



Flood risk, water and environment

Flood Risk Assessment with Evacuation Plan AEG3988_DA11_Gravesend_01 Rev (-)

Prepared for: Gravesham Borough Council

Site address: Vessel 'LV21'

St Andrews Quay

Gravesend

DA11 0BG

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



Flood risk, water and environment

Document Issue Record

Project: Flood Risk Assessment with Evacuation Plan

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Site Location: 'LV21', St Andrews Quay, Gravesend, DA11 0BG

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Table of Contents

Summary	1
1. Introduction.....	3
Site Overview.....	3
Planning Policy and Guidance.....	6
2. Planning Policy.....	7
National Planning Policy Framework (NPPF)	7
Local Plan.....	9
Sequential and Exception Tests	10
3. Sources of Information.....	11
Documents and Online Mapping.....	11
4. Sources of Flood Risk.....	13
Fluvial/Tidal	13
Canals	16
Pluvial.....	16
Reservoirs.....	21
Groundwater.....	21
Sewers.....	22
5. Flood Risk Mitigation	23
Tidal and Fluvial	23
Other Sources.....	23
Increase to Flood Risk Elsewhere.....	23
6. Flood Evacuation.....	24
Trigger Events	24
Flood Warnings.....	24
Responsibilities.....	26
Proposed Flood Evacuation Route and Access/ Egress.....	27

Summary	27
7. Conclusions.....	28
Appendix A - Development Site Plans and Block Plans	30

Summary

Development Description	Existing	Proposed
Development Type	River Thames River bed	Change of use of river to Use Class F1 – Learning and non-residential institution to facilitate the mooring of a vessel.
EA Vulnerability Classification	N/A	Highly Vulnerable (educational facility)
Ground Floor Level	EA 1m LiDAR data shows river bed between 2.42m AOD and a 3.20m AOD.	No change proposed as development comprises mooring of vessel only.
N/A	N/A	N/A (non-residential facilities only)
Impermeable Surface Area	N/A	N/A
Surface Water Drainage	N/A	Direct rainfall runoff to be drained directly into River Thames as per pre-development conditions.
Site Size	Approximately 1425m ² (Application Site Boundary)	No change 'LV21' vessel is only 275m ²
Risk to Development	Summary	Comment
EA Flood Zone	Flood Zone 3b	The whole of the site is within a water body, and thus perceived as Flood Zone 3b
Flood Source	Tidal River. The site is naturally at risk of fluvial flooding from River Thames, albeit it has a floating nature, which means flooding is not expected.	
SFRA Available	Kent Thameside Strategic Flood Risk Assessment (2005)	
Management Measures	Summary	Comment
Ground floor level above extreme flood levels	Yes	Due to its floating nature, the vessel's deck will naturally be above any flood level. Flooding of the quay

Safe Access/Egress Route		platform adjacent to the boat is however expected.
	Yes (subject to a Flood Evacuation Plan)	The quay platform to load/unload passengers is shown to be affected by fluvial flooding of up to 2m for the 2100 climate change scenario presented in TE2100 hydraulic model. As such, safe access/egress is subject to an active monitoring of flood alerts and warnings to ensure users are evacuated upon a Flood Warning.
Flood Resilient Design	No	Site in Flood Zone 1 and unaffected in modelled 1:1000 year pluvial event. Proposed development considered to be at low risk from all reviewed sources.
Site Drainage Plan	No	Runoff to be discharged directly into River Thames as per pre-development conditions
Flood Warning and Evacuation Plan	N/A	Recommended that Site Owners and Management Companies monitor Met Office Weather Warnings for extreme weather events, and also subscribe to the EA's Flood Warning system.
Offsite Impacts	Summary	Comment
Displacement of floodwater	No	Limited to the draft of the vessel
Increase in surface run-off generation	No	Runoff likely to be slightly reduced due to losses on the deck of the vessel, prior to direct discharge into River Thames
Impact on hydraulic performance of channels	No	No due to the floating nature of the vessel

1. Introduction

- 1.1. Aegaea were commissioned by Gravesham Borough Council to undertake a Flood Risk Assessment (FRA) to facilitate a planning application for the change of use from river bed to 'Use Class F1 – Learning and non-residential institutions to facilitate the permanent mooring of a vessel'. This FRA has been prepared in accordance with the requirements set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance.
- 1.2. This FRA is intended to support a full planning application and as such the level of detail included is commensurate and subject to the nature of the proposals.

Site Overview

- 1.3. The site of the proposed development is vessel 'LV21', currently moored at St Andrews Quay, Gravesend, DA11 0BG (Figure 1). At the time this report was written, the vessel is operating as a floating cultural hub, and is seeking planning permission for the change of use from river bed to 'Use Class F1 – Learning and non-residential institutions to facilitate the permanent mooring of a vessel'. The development site plans and block plan can be found in Appendix A.



Figure 1: Site Location (Base map Google Hybrid ©)

- 1.4. In the absence of a topographical survey, Environment Agency's Light Detection and Ranging (LiDAR) data Digital Terrain Model has been used to review the topography of the site. Albeit the river bed where the vessel is located appears to be dry for low tide levels, the accuracy of LiDAR cannot be guaranteed at this location, as water is known to affect the accuracy of LiDAR elevation datasets. The LiDAR dataset shows the average bed level within the Application Site to vary between approximately 2.42m AOD (Above Ordnance Datum), with some parts reaching 3.2m AOD, potentially due to issues with the DTM filtering process (Figure 2).

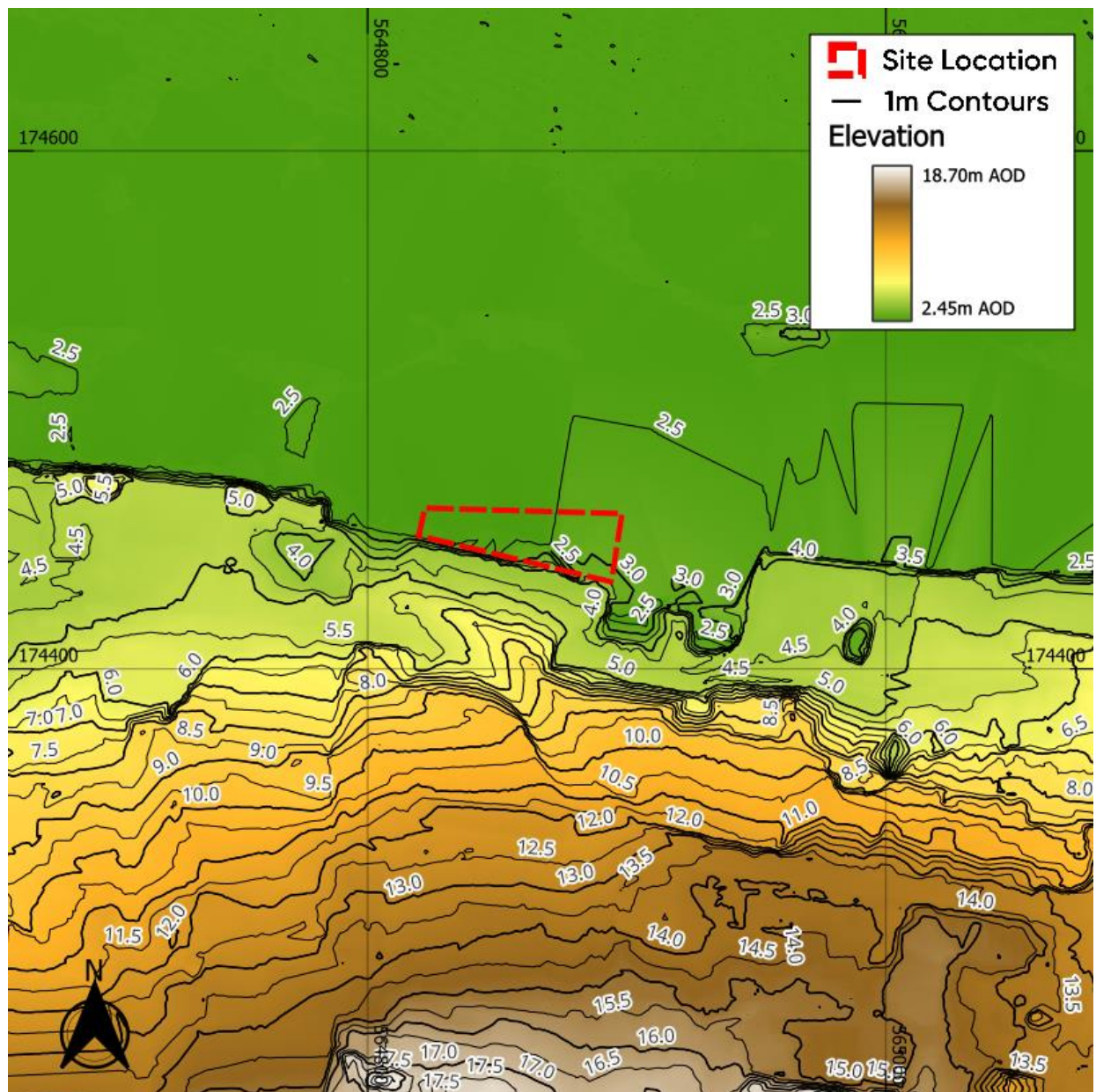


Figure 2: Site Topography (Base map Google Hybrid ©. Contains public sector information licensed under the Open Government Licence v3.0)

- 1.5. Gravesham Borough Council is the Local Planning Authority (LPA) for the site, and Kent County Council is the designated Lead Local Flood Authority (LLFA). The site sits within the Environment Agency's Kent South London and East Sussex region.

Planning Policy and Guidance

1.6. UK government planning guidance states¹ that an FRA is required for developments which are:

- *in flood zone 2 or 3 including minor development and change of use*
- *more than 1 hectare (ha) in flood zone 1*
- *less than 1 ha in flood zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (for example surface water drains, reservoirs)*
- *in an area within flood zone 1 which has critical drainage problems as notified by the Environment Agency*

1.7. The proposed development is located within a body of water which is classed as Flood Zone 3b according to the Environment Agency.

1.8. The objective of this FRA is to demonstrate that the proposals are acceptable in terms of flood risk. This report summarises the findings of the study and specifically addresses the following issues in the context of the current legislative regime:

- Fluvial/ tidal flood risk
- Surface water flood risk
- Risk of flooding from other sources

¹<https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications#when-you-need-an-assessment>

2. Planning Policy

- 2.1. Inappropriate development in a flood risk area could pose significant risk in terms of personal safety and damage to property for the occupiers of the development or for people elsewhere. The approach taken in the assessment of flood risk at the planning stage is set out in national, regional, and local planning policy and associated guidance. This section summarises the key policies and guidance relevant to the proposed development.

National Planning Policy Framework (NPPF)

- 2.2. The National Planning Policy Framework² (NPPF) (DLUHC, 2023) which includes UK Government policy on development and flood risk states:

159. Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.

167. When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

- a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;*
- b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;*
- c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;*

²<https://www.gov.uk/guidance/national-planning-policy-framework>, last updated Sept 2023

- d) any residual risk can be safely managed; and
- e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

168. Applications for some minor development and changes of use should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 55.

2.3. Footnote 55 of the NPPF states:

A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

2.4. Flood Zones in England are defined as follows:

Table 1: Flood Zone Definitions

Flood Zone	Definition
Zone 1 Low Probability	Land having less than 1 in 1,000 annual probability of river or sea flooding (all land outside Zones 2 and 3).
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.
Zone 3b The Functional Floodplain	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. (Not separately distinguished from Zone 3a on the Flood Map)

- 2.5. An FRA should be appropriate to the scale, nature, and location of the development. It should identify and assess the risk from all sources of flooding to and from the development and demonstrate how any flood risks will be managed over the lifetime of the development.
- 2.6. An assessment of hydrological impacts should be undertaken, including to surface water runoff and impacts to drainage networks in order to demonstrate how flood risk to others will be managed following development and taking climate change into account.

Local Plan

- 2.7. The Local Plan prepared by the Local Planning Authority, Gravesham Borough Council, sets out the policies for development in the local area.
- 2.8. Policy CS18 of the Gravesham Local Plan Core Strategy (2014) states:

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.

Sequential and Exception Tests

- 2.9. The Sequential and Exception Tests are applied in specific cases defined by UK Government policy. Their purpose is to drive development to areas of low flood risk and to support developments which improve flood risk for developments in areas at risk of flooding.
- 2.10. Under the NPPF all new planning applications should undergo a Sequential Test accordance with paragraph 168 and footnotes 55 and 56. This test should be implemented by local planning authorities with a view to location particularly vulnerable new developments outside of the floodplain.
- 2.11. Paragraph 168 of the NPPF states:

*"168. Applications for some minor development and **changes of use** should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 55."*

- 2.12. As such, the Sequential and Exception Tests are not deemed required in line with the NPPF, given that the proposal is for a change of use.

3. Sources of Information

Documents and Online Mapping

- 3.1. Local Governments and Lead Local Flood Authorities provide documents which contain data and policies on flood risk and new development in their areas. These documents are introduced and briefly summarised below. For the purposes of this FRA, these documents have been reviewed for relevant information and any relevant data is discussed within the appropriate sub heading of this report.
- 3.2. The following sources of information have been reviewed for this assessment:
- Flood Map for Planning on the Environment Agency website <https://flood-map-for-planning.service.gov.uk/>
 - Long Term Flood Risk Information on the Environment Agency website <https://www.gov.uk/check-long-term-flood-risk>
 - National Planning Policy Framework (NPPF) (Department for Levelling Up, Housing and Communities, 2023)
 - Planning Practice Guidance - Flood Risk and Coastal Change (Department for Levelling Up, Housing and Communities, 2022)
 - Geoindex Onshore (British Geological Survey, 2023)
 - Gravesham Local Plan Core Strategy³ (Gravesham Borough Council, 2014)
 - Kent Thameside Strategic Flood Risk Assessment⁴ (2005)

Strategic Flood Risk Assessment (SFRA)

- 3.3. The Kent Thameside SFRA provides the evidence base for the Local Planning Authority Gravesham Borough Council Local Plan and guidance for consideration when determining planning applications. The SFRA seeks to place new development into areas of lower flood risk

³ <https://drive.google.com/file/d/1bJTgQLmhbjqZFibl-5WFb2tbvixXpLk/view>

⁴ <http://windmz.dartford.gov.uk/media/Eb53%20SFRAReport.pdf>

taking into account current flood risk, future flood risk, and the effect a proposed development would have on the risk of flooding.

- 3.4. The SFRA mapping provided by Gravesham Borough Council has been used throughout production of this report as a source of information, particularly pertaining to historical flood incidents.

4. Sources of Flood Risk

Fluvial/Tidal

- 4.1. Flooding from watercourses arises when flows exceed the capacity of the channel, or where a restrictive structure is encountered, resulting in water overtopping the banks into the floodplain.
- 4.2. Tidal flooding occurs when a high tide and high winds combine to elevate sea levels. An area behind coastal flood defences can still flood if waves overtop the defences or break through them. Tidal flooding can also occur a long way from the coast by raising river levels. Water may overtop the river bank or river defences when tide levels are high.
- 4.3. The vessel is moored in River Thames which is an EA-designated Statutory Main River. The River is tidally-dominated in this location as it is downstream of the tidal limit of the River Thames.
- 4.4. Figure 3 appears to show the site located out of the EA's model domain. However, as the site is located on the River itself, and has an annual chance of flooding greater than 3.3% (1 in 30 year return period), it would be classified as Flood Zone 3b.
- 4.5. The immediate inland vicinity of the vessel is also located within Flood Zone 3 i.e. at a annual chance of flooding equal to or higher than the 1% (1 in 100 year return period). According to this source, there is a flood defence line along the river front, although St Andrews Quay does not benefit from the protection of the local defences.



Figure 3: EA Flood Map for Planning (Base map Google Hybrid © Contains public sector information licensed under the Open Government Licence v3.0)

- 4.6. The EA's TE2100 hydraulic model has been consulted. In the same way shown in the Flood Map for Planning (Figure 3), the quay platform for loading/unloading of passengers is shown to be unprotected from the local flood defences, meaning that any future use of the vessel will not benefit directly from defences.
- 4.7. The TE2100 1000 year flood level for the climate change scenario was found to be 6.47m AOD and, in the absence of flood extents, this level was mapped against publicly available LiDAR – Figure 4. This suggests flood depths of up to 2m in certain parts of the quay, where passengers would transit to access the vessel.
- 4.8. The DEFRA's TE2100 100year 'climate change' scenario also puts the quay platform at risk of flooding, with a flood level of 5.94m AOD.
- 4.9. Note that the flood extents in Figure 4 represent an undefended scenario. However, the EA's TE2100 report shows a protection level of up to 7.10m AOD along the right bank of the river.

Given the location of the defences indicated in Figure 3, Crooke Lane is indicated to not be directly affected from River Thames in reality.



Figure 4: Flood Extents for the TE2100 1000 year extreme water level, mapped against publicly available LiDAR (Base map Google Hybrid © Contains public sector information licensed under the Open Government Licence v3.0)

Historical Fluvial Flooding

- 4.10. Based on the EA Recorded and Historical Flood Outlines dataset, there are no records of historical fluvial flooding in the immediate inland vicinity of the vessel (Figure 5).



Figure 5: EA Historic Flood Mapping (Base map Google Hybrid © Contains public sector information licensed under the Open Government Licence v3.0)

- 4.11. Based on the data reviewed above the risk of fluvial flooding to the immediate inland vicinity of the site is considered to be high. Due to the nature of the development itself, the site is also at high risk of flooding due to its inherent location i.e. a water body.

Canals

- 4.12. The Canal and River Trust (CRT) generally maintains canal levels using reservoirs, feeders, and boreholes and manages water levels by transferring it within the canal system.
- 4.13. No canals were detected within 1km of the site.
- 4.14. The risk of flooding to this site from canals is considered to be low.

Pluvial

- 4.15. Pluvial flooding can occur during prolonged or intense storm events when the infiltration potential of soils, or the capacity of drainage infrastructure is overwhelmed leading to the accumulation of surface water and the generation of overland flow routes.
- 4.16. Annual surface water flood risk is labelled by the EA as:
- 'High Risk'; >3.3% AEP (annual probability greater than 1 in 30).
 - 'Medium Risk'; 1.1% to 3.3% AEP (annual probability between 1 in 100 and 1 in 30).
 - 'Low Risk'; 0.1% to 1% AEP (annual probability between 1 in 1000 and 1 in 100).

- 'Very Low Risk'; <0.1% AEP (annual probability less than 1 in 1000).

4.17. Examination of the EA's Flood Risk from Surface Water mapping shows the site to be at 'very low' risk of surface water flooding, with several roads in the immediate inland vicinity of the site at 'Low' to 'High' risk of surface water flooding (Figure 6).



Figure 6: EA Surface Water Flood Risk Extents (Base map from Google hybrid © Contains public sector information licensed under the Open Government Licence v3.0)

4.18. As can be seen in Figure 7, during the modelled 1 in 30 year probability event, the immediate inland vicinity of the site remains dry, safe egress/access available.



Figure 7: EA Surface Water Flood Risk Mapping 1 in 30 year depth (Base map Google Hybrid © Contains public sector information licensed under the Open Government Licence v3.0)

- 4.19. As can be seen in Figure 8, during the modelled 1 in 100 year probability event, surface water flooding continues to be very limited in the immediate inland vicinity of the site. Therefore, surface water is unlikely to pose a risk to users accessing or egressing the site. Crooked Lane shows some flood depths of up to 300mm towards west, this route remains fairly dry towards the east and south.



Figure 8: EA Surface Water Flood Risk Mapping 1 in 100 year depth (Base map Google Hybrid © Contains public sector information licensed under the Open Government Licence v3.0)

- 4.20. As can be seen in Figure 9, Crooked Lane is shown to be affected by surface water flooding during the modelled 1 in 1000 year probability event, albeit depths are mostly limited to 150mm and the footway remains relatively dry towards southeast.

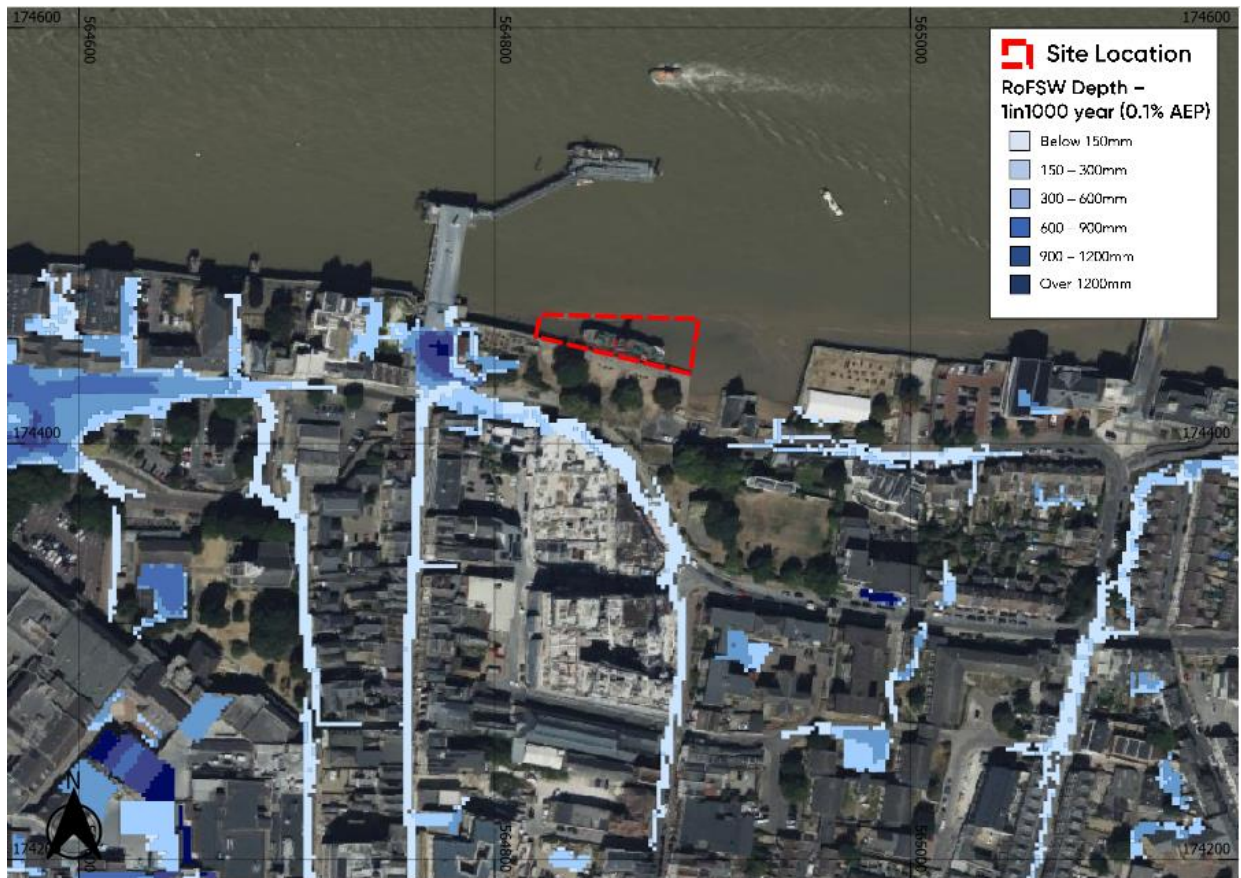


Figure 9: EA Surface Water Flood Risk Mapping 1 in 1,000 year depth (Base map Google Hybrid © Contains public sector information licensed under the Open Government Licence v3.0)

- 4.21. To assess whether the access/egress to the site is safe during the 1 in 100 and 1 in 1000 event, the flood hazard maps are included in Figure 10 and Figure 11. Both maps show flood hazard to remain below 0.75 ('Very low hazard') towards the southeast of Crooked Lane, suggesting safe egress/access is possible for this event.



Figure 10: EA Surface Water Flood Risk Mapping 1 in 100 year hazard (Base map Google Hybrid © Contains public sector information licensed under the Open Government Licence v3.0)

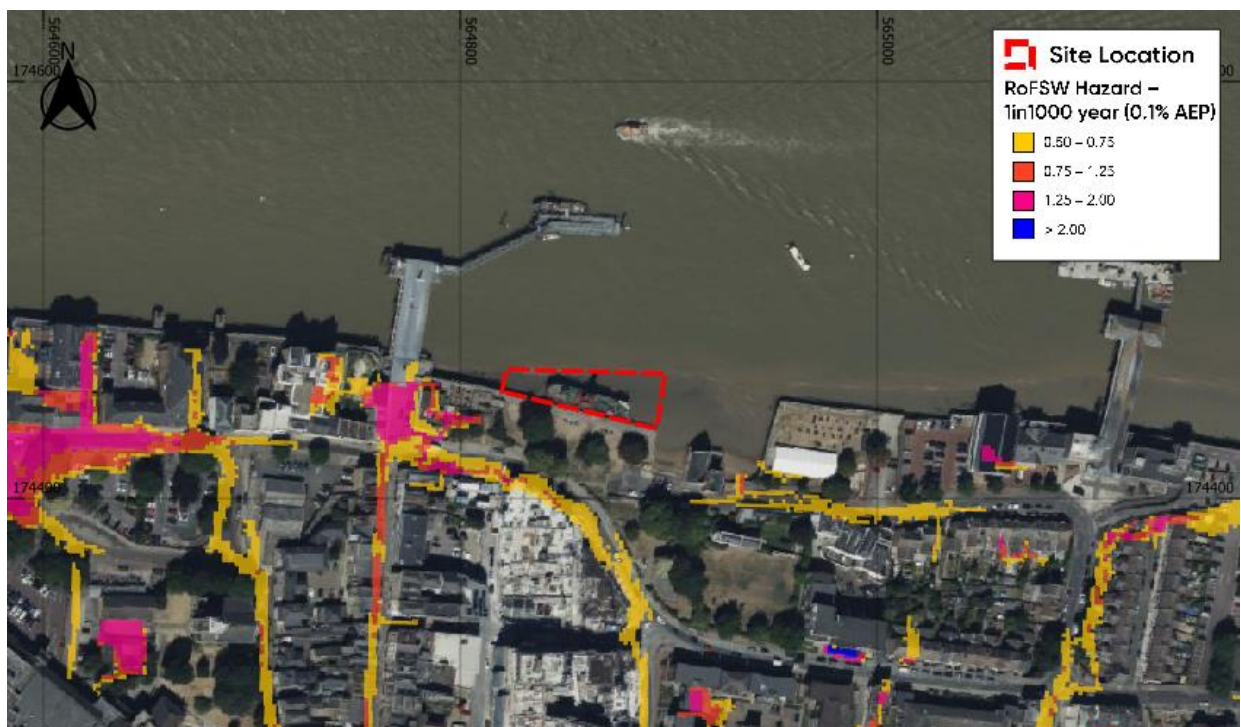


Figure 11: EA Surface Water Flood Risk Mapping 1 in 1000 year hazard (Base map Google Hybrid © Contains public sector information licensed under the Open Government Licence v3.0)

- 4.22. In summary, the surface water flood risk in the immediate vicinity of the site is perceived as mostly 'very low', with safe access/egress possible for the 'low', 'medium' and 'high' risk events, with flood depths limited to 150mm in the southeast part of Crooked Lane.

Reservoirs

- 4.23. Flooding can occur from large waterbodies or reservoirs if they are impounded above the surrounding ground levels or are used to retain floodwater. Although unlikely, reservoirs and large waterbodies could overtop or breach leading to rapid inundation of the downstream floodplain.
- 4.24. According to the EA's Flood Risk from Reservoirs mapping the site is outside modelled flood extents in the event of reservoir flooding.
- 4.25. The site has not been flagged as being at risk of flooding following a reservoir failure.

Groundwater

- 4.26. Groundwater flooding occurs in areas where underlying geology is permeable and water can rise within the strata sufficiently to breach the surface.
- 4.27. The British Geological Survey's (BGS) mapping shows no recorded superficial deposits underlying the site. The bedrock underlying the site is Lewes Nodular Chalk Formation, comprising Chalk.
- 4.28. The SFRA presents the EA's areas at risk of groundwater flooding mapping. Figure 12 shows that the immediate vicinity to the site is at 'high risk' of groundwater.

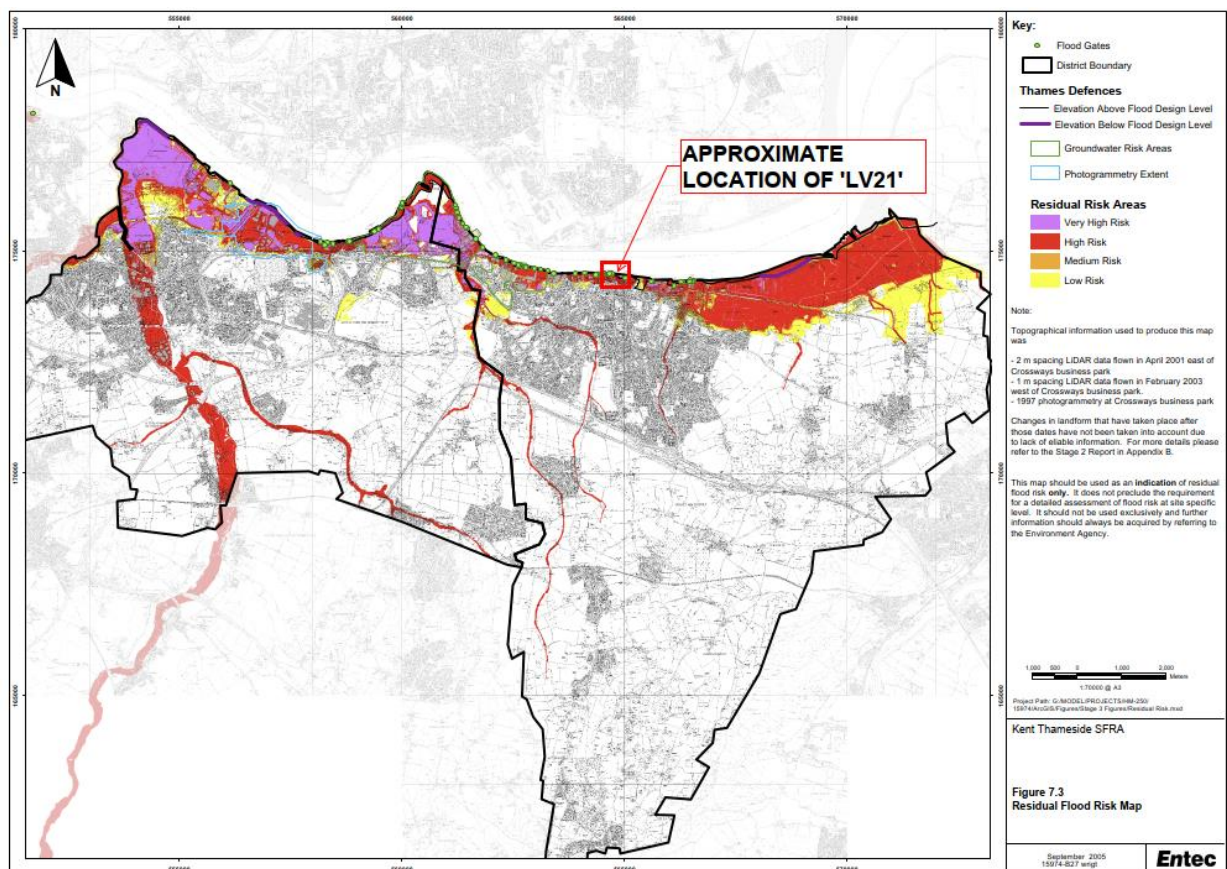


Figure 12: EA Areas at Risk of Groundwater Flooding (<http://windmz.dartford.gov.uk/media/Eb53%20SFRAReport.pdf>)

- 4.29. However, the site is located on the River Thames and therefore the risk of flooding from groundwater in isolation is considered to be low.

Sewers

- 4.30. Foul or surface water sewers can be a cause of flooding if the drainage network becomes overwhelmed, either by blockage or due to local development beyond the designed capabilities of the drainage system.
- 4.31. The SFRA contains historical sewer flood incident records in Kent Thameside, with a total of 3no. properties affected in 'DA1 1' post code. However, due to the nature of the development, sewer flooding is not deemed to directly impact the vessel, with sewer flooding likely to be contained within the highway boundaries in the event of access/egress.
- 4.32. The development and its immediate inland vicinity is therefore considered to be at low risk of flooding from sewers.

5. Flood Risk Mitigation

Tidal and Fluvial

- 5.1. Due to the nature of the development and the location of the vessel, mitigation measures are limited to the safe mooring of the vessel and the safe access/egress to and from the boat.
- 5.2. In terms of mooring, it is important that the vessel remains stable between bed level (low tide) and the 1 in 1000 year extreme water level provided by TE2100 (6.47m AOD). The vessel should adequately moored and ensure the boat remains moored during extreme events to prevent becoming a floating hazard.
- 5.3. In terms of the operation of the vessel as an educational facility, the owners should take in account the limitations in the access/egress at the quay platform, which is likely to become flooded for return periods as low as the 1 in 100 year, as per DEFRA's TE2100 climate change scenario. Therefore, an active monitoring of the local flood alert/warning system should be followed, with a precautionary approach to dealing with flooding due to the potential vulnerability of its users.
- 5.4. Section 6 'Flood Evacuation' provides dedicated information on the preparation for flood events, as well as on the procedures that should follow Flood Alerts and Warnings.

Other Sources

- 5.5. Flood risk from other sources is considered to be low, therefore mitigation is not required.

Increase to Flood Risk Elsewhere

- 5.6. It is understood that the proposed development is for the change of use of river to Use Class F1 – Learning and non-residential institution to facilitate the mooring of a vessel. Given, the floating nature of vessels there is limited displacement of water and no significant increase in flood risk is thus envisaged.

6. Flood Evacuation

Trigger Events

- 6.1. Although employees and users will only be occupying the site during normal working hours, users of educational facilities are unlikely to have detailed knowledge of the dynamics of the flood event and the storminess of the event could result in people panicking or becoming anxious, particularly if they observe flooding in the vicinity of site.
- 6.2. Upon receipt of a Flood Alert, site users should be warned and be prepared to evacuate in case of a Flood Warning i.e. ready to evacuate the moment a Flood Warning is issued. Given the nature of the development and the number of users in the boat, a precautionary approach may be chosen instead, with evacuation happening upon receipt of the flood alert.
- 6.3. Once a Flood Warning is issued, the prior evacuation should begin immediately if it does not begin earlier.
- 6.4. Prior evacuation of the site should be sought as soon as a Flood Warning is issued by the Environment Agency, and before a Severe Flood Warning is issued.

Flood Warnings

- 6.5. The Site Owner and Management Company should sign up to the EA Flood Warning Service for the *Gravesend and Northfleet* location.
- 6.6. This service allows users to register an address, which is at risk of flooding, along with contact details so that in the event of a flood being forecast, the site owner will be sent an alert directly to their chosen method of contact.
- 6.7. Flood warnings/alerts can be enforced at any time of the day or night. Signing up for this service provides site owners some notice before a flood event. Flood alerts and warnings provide users with time to take necessary action, e.g. communication of the risk of flooding to occupants etc, evacuation of occupants offsite or to a safe level, and removal of valuable items out of reach of flooding.
- 6.8. Prior evacuation of the site should be sought as soon as a Flood Warning is issued by the Environment Agency, and before a Severe Flood Warning is issued.

 FLOOD ALERT	FLOOD ALERT What does it mean? ○ Flooding is possible, be prepared. When is it used? ○ Two hours to two days in advance of flooding. Triggers ○ Forecasts that indicate flooding from rivers may be likely. ○ Forecasted intense rainfall for rivers that respond very rapidly. ○ Forecast of high tides, surges, or hind winds. What to do? ○ Prepare to act on your flood plan. ○ Prepare a flood kit of essential items ○ Monitor local water levels, flood forecast, and weather conditions. ○ Call Floodline on 0345 988 1188 for up-to-date information
 FLOOD WARNING	FLOOD WARNING What does it mean? ○ Flooding is expected – immediate action is required. When is it used? ○ Half an hour to one day in advance of flooding. Triggers ○ High tides, and surges coupled with strong winds. ○ Heavy rainfall forecast to cause flash flooding of rivers. ○ Forecast flooding from rivers. What to do? ○ Move people, pets, and valuables to a safe place. ○ Turn off gas, electricity and water supplies (if safe to do so). ○ Put flood protection equipment in place (if possible). ○ Call Floodline on 0345 988 1188 for up-to-date information ○ <u>Evacuate from your home following the agreed evacuation plan.</u> Prior evacuation of the site should be sought as soon as a Flood Warning is issued by the Environment Agency.

 SEVERE FLOOD WARNING	SEVERE FLOOD WARNING What does it mean? - Severe flooding with danger to life. When is it used? - When flooding poses a significant threat to life or severe disruption to communities. Triggers - Actual flooding where the conditions pose a significant risk to life and/or distribution to the community. - On sire observations from flooded locations - A breach in defences or failure of a barrier that is likely to cause significant risk to life. - Discussions with partners. What to do? Prior evacuation of the site should be sought as soon as a <u>Flood Warning</u> is issued by the Environment Agency. <u>If flooding has already occurred by the time a Severe Warning is issued</u>, stay in a safe place with a means of escape. Only when instructed to evacuate by Emergency Services, leave the property and follow the agreed evacuation plan. - Co-operate with emergency services.
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Responsibilities

- 6.9. It is the responsibility of the Site Owner and/or Management Company to establish a Flood Evacuation Plan and to ensure this is adhered to, by regularly providing training to staff.
- 6.10. The Site Owner and/or Management Company should establish Flood Evacuation Leads, which should be responsible for checking Flood Alers/Warning on a daily basis, prior to working hours. The presence of at least one Flood Evacuation Lead on a normal day of operation is compulsory.
- 6.11. It is the responsibility of the Flood Evacuation Lead to inform the site users of any Flood Alerts or Warnings and ensure the Flood Evacuation Plan is adhered to during a flood event. The best practices that should be followed prior and during the flood event are outlined in the sub-sections below.
- 6.12. It is the responsibility of site users to adhere to the Flood Evacuation procedures communicated by the Flood Evacuation Lead or any other staff nominated for flood evacuation procedures.

Proposed Flood Evacuation Route and Access/ Egress

- 6.13. Prior evacuation of the site should be sought as soon as a Flood Warning is issued by the Environment Agency and before a Severe Flood Warning is issued.
- 6.14. Upon the instruction from the Flood Evacuation Lead, the users should egress the site(vessel) towards the east of Crooked Lane, where footways should be dry during extreme flood events, both in surface water and fluvial events, as shown in Figure 4 and Figure 9.
- 6.15. Signs and information plaques should be located across the site to inform people on procedures.

Summary

- 6.16. Given the flood risk in the surrounding inland area to the site from the River Thames, prior evacuation of the site is recommended to reduce the risk to life of occupants/ site users but also reduce the strain on the emergency services.
- 6.17. Prior evacuation of the site should be sought as soon as a Flood Warning is issued by the Environment Agency, and before a Severe Flood Warning is issued. Flood alerts should be closely and actively monitored as soon as they are issued.
- 6.18. Prior to occupation of the site, it is highly recommended that a Flood Risk Evacuation Plan (FREP) is prepared to outline clear responsibilities and procedures that should be taken prior and during flood events.

7. Conclusions

- 7.1. This FRA has been undertaken with reference to the requirements of NPPF and Planning Practice Guidance with respect to the change of use to the river adjacent to St Andrews Quay, Gravesend, DA11 0BG. It has been written to support a planning application and has been prepared with due consideration to the nature of the proposed development to provide the appropriate level of detail.
- 7.2. An assessment of the risk of flooding from all sources has been undertaken and is summarised in the table below:

Source of Flooding	Flood Risk Summary
Fluvial/Tidal	The vessel will be moored at St Andrews Quay, in River Thames. The Environment Agency classes water bodies as Flood Zone 3b and therefore flood risk is perceived as 'high'. Whilst the boat is not expected to flood, TE2100 hydraulic modelling information has shown that St Andrews Quay does not benefit from flood defences and flood depths can reach as much as ~2.0m at the Quay for the 100 year 'climate change' scenario. As such, access/egress would be affected. A flood evacuation plan has been outlined in this report.
Pluvial	The site itself is not affected by pluvial flooding in any of the modelled events in the RoFSW dataset and thus the risk to the proposed development is considered low. Safe access/ egress should be possible between the 'Low' and 'Medium' risk events, provided users egress the area towards the southeast of Crooke Lane.
Reservoirs Groundwater Sewers Canals	The site is considered to be at low risk from these sources.

- 7.3. With respect to Flood Evacuation:

- The Site Owner and Management Company should sign up to the EA Flood Warning Service for the Gravesend and Northfleet location and MetOffice Sever Weather Warning Service.

- Prior evacuation of the site should be sought as soon as a Flood Warning is issued by the Environment Agency and before a Severe Flood Warning is issued.
 - It is the responsibility of the Site Owner and/or Management Company to establish a Flood Evacuation Plan and to ensure this is adhered to, by regularly providing training to staff.
- 7.4. The FRA supports the planning application and demonstrates that there is an acceptable level of flood risk to the site, as long as a Flood Evacuation Plan is in place and establishes safe evacuation procedures.
- 7.5. This Flood Risk Assessment should be submitted as part of the planning application to satisfy the requirements under NPPF.

Appendix A - Development Site Plans and Block Plans

Appendix A - Development Site Plans and Block Plans



Notes

1. Do not scale, except for planning purposes.
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Rev	Date	Description	Drawn / Checked
			NZ/GT

Project name
LV21
Light Vessel 21 Varne

Drawing number	Rev
4004 - LBXXXXDU101002	01

Drawing
Block Plan

Purpose of issue
Planning

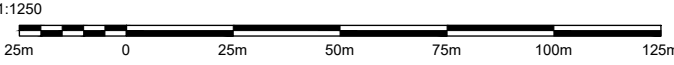
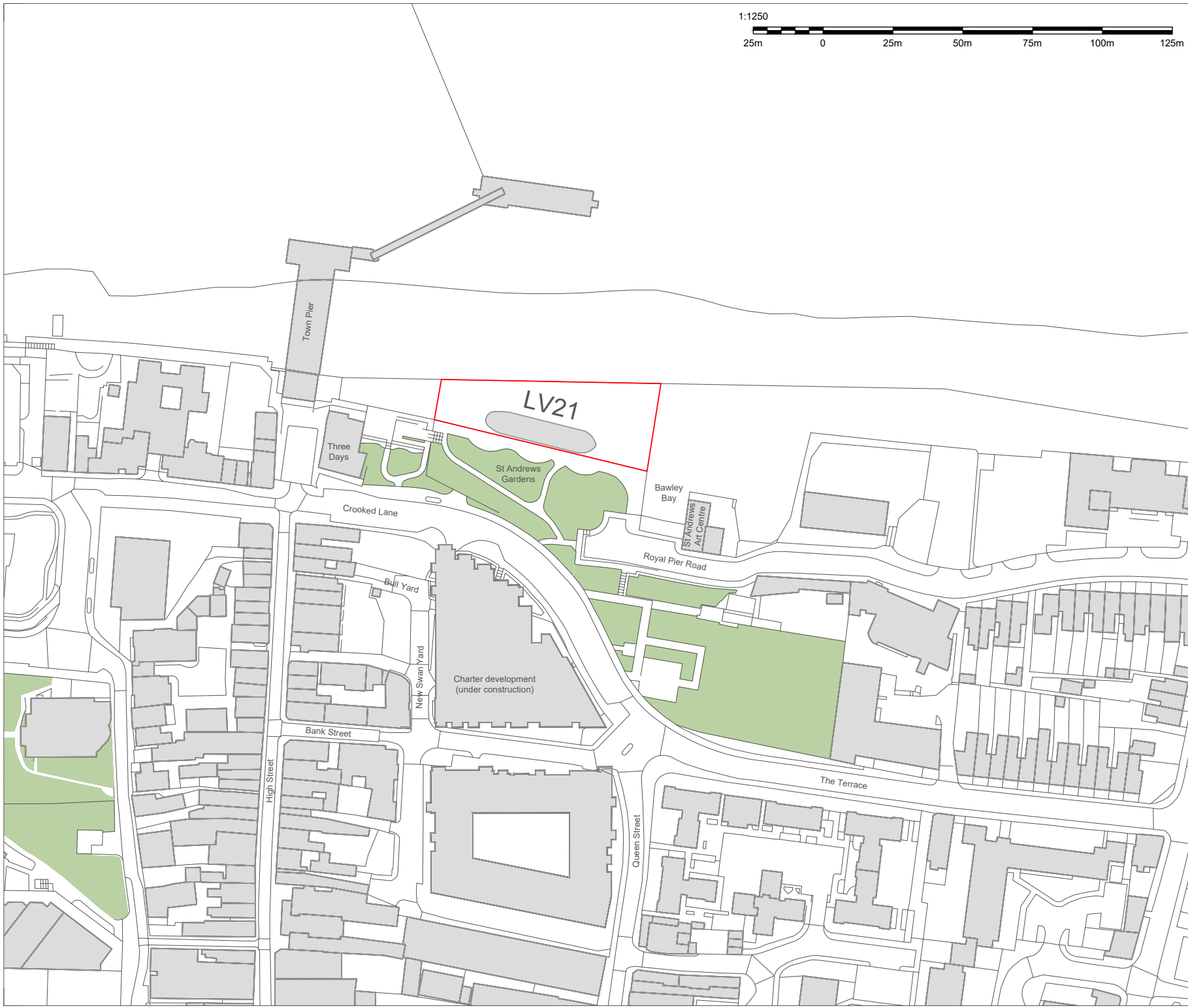
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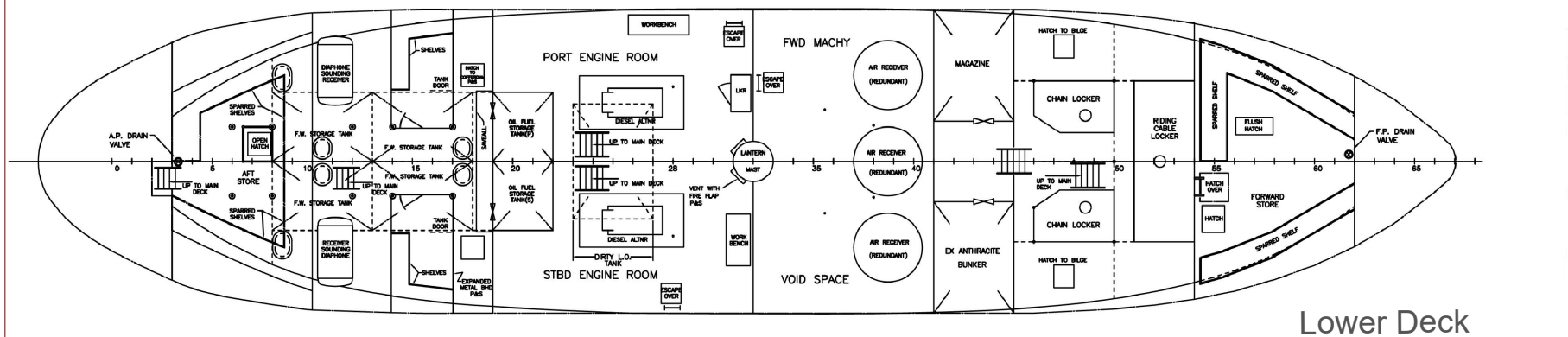
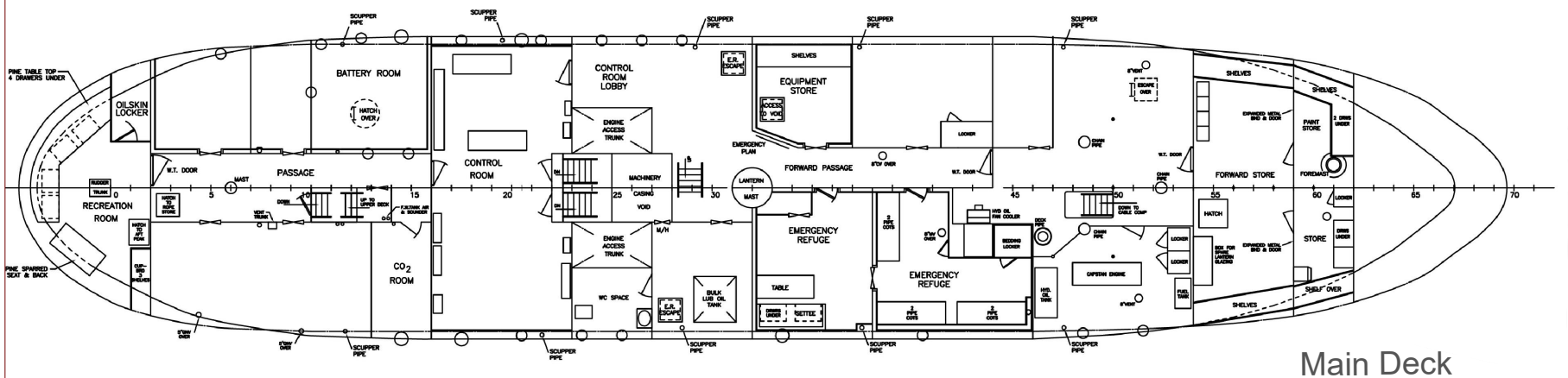
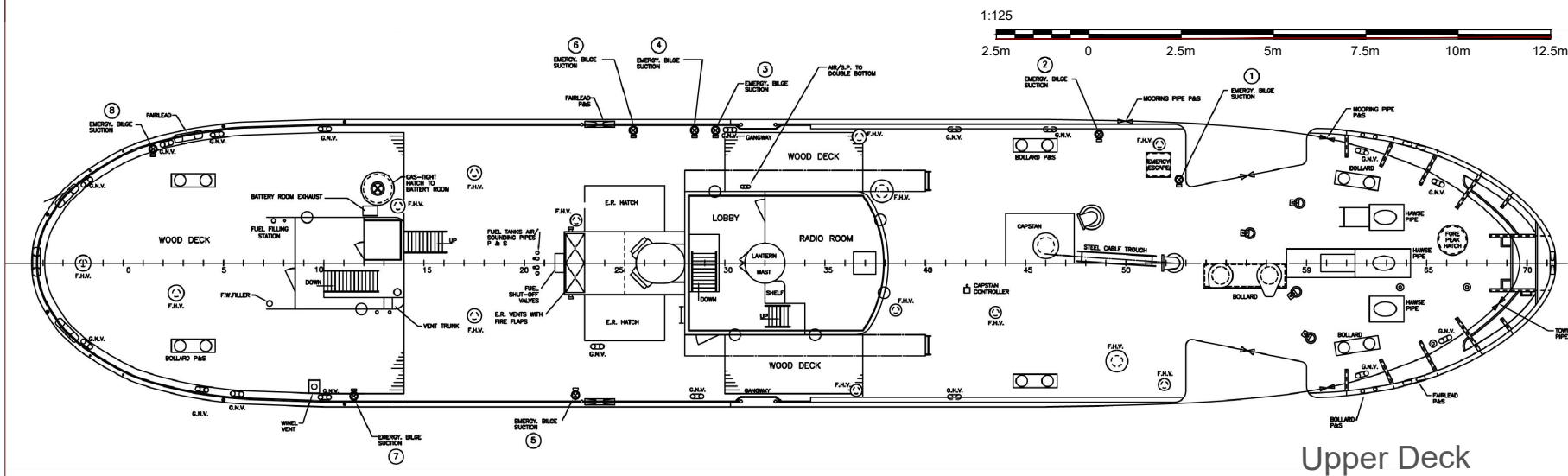
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Rev	Date	Description	Drawn / Checked
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		Drawing number	Rev 01
		4004 - LBXXXXU101001	
		Drawing	
		Location Plan	
		Purpose of issue	
		Planning	
		Scale	Date
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Rev Date Description Drawn / Checked

Project name NZ/GT

LV21

Light Vessel 21 Varne

Drawing number Rev

4004 - LBXXXXU102000

Drawing

Indicative Floorplans

Upper Deck, Main Deck and Lower Deck

Purpose of Issue
Planning

Scale 1:125@A3 Date 16/01/2024

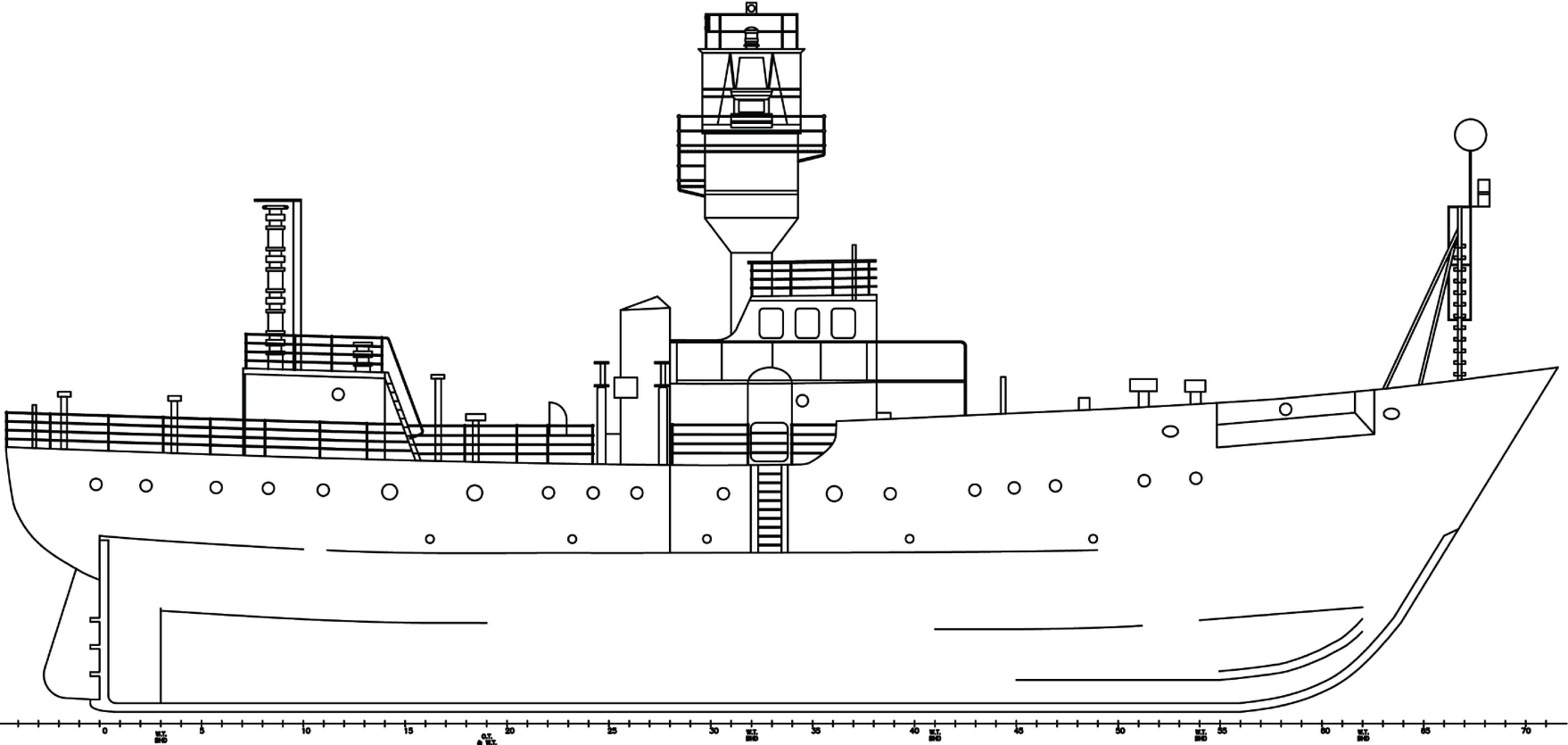
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1:125



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Rev Date Description Drawn / Checked

Project name NZ/GT

LV21

Light Vessel 21 Varne

Drawing number Rev 01

4004 - LBXXXXDU104000

Drawing
Indicative Elevation

Purpose of issue
Planning

Scale 1:125@A3 Date 16/01/2024

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