The Humber Estuary Flood Risk Management Strategy: Summary Strategy and Business Case

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Executive Summary

The Humber Local Authorities, Humber LEP and major businesses around the Estuary are seeking a commitment from Government in this year’s Autumn Statement for a single settlement of £1.28bn to provide the capital and maintenance costs required to replace and raise estuary-wide flood defences around the Humber Estuary. These defences will provide a consistent 0.5% AEP standard of protection to 2057.

Current Flood and Coastal Erosion Risk Management budgets would not stretch to providing this requirement and current funding formulas do not sufficiently recognise the benefits of protecting important nationally critical assets and infrastructure, nor do they adequately recognise the opportunity to unlock significant growth that will contribute to the national economy. As such, it will be impossible to unlock the funding required under current mechanisms.

This document presents the Humber as an overwhelming economic case that justifies this additional investment. Of overriding significance is the broad range of benefits, not just to existing homes and businesses, that can be realised locally, but more importantly at a national level. These benefits cover a range of important themes that can only be fully realised through provision of this settlement and a whole-estuary approach to flood risk management within the Estuary.

On 5th December 2013, the East Coast experienced the most significant tidal surge since 1953. The surge was the highest on record in the Humber Estuary and it led to the flooding of approximately 1,100 properties and 7,000ha of agricultural land on both banks.

Direct damages from the December 2013 event have been estimated so far to exceed £100 million, yet despite this scale of impact the event can be considered a ‘near miss’ by virtue of the fact that more than 100,000 homes in Hull, Goole and Grimsby were not inundated or electricity generation at inland power stations affected.

The Environment Agency has modelled future overtopping scenarios as part of the Updated Humber Flood Risk Management Strategy, and they predict a similar if not slightly larger surge event will occur at least once within the next 50 years, driven by the predicted effects of sea level rise of almost 0.3m.

Modelling of such an event has indicated that in excess of £10bn of direct damages to residential properties, businesses, industry and agriculture could occur. Consequential damages could nearly double this value, which would represent a major loss to the nation and significant economic flood shock, exceeding the Humber’s economic productivity.

A detailed assessment of the costs and benefits of protecting the Estuary to a 0.5% AEP standard indicates potential flood damages of £6.2bn to 2057. Investment of £1.28bn to provide estuary wide protection could avoid £5.9bn of damages over the same period, with a benefit to cost ratio (BCR) of 4.6.

These values do not include the benefits of avoiding flood consequences to a number of important nationally critical assets, critical infrastructure or the opportunities for significant growth in the Humber area that are provided by protecting the whole Estuary to a high standard. These defences will also:

- Enhance energy security to power stations and their supply chains
- Protect industry, refineries and fuel supplies
- Protect agribusiness and food security
- Maintain the continuity of trade through the Humber Ports
- Protect people, jobs and the environment
- Protect critical transport networks
- Support the switch to a Low Carbon economy through growth and investment in the renewables sector
- Secure rather than limit the chance of future investment in economic growth

When taken together, the value to the nation and the Humber area of the benefits secured by protecting the whole Estuary will significantly enhance that from direct damages alone. The Humber Ports for example between them are estimated to contribute £2.2bn to the UK economy, supporting 33,000 jobs across the area. The value of major assets and infrastructure around the estuary is estimated to be in the £ billions and estimates for the growth potential from renewables and port-centric investment vary from £5.65bn to £11.65bn per year by 2025, representing over 20,000 jobs.

There is also a real human element. The December 2013 surge produced some frightening stories and near misses that could have resulted in loss of life. There is also a real risk to the viability of the Humber area if the cities are protected but people’s jobs and future are not.
A single cross-departmental/Treasury settlement of £1.28bn can secure all of these benefits which address much more than just flood risk. Investment will act as a catalyst to private sector investment in flood defences, it will enhance the security and piece of mind of residents around the Humber and provide jobs, skills and training that will contribute towards the development of a sustainable Humber economy that contributes fully towards the national economy. All environmental obligations can also be met.

The Humber Authorities will seek to deliver the necessary programme of investment using a new Lot through a compliant framework or through a new compliant framework over a period of time that meets legislative requirements whilst maximising wider spending targets. The single settlement will be the principal source of finance, with private contributions leveraged from the private sector as appropriate to the scale of the project.

If a single settlement is announced in the Autumn Statement, working in unison the Local Authorities, LEP and Environment Agency are well placed to receive and administer the award. There is an excellent track record for delivery of large infrastructure projects in the Humber area with Local Authorities, LEP and Environment Agency working in partnership to reach stated goals within the private sector.

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1 Introduction

This document sets out the case for an additional single settlement from Government of £1.28bn to provide the capital and maintenance costs required to replace and raise estuary-wide flood defences around the Humber Estuary. These defences will provide a consistent 0.5% AEP\(^1\) (1 in 200 years) standard of protection to 2057.

Current Flood and Coastal Erosion Risk Management (FCERM) budgets could not deliver this settlement without impacting schemes elsewhere and current funding formulas do not sufficiently recognise the benefits of protecting important nationally critical assets and infrastructure or the opportunity to unlock significant growth that will contribute to the national economy to unlock the funding required. This document presents the Humber as a single case that justifies additional investment for the benefit of the UK.

On Tuesday 1st July 2014 a debate was held in the House of Commons\(^2\), led by the Rt. Hon. David Davis MP, on the powerful economic case for significant, Estuary-wide investment in flood defences around the Humber. The debate highlighted the high level of cross-party support for the Government to commit to additional investment in flood defences that would protect nationally important critical assets and transport links and provide the catalyst for major inward investment.

Further discussion took place between local MPs and the Prime Minister on 10th July 2014 to present and strengthen the case. Mr Cameron accepted the principles of the case and gave his approval for further dialogue with his ministerial team in advance of this year’s Autumn Statement. Mr Cameron requested that a strategy document be provided to inform that dialogue.

This Humber Strategy Summary provides that information. This document presents an emerging business case in advance of the full Updated Humber Flood Risk Management Strategy, which will be published in 2015 (the work largely being complete and in the process of being written up into a full report to be signed off amongst the EA and Humber local authorities). Given the challenging timetable, this business case is presented in line with HM Treasury guidance on Public Sector Business Cases\(^3\).

The case for investment to reduce flood risk around the Humber Estuary is undeniable. The current probability of flooding is already high in a number of areas around the Estuary, including Hull, Goole and Immingham, and the effect of climate change will significantly increase the probability of flooding around the majority of the Estuary\(^4\).

The larger urban areas of Hull, Goole, Grimsby and Cleethorpes, which have a high proportion of domestic properties that drive the current (Defra) funding formula, are already a priority for flood defence investment and will remain so. However, other benefits are not taken comprehensive account of, or given sufficient weighting, in current schemes for funding. This is limiting the availability of funds to protect these nationally important benefits:

- Energy Security
- Economic Growth and Investment
- Food and Fuel Security
- Continuity of Trade
- Protection of People and the Environment

Four of the five benefits listed above by their nature are water facing or, in the case of agriculture, by necessity situated in the flood plain and it would be difficult to justify or be impractical to relocate these benefits elsewhere in the UK.

Taken together, reducing flood risk around the Humber is a whole-estuary issue that can’t be compartmentalised or limited to places where current funding rules favour. This is recognised by all the Humber Local Authorities on the basis that the hydrology and geography makes compartmentalisation physically very difficult. Unlike the much smaller Thames Estuary, which protects London by means of a barrier, the sheer size of the Humber means that defences of the banks are the only practical proposition.

Additional investment in flood defences is vital to maintain the security of national as well as Humber area interests in energy, agriculture, food, fuel, commerce and trade. At the same time, flood defence funding can unlock growth and investment that will significantly increase GVA, secure jobs, increase skills, contribute to national and international green energy/low carbon targets and protects people and the environment into the future. Grimsby Docks Flood Risk Management Scheme is an example of how new flood defences open up new areas for future investment.

This is a nationally important issue. With this Humber Strategy Summary we are asking for a cross-departmental/Treasury commitment to provide a single settlement for improving and upgrading defences on the Humber that properly considers all of the benefits that they will bring.

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1. Annual Exceedence Probability – The probability that an event will occur at least once in any given year.
2. www.publications.parliament.uk/pa/cm201415/cmhansrd/cm140701/halltext/140701h0001.htm
1.1 What will be protected?

December 2013 Tidal Surge

On 5th December 2013, the East Coast experienced the most significant tidal surge since 1953. The surge was the highest on record in the Humber Estuary and it led to the flooding of approximately 1,100 properties and 7,000ha of agricultural land on both banks. The surge hit industry and business around the Estuary particularly hard, with significant impacts at the Ports of Immingham, Grimsby and in the English Street area of Hull behind Albert Dock. The Cemex plant at South Ferriby suffered extensive damage, with limited production only commencing 5 months after the event. The total cost to that business is expected to be in the 10’s of millions and this will no doubt have also affected Treasury’s tax revenues.

At Port of Immingham substations were damaged with a loss of power and IT services for 3 days across the facility. There were impacts to railway points and signalling which affected the movement of trains to the Humber International Terminal (HIT) from where coal and biomass are shipped to inland power stations. There were losses to stores and cargo and significant impacts to customers, tenants and stakeholders’ assets resulting in a widespread loss of business for days and in some cases weeks and months. The Port handles more than 55 million tonnes of cargo each year, including 20 million tones of oil, 10 million tones of coal and there are 260 rail freight movements per week. Loss adjusters estimate the overall direct losses to ABP at Immingham to be £10m-15m, with total overall losses to all port users significantly higher.

151 businesses were affected in the English Street area of Hull, which lies behind Albert Dock. The flood defence level at Albert Dock is low at 5.04m AOD and this was the main point of entry for flood waters affecting the area. The area is home to Smith and Nephew, respectively the world’s first and second largest producer of surgical and wound management products. This nationally important business was badly flooded with parts taken out of production for several weeks.

Approximately 40km of flood defences overtopped around the Estuary, which resulted in significant landward damage of soft flood defences caused by erosion and the collapse and breach of the defences.

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6 ABP (2014) ABP Humber Ports Case Study – case for investment in flood defence infrastructure
7 Greenergy facility at Port of Immingham only fully reopened on 19th August 2014
8 www.abports.co.uk/Our_Locations/Grimsby_Immingham/Immingham/
Had the surge peaked only two hours later there would have been a significantly greater impact. The peak tide level could have been up to 40cm higher resulting in a much greater volume overtopping the Humber Defences with wider ranging and considerably more significant impact. Furthermore, had there been an easterly wind or had the Trent and Ouse had higher rates of flow, then the impact could also have been more acute and could have reached further upstream.

Observations on the day noted that water levels were near to the top of defences protecting the 17,600 people who live in Goole. Had the water level been that much higher, the entire town would have been subject to rapid inundation and would have required evacuation. In Hull, had the volume of water flooding the centre of Hull been larger, there would have been flow into the lower lying, residential areas within the City and fatalities might have occurred as flood waters would have affected the majority of the City. It is worth noting that studies have shown that it is impossible to evacuate a city the size of Hull in the timescales required.

Direct damages from the December 2013 event have been estimated so far to exceed £100 million, yet despite this scale of impact the event can be considered a ‘near miss’ by virtue of the fact that more than 100,000 homes in Hull, Goole and Grimsby were not inundated or power generation affected.

The Environment Agency has modelled overtopping scenarios as part of the Updated Humber Flood Risk Management Strategy, and they predict a similar if not slightly larger surge event will occur at least once within the next 50 years, driven by the predicted effects of sea level rise of almost 0.3m. Modelling of such an event has indicated that in excess of £10bn of direct damages to residential properties, businesses, industry and agriculture could occur. CONSEQUENTIAL DAMAGES could nearly double this value, which would represent a major loss to the nation and significant economic flood shock, exceeding regional GVA by a considerable margin.

The Estuary

There are currently 400,000 people, 32,500 businesses, nationally critical industries (see Key Assets Map, p.10), road and rail links and a significant agricultural sector within the estuary that are afforded protection against tidal flood events like that seen in December 2013.

230km of flood defences currently provide a variable standard of protection which, with the benefit of new understanding from the recent surge, is mostly, considerably less than a 0.5% AEP (1 in 200 years) standard. Some of the UK’s highest value assets and critical infrastructure are protected by these defences, including five power stations, two refineries, the country’s largest port complex, a major petrochemicals industry and an SME base upon which the prosperity of the economy depends.

The Humber is the ‘Energy Estuary’, acting as a major conduit of resources into the UK:

• 20% of UK natural gas demand lands at Easington from Norway via the Langeled pipeline
• Five power stations provide up to 17% of the UK’s electricity generation capacity
• A C-Gen Gas-fired power station is planned at a cost of £1bn
• 30% of the UK’s coal and an increasing amount of biomass are landed
• Vivergo Fuels at Saltend produces 30% of the UK’s bioethanol demand for petrol
• New investment of £310m by Siemens and APB in new offshore production facilities, creating 1,000 jobs directly with additional jobs during construction and indirectly in the supply chain.

Because of their location and the existing facilities and transport links, land resources on both banks offer competitive opportunities for renewables and offshore wind in particular. The Humber Local Enterprise Partnership (LEP) predicts that investment linked to renewables and regeneration could result in up to £7bn of further investment across the Humber, particular in Enterprise Zones such as Greenport Hull, Paull, the Port of Grimsby and the South Humber Gateway.

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9 Based on a modelled overtopping scenario assessed with the emerging Updated Humber Strategy (HR Wallingford, 2014)

10 Gross Value Added – a standard measure of the value of goods and services produced in an area, industry or sector


13 Small and Medium Enterprises – Businesses that employ up to 50 and 250 people respectively


15 www.greenporthull.co.uk/hull-humber/

16 Value based on investments and opportunities identified at South Humber Gateway (including AMEP and ALP), Port of Grimsby, Greenport Hull and Paull, Lincolnshire Lakes and planned C-Gen power station identified in the SEP published by Humber LEP (2014). Includes £3bn of planned investment by the Chemicals industry.
This is supported by a University of Hull study into the Humber’s sustainable future, which highlights that development of port-centric logistics and green energy industries could be a potential ‘game changer’ for the region over the next 5 to 10 years, resulting in significant increases in GVA and more than 20,000 jobs. All local authorities support development for renewable energy as long as proposals are suitable and do not significantly impact on the landscape and environment.

The Green Port Hull, Able Marine Energy Park (AMEP) at Immingham and Port of Grimsby are gearing up to support the manufacture, operations and maintenance of windfarms in the North Sea, such as those planned at Dogger Bank and the Hornsea 1 Zones. At Grimsby Docks, ABP and North East Lincolnshire Council have contributed to a Flood Improvement Scheme that will realign flood defences and open up land for the Grimsby Enterprise Zone for future development by the renewables sector. Humber sites typically lie within 100km, less than a day's sailing, of 40% of the sites earmarked to meet UK's national offshore wind capacity and a key component of their development will be protection against flooding now and into the future.

The Estuary's extensive petrochemicals/chemicals sector is worth £6bn per year, providing raw materials for much of the UK energy sector supported by the Humber Ports. The Phillips 66 and Total refineries at Immingham provide approximately 27% of UK oil refining capacity. There are also chemical clusters specialising in a range of sectors including petrochemical refining, personal care, pigments/colours, paint and coatings, agrochemicals, fine chemicals, and inorganic and organic commodities to name a few. Speciality niche sectors contribute to the variety of the industry, including speciality gases, pharmaceuticals and biofuels/biomass processing.

Other industries such as engineering and manufacturing linked to Tata Steel and Guardian Industries (one of the world's largest manufacturers of float glass and fabricated glass products), healthcare technologies with large, market-leading companies such as Smith & Nephew, Reckitt Benckiser and Croda, and a growing creative and digital services industry also contribute significantly to GVA from the area and add to the variety of strategically important sectors operating from the Humber.

In 2011, ONS data showed that between 50% and 65% of GVA within the region came through production, manufacturing, distribution and transport and construction, much of which is directly linked to the existence of the ports and major industries around the Estuary and therefore needs to be located in the floodplain. Analysis by ABP suggests that in terms of direct, indirect and induced employment (employment facilitated by consumer spending by employees), the Humber Ports support in the region of 33,000 jobs.
The land at risk also contains critical transport links. The Strategy Area contains over 40km of Motorway, including nearly 30km of the M62 and 10km of the M18, and 140km of A-Roads. During the December 2013 storm surge event, flooding closed the A63 for 18 hours, with significant impacts felt locally. There are also nearly 3.5km of the A1077 within the area at flood risk, which is the sole route into the Cemex site at South Ferriby. Richard Brown CBE highlighted the priority that should be given to protecting critical links to ports, and specifically those of the Port of Immingham, in the Department of Transport’s review of transport resilience18.

There is a similar issue with railway links, as there are more than 150km of railway line within the Strategy Area at risk from flooding.

The routes affected are between North Ferriby and Hessle on the north bank, which is the principal route into Hull from the west, and all lines between Cleethorpes, Grimsby and Immingham, which is one of the primary means by which coal and biomass arriving at the Port of Immingham are distributed to the power stations inland.

There is approximately 115,000ha of land at risk. Of this, 85% is farmed Grade 1 to Grade 3 agricultural land providing a significant proportion of UK grown fruit and vegetables and employing almost 6,000 people19. On a national scale the area of arable land under cereals and glasshouse crops are significant at 8% and 9% respectively, though more significantly, the land use put to field vegetables represents 29% of the total UK area.

The figure below presents the location and distribution of the estuary’s key assets.

Figure 4: Key assets in the Humber Floodplain

18 Department for Transport (2014) Transport Resilience Review: A review of the resilience of the transport network to extreme weather events
Sea level rise and changing climate is inevitably a major concern within the Estuary. Areas that currently benefit from flood defences will see an increase in the chance of flooding. In and around Goole for example, maintenance of the existing level of protection would see a substantial increase in risk in almost all areas.

Indeed, the December 2013 event highlighted just how vulnerable Goole is to flooding of this nature and investment here will be needed earlier and at greater cost than the 2008 strategy identified.

Summary

It is clear that there is a strong case for the protection of homes. As the approval of the 2008 Humber Flood Risk Management Strategy shows, there is an undoubted commitment to invest in the provision of flood defences where there are benefits to domestic properties. However, in areas where there are fewer domestic properties, using current (Defra) funding criteria, the case is more difficult to make and more, if not all, of the cost of flood defences would be pushed onto commercial beneficiaries and others, delaying if not preventing action.

Taken together, however, there are interconnected and wide-ranging factors of national rather than local or regional importance that warrant a single national funding approach to the Humber Estuary Defences. Energy security and food security are overarching themes that stand out, as highlighted overleaf:
Energy Security

- Five power stations, providing 17% of UK electricity capacity\textsuperscript{20}
- A planned new C-Gen Gas-fired power station
- Transfer of 30% of UK coal demand to inland Power Stations that contribute a further 20% of UK electricity capacity\textsuperscript{21,20}
- Easington Gas Terminal lands 20% of UK natural gas demand\textsuperscript{21}
- Vulnerability of existing road and rail network
- Significant investment linked to green energy and offshore wind
- Deep Water Ports linked to Rotterdam and for servicing Offshore Wind Generation

Existing major energy assets and potential green energy and offshore wind development sites are, understandably, located in areas where there are fewer homes to attract flood defence funding. This is principally what makes the Humber particularly attractive to the energy and other industries; however, the continued operation of these energy assets is of national importance.

Power stations within the Humber (Salt End, Keadby, Killingholme, Immingham and South Humber) and inland power stations (Drax, Ferrybridge, Eggborough and Glanford Brigge) are intrinsically linked via their supply chains to the Humber Ports and specialised facilities for transferring coal and biomass from external suppliers. This reliance on port facilities will increase as these power stations continue to switch from coal to biomass.

The ability to transfer fuels to power stations is as critical to their operation as the ability to land and unload the fuel itself. All major railway lines connecting Humber Ports lie within the floodplain and sections of most major road links are at risk. The security of goods transfer to the power stations, which was highlighted in December 2013, when flooding at Immingham inundated isolated areas of railway infrastructure with water ingress reported to critical items of signalling and points that affected services to the Humber International Terminal (HIT) is a major concern. None of the power stations suffered a significant disruption in the supply of coal to their sites, with buffer stocks at the power stations allowing for the small hiatus in supply, however, a longer delay could have had significant repercussions.

With the Port of Immingham and the power stations investing heavily in infrastructure to handle biomass, the more intricate and expensive handling and storage facilities for coal means that the storage capacity of quayside and power station facilities will be reduced, resulting in a ‘just-in-time’ style delivery structure. This means that the biomass supply chain is leaner and more ‘hand-to-mouth’ than for coal and future disruption of the scale seen in December 2013 would have presented considerably more risk to the continuity of electricity supply to the UK National Grid.

Gas production and transfer facilities are generally more resilient to flooding than others because of the nature of the closed pressurised system. There is some vulnerability, however, as the buoyancy of pipelines buried in areas that are subsequently flooding can cause movement and damage to the pipeline and in extreme cases the buried pipeline can float\textsuperscript{22,23}. All National Grid pipelines from the Easington Gas Terminal pass through the floodplains of the Humber Estuary, particularly across the Sunk Island area west of Easington and to the north west of Immingham. There is national benefit from protecting areas that contain these pipelines.

Growth and Investment

- The Humber is already home to Centrica, RES and Siemens
- ABP and Siemens are investing £130m and £80m respectively in Green Port Hull to accommodate a new wind turbine manufacturing site and export facility
- The Humber Gateway offshore wind farm is underway with £736m investment from E.ON\textsuperscript{14}
- Able UK is investing £400m in its ports facilities locally to attract wind turbine manufacturers and the development of biomass energy generation
- The Humber Enterprise Zone is the largest in the country designated for Original Equipment Manufacturers (OEMs) and their supply chains
- The Humber is designated a Centre for Offshore Renewable Engineering (CORE)
- The region has secured £35m of Regional Growth Fund specifically for the growth of the renewable energy industry
- Dogger Bank and Hornsea 1, served by facilities operating out of the Humber, will provide a significant proportion of North Sea capacity\textsuperscript{24,25}.

\textsuperscript{21} www.greenporthull.co.uk/hull-humber
\textsuperscript{22} www.nationalgridconnecting.com/extreme-measures
\textsuperscript{23} www.publications.parliament.uk/pa/cm200708/cmselect/cmenvfru/49/8020403.htm
\textsuperscript{24} DECC (2011) UK Renewable Energy Roadmap
\textsuperscript{25} www.renewableuk.com/en/renewable-energy/wind-energy/offshore-wind/
The Humber LEP’s Strategic Economic Plan identifies significant planned investment in sites that will manufacture, operate and maintain renewable energy\textsuperscript{14}. These industries will require supporting services and businesses nearby and as such their development will represent a catalyst for the growth of whole industries to develop around them.

The Government has recognised the leading role the Humber is playing in the development of renewable energy. The planned investment is great news for the Humber area and could, according to the University of Hull (UoH), represent a step change in economic output of the region and contribution to the national economy. A UoH report highlighted that these growth industries could contribute an extra £5.65bn to £11.65bn per year to the UK economy by 2025, representing a 38-80% increase in GVA and over 20,000 jobs\textsuperscript{17}.

Not only will investment in flood defences in these areas secure the future of renewables manufacture and expansion of green energy in the Humber, it will significantly contribute towards the UK’s economy and support the delivery of the UK’s offshore potential. The Local Authorities consider that this investment will drive demand for training, increase skills and provide jobs, which will increase tax revenues and reduce reliance on social security benefits. Grimsby Institute of Further and Higher Education (GIFHE) is already running training targeted at jobs and skills in the Energy and Logistics Supply Industry. Growth in jobs is expected to increase inward migration and demand for housing and other services, such as leisure, which will contribute to a sustainable regional and national economy.

**Food and Fuel Security**

- Humber refineries responsible for 28% of UK capacity, which is largely distributed by road
- 96,121ha of agricultural land at risk of flooding, largely Grade 1 to Grade 3
- 29% of UK land growing field vegetables, 9% of UK land under glasshouse crops and 8% of UK arable land under cereals
- Approximately 11% of the UK’s foreign imports of food are via the Humber ports, including fish, palm oil, sugar and grain. Humber Ports also handle a significant proportion of fertiliser imports
- Some resilience within the Humber Ports to the landing of goods but some specialist equipment makes internal transfer within the Humber impossible and external transfer difficult

Refineries around the Humber Estuary are responsible for 28% of the UK’s crude oil processing capacity. The majority of refined product is loaded into tankers at Immingham Dock and distributed by road across the UK. Flooding poses a risk to the refinery, transfer infrastructure and the critical transport links required to distribute the product. Fuel distribution could temporarily cease or at least be significantly reduced to parts of the UK. Indeed, in December 2013 the west side of the Port of Immingham, which contains the Phillips 66 fuel distribution centre, was one of the worst affected areas with flooding to a depth of 3 or 4 feet.

The Humber Strategy area contains a large area of high quality agricultural land that contributes significantly towards the self-sufficiency of the UK in cereals, glasshouse crops and field vegetables. Tidal flooding would be significant, resulting in the loss of crops and a short term reduction in the productivity of the land because of the salt content of the flood water. This could cause price increases because of the need to increase imports to offset the national losses for at least the next growing season if not longer. With the uncertainty of stances taken at an international level for political leverage it is also essential to consider food security along with energy security.

As a modern and internationally connected society, the UK’s trading needs to stretch across the globe. Being an island nation, our balance of trade is substantially dependent upon the transit of seaborne goods through our ports. Some commodities moving through UK port facilities are nationally significant and any delays in their supply chains, particularly in the context of imports, can have deleterious implications for the UK economy.

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\textsuperscript{14} www.foodsecurity.ac.uk/issue/uk.html

\textsuperscript{17} http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=17782
Any supply chain is only as resilient as its most vulnerable element and it is acknowledged that nationally significant ports, which have the infrastructure and capacity to accommodate nationally critical commodities, are disproportionately vulnerable to a number of potential threats, including tidal flooding.

The 2013 surge was particularly damaging to the Port of Immingham. Apart from obvious physical and financial damage to buildings, cargoes and equipment, the port’s greatest vulnerability was its power transmission infrastructure. Around 40 substations within the port estate, supplying electricity to ABP’s facilities and to customers’ operations, were affected and the subsequent power supply disruption had a damaging effect upon all port operations. Points and signalling on critical railway lines serving the Humber International Terminal that transfers coal and biomass to inland power stations were affected.6 With up to 260 rail freight movements per week, the movement of goods from the ports is vital to nationally critical supply chains and external trade.

ABP’s tenants and port operators also experienced significant disruption. Of the facilities that suffered floodwater ingress, it was the sophisticated, process driven activities which fared the worst. For example, electronic control gear required for chemicals handling was rendered inoperable in December 2013. Terminals that engaged in more basic cargo movements, such as RORO28 or unit load activity, found that a very basic level of service was possible in the immediate aftermath because they are mainly based around mobile plant running on diesel power.

The Humber Ports between them facilitate the trade of a wide variety of goods and they are deeply embedded within critical supply chains for the automotive, petrochemical, agricultural, food production, construction and energy sectors. Together the annual contribution to GVA is estimated to be £2.2bn6.

As has been highlighted above, the movement of goods into and out of the Humber Ports and ancillary areas is equally reliant on the network of railway lines, A-roads and motorways around the Estuary. These networks are as much a critical part of the supply chain as the ports themselves and the land through which they pass should be given an equal level of consideration as the more obvious major infrastructure that they serve.

In his *Transport Resilience Review*18 Richard Brown CBE highlighted that:

‘the level of resilience sought [for a transport network] should be related to intensity of use, the availability of alternatives and the economic importance of the route or service.’

Richard Brown CBE went on to state that:

‘the more intensively used and economically or socially important a route or service, the shorter the disruption that is tolerable.’

One of the recommendations of the report is that a critical network of railways, highways, ports and airports be identified to receive prioritised strengthening of resilience, paying particular attention to protecting ‘single points of failure’ in networks and critical links to key airports and ports. This recommendation aligns with the objectives of this strategy and it is considered highly likely that most if not all Humber Ports and the sensitive transport networks serving them and the other major Estuary industries would fall within the critical network that should be prioritised. The Port of Immingham was particularly highlighted as requiring such prioritisation by the DfT Report.

**Human Health and Environment**

- 32 COMAH top-tier sites
- 29 COMAH lower-tier sites

The Control of Major Accident Hazards (COMAH) Regulations29 applies to operators of industries that manufacture, store or transport dangerous chemicals (including petrochemicals, pharmaceuticals and agrochemicals) and explosives in excess of threshold quantities30. The main aim is to prevent and mitigate the effects of those major accidents involving dangerous substances, such as chlorine, liquefied petroleum gas, explosives and arsenic pentoxide which can cause serious damage/harm to people and/or the environment.

The Humber Estuary contains COMAH sites which by the nature of the substances present would pose a significant hazard to people or the environment if they were released in the event of a flood.
COMAH regulations require that operators assess the risks to their sites, including from flooding, and that they have appropriate accident prevention policies and management systems, measures to prevent accidents and limit their consequences to people and the environment and emergency procedures in the event that there is an accident.

The COMAH Regulations require site operators to implement measures to reduce risks to a point where they are as low as reasonably practicable (ALARP). As such, and despite the measures taken by operators, there will remain a residual risk that there could be releases to the environment in tidal flooding conditions. The consequences of sea level rise and failure to invest in appropriate flood defences will increase the risk of flooding at sites such as this and change the risk profile at such sites, which will inevitably prompt a renewed view of whether a risk like that from tidal flooding is ALARP. Investment is required to prevent the residual risks from numerous sites like this from presenting a risk to people and the environment in the future.
2 Financial Summary - The Business Case

The following presents the emerging business case for a single settlement by Government in flood defences around the Humber Estuary. The business case is compatible with HM Treasury guidance on using the five case model3 and concludes that there are opportunities to significantly increase the benefits that can be realised around the Humber by providing a consistent level of protection to the whole estuary rather than just those areas that currently fall within the narrow Defra rules that operate without consideration of future economic growth.

To achieve this, the recommendation of this business case is that a commitment is made to:

- Provide an Estuary-wide programme of flood defence investment to deliver a 0.5% AEP (1 in 200 years) standard of protection
- Fund the programme under a singular cross-departmental/Treasury settlement
- Deliver the programme using local arrangements involving the Local Authorities, LEP, the Environment Agency and other funders
- Devolve funding to a local level programme pipe-line to deliver appropriate flexibility

2.1 The Strategic Case

2.1.1 Organisational Overview and Geographical Area

The Briefing Paper debated in Parliament in July and this Humber Strategy Summary is strongly supported by the six Humber local authorities31, as well as the Humber LEP. These organisations all share a vision of improved quality of place and opportunity that is supported by the delivery of flood defence programmes which provide the stability and security necessary to achieve that vision.

Private sector support input to this business case has come from Associated British Ports (ABP), a major operator and investor in the Humber and key port partner to a number of major businesses operating out of the region. ABP’s operations in the Humber are an intrinsic part of critical supply chains extending throughout the UK and their involvement in the preparation of this document is welcomed.

Wider private sector support and advice has been given through the Humber Local Enterprise Partnership Board members. This is especially important in understanding the local needs and perceptions of insurers, actuaries and investors. Objective technical, regulatory and environmental advice has been provided by the Environment Agency with the support of their consultants.

The Humber Region is centrally located on the east coast, equidistant from London and Edinburgh. The local authorities bordering the Estuary are varied, with East Riding the largest of the Humber Unitary Authorities. Hull is one of the most densely populated, which contrasts with North Lincolnshire and East Riding which are essentially rural with a low population density. North East Lincolnshire, East Lindsey District and Lincolnshire County Council make up the remaining authorities with a direct interest.

Key settlements include Kingston upon Hull, (including the Haltemprice Settlements, within the neighbouring local authority area this represents the third largest urban area in Yorkshire with 311,000 residents), Grimsby, Immingham, Cleethorpes and Goole, as well as Scunthorpe and Beverley.

The ports and heavy industry located in immediate hinterland areas around the Humber have evolved here because of the...
simultaneous benefit from coherent transport links (both terrestrial and maritime) and low population density and it is precisely because of these factors that the Estuary has achieved a position of economic importance.

2.1.2 Strategic Fit

Policy

The National Planning Policy Framework (NPPF) holds at its core a presumption in favour of sustainable development and it requires Local Authorities to positively seek opportunities to meet the development goals of their area. The core planning principles presented in the NPPF indicate that planning should, amongst other things, be a genuinely plan-led creative exercise to enhance and improve place and proactively drive and support sustainable economic development.

In applying the principles of the NPPF, the Local Authorities have identified areas of future investment in infrastructure, support services and housing needs to meet the requirements of their areas, many of which reflect the opportunities presented by the renewables industry but which require investor confidence in a stable and secure environment to invest. This will only be provided by immediate investment in flood defence infrastructure. For example, the development of the Enterprise Zone at Paull is reliant on initial investment in flood defence infrastructure to proceed.

All of the Humber Local Authorities recognise the need for flood defence investment and the opportunities provided by growth in the green energy sector. All have taken a position within their adopted or emerging Core Strategies to support their local economy by strengthening key employment sectors and clusters, such as the Ports, the petrochemicals industry and renewable energy. Similarly, all authorities support the proactive management of flood risk and the improvement of flood defences subject to appropriate compensation where there may be impacts on habitats and the environment.

Other Plans

The ambition of the Humber LEP’s 2014-2020 Strategic Economic Plan (SEP) is to maximise the potential offered by the Humber Estuary, leading to the Humber becoming a renowned national and international centre for renewable energy and an area whose economy is resilient and competitive. One of the five strategic enablers to achieving this ambition is flood risk and environmental management and the SEP highlights that the economic development of the Humber is reliant upon the stimulation provided by investment in flood and coastal erosion risk management that will create an infrastructure that supports growth.

The SEP states that improving flood defences in the Humber is critical to future economic growth and it highlights that flood risk is the most significant environmental barrier to development, investor risk and growth in the Humber. The importance of improvements to flood defences cannot therefore be overstated.

The Humber LEP has identified key activities to achieve strategic priorities. These include investment in flood defences to reduce the risk of flooding and maximising the benefits of flood defence schemes by linking them with new developments and growth proposals, such as with the Grimsby Docks Flood Defence Scheme, which protects 14,000 properties, provided 350 jobs and provided the necessary infrastructure to facilitate upwards of £1bn of future investment.

The SEP is supported by an Investment and Delivery plan that sets out a total investment of £4bn over the coming years. Within that planned investment are 11 projects addressing flood risk in the Humber that will:

• provide employment
• enable development of Enterprise Zones
• reduce risk to port and power infrastructure
• reduce the risk of flooding to more than 50,000 households
• contribute £275m annually towards regional GVA

The value of these planned investments is £144m; however, the source of funding for approximately a third is not confirmed.
2.1.3 The case for change

Current Defra and Treasury funding rules focus on protecting existing domestic properties and do not fully consider the significantly greater additional benefit that can be obtained in unique areas such as the Humber – additional benefits that massively outweigh the investment required to provide that benefit. As highlighted later, and even without considering consequential losses, the benefits from flood defence investment significantly exceed the cost of implementation.

The approved 2008 Humber Flood Risk Management Strategy supports investment in flood risk management around the Humber Estuary. That strategy identified that without improvement rising sea levels and aging flood defences would result in the ultimate failure of defences and the flooding of land and property. The hydraulic connectivity of the estuary was also highlighted, requiring investment along significant lengths. The hydraulic connectivity of the estuary was also highlighted, requiring investment along significant lengths frontage to ensure appropriate management of the risks. Because of much of the Humber Levels are so low and on reclaimed land, it is extremely difficult to protect discrete areas without flood waters finding a way “around the back”. Essentially in general terms the most practical engineering proposition is to protect the entire bank.

An Updated Humber Flood Risk Management Strategy is in development; however, it will not be published until 2015. In line with current Defra and Treasury rules, it will seek to provide a flood risk management approach that delivers a level of protection to the estuary that is agreed by Local Authorities and funded by FDGiA and third party contributions.

The recorded view of elected representatives on all the Humber local authorities and members of the Humber LEP is that a consistent Estuary-wide level of flood protection is critical. Whilst it is recognised that protection of existing domestic property is currently the main driver for flood defence investment, a unique combination of nationally significant factors presents a compelling case for protecting the whole estuary to a high and equal standard. By investing in a consistent, estuary-wide level of flood defence, the Government can demonstrate to residents, business and investors across the UK that it is committed to enhancing their safety and supporting growth and sustainability by:

• protecting home grown agribusiness and the security of food imports
• maintaining and protecting the continuity of trade and distribution of good across the UK
• protecting people and the environment against the direct and potentially harmful consequences of flooding

The Humber is on the brink of an exciting and transformational period of economic activity, driven by major investment in and around the Estuary in green energy and offshore wind. The resilience to tidal flooding of the ports and the transport networks upon which industry relies and the protection of land earmarked to support renewables development is vital to the realisation of this investment and the contribution it will make to both the regional and national economy through investment, job creation and tax revenues.

The network of road and rail permits the distribution of goods throughout the region and country. Further, they make possible the delivery of goods to the ports and industries within the area that are then exported elsewhere. The Government will already be aware of recommendations from Richard Brown CBE that critical transport networks should be prioritised, including ports and the road and rail links upon which they rely, and considered equally when assessing the level of resilience required.

Major assets and industries are at risk, including power stations and refineries, petrochemicals and pharmaceuticals, along with significant areas of high quality agricultural land. Land required for habitat compensation and mitigation is distributed around the estuary, warranting a whole-estuary approach to meeting our legal obligations towards the environment.

What good is protecting the homes of people, when their places of work, the industries that support the wider economy and the land that feeds them are not protected to the same standard? Neither the cities nor the industries can be relocated because of their need to be on the Estuary. Not affording these areas protection will certainly see them flooding in future, leading to insecurity and uncertainty that will drive people and jobs away from the region. The local authorities consider that this would result in greater negative impacts on the region and the UK economy in the long term, for example from increases in people claiming benefits and reductions in tax revenue, than investment now in defences that will prevent these impacts.

For all of these reasons, an Estuary-wide standard of protection is critical to the management of flood risk within the Humber.

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35 Flood Defence Grant in Aid funding – Capital grants towards the cost of building new flood and coastal defences
and this is the principal objective of the Local Authorities, Humber LEP and Elected Members that represent the constituents and businesses within the region. The current Defra and Treasury funding rules would not be able to robustly address these issues.

Finally, in the current National Infrastructure Plan the Government provides a long-term funding settlement for flood defences of £2.3bn over the 6 years between 2015 and 2021. The funding required for the Humber Estuary alone would stretch that funding and potentially limit delivery of schemes by Defra elsewhere.

Given the extent of nationally important and wide ranging benefits to people, business, industry, climate adaptation and transport resilience, and acknowledging the limited funding available over the next 6 years via Defra and constraints posed by its current funding rules, a single cross-departmental/ Treasury source and mechanism of funding will be necessary to achieve the required outcomes for the Humber.

Spending objectives

The Humber Local Authorities/Humber LEP are seeking from Government an outcome that:

- provides an appropriate level of protection to nationally critical energy and petrochemical assets and port infrastructure around the Humber
- secures future investment in green energy and offshore wind
- protects homes, businesses and agriculture around the estuary
- enhances regional and national food security
- protects and creates jobs
- has sea level rise and climate change adaptability built in.

Existing arrangements

Existing spending rules and funding availability will limit the realisation of benefits across the Humber to the protection of existing domestic properties and existing surrounding business. Funding arrangements may, with external contributions, support the protection of major energy and infrastructure assets and would provide for future adaptation for climate change in those locations; however, as outlined in the earlier sections of this document, the relatively limited extent of these areas within the Humber would mean that adoption of existing funding mechanisms to finance the programme of flood risk management required in the Humber would fall far short of securing the full range of benefits available from protecting the whole of the Estuary.

Leaving aside the potential for significant loss of life, there is clearly a nationally important case for a single settlement from Government for improved flood defences on the Humber. The current inflexible rules that focus on protection to existing domestic properties with less weight to critical assets clearly demonstrate major gaps in the current system, and present a compelling case for either urgent re-evaluation of those funding mechanisms or a single settlement for the Humber.

The features that make the Humber so attractive to large industry, energy production and which have resulted in it becoming a hub for national and international imports and exports are the same features that limit the availability of funding for flood risk management to protect these nationally critical assets. Yet, from the events of December 2013, it is now well understood that a major flood event, perhaps one only marginally worse than that experienced, or where the timing was slightly less favourable, or where the winds came from a different direction, could result in enormous disruption of the facilities, infrastructure and networks that struggle to warrant the investment required.

A similar event in future could potentially impact national electricity production by reducing production and preventing the distribution of vital fuels from ports to power stations. It could disrupt the distribution of gas by affecting the National Grid pipelines which cross the floodplains in areas currently afforded the lowest level of protection around the estuary. And it could impact the refining of crude oil and the distribution of refined products to petrol pumps throughout the country, bringing commerce to a halt. It could impact on not just national, but global supply chains of manufactured products.

A similar event in future would not only affect energy, food and fuel, but could also reduce the ability to distribute most other commodities arriving at the ports which are taken for granted in everyday life. In the same way it would limit the export of goods manufactured in this country. It could prevent the use of rail and road networks to move goods to and from the ports and damage those networks in the process, requiring additional time to repair and restore services back to normal.

A similar event in future could destroy crops and reduce productivity of the soil for a number of years, resulting in increases in the price of food as more imports are required. The same event could disrupt imports of food into Ports in the...
short term, resulting in an amplified impact on short-term food prices.

Worst of all, any significant tidal event will almost certainly lead to loss of life. As well as the many villages at risk, the urban centres of Hull, Goole, Grimsby and Cleethorpes are at risk. If a similar future event occurred in the middle of the day then there would have been a much greater risk to life. It is incredible that no person died or was seriously injured in the December 2013 event given that it happened during the hours of darkness. The two examples below provide an indication of rural residents’ experiences:

“\textit{The first we knew of the danger was my friend phoning to ask if we had evacuated, 10 minutes later the Environment Agency called to say get out but it was too late as water was now running down the road. This quickly became a torrent! The kids were hysterical screaming “we’re going to die, we’re going to die” as the water rose to our drive. Within that time we managed to get some of our possessions upstairs, whilst the children were hyperventilating and going hysterical. It was an awfully scary and emotional time and as the water continued to roar down the road it brought with it lots of heavy debris.}”

\textit{Blacktoft Resident, describing the 5th December}\footnote{5}

“\textit{I’d travelled approximately the 400 yards through the village to within 20 yards of the entrance to the [a friend’s] drive, at this point a large wave hit my car and whilst I was still on the phone and I explained what was happening. The water rose quickly over the bonnet of my car and within seconds the call ended as obviously the power to the cars hands free cut out because the car was underwater. I tried to open the car door but could not as the force of water was too great, luckily the window opened so I managed to get out and swim/wade across to the property opposite the drive entrance as the water was by now chest high.}”

\textit{Blacktoft Resident, describing the 5th December}\footnote{5}

Ongoing work has shown that without significant investment in the Humber defences the future risk to life from flooding will increase significantly. Research shows that a 24 hour warning period to enact evacuation procedures is an effective solution to greatly reducing risk to life. Unfortunately, due to the nature of tidal flooding, and the size of some of the cities around the Humber there would not be sufficient warning to evacuate, and enacting these procedures may even increase risk to life. Whilst the presence of defences is only ever part of the solution to managing the risk from flooding, in the case of the Humber it is the only method of effectively reducing the risk to life of people in the flood plain.

In isolation, few of these consequences attract sufficient funding under current rules and funding formula to create a sufficiently strong case for investment. However, at the estuary scale, and based on the recent evidence from the tidal surge, each of these consequences is integral to the UK economy and together represent an integrated and compelling argument for additional investment.

\textbf{Business Needs – current and future}

The current and future needs of the Humber are that a 0.5\% AEP (1 in 200) year standard of protection be provided around the whole estuary taking account of the impacts of climate change for a reasonable horizon. This would address all of the outcomes sought by the Humber authorities, it would improve the effectiveness of the flood defences around the Estuary and it would facilitate the realisation of significantly greater benefit to the UK and regional economy.

Businesses and investors need confidence in their environment in order to commit to development which will secure existing jobs and create new ones. A 0.5\% AEP level of protection will provide the security necessary to provide that confidence.

As highlighted by the testimony of residents above, people also need to feel security of place. With EA/Defra guidance highlighting the costs to the nation from the additional stress caused from living in an area known to be at flood risk\footnote{34}.
The direct benefit of damages avoided by providing this level of protection is in the order of a factor of five higher than the present value cost of the works over the benefit period, which provides a compelling case on its own. Taking into account the indirect and the future impact, the factor is in excess of 8. A wider benefit i.e. that associated with avoidance of consequential losses to businesses within the estuary and across the UK, and the increase in investment and GVA that would follow, make the case even more compelling.

Scope and service requirements
On the basis of the analysis undertaken, the scope for the business case is the protection of existing properties, businesses and industry, the ability to adapt to climate change, the protection of major energy and infrastructure assets, transport links and land use, and the securing of future investment in the region.

Within this scope the service requirements identified are:

- Do Nothing
- Do Minimum – Maintain defences to their current standard
- Do Something – Minimum, a 0.5% AEP Standard of Protection to 2057 with the capability to adapt to climate change
- Do Something – Maximum, a 0.5% AEP Standard of Protection to 2112

<table>
<thead>
<tr>
<th>Option</th>
<th>What</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do Nothing</td>
<td>No further or capital spending into the future</td>
<td>Maintenance of natural processes and habitats</td>
<td>Eventual loss of viable network of defences</td>
<td>Increased risk to existing properties, businesses, infrastructure and nationally critical assets Reduced energy and food security and increasing vulnerability of fuel supplies across the UK Discourage planned investment from the region The present value cost to the UK economy of doing nothing up to 2057 is equivalent to £6.2bn</td>
</tr>
<tr>
<td>Do Minimum – Maintain defences to their current standard</td>
<td>Maintain existing revenue funding of maintenance, including repair of breached or overtopped defences No new capital investment in flood defence infrastructure</td>
<td>A reduction in capital funding of flood defence works</td>
<td>Increasing maintenance burden No climate change adaptation Eventual loss of viable network of defences Active mitigation and/or compensation for any impacts on Water Framework Directive and Habitats Directive objectives would need delivery via alternative and less cost effective means</td>
<td>Sea level rise would eventually place increasing numbers of properties, businesses, infrastructure and nationally critical assets at increased flood risk Reduced energy and food security and increasing vulnerability of fuel supplies across the UK Discourage planned investment from the region</td>
</tr>
</tbody>
</table>
### Benefits and Risks, Constraints and Dependencies

The following table summarises the benefits associated with the both levels of service with the key difference being that the Maximum service level provides all benefits for double the period.

<table>
<thead>
<tr>
<th>Option</th>
<th>What</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do Something – Minimum</td>
<td>No further or capital spending into the future</td>
<td>Protection against significant flood events for a period of 42 years</td>
<td>Funding beyond 2057 uncertain</td>
<td>Reduced risk to existing properties, businesses, infrastructure and nationally critical assets to 2057</td>
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<tr>
<td></td>
<td></td>
<td>Increased level of security to people, property, business and industry</td>
<td></td>
<td>Increased energy and food security</td>
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<tr>
<td></td>
<td></td>
<td>Security to investors to support and facilitate the growth in the region</td>
<td></td>
<td>Reduced vulnerability of fuel supplies across the UK</td>
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<tr>
<td></td>
<td></td>
<td>Climate change adaptation</td>
<td></td>
<td>Delivery of planned investment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Addresses environmental obligations</td>
<td></td>
<td>The present value of damages avoided to 2057 is £5.88bn</td>
</tr>
<tr>
<td>Do Something – Maximum</td>
<td>Construction and maintenance of flood defences around the Estuary to a 0.5% AEP standard of protection up to 2112</td>
<td>Protection against significant flood events for a period of 98 years,</td>
<td>Funding beyond 2112 uncertain</td>
<td>Reduced risk to existing properties, businesses, infrastructure and nationally critical assets to 2112</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increased level of security to people, property, business and industry</td>
<td></td>
<td>Energy and food security</td>
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<tr>
<td></td>
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<td>Security to investors to support and facilitate the growth in the region</td>
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<td>Security of fuel supplies</td>
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<td>Climate change adaptation</td>
<td></td>
<td>Delivery of planned investment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Addresses environmental obligations</td>
<td></td>
<td>The present value of damages avoided to 2112 is £10.28bn</td>
</tr>
</tbody>
</table>

**Benefits**

- **Protection of nationally critical energy, petrochemical and port infrastructure**
- **Facilitation of future investment in green energy, offshore wind and supporting services**
- **Protection of existing property and businesses**
- **Protection of critical transport links, gas pipelines, agricultural land and food security**
- **Increased confidence in security of future investments**
- **Increased growth within region**
- **Short-term reduction in maintenance levels**
- **Reduced human health impacts and stress associated with flood risk to 2057**

**Class**

- Strategic
- Operational
- Low
- Medium

**Value**

- High

**Timescale**

- Long
- Short

**Outcome**

- Direct economic and indirect financial benefit from avoidance of direct and consequential damages at a national scale
- Direct economic and indirect financial benefit from investment
- Direct economic and indirect financial benefit from avoidance of direct and consequential damages
- Direct economic and indirect financial benefit from avoidance of direct and consequential damages
- Direct economic and indirect financial benefit from increased GVA
- Direct benefit from lower maintenance levels
- Indirect intangible benefits
Business Risks

The principal risk is divergence from current Defra and Treasury rules on flood defence investment spending. Although the case is clearly undeniable and favourable relative to more advanced but less beneficial nationally important schemes, there are political ramifications of having to justifying additional investment outside of those rules. The risk is that this would set a precedent for other areas to bid for extra funding.

From a political perspective, the outcome of the spending aligns with objectives to support growth in areas that need it and which have historically performed below the national average in terms of GVA. The outcome also supports the interests of British business, placing them at the forefront of the expansion of renewables at the same time as increasing skills, securing and creating jobs and making existing properties and business safer.

There is a precedent for extra funding (albeit on a smaller scale, but with significantly less benefits) to support growth. As the Environment Agency’s programme of work for 2014/15 indicates, there are 34 schemes identified as being part of the Growth/Acceleration Scheme that benefitted from £120 million extra investment in flood defence spending announced in the 2012 Autumn Statement. Of these, nine schemes, including Exeter Flood Defence Scheme and Leeds City Flood Alleviation Scheme, have received additional funding in order to promote local economic growth or regeneration whilst a further 25 schemes received additional funds as a one-off boost to the existing programme of work.

There may also be a change of political environment after the 2015 elections, with the risk of the withdrawal of any spending commitment. It is anticipated on the basis of the cross-party support for this business case that all political parties will continue to support the principle of investment in flood defences and the securing of future investment and growth within the area.

Service Risks

There are risks associated with design, build, financing and operation of the new flood defences, however, the details of this can’t be known in detail at this stage. The nature if not the magnitude of these risks is well understood by the risk management authorities who deliver investment in flood defences and who would be responsible for the delivery of the flood defences that would be funded by the spending proposals.

The mechanisms of delivery are discussed later, however, the risks are to be tightly controlled through project assurance processes, programme management mechanisms and project management methods such as the use of PRINCE2©. Changes in delivery will be managed through framework and contract arrangements. An allowance for these risks is budgeted within the business case through the application of Optimism Bias, as per HMT’s The Green Book.

External Environmental Risks

There are external environmental risks that are outside of the control of the delivery partners, such as the legislative and the planning environment during delivery. Management of these risks will be delivered through working with delivery partners and regulators to identify and understand the implications of changing legislation and planning requirements on delivery processes and objectives and to manage those implications within the programme of delivery. The flexibility offered by local delivery arrangements, for example via a local assurance framework, could provide the necessary scope to ensure that external risks can be managed in a cost effective manner whilst still meeting spending objectives and critical success factors.

Given the size of the programme, it may warrant delivery as a major infrastructure project, in a similar manner to roads. It is noted that the Planning Inspectorate does not have a planning lead for Flood Risk and Coastal Erosion, so early dialogue may well be necessary, including with the Environment Agency’s team delivering their Thames Estuary Phase 1 portfolio.

A change in energy policy, for example a shift away from renewables, represents a risk to the benefits achievable as businesses will no longer have the necessary certainty of future support. Whilst it is a risk, it is considered that there will remain sufficient justification for an appropriate energy mix to power the UK and sufficient commitment for the schemes currently being planned within the North Sea to maintain the current levels of interest around the Humber.

Constraints
Excluding divergence from current Defra and Treasury rules on flood defence investment spending and the availability of committed funding for flood defence spending presented in the National Infrastructure Plan 2013, the principal constraint to the delivery of the spending objective is the need to comply with European Union (EU) and World Trade Organisation (WTO) procurement rules. These requirements would be met by delivery through existing frameworks for flood risk and coastal erosion management engineering services.

Dependencies
The successful delivery of spending objectives is dependent upon successfully negotiating the planning system, which will be a process that is supported by each of the risk management authorities in the early phase of delivery. The Humber Authorities have the advantage that they are all unitary authorities with Lead Local Flood and Planning Authorities sitting within the same governance which means that overarching strategic objectives are already well defined.

There is a dependency on the commitment of business partners to invest in the opportunities that the Humber provides, particularly in relation to the expansion and delivery of renewables within the North Sea. Certainty of project pipeline will improve partnership funding opportunities.

There are dependencies on the availability and suitability of an existing framework through which to deliver the programme (if that is the preferred option) and with the capacity on the supply side given the imminent implementation of projects such as TEP138 and HS2. These will affect the delivery programme rather than the level of service sought.

The is also a dependency on the identification and provision of compensatory habitats to offset future direct losses of estuarine habitats as a result of building higher flood defences and from coastal squeeze. This is a UK legislative requirement and is delivered before construction commences. It will be important therefore to update the previously adopted Habitats Regulations and Water Framework Directive Assessments.

2.2 Economic Case
2.2.1 Critical Success Factors
The following attributes that are essential to the successful delivery, referred to as the Critical Success Factors (CSFs), have been identified as the following:

- Provides an appropriate level of protection to nationally critical energy and petrochemical assets and port infrastructure around the Humber, including their critical transport links
- Secures future investment in green energy and offshore wind
- Protects homes, businesses and agriculture around the estuary
- Enhances national food security
- Protects people and the environment
- Sea level rise and climate change adaptability
- Aligns with national, regional and local policies and strategies
- Maximises value for money
- Minimises associated risks
- Achievable with existing skills and through existing procurement mechanisms
- Local control of spending
- Aligns with supply side capacity and capability
- Affordability

2.2.2 Options
The options considered include:

Scope Options
- Do Nothing
- Maintain Status Quo (Do Minimum)
- Do Something – see Scope and Service Requirements, above, and Service Solutions, below

Service Solution Options
- Provide funding and protection in line with current Defra and Treasury guidelines
- Provide additional funding outside of the current Defra and Treasury guidelines and Estuary-wide protection to a 1 in 200 year standard of protection.

38 Thames Estuary Project – The management of flood risk within the Thames Estuary to 2100
39 High Speed 2 Project – The construction of High Speed rail between London and stations in the Midlands and the North.
Service Delivery Options

- Use existing compliant consultancy and contract frameworks, e.g. WEM, YORhub
- Introducing a new lot through a compliant framework specifically for the Humber Works.
- Private finance initiative (PFI) – Construction by private consortia

Implementation Options

- Rolling programme over 10 years – very tight but one that aligns with offshore development targets and short term supply chain investor requirements.
- Rolling programme over 17 years – realistic, giving more weight to planning needs and environmental obligations
- Phased delivery

Funding Options

- Private finance – e.g. PFI
- Public finance – Funded by HM Treasury
- Central Funding – Control on how funding spend centralised
- Local Funding – Spending controlled at a local level

2.2.3 Summary Assessment of Options Factors

Scoping Options

<table>
<thead>
<tr>
<th>Description Of Option</th>
<th>Do Nothing</th>
<th>Maintain Status Quo</th>
<th>Do Something</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spending Objectives</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protects nationally critical energy and petrochemical assets and port infrastructure</td>
<td>x</td>
<td>?</td>
<td>✓</td>
</tr>
<tr>
<td>Secures future investment in green energy and offshore wind</td>
<td>x</td>
<td>?</td>
<td>✓</td>
</tr>
<tr>
<td>Protects homes and businesses</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Protects agriculture</td>
<td>x</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Enhances national food security</td>
<td>x</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Protects people and the environment</td>
<td>x</td>
<td>?</td>
<td>✓</td>
</tr>
<tr>
<td>Adaptable to sea level rise and climate change</td>
<td>x</td>
<td>x</td>
<td>?</td>
</tr>
<tr>
<td><strong>Critical Success Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategic Fit</td>
<td>x</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td>Maximises value for money</td>
<td>x</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td>Minimises associated risks</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Achievable with existing skills and through existing procurement mechanisms</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Local control of spending</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Aligns with supply side capacity and capability</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Affordability</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Summary</td>
<td>Discounted</td>
<td>Discounted</td>
<td>Preferred</td>
</tr>
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</table>
## Service Solution Options

<table>
<thead>
<tr>
<th>Description Of Option</th>
<th>Funding/Protection In Line With Defra/Treasury Rules</th>
<th>Funding Outside Of Defra/Treasury Rules, 1 In 200 Year Protection Estuary-Wide</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spending Objectives</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protects nationally critical energy and petrochemical assets and port infrastructure</td>
<td>?</td>
<td>✓</td>
</tr>
<tr>
<td>Secures future investment in green energy and offshore wind</td>
<td>?</td>
<td>✓</td>
</tr>
<tr>
<td>Protects homes and businesses</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Protects agriculture</td>
<td>?</td>
<td>✓</td>
</tr>
<tr>
<td>Enhances national food security</td>
<td>?</td>
<td>✓</td>
</tr>
<tr>
<td>Protects people and the environment</td>
<td>?</td>
<td>✓</td>
</tr>
<tr>
<td>Adaptable to sea level rise and climate change</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

## Critical Success Factors

| Strategic Fit | ✓ | ✓ |
| Maximises value for money | ✓ | ? |
| Minimises associated risks | ✓ | ? |
| Achievable with existing skills and through existing procurement mechanisms | ✓ | ✓ |
| Local control of spending | ? | ? |
| Aligns with supply side capacity and capability | ✓ | ✓ |
| Affordability | ✓ | ? |

## Service Delivery Options

<table>
<thead>
<tr>
<th>Description Of Option</th>
<th>Existing Frameworks</th>
<th>A New Lot Through A Compliant Framework Specifically For The Humber Works</th>
<th>Pfi</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Critical Success Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategic Fit</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
</tr>
<tr>
<td>Maximises value for money</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Minimises associated risks</td>
<td>?</td>
<td>?</td>
<td>✓</td>
</tr>
<tr>
<td>Achievable with existing skills and through existing procurement mechanisms</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
</tr>
<tr>
<td>Local control of spending</td>
<td>?</td>
<td>✓</td>
<td>?</td>
</tr>
<tr>
<td>Aligns with supply side capacity and capability</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
</tr>
<tr>
<td>Affordability</td>
<td>?</td>
<td>?</td>
<td>✓</td>
</tr>
<tr>
<td>Summary</td>
<td>Possible</td>
<td>Preferred</td>
<td>Possible</td>
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### Implementation Options

<table>
<thead>
<tr>
<th>Description Of Option</th>
<th>Rolling Programme Over 10 Years</th>
<th>Rolling Programme Over 17 Years</th>
<th>Phased Delivery</th>
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<tr>
<td><strong>Critical Success Factors</strong></td>
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<tr>
<td>Strategic Fit</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
</tr>
<tr>
<td>Maximises value for money</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Minimises associated risks</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Achievable with existing skills and through existing procurement mechanisms</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Aligns with supply side capacity and capability</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Affordability</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Summary</td>
<td>Possible</td>
<td>Preferred</td>
<td>Discounted</td>
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### Funding Options

<table>
<thead>
<tr>
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<th>Private Finance</th>
<th>Public Finance</th>
<th>Central Funding</th>
<th>Local Funding</th>
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<tbody>
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<td><strong>Critical Success Factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategic Fit</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Maximises value for money</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Minimises associated risks</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
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<tr>
<td>Achievable with existing skills and through existing procurement mechanisms</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Aligns with supply side capacity and capability</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Affordability</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Summary</td>
<td>Possible</td>
<td>Possible</td>
<td>Possible</td>
<td>Preferred</td>
</tr>
</tbody>
</table>

### Options Summary

<table>
<thead>
<tr>
<th>Category Of Choice</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
<th>Option 4</th>
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<tr>
<td>Scoping</td>
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<td>Discounted</td>
<td>Preferred</td>
<td></td>
</tr>
<tr>
<td>Service Solution</td>
<td>Possible</td>
<td>Preferred</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Delivery</td>
<td>Possible</td>
<td>Preferred</td>
<td>Discounted</td>
<td></td>
</tr>
<tr>
<td>Implementation</td>
<td>Possible</td>
<td>Preferred</td>
<td>Discounted</td>
<td></td>
</tr>
<tr>
<td>Funding</td>
<td>Possible</td>
<td>Possible</td>
<td>Possible</td>
<td>Preferred</td>
</tr>
</tbody>
</table>
2.2.4 Preferred Solution

Based on the analysis undertaken, the preferred solution, that will meet the spending objectives set out in Section 2.2.1 above is:

- Provision of an Estuary-wide programme of flood defence investment providing a 0.5% AEP (1 in 200 years) standard of protection
- Delivery using a new lot through a compliant framework or new compliant framework
- Delivery over a programme that meets legislative requirements whilst maximising wider spending targets
- Financed by Public sources with some private contributions appropriate to the scale of the project
- Funded as a single cross-departmental/Treasury settlement with a programme managed at a local level to provide flexibility, efficiency and increased prospects of partnership funding

A solution that provides all of the above would meet all critical success factors set out above for the Humber and provide the greatest benefit to the UK economy. It will also increase the prospect of leveraging additional private sector contributions in line with partnership funding objectives.

2.2.5 Economic Appraisal of Costs and Benefits

An assessment of the costs and benefits of the ‘Do Nothing’ and the Preferred ‘Do Something’ scenarios have been undertaken by the Environment Agency’s consultants and the results are briefly summarised for the Minimum service requirement and the Maximum service requirement below.

Minimum service requirement Benefits and Costs to 2057

<table>
<thead>
<tr>
<th>Economic Factor</th>
<th>Do Nothing</th>
<th>Do Something - Intermediate 1 In 200 Standard Of Protection To 2057</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PV capital costs £m</td>
<td>£0</td>
<td>£728</td>
</tr>
<tr>
<td>PV stoning costs £m</td>
<td>£0</td>
<td>£19</td>
</tr>
<tr>
<td>PV maintenance costs £m</td>
<td>£0</td>
<td>£26</td>
</tr>
<tr>
<td>Optimism bias adjustment (66%) £m</td>
<td>£0</td>
<td>£510</td>
</tr>
<tr>
<td>Total PV Costs £m</td>
<td>£0</td>
<td>£1,283</td>
</tr>
<tr>
<td>Benefits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PV monetised flood damages £m</td>
<td>£6,199</td>
<td>£323</td>
</tr>
<tr>
<td>PV monetised flood damages avoided £m</td>
<td>-</td>
<td>£5,877</td>
</tr>
<tr>
<td>Benefits-Cost Ratio</td>
<td>-</td>
<td>4.58</td>
</tr>
</tbody>
</table>

40 The Briefing Paper debated in July proposed a 10 year programme of construction. Further assessment of delivery requirements have highlighted that whilst it is possible to deliver this amount of spending per year, given the competition for supply side resources with TEP1 and HS2, as well as the need to meet UK environmental legal obligations, a 10 year programme is now considered optimistic. The options appraisal reflects these constraints.

41 The table presents costs and benefits in Present Value terms. As such the values are discounted for the appropriate period in line with Green Book requirements. Values in Cash terms are discussed in Section 2.4.
Maximum service requirement Benefits and Costs to 2112

<table>
<thead>
<tr>
<th>Economic Factor</th>
<th>Do Nothing</th>
<th>Do Something - Intermediate 1 in 200 Standard Of Protection To 2112</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PV capital costs £m</td>
<td>£0</td>
<td>£853</td>
</tr>
<tr>
<td>PV stoning costs £m</td>
<td>£0</td>
<td>£46</td>
</tr>
<tr>
<td>PV maintenance costs £m</td>
<td>£0</td>
<td>£33</td>
</tr>
<tr>
<td>Optimism bias adjustment (66%) £m</td>
<td>£0</td>
<td>£630</td>
</tr>
<tr>
<td>Total PV Costs £m</td>
<td>£0</td>
<td>£1,514</td>
</tr>
<tr>
<td><strong>Benefits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PV monetised flood damages £m</td>
<td>£10,628</td>
<td>£352</td>
</tr>
<tr>
<td>PV monetised flood damages avoided £m</td>
<td>-</td>
<td>£10,276</td>
</tr>
<tr>
<td><strong>Benefits-Cost Ratio</strong></td>
<td></td>
<td>6.79</td>
</tr>
</tbody>
</table>

The economic analysis shows that there is an overall positive benefit from both the Minimum and Maximum service requirements. Assessment of incremental benefit and cost, which is an assessment of the ratio of additional benefits (approximately £4.4bn) to additional costs (£231m) from the more expensive Maximum level of service option, indicates that the Maximum level of service provides both a greater benefit to cost ratio and provides an incremental BCR\(^{42}\) of 19. This indicates that the Maximum level provides both greater value for money and for every additional pound invested than the Minimum level of service option provides 19 times more benefit.

The costs presented refer to a traditional engineering approach for flood defence and are indicative of the higher end of cost estimates for the levels of service sought for the Humber. The Local Authorities and Environment Agency recognise that there may be opportunities to provide equivalent levels of service, safety and resilience at a lower cost using less traditional engineering approaches. The levels of service provided are critical to the maximisation of benefits within the Estuary; however, alternative approaches at lower cost are welcomed.

2.2.6 Distributional Analysis

Information provided by the Environment Agency’s Strategy consultants indicates that approximately 50% of dwellings within the floodplain are located within the 20% most deprived areas within the UK, as defined by the Government’s Indices of Multiple Deprivation. A Do Nothing scenario will therefore have a disproportionate impact on the most deprived locations within the floodplain, whilst the Do Something option will have the opposite outcome and benefit the most deprived areas more than others.

2.2.7 Optimism Bias

Optimism bias has been incorporated into the present value cost estimates at a value of 66%, which is in line with the upper level for non-standard Civil Engineering capital expenditure that is set out in HMT’s The Green Book\(^{37}\) and based on the average historic optimism bias found at the outline stage of traditionally procured projects. The typical range of optimism bias for civil engineering projects, as per the Green Book, is 44% to 66%.

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42 Benefit Cost Ratio – the Present Value of damage avoided (Benefit) divided by the Present Value of Costs.
2.2.8 Risk Assessment and Sensitivity

The economic appraisal presented includes an optimism bias of 66% which accounts for uncertainty relating to procurement, design complexity and environmental impacts, the inadequacy of the business case, funding availability, poor project intelligence and environmental characteristics and external influences such as economics, legislation and technology.

At a strategy level there are inevitably generalisations made with respect to the damage calculations applied through depth-damage curves to properties and land values/gross margins of agriculture, though these often balance out. There are also uncertainties associated with cost estimates, though these draw on relevant local flood defence construction schemes and up-to-date unit costs. A list of costing assumptions was made available from the Environment Agency’s consultants highlighting the assumptions made in developing costs for defence raising, replacement, maintenance and stoning43.

Key risks relate to difficult ground conditions, the degree of specialist work to tie in new works to old infrastructure and there are uplifts to account for managed realignment, flood storage, Water Framework Directive works and increases in cost due to major service crossings. No information on the sensitivity of the cost estimates to uncertainties or other factors is available; however, the sensitivity of the cost and damage estimates to climate change between 2057 and 2112 can be seen in the tables above.

2.3 Commercial Case

2.3.1 Procurement Strategy

There are a number of existing frameworks managed by the Environment Agency and the Local Authorities, see below, that could in principle be used to deliver these services. In most cases they are not set up to deliver a programme of works of this scale and any scheme that exceeds a high value such as £100m would be delivered outside of the framework. As such the preferred solution is a Humber specific Framework with Lots covering specialised elements of the programme, or, a Humber-specific Lot on an existing framework that focuses solely towards delivery of the Humber programme.

There is a desire, however delivered, to ensure that we deliver value for money and to take advantage of the long-term relationships that the Environment Agency and Local Authorities have built up, as this will help achieve this goal. Efficiency will be driven by focusing on the strategic commercial needs and given the scale of the project we will develop a collaborative relationship with suppliers to manage risks.

Water and Environment Management (WEM) Framework

The Environment Agency currently operates the Water and Environment Management (WEM) Framework, a commercial agreement between the Environment Agency, consultants and contractors, with agreed terms for the award of individual contracts. It was signed in July 2013 and is a vital component in the Environment Agency’s ‘Sustainable Engineering Procurement Strategy’ or SEPS44.

Some of the main benefits of WEM are:

- Access to the best teams in the industry on competitive terms for promoters, whilst offering suppliers stability and continuity of work throughout the period
- Long term relationships – a clear commitment to work together for at least four years, and through regular forums, share best practice and develop new ideas around the whole partnership
- A platform for improved performance and efficiency through collaborative working, systematic supplier relationship and performance management
- Efficiency savings through the procurement process, consistent project delivery and bundling projects into programmes of work
- Provides an increased opportunity for innovation, sharing best practice and making them standard to deliver sustainable outcomes

These Lots are available throughout the Environment Agency and to other risk management authorities and is suitable for use in all Flood and Coastal Erosion Risk Management and related work from planning and programming through to construction.

44 www.gov.uk/government/organisations/environment-agency/about/procurement#procurement-strategy
YORconsult Framework

YORconsult is a framework for the procurement of consultancy services, principally for construction related services:

- Civil Engineering
- Building
- Housing
- Environmental Services
- Estates Services
- Local Authority Planning Services
- Development Management Services

In addition to the areas listed above YORconsult also covers specialist areas such as renewable energy services. YORconsult is structured to complement the geography and diversity of demand and is available across the Humber region.

YORcivil Framework

YORcivil is a construction framework for the procurement of civil engineering contractors to carry out construction works within the civic estate in the Yorkshire and Humber Region. The frameworks have been set up to deliver a wide range of civil engineering works, some building works and include for works by Contractor’s design, in the following sectors:

- Local Authority
- General public services
- Public order and safety
- Environment
- Economic and financial affairs (e.g. Regeneration)
- Health
- Housing and community amenities
- Social protection
- Education
- Recreation, culture & religion

The YORcivil framework consists of two sub-regional frameworks each with separate lots dealing with different types or value of works. By structuring YORcivil in this way it ensures that the diverse requirements of regional Local Authorities and other regionally based Public Sector bodies can be met by competent Small and Medium Enterprises (SMEs) in addition to larger regional and national contractors.

Private Finance Initiative\(^45\)

PFI is a procurement method where the private sector finances, builds and operates infrastructure and provides long term management through long term concession agreements. These agreements transfer substantial risks to the private sector in return for payments over the concession life which is usually at least 25 years.

PFI has typically applied to infrastructure projects such as hospitals, schools, roads or prisons and to long term lifecycle investment and routine maintenance services sometimes together with ‘soft services’ such as catering and cleaning. In return, it receives a semi annual payment stream over the life of the concession from the public sector client provided it delivers the services to the specification set out in the concession agreement. So there is no payment for poor delivery or performance.

The Pevensey Bay Sea Defence Scheme was the first sea defence project anywhere in the world to be funded as a Public Private Partnership (PPP/PFI)\(^46\). The PPP focuses on the maintenance of a shingle beach that provides protection to 10,000 properties, caravan parks, road and rail links and internationally designated sites behind the defences. The scheme is considered a successful, albeit relatively small, use of PFI, however, the best-practice developed may prove applicable to a significantly larger programme such as the Humber Estuary.

Whilst PFI mechanisms are an option and can provide solutions for localised areas, having a degree of locally accountable control over the programme through the LAs and LEP is essential on such a sensitive and large project that affects so many local issues so this is not the preferred solution.

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\(^{45}\) [www.pppforum.com](http://www.pppforum.com)

\(^{46}\) [www.pevensey-bay.co.uk/ppp.html](http://www.pevensey-bay.co.uk/ppp.html)
2.3.2 Contractual Strategy

All three frameworks described above are based on the NEC3 suite of contracts, in line with government guidelines, and has been established to allow a broad range of contractual approaches. All contracts use a prescribed set of secondary options with call off arrangements using the main NEC contract options; A, C and E. The use of the NEC3 contracts, which are endorsed by the ICE and used extensively across the public sector, facilitates the identification and management of risk as appropriate to the nature of the contract itself.

Within PFI, the concession agreement transfers those risks to the private sector which the latter is best placed to take. This means construction cost overruns and delay costs are borne by the contractors, finance costs are borne by the finance providers and service delivery by the service contractors. The private sector has shown by experience that it is able to manage these risks very well. There are few, if any, examples of construction risk being returned to the public sector.

The umbrella company created for the project in PFI creates additional discipline which is one of the underlying drivers of efficiency and performance.

This is because the finance providers only receive their returns if their contractors deliver the project and services. So instead of the public sector driving the project it is the finance providers, led by the equity investors who are at most risk.

The allocation of risk will vary across these delivery mechanisms, and most greatly between the existing frameworks, which all use the same base contract terms, and PFI delivery. An initial assessment of the risk profile is presented below.

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Potential Allocation Under Existing Frameworks</th>
<th>Potential Allocation Under PFI Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Public</td>
<td>Private</td>
</tr>
<tr>
<td>Design Risk</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Construction And Development Risk</td>
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<td>✔️</td>
</tr>
<tr>
<td>Transition and Implementation Risk</td>
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<tr>
<td>Availability and Performance Risk</td>
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<tr>
<td>Operating Risk</td>
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<td>Termination Risk</td>
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<td>Technology and Obsolescence Risk</td>
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<tr>
<td>Control Risks</td>
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<td>✔️</td>
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<td>Legislative Risks</td>
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</tr>
<tr>
<td>Other Project Risks</td>
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<td>✔️</td>
</tr>
</tbody>
</table>
2.4 Financial Case

2.4.1 Public Capital Requirements

The Economic case presents the net present value (NPV) benefits of the Do Something schemes – protection to 2057 or protection to 2112 relative to the Do Nothing scenario. The Total PV Cost of the Do Something scheme providing protection a 0.5% AEP (1 in 200 years) standard of protection to 2057 amounts to £1,283m providing a NPV of £5,877m (a benefit to cost ratio of 4.58).

The financial, cash requirement on a year by year basis until 2057 amounts to a total of £1,496m and the stream of funding is indicated below.

![Cash cost (undiscounted) and PV Cost (discounted) to 2057](image)

**Figure 7:** Cash cost (undiscounted) and PV Cost (discounted) to 2057

2.4.2 Impact on Forecast Flood Defence Investment

The figure overleaf presents the required funding in the context of current and potential FCERM funding allocations over a 17 year programme delivery period. At its peak, the project’s financial implications amount to 10.7% of total available FCERM funding (capital and revenue), assuming that 2015/16 continues at the same level in real terms.

In relation to Capital funding alone, the spending requirements relate to 17.4% of national funding available for a period of 5 years (Y3 to Y7) falling to 12.7% for the remainder of the project’s construction lifetime. 
### 2.4.3 Potential Private Sector Contributions

With the current estimates, The Environment Agency has identified using Defra’s Partnership Funding Calculator (PFC)\(^\text{48}\) that a minimum private sector contribution of £770m would be required to deliver the programme under current Defra funding constraints. Whilst the current partnership funding system might be appropriate and successful for smaller inland schemes, this again highlights how implausible it would be to finance this type of tidal works. The majority of the funding for the Humber must therefore come from Government.

The report by Richard Brown CBE highlights that Humber industries are willing to contribute towards flood protection of their assets. This has happened with the Grimsby Flood Defence Scheme and ABP has confirmed a willingness to contribute towards flood protection at the Port of Immingham, which will cost in the region of £17m\(^\text{18}\). Further contributions can be expected in other areas, for example on the tidal Lower Trent, where approximately £9m of private investment is available according to the Humber LEP.

The current funding system does not encourage large businesses such as ABP to commit to partnership funding arrangements unless there is a substantial commitment for financial certainty to the public purse. It is essential that funding is available in a clearly defined project pipe-line that allows flood risk management authorities to have serious and meaningful discussions about partnership funding with the private sector.

The Humber LEP’s Strategic Economic Plan\(^\text{14}\) also indicates that there is funding for some of the 40 flood risk management schemes earmarked within the Humber area to be provided through the competitive Local Growth Fund applications, from the Local Authorities, from the Regional Flood and Coastal Committee and via European Structural Investment Funds (ESIF).

There is a clear case on the Humber for substantial public investment in infrastructure. Unlike public revenue expenditure, for the reasons set out above, capital investment in new and improved flood defences is likely to produce a net return to the exchequer in tax revenues in the medium term; however failure to invest in flood defences is likely to reduce tax revenues.

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\(^{47}\) LTIS (S1) through to LTIS (S5) refers to the five strategies presented in the Environment Agency’s Long Term Investment Strategy  

\(^{43}\) BIS (2010) Guidelines for Managing Programmes: Understanding Programmes and Programme Management

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**Figure 8:** Humber Estuary flood defence costs relative to current FCERM funding

![Humber Estuary flood defence costs relative to current FCERM funding](image-url)
2.5 Management Case

The programme of work to deliver improvements to the Humber Estuary’s flood defences will either sit within the three regional flood and coastal committees’ current programme of flood defence investment or it will be delivered through alternative means, for example via the freedoms and flexibilities undertakings given by central government on the recently announced Humber Growth Deal.

2.5.1 Business Assurance

The Humber LEP is currently working on a generic assurance framework for the Local Growth Fund. This will be developed from the agreed Local Transport Body Assurance Framework previously agreed by the four Humber Authorities (Hull City, East Riding, North Lincolnshire and North East Lincolnshire Councils) and approved as best practice by the Department for Transport.

Governance arrangements are undergoing final approval by the Humber LEP and the assurance framework will be approved by the Department for Business, Innovation and Skills (BIS). It will be the Assurance Framework that will be used to provide governance arrangements for all spend through the Local Growth Fund Awards the Humber has received.

Subject to further discussion and agreement, it is the intention that this mechanism will be adapted for the delivery of local flood risk schemes, adapting national economic appraisal methods to local needs. There is an opportunity, subject to further discussion, for this arrangement to be used in the delivery of the Humber programme of defence works.

If a single settlement is announced in the Autumn Statement, working in unison the Local Authorities, LEP and Environment Agency are well placed to receive and administer the award. There is an excellent track record for delivery of large infrastructure projects in the Humber area with Local Authorities, LEP and Environment Agency working in partnership to reach stated goals.

2.5.2 Programme Management arrangements

The programme will be delivered following the Government’s approach to Programme Management – Managing Successful Programmes (MSPTM)\(^49\) and using the most up to date MSPTM guidance.

The programme will be initially delivered through the existing arrangements; however it is considered that there are opportunities for flexibility that may prove less bureaucratic, more efficient and less costly.

Agreements are currently being developed between local partners/sponsoring group in this respect.

Specific roles are to be determined however, local partners/sponsoring group will include senior representatives from the Local Authorities, the Environment Agency and the Humber LEP but shall also include project assurance and support from the existing government agency single voice group for the Humber. Any programme board will be made up of flood risk professionals from the authorities with a full time programme manager and his staff.

An Integrated Assurance Strategy (IAS) and an Integrated Assurance and Approvals Plan (IAAP) will be developed in line with the Major Project Authority’s assurance processes as the emerging business case develops and to support a full business case supported by the Updated Humber Flood Risk Management Strategy due in 2015.

2.5.3 Project Management arrangements

There will be a series of projects within the programme that will be managed in accordance with Cabinet Office PRINCE\(^2\)© methodology.

The projects will consist of a Project Delivery Team led by a Project Manager appointed by the Programme Board. The Project Teams will report to a Project Board, who shall direct the projects by stages and exceptions.

2.5.4 Consultation and Engagement Strategy

The local authorities and Environment Agency are determined to ensure that the programme of works is undertaken in consultation with key stakeholders and the public, as this will provide the opportunity for micro-scale benefits to be provided where possible and facilitate further funding and contributions in kind to support the overall delivery.

A consultation and engagement strategy will be developed to control the process and to manage and utilise the information collected. A variety of methods, such as workshops, presentations and public consultation days will be used to full effect, along with web-based methods of eliciting feedback from residents, businesses and stakeholders. Updates on how the feedback is being used and further opportunity to engage will be explored.

3 Environmental Summary

The Humber Estuary is the second-largest coastal plain estuary in the UK, and the largest coastal plain estuary on the east coast of Britain. Coastal plain estuaries are formed when pre-existing valleys were flooded at the end of the last glaciation. The Humber Estuary drains a catchment area of some 24,472km², around 20% of the total land surface of England. Water collected from this catchment flows to the estuary through many rivers and tributaries, the largest of these are the Aire, Derwent, Don, Ouse, Trent and Wharfe.

A significant feature of the Humber is the large tidal range, this is due to its position within the North Sea basin; producing a mean spring tidal range of 5.7m at Spurn. The tidal range increases as the tide moves up the estuary; it is 7.4m at Saltend, and 6.9m at Hessle. The Humber is classified as a macro-tidal estuary because of these large tidal ranges.

At its widest point the Humber Estuary is 14km across and its average depth is 6.5m. It covers over 30,550ha (75,492acres). The Humber’s muddy appearance (turbidity) is due to suspended sediment. This comes mainly from the eroding boulder clay cliffs along the Holderness coast and also river sediments. This sediment is vital for the estuary’s function and every tide carries over 1,500 tonnes. It is estimated that up to 1.26 million tonnes of sediment may be present in the water in the estuary. The deposited sediments maintain estuary’s important habitats such as mudflats, sandflats and saltmarsh. The Humber supports a rich variety of habitats and species and is recognised as one of the most important estuaries in Europe for overwintering birds. It supports 9 species of international importance.

The Humber Estuary is internationally important for wildlife and is designated as a Special Area of Conservation (SAC) and a Special Protection Area (SPA) under the Habitats Regulations and also considered an internationally important wetland under the Ramsar Convention.

The Humber Estuary is also a Site of Special Scientific Interest (SSSI), as designated under the Wildlife and Countryside Act 1981.

3.1 Legal Requirements

3.1.1 Habitats Directive

The purpose of the Habitats Directive is to enhance Europe’s biodiversity by protecting its most important habitats and species. The directive requires competent authorities to assess the impact of plans or projects that may have a significant effect on these “European sites”, either alone or in combination with other plans or projects. Competent authorities cannot consent to plans or projects they determine may have an adverse effect on the integrity of a European site following such an assessment. However, all the competent authorities would be working closely with Natural England to ensure that schemes are compatible with the Habitat Regulations.

The directive provides a mechanism under Article 6(4) that allows plans or projects to be approved provided three tests are met:

- There are no feasible alternative solutions to the plan or project which are less damaging.
- There are imperative reasons of overriding public interest (IROPI) for the plan or project to proceed.
- Compensatory measures are secured to ensure that the overall coherence of the network of European sites is maintained.

The implications for the Humber Strategy are important, as approval and construction can only proceed once it is shown through an appropriate Habitats Regulations Assessment (HRA) that the three tests are met. Alternative locations for flood defence upgrades might not be feasible elsewhere and there may be IROPI related to human health, public safety and a widespread public good suggesting the first two would be passed.

The identification and delivery of compensatory measures, such as the re-creation of a comparable habitat, will therefore be critical to the delivery of the strategy and the HRA will be a key deliverable alongside planning and detailed design in the first two years of implementation. The provision of compensation around the Estuary also provides compelling reasons to consider the Estuary in a holistic manner rather than in a compartmentalised fashion:

- There will be some areas in which compensation cannot be delivered within the same location and which will need to be delivered elsewhere in the estuary in conjunction or in advance of works been undertaken to ensure the Directive is met.
- It is likely that where existing defences are realigned the Local Planning Authorities will insist on a 0.5% AEP level of protection for the new defences as part of any planning consent.

Defra approved the existing Humber Strategy Habitat Regulations Assessment in 2011. Whilst not entirely applicable to this business case by virtue of the whole-estuary argument, the approved strategy for compensation will form the starting point for development of a new strategy to meet legal requirements. It is recognised that this is a considerable piece of work; ongoing engagement is being undertaken through the single voice group.

At present, Managed Realignment accounts for 6.24% of the total capital costs of the strategy.

### 3.1.2 Water Framework Directive

As with the HRA, a Water Framework Directive assessment will also be required in the initial phase of implementation and this will:

- Identify if the Strategy proposals are likely to result in any direct or indirect ecological changes which would result in a risk of failing the WFD's objectives for any water body;
- In the cases where such risk exists, assess the compliance of the proposal with Article 4.7 of the Directive; and
- If required, identify any additional mitigation measures which should be included during on-going or future work to implement the Strategy proposals.

Therefore new flood risk management activities must be assessed to identify if they will:

- Cause deterioration in ecological status/potential; and/or
- Lead to failure to achieve good status/potential for ecological objectives in the future.

In the first instance the ethos of delivery shall always aim to be complimentary and sympathetic in its engineering design to either mitigate or provide ecological betterment where possible. If risk cannot be mitigated in this way, as a last resort, Articles 4.7, 4.8 and 4.9 of the Directive provide a potential mechanism for the flood risk management activity to proceed. Article 4.7 lists a series of conditions which must be met in order for the scheme to remain compliant with WFD. These are similar to those of Article 6(4) of the Habitat Regulations in that there should be:

- evidence that the proposal is being promoted for reasons of over-riding public interest;
- evidence that no other option would present an environmentally better, affordable, option;
- evidence that all appropriate mitigation measures for potential new modifications are included in the proposal;
- evidence that the effect on water bodies outside the study area have been considered and that the associated WFD objective 3 would not be compromised;
- evidence of any other overriding issues that should be considered.

Article 4.8 requires that the activity does not cause any other water body to fail its quality objectives, and Article 4.9 requires that all other relevant Directives, such as the requirements of the Habitat Regulations, are still met.

The identification of potential impacts and any additional mitigation measures through a WFD assessment will be a key deliverable alongside the HRA, planning and detailed design in the first phase of implementation.

As with the Habitats Assessment a WFD assessment for the approved 2008 Humber Strategy exists. Whilst not entirely applicable to this business case for the same reason, the approved strategy for compensation will form the starting point for development of a new strategy to meet legal requirements.

At present, WFD costs account for 2.83% of the total capital costs of the strategy.
4 Technical Summary

This Summary Strategy proposes active intervention for 226Km of flood defences around the Humber Estuary, providing an Estuary-wide 0.5% AEP (1 in 200 years) standard of protection. The details presented throughout this Summary Strategy cover the provision of this level of protection up to and including 2057, based on our current understanding of sea level rise\textsuperscript{51} and facilitate further adaptation for the period 2057 to 2112. Full details will be included in the full Strategy, which will be based on hydraulic areas presented in Figure 11, overleaf.

4.1 Current Standard of Protection

The current standard of protection offered by the defence line varies drastically. Most places around the estuary have a current Standard of Protection lower than 0.5% AEP, typically between 2% and 1% AEP. In a number of places the Standard of Protection is less than 5% AEP and in some locations it is as low as 50% AEP.

Many of the major development areas and key assets with the Estuary are not currently protected to a 0.5% AEP standard of protection, with notable vulnerabilities around Brough, Grimsby and Hull despite the principal source of flooding being from coastal flooding and tidal surge. In light of evidence from the tidal surge event the standards of protection identified in the 2008 strategy are likely to have significantly decreased.

4.2 Condition of Defences

The condition of defences around the Estuary is in Figure 10. (below).

The overall picture is variable with respect to the defence condition; 19% of the defences that will be raised or replaced are currently in a Poor to Very Poor condition, amounting to a total length of 43.3km of defence. Notably, defences assessed as being in Poor to Very Poor condition are located near to the urban and industrial areas of Hull, Paull, Immingham, Grimsby, Cleethorpes, Brough, Scunthorpe and Goole.

\textbf{Figure 10: Current Condition of Defences around the Estuary (Environment Agency)}

\textsuperscript{51} Environment Agency (2011) Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities
4.3 Proposals

This Summary Strategy’s proposals for defence upgrades to 2057 include:

- **Raising** of 53.4km of defences, consisting of:
  - 48.4km of embankment
  - 5.0km of wall

- **Replacement** of 172.6km of defences, consisting of:
  - 69.7km of embankment
  - 95.4km of wall
  - 2.8km of protection
  - 4.8km of sheetpile

Under these proposals, all defences currently considered to be in Poor or Very Poor condition will be replaced. Of the defences that are considered to be in Fair condition, 67% will be replaced and the remainder raised. Of the cumulative length of Good to Very Good Defences, 80% will be replaced and the remainder raised.

4.3.1 Summary of Proposals

The following pages provide a summary of the flood defence proposals. The Estuary has been split into 6 reaches, based on natural breaks caused by high ground or the presence of a watercourse such as the River Ouse or River Hull.

Whilst the Reaches used are hydraulically separate, within the Reach there is an element of hydraulic connectivity, which could cause breach or overtopping in one area to impact wider areas. It is for this reason that improving or raising defences in isolated sections would not provide the necessary protection to higher vulnerability land uses. An approach that deals with the entire hydraulic area is required. As indicated in Section 3 above, there are also interdependencies brought about by the need for habitat compensation, which can’t be provided in all Reaches.

The figure below presents the breakdown of reaches used, including reference to the Flood Cells used within the emerging Humber Flood Risk Management Strategy.
The summary identifies the type of flood defence infrastructure proposed and the Present Value (PV) cost associated with each. Other PV costs such as design and planning, outfalls, stoning, managed realignment and maintenance are also presented. Optimism bias at 66% of the sub-total, as per HMT’s Green Book, is also indicated and the Total PV Cost highlighted for each reach. A summary of current condition, standard of protection, proportion being raised or replaced and the environmental status are also provided.
REACH 1 - Total Length 25.6km

<table>
<thead>
<tr>
<th>PV COSTS - PHYSICAL DEFENCES</th>
<th>Cost</th>
<th>Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embankment</td>
<td>£130,036,110</td>
<td>16.7km [27% poor condition]</td>
</tr>
<tr>
<td>Wall</td>
<td>£1,377,737</td>
<td>1.7km [22% poor condition]</td>
</tr>
<tr>
<td>OTHER PV COSTS</td>
<td></td>
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</tr>
<tr>
<td>Design and Planning</td>
<td>£6,918,723</td>
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<tr>
<td>Outfall</td>
<td>£2,154,091</td>
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</tr>
<tr>
<td>Stoning</td>
<td>£0</td>
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</tr>
<tr>
<td>WFD</td>
<td>£1,894,853</td>
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<tr>
<td>Managed Realignment</td>
<td>£4,368,467</td>
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<td>Maintenance</td>
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<td>SUMMARY</td>
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<tr>
<td>Sub-total</td>
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</tr>
<tr>
<td>Optimism Bias (66%)</td>
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<tr>
<td>Total PV Cost</td>
<td>£247,289,108</td>
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</table>

Active intervention is proposed for 18.4km of flood defences within Reach 1. There are 5km of defence line for which intervention is proposed that are in poor condition. The defences provide a standard of protection of between 1 in 5 years and 1 in 200 years. Proposals are to raise 3.3km of the defence line with the remaining 15.1km to be replaced.

The Humber Estuary is a SPA, a SAC, a SSSI and a Ramsar Site. Theddlethorpe Dunes is a SAC, a SSSI and a NNR. Theddlethorpe Dunes and Gibraltar Point is a SAC. Donna Nook is a NNR. The ecological quality of the Lower Humber and the South Yorkshire / Lincolnshire coastal waters is Moderate Potential. The ecological quality of the Northcoates Point Lagoon is Moderate Status. The quantitative quality of the Grimsby Ancholme Louth Chalk Groundwater Unit is Poor.
Active intervention is proposed for 39.6km of flood defences within Reach 2. There are 71km of defence line which are in poor to very poor condition. The defence provides a standard of protection of between 1 in 5 years and 1 in 200 years. Proposals are to raise 3.6km of the defence line with the remaining 36km to be replaced.

The Humber Estuary is a SPA, a SAC, a SSSI and a Ramsar Site. Far Ings is a NNR. The ecological quality of the Middle and Lower Humber is Moderate Potential. The ecological quality of the Barrow Clay Pits is Moderate Status. The ecological quality of the North Killingholme Haven Pits is Good Potential. The quantitative quality of the Grimsby Ancholme Louth Chalk and Limestone Groundwater Units is Poor.
Active intervention is proposed for 68km of flood defences within Reach 3. There are 40.6km of flood defences which are in poor to very poor condition. The defences provide a standard of protection of between 1 in 5 years and 1 in 200 years. Proposals are to raise 25.3km of the defence line with the remaining 42.7km to be replaced.

The Humber Estuary is a SPA, a SAC, a SSSI and a Ramsar Site. The Humberhead Peatlands is a NNR. The ecological quality of the Upper and Middle Humber and Welton Waters is Moderate Potential. The ecological quality of Winterton Beck is Moderate Status. The quantitative quality of the Aire and Don Sherwood Sandstone, East Riding Mercia Mudstone and the Lower Trent Fenswash Secondary Combined Groundwater Units is Good. The quantitative quality of the Idle Torne Secondary Mudrocks and the Grimsby Ancholme Frodingham Ironstone Groundwater Units is Poor.

**PV COSTS - PHYSICAL DEFENCES**

<table>
<thead>
<tr>
<th>Type</th>
<th>Cost (€)</th>
<th>Length (km)</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embankment</td>
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<td>40.6 (8% poor)</td>
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<td>Wall</td>
<td>1,110,966</td>
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<tr>
<td>Protection</td>
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**OTHER PV COSTS**

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<td>Stoning</td>
<td>2,765,496</td>
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<td>WFD</td>
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<td>Managed Realignment</td>
<td>11,777,220</td>
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<tr>
<td>Maintenance</td>
<td>6,656,532</td>
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</table>

**SUMMARY**

| Sub-total       | 159,996,016  |
| Optimism Bias (66%) | 105,597,371  |
| Total PV Cost   | 265,593,387  |
Active intervention is proposed for 55.2km of flood defences within Reach 4. There are 10km of defence line which are in poor to very poor condition. The defence provides a standard of protection of between 1 in 5 years and 1 in 200 years. Proposals are to raise 5.6km of the defence line with the remaining 49.6km to be replaced.

The Humber Estuary is a SPA, a SAC, a SSSI and a Ramsar Site. The ecological quality of the Upper and Middle Humber and Welton Waters is Moderate Potential. The ecological quality of Pool Beck at Brough is Good Status. The quantitative quality of the East Riding Mercia Mudstone and Derwent Sherwood Sandstone Groundwater Units is Good.

### PV Costs - Physical Defences

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<th>Type</th>
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<td>£3,634,446</td>
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### Other PV Costs

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### Summary

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**Reach 4 - Total Length 55.2km**
Active intervention is proposed for 7.2km of flood defences within Reach 5. There is 1km of defence line which is in poor to very poor condition. The defence provides a standard of protection of between 1 in 5 years and 1 in 200 years. Proposals are to raise 3.3km of the defence line with the remaining 3.9km to be replaced.

The Humber Estuary is a SPA, a SAC, a SSSI and a Ramsar Site. The ecological quality of the Middle Humber is Moderate Potential. The quantitative quality of the Hull and East Riding Chalk Groundwater Unit is Poor. The quantitative quality of the East Riding Mercia Mudstone Groundwater Unit is Good.

### PV COSTS - PHYSICAL DEFENCES

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### OTHER PV COSTS

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### SUMMARY

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</table>
Active intervention is proposed for 37.5km of flood defences within Reach 6. There are 12.8km of defence line which is in poor to very poor condition. The defence provides a standard of protection of between 1 in 2 years and 1 in 200 years. Proposals are to raise 12.3km of the defence line with the remaining 25.2km to be replaced.

The Humber Estuary is a SPA, a SAC, a SSSI and a Ramsar Site. The Lagoons is a SSSI. Spurn Point is a NNR. The ecological quality of the Middle and Lower Humber, the South Yorkshire / Lincolnshire Coastal Waters, and the Easington, Fosse, Winestead, Otteringham, Sands/Keyingham/Roos and Burstwick Drains is Moderate Potential. The quantitative quality of the Hull and East Riding Chalk Groundwater Unit is Poor.

Active intervention is proposed for 37.5km of flood defences within Reach 6. There are 12.8km of defence line which is in poor to very poor condition. The defence provides a standard of protection of between 1 in 2 years and 1 in 200 years. Proposals are to raise 12.3km of the defence line with the remaining 25.2km to be replaced.

The Humber Estuary is a SPA, a SAC, a SSSI and a Ramsar Site. The Lagoons is a SSSI. Spurn Point is a NNR. The ecological quality of the Middle and Lower Humber, the South Yorkshire / Lincolnshire Coastal Waters, and the Easington, Fosse, Winestead, Otteringham, Sands/Keyingham/Roos and Burstwick Drains is Moderate Potential. The quantitative quality of the Hull and East Riding Chalk Groundwater Unit is Poor.
4.4 Uplifts

The cost of raising and replacing flood defences has been carried out using the Environment agency’s Unit Cost Database (2007) as a basis. Unit costs have been updated using costs provided by ECI contractors over the last 12 months for Northwich (Birse) and Preston (Volkers) PARs.

Given the strategic nature of the Updated Humber Flood Risk Management Strategy, there remain some uncertainties with respect to various details of construction, including:

- Water Framework Directive mitigation costs
- Managed realignment / Flood Storage mitigation costs
- The cost of major service crossings
- The impact of poor ground conditions
- Tie in details with existing defences and high ground

The need to provide an allowance for these additional costs is undoubted; however, the extent to which they are an influence across the whole of the Estuary remains unclear. These costs are therefore dealt with by adding an uplift, represented by a percentage increase in cost, to account for the uncertainty. The following presents how they are dealt with in this strategy and the value of these uplifts is included in the costs presented above:

- Assets/frontages are subject to a cost uplift to allow for the Water Framework Directive. This has been provided by the Environment Agency as a cost of £100/m. This cost is spread within the first phase of capital costs. The cost is then repeated in 2057-2067 phased as per the capital costs.

- Costs for managed realignment / flood storage areas have been provided by the Environment Agency. This has been costed at £220/m. This cost is spread within the first phase of capital costs. The cost is then repeated in 2057-2067 phased as per the capital costs.

- Nominal costs / uplift for services crossings have been included. Additional costs and details for major service crossings have not been available. Without any further information being provided a 5% uplift has been applied on all the capital costs to allow for services. Outfall replacement costs have been provided by the EA and have been included as an individual sum added to the total capital cost and uplifted to present day costs.

- In the absence of other information on specifically poor ground conditions, an assumption has been made for the length of sheet piles required, based on an empirical rule of 2m embedment for every 1m retained height, for 80% of the sheet piles. In areas of poor ground conditions (we have assumed 20% of sheet piles), a more conservative approach has been used, based on findings from Grimsby Docks and Swinefleet – this has been assumed to be 4m embedment for every 1m retained height.

- This does not take into account specialist works required to tie in new and old infrastructure e.g. raising of clay core, or works to ensure the existing embankment is robust. The cost of this is assumed to be included in the Optimism Bias.
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Appendix A

Flood Defences Cost Money, No Flood Defences Costs More: *An Economic Case for the Humber and United Kingdom*
Appendix B

ABP Humber Ports Case Study:
*Case for Investment in Flood Defence Infrastructure*
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