.289
5.000	1.572	111.1	14.8	1.125	1.596	0.082	0.0	74	1.103
5.001	1.572	111.1	23.3	1.596	1.789	0.129	0.0	93	1.252
5.002	1.572	111.1	26.2	1.789	1.548	0.145	0.0	99	1.293
5.003	2.002	141.5	26.2	1.548	1.424	0.145	0.0	87	1.541
5.004	1.664	264.7	42.3	1.424	0.896	0.234	0.0	121	1.232
5.005	1.434	228.0	61.3	0.896	0.841	0.339	0.0	159	1.223
6.000	1.572	111.1	10.3	1.207	1.155	0.057	0.0	61	0.993
6.001	1.108	78.3	20.4	1.155	0.885	0.113	0.0	104	0.935
6.002	1.108	78.3	23.9	0.885	0.881	0.132	0.0	113	0.976
6.003	1.108	78.3	32.9	0.881	0.840	0.182	0.0	136	1.061
5.006	1.366	217.3	100.3	0.841	0.775	0.555	0.0	215	1.341
7.000	1.108	78.3	6.5	1.208	1.040	0.036	0.0	58	0.679
7.001	1.108	78.3	16.4	1.040	0.956	0.091	0.0	93	0.882
7.002	1.108	78.3	28.0	0.956	0.533	0.155	0.0	124	1.019
8.000	1.008	71.3	4.7	0.700	0.750	0.026	0.0	52	0.576
8.001	2.523	178.4	4.7	0.750	0.573	0.026	0.0	33	1.099
8.002	5.060	6983.1	4.7	0.273	0.233	0.026	0.0	14	0.633

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)
7.003	39	40	28.200	0.600	141.400	141.200	0.200	141.0	600	6.03	50.0
7.004	40	40_OUT	21.500	0.600	141.200	140.000	1.200	17.9	225	6.15	50.0
9.000	41	42	14.000	0.600	143.094	143.001	0.093	150.5	300	5.18	50.0
9.001	42	43	32.442	0.600	143.001	142.804	0.197	165.0	300	5.63	50.0
9.002	43	44	15.358	0.600	142.804	142.711	0.093	165.0	300	5.83	50.0
9.003	44	44_OUT	18.301	0.600	142.561	142.500	0.061	300.0	450	6.10	50.0
10.000	45	46	9.798	0.600	143.000	142.951	0.049	200.0	300	5.15	50.0
10.001	46	46_OUT	18.211	0.600	142.951	142.860	0.091	200.0	300	5.42	50.0
11.000	47	48	6.000	0.600	139.250	139.200	0.050	120.0	300	5.07	50.0
11.001	48	48_OUT	7.027	0.600	139.200	139.085	0.115	61.0	300	5.13	50.0
12.000	49	49_OUT	10.292	0.600	142.350	142.200	0.150	68.6	150	5.14	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)	Pro Depth (mm)	Pro Velocity (m/s)
7.003	3.284	4532.0	34.3	0.233	-0.148	0.190	0.0	55	0.928
7.004	3.106	123.5	36.3	0.227	0.525	0.201	0.0	83	2.705
9.000	1.279	90.4	13.6	1.573	1.294	0.075	0.0	78	0.928
9.001	1.221	86.3	22.0	1.294	1.006	0.122	0.0	103	1.025
9.002	1.221	86.3	32.2	1.006	0.939	0.178	0.0	127	1.135
9.003	1.168	185.8	50.8	0.939	0.700	0.281	0.0	160	1.002
10.000	1.108	78.3	12.8	1.000	1.049	0.071	0.0	82	0.823
10.001	1.108	78.3	12.8	1.049	0.490	0.071	0.0	82	0.823
11.000	1.434	101.4	11.6	1.200	1.250	0.064	0.0	68	0.964
11.001	2.016	142.5	11.6	1.250	1.165	0.064	0.0	57	1.224
12.000	1.215	21.5	3.4	1.150	0.650	0.019	0.0	41	0.895

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)
1.000	28.400	150.0	300	Circular_RGP	144.582	142.847	1.435	144.405	142.658	1.447
1.001	29.501	150.0	300	Circular_RGP	144.405	142.658	1.447	144.174	142.461	1.413
2.000	25.801	50.0	300	Circular_RGP	144.884	142.977	1.607	144.174	142.461	1.413
1.002	9.298	150.0	300	Circular_RGP	144.174	142.461	1.413	143.930	142.399	1.231
1.003	55.002	400.0	1800	3x1800 circular	143.930	140.899	1.231	143.500	140.761	0.939
1.004	3.371	300.0	450	Circular_Default Sewer Type	143.500	140.761	2.289	143.500	140.750	2.300
1.005	32.787	300.0	450	Circular_Default Sewer Type	143.500	140.750	2.300	143.699	140.641	2.608
1.006	12.000	300.0	450	Circular_Default Sewer Type	143.699	140.641	2.608	143.810	140.601	2.759
1.007	23.011	300.0	450	Circular_Default Sewer Type	143.810	140.601	2.759	144.057	140.524	3.083

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1500	Manhole	Adoptable	2	1500	Manhole	Adoptable
1.001	2	1500	Manhole	Adoptable	4	1500	Manhole	Adoptable
2.000	3	1500	Manhole	Adoptable	4	1500	Manhole	Adoptable
1.002	4	1500	Manhole	Adoptable	5		Junction	
1.003	5		Junction		6		Junction	
1.004	6		Junction		7	1500	Manhole	Adoptable
1.005	7	1500	Manhole	Adoptable	8	1500	Manhole	Adoptable
1.006	8	1500	Manhole	Adoptable	9	1500	Manhole	Adoptable
1.007	9	1500	Manhole	Adoptable	11	2100	Manhole	Adoptable

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)
3.000	24.480	165.0	300	Circular_RGP	144.676	140.825	3.551	144.057	140.677	3.080
1.008	42.453	200.0	450	Circular_Default Sewer Type	144.057	140.524	3.083	143.605	140.312	2.843
1.009	11.211	200.0	450	Circular_Default Sewer Type	143.605	140.312	2.843	143.533	140.256	2.827
1.010	16.699	200.0	450	Circular_Default Sewer Type	143.533	140.256	2.827	143.373	140.173	2.750
1.011	47.501	200.0	450	Circular_Default Sewer Type	143.373	140.173	2.750	142.853	139.935	2.468
1.012	8.434	200.0	450	Circular_Default Sewer Type	142.853	139.935	2.468	142.769	139.893	2.426
4.000	20.011	100.0	450	Circular_RGP	143.386	141.178	1.758	143.263	140.978	1.835
4.001	41.500	42.7	450	Circular_RGP	143.263	140.978	1.835	142.844	140.005	2.389
4.002	11.225	100.0	450	Circular_RGP	142.844	140.005	2.389	142.769	139.893	2.426
1.013	10.900	400.0	600	Circular_Default Sewer Type	142.769	139.743	2.426	142.659	139.716	2.343
1.014	62.499	400.0	600	Circular_Default Sewer Type	142.659	139.716	2.343	141.756	139.560	1.596
1.015	24.000	400.0	600	Circular_Default Sewer Type	141.756	139.560	1.596	140.750	139.500	0.650
5.000	25.000	100.0	300	Circular_RGP	146.021	144.596	1.125	146.242	144.346	1.596
5.001	23.800	100.0	300	Circular_RGP	146.242	144.346	1.596	146.197	144.108	1.789
5.002	23.000	100.0	300	Circular_RGP	146.197	144.108	1.789	145.726	143.878	1.548
5.003	12.000	61.9	300	Circular_RGP	145.726	143.878	1.548	145.408	143.684	1.424
5.004	43.600	148.8	450	Circular_RGP	145.408	143.534	1.424	144.587	143.241	0.896
5.005	18.199	200.0	450	Circular_RGP	144.587	143.241	0.896	144.441	143.150	0.841
6.000	30.000	100.0	300	Circular_RGP	145.546	144.039	1.207	145.194	143.739	1.155
6.001	37.000	200.0	300	Circular_RGP	145.194	143.739	1.155	144.739	143.554	0.885
6.002	20.900	200.0	300	Circular_RGP	144.739	143.554	0.885	144.631	143.450	0.881
6.003	29.750	200.0	300	Circular_RGP	144.631	143.450	0.881	144.441	143.301	0.840
5.006	16.501	220.0	450	Circular_RGP	144.441	143.150	0.841	144.300	143.075	0.775
7.000	20.401	200.0	300	Circular_RGP	143.203	141.695	1.208	142.933	141.593	1.040
7.001	16.649	200.0	300	Circular_RGP	142.933	141.593	1.040	142.766	141.510	0.956

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
3.000	10	1500	Manhole	Adoptable	11	2100	Manhole	Adoptable
1.008	11	2100	Manhole	Adoptable	12	1500	Manhole	Adoptable
1.009	12	1500	Manhole	Adoptable	13	1500	Manhole	Adoptable
1.010	13	1500	Manhole	Adoptable	14	1500	Manhole	Adoptable
1.011	14	1500	Manhole	Adoptable	15	1500	Manhole	Adoptable
1.012	15	1500	Manhole	Adoptable	19	1800	Manhole	Adoptable
4.000	16	1500	Manhole	Adoptable	17	1500	Manhole	Adoptable
4.001	17	1500	Manhole	Adoptable	18	1500	Manhole	Adoptable
4.002	18	1500	Manhole	Adoptable	19	1800	Manhole	Adoptable
1.013	19	1800	Manhole	Adoptable	20	1500	Manhole	Adoptable
1.014	20	1500	Manhole	Adoptable	21	1500	Manhole	Adoptable
1.015	21	1500	Manhole	Adoptable	21_OUT		Junction	
5.000	22	1500	Manhole	Adoptable	23	1500	Manhole	Adoptable
5.001	23	1500	Manhole	Adoptable	24	1500	Manhole	Adoptable
5.002	24	1500	Manhole	Adoptable	25	1500	Manhole	Adoptable
5.003	25	1500	Manhole	Adoptable	26	1500	Manhole	Adoptable
5.004	26	1500	Manhole	Adoptable	27	1500	Manhole	Adoptable
5.005	27	1500	Manhole	Adoptable	32	1500	Manhole	Adoptable
6.000	28	1500	Manhole	Adoptable	29	1500	Manhole	Adoptable
6.001	29	1500	Manhole	Adoptable	30	1500	Manhole	Adoptable
6.002	30	1500	Manhole	Adoptable	31	1500	Manhole	Adoptable
6.003	31	1500	Manhole	Adoptable	32	1500	Manhole	Adoptable
5.006	32	1500	Manhole	Adoptable	32_OUT		Junction	
7.000	33	1500	Manhole	Adoptable	34	1500	Manhole	Adoptable
7.001	34	1500	Manhole	Adoptable	35	1500	Manhole	Adoptable






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)
7.002	22.000	200.0	300	Circular_RGP	142.766	141.510	0.956	142.233	141.400	0.533
8.000	12.043	240.9	300	Circular_RGP	143.000	142.000	0.700	143.000	141.950	0.750
8.001	5.857	39.0	300	Circular_RGP	143.000	141.950	0.750	142.673	141.800	0.573
8.002	23.821	59.6	600	swale	142.673	141.800	0.273	142.233	141.400	0.233
7.003	28.200	141.0	600	swale	142.233	141.400	0.233	141.652	141.200	-0.148
7.004	21.500	17.9	225	Circular_Default Sewer Type	141.652	141.200	0.227	140.750	140.000	0.525
9.000	14.000	150.5	300	Circular_RGP	144.967	143.094	1.573	144.595	143.001	1.294
9.001	32.442	165.0	300	Circular_RGP	144.595	143.001	1.294	144.110	142.804	1.006
9.002	15.358	165.0	300	Circular_RGP	144.110	142.804	1.006	143.950	142.711	0.939
9.003	18.301	300.0	450	Circular_RGP	143.950	142.561	0.939	143.650	142.500	0.700
10.000	9.798	200.0	300	Circular_RGP	144.300	143.000	1.000	144.300	142.951	1.049
10.001	18.211	200.0	300	Circular_RGP	144.300	142.951	1.049	143.650	142.860	0.490
11.000	6.000	120.0	300	Circular_RGP	140.750	139.250	1.200	140.750	139.200	1.250
11.001	7.027	61.0	300	Circular_RGP	140.750	139.200	1.250	140.550	139.085	1.165
12.000	10.292	68.6	150	Circular_RGP	143.650	142.350	1.150	143.000	142.200	0.650

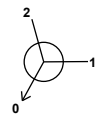




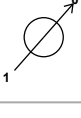
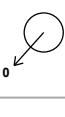
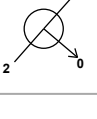
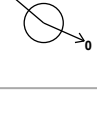
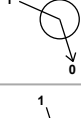
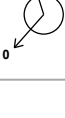
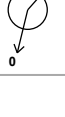

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
7.002	35	1500	Manhole	Adoptable	39		Junction	
8.000	36		Junction		37	1500	Manhole	Adoptable
8.001	37	1500	Manhole	Adoptable	38		Junction	
8.002	38		Junction		39		Junction	
7.003	39		Junction		40		Junction	
7.004	40		Junction		40_OUT		Junction	
9.000	41	1500	Manhole	Adoptable	42	1500	Manhole	Adoptable
9.001	42	1500	Manhole	Adoptable	43	1500	Manhole	Adoptable
9.002	43	1500	Manhole	Adoptable	44	1500	Manhole	Adoptable
9.003	44	1500	Manhole	Adoptable	44_OUT		Junction	
10.000	45		Junction		46	1800	Manhole	Adoptable
10.001	46	1800	Manhole	Adoptable	46_OUT		Junction	
11.000	47		Junction		48	1800	Manhole	Adoptable
11.001	48	1800	Manhole	Adoptable	48_OUT	1500	Manhole	Adoptable
12.000	49		Junction		49_OUT		Junction	

Manhole Schedule

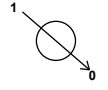
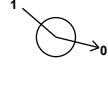
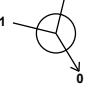
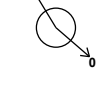
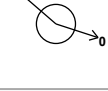
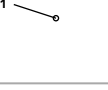
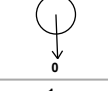
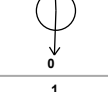



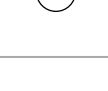

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
1	298787.740	518496.043	144.582	1.735	1500	<div><div>0</div></div>	0	1.000	142.847	300
2	298788.591	518467.656	144.405	1.747	1500	<div><div>1</div><div>0</div></div>	1	1.000	142.658	300
3	298822.277	518439.412	144.884	1.907	1500	<div><div>0</div></div>	0	2.000	142.977	300






























## Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
4	298796.477	518439.229	144.174	1.713	1500	<div></div>	1 2  0	2.000 1.001 1.002	<a href="#">142.461</a> <a href="#">142.461</a> <a href="#">142.461</a>	300 300 300
5	298791.986	518431.088	143.930	3.031		<div></div>	1  0	1.002  1.003	<a href="#">142.399</a>  <a href="#">140.899</a>	300  1800
6	298791.986	518376.086	143.500	2.739		<div></div>	1  0	1.003  1.004	<a href="#">140.761</a>  <a href="#">140.761</a>	1800  450
7	298791.980	518372.715	143.500	2.750	1500	<div></div>	1  0	1.004  1.005	<a href="#">140.750</a>  <a href="#">140.750</a>	450  450
8	298816.406	518350.843	143.699	3.058	1500	<div></div>	1  0	1.005  1.006	<a href="#">140.641</a>  <a href="#">140.641</a>	450  450
9	298824.337	518359.849	143.810	3.209	1500	<div></div>	1  0	1.006  1.007	<a href="#">140.601</a>  <a href="#">140.601</a>	450  450
10	298855.879	518395.352	144.676	3.851	1500	<div></div>	  0	  3.000	  <a href="#">140.825</a>	  300
11	298839.544	518377.119	144.057	3.533	2100	<div></div>	1 2  0	3.000 1.007 1.008	<a href="#">140.677</a> <a href="#">140.524</a> <a href="#">140.524</a>	300 450 450
12	298871.918	518349.657	143.605	3.293	1500	<div></div>	1  0	1.008  1.009	<a href="#">140.312</a>  <a href="#">140.312</a>	450  450
13	298882.171	518345.122	143.533	3.277	1500	<div></div>	1  0	1.009  1.010	<a href="#">140.256</a>  <a href="#">140.256</a>	450  450
14	298887.200	518329.198	143.373	3.200	1500	<div></div>	1  0	1.010  1.011	<a href="#">140.173</a>  <a href="#">140.173</a>	450  450
15	298855.690	518293.653	142.853	2.918	1500	<div></div>	1  0	1.011  1.012	<a href="#">139.935</a>  <a href="#">139.935</a>	450  450
16	298796.256	518328.351	143.386	2.208	1500	<div></div>	  0	  4.000	  <a href="#">141.178</a>	  450





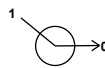









## Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
17	298811.397	518315.267	143.263	2.285	1500		1 4.000	140.978	450
							0 4.001	140.978	450
18	298842.797	518288.132	142.844	2.839	1500		1 4.001	140.005	450
							0 4.002	140.005	450
19	298853.699	518285.457	142.769	3.026	1800		1 4.002	139.893	450
							2 1.012	139.893	450
							0 1.013	139.743	600
20	298859.364	518276.145	142.659	2.943	1500		1 1.013	139.716	600
							0 1.014	139.716	600
21	298906.649	518235.276	141.756	2.196	1500		1 1.014	139.560	600
							0 1.015	139.560	600
21_OUT	298929.476	518227.864	140.750	1.467			1 1.015	139.500	600
22	298851.819	518491.733	146.021	1.425	1500		0 5.000	144.596	300
23	298852.800	518466.752	146.242	1.896	1500		1 5.000	144.346	300
							0 5.001	144.346	300
24	298851.975	518442.966	146.197	2.089	1500		1 5.001	144.108	300
							0 5.002	144.108	300
25	298873.604	518435.144	145.726	1.848	1500		1 5.002	143.878	300
							0 5.003	143.878	300
26	298884.385	518440.413	145.408	1.874	1500		1 5.003	143.684	300
							0 5.004	143.534	450
27	298927.984	518440.766	144.587	1.346	1500		1 5.004	143.241	450
							0 5.005	143.241	450
28	298882.709	518502.680	145.546	1.507	1500		0 6.000	144.039	300

## Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
29	298912.701	518501.984	145.194	1.455	1500		1	6.000	143.739	300
							0	6.001	143.739	300
30	298949.692	518501.156	144.739	1.185	1500		1	6.001	143.554	300
							0	6.002	143.554	300
31	298949.202	518480.262	144.631	1.181	1500		1	6.002	143.450	300
							0	6.003	143.450	300
32	298942.905	518451.186	144.441	1.291	1500		1	6.003	143.301	300
							2	5.005	143.150	450
32_OUT	298959.032	518447.694	144.300	1.274			0	5.006	143.150	450
							1	5.006	143.075	450
33	298903.506	518324.393	143.203	1.508	1500					
							0	7.000	141.695	300
34	298916.494	518308.661	142.933	1.340	1500		1	7.000	141.593	300
							0	7.001	141.593	300
35	298930.779	518300.110	142.766	1.256	1500		1	7.001	141.510	300
							0	7.002	141.510	300
36	298955.583	518340.600	143.000	1.000						
37	298954.598	518328.597	143.000	1.050	1500		0	8.000	142.000	300
							1	8.000	141.950	300
38	298954.716	518322.741	142.673	0.873			0	8.001	141.950	300
							1	8.001	141.800	300
39	298952.751	518299.001	142.233	0.833			0	8.002	141.800	600
							1	8.002	141.400	600
40	298952.183	518270.807	141.652	0.452			2	7.002	141.400	300
							0	7.003	141.400	600
40	298952.183	518270.807	141.652	0.452			1	7.003	141.200	600
							0	7.004	141.200	225

## Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
40_OUT	298942.647	518251.537	140.750	1.467		 1	7.004	140.000	225
41	298887.750	518412.748	144.967	1.873	1500	 0	9.000	143.094	300
42	298901.374	518409.525	144.595	1.594	1500	 1	9.000	143.001	300
43	298926.450	518388.942	144.110	1.306	1500	 1	9.001	143.001	300
44	298938.321	518379.198	143.950	1.389	1500	 1	9.002	142.804	300
44_OUT	298956.621	518379.374	143.650	1.281		 1	9.003	142.561	450
45	298960.739	518422.151	144.300	1.300		 0	10.000	142.500	450
46	298953.552	518415.491	144.300	1.349	1800	 1	10.000	143.000	300
46_OUT	298958.170	518397.875	143.650	1.281		 0	10.001	142.951	300
47	298945.464	518218.771	140.750	1.500		 1	10.001	142.860	300
48	298947.931	518213.302	140.750	1.550	1800	 1	11.000	139.250	300
48_OUT	298950.874	518206.921	140.550	1.465	1500	 1	11.001	139.200	300
49	298957.697	518378.738	143.650	1.300		 0	11.001	139.085	300
						 0	12.000	142.350	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
49_OUT	298957.623	518368.446	143.000	0.972		<div><div>1</div><div></div></div>	12.000	142.200	150

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	Check Discharge Volume	✓
Summer CV	0.750	Drain Down Time (mins)	240	100 year 360 minute (m³)	
Winter CV	0.840	Additional Storage (m³/ha)	20.0		
Analysis Speed	Detailed	Check Discharge Rate(s)	✓		

Storm Durations

15	60	180	360	600	960	2160
30	120	240	480	720	1440	2880

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	40	0
30	0	40	0
100	0	40	0
100	50	40	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		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)		Storm Duration (mins)	360
Soil Index	1	Betterment (%)	0
SPR	0.10	PR	
CWI		Runoff Volume (m³)	

Node 48 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	139.200	Product Number	CTL-SHE-0256-3840-1550-3840
Design Depth (m)	1.550	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	38.4	Min Node Diameter (mm)	1800

## Node 37 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	141.950	Product Number	CTL-SHE-0194-1900-1000-1900
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	19.0	Min Node Diameter (mm)	1500

## Node 46 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	142.951	Product Number	CTL-SHE-0122-7300-1300-7300
Design Depth (m)	1.300	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	7.3	Min Node Diameter (mm)	1200

## Node 11 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	140.524	Product Number	CTL-SHE-0142-1280-2400-1280
Design Depth (m)	2.400	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	12.8	Min Node Diameter (mm)	1500

## Node 47 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	33.079
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	139.250	Main Channel Slope (1:X)	1000.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.350

### Inlets

40\_OUT | 21\_OUT

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	391.1	0.0	0.400	525.8	0.0	0.800	632.4	0.0	1.200	747.4	0.0
0.100	451.3	0.0	0.500	551.7	0.0	0.900	660.4	0.0	1.300	777.5	0.0
0.200	475.6	0.0	0.600	578.1	0.0	1.000	688.9	0.0	1.400	808.0	0.0
0.300	500.5	0.0	0.700	605.0	0.0	1.100	717.9	0.0	1.500	851.8	0.0

## Node 45 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	25.600
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	143.000	Main Channel Slope (1:X)	1000.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.350

### Inlets

32\_OUT

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	261.6	0.0	0.400	433.7	0.0	0.800	615.3	0.0	1.200	806.1	0.0
0.100	303.6	0.0	0.500	478.2	0.0	0.900	662.1	0.0	1.300	856.9	0.0
0.200	346.4	0.0	0.600	523.3	0.0	1.000	709.5	0.0			
0.300	389.8	0.0	0.700	569.0	0.0	1.100	757.5	0.0			

**Node 49 Flow through Pond Storage Structure**

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	19.143
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	142.350	Main Channel Slope (1:X)	1000.0
Safety Factor	2.0	Time to half empty (mins)	19	Main Channel n	0.350

**Inlets**

46\_OUT | 44\_OUT

Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )
0.000	25.6	0.0	0.400	74.8	0.0	0.800	133.3	0.0	1.200	201.1	0.0
0.100	37.0	0.0	0.500	88.6	0.0	0.900	149.4	0.0	1.300	222.1	0.0
0.200	49.0	0.0	0.600	102.9	0.0	1.000	166.1	0.0			
0.300	61.6	0.0	0.700	117.9	0.0	1.100	183.3	0.0			

**Node 36 Flow through Pond Storage Structure**

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	27.921
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	142.000	Main Channel Slope (1:X)	1000.0
Safety Factor	2.0	Time to half empty (mins)	164	Main Channel n	0.350

**Inlets**

49\_OUT

Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )
0.000	25.7	0.0	0.300	78.3	0.0	0.600	137.1	0.0	0.900	201.9	0.0
0.100	42.5	0.0	0.400	97.2	0.0	0.700	158.0	0.0	1.000	267.4	0.0
0.200	60.1	0.0	0.500	116.8	0.0	0.800	179.6	0.0			

**Rainfall**

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year +40% A 15 minute summer	103.654	29.331
2 year +40% A 15 minute winter	72.740	29.331
2 year +40% A 30 minute summer	70.670	19.997
2 year +40% A 30 minute winter	49.593	19.997
2 year +40% A 60 minute summer	50.134	13.249
2 year +40% A 60 minute winter	33.308	13.249
2 year +40% A 120 minute summer	35.220	9.307
2 year +40% A 120 minute winter	23.399	9.307
2 year +40% A 180 minute summer	29.051	7.476
2 year +40% A 180 minute winter	18.884	7.476
2 year +40% A 240 minute summer	24.025	6.349
2 year +40% A 240 minute winter	15.961	6.349
2 year +40% A 360 minute summer	19.297	4.966
2 year +40% A 360 minute winter	12.544	4.966
2 year +40% A 480 minute summer	15.610	4.125
2 year +40% A 480 minute winter	10.371	4.125
2 year +40% A 600 minute summer	12.993	3.554
2 year +40% A 600 minute winter	8.877	3.554
2 year +40% A 720 minute summer	11.704	3.137
2 year +40% A 720 minute winter	7.866	3.137
2 year +40% A 960 minute summer	9.735	2.563

## Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year +40% A 960 minute winter	6.449	2.563
2 year +40% A 1440 minute summer	7.145	1.915
2 year +40% A 1440 minute winter	4.802	1.915
2 year +40% A 2160 minute summer	5.207	1.439
2 year +40% A 2160 minute winter	3.588	1.439
2 year +40% A 2880 minute summer	4.411	1.182
2 year +40% A 2880 minute winter	2.965	1.182
30 year +40% A 15 minute summer	208.683	59.050
30 year +40% A 15 minute winter	146.444	59.050
30 year +40% A 30 minute summer	146.390	41.423
30 year +40% A 30 minute winter	102.730	41.423
30 year +40% A 60 minute summer	105.377	27.848
30 year +40% A 60 minute winter	70.010	27.848
30 year +40% A 120 minute summer	66.883	17.675
30 year +40% A 120 minute winter	44.435	17.675
30 year +40% A 180 minute summer	52.580	13.531
30 year +40% A 180 minute winter	34.178	13.531
30 year +40% A 240 minute summer	42.292	11.177
30 year +40% A 240 minute winter	28.098	11.177
30 year +40% A 360 minute summer	33.033	8.500
30 year +40% A 360 minute winter	21.472	8.500
30 year +40% A 480 minute summer	26.392	6.975
30 year +40% A 480 minute winter	17.534	6.975
30 year +40% A 600 minute summer	21.868	5.981
30 year +40% A 600 minute winter	14.942	5.981
30 year +40% A 720 minute summer	19.694	5.278
30 year +40% A 720 minute winter	13.235	5.278
30 year +40% A 960 minute summer	16.507	4.347
30 year +40% A 960 minute winter	10.934	4.347
30 year +40% A 1440 minute summer	12.412	3.326
30 year +40% A 1440 minute winter	8.341	3.326
30 year +40% A 2160 minute summer	9.360	2.587
30 year +40% A 2160 minute winter	6.449	2.587
30 year +40% A 2880 minute summer	8.079	2.165
30 year +40% A 2880 minute winter	5.430	2.165
100 year +40% A 15 minute summer	258.907	73.262
100 year +40% A 15 minute winter	181.689	73.262
100 year +40% A 30 minute summer	184.234	52.132
100 year +40% A 30 minute winter	129.287	52.132
100 year +40% A 60 minute summer	134.520	35.550
100 year +40% A 60 minute winter	89.372	35.550
100 year +40% A 120 minute summer	84.445	22.316
100 year +40% A 120 minute winter	56.103	22.316
100 year +40% A 180 minute summer	66.111	17.013
100 year +40% A 180 minute winter	42.974	17.013
100 year +40% A 240 minute summer	53.132	14.041
100 year +40% A 240 minute winter	35.299	14.041
100 year +40% A 360 minute summer	41.653	10.719
100 year +40% A 360 minute winter	27.075	10.719
100 year +40% A 480 minute summer	33.554	8.867
100 year +40% A 480 minute winter	22.292	8.867
100 year +40% A 600 minute summer	28.025	7.665



## Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% A 600 minute winter	19.148	7.665
100 year +40% A 720 minute summer	25.421	6.813
100 year +40% A 720 minute winter	17.085	6.813
100 year +40% A 960 minute summer	21.546	5.674
100 year +40% A 960 minute winter	14.272	5.674
100 year +40% A 1440 minute summer	16.334	4.378
100 year +40% A 1440 minute winter	10.978	4.378
100 year +40% A 2160 minute summer	12.246	3.384
100 year +40% A 2160 minute winter	8.438	3.384
100 year +40% A 2880 minute summer	10.475	2.807
100 year +40% A 2880 minute winter	7.040	2.807
100 year +50% CC +40% A 15 minute summer	388.361	109.893
100 year +50% CC +40% A 15 minute winter	272.534	109.893
100 year +50% CC +40% A 30 minute summer	276.350	78.198
100 year +50% CC +40% A 30 minute winter	193.930	78.198
100 year +50% CC +40% A 60 minute summer	201.779	53.324
100 year +50% CC +40% A 60 minute winter	134.057	53.324
100 year +50% CC +40% A 120 minute summer	126.667	33.474
100 year +50% CC +40% A 120 minute winter	84.155	33.474
100 year +50% CC +40% A 180 minute summer	99.166	25.519
100 year +50% CC +40% A 180 minute winter	64.461	25.519
100 year +50% CC +40% A 240 minute summer	79.698	21.062
100 year +50% CC +40% A 240 minute winter	52.949	21.062
100 year +50% CC +40% A 360 minute summer	62.479	16.078
100 year +50% CC +40% A 360 minute winter	40.613	16.078
100 year +50% CC +40% A 480 minute summer	50.331	13.301
100 year +50% CC +40% A 480 minute winter	33.439	13.301
100 year +50% CC +40% A 600 minute summer	42.037	11.498
100 year +50% CC +40% A 600 minute winter	28.723	11.498
100 year +50% CC +40% A 720 minute summer	38.132	10.220
100 year +50% CC +40% A 720 minute winter	25.627	10.220
100 year +50% CC +40% A 960 minute summer	32.319	8.510
100 year +50% CC +40% A 960 minute winter	21.408	8.510
100 year +50% CC +40% A 1440 minute summer	24.502	6.567
100 year +50% CC +40% A 1440 minute winter	16.467	6.567
100 year +50% CC +40% A 2160 minute summer	18.369	5.077
100 year +50% CC +40% A 2160 minute winter	12.657	5.077
100 year +50% CC +40% A 2880 minute summer	15.713	4.211
100 year +50% CC +40% A 2880 minute winter	10.560	4.211

CALCULATION		Job No.	K40340	Page	1 of 4
Job	Harras Dyke	Drg no.	-	Date	16/04/2024
	Whitehaven	Revision	-	Initial	RH
Title	Sustainable Drainage - Treatment		Checked		

## DESIGN BASIS MEMORANDUM - SUSTAINABLE DRAINAGE TREATMENT OF SURFACE WATER

### Design Brief

The following calculations outline the recommended treatment requirements for a sustainable drainage system as outlined in the SuDS Manual 2015. The method used is the simple index approach outlined in section 26.

The requirement for oil interceptors has been assessed in line with the now withdrawn Pollution Prevention Guidance document PPG3, produced by the Environment Agency. An oil interceptor is not required for the proposed development.

Treatment within SuDS components is affected by the flow rate and volume of water which passes through the component. It is not reasonable or practical to treat the entirety of the runoff for infrequent greater intensity design storms. In any case the majority of the pollutants are removed from surfaces by the more frequent rainfall events and in the first flush resulting from the initial runoff from the larger events. and to a certain capacity.

The following references have been used in the preparation of these calculations:

- SUDS Manual, CIRIA Report C753, 2015
- Pollution Mitigation Indices provided by Hydro International

### Results Summary

#### Roof Area:

Treatment component 1 Detention basin

Treatment component 2 None

Indices	Suspended	Metals	Hydrocarbons
Pollution Hazard	0.2	0.2	0.05
Pollution Mitigation	0.5	0.5	0.6
Treatment Suitability	Adequate	Adequate	Adequate

#### Residential Parking:

Treatment component 1 Detention basin

Treatment component 2 None


Indices	Suspended	Metals	Hydrocarbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.5	0.5	0.6
Treatment Suitability	Adequate	Adequate	Adequate

#### Residential Roads

Treatment component 1 Detention basin

Treatment component 2 None

Indices	Suspended	Metals	Hydrocarbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.5	0.5	0.6
Treatment Suitability	Adequate	Adequate	Adequate

 <small>Kendal   01539 729393    Lancaster   01524 32548</small>	<b>CALCULATION</b>		Job No.	K40340	Page	2 of 4
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		Whitehaven	Revision		Initial	RH
	Title	Sustainable Drainage - Treatment		Checked		

**POLLUTION HAZARD INDEX**

		Pollution Hazard Indices		
Source of Runoff	Pollution Hazard	Suspended Solids	Metals	Hydro-carbons
Residential roofing	Very low	0.2	0.2	0.05

**POLLUTION MITIGATION INDEX**


The receiving water body shall be: Surface Water

		Pollution Mitigation Indices		
	Suds Component	Suspended Solids	Metals	Hydro-carbons
1	Detention basin	0.5	0.5	0.6
2	None	0	0	0
3	None	0	0	0
4	None	0	0	0

**Total Pollution Mitigation Index            0.5            0.5            0.6**

**ASSESSMENT OF TREATMENT PROPOSAL**

Indices	Suspended Solids	Metals	Hydro-carbons
Pollution Hazard	0.2	0.2	0.05
Pollution Mitigation	0.5	0.5	0.6
	Adequate	Adequate	Adequate

 <small>Kendal   01539 729393    Lancaster   01524 32548</small>	<b>CALCULATION</b>		Job No.	K40340	Page	3 of 4
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		Whitehaven	Revision		Initial	RH
	Title	Sustainable Drainage - Treatment		Checked		

**POLLUTION HAZARD INDEX**

		Pollution Hazard Indices		
Source of Runoff	Pollution Hazard	Suspended Solids	Metals	Hydro-carbons
Individual driveway	Low	0.5	0.4	0.4

**POLLUTION MITIGATION INDEX**

The receiving water body shall be: Surface Water

		Pollution Mitigation Indices		
	Suds Component	Suspended Solids	Metals	Hydro-carbons
1	Detention basin	0.5	0.5	0.6
2	None	0	0	0
3	None	0	0	0
4	None	0	0	0

**Total Pollution Mitigation Index                    0.5                    0.5                    0.6**

**ASSESSMENT OF TREATMENT PROPOSAL**

Indices	Suspended Solids	Metals	Hydro-carbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.5	0.5	0.6
	<b>Adequate</b>	<b>Adequate</b>	<b>Adequate</b>

<b>R G PARKINS</b> <small>Kendal   01539 729393    Lancaster   01524 32548</small>	<b>CALCULATION</b>		Job No.	K40340	Page	4 of 4
	Job	Harras Dyke	Drg no.		Date	16/04/2024
		Whitehaven	Revision		Initial	RH
	Title	Sustainable Drainage - Treatment		Checked		

**POLLUTION HAZARD INDEX**

Source of Runoff	Pollution Hazard	Pollution Hazard Indices		
		Suspended Solids	Metals	Hydro-carbons
Low traffic roads (e.g. residential roads and general access roads, < 300 traffic movements/day)	Low	0.5	0.4	0.4

**POLLUTION MITIGATION INDEX**


The receiving water body shall be: Surface Water

Suds Component		Pollution Mitigation Indices		
		Suspended Solids	Metals	Hydro-carbons
1	Detention basin	0.5	0.5	0.6
2	None	0	0	0
3	None	0	0	0
4	None	0	0	0

**Total Pollution Mitigation Index            0.5            0.5            0.6**

**ASSESSMENT OF TREATMENT PROPOSAL**

Indices	Suspended Solids	Metals	Hydro-carbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.5	0.5	0.6
	<b>Adequate</b>	<b>Adequate</b>	<b>Adequate</b>

 <small>Kendal   01539 729393    Lancaster   01524 32548</small>	<b>CALCULATION</b>		Job No.	K40340	Page	4 of 4
	Job	Harras Dyke	Drg no.		Date	16/04/2024
		Whitehaven	Revision		Initial	RH
	Title	Sustainable Drainage - Treatment		Checked		

**POLLUTION HAZARD INDEX**

		Pollution Hazard Indices		
Source of Runoff	Pollution Hazard	Suspended Solids	Metals	Hydro-carbons
Low traffic roads (e.g. residential roads and general access roads, < 300 traffic movements/day)	Low	0.5	0.4	0.4

**POLLUTION MITIGATION INDEX**

The receiving water body shall be: Surface Water

		Pollution Mitigation Indices		
	Suds Component	Suspended Solids	Metals	Hydro-carbons
1	Swale	0.5	0.6	0.6
2	Detention basin	0.5	0.5	0.6
3	None	0	0	0
4	None	0	0	0

**Total Pollution Mitigation Index            0.75            0.85            0.9**

**ASSESSMENT OF TREATMENT PROPOSAL**

Indices	Suspended Solids	Metals	Hydro-carbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.75	0.85	0.9
	<b>Adequate</b>	<b>Adequate</b>	<b>Adequate</b>

## APPENDIX C

### UU CORRESPONDENCE

## Rachel Heron

---

**From:** wastewaterdeveloperservices@uuplc.co.uk  
**Sent:** 24 April 2024 11:28  
**To:** Rachel Heron  
**Subject:** RE: 05510346 - Pre Development Enquiry- Harras Dyke Farm, Harras Road, Whitehaven

Good Morning,

Please accept this email as receipt of your updated application received on 23/04/2024 for the above development. This has now been logged on our system and the job reference is 05510346 we would ask that you quote this reference in all future correspondence.

I have reviewed your application (and attachments) and can confirm this is suitable to be passed to Thomas Bethell for technical assessment. You will receive their response within 10 working days.

Kind regards



**Lois Williams**  
Developer Services Assistant  
Developer Services & Metering  
Customer Services  
unitedutilities.com  
**Tel:** 0345 072 6067 Option 2 for Wastewater Services)  
**Direct Tel:**

If you feel you have received a good service from myself, please can you take two minutes to fill in the survey below. This will be much appreciated



Visit: <https://unitedutilities.thewowawards.co.uk/nominate>

----- Original Message -----

**From:** Rachel Heron [rachel.heron@rgparkins.com]  
**Sent:** 24/04/2024 09:04  
**To:** wastewaterdeveloperservices@uuplc.co.uk  
**Subject:** RE: 05510346 - Pre Development Enquiry- Harras Dyke Farm, Harras Road, Whitehaven

Good Morning,



Thank you for your response to the below.

I am just emailing with an update, apologies I had thought there were 77 no. plots proposed on the site, when in actual fact there is 90 no. We are still proposing to split the flows into 2 no. UU manholes, and the estimated peak flows as follows:

1. UU MH 7303 = 1.53 l/s (33 no. plots)
2. UU MH 9003 = 2.64 l/s (57 no. plots)
3. Combined flows from site = 4.17 l/s.

Is this in principle still acceptable to UU?

Kind Regards,

Rachel Heron MSc

Engineer

# R G PARKINS

Meadowside | Shap Road | Kendal | Cumbria | LA9 6NY  
01539 729393

[www.rgparkins.com](http://www.rgparkins.com)

 @RG\_Parkins

---

**From:** wastewaterdeveloperservices@uuplc.co.uk <wastewaterdeveloperservices@uuplc.co.uk>

**Sent:** Wednesday, April 3, 2024 2:27 PM

**To:** Rachel Heron <rachel.heron@rgparkins.com>

**Subject:** RE: 05510346 - Pre Development Enquiry- Harras Dyke Farm, Harras Road, Whitehaven

Good Afternoon Rachel,

**Pre Development Enquiry- Harras Dyke Farm, Harras Road, Whitehaven CA28 6NN – UU ref 05510346**

We have carried out an assessment of your application which is based on the information provided. This pre-development advice on your drainage strategy will be valid for 12 months. Your drainage strategy will need to be reviewed by other competent authorities as part of the planning process, and we advise that you carry out the

necessary site investigations to confirm the viability of your proposals.

If your investigations require access to our public sewer network, we ask that you contact our network engineers with a request for an access certificate via our main contact telephone number 0345 6723 723 or refer to the link below:

<https://www.unitedutilities.com/builders-developers/working-near-our-assets/>

#### **Asset Protection:**

I am aware there are significant clean water assets at this site and particular care is needed when designing the drainage layout. You will need to ensure the proposals are satisfactory with our clean water department – this will require determining the precise location of the water mains and providing any required protection measures/clearance distances before a drainage strategy can be confirmed as acceptable.

#### **Foul Water**

Foul flow from this site will be allowed to drain into the public foul water/combined sewer system. Ultimately, we have no objections to the proposal of two connections, with 48 plots (~2.22 l/s) connecting at UUMH7303 and 29 plots (~1.34 l/s) connecting at UUMH9003.

*If you are able to identify an alternative, more suitable point of discharge, we request that you contact us at your earliest convenience so that we can assess suitability.*

#### **Surface Water**

Thank you for providing the proposed drainage plan showing surface water is proposed to connect to an existing land drainage system which then connects to a watercourse. From a strategy point of view we would have no objections to this, however there would be adoptability concerns as we cannot adopt networks discharging to private assets unless the asset in question is a culverted watercourse. Are you please able to confirm if this drain is recognised as a formal culverted watercourse in the eyes of the LLFA? We would need to be assured the asset is in a good working order. Has the asset been surveyed between the proposed connection point and the downstream watercourse?

As for flow rates, United Utilities cannot agree discharge rates to such assets – this will need to be agreed with the LLFA.

I have also noticed there appears to be an online attenuation tank proposed. From an adoptability point of view there are maintenance issues involved with safely accessing large tanks. The land here also offers a chance for more sustainable attenuation features such as another basin or pond which should be looked into in the first instance. Failing that it may be simpler and more cost effective to have private offline storage here.

#### **Levels**

For low-lying sites, (where the ground level of the site or the level of a basement is below the ground level at the point where the drainage connects to the public sewer), care should be taken to ensure that the property is not at increased risk of flooding. If these circumstances exist, we recommend that you contact us to discuss further. It could affect the detailed design of your site and result in the need to incorporate appropriate mitigating measures in your drainage scheme.

#### **Land drainage / Overland flows / track drainage**

United Utilities have no obligation, and furthermore we do not accept land drainage, overland flows or track drainage into the public sewerage network under any circumstances

#### **Existing Wastewater Assets Crossing the Site**

We have reviewed our records and can confirm that there does not appear to be any charted public sewers located within the boundary of proposed development. However, due to the accuracy of the records and the public sewer transfer legislation in 2011, not all public sewers are shown on our records so we would ask that you proceed with caution and carry out your own site investigation works. If any uncharted sewers are identified while carrying out your works we would ask that you contact United Utilities at the earliest opportunity so that we can offer guidance and update our records.

### **Existing Water Assets Crossing the Site**

It is the developer responsibility to identify utilities on-site. Where clean water assets are shown on our records, we recommend that you contact our Water Pre-Development Team, via the following email address:

[DeveloperServicesWater@uuplc.co.uk](mailto:DeveloperServicesWater@uuplc.co.uk). Further information for this service can be found on our website via the link below:

<https://www.unitedutilities.com/builders-developers/larger-developments/pre-development/water-pre-dev/>

### **Connection Application**

Although we may discuss and agree discharge points and rates in principle, please be aware that you will have to apply for a formal sewer connection. This is so that we can assess the method of construction, Health & Safety requirements and to ultimately inspect the connection when it is made. Details of the application process and the form itself can be obtained from our website by following the link below:

<https://www.unitedutilities.com/builders-developers/wastewater-services/sewer-connections/sewer-connection/>

We recommend that the detailed design should confirm the locations of all utilities in the area and ensure that any proposed drainage solution considers routing and clash checks where required.

If we can be of any further assistance please don't hesitate to contact us further.

### **Sewer Adoptions**

You have indicated on your application form that you intend to put the sewers forward for adoption (including any SuDS components that can come within the meaning of a sewer).

United Utilities assess adoption applications based on the current Design & Construction Guidance and local practices which have now replaced 'Sewers For Adoption 6<sup>th</sup> Edition'.

We recommend that you submit a pre design assessment to the sewer adoption mailbox ([SewerAdoptions@uuplc.co.uk](mailto:SewerAdoptions@uuplc.co.uk)) stating pre design assessment in the title

Please refer to links below to obtain further guidance:

<https://www.unitedutilities.com/builders-developers/larger-developments/wastewater/sewer-adoptions/>

Site drainage must be designed in accordance with Building Regulations, National Planning Policy, and local flood authority guidelines, we would recommend that you speak and make suitable agreements with the relevant statutory bodies.

If you intend to put forward your wastewater assets for adoption by United Utilities, the proposed detail design will be subject to a technical appraisal by an Adoption Engineer as we need to be sure that the proposals meets the requirements set out in the Design & Construction Guidance. The proposed design should give consideration to long term operability and give United Utilities a safe and cost effective proposal for the lifetime of the assets. In these cases, we strongly recommend that no construction commences until the detailed drainage design, submitted as part of the Section 104 application, has been assessed and accepted in writing by United Utilities. Any work carried out prior to the technical assessment being approved is done entirely at the developer's own risk and could be subject to change.

### **SuDS**

If your development proposal incorporates any SuDS component(s) which interact with a sewer network you plan on offering for adoption to United Utilities; contact should be made with our technical team at your earliest convenience, please complete the 'Section 104 pre-application form : ' and include as much relevant detail as you can. These discussions can help prevent delays later in the development process.

#### **Section 104 Pre application form (1b)**

As per the sewerage sector guidance, all SuDS should be designed in accordance with the standards within the Design & construction guidance & the CIRIA SuDS manual (C753)

### Codes For Adoption

The new Codes for Adoption are outlined on the Water UK Website. The link below takes you to their webpage:

<https://www.water.org.uk/technical-guidance/developers-services/codes-for-adoption/>

A free copy of the new Design & Construction Guidance can be downloaded via the link below:

<https://www.water.org.uk/sewerage-sector-guidance-approved-documents/>

Kind regards,

Tom



**Thomas Bethell**

Developer Engineer  
Developer Services & Metering  
Customer Services  
**M:** 07880 339 195  
unitedutilities.com

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----- Original Message -----

**From:** Rachel Heron [rachel.heron@rgparkins.com]

**Sent:** 26/03/2024 11:00

**To:** [wastewaterdeveloperservices@uuplc.co.uk](mailto:wastewaterdeveloperservices@uuplc.co.uk)

**Subject:** Pre Development Enquiry- Harras Dyke Farm, Harras Road, Whitehaven

Good Morning,

We have been asked to produce a Drainage Strategy for a proposed housing development at Harras Dyke Farm at Harras Road, Whitehaven. The development will comprise 77 no. residential dwellings, with associated access roads, driveways and landscaped areas.

It is proposed that foul flows from the site will be conveyed within an adoptable pipe network discharging into the UU 150 mm dia. public foul sewer. Due to the topography, there will need to be 2 no. connections into this system. The north and eastern portion of the site (48 no. plots) will discharge to UU MH 7303 at a predicted peak flow rate of 2.22 l/s, with the remaining 29 no. plots will discharge into UU MH 9003 (1.34 l/s).

Surface water will be attenuated within a series of box culverts within the proposed highways, before discharging into a detention basin to receive the required treatment. Numerous CCTV surveys have confirmed there is an existing surface water pipe in the low point of the site (where the basin will be located). A flow control will limit flows into this outlet pipe, which crosses under Red Lonning, and discharging into a watercourse within the golf course.

Are these proposals in principle acceptable to UU?

Post Code CA28 6NN

Grid Reference 298880E 518392N

Regards,

**Rachel Heron** MSc

**Engineer**

[Image is no longer available]

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