Buildability and Sustainability Analysis

CONTRUCTION TECH 2

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Introduction

This report provides a buildability and sustainability assessment of the proposed medium to high-rise hotel development at Sketty Lane, Sketty, Swansea (SA2 8QB). The site is located along the Swansea coastline and is near Singleton Hospital.

This report follows on from the proposed technical building design established in Construction Technology completed by (Aaron.G 2026) regarding the technical design of the proposed medium high-rise hotel. The proposed design utilises screw pile foundations, which provide a reliable solution for the site due to their effective performance in softer soils, minimal vibration during installation, and strong load-bearing capacity despite variable ground conditions. The inclusion of an outrigger system enhances lateral stability and resistance to coastal wind loading, while Tata Steel's off-site prefabrication approach reduces on-site construction time and minimises disruption caused by unpredictable weather conditions. As a result, these methods form an efficient, resilient, and well-suited construction strategy for the proposed site location.

This report evaluates whether the proposed design is durable, buildable, and appropriate for the site location. With the assessment considering key factors such as, the local environmental conditions, building orientation, material durability and life-cycle performance, aesthetic integration within the coastal context, the incorporation of green façades and Sustainable Drainage Systems (SuDS), and overall buildability.

Environmental Impact Assessment

BUILDING ORIENTATION

A buildings orientation manages to prevail winds, reduce wind turbulence at street level and minimise weather-related wear on external materials. Additionally, effective orientation enhances daylight access, views, and internal comfort, while supporting passive design strategies. Overall, thoughtful building orientation improves performance, durability, and sustainability in high-rise developments.

In the UK, there is no single piece of legislation that mandates a specific building orientation. However, orientation is strongly influenced through a combination of Building Regulations, planning policies, and recognised guidance, particularly for high-rise developments.

Key legislations:

- Building Regulations:

Part L (Conservation of Fuel and Power): Encourages building orientation that maximises daylight and passive solar gain to reduce energy demand.

UK Government (2021). *Conservation of fuel and power: Approved Document L.*

Part O (Overheating) Requires designers to consider solar gains, glazing orientation, and shading to limit overheating risk, especially in high-rise and residential buildings.

GOV.UK (2022). *Overheating: Approved Document O.*

- National Planning Policy Framework (NPPF):
  Promotes sustainable development, energy efficiency, and climate-responsive design, all of which are affected by building orientation.

Ministry of Housing, Communities and Local Government (2024). *National Planning Policy Framework.*

- BRE Guidance – Site Layout Planning for Daylight and Sunlight (BR 209)
  Although non-statutory, BRE 209 is widely adopted by local planning authorities and heavily influences decisions on building massing and orientation to ensure adequate daylight and sunlight.

Littlefair, P., King, S., Howlett, G., Ticleanu, C. and Longfield, A. (n.d.). *Site layout planning for daylight and sunlight A guide to good practice.*

- CIBSE TM37 provides guidance on coordinated mechanical and electrical services design, promoting energy efficiency, buildability, maintainability, and whole-life performance to support sustainable, low-carbon building delivery across complex high-rise projects developments.

www.cibse.org. (n.d.). *TM37: Design for improved solar shading control | CIBSE.* [online] Available at: https://www.cibse.org/knowledge-research/knowledge-portal/tm37-design-for-improved-solar-shading-control.

The proposed hotel is orientated to face South, this optimises natural daylight penetration. This reduces reliance on artificial lighting and lowers operational energy demand, supporting Wales's net-zero carbon ambitions. Increased access to natural daylight also enhances occupant comfort and wellbeing, which is particularly beneficial in a hotel environment where guest experience and internal environmental quality are key design considerations.

South facing:

Advantages:

- Plenty of natural light: In the UK, South-facing homes are often popular because they receive the most natural light throughout the day. This is also true through the winter months due to the sun setting earlier.

- Energy Efficient: Important for most – South-facing homes are ideal for generating energy from solar panels and allow for passive solar heating in the colder months, reducing heating costs.
- Great for Warmth: Throughout the day, sunlight comes in through windows and helps keep the house at a comfortable temperature. This reduces the need for radiators and heaters, making it an eco-friendly choice.

Disadvantages:

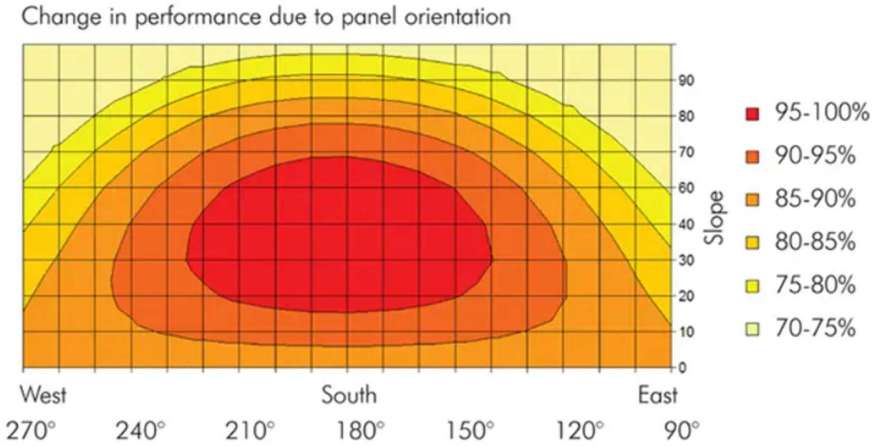
- Excessive Heat in Summer: Although warmer in the winter, they have the opposite effect in the summer – with the sun shining in all day, you may need to utilise blinds and spend on cooling appliances to keep your home cool.
- Window Glare: The glare can interfere with everyday activities, such as watching TV, working (or playing) on a computer, or reading. Blinds or UV-blocking window films can help but reduce the natural light.
- Furniture Fading: The constant sunlight can also cause pictures, carpets, and furniture to fade, meaning more upkeep costs.

(admin (2025). *Does it matter which way your house faces? - Post*.)

PV Panels

With the building's South-facing orientation, it is proposed that PV panels should be installed on the roof of the structure. This orientation is well suited to maximising solar exposure throughout the year, allowing the panels to achieve higher levels of energy generation. Additionally, on-site renewable energy generation contributes and reduces

operating costs and enhances the building's alignment with current low-carbon and net-zero targets.



Further the orientation of the installation is from the south, the more its production will be affected. Source: unknown.

Figure 1 - SolAR (2020). ORIENTATION AND TILT – Solarchitecture.

At UK latitudes, South-facing surfaces with an approximate 30° tilt receive the highest annual solar radiation. However, effective decentralised solar energy generation does not rely solely on optimally orientated roofs or façades. Installing solar technologies on differently oriented building elements, such as East- or West-facing façades and flat roofs, can still be both energy- and cost-effective. (SolAR (2020). *ORIENTATION AND TILT – Solarchitecture*)

By installing these panels a system, such as a solar share system, is proposed to be installed to the hotel. Solar share systems maximise on-site energy self-consumption, reduce reliance on grid electricity, and improve overall energy efficiency. They are particularly effective in multi-occupancy buildings, supporting lower operational costs and contributing to carbon-reduction and net-zero sustainability objectives

It also achieves maximum SAP assessment points by treating solar PV as a direct supply and enables tailored kWp allocation to each room in small increments. This flexibility maximises return on investment and supports EPC targets. By delivering solar energy to the hotel rooms when demand occurs, SolShare increases on-site consumption and delivers greater electricity bill savings for occupants. (Allume Energy. (2025). *SolShare - How it Works - UK - Allume Energy*)

Wind

Due to the exposed coastal location of the proposed development, wind-driven rain presents a significant challenge for high-rise buildings in Sketty. Strong prevailing winds combined with salt in the air increases the risk of moisture penetration and façade deterioration. In which, an effective mitigation depends on an integrated approach that combines robust building envelope design, appropriate material selection, precise detailing, and high construction quality to ensure long-term durability and performance.

When designing the hotel, a good legislation to follow regarding wind loads, is the BS EN 1991-1-4 (Eurocode 1). Which is the European standard that defines how wind actions on buildings and civil engineering structures are calculated. It sets out methods for determining wind velocities, pressures, and forces, factoring in site location, terrain, height, and building shape to ensure structural safety and serviceability under wind loading. (Bsigroup.com. (2025). *BS EN 1991-1-4 - Eurocode 1. Actions on structures. General actions. Wind actions*)

Keyways of orientation, to follow when designing the high-rise construction of the hotel are:

- Turn narrow façades into the wind:
  Orientating the building so the *shortest elevation* faces the prevailing South-westerly coastal winds reduces the surface area exposed to wind-driven rain.

- Protect primary elevations:
  Positioning main façades, balconies, and entrances on leeward sides limits direct rain impact and improves durability and occupant comfort.

- Use building massing as shielding:
  Stepped forms, setbacks, or rotated cores can break up wind flow, reducing pressure on lower façades and limiting rain penetration at height.

- Avoid vulnerable orientations for openings:
  Minimising windows, joints, and façade penetrations on windward elevations reduces the primary points of water ingress.

- Create sheltered zones:
  Orientation can help form protected courtyards, recessed entrances, and service areas that are less exposed to wind and rain.

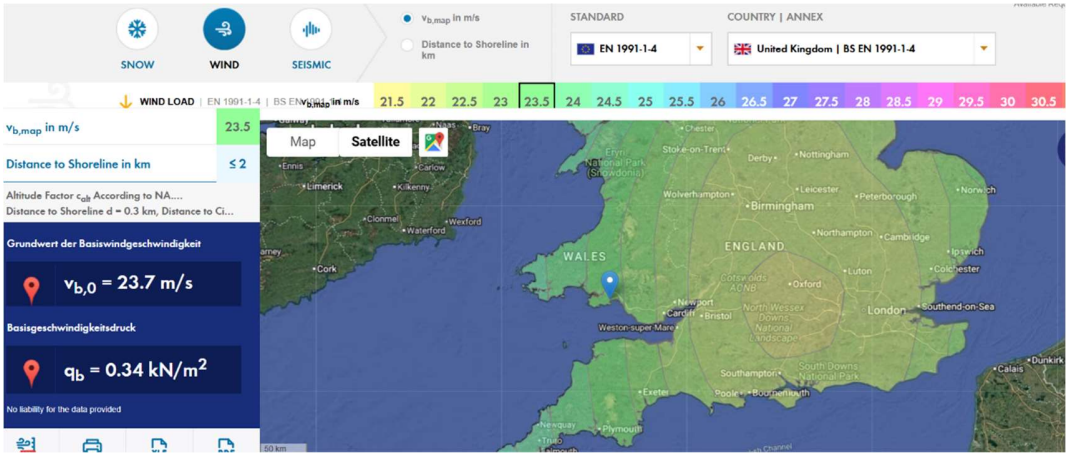


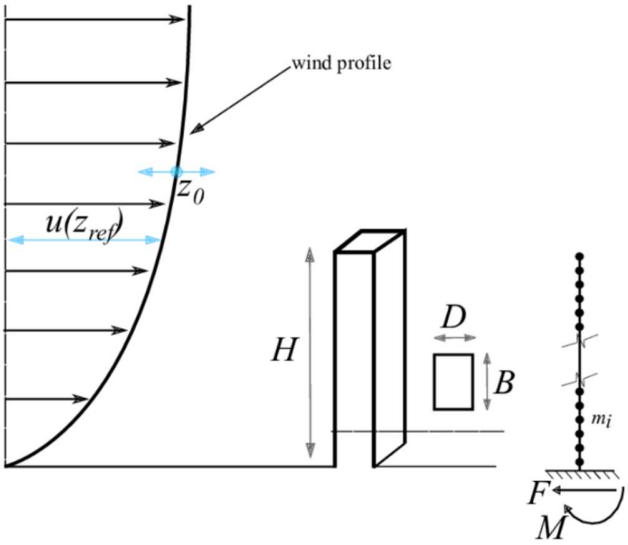
Figure 2 - Dlubal. (2026). Location Selection on Map of the United Kingdom and Wind Load Determination According to BS EN 1991-1-4.

Wind Velocity - Swansea

According to the UK National Annex wind map, the fundamental basic wind velocity (vb,map) for coastal South-West Wales, including Swansea, is typically:

- vb,map - 25 - 26 m/s

This value represents a 10-minute mean wind speed at 10 m above ground in open terrain, before site-specific corrections are applied. (Dlubal. (2026). *Location Selection on Map of the United Kingdom and Wind Load Determination According to BS EN 1991-1-4.*)



. *Figure 3 - Wind load on a high-rise building | Download Scientific Diagram, 2026*

Ventilation

The proposed ventilation strategy for high-rise construction is a Mechanical Ventilation with Heat Recovery (MVHR) system. This a building ventilation strategy that provides a continuous supply of fresh air while recovering heat from stale exhaust air. It is commonly used in airtight, modern buildings, including high-rise developments, to improve indoor air quality and energy efficiency.

Which for a hotel guest room, the recommended air change per hour rate (ACH) is generally 3-8 air changes per hour to ensure comfort and odor control. For specialized areas, such as restaurants within a hotel, a higher rate of 12+ ACH is needed, while public toilets often require 6 - 15 ACH. (Air-Change-per-Hour-Document.pdf, 2026)

Therefore, to keep in line with building regulation Part F (HM Government (2010). *Ventilation: Approved Document F.*)

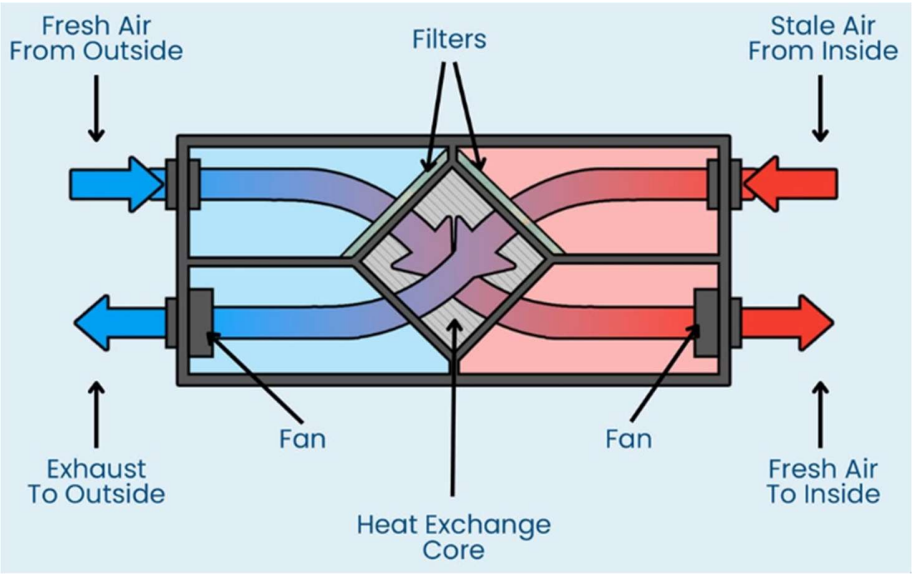


Figure 4 - Mousdell, D. (2024). H2X Pty Ltd.

Reasoning for the chose of ventilation system:

The MVHR systems are specialized, compact, and often ceiling-mounted, designed to provide continuous balanced airflow in airtight, multi-storey residential buildings. These systems recover up to 95% of heat from extracted air, improving energy efficiency while ensuring indoor air quality. (Nuaire.co.uk. (2019). *Mechanical Ventilation with Heat Recovery system (MVHR)*)

Life Cycle

When constructing the development, the life cycle of the building must be carefully considered. As the development is intended to operate as a hotel, it is important to consider its future adaptability, including the potential for the building to be sold and converted to an alternative use. This is decided during the planning stages of the construction

After handover, adaptive ability becomes particularly important during the in-use stage of the building's life cycle. During this phase, operational requirements may change, and future owners may wish to refurbish or repurpose the building. Buildings designed with flexible layouts, accessible services, and robust structural grids are more easily adapted without major reconstruction. (Riba.org. (2020). *RIBA Plan of Work*.)

With the proposed hotel design. The design will have adequate floor-to-ceiling heights, regular column spacing, and accessible service risers can be easily converted into office accommodation. This adaptability helps maintain the building's value and reduces environmental impact by avoiding demolition. (Usgbc.org. (2025). *Building Life-Cycle Impact Reduction Guide | U.S. Green Building Council*)

Case Study:

Sea Containers House, London:

Sea Containers House, located on London's South Bank, was originally built in 1978 as an office building. As demand changed, the underused building was redeveloped rather than demolished and is now a mixed-use development combining the Sea Containers London Hotel with modern office space. (HDR. (2021). *Sea Containers House*.)

Aesthetics

For the aesthetic design I will be using a locally based manufacturer in Port Talbot, Tata Steel. Which supplies Structural Insulated Panel (SIP) systems that would perform effectively and contribute positively to the proposed design. The use of Tata Steel SIPs panels supports build quality, thermal performance, and efficient construction while also promoting the use of regional suppliers.

External Envelope:

Trim panel insulated architectural systems offer a strong aesthetic solution for contemporary high-rise and hotel developments. The panels create a clean, uniform façade with crisp lines and large spans that enhance visual continuity and vertical emphasis. Concealed fixings minimise visual clutter, delivering a refined and modern appearance. A wide choice of colours, coatings, and surface finishes allows the façade to

be tailored to coastal or urban contexts while maintaining long-term visual quality. The smooth steel finish pairs well with glazing and feature detailing, enabling depth and contrast. Overall, Trim panel provides a sleek, durable, and architecturally flexible façade system. (Tata Steel UK. (2026). *Trimapanel® insulated architectural wall panel systems.*)

Figure 5 - Tata Steel UK. (2026). Trimapanel® insulated architectural wall panel systems.

Roof structure:

The Britmet system offers a visually appealing and contemporary aesthetic, which is well suited to modern residential, commercial, and hotel developments. Its clean, uniform profiles and sharp detailing create a refined appearance that can complement both traditional and modern architectural styles. (Britmet.co.uk. (2021). *Lightweight Roof Tiles and Synthetic Slate Roofing Systems from Britmet Tileform*)

Figure 6 - Britmet.co.uk. (2021). Lightweight Roof Tiles and Synthetic Slate Roofing Systems from Britmet Tileform.

Façade Greening and SUDS

GREEN FAÇADES

Green façades are suitable for high-rise buildings when they are carefully designed and properly integrated into the building envelope. They enhance the visual quality of tall structures by softening façades and improving the urban streetscape, while also providing environmental benefits such as reduced solar gain, and improved insulation. Successful application requires wind-resistant systems, lightweight planting solutions, and planned maintenance access to ensure long-term performance and safety at height.

When determining the location and materials for the proposed green façade, compliance with the Fire Safety Act 2021 and the Building Safety Act 2022 is essential. These regulations require increased scrutiny of external wall systems on high-rise buildings, including the specification and performance of materials used within green façade systems, to ensure fire safety and overall building compliance. (Home Office (2022). *Fire Safety Act 2021.*)

For this high-rise building, the indirect green façade system is generally the most suitable and widely recommended option. This system uses trellises, stainless-steel cables, or mesh systems that support climbing plants while keeping vegetation physically separated from the building envelope. This reduces moisture risk, improves durability, and allows the façade to perform effectively under high wind loads. Indirect systems are lighter than living walls, easier to maintain at height, and can be engineered to comply with fire safety and structural requirements. As a result, they offer the best balance of aesthetic impact, safety, performance, and practicality for tall buildings. (Sweco United Kingdom. (2022). *Green Walls Fire Safety Guidance - Sweco UK*)

Figure 7 - SRS (2020). What is a Green Facadé? | Foliage Systems | SRS Group.

SUDS

The image below shows the proposed location of the high-rise hotel development. Sustainable Drainage Systems (SuDS) are especially important because the site is close to the coast. They are needed to manage surface water safely, reduce flood risk, protect the environment, and meet planning requirements in the long term.

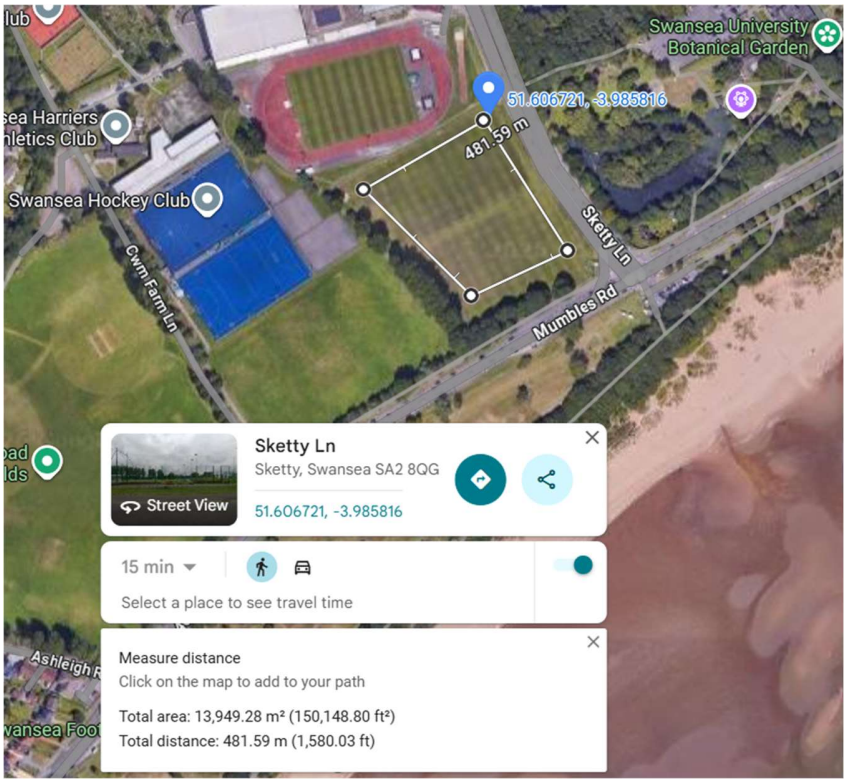


Figure 8 – Proposed site location, google maps 2026

The surface water runoff rate for the proposed high-rise hotel site on Sketty Lane can be calculated using UK Suds.com which determines surface types, and local rainfall intensity. As the development will introduce a significant amount of impermeable hardstanding and roof area, the runoff rate would be higher than the existing greenfield conditions if unmanaged.

SuDS are therefore required to control and restrict runoff to acceptable greenfield or agreed discharge rates, and ensuring that surface water is released safely and gradually, particularly given the site's proximity to the coast.

The calculation below show the estimated Greenfield run off for the proposed site location:

Greenfield runoff rate estimation tool

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

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

Project details

Date	11/05/2026
Calculated by	
Reference	
Model version	2.2.3

Location

Site name	Sketty Lane, Swansea
Site location	

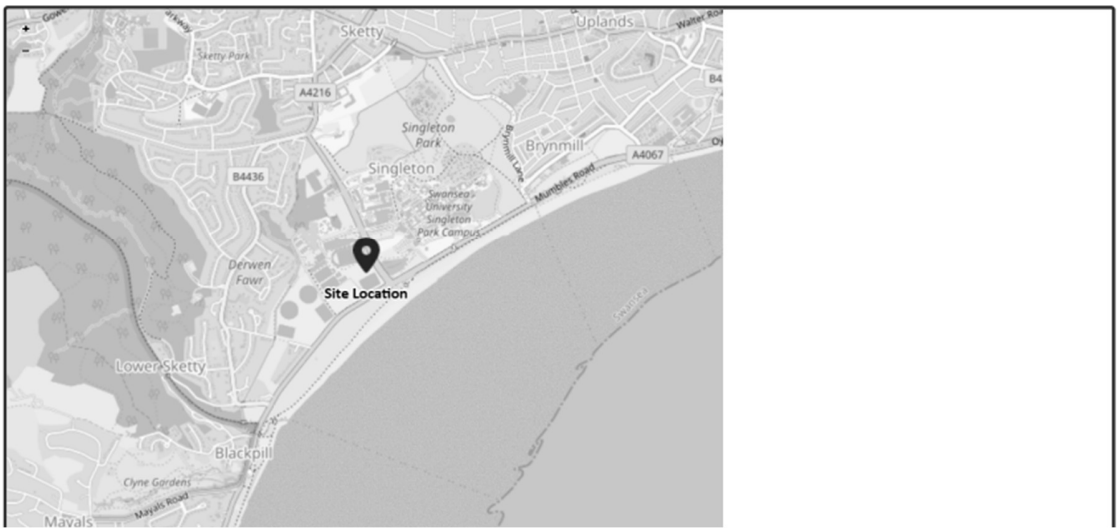


Figure 9

Site easting (British National Grid)	262557
Site northing (British National Grid)	191483

Site details

Total site area (ha)	13,949.28 ha

Greenfield runoff

Method

Method	IH124

IH124

	My value	Map value
SAAR (mm)	1163 mm	1163
How should SPR be derived?	WRAP soil type	
WRAP soil type	3	3
SPR	0.37	
QBar (IH124) (l/s)	67.6 l/s	

Figure 10

Growth curve factors

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

Results

Method	IH124	
Flow rate 1 year (l/s)	59.5	l/s
Flow rate 2 year (l/s)	62.9	l/s
Flow rate 10 years (l/s)	96.0	l/s
Flow rate 30 years (l/s)	120.4	l/s
Flow rate 100 years (l/s)	147.5	l/s
Flow rate 200 years (l/s)	166.4	l/s

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

Disclaimer

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

Figure 11

Figures 9 to 11 - HR Wallingford (2025). *Greenfield runoff rate estimation | UK SuDS.*

Based on the runoff calculations shown (IH124 method), a flow rate of 59.5 L/s would require a soakaway storage volume of 214 m3 – based on one-hour of a designed storm.

Allowing for a typical modular crate void ratio of 95%, this means soakaway size of 225m3.

Which would be 10 m x 7.5 m x 3 m = 225m3.

(Statutory standards for sustainable drainage systems - designing, constructing, operating and maintaining surface water drainage systems 2018 Sustainable Drainage Systems Standards for Wales. (n.d.)) (BRE Group. (2016). *title*.)

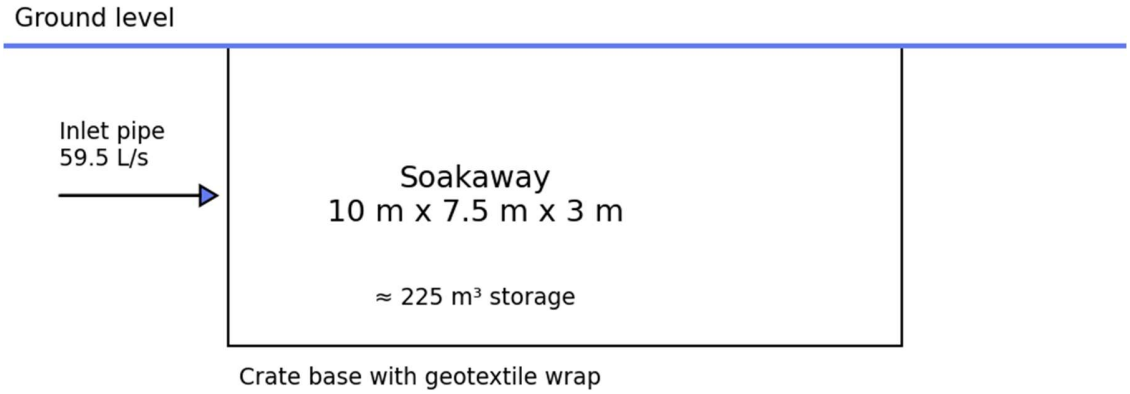


Figure 12 - Soakaway design

Required storage = 225m3

"A fully installed geocellular crate system typically costs £200 - £350 per cubic metre of storage." (Rain, A. (2026). *Attenuation Tank Cost in the UK*.)

£300 x 225m3 = **£67,500 – Estimated value to install soakaway.**

Proposed alternative solutions for my high-rise building design:

Permeable Paving:

Permeable surfaces to car parks, footpaths, and service areas reduce runoff and provide initial water treatment by filtering pollutants.

Rain Gardens and Planters:

Landscaped features around the building capture runoff, improve water quality, and enhance visual amenity, making them ideal for hotel and mixed-use developments.

Flow Control Devices:

Devices such as vortex flow controls ensure runoff is restricted to greenfield or agreed discharge rates, protecting downstream drainage systems.

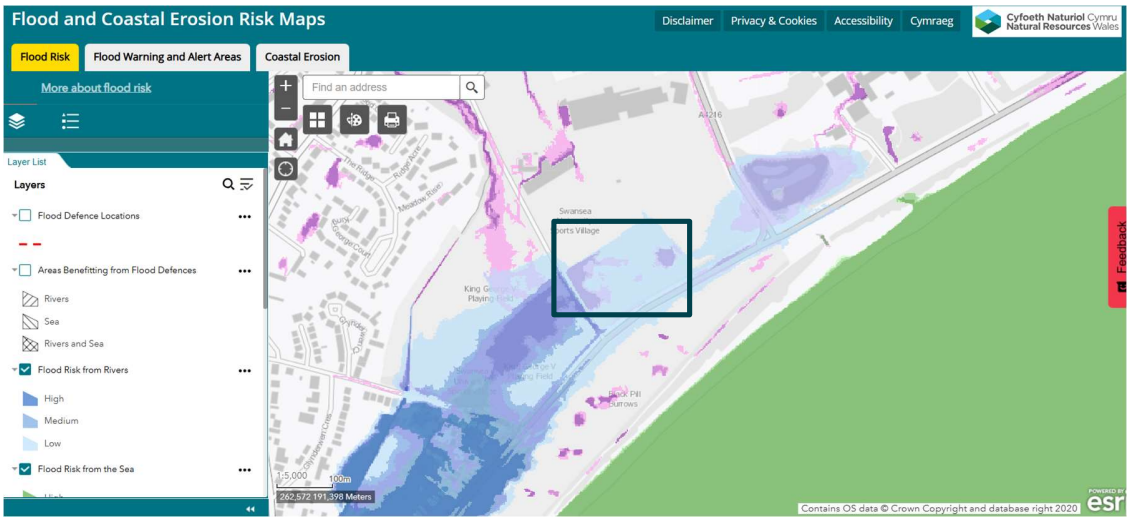


Figure 13 – Flood risk for the proposed site - Natural Resources Wales (2020). Story Map Series.)

Buildability

SITE LOCATION

As the location of the site in a built-up area and located near a leisure centre, sports field and the beach, traffic and noise management is going to be a key aspect of the build.

Traffic mitigation at the Swansea site is essential due to its location adjacent to university sports facilities and a leisure centre, which attract high pedestrian and vehicle movement at peak times.

A detailed Construction Traffic Management Plan should be implemented to define agreed delivery routes, restrict delivery times to off-peak periods, and prevent contractor parking on surrounding roads. These measures align with HSE public protection requirements and UK best practice for managing construction traffic in sensitive locations. (Riba.org. (2020). *RIBA Plan of Work*)

MODULAR CONSTRUCTION

Due to the site's proximity to a university sports field, in the city and leisure centre, modular construction is considered the most appropriate construction method. As it

minimises disruption, reduces construction time, and limits noise and on-site activity in a sensitive location.

Key Benefits of Modular Construction:

- Faster Project Delivery: Because site preparation occurs simultaneously with off-site manufacturing, total construction time is drastically reduced, allowing for earlier building occupancy.
- Lowered Costs: Streamlined factory processes minimise material waste, lower labour costs, and reduce the chance of expensive on-site errors and delays.
- Enhanced Quality Control: Manufactured in a controlled indoor environment, modules undergo strict quality checks, resulting in tighter joints, better insulation, and more durable structures.
- Improved Sustainability: Modular building creates up to 90% less waste than traditional construction, consumes fewer materials, and reduces the carbon footprint, with some projects achieving up to 82% less embodied carbon.
- Reduced Site Disruption: As much as 80% of construction activity occurs off-site, leading to significantly less noise, pollution, and traffic for the surrounding community.
- Improved Safety: Factory conditions reduce the risks of working at heights and in unfavourable weather, improving overall worker safety.
- Flexibility and Reusability: Modular units can be expanded, reconfigured, or even relocated in the future to meet changing needs.

(Boury, A. (2024). *Benefits of Modular Construction | The Access Group*.)

As the project is situated in a busy area of the city this project would be a time sensitive situation. Modular construction would be the best practice to build the development as "Research shows modular high-rise projects can typically be completed in around 18 months, compared to 24–30 months for conventional builds" (Bertram, N., Fuchs, S., Mischke, J., Palter, R., Strube, G. and Woetzel, J. (2019). *Modular construction: From projects to products.)*

Local firms:

To reduce construction times and minimise potential delays, a local firm based in Port Talbot will be used to supply SIPs panels and modular construction components. Sourcing materials locally shortens lead-in times, reduces transportation distances, and improves reliability within the supply chain. This approach also allows closer coordination between

the design team, manufacturer, and contractor, helping to resolve issues quickly and maintain programme certainty. Using a nearby supplier supports more efficient just-in-time deliveries, reduces the risk of logistical disruption, and contributes to sustainability by lowering carbon emissions associated with long-distance transport. (Tatasteeluk.com. (2025). *Home | Tata Steel UK*.)

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Figure 12 Soakaway design

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