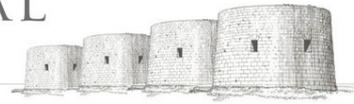


BAWDSEY COASTAL
- PARTNERSHIP -



**AN ECONOMIC AND ENVIRONMENTAL STUDY OF THE
VALUE OF COASTAL DEFENCES IN THE BAWDSEY
COASTAL PARTNERSHIP AREA**



FINAL REPORT

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GLOSSARY OF TERMS AND ACRONYMS

A&OEP	Alde and Ore Estuary Partnership
BCP	Bawdsey Coastal Partnership
CCT	Deben Peninsula Coastal Community Team
DEP	Deben Estuary Partnership
EA	Environment Agency
Present Value	The value in the present of a sum of money, in contrast to some future value it will have when it has been invested at compound interest. This takes account of the time value of money.
NPV	Net Present Value. The NPV is the present value of all cash inflows, discounted at an appropriate rate, less the present value of cash outflows.
SCC	Suffolk County Council
SCF	Suffolk Coastal Forum
SCDC	Suffolk Coastal District Council
SMP	Shoreline Management Plan

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EXECUTIVE SUMMARY

Bawdsey Coastal Partnership (BCP) was established in the wake of the December 2013 tidal surge by the people and Parishes situated between the mouths of the rivers Deben and Ore. The primary objective of the BCP is to ensure that the area's flood & coastal management infrastructure is maintained and fit-for-purpose in the medium term. BCP sees this as the role and responsibility of those statutory agencies tasked to deliver coastal and flood risk management: the maritime authority Suffolk Coastal District Council, and the Environment Agency.

There is, however, a broad and growing recognition that these public authorities may no longer have the sufficient financial resources to guarantee adequate flood/coastal management in the BCP area without other parties making a contribution. It is recognised that local communities will, in many circumstances, have to generate or identify partnership resources, to compliment state subsidies (Flood Defence Grant-in-Aid – FDGiA).

If the Partnership is to help to guarantee fit-for-purpose coastal / flood management, a better understanding of the local economy, and assets at risk, is vital. This study seeks to identify the fundamental economic activity on this stretch of peninsula and from that determine the likely economic consequences of coastal defence failure between the mouths of the rivers Deben and Ore, i.e. from Bawdsey Quay to Shingle Street. The Partnership's motivation to do this is three fold: to better understand and promote the economic activity in the study area at risk; to better understand what is at stake, and to support public and private funding proposals to ensure coastal management.

The coastline of the BCP area comprises approximately 1,800 hectares of both low-lying agricultural land to the north, and high ground behind erodible cliffs to the south. The Suffolk coast is recognised nationally and internationally as an area of unique landscape, wildlife and historic interest. This is reflected in the large number of statutory and non-statutory designations that have been applied to the area.

The main economic activity is agriculture which, because of the nature of the soil, offers above average profitability, provided that irrigation can be maintained. Sea water ingress from a failure of the defences would render irrigation impractical and this would have a substantial impact on the agricultural economics. Second to agriculture is the private boarding school at Bawdsey Manor. Both agriculture and the school contribute to the local economy not only through their profitability but also by employing people locally and by spending money with local businesses. Visitor attractions are the Suffolk Punch Trust and the Radar Museum at Bawdsey. There are also a few shops, pubs and bed and breakfast establishments.

There are a number of interesting environmental features in the area, notably the vegetated shingle and nesting sites for the threatened Little Tern. We have concluded, however, that the adverse environmental impacts of coastal defence failure would not be very great, as most of the important habitats would probably simply move to new locations.

There are several important listed buildings and structures, which are of particular interest to Historic England, including Bawdsey Manor, 4 Martello Towers and many features from the first and second world wars and the Cold War. Almost all of these would be lost to coastal defence failure.

The adverse economic impacts would be substantial. We estimate that the economic impact on agriculture of a coastal defence failure would be as shown in the table below:

Annual Aggregate Impact			
	Before Flooding	After Flooding	Net Change
Farm Revenue	£9,895,95	£2,300,000	(£7,595,955)

	5		
Farm Costs	£5,523,620	£1,605,900	(£3,917,720)
Farm Profits	£4,372,335	£694,100	(£3,678,235)
Local Revenues	£3,620,000	£795,950	(£2,824,050)
Local wages	£2,840,625	£644,100	(£2,196,525)

The revenue losses to non-farm businesses is estimated at £3.3m p.a. The majority of this derived from the school at Bawdsey Manor and the other significant businesses affected are the Suffolk Punch Trust and Suffolk Cottage Holidays.

The value of total residential property at risk is £17.4 million, consisting of Shingle Street (£12.3m) and other housing (£5.1m). Public infrastructure would also be at risk. This is estimated at £20.8 million and comprises mainly water pumping and waste water treatment works, road reconstruction and damage to HM Prison at Hollesley. Agricultural land losses are valued at £23.8 million. Losses to heritage buildings are estimated at £22.2 million.

The table below shows a summary of the economic losses, having been adjusted to take account of their timing, using the present value method.

Impacts on:	Assessed PV (£ million)
Residential property values	12.3
Commercial property values	14.2
Public infrastructure and utility services	13.8
Transport services	0.0
Arable marsh land values (a)	18.7
Light land production values (b)	77.1
Non-agricultural business production values	0.4
Environmental and national heritage values	14.2
Total Net Present Value	150.8

1 INTRODUCTION

This report has been prepared by Nick Crick and Peter Faircloth on behalf of the Bawdsey Coastal Partnership (BCP), with funding gratefully received from Suffolk Coastal District Council (SCDC). It has been prepared against the Terms of Reference which is shown in Appendix A, a separate document.

It aims to identify, within the constraints of the time and funding available, the economic and environmental consequences of failure of the coastal defences along the five miles of coast between the mouths of the rivers Deben and Ore, i.e. from Bawdsey Quay to Shingle Street.

It should be noted that some of the text in this report has been derived, where appropriate, from the PAR for Hollesley to Bawdsey Sea Defences produced by Posford Duvivier (now Royal Haskoning) in 2000.

2 BACKGROUND

Bawdsey Coastal Partnership was established in the wake of the December 2013 tidal surge by the people and Parishes situated between the mouths of the rivers Deben and Ore. The primary objective of the BCP is to ensure that the peninsula's flood & coastal management infrastructure is maintained and fit-for-purpose in the medium term. BCP sees this as the role and responsibility of those statutory agencies tasked to deliver coastal and flood risk management: the maritime authority Suffolk Coastal District Council, and the Environment Agency.

There is, however, a broad and growing recognition that these public authorities may no longer have sufficient resources to guarantee adequate flood/coastal management in the BCP area without other parties making a contribution. It is recognised that local communities will, in many circumstances, have to generate or identify partnership resources, to compliment state subsidies (Flood Defence Grant-in-Aid – FDGiA).

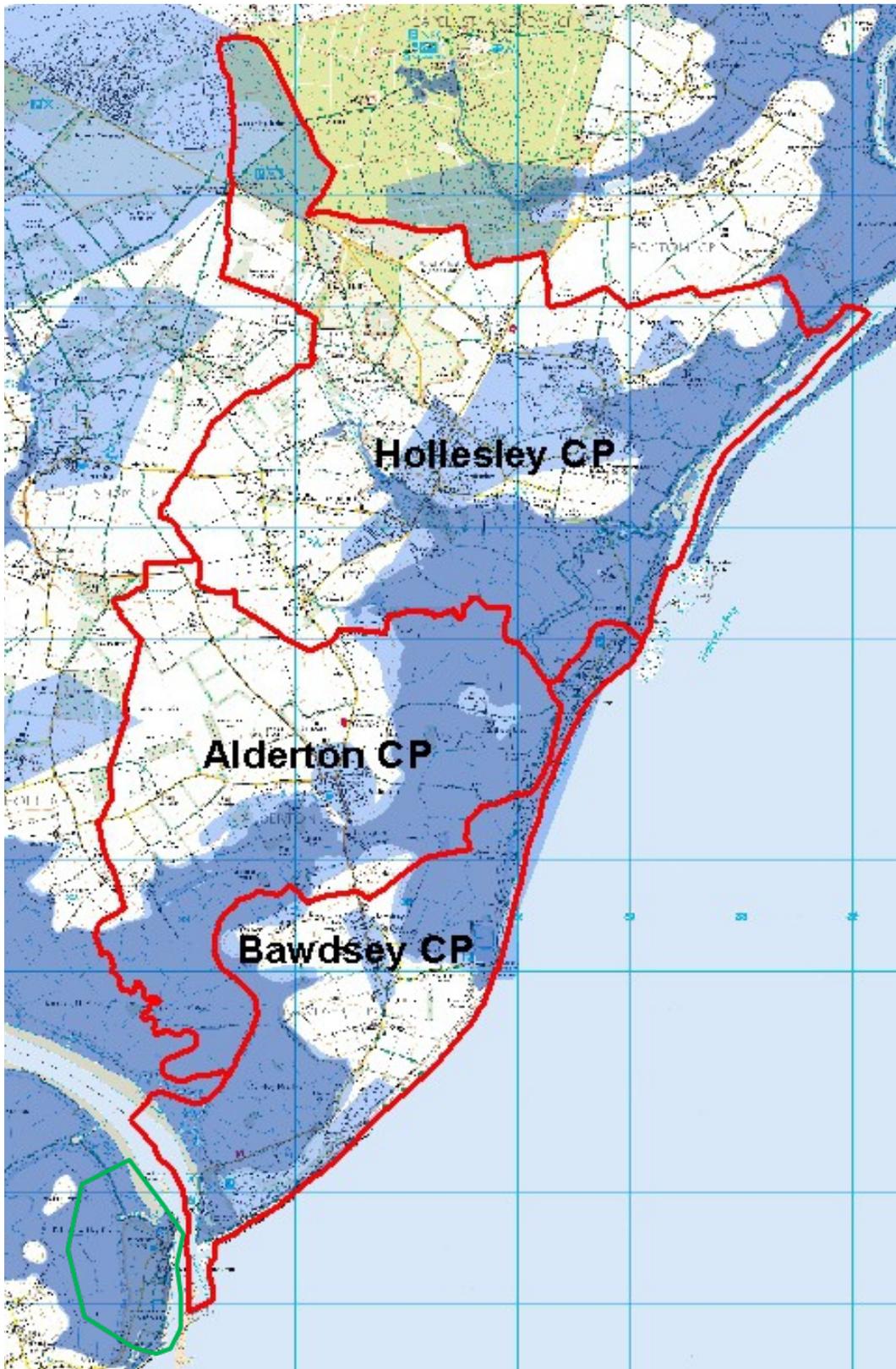
If the Partnership is to help to guarantee fit-for-purpose coastal / flood management, a better understanding of the local economy, and assets at risk, is vital. This study seeks to identify the fundamental economic activity on this stretch of peninsula and from that determine the likely economic consequences of coastal defence failure between the mouths of the rivers Deben and Ore, i.e. from Bawdsey Quay to Shingle Street. The Partnership's motivation to do this is three fold: to better understand and promote the economic activity in the study area at risk to better understand what is at stake better and to support public and private funding proposals to ensure coastal management.

3 THE STUDY AREA

3.1 Geographical location

The area being considered is shown outlined in red on the map below, with the areas at risk of flooding shown in blue (derived from the Environment Agency's flood risk map). In addition, we have been requested to consider also the area outlined in green (Felixstowe Ferry), which may form part of a subsequent report, although a possibility now exists that this study will not now be required.

It should be pointed out that, in practice, there are no hard and fast boundaries to an area from the perspective of flood risk, since flooding in one area can flow into another. Consequently, it is important that the BCP works closely with the adjoining estuary partnerships, namely the Deben Estuary Partnership and the Alde and Ore Estuary Partnership.



3.2 Context

The coastline in the study area has been chosen as the site for various military emplacements, with Martello towers dating back to Napoleonic times and, during the First and Second World Wars, a battery of field guns and other defences. The facilities are described further in section 1.4.

Hard defences at East Lane, offering both flood defence and coast protection, have resulted in this point becoming an artificial promontory which has become more pronounced as the “soft” coastline

on either side has eroded. The seawall at East Lane has suffered repeated damage, and there have been various measures to secure it.

The adjacent coastline comprises approximately 1,800 hectares of both low-lying agricultural land to the north, and high ground behind erodible cliffs to the south. The boundary between the low and high land is at East Lane. The only areas of development in the area is limited to isolated properties at East Lane and in the low lands, and the small settlement at Shingle Street to the north.

The Suffolk coast is recognised nationally and internationally as an area of unique landscape, wildlife and historic interest. This is reflected in the large number of statutory and non-statutory designations that have been applied to the area. The coastline within the Strategy area falls within the Suffolk Coast and Heaths Area of Outstanding Natural Beauty (AONB), and is also contained within the Suffolk River Valleys Environmentally Sensitive Area. The shingle landform at Shingle Street and extensive beach running down to East Lane, Bawdsey is included within the Alde-Ore SSSI/SPA and the Orfordness Special Area of Conservation (SAC) - designated for its important shingle vegetation communities and saline lagoons.

The current problem is the risk of loss or damage to agricultural land and associated properties through flooding, and properties and historical structures in the study area. This risk is caused by the increasing threat of failure of the coastal defences. Should these fail, flood protection would be gradually lost causing frequent flooding and inundation of the northern low lying land, and erosion of the coastline to the south would recommence.

3.3 Demography

The area is sparsely populated. The major settlements are Bawdsey, Alderton and Hollesley, with smaller settlements at Bawdsey Quay and Shingle Street. Approximate 2013 population figures¹ are as follows:

Bawdsey	344
Alderton	461
Hollesley	1694 (including HM Prison – approximately 330 inmates)

¹ Source: Suffolk Observatory – figures derived from ONS.

Approximately 35-37% of the houses in the area are second homers or holiday lets, so they are not occupied on a full time basis.

3.4 The built environment and infrastructure

Although sparsely populated, the area contains a significant number of listed buildings and monuments. Apart from houses of architectural interest, there are many installations devoted to defence against invasion, dating from Napoleon's time, when 5 Martello Towers were built (of which 4 remain today), with a further 2 in Felixstowe Ferry. There are also many structures dating from the First and Second World Wars, including not only pill boxes, gun emplacements and observation posts but also the former RAF complex at Bawdsey Manor (itself a listed building of great interest), which was the world's first operational radar station for the detection of enemy aircraft and was subsequently developed as a Bloodhound missile site during the Cold War, which comprises a two-storey underground ROTOR R3 site.

Infrastructure is provided by Anglian Water (water supply and sewage), UK Power Networks (electricity supply), BT (telephone and internet) and Suffolk Highways (roads). All four organisations have provided information for use in this report.

There is also a prison at Hollesley, which lies partly within the flood risk zone. Unfortunately, no information on the costs that might be incurred in the event of flooding is available.



3.5 Economic activities (agriculture, tourism, other)

The area is predominantly agricultural in nature, with a small amount of holiday accommodation (bed and breakfast only) and a few public houses and cafés etc. Approximately 90,000 tourists visit the area each year and the Coastal Community Team is hoping to increase this number further. Of significant importance to the local economy is the private boarding school located at Bawdsey Manor.

3.6 Natural capital and ecosystem services

The Suffolk coast is recognised nationally and internationally as an area of unique landscape, wildlife and historic interest. This is reflected in the large number of statutory and non-statutory designations that have been applied to the area.

The coastline within the Study area falls within the Suffolk Coast and Heaths Area of Outstanding Natural Beauty. The primary purpose of the designation is to conserve and enhance the natural beauty of the area and to protect its flora, fauna, geological interest and landscape features. However, in pursuing this primary purpose account should be taken of the needs of agriculture, forestry and the economic and social needs of local communities.

It is also contained within the Suffolk Heritage Coast (designated in 1973). The 1992 Heritage Coast Policy set national targets for all Heritage Coasts, namely the provision of a semi-natural strip along the coast, accommodating a coastal path, the clearance of eyesores and meeting standards for water and beach cleanliness.

The shingle landform at Shingle Street and extensive beach running down to East Lane is included within the Alde-Ore SSSI/SPA and Orfordness Special Area of Conservation (SAC). The SAC has been selected for its important shingle vegetation communities and saline lagoons, with both habitat types being well represented within the Shingle Street area. In addition to these statutory designations, pasture and saltmarsh at Oxley Marshes (Hollesley) and the shingle beach to the south of East Lane are County Wildlife Sites. Finally, the area abuts the Ore estuary at Boyton, which is a Ramsar site.

4 THE IMPACTS OF COASTAL DEFENCE FAILURES

4.1 Sources of information

This section has been developed from the PAR for Hollesley to Bawdsey Sea Defences produced by Posford Duvivier (now Royal Haskoning) in 2000, updated by the authors to reflect the current situation. It has been reviewed by the Environment Agency and is now believed to reflect current expectations.

4.2 Potential locations and timing of coastal defence failure

There are two separate types of coastal defence failure: a breach of the defences, leading to flooding, and collapse of higher ground due to erosion. Both could result in loss of, or damage to, physical assets.

Breach of defences could occur anywhere from north of East Lane Point to Shingle Street. Erosion could affect the soft cliffs to the south of East Lane Point. If no further action on coastal defences is taken, the probable course of events is described below. We have divided the impacts in the first ten years into three distinct regions: “North” which covers the coast from Martello tower Y to the mouth of the river Ore, “Central”, which runs from Martello tower Y to Martello tower W, and “South” which runs from Martello tower W to the mouth of the Deben.

East Lane promontory is recognised to be of key strategic importance in management of the wider coast frontage, influencing the section of the coast from the entrance of the Alde/Ore Estuary in the north, through to the entrance of the Deben Estuary in the south (Hollesley Bawdsey Strategic Study, EA 2001). The East Lane promontory acts to hold the basic geomorphological structure of the coastline and regulate the dominant north to south drift. In this strategic role East Lane provides an essential control to the coast, providing a foundation for sustainable defence management well beyond its strategic location.

If no further action is taken, the probable course of events is described below.

0 to 5 years from present:

North

At Shingle Street, overtopping could take place in a storm event, as happened in December 2013. This could lead to a breach in the defences, with consequent flooding of the low lying land to the west of the houses.

Central

Over the course of the next five years the East Lane promontory defences could deteriorate steadily. Sections of the rock revetment and wave return wall to the north of the promontory – which have been the subject of periodic urgent works – would progressively fail. This would reduce, and eventually remove the integrity of the East Lane defence as the revetment deteriorated. Following this, erosion of the earth embankment behind the ‘harder’ rock and concrete defences would be rapid. Over the five years, the standard of defence (based on crest levels) could reduce from around 1 in 1,000 years to 1 in 5. Flood damage to the low lying areas would become increasingly likely, frequent and severe.

A weak point can be identified to the immediate south of East Lane Point. Here defence is provided by the promenade constructed by Sir Cuthbert Quilter during the first 20 years of the twentieth century. On 13 January 1977, the MV Harlestrand collided with East Lane Point and may well have weakened the defences. There is some rock protecting the promenade structure, but possibly not enough to ensure that it does not fail in the face of a storm. If it were to fail, flooding of the low lying land immediately behind would be inevitable.

Apart from at this location, during the first 15 years of the current century, rock revetments have been gradually extended, initially by the works initiated by the East Lane Trust and subsequently as on-going emergency works. Including the promenade mentioned above, the rock revetments now comprise some 920 metres of fortifications. These can, however, be expected to experience gradual failure over a period of time, though probably not within the first five years. Failure would be initiated by the displacement or complete removal of individual rocks, and this would reduce the overall integrity of the structures. Over the next five years it is likely that a progressive collapse or “un-stitching” of the structure would occur during storm events, further exposing the cliffs or defences behind. The cliffs would then be subject to a gradually accelerating erosion due to wave action

South

Further to the south, the cliffs can be expected to experience gradual further erosion, especially from Martello tower W to the former Bloodhound missile site – a location of interest to Historic England, albeit not currently listed.

There is some evidence that wave action is causing the shingle beneath the piling protecting the cliffs in front of Bawdsey Manor to behave as a fluid, so that erosion can take place behind the piling. Furthermore, the Pulhamite cliff, which is a listed structure, is already displaying cracks and damage.

Economic Impact

Over the first five years economic loss is likely to be limited to flood damage due to periodic overtopping of the defences.

5 to 10 years from present:

North

The risk of overtopping at Shingle Street would increase as sea levels rise. The impact would be similar to that described for the first 5 years, but would be more frequent and more likely.

The properties at Shingle Street, although not ‘written off’ by the flooding, would have their access (along a single road well below mean sea level) greatly restricted. It is estimated that this would result in a severe devaluation of market price - in the region of 75%.

Central

Over the course of years 5 to 10, erosion of the largely undefended earth embankment to the north of the rock revetment north of East Lane Point would continue.

Flooding of the lowland through the overtopping of the bank would be increasingly severe and frequent. This overtopping would in time lead to a complete failure and breach of the earth embankment. At this time a large area of agricultural land below MHWS, and many of the isolated properties (all those below the 1 in 1 year flood level) within it, would be permanently lost. At this time major economic losses would occur, and there would be severe social implications.

The low land is sufficiently low to allow widespread flooding on most high tides. The large inflow of water possible would not only maintain the breach, but also encourage its enlargement.

As mentioned above, the rock revetment could well fail during this period.

South

To the south of Martello tower W, the now freely eroding soft cliffs would be moving back. Loss of farmland and some of the facilities at the Bloodhound missile site would be imminent and inevitable.

By the end of this period, it is predicted that Bawdsey Manor itself would be at serious risk and may already start to be lost

Loss of defence to the north and south would result in the outflanking of the East Lane promontory. These central defences would be undermined and they would fail. The process of erosion over the following years would be exacerbated by the loss of the East Lane battery area, although the debris would still exert some regulatory control over longshore sediment transport.

Economic Impact

The economic impact during this period would start to be significant. Irrigation would cease to be possible on most of the farmland by the end of the period resulting in substantial economic losses.

As mentioned above, the properties at Shingle Street would become devalued and Bawdsey Manor would be at serious risk.

10 to 15 years:

By this stage the impacts of an initially localised failure would have become much more widespread. The breach of the flood defences and regular inundation of the land behind it would have created a sediment sink within the former flood plain, thus potentially removing a large volume of material from the longshore transport system. The beaches in front of the Bawdsey cliff coastline would no longer be supplied with material from further north. In this scenario there would therefore be a gradual winnowing down of the downdrift beaches as far south as Felixstowe.

The land level behind the seawall to the north of the rock revetment is approximately 3m AOD and falls away towards the northern limit of the flood risk area, where the land level is approximately 0.5m AOD. Tidal flood water entering the flood risk area would soon overwhelm the land drainage pumping station, which protects the area from fluvial (river) flooding. Floodwater would become trapped behind the defences with no means of escape. In addition, there are two Martello towers situated within the flood plain, which are of archaeological and heritage importance. These would be permanently inundated.

Properties at Shingle Street, although not flooded, would have their access (a single road within the flood risk area and well below mean sea level) cut off due to high standing water levels.

As well as the initial breach, which would widen with each subsequent storm event, there is also a high risk that the revetment works protecting properties to the south of the promontory would be overwhelmed. Evidence of deterioration is already to be seen, as voids behind the revetment leave the crest susceptible to storm damage, due to the potential for rock to fall into voids behind, lowering the crest. As the crest level reduces, recession of the soft cliff behind the revetment would accelerate leaving the properties behind the revetment in imminent risk of loss to erosion. Property loss (Martello tower W/Tin House/Rose Cottage) would occur.

Following failure of the defences and erosion of the land behind, a straighter alignment would develop at East Lane. Being less prominent than the existing headland, shingle currently retained would be able to drift southwards, in an altered drift regime. Consequently more material could be drawn off the Orfordness spit. In a worst case, therefore, the current relative equilibrium of this part of the Suffolk coast could be irreversibly lost.

The reduction in shingle over the bay would make the ridge and defences more vulnerable, leading to further breaches along the main bay frontage. Over time, as such breaches develop at Hollesley Bay, an inlet would form tending to scour away land to the rear. Sediment would become entrapped within this new regime reducing the longshore transport in the coastal system. The coastline in front of Bawdsey cliff would no longer be supplied with material from further north, and there would therefore be a gradual reduction in the size of the downdrift beaches as far south as Felixstowe. This would significantly change the evolution of the coast as far afield as the River Deben.

Changes in the shoreline to the north of the promontory defences could result in significant modification to coastal habitats within the cSAC and SPA. The inundation of low lying agricultural land could lead to the development of a large area of intertidal habitat, and present areas of vegetated shingle and associated saline lagoons would be disrupted. Flows in and out of the flood plain could lead to a build up of shingle to the north of the breach and a localised increase in the area of shingle habitat. However, there would also be a loss of shingle habitat within the sSAC due to realignment of the coast in the East Lane area as described above. Inundation would also represent a significant impact on the local landscape and therefore of the AONB. Erosion of the cliff section to the south of East Lane would maintain and possibly enhance the level of exposure within the geological SSSI, although leading to increased pressure on defences at Bawdsey manor and Felixstowe Ferry.

Furthermore a breach can be expected to the south of Bawdsey Manor into the playing fields area, leading to the opening up of the mouth of the Deben, with potentially serious damage as far up the river a Woodbridge.

The sheet piles at the 'corner' where the River Deben meets the open coast currently hold the estuary mouth in position, and therefore permit the continued existence of the 'Knolls' banks. A reduction in beach levels here would hasten the deterioration of the sheet piles, hence increasing the burden of defence, and significantly disrupting the sediment transport system.

Similarly, beach reductions near Felixstowe Ferry would increase pressure on flood defences to the west of the Deben. This would be exacerbated by the simultaneous reduction in the volume of the Knolls banks, which currently offer a degree of shelter to the Felixstowe Ferry defences.

Over 15 years:

In terms of property damage, all four Martello towers between the Deben and the Ore would be lost, together with, after 20 years, Bawdsey Manor, Stangrove Hall and the properties at Shingle Street. After 30 years, the other properties on the Bawdsey Manor estate would be lost, including the radar museum and the bloodhound missile site.

If the defences on the Western side of the Deben were left to deteriorate, the whole of Felixstowe Ferry (some 88 properties) would be lost, together with a further 2 Martello towers and the golf course.

4.3 Interconnections with adjacent areas

The Deben and Ore estuaries are immediately adjacent to BCP's area and have their own partnerships with similar objectives to our own. If the defences in our area were to fail, the Deben estuary would certainly be adversely affected and so, probably, would the Ore.

Failure of BCP's defences would lead to a widening of the mouth of the Deben. This, in turn, would increase the tidal prism and, in surge conditions would present a serious flooding risk as far up the river as Woodbridge itself.

Similarly, the Alde and Ore would also be adversely affected, and it has been suggested that flooding might actually spread right up to Aldeburgh, which could become an island, and even Southwold.

This study does not attempt to quantify these impacts but recognises that they exist.

4.4 Potential geographical extent of inundation following coastal defence failure

This is shown in section 2.1.

4.5 Assets directly affected by coastal defence failure

The assets directly affected by coastal defence failure are as follows:

4.5.1 Residential Property

The total value of the residential property at risk in the BCP area is estimated at £17,363,900. This has been derived from the values given on the web site www.mouseprice.com. We believe that some of these are rather understated, not reflecting recent improvements etc. The total value might be some £1 – 2 million higher but we have not made any such adjustments.

For the No Active Intervention (NAI) strategy, we expect the timing of these losses would be as follows:

6 – 10 years: Devaluation of Shingle Street by 75% – £9,210,750

11 – 15 years Housing losses – £5,082,900

16 – 20 years Remaining losses at Shingle Street - £3,070,250

4.5.2 Commercial Property

There is very little commercial property at risk in the area. There are a few farm buildings at Buckanay Farm, with a replacement value of perhaps £250,000. These would be lost within 5 – 10 years. The main commercial property, however, is Bawdsey manor, which is a school as well as a residence. It is insured for £27 million, which we take to be its value. In the NAI scenario it would be lost in 20 years.

4.5.3 Heritage Assets

The main heritage assets at risk within 15 to 20 years are the four Martello Towers, which Historic England consider should be dismantled and re-erected at a cost of £5 million each, i.e. a total of £20 million. In addition, there is the radar museum at Bawdsey, which has attracted a grant from the Heritage Lottery Fund of £1.4 million and therefore must have a total value in the region of £2 million. The Bloodhound missile site also has heritage value but this is difficult to quantify. It could be lost during the same period and the land itself has a value of at least £150,000 (the recent purchase price).

Along the coast there are a number of other defence structures built during the two world wars. It is difficult to value these but they could be assumed to have a combined value of some £50,000.

4.5.4 Infrastructure

During the period from 10 to 15 years hence, the infrastructure will be at risk. This is valued by the appropriate authorities as follows:

Anglian Water – sewage works and pumping station – £11 million

Road reconstruction (to form causeways as necessary) – £4.8 million

HM Prison, Hollesley and associated buildings – £5 million²

²In the absence of any available info, we have made our own informed estimate.

4.5.5 Agricultural Land

The low-lying arable marsh and grass marsh would also be lost entirely within 5 to 10 years. We have valued this at £10,000/acre³ and the whole 2,380 acres (960 Ha) would therefore have a value of £23.8 million. Given that this land will be lost to agricultural production entirely, we use this value in Section 4.3.5 to calculate the present value of this loss.

The Suffolk Sandlings comprise valuable light land which is used for growing high value vegetable crops. Recent land sales have taken place at £15,000 per acre. To ensure this value, irrigation must be undertaken as the ground is very porous and the climate relatively arid. In the event of inundation, the wells and reservoirs would become saline and irrigation would no longer be practical⁴. In such an event, the value of the land would decline to a level below average agricultural land prices (currently £9-10,000⁵), possibly to £7,500/acre or below. If £7,500 is taken as a guide, then the land value loss would also be £7,500/ acre, and the total losses from inundation in the BCP area would be £29,625,000 (3,950 acres @ £7,500). However, given that agricultural production will continue on this land, albeit of significantly reduced value, the approach adopted in Section 4.3.6 to calculating economic impact is based on the projected changes in net revenue. In the NAI scenario, these losses are projected to occur in years 6 – 10 of the assessment period.

4.6 Revenues directly affected by coastal defence failure

The annual revenues estimated to be at risk in the NAI scenario are as follows:

4.6.1 Non-farm Revenues

£3,312,250 p.a. consisting mainly of the revenues at Alexander’s College, Suffolk Cottage Holidays and the Suffolk Punch Trust. These figures were obtained from a survey distributed to all businesses in the area. The response rate, however, was not very great – although the three important ones were all obtained as a result of interviews.

It may be assumed that these revenues would commence to be lost after 20 years.

4.6.2 Farm Revenues

We have analysed the farm revenues in some detail. The aggregate impact on annual revenues is as shown in the table below.

Aggregate Impact			
	Before Flooding	After Flooding	Net Change
Farm Revenue	£9,895,955	£2,300,000	(£7,595,955)
Farm Costs	£5,523,620	£1,605,900	(£3,917,720)
Farm Profits	£4,372,335	£694,100	(£3,678,235)
Local Revenues	£3,620,000	£795,950	(£2,824,050)
Local wages	£2,840,625	£644,100	(£2,196,525)

This impact could occur, in the NAI scenario, at any time within the next five years. Local revenues reflect costs to the farmer which are spent with local businesses – and will therefore reflect further lost revenue to the local economy.

³Recent land sales have taken place at this figure.

⁴If all surface water and shallow well sources were lost, it might be possible to sink deep wells into the chalk below the London Clay and use these for irrigation. Six to eight such wells, at a cost of around £250,000 each, would probably be required and it is questionable whether abstraction licences could be obtained from the Environment Agency. It is our view that this would not be a viable solution.

⁵Nix Farm Management Pocketbook, 44th edition (2014)

4.7 Natural capital and ecosystem services directly affected by coastal defence failure

4.7.1 *Natural Capital*

The BCP area contains most of the types of areas classified as natural capital. In particular, the following are all present in the area (and are identified in section 2.6):

- Special Area of Conservation (SAC) – EC Habitats Directive
- Special Protection Area (SPA) – EC Birds Directive
- Ramsar site (International convention – wetlands of international importance)
- Site of Special Scientific Interest (SSSIs) – UK classification
- Area of Outstanding Natural Beauty (AONB)
- Other valuable habitats

4.7.2 *Ecosystems at Risk and Consequences*

Appendix C lists the species of flora and fauna which are to be found in the BCP area, which has been provided to us by the Suffolk Biological Records Centre. The important habitats that would be threatened by failure of the coastal defences and the consequences thereof are discussed below. Because it is a very long list, it is available as a separate document.

Vegetated shingle

The vegetated shingle from Shingle Street all the way to the mouth of the Deben is a scarce and valuable ecosystem and, in conjunction with that on Orfordness forms the largest such habitat in the UK. It provides nesting for Little Terns, a red list species and is also home to a number of rare flora. The issue here is what would happen if the sea wall were breached or the coast were re-aligned. The answer is that the vegetated shingle would probably simply move to a new location. It is unlikely that any species would need to be relocated and the process would probably take place entirely naturally.

Saline lagoons inside the sea wall

There are several saline lagoons inside the sea wall, both at Shingle Street and near to Martello Y. These provide habitats for nesting Avocets and also contain a number of other interesting species. These saline lagoons are ephemeral habitats and as such need movement (by overtopping) or new lagoons to form to maintain their health and condition. By allowing the sea wall to go these lagoons would reform further inland and create a more natural series of habitats. To some extent, however, their quality, especially at Shingle Street is being degraded without this occurring. Again, if the coastline were moved, they would most likely move with it and, if anything, their quality might actually improve.

Wildlife reserves

The RSPB acquired 85 acres of land to form two reserves at Hollesley and Boyton marshes. We understand that they paid market value for this land – a total sum of £900,000 (£10,500 per acre). If the sea wall were breached, this would all become saltmarsh which might be attributed a higher value (see below).

Saltmarsh

There is currently virtually no saltmarsh in the BCP area other than a small area at Shingle Street and it is unlikely that any might be formed in the future. The only possibilities we can see are at Hollesley marshes. Whether the RSPB, which owns this land, would be interested in such a proposition is unknown. It is also relevant that developing saltmarsh in these locations would have little impact on flood risk within the BCP area (though it could affect the neighbouring Alde and Ore).

This is, however, a valuable habitat type and offers four types of ecosystem services:

- ! Flood risk attenuation
- ! Carbon sequestration – although it is somewhat questionable whether this is a long-term or short-term effect, as most carbon bearing material which is adsorbed onto the silt particles is ultimately likely to biodegrade.
- ! Creation of valuable (and scarce) habitat, leading to biodiversity and compliance with the Habitats Directive (92/43/EEC)

! Increase of fish stocks

We have now identified sources of information about valuation of saltmarsh and will use these for the valuation of the saltmarsh in the Deben Estuary, which forms part 2 of this report – if this is completed.

Set-aside land

There are some fairly extensive areas of set-aside land to the immediate West of the sea wall, both at East Lane and near Martello Y. These support species such as corn bunting, linnet, and yellowhammer and also clouded yellow butterflies. If they were lost, it would not cost a great deal to ensure that additional set-aside land were made available to replace any which was lost, and transferring of the endangered species. The value of the additional land made available would be lost, of course. The loss, including the 8 acres of land and protection of endangered species is unlikely to exceed £100,000. It is expected to be incurred within the next five years.

Pulhamite cliff at Bawdsey Manor

The Pulhamite Cliff at Bawdsey Manor is an interesting habitat, although the flora which has colonised it, while interesting, is not classified as endangered. It is however, from a heritage point of view, irreplaceable, since the formula for the construction of Pulhamite was carried to the grave by James Pulham, the inventor. It is not possible to place a value on it but if it had to be moved and relocated, this would probably cost about £2 million. This would probably be practical, since there are many cracks in the material, so it could be carefully removed in sections without doing further damage. This cost is expected to be incurred within the next ten years.

Light land capable of growing root crops

The final ecosystem of importance is the light agricultural land, which is especially good for growing root crops such as onions and carrots, and also brassicas and salad crops. The value of this has been included in sections 3.4.5 and 3.5.2.

4.7.3 *Ecosystem Services*

In summary, the four relevant ecosystem services which are at risk in the BCP area are:

- Agricultural loss avoided
- Expected property damage loss avoided
- Environmental damage avoided
- Recreational / heritage losses avoided

The first two have been discussed in sections 3.4 and 1.1. Section 3.6.2 suggests that the overall cost of environmental and heritage losses would be about £2.1 million. Recreational activity in the area is unlikely to be significantly adversely affected by coastal realignment, provided that all the existing habitats are suitably protected. Regular flooding would have a negative impact, of course, by dissuading visitors, but this would be difficult to quantify.

4.8 *Indirect consequences and social impacts*

The main social impact of flooding will be to local employment. It is worth pointing out that, in the sparsely populated Wilford Peninsula, Alexanders College provides valuable and character-building work experience for most of the young people in the period immediately after leaving school.

4.9 *Risks to life*

In the floods of 1953, 46 people lost their lives in Suffolk, of whom 41 were in Felixstowe. It is believed that no lives were actually lost in the BCP area, although the damage was extensive. With the better quality of weather forecasting and communications, we do not anticipate any loss of life as a consequence of future coastal defence failure.

4.10 *Impacts on adjacent areas*

This subject has been discussed in section 3.2 above

5 ASSESSMENT OF NATIONAL ECONOMIC AND LOCAL FINANCIAL IMPACTS

5.1 Introductory comments

The assessment is based on the do-nothing (No Active Intervention - NAI) scenario. This estimates the value of losses and costs incurred in the event of coastal defence failure without intervention. It provides a baseline against which losses avoided by implementing alternative forms of intervention can be measured. The period over which damage costs can be avoided is ultimately the expected life of the coastal defence measures selected to reduce future vulnerability to flooding and saline inundation. In the event that interventions are made, the actual losses avoided will depend on the form and expected economic life of the selected approach to intervention.

The focus of the assessment is on both national economic and local financial impacts. The national impact assessment estimates the total net economic loss to the nation resulting from coastal defence failure, whereas the local financial assessment estimates the direct financial consequences experienced within the local project area itself. These are measured in terms of reduced levels of employment and expenditure (reduced incomes to local businesses).

The costs of coastal defence failure are measured as potential flood and erosion damage (losses) to:

- ! Agricultural land and output values
- ! Residential and commercial property values
- ! Environmental and heritage resource values

The benefits of any intervention measures are thus mainly in the form of losses avoided.

These losses are measured primarily by reference to market prices, such as the value of lost agricultural output or permanently inundated properties. Each impact is described in general in Chapter 3. The appraisal summary table (AST) attached at Annex C summarises relevant details for each impact type. The period of the assessment is 100 years, from 2016 to 2115. Projected losses are discounted as follows: years 1 to 30, 3.5%; years 31 to 75, 3.0% and years 76 to 100, 2.5%. All values are shown in constant 2015 prices.

We have also completed the Environment Agency's Assessment Summary Table, which will be found in Appendix B, a separate document.

5.2 Overview of agricultural dynamics

A total of 6,330 acres of land is farmed in the project area. This comprises (i) 3,950 acres of light land farmed under irrigation on a two-year cropping cycle between higher-value vegetables and lower-value cereals and beet: none of this land is directly affected by flooding; and (ii) 2,390 acres of drained arable marsh farmed for cereals and beet: all this land is subject to flooding and inundation, making further farming impossible.

Of key concern is the likelihood of saline intrusion into the irrigation water sources utilised by agriculture outside of the flood plain. Such saline intrusion is a major potential source of economic damage, leading to shifts in crop types grown, lower yields and lower net revenues. Of the irrigated light land, 400 acres are irrigated from sources outside the study area. The balance, 3,550 acres, is irrigated from sources subject to permanent saline intrusion.

Two possible approaches to loss evaluation apply under these circumstances. If alternative sources of irrigation water are available, their incremental cost can be taken into the assessment of the "do-nothing" scenario. If no such alternatives exist, then the only farming option is to switch from growing high-value irrigated crops to growing lower-value non-irrigated crops. As alternative irrigation sources have not been identified, economic loss is calculated as the net revenue foregone by switching from higher- to lower- value crops.

Accordingly, the current analysis recognises two types of agricultural economic loss:

- ! The value of land permanently lost to agriculture through saline inundation; and
- ! The reduction in net revenue (profit) generated on land switched from irrigated to non-irrigated cropping

Where farming will become impossible in the absence of flood defences, economic loss is estimated as the loss of the adjusted market value of the agricultural land (MCM P.9-2). This applies to the 2,380 acres referred to above. This land is valued at £10,000 per acre.

Local financial loss is assessed in terms of the expenditures and labour foregone in the project area.

In the absence of alternative irrigation sources, the light land area of 3,550 acres will revert to growing lower-value crops, such as cereals and beet. National economic impact is measured in terms of net revenue foregone and local financial impact in terms of local expenditures and labour foregone. Tables 1 to 6 summarise these outcomes in the before- and after-flooding scenarios for total aggregated agricultural activity:

- ! Areas cropped
- ! Areas by crop type
- ! Aggregate farm economics
- ! Aggregate components of farm revenue
- ! Aggregate net revenue generated by land type
- ! Aggregate local financial impacts

Table 1: Areas cropped before and after flooding

	Before Flooding	After Flooding	Net Loss
Areas cropped (acres)	6330	3950	2380
Light land	3950	3950	0
- Irrigation unaffected	400	400	0
- Irrigation affected	3550	3550	0
Arable marsh	2380	0	2380

Table 2: Areas by crop type before and after flooding

	Before Flooding	After Flooding	Net Loss
Areas sown to crops (acres)	6330	3950	2380
Vegetables	2125	200	1925
Cereals and beet	4205	3750	455
- Light land	1825	3750	-1925
- Marsh land	2380	0	2380

Table 3: Aggregate farm economics before and after flooding

	Before Flooding	After Flooding	Net Loss
Aggregate impact			
Farm revenue	£9,895,955	£2,300,000	£7,595,955
Farm costs	£5,523,620	£1,605,900	£3,917,720
Farm net revenue (profits)	£4,372,335	£694,100	£3,678,235

Table 4: Aggregate components of farm revenue

	Before Flooding	After Flooding	Net Loss
Farm revenue	£9,895,955	£2,300,000	£7,595,955
Light land area unaffected	£825,000	£825,000	£0
Light land area affected	£7,753,125	£1,475,000	£6,278,125
Arable marsh area affected	£1,317,830	£0	£1,317,830

Table 5: Aggregate net revenue generated by land type before and after flooding

	Before Flooding	After Flooding	Net Loss
Net revenue (profit)	4,372,335	694,100	3,678,235
Light land	3,976,850	694,100	3,282,750

- Irrigation unaffected	251,600	251,600	0
- Irrigation affected	3,725,250	442,500	3,282,750
Arable marsh	395,485	-	395,485

Table 6: Aggregate local financial impacts before and after flooding

	Before Flooding	After Flooding	Net Loss
Local expenditure	£3,620,000	£795,950	£2,824,050
Light land area unaffected	£292,000	£292,000	£0
Light land area affected	£2,228,000	£503,950	£1,724,050
Arable marsh area affected	£1,100,000	£0	£1,100,000
Local wages	£2,840,625	£644,100	£2,196,525
Light land area unaffected	£260,000	£260,000	£0
Light land area affected	£1,765,000	£384,100	£1,380,900
Arable marsh area affected	£815,625	£0	£815,625

5.3 National economic and local financial impacts

5.3.1 Impacts on residential property values

The value of total residential property at risk is £17,363,900, consisting of Shingle Street (£12,281,000) and other housing (£5,082,900). The expected timing of losses is:

- ! 6–10 years: 75% of Shingle Street value lost (£9,210,750)
- ! 11–15 years: 100% of other housing lost (£5,082,900)
- ! 16–20 years: 25% balance of Shingle Street value lost: (£3,070,250)

The value of property lost is phased in over each period respectively and then discounted. The total discounted value of residential property lost is £12.3 million.

Local financial impacts have not been assessed. The local impact of the loss of residential properties will depend on whether the occupants displaced relocate to other housing in the project area or move away from it.

5.3.2 Impacts on commercial property values

The most significant potential loss is that of Bawdsey Manor due to cliff erosion in 2035. The buildings are valued at £27 million (Section 3.4.2); this is treated in the assessment as a one-off loss incurred in 2035. It has a discounted value is £14.04 million.

[From an economic perspective, this valuation accounts also for future net revenue lost owing to the closure of Alexander’s College (located at Bawdsey Manor). Annual revenue of the college is understood to be £3 million (Section 4.3.7). As equivalent cost data are not available, the assumption is made that the college generates a profit (net revenue) equal to 10% of total revenue; that is, £0.3 million per annum. It is assumed that this loss is incurred annually from Year 21 (2036) across the assessment period. The present value of this cash flow is calculated to be £4.53 million. This implies a PV for the Bawdsey Hall structure of £9.5 million (£14.04 million - £4.53 million).]

Buckanay Farm is assessed as being lost in Years 6-10. It is valued at £0.25 million; this is treated as being lost progressively over the five-year period 2021 to 2025. It has a discounted value is £0.2 million.

The impact of these asset losses in terms of local business expenditures and employment is assessed in Section 4.3.7 (non-agricultural business production).

5.3.3 Impacts on public infrastructure and utility services

Total damage of £20.8 million to infrastructure assets is assessed to occur in years 11 to 15 as follows:

- ! Anglian Water: £11 million
- ! Road reconstruction: £4.8 million

! HM Prison, Hollesley: £5 million.

The total cost of this damage is phased in progressively over the five-year period 2026 to 2030. The present value of these impacts is £13.8 million.

Impacts at the local community level have not been assessed.

5.3.4 Impacts on transport services

Impacts on transport services have not been assessed.

5.3.5 Impacts on agricultural land values

Sea water incursion and inundation will remove 2,380 acres of currently farmed arable marsh land permanently from production. The value of the land lost is assessed to be £10,000 per acre, indicating a total value today of £23.8 million. The loss is expected progressively to be incurred over years 6 to 10 of the assessment period, from 2021 to 2025. The present value of the loss is £18.7 million.

The reduction in the value of high quality light land has been referred to in Section 3.4.5. Economic loss associated with the reduced value of this land is considered in Section 4.3.6 in terms of the net revenue loss incurred in shifting from high value to low value crops.

Cessation of farming activities on this land leads to a reduction in direct annual expenditure in the local area estimated to be £1.1 million (see Table 6). The annual value of local labour used at the farm and in associated service activities is estimated to be £0.82 million (Table 6). This is projected to occur progressively in the period 2021-2025 and held constant thereafter.

5.3.6 Impacts on agricultural production values

Net revenue losses result from inundation of the irrigation water sources on which much of current high value-added vegetable production depends. The reduction in annual net revenue generated from this land area of 3,550 acres is £3.28 million (Table 5). This loss is phased in over five years from Year 6 (Section 3.4.5) and then held constant over the assessment period. The present value of the loss is £77.12 million.

The change in cropping pattern leads to a reduction in local expenditure of £1.72 million annually (Table 6) from Year 6. Local expenditure on wages falls from £1.77 million to £0.38 million, a drop of £1.38 million (Table 6).

5.3.7 Impacts on non-agricultural business production values

Estimated non-farm revenue lost from sea water incursion and coastal erosion is £3,312,250 p.a. from Alexander's College (Bawdsey Manor), Suffolk Cottage Holidays and Suffolk Punch Trust (Section 3.5.1) and a few small businesses which have responded to our questionnaire. Of these, £3 million is attributable to Alexander's College. This has already been accounted for in Section 4.3.2 above.

The balance of non-farm revenue (£312,250) is projected to be lost from year 21 onwards. It is assumed that 10% of this (£31,225) is lost profit (net revenue) and that this loss will be phased in from 2036 to 2040, after which it is held constant over the assessment period. The present value of this loss is £0.4 million.

From the local perspective, it is assumed that 90% of total non-farm revenue constitutes local expenditures that will cease entirely beyond year 25 (2040). This is an annual loss to the local economy of £3.0 million, and is accompanied by a fall in full-time equivalent employment from 51 to 7 persons (survey results). Wages costs are not available. It should be pointed out that some employers did not respond to our survey and their employment figures are not included.

5.3.8 Impacts on environmental and national heritage values

Significant losses of national heritage sites are projected in years 16 to 20 (Section 3.4.3). These are:

- ! Martello towers (relocation): £20 million
- ! Bawdsey radar museum: £2 million
- ! Bloodhound missile site: £150,000
- ! Other heritage structures: £50,000.

The value of the Martello towers is assessed as the cost of dismantling and relocating them to alternative locations and the figure has been provided by Historic England. Given the scarcity and historical importance

of these structures it is probable that this valuation understates their true heritage value. The other assets would be permanently lost. The total cost of £22.20 million is phased in over the five-year period 2031 to 2035. The present value of this cash flow is £12.4 million.

The Pulhamite cliff at Bawdsey manor is another important national heritage asset at risk, and is expected to be lost to coastal cliff erosion in the following ten year period. The value of £2 million attributed to the site (section 3.6.2) is estimated from the cost of relocating it to a safe site. The present value of the relocation cost is £1.7 million.

The loss of set-aside land is valued in Section 3.6.2 at £0.1 million, this loss occurring in Year 16, with a present value of £0.06 million.

The local financial impact of the loss of heritage properties has not been assessed. The loss of expenditures made in the local area by those employed at the sites and from the loss of visitors to them will adversely affect the local economy.

5.4 Summary outcomes

5.4.1 National economic impacts

Table 7 summarises the present value outcomes reported in Section 4.3. The total cost to society of the “do-nothing” scenario in present value terms is assessed to be £151 million. Of this, agricultural impacts are £96 million, 64% of the total.

Table 7: Summary of Present Value Outcomes

Impacts on:	Assessed PV
Residential property values	12.3
Commercial property values	14.2
Public infrastructure and utility services	13.8
Transport services	0.0
Arable marsh land values (a)	18.7
Light land production values (b)	77.1
Non-agricultural business production values	0.4
Environmental and national heritage values	14.2
Total Value	150.8

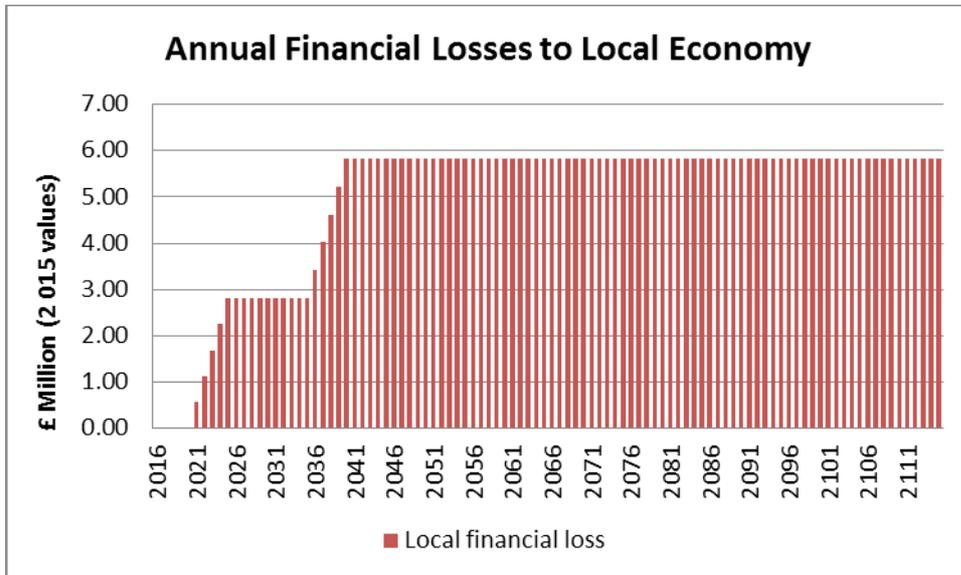
5.4.2 Local financial impacts

The local financial losses that have been assessed are summarised as follows:

- ! Loss of agricultural land and associated production: local expenditure loss of £1.1 million per annum incurred progressively over 2021 to 2025 and held constant thereafter (Section 4.3.5)
- ! Loss of agricultural production due to shift to lower value crop types: local expenditure loss of £1.7 million per annum incurred progressively over 2021 to 2025 and held constant thereafter (Section 4.3.6)
- ! Loss of non-agricultural production: local expenditure loss of £3.0 million per annum incurred progressively over 2036 to 2040 and held constant thereafter (Section 4.3.5)

Local expenditure losses associated with the loss of residential property, interruption of public infrastructure and utility services, transport services and national heritage values have not been assessed due to lack of data.

The following chart illustrates the progressive growth in local expenditure losses over the assessment period. The present value of the losses is £109 million, rising from £0.6 million in 2021 to £5.8 million in 2040 (after which it remains constant).



The present value of lost wages from agricultural employment over the assessment period is £52 million, rising from £0.4 million in 2021 and rising to £2.2 million in 2025 (after which it remains constant at this level over the assessment period).

Although cost data are not available, wages losses associated with the loss of Bawdsey Hall would also be significant. If the same ratio of wages to local expenditures is assumed for Bawdsey Hall as for the agricultural sector (78%), then the present value of future non-agricultural wage losses would be £33 million, giving a total loss of £85 million.