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TOW-TCL-HDG-XX-RP-D-0500

The Oaks, Wrexham

Flood Consequence Assessment and Drainage Strategy

Prepared for:

Cefn Park Developments Ltd.

TerraConsult

The Oaks, Wrexham

**Flood Consequence Assessment
and Drainage Strategy**

May 2019

Carried Out For:

Cefn Park Developments

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1.0 INTRODUCTION

1.1 Context

- 1.1.1 The Oaks is a proposed industrial development on the fringe of Wrexham Industrial Estate.
- 1.1.2 This Flood Consequence Assessment and Drainage Strategy has been produced by TerraConsult on behalf of Cefn Park Developments Ltd. In respect of an Outline Planning Application to construct 11no. Industrial Units and Associated Infrastructure as part of an extension to Wrexham Industrial Estate. The site location is included in Figure 1 below.
- 1.1.3 This Flood Consequence Assessment will look at the consequences of flooding from all sources in line with TAN15 and will propose an option for draining the site in accordance with the Welsh Government Statutory Standards, CIRIA 753 and Schedule 3 of the Flood and water Management Act 2010.

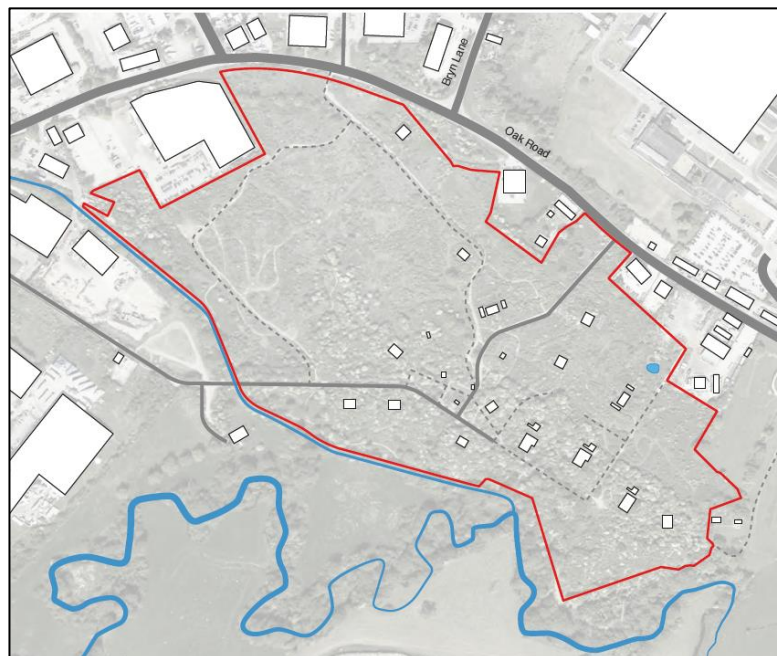


Figure 1 – Site Location Plan

1.2 Existing Site

- 1.2.1 The site is located along Oak Road Wrexham, with a nearby postcode of LL13 9RG. The site is at approximate co-ordinates 338745, 349271 (SJ387492). The site is 10.3 ha.
- 1.2.2 The site was formerly part of the Royal Ordinance Factory that previously occupied Wrexham Industrial Estate.
- 1.2.3 The site is bounded to the north by Oak Road, east by agricultural fields, west by industrial units and to the south by Redwither Brook and the River Clywedog.
- 1.2.4 The site level slope generally in a southerly direction. With slopes of approximately 1:60 in the west and 1:25 in the eastern areas of the site. There is a distinct steepening of gradient to the south of the site towards Redwither Brook. The top of this

steeper embankment follows a former Royal Ordinance Road. A sketch has been included in **Figure 2**.

- 1.2.5 The levels along Oak Road are approximately 31.4m AOD. Falling to between 25 and 26m AOD at the former Royal Ordinance Road, before falling to approximately 23m AOD adjacent to Redwither Brook.

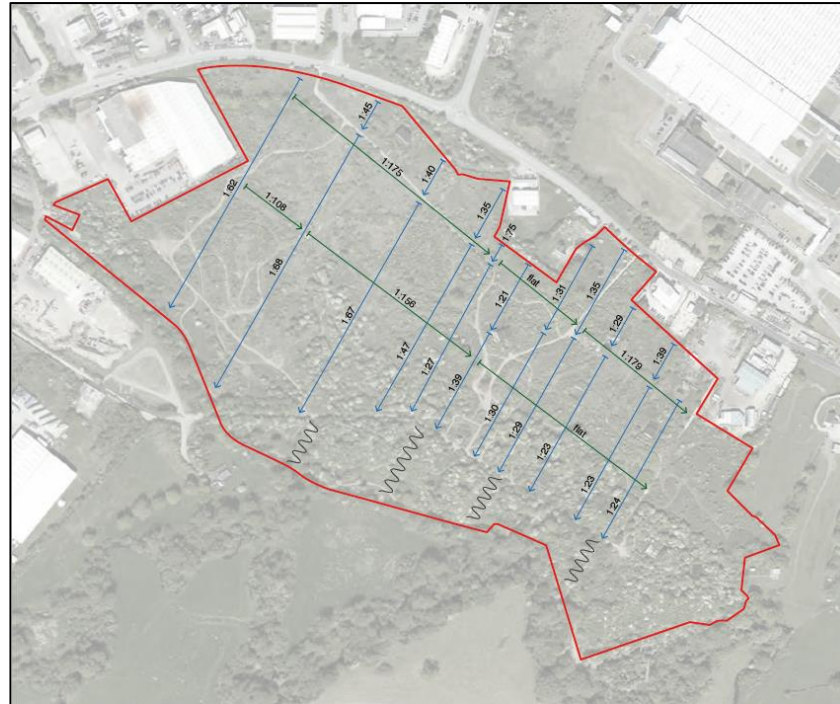


Figure 2 – Levels and Gradients Sketch

- 1.2.6 The site currently comprises of various woodland, scrub and grassland habitats. The north/west half of the site have undergone scrub clearance in 1970 and 2000. These areas have been relatively undisturbed and left to naturally regenerate. The site now largely comprises of dense, continuous hawthorn scrub.
- 1.2.7 Within the wider area of scrub are some small glades of flower-rich, short sward grassland along with ribbons of further flower-rich grassland. Interspersed amongst these areas are patches of bramble underscrub and taller swards of coarser grasses.
- 1.2.8 The southern half of the site comprises various types of broadleaved woodland habitat.
- 1.2.9 The site is crossed by a variety of public utilities, including 132kV, 33kV and 11kV power lines, Dee Valley Water mains, 2no. Dwr Cymru Welsh Water combined sewers.

1.3 Proposed Development

- 1.3.1 The Outline Planning Application at The Oaks Wrexham proposes 8No. Industrial units of classes B1, B2, B8 with associated access road, infrastructure, heritage area and ecological mitigation.
- 1.3.2 Pedestrian links are to be provided across Redwither Brook connecting the development to the wider estate.
- 1.3.3 The site is crossed by 2no. DCWW combined sewers. For details of how the proposals related to the public sewerage system please see **Section X**.

Table 1: Existing Site Details

Site name	The Oaks Wrexham
Location	Wrexham Industrial Estate, LL13 9RG (nearby Postcode)
Grid Reference	338745, 349271 (SJ387492)
Site Area (Red Line)	10.3 ha
Planning Authority	Wrexham County Borough Council
Lead Local Flood Authority	Wrexham County Borough Council
SuDs Adopting Body	Wrexham County Borough Council
IDB	None
Sewerage Undertaker	Dwr Cymru Welsh Water (DCWW)
Development Advice Maps	Red line Boundary – Zone A Blue Line Boundary – Zone B and Zone C2
Critical Drainage Area	None

2.0 POLICY DOCUMENTS AND PLANNING

2.1 Planning Policy Wales and Technical Advice Note 15 (TAN15)

- 2.1.1 Planning Policy Wales¹ (PPW) sets out the Welsh Assembly Government's national policies on different aspects of land use planning in Wales in relation to flood risk. Planning Policy Wales is supplemented by TAN15 which is also available online².
- 2.1.2 TAN15 sets out precautionary framework for to guide planning decisions and ensure that new development is directed away from areas of high risk of flooding and to assess the consequences of flooding both on and off site.
- 2.1.3 It encourages development to be located in areas of lower flood risk where possible, and stresses the importance of preventing increases in flood risk off site to the wider catchment area.
- 2.1.4 TAN15 also states that alternative sources of flooding, other than fluvial (river flooding), should also be considered when preparing a Flood Risk Assessment.
- 2.1.5 TAN15 includes a series of tables that define Development Advice Maps, the vulnerability to flooding classification of development land uses summary of planning requirements and acceptability based on the previous 2 criterion.
- 2.1.6 This Flood Consequence Assessment is written in accordance with the PPW and TAN15.

2.2 Preliminary Flood Risk Assessment

- 2.2.1 The Dee Valley Preliminary Flood Risk Assessment (Dec 2018) is a high level screening exercise to identify where the risk of flooding is considered significant. Significant flood risk is identified as:
 - 2.2.1.1 Past flood events affecting 20 or more properties within a postcode or
 - 2.2.1.2 Information and statistics indicate a future flooding risk of 0.1%AEP.
- 2.2.2 Impact of climate change has been assessed against the Welsh Government Guidance note on adapting to climate change for climate change effects on rivers and sea. For surface water flooding and rainfall intensity the Environment Agency guidance flood risk assessments and climate change has been used.
- 2.2.3 Wrexham Industrial Estate is **not identified** as an area at Significant Risk of flooding.

2.3 Wrexham County Borough Council (WCBC) Flood Risk Management Plan 2016-2021

- 2.3.1 The WCBC Flood Risk Management Plan aims to ensure that development is located away from TAN15 zones C1 and C2 and ensure that all development apply the principals of sustainable drainage.
- 2.3.2 Wrexham Industrial Estate is not identified as a higher risk area but the general principals of the Flood Risk Management Plan should apply.

¹ Planning Policy Wales, Dec 2018

² Welsh Assembly Government Technical Advice Note 15 (TAN15) <https://beta.gov.wales/sites/default/files/publications/2018-09/tan15-development-flood-risk.pdf>

2.4 Factoring In Climate Change

- 2.4.1 Welsh Government Guidance note on adapting to climate change for climate change effects on rivers and sea suggests an upper percentile increase in river flood flows of 45% by the 2080's.
- 2.4.2 Increases in rainfall intensities due to climate change are estimated to be a 40% increase by the 2080's. In line with Welsh Assembly Government Guidance an increase of 40% will be added to the rainfall intensities in the calculation of storm water attenuation and flows.

3.0 FLOOD CONSEQUENCE ASSESSMENT

3.1 Development Advice Maps and TAN15

- 3.1.1 This report will assess the risks and consequences of flooding on the existing site and suggest appropriate mitigation for the proposed development where required.
- 3.1.2 The proposed site is classed as Less Vulnerable Development (General Industrial) and all built development is located entirely in Zone A on the Development Advice Maps.
- 3.1.3 This has been deliberate in the development of the master plan for the development in order to ensure that the consequences of flooding are minimised and that the development takes due account of the flood risk posed from rivers and sea.
- 3.1.4 As such the Justification test is not required.
- 3.1.5 Surface water is discussed in detail below.
- 3.1.6 TAN15 Acceptability Criteria indicate that it should be shown that the development does not increase flooding elsewhere. This is discussed in detail in **Section 3.7** below.
- 3.1.7 No development is to take place within Zone B and C2, which are located within the blue line boundary along the edge of Redwither Brook.

3.2 Rivers and Sea (Fluvial)

- 3.2.1 The blue line boundary is bounded to the south by Redwither Brook and the River Clywedog. The red line boundary is approximately 50m north of the watercourses at the closest point.
- 3.2.2 Both Redwither Brook and the River Clywedog are part of the Dee river catchment and both are classed as Main Rivers.
- 3.2.3 River Clywedog is a natural channel with some minor modifications. Redwither Brook is a heavily modified channel, with a culverted section where the Royal Ordinance road crosses the brook.
- 3.2.4 The culvert is a twin 1.5m diameter concrete culvert (see **Figure 3** below).
- 3.2.5 Liaisons with Natural Resources Wales (NRW) indicate that there is no detailed river modelling available for either watercourse. It is assumed that the flood modelling outlines were generated using JFLOW.
- 3.2.6 NRW long term flood risk mapping shows that the River Clywedog and Redwither Brook are at risk of causing flooding and Flood Zones 2 and 3 have been identified in close proximity to the development area.
- 3.2.7 Although the site is within Zone 1 of the Development Advice Maps, an assessment of the residual risk of flooding, for example, in the event of climate change, has been undertaken.
- 3.2.8 Data has been downloaded from the Lle Geo-Portal along with LIDAR information (1m grid).
- 3.2.9 Based on the flood outlines and the LIDAR information, it has been assessed that the Flood Zone 2 and Flood Zone 3 outlines have very similar extents.



Figure 3 - Redwither Brook - Heavily Modified Channel and Culvert



Figure 4 - River Clywedog – Predominantly Natural Channel

- 3.2.10 The flood outline of Redwither Brook to the west of the site, upstream of the culvert, has extents to a level of approximately 24.5m
- 3.2.11 The flood extents to the east, close to the confluence of Redwither Brook and the River Clywedog are at a level of approximately 21m AOD.
- 3.2.12 There is a sharp change in level to the north of Redwither Brook up to the former Royal Ordinance road. The road is at an approximate level of 25.2m AOD.

Upstream of Redwither Culvert

- 3.2.13 The risk of flooding posed by the Redwither Brook Culvert should be considered in the context of the development. Elevated flood levels upstream of the culvert, through high flows or blockage cannot be discounted
- 3.2.14 The available flood zone 2/3 outline estimates a flood level of approximately 24.5m, with the path over the culvert having a local level of 24.8m AOD.
- 3.2.15 There is no development proposed in the vicinity of the Redwither Culvert. It is assessed that in an extreme event or blockage of the culvert, flood flows would remain within the watercourse valley and overtop the road.

- 3.2.16 The area within the vicinity of the upstream of culvert section of Redwither Brook will not be altered in terms of level and as such no change in flow or flood routing is envisaged.
- 3.2.17 Climate change allowances to river flows suggest that the flows in Redwither Brook could increase by 45% by the 2080's. The finished floor level of the proposed development is expected to be no lower than 26.5m taking account of existing ground levels.
- 3.2.18 The topography of the site suggests that no flood routing, even from increased river flows would impact the proposed development site.

Downstream of Redwither Brook Culvert

- 3.2.19 Downstream of the Redwither Brook Culvert, the modified Redwither Brook and the River Clywedog converge.
- 3.2.20 The general area subject to flooding is flat up to the embankment to the Royal Ordinance road.
- 3.2.21 The site is expected to have a FFL no lower than 26.5m AOD, significantly above the outline modelling flood level (21.0m).
- 3.2.22 It is considered that there is no residual risk of flooding from the Redwither Brook, River Clywedog or the potential blocking of the Redwither Culvert.

3.3 Rainfall (Pluvial)

- 3.3.1 Natural Resources flood risk mapping has been studied as part of the assessment of the surface water flood risk.
- 3.3.2 Based on the extents of surface water flooding and directions of flow, the surface water flood risk at the site is not generated from flows from outside of the site.
- 3.3.3 Areas identified to be at risk of flooding are general low spots or existing roads within the site boundary.
- 3.3.4 The depth of surface water flooding identified within the site ranges from, 0.15-0.9m deep and is slow moving (less than 0.25 m/s).
- 3.3.5 The combination of depth and velocity gives a hazard rating – this hazard rating is a mixture within the site of low, danger for some and danger for all.
- 3.3.6 As part of the proposed redevelopment at the site, a surface water drainage system will be put in place.
- 3.3.7 The surface water drainage design should ensure that surface water is managed appropriately on site and not to pose a hazard to site users.
- 3.3.8 On the basis of the above, whilst there is a medium risk of surface water flooding in the sites current state this is due to the onsite topography and not overland flow from outside the site. The risk of surface water flooding post development would be considered **low**.

3.4 Groundwater

- 3.4.1 The DEE Valley preliminary flood risk assessment, issued in December 2018 states that groundwater flooding in Wales is rare and no incidents have been recorded within the Dee Valley Catchment since the previous PFRA in 2011.
- 3.4.2 The ground investigation carried out by TerraConsult shows that the site is underlain by stiff clays. These stiff clays are likely to act as an aquitard.
- 3.4.3 Based on the above the risk of flooding from groundwater sources is considered **low**.

3.5 Artificial (Canals and Reservoirs)

- 3.5.1 The Natural Resources long term flood risk maps indicate that there is a risk of reservoir flooding within the valley of the River Clywedog. Flood waters in the event modelled would be fast moving (0.5-2.0m/s) and moderately deep (0.3-2.0m).
- 3.5.2 The reservoir flooding extents are outside of the proposed development with finished floor levels >2m above the existing ground level within the areas shown to be at risk.
- 3.5.3 There are no other artificial water sources in the vicinity of the site.
- 3.5.4 The risk of flooding from artificial sources is considered **low**.

3.6 Sewers

- 3.6.1 The risk of sewer flooding cannot be discounted at the site. There are 2no. Welsh Water sewers crossing the site and a drainage system will be installed to serve the development.
- 3.6.2 The drainage system serving the site should either be offered for adoption to DCWW / Wrexham SuDS Adopting Body (WSAB) or a suitable management plan put in place to ensure the system is maintained.
- 3.6.3 Whether adoption is acceptable to DCWW / WSAB will depend upon the disposal strategy at the site any whether the development is considered as a single site.
- 3.6.4 There are no basements proposed as part of the development.
- 3.6.5 The development should follow best practice and ensure external hard standing areas fall away from buildings and pedestrian entry points are 150mm above surrounding ground levels to prevent water ingress.
- 3.6.6 On the basis that best practice is followed the risk of flooding from sewer, whilst not to be discounted would be of a low impact and as such can be considered a **low risk**.

3.7 Wider Catchment/Downstream Flood Risk

- 3.7.1 The risks of flooding in the vicinity of the site and therefore the wider catchment area are from fluvial and pluvial sources.

Fluvial Flood Risk

- 3.7.2 No changes to ground level or structures are proposed in either the DAM Zones B or C or within Flood Zones 2 or 3. As such no change in flood risk within the wider catchment would occur as a result of development.

Surface Water Flood Risk

- 3.7.3 An increase in impermeable area has the potential to increase surface water runoff and therefore flood risk within the wider area.
- 3.7.4 It is proposed that a surface water system is constructed to control run off from the site to existing greenfield run off rates or lower.
- 3.7.5 Any reduction to existing run off rates would mean an improvement of offsite flood risk.
- 3.7.6 For details of the surface water drainage strategy please see **Section 5.0**.

4.0 FLOOD MITIGATION

4.1 Proposed Pluvial Mitigation

- 4.1.1 As part of the proposed development all buildings, roads, parking and service yards are located in Zone A of the Development Advice maps
- 4.1.2 The development site is not likely to have a FFL of less than 26.5m (between 1.5m and 5.5m above the levels of the modelled flood outline). Therefore the development is not thought to be at risk of fluvial flooding.

4.2 Proposed Fluvial Mitigation

- 4.2.1 The site will be served by a drainage network designed to accommodate and control flows up to and including the 100 year storm plus climate change allowance of 40%.
- 4.2.2 The site should allow for hardstanding areas to fall away from buildings in order to prevent water ingress.

4.3 Further Mitigation

- 4.3.1 No further mitigation is proposed.

5.0 DRAINAGE STRATEGY

5.1 Existing Site Run Off

- 5.1.1 The topographical survey undertaken at the site shows a number of manholes potentially serving the existing former Royal Ordinance buildings.
- 5.1.2 For the purposes of this report it has been assumed that these drains are no longer in a serviceable condition and therefore not in use.
- 5.1.3 The site is drained via greenfield run off. A partial factor of urbanisation has been included in the Greenfield run off calculations (carried out my factoring IH124 greenfield run off methodology in line with CIRIA 753) to account for the existing roads and buildings present within the site. The urbanisation factor has been set at 0.1.
- 5.1.4 For existing run off rates see **Table 3** below and **Appendix 4**.

Table 2 – Existing Run-off Rates

Return Period	Run off Rate (l/s/ha)	Total @ 8.05 ha
1 year	5.0 l/s/ha	40 l/s
QBAR	5.7 l/s/ha	46 l/s
30 Year	9.9 l/s/ha	79 l/s
100 Year	11.9 l/s/ha	96 l/s
	Volume (m³/ha)	
100 year 6 hour Volume run off	292 m ³ /ha	2,350 m ³

5.2 Drainage Hierarchy

- 5.2.1 The Sustainable Drainage Systems Standards for Wales; Standard S1 states;

Standard S1 – Surface water runoff destination

This Standard addresses the use of surface water by the development and where it should be discharged. The aim is to ensure that runoff is treated as a resource and managed in a way that minimises negative impact of the development on flood risk, the morphology and water quality of receiving waters and the associated ecology. This will ensure that early consideration is given to the use of rainwater harvesting systems to both manage runoff and deliver a source of non-potable water for the site where practical. Where it is not, prioritisation should be given to infiltration. Discharges to sewerage systems should be limited where possible.

S1 Surface water runoff destination

Priority Level 1: Surface water runoff is collected for use;

**Priority Level 2: Surface water runoff is infiltrated to ground;
Priority Level 3: Surface water runoff is discharged to a surface water body;
Priority Level 4: Surface water runoff is discharged to a surface water sewer,
highway drain, or another drainage system;
Priority Level 5: Surface water runoff is discharged to a combined sewer.**

Re-use

- 5.2.2 It is likely that rainwater harvesting at the site would have a limited impact on surface water discharge.
- 5.2.3 Office locations within the units proposed would likely be limited to toilet flushing as the only non-potable use.
- 5.2.4 It may be possible that larger volumes of surface water could be used for irrigation and landscape watering and this should be considered further at detailed design.
- 5.2.5 For the purposes of this report, water reuse has been discounted from the calculations in order to maintain a conservative approach to surface water management across the site.

Infiltration

- 5.2.6 The ground investigation carried out by Terraconsult shows that the site is underlain by Stiff Clay.
- 5.2.7 2no. infiltration tests were undertaken at the site. The tests were undertaken in accordance with BRE365 – test results are included in **Appendix 5**.
- 5.2.8 The infiltration testing did not conclude (water did not drain from the trial pits). As such infiltration is not considered suitable at this site.

Drain to Watercourse

- 5.2.9 The site is has the Redwither Brook and the River Clywedog to the south (50m at its closest point). The developer has sufficient rights over the land to the south to ensure that a connection can be made to the either watercourse.
- 5.2.10 Based on the above, the most appropriate method for the disposal of surface water at the site is to discharge to watercourse.

5.3 Proposed Run-off Rates

- 5.3.1 In order to comply with the Sustainable Drainage System Standards for Wales and to ensure that surface water discharge mimics natural drainage discharge rates have been designed so as not exceed existing greenfield rates for the for the corresponding return period.
- 5.3.2 For proposed run-off rates see **Table 3** below.

Table 3 – Proposed Run off Rates

Outfall	Impermeable Area	1 year	30 year	100 year +40% (CC)
Outfall 1	6.19 ha	31 l/s	61 l/s	74 l/s
Outfall 2	1.86 ha	9 l/s	18 l/s	22 l/s
Overall	8.05 ha	40 l/s	79 l/s	96 l/s

5.4 Climate Change

5.4.1 Based on a proposed design life for the development of 50 years and a proposed completion date post 2020 the site is thought to be active in the “2080’s” a climate change allowance of 40% has been used in the production of this drainage strategy.

5.4.2 The 40% allowance has been added to the 100 year return period events in accordance with Welsh Planning Policy.

5.5 Attenuation Requirements

5.5.1 In order to limit the discharge from site to that proposed in **Section 2.3** above it is proposed to provide attenuation in the form of ponds.

5.5.2 The flow will be controlled by a flow control device such as and Orifice Plate. The design of the flow control should be such that discharge rates do not exceed those proposed in **Table 4** for the corresponding Return Period. Calculations have been carried out using rainfall profiles generated using the Flood Studies Report Method. Calculations are included in **Appendix 7**.

5.5.3 Calculations in **Appendix 7** have been provided for Swales and Ponds on the basis that these aspects will drain significant portions of the site. On site filter drains should be designed in accordance with the SuDS manual at detailed design.

Table 4 – Calculated Attenuation Volumes

Pond	30 year return period volume (m ³)	100 year +CC return period volume (m ³)
Pond 1	1,750	3500
Pond 2	700	1250

5.5.4 Attenuation volumes should be confirmed at detailed design phase. The volumes of attenuation should be such that:

- All surface water flows up to and including the 1 in 30 year storm will be attenuated below ground (including within ponds and swales)
- Any events greater than 1 in 30 year (up to 1 in 100 year +CC) can be allowed to pond on the surface. This must occur in a controlled manner, must not flood buildings, leave site or prevent access and egress to the site.
- Events in exceedance of the 100 year + CC return period will be classed as an exceedance event. Flows should be mapped once finished levels are available for the site.

5.6 Pollution Prevention

- 5.6.1 In the interest of pollution prevention, the areas of the site have been split into 3 risk zones:

Table 5 - Pollution Hazard Table

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydro-carbons
Commercial Roofs	Very Low Risk	0.3	0.2	0.05
Car Parks and minor access roads	Low Risk	0.5	0.4	0.4
Access Road with >300 trips per day and commercial yards	Medium Risk	0.7	0.6	0.7

- 5.6.2 Based on the above zone types a Suds Treatment Train has been proposed for the site general infrastructure and access roads. On plot pollution mitigation should be considered at detailed design to improve on the site infrastructure water quality.
- 5.6.3 The treatment train has been considered using the simple index approach outlined in CIRIA753. The treatment train will incorporate filter drains, swales and ponds and will have a mitigation index in excess of the pollution hazard index.
- 5.6.4 On plot drainage systems should incorporate catchpits to reduce the loading of suspended solids entering filter drains. Consideration to permeable paving and proprietary treatment should be considered as part of the on plot drainage systems. The final design of on plot systems will depend upon the final use of the units and as such have not been considered in this report.
- 5.6.5 Where concrete service years are required, pre-treatment should be undertaken using catchpits to reduce the TSS load within the flows before being discharged to the wider site drainage system treatment train.
- 5.6.6 The off plot drainage system will utilise a treatment train of Filter Drains > Swales > Ponds. This gives an off plot pollution mitigation index of:

Table 6 - Pollution Mitigation Index and Treatment Train

	Filter Drain	Swale*	Pond*	Total
TSS	0.4**	0.25	0.35	1.00
Metals	0.4	0.3	0.35	1.05
Hydrocarbons	0.4	0.3	0.25	1.05

*Mitigation index reduced by 50% as feature to be used as secondary/tertiary treatment

**Catchpits required on plot to reduce the loading of TSS on the filter drain network

5.6.7 As shown in **Table 5** and **Table 6**, the worst case pollution hazard index is lower than the mitigation index –

- TSS Pollution index $0.7 < 1.00$ mitigation index
- Metals Pollution index $0.6 < 1.05$ mitigation index
- Hydrocarbons Pollution index $0.7 < 1.05$ mitigation index

5.6.8 Detailed design of these features will need to be undertaken at detailed design and approved by the Wrexham SUDS Adopting Body (SAB).

5.6.9 All SuDs features to be designed in accordance with CIRIA 753 the suds manual at detailed design.

5.7 Sustainable Drainage Systems

5.7.1 Infiltration is unsuitable at the proposed site due to the nature of the clayey sub soil, as such all infiltration techniques, along with those unsuitable for high density urban environments, have been discounted.

5.7.2 It is proposed that a series of measures are incorporated within the proposed layout to provide an element of treatment a control surface water runoff, these include:

- Silt traps/catchpits
- Sump outfall units/gullies
- Filter Drains
- Swales
- Ponds

5.8 Residual Risk and Designing for Exceedance

5.8.1 In the event that the capacity of the attenuation is exceeded, flood water will be retained on site within the service yards, dock levellers and car parks to the 100 year + Climate Change event.

5.8.2 Access and Egress routes will be maintained for persons and vehicles always.

5.8.3 Site levels should fall away from buildings to prevent water ingress.

5.8.4 The residual risks and designing for exceedance should be considered further at reserved matters stage.

5.9 Maintenance

- 5.9.1 Requirements for ongoing maintenance of the drainage network will form part of the Operation and Maintenance manual for the site and will be undertaken by the building management. Any specialist or proprietary products that are specified at detailed design will have a manufacturer specific maintenance regime which will be included within the document.
- 5.9.2 All drainage features should be located in open areas which are accessible.
- 5.9.3 All surface water arrangements outlined above are subject to detailed design.

6.0 MANAGEMENT AND MAINTENANCE PLAN

- 6.1.1 Based on Chapter 32 on the CIRIA report C753 The SuDS Manual and manufacturer recommendations a maintenance strategy will be designed for the schemes final design. The responsibility for maintenance will lie with either the Facilities management leaseholders, the park Management Company or Wrexham SAB, if adoption is sought for the SuDS system.

7.0 FOUL WATER STRATEGY

7.1 Existing Site Drainage and Pre Planning Discussion

- 7.1.1 The site is crossed by 2no. Foul Combined Sewers owned by Dwr Cymru Welsh Water (DCWW) shown in **Figure 5** below.
- 7.1.2 No surveys of the position and depth of the combined sewers were able to be undertaken due to the significant vegetation on site.
- 7.1.3 Discussions with DCWW indicate that the sewers on site have capacity to accept domestic type effluent from the proposed development. At this stage no information is available as to the potential future units on the site. Any requirement for trade effluent discharge must be discussed with DCWW and an agreement reached between the undertaker and the tenant.

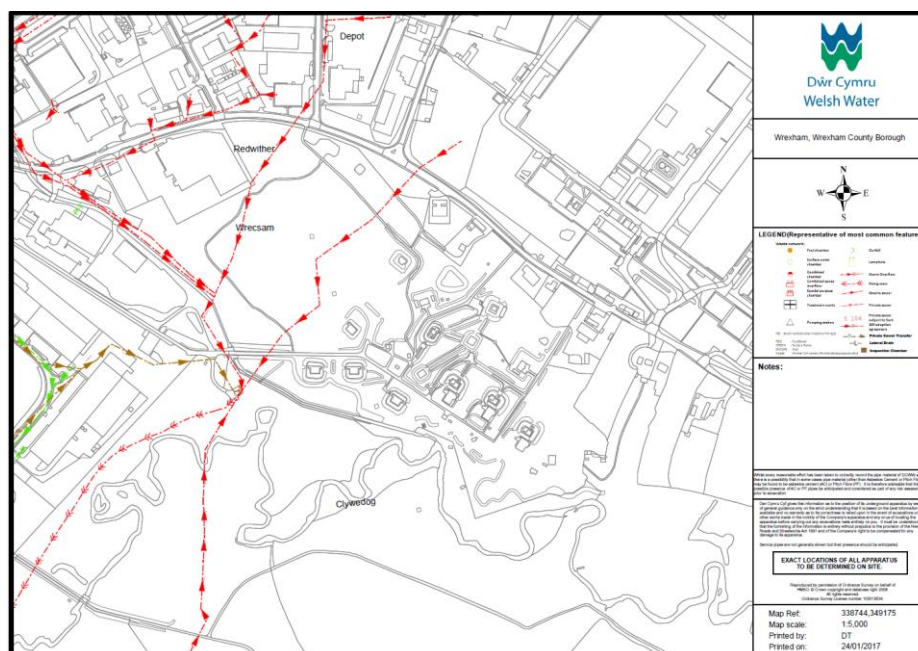


Figure 5 - DCWW Sewer Map

- 7.1.4 DCWW have indicated that the sewers are subject to an implied 6m easement (3m either side of the centreline) across the site and any alterations to the locations of the sewers would be subject to a S185 application for diversion of the public sewer and any alterations will be carried out at the developer expense.
- 7.1.5 It is proposed that the site is developed in such a way that Welsh Water have access to their apparatus at all times, either in open highway, open car parks or public access routes.
- 7.1.6 In order to ensure that adequate protection is provided to DCWW assets the following is proposed –
- *Once site clearance has been undertaken, a CCTV survey, including manhole location and depth, pipe sizes and condition, is undertaken to ascertain the exact location and depth of the DCWW combined sewer network crossing the site.*
 - *No construction of buildings is to be undertaken within 3m of a DCWW asset with access for DCWW to be maintained at all times.*

- *Where the construction of roads and parking areas is undertaken, appropriate measures to ensure the protection of DCWW pipework should be undertaken, such as ensuring adequate cover is maintained to the DCWW asset (in accordance with The Welsh Ministers Standards, 4.1 R10).*
- *Where adequate cover cannot be maintained or where works to manhole cover levels are required, protection of the assets (in accordance with The Welsh Ministers Standards, Section 7 R3) or diversion of DCWW assets under S185 of the WIA1991 should be proposed and submitted to DCWW for approval.*
- *Access for Welsh Water to maintain their assets should be maintained at all times.*
- *Swale crossing points to be designed so sufficient cover and protection of the combined sewer network is maintained.*

7.1.7 A drawing based on the current masterplan has been produced which indicates a diversion to ensure that DCWW assets are accessible. The drawing is included in **Appendix 6**.

7.2 Proposed Drainage

7.2.1 The site is proposed to discharge to the public combined network.

7.2.2 This will be done through a system of private drainage across the site.

7.2.3 It is currently unknown whether the site will require pumping. Until such a time that proposed finished levels and a survey of the existing DCWW assets is finalised the pumping requirement will be To Be Confirmed.

8.0 Summary

8.1 Flood Consequence

- 8.1.1 The proposed site is classed as Less Vulnerable Development (General Industrial) and all built development is located entirely in Zone A on the Development Advice Maps.
- 8.1.2 No development is to take place within Zone B and C2, which are located within the blue line boundary along the edge of Redwither Brook.
- 8.1.3 The site is expected to have a FFL no lower than 26.5m AOD, significantly above the outline modelling flood level (21.0m).
- 8.1.4 It is considered that there is no residual risk of flooding from the Redwither Brook, River Clywedog or the potential blocking of the Redwither Culvert.
- 8.1.5 Based on the extents of surface water flooding and directions of flow, the surface water flood risk at the site is not generated from flows from outside of the site.
- 8.1.6 As part of the proposed redevelopment at the site, a surface water drainage system will be put in place.
- 8.1.7 The surface water drainage design should ensure that surface water is managed appropriately on site and not to pose a hazard to site users.
- 8.1.8 On the basis of the above, whilst there is a medium risk of surface water flooding in the sites current state this is due to the onsite topography and not overland flow from outside the site. The risk of surface water flooding post development would be considered **low**.
- 8.1.9 The risk of flooding from groundwater sources is considered **low**.
- 8.1.10 The risk of flooding from artificial sources is considered **low**.
- 8.1.11 The risk of flooding from sewer, whilst not to be discounted would be of a low impact and as such can be considered a **low risk**.
- 8.1.12 No changes to ground level or structures are proposed in either the DAM Zones B or C or within Flood Zones 2 or 3. As such no change in flood risk within the wider catchment would occur as a result of development.
- 8.1.13 An increase in impermeable area has the potential to increase surface water runoff and therefore flood risk within the wider area.
- 8.1.14 It is proposed that a surface water system is constructed to control run off from the site to existing greenfield run off rates or lower.
- 8.1.15 Any reduction to existing run off rates would mean an improvement of offsite flood risk.

8.2 Flood Risk Mitigation

- 8.2.1 The development site is not likely to have a FFL of less than 26.5m (between 1.5m and 5.5m above the levels of the modelled flood outline). Therefore the development is not thought to be at risk of fluvial flooding.
- 8.2.2 The site will be served by a drainage network designed to accommodate and control flows up to and including the 100 year storm plus climate change allowance of 40%.

8.2.3 The site should allow for hardstanding areas to fall away from buildings in order to prevent water ingress.

8.3 Surface Water

8.3.1 The site is drained via greenfield run off. A partial factor of urbanisation has been included in the Greenfield run off calculations (carried out my factoring IH124 greenfield run off methodology in line with CIRIA 753) to account for the existing roads and buildings present within the site. The urbanisation factor has been set at 0.1.

8.3.2 It is likely that rainwater harvesting at the site would have a limited impact on surface water discharge.

8.3.3 It may be possible that larger volumes of surface water could be used for irrigation and landscape watering and this should be considered further at detailed design.

8.3.4 For the purposes of this report, water reuse has been discounted from the calculations in order to maintain a conservative approach to surface water management across the site.

8.3.5 2no. infiltration tests were undertaken at the site. The tests were undertaken in accordance with BRE365 – test results are included in **Appendix 5**.

8.3.6 The infiltration testing did not conclude (water did not drain from the trial pits). As such infiltration is not considered suitable at this site.

8.3.7 The site is has the Redwither Brook and the River Clywedog to the south (50m at its closest point). The developer has sufficient rights over the land to the south to ensure that a connection can be made to the either watercourse.

8.3.8 Based on the above, the most appropriate method for the disposal of surface water at the site is to discharge to watercourse.

8.3.9 The 40% allowance has been added to the 100 year return period events in accordance with Welsh Planning Policy.

8.3.10 Attenuation volumes should be confirmed at detailed design phase. The volumes of attenuation should be such that:

- All surface water flows up to and including the 1 in 30 year storm will be attenuated below ground (including within ponds and swales)
- Any events greater than 1 in 30 year (up to 1 in 100 year +CC) can be allowed to pond on the surface. This must occur in a controlled manner, must not flood buildings, leave site or prevent access and egress to the site.
- Events in exceedance of the 100 year + CC return period will be classed as an exceedance event. Flows should be mapped once finished levels are available for the site.

8.3.11 Based on the above zone types a Suds Treatment Train has been proposed for the site general infrastructure and access roads. On plot pollution mitigation should be considered at detailed design to improve on the site infrastructure water quality.

8.3.12 The treatment train has been considered using the simple index approach outlined in CIRIA753. The treatment train will incorporate filter drains, swales and ponds and will have a mitigation index in excess of the pollution hazard index.

- 8.3.13 As shown in **Table 5** and **Table 6**, the worst case pollution hazard index is lower than the mitigation index –
- TSS Pollution index $0.7 < 1.00$ mitigation index
 - Metals Pollution index $0.6 < 1.05$ mitigation index
 - Hydrocarbons Pollution index $0.7 < 1.05$ mitigation index
- 8.3.14 Detailed design of these features will need to be undertaken at detailed design and approved by the Wrexham SUDS Adopting Body (SAB).
- 8.3.15 All SuDs features to be designed in accordance with CIRIA 753 the suds manual at detailed design.
- 8.3.16 It is proposed that a series of measures are incorporated within the proposed layout to provide an element of treatment a control surface water runoff, these include:
- Silt traps/catchpits
 - Sump outfall units/gullies
 - Filter Drains
 - Swales
 - Ponds
- 8.3.17 Access and Egress routes will be maintained for persons and vehicles always.
- 8.3.18 Site levels should fall away from buildings to prevent water ingress.
- 8.3.19 The residual risks and designing for exceedance should be considered further at reserved matters stage.
- 8.3.20 The responsibility for maintenance will lie with either the Facilities management leaseholders, the park Management Company or Wrexham SAB, if adoption is sought for the SuDS system.
- 8.4 Foul Water**
- 8.4.1 The site is crossed by 2no. Foul Combined Sewers owned by Dwr Cymru Welsh Water (DCWW) shown in **Figure 5** below.
- 8.4.2 No surveys of the position and depth of the combined sewers were able to be undertaken due to the significant vegetation on site.
- 8.4.3 Discussions with DCWW indicate that the sewers on site have capacity to accept domestic type effluent from the proposed development. At this stage no information is available as to the potential future units on the site. Any requirement for trade effluent discharge must be discussed with DCWW and an agreement reached between the undertaker and the tenant.
- 8.4.4 In order to ensure that adequate protection is provided to DCWW assets the following is proposed –
- *Once site clearance has been undertaken, a CCTV survey, including manhole location and depth, pipe sizes and condition, is undertaken to ascertain the exact location and depth of the DCWW combined sewer network crossing the site.*
 - *No construction of buildings is to be undertaken within 3m of a DCWW asset with access for DCWW to be maintained at all times.*

- *Where the construction of roads and parking areas is undertaken, appropriate measures to ensure the protection of DCWW pipework should be undertaken, such as ensuring adequate cover is maintained to the DCWW asset (in accordance with The Welsh Ministers Standards, 4.1 R10).*
- *Where adequate cover cannot be maintained or where works to manhole cover levels are required, protection of the assets (in accordance with The Welsh Ministers Standards, Section 7 R3) or diversion of DCWW assets under S185 of the WIA1991 should be proposed and submitted to DCWW for approval.*
- *Access for Welsh Water to maintain their assets should be maintained at all times.*
- *Swale crossing points to be designed so sufficient cover and protection of the combined sewer network is maintained.*

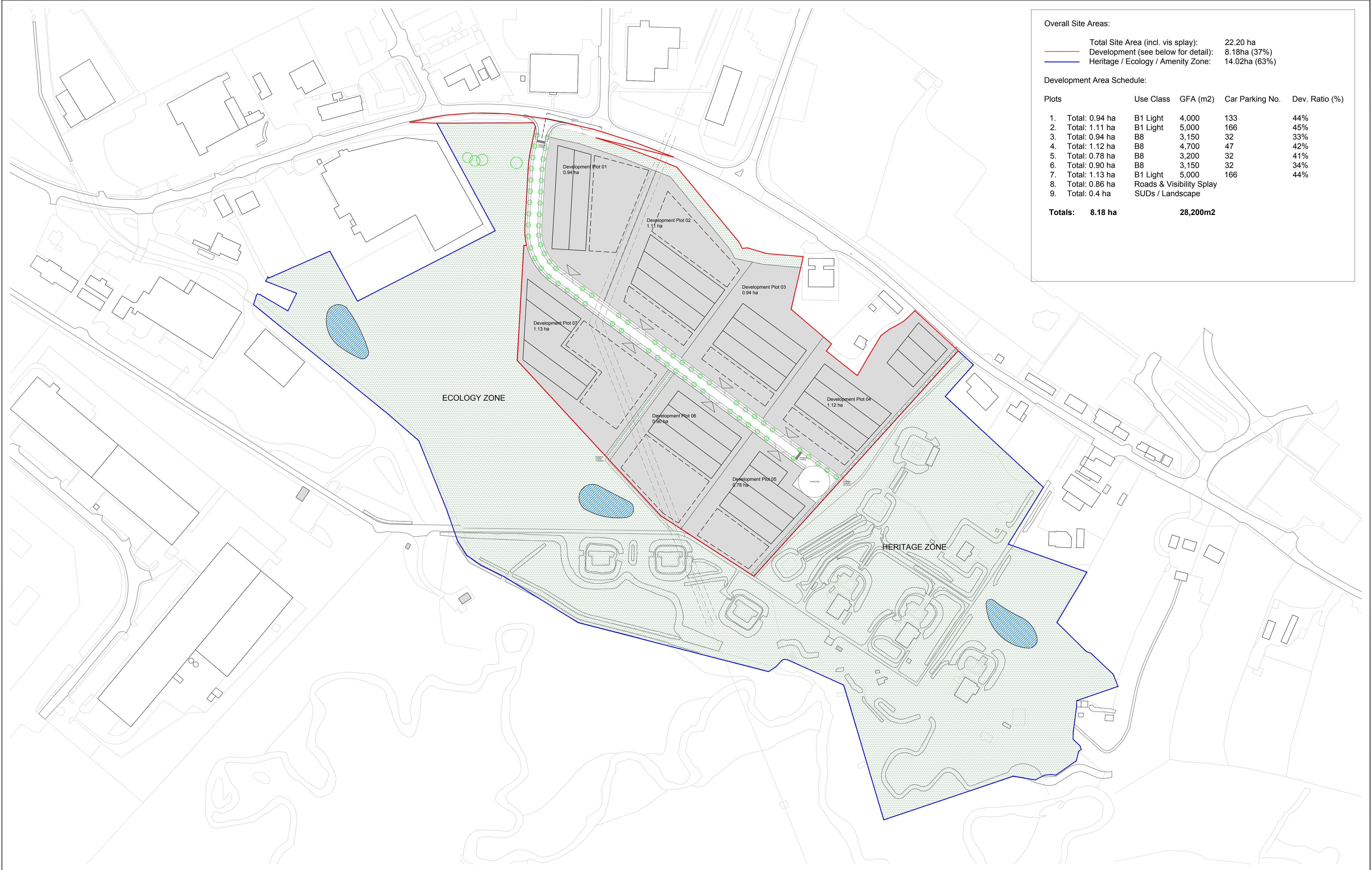
8.4.5 The site is proposed to discharge to the public combined network.

8.4.6 This will be done through a system of private drainage across the site.

8.4.7 It is currently unknown whether the site will require pumping. Until such a time that proposed finished levels and a survey of the existing DCWW assets is finalised the pumping requirement will be To Be Confirmed.

APPENDIX 1

Site Layout



Overall Site Areas:

Total Site Area (incl. vis splay):

Development (see below for detail):

Heritage / Ecology / Amenity Zone:

22.20 ha

8.18ha (37%)

14.02ha (63%)

Development Area Schedule:

Plots	Use Class	GFA (m2)	Car Parking No.	Dev. Ratio (%)
1. Total: 0.94 ha	B1 Light	4,000	133	44%
2. Total: 1.11 ha	B1 Light	5,000	166	45%
3. Total: 0.94 ha	B8	3,150	32	33%
4. Total: 1.12 ha	B8	4,700	47	42%
5. Total: 0.78 ha	B8	3,200	32	41%
6. Total: 0.90 ha	B8	3,150	32	34%
7. Total: 1.13 ha	B1 Light	5,000	166	44%
8. Total: 0.86 ha	Roads & Visibility Splay			
9. Total: 0.4 ha	SUDs / Landscape			
Totals:	8.18 ha	28,200m2		

REVISIONS				
Rev.	Description	Date	By	Chk'd
A	Areas revised to incl. Heritage & new jct.	22.03.19	SR	SR
B	Road alignment, Ecology increase, GFA added	26.03.19	SR	SR
C	Areas and site boundaries revised	28.03.19	SR	SR
D	Plots 4 & 5 combined, plot 5 access removed	23.04.19	SR	SR
E	Internal access road minor amends.	03.05.19	SR	SR
F	Footpath connections added, notes added	16.05.19	SR	SR

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PRELIMINARY client: CEFN PARK DEVELOPMENT LTD project: THE OAKS drawing title: PROPOSED SITE PARAMETERS PLAN

APPENDIX 2

DCWW Correspondence

Philip Barrett

From: Data Distribution <datadistribution@cyfoethnaturiolcymru.gov.uk>
Sent: 21 February 2019 11:18
To: Philip Barrett
Subject: ATI 17013A - Flood Product - The Oaks, Wrexham, LL13 9LU

Hello Philip

Unfortunately we can't provide any flood products as we don't hold any detailed flood risk information for this location.

All the information we have available can be obtained from our free self-service open data as detailed below:

Self Service Open Data:

You can now make the most of open data provided **free online**:

- [NRW Flood Risk Map Viewer](#): create and export an A4 or A3 PDF map at a scale of 1:5000. You will find many spatial risk layers, including the Development Advice Map, flood zones, surface water and reservoir hazard data.
- ["Lle" the Welsh Government Portal for Open Spatial data](#): Spatial data is free to download, view and use within your own GIS system. The flood datasets includes Flood Zones, Flood Defences, Historic Flood Outlines, Areas Benefiting Defences, Surface Water, Development Advice Map, and [LiDAR Composite Dataset](#). You can also download the 'Coastal Design – Extreme Sea Levels' report and data covering still water levels for the Welsh Coastline (wave overtopping is **not** calculated).

Please Note the Following:

- All information supplied will need to be verified by the recipient **PRIOR** to using in a Flood Consequences Assessment (FCA). We would expect to see a review of hydrology, in-channel survey, floodplain topography etc. to demonstrate the data is suitable for the purposes of producing an FCA.
- As of 1st of December, 2016 you will need to apply climate change allowances carefully to ensure compliance with [Welsh Government climate change clarification letter](#).
- For Coastal and Estuarine sites NRW will require assessment of wave overtopping. It is up to the developer to justify why an assessment *isn't* required.
- **Pre-application Advice:** NRW are changing the way in which we provide advice to developers. We will continue to meet our duties as an adviser. In addition, we will offer a free initial opinion on your proposal. However, in cases where you would like to access any extra advice that falls outside of our statutory duties, we can only offer this as part of our Discretionary Planning Advice Service (DPA Service). For more information regarding free service and our discretionary planning can be found in the following links: [Welsh Version](#) / [English version](#).

Your request for our free or charged discretionary advice service needs to be accompanied by the relevant 'Request Form' which is available to download from our website. You will then need to send the form to northplanning@cyfoethnaturiolcymru.gov.uk who will coordinate our response.

Regards

Kathy Banner
Swyddog Cysylltiadu Allanol / External Relations Officer
Cyfoeth Naturiol Cymru / Natural Resources Wales
03000 653568
Llys Afon, Hwlfordd / River Court, Haverfordwest
Dysgwr Cymraeg

www.cyfoethnaturiol.cymru / www.naturalresources.wales

Yn falch o arwain y ffordd at ddyfodol gwell i Gymru trwy reoli'r amgylchedd ac adnoddau naturiol yn gynaliadwy.

Proud to be leading the way to a better future for Wales by managing the environment and natural resources sustainably.



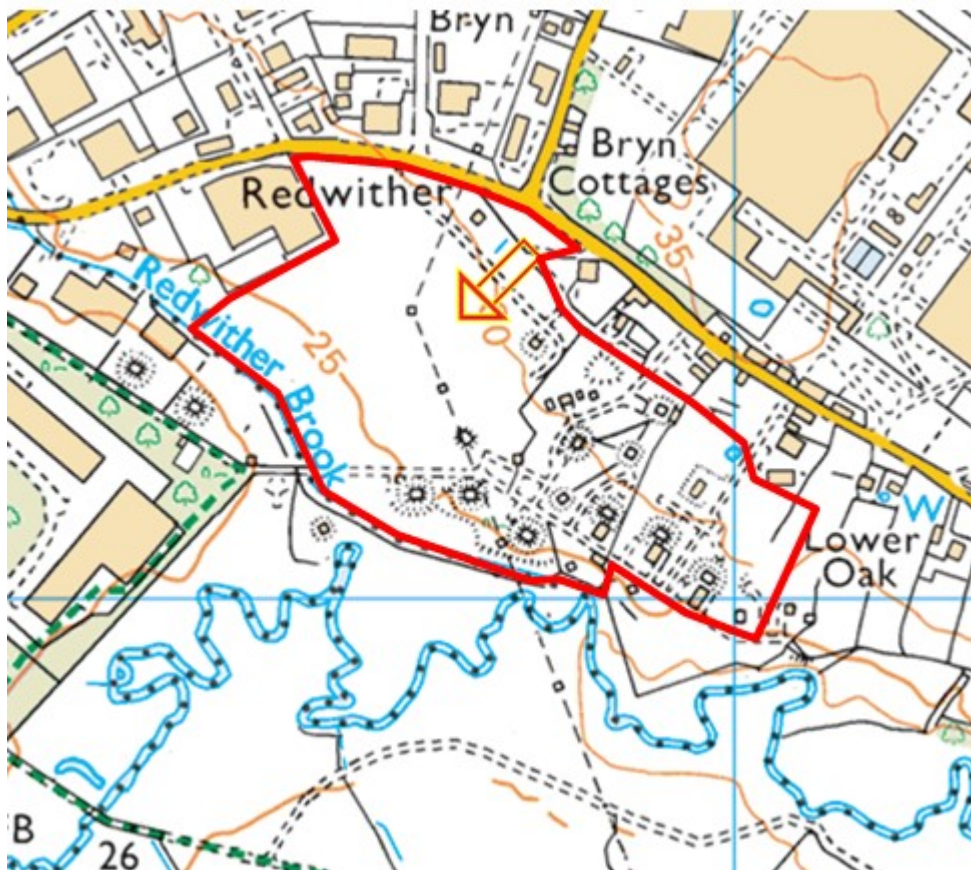
Croesewir gohebiaeth yn Gymraeg a byddwn yn ymateb yn Gymraeg, heb i hynny arwain at oedi

Correspondence in Welsh is welcomed, and we will respond in Welsh without it leading to a delay

From: Philip Barrett <philipbarrett@terraconsult.co.uk>
Sent: 19 February 2019 10:22
To: Data Distribution <datadistribution@cyfoethnaturiolcymru.gov.uk>
Subject: 4292 - The Oaks

Please find attached a data request –

Map of the area required is shown below.



Regards

Philip Barrett

Principal Engineer

Surface Water Department

Office: 01925 291111

Mobile: 07718 476735

TerraConsult

St Helens: Bold Business Centre, Bold Lane, Sutton, St. Helens, WA9 4TX **Tel:** +44 (0)1925 291111

Colchester: Dugard House, Peartree Road, Colchester, Essex, CO3 0UL **Tel:** +44 (0)1206 585600

Email: mailbox@terraconsult.co.uk

Website: www.terraconsult.co.uk

APPENDIX 3

NRW Correspondence

Philip Barrett

From: Jones Alaw <Alaw.Jones@dwrcymru.com>
Sent: 12 March 2019 08:33
To: Philip Barrett
Subject: RE: PPA0003864 - The Oaks, Wrexham Industrial Estate

Hi Philip,

Thank you for your e-mail.

The above pre-planning advice response will be issued today.

Should you have any queries, please do not hesitate to contact me.

Kind regards,
Alaw



Alaw Jones
Development Control Officer | Developer Services | Wholesale Business Services | Services Dwr Cymru Welsh Water
Kinmel Park | Bodelwyddan | LL18 5TQ | T: 0800 917 2652 | www.dwrcymru.com

Developer Services have an on-line service at www.dwrcymru.com. Here you can find all the services available, complete application forms and also make payments. If you have a quotation you can pay for this on-line or alternatively by telephoning 0800 917 2652 using a credit/debit card.

*We will respond to your email as soon as possible but you should allow up to **10 working days** to receive a response. For most of the services we offer we set out the timescales that we work to on our Developer Services section of our website. Just follow this link <http://www.dwrcymru.com/en/Developer-Services.aspx> and select the service you require where you will find more information and guidance notes which should assist you. If you cannot find the information you are looking for then please call us on 0800 917 2652 as we can normally deal with any questions you have during the call.*

From: Philip Barrett [mailto:philipbarrett@terraconsult.co.uk]
Sent: 12 March 2019 08:31
To: Jones Alaw <Alaw.Jones@dwrcymru.com>
Subject: RE: PPA0003864 - The Oaks, Wrexham Industrial Estate

***** External Mail *****

Hi Alaw,

Do you know when the DCWW pre developer response will be ready?

Regards

Regards

Philip Barrett

Principal Engineer

Surface Water Department

Office: 01925 291111
Mobile: 07718 476735

TerraConsult

St Helens: Bold Business Centre, Bold Lane, Sutton, St. Helens, WA9 4TX **Tel:** +44 (0)1925 291111

Colchester: Dugard House, Peartree Road, Colchester, Essex, CO3 0UL **Tel:** +44 (0)1206 585600

Email: mailbox@terraconsult.co.uk

Website: www.terraconsult.co.uk

From: Jones Alaw [<mailto:Alaw.Jones@dwrcymru.com>]

Sent: 22 February 2019 11:59

To: Philip Barrett

Subject: RE: PPA0003864 - The Oaks, Wrexham Industrial Estate

Hi Philip,

Thank you for the additional information.

Kind regards,
Alaw



Alaw Jones



Development Control Officer | Developer Services | Wholesale Business Services | Services Dwr Cymru Welsh Water

Kinmel Park | Bodelwyddan | LL18 5TQ | T: 0800 917 2652 | www.dwrcymru.com

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If we've gone the extra mile to provide you with excellent service, let us know. You can nominate an individual or team for a Diolch award through our [website](#).

From: Philip Barrett [<mailto:philipbarrett@terraconsult.co.uk>]

Sent: 22 February 2019 11:34

To: Jones Alaw <Alaw.Jones@dwrcymru.com>

Subject: RE: PPA0003864 - The Oaks, Wrexham Industrial Estate

***** External Mail *****

Hi Alaw

Unfortunately as we are only at outline stage the development staff numbers are unknown. The development application will be for B2 (general light industry) and B8 (storage and distribution) space. The split is not yet defined.

Approximate areas are included for the units below –

Unit	m ²	ha	Foul Discharge	Domestic	Trade
------	----------------	----	----------------	----------	-------

Plot 1	3500	0.35	0.210	0.245
Plot 2	3500	0.35	0.210	0.245
Plot 3	3900	0.39	0.234	0.273
Plot 4	3600	0.36	0.216	0.252
Plot 5	3300	0.33	0.198	0.231
Plot 6	2200	0.22	0.132	0.154
Plot 7	5000	0.50	0.30	0.350
Plot 8	5300	0.53	0.318	0.371
Plot 9	2300	0.23	0.138	0.161
Plot 10	5000	0.50	0.30	0.350
Plot 11	2200	0.22	0.132	0.154
Total	39,800m ²	3.98ha	2.388 l/s	2.786 l/s
Total Domestic and Foul – 5.17 l/s				

2. The following design flows for industrial developments should be used where the actual details of flows are unknown:

- domestic flow element calculated in accordance with BS EN 752 or, in the absence of appropriate information, 0.6 litres per second per hectare of developable land;
- trade effluent flow based on a metered water supply to premises similar to that proposed, or assumed as 0.5 litres per second per hectare for normal industry and 1 litre per second per hectare for wet industry. Where the proportion of wet industry is unknown, an average flow of 0.7 litres per second per hectare should be used; and
- to obtain the total design flow, the domestic design flow should be added to the trade effluent design flow.

Based on SfA I would anticipate 5.2 l/s.

Regards

Regards

Philip Barrett

Principal Engineer

Surface Water Department

Office: 01925 291111

Mobile: 07718 476735

TerraConsult

St Helens: Bold Business Centre, Bold Lane, Sutton, St. Helens, WA9 4TX **Tel:** +44 (0)1925 291111

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Email: mailbox@terraconsult.co.uk

Website: www.terraconsult.co.uk

From: Jones Alaw [<mailto:Alaw.Jones@dwrcymru.com>]

Sent: 22 February 2019 11:12

To: Philip Barrett

Subject: PPA0003864 - The Oaks, Wrexham Industrial Estate

Good morning Mr Barrett,

I write in respect of the above pre-planning advice request received on the 19/02/2019.

To assist us in assessing whether there is sufficient capacity within the network to accommodate the proposed development, would it be possible to receive further information on the nature of the proposal, breakdown of the types of units and anticipated number of employment please?

Should you have any queries, please do not hesitate to contact me.

Kind regards,
Alaw



Alaw Jones



Development Control Officer | Developer Services | Wholesale Business Services | Services Dwr Cymru Welsh Water

Kinmel Park | Bodelwyddan | LL18 5TQ | T: 0800 917 2652 | www.dwrcymru.com

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If we've gone the extra mile to provide you with excellent service, let us know. You can nominate an individual or team for a Diolch award through our [website](http://www.dwrcymru.com).

Dwr Cymru Welsh Water is firmly committed to water conservation and promoting water efficiency. Please log on to our website www.dwrcymru.com/waterefficiency to find out how you can become water wise. Mae Dwr Cymru Welsh Water wedi ymrwymo i warchod adnoddau dwr a hyrwyddo defnydd dwr effeithiol. Mae cyngor i' ch helpu i ddefnyddio dwr yn ddoeth yn www.dwrcymru.com/waterefficiency

***** This email and any file attached is confidential. If you are not a named recipient or believe you may have received this email in error please delete from your system and promptly inform the sender. Dwr Cymru Cyf (trading as Welsh Water) is a company registered in England and Wales, number 02366777, registered office Pentwyn Road, Nelson, Treharris, Mid Glamorgan CF46 6LY. Mae'r neges e-bost yma ac unrhyw ffeil sydd ynghlwm wrthi'n gyfrinachol. Os nad chi yw'r derbynnydd a enwir, neu os ydych chi'n credu eich bod wedi derbyn y neges yma ar gam, dylech ei dileu o'ch system ar unwaith a hysbysu'r anfonwr. Cwmni sydd wedi ei gofrestru yng Nghymru yw Dwr Cymru Cyf (yn masnachu fel Dwr Cymru), ei rif cofrestredig yw 02366777, ac mae ei swyddfa gofrestredig yn Heol Pentwyn, Nelson, Treharris, Morgannwg Ganol CF46 6LY. *****

Dwr Cymru Welsh Water is firmly committed to water conservation and promoting water efficiency. Please log on to our website www.dwrcymru.com/waterefficiency to find out how you can become water wise. Mae Dwr Cymru Welsh Water wedi ymrwymo i warchod adnoddau dwr a hyrwyddo defnydd dwr effeithiol. Mae cyngor i' ch helpu i ddefnyddio dwr yn ddoeth yn www.dwrcymru.com/waterefficiency

***** This email and any

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Philip Barrett

From: Philip Barrett
Sent: 19 March 2019 11:34
To: 'Jones Alaw'
Subject: RE: PPA0003864 [Filed 19 Mar 2019 11:33]

Hi Alaw,

To confirm our conversation –

Any changes in level over a DCWW sewer will require a scheme to be submitted to Welsh Water to ensure that suitable protection measures are put in place. I will include this within the recommendations of the FCA/Outline drainage Design and this will enable Welsh Water to support the application and recommend a condition on that basis.

Below are the recommendations relating to DCWW assets that will be included in my report.

Once site clearance has been undertaken, a CCTV survey, including manhole location and depth, pipe sizes and condition, is undertaken to ascertain the exact location and depth of the DCWW combined sewer network crossing the site.

No construction of buildings is to be undertaken within 3m of a DCWW asset with access for DCWW to be maintained at all times. Where the construction of roads and parking areas is undertaken, appropriate measures to ensure the protection of DCWW pipework should be undertaken, such as ensuring adequate cover is maintained to the DCWW asset (in accordance with The Welsh Ministers Standards, 4.1 R10). Where adequate cover cannot be maintained or where works to manhole cover levels are required, protection of the assets (in accordance with The Welsh Ministers Standards, Section 7 R3) or diversion of DCWW assets under S185 of the WIA1991 should be proposed and submitted to DCWW for approval.

Access for Welsh Water to maintain their assets should be maintained at all times.

Regards

Philip Barrett

Principal Engineer

Surface Water Department

Office: 01925 291111
Mobile: 07718 476735

TerraConsult

St Helens: Bold Business Centre, Bold Lane, Sutton, St. Helens, WA9 4TX **Tel:** +44 (0)1925 291111

Colchester: Dugard House, Peartree Road, Colchester, Essex, CO3 0UL **Tel:** +44 (0)1206 585600

Email: mailbox@terraconsult.co.uk

Website: www.terraconsult.co.uk

From: Jones Alaw [mailto:Alaw.Jones@dwrcymru.com]
Sent: 12 March 2019 17:46
To: Philip Barrett
Subject: PPA0003864

Hi Philip,

Further to our recent telephone conversation, please accept my apologies, I have been unable to discuss the matter with my line manager today. However, I will give you a call on Thursday afternoon to discuss if that's convenient with yourself?

Kind regards,
Alaw



Alaw Jones

Development Control Officer | Developer Services | Wholesale Business Services | Services Dwr Cymru Welsh Water

Kinmel Park | Bodelwyddan | LL18 5TQ | T: 0800 917 2652 | www.dwrcymru.com

Developer Services have an on-line service at www.dwrcymru.com. Here you can find all the services available, complete application forms and also make payments. If you have a quotation you can pay for this on-line or alternatively by telephoning 0800 917 2652 using a credit/debit card.

*We will respond to your email as soon as possible but you should allow up to **10 working days** to receive a response. For most of the services we offer we set out the timescales that we work to on our Developer Services section of our website. Just follow this link <http://www.dwrcymru.com/en/Developer-Services.aspx> and select the service you require where you will find more information and guidance notes which should assist you. If you cannot find the information you are looking for then please call us on 0800 917 2652 as we can normally deal with any questions you have during the call.*

If we've gone the extra mile to provide you with excellent service, let us know. You can nominate an individual or team for a Diolch award through our [website](http://www.dwrcymru.com).

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Philip Barrett

From: Philip Barrett
Sent: 12 March 2019 11:11
To: Developer.Services@dwrcymru.com
Subject: RE: Re.PPA0003864. Notification

Thank you for the pre development enquiry response.

I have noted the points made in relation to Sewerage (including advice on Trade Effluent), Sewage Treatment and Surface Water.

With regards to Asset Protection - you have stated - *No operational development including the raising or lowering of ground levels will be permitted within 3 metres either side of the centreline of the public sewers. Our strong recommendation is that your site layout takes into account the location of the assets crossing the site and should be referred to in any master-planning exercises or site layout plans submitted as part of any subsequent planning application. Further information regarding Asset Protection is provided in the attached Advice & Guidance note.*

We feel that a condition meaning no change in level within 3m of the DCWW sewers would be overly restrictive and sterilise significant sections of the site from development. The proposals have been put together with due regard to the layout of the DCWW sewer system to ensure that no buildings will interfere with DCWW assets, understanding that no over agreement would be granted. An initial levels assessment has indicated that where proposed highways/parking crosses the combined sewers on site, levels will either be maintained or may need to be raised upto 1.5m.

Until such a time as the site is cleared (the site is currently covered in dense scrub) we will not be able to ascertain the exact depth and location of your assets within the site.

We have carried out a phase 2 SI at the site, and have found that the site is underlain by stiff clay. As such, the raising of ground levels within the range proposed would not be likely to be of detriment to the DCWW assets through settlement.

Increased loading of the pipework due to the installation of roads and parking on top of the DCWW sewers is not thought to be of detriment to the structural stability of the pipes. The material of the pipework laid across the site should be confirmed, though the DCWW layout drawing provided indicate that the sewers are Vitrified Clay or Concrete construction. As long as cover is maintained (in accordance with The Welsh Ministers Standards, 4.1 R10) and an appropriate construction build-up of roads and parking is installed, we believe that the risks to the sewer can be mitigated.

Is it possible to reconsider the constraints imposed in relation to alterations in ground level so that as long as the asset is protected and accessible, and depths of cover are in accordance with the design standards set out in The Welsh Ministers Standards and Sewers for Adoption 7th Edition are maintained that the development would be acceptable? The development is currently to go in for outline planning and this would mean, as a statutory consultee, DCWW would have access to the development proposals as they evolve.

It would be proposed as part of the drainage strategy that -

Once site clearance has been undertaken, a CCTV survey, including manhole location and depth, pipe sizes and condition, is undertaken to ascertain the exact location and depth of the DCWW combined sewer network crossing the site.

No construction of buildings is to be undertaken within 3m of a DCWW asset with access for DCWW to be maintained at all times. Where the construction of roads and parking areas is undertaken, appropriate measures to ensure the protection of DCWW pipework should be undertaken, such as ensuring adequate cover is maintained to

the DCWW asset (in accordance with The Welsh Ministers Standards, 4.1 R10). Where adequate cover cannot be maintained or where works to manhole cover levels are required, protection of the assets (in accordance with The Welsh Ministers Standards, Section 7 R3) or diversion of DCWW assets under S185 of the WIA1991 should be proposed and submitted to DCWW for approval.

Access for Welsh Water to maintain their assets should be maintained at all times.

Regards
Philip Barrett
Principal Engineer
Surface Water Department
Office: 01925 291111
Mobile: 07718 476735

St Helens: Bold Business Centre, Bold Lane, Sutton, St. Helens, WA9 4TX Tel: +44 (0)1925 291111
Colchester: Dugard House, Peartree Road, Colchester, Essex, CO3 0UL Tel: +44 (0)1206 585600
Email: mailbox@terraconsult.co.uk Website: www.terraconsult.co.uk

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

From: donotreply@dwrcymru.com [mailto:donotreply@dwrcymru.com]
Sent: 12 March 2019 09:50
To: Philip Barrett
Cc: BPMCopies@dwrcymru.com
Subject: Re.PPA0003864. Notification

Dear Customer,

Please find attached important information relating to your application.

Should you wish to contact us for any reason, you must use the contact information shown on the attachment(s).

Please do not reply directly to this message.

Best regards,

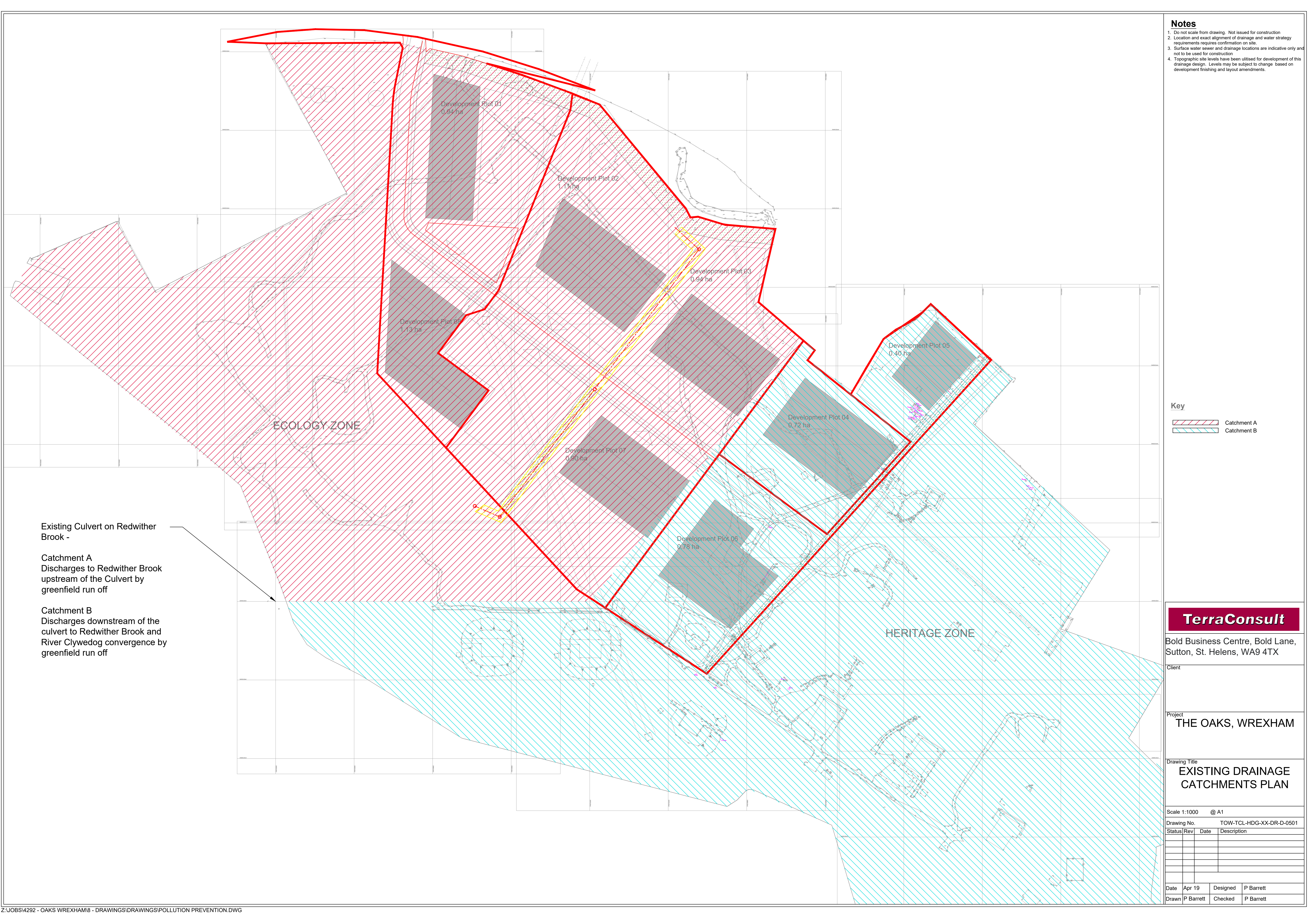
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Dwr Cymru Welsh Water

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APPENDIX 4

Greenfield Run Off



- Notes**
- 1. Do not scale from drawing. Not issued for construction
 - 2. Location and exact alignment of drainage and water strategy requirements requires confirmation on site.
 - 3. Surface water sewer and drainage locations are indicative only and not to be used for construction
 - 4. Topographic site levels have been utilised for development of this drainage design. Levels may be subject to change based on development finishing and layout amendments.

Key

Catchment A

Catchment B

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Sutton, St. Helens, WA9 4TX

Client

Project
THE OAKS, WREXHAM

Drawing Title
EXISTING DRAINAGE
CATCHMENTS PLAN

Scale 1:1000 @ A1

Drawing No. TOW-TCL-HDG-XX-DR-D-0501

Status	Rev	Date	Description

Date	Apr 19	Designed	P Barrett
Drawn	P Barrett	Checked	P Barrett

TerraConsult Ltd		Page 1
Bold Business Centre Sutton St Helens WA9 4TX		
Date 15/03/2019 15:12 File	Designed by philipbarrett Checked by	
Micro Drainage		Source Control 2018.1.1
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 1 Soil 0.450 Area (ha) 1.000 Urban 0.100 SAAR (mm) 767 Region Number Region 9 Results 1/s QBAR Rural 4.9 QBAR Urban 5.7 Q1 year 5.0 Q1 year 5.0 Q30 years 9.9 Q100 years 11.9		
©1982-2018 Innovyze		

APPENDIX 5

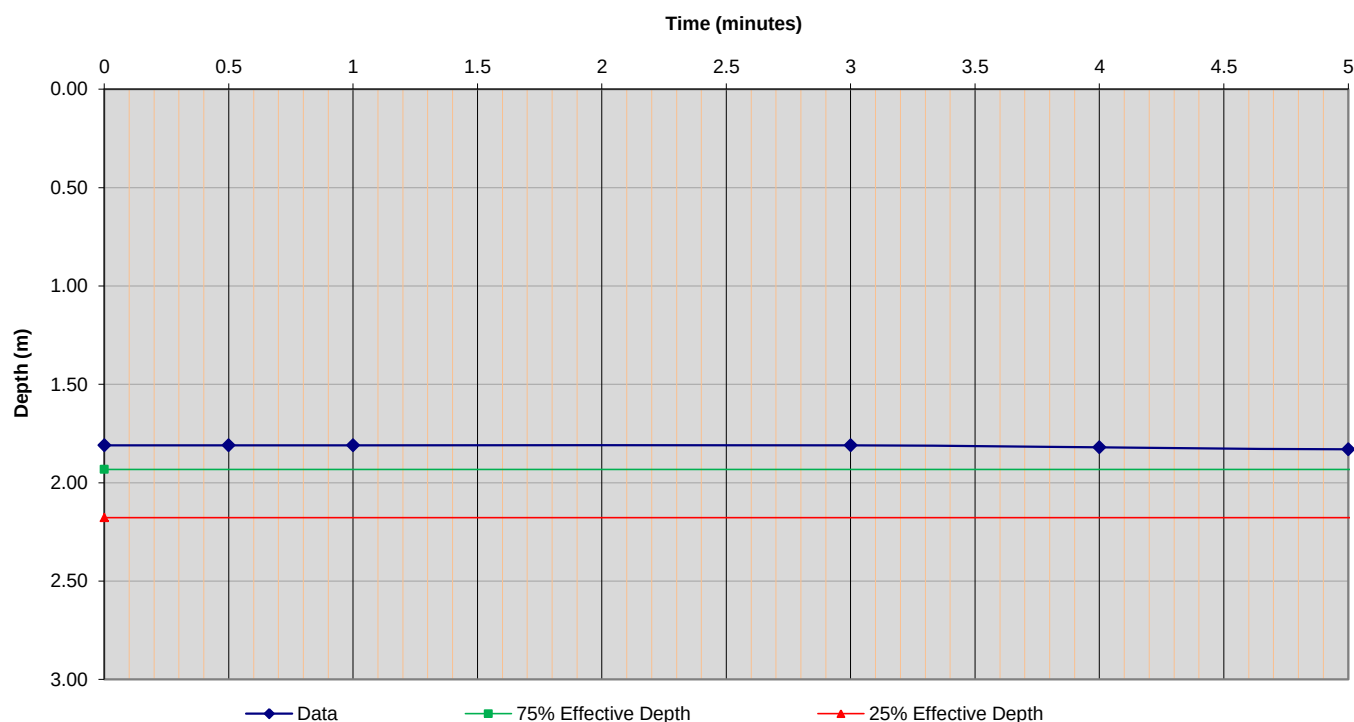
Infiltration Tests

TerraConsult

[illegible]

Soil infiltration rate, f	N/A	m ³ /m ² /s
Soil infiltration rate, f	N/A	m/hr
Percolation Value, vp	N/A	s/mm

Notes: 1. Water drained 0.09m after 180mins
2. See accompanying trial pit log;

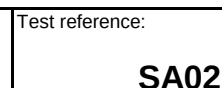


TerraConsult

[illegible]

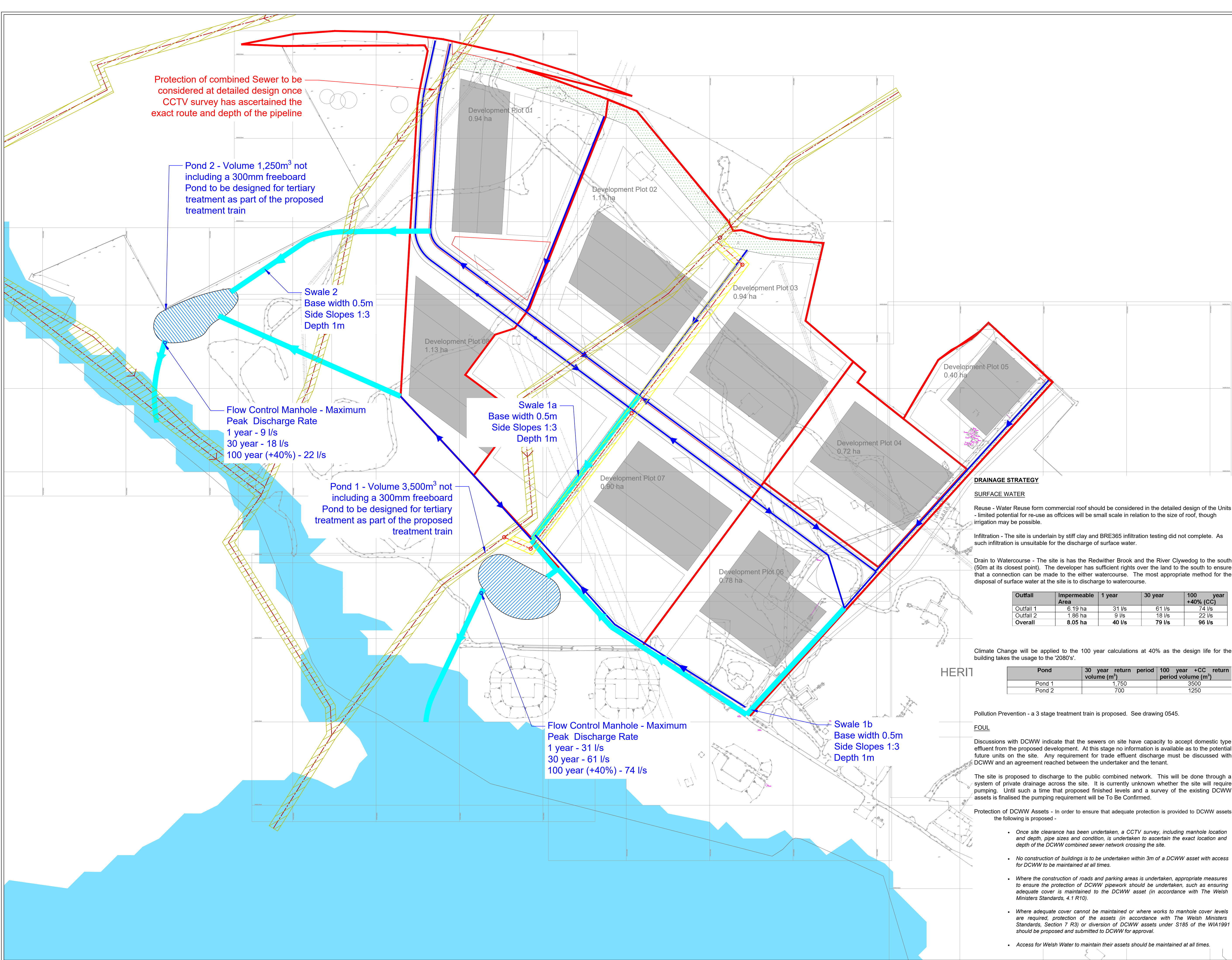
Soil infiltration rate, f	N/A	m ³ /m ² /s
Soil infiltration rate, f	N/A	m/hr
Percolation Value, vp	N/A	s/mm

Notes: 1. Water failed to drain after 180mins
2. See accompanying trial pit log;



APPENDIX 6

Surface Water Strategy Drawing



Protection of combined Sewer to be considered at detailed design once CCTV survey has ascertained the exact route and depth of the pipeline

Pond 2 - Volume 1,250m³ not including a 300mm freeboard
Pond to be designed for tertiary treatment as part of the proposed treatment train

Swale 2
Base width 0.5m
Side Slopes 1:3
Depth 1m

Flow Control Manhole - Maximum Peak Discharge Rate
1 year - 9 l/s
30 year - 18 l/s
100 year (+40%) - 22 l/s

Pond 1 - Volume 3,500m³ not including a 300mm freeboard
Pond to be designed for tertiary treatment as part of the proposed treatment train

Swale 1a
Base width 0.5m
Side Slopes 1:3
Depth 1m

Flow Control Manhole - Maximum Peak Discharge Rate
1 year - 31 l/s
30 year - 61 l/s
100 year (+40%) - 74 l/s

Swale 1b
Base width 0.5m
Side Slopes 1:3
Depth 1m

Notes

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2. Location and exact alignment of drainage and water strategy requirements requires confirmation on site.
3. Surface water sewer and drainage locations are indicative only and not to be used for construction
4. Topographic site levels have been utilised for development of this drainage design. Levels may be subject to change based on development finishing and layout amendments.

Key

- Pond
- Filter Drain
- Swale
- Existing DCWW Easement
- Proposed DCWW Easement
- Existing DCWW Sewer
- Proposed DCWW Sewer
- Lie Flood Zone 2 Outline

DRAINAGE STRATEGY

SURFACE WATER

Reuse - Water Reuse form commercial roof should be considered in the detailed design of the Units - limited potential for re-use as offices will be small scale in relation to the size of roof, though irrigation may be possible.

Infiltration - The site is underlain by stiff clay and BRE365 infiltration testing did not complete. As such infiltration is unsuitable for the discharge of surface water.

Drain to Watercourse - The site is has the Redwither Brook and the River Clywedog to the south (50m at its closest point). The developer has sufficient rights over the land to the south to ensure that a connection can be made to the either watercourse. The most appropriate method for the disposal of surface water at the site is to discharge to watercourse.

Outfall	Impermeable Area	1 year	30 year	100 year +40% (CC)
Outfall 1	6.19 ha	31 l/s	61 l/s	74 l/s
Outfall 2	1.86 ha	9 l/s	18 l/s	22 l/s
Overall	8.05 ha	40 l/s	79 l/s	96 l/s

Climate Change will be applied to the 100 year calculations at 40% as the design life for the building takes the usage to the '2080's'.

Pond	30 year return volume (m ³)	100 year +CC return period volume (m ³)
Pond 1	1,750	3500
Pond 2	700	1250

Pollution Prevention - a 3 stage treatment train is proposed. See drawing 0545.

FOUL

Discussions with DCWW indicate that the sewers on site have capacity to accept domestic type effluent from the proposed development. At this stage no information is available as to the potential future units on the site. Any requirement for trade effluent discharge must be discussed with DCWW and an agreement reached between the undertaker and the tenant.

The site is proposed to discharge to the public combined network. This will be done through a system of private drainage across the site. It is currently unknown whether the site will require pumping. Until such a time that proposed finished levels and a survey of the existing DCWW assets is finalised the pumping requirement will be To Be Confirmed.

Protection of DCWW Assets - In order to ensure that adequate protection is provided to DCWW assets the following is proposed -

- Once site clearance has been undertaken, a CCTV survey, including manhole location and depth, pipe sizes and condition, is undertaken to ascertain the exact location and depth of the DCWW combined sewer network crossing the site.
- No construction of buildings is to be undertaken within 3m of a DCWW asset with access for DCWW to be maintained at all times.
- Where the construction of roads and parking areas is undertaken, appropriate measures to ensure the protection of DCWW pipework should be undertaken, such as ensuring adequate cover is maintained to the DCWW asset (in accordance with The Welsh Ministers Standards, 4.1 R10).
- Where adequate cover cannot be maintained or where works to manhole cover levels are required, protection of the assets (in accordance with The Welsh Ministers Standards, Section 7 R3) or diversion of DCWW assets under S185 of the WIA1991 should be proposed and submitted to DCWW for approval.
- Access for Welsh Water to maintain their assets should be maintained at all times.

TerraConsult

Bold Business Centre, Bold Lane,
Sutton, St. Helens, WA9 4TX

Client

Project

THE OAKS, WREXHAM

Drawing Title

PROPOSED DRAINAGE
STRATEGY

Scale 1:1000 @ A1

Drawing No. TOW-TCL-HDG-XX-DR-D-0510

Status	Rev	Date	Description
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Status	Rev	Date	Description

Date	Apr 19	Designed	P Barrett
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Drawn	P Barrett	Checked	P Barrett
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APPENDIX 7

Surface Water Calculations



- Notes**
1. Do not scale from drawing. Not issued for construction
 2. Location and exact alignment of drainage and water strategy requirements requires confirmation on site.
 3. Surface water sewer and drainage locations are indicative only and not to be used for construction
 4. Topographic site levels have been utilised for development of this drainage design. Levels may be subject to change based on development finishing and layout amendments.

Key

	Catchment 1 - 1.85 ha
	Catchment 2 - 4.04 ha
	Catchment 3 - 2.15 ha

**Bold Business Centre, Bold Lane,
Sutton, St. Helens, WA9 4TX**

Client

Project
THE OAKS, WREXHAM

Drawing Title
**PROPOSED DRAINAGE
CATCHMENTS PLAN**

Scale 1:1000 @ A1

Drawing No.	TOW-TCL-HDG-XX-DR-D-0515		
Status\Rev\	Date	Description	
Date	Apr 19	Designed	P Barrett
Drawn	P Barrett	Checked	P Barrett

TerraConsult Ltd			Page 1																																																																																																																				
Bold Business Centre Sutton St Helens WA9 4TX																																																																																																																							
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<table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Control (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>24.299</td><td>0.299</td><td>65.3</td><td>1314.2</td><td>O K</td></tr><tr><td>30 min Summer</td><td>24.386</td><td>0.386</td><td>73.2</td><td>1745.2</td><td>O K</td></tr><tr><td>60 min Summer</td><td>24.474</td><td>0.474</td><td>74.0</td><td>2199.1</td><td>O K</td></tr><tr><td>120 min Summer</td><td>24.553</td><td>0.553</td><td>74.0</td><td>2628.8</td><td>O K</td></tr><tr><td>180 min Summer</td><td>24.589</td><td>0.589</td><td>74.0</td><td>2832.3</td><td>O K</td></tr><tr><td>240 min Summer</td><td>24.607</td><td>0.607</td><td>74.0</td><td>2932.0</td><td>O K</td></tr><tr><td>360 min Summer</td><td>24.618</td><td>0.618</td><td>74.0</td><td>2992.9</td><td>O K</td></tr><tr><td>480 min Summer</td><td>24.622</td><td>0.622</td><td>74.0</td><td>3019.1</td><td>O K</td></tr><tr><td>600 min Summer</td><td>24.622</td><td>0.622</td><td>74.0</td><td>3019.8</td><td>O K</td></tr><tr><td>720 min Summer</td><td>24.619</td><td>0.619</td><td>74.0</td><td>3003.4</td><td>O K</td></tr><tr><td>960 min Summer</td><td>24.608</td><td>0.608</td><td>74.0</td><td>2935.7</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>24.572</td><td>0.572</td><td>74.0</td><td>2733.4</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>24.510</td><td>0.510</td><td>74.0</td><td>2392.8</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>24.452</td><td>0.452</td><td>74.0</td><td>2082.3</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>24.362</td><td>0.362</td><td>72.7</td><td>1622.9</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>24.311</td><td>0.311</td><td>68.5</td><td>1371.9</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>24.282</td><td>0.282</td><td>60.6</td><td>1232.0</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>24.261</td><td>0.261</td><td>54.2</td><td>1131.6</td><td>O K</td></tr></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status	15 min Summer	24.299	0.299	65.3	1314.2	O K	30 min Summer	24.386	0.386	73.2	1745.2	O K	60 min Summer	24.474	0.474	74.0	2199.1	O K	120 min Summer	24.553	0.553	74.0	2628.8	O K	180 min Summer	24.589	0.589	74.0	2832.3	O K	240 min Summer	24.607	0.607	74.0	2932.0	O K	360 min Summer	24.618	0.618	74.0	2992.9	O K	480 min Summer	24.622	0.622	74.0	3019.1	O K	600 min Summer	24.622	0.622	74.0	3019.8	O K	720 min Summer	24.619	0.619	74.0	3003.4	O K	960 min Summer	24.608	0.608	74.0	2935.7	O K	1440 min Summer	24.572	0.572	74.0	2733.4	O K	2160 min Summer	24.510	0.510	74.0	2392.8	O K	2880 min Summer	24.452	0.452	74.0	2082.3	O K	4320 min Summer	24.362	0.362	72.7	1622.9	O K	5760 min Summer	24.311	0.311	68.5	1371.9	O K	7200 min Summer	24.282	0.282	60.6	1232.0	O K	8640 min Summer	24.261	0.261	54.2	1131.6	O K
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15 min Summer	24.299	0.299	65.3	1314.2	O K																																																																																																																		
30 min Summer	24.386	0.386	73.2	1745.2	O K																																																																																																																		
60 min Summer	24.474	0.474	74.0	2199.1	O K																																																																																																																		
120 min Summer	24.553	0.553	74.0	2628.8	O K																																																																																																																		
180 min Summer	24.589	0.589	74.0	2832.3	O K																																																																																																																		
240 min Summer	24.607	0.607	74.0	2932.0	O K																																																																																																																		
360 min Summer	24.618	0.618	74.0	2992.9	O K																																																																																																																		
480 min Summer	24.622	0.622	74.0	3019.1	O K																																																																																																																		
600 min Summer	24.622	0.622	74.0	3019.8	O K																																																																																																																		
720 min Summer	24.619	0.619	74.0	3003.4	O K																																																																																																																		
960 min Summer	24.608	0.608	74.0	2935.7	O K																																																																																																																		
1440 min Summer	24.572	0.572	74.0	2733.4	O K																																																																																																																		
2160 min Summer	24.510	0.510	74.0	2392.8	O K																																																																																																																		
2880 min Summer	24.452	0.452	74.0	2082.3	O K																																																																																																																		
4320 min Summer	24.362	0.362	72.7	1622.9	O K																																																																																																																		
5760 min Summer	24.311	0.311	68.5	1371.9	O K																																																																																																																		
7200 min Summer	24.282	0.282	60.6	1232.0	O K																																																																																																																		
8640 min Summer	24.261	0.261	54.2	1131.6	O K																																																																																																																		
<table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>116.739</td><td>0.0</td><td>1186.9</td><td>26</td></tr><tr><td>30 min Summer</td><td>78.763</td><td>0.0</td><td>1647.3</td><td>39</td></tr><tr><td>60 min Summer</td><td>50.812</td><td>0.0</td><td>2272.8</td><td>68</td></tr><tr><td>120 min Summer</td><td>31.715</td><td>0.0</td><td>2854.6</td><td>126</td></tr><tr><td>180 min Summer</td><td>23.742</td><td>0.0</td><td>3213.4</td><td>184</td></tr><tr><td>240 min Summer</td><td>19.206</td><td>0.0</td><td>3470.4</td><td>242</td></tr><tr><td>360 min Summer</td><td>14.133</td><td>0.0</td><td>3835.4</td><td>318</td></tr><tr><td>480 min Summer</td><td>11.375</td><td>0.0</td><td>4118.3</td><td>380</td></tr><tr><td>600 min Summer</td><td>9.604</td><td>0.0</td><td>4347.0</td><td>444</td></tr><tr><td>720 min Summer</td><td>8.359</td><td>0.0</td><td>4540.0</td><td>510</td></tr><tr><td>960 min Summer</td><td>6.708</td><td>0.0</td><td>4855.1</td><td>646</td></tr><tr><td>1440 min Summer</td><td>4.910</td><td>0.0</td><td>5316.9</td><td>916</td></tr><tr><td>2160 min Summer</td><td>3.587</td><td>0.0</td><td>5951.1</td><td>1304</td></tr><tr><td>2880 min Summer</td><td>2.866</td><td>0.0</td><td>6333.6</td><td>1676</td></tr><tr><td>4320 min Summer</td><td>2.086</td><td>0.0</td><td>6870.7</td><td>2380</td></tr><tr><td>5760 min Summer</td><td>1.662</td><td>0.0</td><td>7396.4</td><td>3056</td></tr><tr><td>7200 min Summer</td><td>1.393</td><td>0.0</td><td>7739.3</td><td>3752</td></tr><tr><td>8640 min Summer</td><td>1.205</td><td>0.0</td><td>8020.5</td><td>4496</td></tr></table>						Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	116.739	0.0	1186.9	26	30 min Summer	78.763	0.0	1647.3	39	60 min Summer	50.812	0.0	2272.8	68	120 min Summer	31.715	0.0	2854.6	126	180 min Summer	23.742	0.0	3213.4	184	240 min Summer	19.206	0.0	3470.4	242	360 min Summer	14.133	0.0	3835.4	318	480 min Summer	11.375	0.0	4118.3	380	600 min Summer	9.604	0.0	4347.0	444	720 min Summer	8.359	0.0	4540.0	510	960 min Summer	6.708	0.0	4855.1	646	1440 min Summer	4.910	0.0	5316.9	916	2160 min Summer	3.587	0.0	5951.1	1304	2880 min Summer	2.866	0.0	6333.6	1676	4320 min Summer	2.086	0.0	6870.7	2380	5760 min Summer	1.662	0.0	7396.4	3056	7200 min Summer	1.393	0.0	7739.3	3752	8640 min Summer	1.205	0.0	8020.5	4496																			
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Bold Business Centre Sutton St Helens WA9 4TX					
Date 10/04/2019 09:52 File Pollution Train.CASX		Designed by philipbarrett Checked by			
Micro Drainage		Source Control 2018.1.1			
<u>Cascade Summary of Results for Pond 1.SRCX</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	24.244	0.244	49.0	1052.7	O K
15 min Winter	24.331	0.331	71.6	1471.9	O K
30 min Winter	24.429	0.429	73.8	1962.4	O K
60 min Winter	24.526	0.526	74.0	2479.0	O K
120 min Winter	24.615	0.615	74.0	2977.5	O K
180 min Winter	24.657	0.657	74.0	3220.5	O K
240 min Winter	24.678	0.678	74.0	3343.0	O K
360 min Winter	24.690	0.690	74.0	3419.2	O K
480 min Winter	24.689	0.689	74.0	3412.5	O K
600 min Winter	24.687	0.687	74.0	3398.7	O K
720 min Winter	24.681	0.681	74.0	3362.5	O K
960 min Winter	24.661	0.661	74.0	3244.6	O K
1440 min Winter	24.603	0.603	74.0	2906.5	O K
2160 min Winter	24.505	0.505	74.0	2363.4	O K
2880 min Winter	24.418	0.418	73.7	1907.5	O K
4320 min Winter	24.313	0.313	69.0	1380.3	O K
5760 min Winter	24.271	0.271	57.3	1180.3	O K
7200 min Winter	24.244	0.244	49.0	1052.5	O K
8640 min Winter	24.224	0.224	42.8	960.2	O K
10080 min Winter	24.209	0.209	38.2	891.3	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
10080 min Summer	1.068	0.0	8250.0	5240	
15 min Winter	116.739	0.0	1345.5	25	
30 min Winter	78.763	0.0	1860.4	39	
60 min Winter	50.812	0.0	2554.5	68	
120 min Winter	31.715	0.0	3205.9	124	
180 min Winter	23.742	0.0	3607.5	180	
240 min Winter	19.206	0.0	3895.3	238	
360 min Winter	14.133	0.0	4304.2	346	
480 min Winter	11.375	0.0	4621.0	412	
600 min Winter	9.604	0.0	4877.1	474	
720 min Winter	8.359	0.0	5093.1	550	
960 min Winter	6.708	0.0	5445.5	704	
1440 min Winter	4.910	0.0	5963.1	996	
2160 min Winter	3.587	0.0	6672.2	1392	
2880 min Winter	2.866	0.0	7102.4	1756	
4320 min Winter	2.086	0.0	7710.8	2380	
5760 min Winter	1.662	0.0	8288.7	3112	
7200 min Winter	1.393	0.0	8674.4	3824	
8640 min Winter	1.205	0.0	8992.3	4512	
10080 min Winter	1.068	0.0	9257.2	5248	
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Bold Business Centre Sutton St Helens WA9 4TX																																			
Date 10/04/2019 09:52 File Pollution Train.CASX	Designed by philipbarrett Checked by																																		
Micro Drainage		Source Control 2018.1.1																																	
<u>Cascade Rainfall Details for Pond 1.SRCX</u> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Winter Storms</td> <td>Yes</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>18.000</td> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Ratio R</td> <td>0.344</td> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>Summer Storms</td> <td>Yes</td> <td>Climate Change %</td> <td>+40</td> </tr> </table> <u>Time Area Diagram</u> Total Area (ha) 0.000 <table> <tr> <th align="left" colspan="3">Time (mins) Area</th> </tr> <tr> <th align="left">From:</th> <th align="left">To:</th> <th align="left">(ha)</th> </tr> <tr> <td>0</td> <td>4</td> <td>0.000</td> </tr> </table>			Rainfall Model	FSR	Winter Storms	Yes	Return Period (years)	100	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	18.000	Shortest Storm (mins)	15	Ratio R	0.344	Longest Storm (mins)	10080	Summer Storms	Yes	Climate Change %	+40	Time (mins) Area			From:	To:	(ha)	0	4	0.000
Rainfall Model	FSR	Winter Storms	Yes																																
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<u>Cascade Model Details for Pond 1.SRCX</u> Storage is Online Cover Level (m) 25.000 <u>Tank or Pond Structure</u> Invert Level (m) 24.000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr><tr><td>0.000</td><td>4000.0</td><td>0.700</td><td>6000.0</td><td>1.000</td><td>6800.0</td></tr></table> <u>Hydro-Brake® Optimum Outflow Control</u> <table><tr><td>Unit Reference</td><td>MD-SHE-0353-7400-0700-7400</td></tr><tr><td>Design Head (m)</td><td>0.700</td></tr><tr><td>Design Flow (l/s)</td><td>74.0</td></tr><tr><td>Flush-Flo™</td><td>Calculated</td></tr><tr><td>Objective</td><td>Minimise upstream storage</td></tr><tr><td>Application</td><td>Surface</td></tr><tr><td>Sump Available</td><td>Yes</td></tr><tr><td>Diameter (mm)</td><td>353</td></tr><tr><td>Invert Level (m)</td><td>24.000</td></tr><tr><td>Minimum Outlet Pipe Diameter (mm)</td><td>375</td></tr><tr><td>Suggested Manhole Diameter (mm)</td><td>1800</td></tr></table> <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>0.700</td><td>74.0</td></tr><tr><td>Flush-Flo™</td><td>0.465</td><td>74.0</td></tr><tr><td>Kick-Flo®</td><td>0.638</td><td>70.7</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>52.5</td></tr></table> The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>10.2</td><td>1.200</td><td>96.1</td><td>3.000</td><td>150.2</td><td>7.000</td><td>227.5</td></tr><tr><td>0.200</td><td>35.6</td><td>1.400</td><td>103.6</td><td>3.500</td><td>161.9</td><td>7.500</td><td>232.7</td></tr><tr><td>0.300</td><td>65.7</td><td>1.600</td><td>110.5</td><td>4.000</td><td>172.9</td><td>8.000</td><td>240.5</td></tr><tr><td>0.400</td><td>73.5</td><td>1.800</td><td>117.0</td><td>4.500</td><td>183.2</td><td>8.500</td><td>248.1</td></tr><tr><td>0.500</td><td>73.9</td><td>2.000</td><td>123.2</td><td>5.000</td><td>192.9</td><td>9.000</td><td>255.5</td></tr><tr><td>0.600</td><td>72.0</td><td>2.200</td><td>129.1</td><td>5.500</td><td>202.1</td><td>9.500</td><td>262.6</td></tr><tr><td>0.800</td><td>78.9</td><td>2.400</td><td>134.7</td><td>6.000</td><td>210.9</td><td></td><td></td></tr><tr><td>1.000</td><td>88.0</td><td>2.600</td><td>140.0</td><td>6.500</td><td>219.4</td><td></td><td></td></tr></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	4000.0	0.700	6000.0	1.000	6800.0	Unit Reference	MD-SHE-0353-7400-0700-7400	Design Head (m)	0.700	Design Flow (l/s)	74.0	Flush-Flo™	Calculated	Objective	Minimise upstream storage	Application	Surface	Sump Available	Yes	Diameter (mm)	353	Invert Level (m)	24.000	Minimum Outlet Pipe Diameter (mm)	375	Suggested Manhole Diameter (mm)	1800	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	0.700	74.0	Flush-Flo™	0.465	74.0	Kick-Flo®	0.638	70.7	Mean Flow over Head Range	-	52.5	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	10.2	1.200	96.1	3.000	150.2	7.000	227.5	0.200	35.6	1.400	103.6	3.500	161.9	7.500	232.7	0.300	65.7	1.600	110.5	4.000	172.9	8.000	240.5	0.400	73.5	1.800	117.0	4.500	183.2	8.500	248.1	0.500	73.9	2.000	123.2	5.000	192.9	9.000	255.5	0.600	72.0	2.200	129.1	5.500	202.1	9.500	262.6	0.800	78.9	2.400	134.7	6.000	210.9			1.000	88.0	2.600	140.0	6.500	219.4		
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)																																																																																																																						
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Date 10/04/2019 09:52 File Pollution Train.CASX		Designed by philipbarrett Checked by			
Micro Drainage		Source Control 2018.1.1			
<u>Cascade Summary of Results for Pond 2.SRCX</u>					
Upstream Outflow To Overflow To Structures					
Swale 2.SRCX (None) (None)					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	24.274	0.274	21.9	388.9	O K
30 min Summer	24.349	0.349	22.0	518.6	O K
60 min Summer	24.422	0.422	22.0	653.7	O K
120 min Summer	24.485	0.485	22.0	779.8	O K
180 min Summer	24.513	0.513	22.0	837.9	O K
240 min Summer	24.526	0.526	22.0	865.1	O K
360 min Summer	24.531	0.531	22.0	875.7	O K
480 min Summer	24.531	0.531	22.0	874.9	O K
600 min Summer	24.527	0.527	22.0	867.3	O K
720 min Summer	24.522	0.522	22.0	855.4	O K
960 min Summer	24.506	0.506	22.0	823.5	O K
1440 min Summer	24.469	0.469	22.0	746.1	O K
2160 min Summer	24.409	0.409	22.0	628.7	O K
2880 min Summer	24.353	0.353	22.0	525.5	O K
4320 min Summer	24.266	0.266	21.9	375.6	O K
5760 min Summer	24.213	0.213	21.3	290.9	O K
7200 min Summer	24.188	0.188	19.0	253.8	O K
8640 min Summer	24.171	0.171	17.0	228.7	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	116.739	0.0	384.5	25	
30 min Summer	78.763	0.0	524.6	39	
60 min Summer	50.812	0.0	697.1	68	
120 min Summer	31.715	0.0	872.4	126	
180 min Summer	23.742	0.0	980.5	184	
240 min Summer	19.206	0.0	1058.1	242	
360 min Summer	14.133	0.0	1168.5	330	
480 min Summer	11.375	0.0	1254.2	390	
600 min Summer	9.604	0.0	1323.8	452	
720 min Summer	8.359	0.0	1382.6	516	
960 min Summer	6.708	0.0	1479.0	652	
1440 min Summer	4.910	0.0	1622.1	918	
2160 min Summer	3.587	0.0	1793.4	1304	
2880 min Summer	2.866	0.0	1909.9	1676	
4320 min Summer	2.086	0.0	2078.4	2376	
5760 min Summer	1.662	0.0	2221.4	3008	
7200 min Summer	1.393	0.0	2325.9	3744	
8640 min Summer	1.205	0.0	2413.0	4416	
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Date 10/04/2019 09:52 File Pollution Train.CASX		Designed by philipbarrett Checked by			
Micro Drainage		Source Control 2018.1.1			
<u>Cascade Summary of Results for Pond 2.SRCX</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	24.159	0.159	15.3	211.2	O K
15 min Winter	24.302	0.302	22.0	437.0	O K
30 min Winter	24.385	0.385	22.0	584.0	O K
60 min Winter	24.465	0.465	22.0	737.7	O K
120 min Winter	24.535	0.535	22.0	884.6	O K
180 min Winter	24.568	0.568	22.0	955.5	O K
240 min Winter	24.583	0.583	22.0	990.5	O K
360 min Winter	24.592	0.592	22.0	1009.6	O K
480 min Winter	24.589	0.589	22.0	1003.2	O K
600 min Winter	24.582	0.582	22.0	988.3	O K
720 min Winter	24.575	0.575	22.0	971.3	O K
960 min Winter	24.553	0.553	22.0	923.6	O K
1440 min Winter	24.495	0.495	22.0	799.1	O K
2160 min Winter	24.401	0.401	22.0	614.2	O K
2880 min Winter	24.317	0.317	22.0	462.1	O K
4320 min Winter	24.209	0.209	21.3	286.0	O K
5760 min Winter	24.176	0.176	17.6	236.0	O K
7200 min Winter	24.157	0.157	15.0	207.2	O K
8640 min Winter	24.143	0.143	13.0	187.5	O K
10080 min Winter	24.133	0.133	11.6	172.9	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
10080 min Summer	1.068	0.0	2487.7	5152	
15 min Winter	116.739	0.0	432.8	25	
30 min Winter	78.763	0.0	589.5	39	
60 min Winter	50.812	0.0	781.9	68	
120 min Winter	31.715	0.0	978.1	124	
180 min Winter	23.742	0.0	1099.2	182	
240 min Winter	19.206	0.0	1186.0	238	
360 min Winter	14.133	0.0	1309.7	348	
480 min Winter	11.375	0.0	1405.6	450	
600 min Winter	9.604	0.0	1483.4	484	
720 min Winter	8.359	0.0	1549.2	560	
960 min Winter	6.708	0.0	1657.2	716	
1440 min Winter	4.910	0.0	1817.5	1002	
2160 min Winter	3.587	0.0	2009.5	1396	
2880 min Winter	2.866	0.0	2140.2	1756	
4320 min Winter	2.086	0.0	2330.1	2340	
5760 min Winter	1.662	0.0	2488.6	3056	
7200 min Winter	1.393	0.0	2605.8	3752	
8640 min Winter	1.205	0.0	2703.8	4496	
10080 min Winter	1.068	0.0	2788.8	5152	
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Date 10/04/2019 09:52 File Pollution Train.CASX	Designed by philipbarrett Checked by																																																																																																																										
Micro Drainage		Source Control 2018.1.1																																																																																																																									
<u>Cascade Model Details for Pond 2.SRCX</u> Storage is Online Cover Level (m) 25.000 <u>Tank or Pond Structure</u> Invert Level (m) 24.000 <table><tr><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td></tr><tr><td>0.000</td><td>1200.0</td><td>0.700</td><td>2500.0</td><td>1.000</td><td>3100.0</td></tr></table> <u>Hydro-Brake® Optimum Outflow Control</u> <table><tr><td>Unit Reference</td><td>MD-SHE-0210-2200-0700-2200</td></tr><tr><td>Design Head (m)</td><td>0.700</td></tr><tr><td>Design Flow (l/s)</td><td>22.0</td></tr><tr><td>Flush-Flo™</td><td>Calculated</td></tr><tr><td>Objective</td><td>Minimise upstream storage</td></tr><tr><td>Application</td><td>Surface</td></tr><tr><td>Sump Available</td><td>Yes</td></tr><tr><td>Diameter (mm)</td><td>210</td></tr><tr><td>Invert Level (m)</td><td>24.000</td></tr><tr><td>Minimum Outlet Pipe Diameter (mm)</td><td>225</td></tr><tr><td>Suggested Manhole Diameter (mm)</td><td>1500</td></tr></table> <table><tr><td>Control Points</td><td>Head (m)</td><td>Flow (l/s)</td></tr><tr><td>Design Point (Calculated)</td><td>0.700</td><td>22.0</td></tr><tr><td>Flush-Flo™</td><td>0.316</td><td>22.0</td></tr><tr><td>Kick-Flo®</td><td>0.553</td><td>19.7</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>17.6</td></tr></table> The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated <table><tr><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td></tr><tr><td>0.100</td><td>7.2</td><td>1.200</td><td>28.5</td><td>3.000</td><td>44.2</td><td>7.000</td><td>66.7</td></tr><tr><td>0.200</td><td>20.3</td><td>1.400</td><td>30.6</td><td>3.500</td><td>47.7</td><td>7.500</td><td>68.6</td></tr><tr><td>0.300</td><td>22.0</td><td>1.600</td><td>32.7</td><td>4.000</td><td>50.8</td><td>8.000</td><td>70.9</td></tr><tr><td>0.400</td><td>21.7</td><td>1.800</td><td>34.6</td><td>4.500</td><td>53.8</td><td>8.500</td><td>73.1</td></tr><tr><td>0.500</td><td>20.7</td><td>2.000</td><td>36.4</td><td>5.000</td><td>56.7</td><td>9.000</td><td>75.2</td></tr><tr><td>0.600</td><td>20.4</td><td>2.200</td><td>38.1</td><td>5.500</td><td>59.3</td><td>9.500</td><td>77.3</td></tr><tr><td>0.800</td><td>23.4</td><td>2.400</td><td>39.7</td><td>6.000</td><td>61.9</td><td></td><td></td></tr><tr><td>1.000</td><td>26.1</td><td>2.600</td><td>41.3</td><td>6.500</td><td>64.4</td><td></td><td></td></tr></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	1200.0	0.700	2500.0	1.000	3100.0	Unit Reference	MD-SHE-0210-2200-0700-2200	Design Head (m)	0.700	Design Flow (l/s)	22.0	Flush-Flo™	Calculated	Objective	Minimise upstream storage	Application	Surface	Sump Available	Yes	Diameter (mm)	210	Invert Level (m)	24.000	Minimum Outlet Pipe Diameter (mm)	225	Suggested Manhole Diameter (mm)	1500	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	0.700	22.0	Flush-Flo™	0.316	22.0	Kick-Flo®	0.553	19.7	Mean Flow over Head Range	-	17.6	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	7.2	1.200	28.5	3.000	44.2	7.000	66.7	0.200	20.3	1.400	30.6	3.500	47.7	7.500	68.6	0.300	22.0	1.600	32.7	4.000	50.8	8.000	70.9	0.400	21.7	1.800	34.6	4.500	53.8	8.500	73.1	0.500	20.7	2.000	36.4	5.000	56.7	9.000	75.2	0.600	20.4	2.200	38.1	5.500	59.3	9.500	77.3	0.800	23.4	2.400	39.7	6.000	61.9			1.000	26.1	2.600	41.3	6.500	64.4		
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)																																																																																																																						
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0.300	22.0	1.600	32.7	4.000	50.8	8.000	70.9																																																																																																																				
0.400	21.7	1.800	34.6	4.500	53.8	8.500	73.1																																																																																																																				
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0.800	23.4	2.400	39.7	6.000	61.9																																																																																																																						
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Upstream Structures	Outflow To	Overflow To
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340	341	342
343	344	345
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349	350	351
352	353	354
355	356	357
358	359	360
361	362	363
364	365	366

Half Drain Time : 0 minutes.

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
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Cascade Model Details for Swale 1a.SRCX

Storage is Online Cover Level (m) 28.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	120.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	500.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	27.000	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.5		

Orifice Outflow Control

Diameter (m) 0.723 Discharge Coefficient 0.600 Invert Level (m) 24.000

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Date 10/04/2019 09:53 File Pollution Train.CASX		
Micro Drainage		Source Control 2018.1.1

Cascade Summary of Results for Swale 1b.SRCX							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	27.000	0.000	0.0	21.4	21.4	0.0	O K
10080 min Summer	27.000	0.000	0.0	18.9	18.9	0.0	O K
15 min Winter	27.000	0.000	0.0	693.2	693.2	0.0	O K
30 min Winter	27.000	0.000	0.0	717.3	717.3	0.0	O K
60 min Winter	27.000	0.000	0.0	578.7	578.7	0.0	O K
120 min Winter	27.000	0.000	0.0	391.1	391.1	0.0	O K
180 min Winter	27.000	0.000	0.0	298.1	298.1	0.0	O K
240 min Winter	27.000	0.000	0.0	243.0	243.0	0.0	O K
360 min Winter	27.000	0.000	0.0	180.0	180.0	0.0	O K
480 min Winter	27.000	0.000	0.0	145.3	145.3	0.0	O K
600 min Winter	27.000	0.000	0.0	123.0	123.0	0.0	O K
720 min Winter	27.000	0.000	0.0	107.0	107.0	0.0	O K
960 min Winter	27.000	0.000	0.0	85.9	85.9	0.0	O K
1440 min Winter	27.000	0.000	0.0	62.9	62.9	0.0	O K
2160 min Winter	27.000	0.000	0.0	45.9	45.9	0.0	O K
2880 min Winter	27.000	0.000	0.0	36.7	36.7	0.0	O K
4320 min Winter	27.000	0.000	0.0	26.7	26.7	0.0	O K
5760 min Winter	27.000	0.000	0.0	21.3	21.3	0.0	O K
7200 min Winter	27.000	0.000	0.0	17.8	17.8	0.0	O K
8640 min Winter	27.000	0.000	0.0	15.4	15.4	0.0	O K
10080 min Winter	27.000	0.000	0.0	13.7	13.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.205	0.0	2825.1	0
10080 min Summer	1.068	0.0	2919.4	0
15 min Winter	116.739	0.0	532.0	0
30 min Winter	78.763	0.0	717.8	0
60 min Winter	50.812	0.0	926.2	0
120 min Winter	31.715	0.0	1156.2	0
180 min Winter	23.742	0.0	1298.3	0
240 min Winter	19.206	0.0	1400.4	0
360 min Winter	14.133	0.0	1545.7	0
480 min Winter	11.375	0.0	1658.8	0
600 min Winter	9.604	0.0	1750.6	0
720 min Winter	8.359	0.0	1828.4	0
960 min Winter	6.708	0.0	1956.5	0
1440 min Winter	4.910	0.0	2148.2	0
2160 min Winter	3.587	0.0	2353.5	0
2880 min Winter	2.866	0.0	2507.6	0
4320 min Winter	2.086	0.0	2737.1	0
5760 min Winter	1.662	0.0	2908.8	0
7200 min Winter	1.393	0.0	3047.0	0
8640 min Winter	1.205	0.0	3164.2	0
10080 min Winter	1.068	0.0	3269.7	0

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Micro Drainage		Source Control 2018.1.1																								
<u>Cascade Model Details for Swale 1b.SRCX</u> Storage is Online Cover Level (m) 28.000 <u>Swale Structure</u> <table> <tr> <td>Infiltration Coefficient Base (m/hr)</td> <td>0.00000</td> <td>Length (m)</td> <td>120.0</td> </tr> <tr> <td>Infiltration Coefficient Side (m/hr)</td> <td>0.00000</td> <td>Side Slope (1:X)</td> <td>3.0</td> </tr> <tr> <td>Safety Factor</td> <td>2.0</td> <td>Slope (1:X)</td> <td>500.0</td> </tr> <tr> <td>Porosity</td> <td>1.00</td> <td>Cap Volume Depth (m)</td> <td>0.000</td> </tr> <tr> <td>Invert Level (m)</td> <td>27.000</td> <td>Cap Infiltration Depth (m)</td> <td>0.000</td> </tr> <tr> <td>Base Width (m)</td> <td>0.5</td> <td></td> <td></td> </tr> </table> <u>Orifice Outflow Control</u> Diameter (m) 0.723 Discharge Coefficient 0.600 Invert Level (m) 24.000			Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	120.0	Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0	Safety Factor	2.0	Slope (1:X)	500.0	Porosity	1.00	Cap Volume Depth (m)	0.000	Invert Level (m)	27.000	Cap Infiltration Depth (m)	0.000	Base Width (m)	0.5		
Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	120.0																							
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0																							
Safety Factor	2.0	Slope (1:X)	500.0																							
Porosity	1.00	Cap Volume Depth (m)	0.000																							
Invert Level (m)	27.000	Cap Infiltration Depth (m)	0.000																							
Base Width (m)	0.5																									
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Micro Drainage

Micro Drainage

Source Control 2018.1.1

Cascade Summary of Results for Swale 2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	27.000	0.000	0.0	18.3	18.3	0.0	O K
10080 min Summer	27.000	0.000	0.0	16.2	16.2	0.0	O K
15 min Winter	27.000	0.000	0.0	594.9	594.9	0.0	O K
30 min Winter	27.000	0.000	0.0	615.3	615.3	0.0	O K
60 min Winter	27.000	0.000	0.0	496.2	496.2	0.0	O K
120 min Winter	27.000	0.000	0.0	335.2	335.2	0.0	O K
180 min Winter	27.000	0.000	0.0	255.5	255.5	0.0	O K
240 min Winter	27.000	0.000	0.0	208.3	208.3	0.0	O K
360 min Winter	27.000	0.000	0.0	154.3	154.3	0.0	O K
480 min Winter	27.000	0.000	0.0	124.5	124.5	0.0	O K
600 min Winter	27.000	0.000	0.0	105.4	105.4	0.0	O K
720 min Winter	27.000	0.000	0.0	91.8	91.8	0.0	O K
960 min Winter	27.000	0.000	0.0	73.6	73.6	0.0	O K
1440 min Winter	27.000	0.000	0.0	53.9	53.9	0.0	O K
2160 min Winter	27.000	0.000	0.0	39.4	39.4	0.0	O K
2880 min Winter	27.000	0.000	0.0	31.5	31.5	0.0	O K
4320 min Winter	27.000	0.000	0.0	22.9	22.9	0.0	O K
5760 min Winter	27.000	0.000	0.0	18.2	18.2	0.0	O K
7200 min Winter	27.000	0.000	0.0	15.3	15.3	0.0	O K
8640 min Winter	27.000	0.000	0.0	13.2	13.2	0.0	O K
10080 min Winter	27.000	0.000	0.0	11.7	11.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.205	0.0	2421.6	0
10080 min Summer	1.068	0.0	2502.3	0
15 min Winter	116.739	0.0	456.0	0
30 min Winter	78.763	0.0	615.3	0
60 min Winter	50.812	0.0	793.9	0
120 min Winter	31.715	0.0	991.0	0
180 min Winter	23.742	0.0	1112.9	0
240 min Winter	19.206	0.0	1200.3	0
360 min Winter	14.133	0.0	1324.9	0
480 min Winter	11.375	0.0	1421.8	0
600 min Winter	9.604	0.0	1500.5	0
720 min Winter	8.359	0.0	1567.2	0
960 min Winter	6.708	0.0	1677.0	0
1440 min Winter	4.910	0.0	1841.3	0
2160 min Winter	3.587	0.0	2017.3	0
2880 min Winter	2.866	0.0	2149.4	0
4320 min Winter	2.086	0.0	2346.1	0
5760 min Winter	1.662	0.0	2493.2	0
7200 min Winter	1.393	0.0	2611.7	0
8640 min Winter	1.205	0.0	2712.1	0
10080 min Winter	1.068	0.0	2802.6	0

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Date 10/04/2019 09:53 File Pollution Train.CASX	Designed by philipbarrett Checked by	
Micro Drainage Source Control 2018.1.1		

Cascade Rainfall Details for Swale 2.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.344	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.860

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.620	4 8	0.620	8 12	0.620

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Bold Business Centre Sutton St Helens WA9 4TX																										
Date 10/04/2019 09:53 File Pollution Train.CASX	Designed by philipbarrett Checked by																									
Micro Drainage		Source Control 2018.1.1																								
<u>Cascade Model Details for Swale 2.SRCX</u> Storage is Online Cover Level (m) 28.000 <u>Swale Structure</u> <table> <tr> <td>Infiltration Coefficient Base (m/hr)</td> <td>0.00000</td> <td>Length (m)</td> <td>120.0</td> </tr> <tr> <td>Infiltration Coefficient Side (m/hr)</td> <td>0.00000</td> <td>Side Slope (1:X)</td> <td>3.0</td> </tr> <tr> <td>Safety Factor</td> <td>2.0</td> <td>Slope (1:X)</td> <td>180.0</td> </tr> <tr> <td>Porosity</td> <td>1.00</td> <td>Cap Volume Depth (m)</td> <td>0.000</td> </tr> <tr> <td>Invert Level (m)</td> <td>27.000</td> <td>Cap Infiltration Depth (m)</td> <td>0.000</td> </tr> <tr> <td>Base Width (m)</td> <td>0.5</td> <td></td> <td></td> </tr> </table> <u>Orifice Outflow Control</u> Diameter (m) 0.723 Discharge Coefficient 0.600 Invert Level (m) 24.000			Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	120.0	Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0	Safety Factor	2.0	Slope (1:X)	180.0	Porosity	1.00	Cap Volume Depth (m)	0.000	Invert Level (m)	27.000	Cap Infiltration Depth (m)	0.000	Base Width (m)	0.5		
Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	120.0																							
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0																							
Safety Factor	2.0	Slope (1:X)	180.0																							
Porosity	1.00	Cap Volume Depth (m)	0.000																							
Invert Level (m)	27.000	Cap Infiltration Depth (m)	0.000																							
Base Width (m)	0.5																									
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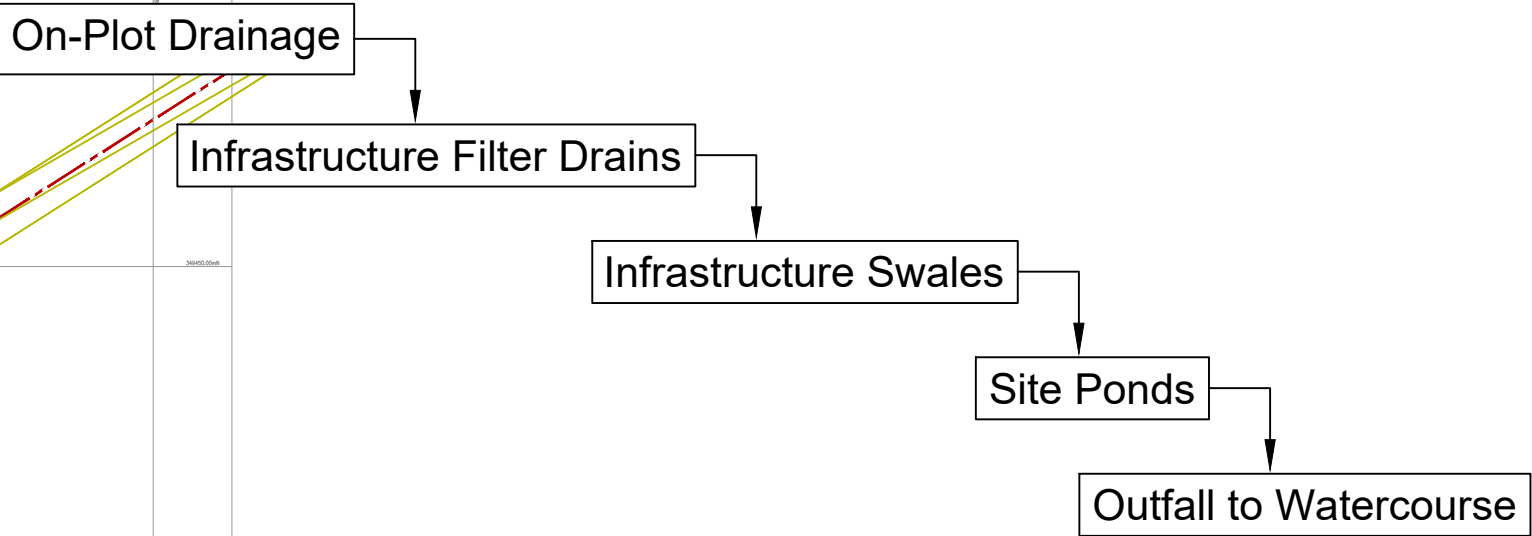
APPENDIX 8

Pollution Hazard Plan

Pollution Hazard Table

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Commercial Roofs	Very Low Risk	0.3	0.2	0.05
Car Parks and minor access roads	Low Risk	0.5	0.4	0.4
Access Road with >200 trips per day and commercial yards	Medium Risk	0.7	0.6	0.7

Pollution Mitigation Index - SuDS Treatment Train



	Filter Drain	Swale*	Pond*	Total
TSS	0.4**	0.25	0.35	1.00
Metals	0.4	0.3	0.35	1.05
Hydrocarbons	0.4	0.3	0.25	1.05

*Mitigation index reduced by 50% as feature to be used as secondary/tertiary treatment
**Catchpits required on site to reduce the loading of TSS on the filter drain network

Notes

- Do not scale from drawing. Not issued for construction
- Location and exact alignment of drainage and water strategy requirements requires confirmation on site.
- Surface water sewer and drainage locations are indicative only and not to be used for construction
- Topographic site levels have been utilised for development of this drainage design. Levels may be subject to change based on development finishing and layout amendments.

Key

- Pollution Hazard - Med
- 1Pollution Hazard - Med
- Pollution Hazard - Low
- Pollution Hazard - V.Low
- Pond
- Filter Drain
- Swale
- Existing DCWW Easement
- Proposed DCWW Easement
- Existing DCWW Sewer
- Proposed DCWW Sewer
- Lle Flood Zone 2 Outline

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Bold Business Centre, Bold Lane,
Sutton, St. Helens, WA9 4TX

Client

Project

THE OAKS, WREXHAM

Drawing Title

PROPOSED DRAINAGE
POLLUTION HAZARDS
PLAN

Scale 1:1000 @ A1

Drawing No. TOW-TCL-HDG-XX-DR-D-0535

Status	Rev	Date	Description
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Date	Apr 19	Designed	P Barrett
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Drawn	P Barrett	Checked	P Barrett
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