



Consulting Civil Engineers

Surface Water Drainage and Flood Risk Report

Fleurie Lake Lane, Barnham

For

Fleurie Nursery Ltd

Rev – **P4**

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1 Introduction

- 1.1.1 CGS Civils Ltd has been appointed to undertake a drainage strategy report for a proposed development at Fleurie Lake Lane, Barnham.
- 1.1.2 The purpose of this drainage strategy is to demonstrate how the development area can be satisfactorily drained without increasing flood risk onsite and elsewhere.
- 1.1.3 The existing site consists as undeveloped Greenfied land. The proposed development will consist of 8 No. mobile homes for seasonal workers at Fleurie Nursery. The proposed development is located as OS Grid Reference **SU 97720 04661** and has the post code **PO22 0AL**.
- 1.1.4 The proposed site plan can be found in **Appendix A**.



Fig 1. Site Location

2 Executive Summary:

- 2.1.1 The Surface water will be discharged into the existing watercourse that runs adjacent to the site. Surface water runoff from the proposed roof areas is to be collected by a positive drainage network. Surface water runoff is then to be attenuated on site before being discharged into the existing watercourse at a restricted rate of 1.0l/s.
- 2.1.2 All new hard paved areas are to be constructed using permeable surface allowing surface runoff to freely drain into the ground via shallow infiltration. The network will make use of an attenuation tank in order to cater for the 1 in 100-year +45% storm.
- 2.1.3 The proposed surface water outlet connection is subject to an OWC approval.

3 Alteration to the Development and Surface Water Drainage

- 3.1.1 If any alterations are proposed to the development, or if works are planned that may impact the surface water drainage system, any proposed changes should be assessed by a qualified drainage engineer to evaluate their impact on the existing surface water drainage strategy. Formal approval may need to be obtained from the relevant authorities, depending on the nature of the modifications.
- 3.1.2 Any changes must maintain compliance with the original design principles, including agreed discharge rates, attenuation volumes, and outfall arrangements. If necessary, hydraulic modelling should be updated to confirm that the revised drainage system can still manage peak flows without increasing flood risk.
- 3.1.3 Upon completion of the works, a CCTV survey should be conducted to confirm the integrity of the modified drainage system. Any modifications must be updated on drainage drawings and maintenance plans to reflect the changes made.
- 3.1.4 All alterations must be documented, and maintenance responsibilities reviewed to ensure the long-term functionality of the drainage system.

4 Site Geology

4.1 British Geological Survey information

- 4.1.1 The British Geological Survey confirms the bedrock geology to be made up London Clay Formation – Clay, silt and sand. The BGS website confirms the superficial deposits on site to be made up of River Terrace Deposits- Sand, silt and clay.
- 4.1.2 The British Geological survey also holds records of historical boreholes near the site which give some insight into the ground geology.
 - Borehole SU90SE47 (Located approx. 274m North-West of the site) – Ground geology
 - Borehole SU90SE56 (Located approx. 289m South of the site) – Ground geology (Sand, Clay, Chalk)
 - Borehole SU90SE28 (Located approx. 489m South-West of the site) – Ground geology (Clay, Clayey sand, Sandy gravel.)
- 4.1.3 The Borehole Logs can be found in **Appendix B**.

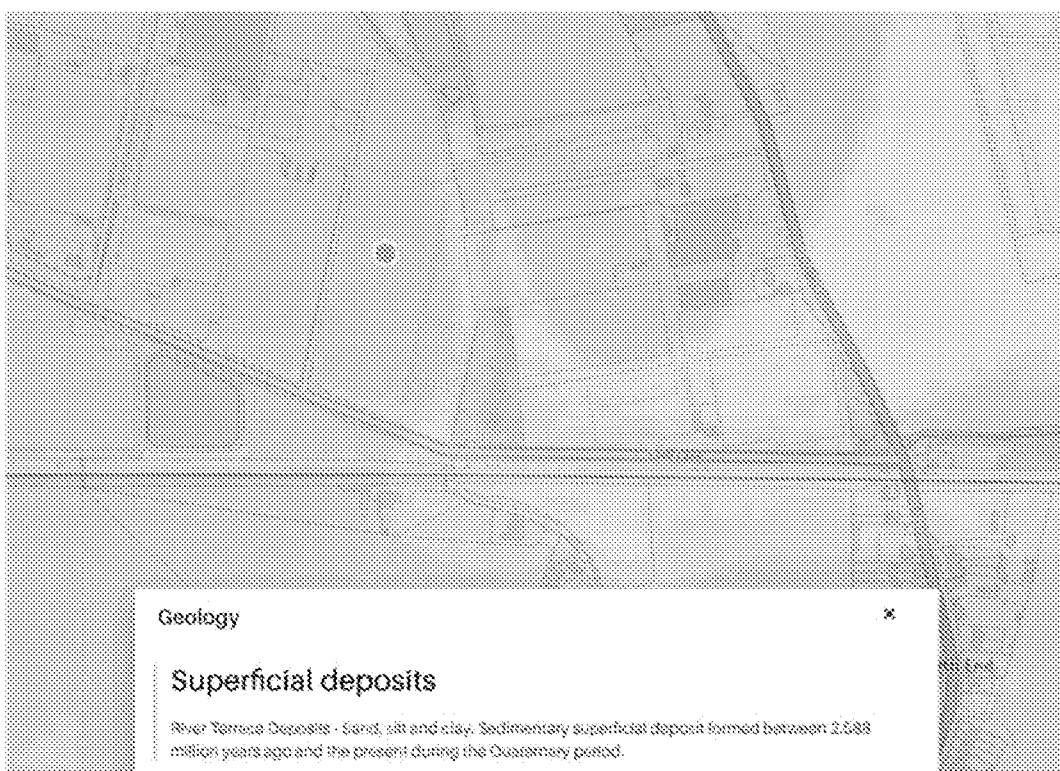


Fig 2. British Geological Survey

Snippet from BGS Website showing Bedrock geology/superficial deposits <http://mapapps.bgs.ac.uk/geologyofbritain/home.html?>

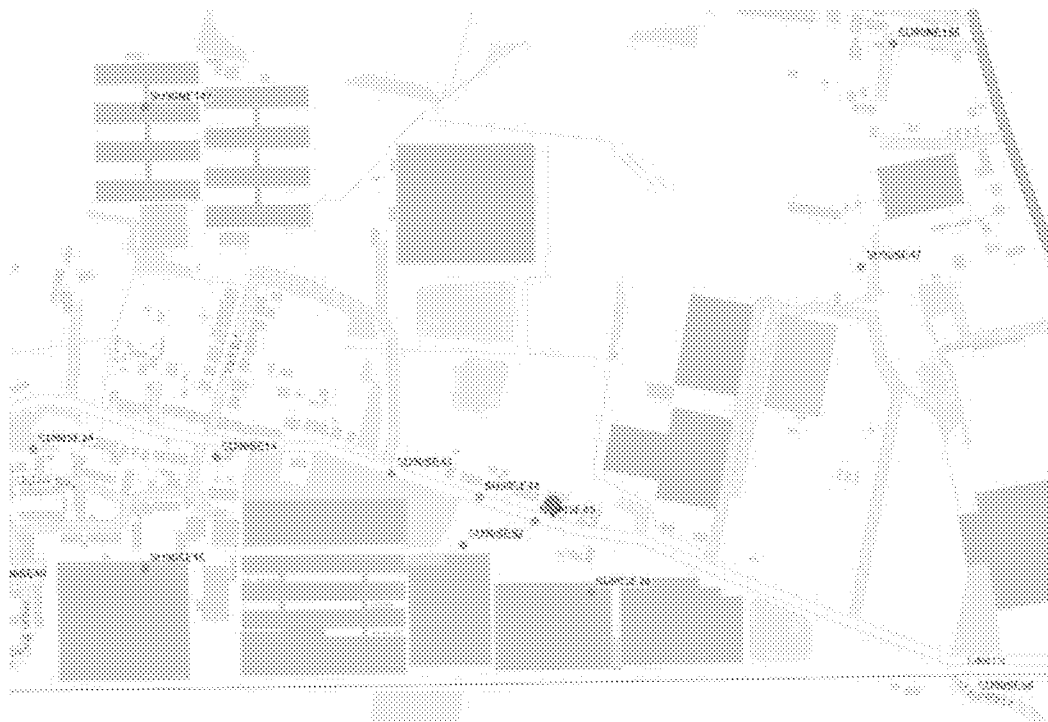


Fig 3. British Geological Survey

Snippet from BGS Website showing the Historical Borehole Log location

4.2 Geological Assessment

- 4.2.1 No intrusive ground investigation testing has been conducted. However, a preliminary infiltration test to a total depth of 0.9m BGL was executed, confirming very low permeability potential and a high groundwater level. This aligns with the information available on the Planning Portal and BGS Historical Borehole logs, which, in conjunction with an existing watercourse, indicate that the site is underlain by soil with low permeability and that there is at risk of a high groundwater level.
- 4.2.2 The nearest borehole logs indicates that site is underlain by London Clay Formation – Clay, silt and sand.
- 4.2.3 It is, therefore, presumed that the traditional soakaway method for surface water disposal should be ruled out due to the expected low infiltration potential and high groundwater level.

4.3 Existing onsite Services

- 4.3.1 Prior to the commencement of any construction activities, the locations of all existing onsite services, including water, gas, electricity, telecommunications, and drainage, must be identified and mapped. This will be achieved through utility surveys, ground-penetrating radar (GPR), and consultation with relevant service providers.
- Appropriate easements must be established for all utilities to ensure accessibility for maintenance and compliance with statutory regulations.
 - Any conflicts between proposed works and existing services must be addressed through design modifications or service diversions as required.
 - The temporary water main currently in use will be decommissioned and removed in accordance with water authority guidelines.
 - A new underground water main will be installed, adhering to all relevant industry standards, ensuring appropriate depth, material selection, and pressure requirements.
 - The new installation will be subject to pressure testing and chlorination before being commissioned for use.

4.4 Existing Access Levels Rising

- 4.4.1 The existing site access levels will be modified to align with the proposed site levels, ensuring smooth integration with the surrounding terrain and adjacent infrastructure. The modified access levels will seamlessly transition to the existing levels adjacent to the glasshouse. This ensures minimal disruption and continuity in the site's accessibility.
- 4.4.2 The adjusted levels will mimic the natural ground slope that directs water flow towards the existing watercourse, maintaining the site's existing drainage patterns and minimizing the risk of surface water ponding. Care will be taken to ensure that the grading and drainage features are optimised to maintain effective surface water runoff management, thereby preventing any waterlogging or flood risk on-site.
- 4.4.3 The transition between the existing glasshouse area and the proposed new site levels will be smooth, ensuring both functional and aesthetic integration of the new works with the existing structures. These modifications will enhance both the accessibility and stormwater management of the site, while ensuring compliance with site-level and water management requirements.

5 Proposed Drainage Strategy

5.1 SuDS Hierarchy

- 5.1.1 All options for the destination of run-off generated on site have been assessed in line with the SuDS hierarchy as set out in Building Regulations Part H document and DEFRA's Draft National Standards for SuDS.

Table 1. SuDS Hierarchy

Discharge Destination	
Rainwater Harvesting	Each Caravan building to be constructed with a 1000 litres water butt for water re-use.
Discharge to Ground	Due to the low infiltration rates and high groundwater level infiltration has been ruled out.
Discharge to Watercourse	Surface water runoff from roof area to be attenuated and discharged into watercourse at restricted rate 1l/s.
Discharge to Surface Water Sewer	N/A
Discharge to Other Sewer	N/A

5.2 Proposed Hydraulic Calculation Specifications:

Table 2. SuDS Hierarchy

Hydraulic Calculation Ratings	
Rainfall Methodology	FEH-22
Volumetric Run-off Coefficient Cv	1
CV Winter and Summer	1
Climate Change Allowances	1:30 – 40% / 1:100 - 45%
Urban Creep Allowances	0% - due to the site being proposed for caravans providing the seasonal workers accommodation.
Additional Storage (m ³ / ha)	0.0
Flow Control	1.5m Head @ 1l/s discharge (0.02m Orifice)
Attenuation Tank Design	Base Coefficient (m/hr): N/A
	Side Coefficient (m/hr): N/A
	Factor of Safety: N/A
	Porosity: 95%
	Time to Half Empty (mins): 180

5.3 Surface Water Drainage

- 5.3.1 Based upon the information gathered from the British Geological Survey website, planning portal and preliminary shallow BRE365 infiltration test results it is deemed that discharge to ground via infiltration is not viable therefore, it is proposed therefore that all surface water runoff is to be discharged to the existing watercourse.
- 5.3.2 On-site infiltration testing indicates the presence of thick clay soil with very low infiltration potential. Additionally, excavations for the new gas main installation and treatment plant, located near the proposed development, identified groundwater at 0.7m BGL, preventing the use of infiltration as a drainage method. On-site photographs can be found in Appendix C at the rear of this statement.
- 5.3.3 A Greenfield runoff calculation has been undertaken. Due to the small contributing area (0.028Ha), the Greenfield runoff has been calculated based on a 0.1Ha area and then proportionally adjusted for the site-specific contributing area. Additionally, due to high groundwater levels and low permeability, the soil type has been updated to Soil Type 5.
- 5.3.4 The actual Greenfield runoff discharge (for roof areas only) has been calculated as 0.162 l/s for the 1 in 1-year event and 0.72 l/s for the 1 in 100-year rainfall event. It is proposed that surface water runoff will be restricted to 1 l/s for all rainfall events, including the 1 in 100-year + climate change scenario.
- 5.3.5 Since surface water runoff will be collected exclusively from roof areas, the risk of suspended solids discharge is minimal. The proposed attenuation tank will be constructed using a single row of Polypipe Polystorm Inspect crates, ensuring accessibility for future maintenance. Combined with catchpit chambers, this setup helps prevent potential blockages. Additionally, a structured maintenance regime and regular inspections will further ensure the system remains clear and fully operational.

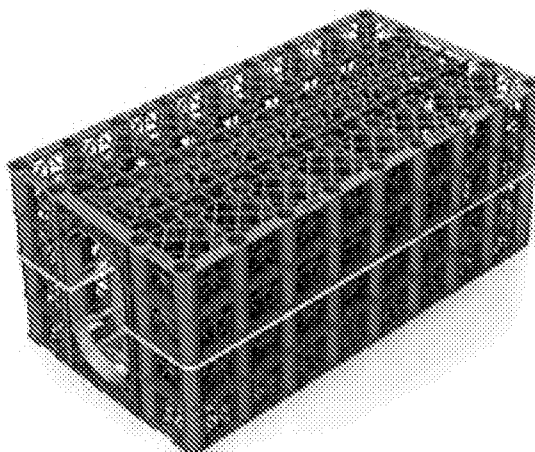


Fig 8. Polypipe Polystorm Inspect Crate

- 5.3.6 It is proposed that surface water runoff from the proposed roof areas is collected and discharged into the onsite attenuation tank before being discharged into the existing watercourse at a restricted discharge rate of **1l/s**.
- 5.3.7 Due to the high groundwater levels confirmed on-site, the underground attenuation tank will be constructed during the summer when groundwater levels are at their lowest. During construction, the impermeable liner will be surrounded with a protective fleece on both the top and bottom to prevent any damage during excavation and compaction. The impermeable liner will be sealed at all joints and around pipe penetrations using welded or taped joints. Given the potential for groundwater fluctuations, the attenuation tank will be constructed with a concrete slab to provide additional loading against potential groundwater pressure and to prevent flotation.

- 5.3.8 It is proposed that each building is being constructed with min. 1000 litres above ground harvesting tank to allow for surface water runoff re-use and runoff interception.
- 5.3.9 The network will make use of a geocellular attenuation tank, which has been designed to cater for a 1 in 100-year +45% storm event. Surface water runoff will be collected via an underground piped system, attenuated within the proposed geocellular underground tank, and discharged into the existing watercourse at a rate of 1 l/s.
- 5.3.10 The proposed orifice chamber will be constructed with a high overflow. Therefore, in the event of blockages or lack of maintenance, surface water runoff will still be discharged into the existing watercourse. Maintenance should be carried out according to the site-specific maintenance regime to reduce the potential risk of blockages.
- 5.3.11 The proposed development site levels have been set at 9.2m AOD, preventing any potential floodwater from entering the proposed drainage system. Any surface water flooding will be directed toward the existing ditch, mimicking the natural site drainage regime and topography.
- 5.3.12 The proposed contributing area plan, proposed drainage plan, typical construction details, exceedance flow plan and hydraulic calculations can be found at **Appendix C**.
- 5.3.13 EA Magic Map can be found at **Appendix D**.
- 5.3.14 Maintenance Statement can be found at **Appendix F**.

5.4 Water Quality

- 5.4.1 A key requirement of any SuDS system is that it protects the receiving water body from the risk of pollution.
- 5.4.2 Frequent and short duration rainfall events are those that are most loaded with potential contaminants (silts, fines, heavy metals, and various organic and inorganic contaminants) Therefore the first 5-10mm of rainfall should be adequately treated with SuDS.
- 5.4.3 The new SuDS Manual (Ciria C753, November 2015) introduces slightly different approach compared to the previous version for the water quality management of surface water. The Manual describes risks posed by the surface water runoff to the receiving environment as a function of:
- The pollution hazard at a particular site (i.e., the pollution source)
 - The effectiveness of SuDS treatment components in reducing levels of pollutants to environmentally acceptable levels
 - The sensitivity of the receiving environment
- 5.4.4 The EA website indicates that the site does not lie within a Source Protection Zone.
- 5.4.5 The recommended approaches for water quality risk management are given in the SuDS Manual Table 26.1.

Table 26.1 from SuDS manual. Approaches to Water Quality Risk Management

Table 26.1 Approaches to Water Quality Risk Management			
Design method	Hazard Characterisation	Risk Reduction	
		For Surface Water	For Groundwater
Simple Index Approach	Simple pollution hazard indices based on land use (Table 26.2)	Simple SuDS hazard mitigation indices (Table 26.3)	Simple SuDS hazard mitigation indices (Table 26.4)
Risk Screening	Factors characterising traffic density and extent of infiltration likely to occur (Table 26.5)	N/A	Factors characterising unsaturated soil depth and type, and predominant flow type through the soils (Table 26.5)

Detailed Risk Assessment	Site specific information used to define likely pollutants and their significance	More detailed, component specific performance information used to demonstrate that the proposed SuDS components reduce the hazard to acceptable levels
Process-based treatment modelling	Time series rainfall used with generic pollution characteristics to determine statistical distributions of likely concentrations and loadings in the runoff	Models that represent the treatment processes in the proposed SuDS components give estimates of reductions in even mean discharge concentrations and total annual load reductions delivered by the system

5.4.6 As per Table 26.1 Simple Index approach will be used as a design method for this site.

5.4.7 Table 26.2 will provide hazard classification of different land uses. The land uses for the surface water drainage for this site are.

- Residential Roofs
- Individual Property driveways and residential car parks

5.4.8 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. Therefore, the following must be achieved for the surface running off the site.

Total SuDS mitigation index $\geq$ pollution hazard index

5.4.9 Pollution Hazard Indices are given for different land uses in Table 26.2 of the SuDS manual;

Table 26.2 from SuDS manual. Pollution Hazard Indices for Different Land Use Classifications

Table 26.2 Pollution hazard indices for different land use classifications				
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 (e.g., cul-de-sacs, homezones and general access roads) and non-residential car parking with infrequent change (e.g., schools, offices) i.e., < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g., hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.7	0.6	0.7
Sites with heavy pollution (e.g., 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	High	0.8	0.8	0.9

5.4.10 From Table 26.2 the following information is tabulated in Table 1

Table 3: Pollution hazard index and destination of runoff for the proposed site

Land Use	Destination of Runoff	Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Residential Roof	Ground Water	Very Low	0.2	0.2	0.05
Car Park	Ground water	Low	0.5	0.4	0.4

5.4.11 The SuDS mitigation index will be obtained from Table 26.4 (for groundwater) of the SuDS manual.

Table 26.4 from SuDS manual. Indicative SuDS Mitigation Indices for discharges to ground waters.

5.4.12 SuDS mitigation index are tabulated in Table 5 as followed.

Table 26.4 Indicative SuDS mitigation indices for discharges to surface waters			
Type of SuDS Components	Mitigation Indices		
	TSS	Metals	Hydrocarbons
Filter Strip	0.4	0.4	0.5
Filter Drain	0.4	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	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area		

Table 4: SuDS mitigation index

Table 4 Mitigation Indices						
Runoff Source	Destination of Runoff	Mitigation Index Source	Type of SuDS Component	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Car Park	Ground water	Table 26.3 (for surface waters)	Permeable Pavement	0.7	0.6	0.7

5.4.13 The above analysis demonstrates that the SuDS devices within the design will mitigate any pollution present within the surface water system.

5.5 Construction Phase Drainage

- 5.5.1 It is an offence to cause or knowingly permit the entry of any polluting, poisonous or noxious material in the water environment. If the pollution is serious enough to lower the ecological status of the water body as set out in terms by the Water Framework Directive (2000/60/EC) then prosecution may occur.
- 5.5.2 Remediation of any damage caused will not require the polluter to be prosecuted first. If the water pollution is serious enough to be classed as environmental damage, the damage will require to be remediated such that the area is returned to the condition it would have been in if the damage had not occurred.
- 5.5.3 If any pollution has not been reported or the polluter has not taken actions to prevent any further damage; they would then be causing an offence. Third parties (e.g., Private water supply users, landowners, recreation users and the public) who may be affected by possible damage may also report the risk of any environmental damage to the enforcing authority.
- 5.5.4 The principles of SuDS (Sustainable Drainage Systems) shall be applied to all components of design and construction regarding surface water management. Any design or site works that may impact on the site drainage or the water quality shall:
- Soakaway where soils allow
 - Consider and manage erosion
 - Remove pollutants in surface water
 - Retain any silts on site and prevent silts from discharging to watercourses or drains
 - Keep runoff rates at existing greenfield runoff
 - Prevent accidental spillages reaching watercourse
- 5.5.5 As infiltration on site is viable, the temporary drainage for the development will be in the form of land drains which will discharge into the ground.
- 5.5.6 Pollution will be controlled via the use of catchpit manholes and geotextiles.
- 5.5.7 Any potential hazardous substances will be within a controlled compound with a separate drainage system that will contain a penstock valve / containment kit in the event of a spillage.

6 Flood Risk Assessment

- 6.1.1 The proposed development is classified as a minor development, is located in Flood Zone 1 and is not affected by any surface water or reservoir flooding.

6.2 Tidal/Sea Flooding

- 6.2.1 The Environment Agency's online mapping confirms that the proposed development is located in Flood zone 1 and is not at risk of flooding from rivers or the sea from anything less extreme than a 1:1000-year flood event.

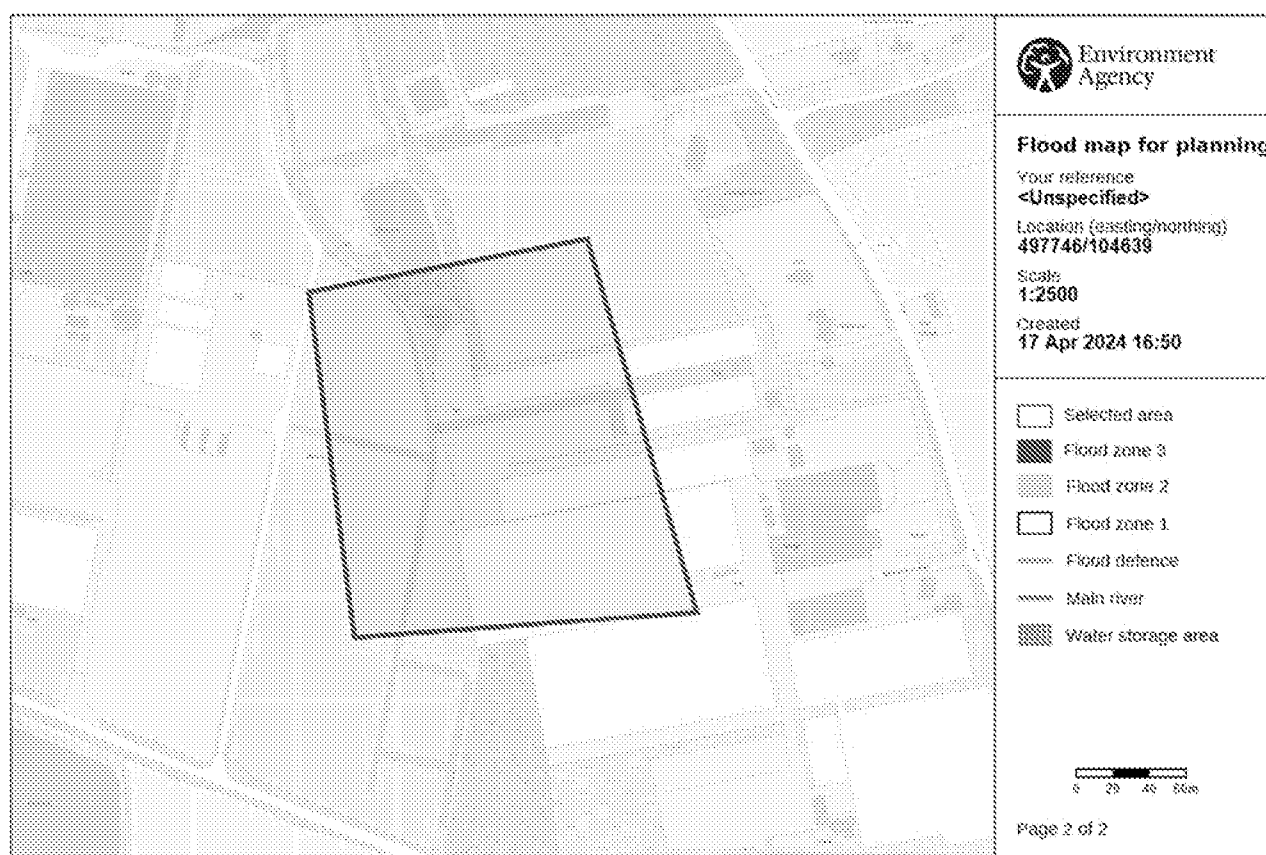


Fig 4. EA Agency Flood Map For Planning

6.3 Fluvial Flooding

- 6.3.1 Based on EA mapping, the proposed development itself is not deemed at risk of surface water flooding. However, the existing watercourse appears to be at risk of surface water flooding.
- 6.3.2 Figure 5 shows the high-risk scenario (1 in 10-year event). In this event, the proposed site is shown not to be affected by surface water flooding.

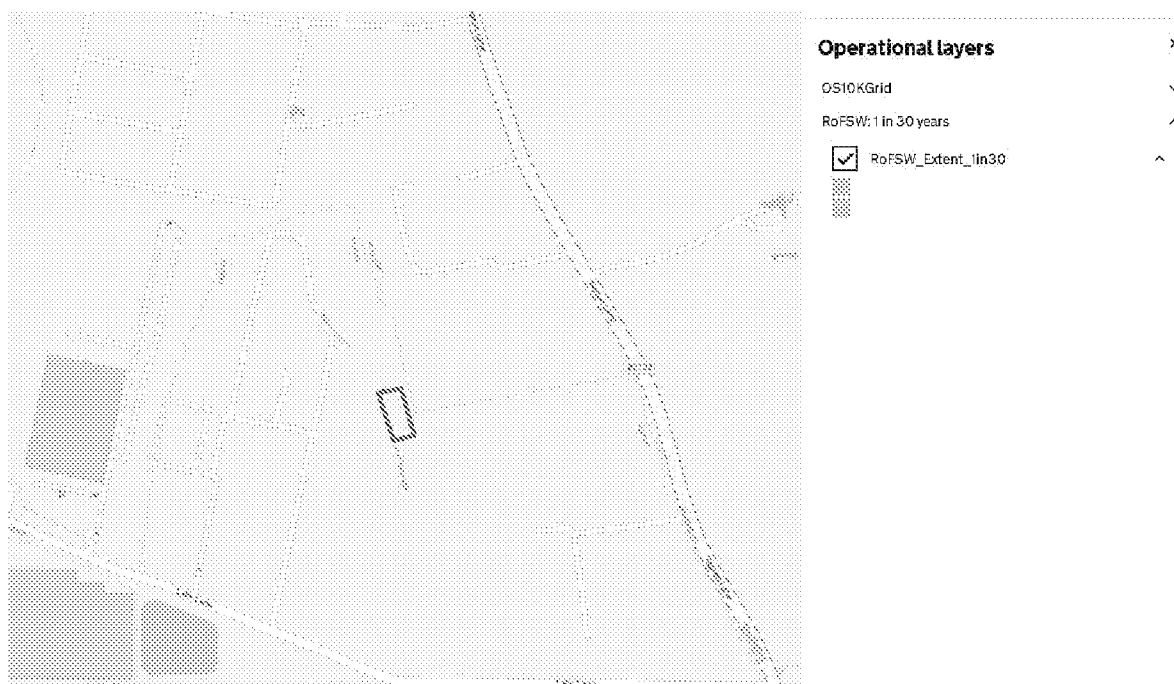


Fig 5. EA Agency Surface Water Flood Map (1:30yr)

6.3.3 Figure 6 present the medium risk scenario (1 in 100-year return period) and continues to show that the proposed development is wholly unaffected by surface water flooding. However, the proposed development is located in close proximity to the existing pond and watercourse which may be affected by surface water flooding below 300mm, but the proposed mobile homes are sequentially located to be wholly unaffected.



Fig 6. EA Agency Surface Water Flood Map (1:100yr)

- 6.3.4 The EA flood mapping indicated surface water flooding within the existing watercourse with a low chance of flooding to the west of the existing watercourse, both not affecting the proposed development land.



Fig 5. EA Flood Map Extract – Surface Water Flooding

- | | |
|--------|---|
| 6.3.5 | The area identified as having a low chance of flooding, located in the southeast of the site, includes the existing Greenhouse building, which has an elevation of 9.2mAOD. Given that the top of the eastern watercourse bank is at 8.10mAOD, the Greenhouse should not be considered at risk of flooding, as it is approximately 1.1m higher than the bank. |
| 6.3.6 | The proposed external ground levels are set at 9.4mAOD, with Finished Floor Levels (FFLs) at 9.7mAOD, ensuring that both the proposed buildings and drainage remain above the potential flood risk level. |
| 6.3.7 | Any potential floodwater will be directed toward the existing ditch and the western side of the watercourse, following the natural topography. |
| 6.3.8 | The proposed parking area and footpaths will be constructed using permeable surfacing, allowing surface water runoff to infiltrate into the ground. In the event of exceedance, excess runoff will be routed into the existing watercourse, replicating the current surface water discharge regime. |
| 6.3.9 | The Adun District Strategic Flood Risk Assessment has been reviewed as part of this study. No historical flooding records have been identified within the proposed development area. |
| 6.3.10 | The low-risk scenario (1 in 100-year event) also indicate that the proposed mobile homes are unaffected by surface water flooding in this event. The existing watercourse, pond to the north and area located to the south adjacent to the existing Greenhouse and watercourse culvert is indicated at risk of flooding with a depth below 300mm. |
| 6.3.11 | It is therefore confirmed that the proposed development and mobile homes are not affected by surface water flooding with a flood depth around the proposed development land shown to be no more than 300mm. |

6.4 Historical, Sewers and Drainage

- 6.4.1 Proposed development is located within the area not served by public sewers and therefore there are no records of the historic flooding in the past. The risk of sewer flooding to the site is considered low, assuming that any new development flows include appropriate protective measures to manage runoff and not increase the risk of sewer flooding.

- 6.5.2 There have been no recorded incidences of groundwater flooding to the site, and it is notably difficult to predict where groundwater may emerge and cause damage. Nevertheless, groundwater flooding is typically low level in depth, and all but the worst case can be managed through appropriate flood resilient designs.

6.6 Reservoir Flooding (Breach)

- 6.6.1 Maps of the flood extents identify the site is not at risk of flooding from reservoirs.

6.7 Summary of Risks:

- 6.7.1 Table below summarises the generalised risk from the various sources of flooding assessed above, and if the site is at risk of a DFE from this source.

Source of Flooding	Flood Risk within the site	Are the buildings at risk of a DFE
Fluvial	Very Low	No
Tidal/Sea	Very Low	No
Surface Water	Very Low	No
Reservoir	Very Low	No
Groundwater	Very Low	No
Sewers and Drainage	Very Low	No

- 6.7.2 The existing site plan indicating existing runoff direction together with the flood map extract can be found at **Appendix E**.

7 Summary and Conclusions

- 7.1.1 CGS Civils has been appointed to produce a Drainage statement under National Planning Policy Framework (NPPF) to support the Planning Application for a permanent fixture of 8 No. mobile homes for seasonal workers.
- 7.1.2 The Surface Water is to be discharged into the existing watercourse at a restricted discharge rate of 1l/s. Proposed connection is subject to OWC agreement.
- 7.1.3 Based on the EA's Flood Maps for Planning and SFRA data, the site is wholly unaffected by both tidal and river flooding, being wholly located in Flood Zone 1 in the present day and into the future. As such, further assessment of the flood risk from these sources is not required.
- 7.1.4 The 1 in 30year, 1 in 100year and 1 in 1000year event shows that the proposed mobile homes are wholly unaffected. The proposed mobile homes are fully located above the 1 in 1000-year event and therefore provide sufficient freeboard and protection to the mobile homes in the DFE from surface water flooding risk.
- 7.1.5 A review of flood risk from all other sources, has been undertaken and flood risk is considered low from all sources assessed (including Fluvial, Tidal, Groundwater and Sewer flood risk).
- 7.1.6 The report demonstrates that the proposals could be accommodated within the site by in accordance with the EA guidance, Council SFRA, and the NPPF. It has also been demonstrated that the proposed drainage measures ensure that suitable means of surface water drainage can be achieved for the proposed development.