

APPENDIX E

CREEKMOUTH

CREEKMOUTH

Area Name: Creekmouth

Location: Barking

River Catchment: River Roding/River Thames

NPPF Flood Zone (majority of area): Flood Zone 3a

NPPF Flood Zone (worst case): Flood Zone 3a

Introduction

The Creekmouth strategic development site covers an area of approximately 0.24 km² and is located at the south-western boundary of Barking and Dagenham (refer to Appendix A). The site is bounded by Trafalgar Business Centre to the north, the Barking Riverside strategic development site to the east, the River Thames to the south and the River Roding to the west.

The existing land use in the area is predominately industrial with Buzzard Creel Industrial Estate located in the centre of the area and a gravel works in the south. The proposals for the development of the Creekmouth strategic development site comprise the development of c. 3,000 residential properties.

Description of Flood Risk

Fluvial and Tidal

The primary sources of flood risk in Creekmouth are tidal flooding from the River Thames and fluvial flooding from the River Roding. Buzzard Mouth Creek flows in a southerly direction through the eastern part of the site to discharge to the River Thames via a sluice gate and also poses a fluvial flood risk. It is understood that the upstream alignment of Buzzard Mouth Creek has been amended as part of the Barking Riverside development to include the creation of floodplain storage compensation. It is likely that these works have reduced fluvial flood risk associated with the downstream extents of the watercourse, although this would need to be considered with a site-specific FRA for the area.

The tidal influence of the River Roding is mitigated by the Barking Barrier which can be closed when water levels in the River Thames are high to prevent tide levels propagating upstream. The majority of the Creekmouth strategic development site (c. 97%) is located within Flood Zone 3a. Analysis of local topography and Flood Zones indicates the flood depths are expected to reach up to 2m in areas in Flood Zone 3a.

The extents of Flood Zone 3a and Flood Zone 2 are very similar, with the only nominal difference within the strategic development site located in the north-west corner. The only area identified as being within Flood Zone 1 is also located in the north-western corner of the site.

The functional floodplain, Flood Zone 3b, is limited to within the channel of the Barking Creek and River Thames and is therefore behind the flood defences which form the southern boundary of the Creekmouth site.

Fluvial and tidal flooding within the Creekmouth strategic development site is illustrated in Figures E1 and E2A.

Surface Water

The Environment Agency Risk of Flooding from Surface Water map indicates that the Creekmouth strategic development site is generally at low risk of surface water flooding.

The most significant surface water flood risk within the strategic development site is along River Road, which is the main road through the site, where depths of up to 0.6m are predicted for a length of road of approximately 0.5km within and to the north of the site during a rainfall event with an annual probability of 1 in 100 (1%). Similar depths are also predicted at the junction of River Road and Atcost Road near the eastern extent of the site, but over a smaller area.

Flood hazards associated with surface water flooding during the 1 in 100 (1%) annual probability event are illustrated in Figure E3.

Groundwater

The increased Potential for Elevated Groundwater map (iPEG), developed for the Barking and Dagenham SWMP, indicates that Creekmouth is not within the area identified as having an increased potential for groundwater to interact with or rise to within 2m of the ground surface.

Defence or Reservoir Failure

The Creekmouth strategic development site benefits from flood defence walls on the River Roding and from the Thames tidal defences, including the Barking Barrier. Areas identified to benefit from existing flood defences are illustrated in Figures E4 and E5, but noting that this does not take the potential effects of climate change into account.

The Lower Roding Flood Risk Mapping study (undertaken by Capita Symonds in 2009) indicates that the defences along the River Roding provide a Standard of Protection (SoP) to Creekmouth equivalent to a 1 in 200 (0.5%) annual probability fluvial flood. This study only assessed the fluvial flood risk from the River Roding and no assessment was undertaken of a fluvial flood event occurring when the Barking Barrier is closed or when tide levels in the River Thames are high.

The River Thames tidal defences provide a present day SoP equivalent to a 1 in 2000 (0.05%) annual probability tidal flood event. It is believed that by 2030 the SoP will decrease to approximately 1 in 1000 (0.1%).

Site-specific flood risk assessments for developments within the areas benefitting from the defences along the River Roding and the River Thames should include an assessment of the risk of overtopping of the defences, as well as the risk of a breach in the defences. This should also consider the condition of flood defences as discussed in the Level 1 SFRA.

The Environment Agency River Thames breach analysis published in 2017, and the breach analysis undertaken for the Barking and Dagenham SFRA published in 2008, indicates that the degree of flood hazard in a significant proportion of the Creekmouth strategic development site would be 'very high' (Danger for all) should a breach in the Barking Creek or River Thames defences occur. In general the areas shown to be at risk of flooding following a breach are broadly similar to those areas identified to be at risk within the mapped Flood Zone 2 and 3, which identify that the majority of the site is at risk.

Mapped outputs of breach analysis relevant to the Creekmouth strategic development site are provided in Figures E6 to E9.

Review of the available breach mapping indicates that following a breach of the flood defences along the Barking Creek, flooding would occur relatively rapidly in many areas of Creekmouth, with a predicted rate of inundation of less than 5 hours and between 5 and 10 hours.

During the most recent inspections undertaken by the Environment Agency in 2015-2016, generally, the flood defence assets protecting Barking and Dagenham are in good condition; of the 120 flood defence assets surveyed, 105 were classified as being 'Good' or 'Very Good'. However, four of the surveyed flood defence assets were classified as being 'Poor' or 'Very Poor'.

Two of the flood defence assets on the River Roding, approximately 6.5km upstream from the confluence with the Thames, were assessed as being in 'Poor' condition, (Environment Agency asset numbers 8742 and 15371). A failure of flood defence asset no. 15371 would be likely to affect the Creekmouth strategic development site.

Part of the flood defences on the River Thames were also assessed as being in 'Poor' and 'Very Poor' condition during the Environment Agency's last inspections. These are located at the confluence with the River Beam (Environment Agency asset number 7391) and approximately 2.2km downstream of the confluence with the River Roding (Environment Agency asset number 14860) respectively. A failure of the 'Very Poor' flood defence asset (no. 14860) would be likely to affect the Creekmouth strategic development site.

The Environment Agency Risk of Flooding from Reservoirs map indicates that Creekmouth is not at risk from reservoir flooding.

Flood Warning Areas

The areas identified as being at fluvial or tidal flood risk within the Creekmouth strategic development site are within the Environment Agency 'Tidal Thames from Mar Dyke to Barking Creek' Flood Warning Area.

Flood Warnings are issued to specific areas when flooding is expected. Flood Warnings apply to fluvial and tidal flooding, not to flooding from other sources such as sewer and surface water flooding.

Areas of the Creekmouth strategic development site which benefit from Environment Agency Flood Warnings are illustrated in Figure E10.

Impact of Climate Change

Updated climate change analysis has not yet been undertaken for the Lower Roding that affects the Creekmouth strategic development site. This is expected to be published by the Environment Agency in December 2017. Review of the mapped extents of the present day Flood Zones 2 and 3, as well as the mapped extents of flood defence breach that considers climate change effects indicates that the impact of climate change on the extent of fluvial and tidal flood risk at this development site will be small, albeit potentially to a greater depth. Review of the Thames tidal defence breach mapping for the current day and future scenarios also indicates little change as a result of climate change effects for tidal flooding events. However, users of this SFRA should undertake their own analysis (in accordance with the detailed and intermediate approach outlined in Section 6.4 of the Level 1 SFRA) of climate change effects if necessary.

The effects of climate change will affect not only the risk of flooding posed to property as a result of river and/or tidal flooding, but it will also potentially increase the frequency and intensity of surface water flood risk within the Borough. A comparison of the Environment Agency 1 in 100 (1%) annual probability and 1 in 1000 (0.1%) annual probability predicted surface water flood extents, provided in the Level 1 SFRA report, indicates that flooding of River Road (the access route through the site) is likely to be exacerbated but there would only be a nominal increase in surface water flood risk elsewhere.

Planning Recommendations

Spatial Planning and Development Control

Development of the site should be undertaken in accordance with the principles as set out within Section 1 of this report and Section 7 of the Level 1 SFRA. It is understood that the proposed development within the Creekmouth strategic development site comprises residential development of c. 3,000 homes.

Proposed development within the Creekmouth strategic development site should be located within areas identified as Flood Zone 1 and Flood Zone 2 wherever possible. However this only accounts for a nominal proportion of the site, with the vast majority of the site in the higher risk Flood Zone 3. Residential development may be acceptable in the high risk Flood Zone 3a following the successful application of the Exception Test. It will be necessary to demonstrate that the suitability of all other sites at lower flood risk has been considered and, if so, that the location of development in Flood Zone 3a provides wider sustainability benefits to the community that outweigh flood risk. This may include the redevelopment of derelict sites, wider benefits to the local economy and the need to meet demanding housing needs.

Development in Flood Zones 1, 2 and 3

Given that the vast majority of this site is located within the high risk Flood Zone 3, the same development control recommendations apply to all of this site.

A site-specific flood risk assessment is required to support any planning application in Creekmouth, including those areas that may benefit from flood defences or that are indicated to be located within Flood Zone 1. The site-specific flood risk assessment should be undertaken in accordance with Section 7.5 of the Level 1 SFRA.

Within the development site, a sequential approach should be adopted that steers development to those areas at lesser flood risk, takes into account the potential effects of climate change on fluvial and tidal flood risk, and takes into account flooding from other sources.

The assessment of flood risk in areas that benefit from flood defences should include an assessment of risk following a breach in the flood defences, as informed by breach analysis completed by the Environment Agency.

It is recommended that floor levels within new development are situated a minimum of 0.3m above the predicted 1 in 100 (1%) annual probability design flood level for fluvial flooding scenarios, including an allowance for climate change effects. Within tidal areas, this should be taken as the 1 in 200 (0.5%) annual probability design flood level, including an allowance for climate change effects, calculated assuming a breach of the raised flood defences.

Development located within the defended flood zones may be at risk from sudden inundation following a breach of the flood defences, with an associated 'very high' flood hazard due to the predicted depth and velocity of flood waters in some areas. If it is not possible to locate the ground floor level of the development above the predicted 1 in 100 (1%) annual probability fluvial flood level or 1 in 200 (0.5%) annual probability tidal flood level, it is recommended that the developer strives to reduce the rate of inundation (i.e. through raising ground levels as high as practicable) to 10 hours or greater to provide sufficient time to facilitate evacuation of the site.

Dry access should be provided above the 1 in 100 (1%) annual probability fluvial flood level or 1 in 200 (0.5%) annual probability tidal flood level, calculated assuming a breach of the raised flood defences in those areas benefitting from flood defences. Where this is not possible, safe access with 'very low' flood hazard should be demonstrated. Only where neither of these is feasible, a dedicated 'safe haven' should be provided. This may be provided in the form of a sheltered communal space within the building, accessed via internal stairs. It will be necessary to ensure that the safe haven is sufficient in size to safely house all residents/users of the building.

All development proposed within this site should be supported by a flood evacuation plan and/or emergency response plan prepared in consultation with the local emergency planning department and emergency services.

Any basement structures within this site should provide safe internal access to a level 0.3m above the 1 in 100 (1%) annual probability fluvial flood level or 1 in 200 (0.5%) annual probability tidal flood level with an allowance for climate change. Basement structures should also be protected with a continuous secondary fixed flood defence. In practical terms, this may be a raised wall incorporated into the landscaping that will withstand the ponding of water (i.e. following a breach failure), and will prevent water surging into the basement area with little or no warning. Flood resilient design techniques should be adopted for all basement uses.

Basements in the defended Flood Zone 3a where the rate of inundation is less than 5 hours are not considered appropriate. Similarly, no basement that is to be used as a habitable dwelling is considered acceptable in Flood Zone 3a and it is advisable that basements used as a habitable dwelling are also not proposed in other areas of this site.

Consideration should also be given to the impact of flooding from other sources.

Sustainable Drainage Systems

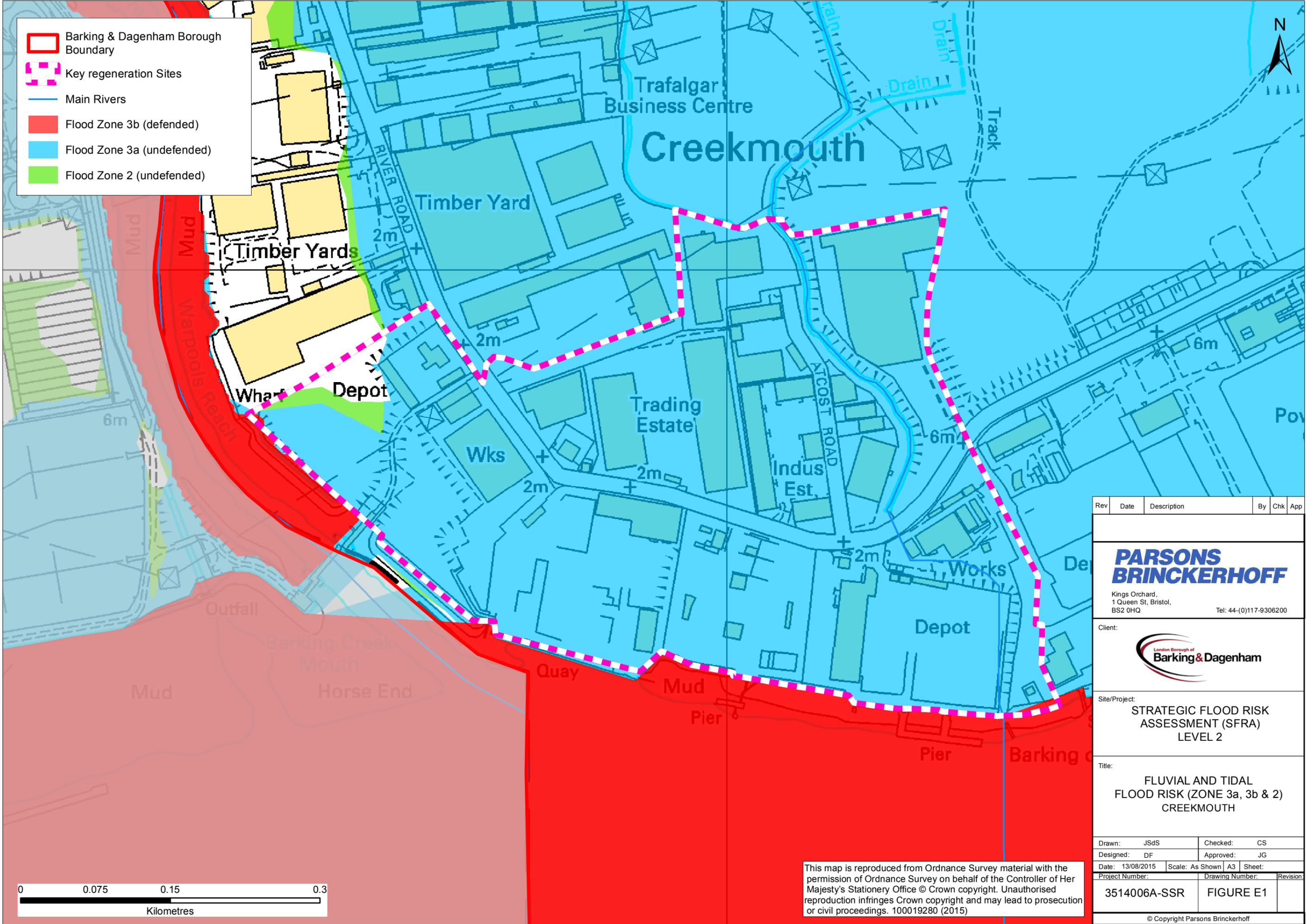
SUDS techniques as discussed in Section 7.7 of the Level 1 SFRA should be promoted wherever possible. The site should seek opportunities to integrate SUDS within the design of the site and provide

an exemplar of best practice techniques including good use of green space to accommodate a variety of SUDS features in order to control and treat runoff from the site.

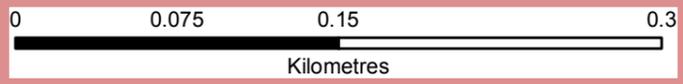
The development of the Creekmouth strategic development site is likely to be completed in phases as plots of land are made available for development. The type of drainage system(s) adopted at the site may be constrained by the size of the development sites brought forward at different times, the contamination risks posed by the sites current and historic industrial heritage and possible high ground water levels due to the sites proximity to the River Thames and low elevation. However it is deemed likely that the provision of 1,000 homes within the site will offer opportunities to provide a system that demonstrates exemplar SUDS within the larger development sites and/or that serves multiple smaller developments within the site by implementing an overall drainage strategy.

As this is a previously developed site it should strive to achieve betterment over existing discharge rates. Minimum betterment of 20% is considered appropriate whilst also taking the potential effects of climate change into consideration, with developers striving to achieve pre-developed greenfield rates as far as practicable. A higher discharge rate may be acceptable where the outfall is directly into the River Thames, although the effects of tide locking must be considered up to the 1 in 100 annual probability event.

-  Barking & Dagenham Borough Boundary
-  Key regeneration Sites
-  Main Rivers
-  Flood Zone 3b (defended)
-  Flood Zone 3a (undefended)
-  Flood Zone 2 (undefended)



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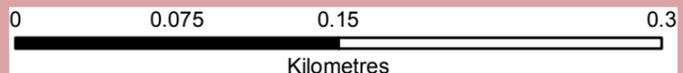
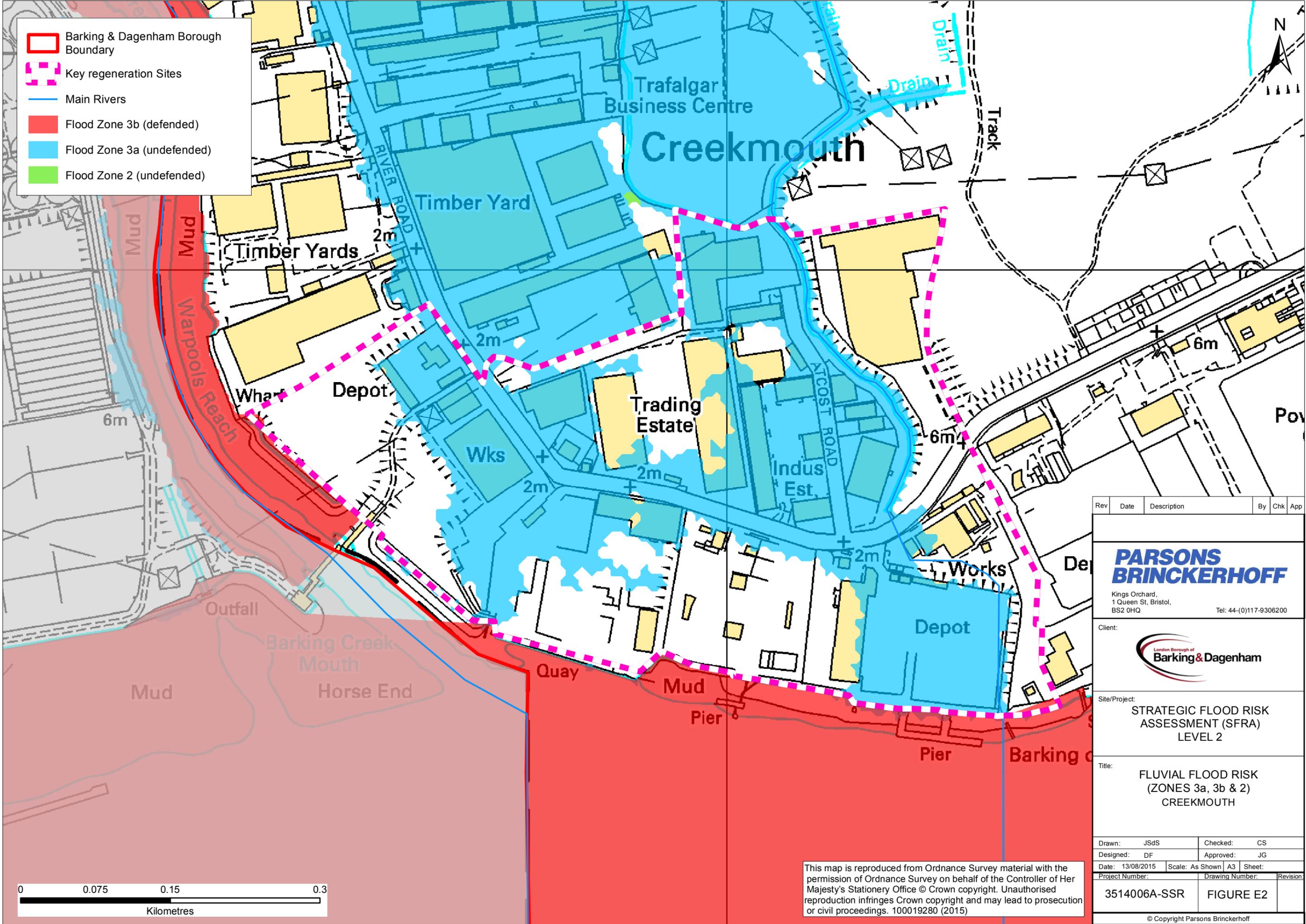


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PARSONS BRINCKERHOFF Kings Orchard, 1 Queen St, Bristol, BS2 0HQ Tel: 44-(0)117-9306200					
Client: 					
Site/Project: STRATEGIC FLOOD RISK ASSESSMENT (SFRA) LEVEL 2					
Title: FLUVIAL AND TIDAL FLOOD RISK (ZONE 3a, 3b & 2) CREEKMOUTH					
Drawn:	JSdS	Checked:	CS		
Designed:	DF	Approved:	JG		
Date:	13/08/2015	Scale:	As Shown	A3	Sheet:
Project Number:	3514006A-SSR	Drawing Number:	FIGURE E1	Revision:	
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-  Barking & Dagenham Borough Boundary
-  Key regeneration Sites
-  Main Rivers
-  Flood Zone 3b (defended)
-  Flood Zone 3a (undefended)
-  Flood Zone 2 (undefended)

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 Plot Date: 13/08/2015
 Login: desouzaj



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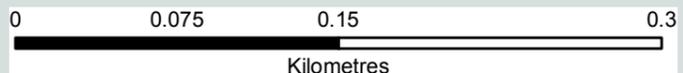
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Site/Project:					
STRATEGIC FLOOD RISK ASSESSMENT (SFRA) LEVEL 2					
Title:					
FLUVIAL FLOOD RISK (ZONES 3a, 3b & 2) CREEKMOUTH					
Drawn:	JSdS	Checked:	CS		
Designed:	DF	Approved:	JG		
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Legend

- Barking & Dagenham Borough Boundary
- Key regeneration Sites
- Main Rivers
- Surface water flood hazard
 - Very Low - Caution
 - Moderate - Danger for some
 - Significant - Danger for most
 - Very High - Danger for all



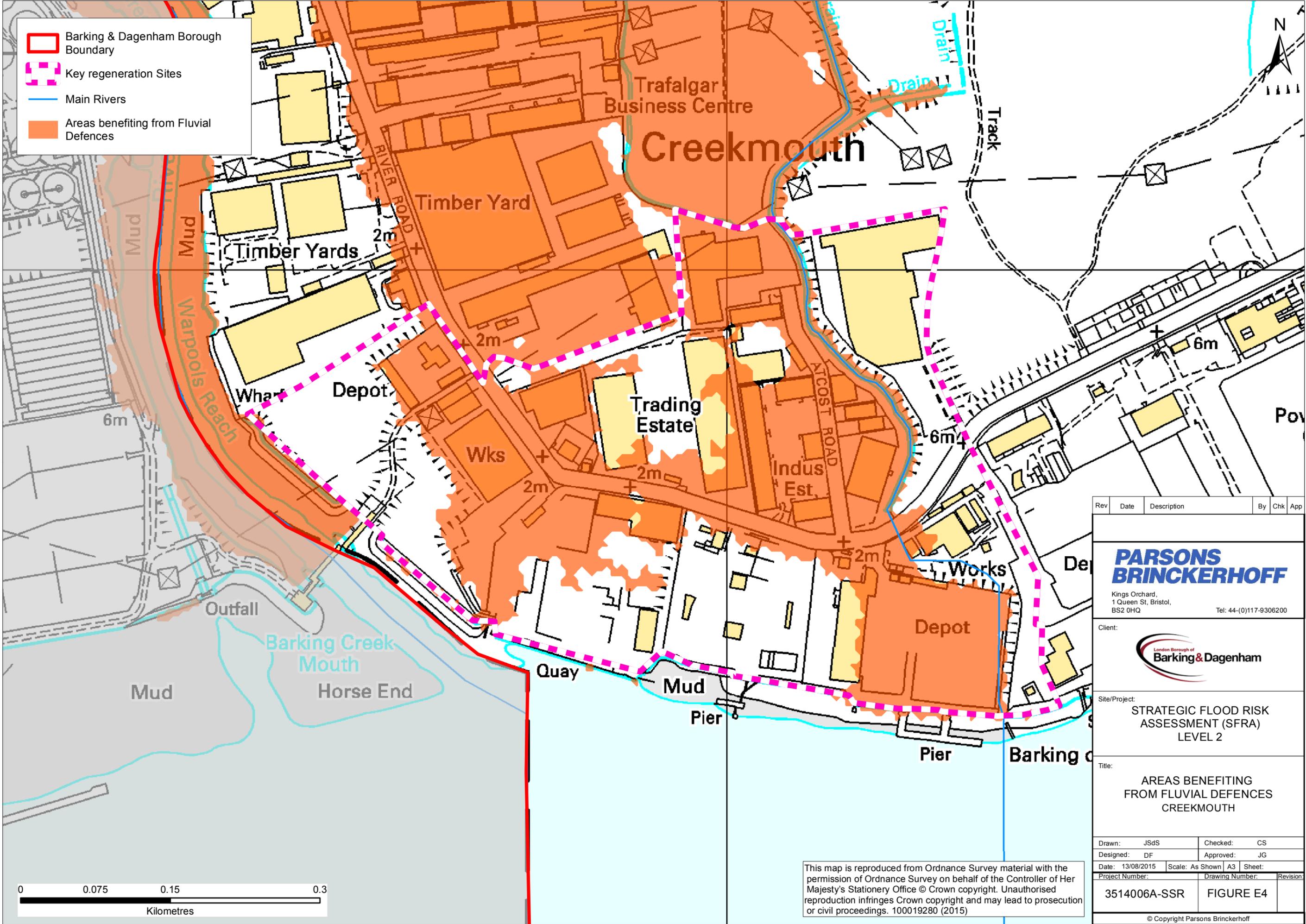
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Client:					
Site/Project: STRATEGIC FLOOD RISK ASSESSMENT (SFRA) LEVEL 2					
Title: SURFACE WATER FLOODHAZARD (1 IN 100 YEAR) CREEKMOUTH					
Drawn:	JSdS	Checked:	CS		
Designed:	DF	Approved:	JG		
Date:	13/08/2015	Scale:	As Shown	A3	Sheet:
Project Number:	3514006A-SSR	Drawing Number:	FIGURE E3	Revision:	
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-  Barking & Dagenham Borough Boundary
-  Key regeneration Sites
-  Main Rivers
-  Areas benefiting from Fluvial Defences



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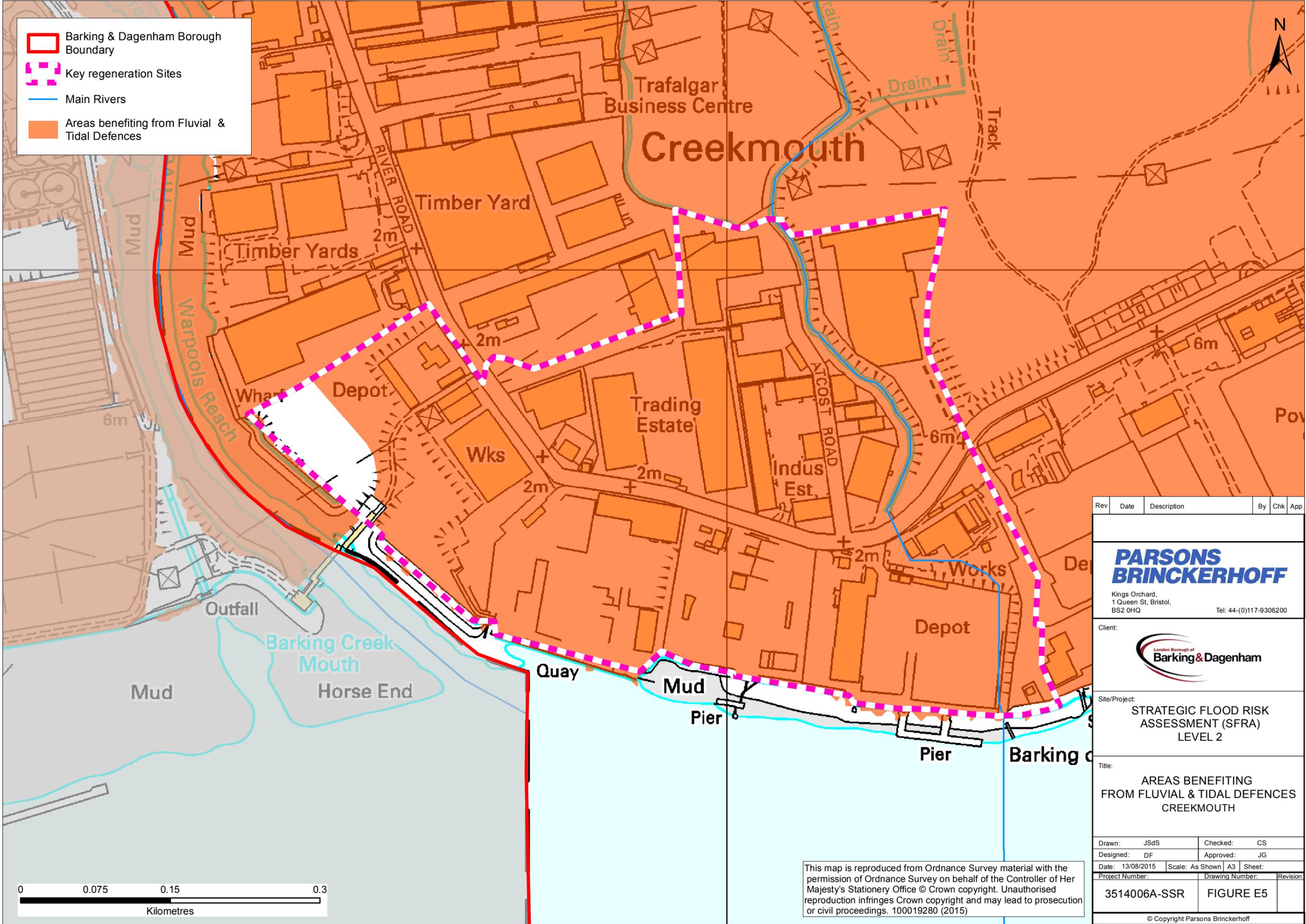
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Site/Project:
 STRATEGIC FLOOD RISK ASSESSMENT (SFRA) LEVEL 2

Title:
 AREAS BENEFITING FROM FLUVIAL DEFENCES CREEKMOUTH

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Designed: DF	Approved: JG
Date: 13/08/2015	Scale: As Shown
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-  Barking & Dagenham Borough Boundary
-  Key regeneration Sites
-  Main Rivers
-  Areas benefiting from Fluvial & Tidal Defences



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STRATEGIC FLOOD RISK ASSESSMENT (SFRA) LEVEL 2

Title:
AREAS BENEFITING FROM FLUVIAL & TIDAL DEFENCES CREEKMOUTH

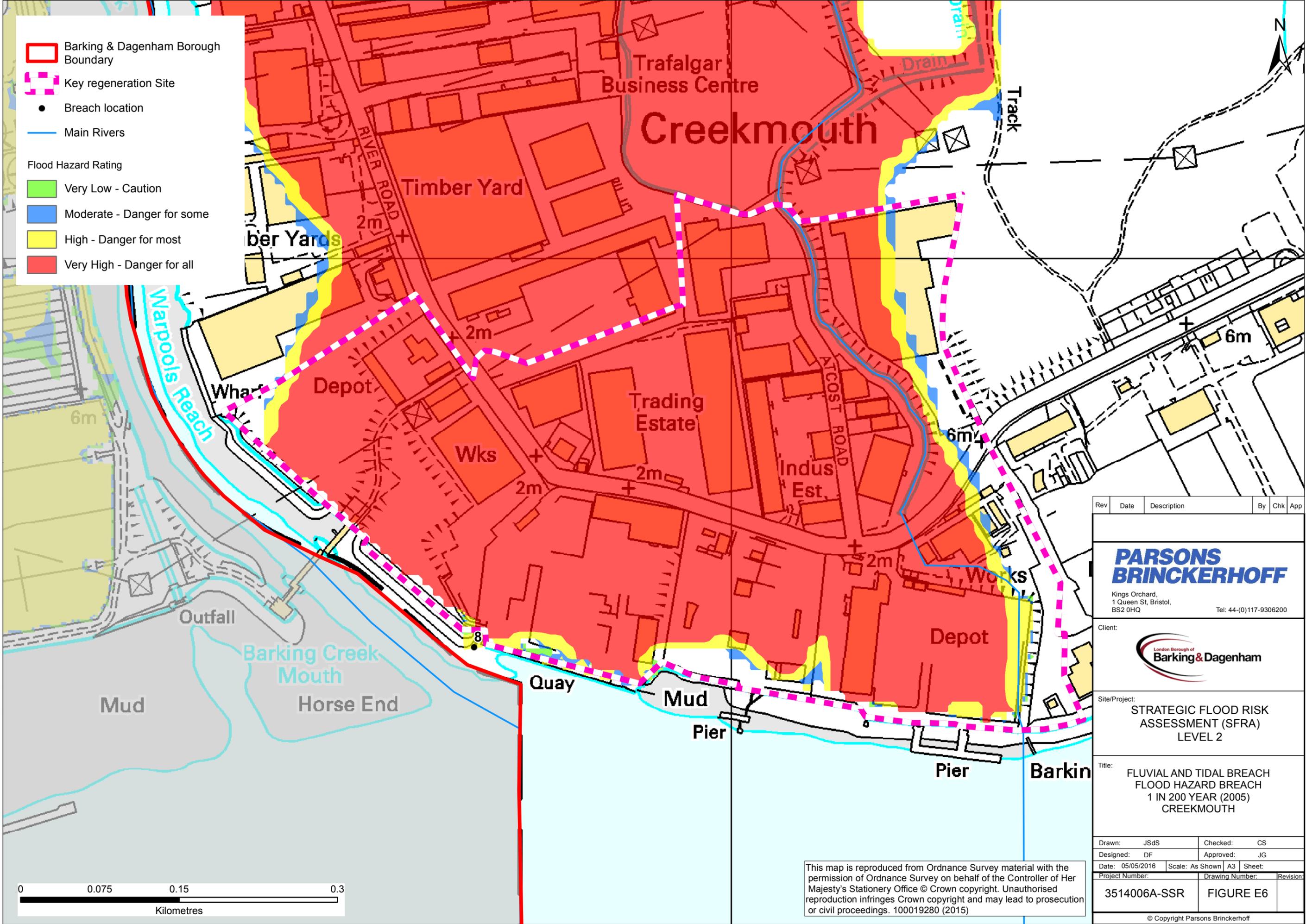
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3514006A-SSR **FIGURE E5**

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-  Barking & Dagenham Borough Boundary
 -  Key regeneration Site
 -  Breach location
 -  Main Rivers
- Flood Hazard Rating
-  Very Low - Caution
 -  Moderate - Danger for some
 -  High - Danger for most
 -  Very High - Danger for all



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STRATEGIC FLOOD RISK ASSESSMENT (SFRA) LEVEL 2

Title:
FLUVIAL AND TIDAL BREACH FLOOD HAZARD BREACH 1 IN 200 YEAR (2005) CREEKMOUTH

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Date: 05/05/2016	Scale: As Shown A3 Sheet:
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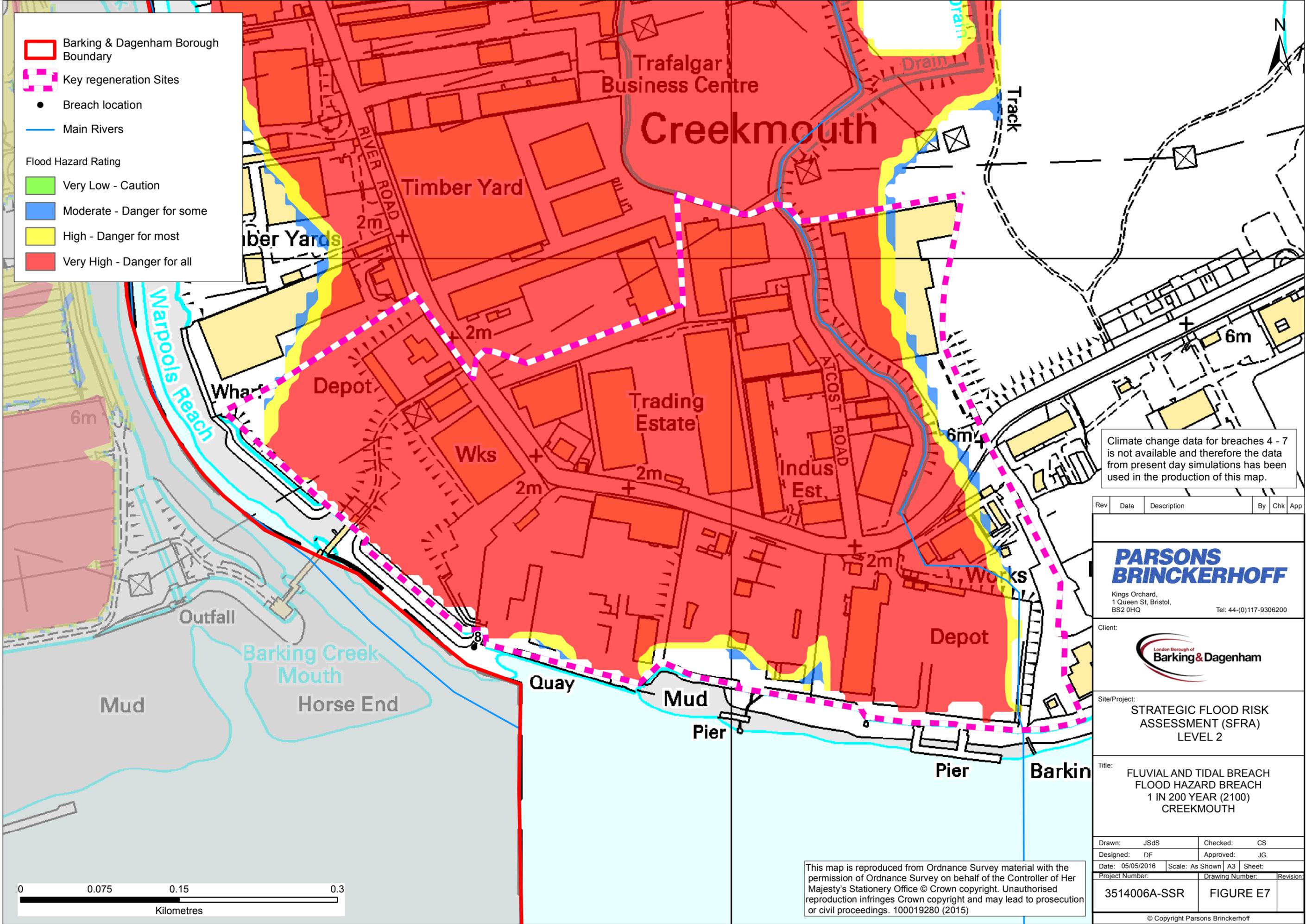
3514006A-SSR FIGURE E6

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 Plot Date: 07/06/2016

-  Barking & Dagenham Borough Boundary
 -  Key regeneration Sites
 -  Breach location
 -  Main Rivers
- Flood Hazard Rating
-  Very Low - Caution
 -  Moderate - Danger for some
 -  High - Danger for most
 -  Very High - Danger for all



Climate change data for breaches 4 - 7 is not available and therefore the data from present day simulations has been used in the production of this map.

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Site/Project:
 STRATEGIC FLOOD RISK ASSESSMENT (SFRA) LEVEL 2

Title:
 FLUVIAL AND TIDAL BREACH FLOOD HAZARD BREACH 1 IN 200 YEAR (2100) CREEKMOUTH

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Login: DeSouzaJ
Plot Date: 07/06/2016

Barking & Dagenham Borough Boundary

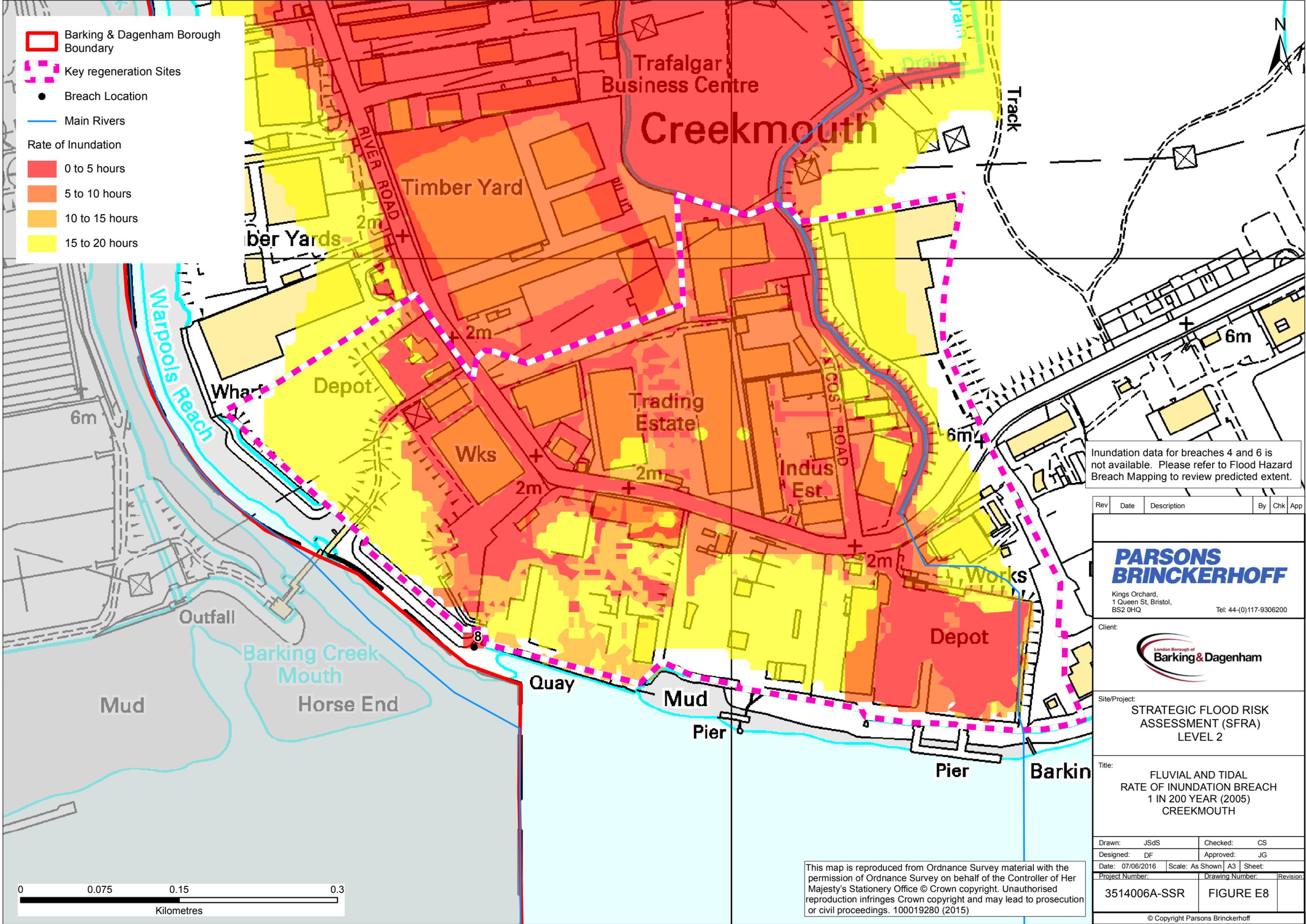
Key regeneration Sites

Breach Location

Main Rivers

Rate of Inundation

- 0 to 5 hours
- 5 to 10 hours
- 10 to 15 hours
- 15 to 20 hours



Inundation data for breaches 4 and 6 is not available. Please refer to Flood Hazard Breach Mapping to review predicted extent.

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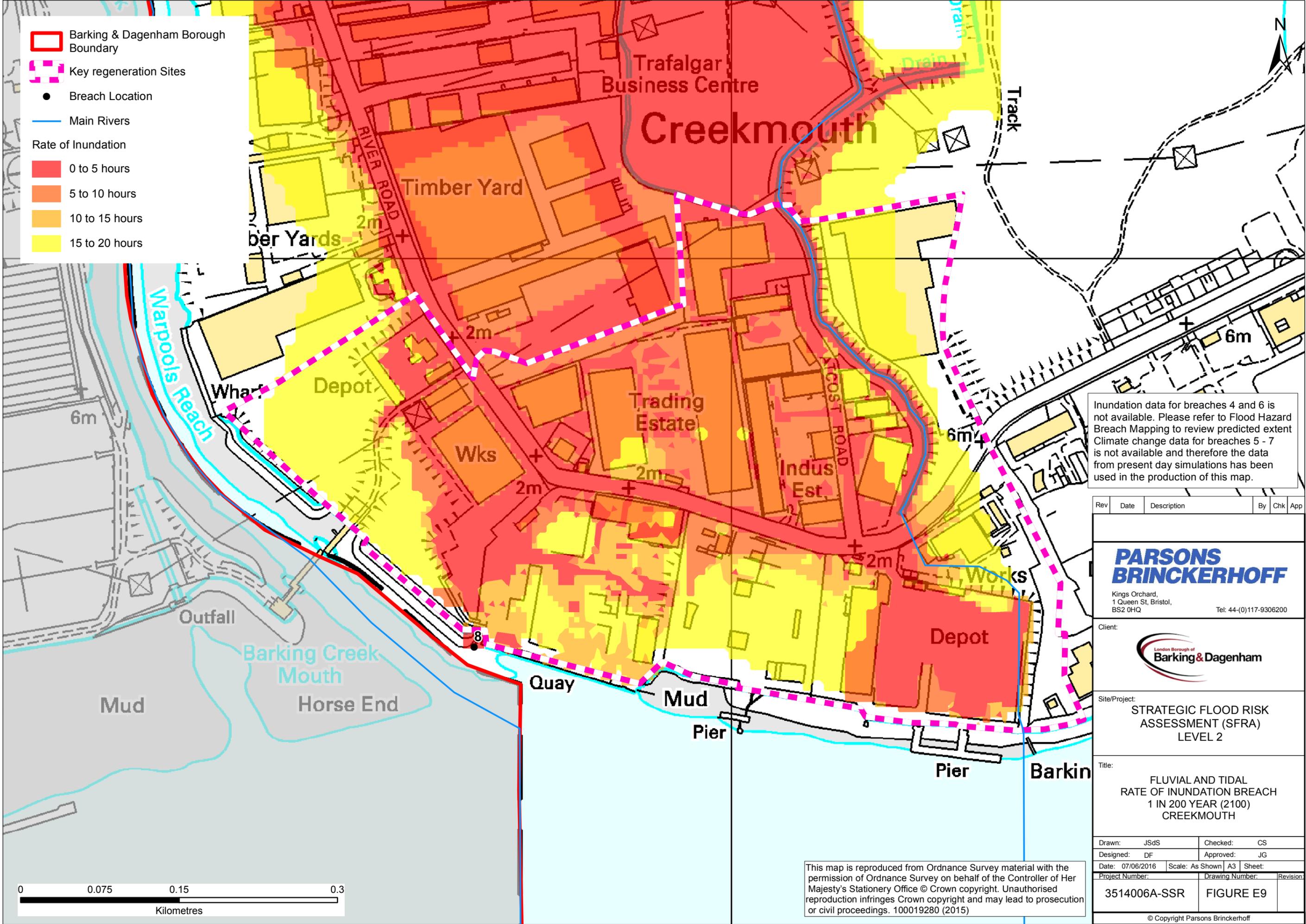
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FLUVIAL AND TIDAL RATE OF INUNDATION BREACH 1 IN 200 YEAR (2005) CREEKMOUTH

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Date: 07/06/2016	Scale: As Shown
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-  Barking & Dagenham Borough Boundary
 -  Key regeneration Sites
 -  Breach Location
 -  Main Rivers
- Rate of Inundation
-  0 to 5 hours
 -  5 to 10 hours
 -  10 to 15 hours
 -  15 to 20 hours



Inundation data for breaches 4 and 6 is not available. Please refer to Flood Hazard Breach Mapping to review predicted extent. Climate change data for breaches 5 - 7 is not available and therefore the data from present day simulations has been used in the production of this map.

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Site/Project:
STRATEGIC FLOOD RISK ASSESSMENT (SFRA) LEVEL 2

Title:
FLUVIAL AND TIDAL RATE OF INUNDATION BREACH 1 IN 200 YEAR (2100) CREEKMOUTH

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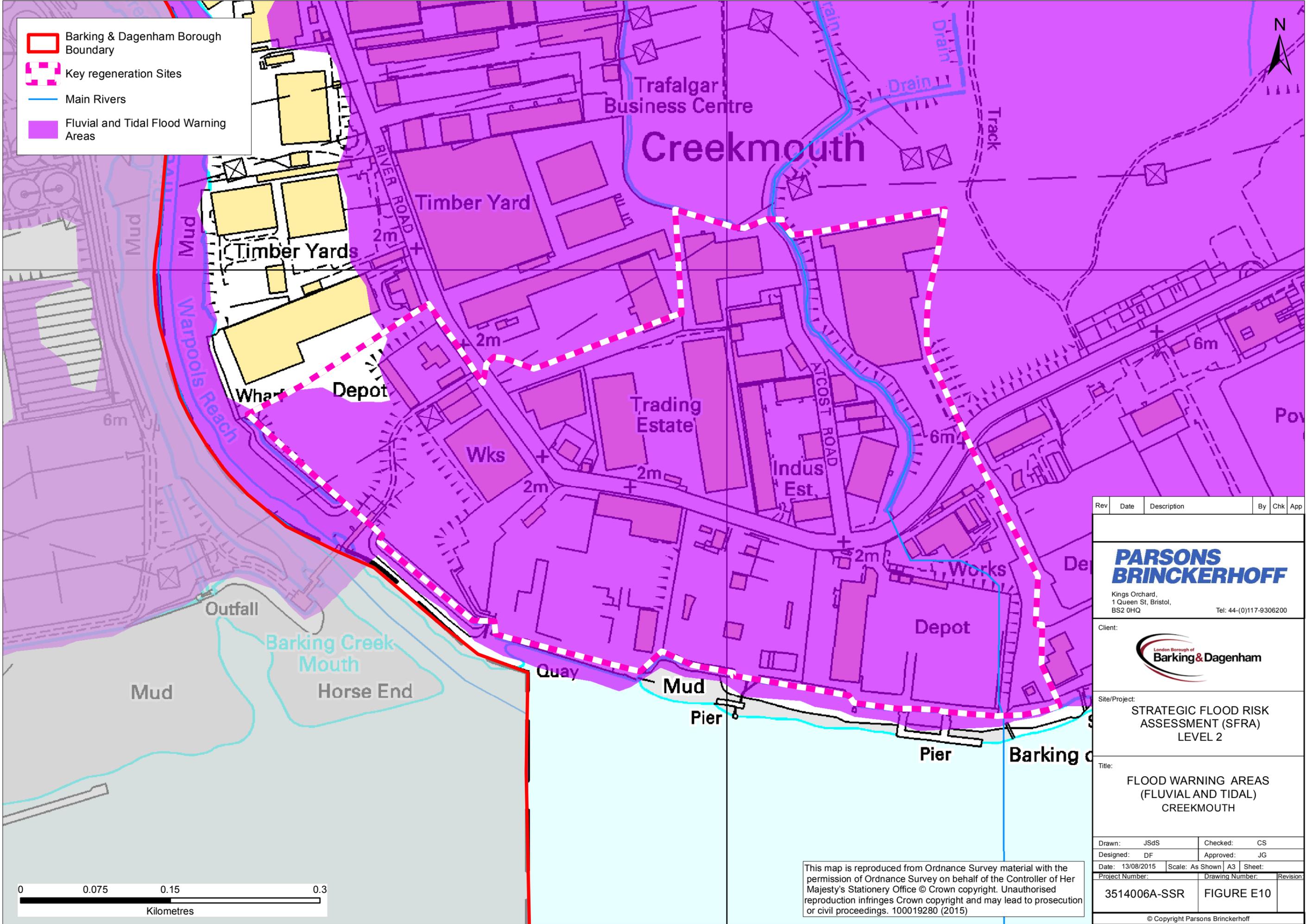
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Plot Date: 07/06/2016



-  Barking & Dagenham Borough Boundary
-  Key regeneration Sites
-  Main Rivers
-  Fluvial and Tidal Flood Warning Areas



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Rev	Date	Description	By	Chk	App

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Site/Project:
STRATEGIC FLOOD RISK ASSESSMENT (SFRA) LEVEL 2

Title:
FLOOD WARNING AREAS (FLUVIAL AND TIDAL) CREEKMOUTH

Drawn: JSdS	Checked: CS
Designed: DF	Approved: JG
Date: 13/08/2015	Scale: As Shown A3 Sheet:
Project Number:	Drawing Number: Revision:

3514006A-SSR FIGURE E10

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