

APPENDIX G

**DAGENHAM DOCK**



## **DAGENHAM DOCK**

**Area Name:** Dagenham Dock

**Location:** Dagenham

**River Catchment:** River Thames / Beam River

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

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

### **Introduction**

The Dagenham Dock strategic development site is approximately 1.3km<sup>2</sup> in area and is located in the south-west of Barking and Dagenham (refer to Appendix A). The area is bounded by the railway in the north, the Ford Motor Works and Dagenham Diesel Centre in the east, the River Thames in the south and the Barking Riverside strategic development site in the west.

The existing land use in the area is predominantly industrial with Barking Power Station, an oil storage depot and Thames Gateway Park all located in the area. The proposed development of Dagenham Dock will see it retained for industrial use, however it is proposed to develop green industries in the area.

### **Description of Flood Risk**

#### *Fluvial and Tidal*

The primary sources of flooding to the Dagenham Dock strategic development site are tidal flooding from the River Thames and fluvial flooding from the Beam River which flows in a southerly direction approximately 1km east of the site boundary. There is also a fluvial flood risk from the Gores Brook which flows along the northern and western boundaries of the development site and from the Dagenham Breach which is located to the east of the site. The Dagenham Breach is a body of water which formed in 1707 due to the collapse of a section of the River Thames defences.

The entirety of the strategic development site is located within Flood Zone 3a. Analysis of local topography and Flood Zones indicates that flood depths are expected to reach up to 3m.

The functional floodplain, Flood Zone 3b, is limited to within the extents of the Dagenham Breach and within the channel of the Gores Brook and River Thames. The site is not indicated to be at risk.

Fluvial and tidal flooding within the Dagenham Dock strategic development site is illustrated in Figures G1 and G2A.

#### *Surface Water*

The Environment Agency Risk of Flooding from Surface Water map indicates that the Dagenham Dock strategic development site is generally at low risk of surface water flooding, however the majority of Chequers Lane is shown to be at risk of surface water flooding during a 1 in 100 (1%) annual probability rainfall event. This area is also identified as a Local Flood Risk Zone (LFRZ) within the SWMP with depths of surface water up to 1m predicted.

The predicted flood hazard during a 1 in 100 (1%) annual probability rainfall event at Chequers Lane is generally classified as 'very low' or 'moderate' (Danger for some) however does increase to 'significant' (Danger for most) towards the southern end of the road. The junction between Choats Road and Choats Manor Road is also predicted to be at increased risk from surface water flooding.

Flood hazards associated with surface water flooding during the 1 in 100 (1%) annual probability event are illustrated in Figure G3.

### *Groundwater*

The increased Potential for Elevated Groundwater map (iPEG), developed for the Barking and Dagenham SWMP, indicates the north-east corner of the area, south of the A13, and the north-west corner, adjacent to the Gores Brook, are within areas identified as having an increased potential for groundwater to interact with or rise to within 2m of the ground surface. For details of the iPEG map refer to the Level 1 SFRA report Section 5.3 and Appendix I. Groundwater emergence could pose flood risk to basement or below ground structures, as well as generate overland flows that are likely to pond in areas of flat topography or be similar in location to those discussed as part of the surface water flood analysis.

### *Defence or Reservoir Failure*

The whole of the Dagenham Dock strategic development site benefits from flood defences on the River Beam, including the Beam Washlands, the River Roding and from the Thames tidal defences. Areas identified to benefit from existing flood defences are illustrated in Figures G4 and G5, but noting that these do not take climate change into account.

The Beam, Ingrebourne and Mayes Brook Flood Risk Mapping study (undertaken by Halcrow in 2013) indicates that the SoP afforded to the site by the Beam defences is equivalent to approximately a 1 in 100 (1%) annual probability fluvial flood when combined with a Mean High Water Spring tide. Should a larger tidal event occur simultaneously with a large fluvial event, or in the event of a failure of the outfall to the Thames, further overtopping of the defences could occur and there may be significant flooding in the area.

Less information is available for the Gore Brook, but it is understood that the Gores Brook and River Beam Flood Alleviation Scheme, completed in 2011, increased the SoP on the Gores Brook from a 1 in 10 (10%) to a 1 in 150 (0.67%) annual probability of flooding.

The Lower Roding Flood Risk Mapping study (undertaken by Capita Symonds in 2009) indicates that the defences along the River Roding provide a SoP 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 Beam River, 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 undertaken 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 Dagenham Dock strategic development site would be 'very high' (Danger for all) should a breach in the River Thames or Barking Creek defences occur. In general the areas shown to be at greatest risk of flooding following a breach are within the north of the site and are broadly similar to those areas identified to be at risk within the mapped fluvial Flood Zone 3.

Mapped outputs of breach analysis relevant to the Dagenham Dock strategic development site are provided in Figures G6 to G9.

Review of the available breach mapping indicates that following a breach of the River Thames and Barking Creek defences, flooding of the Dagenham Dock strategic development site would occur rapidly in many areas of the site, with a predicted rate of inundation of less than 5 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 Dagenham Dock 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 either flood defence asset would be likely to affect the Dagenham Dock strategic development site.

There are no obvious informal (defacto) flood defences in the area. However, some of the existing large warehouses and buildings may currently obstruct flow to an extent.

The Environment Agency Risk of Flooding from Reservoirs map indicates that the east of the site, in the vicinity of Choats Manor Way and the railway line, is at risk of flooding from the Washlands Flood Storage Area should a breach (failure) of the flood storage area embankment occur.

#### *Flood Warning Areas*

The areas identified as being at fluvial or tidal flood risk within the Dagenham Dock strategic development site are within the Environment Agency's '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, but not to flooding from other sources such as sewer and surface water flooding.

Areas of the Dagenham Dock strategic development site which benefit from Environment Agency Flood Warnings are illustrated in Figure G10.

#### *Impact of Climate Change*

Updated guidance for considering the potential effects of climate change for the 1 in 100 (1%) annual probability event has been considered within the fluvial modelling of the Beam River, Gores Brook and Wants Stream. The mapping, provided in Figure G2B, indicates a significant increase in fluvial flood risk associated with these watercourses when climate change effects are taken into account, although it is recognised that tidal flooding is likely to still dominate risk in this area. The mapping indicates a smaller fluvial flood extent to that predicted for the present day scenario; this is likely to be associated with amendments to model hydrology and catchment descriptors or to changes to the modelling approach since the previous modelling was undertaken by Halcrow in 2013.

Updated climate change analysis has not yet been undertaken for the Lower Roding located to the west of the borough. Although a significant distance from the site, the undefended flood extent of the Lower Roding could pose risk to the site when the potential effects of climate change are considered. This is expected to be published by the Environment Agency in December 2017.

The effects of climate change will not only increase 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 the northern areas of the Dagenham Dock strategic development site, near to Choats Manor Way and Chequers Lane, may be vulnerable to the impacts of climate change and in addition a number of areas adjacent to the southern extent of Chequers Lane may be vulnerable in the future.

## **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 Dagenham Dock strategic development site comprises industrial development.

In accordance with NPPF industrial development is classified as 'less vulnerable' and therefore is deemed suitable for the high risk Flood Zone 3a. However, 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 is the most appropriate choice.

### *Development in Flood Zone 3*

A site-specific flood risk assessment is required to support any planning application in the Dagenham Dock strategic development site. The site-specific flood risk assessment should be undertaken in accordance with Section 7.5 of the Level 1 SFRA.

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. This should include an assessment of potential impacts associated with the Washlands Flood Storage Area.

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.

Where possible, development should be located outside of areas identified to be at risk following breach of the flood defences, particularly those areas that may be at risk from sudden inundation 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 'moderate' 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 users of the building.

Development proposed within Flood Zone 3a, including that within areas identified to benefit from flood defences, 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 loss of flood plain storage within the undefended fluvial Flood Zone 3a up to the 1 in 100 (1%) annual probability plus climate change event should be compensated for on a like-for-like basis to ensure no increased flood risk elsewhere as a result of development, unless detailed site assessment demonstrates that development within these areas causes no increased flood risk elsewhere. This may be appropriate to fluvial flood risks that exceeds the protection served by fluvial flood defences during the 1 in 100 (1%) annual probability event when the effects of climate change are considered.

Compensation is not required for areas at tidal flood risk or that benefit from flood defences up to the 1 in 100 (1%) annual probability fluvial flood level and allowing for the potential effects of climate change.

Any basement structures within the defended or undefended high risk Flood Zone 3a 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 within the defended Flood Zone 3a and in areas that are indicated to be at risk following breach of the flood defences 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.

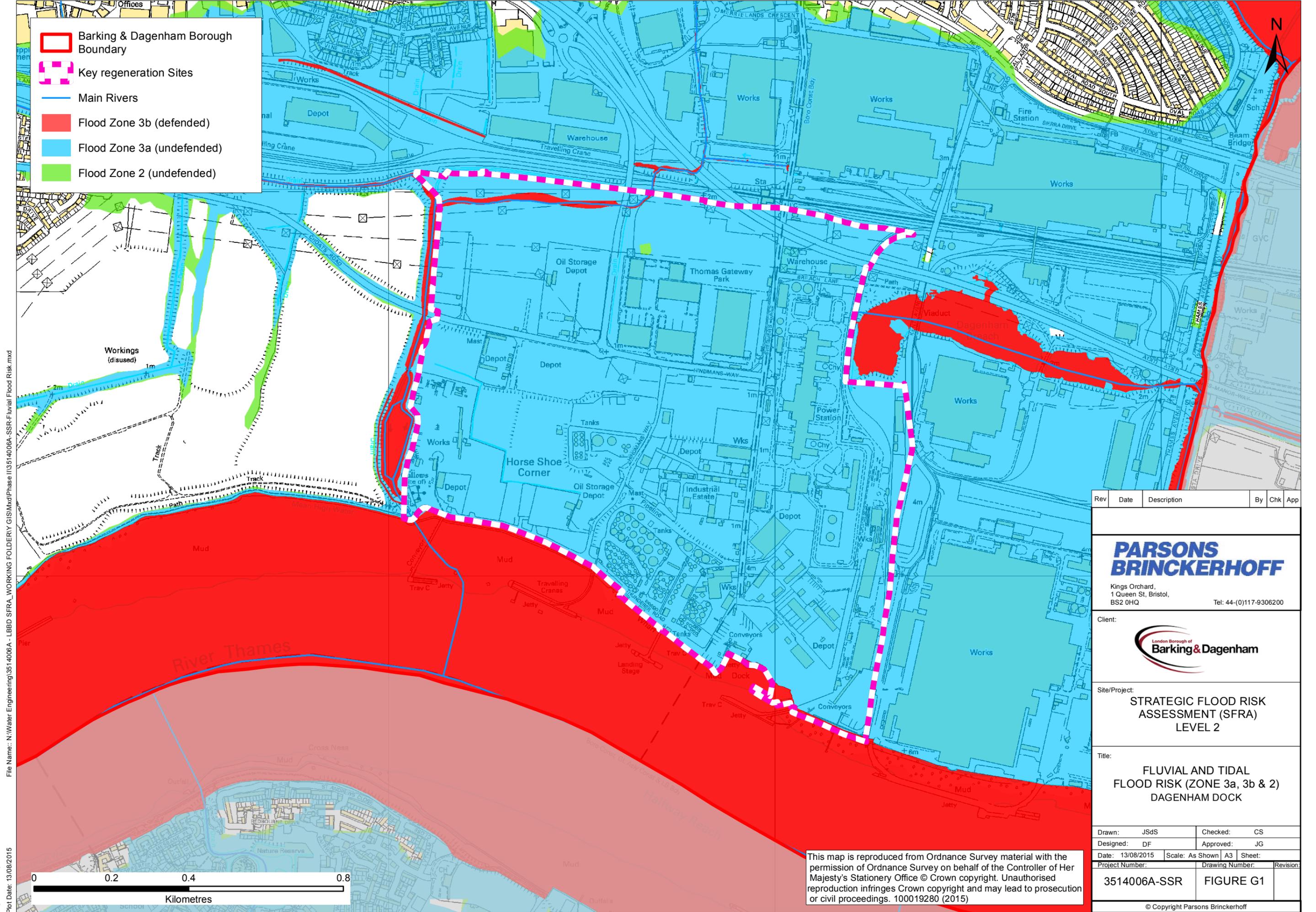
#### *Sustainable Drainage Systems*

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 Dagenham Dock strategic development site may 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 groundwater levels due to the sites proximity to the River Thames and low elevation. However it is deemed probable that given the size of the likely development plots at this site, opportunities will be available to provide a system that demonstrates exemplar SUDS within the development sites and/or that serves multiple 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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 Login: desouzaj  
 Plot Date: 13/08/2015

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Client:

Site/Project:  
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ASSESSMENT (SFRA)  
LEVEL 2**

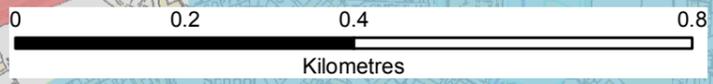
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FLOOD RISK (ZONE 3a, 3b & 2)  
DAGENHAM DOCK**

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Designed: DF	Approved: JG
Date: 13/08/2015	Scale: As Shown   A3   Sheet:
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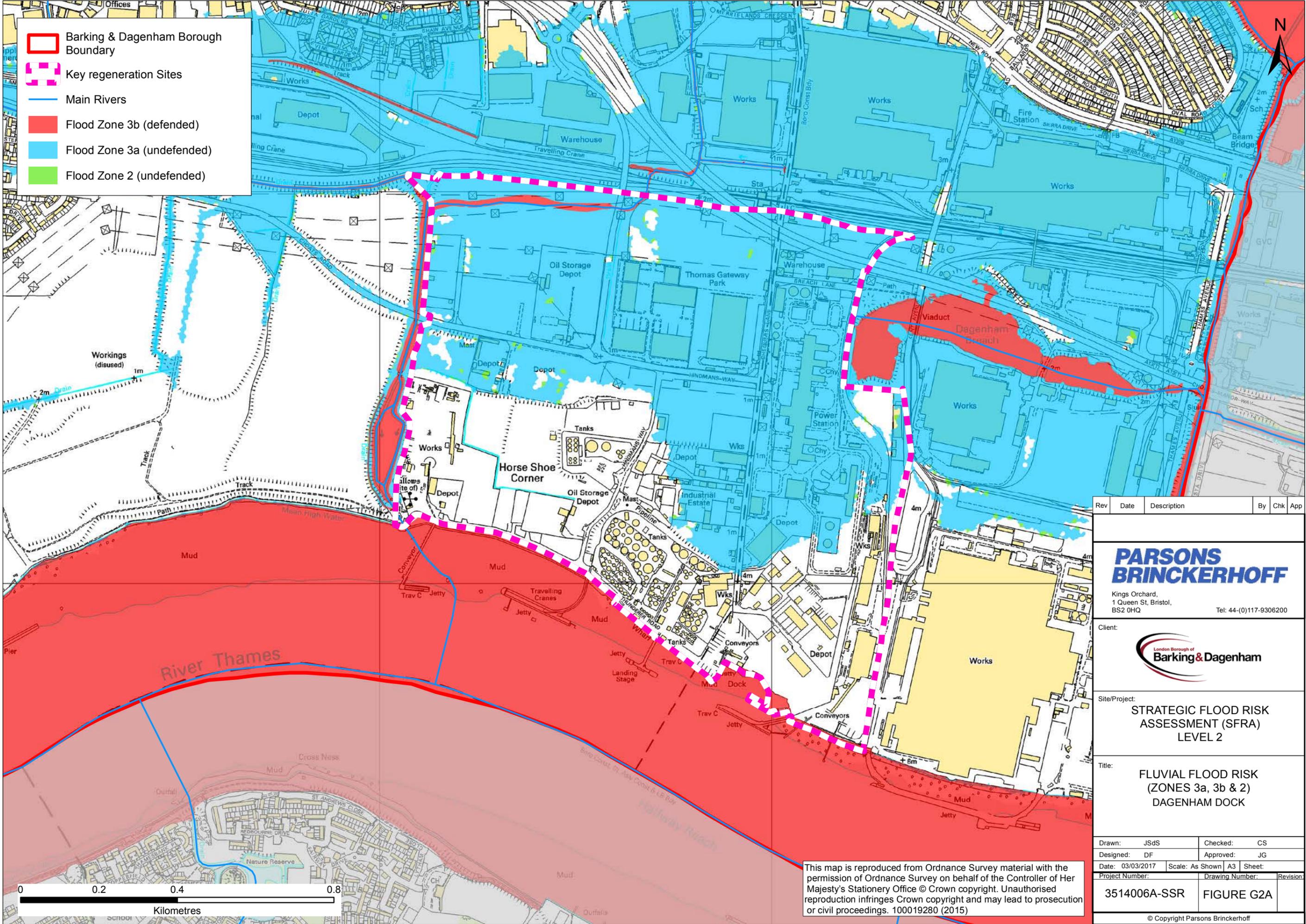
3514006A-SSR      FIGURE G1

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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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Client:  
 London Borough of Barking & Dagenham

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

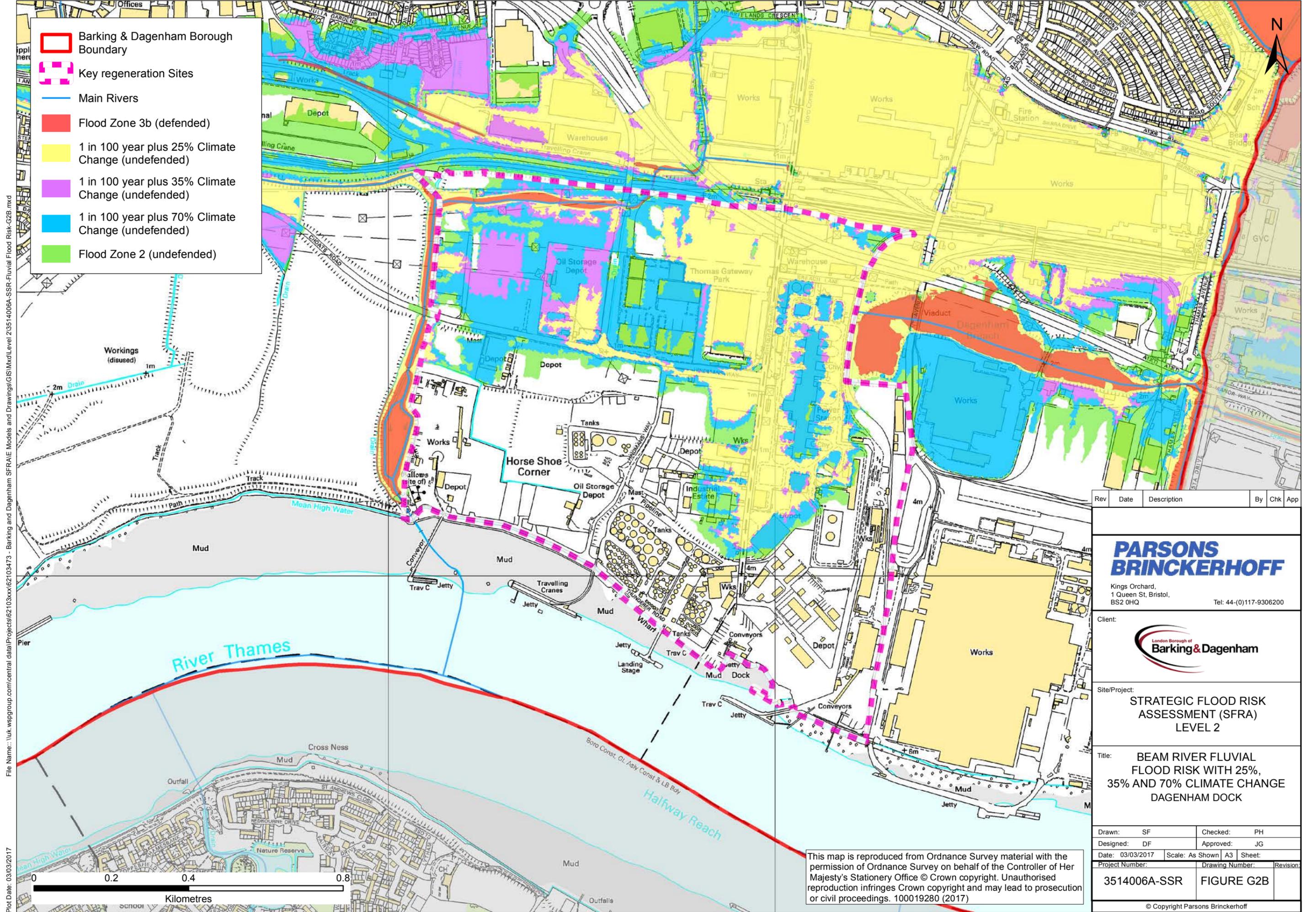
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Designed: DF	Approved: JG
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Project Number:	Drawing Number: Revision:

3514006A-SSR      FIGURE G2A

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 Login: UKSLF003  
 Plot Date: 03/03/2017

- Barking & Dagenham Borough Boundary
- Key regeneration Sites
- Main Rivers
- Flood Zone 3b (defended)
- 1 in 100 year plus 25% Climate Change (undefended)
- 1 in 100 year plus 35% Climate Change (undefended)
- 1 in 100 year plus 70% Climate Change (undefended)
- Flood Zone 2 (undefended)

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**STRATEGIC FLOOD RISK ASSESSMENT (SFRA) LEVEL 2**

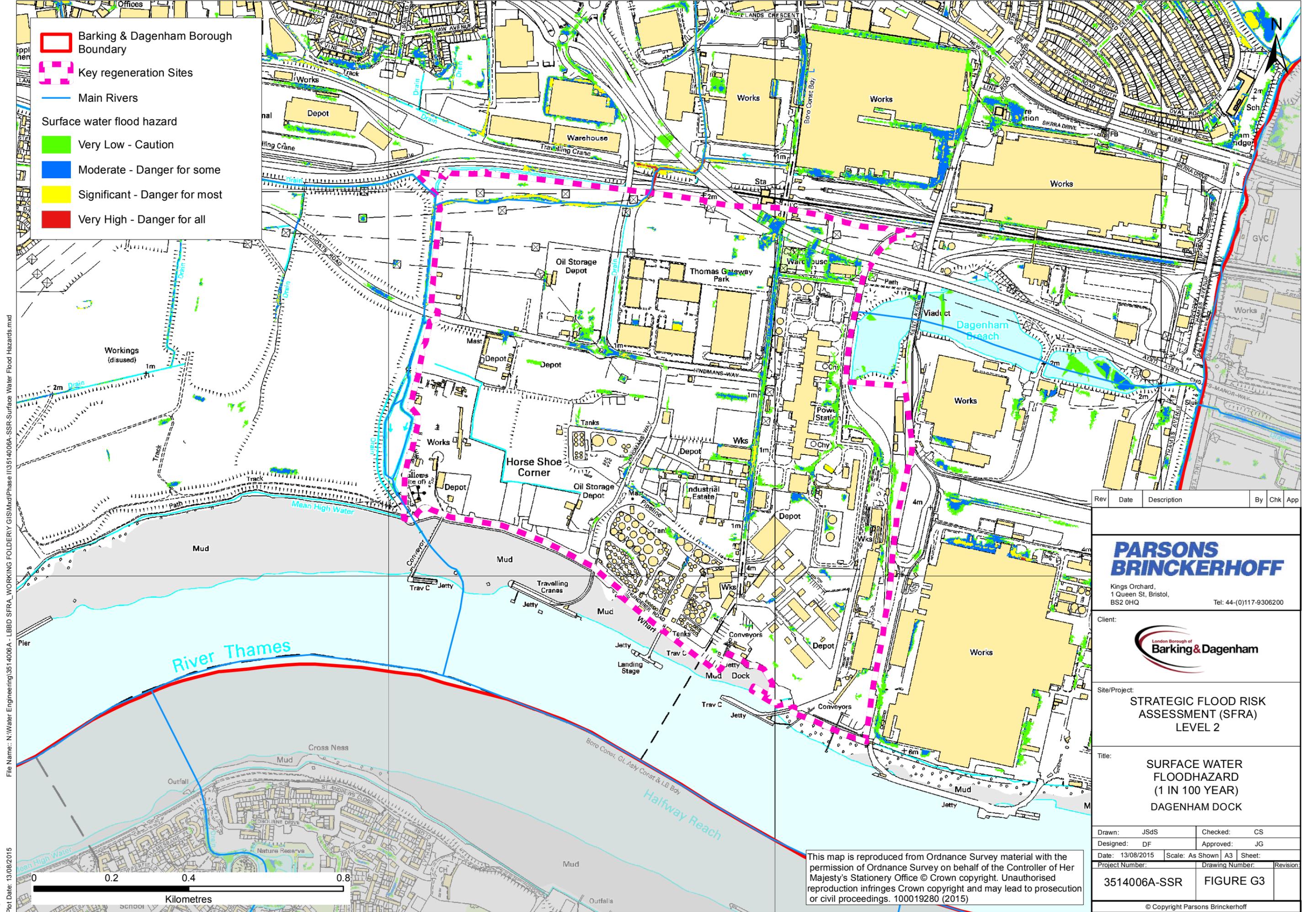
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**BEAM RIVER FLUVIAL FLOOD RISK WITH 25%, 35% AND 70% CLIMATE CHANGE DAGENHAM DOCK**

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Designed: DF	Approved: JG
Date: 03/03/2017	Scale: As Shown A3 Sheet:
Project Number:	Drawing Number: Revision:

**3514006A-SSR FIGURE G2B**

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- 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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 Login: desouzaj  
 Plot Date: 13/08/2015

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

Title:  
**SURFACE WATER FLOODHAZARD (1 IN 100 YEAR) DAGENHAM DOCK**

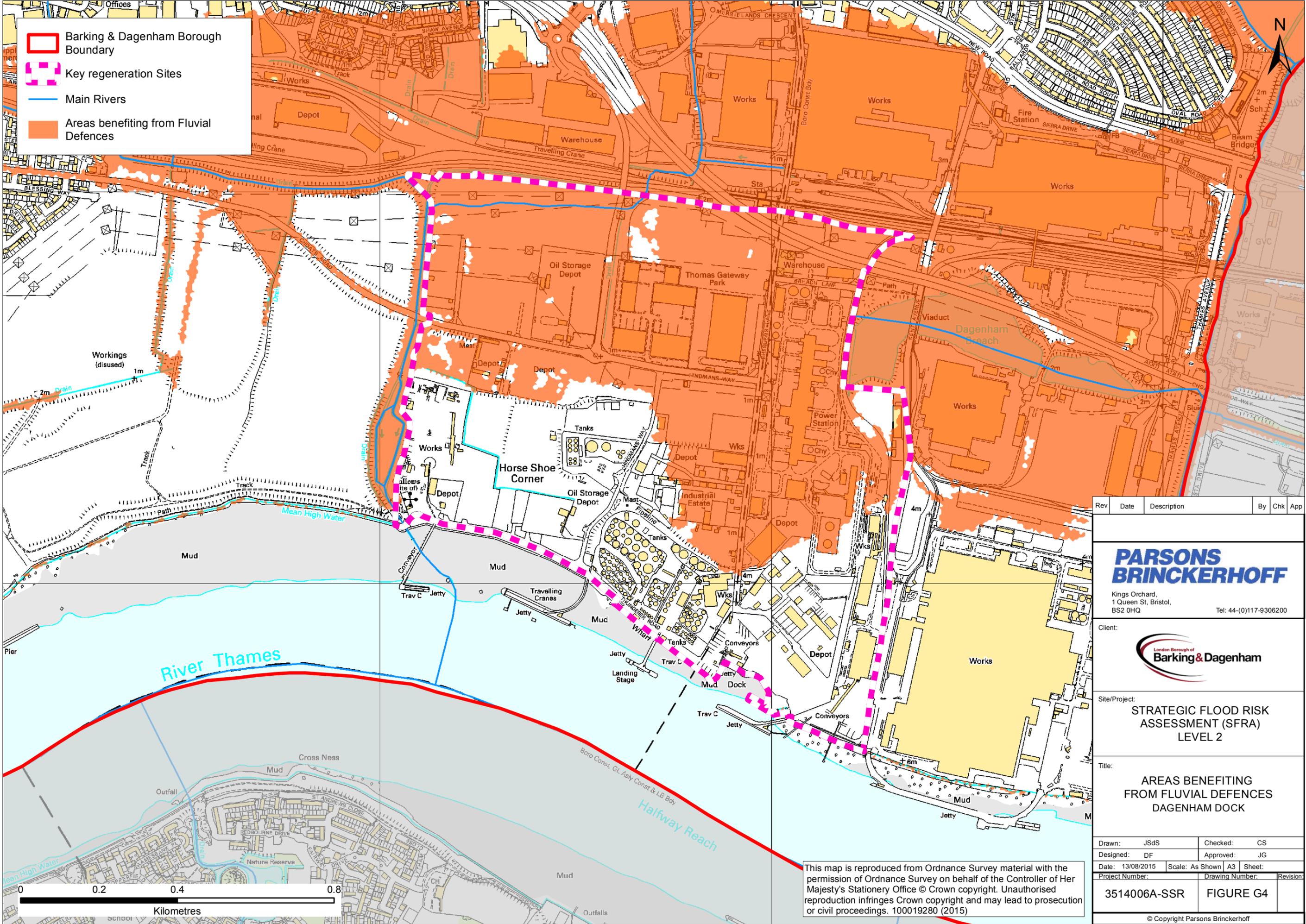
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-  Barking & Dagenham Borough Boundary
-  Key regeneration Sites
-  Main Rivers
-  Areas benefiting from Fluvial Defences



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Client:  
**STRATEGIC FLOOD RISK ASSESSMENT (SFRA) LEVEL 2**

Title:  
**AREAS BENEFITING FROM FLUVIAL DEFENCES DAGENHAM DOCK**

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Designed: DF	Approved: JG
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**3514006A-SSR**      **FIGURE G4**

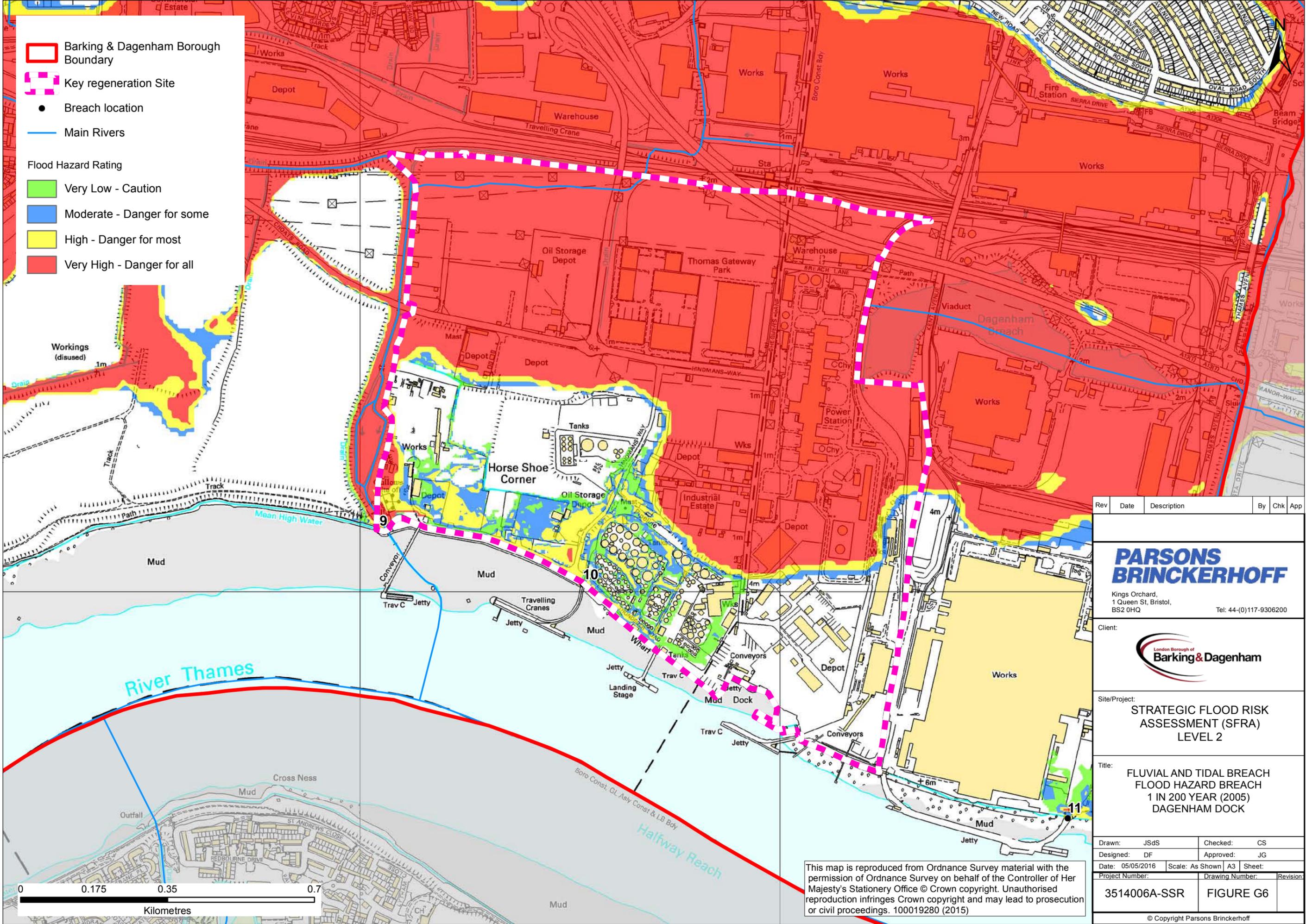
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 Plot Date: 07/06/2016



- 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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Client:  
**Barking & Dagenham**

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

Title:  
**FLUVIAL AND TIDAL BREACH FLOOD HAZARD BREACH 1 IN 200 YEAR (2005) DAGENHAM DOCK**

Drawn: JSdS	Checked: CS
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**3514006A-SSR**      **FIGURE G6**

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 Plot Date: 07/06/2016

**Barking & Dagenham Borough Boundary**

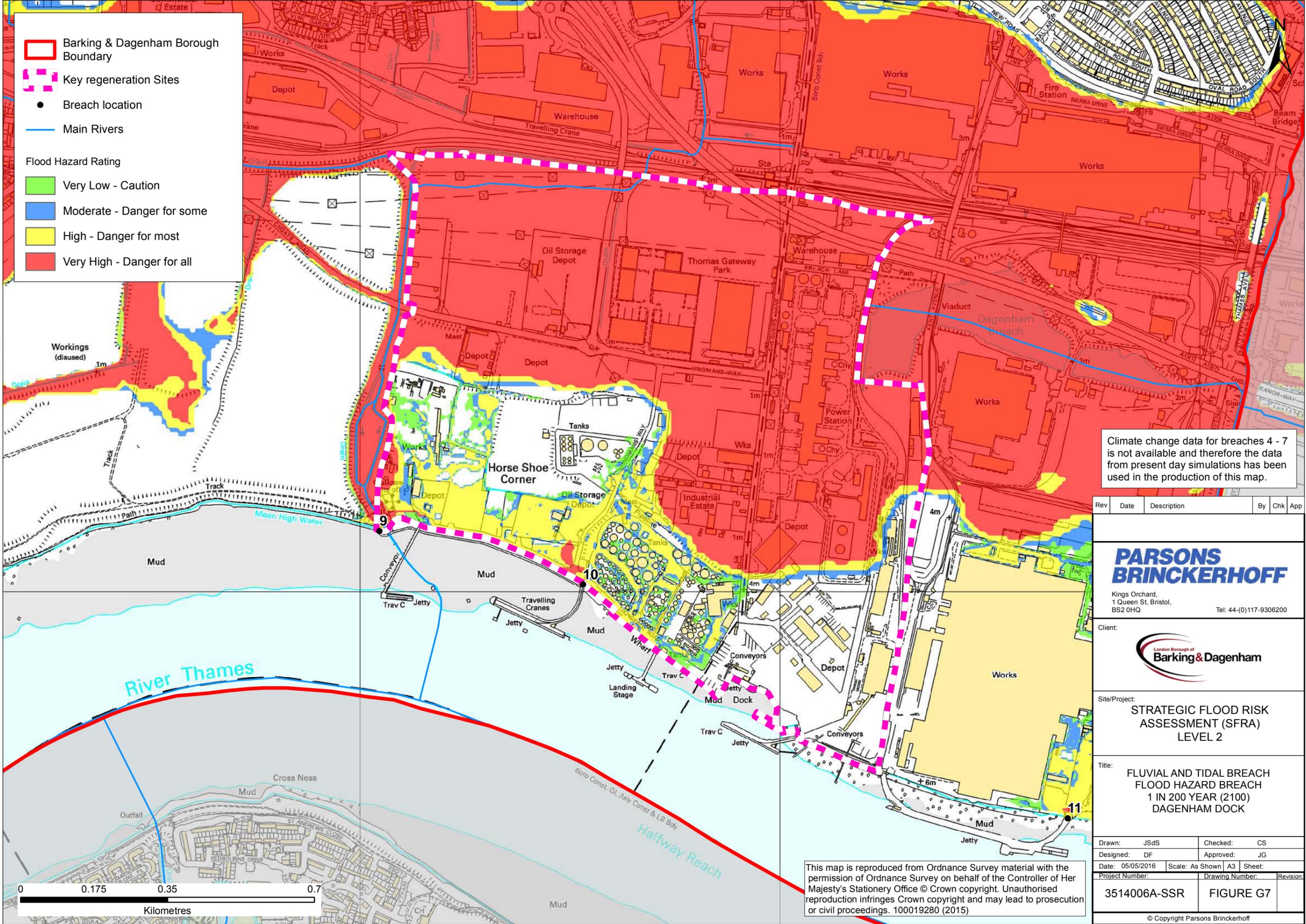
**Key regeneration Sites**

**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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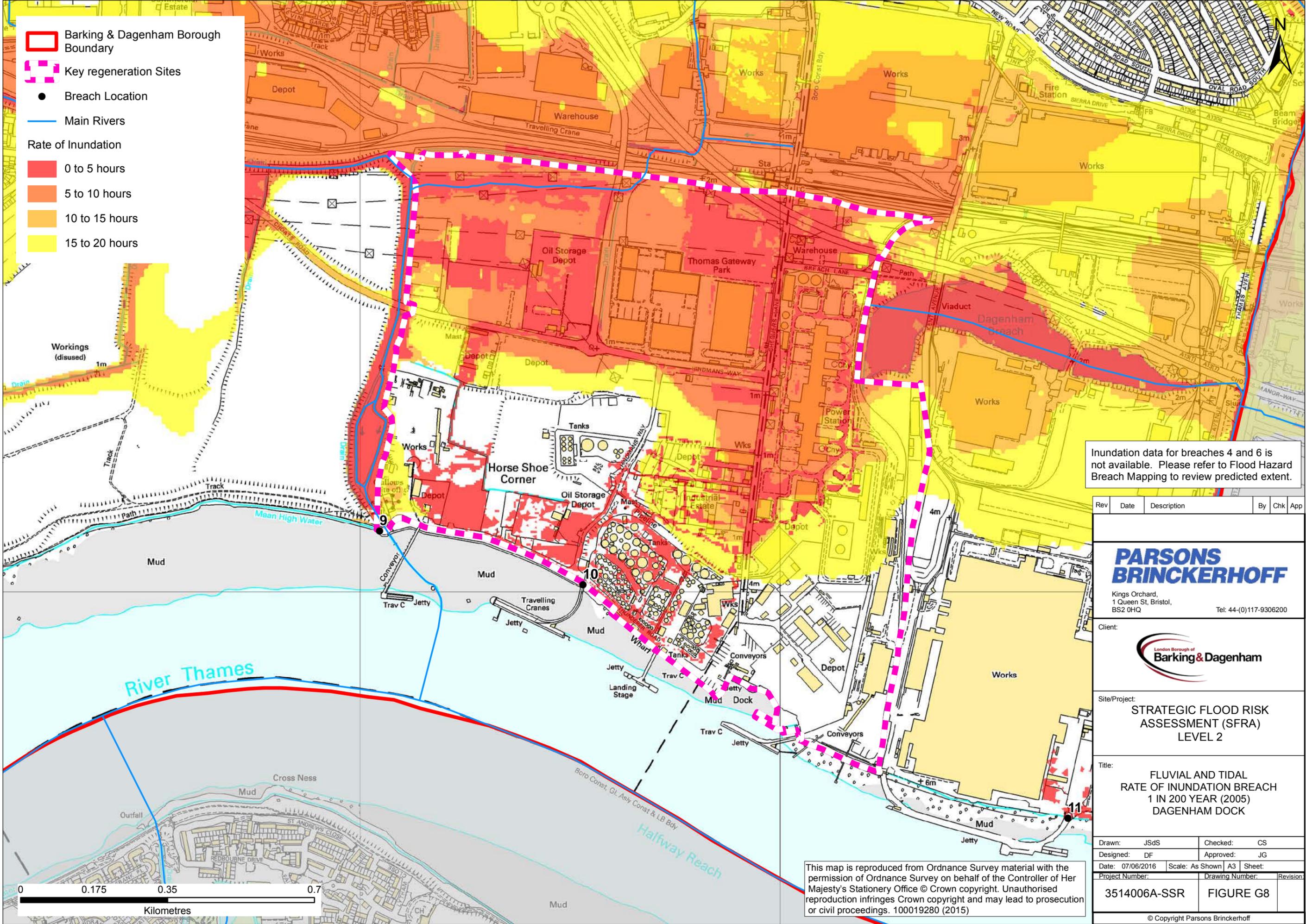
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**STRATEGIC FLOOD RISK ASSESSMENT (SFRA) LEVEL 2**

Title:  
**FLUVIAL AND TIDAL BREACH FLOOD HAZARD BREACH 1 IN 200 YEAR (2100) DAGENHAM DOCK**

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Date: 05/05/2016	Scale: As Shown
Project Number: 3514006A-SSR	Drawing Number: FIGURE G7

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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.

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Client:  
**STRATEGIC FLOOD RISK ASSESSMENT (SFRA) LEVEL 2**

Site/Project:  
**FLUVIAL AND TIDAL RATE OF INUNDATION BREACH 1 IN 200 YEAR (2005) DAGENHAM DOCK**

Drawn: JSdS	Checked: CS
Designed: DF	Approved: JG
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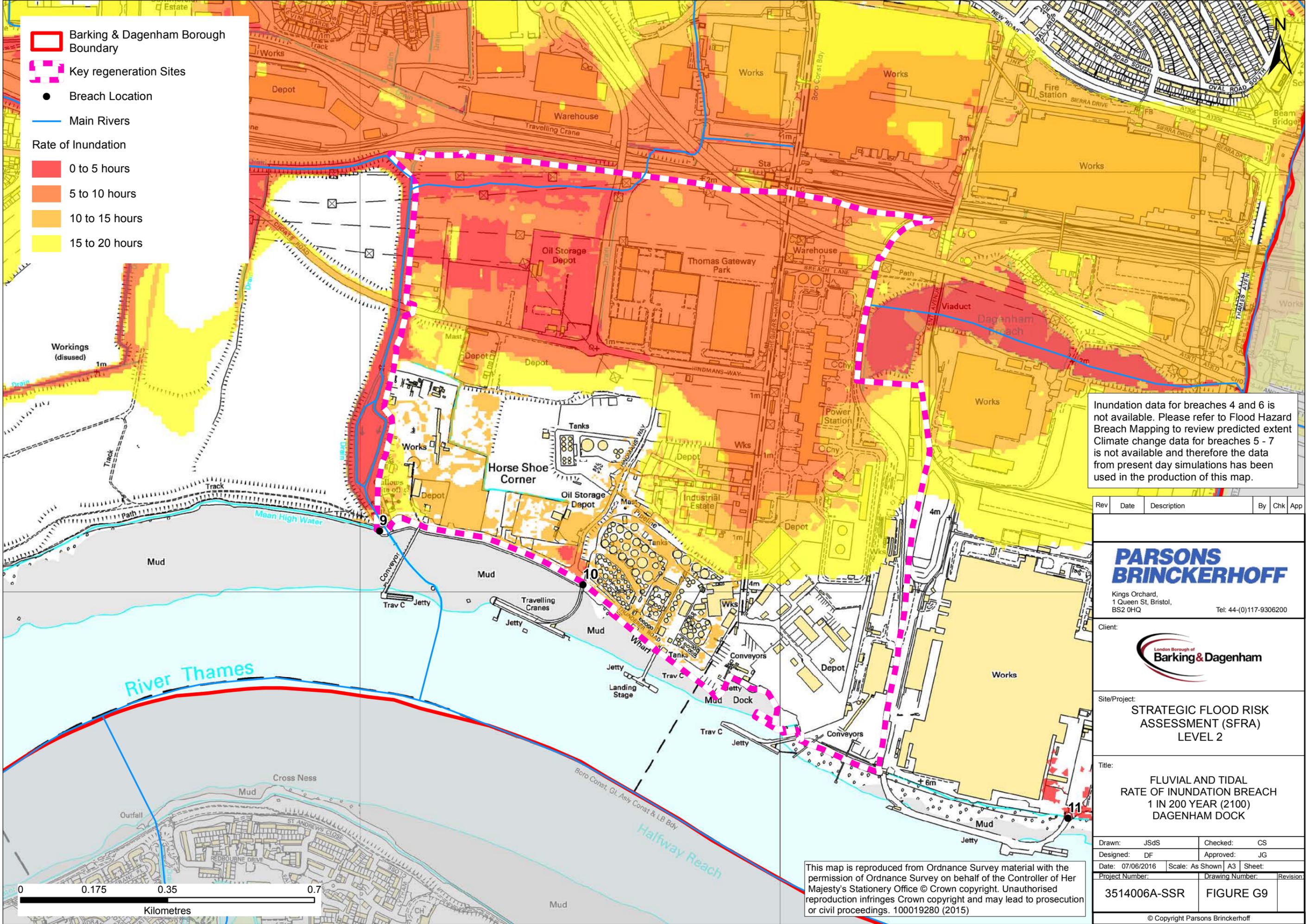
**3514006A-SSR** **FIGURE G8**

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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 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.

Rev	Date	Description	By	Chk	App

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Client:  
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**STRATEGIC FLOOD RISK ASSESSMENT (SFRA) LEVEL 2**

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

Drawn: JSdS	Checked: CS
Designed: DF	Approved: JG
Date: 07/06/2016	Scale: As Shown A3 Sheet:
Project Number:	Drawing Number: Revision:

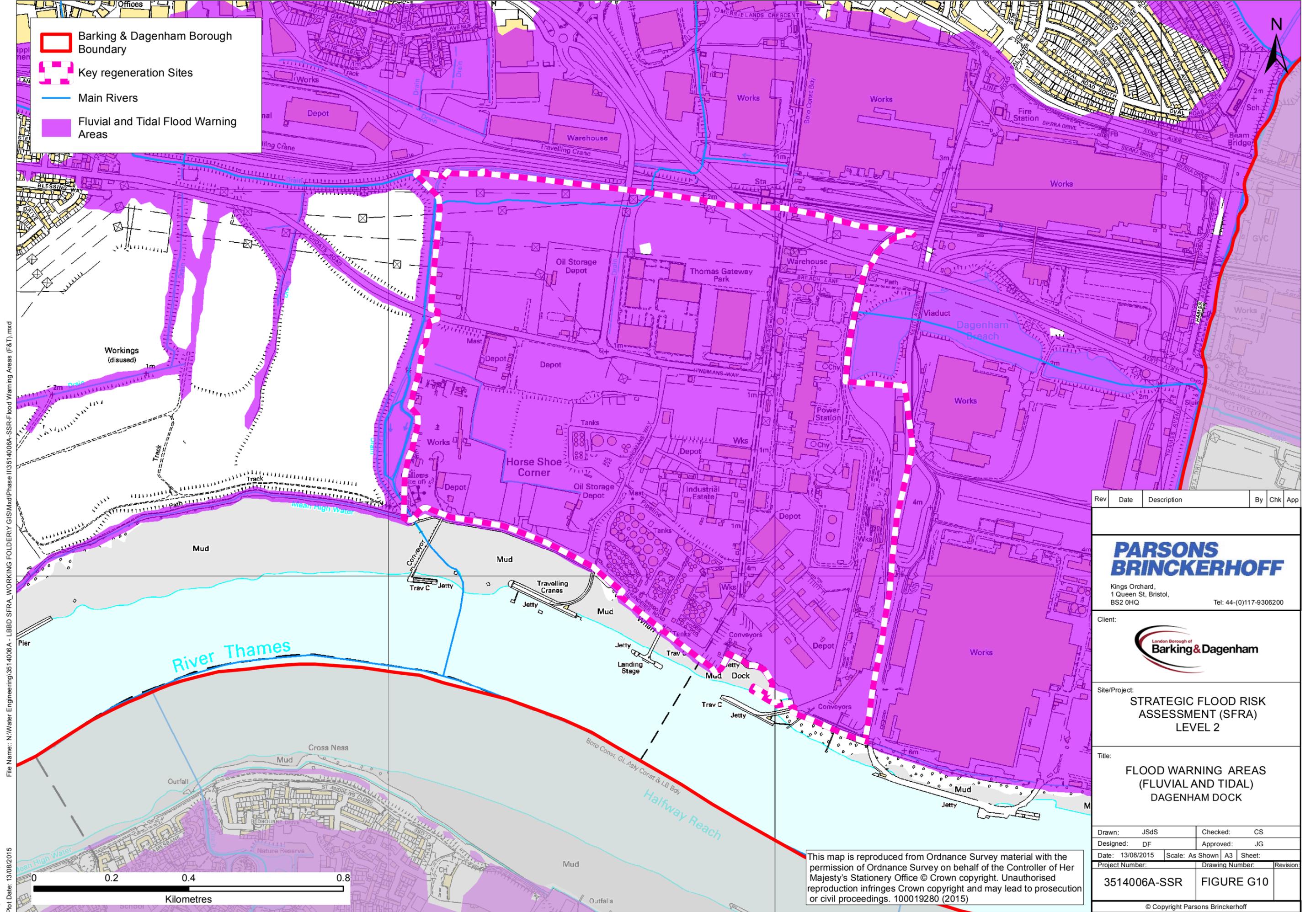
**3514006A-SSR** **FIGURE G9**

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File Name: N:\Water Engineering\3514006A - LBBD SFRA - WORKING FOLDER\GIS\Map\April 2016\3514006A-SSR-Phase\_II\_Rate\_of\_Inundation\_2100.mxd  
Login: DeSouzaJ  
Plot Date: 07/06/2016

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



File Name: N:\Water Engineering\3514006A - LBBB SFRA - WORKING FOLDER\GIS\Map\Phase 1\3514006A-SSR-Flood Warning Areas (F&T).mxd  
 Login: desouzaj  
 Plot Date: 13/08/2015

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Title:  
**FLOOD WARNING AREAS (FLUVIAL AND TIDAL) DAGENHAM DOCK**

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 G10**

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