Preliminary Drainage Strategy

Project:

Residential Development to Land East of St Margarets, Quadring

Client:

Seagate Homes Ltd

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Introduction

Jackson consulting engineers have been appointed by Seagate Homes Ltd, to undertake a drainage strategy, forming part of the supporting evidence of the planning submission for the proposed residential development to land East of St Margarets, Quadring, PE11 4PR. The following document is to assist the planners and Lead Local Flood Authority (LLFA) in demonstrating that the development is acceptable in terms of sustainable drainage strategy and flood risk as a result of the development.

Existing Site

The site lies to the east of St Margarets. An aerial location plan is shown in figure 1.



Figure 1 - Site Location

Site Topography

A site survey has been carried out by Axis Surveys Ltd, drawing number AS2513/1, which can be found in appendix A.

The development sits just north of the A152, known as 'Main Road' which is separated by a single row of houses, the development backs up to their back gardens. There is a thin access point which connects the site to the junction of Sarah Gate/Main Road. The eastern boundary of the site is bounded by Sarah Gate, with the north section of the eastern boundary being a ditch. The northern boundary has a ditch which is assumed to be riparian and draining in a westerly direction. At the time of survey, the ditch had a water level of 2.19m AOD. This ditch leads into an IDB drain. To the north of this boundary

is open fields. The western boundary is mainly bounded by existing gardens, with the middle section being existing public open space. The total area of the site is approximately 1.08 hectares.

The site is accessed from the eastern arm of St Margarets. The existing road leading into the access is generally longitudinally flat with a camber falling either side of the central crown. The road does not have kerb upstands (some concrete channels laid level/below the surfacing appear to be visible) and any surface water discharges into the PoS to the north or soft landscaping to the south. The crown level of the road varies from 3.21 to 3.24m AOD along this stretch of road with a crossfall level reduction of approximately 70mm either side. The end of the road at the tie in point is approximately 3.19m AOD.

The site is greenfield with no evidence of existing or historic structures. The topography of the site is generally flat, with the majority of the site ranging between 2.74 to 3.35m AOD. The site subtly falls towards the north east and north ditch before eventually all flows enter the north ditch.

Ground Conditions

A phase 1 or 2 ground investigation report is not available for this site currently, and the findings of this section area based on publicly available information. A full ground investigation will be undertaken prior to detailed design.

The bedrock geology of the site is described as 'Oxford Clay Formation'. This generally indicates that deeper infiltration devices, such as house soakaways are not viable for the site.

The superficial deposits are described as 'Tidal Flat Deposits', consisting of clays and silts. This type of strata can offer some limited infiltration but is generally restricted by the underlying clay. Additionally, the soaked CBR's of the silty clay are likely to be poor and not allow the use of items such as porous paving.

There is no borehole information in close enough proximity of the site to be relevant. Given experience with the local ground conditions, it is anticipated that the water level will be relatively close to the surface, potentially perched on top of the Oxford Clay strata. It is anticipated that these conditions will mean that deeper infiltration devices are not viable other than very shallow installations.

Both British Geological Survey definitions can be found respectively in figures 2 and 3 below.

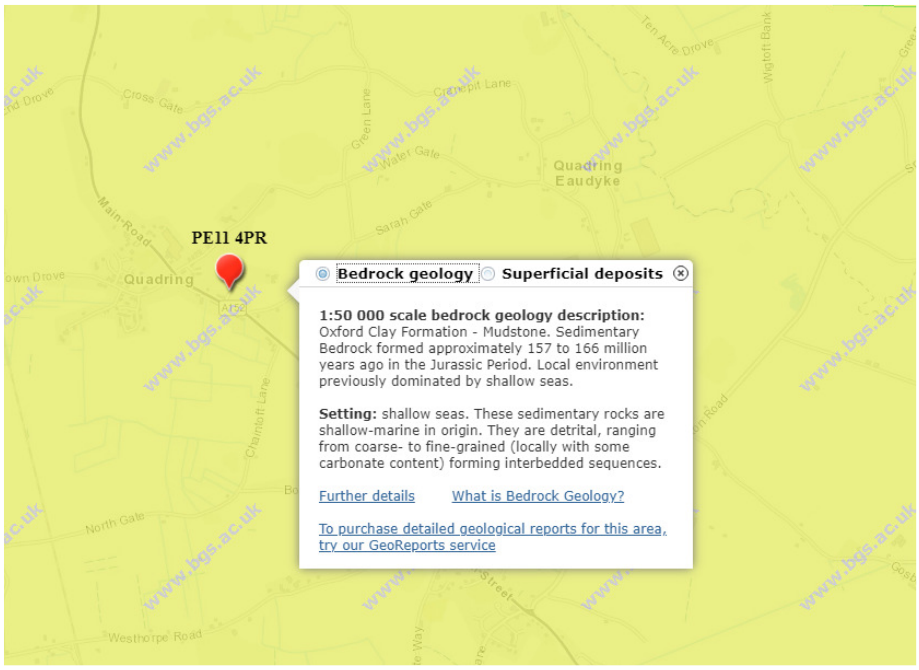


Figure 2 - BGS Bedrock Geology

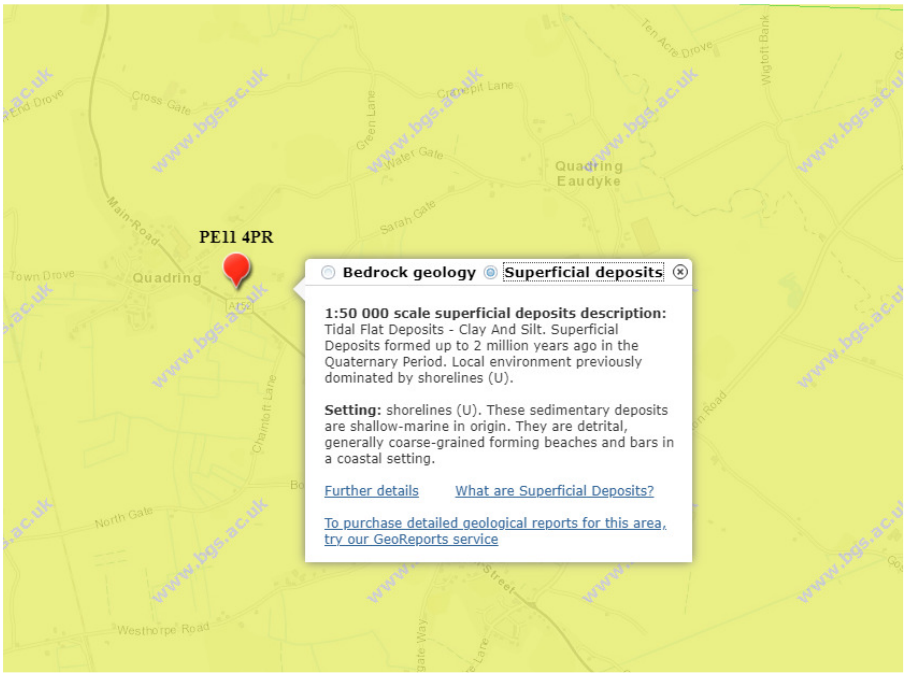


Figure 3 - BGS Superficial Deposits

Local Watercourses

There is a ditch which runs to the north of the site, and it is expected that this falls under riparian rights. Under any circumstance the natural gradients fall towards the ditch, and this would currently drain any greenfield run-off.

The watercourse/ditch to the north of the eastern boundary and the north boundary is generally in good condition, but would benefit from being cleared during the development to remove any silt and

overgrown vegetation. The northern ditch flows east where it joins into the Welland and Deepings IDB drain known as Watergate Dyke, which flows north into the overall IDB system. The IDB drain is approximately 70m from the north east corner of the site. The IDB drains are shown in figure 4.

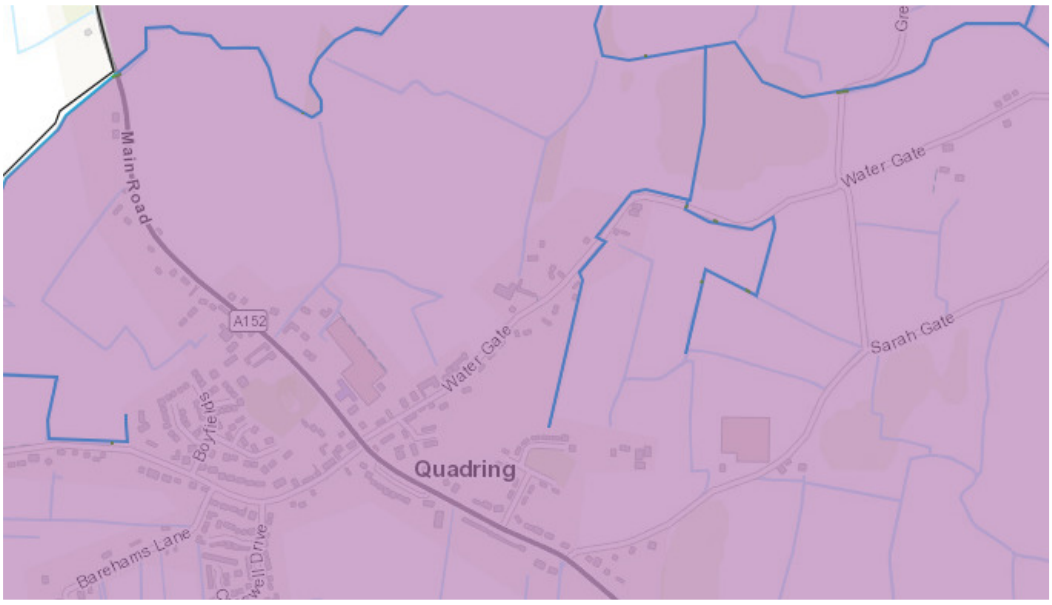


Figure 4 – Welland and Deepings IDB Drain Locations

Surface Water Flood Risk

The existing flood risk for the site has been assessed by a different consultant and can be found within report: SAL-1249-01-FRA-001. The purpose of this document is to justify that flood risk as a result of the development will not be increased, and any discussions relating to the development proposals being suitable as a result of the existing flood risk assessment. The FRA has recommendations for the finished floor levels and this has been taken into consideration with the drainage design.

Development Proposals

The proposed development consists of creating 36 new dwelling consisting of a mixture of detached, semidetached and terraced housing, with the majority of the dwellings being semidetached. Each dwelling benefits from modest garden. Outline planning permission for the site was granted under South Holland District Council reference: H15-1039-17.

It is proposed that the main road running through the site and the main drainage will be put forward for adoption under a section 38 and section 104 agreement with Lincolnshire County Council and Anglian Water respectively. Because the site is flat and depths to both the surface and foul water outfalls are limited, parts of the drainage will be laid in private gardens (and remain private in places) to ensure the design solution is viable, especially in respect to gradient and cover depths of existing pipes.

The minimum recommended floor levels in the FRA are set at no lower than 3.800m AOD, and some of these floor levels need to be raised higher to allow for the drainage solution.

Drainage Strategy

The following section provides narrative on the principles behind the drainage strategy and has been carried out in general accordance with Lincolnshire County Council's "Sustainable Drainage Design and Evaluation Guide" (SDDEG), and "CIRIA's C753 – the SUDS Manual", where appropriate.

Surface Water Drainage

For new developments there is a requirement to apply sustainable drainage principles (SuDS) to the disposal of surface water from the site where practicable. As required by Building Regulations and Defra's "Non-statutory Technical Standards for Sustainable Drainage Systems" (NTS), surface water must discharge to the following, listed in priority.

1. To ground – in an adequate soakaway or some other adequate infiltration system.
2. To a watercourse.
3. To a surface water sewer, highway drain or other drainage system.
4. To a combined sewer.

Infiltration

Infiltration results are currently not available but giving to the underlying clay and anticipated high-water tables, it is assumed that infiltration is generally unsuitable for the site, although it could potentially be used in limited capacities. Additionally, the soaked CBR values are likely to not be suitable owing to the silty cray strata.

The entrance of the site has a section which needs to be raised to satisfy the flood risk levels which creates a section of the proposed road which is not suitable to be drained into the proposed drainage network. For this area the only option is to drain via. infiltration and a very shallow swale will be created with run-off from the road soaking into the high-level silty clay and topsoil. It should be noted that the existing road drains into soft landscaped areas and the approach is to match this, as this appears to create no flooding issues.

Watercourse

There is a watercourse located to the north of the development and the site naturally flows towards this, therefore any existing overland flows and run-off will be drained by the watercourse. The client has confirmed they have a right to connect into this.

As previously confirmed the northern ditch flows east where it joins into the Welland and Deepings IDB drain known as Watergate Dyke, which flows north into the overall IDB system. The IDB drain is approximately 70m from the edge of the site. The IDB drains are shown in figure 4.

This is the proposed method of waste surface water disposal from the site and given the strata on-site it is deemed that this method of surface water disposal mimics the existing greenfield drainage.

Surface Water Sewer

There are no identified surface water sewers in the vicinity of the site. A discussion with LCC has taken place regarding existing highways gullies which are located in proximity to the proposed development. These gullies are known to be blocked and the outfall is unknown.

As a watercourse connection is viable, then there is no need for a surface water sewer to be considered.

Run-off Rates

Existing Drainage Arrangements

As the site is greenfield it has no current surface water drainage. The natural topography of the site directs surface runoff into the existing watercourses to the east and north of the site and will either flow directly overland or laterally within the strata layers, certainly as the underlying strata, the Oxford Clay Formation, would be considered as being very slow draining to impermeable.

Existing greenfield run-off

The greenfield run-off for the site is summarised in figure 5, with a full copy of the report provided in appendix B.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	1.51	1.51
1 in 1 year (l/s):	1.31	1.31
1 in 30 years (l/s):	3.7	3.7
1 in 100 year (l/s):	5.37	5.37
1 in 200 years (l/s):	6.36	6.36

Figure 5 - Existing Greenfield Runoff Rates

The Q_{BAR} greenfield run-off for the site is calculated at 1.5 l/s, and this is in accordance with industry guidance with only large PoS areas being discounted for the calculation.

The IDB have their own allowable rate based on their pumped catchment, and this is set at 1.4l/s per hectare, which is roughly in line with the figures above. The existing actual run-off from the site will not be increased above Q_{BAR} and flood risk as a result of the development is not increased.

The HR Wallingford Greenfield runoff rate estimation for sites is an industry standard way to determine the greenfield run-off. The calculator uses the IH124 method to determine the runoff.

Existing Run Off Volume

The runoff volume for the 1 in 100, 360 minute storm is 221m^3, as shown in figure 6. This has been calculated using Causeway Flow.

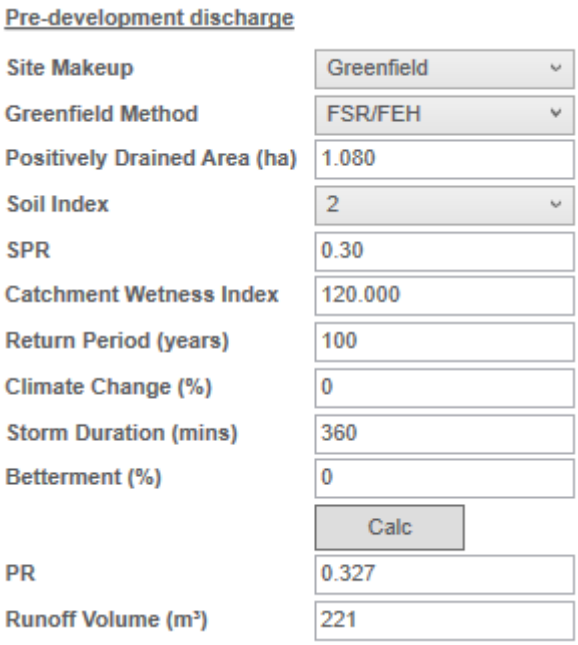


Figure 6 - Existing Greenfield Runoff Volume

Proposed Run-off

The greenfield run-off from the site should, as far as reasonably practical, not exceed the greenfield runoff rate for the Q_{BAR} event, which in this instance is 1.5 l/s. Therefore, the proposed discharge from the site will have a maximum runoff of 1.5 l/s, for all storms up to and including the 1 in 100 year + 40% climate change event. The post development run-off values are summarised in the table below. These figures represent the non-surcharged event. The full calculations can be found in appendix C.

Storm	Critical Flow
1 Year	1.4 l/s
2 Year	1.5 l/s
30 Year	1.5 l/s
100 Year	1.5 l/s
100 Year + 40% CC	1.5 l/s

Proposed Discharge Volume

The proposed discharge volume for the 1 in 100-year 6-hour duration winter event is 42.8m^3, which is substantially lower than the existing greenfield discharge volume for the same storm being 221m^3.

As the runoff into the existing ditch is not being increased above the current scenario, it has sufficient capacity. It should also be noted that the runoff velocity for the Q_{BAR} event is not being increased, therefore the run-off rate from the site for all storms approximately above the 1 in 2 year event is being reduced, given a betterment over the existing natural site for storms greater than this.

Drainage Proposals

The site has been designed to incorporate source control as far as reasonably practical, and it is our opinion that SUDS has been fully considered for this type of development, meeting all of the

appropriate standards. All of the water from these sources will pass through at least one treatment device.

The buildings are being drained by traditional rainwater pipes, before connecting into below ground drainage pipes, or discharging into porous paving sub-base.

The highway drainage generally falls into an under drained filter drain, providing suitable source control for this area. As the filter drain will receive domestic water it is proposed that the under draining pipe will be maintained by Anglian Water. The final arrangements will be determined at detailed design stage.

Given the limited room on site, it is proposed that the domestic drives will be constructed using tanked porous paving, which will feed into the private or Anglian Water drainage system.

As previously described, the start of the entrance road cannot be included within the proposed drainage system as the levels will not allow this to happen. This area will be drained via. a shallow side swale, with the water discharging into the existing top strata and topsoil. The proposed area to be drained is approximately 220m^2, which includes the swale area. The existing road drains in this fashion, and as the water will be directed towards the existing PoS, and any flooding will be confined to a small volume, dispersed over a large area, giving shallow water depths, or result in 'soggy' ground. This strategy has tentatively been discussed with LCC and at the time of writing this report we still await an official response.

The site utilises a Hydrobrake, which has a provisional opening size of 61mm to control the discharge to greenfield run-off rates. The surface water will pass through devices such as porous paving, filter drains and the basin, and therefore the risk of blockage is very low as debris will be filtered before entering the Hydrobrake. If the Hydrobrake was to become blocked, or a higher storm period encountered then there would be more flooding than currently modelled. A provisional flood route is shown on the proposed drainage plans, but to summarise, flood water would flow towards the attenuation basin, utilise the freeboard, then overtop into the existing watercourse, away from any buildings.

The system has been designed so that there is no above ground flooding for the 1 in 30-year event and all flooding up to and including the 1 in 100 year + 40% climate change event is contained within the site. The calculations demonstrate that the 1 in 30-year storm event is stored below ground. For the 1 in 100-year + 40% climate change event, there is some minor flooding – a total of approximately 6m^3 located in rear gardens – this would easily dissipate into the surrounding area, or within the private, unmodelled drainage pipes.

Rear garden patios or pavements will be laid to soft landscaping or laid with open joints and mimic a like for like drainage arrangement.

To comply with the NTS, the site's drainage has been design considered a 40% climate change allowance, and to comply with LCC's requirements, an allowance of 10% for urban creep has been allowed for. As the urban creep factor only applies for the domestic areas, this creates an actual percentage increase for the whole site of 6%.

Most of the main drainage is proposed to be put forward for adoption to Anglian Water. Some of the private drainage will remain private as they will not meet the criteria for adoption. The provisional

sizing of the Hydrobrake is 61mm, which may not be suitable for adoption, but is subject to further discussions with AW. In the event that it is not suitable then the Hydrobrake will be placed into a private management company. The basin generally meets the criteria for adoption, but this is dependent on confirmation of the existing FFL's and dependant on the adoption of the Hydrobrake. It will be beneficial to have a weir to ensure if the Hydrobrake was to fail, the site would discharge into the existing watercourse. Again, the agreement of the basin is subject to further discussion with AW and if not suitable for adoption it will be placed into a management company.

The proposed drainage layout is shown on JCE drawing 077-JCE-00-SI-DR-C-3000, which can be found in appendix D and a 3D schematic of the drainage model shown in figure 7.

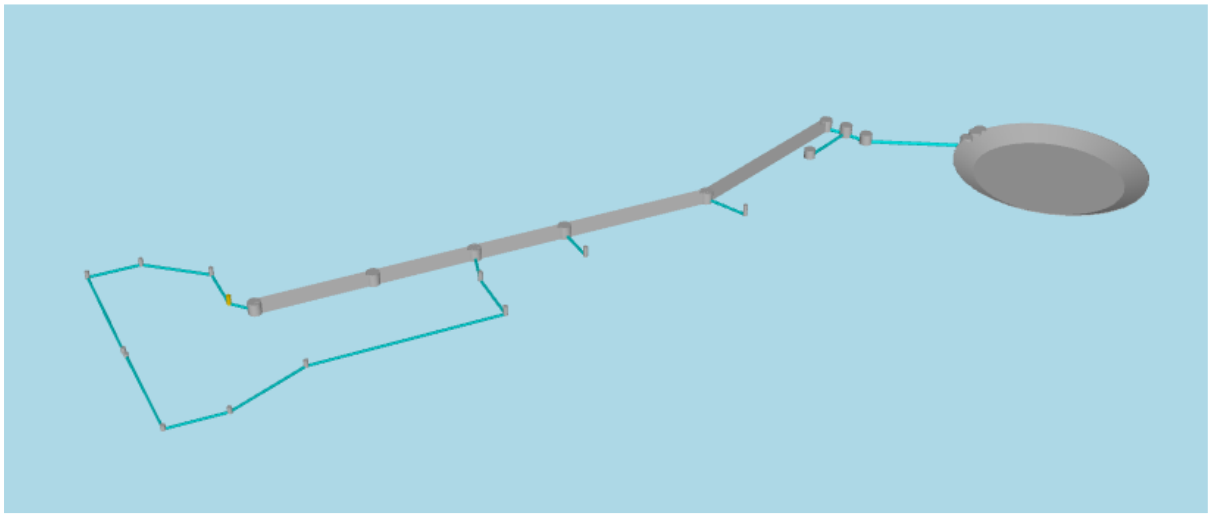


Figure 7 - 3D View of Drainage Model

Surcharged Outfall

During storm events, it is unknown if the water in the existing watercourse network will surcharge the outfall device, which needs to be considered. As this cannot be determined, the model has included a second set of calculations, 077-CAL-3010, found in appendix E, to consider a surcharged event. The field levels in relation to the water level in the ditch are only around 600mm and this is the maximum possible surcharge event. A flap valve is to be fitted downstream of the Hydrobrake to ensure offsite water does not enter the site, subject to agreement with the adopting body.

The maximum water level in this event is 2.962m AOD, and this represents the worst case, highest pond level scenario. This gives an approximate water depth in the basin of 0.75m.

Exceedance Flows

There is always the possibility that a device can become temporarily blocked or fail, resulting in the system flooding. Additionally, the site has been designed up to and including storms of 1 in 100 year + 40% climate change, any storms greater than this will cause above ground flooding. The proposed flood routing in storms of exceedance or device failure can be found on the drainage drawing. A weir overflow is to be considered at the basin/watercourse location to ensure exceedance flows leave the site at this point and not the uncontrolled within the site. The topo of bank for the pond is set at 3.300m AOD, which is similar to the surrounding levels. The modelled water level in the pond during the critical 1 in 100 year + 40% storm event is 2.892m AOD, therefore more than 400mm of free board

is being provided. In reality this creates approximately 250m3 of spare storage in the device so there will have to be a significant event above the 1 in 100 year + 40% storm event to create above ground flooding.

Water Quality

The methods of surface water disposal mentioned above have included provisions for water quality. In accordance with CIRIA C753, the pollution hazard features for the drainage areas are:

- Residential roofs - Low
- Residential parking - Low
- Cul de sac - Low

To remove the pollution risks, CIRA have developed 'Pollution hazard indices' and the 'mitigation indices' that the SuDS components provide, further details of these are found in figures 8 and 9 below. This simple approach is considered suitable for this type of development.

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Figure 8 - Pollution hazard indices for different land use classifications

	Mitigation indices[1]		
Type of SuDS component	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Figure 9 - Indicative SuDS mitigation indices for discharging to a surface water

To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type):

Total SuDS mitigation index ≥ pollution hazard index
(for each contaminant type) (for each contaminant type)

Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required where:

$$\text{Total SuDS mitigation index} = \text{mitigation index}_1 + 0.5\ (\text{mitigation index}_2)$$

Where:

$$\text{Mitigation index}_n = \text{mitigation index for component } n$$

Provided the total SuDS mitigation index exceeds the pollution hazard indices, then sufficient water quality will be provided.

For the calculations below the hazards are represented by;

Total suspended solids = Red

Metals = Blue

Hydrocarbons = Green

The figures are presented to show the actual achieved in the right-hand side column. The right-hand side's total must be higher than the left-hand side.

Roof areas

The roof water generally enters the below ground pipework directly, although at detailed design some of this will enter the porous paving and filter into the system. Roof water will generally be considered to be clean, but will flow through the attenuation basin prior to discharging into the watercourse. The mitigation for this area is:

0.2 0.2 0.05 = Detention Basin 0.5 0.5 0.6

The mitigation provided by the detention basin creates enough water quality improvement for this aspect of the development.

Residential parking

The residential parking will generally consist of permeable paving with limited options for any other source control. The mitigation for this area is:

0.5 0.4 0.4 = Permeable Paving 0.7 0.6 0.7

The mitigation provided by the porous paving creates enough water quality improvement for this aspect of the development.

Cul-de-sac

The cul-de-sac will be drained by an under drained filter drain, with the overland flow from the carriageway discharging over a filter strip first. The mitigation for this area is:

0.5 0.4 0.4 = Filter Strip 0.4 0.4 0.5 + 0.5 Filter Drain 0.2 0.2 0.2

The combined SUDS features provide sufficient water quality for this aspect of the development.

All the methods above provide enough water quality in accordance with CIRIA's C753 document or a suitable compared to the existing drainage arrangements. Further evidence will need to be provided at detailed design stage.

Finished Floor Levels

The FRA highlights that the finished floor levels should be set at 3.800m AOD.

Flood Risk off-site

Most sites have to be raised in this area of development to protect against the flood zone flood risk form the site, and this site is no exception with the FFL's requiring being raised by up to a metre above existing ground levels, with the FFL's in places being raised event further to allow for a gravity drainage solution. This will mean that the finished floor levels are up to a metre higher than the existing FFL's.

If the sites drainage was to fail, or an exceedance event were to occur the flow route will be along the proposed filter drain location, which flow away from the proposed and existing buildings, which leads into the attenuation basin which will be fitted with a high level overflow to ensure the water levels do not reach existing property FFL's.

The rear gardens will be raised using permeable soil, and therefore rainwater in the rear gardens will filter back to the sites natural ground levelsl. The driveways will fall towards the proposed carriageway, which has the flow routes as described above. The existing PoS is a large flat area, generally lower than the surrounding, existing FFL's and any flooding will naturally find its way to this point, which would offer a high amount of storage. It should be noted that the PoS is not part of the drainage proposal.

As a result, the flood risk offsite has not been increased as a result of the development.

Management/Maintenance

It is crucial that the elements mentioned in the drainage elements and water quality are maintained to a sufficient standard to ensure that the devices can still function as designed. Generally, the maintenance requirements are either from CIRIA 753, or manufacturer guidance.

The adopted areas will have their own maintenance requirements and when the site's elements become adopted it is expected that the maintenance requirements will revert back to the adopting bodies policy.

The devices outlined below are preliminary only and subject to detailed design.

Filter Strip and Filter Drain

Operation and maintenance requirements for filter drains

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

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Operation and maintenance requirements for filter strips		
Maintenance schedule	**Required action**	**Typical frequency**
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect filter strip surface to identify evidence of erosion, poor vegetation growth, compaction, ponding, sedimentation and contamination (eg oils)	Monthly (at start, then half yearly)
	Check flow spreader and filter strip surface for even gradients	Monthly (at start, then half yearly)
	Inspect gravel flow spreader upstream of filter strip for clogging	Monthly (at start, then half yearly)
	Inspect silt accumulation rates and establish appropriate removal frequencies	Monthly (at start, then half yearly)
Occasional maintenance	Reseed areas of poor vegetation growth; alter plant types to better suit conditions, if required	As required or if bare soil is exposed over > 10% of the filter strip area.
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Hydrobrake Maintenance

Maintenance

Normally, little maintenance is required as there are no moving parts within the Flow Control. Experience has shown that if blockages occur they do so at the intake, and the cause on such occasions has been due to a lack of attention to engineering detail such as approach velocities being too low, inadequate benching, or the use of units below the minimum recommended size. The Flow Control (where applicable) is fitted with a pivoting bypass door, which allows the manhole chamber to be drained down should blockage occur. The smaller conical units, below the minimum recommended size, are also supplied with rodding facilities or vortex suppressor pipes as standard.

Following installation of the Flow Control it is vitally important that any extraneous material i.e. building materials are removed from the unit and the chamber. After the system is made live, and assuming that the chamber design is satisfactory, it is recommended that each unit be inspected monthly for three months and thereafter at six monthly intervals with hose down if required. If problems are experienced, please do not hesitate to contact the company so that an investigation may be made.

All Flow Control units are typically manufactured from grade 304 Stainless Steel, and if required they can also be manufactured in grade 316 Stainless Steel. Both materials have an estimated life span in excess of the design life of drainage systems.

Detention Basin

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

Porous paving

Operation and maintenance requirements for pervious pavements		
Maintenance schedule	**Required action**	**Typical frequency**
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Foul Proposals

The site will need to be served by foul drainage, and it is proposed that the main foul water sewers will be adopted by Anglian Water. Similar to the surface water, parts of the foul drainage will need to be positioned in private areas as they will not meet the criteria for adoption.

There is an existing Anglian Water connection point located at the junction of Sarah gate and Main Road, manhole reference 8905 - as shown in figure 10, and it is proposed that the site will connect into the sewer just downstream of this manhole – subject to confirmed suitable levels. An easement will need to be offered for the adopted foul drainage sewer where it passes through the non-adopted highway and the position of the connection ensure this will not be across third party land.

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Figure 10 - Anglian Water Asset Map Extract

It is not expected that the proposals will cause any capacity issues for the existing sewer, and even if they do, Anglian Water will be required to upgrade their system to provide capacity. A section 106 application will be submitted at detailed design stage, and upon receiving full planning permission.

Conclusion

- The above drainage strategy demonstrates that the site can be drained through the use of a Sustainable Drainage System at an appropriate level for the development.
- Volume of run-off will not exceed pre-development greenfield run-off for the 1 in 100 year, 360 minute storm.
- The flow offsite will be restricted to a maximum of 1.5 l/s.
- Calculations have been included to represent a surcharged outfall.
- Maximum water depth in the basin is less than 0.75m.
- Less that $6m^3$ of flooding is currently anticipated for the 1 in 100 year + 40% climate change event.
- Existing greenfield offsite flow from the undeveloped site is reduced for all storms above the Q_{BAR} event.
- The proposed scheme does not increase the risk of flooding either on or off site as a result of the development.
- A full maintenance strategy will be developed at the detailed design stage.
- A preliminary drainage layout can be found on JCE's Preliminary Drainage Strategy drawing: 077-JCE-00-SI-DR-C-3000.
- Finished floor levels will be set at a minimum of 3.800m AOD, in accordance with the FRA.
- flood risk offsite has not been increased as a result of the development.

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Appendices

Appendix A – Existing Topographical Survey



KEY:

- BUILDING
- FENCE
- HEDGE
- CHANNEL
- WALL
- BANK EDGE
- STORM DRAINAGE
- FOUL DRAINAGE
- CHANGE OF SURFACE
- OVERHEAD ELECTRIC
- OVERHEAD TELEPHONE

TREE BOREHOLE MANHOLE

CONTROL STATION

B	BOLLARD	RE	ROD EYE
BIN	BIN	RI	RIDGE
BT	BRITISH TELECOM	SP	SIGN POST
CR	PIPE CROWN	STAY	STAY
CTV	CABLE TELEVISION	SV	STOP VALVE
EA	EARTH	TBM	BENCH MARK
EL	ELECTRIC BOX	TH	THRESHOLD
EP	ELECTRIC POLE	TL	TRAFFIC LIGHT
EV	EAVES	TP	TELEGRAPH POLE
FH	FIRE HYDRANT	TS	TRAFFIC SIGNAL
G	GULLY	VC	VENT COLUMN
GA	GAS VALVE	VP	VENT PIPE
IC	INSPECTION CHAMBER	WL	WATER LEVEL
IL	INVERT LEVEL	WM	WATER METER
KO	KERB OFFLET	WT	WALL TOP
LH	LAMP HOLE		
LP	LAMP POST		
MP	MARKER POST		
PB	POST BOX		

NOTES:

1. Survey plotted to OS National Grid.
2. All levels related to OS Datum.
3. GPS/GLONASS ETRS89 observations transformed to OSGB36 using OSTN15 Transformation.
4. ETRS89 ellipsoid heights converted to heights above mean sea level using National Geoid Model OSGM15.

Initial Survey Date: 18 JAN 2021

CONTROL STATIONS

Stn:	Eastings:	Northings:	Height:
9000	522762.263	333092.064	3.122
9001	522784.719	333133.447	3.128
9002	522750.917	333119.846	3.048
9003	522768.725	333098.810	3.016
9004	522760.681	333088.192	3.157
9005	522756.035	333073.071	3.249
9006	522706.843	332973.384	3.608
9007	522843.895	332920.928	3.488
9008	522863.843	333025.594	2.914

Rev:	Amendments:	Date:

Client: SEAGATE HOMES

Project Title: ST.MARGARETS QUADRING LINCOLNSHIRE

Drawing Title: OGL SURVEY

Scale:	Date:
1:500	22 JAN 2021

Drawing No:	Rev:
AS2513/1	A1

C.A.D. Title: SEAGATEQUADRING180121

Drawn By: D.J.SMITH

AXIS SURVEYS LTD.
CHARTERED LAND SURVEYORS

10 SYCAMORE DRIVE, LOUTH, LINCOLNSHIRE, LN11 8RT.
TEL (01507) 606397
FAX (01507) 354050
www.axissurveys.co.uk
office@axissurveys.co.uk
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Appendix B – Greenfield Runoff

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Ben Jackson
Site name:	St Margarets
Site location:	Quadring

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

Site Details

Latitude:	52.88097° N
Longitude:	0.1758° W
Reference:	2870418528
Date:	May 03 2021 10:37

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 1.08

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	558	558
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Growth curve factor 200 years:	4.21	4.21

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	1.51	1.51
1 in 1 year (l/s):	1.31	1.31
1 in 30 years (l/s):	3.7	3.7
1 in 100 year (l/s):	5.37	5.37
1 in 200 years (l/s):	6.36	6.36

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at 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 www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of 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, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Appendix C – Proposed Drainage Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
PS1	0.012	5.00	4.150	150	0.700
PS2	0.013	5.00	3.850	450	0.588
PS3	0.006	5.00	3.850	450	0.658
PS4			3.900	450	0.805
PS5			4.000	450	0.978
S1	0.074	5.00	4.041	1200	1.281
S2	0.056	5.00	3.953	1200	1.267
PS6	0.011	5.00	4.150	150	0.525
PS7	0.008	5.00	4.150	450	0.681
PS8	0.006	5.00	4.150	450	0.758
PS9	0.031	5.00	4.100	450	0.827
PS10	0.015	5.00	4.100	450	1.087
PS11	0.011	5.00	4.150	450	1.224
S3	0.033	5.00	3.896	1200	1.276
PS12	0.032	5.00	4.100	450	1.200
S4	0.054	5.00	3.838	1200	1.279
PS13	0.018	5.00	4.050	450	1.250
S5	0.071	5.00	3.723	1200	1.266
S6			3.400	1200	1.079
S7	0.035	5.00	3.650	1200	1.000
S8			3.400	1200	1.094
HW1			3.350	2300	1.060
HW2	0.110	5.00	3.350	2300	1.128
S9			3.350	1350	1.139
HW3			3.350	2300	1.145

Links (Input)

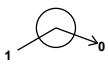
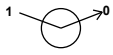
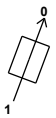
Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Slope (1:X)	Dia (mm)	T of C (mins)
1.000	PS1	PS2	28.212	0.600	3.450	3.262	150.0	150	5.57
1.001	PS2	PS3	10.443	0.600	3.262	3.192	150.0	150	5.79
1.002	PS3	PS4	14.506	0.600	3.192	3.095	150.0	150	6.08
1.003	PS4	PS5	10.986	0.600	3.095	3.022	150.0	150	6.31
1.004	PS5	S1	5.561	0.600	3.022	2.985	150.0	150	6.42
1.005	S1	S2	23.576	0.600	2.760	2.686	320.0	375	6.81
1.006	S2	S3	21.205	0.600	2.686	2.620	320.0	375	7.16
2.000	PS6	PS7	23.388	0.600	3.625	3.469	150.0	150	5.48
2.001	PS7	PS8	11.546	0.600	3.469	3.392	150.0	150	5.71
2.002	PS8	PS9	17.896	0.600	3.392	3.273	150.0	150	6.08
2.003	PS9	PS10	39.040	0.600	3.273	3.013	150.0	150	6.87

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Links (Input)

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Slope (1:X)	Dia (mm)	T of C (mins)
2.004	PS10	PS11	12.991	0.600	3.013	2.926	150.0	150	7.14
2.005	PS11	S3	9.314	0.600	2.926	2.864	150.0	150	7.33
1.007	S3	S4	19.620	0.600	2.620	2.559	320.0	375	7.65
3.000	PS12	S4	9.607	0.600	2.900	2.836	150.0	150	5.20
1.008	S4	S5	32.731	0.600	2.559	2.457	320.0	375	8.19
4.000	PS13	S5	10.084	0.600	2.800	2.733	150.0	150	5.21
1.009	S5	S6	43.627	0.600	2.457	2.321	320.0	375	8.91
1.010	S6	S8	4.875	0.600	2.321	2.306	320.0	375	9.00
5.000	S7	S8	14.700	0.600	2.650	2.552	150.0	150	5.30
1.011	S8	HW1	5.214	0.600	2.306	2.290	320.0	375	9.08
1.012	HW1	HW2	21.809	0.600	2.290	2.222	320.0	375	9.44
1.013	HW2	S9	3.459	0.600	2.222	2.211	320.0	375	9.50
1.014	S9	HW3	1.959	0.600	2.211	2.205	320.0	375	9.53

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Node Type	MH Type	Connections
PS1	522822.725	332977.290	4.150	0.700	150		Manhole	Adoptable	 0
PS2	522796.399	332987.431	3.850	0.588	450		Manhole	Adoptable	 1 0
PS3	522799.880	332997.277	3.850	0.658	450		Manhole	Adoptable	 1 0
PS4	522812.415	333004.578	3.900	0.805	450		Manhole	Adoptable	 1 0
PS5	522822.722	333000.777	4.000	0.978	450		Manhole	Adoptable	 1 0
S1	522827.906	333002.790	4.041	1.281	1200	900	Manhole	Adoptable	 1 0
S2	522836.154	333024.876	3.953	1.267	1200	900	Manhole	Adoptable	 1 0
PS6	522824.570	332976.595	4.150	0.525	150		Manhole	Adoptable	 0

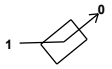
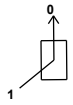
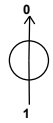
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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Node Type	MH Type	Connections
PS7	522846.533	332968.555	4.150	0.681	450		Manhole	Adoptable	1 0
PS8	522850.654	332979.340	4.150	0.758	450		Manhole	Adoptable	1 0
PS9	522849.404	332997.192	4.100	0.827	450		Manhole	Adoptable	1 0
PS10	522862.859	333033.840	4.100	1.087	450		Manhole	Adoptable	1 0
PS11	522850.961	333039.056	4.150	1.224	450		Manhole	Adoptable	1 0
S3	522843.581	333044.738	3.896	1.276	1200	900	Manhole	Adoptable	1 2 0
PS12	522859.466	333059.563	4.100	1.200	450		Manhole	Adoptable	0
S4	522850.529	333063.087	3.838	1.279	1200	900	Manhole	Adoptable	1 2 0
PS13	522872.174	333093.880	4.050	1.250	450		Manhole	Adoptable	0
S5	522862.091	333093.708	3.723	1.266	1200	900	Manhole	Adoptable	1 2 0
S6	522860.967	333137.321	3.400	1.079	1200	900	Manhole	Adoptable	1 0
S7	522866.614	333123.480	3.650	1.000	1200	900	Manhole	Adoptable	0
S8	522865.770	333138.156	3.400	1.094	1200	900	Manhole	Adoptable	1 2 0

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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Node Type	MH Type	Connections
HW1	522870.982	333138.302	3.350	1.060	2300	1500	Manhole	Adoptable	1  0
HW2	522887.876	333152.095	3.350	1.128	2300	1500	Manhole	Adoptable	1  0
S9	522887.843	333155.554	3.350	1.139	1350		Manhole	Adoptable	1  0
HW3	522887.876	333157.513	3.350	1.145	2300	1500	Manhole	Adoptable	1 

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	0.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
2	0	6	0
30	0	6	0
100	0	6	0
100	40	6	0

Node S9 Online Hydro-Brake® Control

Flap Valve	✓	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	2.211	Product Number	CTL-SHE-0061-1500-0800-1500
Design Depth (m)	0.800	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.5	Min Node Diameter (mm)	1200

Node HW2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.222
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

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Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	607.0	0.0	1.200	1011.0	0.0

Node S2 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	1.005
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.686	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	6	Diameter (mm)	675

Node S3 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	1.006
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.620	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	6	Diameter (mm)	675

Node S4 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	1.007
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.559	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	6	Diameter (mm)	675

Node S5 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	1.008
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.457	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	5	Diameter (mm)	675

Node S6 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	1.009
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.321	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	4	Diameter (mm)	675

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Results for 1 year Critical Storm Duration. Lowest mass balance: 99.66%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	PS1	10	3.484	0.034	1.7	0.0006	0.0000	OK
15 minute winter	PS2	11	3.313	0.051	3.4	0.0081	0.0000	OK
15 minute winter	PS3	11	3.249	0.057	4.2	0.0091	0.0000	OK
15 minute winter	PS4	11	3.152	0.057	4.2	0.0091	0.0000	OK
15 minute winter	PS5	12	3.081	0.059	4.1	0.0093	0.0000	OK
15 minute winter	S1	11	2.848	0.088	13.9	0.0954	0.0000	OK
15 minute winter	S2	11	2.803	0.117	21.4	0.3800	0.0000	OK
15 minute winter	PS6	10	3.658	0.033	1.6	0.0006	0.0000	OK
15 minute winter	PS7	11	3.514	0.045	2.6	0.0071	0.0000	OK
15 minute winter	PS8	11	3.442	0.050	3.4	0.0079	0.0000	OK
15 minute winter	PS9	11	3.349	0.076	7.6	0.0121	0.0000	OK
15 minute winter	PS10	11	3.107	0.094	9.5	0.0149	0.0000	OK
15 minute winter	PS11	11	3.030	0.104	10.9	0.0166	0.0000	OK
15 minute winter	S3	11	2.779	0.159	36.0	0.5047	0.0000	OK
15 minute winter	PS12	10	2.960	0.060	4.5	0.0095	0.0000	OK
15 minute winter	S4	12	2.735	0.176	46.6	0.5351	0.0000	OK
15 minute winter	PS13	10	2.843	0.043	2.5	0.0069	0.0000	OK
15 minute winter	S5	12	2.651	0.194	56.8	0.7718	0.0000	OK
15 minute winter	S6	12	2.584	0.263	55.7	1.2483	0.0000	OK
15 minute winter	S7	10	2.712	0.062	4.9	0.0666	0.0000	OK
15 minute winter	S8	12	2.567	0.261	60.2	0.2817	0.0000	OK
15 minute winter	HW1	12	2.545	0.255	61.0	0.8807	0.0000	OK
720 minute winter	HW2	570	2.366	0.144	7.7	91.1383	0.0000	OK
720 minute winter	S9	570	2.366	0.155	1.4	0.2212	0.0000	OK
15 minute summer	HW3	1	2.205	0.000	1.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	PS1	1.000	PS2	1.6	0.403	0.113	0.1167	
15 minute winter	PS2	1.001	PS3	3.4	0.593	0.234	0.0596	
15 minute winter	PS3	1.002	PS4	4.2	0.679	0.289	0.0894	
15 minute winter	PS4	1.003	PS5	4.1	0.662	0.285	0.0686	
15 minute winter	PS5	1.004	S1	4.1	0.679	0.286	0.0339	
15 minute winter	S1	1.005	S2	13.9	0.574	0.125	0.5794	
15 minute winter	S2	1.006	S3	21.0	0.578	0.189	0.7850	
15 minute winter	PS6	2.000	PS7	1.5	0.435	0.107	0.0845	
15 minute winter	PS7	2.001	PS8	2.6	0.562	0.183	0.0545	
15 minute winter	PS8	2.002	PS9	3.4	0.488	0.236	0.1260	
15 minute winter	PS9	2.003	PS10	7.5	0.732	0.520	0.4023	
15 minute winter	PS10	2.004	PS11	9.4	0.759	0.648	0.1602	
15 minute winter	PS11	2.005	S3	10.7	0.860	0.738	0.1158	
15 minute winter	S3	1.007	S4	35.3	0.741	0.318	0.9357	
15 minute winter	PS12	3.000	S4	4.4	0.699	0.305	0.0606	
15 minute winter	S4	1.008	S5	46.0	0.852	0.414	1.7712	
15 minute winter	PS13	4.000	S5	2.5	0.599	0.170	0.0414	
15 minute winter	S5	1.009	S6	55.7	0.829	0.500	3.0518	
15 minute winter	S6	1.010	S8	56.9	0.739	0.512	0.4005	
15 minute winter	S7	5.000	S8	4.8	0.721	0.331	0.0975	
15 minute winter	S8	1.011	HW1	61.0	0.840	0.548	0.4216	
15 minute winter	HW1	1.012	HW2	64.2	1.896	0.577	0.8974	
720 minute winter	HW2	1.013	S9	1.4	0.113	0.013	0.1411	
720 minute winter	S9	Hydro-Brake®	HW3	1.4				59.4

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Results for 2 year +6% A Critical Storm Duration. Lowest mass balance: 99.66%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	PS1	10	3.490	0.040	2.3	0.0007	0.0000	OK
15 minute winter	PS2	11	3.323	0.061	4.7	0.0098	0.0000	OK
15 minute winter	PS3	11	3.261	0.069	5.8	0.0109	0.0000	OK
15 minute winter	PS4	11	3.165	0.070	5.8	0.0111	0.0000	OK
15 minute winter	PS5	11	3.093	0.071	5.8	0.0113	0.0000	OK
15 minute winter	S1	11	2.867	0.107	19.3	0.1155	0.0000	OK
15 minute winter	S2	11	2.835	0.149	29.5	0.4941	0.0000	OK
15 minute winter	PS6	10	3.663	0.038	2.1	0.0007	0.0000	OK
15 minute winter	PS7	11	3.521	0.052	3.6	0.0083	0.0000	OK
15 minute winter	PS8	11	3.450	0.058	4.7	0.0093	0.0000	OK
15 minute winter	PS9	11	3.366	0.093	10.5	0.0148	0.0000	OK
15 minute winter	PS10	11	3.135	0.122	13.0	0.0195	0.0000	OK
15 minute winter	PS11	12	3.062	0.136	14.7	0.0216	0.0000	OK
15 minute winter	S3	12	2.817	0.197	49.1	0.6202	0.0000	OK
15 minute winter	PS12	10	2.972	0.072	6.2	0.0114	0.0000	OK
15 minute winter	S4	12	2.776	0.217	63.5	0.6541	0.0000	OK
15 minute winter	PS13	10	2.852	0.052	3.5	0.0083	0.0000	OK
15 minute winter	S5	12	2.708	0.251	77.9	1.0086	0.0000	OK
15 minute winter	S6	12	2.634	0.313	75.1	1.5250	0.0000	OK
15 minute winter	S7	10	2.725	0.075	6.8	0.0807	0.0000	OK
15 minute winter	S8	12	2.610	0.304	81.8	0.3287	0.0000	OK
15 minute winter	HW1	11	2.579	0.289	82.7	0.9981	0.0000	OK
720 minute winter	HW2	675	2.411	0.189	9.7	121.6776	0.0000	OK
720 minute winter	S9	675	2.411	0.200	1.5	0.2868	0.0000	OK
15 minute summer	HW3	1	2.205	0.000	1.2	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	PS1	1.000	PS2	2.2	0.432	0.155	0.1482	
15 minute winter	PS2	1.001	PS3	4.7	0.640	0.324	0.0765	
15 minute winter	PS3	1.002	PS4	5.8	0.733	0.403	0.1154	
15 minute winter	PS4	1.003	PS5	5.8	0.715	0.401	0.0890	
15 minute winter	PS5	1.004	S1	5.7	0.738	0.396	0.0432	
15 minute winter	S1	1.005	S2	19.3	0.598	0.173	0.7833	
15 minute winter	S2	1.006	S3	28.6	0.600	0.257	1.0491	
15 minute winter	PS6	2.000	PS7	2.1	0.464	0.142	0.1045	
15 minute winter	PS7	2.001	PS8	3.6	0.603	0.246	0.0681	
15 minute winter	PS8	2.002	PS9	4.7	0.523	0.323	0.1596	
15 minute winter	PS9	2.003	PS10	10.3	0.777	0.714	0.5251	
15 minute winter	PS10	2.004	PS11	12.7	0.790	0.880	0.2088	
15 minute winter	PS11	2.005	S3	14.5	0.933	1.003	0.1437	
15 minute winter	S3	1.007	S4	48.1	0.772	0.432	1.2234	
15 minute winter	PS12	3.000	S4	6.1	0.758	0.421	0.0771	
15 minute winter	S4	1.008	S5	62.2	0.885	0.559	2.3631	
15 minute winter	PS13	4.000	S5	3.4	0.655	0.237	0.0529	
15 minute winter	S5	1.009	S6	75.1	0.865	0.675	3.8534	
15 minute winter	S6	1.010	S8	77.3	0.841	0.695	0.4734	
15 minute winter	S7	5.000	S8	6.6	0.784	0.460	0.1248	
15 minute winter	S8	1.011	HW1	82.7	0.973	0.743	0.4855	
15 minute winter	HW1	1.012	HW2	86.2	2.062	0.775	1.0335	
720 minute winter	HW2	1.013	S9	1.5	0.115	0.013	0.2001	
720 minute winter	S9	Hydro-Brake®	HW3	1.5				63.6

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Results for 30 year +6% A Critical Storm Duration. Lowest mass balance: 99.66%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	PS1	10	3.506	0.056	4.4	0.0010	0.0000	OK
15 minute winter	PS2	11	3.354	0.092	9.1	0.0146	0.0000	OK
15 minute winter	PS3	11	3.297	0.105	11.0	0.0167	0.0000	OK
15 minute winter	PS4	11	3.202	0.107	11.0	0.0171	0.0000	OK
15 minute winter	PS5	11	3.130	0.108	11.0	0.0172	0.0000	OK
15 minute winter	S1	12	3.086	0.326	36.7	0.3525	0.0000	OK
15 minute winter	S2	12	3.072	0.386	53.8	1.3440	0.0000	SURCHARGED
15 minute winter	PS6	13	3.713	0.088	4.0	0.0016	0.0000	OK
15 minute winter	PS7	13	3.707	0.238	6.8	0.0378	0.0000	SURCHARGED
15 minute winter	PS8	12	3.694	0.302	8.0	0.0480	0.0000	SURCHARGED
15 minute winter	PS9	12	3.678	0.405	17.7	0.0643	0.0000	SURCHARGED
15 minute winter	PS10	12	3.402	0.389	19.0	0.0619	0.0000	SURCHARGED
15 minute winter	PS11	12	3.235	0.309	22.2	0.0491	0.0000	SURCHARGED
15 minute winter	S3	12	3.060	0.440	79.0	1.5229	0.0000	SURCHARGED
15 minute winter	PS12	12	3.050	0.150	11.7	0.0239	0.0000	SURCHARGED
15 minute winter	S4	12	3.026	0.467	100.2	1.5858	0.0000	SURCHARGED
15 minute winter	PS13	12	2.927	0.127	6.6	0.0203	0.0000	OK
15 minute winter	S5	12	2.921	0.464	120.6	2.1594	0.0000	SURCHARGED
15 minute winter	S6	11	2.736	0.415	120.2	2.2150	0.0000	SURCHARGED
15 minute winter	S7	10	2.768	0.118	12.8	0.1277	0.0000	OK
15 minute winter	S8	11	2.695	0.389	130.0	0.4202	0.0000	SURCHARGED
15 minute winter	HW1	10	2.651	0.361	130.6	1.2469	0.0000	OK
720 minute winter	HW2	705	2.583	0.361	16.9	242.6670	0.0000	OK
720 minute winter	S9	720	2.583	0.372	2.3	0.5321	0.0000	OK
15 minute summer	HW3	1	2.205	0.000	1.4	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	PS1	1.000	PS2	4.3	0.499	0.296	0.2426	
15 minute winter	PS2	1.001	PS3	8.9	0.726	0.614	0.1279	
15 minute winter	PS3	1.002	PS4	11.0	0.832	0.764	0.1934	
15 minute winter	PS4	1.003	PS5	11.0	0.811	0.759	0.1487	
15 minute winter	PS5	1.004	S1	10.8	0.846	0.747	0.0729	
15 minute summer	S1	1.005	S2	34.0	0.635	0.305	2.2571	
15 minute winter	S2	1.006	S3	46.0	0.628	0.414	2.3388	
15 minute winter	PS6	2.000	PS7	3.9	0.537	0.272	0.3308	
15 minute winter	PS7	2.001	PS8	6.8	0.685	0.472	0.2033	
15 minute winter	PS8	2.002	PS9	9.2	0.581	0.636	0.3151	
15 minute summer	PS9	2.003	PS10	14.1	0.803	0.977	0.6873	
15 minute winter	PS10	2.004	PS11	18.4	1.045	1.273	0.2287	
15 minute winter	PS11	2.005	S3	21.9	1.247	1.517	0.1640	
15 minute winter	S3	1.007	S4	74.9	0.783	0.673	2.1640	
15 minute winter	PS12	3.000	S4	11.5	0.874	0.796	0.1691	
15 minute winter	S4	1.008	S5	96.8	0.922	0.870	3.6101	
15 minute winter	PS13	4.000	S5	6.7	0.750	0.466	0.1691	
15 minute winter	S5	1.009	S6	120.2	1.090	1.080	4.8119	
15 minute winter	S6	1.010	S8	122.0	1.107	1.097	0.5377	
15 minute winter	S7	5.000	S8	12.5	0.876	0.863	0.2365	
15 minute winter	S8	1.011	HW1	130.6	1.234	1.174	0.5717	
15 minute winter	HW1	1.012	HW2	132.8	2.267	1.194	1.2614	
960 minute winter	HW2	1.013	S9	3.0	0.120	0.027	0.3776	
60 minute winter	S9	Hydro-Brake®	HW3	1.5				24.8

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Results for 100 year +6% A Critical Storm Duration. Lowest mass balance: 99.66%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	PS1	10	3.515	0.065	5.7	0.0012	0.0000	OK
15 minute winter	PS2	13	3.487	0.225	11.8	0.0357	0.0000	SURCHARGED
15 minute winter	PS3	13	3.461	0.269	14.2	0.0427	0.0000	SURCHARGED
15 minute winter	PS4	13	3.407	0.312	13.6	0.0497	0.0000	SURCHARGED
15 minute winter	PS5	13	3.361	0.339	13.1	0.0539	0.0000	SURCHARGED
15 minute winter	S1	12	3.341	0.581	43.2	0.6273	0.0000	SURCHARGED
15 minute winter	S2	12	3.332	0.646	62.8	2.8247	0.0000	SURCHARGED
15 minute winter	PS6	13	4.104	0.479	5.5	0.0086	0.0000	FLOOD RISK
15 minute winter	PS7	13	4.096	0.627	10.2	0.0998	0.0000	FLOOD RISK
15 minute winter	PS8	13	4.084	0.692	8.6	0.1100	0.0000	FLOOD RISK
15 minute winter	PS9	13	4.052	0.779	18.8	0.1239	0.0000	FLOOD RISK
15 minute winter	PS10	13	3.727	0.714	21.7	0.1135	0.0000	SURCHARGED
15 minute winter	PS11	13	3.522	0.596	24.3	0.0948	0.0000	SURCHARGED
15 minute winter	S3	12	3.311	0.691	89.5	2.8688	0.0000	SURCHARGED
15 minute winter	PS12	12	3.314	0.414	15.2	0.0658	0.0000	SURCHARGED
15 minute winter	S4	12	3.259	0.700	116.4	2.7672	0.0000	SURCHARGED
15 minute winter	PS13	12	3.138	0.338	8.6	0.0538	0.0000	SURCHARGED
15 minute winter	S5	12	3.121	0.664	146.9	3.6962	0.0000	SURCHARGED
15 minute winter	S6	12	2.843	0.522	144.6	3.1255	0.0000	SURCHARGED
15 minute winter	S7	11	2.899	0.249	16.7	0.2688	0.0000	SURCHARGED
15 minute winter	S8	12	2.774	0.468	158.7	0.5051	0.0000	SURCHARGED
960 minute winter	HW1	930	2.698	0.408	14.0	1.4081	0.0000	SURCHARGED
960 minute winter	HW2	945	2.698	0.476	17.1	328.8086	0.0000	SURCHARGED
960 minute winter	S9	945	2.696	0.485	3.4	0.6937	0.0000	SURCHARGED
15 minute summer	HW3	1	2.205	0.000	1.5	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	PS1	1.000	PS2	5.6	0.522	0.387	0.3389	
15 minute winter	PS2	1.001	PS3	11.3	0.743	0.778	0.1838	
15 minute winter	PS3	1.002	PS4	13.6	0.856	0.941	0.2554	
15 minute winter	PS4	1.003	PS5	13.1	0.828	0.908	0.1934	
15 minute winter	PS5	1.004	S1	14.0	0.903	0.970	0.0979	
15 minute summer	S1	1.005	S2	38.1	0.653	0.342	2.6004	
15 minute winter	S2	1.006	S3	53.4	0.631	0.480	2.3388	
15 minute winter	PS6	2.000	PS7	4.9	0.547	0.337	0.4117	
15 minute winter	PS7	2.001	PS8	8.3	0.689	0.576	0.2033	
15 minute winter	PS8	2.002	PS9	10.9	0.620	0.755	0.3151	
15 minute winter	PS9	2.003	PS10	15.6	0.884	1.077	0.6873	
15 minute winter	PS10	2.004	PS11	19.8	1.127	1.372	0.2287	
15 minute winter	PS11	2.005	S3	23.5	1.335	1.626	0.1640	
15 minute winter	S3	1.007	S4	87.2	0.791	0.784	2.1640	
15 minute winter	PS12	3.000	S4	13.6	0.913	0.943	0.1691	
15 minute winter	S4	1.008	S5	115.1	1.044	1.035	3.6101	
15 minute winter	PS13	4.000	S5	8.0	0.755	0.553	0.1775	
15 minute winter	S5	1.009	S6	144.6	1.311	1.300	4.8119	
15 minute winter	S6	1.010	S8	148.1	1.343	1.331	0.5377	
15 minute winter	S7	5.000	S8	15.8	0.899	1.095	0.2588	
15 minute winter	S8	1.011	HW1	159.4	1.445	1.433	0.5751	
15 minute winter	HW1	1.012	HW2	161.7	2.237	1.453	1.4868	
960 minute summer	HW2	1.013	S9	4.2	0.121	0.038	0.3815	
30 minute winter	S9	Hydro-Brake®	HW3	1.5				23.0

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Results for 100 year +40% CC +6% A Critical Storm Duration. Lowest mass balance: 99.66%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	PS1	12	3.902	0.452	8.0	0.0081	0.0000	FLOOD RISK
15 minute winter	PS2	12	3.850	0.588	15.3	0.0935	0.9641	FLOOD
15 minute winter	PS3	12	3.845	0.653	15.7	0.1038	0.0000	FLOOD RISK
15 minute winter	PS4	12	3.820	0.725	13.7	0.1153	0.0000	FLOOD RISK
15 minute winter	PS5	12	3.803	0.781	14.4	0.1241	0.0000	FLOOD RISK
15 minute winter	S1	12	3.793	1.033	50.8	1.1155	0.0000	FLOOD RISK
15 minute winter	S2	12	3.780	1.094	84.3	5.4475	0.0000	FLOOD RISK
15 minute winter	PS6	10	4.150	0.525	8.2	0.0095	1.0914	FLOOD
15 minute winter	PS7	10	4.150	0.681	13.2	0.1083	0.4641	FLOOD
15 minute winter	PS8	10	4.150	0.758	9.0	0.1205	0.1401	FLOOD
15 minute winter	PS9	10	4.100	0.827	27.3	0.1315	3.6655	FLOOD
15 minute winter	PS10	12	4.025	1.012	23.9	0.1609	0.0000	FLOOD RISK
15 minute winter	PS11	12	3.908	0.982	26.9	0.1561	0.0000	FLOOD RISK
15 minute winter	S3	12	3.746	1.126	107.8	5.2048	0.0000	FLOOD RISK
15 minute winter	PS12	12	3.778	0.878	21.3	0.1396	0.0000	SURCHARGED
15 minute winter	S4	12	3.673	1.114	145.6	4.8580	0.0000	FLOOD RISK
15 minute winter	PS13	12	3.498	0.698	12.0	0.1109	0.0000	SURCHARGED
15 minute winter	S5	13	3.471	1.014	187.0	6.3944	0.0000	FLOOD RISK
15 minute winter	S6	13	3.050	0.729	179.1	5.1815	0.0000	SURCHARGED
15 minute winter	S7	11	3.164	0.514	23.3	0.5556	0.0000	SURCHARGED
15 minute winter	S8	13	2.940	0.634	196.1	0.6850	0.0000	SURCHARGED
1440 minute winter	HW1	1440	2.894	0.604	13.9	2.0838	0.0000	SURCHARGED
1440 minute winter	HW2	1410	2.893	0.671	17.0	485.1115	0.0000	SURCHARGED
1440 minute winter	S9	1380	2.892	0.681	3.9	0.9750	0.0000	SURCHARGED
15 minute summer	HW3	1	2.205	0.000	1.5	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	PS1	1.000	PS2	7.1	0.534	0.493	0.4967	
15 minute summer	PS2	1.001	PS3	12.7	0.747	0.882	0.1838	
15 minute summer	PS3	1.002	PS4	14.9	0.873	1.032	0.2554	
15 minute summer	PS4	1.003	PS5	14.8	0.857	1.023	0.1934	
15 minute winter	PS5	1.004	S1	17.2	0.975	1.187	0.0979	
15 minute winter	S1	1.005	S2	49.3	0.647	0.443	2.6004	
15 minute winter	S2	1.006	S3	68.1	0.641	0.612	2.3388	
15 minute winter	PS6	2.000	PS7	5.2	0.551	0.363	0.4117	
15 minute winter	PS7	2.001	PS8	8.9	0.687	0.616	0.2033	
15 minute winter	PS8	2.002	PS9	11.3	0.646	0.782	0.3151	
60 minute summer	PS9	2.003	PS10	16.3	0.923	1.125	0.6873	
60 minute summer	PS10	2.004	PS11	20.7	1.177	1.433	0.2287	
60 minute summer	PS11	2.005	S3	24.4	1.384	1.686	0.1640	
15 minute winter	S3	1.007	S4	100.7	0.913	0.905	2.1640	
15 minute winter	PS12	3.000	S4	17.7	1.005	1.224	0.1691	
15 minute winter	S4	1.008	S5	139.8	1.268	1.257	3.6101	
15 minute winter	PS13	4.000	S5	9.2	0.757	0.634	0.1775	
15 minute winter	S5	1.009	S6	179.1	1.624	1.610	4.8119	
15 minute winter	S6	1.010	S8	181.0	1.641	1.627	0.5377	
15 minute winter	S7	5.000	S8	21.6	1.225	1.492	0.2588	
15 minute winter	S8	1.011	HW1	196.5	1.781	1.766	0.5751	
15 minute winter	HW1	1.012	HW2	197.7	2.343	1.778	1.8250	
480 minute winter	HW2	1.013	S9	4.0	0.139	0.036	0.3815	
15 minute summer	S9	Hydro-Brake®	HW3	1.5				22.1

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Appendix D – Proposed Drainage Plan



Drainage Key

- Proposed adoptable surface drainage (pipe size/gradient, manhole reference & size)
- Proposed adoptable foul drainage (pipe size/gradient, manhole reference & size)
- Proposed private foul water sewer (pipe size/gradient, manhole reference & size)
- Proposed private surface drainage
- Existing Anglian Water surface sewer with references
- Existing Anglian Water foul sewer with references
- Proposed Anglian Water easement
- FFL 7.700 (7.55) — Finished Floor Level / Proposed Level / (Approx. Existing Level)

Permeable Paving - Private Areas

Providing some additional attenuation in storms of exceedance, and the main water quality improvement method for the properties.

Sub-base to be voided granular and the porous paving will drain into the sub-base, with the porous sub-base being drained by a fin-drain or perforated pipe.

Attenuation Basin

The main method of attenuation, restricting the site to greenfield run-off rates is via. a Hydrobrake which slows the flow and is stored within this basin.

It is intended that this basin will be online, and as the site is generally designed in accordance with a SuDS treatment train it will be adopted by Anglian Water - to be determined at the detailed design phase.

Denotes proposed surface flow routes.

The drainage strategy is preliminary and subject to full detail drainage and level design.

Discharge rate to be agreed with the IDB, and subject to written approval.

The existing Anglian Water foul sewer's invert level is to be confirmed, including the pipe diameter.

The infiltration rate of the existing ground near the entrance section of road - filter drain to utilise infiltration

The infiltration rate of the existing ground near the entrance section of road - filter drain to utilise infiltration

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Drawing must be printed in colour. This text will be red if a coloured drawing.

Notes:

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2. If in doubt - ASK!
3. Any discrepancies are to be reported back to the engineer immediately.
4. This drawing is not to be scaled.
5. All dimensions are in metres unless noted otherwise (pipe diameters are generally shown in milimetres, unless noted otherwise).
5. Drawings marked Preliminary, Information or Tender are for guidance/ approval only, i.e. NOT for Construction.
6. It is likely that existing services will be present within the existing site. Contractor to ensure all necessary precautions have been taken before any excavation takes place.
7. It is the contractors responsibility to locate existing services where they may be affected by proposed works and protect them as necessary and agreed by the utility provider.Drawings to be read in conjunction with all other relevant drawings.
8. Drawings to be read in conjunction with all relevant drawings.
9. Setting out to be in accordance with the Architectural plans.
10. All proprietary items to be installed in strict accordance with the manufacturers instructions and recommendations.
11. All works to be carried out in accordance with the current British Standards, Codes for practice and Building Regulations.
12. Manhole covers are to be D400 in adoptable areas and the main access way, C250 for shared parking areas, B125 for private domestic car parking and A15 for soft landscaped and non-vehicle areas.
13. For private drainage, the pipework does not need concrete pipe protection if the following cover depths are exceeded:
    - 13.1. For PVC - 0.9m in vehicular areas or 0.6m in soft landscaping.
    - 13.2. For clayware or concrete - 1.2m in vehicular areas or 0.6m in soft landscaping.
14. Pipe materials to be the following;
    - 14.1. Clayware to be Class 120
    - 14.2. Concrete to be Class M
    - 14.3. Thermoplastic to have a nominal ring stiffness of SN4.
15. PPIC's deeper than 1.2m are to be fitted with a non-access cover.
16. Unused PPIC connections are to be installed with caps.
17. Excavations near foundations need to be carefully considered. Refer to building regulations, and consult with the structural engineer where appropriate.
18. No work is to be started until all necessary approvals have been obtained.
19. The junctions from RWP's, SVP's and similar connections into main runs are to be determined on site, and in accordance with building regulations.
20. All RWP's, to be fitted with rodding access.
21. For PPIC's the orientation of the main channel is to generally connect upstream and downstream pipes with stated inverts. Non stated inverts such as RE's, R's and F's to generally connect into side inlets.
22. Drainage generally designed to incorporate a side step in preformed bases down into the main channel invert of of 100mm. Details vary dependant on the preformed base and manufacturer selected.
23. Backdrops might be required to ensure that building drainage above foundations are able to enter the PPIC - refer to details.
24. Unless noted, rain water pipes (R's) and below ground foul drainage pipes (F's) to be 100mmØ . R's to have a minimum fall of 1:100, and F's to have a minimum fall of 1:40, unless a WC is connected when the minimum fall shall be 1:80.
25. All RWP's and below ground foul drainage to be set out from the Architect's drawings.
26. Where drainage gradients have been stated, these represent the minimum gradients, and can be steeper - subject to a maximum gradient of 1:10.
27. If the contractor is unsure which manhole/PPIC reference is being used for the actual manhole/PPIC, ask!
28. Cover levels are approximate only and must suit the finished external levels.
29. Threshold drains are to the Architect's details.
30. Rear patios to fall towards soft landscaped areas.
31. If compartments are created in the porous sub-base it is the developers responsibility to ensure a drainage point is added.
32. Porous sub-bases must nominally drain towards the fin drains.

Preliminary
For client approval

Rev	Description	Drn	Ck'd	Date
P01	Site plan updated.	BJ	JCE	03/09/21

Client:
Seagate Homes Ltd

JACKSON CONSULTING ENGINEERS
JCE
Red Lion Quarter
Red Lion Street,
Spalding,
Lincolnshire
PE11 1SX
Tel: 01775 729259
Email: enquiries@j-ce.co.uk
Web: www.j-ce.co.uk

Project Title:
Land of St Margarets,
Quadring, PE11 4PR

Drawing Title:
Drainage General Arrangement

Drawing Status:
Preliminary

Scale: 1:500	Paper size: A1	Date:03/05/2021
Drawn: BJ	Checked: JCE	Approved: JCE

Drawing Number: 077-JCE-00-SI-DR-C-3000
Rev P01



Impermeable Areas

- Area PS1 = 117m^2
- Area PS2 = 132m^2
- Area PS3 = 60m^2
- Area S1 = 744m^2
- Area S2 = 559m^2
- Area S3 = 327m^2
- Area PS6 = 103m^2
- Area PS7 = 84m^2
- Area PS8 = 90m^2
- Area PS9 = 304m^2
- Area PS10 = 145m^2
- Area PS11 = 104m^2
- Area PS12 = 312m^2
- Area S4 = 536m^2
- Area PS13 = 180m^2
- Area S5 = 708m^2
- Area S7 = 343m^2
- Detention Basin = 1011m^2

Total Catchment Area = 5829m^2

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22. Drainage generally designed to incorporate a side step in preformed bases down into the main channel invert of of 100mm. Details vary dependant on the preformed base and manufacturer selected.
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24. Unless noted, rain water pipes (R's) and below ground foul drainage pipes (F's) to be 100mmØ . R's to have a minimum fall of 1:100, and F's to have a minimum fall of 1:40, unless a WC is connected when the minimum fall shall be 1:80.
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26. Where drainage gradients have been stated, these represent the minimum gradients, and can be steeper - subject to a maximum gradient of 1:10.
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32. Porous sub-bases must nominally drain towards the fin drains.

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For client approval

Rev	Description	Drn	Ck'd	Date
P01	Site plan updated.	BJ	JCE	03/09/21

Client:
Seagate homes Ltd.

JACKSON CONSULTING ENGINEERS
JCE
Red Lion Quarter
Red Lion Street,
Spalding,
Lincolnshire
PE11 1SX
Tel: 01775 729259
Email: enquiries@j-ce.co.uk
Web: www.j-ce.co.uk

Project Title:
Land of St Margarets,
Quadring, PE11 4PR

Drawing Title:
Proposed Impermeable Area Plan

Drawing Status:
Preliminary

Scale: 1:500	Paper size: A1	Date:03/05/2021
Drawn: BJ	Checked: JCE	Approved: JCE

Drawing Number: 077-JCE-00-SI-DR-C-3010
Rev P01

Appendix E – Surcharged Outfall Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
PS1	0.012	5.00	4.150	150	0.700
PS2	0.013	5.00	3.850	450	0.588
PS3	0.006	5.00	3.850	450	0.658
PS4			3.900	450	0.805
PS5			4.000	450	0.978
S1	0.074	5.00	4.041	1200	1.281
S2	0.056	5.00	3.953	1200	1.267
PS6	0.011	5.00	4.150	150	0.525
PS7	0.008	5.00	4.150	450	0.681
PS8	0.006	5.00	4.150	450	0.758
PS9	0.031	5.00	4.100	450	0.827
PS10	0.015	5.00	4.100	450	1.087
PS11	0.011	5.00	4.150	450	1.224
S3	0.033	5.00	3.896	1200	1.276
PS12	0.032	5.00	4.100	450	1.200
S4	0.054	5.00	3.838	1200	1.279
PS13	0.018	5.00	4.050	450	1.250
S5	0.071	5.00	3.723	1200	1.266
S6			3.400	1200	1.079
S7	0.035	5.00	3.650	1200	1.000
S8			3.400	1200	1.094
HW1			3.350	2300	1.060
HW2	0.110	5.00	3.350	2300	1.128
S9			3.350	1350	1.139
HW3			3.350	2300	1.145

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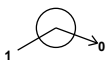
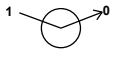
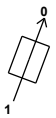
Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Slope (1:X)	Dia (mm)	T of C (mins)
1.000	PS1	PS2	28.212	0.600	3.450	3.262	150.0	150	5.57
1.001	PS2	PS3	10.443	0.600	3.262	3.192	150.0	150	5.79
1.002	PS3	PS4	14.506	0.600	3.192	3.095	150.0	150	6.08
1.003	PS4	PS5	10.986	0.600	3.095	3.022	150.0	150	6.31
1.004	PS5	S1	5.561	0.600	3.022	2.985	150.0	150	6.42
1.005	S1	S2	23.576	0.600	2.760	2.686	320.0	375	6.81
1.006	S2	S3	21.205	0.600	2.686	2.620	320.0	375	7.16
2.000	PS6	PS7	23.388	0.600	3.625	3.469	150.0	150	5.48
2.001	PS7	PS8	11.546	0.600	3.469	3.392	150.0	150	5.71
2.002	PS8	PS9	17.896	0.600	3.392	3.273	150.0	150	6.08
2.003	PS9	PS10	39.040	0.600	3.273	3.013	150.0	150	6.87

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Links (Input)

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Slope (1:X)	Dia (mm)	T of C (mins)
2.004	PS10	PS11	12.991	0.600	3.013	2.926	150.0	150	7.14
2.005	PS11	S3	9.314	0.600	2.926	2.864	150.0	150	7.33
1.007	S3	S4	19.620	0.600	2.620	2.559	320.0	375	7.65
3.000	PS12	S4	9.607	0.600	2.900	2.836	150.0	150	5.20
1.008	S4	S5	32.731	0.600	2.559	2.457	320.0	375	8.19
4.000	PS13	S5	10.084	0.600	2.800	2.733	150.0	150	5.21
1.009	S5	S6	43.627	0.600	2.457	2.321	320.0	375	8.91
1.010	S6	S8	4.875	0.600	2.321	2.306	320.0	375	9.00
5.000	S7	S8	14.700	0.600	2.650	2.552	150.0	150	5.30
1.011	S8	HW1	5.214	0.600	2.306	2.290	320.0	375	9.08
1.012	HW1	HW2	21.809	0.600	2.290	2.222	320.0	375	9.44
1.013	HW2	S9	3.459	0.600	2.222	2.211	320.0	375	9.50
1.014	S9	HW3	1.959	0.600	2.211	2.205	320.0	375	9.53

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Node Type	MH Type	Connections
PS1	522822.725	332977.290	4.150	0.700	150		Manhole	Adoptable	 0
PS2	522796.399	332987.431	3.850	0.588	450		Manhole	Adoptable	 1 0
PS3	522799.880	332997.277	3.850	0.658	450		Manhole	Adoptable	 1 0
PS4	522812.415	333004.578	3.900	0.805	450		Manhole	Adoptable	 1 0
PS5	522822.722	333000.777	4.000	0.978	450		Manhole	Adoptable	 1 0
S1	522827.906	333002.790	4.041	1.281	1200	900	Manhole	Adoptable	 1 0
S2	522836.154	333024.876	3.953	1.267	1200	900	Manhole	Adoptable	 1 0
PS6	522824.570	332976.595	4.150	0.525	150		Manhole	Adoptable	 0

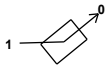
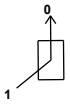
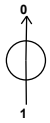
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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Node Type	MH Type	Connections
PS7	522846.533	332968.555	4.150	0.681	450		Manhole	Adoptable	1 0
PS8	522850.654	332979.340	4.150	0.758	450		Manhole	Adoptable	1 0
PS9	522849.404	332997.192	4.100	0.827	450		Manhole	Adoptable	1 0
PS10	522862.859	333033.840	4.100	1.087	450		Manhole	Adoptable	1 0
PS11	522850.961	333039.056	4.150	1.224	450		Manhole	Adoptable	1 0
S3	522843.581	333044.738	3.896	1.276	1200	900	Manhole	Adoptable	1 2 0
PS12	522859.466	333059.563	4.100	1.200	450		Manhole	Adoptable	0
S4	522850.529	333063.087	3.838	1.279	1200	900	Manhole	Adoptable	1 2 0
PS13	522872.174	333093.880	4.050	1.250	450		Manhole	Adoptable	0
S5	522862.091	333093.708	3.723	1.266	1200	900	Manhole	Adoptable	1 2 0
S6	522860.967	333137.321	3.400	1.079	1200	900	Manhole	Adoptable	1 0
S7	522866.614	333123.480	3.650	1.000	1200	900	Manhole	Adoptable	0
S8	522865.770	333138.156	3.400	1.094	1200	900	Manhole	Adoptable	1 2 0

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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Node Type	MH Type	Connections
HW1	522870.982	333138.302	3.350	1.060	2300	1500	Manhole	Adoptable	1  0
HW2	522887.876	333152.095	3.350	1.128	2300	1500	Manhole	Adoptable	1  0
S9	522887.843	333155.554	3.350	1.139	1350		Manhole	Adoptable	1  0
HW3	522887.876	333157.513	3.350	1.145	2300	1500	Manhole	Adoptable	1 

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	0.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
2	0	6	0
30	0	6	0
100	0	6	0
100	40	6	0

Node HW3 Surcharged Outfall

Overrides Design Area	x	Depression Storage Area (m²)	0	Evapo-transpiration (mm/day)	0
Overrides Design Additional Inflow	x	Depression Storage Depth (mm)	0		

Applies to All storms

Time (mins)	Depth (m)	Time (mins)	Depth (m)
0	0.600	20160	0.600

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Node S9 Online Hydro-Brake® Control

Flap Valve	✓	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	2.211	Product Number	CTL-SHE-0061-1500-0800-1500
Design Depth (m)	0.800	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.5	Min Node Diameter (mm)	1200

Node HW2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.222
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	607.0	0.0	1.200	1011.0	0.0

Node S2 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	1.005
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.686	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	6	Diameter (mm)	675

Node S3 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	1.006
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.620	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	6	Diameter (mm)	675

Node S4 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	1.007
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.559	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	6	Diameter (mm)	675

Node S5 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	1.008
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.457	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	5	Diameter (mm)	675

Node S6 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	1.009
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.321	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	4	Diameter (mm)	675

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Results for 1 year Critical Storm Duration. Lowest mass balance: 96.01%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	PS1	10	3.484	0.034	1.7	0.0006	0.0000	OK
15 minute winter	PS2	11	3.313	0.051	3.4	0.0081	0.0000	OK
15 minute winter	PS3	11	3.249	0.057	4.2	0.0091	0.0000	OK
15 minute winter	PS4	11	3.152	0.057	4.2	0.0091	0.0000	OK
15 minute winter	PS5	12	3.081	0.059	4.1	0.0093	0.0000	OK
15 minute winter	S1	11	2.848	0.088	13.9	0.0954	0.0000	OK
15 minute winter	S2	11	2.803	0.117	21.4	0.3800	0.0000	OK
15 minute winter	PS6	10	3.658	0.033	1.6	0.0006	0.0000	OK
15 minute winter	PS7	11	3.514	0.045	2.6	0.0071	0.0000	OK
15 minute winter	PS8	11	3.442	0.050	3.4	0.0079	0.0000	OK
15 minute winter	PS9	11	3.349	0.076	7.6	0.0121	0.0000	OK
15 minute winter	PS10	11	3.107	0.094	9.5	0.0149	0.0000	OK
15 minute winter	PS11	11	3.030	0.104	10.9	0.0166	0.0000	OK
15 minute winter	S3	11	2.779	0.159	36.0	0.5047	0.0000	OK
15 minute winter	PS12	10	2.960	0.060	4.5	0.0095	0.0000	OK
15 minute winter	S4	12	2.735	0.176	46.6	0.5351	0.0000	OK
15 minute winter	PS13	10	2.843	0.043	2.5	0.0069	0.0000	OK
15 minute winter	S5	12	2.651	0.194	56.8	0.7718	0.0000	OK
15 minute winter	S6	12	2.584	0.263	55.7	1.2483	0.0000	OK
15 minute winter	S7	10	2.712	0.062	4.9	0.0666	0.0000	OK
15 minute winter	S8	12	2.567	0.261	60.2	0.2817	0.0000	OK
15 minute winter	HW1	12	2.545	0.255	61.0	0.8807	0.0000	OK
1440 minute winter	HW2	1590	2.445	0.223	4.6	144.7633	0.0000	OK
1440 minute winter	S9	1560	2.445	0.234	0.0	0.3354	0.0000	OK
15 minute summer	HW3	1	2.805	0.600	0.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	PS1	1.000	PS2	1.6	0.403	0.113	0.1167	
15 minute winter	PS2	1.001	PS3	3.4	0.593	0.234	0.0596	
15 minute winter	PS3	1.002	PS4	4.2	0.679	0.289	0.0894	
15 minute winter	PS4	1.003	PS5	4.1	0.662	0.285	0.0686	
15 minute winter	PS5	1.004	S1	4.1	0.679	0.286	0.0339	
15 minute winter	S1	1.005	S2	13.9	0.574	0.125	0.5794	
15 minute winter	S2	1.006	S3	21.0	0.578	0.189	0.7850	
15 minute winter	PS6	2.000	PS7	1.5	0.435	0.107	0.0845	
15 minute winter	PS7	2.001	PS8	2.6	0.562	0.183	0.0545	
15 minute winter	PS8	2.002	PS9	3.4	0.488	0.236	0.1260	
15 minute winter	PS9	2.003	PS10	7.5	0.732	0.520	0.4023	
15 minute winter	PS10	2.004	PS11	9.4	0.759	0.648	0.1602	
15 minute winter	PS11	2.005	S3	10.7	0.860	0.738	0.1158	
15 minute winter	S3	1.007	S4	35.3	0.741	0.318	0.9357	
15 minute winter	PS12	3.000	S4	4.4	0.699	0.305	0.0606	
15 minute winter	S4	1.008	S5	46.0	0.852	0.414	1.7712	
15 minute winter	PS13	4.000	S5	2.5	0.599	0.170	0.0414	
15 minute winter	S5	1.009	S6	55.7	0.829	0.500	3.0518	
15 minute winter	S6	1.010	S8	56.9	0.740	0.512	0.4005	
15 minute winter	S7	5.000	S8	4.8	0.721	0.331	0.0975	
15 minute winter	S8	1.011	HW1	61.0	0.841	0.548	0.4216	
15 minute winter	HW1	1.012	HW2	64.2	1.897	0.577	0.8974	
15 minute winter	HW2	1.013	S9	0.6	0.280	0.006	0.0465	
15 minute summer	S9	Hydro-Brake®	HW3	0.0				0.0

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Results for 2 year +6% A Critical Storm Duration. Lowest mass balance: 96.01%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	PS1	10	3.490	0.040	2.3	0.0007	0.0000	OK
15 minute winter	PS2	11	3.323	0.061	4.7	0.0098	0.0000	OK
15 minute winter	PS3	11	3.261	0.069	5.8	0.0109	0.0000	OK
15 minute winter	PS4	11	3.165	0.070	5.8	0.0111	0.0000	OK
15 minute winter	PS5	11	3.093	0.071	5.8	0.0113	0.0000	OK
15 minute winter	S1	11	2.867	0.107	19.3	0.1155	0.0000	OK
15 minute winter	S2	11	2.835	0.149	29.5	0.4941	0.0000	OK
15 minute winter	PS6	10	3.663	0.038	2.1	0.0007	0.0000	OK
15 minute winter	PS7	11	3.521	0.052	3.6	0.0083	0.0000	OK
15 minute winter	PS8	11	3.450	0.058	4.7	0.0093	0.0000	OK
15 minute winter	PS9	11	3.366	0.093	10.5	0.0148	0.0000	OK
15 minute winter	PS10	11	3.135	0.122	13.0	0.0195	0.0000	OK
15 minute winter	PS11	12	3.062	0.136	14.7	0.0216	0.0000	OK
15 minute winter	S3	12	2.817	0.197	49.1	0.6202	0.0000	OK
15 minute winter	PS12	10	2.972	0.072	6.2	0.0114	0.0000	OK
15 minute winter	S4	12	2.776	0.217	63.5	0.6541	0.0000	OK
15 minute winter	PS13	10	2.852	0.052	3.5	0.0083	0.0000	OK
15 minute winter	S5	12	2.708	0.251	77.9	1.0086	0.0000	OK
15 minute winter	S6	12	2.634	0.313	75.1	1.5249	0.0000	OK
15 minute winter	S7	10	2.725	0.075	6.8	0.0807	0.0000	OK
15 minute winter	S8	12	2.610	0.304	81.8	0.3286	0.0000	OK
15 minute winter	HW1	11	2.579	0.289	82.7	0.9981	0.0000	OK
1440 minute winter	HW2	1650	2.509	0.287	5.6	188.9785	0.0000	OK
1440 minute winter	S9	1470	2.509	0.298	0.0	0.4262	0.0000	OK
15 minute summer	HW3	1	2.805	0.600	0.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	PS1	1.000	PS2	2.2	0.432	0.155	0.1482	
15 minute winter	PS2	1.001	PS3	4.7	0.640	0.324	0.0765	
15 minute winter	PS3	1.002	PS4	5.8	0.733	0.403	0.1154	
15 minute winter	PS4	1.003	PS5	5.8	0.715	0.401	0.0890	
15 minute winter	PS5	1.004	S1	5.7	0.738	0.396	0.0432	
15 minute winter	S1	1.005	S2	19.3	0.598	0.173	0.7833	
15 minute winter	S2	1.006	S3	28.6	0.600	0.257	1.0491	
15 minute winter	PS6	2.000	PS7	2.1	0.464	0.142	0.1045	
15 minute winter	PS7	2.001	PS8	3.6	0.603	0.246	0.0681	
15 minute winter	PS8	2.002	PS9	4.7	0.523	0.323	0.1596	
15 minute winter	PS9	2.003	PS10	10.3	0.777	0.714	0.5251	
15 minute winter	PS10	2.004	PS11	12.7	0.790	0.880	0.2088	
15 minute winter	PS11	2.005	S3	14.5	0.933	1.003	0.1437	
15 minute winter	S3	1.007	S4	48.1	0.772	0.432	1.2234	
15 minute winter	PS12	3.000	S4	6.1	0.758	0.421	0.0771	
15 minute winter	S4	1.008	S5	62.2	0.885	0.559	2.3631	
15 minute winter	PS13	4.000	S5	3.4	0.655	0.237	0.0529	
15 minute winter	S5	1.009	S6	75.1	0.865	0.675	3.8534	
15 minute winter	S6	1.010	S8	77.3	0.841	0.695	0.4734	
15 minute winter	S7	5.000	S8	6.6	0.784	0.460	0.1248	
15 minute winter	S8	1.011	HW1	82.7	0.974	0.743	0.4854	
15 minute winter	HW1	1.012	HW2	86.2	2.062	0.775	1.0335	
15 minute summer	HW2	1.013	S9	0.8	0.300	0.007	0.0603	
15 minute summer	S9	Hydro-Brake®	HW3	0.0				0.0

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Results for 30 year +6% A Critical Storm Duration. Lowest mass balance: 96.01%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	PS1	10	3.506	0.056	4.4	0.0010	0.0000	OK
15 minute winter	PS2	11	3.354	0.092	9.1	0.0146	0.0000	OK
15 minute winter	PS3	11	3.297	0.105	11.0	0.0167	0.0000	OK
15 minute winter	PS4	11	3.202	0.107	11.0	0.0171	0.0000	OK
15 minute winter	PS5	11	3.130	0.108	11.0	0.0172	0.0000	OK
15 minute winter	S1	12	3.086	0.326	36.7	0.3525	0.0000	OK
15 minute winter	S2	12	3.072	0.386	53.8	1.3439	0.0000	SURCHARGED
15 minute winter	PS6	13	3.713	0.088	4.0	0.0016	0.0000	OK
15 minute winter	PS7	13	3.707	0.238	6.8	0.0378	0.0000	SURCHARGED
15 minute winter	PS8	12	3.694	0.302	8.0	0.0480	0.0000	SURCHARGED
15 minute winter	PS9	12	3.678	0.405	17.7	0.0643	0.0000	SURCHARGED
15 minute winter	PS10	12	3.402	0.389	19.0	0.0619	0.0000	SURCHARGED
15 minute winter	PS11	12	3.235	0.309	22.2	0.0491	0.0000	SURCHARGED
15 minute winter	S3	12	3.060	0.440	79.0	1.5227	0.0000	SURCHARGED
15 minute winter	PS12	12	3.050	0.150	11.7	0.0238	0.0000	OK
15 minute winter	S4	12	3.026	0.467	100.2	1.5855	0.0000	SURCHARGED
15 minute winter	PS13	12	2.927	0.127	6.6	0.0202	0.0000	OK
15 minute winter	S5	12	2.921	0.464	120.7	2.1588	0.0000	SURCHARGED
15 minute winter	S6	11	2.736	0.415	120.2	2.2139	0.0000	SURCHARGED
15 minute winter	S7	10	2.768	0.118	12.8	0.1277	0.0000	OK
15 minute winter	S8	11	2.695	0.389	130.0	0.4201	0.0000	SURCHARGED
1440 minute winter	HW1	1530	2.691	0.401	7.9	1.3832	0.0000	SURCHARGED
1440 minute winter	HW2	1500	2.691	0.469	9.6	323.2273	0.0000	SURCHARGED
1440 minute winter	S9	1500	2.691	0.480	0.0	0.6867	0.0000	SURCHARGED
15 minute summer	HW3	1	2.805	0.600	0.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	PS1	1.000	PS2	4.3	0.499	0.296	0.2426	
15 minute winter	PS2	1.001	PS3	8.9	0.726	0.614	0.1279	
15 minute winter	PS3	1.002	PS4	11.0	0.832	0.764	0.1934	
15 minute winter	PS4	1.003	PS5	11.0	0.811	0.759	0.1487	
15 minute winter	PS5	1.004	S1	10.8	0.846	0.747	0.0729	
15 minute summer	S1	1.005	S2	34.0	0.635	0.305	2.2570	
15 minute winter	S2	1.006	S3	46.0	0.628	0.414	2.3388	
15 minute winter	PS6	2.000	PS7	3.9	0.537	0.272	0.3308	
15 minute winter	PS7	2.001	PS8	6.8	0.685	0.472	0.2033	
15 minute winter	PS8	2.002	PS9	9.2	0.581	0.636	0.3151	
15 minute summer	PS9	2.003	PS10	14.1	0.803	0.977	0.6873	
15 minute winter	PS10	2.004	PS11	18.4	1.045	1.273	0.2287	
15 minute winter	PS11	2.005	S3	21.9	1.247	1.517	0.1640	
15 minute winter	S3	1.007	S4	74.9	0.783	0.673	2.1640	
15 minute winter	PS12	3.000	S4	11.5	0.874	0.796	0.1691	
15 minute winter	S4	1.008	S5	96.8	0.922	0.870	3.6101	
15 minute winter	PS13	4.000	S5	6.7	0.750	0.466	0.1691	
15 minute winter	S5	1.009	S6	120.2	1.090	1.080	4.8119	
15 minute winter	S6	1.010	S8	122.0	1.107	1.097	0.5377	
15 minute winter	S7	5.000	S8	12.5	0.876	0.863	0.2364	
15 minute winter	S8	1.011	HW1	130.6	1.235	1.174	0.5717	
15 minute winter	HW1	1.012	HW2	132.8	2.266	1.194	1.2613	
15 minute winter	HW2	1.013	S9	1.3	0.319	0.012	0.1560	
15 minute summer	S9	Hydro-Brake®	HW3	0.0				0.0

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Results for 100 year +6% A Critical Storm Duration. Lowest mass balance: 96.01%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	PS1	10	3.515	0.065	5.7	0.0012	0.0000	OK
15 minute winter	PS2	13	3.487	0.225	11.8	0.0357	0.0000	SURCHARGED
15 minute winter	PS3	13	3.461	0.269	14.2	0.0427	0.0000	SURCHARGED
15 minute winter	PS4	13	3.407	0.312	13.6	0.0497	0.0000	SURCHARGED
15 minute winter	PS5	13	3.361	0.339	13.1	0.0539	0.0000	SURCHARGED
15 minute winter	S1	12	3.341	0.581	43.2	0.6272	0.0000	SURCHARGED
15 minute winter	S2	12	3.332	0.646	62.8	2.8242	0.0000	SURCHARGED
15 minute winter	PS6	13	4.104	0.479	5.5	0.0086	0.0000	FLOOD RISK
15 minute winter	PS7	13	4.096	0.627	10.2	0.0997	0.0000	FLOOD RISK
15 minute winter	PS8	13	4.084	0.692	8.6	0.1100	0.0000	FLOOD RISK
15 minute winter	PS9	13	4.052	0.779	18.8	0.1239	0.0000	FLOOD RISK
15 minute winter	PS10	13	3.727	0.714	21.7	0.1135	0.0000	SURCHARGED
15 minute winter	PS11	13	3.522	0.596	24.3	0.0947	0.0000	SURCHARGED
15 minute winter	S3	12	3.311	0.691	89.5	2.8683	0.0000	SURCHARGED
15 minute winter	PS12	12	3.314	0.414	15.2	0.0658	0.0000	SURCHARGED
15 minute winter	S4	12	3.259	0.700	116.4	2.7666	0.0000	SURCHARGED
15 minute winter	PS13	12	3.138	0.338	8.6	0.0537	0.0000	SURCHARGED
15 minute winter	S5	12	3.121	0.664	146.9	3.6949	0.0000	SURCHARGED
15 minute winter	S6	12	2.842	0.521	144.7	3.1223	0.0000	SURCHARGED
15 minute winter	S7	11	2.899	0.249	16.7	0.2685	0.0000	SURCHARGED
1440 minute winter	S8	1470	2.803	0.497	10.2	0.5363	0.0000	SURCHARGED
1440 minute winter	HW1	1440	2.801	0.511	10.1	1.7633	0.0000	SURCHARGED
1440 minute winter	HW2	1680	2.800	0.578	12.4	409.4141	0.0000	SURCHARGED
1440 minute winter	S9	1620	2.801	0.590	0.1	0.8440	0.0000	SURCHARGED
15 minute summer	HW3	1	2.805	0.600	0.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	PS1	1.000	PS2	5.6	0.522	0.387	0.3389	
15 minute winter	PS2	1.001	PS3	11.3	0.743	0.778	0.1838	
15 minute winter	PS3	1.002	PS4	13.6	0.856	0.941	0.2554	
15 minute winter	PS4	1.003	PS5	13.1	0.828	0.908	0.1934	
15 minute winter	PS5	1.004	S1	14.0	0.903	0.971	0.0979	
15 minute summer	S1	1.005	S2	38.1	0.653	0.342	2.6004	
15 minute winter	S2	1.006	S3	53.4	0.631	0.480	2.3388	
15 minute winter	PS6	2.000	PS7	4.9	0.547	0.337	0.4117	
15 minute winter	PS7	2.001	PS8	8.3	0.689	0.576	0.2033	
15 minute winter	PS8	2.002	PS9	10.9	0.620	0.755	0.3151	
15 minute winter	PS9	2.003	PS10	15.6	0.884	1.077	0.6873	
15 minute winter	PS10	2.004	PS11	19.8	1.127	1.373	0.2287	
15 minute winter	PS11	2.005	S3	23.5	1.335	1.626	0.1640	
15 minute winter	S3	1.007	S4	87.2	0.791	0.784	2.1640	
15 minute winter	PS12	3.000	S4	13.6	0.913	0.943	0.1691	
15 minute winter	S4	1.008	S5	115.2	1.044	1.035	3.6101	
15 minute winter	PS13	4.000	S5	8.0	0.755	0.553	0.1775	
15 minute winter	S5	1.009	S6	144.7	1.312	1.300	4.8119	
15 minute winter	S6	1.010	S8	148.3	1.344	1.333	0.5377	
15 minute winter	S7	5.000	S8	15.8	0.899	1.095	0.2588	
15 minute winter	S8	1.011	HW1	159.3	1.445	1.432	0.5751	
15 minute winter	HW1	1.012	HW2	161.6	2.236	1.453	1.4879	
15 minute winter	HW2	1.013	S9	1.5	0.334	0.014	0.2113	
15 minute summer	S9	Hydro-Brake®	HW3	0.0				0.0

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Results for 100 year +40% CC +6% A Critical Storm Duration. Lowest mass balance: 96.01%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	PS1	12	3.902	0.452	8.0	0.0081	0.0000	FLOOD RISK
15 minute winter	PS2	12	3.850	0.588	15.3	0.0935	0.9614	FLOOD
15 minute winter	PS3	12	3.845	0.653	15.7	0.1038	0.0000	FLOOD RISK
15 minute winter	PS4	12	3.820	0.725	13.7	0.1153	0.0000	FLOOD RISK
15 minute winter	PS5	12	3.803	0.781	14.4	0.1241	0.0000	FLOOD RISK
15 minute winter	S1	12	3.793	1.033	50.8	1.1152	0.0000	FLOOD RISK
15 minute winter	S2	12	3.780	1.094	84.3	5.4456	0.0000	FLOOD RISK
15 minute winter	PS6	10	4.150	0.525	8.2	0.0095	1.0912	FLOOD
15 minute winter	PS7	10	4.150	0.681	13.2	0.1083	0.4642	FLOOD
15 minute winter	PS8	10	4.150	0.758	9.0	0.1205	0.1404	FLOOD
15 minute winter	PS9	10	4.100	0.827	27.3	0.1315	3.6637	FLOOD
15 minute winter	PS10	12	4.025	1.012	23.9	0.1608	0.0000	FLOOD RISK
15 minute winter	PS11	12	3.907	0.981	26.9	0.1560	0.0000	FLOOD RISK
15 minute winter	S3	12	3.745	1.125	107.7	5.2032	0.0000	FLOOD RISK
15 minute winter	PS12	12	3.778	0.878	21.3	0.1396	0.0000	SURCHARGED
15 minute winter	S4	12	3.672	1.113	145.7	4.8561	0.0000	FLOOD RISK
15 minute winter	PS13	12	3.497	0.697	12.0	0.1109	0.0000	SURCHARGED
15 minute winter	S5	13	3.471	1.014	187.1	6.3913	0.0000	FLOOD RISK
15 minute winter	S6	13	3.049	0.728	179.1	5.1768	0.0000	SURCHARGED
15 minute winter	S7	11	3.164	0.514	23.3	0.5552	0.0000	SURCHARGED
1440 minute winter	S8	1350	2.958	0.652	14.2	0.7037	0.0000	SURCHARGED
1440 minute winter	HW1	1380	2.958	0.668	13.6	2.3049	0.0000	SURCHARGED
1440 minute winter	HW2	1410	2.958	0.736	16.8	540.4903	0.0000	SURCHARGED
1440 minute winter	S9	1410	2.958	0.747	3.6	1.0691	0.0000	SURCHARGED
15 minute summer	HW3	1	2.805	0.600	0.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	PS1	1.000	PS2	7.1	0.534	0.493	0.4967	
15 minute summer	PS2	1.001	PS3	12.7	0.747	0.882	0.1838	
15 minute summer	PS3	1.002	PS4	14.9	0.873	1.032	0.2554	
15 minute summer	PS4	1.003	PS5	14.8	0.857	1.023	0.1934	
15 minute winter	PS5	1.004	S1	17.2	0.975	1.187	0.0979	
15 minute winter	S1	1.005	S2	49.3	0.647	0.443	2.6004	
15 minute winter	S2	1.006	S3	68.1	0.641	0.612	2.3388	
15 minute winter	PS6	2.000	PS7	5.2	0.551	0.363	0.4117	
15 minute winter	PS7	2.001	PS8	8.9	0.687	0.616	0.2033	
15 minute winter	PS8	2.002	PS9	11.3	0.646	0.782	0.3151	
60 minute summer	PS9	2.003	PS10	16.3	0.923	1.124	0.6873	
60 minute summer	PS10	2.004	PS11	20.7	1.177	1.433	0.2287	
60 minute summer	PS11	2.005	S3	24.4	1.384	1.686	0.1640	
15 minute winter	S3	1.007	S4	100.7	0.913	0.905	2.1640	
15 minute winter	PS12	3.000	S4	17.7	1.005	1.224	0.1691	
15 minute winter	S4	1.008	S5	139.8	1.268	1.257	3.6101	
15 minute winter	PS13	4.000	S5	9.2	0.757	0.636	0.1775	
15 minute winter	S5	1.009	S6	179.1	1.624	1.610	4.8119	
15 minute winter	S6	1.010	S8	181.0	1.641	1.627	0.5377	
15 minute winter	S7	5.000	S8	21.6	1.226	1.492	0.2588	
15 minute winter	S8	1.011	HW1	196.5	1.782	1.766	0.5751	
15 minute winter	HW1	1.012	HW2	197.7	2.341	1.778	1.8299	
960 minute winter	HW2	1.013	S9	3.9	0.064	0.035	0.3815	
1440 minute winter	S9	Hydro-Brake®	HW3	1.4				62.6

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