APPENDIX H

FLOOD RISK ASSESSMENT

H FLOOD RISK ASSESSMENT

Contents Summary

Contents Summary

A Flood Risk Assessment was prepared for Damhead Creek 2. This is presented in this Appendix in:

H.1 Flood Risk Assessment

H.1 Flood Risk Assessment

SCOTTISHPOWER

DAMHEAD CREEK 2

FLOOD RISK ASSESSMENT

JUNE 2009

PB PARSONS BRINCKERHOFF
100 YEARS

LIST OF ABBREVIATIONS

AOD	Above Ordnance Datum
CCGT	combined cycle gas turbine
EA	Environment Agency
FRA	Flood Risk Assessment
ha	Hectares
km	Kilometres
LNG	liquefied Natural Gas
MC	Medway Council
MW	Megawatts
PB	Parsons Brinckerhoff
PFA	Pulverised Fuel Ash
PPS	Planning Policy Statement
SFRA	Strategic Flood Risk Assessment
SUDS	sustainable urban drainage system

CONTENTS

SECTION 1

INTRODUCTION

1 INTRODUCTION

1.1 Project Background

1.1.1 ScottishPower (DCL) Limited (ScottishPower) proposes to further develop the existing Damhead Creek Power Station to include two additional Combined Cycle Gas Turbine (CCGT) units to be known as Damhead Creek 2. The Damhead Creek 2 plant will have an approximate capacity of 1000 MW and will be located on land to the east of the existing Damhead Creek Power Station. Land to the east of the Damhead Creek 2 Power Station site will be utilized as a laydown area during construction and as a potential future carbon capture and storage site. In addition land to the north of the site will house a substation for the project.

1.1.2 As part of the planning process, Parsons Brinckerhoff (PB) was commissioned by ScottishPower to prepare a Flood Risk Assessment (FRA) in support of an application under Section 36 of the Electricity Act 1989 to construct and operate a generating plant greater than 50 MW. This assessment identifies the flood risk to the site based on the available information and addresses the requirements of Planning Policy Statement 25 (PPS25) – Development and Flood Risk and CIRIA C624: 'Development and Flood Risk Guidance'.

1.2 Site Location and Description

1.2.1 The Damhead Creek site is located approximately 8 km north-east of Rochester, Kent at National Grid Reference 581230, 172810. It lies on the southern edge of a tongue of land between the Thames and Medway estuaries known as Hoo Peninsula. A small tidal creek – Damhead Creek – borders the easternmost part of the site.

1.2.2 The overall Damhead Creek Power Station site is roughly triangular in shape, and bounded on the southern and eastern sides by earth bunds with a crest level of circa 5.6 m Above Ordnance Datum (AOD). The area to be used as a laydown area and as a potential site for carbon capture and storage is situated to the east of the proposed extension. This area is at a similar level to Damhead Creek 2 site, although it is not offered protection from an earth bund. A small area of land to the north-west of the proposed power station development will be used as an electricity substation. This area is also at a similar level to the main site to be used for Damhead Creek 2.

1.2.3 The main tidal protection for the area is provided by primary sea defences, which offer protection to the entire footprint of the Damhead Creek 2 development including the site for laydown and the substation. The tidal defences have a crest elevation of 5.7m AOD or greater, and are located to the south and east of the site (see Section 1.3 "Adjacent Sites" below). The proposed development land for Damhead Creek 2, including the laydown/carbon capture and storage area and the site for the electricity sub station consists of approximately 23.8 ha of land.

1.2.4 Prior to the development of the existing Damhead Creek Power Station, the general level of the site varied from circa 2.0 m AOD in the south west corner to circa 4.1 m AOD at the northern boundary of the site. During the construction of existing plant, the site was generally raised to circa 4.0 m AOD. On the western side of the site, the existing ground level flanking the industrial development is at an elevation of 3.8 m AOD. A new earth embankment has been constructed along the western boundary with a top elevation of not less than 4.8 m AOD. The area of land to be used for the laydown area and any future carbon capture and storage plant, situated to the northeast of the Damhead Creek 2 Power Station site is at an elevation of between 5.11 – 9.96 m, well above the Environment Agency (EA) 1 in 200 year flood levels. This area is also offered protection by primary sea defences. The area of land which will be used for the electricity substation is at approximately 4.8 m AOD. Although this is below the EA 1 in 200 year flood risk, this area is protected by earth bunds and is also offered protection from primary sea defences and is therefore not considered to be at risk from flooding.

1.2.5 Despite this, the areas to be used for the Damhead Creek 2, the laydown/carbon capture and storage area and electricity substation lie within an area classified by the

EA as being at risk from flooding, as shown by EA indicative flood maps. The relevant EA indicative flood map has been reproduced as Appendix A.

1.3 Adjacent Sites

1.3.1 The site of the Damhead Creek 2 Power Station site is bordered by industrial development to the northwest, by wetland lagoons to the north-east and by Kingsnorth coal-fired Power Station to the south. The site to be used as a laydown/carbon capture and storage area is bounded to the north and north-west by brownfield land which has been set aside under the Medway Local Plan as land for future commercial development (and is currently the subject of a planning application by the Goodman Developments Limited). The site is bounded to the west by the site of the proposed Damhead Creek 2 Power Station site and to the southeast by the Damhead Creek, a tidal tributary of the River Medway. The site of the proposed electricity substation is bounded to the north by more brownfield land set aside for future commercial development, and the existing Damhead Creek Power Station/proposed plant to the south.

1.3.2 The existing Damhead Creek Power Station was constructed with a balancing pond to provide on site storage of site generated runoff and a pumped outlet to control the rate of discharge to the creek. A discharge consent for the plant drainage exists, with a maximum allowable discharge of 627 m^3/day or 28m^3/hour. Drainage ditches around the southern and eastern boundaries of the site provide further on site drainage measures.

1.3.3 The southern and eastern boundaries of the Kingsnorth Power Station are protected from tidal inundation by a concrete wall sea defence up to the closure with the Damhead Creek earth embankments. The Environmental Statement for the new Kingsnorth Power Station (that would be located immediately to the south of the Damhead Creek plant) states that "the embankment bunds around the Kingsnorth Power Station are compliant to the 1 in 200 year standard, with the majority of bunds being [at an elevation of] 5.7 m AOD or higher". The ES also states that work is underway to raise the level of the earth embankments around the ash lagoons to a height of 6.3m AOD. The proposed site of the laydown/carbon capture and storage area for Damhead Creek 2 is protected to the east by the same sea defences. In addition, much of this area has been raised above 5 m AOD by large quantities of pulverized fuel ash (PFA) which have been placed on the site as a result of previous development. Therefore, a substantial proportion of this area is not considered to be at risk from flooding, this is reflected by the EA flood maps. The proposed site of the electricity substation is located partially within an area at risk of flooding (flood zone 3a as designated by the EA). The site is however protected from flooding from the Damhead Creek by the same flood defences as the main Damhead Creek 2 development. A topographic survey showing all site levels is included in Appendix B of this FRA.

1.4 Consultation with Relevant Bodies

1.4.1 The EA was consulted in December 2006 (reference ERM letter dated 7 December 2006). The EA's response (reference KT/2006/100572/01-L01) confirmed that a flood risk assessment would be required with the planning application, and that it should address the risk of flooding from all potential sources at the site.

1.4.2 Information provided by the EA, comprising predicted tidal high water levels for 1 in 200 years and 1 in 1000 year tidal events, has been used in this assessment.

1.4.3 Consultation has also been made with officers of Medway Council (MC) regarding the Strategic Flood Risk Assessment (SFRA) for the River Medway and historical flooding in this area.

1.4.4 Flood risk assessments undertaken to support a planning application for a warehouse development (Goodmans Group) and the new Kingsnorth Power Station development have also been consulted as part of this Flood Risk Assessment.

1.5 Potential Sources of Flooding

1.5.1 The potential sources of flooding at the site, and considered in this assessment, are outlined below:

- Tidal flooding from the Thames/Medway Estuary;
- Fluvial flooding from inland watercourses;
- Site-related flooding (surface water runoff and sewers);
- Overland flow from adjacent sites; and
- Groundwater flooding.

1.5.2 The impacts that each may have on the site are discussed in detail in the following sections.

SECTION 2

FLOODING AND FLOOD RISK

2 FLOODING AND FLOOD RISK

2.1 Indicative Floodplain Maps

2.1.1 The EA produces indicative floodplain maps which highlight areas that would flood from either tidal inundation or fluvial flows if existing flood defences were not present. The map covering the area around Damhead Creek 2 illustrates that the all sites proposed for development lie within an area that the EA has classified as being at "significant" risk of flooding if flood defences were not present (Flood Zone 3a). The indicative floodplain map for the area is included in Appendix A.

2.2 Historical Flooding

2.2.1 The site is potentially at risk from tidal flooding in the Medway Estuary, and from inland or site generated surface water runoff. The site is known to have flooded in 1953 when a tide level of 4.75 m AOD was recorded. It is commonly believed that the flooding at the site did not result from tidal inundation, or from a breach of the sea defences, but was the result of flash rainfall from inland combined with high tide restricting drainage runoff.

2.2.2 Flooding in the Medway area has also been recorded in 1927, 1949, 1960, 1965, 1978 and 2005. The December 2005 event, a tidal surge caused low level flooding in parts of Rochester but had no impact at the site of the Damhead Creek Power Station.

2.2.3 There is no record of any flooding on the Damhead Creek Power Station site since the construction of the existing development in the late 1990s.

2.3 Risk of Tidal Flooding

2.3.1 In 2006, the Environment Agency identified that the 1 in 200 year tidal high water level is 5.3 m AOD and the 1 in 1000 year tidal high water level is 5.8 m AOD. These figures are still water levels with a design year horizon of 2060. The effect of climate change is already accounted for in the levels but no allowance is made for tidal surges, wave height or wave intensity.

2.3.2 The general area within which the site lies is protected by primary sea defences with a crest elevation of 5.7 m AOD or higher. It is understood that the defences are under riparian ownership and responsibility for maintenance lies with the riparian owners. Assuming that the defences are suitably maintained to preserve the current crest level the proposed sites of the Damhead Creek 2 Power Station as well as the laydown/carbon capture and storage area and the electricity sub station will all benefit from a level of protection against tidal flooding of between 1 in 200 years and 1 in 1000 years and as such any additional flood defence is not required.

2.3.3 In addition to the primary sea defences, the Damhead Creek Power Station site is protected by secondary bunds adjacent to the site, with a crest elevation of circa 5.6 m AOD. These bunds provide further protection form tidal inundation to a standard of between 1 in 200 years and 1 in 1000 years. In addition, a substantial area of the site proposed for the development of the carbon capture and storage/laydown area is situated above 5.3 m AOD due to large quantities of PFA deposited on the site from its former use as a landfill. Therefore much of this site is not considered at risk from flooding. The site proposed for the new electricity sub station is partially situated within Flood Zone 3a. However, this site is also afforded protection form flooding from Damhead Creek via the primary sea defences which currently protect the existing Damhead Creek Power Station site.

2.3.4 Given that the sites are protected by a mixture of primary sea defences, secondary earth bunds and land which has been artificially raised above 5.3 m AOD, all of which provide a level of protection of greater than 1 in 200 years, the risk of tidal flooding on the sites is not considered to be high.

2.3.5 The Strategic Flood Risk Assessment (SFRA) for the River Medway does not extend as far downstream as the site of the existing Damhead Creek Power Station. There is, therefore, very little available information that considers the mechanism for tidal

inundation onto this part of the estuary. Although there is the potential for the effects of a tidal surge in the Thames Estuary to reach the sea defences in this part of the Medway Estuary, the presence of the Stoke Saltings, and the ash lagoons to the north east of the site, are likely to limit the generation of large wave heights acting on the sea defences at this location. The sea defences themselves and the earth bunds surrounding the existing site will not be altered by the proposed development and the mechanism for tidal flooding onto the site will remain unaffected by the proposals.

2.4 Breaching Scenarios

2.4.1 The SFRA for the River Medway concentrates largely on the residential areas around Rochester and Chatham. Although inundation maps have been produced for breaching scenarios, these do not extend as far downstream as the site of the power station.

2.4.2 The Damhead Creek Power Station site is protected by both primary sea defences and secondary earth embankments and it would take a breach of both embankments to cause inundation into the site. Should such a situation arise, it is unlikely that the site would be rapidly inundated, and the breach water would be most likely to have a low velocity and to be of relatively shallow depth.

2.5 Risk of Fluvial Flooding

2.5.1 Other than the Medway Estuary and some local ditches, there are no adjacent or nearby rivers and the sites are not at risk from fluvial flooding of inland watercourses.

2.6 Risk of Overland Surface Water Flooding from Adjacent Sites

2.6.1 The site of the proposed Damhead Creek 2 plant is surrounded by earth bunds of heights varying between 4.8 m AOD on the western boundary and 5.6 m AOD on the southern and eastern boundaries. Therefore, the site is well protected from overland surface flooding from adjacent sites and is, in effect, self-contained. The site is, considered to be at very low risk from overland surface water from adjacent sites. The proposed site of the laydown/carbon capture and storage area has been raised to above 5.3 m AOD by artificial deposition of PFA, therefore this site is also considered to be at very low risk from overland flooding from adjacent sites.

2.7 Site Generated Surface Water Runoff and Sewers

2.7.1 The proposed Damhead Creek 2 development including the electricity substation and laydown/carbon capture and storage area will increase the area of hard, impermeable surfacing and thereby increase the amount of surface water generated by the sites as a whole. Site levels across the Damhead Creek 2 area will generally be raised and levelled to a level of about 4.5 m AOD. A new drainage system, separate from the existing drainage system, will be constructed for the Damhead Creek 2 development, along with a new balancing pond having a controlled outlet to limit the final discharge into the Creek. Where possible, swale ditches and other sustainable urban drainage system (SUDS) drainage techniques will be incorporated into the drainage design.

2.7.2 The new drainage system will be designed and sized in accordance with current best practice to ensure that no flooding out of manholes results from storms of 1 in 30 year return period. In addition, the new drainage systems will be simulated under a 1 in 100 year design storm to determine which parts of the drainage systems are likely to flood in such a storm event. Road levels and building floor levels in these areas will be arranged in such a manner that essential buildings are not put at risk, and that there is no increased risk of flooding to existing parts of the site, or outside the site.

2.7.3 A new balancing pond will be constructed as part of the Damhead Creek 2 development. A preliminary analysis indicates that a balancing pond with a storage volume of about 1150 m^3 will be required to attenuate design storms of up to 1 in 100 years return period with a maximum discharge rate of 8 l/s to the Creek allowing for a 20 per cent in rainfall intensity as required by PPS 25.

2.7.4 An oil interceptor will be incorporated into the new drainage system upstream of the balancing pond to provide pollution control measures for the site runoff.

2.8 Ground water flooding

2.8.1 Groundwater flooding occurs as a result of the groundwater table rising up from the underlying aquifers contained in subsurface geology, or from water flowing from abnormal springs. This tends to occur after much longer periods of sustained high intensity rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels. Groundwater tends to flow from areas where the ground level is high, to areas where the ground level is low. In low-lying areas the water table is usually at shallower depths, but during very wet periods, with all the additional groundwater flowing towards these areas, the water table can rise up to the surface causing groundwater flooding.

2.8.2 Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). These may be extensive, regional aquifers, such as chalk or sandstone, or may be localised sands or river gravels in valley bottoms underlain by less permeable rocks. Groundwater flooding takes longer to dissipate because groundwater moves much more slowly than surface water and will take time to flow away underground.

2.8.3 Due to the nature of the underlying geology (river terrace deposits classified as a minor aquifer) together with the elevation of the site (approx 4.0m AOD, compared with surrounding land at lower levels) it should not be prone to ground water flooding. Nor has flooding of this nature been recorded at the Existing Power Station in the past.

2.9 Flood Warning

2.9.1 There is no residential development planned for the site, although some parts of the power station may be manned for 24 hours per day. The EA operates a flood warning service for this area. A flood warning procedure is already in place for the existing power station to ensure those present have enough time to vacate the site should a significant flood risk occur. This procedure will also apply to the proposed Damhead Creek 2 development.

2.10 Safe Access To and From the Site

2.10.1 The site is protected by primary sea defences and secondary earth embankments providing a level of protection of between 1 in 200 years and 1 in 1000 years. The site access road will be a branch from the existing Damhead Creek Power Station access road. It will be constructed on fill material at a level of circa 5.7 m AOD where it joins with the existing road. The main access road is above the 1 in 200 year tidal flood level and just below the 1 in 1000 year tidal flood level.

2.10.2 The existing Power Station already has in place a procedure for emergency evacuation of the site. Advance warnings will be provided by EA and other local services in the event of an extreme tidal flood that could overtop the existing defences. Ground levels rise to over 10.0 m AOD within a few hundred metres of the main site entrance. Therefore, safe ground is available nearby and safe evacuation of the site can be made speedily such that the risk to human life at the site, in the event of an extreme tidal event, is managed at a low residual level.

2.11 Cumulative impacts

2.11.1 Cumulative impacts associated with the development of the warehouses to the east of the site and the Kingsnorth Units 5 and 6 to the south should not prove to be significant.

2.11.2 Each of the projects proposed have identified mitigation measures to ensure that the proposed developments do not increase the risk of flooding to the surrounding area. Of the projects proposed this is has been a particular concern to the Goodman Group Limited development to the east which includes large areas of warehouses and hard standing and which has incorporated an extensive number of balancing points.

SECTION 3

THE SEQUENTIAL TEST AND EXCEPTION TEST

3 THE SEQUENTIAL TEST AND EXCEPTION TEST

3.1 The Sequential Test

3.1.1 In terms of Planning Policy Statement 25 (PPS 25), the site is classified by the Environment Agency as lying within Flood Zone 3a. This zone comprises land assessed as having a 1 in 100 year or greater (>1%) annual probability of river flooding or a 1 in 200 year or greater (0.5%) annual probability of flooding from the sea. The purpose of the Sequential Test is to steer new development towards the areas with the lowest probability of flooding. Ideally this would be areas classified as Flood Zone 1.

3.1.2 The location of new generation projects is driven by proximity to fuel sources and centres of demand. In general terms, the disposition of demand and generation capacity across the transmission system is such that much of the generation capacity is located in or towards the north of England, while much of the demand is in the south. For this reason, National Grid encourages new generation to be built near centres of demand, generally in the south. This is achieved through the application of differential charging for transmission, resulting in the lowest charges being in the south and south east.

3.1.3 Gas supplies are also an important element of siting a new CCGT and with significant new supplies coming from Europe through pipelines in the south-east, and the liquefied natural gas (LNG) terminal at the Isle of Grain, the prime location for a new build CCGT is in the south-east of the UK.

3.1.4 Consultation with Medway Council confirms that a Strategic Flood Risk Assessment (SFRA) has been undertaken for the River Medway. However, the SFRA largely concentrates on the land and river frontages around Rochester, Chatham and Gillingham, and does not extend as far downstream as the site of the Damhead Creek Power Station. It is generally considered by Medway Council that the site is protected by sea defences that offer appropriate protection against tidal inundation for the existing development at the site. Furthermore in the Scoping Response issued by the Environment Agency in March 2009 they confirm that 'the site is adequately protected by primary and secondary defences'.

3.1.5 Notwithstanding the above, the type of development proposed would be classified as 'Essential Infrastructure'; and an Exception Test will be required.

3.2 The Exception Test

3.2.1 In accordance with PPS25, the proposed development is classified as 'Essential Infrastructure' and requires that an Exception Test is applied. For the Exception Test to be passed, it must be demonstrated that:

1. The development provides wider sustainability benefits to the community that outweigh the flood risk;
2. The development should be preferably on developable, previously-developed land; and
3. A Flood Risk Assessment demonstrates that the development will be safe, without increasing flood risk elsewhere.

3.2.2 The proposed development provides electricity generation that strengthens the local and regional grid network, which, in turn, underpins the development of other services within the south east region. The plant will be highly efficient when compared with other power stations currently in operation and will assist the UK Government in their aims of reducing overall emissions of carbon dioxide through the displacement of coal and oil power stations which are due to close in the coming years.

3.2.3 This application would be on land already designated as part of a power station site or as land set aside for future developments under the Medway Local Plan. The

proposed development is similar to that which already exists at the site. Much of the infrastructure required for such a development already exists at the site and can support the development with minimal impact upon the surrounding environment. There is no requirement to build an access road to the site because access to the existing power station already exists. Furthermore, there is no requirement to build a gas pipeline to the site because the existing gas pipeline into the existing Damhead Creek Power Station has the spare capacity required for the Damhead Creek 2 development.

3.2.4 The Flood Risk Assessment demonstrates that the site is protected by primary and secondary defences that provide a level of protection that is commensurate with the type of development and that the development would not increase the risk of flooding either on the site or elsewhere.

SECTION 4

CONCLUSIONS

4 CONCLUSIONS

4.1.1 The proposed development comprises electricity generation infrastructure that is much needed in the south of England and particularly in the south east of England. The proposed location is on land that is already the site of a CCGT power station or brownfield land set aside for development and already has the basic infrastructure required for such a facility. An Exception Test has been applied in accordance with PPS25 and is considered to meet the requirements to pass the Exception Test.

4.1.2 The Flood Risk Assessment has considered the various types of flooding that could result at this site and concludes that:

- All sites which make up the Damhead Creek 2 Development are protected by separate sea defence and/or secondary earth embankments, which have a crest elevation of about 5.7 m AOD. These defences provide a level of protection that is above the estimated 1 in 200 year tidal high water level for this area (5.3 m AOD) allowing for climate change to a design year of 2060. In addition, a significant part of the site proposed for siting a laydown/carbon capture and storage area has land which has been artificially raised above 5.3 m AOD and is not considered by the EA to be at risk from flooding.

- The mechanism for tidal flooding onto the existing sites is unaffected by the proposed development. There is a risk of the sea defences being overtopped by tidal levels in the Medway Estuary approaching the estimated 1 in 1000 year high water level for the area (5.8 m AOD). In such circumstances, it is considered unlikely that the site would be rapidly inundated because both the primary sea defences and the secondary earth embankments around the site would have to be overtopped.

- A new surface water drainage system will be provided for the proposed developments that will include a balancing pond to mitigate for the increased amount of surface water runoff generated by the site. The drainage system will also include an oil separator to provide pollution control for the site generated runoff. The drainage system for the existing power station has incorporated wetlands and other features, and it is proposed that the new surface water drainage system will be similar; incorporating SUDS drainage measures wherever possible.

- The development would not increase the risk of flooding either on the site or elsewhere off the site.

- A flood warning system and an emergency site evacuation procedure is already in place.

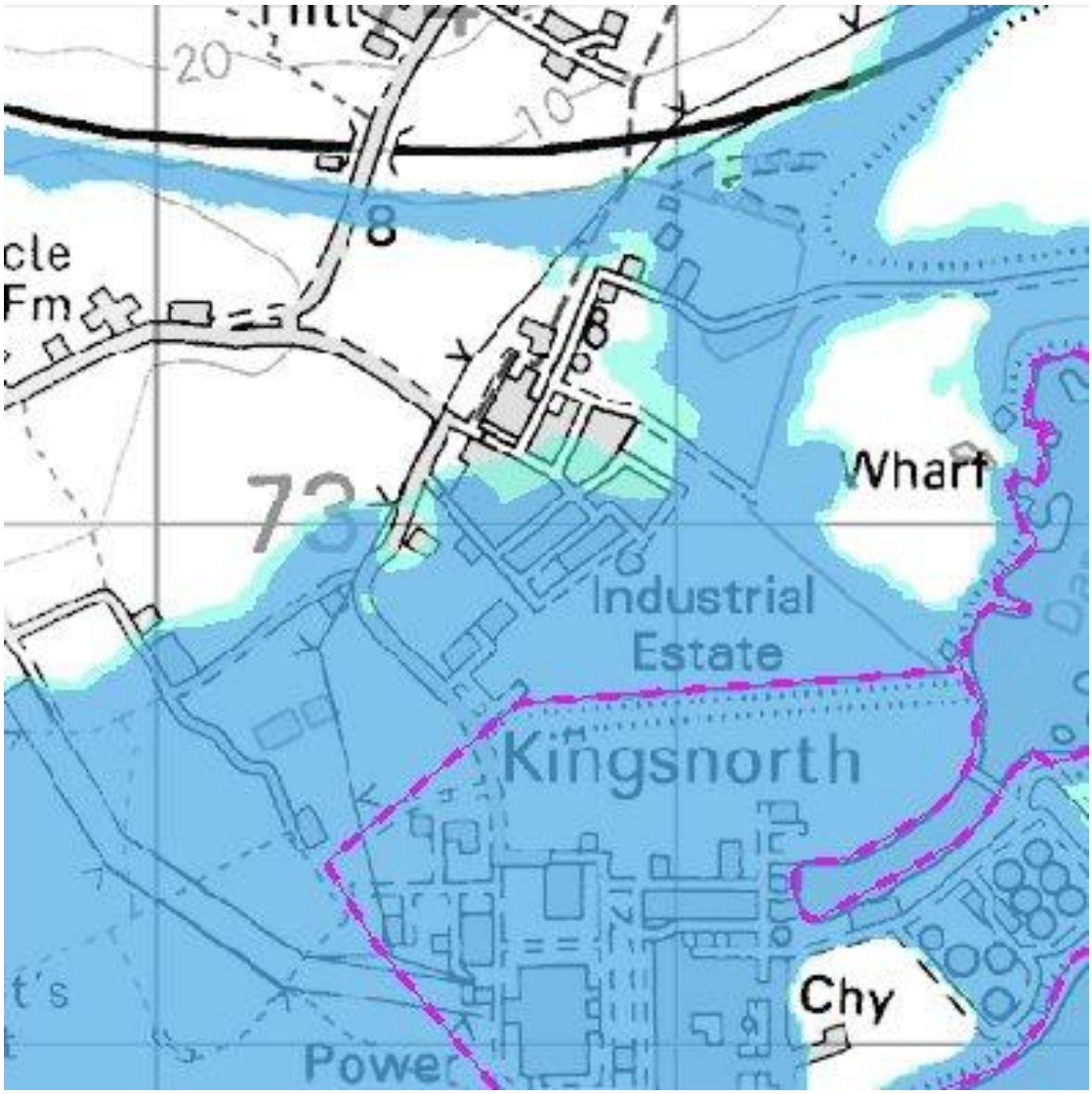
- As required by PPS 25 the plant which represents essential infrastructure will be designed to remain operational when floods occur in the surrounding area noting that the site itself is not at risk of flooding due to the existing defences.

APPENDIX A

ENVIRONMENT AGENCY INDICATIVE FLOODPLAIN MAP

ENVIRONMENT AGENCY INDICATIVE FLOODPLAIN MAP

FIGURE 1: ENVIRONMENT AGENCY INDICATIVE FLOODPLAIN MAP



APPENDIX B

TOPOGRAPHIC SURVEY

TOPOGRAPHIC SURVEY