

Metropolitan Police Service Specialist Training Centre

Flood Risk Assessment

Metropolitan Police Service

December 2019

Notice

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This document has 23 pages including the cover.

Document history

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1. Introduction

1.1. FRA purpose

Atkins Limited was commissioned by the Metropolitan Police Service (MPS) to complete a Flood Risk Assessment (FRA) to support a planning application for a new training facility on an existing Metropolitan Police site in Gravesend, Kent. This document describes the proposed works, the flood risks at the site and the potential implications of this development in terms of flood risk. This document also identifies relevant planning policies (both national and local) and concludes with recommendations for the design work to ensure that planning policy requirements are met.

1.2. Sources of data

To inform this FRA, data and information has been obtained from the following sources:

- Site Information and option plans provided by the design team;
- Environment Agency (EA) flood product data;
- Publicly available information on the Environment Agency website (Environment Agency, Flood map for planning, 2019);
- Site drainage plans provided by MPS;
- Geology information from the Geology of Britain online viewer (British Geological Survey, 2019); and
- Information and data available from Kent County Council (KCC) and Gravesham Borough Council (GBC) (full reference list available at the end of this document).

1.3. Site description

1.3.1. Location

The MPS Specialist Training Centre (MPSTC) is located 2.5km from the centre of Gravesend, a town located on the south bank of the River Thames (Figure 1-1).

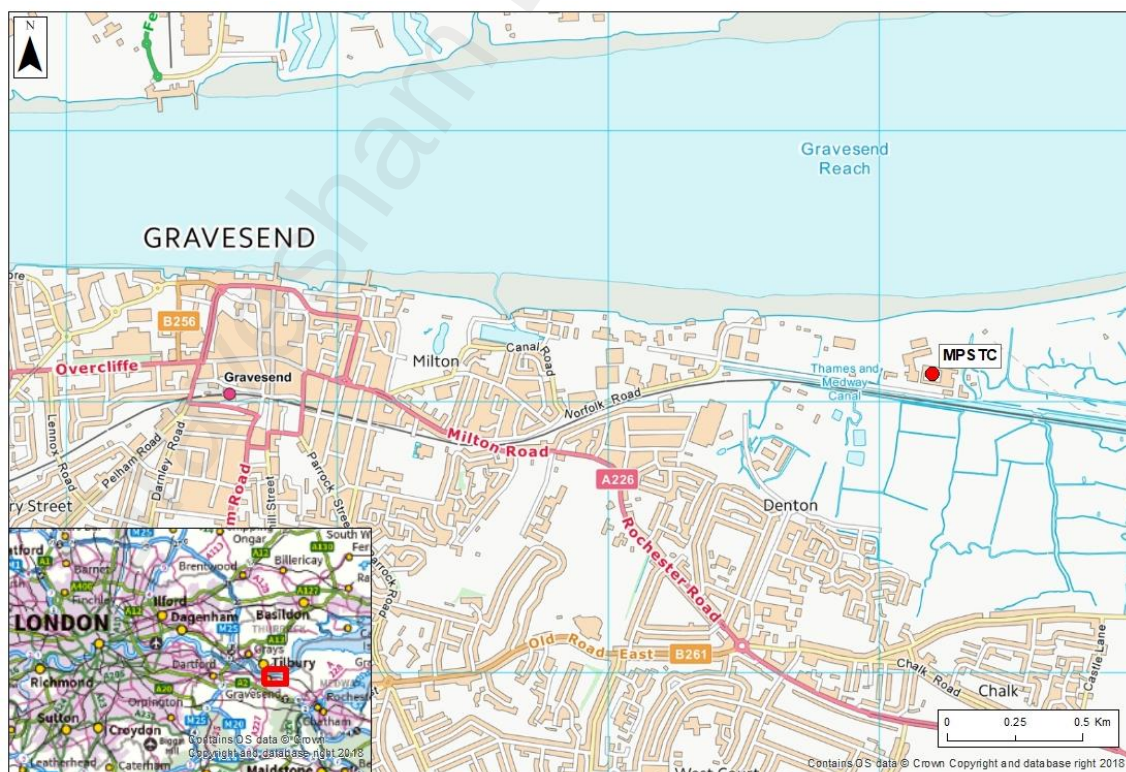


Figure 1-1 - Location Map of MPSTC

1.3.2. Watercourses

The site is within 100m of the River Thames to the north, the Thames and Medway Canal to the south, and a series of drainage ditches surrounding the site, some of which are classified as Environment Agency main rivers. The location of these watercourses is shown in Figure 1-2. It is unclear at present whether one of these ditches runs beneath the existing site.

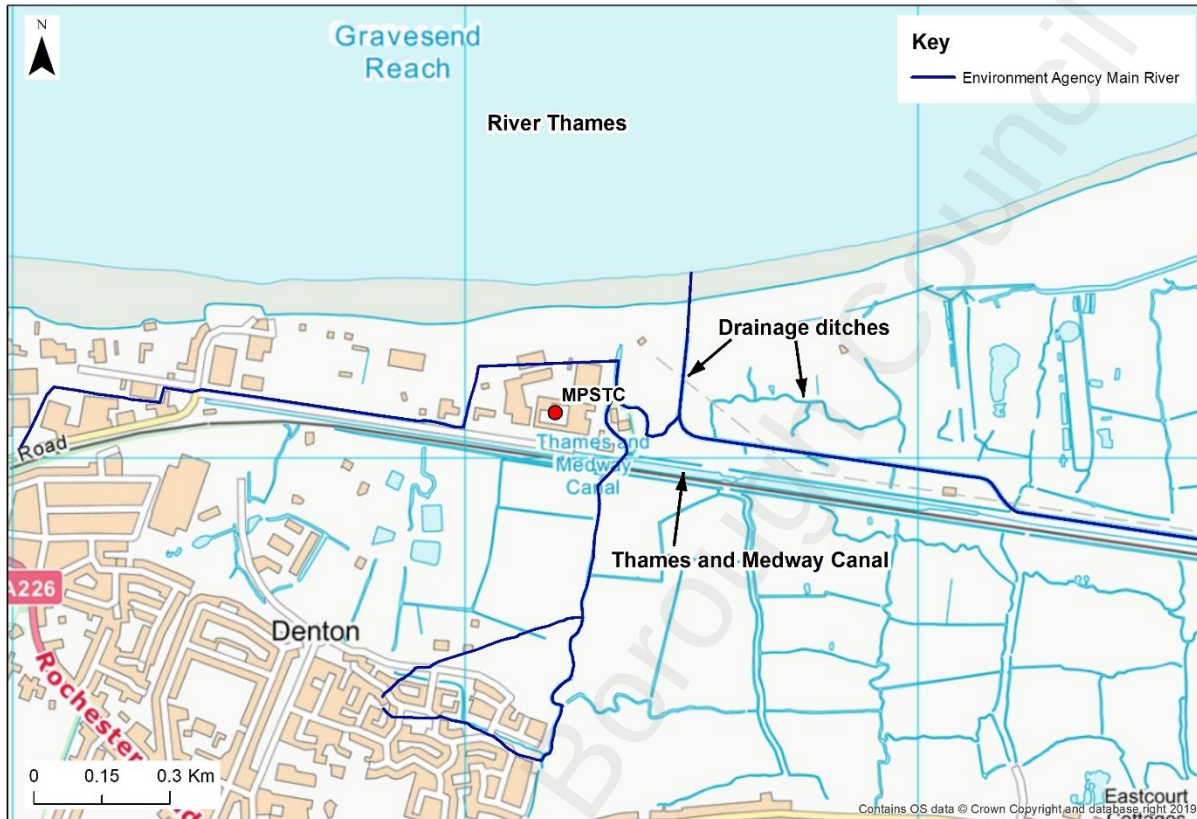


Figure 1-2 - Watercourses near MPSTC Site

1.3.3. Topography, geology and soils

The MPSTC is located on low lying land, with average site levels believed to be around 2.3 – 2.5m AOD. The underlying bedrock geology of the site is Lewes Nodular chalk formation, Seaford chalk formation and Newhaven chalk formation, with superficial deposits of Alluvium – clay, silt, sand and peat (British Geological Survey, 2019). The Soil type is soilscape 21, which is Loamy and Clayey and naturally wet (LandIS, 2019).

1.3.4. Existing land use

The proposed development is at the north eastern extent of the existing site, closest to the River Thames (Figure 1-3). The development site spans 1,506m² and the current land use is tarmacked car park (Figure 1-4).

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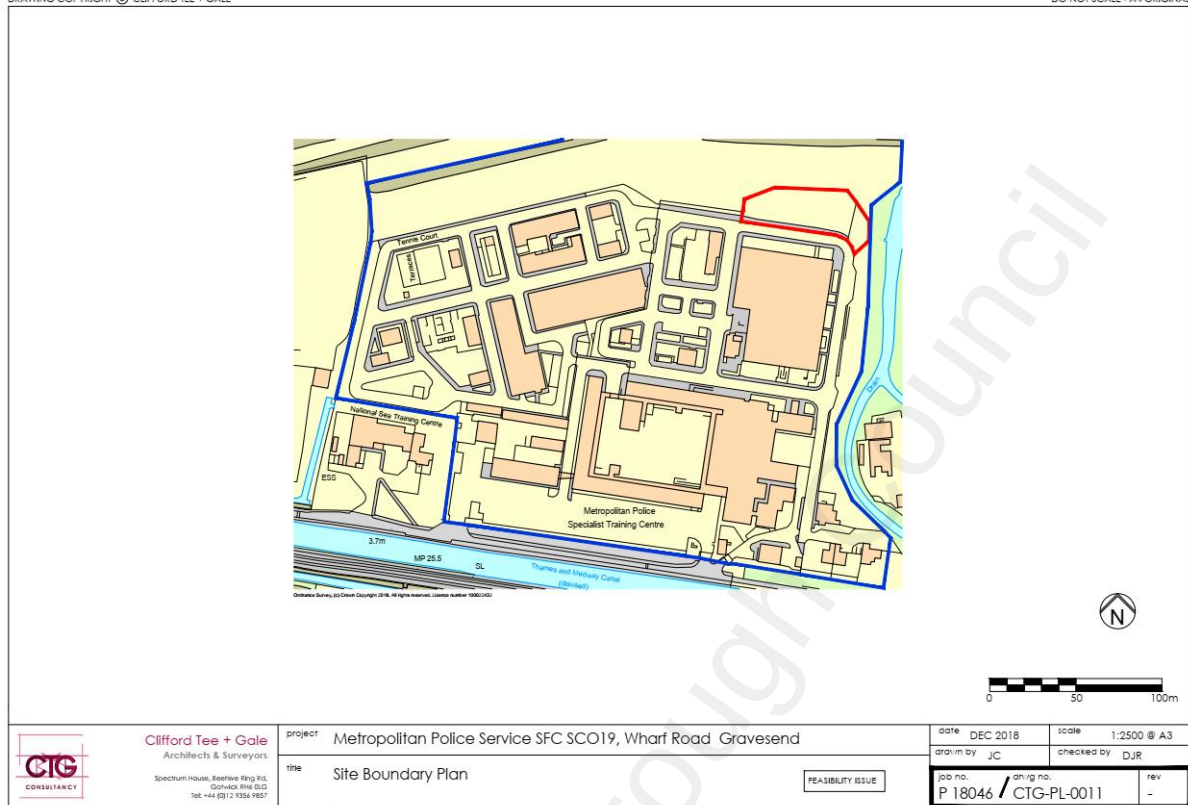


Figure 1-3 - Plan of MPSTC site

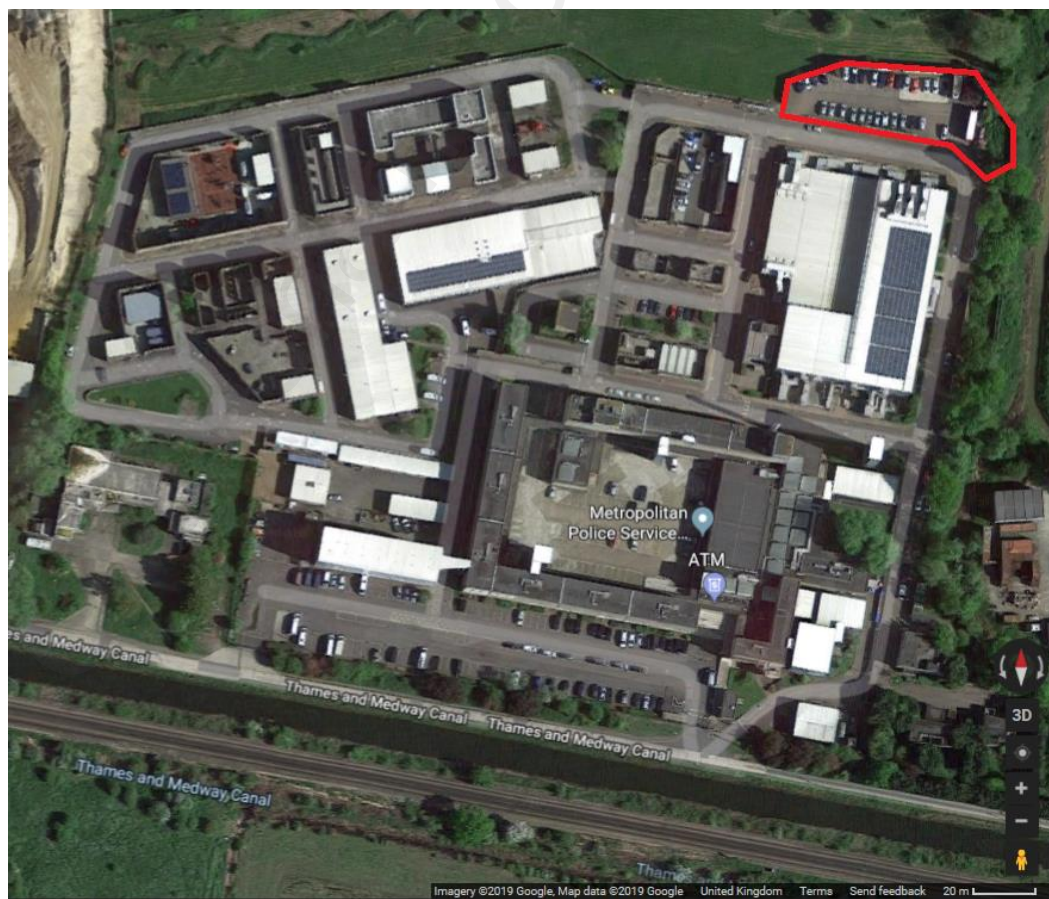


Figure 1-4 - Imagery of the current use of site

1.4. Development proposal

The proposal includes two new buildings on the site (Figure 1-5 and Appendix A site plan):

- 1) A live fire skills training house (three-storey plus abseil frame) with a:
 - Floor space of 1,046m² and;
 - Height of 11m (13m with abseil frame)
- 2) An ancillary support building (single storey) with a floor space of 134m².



Figure 1-5 - Design of proposed development

1.5. Consultation

After the submission of a Pre-Application to Gravesham Borough Council (LSH, Jan 2019), the following advice was given:

- Policy CS18 of Gravesham Core Strategy (2014) sets out the requirements for dealing with sustainable drainage and surface water run-off. Sustainable Drainage Systems (SuDS) for the site should be included within the scheme.
- As the property is within Flood Zone 3 any future application should be accompanied with an appropriate flood risk assessment. Any future scheme should take into account the recommendations of your flood risk assessment and I would suggest that prior to submitting an application you engage directly with the Environment Agency who provided a pre-application service.
- Any future application would need to include a drainage strategy for the site ideally with the planning application or it would be the requirement of a planning condition. Kent County Council is the Lead Local Flood Authority. Please note any SuDS scheme would need to take into account the recommendations set out by the EA/flood risk assessment.

A pre – application request has been submitted to the EA for comment and is pending a response.

2. Assessment of all sources of flooding

The National Planning Policy Framework (NPPF) states that all sources of flooding should be considered (Ministry of Housing, Communities and Local Government, 2019).

Table 2-1 provides definitions and a summary assessment for each of the sources of flooding, identifying those that could pose a risk or be affected by the proposed development. The remainder of the document then focuses on those flood risks identified as being significant.

Table 2-1 - Assessment of flood risk

Source	Definition	Risk to and from the proposed development	Significant flood source?
Tidal flooding	Flooding from the sea as a result of high tide levels and / or wave action. Alternatively, propagation of high tides and storm surges up tidal river channels, leading to overtopping of the river banks and inundation of the surrounding land.	The site is located in Flood Zone 3, which in this location is dominated by the risk of flooding from the tidal reach of the River Thames. Flood zone 3 indicates a greater than 0.5% (1 in 200) Annual Probability (AP) of tidal flooding (Environment Agency, 2019) in an undefended scenario. The River Thames however, has extensive defences, which in this location comprises flood embankments. The actual probability of tidal flooding is therefore low and Figure 3-1 shows that the site is in an area benefitting from flood defences. There remains a residual risk of tidal flooding from defence overtopping and / or breaching in a more extreme event and under future climate change scenarios. See Section 3 for further analysis of tidal flood risk and mitigation measures.	Yes
Fluvial flooding	Exceedance of the flow capacity of river channels, leading to overtopping of the river banks and inundation of the surrounding land.	The site is located in Flood Zone 3, which in this location is dominated by the risk of flooding from the tidal reach of the River Thames and is therefore considered as tidal risk. There are a series of drainage ditches which are classified as EA Main Rivers that surround the site (Figure 1-2). These ditches provide the main surface water drainage for the surrounding area and drain into the River Thames via a flapped outfall to the east of the site. The ditches are therefore subject to tide locking during high tides. The risk of flooding from these ditches is discussed further under surface water flood risk.	No
Surface water (pluvial) flooding	Intense rainfall exceeds the available infiltration capacity and / or the drainage capacity leading to overland flows and surface water flooding.	The site is identified as being at low risk of surface water flooding on the Environment Agency Risk of Flooding from Surface Water maps (Environment Agency, 2019), with an annual probability of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%) and flood depths estimated to range from 300 to 900mm. The drainage ditches mentioned in the fluvial flooding section above provide a surface water drainage function, outfalling to the River	Yes

		Thames via flapped outfalls. There is a risk, therefore, that at high tide conditions these drainage ditches can become tidelocked and increase the surface water risk. See Section 4 for further analysis of surface water flood risk and mitigation measures.	
Ground-water flooding	Emergence of groundwater at the surface (and subsequent overland flows) or into subsurface voids as a result of abnormally high groundwater flows, the introduction of an obstruction to groundwater flow and / or the rebound of previously depressed groundwater levels.	The underlying geology is Chalk, with some of the site being overlain with alluvium deposits (British Geological Survey, 2019). Soils are Loamy and Clayey (LandIS, 2019). There is a major aquifer underneath the site (Defra, 2019). Groundwater fluctuations in this location are linked to the River Thames which poses a greater flood risk to the site compared to groundwater. The made ground across this site would also prevent groundwater emergence and for this reason is not considered further. The Kent Thameside SFRA (Kent Thameside Delivery Board, 2005) highlights within a Source-Pathway-Receptor Matrix, that Groundwater flooding poses low risk to Kent. It also shows that the site under investigation is not within a Groundwater Risk Area.	No
Sewer flooding	Flooding from sewers is caused by exceedance of sewer capacity and / or a blockage in the sewer network.	Southern Water provide and maintain the sewer system within Gravesend. Site specific details of the on-site sewer network are not currently known. The proposed development includes addition of 3 toilets and will contribute a small volume to the foul network. This is not considered a significant risk as the number of staff using the site as a whole is not expected to increase. No increase in foul flows is therefore expected.	No
Other sources of flood risk	Flooding from canals, reservoirs (breach or overtopping).	As shown in Figure 1-2 the site is located near the Thames and Medway Canal (disused). In storm events, there is a risk of the channel overtopping and inundating the site however, the depth of the channel has recently been increased and a pumping system installed to maintain water levels (Gravesham Borough Council, 2014).	No

3. Tidal Flooding

Figure 3-1 shows that the sites location is within Flood Zone 3, in an area benefitting from flood defences. This means that there is a 0.5% (1 in 200) or greater AP of tidal flooding in an undefended scenario.

The River Thames has a series of statutory flood defences, which in this location are comprised of flood defence embankments, raised to a level of 6.35m AOD. This is in line with the statutory flood defence level for this area, as defined by the Environment Agency. These embankments defend the site during flood events exceeding a present day 0.1% (1 in 1000) AP. They are privately owned and it is the responsibility of the riparian owners to maintain the crest level at 6.35m AOD. They are inspected twice a year and their condition is currently graded at 2 (good) in this area on a scale from 1 (very good) to 5 (very poor).

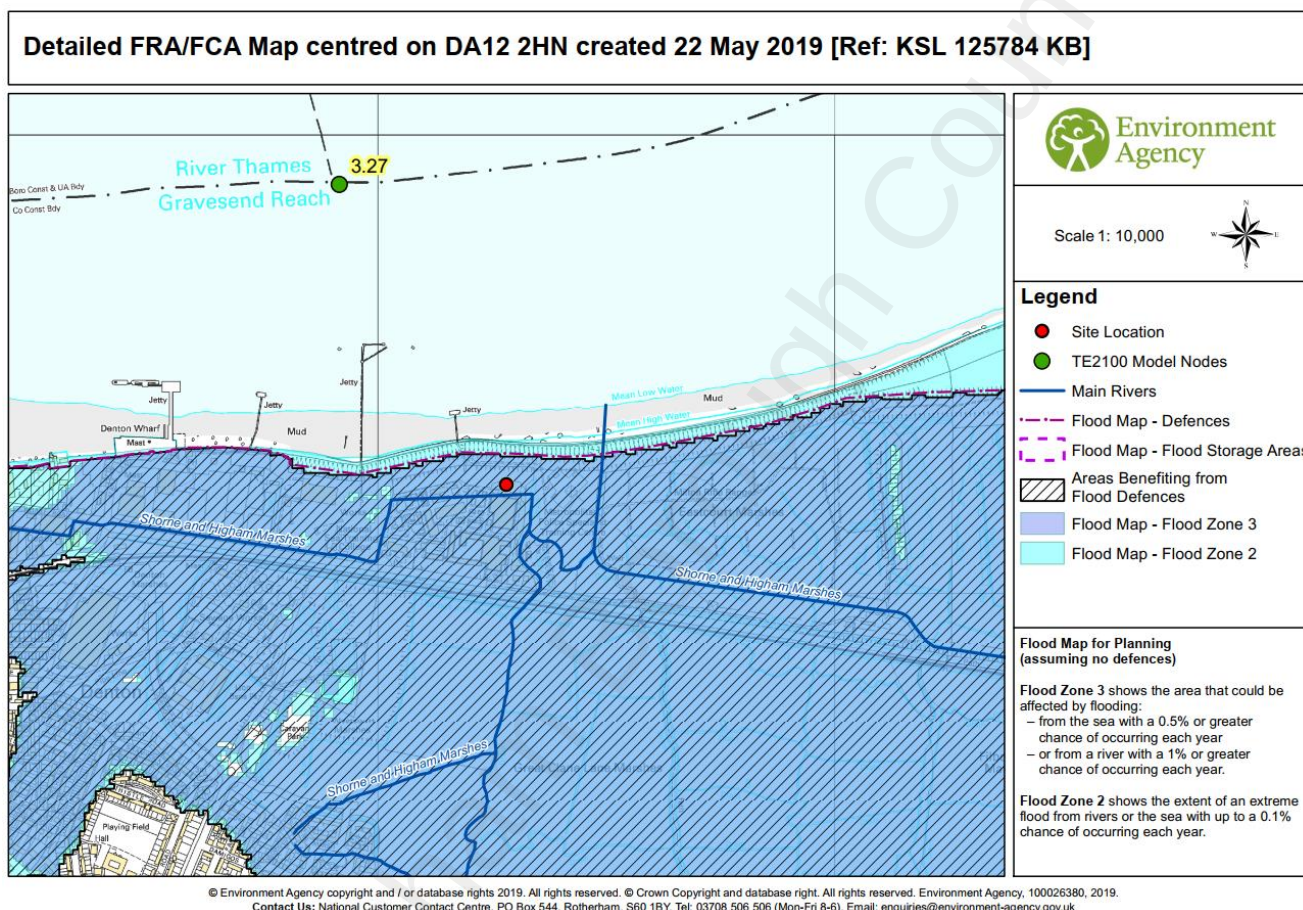


Figure 3-1 - Flood map for Planning (assuming no defences)

For the node 3.27 shown on Figure 3-1, the EA have provided 0.1% (1 in 1000) AP water levels. The 2008 flood levels and climate change modelled water levels (taking into account operation of the Thames Barrier) are shown in Table 3-1.

This indicates that during a 0.1% AP event, there is an estimated 0.64m difference between the 2008 extreme water level and the crest of the River Thames defence. The bank defences would be sufficient to provide protection from overtopping during a 0.1% (1 in 1000) AP event until at least 2070. After interpolation of results, it was estimated to provide protection till at least 2090. The design life of the proposed training facility is estimated to be 50 years. It can therefore be concluded that the current defences will provide a minimum of a 0.1% (1 in 1000) standard of protect for the life time of the proposed development.

Table 3-1 - Climate change River Thames levels for 0.1% (1 in 1000) AP

Node	Easting	Northing	Defence Level (m)	2008 Extreme water Level (m)	1000-year design water levels (m)					
					2000	2040	2070	2100	2120	2170
3.27	556916	174891	6.35	5.71	5.71	5.92	6.08	6.38	6.61	7.19

The site is however, at risk of flooding should the flood embankment breach. Figures Figure 3-2 and Figure 3-3 show flood hazard maps for the future climate change scenario in 2115.

At both the 0.5% (1 in 200) AP breach, and 0.1% (1 in 1000) AP breach, the site is estimated to have a maximum hazard rating of greater than 2.0, meaning danger for all. This equates to maximum depths of >2.0m, and velocities of between 1.5-2.5 m/s.

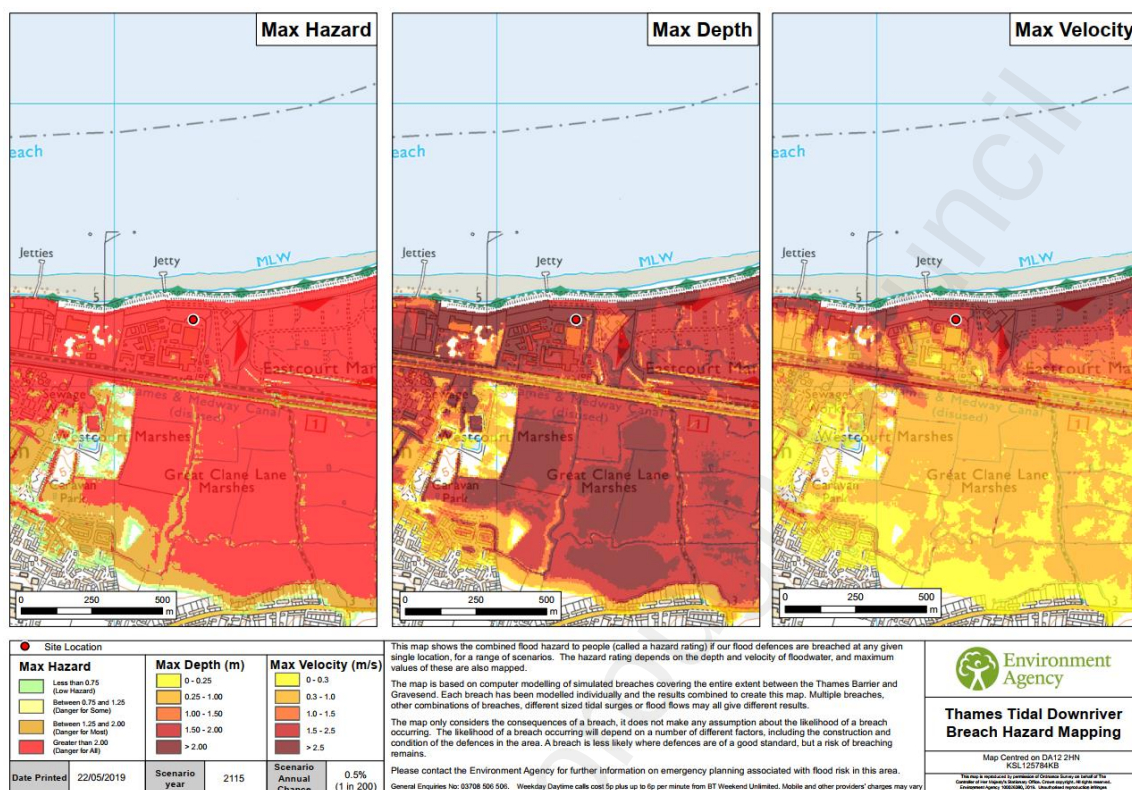


Figure 3-2 - Thames tidal downriver breach hazard mapping for 0.5% (1 in 200) AP (2115)

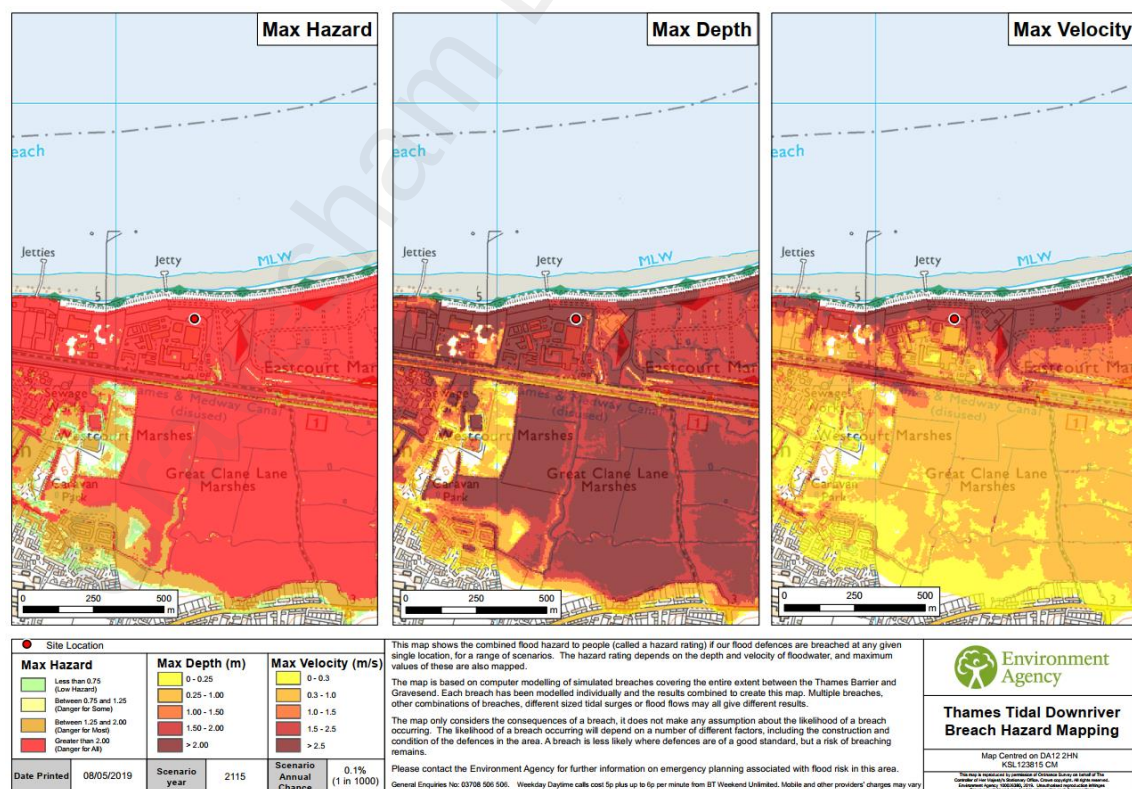


Figure 3-3 - Thames tidal downriver breach hazard mapping for 0.1% (1 in 1000) AP (2115)

The expected flood water levels across the sites in 2014 and 20115, following a breach in the defences have been provided by the Environment Agency. The reference nodes on the site are shown in Figure 3-4 and the flood depths in Table 3-2. The 20115 water levels include allowances for climate change in line with current EA guidance (2016). Only nodes within or in very close proximity to the site perimeter have been included in Table 3-2.

Table 3-2 - Thames tidal downriver breach inundation modelling

Node	National grid reference		Modelled levels in m AOD for 0.5% AP		Modelled levels in m AOD for 0.1% AP	
	Easting	Northing	2014	2115	2014	2115
1	567251	174229	4.27	4.58	4.39	4.69
2	567280	174226	4.25	4.56	4.37	4.67
3	567312	174221	4.16	4.41	4.26	4.50
4	567314	174241	4.16	4.41	4.26	4.50
5	567285	174246	4.20	4.49	4.31	4.58
6	567254	174246	4.20	4.48	4.31	4.57
Average	Across the site		4.20	4.49	4.32	4.59

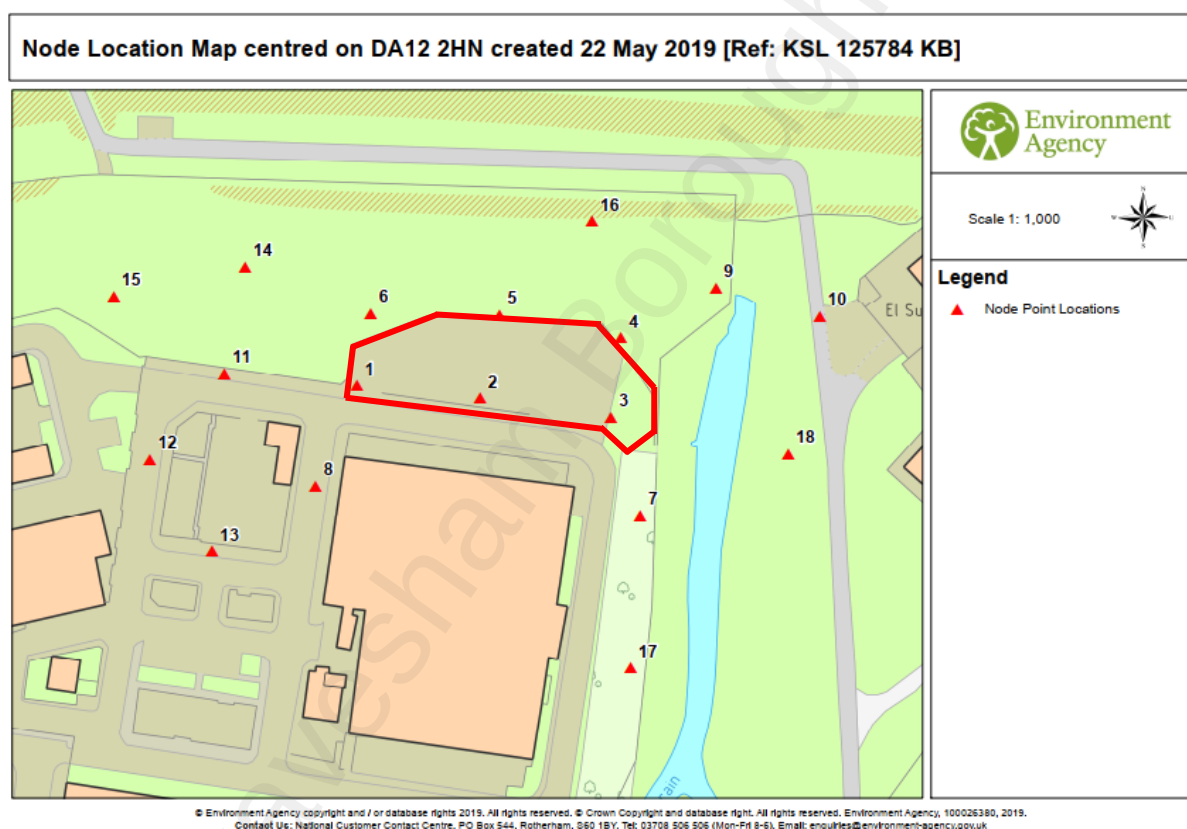


Figure 3-4 - Node location map

The average ground level on this site is approximately 2.4m AOD, resulting in expected flood depths as presented in Table 3-3.

Average flood depths (m) for 0.5% AP		Average flood depths (m) for 0.1% AP	
2014	2115	2014	2115
1.8	2.09	1.92	2.19

Table 3-3 - Average flood depths

The proposed development includes a live fire skills house with a height of 11m (13m with abseil frame) and an ancillary support building (single storey). The live fire skills house will be built at ground level, however the ancillary support building will be raised by 1.2m to a level of 3.6m AOD. This is in line with other buildings on the site which have been raised by a minimum of 900mm, in line it is understood with prior discussions with the EA (Pers Comm David Ross, scheme architect, 2019).

This means that should a breach occur, the ancillary support building will be expected to flood to a depth of 0.6m during a 0.5% (1 in 200) AP event and 0.72m during a 0.1% (1 in 1000) AP event. Under climate change scenarios in 2115 this would increase to 0.89m and 0.99m respectfully.

Due to the likelihood of flooding in the event of breaching of flood defences, the MPS have a contingency reaction plan, which covers the eventuality of flooding and is regularly reviewed, updated and tested. The flood warning and evacuation procedure is shown in Appendix B. Site evacuation occurs upon receipt of a flood warning, which is expected to give 4-6 hours' notice prior to peak water levels in the river. Evacuation of the site occurs upon receipt of this warning to ensure that no personnel are on site during predicted peak water levels in the river, when the probability and consequence of a breach is at its highest.

4. Surface Water flood risk and drainage strategy

The site is surrounded by a number of drainage ditches, some of which are classified as main rivers (See Figure 1-2). The outfall from these ditches to the River Thames is flapped and maintained by the EA. This is known to not provide a complete seal and it allows some back flow at high tides, into the ditches (Confirmed by MPSTC, 2019). In the event of high rainfall coinciding with a high tide, this could cause localised surface water flooding, if the capacity of the ditches is exceeded. There is however, no historical evidence of fresh water flooding seen on this site (confirmed by MPSTC, 2019).

The Risk of Flooding from Surface Water maps (RoFSW), provided by the Environment Agency, as shown in Figure 4-1, classifies the site as having a low risk of surface water flooding between a 1% and 0.1% AP (1 in 100 – 1 in 1,000). Estimated flood depths on the site during these extreme events are estimated to be between 300-900mm (Figure 4-2). As discussed above, the support building is 1.2m higher than ground level, and therefore will be protected from surface water flooding.

Currently, the surface water from the site outfalls into the drainage ditches, although the drainage network is not fully understood at this stage. The design of the surface water drainage has not yet been undertaken for the new development, and therefore this FRA may need to be re-visited once the design has been finalised.

The proposed development, however, will not increase the risk of surface water flooding, because the works are taking place on an existing hardstanding site, so there will be no change in impermeable areas contributing to increased runoff rates and volumes.

The proposed development will therefore not be at risk of surface water flooding and will not increase the existing risk of surface water flooding.

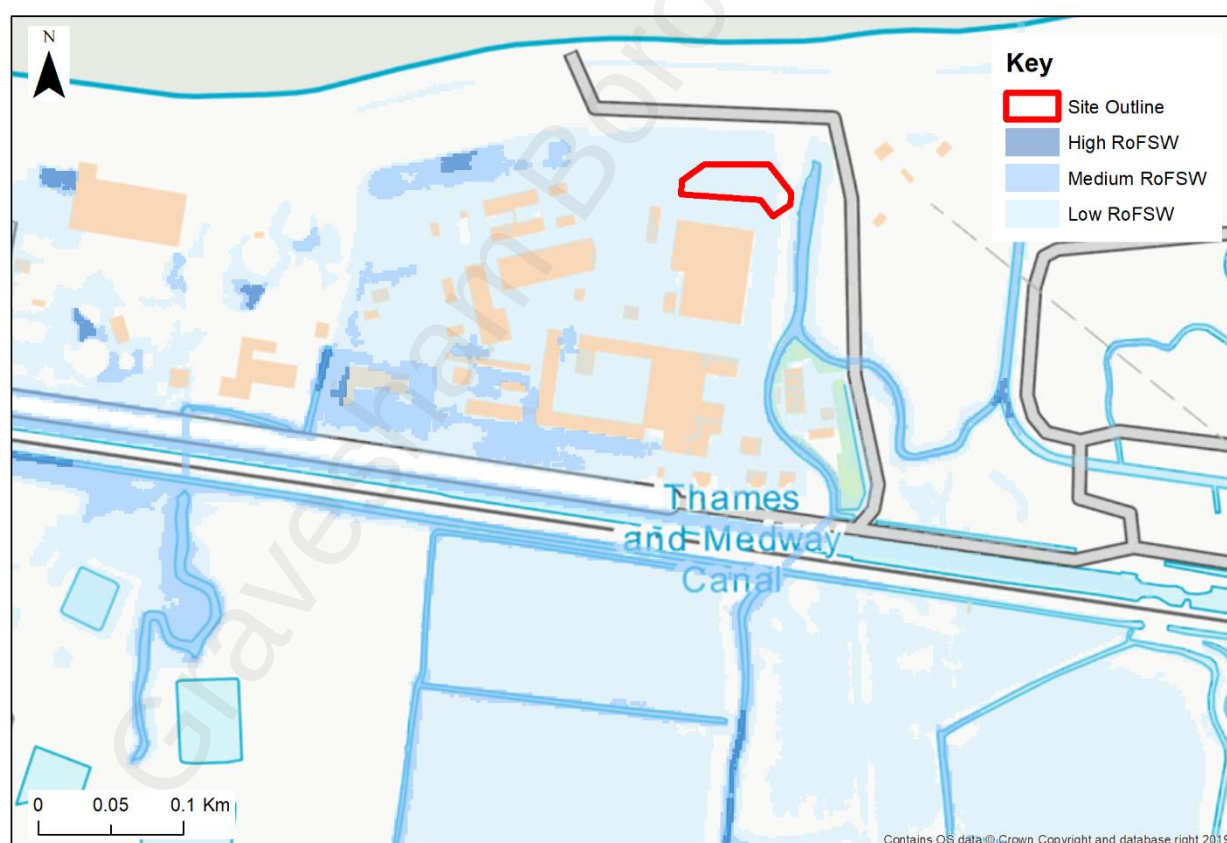


Figure 4-1 – RoFSW (Source: Environment Agency 2019)

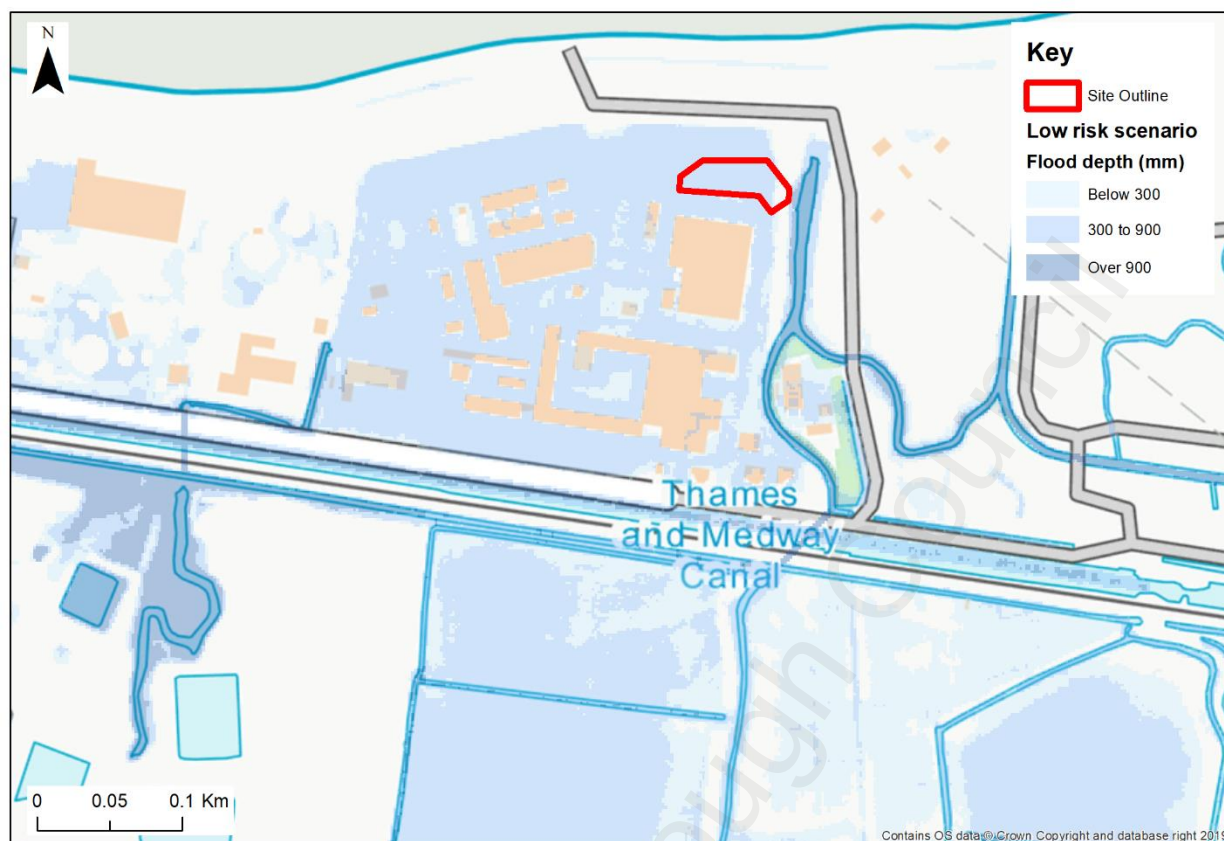


Figure 4-2 - Depths from RoFSW for Low Risk flooding (Source: Environment Agency 2019)

It is noted however, that one of the drainage ditches, that are classified as main river runs beneath the site. Consequently, the proposed scheme is likely to require a Food Risk Activity Permit, prior to construction.

4.1. Local surface water drainage policy

The Gravesham Local Plan Core Strategy (Gravesham Borough Council, 2014) is the latest version of the Borough's local planning policy. This sets out a policy (CS18) to ensure that developments do not increase flood risk now or under a changing future climate.

The policy states that the run-off rates on the proposed development area should not, at a minimum, exceed the existing rates of run-off and that where feasible, Sustainable Drainage Systems (SuDS) should be included. This is to ensure that under the impact of climate change, the combined sewers and other surface water drainage systems can convey the increased flows. SuDS should also enhance water quality, provide a wildlife habitat and provide a sympathetic environmental setting for development.

Gravesham Borough Council also require all non-residential developments of over 1,000 sq. m to meet the BREEAM 'excellent standards in water efficiency and include provision for rainfall collection (Gravesham Borough Council, 2014).

5. Planning policy

5.1. National planning policy

The Government published an updated NPPF in 2019 (Ministry of Housing, Communities and Local Government, 2019). This is accompanied by the NPPF Planning Practice Guidance – Flood Risk and Coastal Change (Ministry of Housing, Communities and Local Government, 2014).

The NPPF aims to ensure that flood risk is considered by all relevant statutory bodies to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest risk. Where new development is necessary in such areas, Government policy aims to make it safe, without increasing flood risk elsewhere and, where possible, reducing flood risk overall. FRAs are required for all developments sited in Flood Zones 2 and / or 3 and development areas greater than 1 hectare (ha) sited in Flood Zone 1.

5.2. Flood classification and development vulnerability

The development is located within Flood Zone 3a – with a high probability of flooding. Whilst located within Flood Zone 3a, the proposed site is protected from direct flooding by the presence of earth embankments which make up part of the River Thames tidal defences. As such this means that the proposed site is protected from direct flooding during flood events with a 0.1% AP and this report has demonstrated that this level of protection will exist beyond the design life of 50 years and until 2090.

The NPPF contains a classification of development type based on vulnerability to flooding. These classifications aid in determining whether a development is suitable when it is situated within a specific Flood Zone. The proposed development is classified as 'less vulnerable' and, in accordance with Table 3 of the NPPF Planning Practice Guidance, is appropriate for Flood Zone 3a, subject to application of the Sequential Test. There is no requirement to apply the Exception Test.

5.2.1. Sequential Test

The NPPF sets out the details of a Sequential Test, which aims to steer new developments wherever possible in Flood Zone 1 and on sites with a low risk of flooding from all other sources.

The proposed development is an extension to an existing training facility and by its nature must be located on the same site. The most significant risk of flooding on the site would occur as a result of a breach in the tidal defences. During this scenario the risk and depth of flooding would be consistent across the site and so sequentially, the proposed location of the training facility cannot be located in an area of the site with a lower risk of flooding. The proposed development is therefore considered to pass the Sequential Test.

Less vulnerable development is appropriate within Flood Zone 3a and there is no further requirement to apply the Exception Test. The proposed development including the mitigation of raising the support building and the provision of a flood evacuation plan, is therefore considered appropriate for the level of risk on the site and in line with NPPF.

6. Conclusions and recommendations

6.1. Summary

This FRA has been undertaken in accordance with the NPPF to assess flood risk from all sources for the proposed extension to a training facility on the existing metropolitan Police Service Training Centre in Gravened, Kent.

Based on the geography of the site and information available from the Environment Agency, it is considered that there is a low probability of flooding from fluvial, surface water, groundwater, sewers, canals and reservoirs. There is a high residual probability of tidal flooding from the River Thames. This has been considered alongside the impact of the proposed training facility on local tidal and surface water flood risk.

6.2. Conclusions

6.2.1. Tidal flooding

This report has concluded that the proposed site for the training facility is protected from direct tidal flooding by the presence of earth embankments which make up part of the River Thames tidal defences. These defence protect the site from tidal flooding during events with an 0.1% AP for the lifetime of the development (50 years) and up to 2090.

The site has a high residual risk of tidal flooding should these defences breach, with average flood depths across the site estimated to be 1.8m during 0.5% AP event, increasing to 2.09m after 100 years of climate change. These depths and the associate velocities mean that the site would have the maximum flood hazard rating in the event of a breach.

The live fire skills house will be built at ground level, however the ancillary support building will be raised by 1.2m. Flood depths within the ancillary building are estimated to be 0.6m during a 0.5% AP event.

The MPS have a Flood Warning and Evacuation Procedure that triggers a site evacuation upon receipt of a flood warning, which is expected to give 4-6 hours' notice prior to peak water levels in the river. This will ensure no staff and trainees are on site when the risk of breach is at its highest.

6.2.2. Surface water flooding

The site is surrounded by a number of drainage ditches, some of which are classified as main rivers. The outfall of these ditches to the River Thames is flapped and maintained by the EA. In the event of high rainfall coinciding with a high tide, localised surface water flooding could occur across the site, if the capacity of the ditches is exceeded. The Environment Agency's RoFSW classifies the site as having a low risk of surface water flooding between a 1% and 0.1% AP. Flood depths on the site during these events are estimated to be between 300-900mm. The support building is 1.2m higher than ground level, and therefore will be protected from surface water flooding.

The proposed development will not increase the existing risk of surface water flooding, because the works are taking place on an existing hardstanding site, so there will be no change in impermeable areas contributing to increased runoff rates and volumes. The design of the proposed surface water drainage has not yet been finalised, and therefore this FRA may need to be re-visited once the design has been completed.

6.3. Planning policy

The proposed development is an extension to an existing training facility and by its nature must be located on the same site. The most significant risk of flooding on the site would occur as a result of a breach in the tidal defences. During this scenario the risk and depth of flooding would be consistent across the site and so sequentially, the proposed location of the training facility cannot be located in an area of the site with a lower risk of flooding. The proposed development is therefore considered to pass the Sequential Test.

Less vulnerable development is appropriate within Flood Zone 3a and there is no further requirement to apply the Exception Test. The proposed development including the mitigation of raising the support building and provision of a flood evacuation plan, is therefore considered appropriate for the level of risk on the site and in line with NPPF.

6.4. Recommendations

Once the proposed surface water drainage design has been finalised, this FRA should be updated to include details of how surface water runoff will be managed on the site, to reduce the risk of flooding and where possible provide details of any positive benefits the development may bring to the local risk of surface water flooding. This document could then be used to support any BREEAM application.

Gravesham Borough Council

7. References

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Appendices

Gravesham Borough Council

Appendix A. Site Plan

Drawing reference: P18046-CTG-PL-0002 Proposed Site Plan-A1

Gravesham Borough Council

Appendix B. MPSTC Flood Warning and Evacuation Procedure

9.1. Warning and Evacuation Procedure

The flood warning and evacuation procedure will be in three stages.

Flood Watch – flooding is possible and the situation could worsen

1. Advise senior MPS officer who will review training and cancel if prudent
2. Range staff to inspect water levels hourly
3. Site Manager to ring 'Floodline' and/or check web site and report to senior MPS officer
4. Advise Kent Police and Contingency Reaction Team
5. Remove horses from site
6. Warn MPS that next day's training could be affected.
7. Listen to local radio for announcements.
8. Keep emergency number free for incoming calls.
9. Display flood status signs in reception and Gatehouse areas.

Flood Warning – flooding is now expected within 4 to 6 hours

1. Evacuate all non-essential staff.
2. Advise Kent Police and take their instructions regarding security
3. Move important documents and essential equipment to upper floors
4. Move emergency food supply, bottled water, torches, blankets and mobile phone to upper floor base for stranded or security staff if necessary.
5. Prepare to turn off gas and electricity.
6. Essential staff prepare to evacuate
7. Sand bag vulnerable areas
8. mobilise Contingency Reaction Team

Severe Flood Warning – severe flooding is now expected

1. Advise police of impending evacuation and take their instructions regarding security
2. Turn off gas supply
3. Turn off auto start to generator
4. Prepare to turn off electricity and turn off before floodwater enters buildings
5. Check all buildings to ensure they are unoccupied.
6. All essential staff should stay together and evacuate subject to security instructions
7. MPS to provide armed Instructors on upper floors to protect armoury
8. Contingency Reaction Plan operational

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