Outline Surface Water Drainage Strategy - The Mole, Barry Docks

Draft

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Contract

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This report describes work commissioned by Associated British Ports, by an instruction dated 26th August 2022. The Client's representative for the contract was Nick Card of Associated British Ports. Erica Skinner and Faye Tomalin of JBA Consulting carried out this work.

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Abbreviations

ABP	Associated British Ports
AEP	Annual Exceedance Probability
BFI	Base Flow Index
BGS	British Geological Survey
CDM	Construction (Design and Management) Regulations 2007
CIRIA	Company providing research and training in the construction industry
FEH	Flood Estimation Handbook
HOST	Hydrology of Soil Types
LiDAR	Light Detection And Ranging
NRW	Natural Resources for Wales
QBAR	Mean Annual Maximum Flood
R&D	Research and Development
ReFH	Revitalised Flood Hydrograph method
SPR	Standard percentage runoff
SuDS	Sustainable Urban Drainage Systems

1 Introduction

1.1 Terms of Reference

JBA Consulting were commissioned by Associated British Ports (ABP) to prepare an Outline Drainage Strategy for land at The Mole, Barry. The assessment is to support a planning application and to seek SAB pre-application advice for the proposed development.

1.2 Site Description

The proposed development site is located off Neptune Road, Barry, Vale of Glamorgan, as shown in Figure 1-1. The red line boundary area is approximately 15.2ha, incorporating the dock itself. 2.8 ha of the site is developable, as shown in Figure 1-1.

The proposed developable area is a brownfield site that currently houses the Barry Community Water Activity Centre. To the west of the site, along Neptune Road, is existing residential development, with all other boundaries surrounded by Barry Dock.

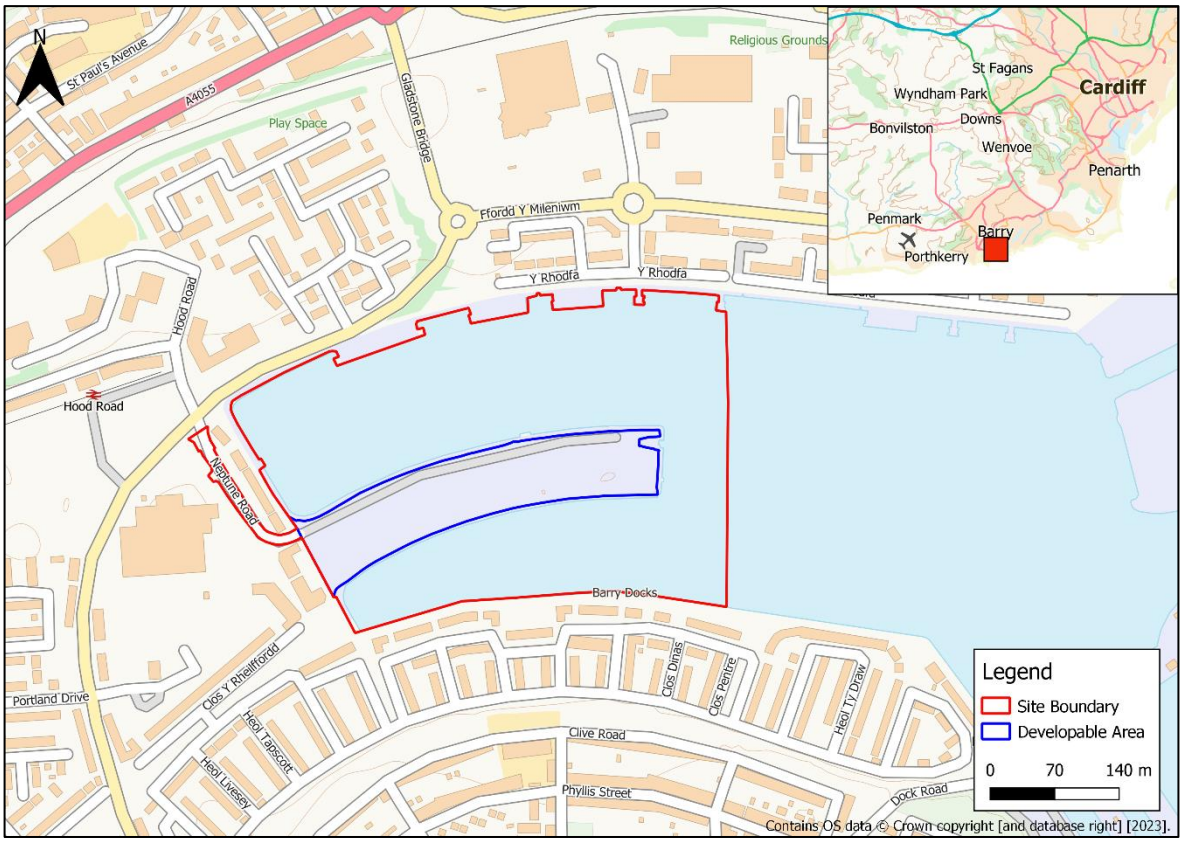


Figure 1-1 Site Location

1.3 Site Topography

Welsh Government's new 2021 1m Light Detection and Ranging (LiDAR) data has been used to analyse existing ground levels across the site. This data is not yet publicly available but was obtained via a data request directly to Welsh Government.

The site has a generally flat topography as shown in Figure 1-2. There is a slight slope from 9.25mAOD in the west of the site to 8.57mAOD in the east. From north to south the site is generally level, except for an existing access road along the northern boundary of the site which lies at 8.1mAOD, approximately 0.9m lower than the surrounding ground level.

Off site, ground levels generally rise from east to west from The Mole access point towards the Asda supermarket site nearby.

Figure 1-3 illustrates a topographic profile of Welsh Government's 1m DTM LiDAR dataset. The ground levels from Point A to The Mole access all lie at around 9.3m AOD. The point identified with a pink cross on Figure 1-2 corresponds with the pale blue hatched on Figure 1-3.

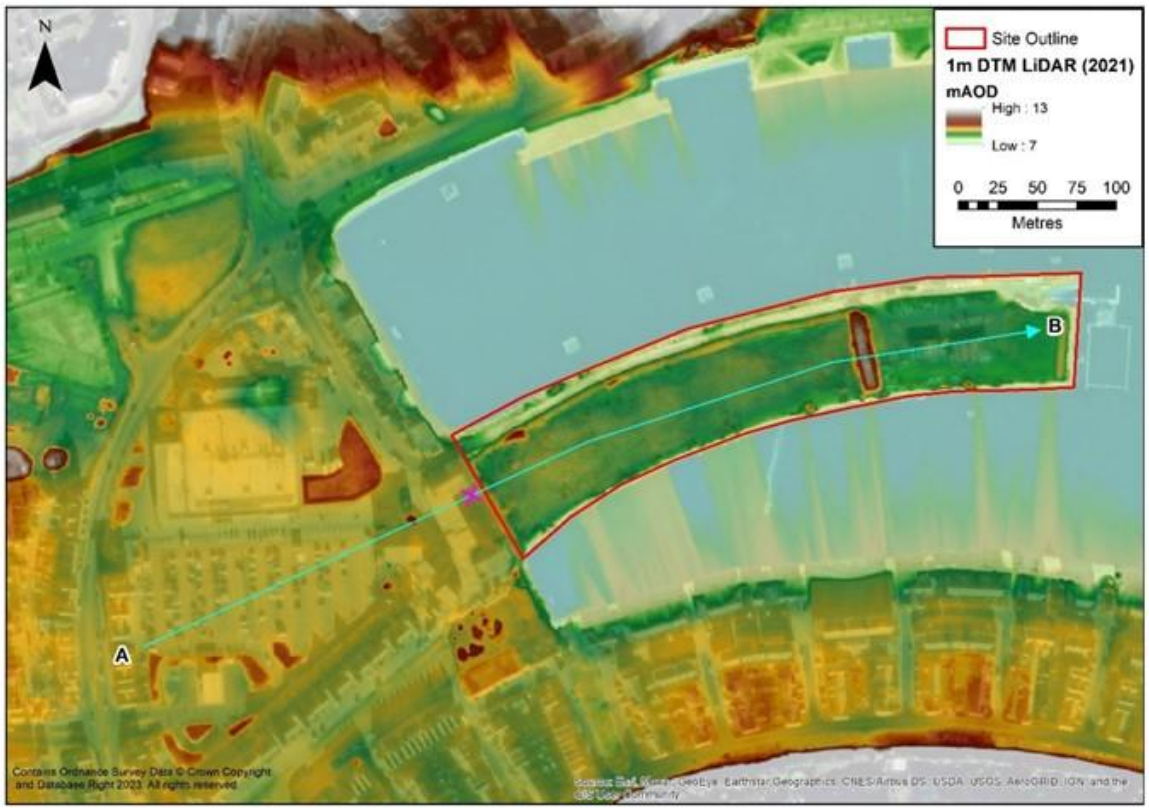


Figure 1-2 Site topography using Welsh Government 1m LiDAR

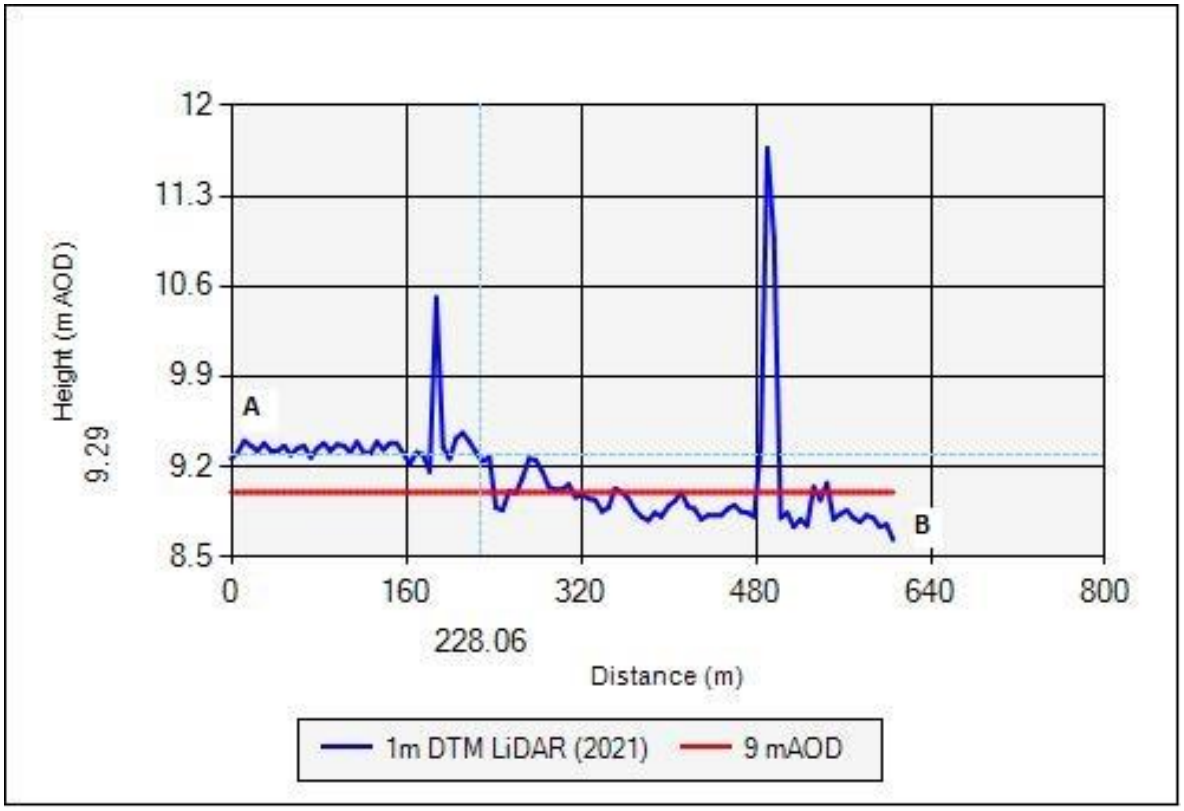


Figure 1-3 Topographic profile of The Mole and surrounding access areas

Peak Surveying Services produced a detailed topographic survey of the site in 2020 which can be found in Appendix A. This survey covers The Mole only, and not the adjacent access points.

An additional topographic survey, undertaken by Laser Surveys in January 2023, details updated levels for the existing access road (Neptune Road) to the proposed development site. In recent years, the areas located adjacent to The Mole access have undergone extensive redevelopment which included significant ground raising. As this ground raising is a recent addition, it is not reflected in NRW's 2011 LiDAR Open-Source dataset or resultant flood mapping.

As indicated by both the topographic survey and new LiDAR data, at the existing access point of the proposed development, the road has been raised to 8.98mAOD. As the road turn and directs north, the level raises to 9.2mAOD

1.4 Proposed Development

Development proposals for the site are for a mixed use, residential, leisure, and business site, with the creation of a 400-berth marina with floating pontoons. The west of the proposed development site will comprise of 19 x 1-2 bed apartments and 45 x 3-4 bed townhouses with a maximum height of 4 storeys, with associated parking and access. Towards the east of the proposed site, proposals include an incubation

workspace building comprising of offices, smart innovation spaces, breakout spaces and a café. Further to the east of the proposed development site lies a marine office building with facilities for visitors/members and a restaurant. The eastern vicinity will also host public open space and car parking. The proposed development plan and indicative site levels are provided in full within Appendix B.

To support the development aspirations, ground raising at the site is required to mitigate the risk of flooding. All areas of built development (including, roads, parking and buildings) will be raised to an approximate level of 9.20mAOD and a minimum level of 9.00mAOD. Areas outside of the development plateau will be graded down to existing ground levels retained behind the dock walls, providing a perimeter footpath around the Mole.

Development proposals are likely to take a phased approach, where public open space and development across the eastern area of the site shall be undertaken separately to the proposed residential areas. However, development phasing shall be dependent on the allocation of grant funding from the UK Levelling Up Funding programme. The Land Use Parameters Plan, indicative of development phasing, is also contained in Appendix B.

The existing access road (Neptune Road) has already been raised to 8.98mAOD, linking the site to high ground.

1.5 Summary of Surface Water and Small Watercourse Flood Risk

The NRW Flood Risk Assessment Wales (FRAW) map for surface water and small watercourses is shown in Figure 1-4. The proposed developable area is at ‘very low’ risk from surface water and small watercourse flooding, where there is a less than a 0.1% AEP chance of flooding in any given year.

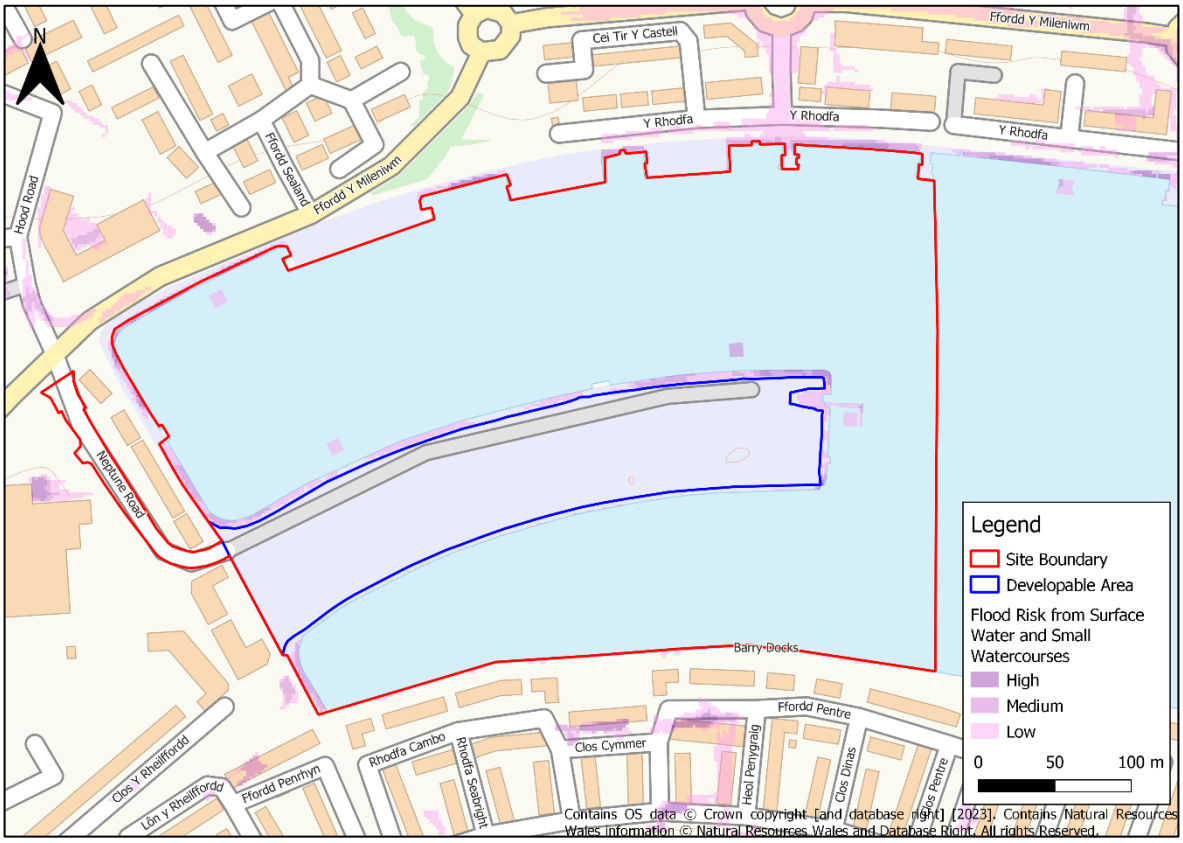


Figure 1-4 Flood Risk from Surface Water and Small Watercourses

1.6 Summary of Groundwater Flood Risk

Groundwater flooding is caused by unusually high groundwater levels. It occurs as excess water emerging at the ground surface or within manmade structures such as basements. Groundwater flooding tends to be more persistent than surface water flooding, in some cases lasting for weeks or months, and can result in significant damage to property. The risk of groundwater flooding depends on the nature of the geological strata underlying the sites, as well as on local topography.

The Vale of Glamorgan Local Flood Risk Management Strategy[1] states that the risk of groundwater flooding in the study area is considered to be between a 50% to 75% chance of flooding. Barry has historically been affected by groundwater flooding; however, the risk of groundwater flooding in Barry is typically linked to areas of overlying limestone. This does not apply to the Mole site, which is built on significant made ground and will have a groundwater table directly linked with the water level of the Dock. Consequently, we conclude that the risk of groundwater flooding is very low for the Mole.

1 The Vale of Glamorgan. Local Flood Risk Management Strategy (2013) https://www.valeofglamorgan.gov.uk/Documents/Living/Environment/Flood-and-coastal-erosion-risk/VoGC-LFRMS.pdf

2 Existing Surface Water Drainage Regime

2.1 Existing Site Geology and Drainage

Ground investigations are not currently available for the proposed development site. Consequently, a desktop study of the site geology and soils has been carried out.

The geology of the site has been assessed using the British Geological Survey (BGS) Geology of Britain Viewer[2]. The bedrock is shown to be Blue Anchor Formation comprised of mudstone and other sedimentary bedrock. The superficial geology is formed of tidal flat deposits, comprised of clay, silt and sand.The soils on site have been assessed on the Cranfield University Soilscape Viewer[3] and are shown to be freely draining slightly acid but base-rich soils.

Due to the industrial nature and setting of the site this description should be used with caution as the soils are likely to be highly compacted and the site comprised of made ground to significant depths.

It is unknown whether there is an existing surface water drainage system at the proposed development site and as a result of the above geological characteristics, infiltration is unlikely. However, it is assumed that surface water from the site currently flows into the surrounding dock. It is assumed, but unknown, as to whether there are any existing surface water outfalls serving the site.

2.2 Greenfield Runoff Rates

Table 24.1 of the SuDS Manual indicates that the FEH methods (FEH Statistical and ReFH) should be the preferred methods for calculating peak runoff rates. This is supported by Natural Resources Wales GN008 Flood Estimation: Technical Guidance and Environment Agency research by Faulkner et al which concluded that FEH methods are applicable across a range of catchment sizes and that they should be used in place of outdated methods such as IH124 and ADAS 345 where possible.

The UK SuDS tool has been used to calculate Greenfield runoff rates for the sites developable area (2.8ha) using the FEH Statistical Method, as seen in Appendix C. FEH characteristics have been downloaded for the site from the FEH Webservice. The calculated Greenfield runoff rates are shown in Table 2-1.

2 http://mapapps.bgs.ac.uk/geologyofbritain/home.html
3 http://www.landis.org.uk/soilscapes/

Table 2-1 Greenfield Runoff Rates

Return Period	Specific Runoff (l/s/ha)	Peak Runoff Rate (l/s)
1	4.77	13.35
QBAR	5.42	15.17
30	9.64	27.00
100	11.81	33.07

2.3 Greenfield Runoff Volumes

Greenfield runoff volumes were calculated for a six-hour storm event at the site using the FSSR16 method as shown in Equation 1 below.

Runoff volume = Site Area x Rainfall Depth x Percentage Runoff

Equation 1: FSSR16 method for calculating Greenfield runoff volumes

Percentage runoff was calculated using the FSSR16 methodology which accounts for soil type, catchment wetness and storm intensity. The rainfall depths for a six-hour 100-year storm event were extracted from the FEH Web Service and are summarised in Table 2-2 with the calculated Greenfield runoff volumes.

Table 2-2 Greenfield Rainfall Depths and Runoff Volumes

Return Period	6-hour rainfall runoff depth (mm)	Site runoff volume (m3)
100	70.24	756
100 plus climate change (40%)	98.34	1137

3 Surface Water Management Approach

3.1 Sustainable Drainage Systems

Sustainable Drainage Systems (SuDS) aim to mimic the natural processes of Greenfield surface water drainage by allowing water to flow along natural flow routes and also aims to reduce the runoff rates and volumes during storm events, whilst providing water treatment benefits. SuDS also have the advantage of providing Blue and Green Infrastructure and ecology and recreational benefits when designed and maintained properly.

Schedule 3 of the Flood and Water Management Act 2010 was enacted in Wales in January 2019, leading to the requirement for all new developments to incorporate SuDS in the development. This needs to encompass the four pillars of SuDS design, shown in Figure 3-1.

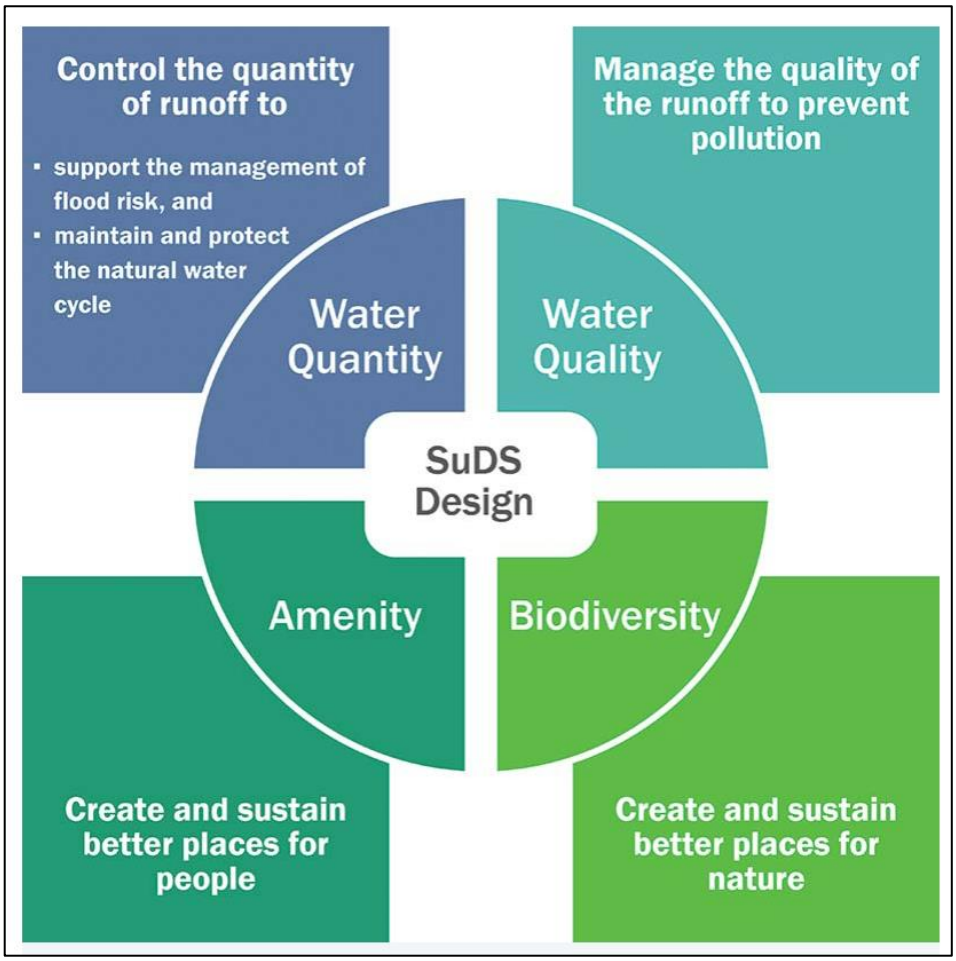


Figure 3-1 Four Pillars of SuDS Design (CIRIA, 2015)

3.2 Design Criteria

The following national guidance documents and design standards are considered when developing a SuDS strategy for a new development site:

- C753 The SuDS Manual (CIRIA, 2015)
- Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems (Welsh Government, 2018)
- Planning Policy Wales – Edition 10, December 2018
- The Building Regulations 2010 Part H: Drainage and Waste Disposal
- Sewers for Adoption 7th Edition
- County/City wide guidance from the local SuDS Approval Body (SAB), if available.

The Vale of Glamorgan Council does not currently have county-wide SuDS guidance available. Should such guidance become available in the future, it should be incorporated into detailed design work for full SAB approval.

3.3 Principles of SuDS

The proposed surface water drainage scheme complies with the standard principles of SuDS in the following way:

- Wherever possible across the site, water is managed as close to the surface as possible through the use of SuDS planters and trees, rain gardens, swales and filter drains which all convey flow across the site.
- Rainwater is treated as a valuable natural resource across the site by keeping water as close to the surface as possible through the use of SuDS planters and trees, rain gardens, swales and filter strips. SuDS assets will provide amenity and biodiversity benefits across the site.
- Across the site, rainfall shall be managed to help protect people from increased flood risk through the implementation of source control techniques such as filter drains and rain gardens.
- Rainfall will be managed across the site to ensure that the site does not flood during the 1 in 30-year event, and no property will flood during the 1 in 100-year event plus 40% for climate change.
- During detailed design, a 10% allowance for urban creep shall be applied to hydraulic calculations. This shall be applied to areas of residential development across the site. No allowance for urban creep shall be required for areas of access roads / parking, and public / commercial buildings. A 40% climate change allowance will be applied to peak rainfall intensity and design inflows across the entirety of the development site.
- A SuDS Management Train is included across the site as water is intercepted via SuDS planters and tree pits, before entering rain gardens or a basin before it is

discharged into the dock. The commercial buildings in the east will enter a swale before entering a basin or a rain garden prior to discharge. The Simple Index Approach, in line with C753, will be used to demonstrate how surface water shall be managed to ensure that the proposed development shall not have a detrimental effect on water quality.

- Biodiversity and amenity benefits are maximised across the site wherever possible. The use of planting within SuDS planters, tree pits and rain gardens increases opportunities for habitat creation and connectivity, in addition to promoting a sense of well-being for site employees.
- We propose to make the best use of available land by integrating SuDS into the landscaped environment. Basins are proposed as shallow scrapes, allowing access for site residents, employees and visitors, whilst also providing a water treatment and conveyance function. SuDS features are placed in green areas of the proposed design, enhancing the environment and providing multi-functional areas of open space.
- To ensure that the scheme performs reliably and effectively for the lifetime of the development, a maintenance plan shall be produced during detailed design stage, which shall detail the management and maintenance requirements of the system to ensure that it functions to its optimal capacity in perpetuity. Throughout the design of the system, a designer's risk assessment shall be carried out to ensure that all SuDS assets are safe and fit for purpose.
- All surface water shall be drained via gravity towards the dock.
- During detailed design stage, further information shall be provided on the affordability in terms of long-term maintenance costs through provision of a SuDS maintenance plan. The social and environmental benefits of the scheme are detailed in Section 3.4 and 3.5. At detailed design stage, further information shall be provided within an Amenity and Biodiversity Plan.

3.4 S1: Surface water runoff destination

The statutory standards for SuDS in Wales address the use of surface water by the development and where it should be discharged. It has developed a destination hierarchy which sets out the preferred routes for discharge of runoff from the site:

- Priority Level 1: Surface water runoff is collected for reuse
- Priority Level 2: Surface water runoff is infiltrated to ground
- Priority Level 3: Surface water runoff is discharged to a surface water body
- Priority Level 4: Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system
- Priority Level 5: Surface water runoff is discharged to the combined sewer

Priority Level 1 is the preferred (highest priority) and 4 and 5 should only be used in exceptional circumstances. The following outlines how the proposed development adheres to the drainage hierarchy.

Priority Level 1 - Water for re-use

It is envisaged that the yield to use ratio will not be sufficient to dispose of a significant volume of surface water runoff across the development site via rainwater harvesting. It is proposed to supply rainwater butts to each residential property to promote rainwater reuse.

Priority Level 2- Infiltration

As the proposed development is located within Barry Dock with a historical industrial use, there is a high potential for contamination of the subsoils. As a result, infiltration is unlikely to be viable for the site due to the risk of mobilisation of contaminants and ground contamination tests should be carried out to confirm this. The Vale of Glamorgan Council have confirmed that infiltration tests shall not be required to be submitted with a full SAB application if contamination reports demonstrate that the site is highly contaminated.

The proposed development site is also comprised of Made Ground to significant depths, not likely to support an infiltration based SuDS solution. Further Ground Investigations shall be provided at detailed design stage.

For the purposes of this report, infiltration is not considered to be a viable means of disposing of surface water from this development site.

Priority Level 3- Discharge to a surface water body

As infiltration across the site is not viable, opportunities to discharge surface water to a surface water body should be explored. The most suitable surface water body is Barry Dock surrounding the north, east and south of the site. Outfalls for the disposal of surface water into this dock are already on site and are assumed to be in use. Further investigation work will be needed to confirm this, along with their viability for use. Should existing outfalls not be viable, the SuDS scheme shall propose new outfalls for surface water drainage into Barry Dock.

As this is a viable solution for the site, Priority Levels 4 and 5 do not need to be considered.

3.5 S2: Surface Water Runoff Hydraulic Control: Proposed Discharge Rate

3.5.1 Allowance for Climate Change

The Welsh Government has produced a Climate Change Allowance guidance[4] which contains updated representative climate changes allowances for Wales for peak flows. The guidance contains indicative sensitivity ranges for peak rainfall intensity. As the

4 Flood Consequences Assessments: Climate change allowances in Wales: https://www.gov.wales/sites/default/files/publications/2021-09/climate-change-allowances-and-flood-consequence-assessments_0.pdf

site is proposed to be a mixed development, the assumed lifetime of development at the site is 100 years, and as such the 2070-2115 estimate should be used. The recommended climate change factor for small catchments using the central estimate for the 2070-2115 epoch is 20%. However, for the purpose of this report the upper estimate of 40% has been used.

3.5.2 Discharge limits and Attenuation Volume

In accordance with G2.1 of the Statutory Standards for SuDS in Wales, "*where the surface water body is unaffected by either the discharge rate or volume of runoff (e.g. an estuary, the sea, or a waterbody identified in the Local Flood Risk Management Strategy (LFRMS) as not needing hydraulic control to runoff to it), the hydraulic management control requirements are limited to the drainage service provisions for the site and adjacent areas that could be affected by performance of the system*".

As a result, there is no requirement to limit runoff from the proposed development as a consequence of discharging surface water directly into the tidal waters of Barry Dock. As there is no limit to surface water discharge, a volume for surface water attenuation on site is not required.

However, consideration should be given to the potential for the proposed outfall of the system to be hydraulically locked during rainfall events as a result of tidal levels. The design event for consideration is the 100 year (plus climate change) 6 hour rainfall event.

In order to determine the most appropriate tidal return period to apply to the tide level during the 100 year rainfall event, reference was made to Defra R&D Technical Report FD2308/TR1, dated 2005 "Joint Probability: Dependence mapping and best practice5". Joint probability analysis predicts the probability of occurrence of events in which two or more partially dependent variables simultaneously take high or extreme values. The Defra report summarises dependence between key pairs of variables around England, Wales and Scotland in a form suitable for use in simplified joint exceedance analysis methods.

Correlation coefficients for the nearest tide and rain gauges are contained within the Defra report. Table 4.6 (rainfall and sea-level) of the report contains the correlation coefficients for Avonmouth tide gauge and Rhiwbina rainfall gauge, the nearest gauges to the site. The best estimate of dependence is 0.04 and the 'high end' estimate is 0.14. A value of 0 means that there is no correlation, and a value of 1 is a

5 Defra R&D Technical Report , accessed: FD2308/TR1https://assets.publishing.service.gov.uk/media/602bacfd8fa8f50381945d04/Joint_probability_Dependence_mapping_and_best_practice_Technical_report_on_dependence_mapping_Technical_Report.pdf

perfect correlation. Therefore, the correlation values for the site are indicative of a very weak correlation between rainfall and tidal conditions.

Applying the methods of FD2308 for the correlation values above, it is possible to calculate the return period of the tidal boundary for any rainfall return period event. In all cases, including using the high end correlation value and up to the 1 in 10,000 year rainfall event, the corresponding tidal return period is 1:0.1 or less. This is as low as the analysis allows and corresponds to a tidal value of Mean High Water Springs (MHWS).

Effectively, the probability of a peak tidal event greater than MHWS coinciding with an extreme rainfall event is negligible. Consequently, the MHWS event has been used to determine an appropriate outfall level for the proposed surface water drainage system which would allow for a free discharge during all conditions.

The MHWS still water level has been extracted from node 424 of the Coastal Design Sea Levels - Coastal Flood Boundary Extreme Sea Levels data set6 released in 2018. The base year of 2017 was uplifted to present day levels using Welsh Government climate change guidance. This provides a 2023 MHWS level of 5.65mAOD.

The proposed development includes residential dwellings, thus having a lifetime of development of 100 years. Consequently, the 2123 MHWS tide level was calculated using the same methodology. The 2123 MHWS tide level is 6.69mAOD.

Outfalls from the proposed surface water drainage system shall be sited at a level greater than 7mAOD to ensure a free outfall during the extreme rainfall event. A minimum ground level of 9.0mAOD is to be provided across the development site. As a result of a free outfall, and discharge into tidal waters, there is no requirement to attenuate surface water across the site, and no storage volume calculations have been provided.

3.5.3 Interception of Rainfall

When rainfall takes place on Greenfield sites there is, for the majority of rainfall events, no runoff from a site due to evapotranspiration or groundwater recharge. Therefore, interception mechanisms are based on runoff volume reduction using evapotranspiration and infiltration processes.

The proposed SuDS system for The Mole is proposed to discharge into a Barry Dock. As a result, there is no requirement to limit runoff from the proposed development as a consequence of discharging surface water directly into tidal waters. Reduction to greenfield runoff rates is a measure specifically designed to mitigate fluvial flood risk,

6 Coastal Design Sea Levels - Coastal Flood Boundary Extreme Sea Levels data set. Accessed: https://www.data.gov.uk/dataset/73834283-7dc4-488a-9583-a920072d9a9d/coastal-design-sea-levels-coastal-flood-boundary-extreme-sea-levels-2018

therefore reduction to greenfield runoff rates is not particularly relevant to this site. As interception aims to “mimic greenfield runoff conditions” (G2.11) and the scheme is not strictly required to reduce to greenfield runoff rates, it is considered that the requirements of Standard 2 do not apply to the proposed SuDS scheme.

3.5.4 Proposed Surface Water Drainage Strategy

The outline drainage strategy for the development is contained in Appendix D. Final proposed ground levels for the development site were not available at the time of writing. However, it is known that the site will be raised to a minimum of 9mAOD and that the site will slope towards the dock from the centre of the site to the north, south and east in order for the site to tie in with existing sea walls retaining the spur into the dock. These assumptions have been used to develop the drainage strategy.

Despite attenuation not being required on the site, a range of SuDS components have been proposed across the development in an interconnected system designed to manage, treat and make best use of surface water runoff. A central design concept for SuDS is the SuDS management train. This describes the use of a sequence of components that collectively provide the necessary processes to reduce concentrations of potential contaminants to acceptable levels.

The development site has been split into a number of sub-catchments with independent drainage systems served by independent outfalls to Barry Dock. Surface water shall be discharged into the dock at an unattenuated rate. Each outfall shall be served by a flap-valve to mitigate against rising dock levels entering the surface water network during tidal flood events.

Despite a large number of sub-catchments across the site, a holistic approach to the use of SuDS has been utilised, incorporating SuDS into the landscape and areas of open space, promoting SuDS for the end user.

SuDS features proposed for the development site include tree pits, SuDS planters and swales as source control features for proposed buildings/properties across the site. A network of rain gardens is located alongside roads, pavements and car parking spaces which will outfall into the dock. Basins are provided across the site to treat flows prior to their discharge into the dock, promoting the multi-functional use of SuDS, allowing access to site users in area of public open space.

Full hydraulic calculations have not yet been undertaken for the proposed surface water system, with this pre-application submission is intended to gain in-principal agreement to the proposals only, prior to detailed design work. Table 3-1 summarises key site characteristics which are proposed to be taken forward to detail design.

Table 3-1 User Defined Values

Variable	Value
Site Area	15.2 ha
Developable Area	2.8 ha
Area of Open Space	1.37 ha
Impermeable Area	1.43 ha
Climate change allowance	40%
Urban creep allowance	10% (residential areas only)
BFI HOST	0.538
SPR HOST	0.34
SAAR	930

3.5.5 Exceedance Events

Extreme events exceeding the design event could occur and may result in overland flows across the site. It is envisaged that exceedance flow routes will be along impermeably surfaced areas and surface water will be directed towards the dock. Further information on exceedance flows shall be provided at detailed design stage.

Additionally, it is recognised that the above methodology in section 3.5.2 applies a high return period rainfall event against a low return period tidal event. It is therefore considered appropriate to undertake sensitivity analysis on the system to determine the impact on the proposed network in the event of a low return period rainfall event and high return period tidal event. It is therefore considered appropriate to utilise the 2 year rainfall event in conjunction with the 200 year tidal event, with an allowance for climate change.

The T200 still water level has been extracted from node 424 of the Coastal Design Sea Levels - Coastal Flood Boundary Extreme Sea Levels data set The base year of 2017 was uplifted to 2123 levels using Welsh Government climate change guidance. This provides a 2123 T200 level of 8.56mAOD.

With a minimum ground level of 9mAOD, it is envisaged that there will be insufficient fall across the system to raise the outfall of the system above the T200 2123 tide level of 8.56mAOD. Consequently, it is likely that the surface water drainage network shall be surcharged in this event. However, given the difference in level from proposed ground level (9mAOD) to proposed outfall level (7mAOD) it is likely that there shall be sufficient hydraulic head on the system to force surface water out into the dock during this design event. This shall be demonstrated further during detailed design. Should this not be the case, and surface water backs up into the surface water network, any flooded volume shall utilise the proposed exceedance routes to flow overland directly into Barry Dock.

3.6 S3: Water Quality

The surface water drainage system should provide a sufficient level of water quality treatment to prevent pollution of receiving waterbodies.

Table 4.3 of the SuDS Manual advocates the use of the “simple index approach” to determine an appropriate level of pollution mitigation for development sites. This splits pollution into three contaminant types (Total Suspended Solids, Metals and Hydrocarbons) and assigns a “pollution hazard index” to each type. Different SuDS features are then assigned a “SuDS Mitigation Index” and sufficient treatment is deemed to be provided if the “SuDS Mitigation Index” is equal to or greater than the “pollution hazard index” for each pollutant type. When more than one SuDS component is required a multiplication factor of 0.5 is applied to mitigation indices for secondary and tertiary components to account for reduced performance.

The proposed development is for residential, leisure and business purposes. It is defined as having a 'Low Pollution Level' classification in line with Table 26.2 in the CIRIA SuDS Manual, as residential driveways and small commercial sites with traffic movements of less than 300 a day usually have a ‘low’ pollution hazard level. The “pollution hazard indices” for a low pollution hazard site are given in Table 3-2 below.

Table 3-2 Pollution Hazard Indices for the Site

Pollution hazard level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Low	0.5	0.4	0.4

Table 26.3 of the SuDS Manual provides indicative SuDS mitigation indices for discharges to surface water.

The proposed development will use a number of methods to manage drainage on site and mitigate the potential pollution hazards across the site, as shown in Table 3-3. Table 3-3 demonstrates sufficient mitigation of potential contaminants by each individual SuDS feature proposed for the site without the need for a treatment train and further consideration of appropriate mitigation indices.

Table 3-3 Pollution Hazard Indicates for SuDS Features

SuDS Component	Mitigation Indices		
	Total Suspended Solids (TSS)	**Metals**	**Hydrocarbons**
Swale	0.5	0.6	0.6
Rain garden	0.8	0.8	0.8
SuDS planters	0.8	0.8	0.8
Tree Pits	0.8	0.8	0.8
Detention Basin	0.5	0.5	0.6
Filter drain	0.4	0.4	0.4

3.7 S4: Amenity Value

The design of the surface water management system should maximise amenity benefits across the site. SuDS components can enhance the provision of high-quality, attractive public space which can help to provide health and well-being benefits and contribute to improving the climate resilience of new developments.

The aim of Standard 4 is to ensure that wherever possible and having regard to the need to prioritise infiltration drainage, the SuDS scheme makes the best contribution towards maximising benefits for amenity.

It is recognised, that as the site will have unattenuated flows into Barry Dock, the use of detention SuDS on site will be minimal, but an adequate treatment will still be necessary.

SuDS trees, planters and rain gardens across the site will assist in the climatic resilience of the development and promote carbon sequestration, along with the creation of a pleasant green environment for site visitors and employees, improving their mental health and wellbeing.

3.8 S5: Biodiversity

The surface water drainage system should seek to enhance existing habitats within the area and complement neighbouring habitats such as the coastal and marine environment. The ecological potential of the SuDS system can be maximised by utilising local native planting.

SuDS features where planting is included across the site will contribute to the creation of new habitats and ecosystems connecting the landscape to existing local habitats. A variety of native planting will be used to encourage biodiversity within the site. The use

of rain gardens and tree pits shall introduce wildlife corridors across the site, helping to improve biodiversity.

3.9 S6: Design for Construction, Maintenance and Structural Integrity

The national SuDS standards state that components must be designed to ensure structural integrity of the drainage system and any adjacent structures or infrastructure under anticipated loading conditions over the design life of the development taking into account the requirement for reasonable levels of maintenance.

3.9.1 Health and Safety

The surface water drainage system should be designed so that it minimises health and safety risks to the residents of the site. SuDS are sometimes perceived as unsafe features, but with correct design, these risks can be mitigated. A CDM Designers Risk Assessment should be undertaken demonstrating that any proposed surface water drainage system is fit for purpose, with risks designed out of the proposal, or mitigated wherever necessary. A CDM Risk Assessment for the outline drainage strategy is contained in Appendix E. This should be further updated at detailed design stage.

3.9.2 Adoption And Maintenance

Schedule 3 of the Flood and Water Management Act was implemented in Wales on the 7th January 2019. Under this legislation, SuDS that serve multiple properties must be approved and adopted by the SuDS Approval Body (SAB) – a function performed by the Lead Local Flood Authority at the Vale of Glamorgan County Council.

As a result of development phasing and the proposal for independent drainage systems based on sub-catchments across the site, the requirement for SuDS adoption shall be dependent upon the nature of the sub-catchments. Surface water systems serving residential areas shall be adoptable by the SAB by nature of the system serving a number of landowners. SuDS serving the highway are likely to be adoptable by the Highway Authority. SuDS serving the incubator building and marine offices to the east of the site, if belonging to a single landowner, shall not be adoptable. At Detailed Design stage, a full SuDS Adoption Plan shall be submitted for approval.

During detailed design phase, a detailed maintenance plan shall be developed to demonstrate the maintenance required to ensure that the proposed drainage system functions to optimal capacity in perpetuity.

3.9.3 Construction Environmental Management Plan & Development Phasing

With any SAB application there is a requirement to consider development phasing and to prepare a Construction Management Plan to provide a structured approach to construction activities and temporary works for constructing SuDS, ensuring that key construction site issues such as drainage, flooding, sediment control, pollution

prevention, storage of materials and existing habitats are sensitively and effectively managed until site construction is complete. Further details on Construction Management and Phasing shall be supplied at detailed design stage.

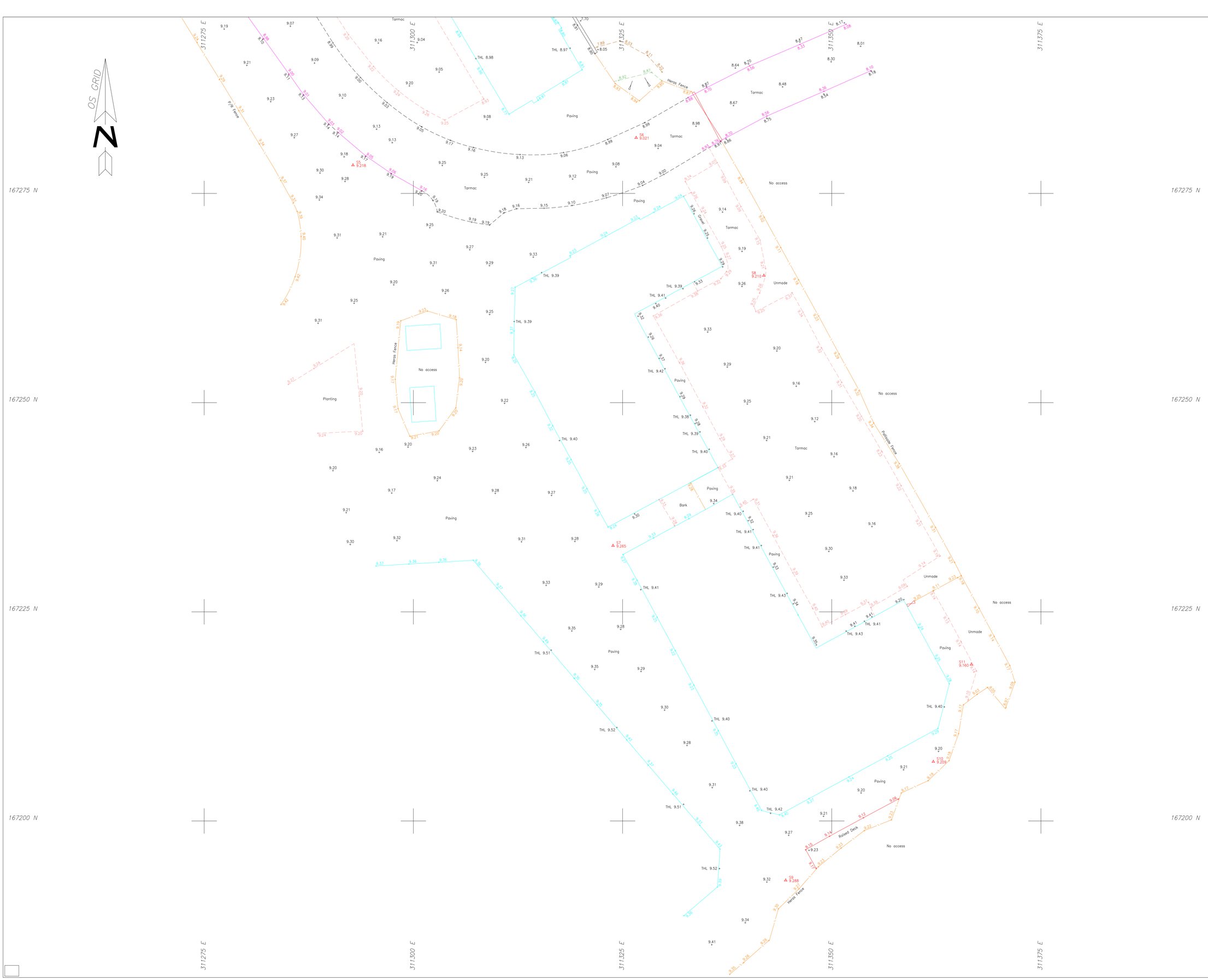
As detailed in Section 1.4, development proposals are likely to take a phased approach, where areas of public open space, development across the eastern area of the site and access roads and associated parking for these areas are constructed separately to the proposed areas of residential development. The Land Use Parameters Plan, indicative of development phasing, is contained in Appendix B. Across the outline drainage strategy, consideration has been given to the placement of SuDS assets serving each likely construction phase, and the impact on future development works and adoption of SuDS assets by the SAB. Sub-catchments have been derived based on the Land Use Parameters Plan, ensuring that each phase of development can be served by individual drainage systems.

Further advice is sought from the SAB as to the impact of this approach on the intended adoption of SuDS assets and further phases of development across the site.

4 Conclusions

- JBA Consulting were commissioned by Associated British Ports (ABP) to prepare an Outline Drainage Strategy for the land at The Mole, Barry. The assessment is to support a planning application and to seek SAB pre-application advice for proposed development.
- Development proposals for the site are for a mixed use, residential, leisure and business site, with the creation of a 400-berth marina with floating pontoons.
- The current topography on site is relatively flat with a slight decline from the centre (8.73mAOD) to the south (8.68mAOD). The site also falls towards the north across the access road.
- As a tidal flood mitigation measure, it is proposed to raise the ground levels to a minimum of 9mAOD, with the majority of the site set to 9.2mAOD.
- The site is at a little to no risk of flooding from groundwater, surface water or small watercourses.
- The soils on site are shown to be freely draining slightly acid but base-rich soils. Due to the industrial nature and setting of the site this description should be used with caution as the soils are likely to be highly compacted and constitute of made ground to significant depths, making infiltration unlikely.
- It is unknown whether there is an existing surface water drainage system at the proposed development site. However, it is assumed that surface water from the site flows into the surrounding dock.
- Greenfield runoff rates for the site for QBAR were calculated at 5.4 l/s/ha.
- Due to the site's location next to Barry Docks, surface water discharge from the site does not need to be limited. This is in line with standard G2.1 of the Statutory Standards for SuDS.
- SuDS that serve multiple properties must be approved and adopted by the SUDS Approval Body (SAB) – a function usually performed by the Lead Local Flood Authority at the Vale of Glamorgan County Council.

A Topographic Survey



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DATUM NOTES

CO-ORDINATES USED ARE BASED ON ORDNANCE SURVEY NATIONAL GRID, OBTAINED VIA THE ACTIVE GPS NETWORK AND ADJUSTED TO A LOCAL GRID WITH A SCALE FACTOR OF 1.0000.

LEVELS ARE RELATED TO :- ORDNANCE SURVEY ACTIVE GPS NETWORK.

SURVEY CONTROL STATIONS SHOWN

ABBREVIATIONS (where applicable)

(A)	Assumed/Approximate	OH	Overhead
A	Arch Ht	PAV	Paving
AC	Air-Con Unit	PB	Post Box
AG	Above Ground	PD	Pit Depth
AV	Air Valve	PE	Pipe
B	Beam Ht	PL	Pit Level
BL	Backdrop Invert Level	PM	Parking Meter
BK	Brick	P/R	Post and Rail
BL	Bollard	PSC	Size Change
BS	Bus Stop	P/T	Post
BSU	Beam Slopes Up	P/W	Post and Wire
BT	British Telecom	RE	Rodding Eye
C	Cable TV	RET	Retaining
C/B	Close Boarded	RS	Road Sign
C/F	Coverfast	RSJ	Rolled Steel Joist
CL	Cover Level	S	Silt Ht
CLK	Chainlink	SA-	Survey Abandoned-
CN	Connection	-BE	-Stuck at Bend
CO	Column	-CXI	-Intruding Connection
Conc	Concrete	-DA	-Debris Attached
CP	Catch Pit	-DS	-Debris Settled
CPS	Concrete Paving Slabs	-JD	-Joint Displaced
CSU	Ceiling Slopes Up	-LT	-Loss of Traction
CTV	Cable Television	-OB	-Obstruction
CW	Combined Water	-OL	-Operating Limit
DC	Drainage Channel	-R	-Roots
D	Depth	-SDP	-Small Diameter Pipe
DH	Depth in	-SP	-Surcharged
DP	Drain Pipe	-UW	-Under Water
EP	Electricity Pole	S/C	Surcharged
ER	Earthing Rod	SD	Silt Depth
FC	False Ceiling Ht	SK	Soakaway
FB	Flower Bed	SL	Silt Level
FE	Fence	SP	Spring Ht
FH	Fire Hydrant	SPT	Septic Tank
FL	Floor Level	ST	Silt Trap
FP	Flag Pole	SV	Stop Valve
FW	Foul Water	SVC	Security Video Camera
GP	Gate Post	SW	Storm Water
GV	Gas Valve	TCB	Telephone Call Box
G/U	Grill Up	THL	Threshold Level
H	Hand Ht	TL	Traffic Light
HIL	High Level Invert	TN	Tank
HT	Height	TP	Telegraph Pole
IC	Inspection Cover	TXnx	Item Number in CCTV Report
IL	Invert Level	UG	Underground
INJNT	Interceptor	UTC-	Unable to Camera-
I/R	Iron Railings	-A	-No Access
JB	Junction Box	-D	-Debris
JN	Junction	-DRP	-Drop Pipe
KO	Kerb Outlet	-F	-Flow/Water Level
LB	Litter Bin	-RT	-Roots
LP	Lamp Post	-S/C	-Surcharged
MC	Material Change	UTI	Unable to Trace Further
MG	Multi Girth Tree	UTL	Unable to Locate
MH	Manhole Cover	UTP	Unable to Raise
MK	Marker	UTT	Unable to Trace
NDP	No Depths Possible	VP	Vent Pipe
NPV	No Pipes Visible	WL	Water Level
NOPV	No Other Pipes Visible	WM	Water Meter
NVV	No Valve Visible	WO	Wash Out

NOTES

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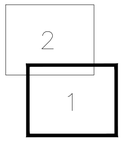
SHEET LAYOUT
(NOT TO SCALE)



Neptune Road
Barry
Vale of Glamorgan
CF62 5BR

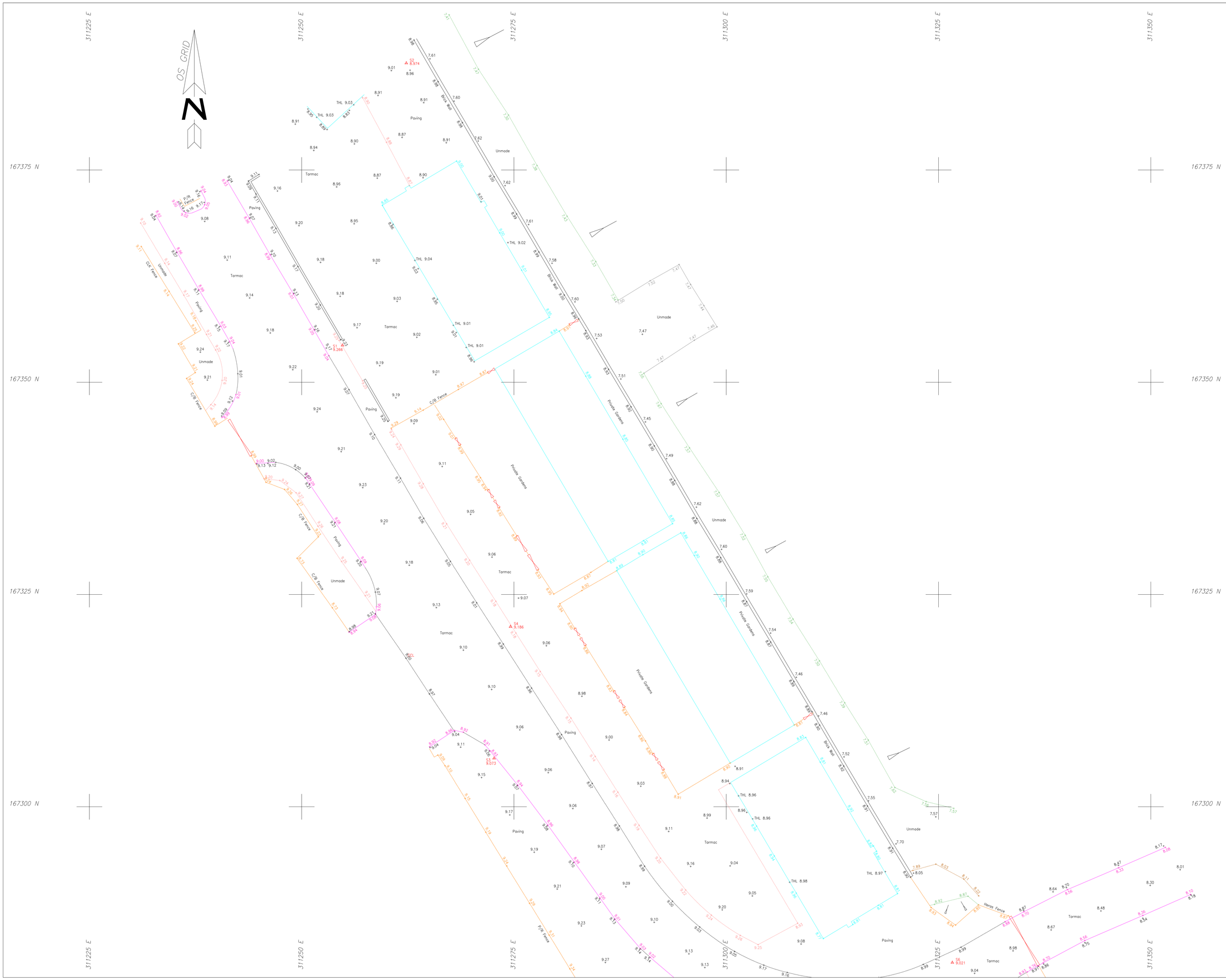
TOPOGRAPHICAL SURVEY

SURVEYED FOR: Associated British Ports, Port House, Northern Gateway, Hull, HU9 5PQ

SURVEYOR: AW/OS
DATE: Jan 2023

NO	DATE	REVISION NOTES

SHEET NUMBER	N 1716/1 REVISION 0
DRAWING TITLE	Topographical
SCALE	1 : 200 (A1)
SEE ALSO DWG NOS	
SHEET	1 of 2
JOB NUMBER	N 1716



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C	Cover Level	RET	Retaining
C/B	Close Boarded	RS	Road Sign
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SHEET LAYOUT
(NOT TO SCALE)

2
1

Neptune Road
Barry
Vale of Glamorgan
CF62 5BR

TOPOGRAPHICAL SURVEY

SURVEYED FOR: Associated British Ports, Port House, Northern Gateway, Hull, HU9 5PQ

SURVEYOR: AW/OS
DATE: Jan 2023

NO	DATE	REVISION NOTES

SHEET NUMBER	N 1716/2 REVISION 0
DRAWING TITLE	Topographical
SCALE	1 : 200 (A1)
SEE ALSO DWG NOS	
SHEET	2 of 2
JOB NUMBER	N 1716

B Proposed Site Layout

Schedule

Type	Quantity
Flats (1 & 2 Bed)	19
Town House (3 & 4 Bed)	45
Total	64

Type	Quantity
Car Parking (Resi.)	54
Car Parking (Resi. visitor)	16
Car Parking (Marina)	114
Total	184

Figured dimensions and levels to be used.
Any inaccuracies must be notified to the architect.
Detail drawings and large scale drawings take precedence over smaller drawings.

Rev:	Chk'd:	Rev:	Chk'd:	Rev:	Chk'd:
			-		

PRELIMINARY	
PLANNING	✓
DESIGN	
TENDER	
CONSTRUCTION	

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Tel:+44 (0)33 33 201 001 www.powelldobson.com

Drawing No.	Rev.
20065 (05) 100	-

Contract: ABP
Barry Waterfront 'The Mole' Masterplan

Title: Illustrative masterplan - Ground Floor

Scale: 1:1000 @ A1
Date: 03 10 2022
Drawn: KP
Checked: AMS

Figured dimensions and levels to be used.
Any inaccuracies must be notified to the architect.
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Rev:	Chk'd:	Rev:	Chk'd:	Rev:	Chk'd:
			-		

PRELIMINARY	
PLANNING	✓
DESIGN	
TENDER	
CONSTRUCTION	

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Drawing No.	Rev.
20065 (05) 200	-

Contract: ABP
Barry Waterfront 'The Mole' Masterplan

Title: Land Use Parameters

Scale:	1:1000 @ A1
Date:	03 10 2022
Drawn:	KP
Checked:	AMS

C UK SuDS Tool - Greenfield Runoff Rates

Print | Close Report

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	faye tomalin
Site name:	The Mole
Site location:	Barry Docks

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

Site Details

Latitude:	51.39786° N
Longitude:	3.27425° W
Reference:	2025180127
Date:	Feb 02 2023 16:03

Runoff estimation approach FEH Statistical

Site characteristics

Total site area (ha): 2.8

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.538
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.08

Hydrological characteristics	Default	Edited
SAAR (mm):	909	930
Hydrological region:	9	9
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 30 years:	1.78	1.78
Growth curve factor 100 years:	2.18	2.18
Growth curve factor 200 years:	2.46	2.46

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):		15.17
1 in 1 year (l/s):		13.35
1 in 30 years (l/s):		27
1 in 100 year (l/s):		33.07
1 in 200 years (l/s):		37.31

D Outline Drainage Strategy

N

Eastern Area

Central Area

Western Area

0 37.5 75 150 Metres

Original @ A3

KEYPLAN

KEY

- Sub-catchments
- Other Hardstanding
- Road
- Roof
- Outfall
- SuDS Planter
- Manhole
- SuDS Tree
- Filter Drain / Strip
- SW Sewer
- Swale
- Rain Garden
- Basin

JBA consulting

Notes.
1. All drainage / SuDS features shown are indicative only.
2. The drainage system shown is based on discharge to the dock at the north and south of the site.
3. No detailed hydraulilc modelling, geotechnical assessment or engineering assessment has been undertaken at this stage.
4. All values are approximate.
5. No existing services are shown on this plan.

Outline Surface Water Drainage Strategy - The Mole

Overview

N

Surface water flows from the footpath are intercepted by a filter strip prior to entering a filter drain to be conveyed to the outfall. The filter strip is proposed to be planted to provide additional amenity and biodiversity benefits, along with performing a treatment function

Rain gardens and tree pits serve the proposed access road into the development, providing water quality treatment, amenity and biodiversity benefits

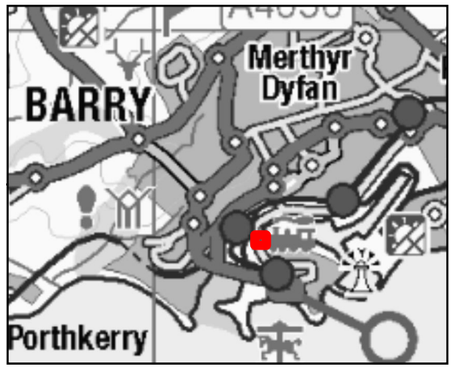
SuDS planters are provided at each property to provide source control water quality treatment

Final proposed ground levels are still to be confirmed; however in areas where ground levels fall to tie in with existing dock levels, SuDS assets shall be cascaded to ensure functionality for treatment and conveyance purposes

Surface water is discharged at an unattenuated rate into Barry Dock. The outfall level shall be set above the 2123 MHWS tide level to ensure a free outfall for the design rainfall event

0 12.5 25 50 Metres
Original @ A3

KEYPLAN



KEY

- Catchments
- Other Hardstanding
- Road
- Roof
- Outfall
- SuDS Planter
- Manhole
- SuDS Tree
- Filter Drain / Strip
- SW Sewer
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4. All values are approximate.
5. No existing services are shown on this plan.

Outline Surface Water Drainage Strategy - The Mole

Western Area

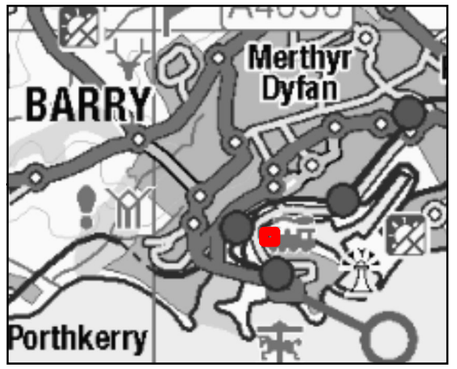
N

SuDS have been proposed to be kept within development phases (and sub-catchments) to enable future development and adoption of assets

Surface water shall be discharged at an unattenuated discharge rate into Barry Dock. The site shall be split into a number of catchments servedd by individual drainage systems and outfalls.

0 12.5 25 50 Metres
Original @ A3

KEYPLAN



KEY

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- Other Hardstanding
- Road
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4. All values are approximate.
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Outline Surface Water Drainage Strategy - The Mole

Central Area

N

A shallow basin is provided within the area of public open space to treat and convey surface water. The basin shall be shallow, with shallow side slopes to encourage its mutlifunctionality for site users.

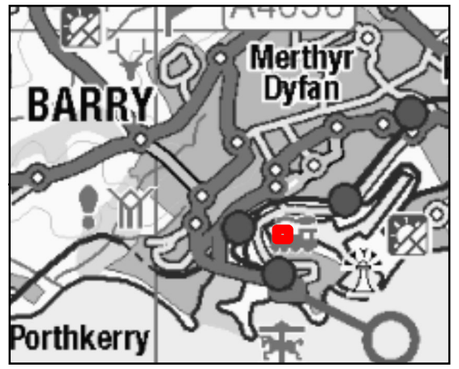
The access road is lined by rain gardens, tree fits and a filter strip to provide amenity and biodiversity benefits for the end user

A swale surrounding the building provides source control, whilst also providing amenity and biodiversity benefits

The outfall level will be set above 2123 MWHS tide level to allow for a free outfall for the design rainfall event. Consequently, SuDS assets are for treatment and conveyance only

0 12.5 25 50 Metres
Original @ A3

KEYPLAN



KEY

- Catchments
- Other Hardstanding
- Road
- Roof
- Outfall
- SuDS Planter
- Manhole
- Tree Pit
- Filter Drain/Strip
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4. All values are approximate.
5. No existing services are shown on this plan.

Outline Surface Water Drainage Strategy - The Mole

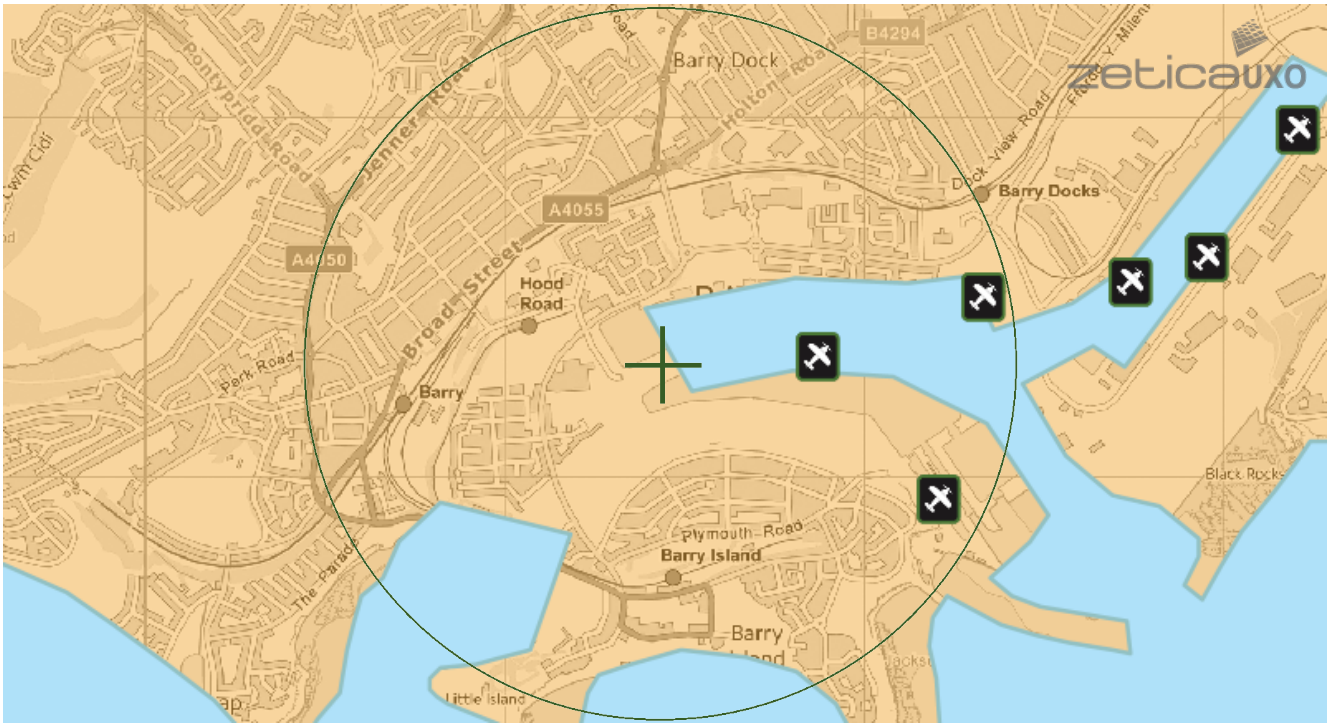
Eastern Area

E CDM Designer Risk Assessment

UNEXPLODED BOMB RISK MAP

SITE LOCATION

Map Centre: 311445,167317



LEGEND

- **High:** Areas indicated as having a bombing density of 50 bombs per 1000acre or higher.
- **Moderate:** Areas indicated as having a bombing density of 15 to 49 bombs per 1000acre.
- **Low:** Areas indicated as having 15 bombs per 1000acre or less.

miltary	**industry**	**UXO find**
transport	**dock**	**Luftwaffe targets**
utilities	**Bombing decoy**	**other**

How to use your Unexploded Bomb (UXB) risk map?

The map indicates the potential for Unexploded Bombs (UXB) to be present as a result of World War Two (WWII) bombing.

You can incorporate the map into your preliminary risk assessment* for potential Unexploded Ordnance (UXO) for a site. Using this map, you can make an informed decision as to whether more in-depth detailed risk assessment* is necessary.

What do I do if my site is in a moderate or high risk area?

Generally, we recommend that a detailed UXO desk study and risk assessment is undertaken for sites in a moderate or high UXB risk area.

Similarly, if your site is near to a designated Luftwaffe target or bombing decoy then additional detailed research is recommended.

More often than not, this further detailed research will conclude that the potential for a significant UXO hazard to be present on your site is actually low.

Never plan site work or undertake a risk assessment using these maps alone. More detail is required, particularly where there may be a source of UXO from other military operations which are not reflected on these maps.

If my site is in a low risk area, do I need to do anything?

If both the map and other research confirms that there is a low potential for UXO to be present on your site then, subject to your own comfort and risk tolerance, works can proceed with no special precautions.

A low risk really means that there is no greater probability of encountering UXO than anywhere else in the UK.

If you are unsure whether other sources of UXO may be present, you can ask for one of our **pre-desk study assessments (PDSA)**

If I have any questions, who do I contact?

tel: **+44 (0) 1993 886682**

email: **uxo@zetica.com**

web: **www.zeticauxo.com**

The information in this UXB risk map is derived from a number of sources and should be used in conjunction with the accompanying notes on our website: **(https://zeticauxo.com/downloads-and-resources/risk-maps/)**

It is important to note that this map is not a UXO risk assessment and should not be reported as such when reproduced.

*Preliminary and detailed UXO risk assessments are advocated as good practice by industry guidance such as CIRIA C681 'Unexploded Ordnance (UXO), a guide for the construction industry'.

Design Risk Assessment

Document control	2022s0996 – The Mole, Barry – Outline Surface Water Drainage Strategy				
Contributing designers	Revision	Purpose of issue	Checked	Reviewed	Date
Erica Skinner	P01	Planning	Faye Tomalin		1st February 2023

Health and Safety Considerations

Stage 1 **Identify**				Stage 2 **Eliminate / Reduce**	Stage 3 **Inform**		Stage 4 **Control**	
Ref. no.	Project element, material or activity	Key health and safety hazards and their possible effects	People/ environment at risk from the hazard	Design measures taken to eliminate the hazard or reduce the risk	Significant residual hazards and risks	Communication method	Risk owner(s)	Proposed control measures
Guidance	Consider all aspects involved in each stage of interface with the site, environment and structure(s).	Record the key hazards and their potential consequences.	Identify the categories of people at risk.	Include obtaining adequate data for design certainty and any further studies carried out during the risk evaluation process. Proposed measures to be taken by constructors and operators are to be included in Stage 4.	Provide details of residual hazards and risks that will need to be communicated and managed.	Record how information is provided, whether on drawings, pre-construction information, buildability statement, specification, reports or H&S File	Record the name of designers, contractors, the client or other stakeholders who are to ensure the significant residual risk is minimised and controlled.	Recommend measures to be taken by the risk owner(s) to minimise and control the significant residual risk.
Design								
Des1	Design of drainage	Services: potential for underground services crossing the site - gas, electricity, and surface water drains Risk of striking services.	- Site personnel. - Existing infrastructure	Hazard cannot be eliminated by design. Available information should be reviewed and mapped.	Potential unidentified services	DRA	Designer at detailed stage (identifying known risks) Contractor (construction of the scheme)	Detailed survey of services prior to detailed design and construction. Liaison with utility providers. Risk assessments and method statements and adequate briefing of site personnel.
Des2	Design of drainage	Ground and groundwater conditions: No groundwater envisaged to be encountered Potential for: Contamination Instability Groundwater in excavations	Site personnel Site plant	Hazard cannot be eliminated by design. Preliminary drainage design assumes largely shallow drainage / SuDS features	Unknown ground conditions remain	DRA	Designer (identifying known risks) Contractor (construction of the scheme)	Follow recommendations arising from ground investigation report.
Des3	Design of drainage	Unexploded ordnance	Site personnel Site plant Public	An unexploded ordnance map has been consulted at zeticauxo.com This has highlighted that there is a moderate risk of finding UXO across the proposed development site. Further investigation is recommended	Moderate risk from UXO	DRA	Designer (identifying known risks) Contractor (construction of the scheme)	Risk assessments and method statements and adequate briefing of site personnel.

Design Risk Assessment

Health and Safety Considerations

Stage 1 **Identify**				Stage 2 **Eliminate / Reduce**	Stage 3 **Inform**		Stage 4 **Control**	
Ref. no.	Project element, material or activity	Key health and safety hazards and their possible effects	People/ environment at risk from the hazard	Design measures taken to eliminate the hazard or reduce the risk	Significant residual hazards and risks	Communication method	Risk owner(s)	Proposed control measures
Des4	Design of above ground SUDS features	Risk of trips and falls, drowning	End user	Preliminary design undertaken in accordance with CIRIA C753. Proposals to provide planting to demarcate SuDS features whilst not obscuring visibility.	Lack of knowledge about the SuDS features. Disrepair/lack of maintenance causing instability or obscured visibility	DRA	Owner/operator/ scheme designer	Detailed design should consider the use of appropriate planting around swales to reduce the risk of people entering the SuDS assets. Passive surveillance on all above ground SuDS features is good due to the presence of roads and well-used footpaths and good visibility. Side slopes on features are a maximum of 1:3. Maintenance schedule to be prepared.
Construction								
Con1	Excavations	Potential for instability of excavations Potential for groundwater flooding of excavations and contamination spread/mobilisation of contaminants Potential for striking of services/UXO	Site personnel Existing infrastructure Site plant	Hazard cannot be eliminated by design Limit depth of excavations where practicable Ground investigations required	Ground conditions and potential services	DRA	Contractor	Early involvement of temporary works designer recommended Risk assessments and method statements and adequate briefing of site personnel. Follow recommendations arising from ground investigation report. Detailed survey of services prior to construction. Liaison with utility providers.

Design Risk Assessment

Health and Safety Considerations

Stage 1 **Identify**				Stage 2 **Eliminate / Reduce**	Stage 3 **Inform**		Stage 4 **Control**	
Ref. no.	Project element, material or activity	Key health and safety hazards and their possible effects	People/ environment at risk from the hazard	Design measures taken to eliminate the hazard or reduce the risk	Significant residual hazards and risks	Communication method	Risk owner(s)	Proposed control measures
Con2	Plant/ material deliveries	Access via Neptune Road Unauthorised access by members of public Existing site operations – deliveries and shipments, and site manoeuvres Site traffic causing hazards to general public/ collisions	Site personnel Public	Hazard cannot be eliminated by design	Site access	DRA	Contractor	Traffic management plans, consultations with stakeholders, traffic management design and relevant NRSWA applications. Consider access to sites and expected levels of traffic, road widths, parking arrangements etc. Limit volumes of imported material or muck away where possible. Risk assessments and method statements and adequate briefing of site personnel.
Operation & Maintenance								
O&M1	Drainage system in operation	Potential for failure of the drainage system and flooding of the site	End users Maintenance personnel	Design drainage to an appropriate design life and design storm event Consideration given appropriate arrangements for operation, maintenance and cleansing of features	Risk of flooding remains during exceedance events and if maintenance requirements are not followed.	Operation and maintenance manual (to be prepared)	Asset owner/operator	Regular maintenance in accordance with O&M manual, normal site safety controls, designated overland flow routes away from properties.
O&M2	Maintenance of drainage system	Water Working at height Confined spaces	Maintenance personnel	Reduce or remove the need to enter confined spaces through the design of inspection chambers and access reducers where practicable. Above ground shallow SuDS features recommended where possible.	Water Working at height	Operation and maintenance manual (to be prepared)	Asset owner/operator	Non-person entry inspection chambers to be used, where possible, to eliminate confined space entry. Record non-entry methods of maintenance in O&M manual. Edge barriers to be used. Regular maintenance in accordance with O&M manual, normal site safety controls.

Design Risk Assessment

Health and Safety Considerations

Stage 1 **Identify**				Stage 2 **Eliminate / Reduce**	Stage 3 **Inform**		Stage 4 **Control**	
Ref. no.	Project element, material or activity	Key health and safety hazards and their possible effects	People/ environment at risk from the hazard	Design measures taken to eliminate the hazard or reduce the risk	Significant residual hazards and risks	Communication method	Risk owner(s)	Proposed control measures
Demolition								
Dem1	Removal of drainage features requiring excavation	Hazards and risks: largely as per the construction stage, except that the removal of the drainage system will increase a risk of flooding to the site.	Site personnel End user	Replacement SuDS based drainage system to be provided.	Instability of excavations, disturbance of services Increase of flood risk	DRA	Demolition contractor	Full as-built records, specifications and maintenance procedures included in O&M manual to aid in planning of demolition

Environmental Considerations

Stage 1 **Identify**				Stage 2 **Eliminate / Reduce**	Stage 3 **Inform**		Stage 4 **Control**	
Ref. no.	Project element, material or activity	Key environmental hazards and their possible effects	Who or what is at risk from the hazard	Design measures taken to eliminate the hazard or reduce the risk	Significant residual hazards and risks	Communication method	Risk owner(s)	Proposed control measures
Guidance	Consider all aspects involved in each stage of interface with the site, environment and structure(s).	Record the key hazards and their potential consequences.	Identify the categories of people, animals or environments at risk.	Include obtaining adequate data for design certainty and any further studies carried out during the risk evaluation process. Proposed measures to be taken by constructors and operators are to be included in Stage 4.	Provide details of residual hazards and risks that will need to be communicated and managed.	Record how information is provided, whether on drawings, pre-construction information, buildability statement, specification, reports or H&S File	Record the name of designers, contractors, the client or other stakeholders who are to ensure the significant residual risk is minimised and controlled.	Recommend measures to be taken by the risk owner(s) to minimise and control the significant residual risk.
Design								
EDes1	Design of drainage system	Potential for ground contamination, Risk of pollution	Groundwater / surface water bodies	Ground investigations to be undertaken prior to work beginning to assess any contaminants across the site.	N/A	DRA	Contractor	Ground investigation to be undertaken to assess the risk of ground contamination, and any remediation measures needed in order to mitigate risk of mobilisation of contaminants.

Design Risk Assessment

Environmental Considerations

Stage 1 **Identify**				Stage 2 **Eliminate / Reduce**	Stage 3 **Inform**		Stage 4 **Control**	
Ref. no.	Project element, material or activity	Key environmental hazards and their possible effects	Who or what is at risk from the hazard	Design measures taken to eliminate the hazard or reduce the risk	Significant residual hazards and risks	Communication method	Risk owner(s)	Proposed control measures
EDes2	Design of drainage system	Oil spillage Pollution	Groundwater/ surface water bodies	SUDS including rain gardens, vegetated swale and tree pits have been used to treat flows. The Simple Index Approach has been utilised to demonstrate that the proposed SuDS features provide sufficient treatment to ensure there is no detrimental effect to water quality. Therefore, the SuDS measures are considered sufficient to control pollution within the development.	Lack of maintenance of SUDS features may mean pollution events bypass the SUDS features and pollute groundwater and/or Barry Dock.	O&M manual	Asset owner/operator	Regular maintenance in accordance with O&M manual.
Construction								
Con1	Construction of drainage system	Pollution of watercourses/drainage systems during construction, with sediments, oils and chemicals	Water bodies	Hazard cannot be eliminated by design.	Pollution	Construction Management Plan (to be prepared)	Contractor	Risk assessment and method statement undertaken to avoid pollution during the works. Water from excavations not to be connected to the drainage system. Use of silt curtains, bunded storage tanks, spill kits envisaged.
Con 2	General site clearance	Decreased amenity value	Environment	Hazard cannot be eliminated by design.		DRA	Contractor	SuDS will be utilised to provide amenity value and compensate for any habitat loss as part of the site clearance. Works should take all appropriate measures to avoid damaging any existing vegetation that is to remain on site.
Operation & Maintenance								
O&M1	Inspection and clearance of manholes/ basins/ rain gardens	Oil/fuel, sediment Pollution	Environment Maintenance personnel	Hazard cannot be eliminated by design.	Pollution	Operation and maintenance manual (to be prepared)	Asset owner/operator	Regular maintenance in accordance with O&M manual, normal site safety controls. Materials/sediments removed to be treated as contaminated and disposed of to a licenced waste management facility

Design Risk Assessment

Environmental Considerations

Stage 1 **Identify**				Stage 2 **Eliminate / Reduce**	Stage 3 **Inform**		Stage 4 **Control**	
Ref. no.	Project element, material or activity	Key environmental hazards and their possible effects	Who or what is at risk from the hazard	Design measures taken to eliminate the hazard or reduce the risk	Significant residual hazards and risks	Communication method	Risk owner(s)	Proposed control measures
Demolition								
Dem1	Removal of the drainage system/ general demolition activities	Hazards and risks: largely as per the construction stage, except that the removal of the drainage system will increase a risk of pollution to the water environment.	Water bodies, groundwater	Replacement SuDS based drainage system to be provided.	Pollution	Operation and Maintenance manual	Demolition contractor	Full as-built records, specifications and maintenance procedures included in O&M manual to aid in planning of demolition Risk assessment and method statement undertaken to avoid pollution during the works. Water from excavations not to be connected to the drainage system. Use of silt curtains, bunded storage tanks, spill kits envisaged.

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