



# Condition Assessment Summary Report

Hunstanton Coastal Management Plan

60552153

December 2018

Borough Council of  
King's Lynn & West Norfolk  
King's Court  
Chapel Street  
King's Lynn  
Norfolk  
PE30 1EX

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Prepared by	Checked by	Approved by
George Batt Engineer	Dan Glasson Associate Director	Paul Norton Director

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**Prepared for:**

Borough Council of King's Lynn & West Norfolk  
King's Court  
Chapel Street  
King's Lynn  
Norfolk  
PE30 1EX

**Prepared by:**

AECOM Infrastructure & Environment UK Limited  
Midpoint  
Alencon Link  
Basingstoke  
Hampshire RG21 7PP  
UK

T: +44(0)1256 310200

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## Table of Contents

<b>1.</b>	<b>Introduction.....</b>	<b>1</b>
1.1	Project background .....	1
1.2	Purpose of report .....	1
1.3	The site .....	1
1.4	Previous studies.....	1
<b>2.</b>	<b>Methodology .....</b>	<b>3</b>
2.1	Site inspection .....	3
2.2	Condition assessment methodology.....	5
<b>3.</b>	<b>Condition Assessment Results Summary .....</b>	<b>7</b>
<b>4.</b>	<b>Residual Life Assessment .....</b>	<b>11</b>
4.1	Asset deterioration guidance .....	11
4.2	Application of guidance .....	13
4.3	Engineering judgement .....	13
<b>5.</b>	<b>References .....</b>	<b>17</b>

## Appendices

<b>Appendix A – Inspection Notes .....</b>	<b>18</b>
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# 1. Introduction

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## 1.1 Project background

AECOM Infrastructure and Environment UK Limited has been appointed by the Borough Council of King's Lynn and West Norfolk (BCKLWN) to develop a Coastal Management Plan (CMP) to implement the 2010 Shoreline Management Plan's (SMP2) preferred management policy for the Hunstanton frontage.

## 1.2 Purpose of report

This report serves to update the previous condition assessment report by Royal HaskoningDHV in 2015. The previous report contained assessment through visual inspections, ground penetrating radar and falling weight deflectometer investigations. This report will only update the visual inspection element of the previous report.

The updated visual inspection from this report along with previous condition assessment data will subsequently be used to inform the economic analysis of the residual lives of the assets and also will be used to develop potential options in the option appraisal. Both of these elements of work will be used to develop a management plan for the frontage.

## 1.3 The site

Hunstanton is a seaside town along the west facing coast of the Wash in Norfolk, approximately 21km north east of the town of King's Lynn (Figure 1). The study area comprises approximately 1.3km of undefended cliffs (Unit A) and approximately 1.5km of defended coastline (Unit B) that consists of seawalls, promenade, rear wave wall and beach management groynes. The entire coastline is fronted by a sandy/shingle beach of varying levels.

Hunstanton is a popular tourist area, particularly in the summer months. The promenade is a prominent amenity area with an array of attractions which are well trafficked by the public. There are numerous seasonal kiosks located along the promenade with a leisure centre, aquarium, small funfair and caravan park located just behind the rear wave wall.

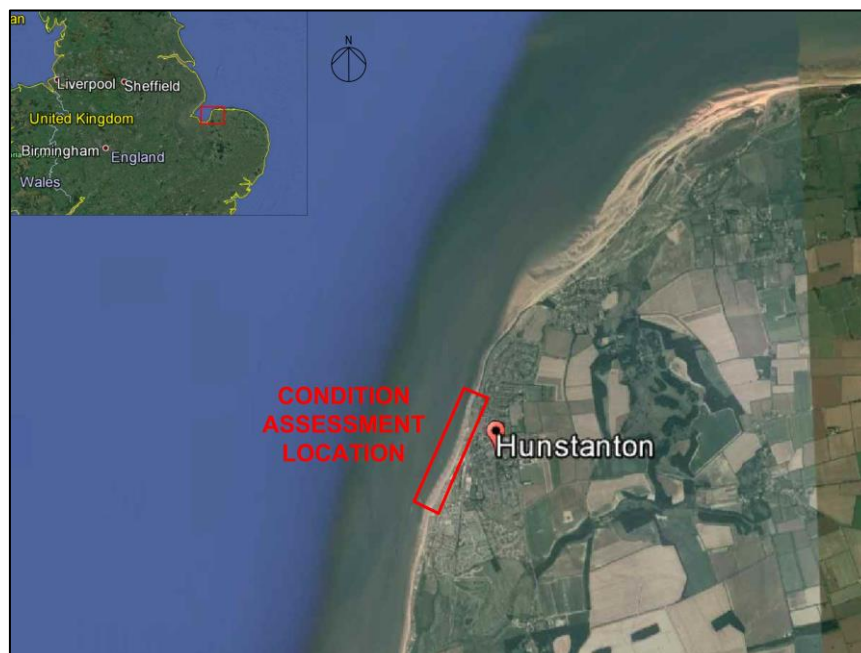


Figure 1: Location of study area (imagery ©2017 Google)

## 1.4 Previous studies

A number of condition assessments of the Hunstanton frontage take taken place in the past including:

- Condition Assessment and Ground Investigation 1996 (Mott MacDonald Investigation, 1996);
- The seawall and groynes visual survey undertaken in spring 2005 (St La Haye Ltd, 2005);
- The seawall and groynes visual survey undertaken in spring 2008 (St La Haye Ltd, 2008);
- Hunstanton Promenade and Sea Wall Condition Survey – Phase 1 Geotechnical Desk Study 2012 (Royal HaskoningDHV, 2012);
- Hunstanton Promenade and Seawall Condition Assessment – Condition Assessment Report 2013 (Royal Haskoning, 2013);
- Hunstanton Promenade Survey and Inspection 2015 – Summary of the Visual, GPR & FWD Surveys 2015 (Royal HaskoningDHV, 2015).

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## 2. Methodology

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### 2.1 Site inspection

The inspection of the frontage took place on the 11/12<sup>th</sup> October 2017 and 5<sup>th</sup> December under good visibility, the weather conditions were largely overcast. A programme of work was established to recognise the constraints imposed by the tide times and work around these.

The previous inspections have used the reference system established by the 1996 Mott MacDonald inspection and also used in the subsequent inspections. The frontage is divided into seven sections (A to G) based on the different types of seawall, as shown in Figure 2 and then within these sections given sub-sections by panels (i.e. construction joint to construction joint).



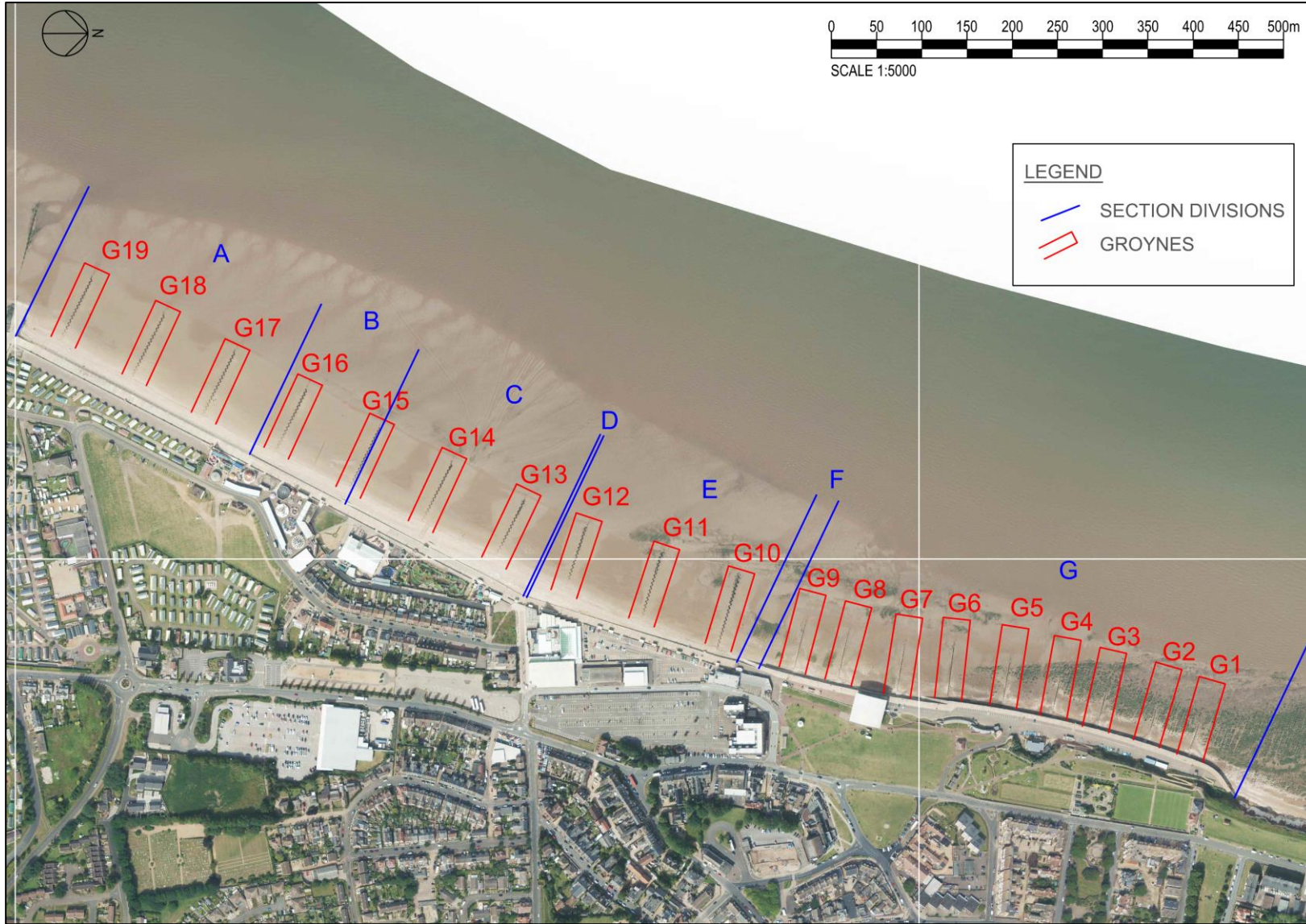


Figure 2: Asset identification system along the frontage (aerial imagery ©2017 CCO)



Each section generally consists of a seawall structure, a raised promenade behind the seawall and a rear wave wall on the landward side of the promenade. The length of the seawall, promenade slab and rear wave wall panels varied in each section and did not always coincide. Table 1 below outlines the number of each panel type in each section.

**Table 1: Number of panels of the seawall, promenade slab and rear wave wall**

Defence Section	Length (metres)	Number of panels		
		Seawall	Promenade Slab	Rear Wave Wall
A	292m	68	68	68
B	117m	33	20	20
C	204m	59	34	34
D	6m	1	1	1
E	260m	46	46	46
F	33m	5	N/A	4
G	561m	93	156	N/A

Observations and the condition of each individual panel were assessed and recorded in detail during the visual inspection.

To reference the 19 groynes inspected along the frontage the numbers on the marker signs at the end of the groynes were used (1 to 19).

## 2.2 Condition assessment methodology

This defence condition assessment is based on a visual site inspection. No intrusive investigations were performed as part of this inspection as have been carried out in previous condition assessments.

The condition of the defences has been assessed in line with the Environmental Agency (2006) Condition Assessment Manual. Using this condition rating system is consistent with the previous assessments. The Condition Assessment Manual used a 1 to 5 grading scale to rate the condition of different types of structures, these are defined for relevant structures in Table 2.

**Table 2: Condition assessment grading system**

Grade	Rating	Description			
		General	Concrete Structures	Seawalls	Timber Groynes
1	Very Good	Cosmetic defects that will have no effect on performance	Hair-line cracks and small surface cavities may be apparent.	No significant visible defects. Hair-line cracks and small surface cavities are visible. Precast units fully seated with no joint deformation. Joints fully sealed.	Timber planks, walings, piles and fixings sound. Minimal gap between planks to arrest drift of beach material.
2	Good	Minor defects that will not reduce the overall performance of the asset	Minor cracks, slight sealant loss, localised honeycombing or flaking. Although not in pristine condition the structure has no significant defects, is structurally sound and in serviceable condition. Mastic joints may have been replaced.	Minor cracking, no sealant loss from joints, localised honeycombing or flaking. Although not in pristine condition the structure has no significant defects, is structurally sound and in good serviceable condition. Mastic joints may have been replaced.	Timber planks, walings, piles and fixings sound, though small gaps between planks may be evident. Occasional plank requires replacement.
3	Fair	Defects that could reduce	Rust staining, localised spalling, lack of cover,	Rust staining or exposed anti cracking steel, localised	Some missing or broken planks. Gaps

		performance of the asset	lengthy cracking and some movement or extensive honeycombing. Loss of joint sealant. Damage limited to non-critical elements.	spalling, lack of cover, lengthy cracking and some movement or extensive honeycombing. Minor loss of joint sealant.	between planks allowing shingle through. Fixings reasonably sound. Some rotation (main image) or bulging (insert) may be evident.
4	Poor	Defects that would significantly reduce the performance of the asset. Further investigation needed	Extensive spalling and severe cracking, exposed rebar, leakage, staining, sealant loss (leakage), extensive movement or damage likely to affect structural integrity. Lowered crest in section. Structurally unsound now or in the near future.	Extensive spalling, exposed rebar, leakage, staining, sealant loss (leakage), extensive movement or damage likely to affect structural integrity.	Large number of planks and fixings missing or damaged. Timber walings are distressed and fixings severely corroded. Large gaps between planks allowing beach material through. Piles abraded and split.
5	Very Poor	Severe defects resulting in complete performance failure	Completely derelict, structurally failed beyond repair. Concrete has failed and moved or completely collapsed (top left and main photo). Considerable loss of wall thickness and reinforcement cover (top right insert).	Completely derelict, structural failure beyond repair. Concrete has failed and moved or completely collapsed. Considerable loss of wall thickness and reinforcement cover.	Significant number of timber planks missing, some piles damaged. Fixings missing, walings and ties disconnected or missing. Timber at end of useful life.

### 3. Condition Assessment Results Summary

A summary of all visual inspection notes for the different elements of the frontage are presented below along with recommendations of repairs that would improve the condition of the frontage. The full inspection records are contained in Appendix A along with results from the previous visual inspection (2015) for comparison.

**Table 3: Summary of visual inspection results**

<b>Section A</b>					
<b>Defence Element</b>	<b>Rating of Panels</b>				
	<b>Very Good</b>	<b>Good</b>	<b>Fair</b>	<b>Poor</b>	<b>Very Poor</b>
Seawall (68)	-	63	5	-	-
Promenade (68)	5	6	57	-	-
Rear Wave Wall (68)	27	40	1	-	-
<b>General notes about Section and Recommended Repairs to Improve Condition</b>					
Seawall	<p>General Notes about Section: Stepped revetment. Beach material generally partially covers 3rd step from top with sometimes 4th step visible where beach levels are lower, 2015 report refers to 6th step down being visible indicating previous survey was undertaken at a time of lower beach levels.</p> <p>Throughout Section A there are gaps on RHS panel joints measuring approximately 4mm with sealant loss. Generally throughout there is abrasion, but it is superficial with no effect on performance. In a small number of sections there is minor cracking. Recent patch repairs appear to have been made throughout.</p>				
Promenade	<p>General Notes about Section: Generally there are cracks throughout the promenade section. Historical repairs are in mixed condition. Small patches of abrasion were observed. The section is generally in fair/good condition.</p>				
Rear Wave Wall	<p>General Notes about Section: Recurve concrete wall approximately 1.25m high and 300mm thick, set back from the seawall at the rear of the promenade. In general this section is good to very good with limited surface and sealant damage and no apparent significant structural damage.</p>				
<b>Section B</b>					
<b>Defence Element</b>	<b>Rating of Panels</b>				
	<b>Very Good</b>	<b>Good</b>	<b>Fair</b>	<b>Poor</b>	<b>Very Poor</b>
Seawall (33)	-	33	-	-	-
Promenade (20)	-	20	-	-	-
Rear Wave Wall (20)	-	17	3	-	-
<b>General notes about Section and Recommended Repairs to Improve Condition</b>					
Seawall	<p>General Notes about Section: Seawall is mostly vertically faced (the last few panels of Section B are slightly inclined). Some flap valves were observed along the wall, all of which were partially buried and therefore would not open. All of wall in good condition. Joints have no gaps, but there is sealant missing from the joints on the front face of the wall.</p>				
Promenade	<p>General Notes about Section: There are non-severe cracks throughout the promenade section. Historic repairs which have been carried out are in mixed condition. Patches of abrasion were also seen. There is a significant loss of sealant between many of the panels.</p>				
Rear Wave Wall	<p>General Notes about Section: Recurve concrete wall approximately 1.25m high and 300mm thick, set back from the seawall behind the promenade. In general this section is good to fair with limited surface</p>				

	damage and no apparent significant structural damage. There are a series of cracks in various sections, along with the displacement of a number of sections. There is also moderate loss or damage to the sealant of the joints between many of the sections.
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### Section C

Defence Element	Rating of Panels				
	Very Good	Good	Fair	Poor	Very Poor
Seawall (59)	-	59	-	-	-
Promenade (34)	-	18	16	-	-
Rear Wave Wall (34)	-	32	2	-	-

#### General notes about Section and Recommended Repairs to Improve Condition

Seawall	General Notes about Section: There are a number of panels which have vertical cracks running through, generally located in the centre of the panel. However, these cracks are minor and there is no evidence of structural movement. Sealant is missing from joints on the front face of the wall. All of wall is in good condition. One flap valve was observed, half buried by beach material.
Promenade	General Notes about Section: There are minor cracks throughout the whole promenade. Historic repairs in mixed condition were observed. Patches of abrasion were observed. There is a significant loss of sealant between many of the panels.
Rear Wave Wall	General Notes about Section: Recurve concrete wall approximately 1.25m high and 300mm thick, set back from the seawall behind the promenade. In general this section is good to fair with limited surface damage and no apparent significant structural damage. There are a series of cracks in various sections, along with the displacement of a number of sections. There is also moderate loss or damage to the sealant and joint between many of the sections.

### Section D

Defence Element	Rating of Panels				
	Very Good	Good	Fair	Poor	Very Poor
Seawall (1)	-	1	-	-	-
Promenade (1)	-	1	-	-	-

#### General notes about Section and Recommended Repairs to Improve Condition

Seawall	General Notes about Section: Section D1 is formed of 3 panels. Joints have been repaired with mortar, appears to be recent. There is a minor vertical crack in middle panel. Superficial abrasion throughout.
Promenade	General Notes about Section: There are minor cracks in the promenade and a repair patch is observed.

### Section E

Defence Element	Rating of Panels				
	Very Good	Good	Fair	Poor	Very Poor
Seawall (46)	-	-	46	-	-
Promenade (46)	-	14	25	7	-
Rear Wave Wall (46)	-	42	4	-	-

#### General notes about Section and Recommended Repairs to Improve Condition

Seawall	<p>General Notes about Section: Seawall is formed of concrete blockwork with concrete top (part of promenade). Throughout there is abrasion to the concrete top and concrete blockwork, but this is superficial and does not affect performance. There are many gaps between the joints of the concrete top where the sealant is missing, in one location grass is growing in the gap. There are also many gaps between the concrete blockwork where there is missing mortar. Generally, these gaps are small, however in isolated locations, where abrasion has occurred more heavily bigger gaps of up to 5cm are evident.</p> <p>Any cracks are minor and there is no evidence of movement of the structure. There have been small sections of patch repairs made along the concrete top.</p> <p>At the time of the inspection there are two health and safety concerns: (1) the staircase in E16 has a step with heavy abrasion in the middle, and (2) in E34 there is a flap valve with a cover attached with a double hinge where one of the hinges is broken.</p> <p>Note that the previous condition assessment graded much of Section E as Poor condition. However, for masonry structures the Condition Assessment Manual describes the Poor grading as "extensive spalling of bricks or blocks, substantial cracking, movement, or severe damage". And following the 2017 inspection it is not thought that the defects inspected in Section E justify this grading.</p>				
Promenade	<p>General Notes about Section: Generally minor cracks throughout the promenade. Historic repairs are in mixed condition. Patches of abrasion were observed. There is a significant loss of sealant between many of the panels. Some of the panels are demonstrating evidence of settlement towards the seawall.</p>				
Rear Wave Wall	<p>General Notes about Section: Recurve concrete wall approximately 1.25m high and 300mm thick, set back from the seawall behind the promenade. The wave wall has been built upon with seafront properties in some locations. In general this section is good to fair with limited surface damage and no apparent significant structural damage. There are a series of minor cracks in various sections. There is also moderate loss or damage to the sealant in the joints between many of the sections.</p>				
<b>Section F</b>					
Defence Element	<b>Rating of Panels</b>				
	<b>Very Good</b>	<b>Good</b>	<b>Fair</b>	<b>Poor</b>	<b>Very Poor</b>
Seawall (5)	-	-	5	-	-
Slipway (5)	-	-	5	-	-
Rear Wave Wall (4)	-	4	-	-	-
<b>General notes about Section and Recommended Repairs to Improve Condition</b>					
Seawall	<p>General Notes about Section: There is superficial abrasion on the face of the wall throughout Section F. There are cracks in some panels, which are minor with no observable movement of the structure. There is also sealant missing from joints along the wall.</p>				
Slipway	<p>General Notes about Section: The slipway wall is approximately 300-400mm thick, rising from the beach level to the promenade – approximately 2.5m higher. There are corresponding sections of concrete slipway behind the wall sections. The wall and slipway are generally in a fair condition, with some significant cracks in the wall and smaller cracks in the slipway. There is also some evidence of past repairs which are generally intact. The two most significant cracks consist of (1) a crack extending through sections F2 and F3 of the slipway wall in total approximately 7m long, and (2) a crack below a former repair in section F3, approximately 3m long. It is unclear whether these only affect the surface or the entire wall section. The cracks/abrasion holes along the slipway are generally located at the joints.</p>				
Rear Wave Wall	<p>General Notes about Section: Recurve concrete wall approximately 1.25m high and 300mm thick, set back from the seawall behind the promenade. In general this section is good with limited surface damage and no apparent significant structural damage. There are a couple of minor surface cracks in</p>				

	Section F. There is also moderate loss or damage to the sealant of the joint between section F2 and F3.
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## Section G

Defence Element	Rating of Panels				
	Very Good	Good	Fair	Poor	Very Poor
Seawall (93)	-	-	93	-	-
Promenade (156)	-	144	12	-	-

### General notes about Section and Recommended Repairs to Improve Condition

Seawall	General Notes about Section: Section G is a recurve seawall. There is superficial abrasion on the lower bottom panels throughout Section G. A large proportion of upper panels have minor vertical cracks through their centres, as do some of the landward panels of the parapets. Generally, there is abrasion/spalling damage where the vertical and horizontal joints meet, some of this abrasion damage have been patch repaired. There has also been new sealant applied to the vertical joints, however this is missing from the bottom half of the lower panels. There are a few panels where cracks appear horizontally through the lower panels. The seawall is generally considered to be in fair condition.
Promenade	General Notes about Section: The promenade is generally in good condition, with little spalling or abrasion and few cracks, which are minor. There was no observed displacement of the slabs or extensive erosion or structural damage.

## Groynes

Groyne Type	Rating of Groynes				
	Very Good	Good	Fair	Poor	Very Poor
Concrete (9)	-	-	9	-	-
Timber (10)	-	-		10	-

### General notes about Groynes and Recommended Repairs to Improve Condition

Concrete	General Notes about Section: Generally, the concrete slabs have minor cracking and spalling. Two concrete boards are missing throughout all the groynes. The beach profile appears to have dropped from when the groynes were originally installed and some gaps between bottom of groynes and beach level have been filled with a concrete step below the original groyne structure to deal with lower material level, although some gaps are still observed. The connections to the seawall are heavily corroded, but intact. The markers at the end of the groynes are also corroded but appear structurally intact.
Timber	General Notes about Section: All the timber groynes are zig-zag type. Generally the vertical sheeters have signs of necking, with the lower half of the groynes having heavy/severe necking. Some of the groynes have a large number of vertical sheeters missing, there are also some waling beams missing throughout. The piles however are generally intact and appear to be in fair condition, there is no rotation of the groyne that would indicate the piles might be structurally unsound (the condition of the piles is the primary reason the grade is Poor/Fair rather than just Poor). The marker posts have corrosion evident but appear stable, although on Groyne 17 the diagonal strut has become disconnected from the end of the groyne and is loose.



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## 4. Residual Life Assessment

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### 4.1 Asset deterioration guidance

In order to establish the economic baseline the residual lives of the structures on the frontage need to be estimated. To estimate the residual life of the structures the grades from the Environment Agency Condition (2006) Assessment Manual can be used along with the Environment Agency (2013) Condition Grade Deterioration Curves guidance. This guidance sets out the estimated time (years) for structures to deteriorate from one condition grade to another under different maintenance regimes.

The maintenance regimes are:

1. Low/basic – do minimum repair/maintenance
  - Inspection + H&S repair (annually)
2. Medium maintenance regime
  - Inspection + H&S repair (annually)
  - Maintenance activities for maintaining a target of Condition Grade 3
3. High maintenance regime
  - Inspection + H&S repair (annually)
  - Maintenance activities for maintaining a target of Condition Grade 2

The guidance sets out different expected deterioration times considering asset class, environment, material and maintenance regime. For the purposes of this assessment, to inform the economic assessment, the structure that should have its residual life assessed is the seawall. The seawall is critical to stopping erosion of the coastline. If the seawall was to fail the promenade and rear wave wall would be undermined and would also fail. However, if the promenade or rear wave wall were to fail erosion would not begin whilst the seawall remains.

There are three types of seawall present in the frontage: concrete vertical walls (some walls have slight incline or recurve, but for the purposes of this assessment will be considered vertical), concrete blockwork (masonry) vertical walls and stepped revetment. As there is no guidance provided on a stepped revetment (Section A) in the coastal environment this shall be considered as a vertical concrete wall. The expected deterioration for these structures is shown in Table 4.

Table 4: Data extracted from the Environment Agency condition grade guidance

Asset class	Environment	Material	Maintenance Regime	Expected deterioration times (years) to specified CG from new														
				Medium deterioration					Fastest deterioration					Slowest deterioration				
				1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Vertical wall	Coastal/estuarine	Concrete	1	0	10	30	40	50	0	5	15	25	30	0	15	45	60	80
			2	0	15	40	55	70	0	10	20	30	40	0	20	60	80	100
			3	0	20	50	70	90	0	15	25	35	50	0	25	75	100	120
Vertical wall	Coastal/estuarine	Brick/masonry	1	0	10	30	40	50	0	5	15	25	30	0	15	45	60	80
			2	0	15	40	55	70	0	10	20	30	40	0	20	60	80	100
			3	0	20	50	70	90	0	15	25	35	50	0	25	75	100	120

## 4.2 Application of guidance

An asset should be considered failed when it reaches Condition Grade 5 'Very Poor – Severe defects resulting in complete performance failure'. The guidance advises for a strategic study the asset should be considered to be at the mid-point of the condition grade transition interval when no further information is known other than the visual inspection. To forecast the estimated time to Condition Grade 5 (CG5) the transition to this condition grade is considered to be in the middle of the expected deterioration time for CG4 and CG5 (i.e. if CG4 is 60 years and CG 5 is 80 years, the transition to CG5 occurs at 70 years).

For the baseline economic scenario Maintenance Regime 1 should be assumed. Assuming this maintenance regime Table 5 presents the estimated residual lives of the seawall structures on the frontage based on condition grade. The full range of deterioration times are presented, for the frontage estimates for medium deterioration shall be used.

**Table 5: Expected residual lives of the seawall sections (Maintenance Regime 1)**

Seawall Defence Section	Rating	No. of Panels	Expected Deterioration Times (years) to Condition Grade 5		
			Fastest	Medium	Slowest
Section A – stepped revetment (to be considered as concrete vertical wall for grading and residual life prediction)	Good (CG 2)	63	22.5	35	55
	Fair (CG 3)	5	12.5	15	25
Section B – concrete vertical wall	Good (CG 2)	33	22.5	35	55
Section C – concrete vertical wall	Good (CG 2)	59	22.5	35	55
Section D – concrete vertical wall	Good (CG 2)	1	22.5	35	55
Section E – concrete blockwork (masonry) vertical wall	Fair (CG 3)	46	12.5	15	25
Section F – concrete vertical wall	Fair (CG 3)	5	12.5	15	25
Section G – concrete vertical wall	Fair (CG 3)	93	12.5	15	25

## 4.3 Engineering judgement

The residual lives presented above are solely based on data from the updated visual inspection. However, there is other information available that should be considered to inform the condition and estimated residual lives:

- Previous 2015 visual inspection results. The previous visual inspection records show that when it was undertaken there were lower beach levels than during the 2017 inspection. This potentially means that the earlier inspection observed defects that were below the beach level of the updated visual inspection. Comparison of the results of the 2015 inspection and that completed by AECOM in 2017 does not indicate that there were any significant defects recorded in the 2015 inspection that were below the beach level

during the 2017 inspection. However, the comments from the previous report were considered when determining the condition grading of the 2017 inspection.

- The 2015 inspection also used Ground Penetrating Radar and Falling Weight Deflectometer surveys to inform on the condition of the structures. However, these surveys were only undertaken on the promenade and therefore will not aid assessing the condition of the seawall. Furthermore, the results did not present enough certainty to predict residual lives from.
- An earlier 2013 condition report involved intrusive ground investigation using concrete cores and trial pits and also a beach level assessment of 20 years of data.
  - The intrusive investigations only focused on Sections A-E where the most prominent settlement and cracks were noted. Whilst both the seawall and promenade were investigated only one core was taken from the seawall, five trial pits were excavated at the toe of the seawall. These intrusive investigations revealed no defects in the seawall.
  - The beach level assessment used beach annual profile data obtained by the Shoreline Monitoring Group from 1991. The assessment concluded that variations occur of up to 1.5m and whilst the beach has a relatively high response to the wave environment, the overall trend over the monitoring period is one of no movement. Note that the 2013 report highlights that this assessment is based on one the beach monitoring profiles (in Section A) which are spaced every kilometre and it recommends that more beach profiles be taken along the frontage at higher spatial frequency.

The 2013 report did provide residual lives for the different sections as follows:

- Section A – 30 to 50 years provided that maintenance works to the frontage continue and the beach levels remain stable.
- Section B – 30 to 50 years provided that maintenance works to the frontage continue and the beach levels remain stable.
- Section C – 30 to 50 years provided that maintenance works to the frontage continue and the beach levels remain stable.
- Section D – 10 to 20 years provided that maintenance works to the frontage continue and the beach levels remain stable. The residual life was lowered because there was evidence to show that beach levels had in the past dropped lower than the end of the concrete toe.
- Section E – 10 to 20 years provided that maintenance works to the frontage continue and the beach levels remain stable. The residual life was lowered because there was evidence to show that beach levels had in the past dropped near than the toe of the structure.
- Section F – 10 to 20 years provided that maintenance works to the frontage continue and the beach levels remain stable. The residual life was lowered because there was evidence to show that beach levels had in the past dropped near than the toe of the structure.
- Section G – 10 to 20 years provided that maintenance works to the frontage continue and the beach levels remain stable. The residual life was lowered because there was evidence to show that beach levels had in the past dropped near than the toe of the structure.

Note that the estimated residual lives of the structures above assumes that the structures are maintained, although the level of maintenance is not defined in the report.

A comparison of the results from the 2017 visual inspection and the 2013 assessment (considering visual, intrusive investigation and beach level assessment) is presented in Table 6. Note the 2015 assessment did not include a breakdown of the residual lives for each section so information from the 2013 is being used for comparison.

**Table 6: Comparison between 2013 and 2017 results**

Seawall Defence Section	Range (years)		Best Estimate (years)	
	2013	2017	2013 adjusted (-4 years to present day)	2017
Section A*	30 to 50	22.5 to 55	36	35

Section B	30 to 50	22.5 to 55	36	35
Section C	30 to 50	22.5 to 55	36	35
Section D	10 to 20	22.5 to 55	11	35
Section E	10 to 20	12.5 to 25	11	15
Section F	10 to 20	12.5 to 25	11	15
Section G	10 to 20	12.5 to 25	11	15

\*In the 2017 visual inspection 63 panels in Section A have been assessed as good, 5 have been assessed as fair. For the purposes estimating the residual life it has been assumed that all of Section A is good based on the small proportion of panels that deviate from this and the minor amount of works required to improve their condition.

Table 6 shows that with the exception of Section D the best estimate of the residual lives are broadly similar, within 5 years of each other once the time passed since the 2013 assessment has been considered. With the ranges of the estimates being at least 10 years to account for uncertainty this difference seems reasonable.

In Section D, there is a larger difference between estimates. This difference appears to originate because the residual life was lowered in the 2013 assessment because of concerns over the beach level potentially lowering below the toe of the structure.

Table 7 presents the best estimates for the residual life of the structures taking into account all the relevant available information. This information will be used to inform the economic assessment. In order to take into account the 2013 beach level assessment work (which typically caused a reduction in residual lives in the 2013 report) a decision has been taken to lower the residual life of Section D from the results in the 2017 visual inspection. Whilst it cannot be known whether the beach levels will lower to a critical level and cause the structure to fail, based on the available information a judgement has been made to come up with a conservative best estimate.

**Table 7: Predicted residual lives of Defence Sections (with low levels of maintenance)**

Seawall Defence Section	Estimated Residual Life (years)
Section A	35
Section B	35
Section C	35
Section D	15
Section E	15
Section F	15
Section G	15

### 4.3.1 Note on recent repairs

During a site visit on 5<sup>th</sup> December 2017 it was observed that patch repairs were being completed along the face of the seawall in Section G as shown in Figure 3. It was suggested by the Contractor carrying out the work that approximately 50 patch repairs were being made. From inspection the majority of these were on the face of the seawall in Section G where the bottom corners of the upper panel meet the top corners of the lower panel. The visual inspection of this section had already taken place at the time these repairs were observed and therefore the repairs and any potential influence they might have on condition grade or residual life of the structures have not been included in this report.



Figure 3: Photograph of recent patch repairs on seawall in Section G



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## 5. References

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Environment Agency (2006) Managing flood risk, Condition Assessment Manual, Document Reference 166\_03\_SD01

Environment Agency (2013) Practical guidance on determining asset deterioration and the use of condition grade deterioration curves: Revision 1, Report – SC060078/R1

Royal Haskoning (2013) Hunstanton Promenade and Seawall Condition Assessment – Condition Assessment Report

Royal Haskoning (2015) Hunstanton Promenade Survey and Inspection – Summary of the Visual, GPR & FWD Surveys

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# Appendix A – Inspection Notes

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