LandStudio




# IPSEN EAST MSCP

Flood Consequence Assessment and Drainage Strategy

June 2026

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This document has been produced by Land Studio on behalf of Lovelock Mitchell for Ipsen. The contents of the document are intended for submission with a planning application for a proposed new multi story car park on the Ipsen East site. Land Studio has prepared this report in accordance with the instructions of the above-named client for their sole and specific use. Any third parties who may use the information contained herein do so at their own risk.

# CONTENTS


**01 INTRODUCTION 4**

Introduction
The Site
Relevant Planning Policy & Guidance

**02 BASELINE REVIEW 8**

Flood Risk
Flood Risk from Rivers and Seas
Flood Risk from Surface Water
Flooding from Reservoirs
Flooding from Sewers and Drains
Geological Setting
Existing Drainage

**03 ASSESSMENT OF FLOOD RISK 11**

Assessment of Flood Risk
Maintaining Exceedance Events
Sustainable Drainage
Flood Risk Conclusion

**04 DRAINAGE DESIGN CRITERIA 13**

S1 - Surface water drainage discharge
S2 - Surface water control
S3 - Water Quality
S4 - Amenity
S5 - Biodiversity
S6 - Construction, Integrity & Maintenance

**05 APPENDICES 16**

Ipsen East MSCP: **INTRODUCTION**

# 01

# **IPSEN EAST MSCP:** INTRODUCTION

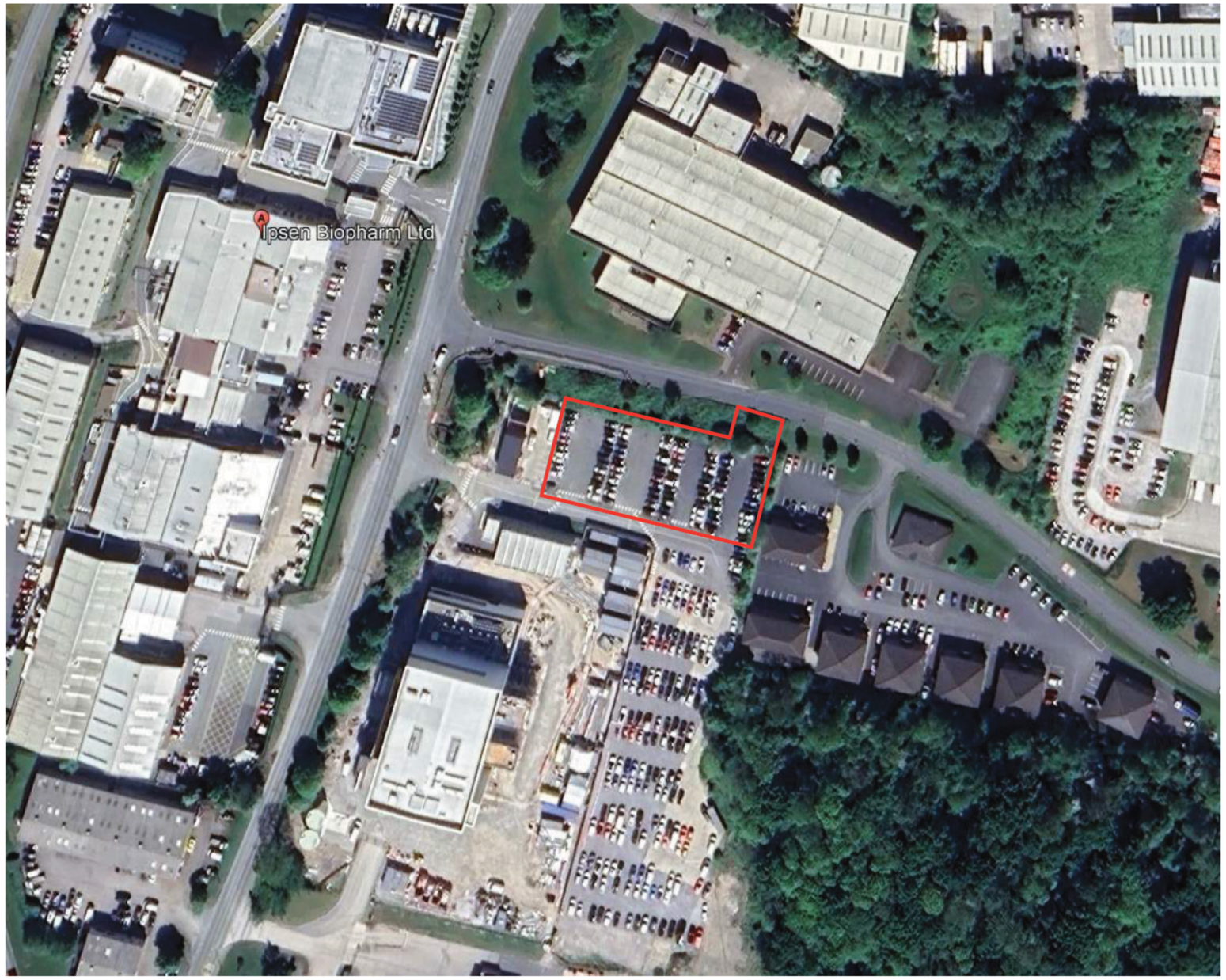



Figure 1: Site Location and Planning Redline Boundary

Land Studio have been appointed by Lovelock Mitchell on behalf of Ipsen to produce a Flood Consequence Assessment and Drainage Strategy in support of a planning application for the construction of a phased construction for a new multi storey car park at Ipsen East Site, Ash Road North, Wrexham Industrial Estate, Wrexham.

This report records the results of a Flood Consequence Assessment for the planning redline boundary and Drainage Strategy for the multi storey car park which has been carried out in accordance with Planning Policy Wales (PPW), Technical Advice Note (TAN 15) and Welsh Government Statutory Standards for Sustainable Drainage Systems (SuDS). Further development of the SuDS strategy within this report will be required for SAB approval.

This report considers the risk of various sources of flooding to the site and the consequent risk of flooding to the downstream receptors (such as people, property, habitats, infrastructure and statutory sites) and recommends any necessary measures to reduce or mitigate flood risk to both the site and downstream catchment.

This report also considers the existing drainage situation and indicates the proposed surface water drainage scheme for the development of the multi storey car park taking into account the Statutory Standards for SuDS.

In preparation of the report and performance of any other services, Land Studio has relied upon publicly available information, information provided by the client and information provided by third parties. Accordingly, the conclusions reached in this report are valid only to the extent that the information provided was accurate and complete. Land Studio cannot accept liability for the accuracy or otherwise of any information derived from third party sources.

# **IPSEN EAST MSCP:** THE SITE

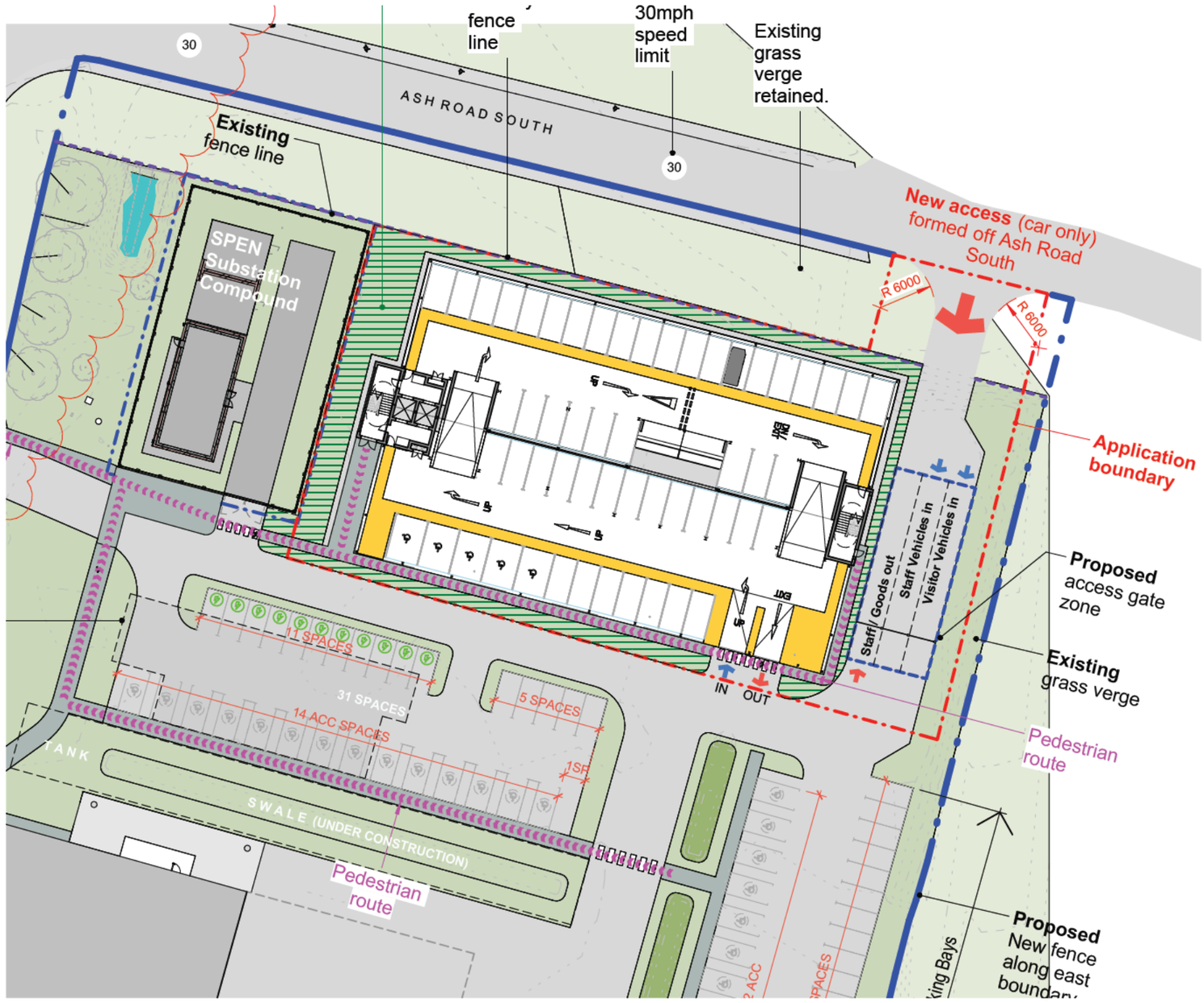



Figure 2: Proposed Development

The multi storey car park development is located on the existing Ipsen East Site surface level car park which is on the corner of Ash Road North and Ash Road South, Wrexham Industrial Estate, LL13 9UG.

The development will comprise the construction of a new access onto Ash Road South and the construction of a new multi storey car park on the existing asphalt surface level car park. The proposed development will provide split level parking for approximately 406 cars and will be 7 storeys high. The grid reference for the centre of this development is SJ 37598 50209 and the site location can be found in Figure 1.

The proposed development site is bound by an industrial unit and access road to the south which is currently under construction, a substation to the west, existing landscape strip to the south between the site and Ash Road South, and landscaping to the west.

The car park will be accessed from a new entrance from Ash Road South.

# **IPSEN EAST MSCP:** RELEVANT PLANNING POLICY & GUIDANCE

The following legislation and planning guidance have been reviewed and considered in preparation of this report and the subsequent design.

**Planning Policy and Guidance**

The following legislation and planning guidance has been reviewed in regards to Flood Risk. Additional policy and guidance in relation to drainage design is available and will be covered by the separate drainage strategy report.

**Planning Policy Wales (PPW)**

Planning Policy Wales (PPW) sets out governments planning policies for Wales and how these are expected to be applied. TAN 15 provides technical guidance which supplements the policy within PPW and seeks to ensure that flood risk is taken into account at all stages in the planning process and is appropriately addressed.

National policy requires that planning applications for new developments should incorporate sustainable drainage systems (SuDS) to appropriate operational standards and with maintenance arrangements in place unless there is clear evidence that this would be inappropriate.

PPW states that the planning system protects water features and fosters sustainable water management as key attributes of attractive and resilient places to live and is closely aligned with securing the multiple benefits of green infrastructure. The outcome of which should make a contribution towards achieving the requirements imposed by EU Water Framework Directive along with Welsh Government Policy for the integrated planning and management of water both in the urban and rural areas.

New developments of more than one dwelling or where the area covered by construction work equals or exceeds 100m$^2$ also requires approval from the SuDS Approval Body (SAB) before construction can commence.

The provision of SuDS must be considered as an integral pat of the design of new developments and proposals should incorporate design of surface water management based on the principles which work with nature to facilitate the natural functioning of the water cycle.

Any developments discharging domestic sewage should connect to the foul sewer where it is reasonable to do so. Developments proposing the use of non-mains drainage schemes will only be considered acceptable where connection to the main sewer is not feasible. Non mains drainage schemes should be subject to as assessment of their effects on the environment, amenity and public health in the locality.

All developments should reduce, and must not increase, flood risk arising from river and/or coastal flooding on and off the development itself.

All developments should not cause additional run-off and therefore requires control as close to source as possible by the use of SuDS.

**Technical Advice Note 15: Development and Flood Risk**

TAN 15 sets out a precautionary framework to guide planning decisions in areas at high risk of flooding. The aim of the framework is to direct new developments away from those areas which are at high risk of flooding and where developments are considered in high risk flood areas only those developments which can be justified should be located in such areas. The aim of TAN15 is also to ensure that flood risk is considered at all stages in the planning process and to direct development run-off away from the areas at highest risk. Where new development is proposed in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible to reduce flood risk overall.

The Flood Consequence Assessment will need to indicate that if less vulnerable construction, which car parks are classified as, are proposed then the development can be safely managed over its lifetime, that the development does not increase flood risk to other properties and that climate change has been considered

The Flood Map for Planning provided by Natural Resources Wales (NRW indicate the level of risk associated fluvial, coastal and surface water on the location of the site and how to assess the consequences of flooding on the site.

To reduce surface water run-off from the site sustainable drainage solutions both hard and soft should be employed to manage and treat surface water run-off prior to discharge in accordance with the Welsh Government Sustainable Drainage Systems Standards.

**Statutory Authority Guidance**

The approach outlined in the Welsh Government Sustainable Drainage Systems Standards for Wales (SuDS Standards) and the CIRIA SuDS manual seek to manage the quality and quantity of rainwater runoff close to where it falls and to bring not just drainage design solutions but also amenity benefits to site users and encourage biodiversity.

The SuDS Standards require compliance with the following objectives.

S1: Surface water runoff destination;

S2: Surface water runoff hydraulic control;

S3: Water Quality;

S4: Amenity;

S5: Biodiversity;

S6: Construction, Maintenance and Integrity.

Ipsen East MSCP: **BASELINE DATA REVIEW**

# 02

# **IPSEN EAST MSCP:** BASELINE DATA REVIEW

**Flood Risk**

Technical Advice Note 15 (TAN15) part of Planning Policy Wales sets out a precautionary framework to guide planning decisions in areas at high risk of flooding. The aim of TAN15 is to guide development away from high risk flood zones and ensure that flood risk is considered at all stages in the planning process. Where new development is proposed in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible to reduce flood risk overall.

Flood risk is a combination of the probability and the potential consequence of flooding. Areas at risk of flooding are those at risk of flooding from any source now or in the future.

**Flood Risk from Rivers and Seas (Fluvial and Tidal)**

A review of the Natural Resources Wales Flood Maps for Planning indicates the site redline boundary is within a Flood Zone 1 from river and sea flooding which is land that has been assessed as having a less than 1 in 1000 annual probability of river flooding (<0.1%).

The site is therefore at a very low risk of river and sea flooding.

**Flood Risk from Surface Water Flooding (Pluvial)**

A review of the Natural Resources Wales Flood Maps for Planning indicates the redline boundary is within a Flood Zone 1 from surface water flooding. The small areas of surface water flooding close to the boundary relate to existing SuDS features on the wider site.

The site is therefore at a very low risk of surface water flooding.

**Flooding from Reservoirs**

The site is not located in proximity of any reservoirs and the Flood Maps for Planning indicate that flooding from reservoirs is at very low risk at this site.

**Flooding from Sewers and Drains**

If the capacity of the sewer or private drains are exceeded in an extreme weather event, or a blockage occurs within the system, surcharging of the drainage network can result in flooding. An existing private surface water drainage system exists within the wider land ownership site boundary. There are no public sewers crossing the site. The privates systems are managed by the same land owner and therefore flooding from sewers and drains is deemed to be low risk.




Figure 3: Flood Map for Planning (March 2026)

# **IPSEN EAST CAR PARK:** BASELINE DATA REVIEW

**Geological Setting**

Heavy rain falling on waterlogged ground or impermeable surfaces can cause localised flooding almost anywhere. Site investigation was undertaken for the works being undertaken on the development on the adjacent land to the multistory car park. Drilling records indicate stiff brown slightly sandy slightly gravelly CLAY to approximately 2m below existing ground levels. Beneath this is a layer of Glacial Till of stiff slightly sandy slightly gravelly CLAY.

Falling Head Permeability Tests were undertaken within one of the boreholes. Results indicated infiltration rates of $6.53\times10^{-8}$ m/s and $3.28\times10^{-7}$ m/s. Records from the site investigation and falling head test are included within the appendices.

**Existing Drainage**

The surface water network serving the existing surface car parking discharges into an existing pond and outfall structure located in the north west corner of the site, indicated in orange in Figure 4. There is a 450mm pipe which discharges into this pond from the existing wider site drainage, indicated in cyan. Once water reaches a sufficient level in the pond it discharges through a concrete headwall located on the boundary of the site allowing discharge into a short length of underground culvert outside the site boundary in the road verge and into a catch pit manhole at end of culvert in Ash Road South. The water then discharges through a 375mm diameter surface water pipe across the Ash Road South/North junction, indicated in dark blue Figure 4, to a manhole within the pavement outside the Ipsen West site. At this point the discharge combines with the wider Ipsen surface water drainage and discharges into a culverted watercourse indicated in green.

No formal connections from gullies or drainage channels have been established from the surface level car park into the existing surface water drainage system.

Welsh Water sewer records indicate there are no public sewer assets within the vicinity of the site boundary with the closest sewers in Ash Road North and Ash Road South.

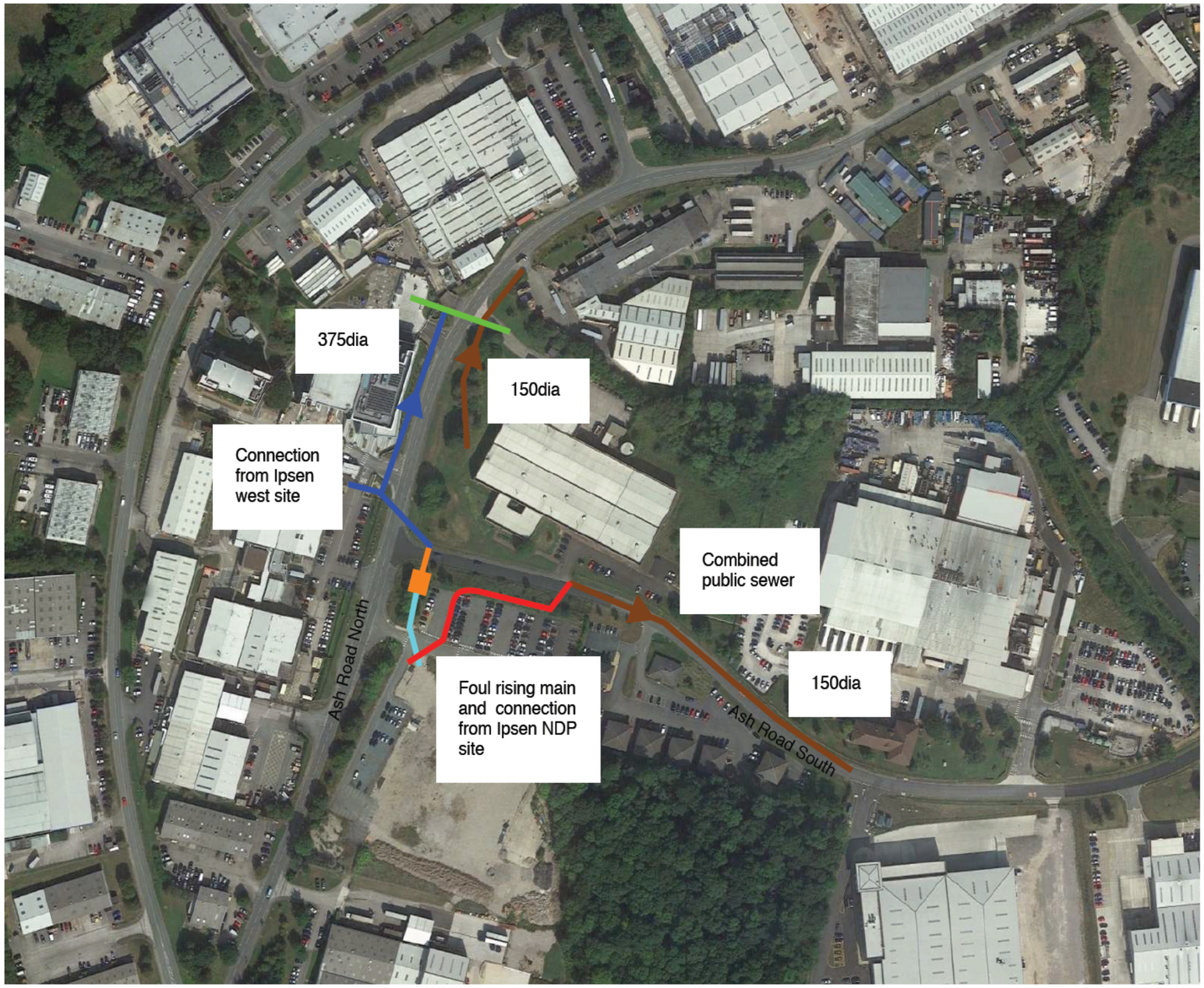



Figure 4: Existing Drainage Offsite Discharge

Ipsen East MSCP: **ASSESSMENT OF FLOOD RISK**

# 03

# **IPSEN EAST MSCP:** ASSESSMENT OF FLOOD RISK

**Assessment of Vulnerability to Flood Risk**

Figure 4 of TAN 15 Development, Flooding and Costal Erosion indicates that car parking is classed as “less vulnerable” development therefore with the site located in a Flood Zone 1 from all sources of flooding and being less vulnerable development the site does not have restrictions on locations or levels due to existing flooding.

**Sustainable Drainage Systems (SuDS)**

Sustainable drainage developed (SuDS) objectives are to minimise the impacts from the development on the quantity and quality of the runoff and maximise amenity and biodiversity opportunities where possible.

The implementation of SuDS is a statutory requirement under the Flood and Water Management Act 2010, Schedule 3 and is a key part of complying with TAN 15. All new developments of more than one dwelling or where the new construction area exceeds 100m² require SuDS approval from the SuDS Approving Body (SAB) at the local authority.

The design of SuDS should aim to manage surface water on or close to the surface mimicking the natural flow and infiltration patterns of the site with no increase in post development runoff volume and not exceeding the greenfield pre development rates for all storm events including an allowance of 40% climate change. Further details are given in Section 4 of this report with the aim to minimise flood risk after development has occurred.

**Exceedance Events**

Exceedance events are storm or flood events that go beyond what can be practicably quantified and flows from such events will need to be directed through the proposed development, away from any high risk areas, such as building thresholds and towards low risk areas and then off site.

To ensure localised flooding does not occur from the private drainage systems regular maintenance of both the foul and surface water networks will need to be undertaken.

**Flood Risk Conclusion**

A review of all potential flood sources has been undertaken using data from Natural Resources Wales (NRW), the Welsh Government’s Flood Map for Planning Service and a review of topography.

In conclusion, the potential consequences of flooding for this development are considered acceptable, as the site is at a very low risk from all existing flood sources.

The proposed development will not increase flood risk to the site itself or third parties elsewhere when flood mitigation is included within Sustainable Drainage Systems (SuDS) and a betterment is provided on flows leaving the site.

SuDS will manage the new surface water runoff volume and rate in accordance with the SuDS Statutory Standards for Wales, ensuring no detrimental impact on downstream flood risk.



Ipsen East MSCP: **SURFACE WATER DRAINAGE**

# 04

# **IPSEN EAST CAR PARK:** SURFACE WATER DRAINAGE

**S1. Surface water runoff destination in regards to hierarchy**

Standard S1 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.  The SuDS Standard has five priority levels for surface water runoff and these have been reviewed.

• Priority 1: Surface water runoff collected for use

There is no foreseeable demand for non-potable water on the site and no foreseeable need to harvest water as potential stresses are not indicated on undertakers water resource and drought management plans. There are no uses within the building for full rainwater harvesting but reuse in regards to irrigation of localised landscaping is possible.

• Priority 2: Surface water runoff is infiltrated to ground

Existing ground conditions preclude the use of infiltration within the scheme therefore infiltration to ground is not possible.

• Priority 3: Surface water runoff is discharged to a surface water body

The existing Ipsen site drains via an existing 450mm pipe which discharges into an existing basin feature, located in the north west corner of the site, before discharging off site. Whilst the existing car park does not have any visible drainage gullies or channels and can not be proved to connect into this downstream system runoff from the car park would possibly end up in gullies within the wider site which do drain into this outfall pipework.

In accordance with the hierarchy the surface water run-off from the proposed development areas (roof and hardstanding) is proposed to discharge into the existing 450mm outfall pipework and pond feature before discharge as this has a direct connection to the watercourse to the north of the site as indicated in Figure 4.

**S2 - Surface Water Control**

The aim of Standard S2 is to manage surface water runoff from and on a site to protect people on the site from flooding from the drainage system for events up to and including the 1 in 100 year return period with an allowance for climate change of 40% and 10% urban creep.

Whilst the existing site is a brownfield development there has been no positive downstream connection found and infiltration testing indicates discharge to ground is not possible. The standards require discharge on sites without a positive discharge to be drained off site as close to greenfield rates as possible.

The pre development greenfield runoff rates has been calculated using the FEH method. A site area of 0.332ha indicates a QBar rate of 1.2l/s.

To discharge at 1.2l/s the site surface water will be required to be attenuated before discharge. Hydraulic modelling indicates that approximatley 229m³ of storage will be required.

As space is limited on the site surface water will be collected from the downpipes into structured raingardens which are located along the elevations as seen in Figure 5. Some attenuation will occur within these features which will also be utilised for conveyance and treatment of water. The majority of the attenuation will occur within the below ground shallow attenuation geocellular tanks beneath the car park.



Figure 5: Structured raingardens for attenuation

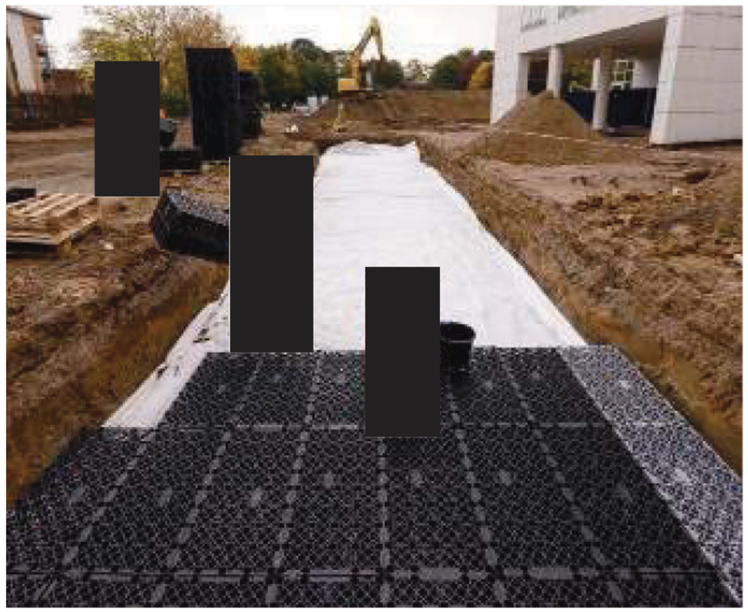


Figure 6: Geocellular tanks

# **IPSEN EAST MSCP:** SURFACE WATER DRAINAGE

**S3 - Water Quality**

Standard S3 addresses the drainage design requirements to minimise the potential pollution risk posed by the surface water runoff to the receiving water body. Where possible, surface water runoff will be managed using interception and treatment components close to its source and be part of a treatment train.

Table G3.1 indicates that non residential car parking with infrequent change overs indicate a low pollution level and the simple index approach is possible for discharge to surface waters.

Table 26.2 of The SuDS Manual CIRIA C753 indicates the pollution hazard indices for a car park as.

0.5 Total Suspended Solids (TSS)

0.4 Metals

0.4 Hydrocarbons

G3.12 of the SuDS Standards states that if interception of the first 5mm of water is possible not only will this reduce the number of runoff events discharged downstream this will also act to reduce contaminant loadings and associated pollution risks to receiving surface waters. Utilising raingardens from the proposed structure will allow the first 5mm of water to be utilised for irrigation.

To deliver adequate treatment the SuDS component is required to have a pollution mitigation index that exceeds the pollution hazard index. Where the mitigation index of an individual component is insufficient, two or more components in series will be required with a reduced performance of the secondary component.

Table 26.3 of CIRIA C753 indicates the following mitigation indices for discharges to surface water.

Raingarden/Bioretention 0.8 TSS, 0.8 Metals, 0.8 Hydrocarbons

Existing Pond (Final Treatment) 0.7 TSS, 0.7 Metals, 0.5 Hydrocarbons

The use of raingardens/bioretention features prior to attenuation in geocellular tanks will give the treatment required. With the final polishing provided within the existing pond prior to discharge.

**S4 - Amenity**

Standard S4 addresses the design of SuDS components to ensure that, where possible, they enhance the provision of high quality, attractive public space which can help provide health and wellbeing benefits, they improve liveability for local communities and they contribute to improving the climate resilience of new developments.

By providing raingarden features around the car park will enhance the site and increase the visual impact of the space.

**S5 - Biodiversity**

Standard S5 addresses the design of SuDS to ensure, where possible, they create ecologically rich green and blue corridors in developments and enrich biodiversity value by linking networks of habitats and ecosystems together.

Through the implementation of linear raingardens/biodiverse SuDS features provides nature corridors through the site. By providing planting which are drought and water tolerant and which will attract insects, bees and birds to the site will increase the biodiversity on the site from the existing situation.



Figure 7: Structured raingardens for treatment and biodiversity enhancements



Figure 8: Existing pond area for additional settlement/treatment

# **IPSEN EAST MSCP:** S6 - CONSTRUCTION, OPERATION AND MAINTENANCE

**S6 - Design of drainage for construction, operation, maintenance and structural integrity.**

Standard S6 deals with designing robust surface water drainage systems so they can be easily and safely constructed, maintained and operated, taking into account the need to minimise negative impacts on the environment and natural resources. All elements of the drainage system will be designed so that they can be constructed easily, safely and cost-effectively, in a timely manner, and with the aim of minimising the use of scarce resources and embedded carbon. The drainage system will be designed to ensure structural integrity of all elements under anticipated loading conditions over the design life of the development site, taking into account the requirement for reasonable levels of maintenance. The design of the proposed surface water drainage system will follow the good practice contained in SuDS Standards and the CIRIA SuDS manual. Any parties involved with the disposal of any waste materials from the underground drainage system should hold appropriate management licenses to undertake any such activities. Disposal of any site materials is required to be made in accordance with current legislation and guidance. The SuDS features will be privately maintained by Ipsen and not offered for adoption to Welsh Water. The SuDS manual guidance gives the likely maintenance requirements for the SuDS features proposed within this project as indicated in Figure 9, 10 and 11.

CIRIA C753 Table 18.3 Operation and maintenance requirments for bioretention systems

| Maintenance Schedule | Required Action | Typical Frequency |
|---|---|---|
| Regular Inspections and Maintenance | Remove Litter and Debris | Monthly, or as required |
| | Check operation of underdrains by inspection of flows after rain | Monthly at start, then annually |
| | Inspect vegetation and plants for disease infection, poor growth, invasive species etc. and replace as neccesary | Quarterly |
| | Replace any plants to maintain planting density | As required |
| | Inspect infiltration surfaces for silting and ponding and record to determine if maintenance/remedials neccesary | Quarterly |
| | Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies | Quarterly |
| Occasional Actions | Infill any holes or scour in the filter medium, improve erosion protection if required | As required |
| | Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch | As required |
| Remedial Actions | Remove and replace filter medium and vegetation above | As required but likely >20 years |

Figure 9: Typical Maintenance Requirements - Raingardens

CIRIA C753 Table 21.3 Operation and maintenance requirments for geocellular tanks

| Maintenance Schedule | Required Action | Typical Frequency |
|---|---|---|
| Regular Maintenance | Inspect and identify any areas that are not operating correctly. If required take remedial action | Monthly for 3 months, then annually |
| | Remove debris from the catchment surface (where it may cause risks to performance) | Monthly |
| | For systems where rainfall infiltrates into the tank from above, check surface of filter for blockages by sediment, algae or other matter; remove and replace surface infiltration medium as necessary | Annually |
| | Remove sediment from pre treatment structures and/or internal forebays | Annually, or as required |
| Remedial Actions | Repair/rehabilitate inlets, outlets, overflows and vents | As required |
| Monitoring | Inspect, check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed | Annually |
| | Survey inside of tank for sediment build up and remove if neccesary | Every 5 years or as required |

Figure 10: Typical Maintenance Requirements - Tanks

CIRIA C753 Table 23.1 Operation and maintenance requirments for existing pond

| Maintenance Schedule | Required Action | Typical Frequency |
|---|---|---|
| Regular Maintenance | Remove Litter and Debris | Monthly, or as required |
| | Cut grass/landscape around the edges | Monthly (during growing season), or as required |
| | Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years) | Monthly at start, then as required |
| | Inspect inlets, outlets, overflows, banksides, structures, pipework for evidence of blockages and/or physical damage | Monthly |
| | Inspect water body for signs of poor water quality | Monthly (May - October) |
| | Inspect silt accumulation rates and establish appropriate removal frequencies; undertake contamination testing once some build up has occurred, to inform management and disposal | 6 Monthly |
| | Tidy all dead growth before start of growing season | Annually |
| | Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays | Every 5 years or as required |
| Remedial Actions | Repair erosion or other damage | As required |
| | Replant where necessary | As required |
| | Aerate pond when signs of eutrophicaution are detected | As required |
| | Repair/rehabilitate inlets, outlets and overflows | As required |

Figure 11: Typical Maintenance Requirements - Existing Pond

Ipsen East MSCP: **APPENDICES**

# 05

Ipsen East MSCP: **APPENDIX 1 - SITE INVESTIGATION**

# GroundSolve Ltd — Cable Percussion Drilling Record — CP01

| | | |
|---|---|---|
| Project Name: Ipsen East Site, Wrexham | Client: Ipsen Biopharm Ltd. | Date: 08/02/2023 - 09/02/2023 |
| Location: Wrexham Industrial Estate | Contractor: Cheshire Drilling | Co-ords: E337579.76 N350152.44 |
| Project No. : 2867 | Crew Name: GC and DB | Drilling Equipment: Dando 2000 |

| Borehole Number | Hole Type | Level | Logged By | Scale | Page Number |
|---|---|---|---|---|---|
| CP01 | CP | 37.12m AoD | JP | 1:50 | Sheet 1 of 2 |

| Well | Water Strikes | Sample and In Situ Testing: Depth (m) | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | 0.30 | D | | 0.50 | 36.62 | | Very dense greyish brown sandy angular to subangular fine to coarse GRAVEL of brick, concrete, and metal. (MADE GROUND) |
| | | 1.00 | D | | | | | Stiff brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of concrete, limestone, and sandstone. (MADE GROUND) |
| | | 1.20 | SPT | N=6 (2,2/2,1,1,2) | | | | |
| | | 2.00 | D | | 1.85 | 35.27 | | Stiff reddish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of quartzite. (GLACIAL TILL) |
| | | 2.00 | SPT | N=16 (1,1/3,4,4,5) | | | | |
| | | 3.00 | SPT | N=15 (2,2/3,3,4,5) | | | | |
| | | 4.00 | U | | | | | |
| | | 5.00 | B | | | | | |
| | | 5.00 | D | | | | | |
| | | 5.00 | SPT | N=28 (3,3/5,6,8,9) | | | | |
| | | 6.00 | U | | | | | |
| | | 7.50 | SPT | N=22 (3,4/5,5,6,6) | | | | |
| | | | | | | | | *Less mottling and no gravel from 8.00m bgl.* |
| | | 9.00 | D | | | | | |
| | | 9.00 | U | | | | | |

| Hole Diameter | | Casing Diameter | | Chiselling | | | | Inclination and Orientation | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth Base | Diameter | Depth Base | Diameter | Depth Top | Depth Base | Duration | Tool | Depth Top | Depth Base | Inclination | Orientation |
| 15.00<br>15.45 | 150<br>50 | 14.50 | 150 | | | | | | | | |

## Remarks

Terminated at 15.45m bgl due to reaching target depth. Groundwater encountered at 13.00m bgl.

GroundSolve Ltd
Unit 1 Well House Barns
Chester Road
Bretton
CH4 0DH

| GroundSolve Ltd | Cable Percussion Drilling Record | CP01 |
|---|---|---|

| | | |
|---|---|---|
| Project Name: Ipsen East Site, Wrexham | Client: Ipsen Biopharm Ltd. | Date: 08/02/2023 - 09/02/2023 |
| Location: Wrexham Industrial Estate | Contractor: Cheshire Drilling | Co-ords: E337579.76 N350152.44 |
| Project No. : 2867 | Crew Name: GC and DB | Drilling Equipment: Dando 2000 |

| Borehole Number | Hole Type | Level | Logged By | Scale | Page Number |
|---|---|---|---|---|---|
| CP01 | CP | 37.12m AoD | JP | 1:50 | Sheet 2 of 2 |

| Well | Water Strikes | Sample and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| | | 10.50 | SPT | N=20 (3,3/4,5,5,6) | | | | Stiff reddish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of quartzite. (GLACIAL TILL) |
| | | 12.00 | D | | | | | |
| | | 12.00 | U | | | | | |
| | ▼ | | | | 13.00 | 24.12 | | |
| | | | | | | | | Medium dense brown silty fine to medium SAND. (GLACIAL TILL) |
| | | 13.50 | D | | | | | |
| | | 13.50 | SPT | N=12 (2,3/2,3,3,4) | | | | |
| | | 15.00 | SPT | N=17 (3,3/4,4,4,5) | | | | |
| | | | | | 15.45 | 21.67 | | End of Borehole at 15.450m |

| Hole Diameter | | Casing Diameter | | Chiselling | | | | Inclination and Orientation | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth Base | Diameter | Depth Base | Diameter | Depth Top | Depth Base | Duration | Tool | Depth Top | Depth Base | Inclination | Orientation |
| 15.00 | 150 | 14.50 | 150 | | | | | | | | |
| 15.45 | 50 | | | | | | | | | | |

Remarks

Terminated at 15.45m bgl due to reaching target depth. Groundwater encountered at 13.00m bgl.

GroundSolve Ltd
Unit 1 Well House Barns
Chester Road
Bretton
CH4 0DH

# GroundSolve Ltd — Cable Percussion Drilling Record — CP02

| | | |
|---|---|---|
| Project Name: Ipsen East Site, Wrexham | Client: Ipsen Biopharm Ltd. | Date: 09/02/2023 - 10/02/2023 |
| Location: Wrexham Industrial Estate | Contractor: Cheshire Drilling | Co-ords: E337534.67 N350115.09 |
| Project No. : 2867 | Crew Name: GC and DB | Drilling Equipment: Dando 2000 |

| Borehole Number | Hole Type | Level | Logged By | Scale | Page Number |
|---|---|---|---|---|---|
| CP02 | CP | 37.14m AoD | JP | 1:50 | Sheet 1 of 2 |

| Well | Water Strikes | Sample and In Situ Testing Depth (m) | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | 0.10 | D | | 0.55 | 36.59 | | Very dense greyish brown sandy angular to subangular fine to coarse GRAVEL of brick, concrete, and metal. (MADE GROUND) |
| | | 0.80 | D | | | | | Firm becoming soft brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of concrete, limestone, and sandstone. (MADE GROUND) |
| | | 1.20 | SPT | N=12 (5,4/3,2,3,4) | | | | |
| | | 2.00 | SPT | N=6 (2,1/1,2,1,2) | 2.00 | 35.14 | | Soft becoming stiff reddish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to medium of quartzite. (GLACIAL TILL) |
| | | 2.50 | D | | | | | |
| | | 3.00 | SPT | N=21 (3,3/4,5,6,6) | | | | |
| | | 4.00 | U | | | | | |
| | | 5.00 | D | | | | | |
| | | 5.00 | SPT | N=24 (4,4/5,6,6,7) | | | | |
| | | 6.00 | U | | | | | |
| | | 7.00 | D | | | | | |
| | | 7.50 | SPT | N=24 (4,4/4,6,7,7) | | | | *Less mottling and no gravel from 7.50m bgl.* |
| | | 10.00 | D | | | | | |

| Hole Diameter | | Casing Diameter | | Chiselling | | | | Inclination and Orientation | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth Base | Diameter | Depth Base | Diameter | Depth Top | Depth Base | Duration | Tool | Depth Top | Depth Base | Inclination | Orientation |
| 15.00<br>15.45 | 150<br>50 | 3.00 | 150 | | | | | | | | |

## Remarks

Terminated at 15.45m bgl due to reaching target depth. Groundwater encountered at 11.00m bgl.

GroundSolve Ltd
Unit 1 Well House Barns
Chester Road
Bretton
CH4 0DH

# GroundSolve Ltd — Cable Percussion Drilling Record — CP02

| | | |
|---|---|---|
| Project Name: Ipsen East Site, Wrexham | Client: Ipsen Biopharm Ltd. | Date: 09/02/2023 - 10/02/2023 |
| Location: Wrexham Industrial Estate | Contractor: Cheshire Drilling | Co-ords: E337534.67 N350115.09 |
| Project No. : 2867 | Crew Name: GC and DB | Drilling Equipment: Dando 2000 |

| Borehole Number | Hole Type | Level | Logged By | Scale | Page Number |
|---|---|---|---|---|---|
| CP02 | CP | 37.14m AoD | JP | 1:50 | Sheet 2 of 2 |

| Well | Water Strikes | Sample and In Situ Testing: Depth (m) | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | ▼ | 10.50 | SPT | N=16 (3,3/3,4,4,5) | | | | Soft becoming stiff reddish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to medium of quartzite. (GLACIAL TILL) |
| | | | | | | | | *Damp from 11.00m bgl.* |
| | | 12.00 | U | | | | | |
| | | 12.50 | D | | | | | |
| | | 13.50 | SPT | N=17 (3,3/4,4,4,5) | | | | |
| | | | | | 14.70 | 22.44 | | Dense brown slightly clayey silty fine to coarse SAND. (GLACIAL TILL) |
| | | 15.00 | SPT | N=26 (4,5/6,7,7) | | | | |
| | | | | | 15.45 | 21.69 | | End of Borehole at 15.450m |

| Hole Diameter | | Casing Diameter | | Chiselling | | | | Inclination and Orientation | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth Base | Diameter | Depth Base | Diameter | Depth Top | Depth Base | Duration | Tool | Depth Top | Depth Base | Inclination | Orientation |
| 15.00<br>15.45 | 150<br>50 | 3.00 | 150 | | | | | | | | |

## Remarks

Terminated at 15.45m bgl due to reaching target depth. Groundwater encountered at 11.00m bgl.

GroundSolve Ltd
Unit 1 Well House Barns
Chester Road
Bretton
CH4 0DH

GroundSolve Ltd
Consulting Geotechnical Engineers

# FALLING HEAD TEST PERMEABILITY CALCULATION

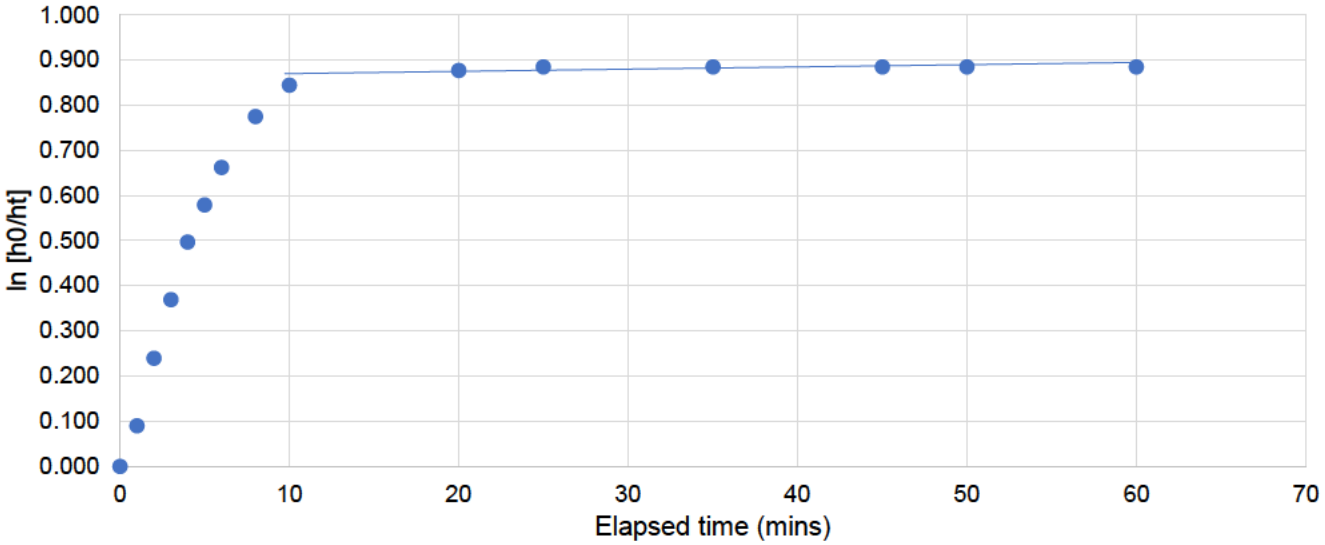
Variable Head Test Method, BS EN ISO 22282-2:2012

| | |
|---|---|
| Project No. | Ipsen East Site |
| Project Name | 2867 |
| Borehole | CP01 |
| Date | 08/02/2023 |

| | |
|---|---|
| BH Depth (m) | 3.00 |
| Casing Depth (m) | 1.80 |
| Casing Dia (m) | 0.15 |
| Casing Height (m) | 0.24 |

| | |
|---|---|
| L/D Ratio | 8.00 |
| Shape Factor | 2.7156 |

| Time (mins) | Depth to Water | ln (h0/ht) |
|---|---|---|
| 0 | 0.09 | 0.000 |
| 1 | 0.34 | 0.090 |
| 2 | 0.71 | 0.240 |
| 3 | 0.99 | 0.370 |
| 4 | 1.23 | 0.497 |
| 5 | 1.37 | 0.580 |
| 6 | 1.50 | 0.663 |
| 8 | 1.66 | 0.775 |
| 10 | 1.75 | 0.845 |
| 20 | 1.79 | 0.878 |
| 25 | 1.80 | 0.886 |
| 35 | 1.80 | 0.886 |
| 45 | 1.80 | 0.886 |
| 50 | 1.80 | 0.886 |
| 60 | 1.80 | 0.886 |
| | | |
| | | |
| | | |
| | | |
| | | |




| | |
|---|---|
| α (gradient) | 0.00001 |
| Area of BH ($m^2$) | 0.01767 |

| | | |
|---|---|---|
| Infiltration Rate, k | **6.536E-08** | m/s |

| | |
|---|---|
| Notes | Calculated between 10 minutes and 60 minutes, as initial 10 minute surge likely not representative due to hydrostatic pressure forcing water up around edges of drill casing. Depth to water calculated from top of drill casing. |

GroundSolve Ltd
Consulting Geotechnical Engineers

# FALLING HEAD TEST PERMEABILITY CALCULATION

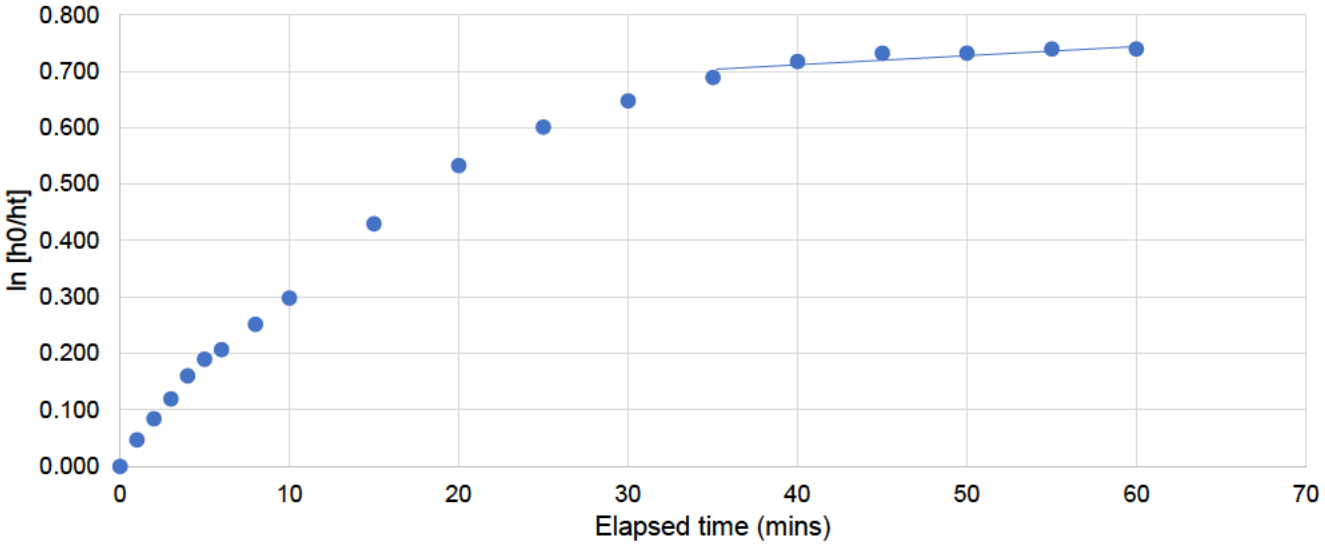
Variable Head Test Method, BS EN ISO 22282-2:2012

| | |
|---|---|
| Project No. | Ipsen East Site |
| Project Name | 2867 |
| Borehole | CP01 |
| Date | 08/02/2023 |

| | |
|---|---|
| BH Depth (m) | 3.00 |
| Casing Depth (m) | 2.50 |
| Casing Dia (m) | 0.15 |
| Casing Height (m) | 0.80 |

| | |
|---|---|
| L/D Ratio | 3.33 |
| Shape Factor | 1.6372 |

| Time (mins) | Depth to Water | ln (h0/ht) |
|---|---|---|
| 0 | 0.17 | 0.000 |
| 1 | 0.30 | 0.047 |
| 2 | 0.40 | 0.085 |
| 3 | 0.49 | 0.120 |
| 4 | 0.59 | 0.161 |
| 5 | 0.66 | 0.190 |
| 6 | 0.70 | 0.207 |
| 8 | 0.80 | 0.252 |
| 10 | 0.90 | 0.298 |
| 15 | 1.16 | 0.431 |
| 20 | 1.34 | 0.533 |
| 25 | 1.45 | 0.602 |
| 30 | 1.52 | 0.648 |
| 35 | 1.58 | 0.690 |
| 40 | 1.62 | 0.718 |
| 45 | 1.64 | 0.733 |
| 50 | 1.64 | 0.733 |
| 55 | 1.65 | 0.740 |
| 60 | 1.65 | 0.740 |
| | | |




| | |
|---|---|
| α (gradient) | 0.00003 |
| Area of BH ($m^2$) | 0.01767 |

| | | |
|---|---|---|
| Infiltration Rate, k | **3.276E-07** | m/s |

| | |
|---|---|
| Notes | Calculated between 35 minutes and 60 minutes, as initial 35 minute surge likely not fully representative due to hydrostatic pressure forcing water up around edges of drill casing. Depth to water calculated from top of drill casing. |

Ipsen East MSCP: **APPENDIX 2 -  PROPOSED DRAINAGE ARRANGEMENT**

CDM Regulations 2015

All design work has been carried out with full consideration given to health and safety. Where possible risks have been removed from the design. It is not always possible to remove all risks in the design and those remaining risks have been identified below. The contractor is responsible for ensuring these risks have been allowed for in methods of working and that only competent workers are employed to undertake these works.

DR1: Encountering existing services
DR2: Undermining of existing structures
DR3: Traffic management during construction

⚠ Indicates a residual risk

Coordination to be undertaken for final location of outfall pipework with location of existing services

Structured Raingarden
Length 15.00m
Width 1.00m
Depth 0.8m
Soil void ratio 22%

Structured Raingarden
Length 38.50m
Width 1.00m
Depth 0.8m
Soil void ratio 22%

Structured Raingarden
Length 27.00m
Width 1.00m
Depth 0.8m
Soil void ratio 22%

Existing foul outfall route from main Ipsen NDP site

Hit and miss kerbing to allow surface water from access road to drain into the raingarden

Existing chamber

Location of chamber and connection point to be confirmed once coordinated with existing infrastructure

Flow Control - HydroBrake
CTL-SHE-0048-1100-1080-1100
Discharge rate 1.2 l/s

Hit and miss kerbing to allow water from access road to fall into raingarden

Structured Raingarden
Length 43.00m
Width 1.00m
Depth 0.8m
Soil void ratio 22%

Geocellular Attenuation Tank1
Length 48.00m
Width 7.5m
Depth 0.4m
Provisional storage 136.8m³
Gradient 1:200
Void ratio 95%

Structured Raingarden
Length 3.00m
Width 1.00m
Depth 0.8m
Soil void ratio 22%

Geocellular Attenuation Tank 2
Length 30.00m
Width 5.0m
Depth 0.4m
Provisional storage 57.0m³
Gradient 1:200
Void ratio 95%

Notes

1. This drawing is to be read in conjunction with all relevant surveys and architectural drawings.
2. Third party information has been used to complete this design. Land Studio are not liable for this information.
3. Dimensions given are in millimetres unless otherwise specified.
4. Levels are in metres AOD.
5. Surface water features designed to manage a 1 in 100 year (1% AEP) plus 40% climate change plus 10% urban creep event without flooding off site with a discharge of 1.2l/s and a minimum of 229m² of attenuation provided within the site.
6. Existing drainage and services location and levels must be checked prior to any works commencing and any discrepancies in dimensions or details should be drawn to the attention of the engineer.
7. All surface water pipework are to be structured wall HDPE to BS EN 13476, kitemarked, agrement certified or CE marked.
8. All inspection chambers to be polypropylene in accordance with BS EN 13598, agrement certified. Minimum internal diameter 450mm fitted with D400 bolted chamber covers and frames.
9. All pipework to be Class Z concrete encased where cover is less than 1.2m in vehicular areas, 0.9m in pedestrian areas and 0.6m elsewhere.
10. Refer to landscape architect plan for details of planting within SuDS features.
11. All trenches within 5m of tree roots to include tree root protection membrane. Trenches within tree root protection zones (RPA) should retain existing soil levels and any roots >25mmØ should be discussed with an arborculturlist prior to affecting tree root system.

Key

- Site Planning Boundary
- Proposed surface water chamber and pipework
- Proposed geocellular attenuation tank
- Existing Surface Water System
- RWP — Proposed rainwater downpipe
- Structured Raingardens
- Existing Private Rising Main
- Existing Public Sewer Connection

| Revision | Date | Description | Drawn | Apprvd. |
|---|---|---|---|---|
| P04 | 19.06.26 | Hatching removed | AW | LS |
| P03 | 18.06.26 | Green line Updated | AW | LS |
| P02 | 02.04.26 | Issued for Planning | AW | LS |
| P01 | 01.04.26 | Issued for Planning | PE | LS |

N

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| | |
|---|---|
| Client | Ipsen |
| Project | Ipsen East, MSCP |
| Drg Title | Drainage General Arrangement |

| Created on | Created by | Approved by |
|---|---|---|
| 23.02.26 | AW | LS |

| Scale | Size | Workstage |
|---|---|---|
| 1:250 | A1 | Stage 3 |

| Drg No. | Suitability | Revision |
|---|---|---|
| 498-LST-XX-XX-DR-D-0100 | S3 | P04 |

LandStudio

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Ipsen East MSCP: **APPENDIX 3 - CALCULATIONS**

# Greenfield runoff rate estimation tool

www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

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

## Project details

| | |
|---|---|
| Date | 09/03/2026 |
| Calculated by | Phillip Evans |
| Reference | Ipsen Car Park |
| Model version | 2.2.3 |

## Location

| | |
|---|---|
| Site name | Ipsen, Wrexham Industrial Estate |
| Site location | Ipsen, Wrexham Industrial Estate |




| | |
|---|---|
| Site easting (British National Grid) | 337478 |
| Site northing (British National Grid) | 350264 |

## Site details

| | |
|---|---|
| Total site area (ha) | 0.332 ha |

# Greenfield runoff

## Method

| | |
|---|---|
| Method | FEH statistical (2025) |

## FEH statistical (2025)

| | My value | | Map value |
|---|---|---|---|
| SAAR9120 (mm) | 724 mm | | |
| BFIHOST19scaled | 0.455 | | |
| QMed-QBar conversion | 1.075 | | 1.075 |
| QMed (l/s) | 1.1 l/s | | |
| QBar (FEH statistical 2025) (l/s) | 1.2 l/s | | |

## Growth curve factors

| | My value | | Map value |
|---|---|---|---|
| Hydrological region | 9 | | 9 |
| 1 year growth factor | 0.88 | | |
| 2 year growth factor | 0.93 | | |
| 10 year growth factor | 1.42 | | |
| 30 year growth factor | 1.78 | | |
| 100 year growth factor | 2.18 | | |
| 200 year growth factor | 2.46 | | |

## Results

| | |
|---|---|
| Method | FEH statistical (2025) |
| Flow rate 1 year (l/s) | 1.1 l/s |
| Flow rate 2 year (l/s) | 1.1 l/s |
| Flow rate 10 years (l/s) | 1.7 l/s |
| Flow rate 30 years (l/s) | 2.2 l/s |
| Flow rate 100 years (l/s) | 2.7 l/s |
| Flow rate 200 years (l/s) | 3.0 l/s |

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

### Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.2.3) developed by HR Wallingford and available at uksuds.com (https://www.uksuds.com/). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at uksuds.com/terms-conditions (https://www.uksuds.com/terms-conditions). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

## Design Settings

| | | | | | |
|---|---|---|---|---|---|
| Rainfall Methodology | FEH-22 | Maximum Time of Concentration (mins) | 30.00 | Preferred Cover Depth (m) | 1.200 |
| Return Period (years) | 2 | Maximum Rainfall (mm/hr) | 50.0 | Include Intermediate Ground | x |
| Additional Flow (%) | 0 | Minimum Velocity (m/s) | 1.00 | Enforce best practice design rules | x |
| CV | 0.750 | Connection Type | Level Soffits | | |
| Time of Entry (mins) | 5.00 | Minimum Backdrop Height (m) | 0.200 | | |

## Simulation Settings

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Rainfall Methodology | FEH-22 | Analysis Speed | Detailed | Starting Level (m) | | 30 year (l/s) | 2.4 |
| Rainfall Events | Singular | Skip Steady State | x | Check Discharge Rate(s) | ✓ | 100 year (l/s) | 3.0 |
| Summer CV | 0.750 | Drain Down Time (mins) | 240 | 1 year (l/s) | 1.0 | Check Discharge Volume | x |
| Winter CV | 0.840 | Additional Storage (m³/ha) | 20.0 | 2 year (l/s) | 1.1 | | |

### Storm Durations

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

| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) | Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 30 | 20 | 0 | 0 |
| 2 | 0 | 0 | 0 | 100 | 40 | 0 | 10 |

## Pre-development Discharge Rate

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Site Makeup | Greenfield | BFIHost | 0.455 | Growth Factor 30 year | 1.95 | Q 1 year (l/s) | 1.0 |
| Greenfield Method | FEH | Region | 1 | Growth Factor 100 year | 2.48 | Q 2 year (l/s) | 1.1 |
| Positively Drained Area (ha) | 0.300 | QBar/QMed conversion factor | 1.111 | Betterment (%) | 0 | Q 30 year (l/s) | 2.4 |
| SAAR (mm) | 724 | Growth Factor 1 year | 0.85 | QMed | 1.1 | Q 100 year (l/s) | 3.0 |
| Host | 1 | Growth Factor 2 year | 0.90 | QBar | 1.2 | | |

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## Node S20 Online Hydro-Brake® Control

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Downstream Link | 1.003 | Sump Available | ✓ |
| Replaces Downstream Link | x | Product Number | CTL-SHE-0048-1100-1080-1100 |
| Invert Level (m) | 35.330 | Min Outlet Diameter (m) | 0.075 |
| Design Depth (m) | 1.080 | Min Node Diameter (mm) | 1200 |
| Design Flow (l/s) | 1.1 | | |

## Node S25 Tank Storage Structure

| | | | | | |
|---|---|---|---|---|---|
| Invert Level (m) | 35.600 | Analyse flow through structure | ✓ | Main Channel Slope (1:X) | 200.0 |
| Time to half empty (mins) | | Main Channel Length (m) | 49.000 | Main Channel n | 0.030 |

**Inlets**

S26

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 342.0 | 0.400 | 342.0 |

## Node S23 Porous northern hydroplanters

| | | | | | |
|---|---|---|---|---|---|
| Underdrain Link Type | Circular | Underdrain Slope (1:X) | 200.0 | Porosity | 0.22 |
| Underdrain Diameter (mm) | 150 | Underdrain Height above base (m) | 0.000 | Invert Level (m) | 36.000 |
| Underdrain Velocity | Colebrook-White | Base Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) | 12 |
| Underdrain ks (mm) / n | 0.030 | Side Inf Coefficient (m/hr) | 0.00000 | | |
| Underdrain Length (m) | 55.000 | Safety Factor | 2.0 | | |

**Inlets**

J1

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 55.0 | 55.0 | 0.800 | 55.0 | 140.4 | 0.801 | 0.0 | 140.4 |

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## Node S28 Tank Storage Structure

| | | | | | |
|---|---|---|---|---|---|
| Invert Level (m) | 35.915 | Analyse flow through structure | ✓ | Main Channel Slope (1:X) | 200.0 |
| Time to half empty (mins) | | Main Channel Length (m) | 24.000 | Main Channel n | 0.030 |

**Inlets**

5

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 142.5 | 0.400 | 142.5 |

## Node S21 southern hydroplanters

| | | | | | |
|---|---|---|---|---|---|
| Underdrain Link Type | Circular | Underdrain Slope (1:X) | 200.0 | Porosity | 0.22 |
| Underdrain Diameter (mm) | 150 | Underdrain Height above base (m) | 0.000 | Invert Level (m) | 35.500 |
| Underdrain Velocity | Colebrook-White | Base Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) | |
| Underdrain ks (mm) / n | 0.030 | Side Inf Coefficient (m/hr) | 0.00000 | | |
| Underdrain Length (m) | 40.000 | Safety Factor | 2.0 | | |

**Inlets**

J2

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 44.7 | 44.7 | 0.800 | 44.7 | 114.1 | 0.801 | 0.0 | 114.1 |

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

**Results for 1 year Critical Storm Duration. Lowest mass balance: 99.60%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | S16 | 95 | 35.275 | 0.025 | 0.9 | 0.0000 | 0.0000 | OK |
| 480 minute winter | S20 | 432 | 35.729 | 0.399 | 1.1 | 0.5709 | 0.0000 | SURCHARGED |
| 480 minute winter | S21 | 432 | 35.730 | 0.230 | 2.0 | 1.8035 | 0.0000 | SURCHARGED |
| 15 minute winter | S22 | 11 | 35.746 | 0.081 | 7.8 | 0.0916 | 0.0000 | OK |
| 15 minute winter | S23 | 11 | 36.053 | 0.053 | 8.2 | 0.5868 | 0.0000 | OK |
| 480 minute winter | S24 | 432 | 35.730 | 0.175 | 1.1 | 0.2499 | 0.0000 | SURCHARGED |
| 480 minute winter | S25 | 432 | 35.730 | 0.130 | 2.8 | 22.7108 | 0.0000 | OK |
| 15 minute winter | S26 | 12 | 35.860 | 0.015 | 11.3 | 0.0000 | 0.0000 | OK |
| 120 minute winter | S27 | 86 | 35.896 | 0.026 | 0.8 | 0.0296 | 0.0000 | OK |
| 120 minute winter | S28 | 80 | 35.939 | 0.024 | 1.2 | 1.9406 | 0.0000 | OK |
| 15 minute summer | J1 | 1 | 36.275 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 480 minute winter | J2 | 440 | 35.729 | 0.029 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 5 | 11 | 36.043 | 0.008 | 3.2 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 480 minute winter | S20 | 1.003 | S16 | 0.9 | 0.461 | 0.059 | 0.0216 | 31.2 |
| 480 minute winter | S21 | 1.002 | S20 | 1.1 | 0.271 | 0.073 | 0.4134 | |
| 15 minute winter | S22 | 1.001 | S21 | 7.8 | 0.883 | 0.536 | 0.2853 | |
| 15 minute winter | S23 | 1.000 | S22 | 7.8 | 1.032 | 0.270 | 0.0972 | |
| 480 minute winter | S24 | 2.001 | S21 | 0.9 | 0.251 | 0.062 | 0.1453 | |
| 480 minute winter | S25 | 2.000 | S24 | 1.1 | 0.475 | 0.052 | 0.0568 | |
| 15 minute winter | S26 | Tank | S25 | 11.0 | 0.127 | 0.005 | | |
| 120 minute winter | S27 | 3.001 | S26 | 0.8 | 0.763 | 0.049 | 0.0036 | |
| 120 minute winter | S28 | 3.000 | S27 | 0.8 | 0.405 | 0.053 | 0.0126 | |
| 15 minute summer | J1 | **hydroplanters** | S23 | 0.0 | 0.000 | 0.000 | | |
| 480 minute winter | J2 | **hydroplanters** | S21 | -0.1 | -0.007 | -0.004 | | |
| 15 minute winter | 5 | Tank | S28 | 3.5 | 0.081 | 0.002 | | |

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**Results for 2 year Critical Storm Duration. Lowest mass balance: 99.33%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | S16 | 193 | 35.275 | 0.025 | 0.9 | 0.0000 | 0.0000 | OK |
| 480 minute winter | S20 | 464 | 35.796 | 0.466 | 1.2 | 0.6670 | 0.0000 | SURCHARGED |
| 480 minute winter | S21 | 464 | 35.797 | 0.297 | 1.9 | 2.6958 | 0.0000 | SURCHARGED |
| 480 minute winter | S22 | 464 | 35.797 | 0.132 | 1.9 | 0.1488 | 0.0000 | OK |
| 15 minute winter | S23 | 11 | 36.067 | 0.067 | 12.4 | 0.7505 | 0.0000 | OK |
| 480 minute winter | S24 | 464 | 35.797 | 0.242 | 1.0 | 0.3458 | 0.0000 | SURCHARGED |
| 480 minute winter | S25 | 464 | 35.797 | 0.197 | 4.0 | 34.2585 | 0.0000 | SURCHARGED |
| 15 minute winter | S26 | 11 | 35.864 | 0.019 | 17.1 | 0.0000 | 0.0000 | OK |
| 120 minute summer | S27 | 78 | 35.902 | 0.032 | 1.2 | 0.0363 | 0.0000 | OK |
| 120 minute summer | S28 | 76 | 35.945 | 0.030 | 2.2 | 2.4395 | 0.0000 | OK |
| 15 minute summer | J1 | 1 | 36.275 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |
| 480 minute winter | J2 | 464 | 35.797 | 0.097 | 0.0 | 0.0000 | 0.0000 | OK |
| 15 minute winter | 5 | 10 | 36.044 | 0.009 | 4.8 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 480 minute winter | S20 | 1.003 | S16 | 0.9 | 0.461 | 0.059 | 0.0216 | 29.9 |
| 480 minute winter | S21 | 1.002 | S20 | 1.2 | 0.251 | 0.075 | 0.4134 | |
| 480 minute winter | S22 | 1.001 | S21 | 1.9 | 0.356 | 0.130 | 0.4128 | |
| 15 minute winter | S23 | 1.000 | S22 | 11.9 | 1.138 | 0.411 | 0.1332 | |
| 480 minute winter | S24 | 2.001 | S21 | -0.8 | 0.259 | -0.058 | 0.1453 | |
| 480 minute winter | S25 | 2.000 | S24 | 1.0 | 0.479 | 0.046 | 0.0592 | |
| 15 minute winter | S26 | Tank | S25 | 18.4 | 0.155 | 0.009 | | |
| 120 minute summer | S27 | 3.001 | S26 | 1.2 | 0.861 | 0.075 | 0.0049 | |
| 120 minute summer | S28 | 3.000 | S27 | 1.2 | 0.463 | 0.081 | 0.0171 | |
| 15 minute summer | J1 | **hydroplanters** | S23 | 0.0 | 0.000 | 0.000 | | |
| 480 minute winter | J2 | **hydroplanters** | S21 | -0.2 | -0.017 | -0.011 | | |
| 15 minute winter | 5 | Tank | S28 | 5.5 | 0.098 | 0.003 | | |

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**Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 98.29%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 960 minute winter | S16 | 930 | 35.275 | 0.025 | 0.9 | 0.0000 | 0.0000 | OK |
| 960 minute winter | S20 | 930 | 36.062 | 0.732 | 1.0 | 1.0475 | 0.0000 | SURCHARGED |
| 960 minute winter | S21 | 930 | 36.063 | 0.563 | 2.9 | 5.6871 | 0.0000 | SURCHARGED |
| 15 minute winter | S22 | 14 | 36.185 | 0.520 | 21.5 | 0.5886 | 0.0000 | SURCHARGED |
| 15 minute winter | S23 | 13 | 36.386 | 0.386 | 38.1 | 4.7273 | 0.0000 | SURCHARGED |
| 960 minute winter | S24 | 930 | 36.063 | 0.508 | 1.8 | 0.7268 | 0.0000 | SURCHARGED |
| 960 minute winter | S25 | 930 | 36.063 | 0.463 | 5.6 | 107.2232 | 0.0000 | SURCHARGED |
| 960 minute winter | S26 | 930 | 36.063 | 0.218 | 6.0 | 0.0000 | 0.0000 | OK |
| 960 minute winter | S27 | 930 | 36.063 | 0.193 | 1.1 | 0.2182 | 0.0000 | SURCHARGED |
| 960 minute winter | S28 | 930 | 36.063 | 0.148 | 1.1 | 12.7571 | 0.0000 | OK |
| 15 minute winter | J1 | 14 | 36.388 | 0.113 | 0.9 | 0.0000 | 0.0000 | OK |
| 960 minute winter | J2 | 930 | 36.063 | 0.363 | 0.0 | 0.0000 | 0.0000 | OK |
| 960 minute winter | 5 | 930 | 36.063 | 0.028 | 1.1 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 960 minute winter | S20 | 1.003 | S16 | 0.9 | 0.465 | 0.061 | 0.0221 | 59.0 |
| 960 minute winter | S21 | 1.002 | S20 | 1.0 | 0.170 | 0.065 | 0.4134 | |
| 15 minute winter | S22 | 1.001 | S21 | 19.9 | 1.128 | 1.361 | 0.4277 | |
| 15 minute winter | S23 | 1.000 | S22 | 21.5 | 1.259 | 0.743 | 0.2237 | |
| 960 minute winter | S24 | 2.001 | S21 | -1.8 | 0.274 | -0.125 | 0.1453 | |
| 960 minute winter | S25 | 2.000 | S24 | -1.8 | 0.476 | -0.087 | 0.0592 | |
| 960 minute winter | S26 | Tank | S25 | 4.3 | 0.020 | 0.002 | | |
| 960 minute winter | S27 | 3.001 | S26 | 1.1 | 0.790 | 0.071 | 0.0554 | |
| 960 minute winter | S28 | 3.000 | S27 | 1.1 | 0.482 | 0.077 | 0.1151 | |
| 15 minute winter | J1 | **hydroplanters** | S23 | -2.3 | -0.144 | -0.144 | | |
| 960 minute winter | J2 | **hydroplanters** | S21 | -0.2 | -0.014 | -0.014 | | |
| 960 minute winter | 5 | Tank | S28 | 1.1 | 0.012 | 0.001 | | |

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**Results for 100 year +40% CC +10% Q Critical Storm Duration. Lowest mass balance: 92.60%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 1440 minute winter | S16 | 1380 | 35.279 | 0.029 | 1.2 | 0.0000 | 0.0000 | OK |
| 1440 minute winter | S20 | 1380 | 36.752 | 1.422 | 1.2 | 2.0347 | 0.0000 | FLOOD RISK |
| 1440 minute winter | S21 | 1380 | 36.753 | 1.253 | 3.3 | 10.0395 | 0.0000 | FLOOD RISK |
| 1440 minute winter | S22 | 1380 | 36.753 | 1.088 | 3.3 | 1.2310 | 0.0000 | FLOOD RISK |
| 30 minute winter | S23 | 23 | 36.868 | 0.868 | 49.0 | 11.7005 | 0.0000 | FLOOD RISK |
| 1440 minute winter | S24 | 1380 | 36.753 | 1.198 | 2.2 | 1.7150 | 0.0000 | FLOOD RISK |
| 1440 minute winter | S25 | 1380 | 36.754 | 1.154 | 4.3 | 142.0620 | 0.0000 | FLOOD RISK |
| 1440 minute winter | S26 | 1380 | 36.754 | 0.909 | 4.9 | 0.0000 | 0.0000 | OK |
| 1440 minute winter | S27 | 1380 | 36.754 | 0.884 | 3.0 | 0.9994 | 0.0000 | FLOOD RISK |
| 1440 minute winter | S28 | 1380 | 36.754 | 0.839 | 3.0 | 59.3978 | 0.0000 | FLOOD RISK |
| 30 minute winter | J1 | 23 | 36.875 | 0.600 | 2.2 | 0.0000 | 0.0000 | OK |
| 1440 minute winter | J2 | 1380 | 36.753 | 1.053 | 0.1 | 0.0000 | 0.0000 | OK |
| 1440 minute winter | 5 | 1380 | 36.754 | 0.719 | 2.0 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 1440 minute winter | S20 | 1.003 | S16 | 1.2 | 0.507 | 0.083 | 0.0274 | 95.4 |
| 1440 minute winter | S21 | 1.002 | S20 | 1.2 | 0.170 | 0.081 | 0.4134 | |
| 1440 minute winter | S22 | 1.001 | S21 | 3.3 | 0.313 | 0.224 | 0.4277 | |
| 30 minute winter | S23 | 1.000 | S22 | 25.0 | 1.422 | 0.864 | 0.2237 | |
| 1440 minute winter | S24 | 2.001 | S21 | -2.2 | 0.236 | -0.149 | 0.1453 | |
| 1440 minute winter | S25 | 2.000 | S24 | -2.1 | 0.445 | -0.104 | 0.0592 | |
| 1440 minute winter | S26 | Tank | S25 | 3.5 | 0.020 | 0.002 | | |
| 1440 minute winter | S27 | 3.001 | S26 | -3.0 | 0.743 | -0.190 | 0.0554 | |
| 1440 minute winter | S28 | 3.000 | S27 | -3.0 | 0.469 | -0.203 | 0.1152 | |
| 30 minute winter | J1 | **hydroplanters** | S23 | -4.2 | -0.239 | -0.264 | | |
| 1440 minute winter | J2 | **hydroplanters** | S21 | 0.2 | 0.010 | 0.011 | | |
| 1440 minute winter | 5 | Tank | S28 | 1.3 | 0.012 | 0.001 | | |

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