



Flood Risk Assessment

Proposed emissions management building, comprising of baghouse and stack at the BRM site in Northfleet, Gravesend, DA11 9BG

Britannia Refined Metals

Botany Road, Northfleet, Gravesend, DA11 9BG

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23 July 2024

Revision: 01

Revision Record

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Basis of Report

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Executive Summary

SLR Consulting Limited (SLR) has been appointed by Britannia Refined Metals (BRM) Limited (the 'Client') to prepare a Flood Risk Assessment (FRA) to support a planning application for the development for a proposed emission management building, comprising of a baghouse and stack, situated at BRM, Botany Road, Northfleet, Gravesend, DA11 9BG. The emission management building would be ancillary to the operation of the Sample Preparation Building, which was deemed to be permitted development, by GBC in November 2023 (Ref.20230770).

Subject	Element	Findings
Site	Name	E-Waste emission management baghouse and stack plant.
Existing Site	Description	The Site is located within a metal processing facility operated by the Client on the south bank of the River Thames. It is part of a brownfield industrial estate that includes material processing plants and supporting infrastructure. To the west, the Site is adjacent to Swanscombe Peninsula, an undeveloped marshland designated as a Site of Special Scientific Interest (SSSI) and is owned by the applicant. To the south, is the Northfleet Industrial Park. Access to the Site is via Manor Way which then joins the A226, providing access to the broader national road network.
	Topography	The wider BRM facility is on leveled land raised above the River Thames at varied elevations. The Site is on a flat area at approximately 3.80m above Ordnance Datum (aOD). To the northeast, the area consists of foundations with ramp access, elevated between 4.00 – 4.35m aOD. There is a depression at 3.00m aOD immediately to the southwest of the Site.
	Geology & Hydrogeology	The bedrock geology is indicated to consist of Chalk (Lewes Nodular, Seaford and Newhaven) formations. Superficial deposits are indicated to comprise Alluvium consisting of silt and clay. Given the developed nature of the Site, significant made ground is likely present. The Site is overlain by impermeable concrete hardstanding of 0.58m depth The EA Aquifer Designation mapping indicates the bedrock is classed as 'Principal' aquifer, with the superficial layers designated as 'Secondary (undifferentiated)' aquifer. The Site lies within a Source Protection Zone 2 (SPZ) and has 'medium - high' groundwater vulnerability.
	Hydrology	The Site is located 190m inland from the south bank of the tidal River Thames. To the west is the Swanscombe Peninsula, featuring marshlands including Botany Marsh adjacent the BRM facility, with surface water ponds, wetlands, and ditches.
	Drainage	The BRM facility surface water drainage system includes privately owned attenuation ponds, land drains, and surface water drainage networks. The EA Asset database indicates flood gates and pump stations along the south bank of the Thames. The facility is divided into 'Surface Water Contained' and 'Surface Water Outflow' catchments. 'Surface Water Outflow' discharges into the Southern Water foul sewer network offsite to Manor Way. 'Surface Water Contained' discharges rainwater into raised attenuation lagoons within the BRM facility, located 200m northwest and 390m north of the site. An open channel drain near the northwest lagoon runs around the



Subject	Element	Findings
		perimeter of the BRM facility, discharging into the River Thames.
Proposals	Description	The proposed emissions management building, designed for dust extraction and emissions control, will include a baghouse and stack. It will be adjacent to the Sample Preparation Building, which houses furnaces and grinding/milling equipment requiring dust extraction. The total footprint of the emissions management building is 109m ² (13.5m by 8.1m).
	Lifetime	The proposed building has an expected 20-year lifetime up to 2044.
	Vulnerability	Flood risk vulnerability classification at PPG Annex 3, the development is considered to be 'Essential Infrastructure'.
Site Flood Risk	Fluvial	The River Thames is predominately tidally influenced where it is adjacent the Site. As such, the primary flood risk to the Site is from tidal sources. On this basis the flood risk from River or Fluvial Flooding is assessed to be low.
	Tidal	The Site is located adjacent to the tidally influenced River Thames and falls within Flood Zone 3, indicating a high probability of tidal flooding if flood defences were not present. However, the Site benefits from flood defences directly adjacent the BRM facility's northeast boundary, including tidal walls with a crest level of 6.75m aOD, providing a 1 in 1000-year (0.1% AEP) standard of protection. Current flood level data indicates that a 1 in 200-year (0.5% AEP) flood level is 5.85m aOD. Uplifting peak flood levels by 0.22m for climate change up to 2044 equates to 6.07m aOD. With existing crest levels, defences provide up to 0.68m of freeboard for the BRM facility. In line with TE2100 Policy 4, the site may benefit from raised defences with crest level of 7.00m aOD by 2040. The BRM facility is protected by a 3.0m high embankment from Botany Marsh, which is adjacent to the Swanscombe Peninsula. The peninsula itself is protected by a second earth embankment with a crest level of 8.8m aOD, providing additional flood protection from the River Thames. These defences provide a 1 in 1000-year (0.1% AEP) standard of protection. The marshes are well drained through an extensive ditch and pond network leading to two open relief channels that discharge to the Thames via a non return flap valve. Flooding from Botany Marsh is not expected to affect the Site.
	Infrastructure Failure	The Site is located 180m from the nearest modelled breach to the northeast. In the event of a breach failure, the site would experience rapid inundation with water depths exceeding 1.32m, posing a significant hazard to site personnel. However, the BRM facility has a series of on-site flood gates and emergency procedures to protect 'Employee Work Areas,' ensuring safe refuge. The facility is regularly staffed, and defences are routinely monitored for defects, making the likelihood of breach failure relatively low.



Subject	Element	Findings
	Surface Water	The Site is located on levelled hardstanding, with surface water runoff flowing from the northeast to the southwest where it is collected by the existing drainage network. The proposed development finished floor level is to be raised by 0.55m above ground level. The Site is predominantly at 'low risk' of surface water flooding, Therefore, the flood risk from surface water is considered low and not considered further.
	Groundwater	SLR revisited the Site to undertake three rounds of winter groundwater monitoring in the newly installed boreholes in 2023. The 2No. wells were monitored to measure the depth to groundwater. Groundwater is limited to 0.83m depth below ground level. The Site is overlain by impermeable 0.58m thick concrete hardstanding and is not considered at risk of emergence.
	Sewers and Artificial Sources	The Site contains an existing drainage network. The Site is located primarily within the 'Surface Water Outflow' network which drains off-site to sewers under Manor Way. Upstream overland flow would move towards the Site. The potential for significant flood volumes inundating the Site is low. The upstream network receives no offsite flows, and the development's finished floor level is raised by 0.55m. Flood risk is therefore considered low.
Planning Requirements	Sequential Test and Exception Test	The proposed development is an emissions management building in the existing BRM facility, comprising a baghouse and stack, on a total site area of 185m², i.e., a minor development less than 250m². The Emissions Management Building will be ancillary to and necessary to the efficient operation of the adjacent Sample Preparation Building, which was deemed to be permitted development by Gravesham Borough Council in November 2023 (Ref. 20230770). Due to the size and nature of the proposed development, it is exempt from sequential testing. The proposed Emissions Management Building will support the Sample Preparation Building's furnaces and grinding/milling equipment. It aligns with sustainable development goals and will aid the BRM site, a key local employer. Located on brownfield land within an established industrial site, the proposed development includes plant and equipment only, with no habitable or welfare spaces. The site is considered to be at residual risk of flooding from tides or unlikely infrastructure failure. Close monitoring of assets and early flood warnings with contingency Evacuation Plans have suitably mitigated remaining risk. Both the sequential and exception test have therefore been passed.
Summary	Conclusion	Flood risk at the Site has been assessed according to BS8533, considering all potential sources, including fluvial, tidal, surface water, groundwater, sewer, reservoirs, canals, and infrastructure failure. The screening assessment concludes that the primary flood risk at the Site is from the tidally influenced reach of the River Thames. Modelled flood level data from the EA indicates that the Site is located within Flood Zone 3a and benefits from tidal flood defences protecting against events up to 1 in 1000-year (0.1%



Subject	Element	Findings
		AEP) event. In channel flood level data inclusive of climate uplifts accounting for climate change confirms the Site is currently safe from flooding from tidal sources. In addition to the 0.68m freeboard provided by existing defences, residual tidal flood risk is additionally anticipated to be mitigated by raised flood defences over the proposed 20-year lifetime of the development. TE2100 Policy 4 for Swanscombe and Northfleet states that defences are to provide sufficient protection by 2040. It is anticipated that future tidal flood risk will remain acceptably low. Site-specific modelling indicates that, although infrastructure failure could pose significant risks to personnel, established early flood warning systems and Evacuation Plans effectively mitigate these risks. The TE2100 policy ensures ongoing monitoring and upgrades of defences, securing the Site's safety for the proposed 20-year development lifespan. Overall, the development will be safe from all flood risks, with no adverse off-site impacts.



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Acronyms and Abbreviations

AEP	Annual Exceedance Probability
aOD	Above Ordnance Datum
BGL	Below Ground Level
BRM	Britannia Refined Metals
BS	British Standards
CIRIA	Construction Industry Research and Information Association
DS	Drainage Statement
EA	Environment Agency
FRA	Flood Risk Assessment
GBC	Gravesham Borough Council
GIS	Geographic Information System
LFWMS	Local Flood Water Management Strategy
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
MAGIC	Multi-Agency Geographic Information for the Countryside
NGR	National Grid Reference
NPPF	National Planning Policy Framework
PPG	Planning Practice Guidance
SLR	SLR Consulting Limited
SoP	Standard of Protection
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
TE2100	Thames Estuary 2100
WFD	Water Framework Directive



1.0 Introduction

1.1 Terms of Reference

SLR Consulting Limited (SLR) has been appointed by Britannia Refined Metals (BRM) Limited (the 'Client') to prepare a Flood Risk Assessment (FRA) to support a planning application for the development for a proposed emission management building, comprising of a baghouse and stack, situated at BRM, Botany Road, Northfleet, Gravesend, DA11 9BG. The emission management building would be ancillary to the operation of the Sample Preparation Building, which was deemed to be permitted development, by Gravesham Borough Council in November 2023 (Ref.20230770).

Reporting has been completed in accordance with guidance presented within the National Planning Policy Framework¹ (NPPF) and its associated Planning Practice Guidance² (PPG), taking due account of current best practice documents relating to assessment of flood risk published by the Construction Industry Research and Information Association (CIRIA)³, the British Standards Institution BS8533⁴ and the Environment Agency's (EA) National Standing Advice on Development and Flood Risk⁵.

1.2 Administrative Context

The Site falls under the planning jurisdiction of Gravesham Borough Council who are the Local Planning Authority (LPA) and Kent County Council who acts as the Lead Local Flood Authority (LLFA).

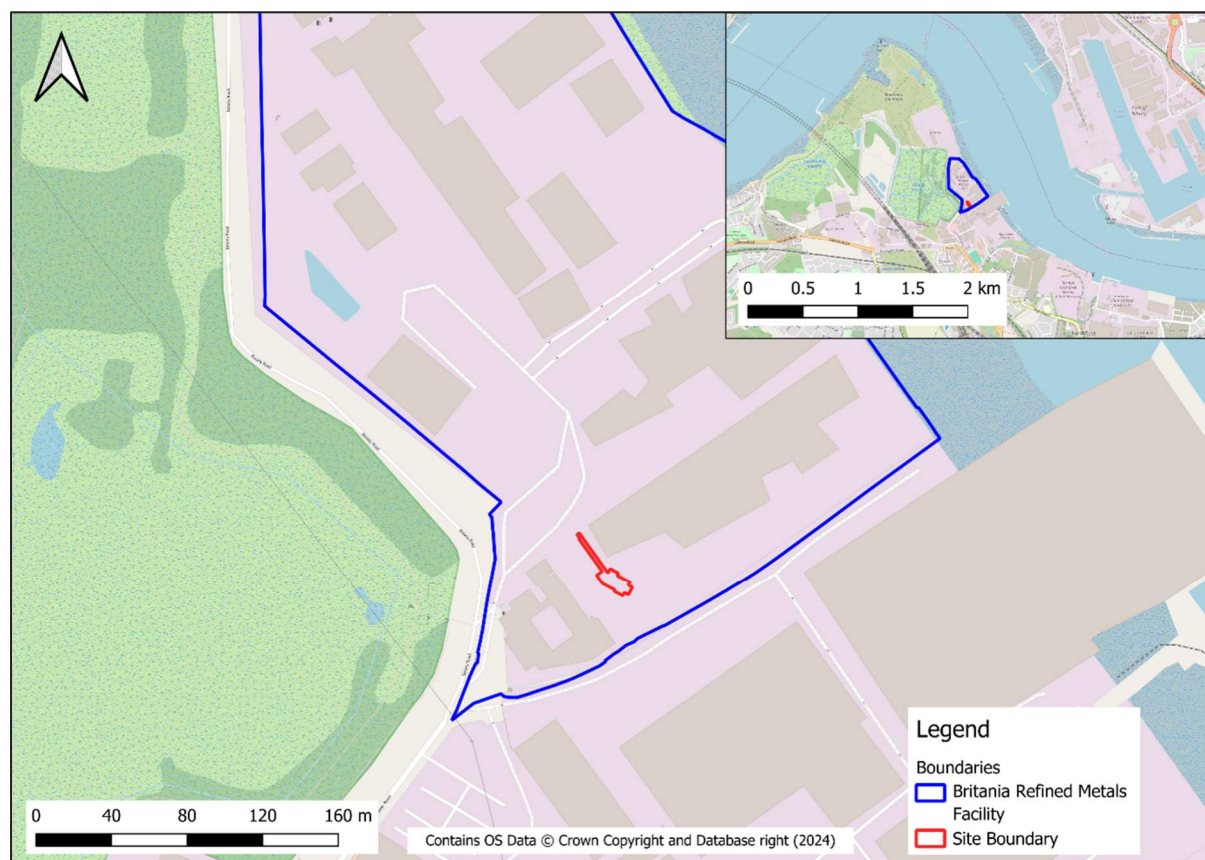
1.3 Site Location

The Site, which covers an area of approximately 185m², is situated within the south-western section of the wider BRM site and will be situated adjacent to the Sample Preparation building. The application area is situated close to the main site entrance on Manor Way. The Site is centred at National Grid Reference (NGR) TQ 61401 75307, as shown in Figure 1-1.

-
- 1 National Planning Policy Framework: Communities and Local Government (Updated December 2023)
 - 2 Planning Practice Guidance: Communities and Local Government (Updated July 2021)
 - 3 CIRIA Report C624, Development and flood risk – guidance for the construction industry (October 2004)
 - 4 BS8533:2017, Assessing and managing flood risk in development: Code of Practice (December 2017)
 - 5 Department for Environment, Food & Rural Affairs and Environment Agency (2015). Flood risk assessment: local planning authorities, <https://www.gov.uk/guidance/flood-riskassessmentlocal-planning-authorities>



Figure 1-1: Site Location Plan



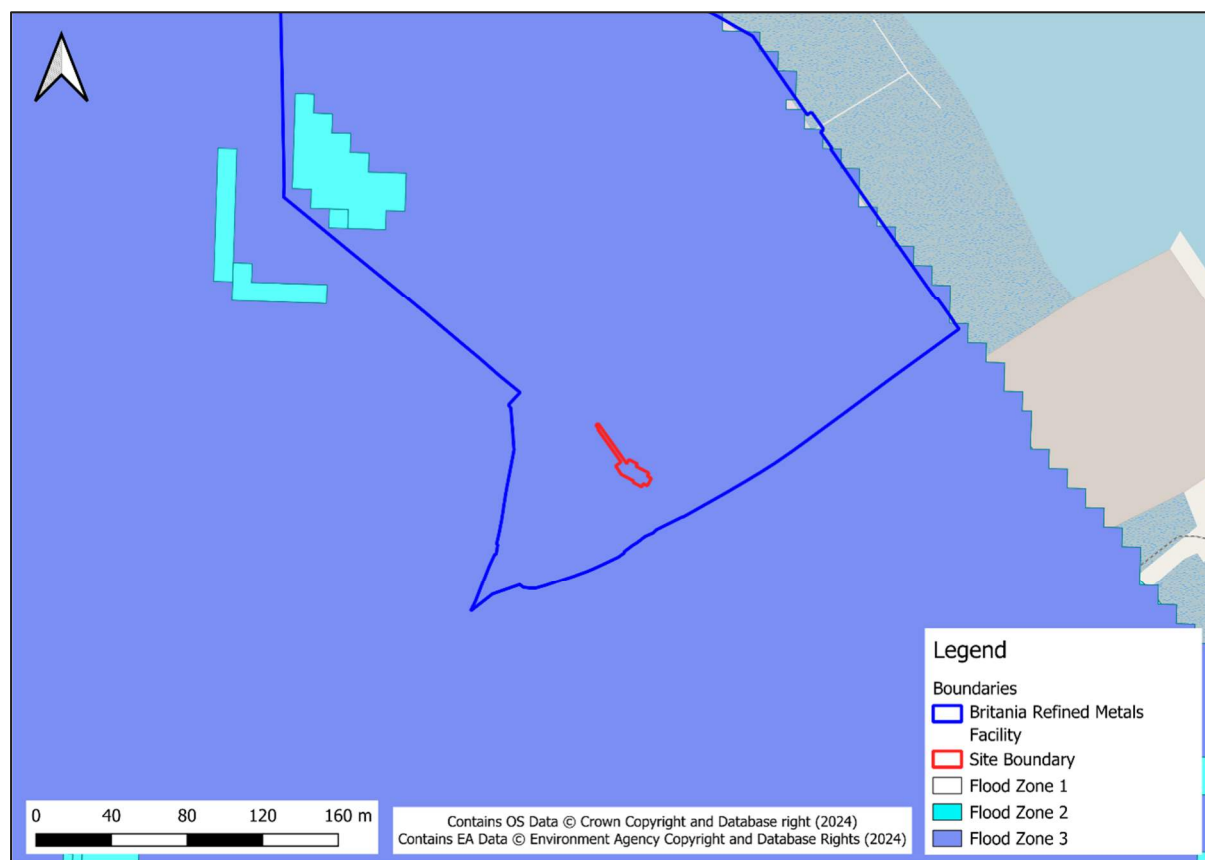
1.4 Background and Aims

With reference to the Environment Agency's *Long Term Flood Risk*⁶, the Site lies within an area considered to be at risk of fluvial and/or tidal flooding. An extract of the Flood Map for Planning is provided by Figure 1-2.

6 Government Digital Service <https://flood-map-for-planning.service.gov.uk> (Accessed: 23 June 2024)



Figure 1-2: Extract of the Environment Agency Flood Maps for Planning



The Site is situated within of Flood Zone 3, indicating that, without flood defences, the annual probability of fluvial flooding is greater than 1% Annual Exceedance Percentage (AEP), while tidal flooding would be at least 1 in 200 or 0.5% AEP.



2.0 Site Details

2.1 Existing Site Description

The Site is situated within an existing metal processing facility operated by the Client on the south bank of the River Thames. The Site is a brownfield industrial estate comprising of material processing plants and ancillary infrastructure.

To the west of the Site lies undeveloped low lying marshland which is a designated Site of Special Scientific Interest (SSSI). There is another industrial estate consisting of warehouses and dockyards within the Northfleet Industrial Park to the south; other neighbouring companies include sheet metal solutions; the London Bus Company; B & W Products; and Brett Aggregates & Brett Concrete.

The Site is accessed via Manor Way, which provides access to BRM and neighbouring industrial areas to the north. Manor Way connects to Lower Road to the south, which then joins to the A226 which provides access to the wider national road network.

The area northeast of Manor Way is the working BRM metals recovery site, whilst the southwest includes an area of green space which is part of the wider Swanscombe Peninsula SSSI and under the ownership of the applicant.

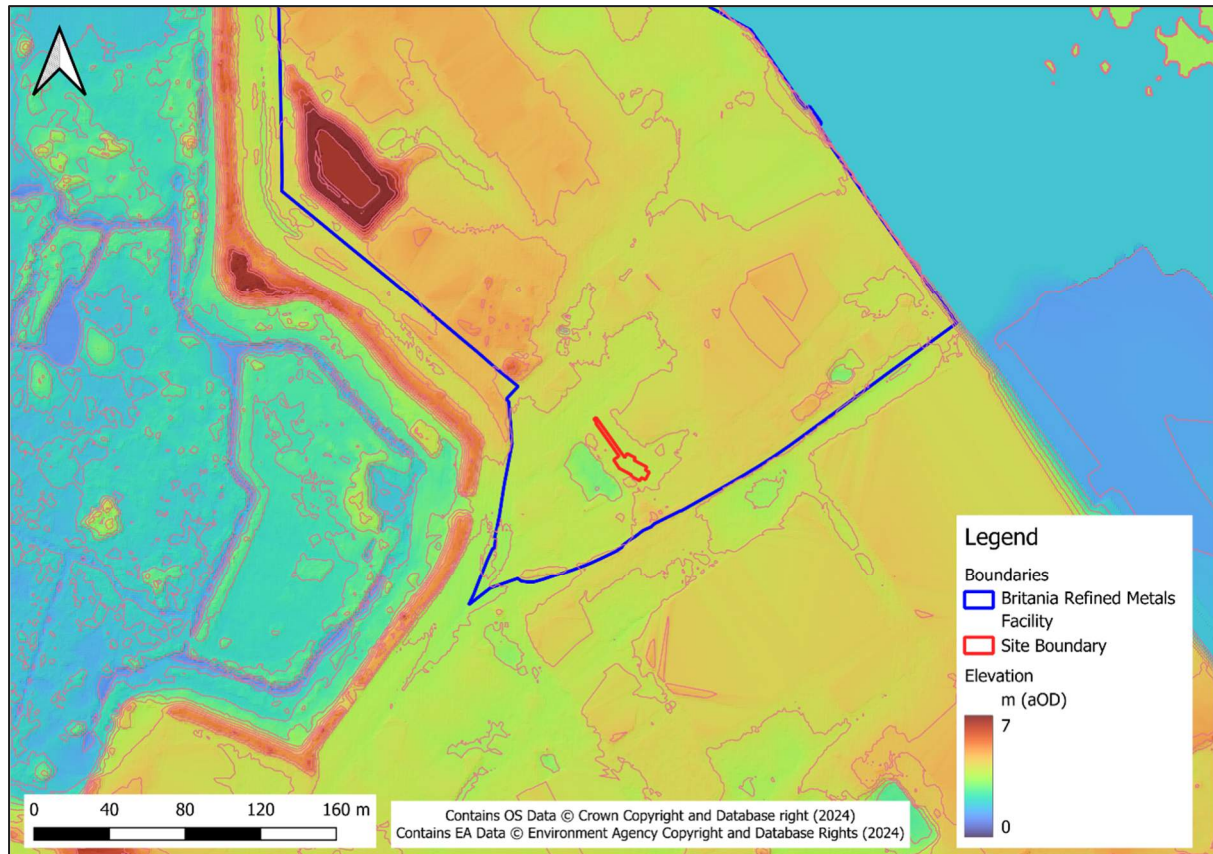
Figure 2-1: Satellite Imagery



2.2 Topography

The EA have collected and compiled a Light Detection and Ranging (LiDAR) database for the UK⁷. LiDAR is an airborne mapping technique to measure distance between the land surface and the aircraft. The data has been used to generate 0.5m contours, as shown in Figure 2-2.

Figure 2-2: Digital Terrain Model at the Site



The wider BRM facility is located on a roughly levelled area of land raised above the River Thames at varied elevations. The Site is situated on a flat area at an approximate elevation of 3.80m above Ordnance Datum (aOD). The immediate area to the northeast consists of foundations with a ramp access, elevated to a range between 4.00 – 4.35m aOD. A depression exists at 3.00m aOD immediately to the southwest of the Site.

The data additionally highlights a raised embankment located on the west side of Manor Way. It is assessed that the embankment is raised by approximately 3.0m above nominal levels at the Swanscombe Peninsula to the west.

⁷ Environment Agency, LiDAR database, <http://environment.data.gov.uk> (Accessed 25 June 2024)



2.3 Hydrological Context

2.3.1 Local Hydrology

The Site is located 190m inland of the south bank of the River Thames, a designated EA Main River⁸, which is tidally influenced adjacent the Site.

The large area of marshlands to the west of the BRM facility is located on the Swanscombe Peninsula and consists of an extensive network of surface water ponds, wetlands and ditches. The area is well drained through the Swanscombe Marsh Outfall operated and maintained by the EA. The outfall is outfitted with inspection chambers, control grates and non-return flap valves⁹.

The River Thames exerts a tidal influence on the area, leading to periodic inundation of the marshlands. Adjacent the BRM facility to the west is an area known as Botany Marshes.

2.3.2 Site Drainage

The existing BRM facility surface water drainage consists of a series of privately owned attenuation lagoons, land drains and surface water drainage networks. EA asset database information indicates that there are flood gates and pump stations along the south bank of the River Thames.

Existing surface water drainage plans, provided in Appendix A, indicate that the network conveys flows from a series of downpipes gullies. Due to runoff potentially mobilising harmful contaminants, the facility is split into 'Surface Water Contained' and 'Surface Water Outflow' catchments.

'Surface Water Outflow' discharges into the Southern Water¹⁰ foul sewer network located offsite to the southwest within Manor Way.

'Surface Water Contained' discharges rainwater into raised attenuation lagoons located within the BRM facility 200m northwest and 390m to the north of the Site.

There is an open channel drain adjacent to the 200m northwest lagoon. This drain runs north around the western and northern perimeter of the BRM facility before it discharges to the River Thames.

2.4 Geological and Hydrogeological Context

2.4.1 Geology

Published British Geological Survey (BGS) online geology maps¹¹ indicate that the Site is situated upon superficial geology consisting of *Alluvium – Clay, Silt, Sand and Peat*. The bedrock geology consists primarily of sedimentary *Lewes Nodular Chalk Formation, Seaford*

8 Designation of 'main rivers': guidance to the Environment Agency (Accessed 24 June 2023), <https://www.gov.uk/government/publications/designation-of-main-rivers-guidance-to-the-environment-agency/designation-of-main-rivers-guidance-to-the-environment-agency>

9 Environment Agency, (2024). Asset Management (Updated March 2024). Available from: Item: /asset-management/id/asset (data.gov.uk) (Accessed: 8 July 2024)

10 Kent County Council, (May 2013) Thameside Stage 1 Surface Water Management Plan. (Accessed: 24 June 2024).

11 British Geological Survey, Geoindex (Accessed: 24 June 2024), <https://mapapps2.bgs.ac.uk/geoindex/home.html>



Chalk Formation And Newhaven Chalk Formation (Undifferentiated). The BGS mapping also indicates the presence of made ground at the site location.

A ground investigation report (GIR) has been completed by SLR in October 2022¹² to identify geological strata. Works included 2No. dynamic sampling boreholes with rotary follow on to 32.20m below ground level (bgl) boreholes. A summary of the encountered strata has been provided in Table 2-1.

Table 2-1: SLR 2023 GIR borehole strata description summary

Ground Type	Fomation and Description	Depth Range (m bgl)
Hardstanding	Concrete - Hardstanding with 1 – 2cm rebar	Ground level – 0.58
Made ground	Made Ground - Very soft to firm black/greyish brown/dark grey slightly gravelly sandy clay. Loose to medium dense dark grey sandy gravel, Anthropogenic slag, glass flint concrete, brick.	0.42 -4.40
	Reworked Clay - Very soft to firm dark grey/brown clay	1.30-4.80
Superficial deposits	Alluvium - Very soft to soft silty clay. Occasionally gravelly with flint. Occasionally with organic atter and wood.	4.40 – 13.10
	Peat - Soft dark brown spongy peat with frequent wood and organic matter.	8.80 – 12.80
	Boyn Hill Gravel Member - Very loose to very dense orangeish/yellowish/greyish brown, brown, multicoloured sandy gravel of flint / gravelly sand.	13.10 – 22.50
Solid Deposit	Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated) Structureless, weak, low to medium density.	21.70 – 32.20

2.4.2 Hydrogeology

A review of the online MAGIC mapping¹³ indicates that the bedrock at the Site is designated by the EA as 'Principal' aquifer, defined as: *'... units that are highly permeable and have significant water storage capacity. They can provide water on a large scale and are important for groundwater supply and base flow to rivers...'*

The Site falls within the West Kent Daren and Cray Chalk groundwater water body catchment under the Water Framework Directive (WFD).

Superficial geologies are classified as 'Secondary (undifferentiated)', defined as: *'... those that do not fall neatly into either the secondary A or B categories. These aquifers may consist of mixed lithologies with variable permeability. They are typically less productive than principal aquifers but can still provide useful amounts of groundwater locally.'*

¹² SLR Limited (October 2023) Ground Investigation Report E-Scrap Sample Preparation Plant. Version 2 (Accessed: 24 June 2024).

¹³ Defra, MAGIC Map, <http://magic.defra.gov.uk/MagicMap.aspx> (Accessed: 24 June 2024)



The Site is situated within a Source Protection Zone (SPZ) 2. An SPZ 3 is located approximately 1.12km southeast of the Site. The groundwater within the bedrock strata is classified as medium - high vulnerability.



3.0 Development Proposal

3.1 Proposed Development

The proposed emissions management building would consist of a baghouse and stack, situated adjacent to the Sample Preparation Building. The Sample Preparation Building will house furnaces and grinding/milling equipment, which require dust extraction, hence the need for the emissions management building and baghouse. The proposed building will lie to the northeast of the Sample Preparation Building. A proposed development layout plan has been provided in Appendix B.

The footprint of the emissions management building would be 13.5m long by 8.1m wide, giving an area of 109m², excluding the vent which will link the emissions management building to the Sample Preparation Building.

The E-scrap Sample Preparation Building will accommodate 4 furnaces and grinding/milling equipment to prepare the samples for analysis via a third-party laboratory. The process emissions from the furnaces and equipment will need to be extracted via a duct system to an abatement unit, which is the emissions management building being subject to the current planning application. The abatement unit will include common dust extraction, high-capacity dust pre-filters and a deep bed absorption unit that uses activated carbon to provide treatment of emissions prior to release via a dispersion stack (approx. 20m high). A 450 - 750 mm diameter duct would link the Sample Preparation Building to the emissions management building.

3.2 Anticipated Lifetime of Development

The anticipated lifetime of the development is 20 years; therefore, the development has been assessed up to 2044.

3.3 Flood Risk Vulnerability

With reference NPPF¹: *Flood risk vulnerability classification* at PPG² Annex 3, Developments such as E – Waste Processing are classified as:

Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as ‘Essential Infrastructure’.)

The development is located within the BRM facility adjacent the River Thames and is in Flood Zone 3. The development is required to operate in this location which is considered a ‘water side location’ and is therefore classed as ‘Essential Infrastructure’.

3.4 Planning Context

3.4.1 National Planning Policy

This FRA report has been completed in accordance with the guidance presented in the NPPF¹ and with reference to PPG². The NPPF states that Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA)¹⁴, and develop policies to manage flood risk

¹⁴ Gravesham Borough Council, (October 2020). GRAVESHAM WATER AND FLOOD RISK Background paper. (Accessed: 28 June 2024)



from all sources taking account of advice from the EA. It is crucial that Local Planning Authorities consider the risks posed by flooding within their boundary when determining planning applications.

3.4.2 County Planning Policy

Kent County Council, as the LLFA for the area, aims to ensure that new developments are planned with flood risk in mind, promoting sustainable flood risk management practices through their Local Flood Water Management Strategy¹⁵ (LFWMS).

The strategy focuses on improving the safety and well-being of Kent's residents, protecting the local economy from flooding impacts, and ensuring effective collaboration among authorities. It emphasises the use of natural processes where appropriate and aims to make Kent more resilient to flooding through sustainable techniques and informed planning decisions. The strategy also aims to empower residents to understand and manage their own flood risks.

OBJECTIVE 1: UNDERSTANDING RISK

Risk management authorities have a clear understanding of flood risk.

Risk Management Authorities in Kent have a clear understanding of local flood risk mechanisms, risks and management opportunities and this understanding is shared with partners to create an evidence base for flood risk and how it can be managed to ensure we target resources where they are most effective.

OBJECTIVE 2: REDUCING THE RISK OF FLOODING

People and businesses in Kent are protected from flooding

To protect the people and businesses of Kent from flooding through the delivery of flood risk management projects and programmes using new or innovative techniques where appropriate

OBJECTIVE 3: RESILIENT PLANNING

Development planning in Kent contributes to effective flood risk management

Development and spatial planning in Kent takes account of flood risk issues and plans to effectively manage any impacts.

OBJECTIVE 4: RESILIENT COMMUNITIES

Communities are supported to be resilient and empowered to take a proactive role in their flood risk management

Residents and businesses of Kent have access to appropriate data and information to understand flood risk in their area, how it is managed and by whom. Emergency plans are in place for flood vulnerable communities. Communities and individuals are empowered to act to protect themselves from flooding through individual efforts, partnerships and joint working

¹⁵ Kent County Council (2017), Kent Local Flood Risk Management Strategy, <https://documents.hants.gov.uk/flood-water-management/local-flood-water-management-strategy.pdf>



3.4.3 Local Planning Policy

The Gravesham Local Plan Core Strategy 2014¹⁶ sets out the planning framework for the borough to deliver sustainable development. The planning policies related to flood risk and drainage are considered in determination of planning application approval. The policies relating to flood risk and climate change are outlined below:

Policy CS18: Climate Change

Flood Risk

5.14.36 With the exception of the previously developed sites along the Thames Riverside (see Policies CS03, CS04 and CS05) and those other regeneration sites which have already been evaluated in accordance with the sequential and exception tests at the application stage, development will be directed sequentially to those areas at least risk of flooding.

5.14.37 Proposals in areas at risk of flooding must be accompanied by a Flood Risk Assessment (in accordance with national policy and Environment Agency standing guidance as appropriate) and a Flood Risk Management Plan (if required) to demonstrate that they are adequately defended and safe over their lifetime. Planning permission will be refused for schemes which do not pass the sequential and exception tests.

5.14.38 The Council will prioritise the maintenance, improvement or replacement of flood defence infrastructure over other land uses where relevant. In addition to meeting their own flood defence and management needs, the Council will expect new development to take advantage of opportunities to reduce the causes and impacts of flooding from all sources where it is technically and financially feasible.

Water Quality

5.14.39 As part of its approach to climate change and environmental improvement, the Council will have regard to the delivery of the Water Framework Directive and associated Thames River Basin Management Plan objectives to support water bodies being progressively improved to “good” status over the plan period.

Sustainable Drainage and Surface Water Run-Off

5.14.40 The Council will seek to minimise the impact of drainage from new development on waste water systems. In particular, the Council will:

- Require that surface water run-off from all new development has, as a minimum,*
- No greater adverse impact than the existing use; and*
- Require the use of Sustainable Drainage Systems on all developments where*
- Technically and financially feasible.*

16 Gravesham Borough Council (2014) Gravesham Local Plan Core Strategy Local Plan Core Strategy. Available from: <https://www.gravesham.gov.uk/local-plan-policy/local-plan#Gravesham%20Local%20Plan%20CORE%20Strategy#:~:text=The%20Local%20Plan%20Core%20Strategy>



3.4.4 Thames Estuary 2100

Thames Estuary 2100 (TE2100), produced by the EA, is a long-term plan split into epochs to strategize climate adaptation of the Thames Estuary to protect people and property the following flood risks:

- High tides
- Storm surges
- Heavy rainfall

The Site falls under Swanscombe & Northfleet, Policy 4 (P4), defined: *“take further action to keep up with climate and land use change so that flood risk does not increase”*.

Updates to the TE2100 indicate that the delivery of the plan will incorporate more partners in the future, including developers.

3.5 Flood Risk Compatibility

As discussed at Section 3.3 the proposed development is classified as a ‘*Essential Infrastructure*’ and has been assessed to lie in Flood Zone 3a.

Therefore, with reference to *Table 2: Flood risk vulnerability and flood zone ‘incompatibility’* at PPG Paragraph 078 (reproduced as Table 3-1), the proposed development would be considered an ‘appropriate’ form of development.

Table 3-1 Flood Risk Vulnerability and Flood Zone ‘Compatibility’

Flood Risk Vulnerability Classification (PPG Table 2)		Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone (PPG Table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	Exception Test Required	✓	✓	✓
	Zone 3a	Exception Test Required	x	Exception Test Required	✓	✓
	Zone 3b (functional floodplain)	Exception Test Required	x	x	x	✓

Key: ✓ Development is appropriate x Development should not be permitted

3.6 Sequential Test

NPPF Paragraph 162 advises that the aim of the Sequential Test is to ‘*steer new development to areas with the lowest risk of flooding from any source*’. Furthermore, it states:

‘Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding.’

The *Flood Map for Planning (Rivers and Sea)*⁵ as seen in Figure 1-2 and the local flood risk modelling to provide the basis for applying this test. The Site is located entirely within Flood



Zone 3 (i.e., Land having a 1% or greater annual probability of river flooding; or Land having a 0.5% or greater annual probability of sea).

The proposed development is an emissions management building, comprising a bag house and stack, on a total site area is 185m². The building will be ancillary to and essential to the efficient operation of the Sample Preparation Building, which was deemed to be permitted development, by GBC in November 2023 (Ref.20230770).

As the proposed development falls within the definition of a 'minor development' i.e. a small, non-domestic extension where the floor space created by the development does not exceed 250m², it is exempt from the sequential test. Furthermore, the proposed development is located within the Northfleet Embankment and Swanscombe Peninsula East Opportunity Area and is consistent with the site's allocated use i.e. the metal refinery.

It has therefore been deemed that the Sequential Test has been passed.

3.7 Exception Test

The Exception Test is required to show that the sustainability benefits of the proposed development to the community outweigh the flood risk. The Exception Test must also show that the development will be safe for its lifetime and will not increase the flood risk elsewhere.

The NPPF¹ states that where it is not possible for a development to be in an area of lower flood risk, the Exception Test may have to be applied. The Flood Risk Vulnerability Classification set out in the NPPF confirms that essential infrastructure in flood zones 3a and 3b will need to pass the Exception Test.

The purpose of the proposed emissions building is to house a dust extraction and treatment system with a stack for dust/fumes generated from furnaces and grinding/milling equipment that are located in the Sample Preparation Building.

In addition to enabling BRM to meet their required emissions management standards, the proposed development is considered to be in accordance with the aim of achieving sustainable development, as it will contribute to the continuing, successful operation of the BRM site, which is a significant employer in this area.

In line with the NPPF, the proposed development would be located on a brownfield site, within a much larger, established industrial site, and will be ancillary to existing operations on that site. The proposed development comprises plant and equipment. There are no habitable or office spaces within the building, nor any welfare facilities.

In the event of residual flood risk from the River Thames, the BRM facility operates with an early flood warning system and Evacuation Plan which has been provided in Appendix C. Under extreme scenarios, flood gates will protect the development from inundation.

On this basis, it is deemed that the Exception Test has been passed.



4.0 Assessment of Flood Risk

This report has been prepared in accordance with the advice and requirements prescribed in current best practice documents relating to management of flood risk in development published by the Construction Industry Research and Information Association (CIRIA)¹⁷ and The British Standards Institution (BSI) BS8533⁴⁴.

A screening study has been completed to identify whether there are any potential sources of flooding at the Site which may warrant further consideration. If required any potential flooding issues identified in the screening study would then be considered in subsequent sections of the assessment.

4.1 Potential Sources of Flooding

There are a number of potential sources of flooding, and these include:

- Flooding from rivers or fluvial flooding;
- Flooding from the sea or tidal flooding;
- Flooding from surface water or pluvial flooding;
- Flooding from groundwater;
- Flooding from sewers;
- Flooding from reservoirs, canals, and other artificial sources; and
- Flooding from infrastructure failure.

The flood risk from each of these potential sources is discussed below.

4.1.1 Flooding from Sea or Tidal Flooding

The Site is located adjacent to the tidally influenced River Thames¹⁴, as confirmed by the EA in a data request provided in Appendix C. This information has been supplied in Geographic Information System (GIS) format from the TE2100 hydraulic modelling study. The data was analysed concerning the development, alongside supporting information regarding coastal defences and modelling parameters.

The EA flood mapping shown Figure 1-2 places the site in Flood Zone 3. This indicates that if flood defences were not present, the annual probability of tidal flooding would be greater than 1 in 200 (0.5% AEP).

The Site is not located within EA TE2100 Designated Flood Storage Areas¹⁸.

4.1.1.1 Flood Defences

Flood defences maintained by the EA⁹ are present 190m northeast of the Site. These defences are tidal walls providing standard of protection (SoP) for up to and including the 1

¹⁷ CIRIA Report C624, Development and flood risk: guidance for the construction industry

¹⁸ Environment Agency (June 2024) Thames Estuary 2100 Flood Storage areas.
<https://www.data.gov.uk/dataset/b25962d1-e8b7-4d2a-a287-106c300d7ac0/thames-estuary-2100-flood-storage-areas> (Accessed: 11 July 2024).



in 1000-year (0.1% AEP) event. The wall is raised to an effective crest level of 6.75 m aOD and is in 'fair' condition¹⁹.

The area falls within Policy 4 of the TE2100 which requires defences to “*keep up with climate and land use change so that flood risk does not increase.*” Therefore, asset owners are required to work with the EA and LPA to have ensure sufficient SoP is provided by defences by 2040.

Appendix C shows how defences along the Thames Estuary are to respond to increasing tidal risk overtime because of climate change. In line with Policy 4 for Swanscombe and Northfleet, flood defences by 2040 are expected to have provide effective crest levels of 7.00m so that flood risk at the Site does not increase when accounting for climate change.

4.1.1.2 Swanscombe Peninsula

It was assessed that the Swanscombe Peninsula, and by extension Botany Marshes, is a floodplain that has potential to be inundated by the River Thames during high tides. With reference to Section 2.2, the Site benefits from embankments raised c3.0m above the Botany Marshe ground levels which separating the BRM facility. It is not identified as a formal flood defence asset in the EA Asset database²⁰.

The Flood Map for Planning therefore overrepresents flood risk from the peninsula at the Site because the mapping does not account for existing defences in the area and instead represents a natural floodplain extent. The peninsula has a perimeter earth embankment at a crest level of 8.8m aOD, providing a 1 in 1000-year (0.1% AEP) SoP from the Thames 750m to the northwest. By extension, this embankment offers protection to Botany Marshes.

EA asset mapping of Swanscombe Marsh identifies a 'Main Drain' and outfall to the Thames equipped with a penstock control gate. It is considered that the area is well-drained, and water levels are not expected to exceed 3m in depth where it may overtop the raised embankment and ingress the Site.

4.1.1.3 Flood Level Data

Flood level data taken at TE2100 Extreme Water Level²¹ node: 3.27 (NGR: TQ 62089 75409), a current day 1 in 200 annual probability (0.5% AEP) flood level of 5.85m aOD is anticipated.

Current day tide level for the 1 in 200 annual probability (0.5% AEP) flood is therefore lower than the current day crest of the wall adjacent the Site by 0.9m. As such direct over topping from tides is unlikely.

Additionally, flood risk from Botany Marshes is considered low due to the significant protection provided by two earth embankments from the Swanscombe Peninsula and Botany Marshes.

Therefore, Flood risk from this source is considered high but the development is protected by well-maintained flood defences. Residual flood risk from this source would therefore occur under exceptional scenarios.

¹⁹ Environment Agency, (2024). Asset Management (Asset ID: Wall: 127260) (Updated March 2024). Available from: <https://environment.data.gov.uk/asset-management/id/asset/127260> (Accessed: 27 June 2024)

²⁰ Environment Agency, (2024). Asset Management (Updated March 2024). Available from: [Item: /asset-management/id/asset \(data.gov.uk\)](https://environment.data.gov.uk/asset-management/id/asset) (Accessed: 8 July 2024)

²¹ Environment Agency, Thames Estuary 2100 Extreme Water Level nodes (updated June 2024) <https://www.data.gov.uk/dataset/69728968-613b-445d-9e6d-de854c0af461/thames-estuary-2100-extreme-water-level-nodes#licence-info> (Accessed: 8 July 2024)



4.1.2 Flooding from Rivers or Fluvial Flooding

The primary flood risk to the Site is from tidal sources as confirmed by the EA. The tidal reach of the River Thames extends to Teddington Weir, located 44km west of the Site where extreme tide surges are controlled up to the Thames Barrier 22km to the west.

The barrier serves to protect London from tidal surges from the North Sea. Its operation coordinates both upstream fluvial flow with tide surges to reduce coincidental extreme flood risk upstream and downstream.

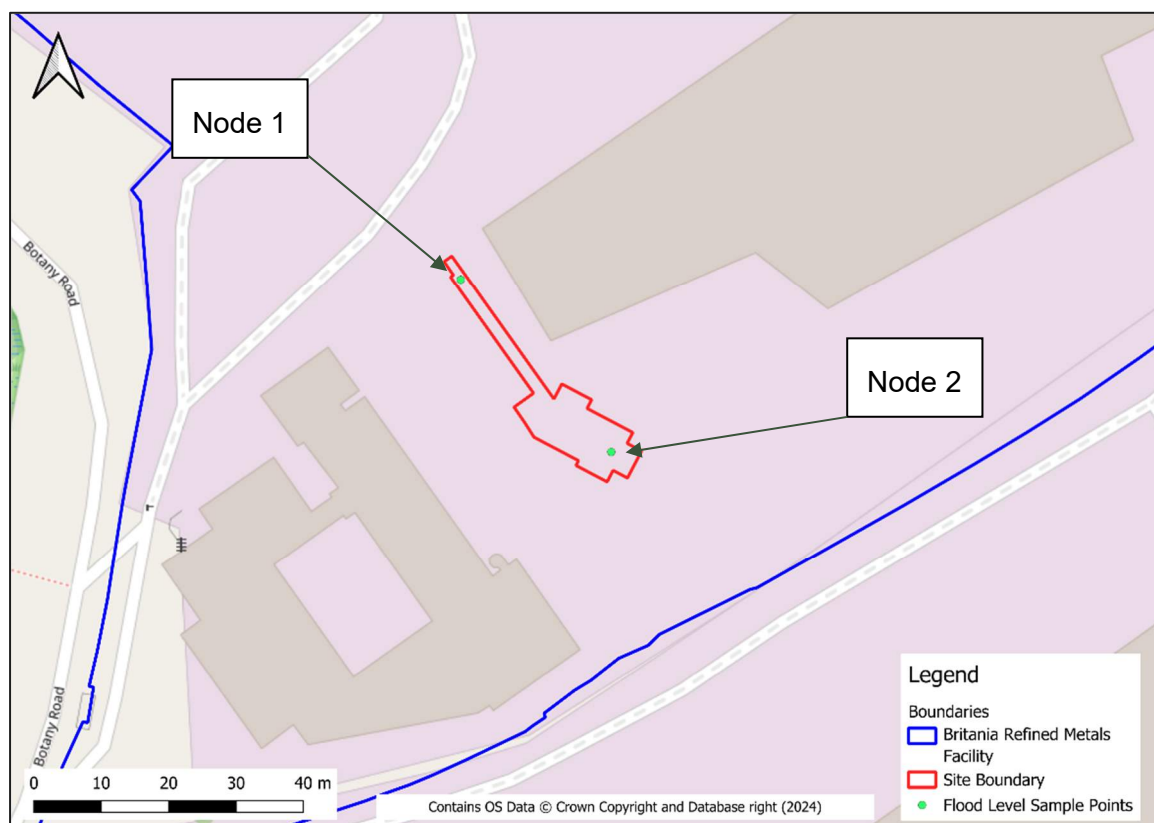
On this basis the flood risk from river or fluvial flooding is assessed to be low.

4.1.3 Flooding from Infrastructure Failure

During an extreme tidal flood event, over topping of the flood defences is possible. Such overtopping would significantly increase the potential for scour and erosion of flood embankments, and this could result in major breaches through which significant quantities of flood water would enter the Site.

Model output data from the Thames Tidal Downriver Breach Inundation Modelling 2018²² was used to perform a detailed analysis of infrastructure failure at the Site in line with Product 6 guidance provided by the EA. Outputs were sampled using GIS software to derive hazard information at specific locations for the Site. Samples were taken from the points shown in Figure 4-1, with the results produced in Table 4-1.

Figure 4-1: Environment Agency Infrastructure Failure Point Sample Locations



²² Environment Agency (May 2018) Thames Estuary Breach Assessment Thames Barrier to Gravesend and Linford Methodology Report. [Accessed: 08 July 2024].





Table 4-1: Infrastructure Failure Sampled Point Data Summary for Flood Elevation, Depth and Velocity for 0.5% and 0.1% AEP.

Year	Sample		Node 1	Node 2
2115	Elevation (m aOD)	0.5% AEP	5.12	5.15
		0.1% AEP	5.60	5.60
	Depth (m)	0.5% AEP	1.32	1.43
		0.1% AEP	1.80	1.87
	Velocity (m/s)	0.5% AEP	0.63	0.61
		0.1% AEP	0.68	0.64
2005	Elevation (m aOD)	0.5% AEP	4.79	4.79
		0.1% AEP	4.92	4.93
	Depth (m)	0.5% AEP	0.993	1.06
		0.1% AEP	1.12	1.20
	Velocity (m/s)	0.5% AEP	0.62	0.61
		0.1% AEP	0.63	0.64

The Site is located 180m from the nearest modelled breach to the northeast. Should a breach failure occur, the site would be inundated quickly with depths that exceed 1.32m. This reflects significant hazard to site personnel.

The BRM facility has a series of on-site flood gates and emergency procedures in the event of flood defence failure which protects 'Employee Work Areas' as shown in Appendix C. The development shall be incorporated into the existing arrangement to ensure safe refuge is immediately available for site personnel and flood gates mitigate risk of inundating sensitive assets.

The modelled data reflect a worst-case scenario where defences fail suddenly. The BRM facility is regularly staffed where defences are routinely monitored for defects. The likelihood of a breach failure is considered relatively low and effectively mitigated from existing emergency procedures in-place at the Site.

The probability of flood risk from this source is considered low due to ongoing maintenance and the condition of defences. However, should failure occur the Site would be directly impacted.

4.1.4 Flooding from Surface Water or Pluvial Flooding

The Site is located on levelled hardstanding. Topographic data suggests that surface water runoff from the wider BRM facility would flow from the northeast to the southwest. Surface water runoff is anticipated to temporarily pond in nearby depressions adjacent the Site. The area immediately around the Site benefits from a surface water drainage network.

Appendix E shows that the finished floor level of the development is to be raised by 0.55m above the existing ground level. The development may obstruct incoming surface water runoff as a result. However, the drainage pathway is expected to flow around the development before continuing on its natural course.

It is considered that there will be no significant loss of flood storage for the design 1.0% AEP event, and flood risk downstream is not expected to increase.

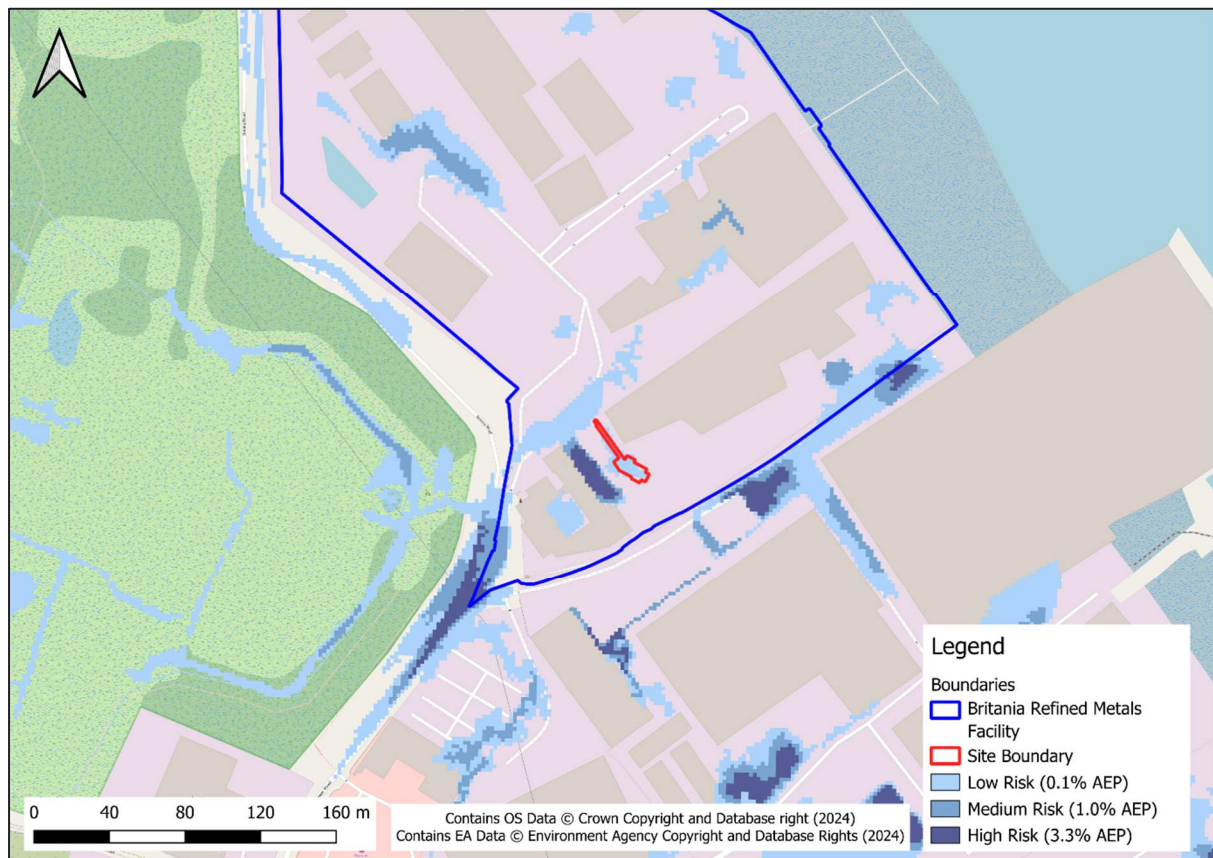


An extract from the *Long Term Flood Risk Information*²³ mapping showing areas potentially at risk of flooding from surface water has been provided as Figure 4-2.

The surface water flood risk categories are defined as:

- **Very Low:** less than 1 in 1,000 (0.1% AEP) chance of flooding in any given year;
- **Low:** less than 1 in 100 (1% AEP) but greater than or equal to 1 in 1,000 (0.1% AEP) chance of flooding in any given year;
- **Medium:** between 1 in 100 (1% AEP) and 1 in 30 (3.3% AEP) chance of flooding in any given year; and
- **High:** greater than 1 in 30 (3.3% AEP) chance of flooding in any given year.

Figure 4-2: Environment Agency Surface Water Flood Risk Map



With reference to Figure 4-2, the Site is predominantly at a 'low risk' of surface water flooding. The conceptual understanding of the drainage arrangement was therefore confirmed as ponding is shown to occur to the southwest in the nearby depression. These areas are expected to drain via sewer networks or follow existing drainage pathways away from the Site to the southwest.

Flooding from surface water is therefore low and not considered further.

²³ Long Term Flood Risk, Government Digital Service (Accessed: 05 July 2024) <https://www.gov.uk/check-long-term-flood-risk>



4.1.5 Flooding from Groundwater

Groundwater flooding can occur where sites are located on permeable ground, particularly where there are significant variations in local topography and geology. After a prolonged period of rainfall and groundwater recharge, a considerable rise in the water table can result in this intersecting the ground surface, resulting in flooding. Due to the slow response of groundwater systems, any resulting flows and inundation could persist for an extended period.

SLR revisited the Site to undertake three rounds of winter groundwater monitoring in 2023¹². The 2No. wells measured the depth to groundwater; a summary of the data is shown in Table 4-1 below. The location of the boreholes is provided in Appendix F.

Table 4-2: Groundwater Monitoring Data

BH Ref	BH Elevation (m aOD)	Borehole Screen Interval (m bgl)	Date	Well Headspace (ppm)	Depth to Water (m)	Groundwater Elevation (m aOD)	Notes
BH2023-01S	3.85	0.5-1.5	20/09/2023	<1	0.83	3.02	Sampled
			02/10/2023	<1	0.83	3.02	
			06/10/2023	<1	0.93	2.92	
BH2023-01D	3.85	14.0-20.0	20/09/2023	<1	3.48	0.37	Sampled
			02/10/2023	<1	3.44	0.41	
			06/10/2023	<1	3.47	0.38	
BH2023-02S	3.79	1.0-3.0	20/09/2023	<1	Dry	-	
			02/10/2023	<1	Dry	-	
			06/10/2023	<1	Dry	-	
BH2023-02D	3.79	13.0-20.0	20/09/2023	<1	1.03	2.76	Sampled
			02/10/2023	<1	1.21	2.58	
			06/10/2023	<1	1.01	2.78	

The data shows that groundwater is limited to 0.83m depth below ground level. The Site is overlain by impermeable 0.58m thick concrete hardstanding and is not considered susceptible to groundwater emergence. The development does not include works that require installation of permanent below ground equipment that would be susceptible to flooding from groundwater.

Flooding from groundwater is therefore low and not considered further.

4.1.6 Flooding from Sewers

Sewer plans provided by the client indicate that there are existing sewers that service the BRM facility. Due to runoff potentially mobilising harmful contaminants, the facility is split into 'Surface Water Contained' and 'Surface Water Outflow' which discharges into the Southern Water foul sewage network located offsite to the southwest. The drainage arrangements for the Site and BRM facility are included in Appendix A.

Should upstream sewers within the network to the northeast flood, overland flow would be conveyed down gradient towards the Site. Sewer flows are typically shallow and are expected to attenuate in depressions located near the Site.



It is considered that there is insufficient potential for significant flood volumes to risk inundating the Site. The network receives no additional offsite flows and, the final finished floor level of the development is raised by 0.55m above ground level.

Flooding from sewers is therefore low and not considered further.

4.1.7 Flooding from Reservoirs, Canals and other Artificial Sources

The EA's 'Flood Risk from Reservoirs' mapping indicates that the Site is not at risk of flooding in the event of multiple upstream reservoir failures.

The flood risk from these sources is therefore low and is not considered further.

4.2 Flood Risk Summary

A summary of the potential sources of flooding and the flood risk arising from them is presented in **Table 4-3**.

Table 4-3: Potential Sources of Flooding

Potential Source of flooding	Significant Flood Risk at the Site (Y/N)
Rivers or Fluvial Flooding	High
Sea or Tidal Flooding	Low
Surface Water or Pluvial Flooding	Low
Groundwater	Low
Sewers	Low
Reservoirs, Canals and other Artificial Sources	High
Infrastructure Failure	Low

The Flood Risk Assessment confirms that the primary flood risks at Site are tidal from the adjacent River Thames.

4.3 Flood Zone

The definition of flood zones is provided by *Table 1: Flood zones* at PPG Paragraph 077 and is summarised below:

- **Zone 1 – low probability** (Flood Zone 1). Land having a less than 0.1% annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map for Planning – all land outside Zones 2, 3a and 3b)
- **Zone 2 – medium probability** (Flood Zone 2) Land having between a 1% and 0.1% annual probability of river flooding; or land having between a 0.5% and 0.1% annual probability of sea flooding. (Land shown in light blue on the Flood Map)
- **Zone 3a – high probability** (Flood Zone 3a) Land having a 1% or greater annual probability of river flooding; or Land having a 0.5% or greater annual probability of sea. (Land shown in dark blue on the Flood Map)
- **Zone 3b – the functional floodplain** (Flood Zone 3b) This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise:
 - land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or



- land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding). Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

Based on the screening study, the entire site lies within Flood Zone 2. The Site benefits from existing defences that provide a SoP for flood events up to the 1 in 1000-year (0.1% AEP) event from tidal sources, which is considered the primary risk at the Site.



5.0 Climate Change

In July 2021 the EA issued updated guidance on the impacts of climate change on flood risk in the UK²⁴ to support NPPF. This advice sets out that peak rainfall intensity, sea level, peak river flow are all expected to increase in the future as a result of climate change.

The PPG recommends that considerations for future climate change are included in FRAs for proposed developments. Given that the site has only been identified as being at risk of tidal flooding, only consideration of climate change in relation to sea level rise has been included herein.

Sea Level Change

Sea Level Allowances, published by the EA for the 'Thames Basin District' (South East), are presented in Table 5-1. This shows the estimated annual uplifts to mean sea level which increase over time.

Table 5-1 Sea level allowances by river basin district for each epoch in mm for each year (based on a 1981 to 2000 baseline)

Area of England	Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
South East	Higher Central	5.8 (200)	8.7 (261)	11.6 (348)	13.1 (393)	1.21
	Upper end	7.0 (242)	11.3 (339)	15.8 (474)	18.2 (546)	1.62

Using the baseline of 2018²⁵, the anticipated sea level rise throughout the 20-year anticipated lifetime of development, up until 2044, is 0.18m using the higher central allowance and up to 0.22m using the upper end allowance. A summary of these calculations is provided in Appendix G.

These uplifts are used to predict changes to sea level along coastlines which have been modelled through the EA's Coastal Design Sea Levels²⁶. Where available, the outputs of such modelling should be used in preference to simply uplift base day estimates of extreme flood levels. However, the data provided by the EA did not include defended tidal flood risk modelling for accurate assessment. Therefore, for conservatism, the 'Upper end' allowance has been used using level data provided in Section 4.1.1.3.

Assessing current day TE2100 Extreme Water Levels at 5.85m aOD and applying climate uplift up to 2044 gives an approximate level of 6.07m aOD. Should nearby defences provide the existing crest level of 6.75m aOD during the 1 in 200 (0.5% AEP) event plus climate

²⁴ Environment Agency, February 2016 (updated October 2021). Flood risk assessments: climate change allowances (Accessed: 10 July 2024) <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

²⁵ Environment Agency, January 2012. (Updated June 2024) Thames Estuary 2100 Extreme Water Level nodes

²⁶ Environment Agency (2018) Coastal Design Sea Levels - Coastal Flood Boundary Extreme Sea Levels (2018) <https://www.data.gov.uk/dataset/73834283-7dc4-488a-9583-a920072d9a9d/coastal-design-sea-levels-coastal-flood-boundary-extreme-sea-levels-2018>



change, there would be a freeboard of 0.68m, which would not reflect significant risk to the Site.

6.0 Conclusions

SLR Consulting Limited (SLR) has been appointed by Britannia Refined Metals (BRM) Limited (the Client) to prepare a Flood Risk Assessment (FRA) to support a planning application for the development for a proposed emission management building, comprising of a baghouse and stack, situated at BRM, Botany Road, Northfleet, Gravesend, DA11 9BG. The emission management building would be ancillary to the operation of the Sample Preparation Building, which was deemed to be permitted development, by GBC in November 2023 (Ref.20230770).

6.1 Flood Risk

Flood risk has been assessed in line with BS8533⁴ taking account of national and local planning policy and guidance, and all potential sources of flooding to the site have been considered.

A screening assessment reviewed the flood risk posed by sources including fluvial, tidal, surface water, groundwater, sewer, reservoirs, canals and infrastructure failure. It is concluded that the Site is at risk of flooding from the tidally influenced River Thames. However, the Site benefits from the protection of flood defences.

The Site is located within Flood Zone 3a as the Site benefits from tidal flood defences for events up to 1 in 1000 (0.1% AEP). The development is classified as '*Essential Infrastructure*' and subjected to both the Sequential and Exception Tests. It is concluded that the Site is suitable for development under NPPF and PPG requirements.

Modelling data has been provided by the EA which indicates in-channel flood levels along the River Thames which confirm that the Site will be safe up to 2044 including anticipated increases as a results of climate change.

Site specific infrastructure failure modelling has concluded that, in a highly unlikely event of a breach of the flood defences, the risk to site personnel would be significant. However, there are already established early flood warning systems and Evacuation Plans for staff to mitigate significant risk. The flood defence assets are routinely monitored and maintained by the EA and BRM and are considered unlikely to fail.

The TE2100 policy zone for Swanscombe & Northfleet intends to monitor and upgrade defences over time. The Site has therefore shown that it will be safe from flooding for the anticipated 20-year lifetime of the proposed redevelopment.

It is concluded that the development will be safe from all sources of flood risk. Additionally, there will be no adverse off-site impact with respect to flood risk.



Appendix A BRM Facility Drainage Layout Plan

Flood Risk Assessment

**Proposed emissions management building, comprising of baghouse and stack
at the BRM site in Northfleet, Gravesend, DA11 9BG**

Britannia Refined Metals

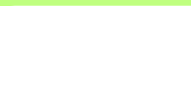
SLR Project No.: 402.064683.00001

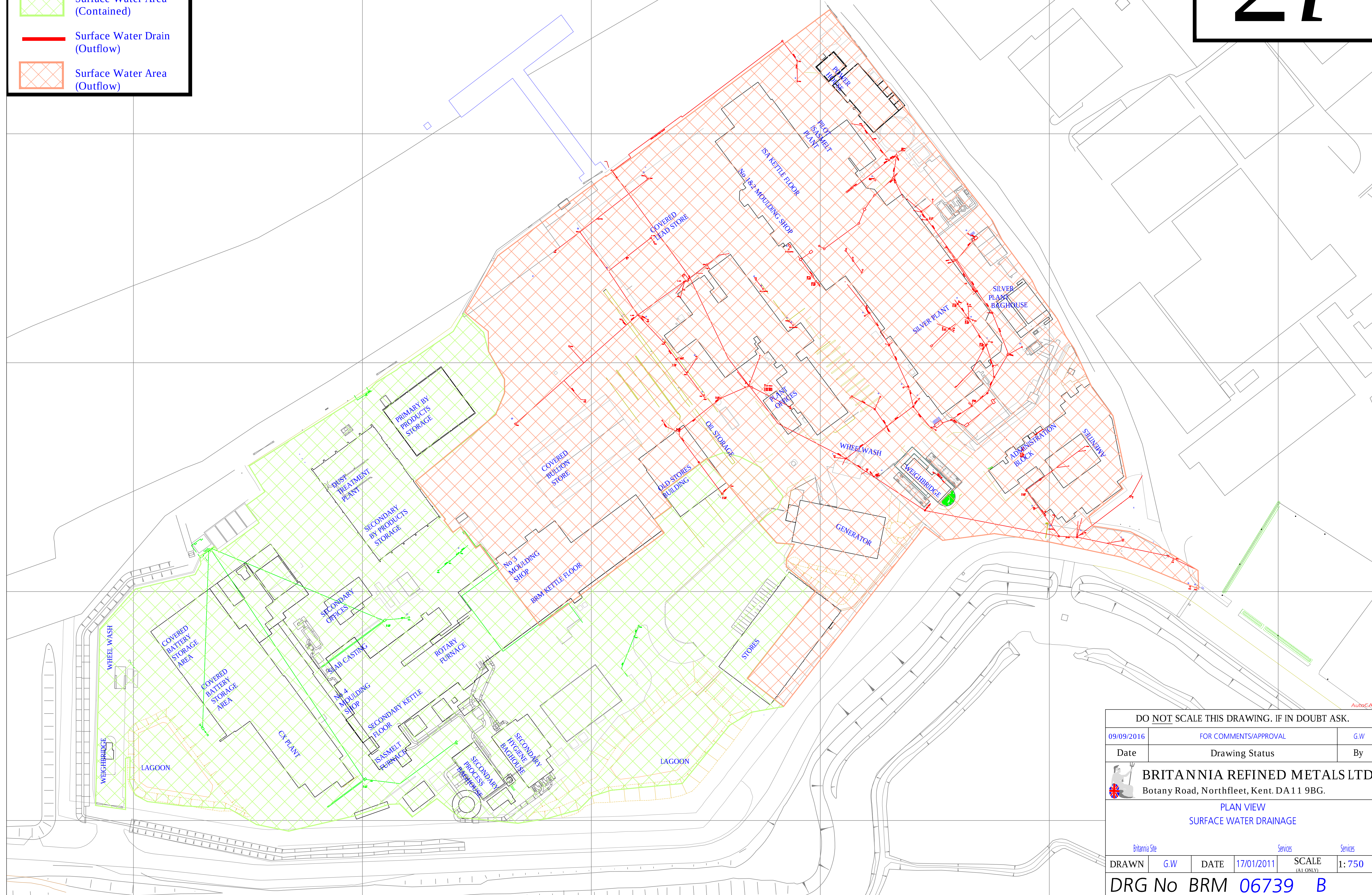
23 July 2024



21

KEY

	Surface Water Drain (Contained)
	Surface Water Area (Contained)
	Surface Water Drain (Outflow)
	Surface Water Area (Outflow)



AutoCAD

09/09/2016	FOR COMMENTS/APPROVAL	G/W
Date	Drawing Status	By
 BRITANNIA REFINED METALS LTD. Botany Road, Northfleet, Kent. DA11 9BG.		

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[Services](#)
[Services](#)

DRG No	BRM	06739	B
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DRG No	BRM	06739	B
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Appendix B Development Layout Plan

Flood Risk Assessment

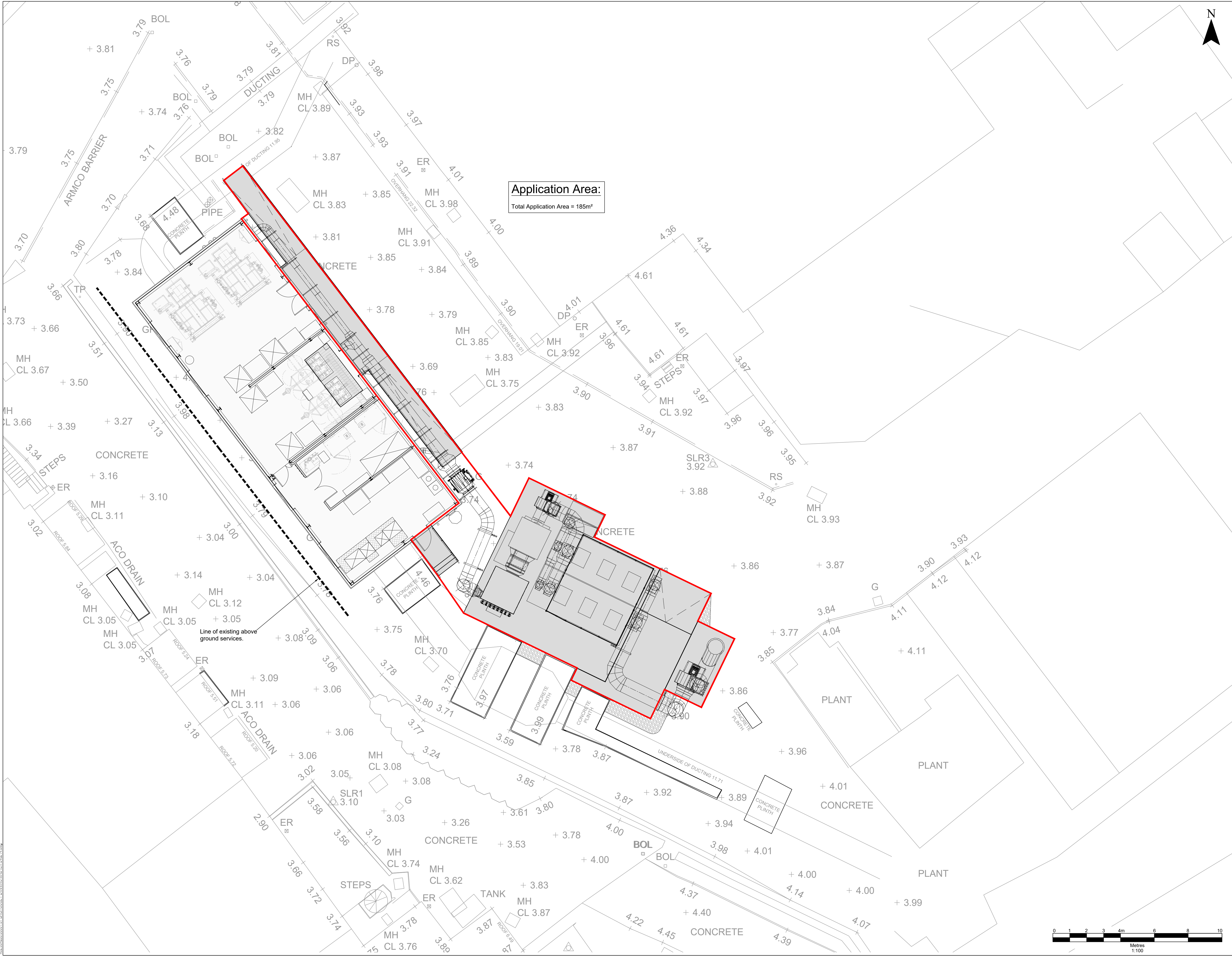
Proposed emissions management building, comprising of baghouse and stack at the BRM site in Northfleet, Gravesend, DA11 9BG

Britannia Refined Metals

SLR Project No.: 402.064683.00001

23 July 2024





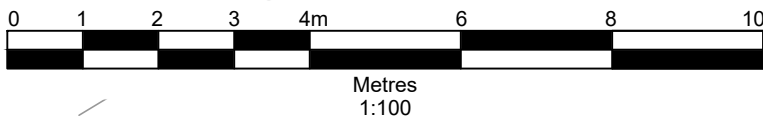
Application Area:
Total Application Area = 185m²



NOTES
1. Do not scale this drawing. If in doubt ask.

LEGEND
Application Boundary
Total Application Area = 185m²

P0	RW	PS	FEB 24	PLANNING ISSUE
Revision	By	Chk'd By	Date	Comments
BRITANNIA REFINED METALS Ltd				
 global environmental solutions				
Site BRITANNIA REFINED METALS LTD BOTANY ROAD, NORTHFLEET, KENT, DA11 9BG				
Project BAGHOUSE FACILITY				
Drawing Title APPLICATION BOUNDARY				
Scale 1:100 @ A1			Date FEBRUARY 2024	
Drawing Number 03				Revision P0
PLANNING				



Appendix C Flood Gate Location Plan

Flood Risk Assessment

Proposed emissions management building, comprising of baghouse and stack at the BRM site in Northfleet, Gravesend, DA11 9BG

Britannia Refined Metals

SLR Project No.: 402.064683.00001

23 July 2024



PbO

P

KEY:
Building/Bay Containing PbO
fitted with Flood Gate

Employee Work Area

2s

FLOOD GATE FB05
AND FLOOD DOOR FB09
(SEE DRAWING BRM 08626)

Baghouse containing
Lead Oxide (PbO)

FLOOD GATE FB01
(SEE DRAWING
BRM 08622)

FLOOD GATE FB02
(SEE DRAWING
BRM 08623)

FLOOD GATE FB03
(SEE DRAWING
BRM 08624)

'Penstock Valve'

FLOOD GATE FB04
(SEE DRAWING
BRM 08625)

FLOOD GATE FB06
(SEE DRAWING
BRM 08627)

'Darcy/Balloon (Inner)
and 'Tideflex' (Outer-
on Seawall) Valves

Baghouse containing
Lead Oxide (PbO)

FLOOD DOOR FB07
(SEE DRAWING BRM 08628)

Baghouse containing
Lead Oxide (PbO)

FLOOD GATE FB08
AND FLOOD DOOR FB10
(SEE DRAWING BRM 08629)

Baghouse containing
Lead Oxide (PbO)

AutoCAD

Do <u>Not</u> Scale, If in Doubt Ask				
04/05/2021	AS INSTALLED			G.W
Date	Drawing Status			By
 BRITANNIA REFINED METALS LTD. Botany Road, Northfleet, Kent. DA 11 9BG.				
GENERAL ARRANGEMENT FLOOD GATE				
- -				
Britannia Site				
DRAWN	M.M	DATE	04/05/2021	SCALE (A1 ONLY)
				1: 1000
DRG No BRM 08621 B				

Appendix D Environment Agency Data Request

Flood Risk Assessment

**Proposed emissions management building, comprising of baghouse and stack
at the BRM site in Northfleet, Gravesend, DA11 9BG**

Britannia Refined Metals

SLR Project No.: 402.064683.00001

23 July 2024



Subject: RE: KSL 365609 RL: Botany Road, Northfleet, Gravesend DA11 9BG
Sent: 03/07/2024, 13:11:46
From: KSL PSO SE London & North Kent<PSO.SELondonandNKent@environment-agency.gov.uk>
To: Chris Middleton
Cc: KSL Enquiries

Categories: TASKS

You don't often get email from ps0.selondonandnkent@environment-agency.gov.uk. [Learn why this is important](#)

Dear Chris,

Re: KSL 365609 RL: Botany Road, Northfleet, Gravesend DA11 9BG

Thank you for your enquiry which was received on 24 June 2024.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004.

You have requested a Product 4 and 8, please see Appendix 1 below detailing each product.

Your request for a Product 4 and 8 falls under the exemption in provision 6(1)(a) and (b) of the Environmental Information Regulations 2004 (EIR), and on this occasion we are not providing the information in the requested format but in an alternative format. Further detail of the provisions under the EIR can be found in Appendix 2.

Please find below the link containing the Product 5 and 6

Thames Tidal Downriver Breach Inundation Modelling 2018 <https://defra.sharefile.com/d-s7fa7e1d01734d5a9>

Product 8 data can be derived using the depth (d) velocity (v) and hazard (ZKU0) 2D grids which are provided in the Product 6 dataset.

We have also enclosed Thames Estuary 2100 information.

We are licensing the supplied data to you under the [Environment Agency Conditional Licence](#), details of which are included in the ShareFile link. You must first check this supporting information to determine if the conditions of use are suitable for your purposes. If the conditions for use are not suitable for your purposes, this information is not provided with a licence for use and the data is provided for the right to read only.

The information provided in the ShareFile link is based on the best data available as of the date of this letter. You may feel it is appropriate to contact us at regular intervals to check whether any amendments/improvements have been made to the data for this location. Should you re-contact us after a period of time, please quote the above reference in order to help us deal with your query.

Please be aware that the Environment Agency supply data but we do not interpret it for use in a Flood Risk Assessment. Flood Risk Assessments should be completed by a suitably competent and qualified person.

Requests for flood products in Kent, South London and East Sussex

Please note that we changed our process in December 2019 for responding to flood product data requests. Where appropriate, we supply the data in its raw form (Product 6), as opposed to in the Product 4 and/or 8 PDF format. This is to improve efficiency within our area of the Environment Agency, and to provide customers with a more rapid and flexible response. Where customers are unable to use the Model Output Data (Product 6), or if the data is particularly complex, we will continue to produce Product 4 and 8 formats.

The Product 4 and 8 itself is not a direct requirement in the planning process, but the data that goes into the Product 4 and 8 is required to inform your Flood Risk Assessment. This data can be extracted from the Product 6 data provided in the ShareFile link and in open data sources listed below. Instructions on how to use the appropriate data are provided on the ShareFile link.

Other flood data sources

The Flood Map for Planning is available to view and export maps for your site at: <https://flood-map-for-planning.service.gov.uk/>

Flood Zone 3 <https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-flood-zone-3>

Flood Zone 2 <https://data.gov.uk/dataset/flood-map-for-planning-rivers-and-sea-flood-zone-2>
Historic Flood Map <https://data.gov.uk/dataset/historic-flood-map1>

Please note that our historic flood event maps may not be comprehensive. We would therefore advise that you make further enquiries locally with specific reference to flooding at your location. You should consider contacting the relevant Local Planning Authority and/or water/sewerage undertaker for the area.

Please be aware that flooding can come from different sources. Examples of these are:

- from rivers or the sea
- surface water (i.e. rainwater flowing over or accumulating on the ground before it is able to enter rivers or the drainage system)
- overflowing or backing up of sewer or drainage systems which have been overwhelmed
- groundwater rising up from underground aquifers

Currently the Environment Agency can only supply flood risk data relating to the chance of flooding from rivers or the sea. The Lead Local Flood Authority is responsible for surface water flooding issues. Please contact them for further information or for details on groundwater flood risk.

Defence Information

Defence 1

Asset type – Wall

Description – 232.54m long

Maintainer – Environment Agency

Standard of protection – 1000

Asset protection type – Tidal

Condition – 3

Crest level – 6.85 mOAD

Date asset commissioned / opened – 01/01/1985

Environment Agency planning guidance and pre application service.

0. Planning practice guidance - provides information about planning considerations in areas at risk of flooding
<https://www.gov.uk/guidance/flood-risk-and-coastal-change>
1. Planning applications: assessing flood risk - information about completing flood risk assessments
<https://www.gov.uk/planning-applications-assessing-flood-risk>
2. Site specific flood risk assessment checklist - a checklist to help ensure you have considered all the relevant factors in your flood risk assessment <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/site-specific-flood-risk-assessment-checklist/>
3. Climate change allowance guidance - <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

We recommend that you discuss your proposals with the Local Planning Authority at the earliest opportunity. They will be able to advise you on a wide range of planning matters in addition to flood risk.

Please see our website for details on how to get planning advice from the Environment Agency, including charged-for discretionary advice <https://www.gov.uk/guidance/developers-get-environmental-advice-on-your-planning-proposals#when-to-consult>. Our planning team can be contacted at kslplanning@environment-agency.gov.uk

If you have a new enquiry or would like us to review the information we have provided under the Freedom of Information Act 2000 and Environmental Information Regulations 2004 please contact us within two months by email at KSLE@environment-agency.gov.uk

Kind regards,

Layo Oluwole

Flood & Coastal Risk Management Officer

Partnership & Strategic Overview - South East London & North Kent

Kent, South London and East Sussex Area

Environment Agency | Orchard House, London Road, Addington, West Malling, ME19 5SH

PSO.SELondonandNKent@environment-agency.gov.uk



Appendix 1

Product 4	Detailed Flood Risk Assessment Map, including flood zones, defences and storage areas, areas benefiting from defences, statutory main river designations, historic flood event outlines and more detailed information from hydraulic models (including model extents and 2D flood level data for specific points)
Product 5	Reports, including flood modelling reports, model user logs and guides, hydrology reports, etc
Product 6	Model Output Data, including product 5. • flood outlines usually provided in shapefile format • 2D grids (level (h), depth (d) velocity (v) and hazard ZKU0) usually provided in ASCII or GeoTIFF format • 1D flow and level data Requires GIS software such as ArcGIS, MapInfo, QGIS or similar.
Product 7	Calibrated and Verified Model Input Data (CaVMID), including product 5. Enables customer to re-run and/or make changes to a hydraulic model. Requires specific hydraulic modelling software such as Flood Modeller, TUFLOW, or ICM InfoWorks.
Product 8	Breach Hazard Map Provides a hazard map of breaches in PDF format including, maximum flood depth, maximum flood velocity and maximum flood hazard. Please note product 8 is not available for fluvial models.

Appendix 2

The exemption in provision 6(1)(a) and (b) of the Environmental Information Regulations 2004 (EIR) states that

*‘.....6.—(1) Where an applicant requests that the information be made available in a particular form or format, a public authority shall make it so available, unless—
(a) it is reasonable for it to make the information available in another form or format; or
(b) the information is already publicly available and easily accessible to the applicant in another form or format.....’*

On this occasion we are not providing the information in the requested format, for the following reasons:

- Complying with the preference would incur a significant cost, which the public authority [The Environment Agency] cannot pass on to the requester;
- Using a Product 5/6/7 allows us to make the information available at a lower cost; and
- The impact on the available resources of the public authority [The Environment Agency], of supplying a Product 5/6/7, is therefore much less.

From: Chris Middleton <cmiddleton@slrconsulting.com>
Sent: Monday, June 24, 2024 3:41 PM
To: Enquiries, Unit <enquiries@environment-agency.gov.uk>
Subject: 240625/rg02 Data Request: Botany Road, Northfleet, Gravesend, DA11 9BG

To whom it may concern,

Please can you provide **products 4 and 8** outputs with respect to a proposed extension (Shown in Red) to the British Refined Metals industrial estate centre point NGR: TQ 61401 75307 (see attached plan). This data is required to better understand flood risk at the Site.

Please can you ensure that the data provides:

- In channel flood levels for range of events
- In channel flood flows for a range of events
- 2D flood levels in floodplain at and around the site
- Details of local flood defence structures including condition and crest heights

Please can you also advise whether there are any expected forthcoming changes to flood management or asset management in this area (i.e. new defence schemes) or any forthcoming new studies that might change the baseline understanding of flood risk (i.e. new modelling studies).

If you have any queries concerning this request, please do not hesitate to get in touch.

Kind Regards,

Chris Middleton.

Chris Middleton *(he/him/his)*
Graduate Hydrologist - Hydrology & Hydrogeology

O [+44 3300 886631](tel:+443300886631)
M [+44 7890 971494](tel:+447890971494)
E cmiddleton@slrconsulting.com

SLR Consulting Limited
3rd Floor, Brew House, Jacob Street, Bristol, United Kingdom BS2 0EQ



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KSLES Guidance on using Product 6 data in a Flood Risk Assessment

The Product 6 data can be viewed using several GIS applications such as:

- ArcGIS
- Civil3D
- AutoCad
- Mapinfo
- Qgis

As an example, QGIS is an open source GIS application which is licensed under the General Public License (GNU) and can be freely used for commercial purposes on a wide range of devices.

The flood outlines (usually in shapefile format), along with flood level (h) grids (usually in ASCII, or GeoTIFF format) can be loaded into GIS software for further interrogation.

Please provide a node map and accompanying table in the Flood Risk Assessment similar to the example given below. You should clearly demonstrate the highest and most representative flood levels for your proposed development. For example, if it is a small extension (< 250 square metres) then approximately 5-10 nodes would be sufficient. For larger sites, approximately 10 to 20 nodes would be appropriate.

If you have any further queries regarding how to use the above data please contact the Partnership and Strategic Overview (PSO) team directly by reply email.



1. Outline your site boundary clearly
2. Clearly mark the node points where you are extracting data from
3. Select node points that cover the site, around the site itself, and along the access route to the site to give a representative sample.
- 4 Provide the flood level extracted from the data points in a table, similar to the one below.

Example Flood Level table:

Node	National Grid Reference		Modelled Levels
	Easting	Northing	[insert return periods]
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Advice to Consultants

The data provided in a Flood Risk Assessment will be checked against our records as we review the FRAs when consulted by the Local Planning Authority in our remit as statutory consultee for flood risk from tidal and fluvial sources. We require you to get in touch with us to check for the most up to date model information and FRA checklist. Having the latest data is important, as not having the data will possibly delay us in reviewing your application at planning stage.

Thank you for your enquiry.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004. The information is attached.

Name	Products 5, 6 and 7
Description	Report names: Thames Estuary Breach Assessment Methodology Report, May 2018, Rev 1.0, by Atkins Thames Estuary Breach Assessment Model User Guide, June 2018, by Atkins Thames Estuary Breach Assessment Outputs User Note, June 2018, by Atkins Model output data for Thames Tidal Downriver Breach Inundation Modelling 2018 Calibrated and Verified Model Input Data for Thames Tidal Downriver Breach Inundation Modelling 2018
Licence	Environment Agency Conditional Licence
Conditions	1.0 You may use the Information for your internal or personal purposes and may only sublicense others to use it if you do so under a written licence which includes the terms of these conditions and the agreement and in particular may not allow any period of use longer than the period licensed to you. 2.0 Notwithstanding the fact that the standard wording of the Environment Agency Conditional Licence indicates that it is perpetual, this Licence has a limited duration of 5 years at the end of which it will terminate automatically without notice. 3.0 We have restricted use of the Information as a result of legal restrictions placed upon us to protect the rights or confidentiality of others. In this instance it is because of third party data. If you contact us in writing (this includes email) we will, as far as confidentiality rules allow, provide you with details including, if available, how you might seek permission from a third party to extend your use rights. 4.1 The Information may contain some data that we believe is within the definition of "personal data" under the Data Protection Act 1998 but we consider that we will not be in breach of the Act if we disclose it to you with conditions set out in this condition and the conditions above. This personal data comprises names of individuals or commentary relating to property that may be owned by an individual or commentary relating to the activities of an individual. 4.2 Under the Act a person who holds and uses or passes to others personal data is responsible for any compliance with the Act and so we have

	no option but to warn you that this means you have responsibility to check that you are compliant with the Act in respect of this personal data. 5.0 The location of public water supply abstraction sources must not be published to a resolution more detailed than 1km². Information about the operation of flood assets should not be published.. 6.1 Where we have supplied model data which may include model inputs or outputs you agree to supply to the Environment Agency copies of any assessments/studies and related outputs, modifications or derivatives created pursuant to the supply to you of the Information, all of which are hereinafter referred to as “the Data”. 6.2 You agree, in the public interest to grant to the Environment Agency a perpetual royalty free non-exclusive licence to use the Data or any part thereof for its internal purposes or to use it in any way as part of Environment Agency derivative products which it supplies free of charge to others such as incorporation into the Environment Agency's Open Data mapping products.
Information Warnings	Please be aware that model data is not raw, factual or measured but comprises of estimations or modelled results based on the data available to us.
Attribution	Contains Environment Agency information © Environment Agency and/or database rights. May contain Ordnance Survey data © Crown copyright 2019 Ordnance Survey 100024198.

Data Available Online

Many of our flood datasets are available online:

- Flood Map For Planning ([Flood Zone 2](#), [Flood Zone 3](#), [Flood Storage Areas](#), [Flood Defences](#), [Areas Benefiting from Defences](#))
- [Risk of Flooding from Rivers and Sea](#)
- [Historic Flood Map](#)
- [Current Flood Warnings](#)

Appendix E Building Elevations

Flood Risk Assessment

Proposed emissions management building, comprising of baghouse and stack at the BRM site in Northfleet, Gravesend, DA11 9BG

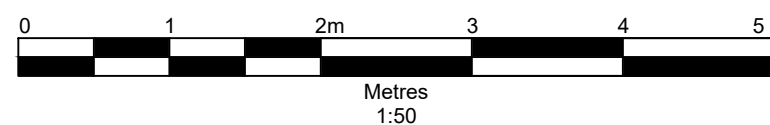
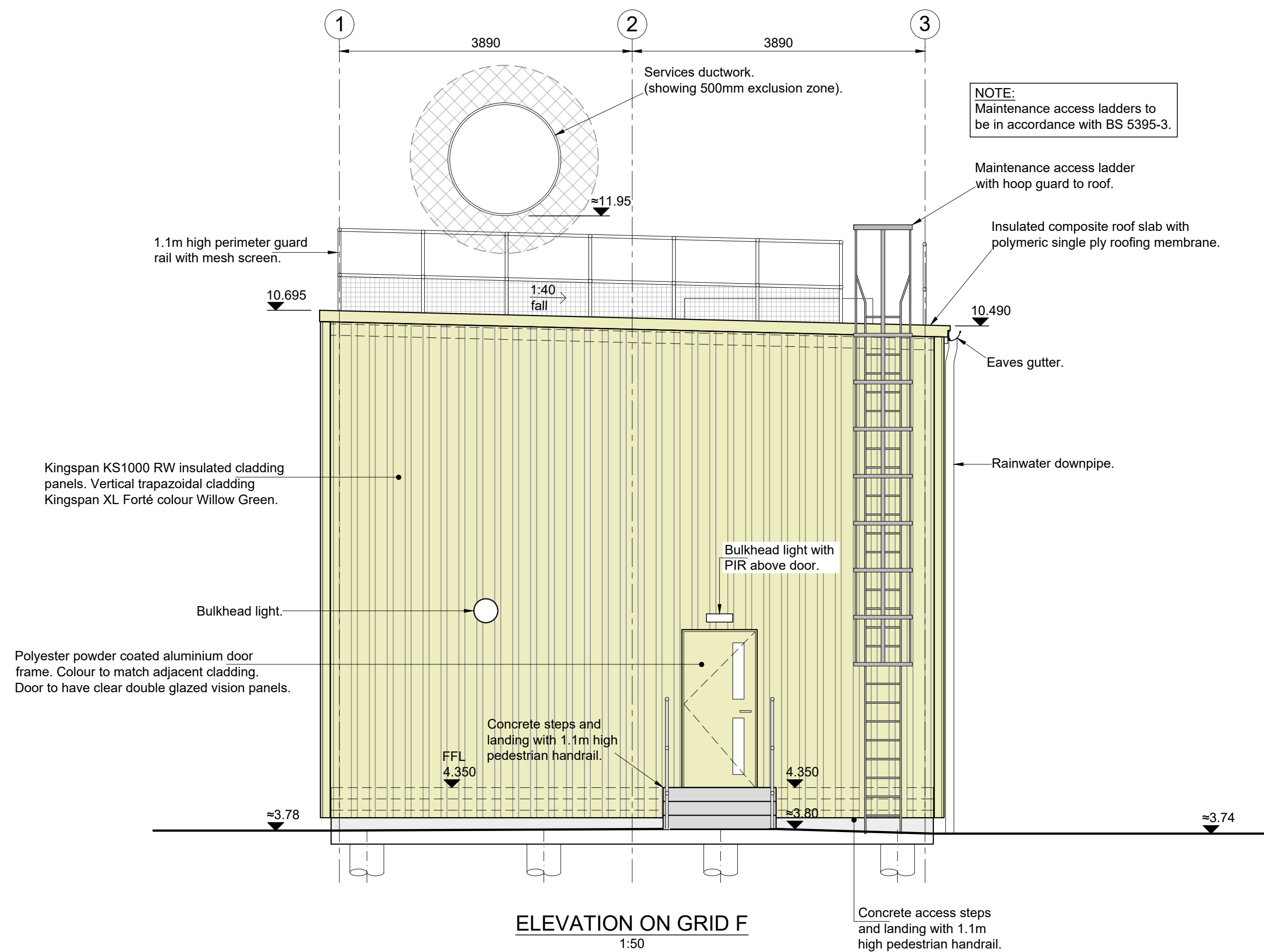
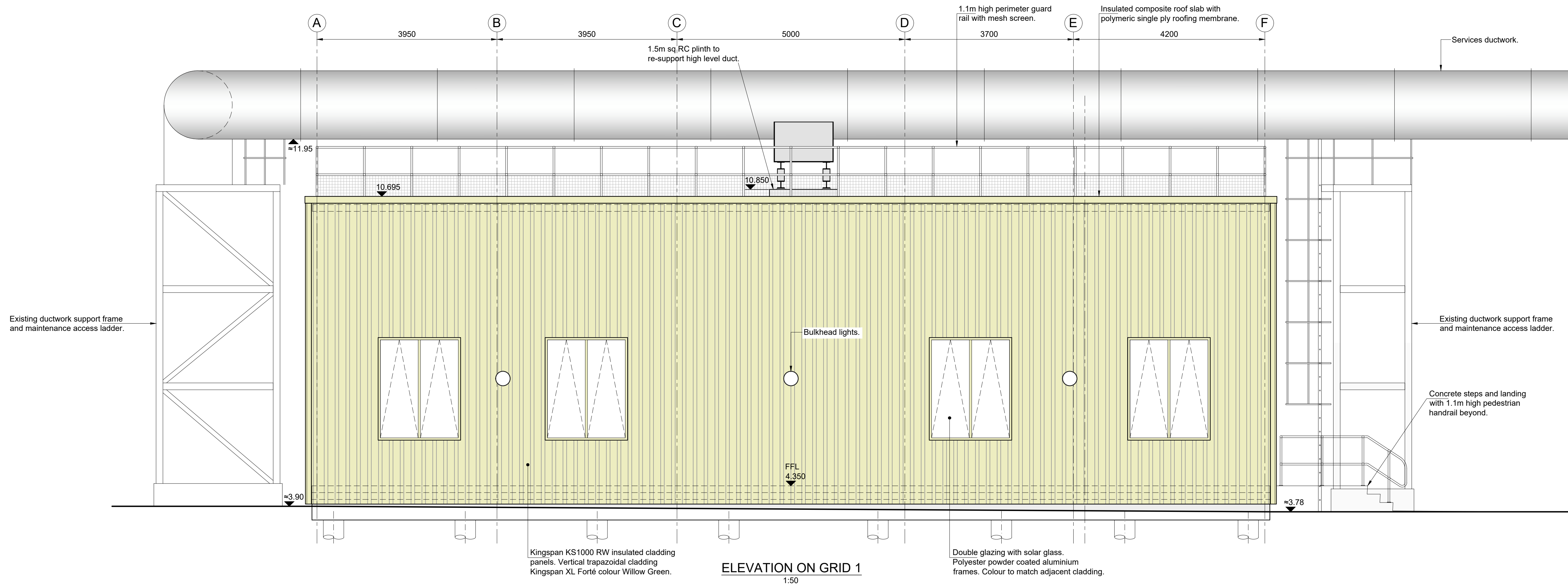
Britannia Refined Metals

SLR Project No.: 402.064683.00001

23 July 2024



402 04683 00001 00 Building MASTER 2011 125 Planning.dwg



NOTES

1. Do not scale this drawing. If in doubt ask.
2. This drawing to be read in conjunction with all relevant Specialists and Engineers drawings and specifications.
3. The Contractor is to remain responsible for the temporary stability of the structure and surrounding ground throughout the construction.
4. Method statement must be agreed before work is carried out.
5. All steelwork to be in fabricated, installed and tested in accordance with the latest published edition of the National Structural Steelwork Specification for Building Construction.
6. Structural steelwork shall comply with the materials standards BS EN10025-2 for general sections and plates; and BS EN 10210-1 for hollow sections.
7. All structural steelwork sections to be grade S355 JR but baseplates / end plates may be S275 JR.
8. All steelwork to be painted using intumescent top coat paint - 90mins rating (dft - TBC) on compatible primer. All paint to be factory applied in strict accordance with the Manufactures details and Specifications. Any damaged areas of paintwork are to be touched up after erection of the steelwork.
9. All bolts to be grade 8.8 galvanised or similarly protected against corrosion. Min. 4No. M16 bolts per connection to UB's and UC's or 2No. M16 bolts to PFC's.
10. All welds are to be 6mm continuous fillet type unless noted otherwise.
11. Cold formed steel sections and cladding panels to comply with BS EN 10326.
12. Secondary cladding elements i.e. cleader rails, tie wires etc to be by Cladding Specialist.

P1	PS	SDE	NOV 23	Ramps omitted and steps added.
P0	DH	LN	AUG 23	PLANNING ISSUE
Revision	By	Chk'd By	Date	Comments

BRITANNIA REFINED METALS Ltd



Site: BRITANNIA REFINED METALS LTD, BOTANY ROAD, NORTHFLEET, KENT, DA11 9BG

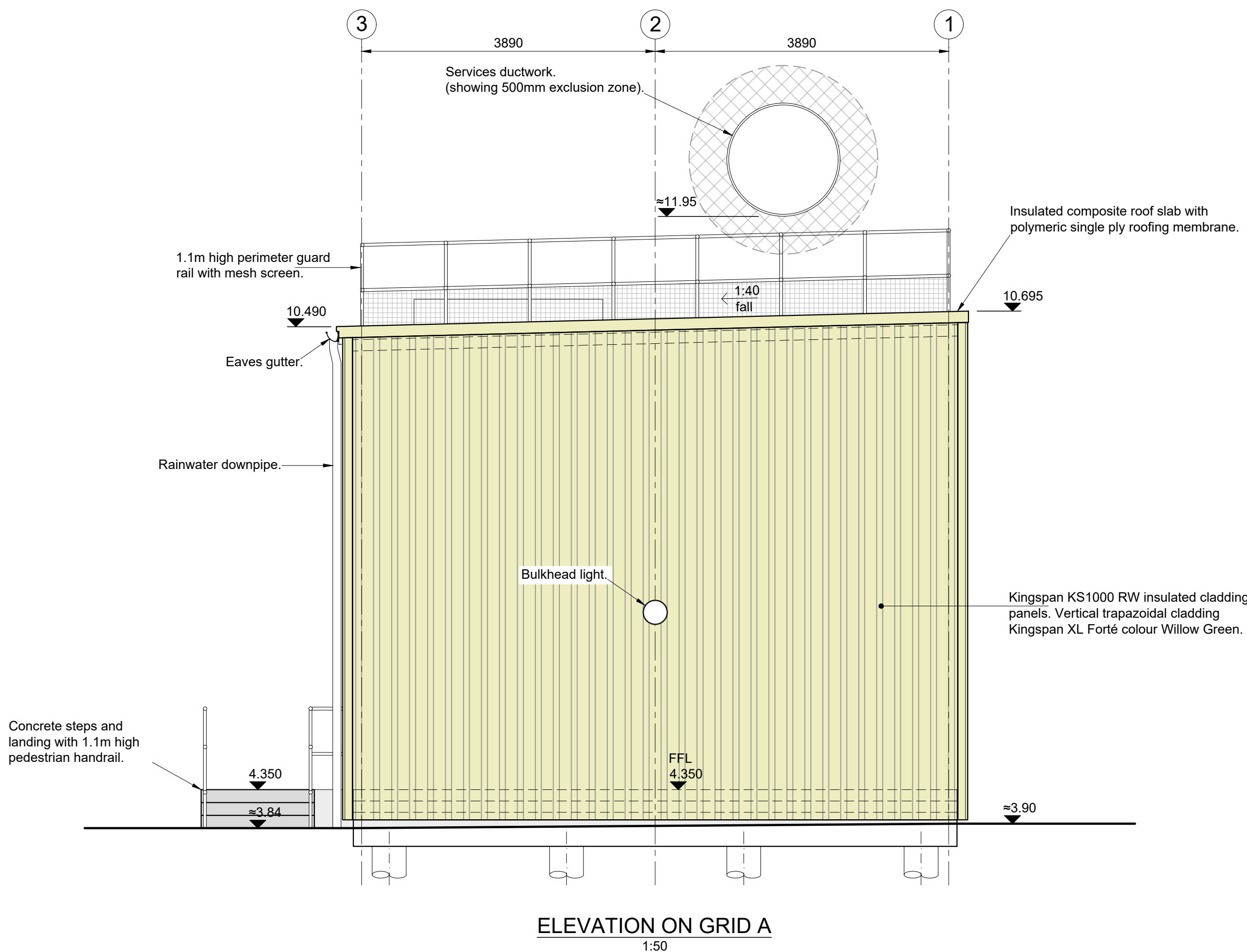
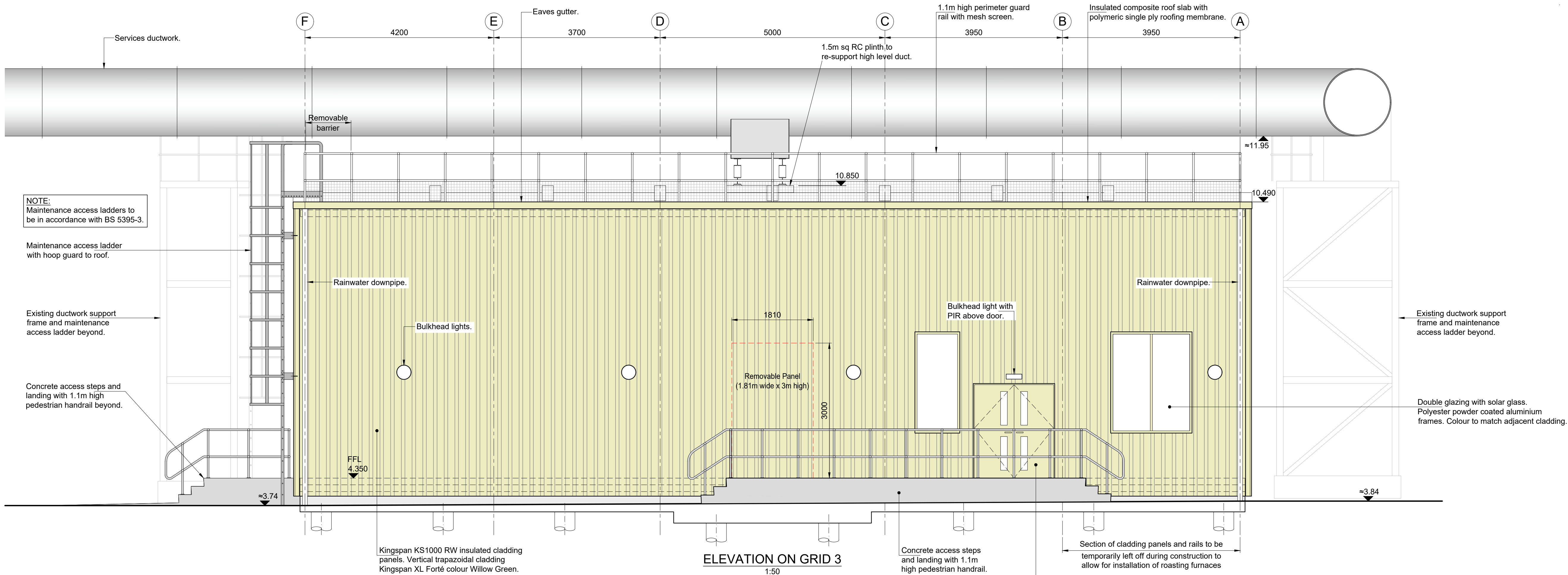
Project: PLANNING ISSUE

Drawing Title: **SAMPLE PREP BUILDING BUILDING ELEVATIONS SHEET 1**

Scale: 1:50 @ A1 Date: AUGUST 2023

Drawing Number: **03** Revision: **P1**

PLANNING



- NOTES
- Do not scale this drawing. If in doubt ask.
 - This drawing to be read in conjunction with all relevant Specialists and Engineers drawings and specifications.
 - The Contractor is to remain responsible for the temporary stability of the structure and surrounding ground throughout the construction.
 - Method statement must be agreed before work is carried out.
 - All steelwork to be in fabricated, installed and tested in accordance with the latest published edition of the National Structural Steelwork Specification for Building Construction.
 - Structural steelwork shall comply with the materials standards BS EN10025-2 for general sections and plates; and BS EN 10210-1 for hollow sections.
 - All structural steelwork sections to be grade S355 JR but baseplates / end plates may be S275 JR.
 - All steelwork to be painted using intumescent top coat paint - 90mins rating (dft - TBC) on compatible primer. All paint to be factory applied in strict accordance with the Manufacturers details and Specifications. Any damaged areas of paintwork are to be touched up after erection of the steelwork.
 - All bolts to be grade 8.8 galvanised or similarly protected against corrosion. Min. 4No. M16 bolts per connection to UB's and UC's or 2No. M16 bolts to PFC's.
 - All welds are to be 6mm continuous fillet type unless noted otherwise.
 - Cold formed steel sections and cladding panels to comply with BS EN 10326.
 - Secondary cladding elements i.e. cleader rails, tie wires etc to be by Cladding Specialist.

P1	PS	SDE	NOV 23	Ramps omitted and steps added.
P0	DH	LN	AUG 23	PLANNING ISSUE
Revision	By	Chk'd By	Date	Comments

BRITANNIA REFINED METALS Ltd

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BRADFORD-ON-AVON
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F: 01225 309401
www.slrconsulting.com

Site
BRITANNIA REFINED METALS LTD
BOTANY ROAD, NORTHFLEET, KENT, DA11 9BG

Project
SAMPLE PREPARATION FACILITY

Drawing Title
**SAMPLE PREP BUILDING
BUILDING ELEVATIONS
SHEET 2**

Scale 1:50 @ A1	Date AUGUST 2023	Revision
Drawing Number 04	Revision P1	
PLANNING		

Appendix F Groundwater Monitoring Borehole Location Plan

Flood Risk Assessment

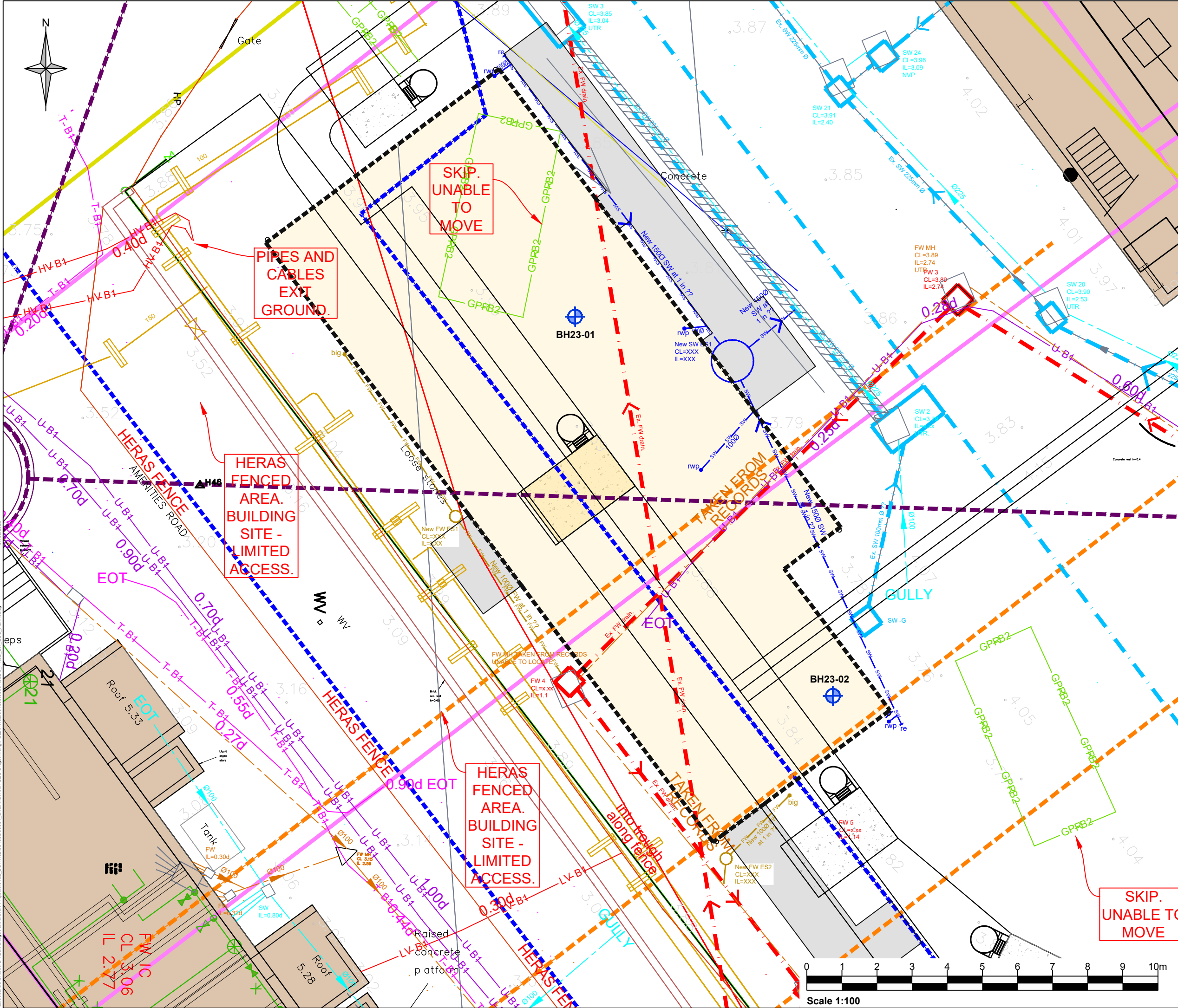
**Proposed emissions management building, comprising of baghouse and stack
at the BRM site in Northfleet, Gravesend, DA11 9BG**

Britannia Refined Metals

SLR Project No.: 402.064683.00001

23 July 2024





Notes:

1. DRAWING IS BASED ON SLR PLANS UTLS-01 P0 AND SITE LAYOUT SINGLE BUILDING OPTION SK01 P5.

Legend:

- BOREHOLE LOCATION
- LUG GPR LINEAR
- LUG UNIDENTIFIED UTILITIES
- WATER SURFACE
- WATER REDUNDANT
- SLR FW DRAINAGE EXISTING
- LUG FWS
- SLR FW DRAINAGE NEW
- SLR SW DRAINAGE NEW
- SLR SW DRAINAGE EXISTING
- LUG SWS
- DRAINAGE REPAIRS 2009
- FIRE
- ELECTRIC CABLES
- PCME CABLES
- OPTIC NEW
- GAS
- WIFI FORK TRUCK

Rev	Amendments	Date	By	Chk	Auth



www.slrconsulting.com

Client
BRITANNIA REFINED METALS LTD

Project
**SAMPLE PREPARATION BUILDING PHASE 2
GEOTECHNICAL AND ENVIRONMENTAL
ASSESSMENT**

Figure Title
BOREHOLE LOCATION PLAN

Scale 1:100	SLR Project No. 402.064683.00001		
Designed AK	Drawn TKS	Checked SK	Authorised
Date SEPT 2023	Date SEPT 2023	Date SEPT 2023	Date
Figure Number 02			Rev. 0



Appendix G Sea Level Rise Calculations

Flood Risk Assessment

**Proposed emissions management building, comprising of baghouse and stack
at the BRM site in Northfleet, Gravesend, DA11 9BG**

Britannia Refined Metals

SLR Project No.: 402.064683.00001

23 July 2024

PROJECTED UPLIFT SUMMARY				
	mm to m conversion			1000
CC Allowance Type	Higher Central (m)	Upper End (m)		
	0.18	0.22		

Extreme Sea Level Calculations				
	PPG Table higher central uplift (mm)	Calculated Outcome (mm)	PPG Table upper end uplift (mm)	Calculated Outcome (mm)
2018	N/A	0	N/A	0
2019	5.8	5.8	7	7
2020	5.8	11.6	7	14
2021	5.8	17.4	7	21
2022	5.8	23.2	7	28
2023	5.8	29	7	35
2024	5.8	34.8	7	42
2025	5.8	40.6	7	49
2026	5.8	46.4	7	56
2027	5.8	52.2	7	63
2028	5.8	58	7	70
2029	5.8	63.8	7	77
2030	5.8	69.6	7	84
2031	5.8	75.4	7	91
2032	5.8	81.2	7	98
2033	5.8	87	7	105
2034	5.8	92.8	7	112
2035	5.8	98.6	7	119
2036	8.7	107.3	11.3	130.3
2037	8.7	116	11.3	141.6
2038	8.7	124.7	11.3	152.9
2039	8.7	133.4	11.3	164.2
2040	8.7	142.1	11.3	175.5
2041	8.7	150.8	11.3	186.8
2042	8.7	159.5	11.3	198.1
2043	8.7	168.2	11.3	209.4
2044	8.7	176.9	11.3	220.7



Making Sustainability Happen