



Drainage Strategy 5597_BN5_Woodmancote_07

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water, civils and environment

Site Address: Pear Tree Farm
Furners Lane
Woodmancote
West Sussex
BN5 9HX

UK Experts in Flood Modelling, Flood Risk
Assessments, and Surface Water Drainage Strategies

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Document Issue Record

Project: Drainage Strategy

Prepared for: Ben Kirk

Reference: 5597_BN5_Woodmancote_07

Site Location: Pear Tree Farm, Furners Lane, Woodmancote, West Sussex, BN5 9HX

Issue	Date	Author	Check	Auth.	Comments
1	28/06/2024	Daniel Buciak	James Mahoney	Victoria Walker	First issue
2	30/09/2024	Daniel Buciak	James Mahoney	James Mahoney	Updated in accordance with HDC drainage comments dated 16.09.24.
3	05/11/2024	Daniel Buciak	James Mahoney	James Mahoney	Appendix E and F updated to address discrepancies.
4	13/02/2025	Daniel Buciak	Daniel Buciak	Daniel Buciak	Appendix E updated to address HDC Drainage Comments dated Nov 2024.
5	19/11/2025	Daniel Buciak	Daniel Buciak	Daniel Buciak	Updated in accordance with HDC comments and proposed BNG ditch.

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Summary

Development Description	Existing	Proposed
Development Type	Predominantly greenfield with existing access arrangements, parking and associated buildings/structures	12 no. pitches comprising three sites submitted for planning consent
Impermeable Surface Area	3,000m ²	4,820m ²
Surface Water Drainage	Unrestricted discharge to ordinary watercourse via overland flows.	Runoff attenuated at a restricted rate prior to discharge to ordinary watercourse along the eastern boundary of the development.
Site Size	Approximately 2.0ha	No change
Management Measures	Summary	Comment
Site Drainage Plan	No details of existing drainage arrangements have not been identified; surface water runoff assumed to discharge into ordinary watercourse east of the site.	It is proposed that surface water from roofs and hardstanding areas is attenuated on site within below ground tanks prior to discharge to the ordinary watercourse. Foul flows will be treated through proposed package treatment plants prior to discharging treated flows into ordinary watercourse.

1. Introduction

- 1.1. Aegaea were commissioned by the client to prepare a Drainage Strategy to support development proposals for 12 no. pitches and associated utility buildings for settled gypsy accommodation. The 12 no. pitches comprise three sites that have been submitted for planning consent at Pear Tree Farm, Furners Lane, Woodmancote, West Sussex, BN5 9HX.

Site Overview

- 1.2. The site of the proposed development is Pear Tree Farm, Furners Lane, Woodmancote, West Sussex, BN5 9HX.



Figure 1: Site Location Plan

- 1.3. The overall site boundary for all three sites measures approximately 2.0ha and is currently occupied by existing access arrangements, parking and associated buildings/structures located within the blueline shown in Figure 1 above.
- 1.4. A topographical survey has been undertaken and is contained within Appendix A.
- 1.5. Southern Water are the sewerage undertaker and water provider for the area, however, there are no known assets located within, or in close proximity to, the proposed development site.

Development Proposals

- 1.6. The proposed development comprises 12 no. pitches for settled gypsy accommodation and associated utility buildings. The 12 no. pitches span three separate planning applications.
 1. Application (DC/17/1374) has been granted permission for three pitches in the north-eastern part of the site.
 2. Application (DC/21/1796) has been granted permission for five pitches along the western side of the development.
 3. Application is pending for the four pitches in the south-eastern part of the development site.
- 1.7. The proposed site layouts are included with Appendix B.

2. Surface Water Drainage Strategy

Existing Drainage System

- 2.1. No details of existing drainage arrangements have been identified for site; it is therefore assumed that surface water runoff from existing hardstanding areas follows the existing topography, which directs overland flows towards the watercourse located along the eastern boundary of the site.
- 2.2. The watercourse located along the eastern boundary flows northwards towards the Cutlers Brook, a tributary of the River Adur.

Ground Conditions/Infiltration Tests

- 2.3. Infiltration tests conducted in August 2024 encountered soils with poor permeability located within the site. The soils encountered are therefore unviable for disposing surface water runoff from the proposed development due to their poor permeability. The infiltration tests are contained in Appendix C.

Greenfield Runoff Rates

- 2.4. The greenfield runoff rate has been calculated based on proposed impermeable area of 0.482ha.
- 2.5. The greenfield runoff rate has been calculated as 2.4 l/s using IH124 method via HR Wallingford Greenfield Runoff Estimation Tool as shown in Appendix D. Table 1 below shows a summary of the estimated greenfield runoff rates.

Return Period	Greenfield Runoff Rate
Q_{BAR}	2.8 l/s
1 in 1 Year	2.4 l/s
1 in 30 Year	6.4 l/s
1 in 100 Year	10.4 l/s

Table 1: Greenfield Runoff Rates

- 2.6. The proposed drainage strategy detailed below will restrict runoff rates to ensure they do not exceed those stated in Table 1 above, and hence those contained in the FRA submitted at planning.

Proposed Drainage Strategy

- 2.7. Current guidance indicates that the following surface water disposal options should be considered, listed in order of preference:
- i. **Disposal via on-site infiltration systems:** As discussed above, discharge to the ground has been discounted due to unsuitable ground conditions.
 - ii. **Disposal to a watercourse/surface water body:** Surface water from the proposed development will outfall to the watercourse located along the eastern part of the site.
 - iii. **Disposal to surface water sewer:** Discharge hierarchy satisfied above.
 - iv. **Disposal to combined sewer:** Discharge hierarchy satisfied above
- 2.8. In accordance with the SuDS hierarchy, it is proposed that surface water is to drain to a watercourse located along the eastern boundary of the site. Prior to discharge it is proposed that surface water is to be attenuated on-site using below ground geocellular attenuation tanks.
- 2.9. It is proposed that surface water is to be discharged at a controlled rate of Q_1 2.4 l/s, based off greenfield runoff rates. Flows will be restricted through use of a suitably sized vortex flow control.

- 2.10. All SuDS features have been sized to accommodate surface water runoff from all proposed impermeable areas on site, including all modelled 1 in 100 year storm events with an appropriate allowance (45%) made for climate change.
- 2.11. The proposed drainage layout, catchment plans, exceedance flow routes and details can be found in Appendix E. Supporting drainage calculations can be found in Appendix F.

Proposed Outfall

- 2.12. The outfall pipe to the existing watercourse will be laid via a trenchless construction technique where it passes through the Ancient Woodland buffer zone so as to avoid disturbance of soils.
- 2.13. It is proposed to use a pneumatic hammer (mole) suitable for diameters up to 150mm and for distances up to 30m driven through the soil along a preset line to create a bore for the pipe.
- 2.14. A small entry pit will be excavated outside of the Ancient Woodland buffer zone, a pneumatic mole will be placed in the entry pit, aligned toward the exit. Compressed air will be used to drive an internal piston that repeatedly strikes the tool's head, pushing it through the soil. The drainage pipe is then pushed through the bore.
- 2.15. As the process requires no excavation other than the entry pit (which would be outside the Ancient Woodland buffer zone) it results in minimal surface disturbance and so would avoid any adverse impact on the soils.

3. Future Maintenance Strategy

General Maintenance

- 3.1. The surface water drainage network will be managed throughout the lifetime by the owners of the proposed development in accordance with details set out below.
- 3.2. All drainage, whether piped or SuDS require regular maintenance. The tables below provide an overview of general maintenance tasks and frequency of which they need to be undertaken.

Maintenance Schedule	Required Action	Typical frequency
Regular Maintenance	Inspect for sediment and debris in catchpit manholes and gullies. Clean out as required	Twice Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional Maintenance	Remove sediment and debris in catchpits, gullies, attenuation devices and inside concrete manhole rings.	As required, based on inspections.
Remedial actions	Reconstruct and/or replace components, if performance deteriorates or failure/blockage occurs.	As required
	Replacement of clogged components (flow restriction)	As required
Monitoring	Inspect silt traps/gullies/catchpits and note rate of sediment accumulation.	Monthly in the first year and then annually
	Check attenuation devices	Annually

General maintenance for Surface Water Drainage Systems as per CIRIA C753.

- 3.3. The required maintenance for each component making up the drainage system is scheduled in the tables below, based on CIRIA report C753 – The SuDS manual.

Cellular Attenuation Tank

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings.	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional Maintenance	Remove sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings.	As required, based on inspections.
Remedial actions	Reconstruct tank and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of tank)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation.	Monthly in the first year and then annually
	Check tank to ensure emptying is occurring	Annually

General maintenance for a Cellular Attenuation Tank as per CIRIA C753.

- 3.4. Maintenance will usually be carried out manually, although a suction tanker can be used for sediment/debris removal for large systems. If maintenance is not undertaken for long periods, deposits can become hard packed and require considerable effort to remove.

Hydro-Brake (Vortex Flow Control)

Maintenance Schedule	Required Action	Typical frequency
Regular Maintenance	Remove sediment and debris from flow control chambers and upstream manholes	Monthly (for the first 12 months, then 6 monthly).
Remedial Actions	Replace or clean hydrobrake if performance deteriorates or failure occurs.	As necessary.
Monitoring	Check flow control to ensure emptying is occurring.	Quarterly and post high intensity storm event.

Filter Drains

Maintenance Schedule	Required Action	Typical frequency
Regular Maintenance	Remove 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 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 overlaying filter medium.	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Surface Water Drainage Systems

Maintenance Schedule	Required Action	Typical frequency
Regular Maintenance	Inspect for sediment and debris in catchpit manholes and gullies. Clean out as required	Twice Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional Maintenance	Remove sediment and debris in catchpits, gullies, attenuation devices and inside concrete manhole rings.	As required, based on inspections.
Remedial actions	Reconstruct and/or replace components, if performance deteriorates or failure/blockage occurs.	As required
	Replacement of clogged components (flow restriction)	As required
Monitoring	Inspect silt traps/gullies/catchpits and note rate of sediment accumulation.	Monthly in the first year and then annually
	Check attenuation devices	Annually

Permeable Hardstanding Surface

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Regular raking to ensure even spread and smooth surface, may require additional top up.	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. Alternative methods for weeding should be considered such as hand weeding, hot foam or hot water systems.	As required – once per year on less frequently used pavements
Remedial Maintenance	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.	As required
	Remediate 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
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 hr after large storms in the first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

4. Pollution Prevention & Water Quality Management

SuDS Mitigation Indices

- 4.1. Chapter 26 of the CIRIA C753 The SuDS Manual, provides design advice to meet water quality standards by adopting the SuDS train treatment mechanism and thereby reduce the risk of pollution by evaluating potential pollution hazards at the outset.
- 4.2. The proposed site layout provides the opportunity to introduce SuDS into the scheme to reduce potential contaminant risk further.
- 4.3. Runoff from individual property driveways, residential car parks and low traffic roads are generally viewed as low risk (as per Table 26.2 of C753), shown in the tables below.

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Individual property driveways, residential car parks and low traffic roads	Low	0.5	0.4	0.4

Pollutant Hazard Indices

	Mitigation Indices				Indices for Calculation		
	TSS	Metals	Hydrocarbons		TSS	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7	100%	0.7	0.6	0.7
Filter Drain	0.4	0.4	0.4	50%	0.2	0.2	0.2
Total Mitigation Indices score					0.9	0.8	0.9
Sufficiency of Pollution Mitigation Indices					Sufficient (No additional mitigation required)		

Indicative SuDS Mitigation Indices

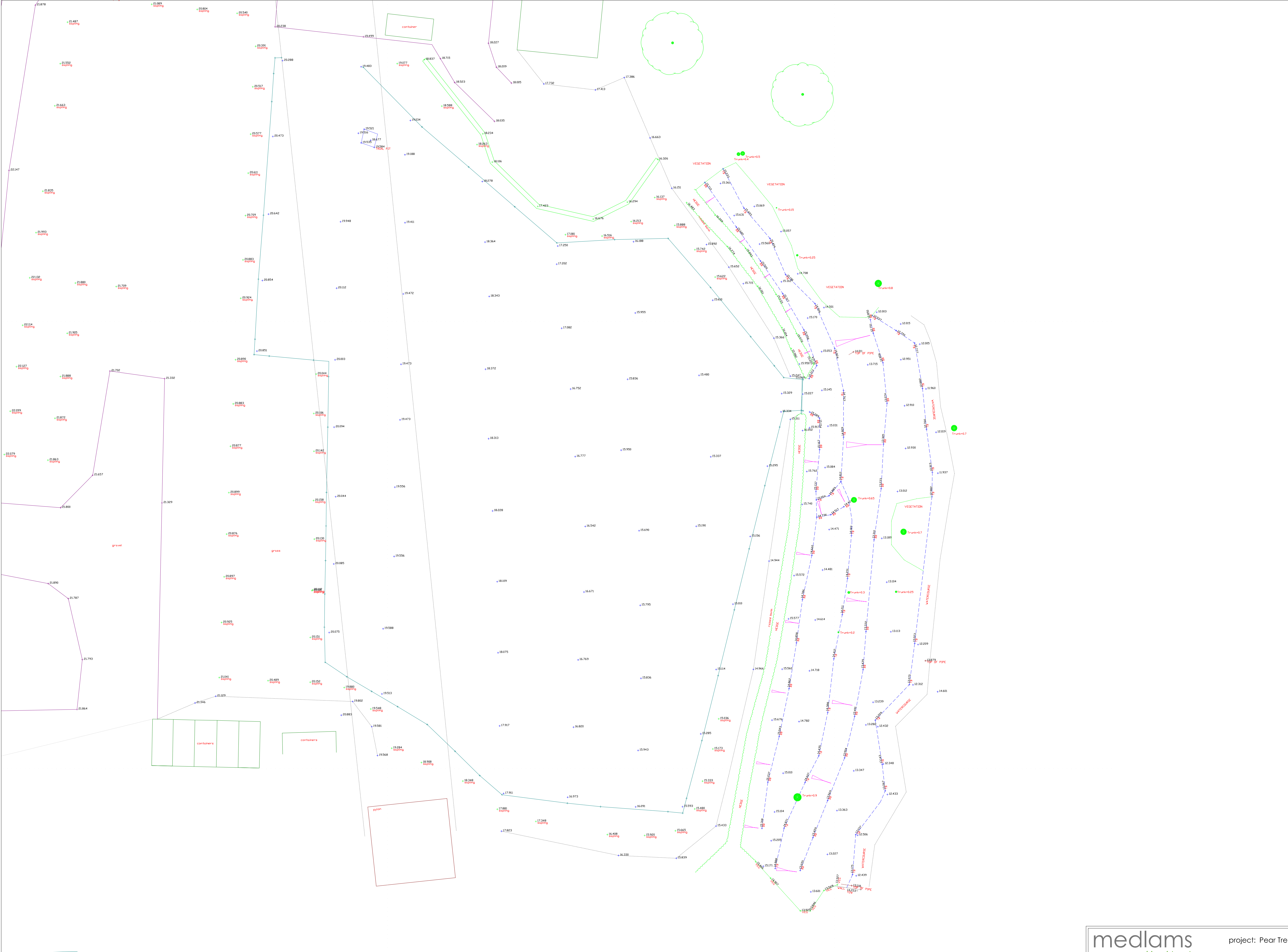
- 4.4. The mitigation indices offered by the proposed permeable pavement exceed the hazard indices from individual property driveways and therefore provides adequate mitigation.
- 4.5. It is therefore considered that the proposed SuDS features on site are appropriate and acceptable in terms of water quality.

5. Foul Drainage Strategy

Proposed Strategy

- 5.1. The proposed development would be served by two separate package treatment plants used to treat the foul flows generated by the development, before ultimately discharging into the watercourse along the eastern boundary.
- 5.2. The package treatment plants are sized based on flows generated in accordance with guidance set out in British Flows and Loads - 4. Each of the proposed pitches contains 2 no. bedrooms, in accordance with Flows and Loads guidance a minimum population (P) of 5 no. people has been assumed per pitch.
- 5.3. The first package treatment plant will serve the 5 no. pitches located along the western boundary and will be required to serve a population equivalent of 25. In accordance with Flows and Loads guidance a reduction factor of 0.9 is applied where the total P is between 13-25. The resulting package treatment plant must therefore be sized to accommodate a minimum population of 23.
- 5.4. The second package treatment plant will serve the remaining 7 no. pitches and will be required to serve a population equivalent of 35. In accordance with Flows and Loads guidance a reduction factor of 0.8 is applied where the total P is between 26-50. The resulting package treatment plant must therefore be sized to accommodate a minimum population of 28.
- 5.5. Full details of discharge should be confirmed at detailed design stage and be agreed with Environment Agency prior to construction. An environmental permit would be required for the foul discharge from the proposed development.

Appendix A - Topographical Survey



NOTES

Survey accurate at time of site attendance. Do not scale from printed drawings except for planning purposes.

Grid is based on ordnance survey national grid fixed by GPS satellite active network.

Levels are related to the ordnance survey GPS active Network and transformed using the OSGM15 & OSTN15 model.

Drainage pipe sizes (where shown) have been gauged from the surface for safety reasons and should be regarded as approximate only.

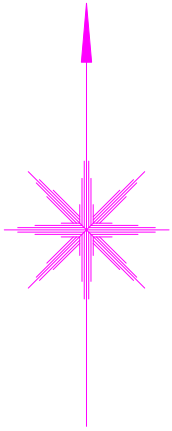
Tree species (where shown) should be treated with caution and expert identification is advised.

Although this is a digital survey the accuracy and amount of detail shown is only commensurate with the graphical scale of mapping as specified. Care should be exercised when working to larger scales.

Visible features in the vicinity of the boundaries as shown above, may not represent the extent of legally conveyed ownership.

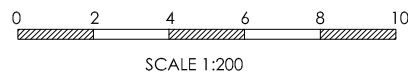
Whilst every effort has been made to achieve accuracy on this plan, CRUCIAL clearance dimensions, levels and invert levels should be checked prior to design and construction.

Areas of dense undergrowth cannot be surveyed in detail, these areas will be shown in outline only and marked as 'dense undergrowth' on the plan.



ABBREVIATIONS (where applicable)

BB	Bottom of Bank	MT	Meter
BRK	Brick	OH	Overhead
BOL	Bollard	PB	Post Box
BT	British Telecom	P/R	Post and Rail
C/B	Close Boarded	P/W	Post and Wire
CL	Cover Level	RWP	Rainwater Pipe
Conc.	Concrete	ROD	Rodding Eye
CATV	Cable Television	RET	Retaining
CP	Control Point	SC	Stopcock
ER	Earthing Rod	SP	Signpost
FB	Flower Bed	SVP	Soil Vent Pipe
FH	Fire Hydrant	TB	Top of Bank
FFL	Finished Floor Level	TK	Tank
G	Gas	TL	Traffic Light
GY	Gully	TP	Telegraph Pole
HT	Height	UTF	Unable to Trace Further
IC	Inspection Cover	UTL	Unable to Lift
IL	Invert Level	VP	Vent Pipe
LP	Lamp Post	WL	Water Level
MH	Manhole Cover	WM	Water Meter



SCALE 1:200

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project: Pear Tree Farm, Furners Lane, Henfield

client: Mr S Tingey job ref: S1986

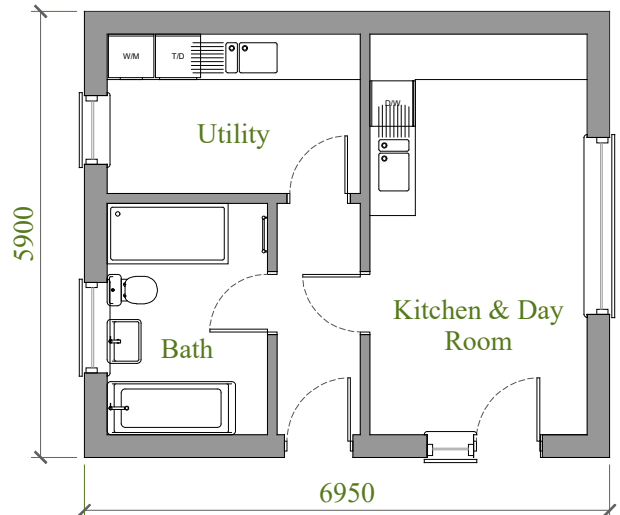
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date AUG 2024 dwg no: EX01 rev:

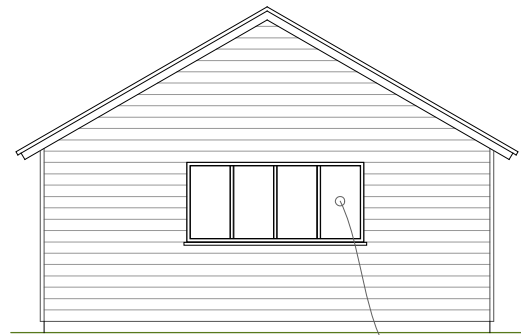
Appendix B - Site Layout



Block Plan
1:500 | PROPOSED



Ground Floor Plan
1:100 | PROPOSED



East
1:100 | PROPOSED

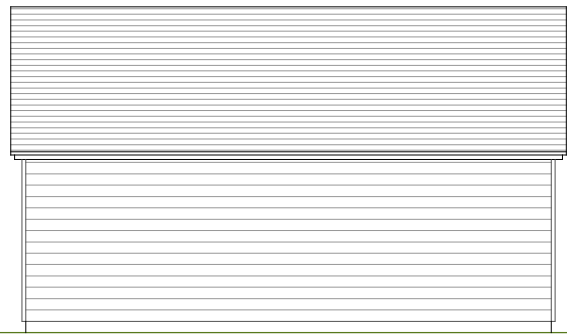
Note: All fenestration to be white PVCu



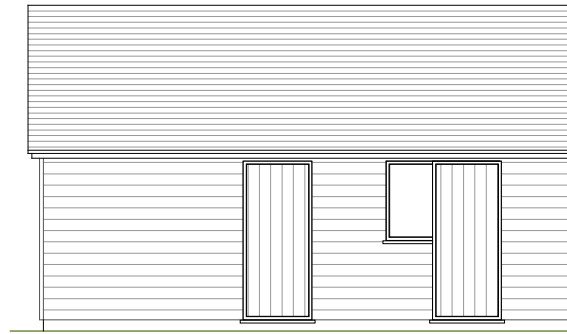
West
1:100 | PROPOSED



Roof Plan
1:100 | PROPOSED



North
1:100 | PROPOSED



South
1:100 | PROPOSED

Planting Specification for new boundary hedgerows

Plants to be between 60-90cm when planted

Main Matrix (Transplants/Quicks)

70% of planting stock
Hawthorn Crataegus monogyna
Blackthorn Prunus spinosa

Interplant (Whips/Transplants)

30% of planting stock
Hazel Corylus avellana
Holly Ilex aquifolium
Dog Rose Rosa canina
Field Maple Acer campestre
Dogwood Cornus sanguinea
Spindle Euonymus europaeus
Wild Privet Ligustrum vulgare

Hedging should be planted in two staggered rows at a density of not less than 5 per metre, with approximately 450mm between plants in the same row, and 300-400mm between rows.

The interplant whips/transplants should be planted within this pattern in groups of 2/3.

Planting will be protected from grazing animals with a 1.5m high galvanised equine stock fence planted 1m away from new plants on the paddock side.

All hedgerow planting should be carried out in accordance with BS4428:1989, Code of practice for general landscape operations.

Hedgerow shrubs should either be notch planted or trench planted.

Hedge trenches should be dug to a minimum depth of 400mm and width of 600mm, with the plants put into the ground at the same depth at which they had been previously grown in the nursery. All plants need to be well heeled in after planting and watered in during dry weather.

Hedges to be planted between November and March while plants are still dormant. Avoid planting in very cold or wet weather.

Native Tree Types:

Alder (Alnus glutinosa)
Alder Buckthorn (Frangula alnus)
Ash (Fraxinus excelsior)
Aspen (Populus tremula)
Beech (Fagus sylvatica)
Silver Birch (Betula pendula)
Blackthorn (Prunus spinosa)
Box (Buxus sempervirens)
Wild Cherry (Prunus avium)
Crab Apple (Malus sylvestris)



Slate Tile

Michelmersh first quality mulit brick



Klargester 'Bio-tec' 4' 25 person unit



Luminite 'Niteguard' PIR wall mounted light. One per Day Room



Electric vehicle charging point



Bird box



Bat box

The following ecological enhancements will be implemented:

Instillation of a bat box to the mobile home or within a tree positioned approx. 3-5m above ground.

Installation of a bird box to the mobile home or within a tree within the site.

Infilling of any gaps within the existing hedgerows with a native species hedge.

Gaps to be included at the bottom of fences to allow for movement of small mammals across the site.

1no Electric Vehicle (EV) charging point will be provided

1no. Covered and secure cycle parking space will be provided

1no. Refuse and recycling storage facility will be provided

This drawing is the copyright of Manorwood Construction Ltd but may be used for planning purposes by the Local Authority without breach of copyright.

Do not scale from this drawing unless for Local Authority planning purposes.

All dimensions must be checked on site prior to commencement of works.

Construction (Design and Management) Regulations 2015

This drawing is intended for Planning purposes only and as such does not highlight residual design related health and safety risks.

This information can be provided on request; however, it is anticipated that the full extent of residual risks will be identified during the detailed Building Regulations or construction design Status and prior to construction works commencing on site.

All responsibilities and duties of Principle Designer as stated within the above regulations now revert to the client unless Manorwood are appointed to undertake Building Regulations or construction drawings.



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Drawing No. 2403PE_R0_000

Scale @ A2 As Indicated

Job No. 2403PE_R0

Drawn By MD

Checked By BK

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Issued On 02.05.2024

Status #####

Drawing #####

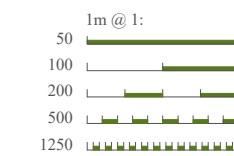
Submission Planning

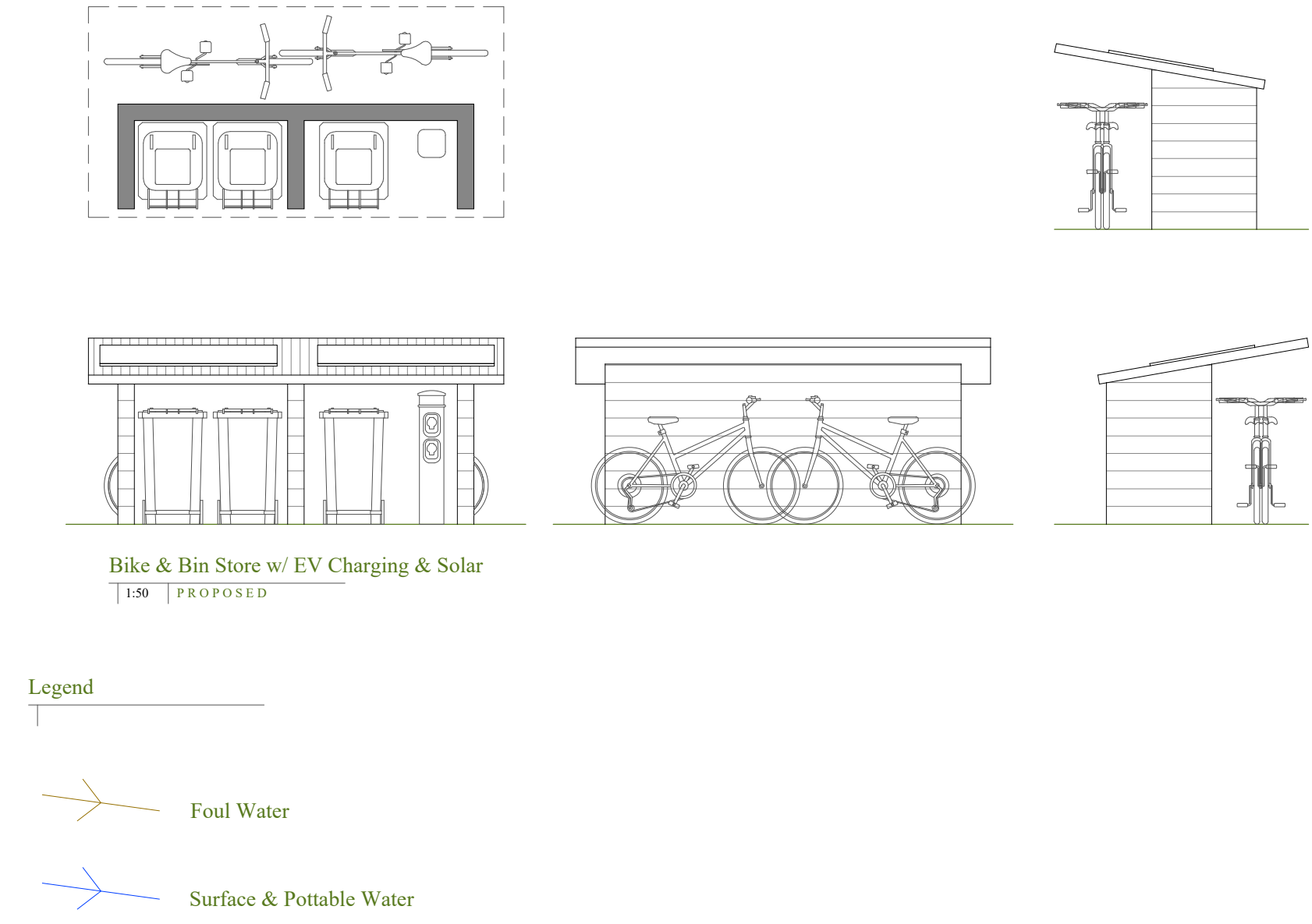
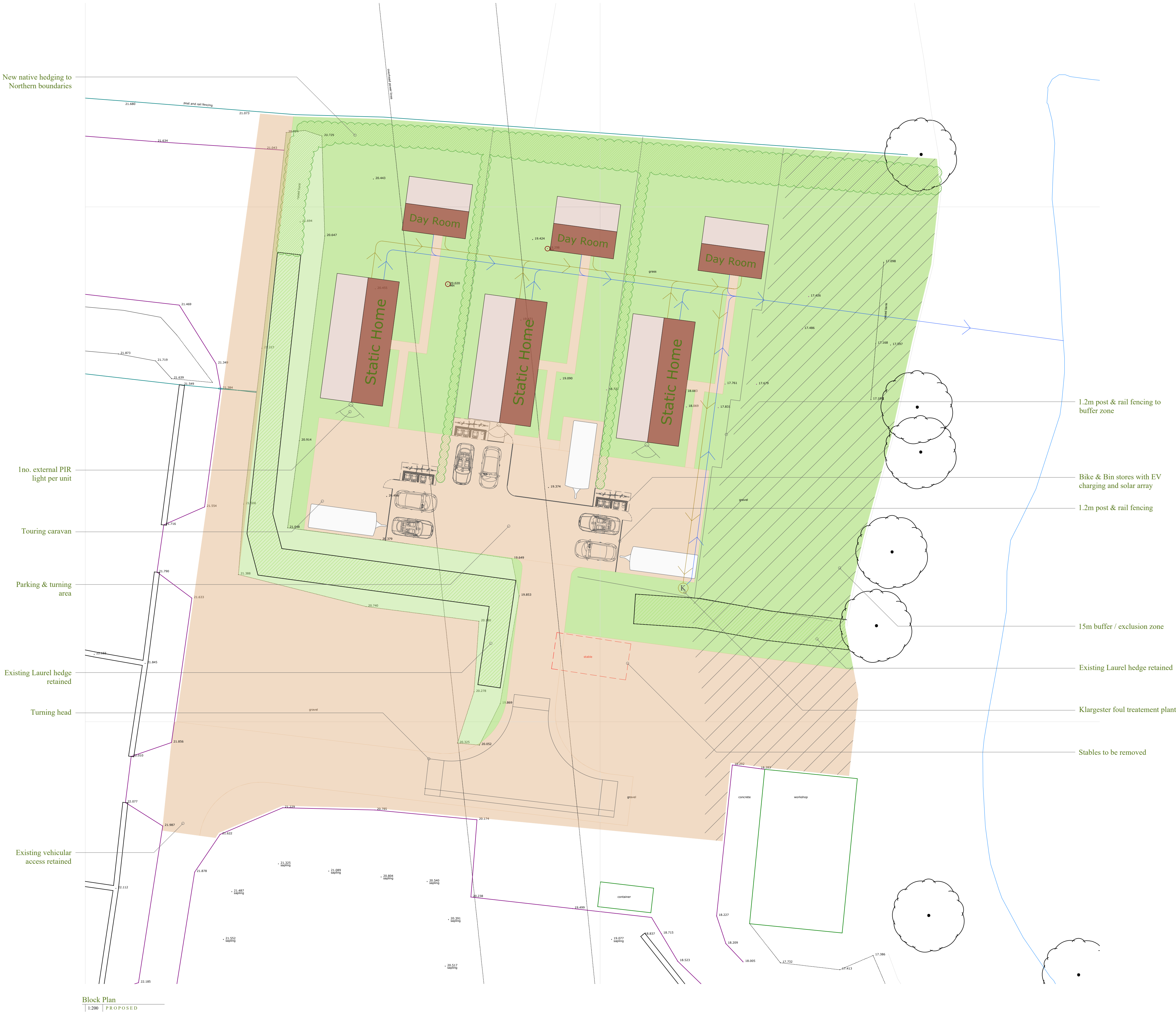
Revision 000

Application Area: 4572m²



Indicative: 0.0°





CONDITION 6:
No development shall take place until a scheme, hereafter referred to as the Site Development Scheme, shall have been submitted to and approved in writing by the local planning authority. The Site Development Scheme shall include a timetable for its implementation and details of:
(a) the means of foul and surface water drainage of the site;
(b) the facilities for, and location of, the storage and collection of refuse and recycling;
(c) external lighting on the boundary of and within the site;
(d) the internal layout of the site (notwithstanding application plan No. PR1 Rev A), including: the siting of caravans and pitches; handstanding; access road; parking; amenity areas; gates, fencing and boundary treatments; vehicle turning space of sufficient size to accommodate a waste/recycling vehicle and that of emergency/fire services;
(e) tree, hedge and shrub planting and where appropriate earth mounding including details of species, plant sizes and proposed numbers and densities.

The approved Site Development Scheme shall be carried out and completed in accordance with the approved timetable. Upon implementation of the approved Site Development Scheme, that scheme shall thereafter be retained.

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Main Matrix (Transplants/Quickies)

70% of planting stock
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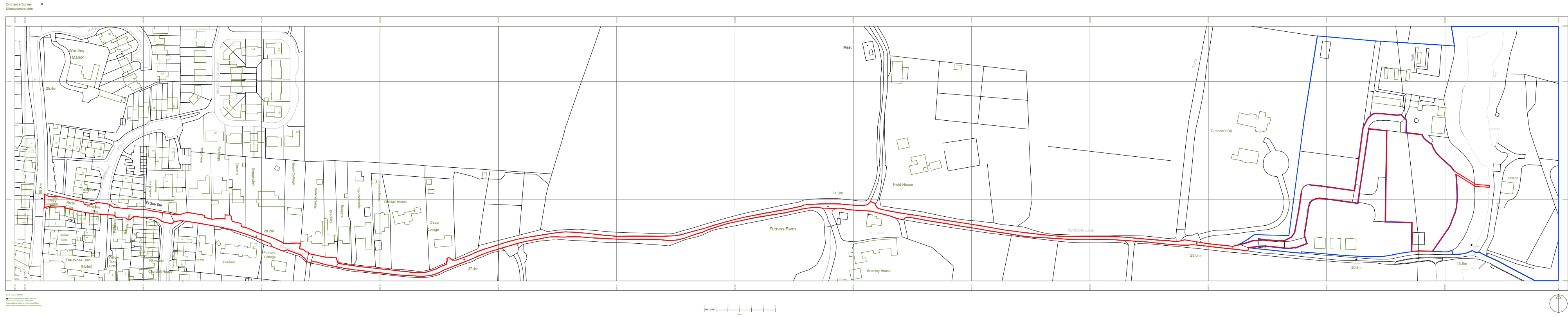
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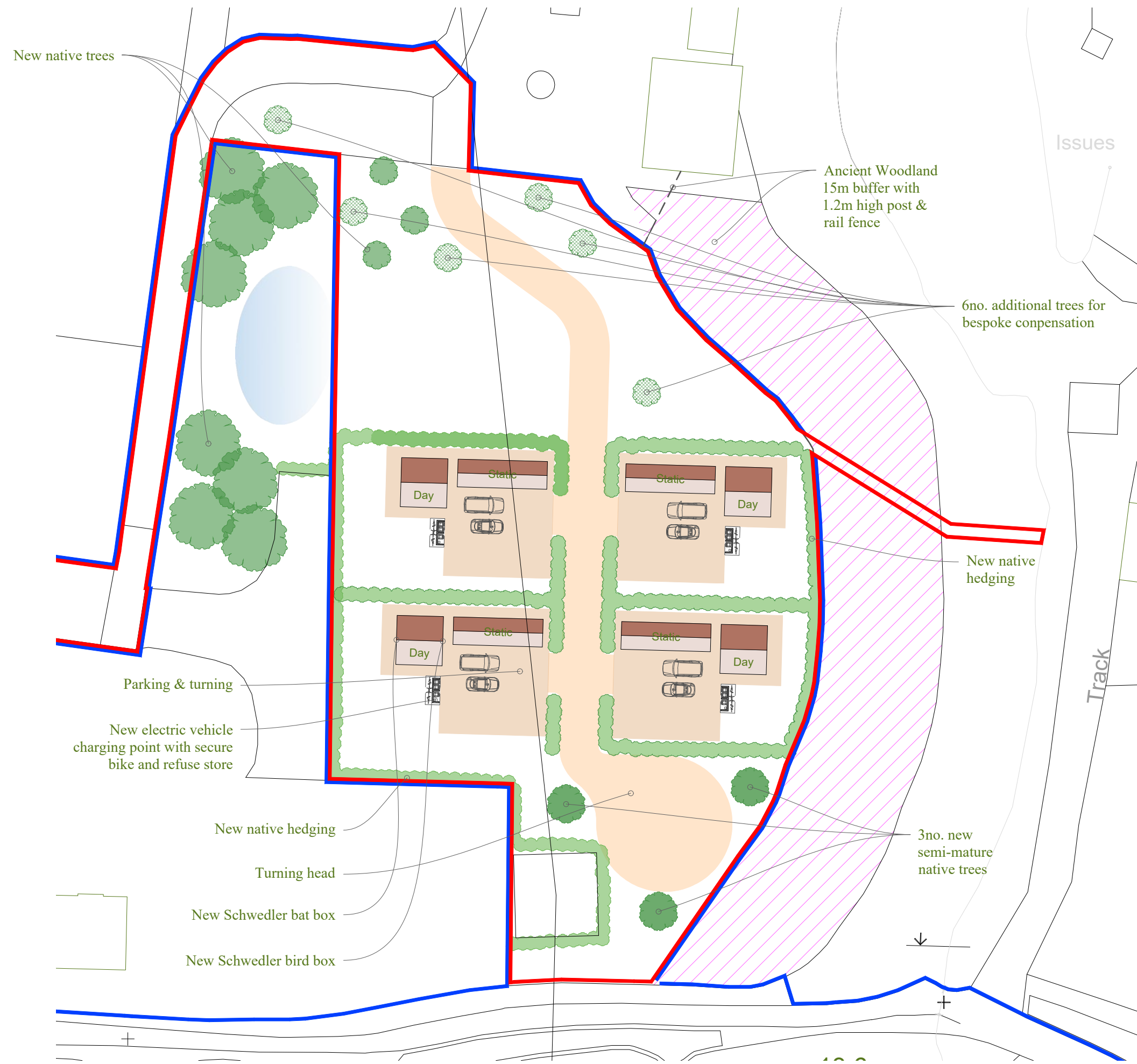
Klargester 'Bio-tec 4' 25 person unit



Luminite 'Niteguard' PIR wall mounted light



Location Plan
1:2500 | EXISTING



Block Plan
1:500 | PROPOSED



Electric vehicle charging point



Bat box



Bird box

The following ecological enhancements will be implemented:

Installation of a bat box to the mobile home or within a tree positioned approx. 3-5m above ground.

Installation of a bird box to the mobile home or within a tree within the site.

Infilling of any gaps within the existing hedgerows with a native species hedge.

Gaps to be included at the bottom of fences to allow for movement of small mammals across the site.

1no. Covered and secure cycle parking space will be provided

1no. Refuse and recycling storage facility will be provided

1no. Philips myGarden Dusk Outdoor Wall Light to be located on day room.

Specs:
Color Temperature: 3000K
Lumens: 500 lm
Motion Sensor: Integrated motion/proximity sensor with adjustable timer (1-2 minutes)
Mounting: Horizontally mounted with no upward tilt and no light output above 90°
IP Rating: Suitable for outdoor use, weather-resistant

Planting Specification for new boundary hedgerows

Plants to be between 80-90cm when planted

Main Matrix (Transplants/Quicks)
70% of planting stock
Hawthorn Crataegus monogyna
Blackthorn Prunus spinosa

Interplant (Whips/Transplants)
30% of planting stock

Hazel Corylus avellana
Holly Ilex aquifolium
Dog Rose Rosa canina
Field Maple Acer campestre
Dogwood Cornus sanguinea
Spindle Euonymus europaeus
Wild Privet Ligustrum vulgare
Common Beach Fagus sylvatica
Common Hornbeam Carpinus betulus
Guelder rose Viburnum opulus

Hedging should be planted in two staggered rows at a density of not less than 5 per metre, with approximately 450mm between plants in the same row, and 300-400mm between rows.

The interplant whips/transplants should be planted within this pattern in groups of 2/3.

Planting will be protected from grazing animals where applicable with a 1.5m high galvanised equine stock fence (or similar) erected 1m away from new plants.

Hedgerow shrubs should either be notch planted or trench planted.

Hedge trenches should be dug to a minimum depth of 400mm and width of 600mm, with the plants put into the ground at the same depth at which they had been previously grown in the nursery. All plants need to be well heeled in after planting and watered in during dry weather.

Hedges to be planted between November and March while plants are still dormant. Avoid planting in very cold or wet weather.

Trees:

Semi-mature native trees to be a mix of:
English Oak Quercus Robur
Hornbeam Carpinus Betulus
Field Maple Acer Campestre

20 year Management Plan:

Plant new hedgerows during winter³
Connect them to other natural features to support wildlife spread¹
Prune new hedgerows for the first 3-5 years to encourage dense, bushy growth¹

Ongoing Management:
Manage hedgerows on a cycle to maintain their health and value for wildlife²
Gradually cut hedges higher and wider to prevent them from becoming 'leggy' or 'gappy'
Rejuvenate hedges through laying or coppicing every 40+ years²

Protection Measures:
Establish or maintain green cover buffer strips adjacent to hedgerows²
Protect hedge nesting birds by avoiding cutting or trimming during their nesting period¹
Hedgerows will be protected from damage by ensuring these measures are in place²

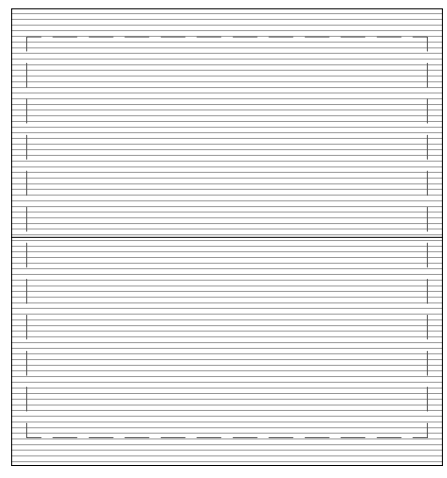
Long-Term Maintenance:
Aim for a balance of old and young hedgerow trees to support diverse wildlife²
Trim at the best time for nature, ideally late winter, to allow wildlife to feed on berries and fruits²

Environmental Benefits:
Hedgerows enhance biodiversity and provide habitat for a wide range of species¹
They offer erosion control, water regulation, and carbon storage to combat climate change¹

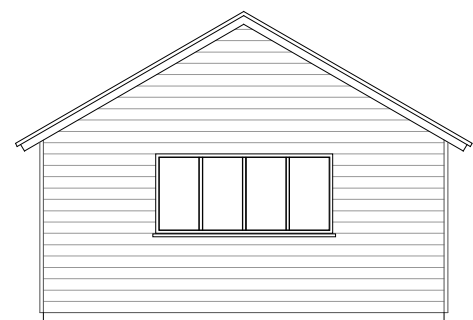
A new hedgerow can store 600 to 800 kilograms of carbon dioxide per year for up to 20 years⁸

By following these guidelines, hedgerows can be effectively managed and protected to ensure their ecological and environmental benefits are sustained over the long term. Consult with local wildlife trusts or experts for tailored advice and to comply with any specific regulations in your area.

Sources:
(1) Hedgerow management - Farming for Nature.
<https://www.farmingfornature.ie/your-farm/resources/best-practice-guides/hedgerow-management/>.
(2) Top tips for managing hedgerows - People's Trust for Endangered Species.
<https://ptes.org/hedgerow/managing-hedgerows-top-tips/>.
(3) The Management of Hedgerows (England) Regulations 2024 - Legislation.gov.uk.
https://www.legislation.gov.uk/ukdsi/2024/9780348260472/pdfs/ukdsiem_9780348260472_en_001.pdf.
(4) How to manage a hedgerow for wildlife | The Wildlife Trusts.
<https://recreation.org/nature/edu/catalog/pubs/0721>.
(5) Hedges of Biodiversity - National Geographic Society.
<https://education.nationalgeographic.org/resource/hedging-biodiversity/>.
(6) How to establish, manage and rejuvenate hedgerows.
<https://www.fvs.co.uk/arable/how-to-establish-manage-and-rejuvenate-hedgerows>.
(7) Hedgerow planting: answers to 18 common questions - The Tree Council.
<https://treecouncil.org.uk/wp-content/uploads/2020/05/Hedgerow-planting.pdf>.
(8) A Guide to Hedgerows: Plantings That Enhance Biodiversity ...
<https://recreation.org/nature/edu/catalog/pubs/0721>.
(9) Hedgerow Regulations L&I: Removing or Working on Hedges - UK Rules.
<https://www.theukrules.co.uk/rules/legal-environment/countryside/hedgerow-regulations/>.
(10) Common Trees in the UK.
<https://www.woodlandtrust.org.uk>
(11) Royal Horticultural Society
<https://rhc.org.uk>



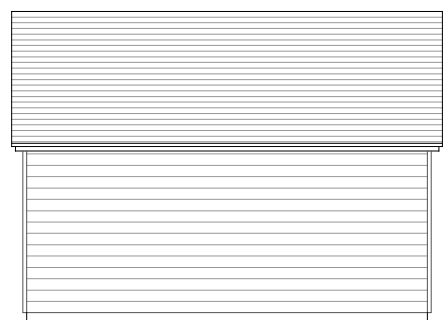
Ground Floor Plan
1:100 | PROPOSED



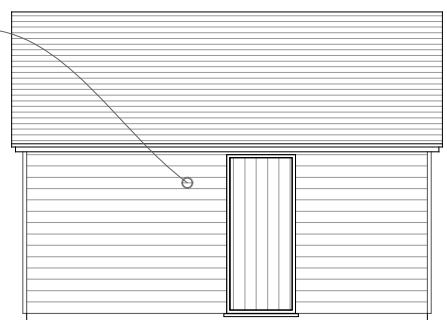
East
1:100 | PROPOSED



West
1:100 | PROPOSED

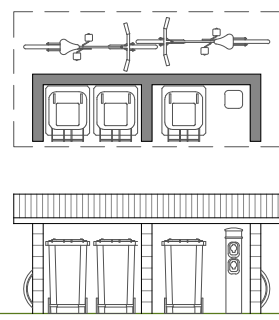


North
1:100 | PROPOSED

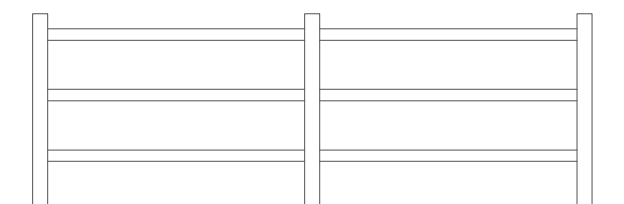
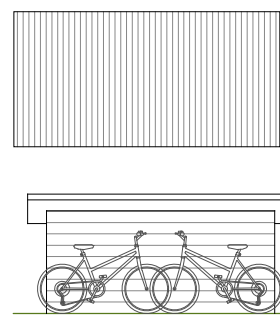


South
1:100 | PROPOSED

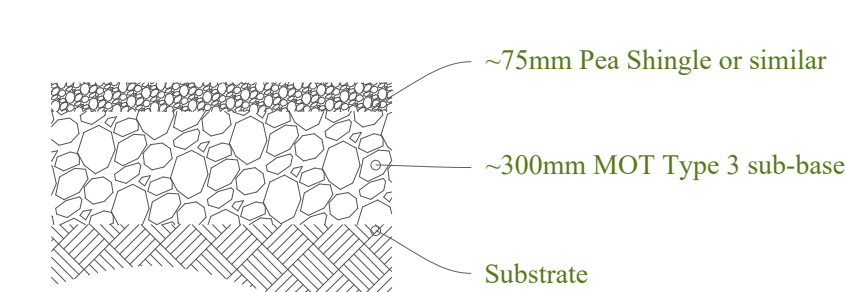
External light with PIR
(refer to spec below)



Bin & Bike Store
1:100 | PROPOSED



Typical 1.2m post & rail fence
1:50 | PROPOSED



Scale Bar
1:20 | PROPOSED

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Do not scale from this drawing unless for Local Authority planning purposes. All dimensions must be checked on site prior to commencement of works.

Construction (Design and Management) Regulations 2015

This drawing is intended for Planning purposes only and as such does not highlight residual design related health and safety risks.

This information can be provided on request; however, it is anticipated that the full extent of residual risks will be identified during the detailed Building Regulations or construction design Status and prior to construction works commencing on site.

All responsibilities and duties of Principle Designer as stated within the above regulations now revert to the client unless Manorwood are appointed to undertake Building Regulations or construction drawings.



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Address

Pear Tree Farm, Farners Lane,
Woodmancote, Henfield, BN5
9BX

Drawing No. 2403PE_R0_000.5

Scale @ A1 As Indicated

Job No. 2403PE_R0

Drawn By MD

Checked By BK

Drawn On 07.11.2025

Issued On 07.11.2025

Status Proposed

Drawing Site Details

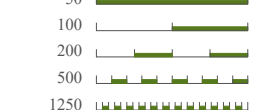
Submission Planning

Revision 005

Application Area: 4572m²



Indicative 0.0°



Appendix C - Soakage Tests

Percolation tests to BRE365

Site location:

Pear Tree Farm
Furners Lane
Woodmancote
West Sussex
BN5 9HX

The test procedure:

Percolation tests were undertaken on 1st August 2024 to establish the suitability of the ground for infiltration.

Two test holes were excavated in accordance with BRE 365 methodology at locations to the north west and south east corners of the site.

The trial hole specifications were 600 mm w x 1000 mm d x 1000 mm l

The trial holes were filled with a water bowser and timed to see how long the water took to percolate through the soil from 75% to 25% of the depth of the test hole, care was taken to avoid abnormal conditions, i.e. heavy rain, severe frost, and drought.

Results:

24 hours after the holes were filled both holes had drained to around 75% depth of the test hole and it was clear that the ground was not suitable for infiltration.

As a result, the tests were aborted.

Appendix D - Greenfield Runoff Rate Calculations

Calculated by: Daniel Buciak

Site name: Pear Tree Farm

Site location: Furners Lane

Site Details

Latitude: 50.93252° N

Longitude: 0.25622° W

Reference: 3659269375

Date: Sep 30 2024 08:52

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.

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.482

Methodology

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

SPR estimation method: Calculate from SOIL type

Notes

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

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

Soil characteristics

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

(2) Are flow rates $< 5.0 \text{ l/s}$?

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.

Hydrological characteristics

	Default	Edited
SAAR (mm):	817	817
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

(3) Is $\text{SPR/SPRHOST} \leq 0.3$?

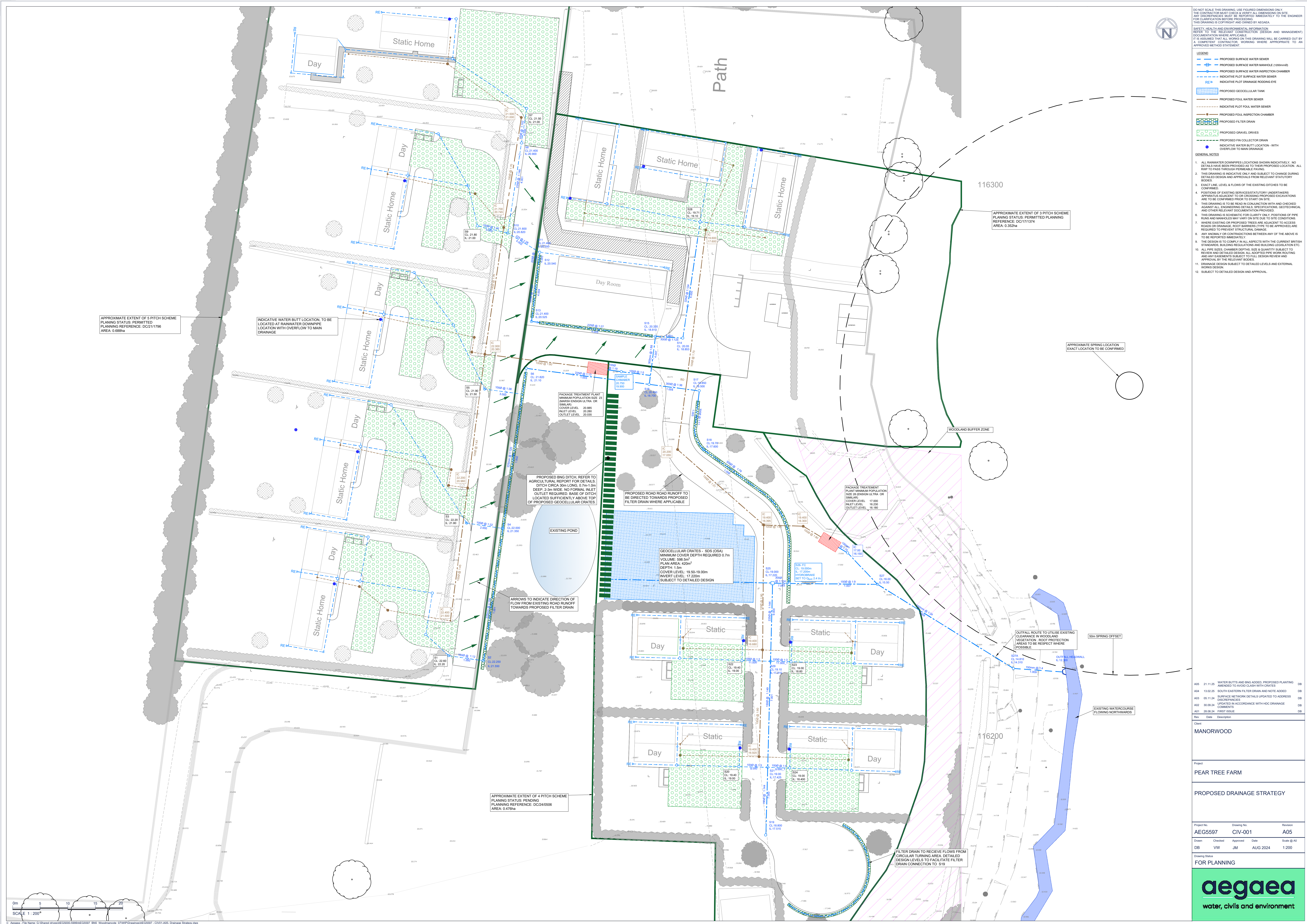
Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
-------------------------	---------	--------

Q_{BAR} (l/s):	2.79	2.79
1 in 1 year (l/s):	2.37	2.37
1 in 30 years (l/s):	6.41	6.41
1 in 100 year (l/s):	8.89	8.89
1 in 200 years (l/s):	10.43	10.43

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 E - Proposed Drainage Strategy



- DO NOT SCALE THIS DRAWING. USE FIGURED DIMENSIONS ONLY. THE CONTRACTOR MUST CHECK & VERIFY ALL DIMENSIONS ON SITE. ANY DISCREPANCIES MUST BE REPORTED IMMEDIATELY TO THE ENGINEER FOR CLARIFICATION BEFORE PROCEEDING. THIS DRAWING IS COPYRIGHT AND OWNED BY AEGAEA.
- SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION:**
REFER TO THE RELEVANT CONSTRUCTION DESIGN AND MANAGEMENT DOCUMENTATION ADJACENT TO OR CROSSING PROPOSED EXCAVATIONS ARE TO BE CONFIRMED PRIOR TO START ON SITE.
IT IS ASSUMED THAT ALL WORKS ON THIS DRAWING WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING WHERE APPROPRIATE TO AN APPROVED METHOD STATEMENT.
- LEGEND**
- PROPOSED SURFACE WATER SEWER
 - PROPOSED SURFACE WATER MANHOLE (1000mm)
 - PROPOSED SURFACE WATER INSPECTION CHAMBER
 - INDICATIVE PLOT SURFACE WATER SEWER
 - INDICATIVE PLOT DRAINAGE RODDING EYE
 - PROPOSED GEOCELLULAR TANK
 - PROPOSED FOLL WATER SEWER
 - INDICATIVE FOLL WATER SEWER
 - PROPOSED FOLL INSPECTION CHAMBER
 - PROPOSED FILTER DRAIN
 - PROPOSED GRAVEL DRIVES
 - PROPOSED FIM COLLECTOR DRAIN
 - INDICATIVE WATER BUTT LOCATION - WITH OVERFLOW TO MAIN DRAINAGE
- GENERAL NOTES**
- ALL RAINWATER DOWNPIPES LOCATIONS SHOWN INDICATIVELY. DETAILS HAVE BEEN PROVIDED AS TO THEIR PROPOSED LOCATION. ALL RWP TO PASS THROUGH PERMEABLE PAVING.
 - THIS DRAWING IS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN AND APPROVALS FROM RELEVANT STATUTORY BODIES.
 - EXACT LINE LEVEL & FLOWS OF THE EXISTING DITCHES TO BE CONFIRMED.
 - POSITIONS OF EXISTING SERVICES/STATUTORY UNDERTAKERS APPARATUS ADJACENT TO OR CROSSING PROPOSED EXCAVATIONS ARE TO BE CONFIRMED PRIOR TO START ON SITE.
 - THIS DRAWING IS TO BE READ IN CONJUNCTION WITH AND CHECKED AGAINST ALL ENGINEERING DETAILS, SPECIFICATIONS, GEOTECHNICAL AND OTHER RELEVANT DOCUMENTATION PROVIDED.
 - THIS DRAWING IS SCHEMATIC FOR CLARITY ONLY. POSITIONS OF PIPE RUNS AND MANHOLES MAY VARY ON SITE DUE TO SITE CONDITIONS.
 - WHERE EXISTING OR PROPOSED TREES ARE ADJACENT TO ACCESS ROADS OR DRAINAGE, ROOT BARRIERS (TYPE TO BE APPROVED) ARE REQUIRED TO PREVENT STRUCTURAL DAMAGE.
 - ANY ANOMALY OR CONTRADICTIONS BETWEEN ANY OF THE ABOVE IS TO BE REPORTED IMMEDIATELY.
 - THE DESIGN IS TO COMPLY IN ALL ASPECTS WITH THE CURRENT BRITISH STANDARDS, BUILDING REGULATIONS AND BUILDING LEGISLATION ETC.
 - ALL PIPE SIZES, CHAMBER DEPTHS, SIZE & QUANTITY SUBJECT TO REVIEW AND DETAILED DESIGN. ALL ADOPTED PIPE WORK ROUTING AND ANY EASEMENTS SUBJECT TO FULL DESIGN REVIEW AND APPROVAL BY THE RELEVANT BODIES.
 - DRAINAGE DESIGN SUBJECT TO DETAILED LEVELS AND EXTERNAL WORKS DESIGN.
 - SUBJECT TO DETAILED DESIGN AND APPROVAL.

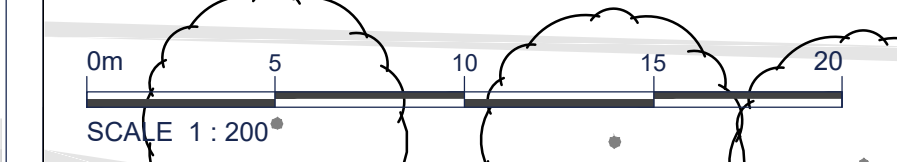
Rev	Date	Description	Rev
A05	21.11.25	WATER BUTTS AND BNG ADDED. PROPOSED PLANTING AMENDED TO AVOID CLASH WITH CRATES	05
A04	13.02.25	SOUTH EASTERN FILTER DRAIN AND NOTE ADDED	06
A03	06.11.24	SURFACE NETWORK DETAILS UPDATED TO ADDRESS DISCREPANCIES	07
A02	30.09.24	UPDATED IN ACCORDANCE WITH HGC DRAINAGE COMMENTS	08
A01	28.08.24	FIRST ISSUE	09

Client: MANORWOOD

Project: PEAR TREE FARM

PROPOSED DRAINAGE STRATEGY

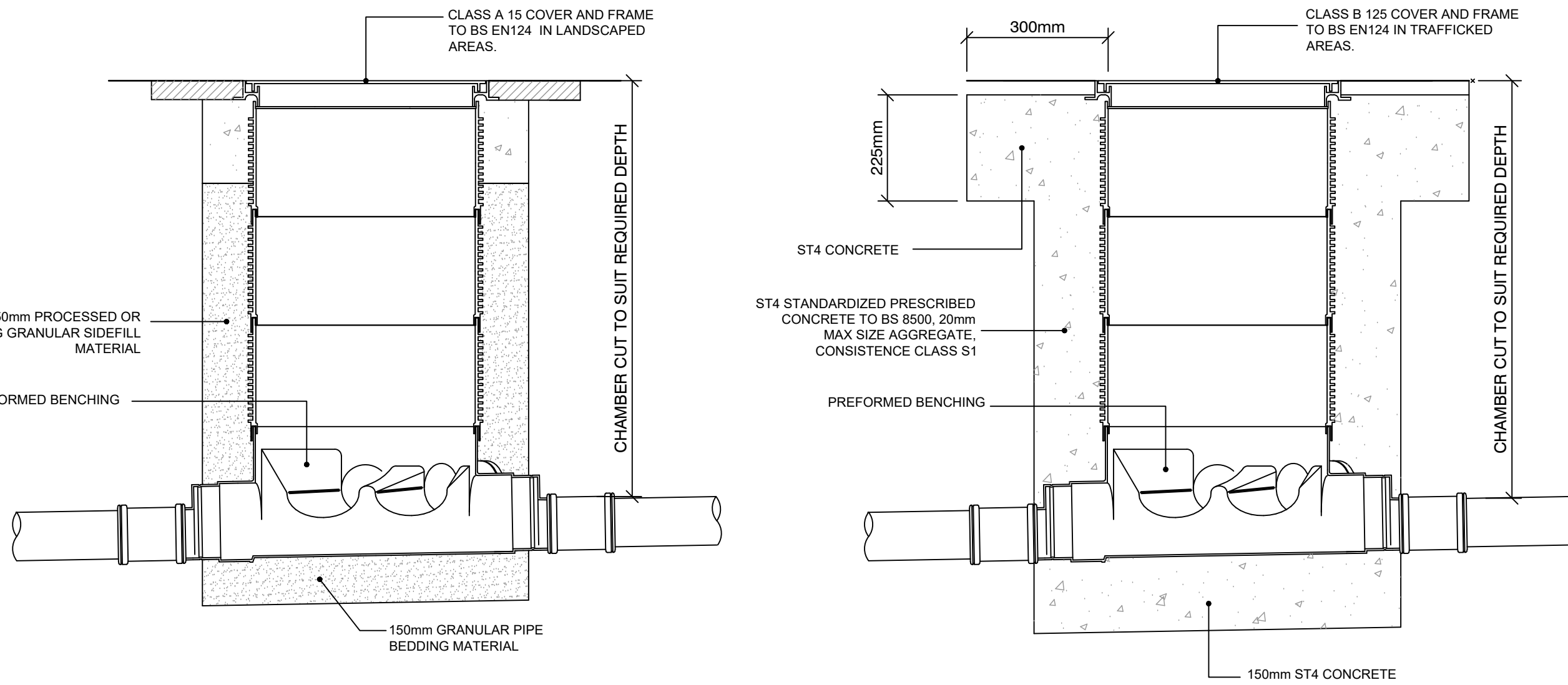
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AEG5597		CIV-001		A05	
Drawn	Checked	Approved	Date	Scale @ A0	
DB	VW	JM	AUG 2024	1:200	
Drawing Status					
FOR PLANNING					



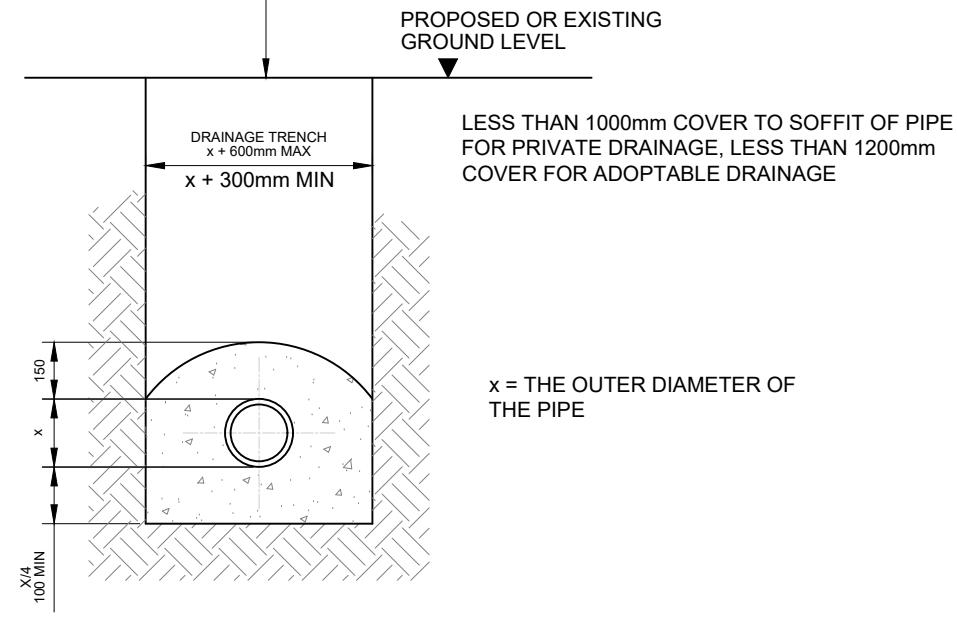
TYPICAL INSPECTION CHAMBER DETAIL

SCALE 1:10

WAVIN OR SIMILAR APPROVED
 MAXIMUM DEPTH TO INVERT 0.6m - SHALLOW INSPECTION CHAMBER (SIC) 250mm DIA. (SEE DETAIL ABOVE)
 MAXIMUM DEPTH TO INVERT 1.2m - UNIVERSAL INSPECTION CHAMBER (UIC) 450mm DIA. (RECTANGULAR INSPECTION CHAMBERS TO HAVE MINIMUM NOMINAL INTERNAL DIMENSIONS OF 450X450mm)
 MAXIMUM DEPTH TO INVERT 3.0m - NON-ENTRY INSPECTION CHAMBER (NIC) 450mm DIA WITH REDUCED OPENING OF 350mm.



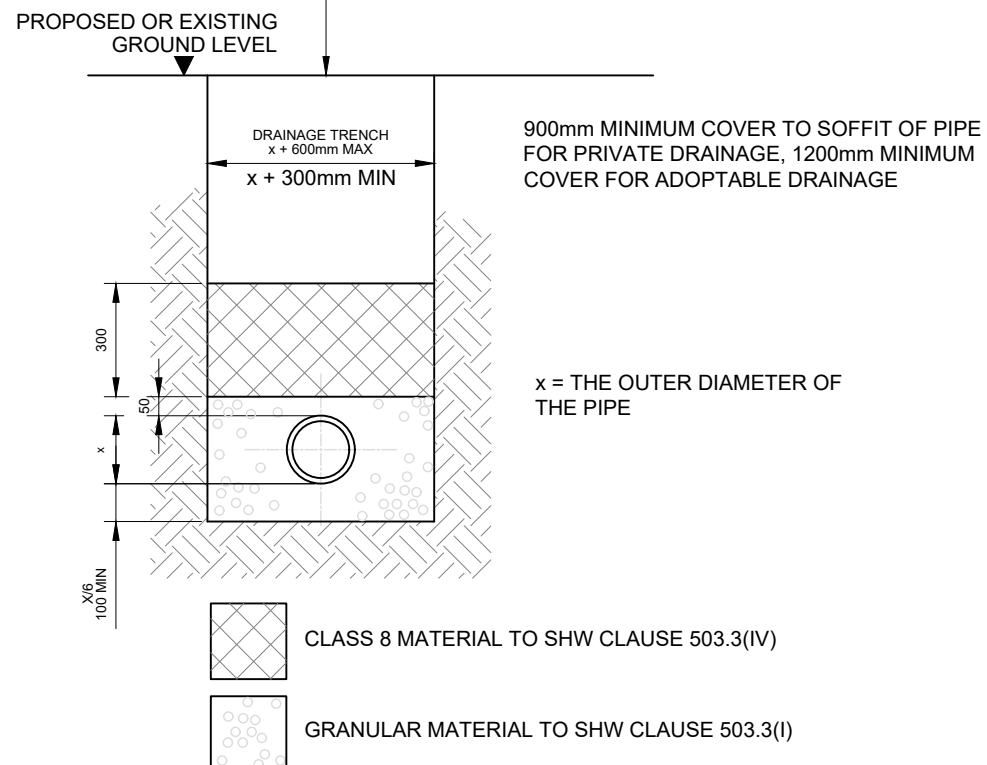
FOR SURFACE FINISH TO DRAINAGE EXCAVATION REFER TO THE EXTERNAL FINISHES PLAN AND THEN RELEVANT HIGHWAY DETAILS. NOTE THAT REINSTATEMENT FOR WORKS IN EXISTING ADOPTED HIGHWAYS ARE TO BE AGREED BY THE CONTRACTOR WITH THE RELEVANT HIGHWAY AUTHORITY.



CONCRETE TO S.H.W CLAUSE 503.3 (II).
 ST4 CONCRETE WITH COMPRESSIBLE FILLER BOARD AT 3m MAXIMUM CENTRES AND ALL PIPE JOINTS. FILLER BOARD SHALL CONSIST OF BITUMEN IMPREGNATED INSULATION BOARD TO B.S. EN 622, AND B.S. EN 317. THICKNESS OF COMPRESSIBLE BOARD AS TABLE ABOVE.
 NOTE: CLASS 'Z' BEDDING FOR USE WITH ALL ADOPTABLE DRAINAGE WITH COVER TO SOFFIT OF PIPE LESS THAN 1200mm.

CLASS 'Z' PIPE BEDDING

FOR SURFACE FINISH TO DRAINAGE EXCAVATION REFER TO THE EXTERNAL FINISHES PLAN AND THEN RELEVANT HIGHWAY DETAILS. NOTE THAT REINSTATEMENT FOR WORKS IN EXISTING ADOPTED HIGHWAYS ARE TO BE AGREED BY THE CONTRACTOR WITH THE RELEVANT HIGHWAY AUTHORITY.

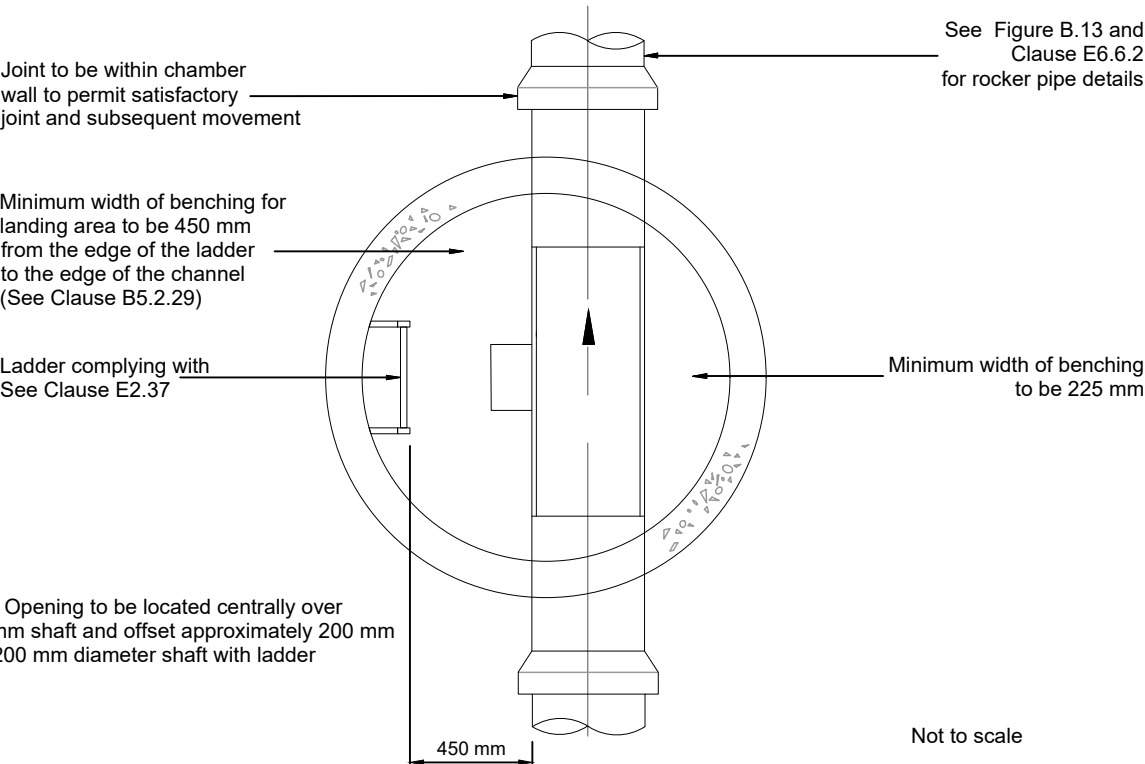
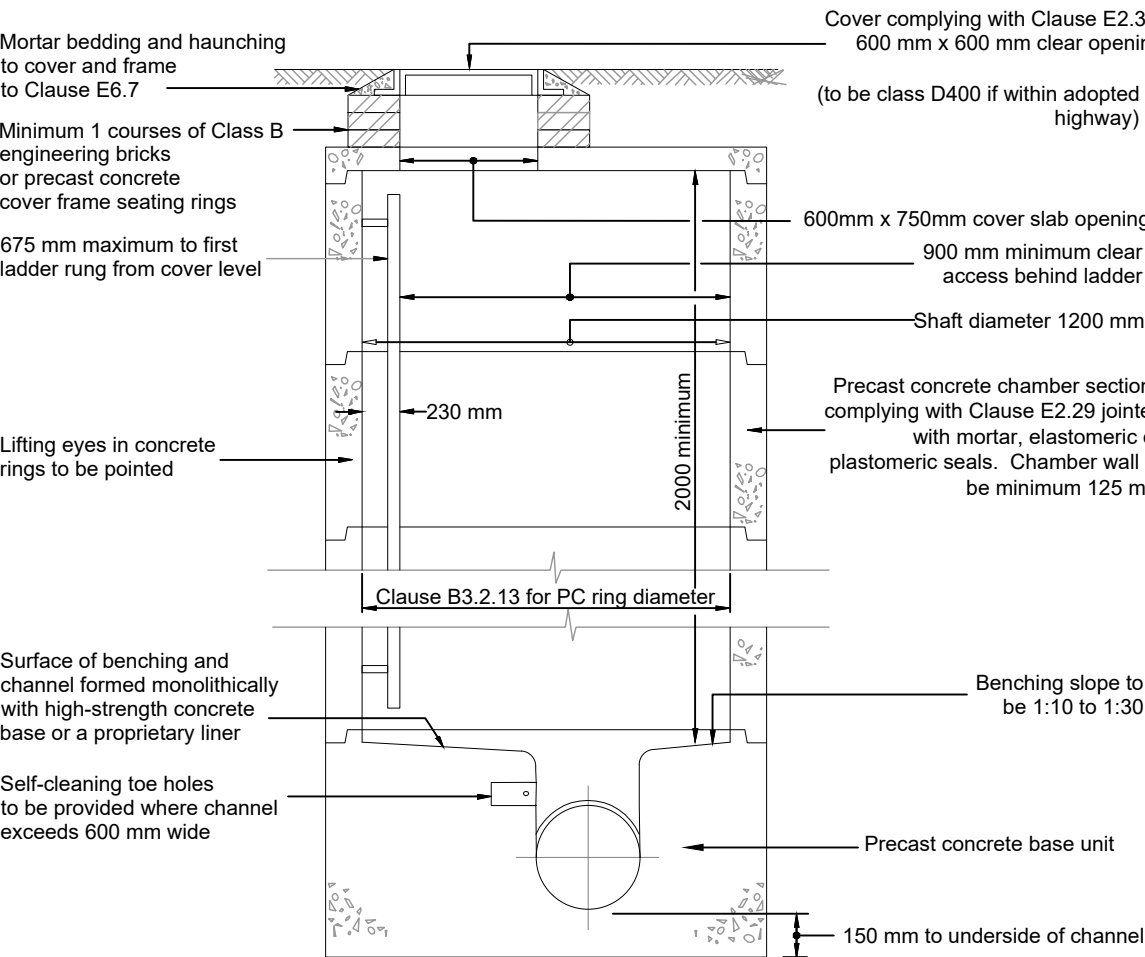


NOTE: CLASS 'S' BEDDING FOR USE WITH ALL ADOPTABLE DRAINAGE WITH COVER TO SOFFIT OF PIPE GREATER THAN 1200mm. PRIVATE DRAINAGE WITHIN LANDSCAPED AND OTHER NON-TRAFFICKED AREAS WITH COVER GREATER THAN 1000mm TO THE PIPE SOFFIT MAY USE PIPE BEDDING CLASS 'T' REFER TO DRAWING F1 (SHW) HIGHWAY CONSTRUCTION DETAILS.

CLASS 'S' PIPE BEDDING

FIGURE B.6 TYPICAL MANHOLE DETAIL - TYPE A2

Depth from cover level to soffit of pipe 3 m to 6 m with ladder rigid material construction without concrete surround



Note: Opening to be located centrally over 900 mm shaft and offset approximately 200 mm for 1200 mm diameter shaft with ladder

See Figure B.13 and Clause E6.6.2 for rocker pipe details

Minimum width of benching for landing area to be 450 mm from the edge of the ladder to the edge of the channel (See Clause B5.2.29)

Ladder complying with See Clause E2.37

Minimum width of benching to be 225 mm

450 mm minimum from edge of stepping

Not to scale

Joint to be within chamber wall to permit satisfactory joint and subsequent movement

Surface of benching and channel formed monolithically with high-strength concrete base or a proprietary liner

Self-cleaning toe holes to be provided where channel exceeds 600 mm wide

Precast concrete base unit

Benching slope to be 1:10 to 1:30

Clause B3.2.13 for PC ring diameter

675 mm maximum to first ladder rung from cover level

Minimum 1 courses of Class B engineering bricks or precast concrete cover frame seating rings

Mortar bedding and haunching to cover and frame to Clause E6.7

Cover complying with Clause E2.32. 600 mm x 600 mm clear opening (to be class D400 if within adopted highway)

600mm x 750mm cover slab opening

900 mm minimum clear access behind ladder

Shaft diameter 1200 mm

Precast concrete chamber sections complying with Clause E2.29 jointed with mortar, elastomeric or plastomeric seals. Chamber wall to be minimum 125 mm

2000 minimum

230 mm

Clause B3.2.13 for PC ring diameter

600mm x 750mm cover slab opening

900 mm minimum clear access behind ladder

Shaft diameter 1200 mm

Precast concrete chamber sections complying with Clause E2.29 jointed with mortar, elastomeric or plastomeric seals. Chamber wall to be minimum 125 mm

2000 minimum

230 mm

Clause B3.2.13 for PC ring diameter

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Shaft diameter 1200 mm

Precast concrete chamber sections complying with Clause E2.29 jointed with mortar, elastomeric or plastomeric seals. Chamber wall to be minimum 125 mm

2000 minimum

230 mm

Clause B3.2.13 for PC ring diameter

600mm x 750mm cover slab opening

900 mm minimum clear access behind ladder

Shaft diameter 1200 mm

Precast concrete chamber sections complying with Clause E2.29 jointed with mortar, elastomeric or plastomeric seals. Chamber wall to be minimum 125 mm

2000 minimum

230 mm

Clause B3.2.13 for PC ring diameter

600mm x 750mm cover slab opening

900 mm minimum clear access behind ladder

Shaft diameter 1200 mm

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2000 minimum

230 mm

Clause B3.2.13 for PC ring diameter

600mm x 750mm cover slab opening

900 mm minimum clear access behind ladder

Shaft diameter 1200 mm

Precast concrete chamber sections complying with Clause E2.29 jointed with mortar, elastomeric or plastomeric seals. Chamber wall to be minimum 125 mm

2000 minimum

230 mm

Clause B3.2.13 for PC ring diameter

600mm x 750mm cover slab opening

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Precast concrete chamber sections complying with Clause E2.29 jointed with mortar, elastomeric or plastomeric seals. Chamber wall to be minimum 125 mm

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Clause B3.2.13 for PC ring diameter

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900 mm minimum clear access behind ladder

Shaft diameter 1200 mm

Precast concrete chamber sections complying with Clause E2.29 jointed with mortar, elastomeric or plastomeric seals. Chamber wall to be minimum 125 mm

2000 minimum

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Clause B3.2.13 for PC ring diameter

600mm x 750mm cover slab opening

900 mm minimum clear access behind ladder

Shaft diameter 1200 mm

Precast concrete chamber sections complying with Clause E2.29 jointed with mortar, elastomeric or plastomeric seals. Chamber wall



A01	30.09.24	FIRST ISSUE	
Rev	Date	Description	
Client MANORWOOD			
Project PEAR TREE FARM			
CONTRIBUTING AREAS & EXCEEDANCE FLUV ROUTES PLAN			
Project No. AE65597		Drawing No. CIV-003	Revision A01
Drawn DB	Checked VW	Approved JM	Date SEP 2024
			Scale @ A0 1:200
Drawing Status FOR PLANNING			
 aegaea water, civils and environment			





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APPROVED METHOD STATEMENT.

LEGEND

EXISTING GRAVEL SURFACE

EXISTING BUILDING EXTENT



Rev Date Description

01 30.09.24 FIRST ISSUE

Client

MANORWOOD

Project

PEAR TREE FARM

EXISTING AREAS PLAN

Project No. Drawing No. Revision

AEG5597 CIV-004 A01

Drawn Checked Approved Date Scale @ A0

DB VW JM SEP 2024 1:200

Drawing Status

FOR PLANNING

aegaea

water, civils and environment

SDS Structural Design Calculations

1no 1.5m Deep Tank

27/09/2024

Version 1

1 Introduction

This is a report showing the structural analysis of a geocellular modular drainage tank. Tank loading is calculated using DIN 1072 loading classification 9/9 for vehicles up to 9000kg

Assumptions:

- Pressure from point load of tyre disperses at an angle of 26.6°.
- Shear angle of resistance taken as 38°.
- Soil/ fill density of 20kNm³.
- Cover depth of 0.70m
- Groundwater level 1m below surface

2 Design information

Calculations are based on the following design information:

Site Levels and tank dimensions	<i>Email – 27/09/24 - Floatation and Structural Enquiry</i>
Loading	<i>CIRIA C680 – Table 4.2 Characteristic loads for different land use 2008</i>
Factors	<i>CIRIA C680 – Table 4.5 Partial load factors (based on EN 1997-1:2004) 2008</i>

3 Design equations

3.1 Vertical pressure equations:

Vertical loading takes account of permanent loading from cover backfill c according to (3.1), variable load from vehicles etc (surcharge) q and accidental loading from HGVs (point) w . Pressure from HGV assumes a 26.6° distribution, from point of application. Load due to depth of cover over tank is given by equation (3.1)

$$c = \gamma.z \quad (3.1)$$

where γ is soil density and z the cover depth. Therefore design vertical pressure given by:

$$\sigma_{v,d} = c.\lambda + q.\lambda + w.\lambda \quad (3.2)$$

where λ are appropriate the load factors.

3.2 Lateral pressure equations:

Lateral pressures calculated using the coefficient of lateral earth pressure and vertical pressure resulting from permanent backfill and variable surcharge. Maximum pressure taken at 200mm above the base of tank.

$$\sigma_{h,d} = \{K_a(q + \gamma h)\} \times \lambda \quad (3.3)$$

where K_a is the coefficient of lateral earth pressure given by equation (3.4), h is the reference depth at which the lateral pressure is ascertained. Again λ is the factor of safety.

$$K_a = \frac{1 - \sin \phi}{1 + \sin \phi} \quad (3.4)$$

where ϕ is the angle of shear resistance.

3.3 Uplift pressure equations:

If the tank is located below the water table, uplift can occur, whereby the uplift pressure equals to the weight of water displaced.

Case1: Water table level between top and bottom of tank, i.e. depth of ground water table greater than depth of cover. Thus uplift U given by equation (3.5)

$$U = D_{dw} \times \gamma_w \quad (3.5)$$

where D_{dw} is depth of water displaced and γ_w the unit weight of water.

Case2: Water table level above tank, i.e. depth of ground water table less than or equal to the depth of cover. In this case design uplift U_d is given by equation (3.6)

$$U_d = H \times \gamma_w \times \lambda \quad (3.6)$$

where H is the height of the tank

The uplift force is resisted by the weight of soil overlying the tank, neglecting the weight of tank. Thus vertical resisting pressure calculated from equation (3.7)

$$\sigma_{v,r} = \gamma \times z \quad (3.7)$$

Note that when case 2 is in effect, the unit weight of backfill must be considered separately as normal and saturated soils. For the saturated soil, and effective unit weight must be used and derived from equation (3.8)

$$\gamma' = \gamma - \gamma_w \quad (3.8)$$

4 Design calculation spreadsheets

Site Elevations (m)		
Ground Level AOD	Max	2.200
	Min	2.200
Tank Level	Top	1.500
	Bottom	0.000
Cover Depth, z	Max, $z_{\max}$	0.700
	Min, $z_{\min}$	0.700
Ground water table depth AOD	z_w	1.200

Soil/Fill Characteristics	
γ (kNm^{-3})	20.00
ϕ ($^\circ$)	38.00

VERTICAL

Area Due To Spread Of Point Load, A (m^2)		
Spread angle (degrees)		26.60
A ($z_{\max}$)		0.87
A ($z_{\min}$)		0.87

Load Area (m.m)	
0.20	0.26

Loading Case (Din 1072)	9/9.	
Surcharge, q	5.00	kNm^{-2}
Cover Fill, c Max/Min [$\gamma \cdot z$]	14.00	kNm^{-2}
	14.00	kNm^{-2}
Point, w	30.00	kN

Factors, λ	
Surcharge	1.50
Cover	1.35
Point	1.50

Factored Vertical Loading, (kNm^{-2})	
Surcharge [$q_d = q \cdot \lambda$]	7.50
Cover [$c_d = c \cdot \lambda$]	18.90
	18.90
Point [$w_d = (w/A) \cdot \lambda$]	51.96
	51.96

Design Vertical Loading, $\sigma_{v,d}$		
$\sigma_{v,d}(z_{\max})$	78.4	kNm^{-2}
$\sigma_{v,d}(z_{\min})$	78.4	

LATERAL

Reference Depth	
h (m)	2.00

ϕ (rad)	0.66
$k_a [1 - \sin\phi / 1 + \sin\phi]$	0.24

Loading Case (Din 1072)	9/9.	
Surcharge, q	5.00	kNm^{-2}
Cover, c [$\gamma \cdot h$]	40.00	kNm^{-2}

Factors, λ	
Permanent	1.35
Variable	1.50

Factored Lateral Loading, (kNm^{-2})	
Surcharge [$q_d = k_a \cdot q \cdot \lambda$]	1.78
Cover Fill [$c_d = k_a \cdot c \cdot \lambda$]	12.85

Design Lateral Loading, $\sigma_{l,d}$		
$\sigma_{l,d}(z_{\max})$	14.6	kNm^{-2}

UPLIFT			
Water table elevation (m)	1.20	Depth of tank D_T (m)	1.50
Water displaced D_{dw} (m)	1.20	Factors λ	
		Permanent Uplift	1.0
		Permanent Resist press.	0.9
Case 1 $D_{dw} < D_T$ TRUE			
Design Uplift kNm^{-2}			
$U_d [D_{dw} \cdot \gamma_w \cdot \lambda]$	12.00	Satisfactory: TRUE	
Design Resisting Pressure $\sigma_{r,d}$			
Cover Fill $c_d [\gamma \cdot z \cdot \lambda]$	12.60		
Case 2 $D_{dw} > D_T$ FALSE			
Submerged Cover z_s (m)	-0.30		
Unsubmerged cover z_u (m)	1.00		
Design Uplift (kNm^{-2})			
$U_d [D_T \cdot \gamma_w \cdot \lambda]$	15.00	Satisfactory: TRUE	
Design Resisting Pressure (kNm^{-2})			
Submerge cover $c_{d,s} [\gamma' \cdot z_s]$	-2.70		
Cover $c_{d,u} [\gamma \cdot z_u \cdot \lambda]$	18.00		
TOTAL	15.30		

Appendix F - Drainage Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	150.0
Additional Flow (%)	10	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.000
Ratio-R	0.350	Preferred Cover Depth (m)	0.900
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.037	5.00	22.600		522622.317	116206.941	0.400
2	0.021	5.00	22.250	450	522628.648	116205.943	0.700
3	0.037	5.00	22.200		522626.825	116239.093	0.400
4			22.000		522633.439	116236.825	0.650
5	0.035	5.00	21.902		522632.360	116267.166	0.402
6			21.820	450	522638.748	116266.441	0.720
7	0.045	5.00	21.500		522636.938	116309.362	0.500
8			21.400	450	522636.763	116308.034	0.500
9	0.035	5.00	21.800		522628.762	116292.996	0.800
10			21.600	450	522634.261	116291.715	0.780
11	0.013	5.00	21.400	450	522641.767	116288.235	0.850
12	0.010	5.00	21.400		522641.429	116286.868	0.860
13	0.021	5.00	21.400	450	522638.568	116275.687	0.875
27A			14.810	450	522725.962	116212.733	0.500
15			20.320	500	522661.051	116272.962	1.507
16	0.010	5.00	20.450	450	522659.918	116264.309	1.750
17			19.850	500	522668.994	116263.098	1.350
18	0.023	5.00	19.700	450	522669.219	116253.081	2.100
19	0.025	5.00	18.800	1200	522681.632	116184.250	1.285
21			19.000	1200	522682.362	116197.181	1.575
29			19.100	1200	522682.822	116214.294	1.790

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
25	0.025	5.00	19.000	1200	522683.134	116225.933	1.780
26			19.000	1200	522685.605	116225.977	1.800
20	0.027	5.00	19.400		522678.144	116197.143	0.400
22	0.027	5.00	19.400		522679.212	116214.177	0.400
23	0.027	5.00	19.000		522685.649	116213.953	0.400
27			16.000	450	522701.317	116227.991	0.500
28	0.052	5.00	19.710		522669.145	116293.740	0.610
24	0.027	5.00	19.000		522685.902	116197.220	0.600
OUTFALL			12.800		522734.939	116211.540	0.500
14			20.050	450	522666.004	116272.642	1.197

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	6.409	0.600	22.200	21.675	0.525	12.2	100	5.05	84.7
1.001	2	4	31.251	0.600	21.550	21.350	0.200	156.3	225	5.55	81.5
2.000	3	4	6.992	0.600	21.800	21.475	0.325	21.5	100	5.07	84.5
1.002	4	6	30.088	0.600	21.350	21.100	0.250	120.4	225	5.97	79.0
3.000	5	6	7.525	0.600	21.500	21.300	0.200	37.6	100	5.10	50.0
1.003	6	16	29.905	0.600	21.100	18.775	2.325	12.9	225	6.10	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.000	2.223	17.5	12.5	0.300	0.475	0.037	0.0
1.001	1.043	41.5	18.8	0.475	0.425	0.058	0.0
2.000	1.672	13.1	12.4	0.300	0.425	0.037	0.0
1.002	1.190	47.3	29.9	0.425	0.495	0.095	0.0
3.000	1.261	9.9	7.0	0.302	0.420	0.035	0.0
1.003	3.668	145.8	25.8	0.495	1.450	0.130	0.0

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
4.000	7	8	2.545	0.600	21.000	20.975	0.025	101.8	150	5.04	50.0
4.001	8	10	11.674	0.600	20.900	20.820	0.080	145.9	225	5.22	50.0
5.000	9	10	2.209	0.600	21.000	20.945	0.055	40.2	100	5.03	50.0
4.002	10	11	7.564	0.600	20.820	20.550	0.270	28.0	225	5.27	50.0
4.003	11	12	1.428	0.600	20.550	20.540	0.010	142.8	225	5.30	50.0
4.004	12	13	1.900	0.600	20.540	20.525	0.015	126.7	225	5.32	50.0
4.005	13	15	22.648	0.600	20.525	19.700	0.825	27.5	225	5.47	82.0
1.008	27	27A	28.986	0.600	15.500	14.310	1.190	24.4	150	6.80	74.7
4.007	15	16	9.920	0.600	18.813	18.700	0.113	87.8	300	5.57	50.0
1.004	16	17	7.112	0.600	18.700	18.500	0.200	35.6	300	6.15	50.0
1.005	17	18	10.020	0.600	18.500	17.600	0.900	11.1	300	6.18	77.8
1.006	18	26	31.672	0.600	17.600	17.200	0.400	79.2	300	6.48	76.3
7.000	19	21	12.952	0.600	17.515	17.425	0.090	143.9	150	5.26	83.3
7.001	21	29	17.119	0.600	17.425	17.310	0.115	148.9	150	5.61	81.2

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
4.000	0.996	17.6	8.9	0.350	0.275	0.045	0.0
4.001	1.080	42.9	8.9	0.275	0.555	0.045	0.0
5.000	1.220	9.6	7.0	0.700	0.555	0.035	0.0
4.002	2.481	98.6	15.9	0.555	0.625	0.080	0.0
4.003	1.092	43.4	18.5	0.625	0.635	0.093	0.0
4.004	1.160	46.1	20.5	0.635	0.650	0.103	0.0
4.005	2.506	99.7	40.4	0.650	0.395	0.124	0.0
1.008	2.048	36.2	147.5	0.350	0.350	0.497	0.0
4.007	1.679	118.7	35.0	1.207	1.450	0.176	0.0
1.004	2.645	186.9	62.8	1.450	1.050	0.316	0.0
1.005	4.737	334.8	97.8	1.050	1.800	0.316	0.0
1.006	1.768	125.0	102.8	1.800	1.500	0.339	0.0
7.000	0.835	14.8	8.3	1.135	1.425	0.025	0.0
7.001	0.821	14.5	25.5	1.425	1.640	0.079	0.0

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
9.000	29	25	12.955	0.600	17.310	17.220	0.090	143.9	225	5.80	50.0
7.003	25	26	2.471	0.600	17.220	17.200	0.020	123.6	300	5.83	79.8
6.000	28	14	21.330	0.600	19.100	18.928	0.172	124.0	225	5.30	83.0
1.007	26	27	15.841	0.600	17.200	15.500	1.700	9.3	150	6.56	75.9
8.000	20	21	4.218	0.600	19.000	17.425	1.575	2.7	100	5.01	50.0
9.000_1	24	21	3.574	0.600	18.400	17.425	0.975	3.7	100	5.01	50.0
11.000	22	29	3.611	0.600	19.000	17.310	1.690	2.1	100	5.01	50.0
11.000_1	23	29	2.848	0.600	18.600	17.435	1.165	2.4	100	5.01	84.9
1.009	27A	OUTFALL	9.056	0.600	14.310	12.300	2.010	4.5	150	6.83	74.5
6.001	14	15	4.963	0.600	18.853	18.813	0.040	124.1	300	5.36	82.7

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
9.000	1.087	43.2	26.4	1.565	1.555	0.133	0.0
7.003	1.413	99.9	50.1	1.480	1.500	0.158	0.0
6.000	1.173	46.6	17.2	0.385	0.897	0.052	0.0
1.007	3.320	58.7	149.9	1.650	0.350	0.497	0.0
8.000	4.762	37.4	5.4	0.300	1.475	0.027	0.0
9.000_1	4.068	32.0	5.4	0.500	1.475	0.027	0.0
11.000	5.333	41.9	5.4	0.300	1.690	0.027	0.0
11.000_1	4.985	39.2	9.1	0.300	1.565	0.027	0.0
1.009	4.780	84.5	147.2	0.350	0.350	0.497	0.0
6.001	1.410	99.7	17.1	0.897	1.207	0.052	0.0

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	0.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
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Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	45	10	0

Node 26 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	17.200	Product Number	CTL-SHE-0067-2400-1500-2400
Design Depth (m)	1.500	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.4	Min Node Diameter (mm)	1200

Node 4 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	1.001
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	21.350	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	4	Diameter (mm)	600

Node 6 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	1.002
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	21.100	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	0	Diameter (mm)	600

Node 13 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	4.004
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	20.525	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	2	Diameter (mm)	600

Node 15 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	4.005
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	19.700	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	2	Diameter (mm)	600

Node 18 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)	17.600	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	5	Diameter (mm)	600

Node 26 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)	17.200	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)		Diameter (mm)	600

Node 25 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	17.220
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	420.0	0.0	1.500	420.0	0.0	1.501	0.0	0.0

Other (defaults)

Entry Loss (manhole)	0.000	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.000	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 99.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	9	22.600	0.400	34.7	0.0000	0.0000	FLOOD RISK
15 minute summer	2	12	22.109	0.559	48.2	0.0888	0.0000	FLOOD RISK
15 minute summer	3	8	22.200	0.400	34.7	0.0000	0.0000	FLOOD RISK
15 minute summer	4	12	21.869	0.519	76.0	1.9870	0.0000	FLOOD RISK
15 minute summer	5	8	21.902	0.402	32.8	0.0000	0.0000	FLOOD RISK
15 minute summer	6	12	21.248	0.148	99.0	0.1877	0.0000	OK
15 minute summer	7	10	21.273	0.273	42.2	0.0000	0.0000	FLOOD RISK
15 minute summer	8	12	21.148	0.248	42.0	0.0395	0.0000	FLOOD RISK
15 minute summer	9	11	21.702	0.702	32.8	0.0000	0.0000	FLOOD RISK
15 minute summer	10	12	21.095	0.275	72.8	0.0437	0.0000	SURCHARGED
15 minute summer	11	12	20.978	0.428	83.9	0.0680	0.0000	SURCHARGED
15 minute summer	12	12	20.948	0.408	93.0	0.0000	0.0000	SURCHARGED
15 minute summer	13	12	20.900	0.375	112.5	0.1626	0.0000	SURCHARGED
1440 minute winter	27A	1410	14.327	0.017	2.4	0.0028	0.0000	OK
15 minute summer	15	12	20.090	1.277	143.5	0.5631	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	29.4	3.755	1.682	0.0501	
15 minute summer	2	1.001	4	46.6	1.172	1.124	1.2429	
15 minute summer	3	2.000	4	29.3	3.749	2.234	0.0547	
15 minute summer	4	1.002	6	70.2	1.900	1.484	1.0162	
15 minute summer	5	3.000	6	29.0	3.709	2.930	0.0583	
15 minute summer	6	1.003	16	97.9	3.375	0.671	1.0100	
15 minute summer	7	4.000	8	42.0	2.384	2.385	0.0448	
15 minute summer	8	4.001	10	41.4	1.340	0.965	0.4643	
15 minute summer	9	5.000	10	31.4	4.008	3.272	0.0173	
15 minute summer	10	4.002	11	71.7	1.860	0.726	0.3008	
15 minute summer	11	4.003	12	83.6	2.101	1.925	0.0568	
15 minute summer	12	4.004	13	92.8	2.333	2.012	0.0756	
15 minute summer	13	4.005	15	108.4	2.790	1.087	0.9007	
1440 minute winter	27A	1.009	OUTFALL	2.4	2.104	0.028	0.0103	195.4
15 minute summer	15	4.007	16	136.7	1.942	1.152	0.6986	

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 99.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	16	13	19.960	1.260	238.4	0.2003	0.0000	SURCHARGED
30 minute summer	17	20	19.650	1.150	225.1	0.2255	0.0000	FLOOD RISK
30 minute summer	18	20	19.226	1.626	240.2	2.1673	0.0000	SURCHARGED
15 minute summer	19	9	18.800	1.285	23.4	0.0000	0.0000	FLOOD RISK
15 minute summer	21	10	19.000	1.575	56.0	0.0000	0.0000	FLOOD RISK
1440 minute winter	29	1410	18.682	1.372	5.8	0.0000	0.0000	SURCHARGED
1440 minute winter	25	1410	18.682	1.462	20.3	584.8708	0.0000	SURCHARGED
1440 minute winter	26	1410	18.682	1.482	18.4	8.3097	0.0000	SURCHARGED
15 minute summer	20	10	19.400	0.400	25.3	0.0000	0.0000	FLOOD RISK
15 minute summer	22	10	19.055	0.055	25.3	0.0000	0.0000	OK
1440 minute winter	23	1410	18.682	0.082	1.5	0.0000	0.0000	OK
1440 minute winter	27	1410	15.528	0.028	2.4	0.0045	0.0000	OK
15 minute summer	28	10	19.710	0.610	48.8	0.0000	0.0000	FLOOD RISK
15 minute summer	24	10	19.000	0.600	25.3	0.0000	0.0000	FLOOD RISK
1440 minute winter	OUTFALL	1410	12.317	0.017	2.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	16	1.004	17	231.3	3.705	1.237	0.5008	
30 minute summer	17	1.005	18	223.9	3.180	0.669	0.7056	
30 minute summer	18	1.006	26	238.0	3.380	1.904	2.2303	
15 minute summer	19	7.000	21	17.7	1.008	1.202	0.2280	
15 minute summer	21	7.001	29	54.2	3.078	3.733	0.3014	
1440 minute winter	29	9.000	25	5.7	0.658	0.133	0.5152	
1440 minute winter	25	7.003	26	-17.8	-0.415	-0.178	0.1740	
1440 minute winter	26	Hydro-Brake®	27	2.4				
15 minute summer	20	8.000	21	19.1	2.756	0.512	0.0330	
15 minute summer	22	11.000	29	25.2	3.662	0.602	0.0220	
1440 minute winter	23	11.000_1	29	2.2	1.731	0.057	0.0209	
1440 minute winter	27	1.008	27A	2.4	1.420	0.066	0.0496	
15 minute summer	28	6.000	14	45.0	1.273	0.966	0.8483	
15 minute summer	24	9.000_1	21	19.1	2.445	0.599	0.0280	

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 99.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	14	12	20.050	1.197	45.0	0.0000	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	14	6.001	15	41.0	0.642	0.411	0.3495	