



**Cell 1 Regional Coastal Monitoring Programme
Update Report 10: 'Partial Measures' Survey 2018**



Durham Council

June 2018

Contents

Disclaimer	i
Abbreviations and Acronyms	ii
Water Levels Used in Interpretation of Changes	ii
Glossary of Terms.....	iii
Preamble.....	iv
1. Introduction.....	1
1.1 Study Area	1
1.2 Methodology.....	1
2. Analysis of Survey Data.....	4
2.1 Featherbed Rocks.....	4
2.2 Seaham (Dawdon)	5
2.3 Blast Beach	6
2.4 Hawthorne Hive.....	8
3. Problems Encountered and Uncertainty in Analysis.....	9
4. Recommendations for 'Fine-tuning' the Monitoring Programme	9
5. Conclusions and Areas of Concern	9

Appendices

Appendix A	Beach Profiles
Appendix B	Cliff Top Survey

List of Figures

Figure 1	Sediment Cells in England and Wales
Figure 2	Survey Locations

List of Tables

Table 1	Analytical, Update and Overview Reports Produced to Date
Table 2	Sub-division of the Cell 1 Coastline

Authors	
Emma Hick	Royal HaskoningDHV
Dr Nick Cooper – Approval	Royal HaskoningDHV

Disclaimer

Royal HaskoningDHV has prepared this report in accordance with the instructions of our client Scarborough Borough Council (SBC) for the client's sole and specific use. Any other persons who use any information contained herein do so at their own risk. Royal HaskoningDHV has used reasonable skill, care and diligence in the interpretation of data provided to them and accepts no responsibility for the content, quality or accuracy of any Third party reports, monitoring data or further information provided either to them by SBC or, via SBC from a Third party source, for analysis under this term contract.

Data and reports collected as part of the Cell 1 Regional Coastal Monitoring Programme are available to download via the North East Coastal Observatory via the webpage: www.northeastcoastalobservatory.org.uk.

The North East Coastal Observatory does not "license" the use of images or data or sign license agreements. The North East Coastal Observatory generally has no objection to the reproduction and use of these materials (aerial photography, wave data, beach surveys, bathymetric surveys, reports), subject to the following conditions:

1. North East Coastal Observatory material may not be used to state or imply the endorsement by North East Coastal Observatory or by any North East Coastal Observatory employee of a commercial product, service, or activity, or used in any manner that might mislead.
2. North East Coastal Observatory should be acknowledged as the source of the material in any use of images and data accessed through this website, please state "Image/Data courtesy of North East Coastal Observatory". We recommend that the caption for any image and data published includes our website, so that others can locate or obtain copies when needed. We always appreciate notification of beneficial uses of images and data within your applications. This will help us continue to maintain these freely available services. Send e-mail to Robin.Siddle@scarborough.gov.uk
3. It is unlawful to falsely claim copyright or other rights in North East Coastal Observatory material.
4. North East Coastal Observatory shall in no way be liable for any costs, expenses, claims, or demands arising out of the use of North East Coastal Observatory material by a recipient or a recipient's distributees.
5. North East Coastal Observatory does not indemnify nor hold harmless users of North East Coastal Observatory material, nor release such users from copyright infringement, nor grant exclusive use rights with respect to North East Coastal Observatory material.
6. North East Coastal Observatory material is not protected by copyright unless noted (in associated metadata). If copyrighted, permission should be obtained from the copyright owner prior to use. If not copyrighted, North East Coastal Observatory material may be reproduced and distributed without further permission from North East Coastal Observatory.

Abbreviations and Acronyms

Acronym / Abbreviation	Definition
AONB	Area of Outstanding Natural Beauty
DGM	Digital Ground Model
HAT	Highest Astronomical Tide
LAT	Lowest Astronomical Tide
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
MLWS	Mean Low Water Neap
MLWS	Mean Low Water Spring
m	metres
ODN	Ordnance Datum Newlyn

Water Levels Used in Interpretation of Changes

Water Level Parameter	Water Level (m AOD)			
	River Tyne to Frenchman's Bay	Frenchman's Bay to Souter Point	Souter Point to Chourdon Point	Chourdon Point to Hartlepool Headland
1 in 200 year	3.41	3.44	3.66	3.91
HAT	2.85	2.88	3.18	3.30
MHWS	2.15	2.18	2.48	2.70
MLWS	-2.15	-2.12	-1.92	-1.90

Source: *River Tyne to Flamborough Head Shoreline Management Plan 2.*
Royal Haskoning, February 2007.

Glossary of Terms

Term	Definition
Beach nourishment	Artificial process of replenishing a beach with material from another source.
Berm crest	Ridge of sand or gravel deposited by wave action on the shore just above the normal high water mark.
Breaker zone	Area in the sea where the waves break.
Coastal squeeze	The reduction in habitat area which can arise if the natural landward migration of a habitat under sea level rise is prevented by the fixing of the high water mark, e.g. a sea wall.
Downdrift	Direction of alongshore movement of beach materials.
Ebb-tide	The falling tide, part of the tidal cycle between high water and the next low water.
Fetch	Length of water over which a given wind has blown that determines the size of the waves produced.
Flood-tide	Rising tide, part of the tidal cycle between low water and the next high water.
Foreshore	Zone between the high water and low water marks, also known as the intertidal zone.
Geomorphology	The branch of physical geography/geology which deals with the form of the Earth, the general configuration of its surface, the distribution of the land, water, etc.
Groyne	Shore protection structure built perpendicular to the shore; designed to trap sediment.
Mean High Water (MHW)	The average of all high waters observed over a sufficiently long period.
Mean Low Water (MLW)	The average of all low waters observed over a sufficiently long period.
Mean Sea Level (MSL)	Average height of the sea surface over a 19-year period.
Offshore zone	Extends from the low water mark to a water depth of about 15 m and is permanently covered with water.
Storm surge	A rise in the sea surface on an open coast, resulting from a storm.
Swell	Waves that have travelled out of the area in which they were generated.
Tidal prism	The volume of water within the estuary between the level of high and low tide, typically taken for mean spring tides.
Tide	Periodic rising and falling of large bodies of water resulting from the gravitational attraction of the moon and sun acting on the rotating earth.
Topography	Configuration of a surface including its relief and the position of its natural and man-made features.
Transgression	The landward movement of the shoreline in response to a rise in relative sea level.
Updrift	Direction opposite to the predominant movement of longshore transport.
Wave direction	Direction from which a wave approaches.
Wave refraction	Process by which the direction of approach of a wave changes as it moves into shallow water.

Preamble

The Cell 1 Regional Coastal Monitoring Programme covers approximately 300km of the north east coastline, from the Scottish Border (just south of St. Abb's Head) to Flamborough Head in East Yorkshire. This coastline is often referred to as 'Coastal Sediment Cell 1' in England and Wales (Figure 1).

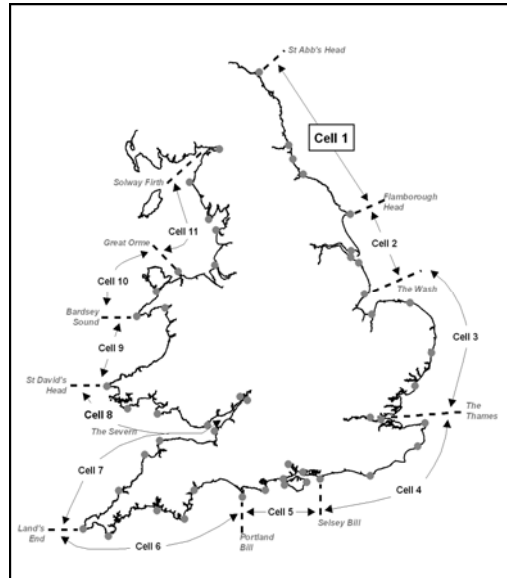


Figure 1 Sediment Cells in England and Wales

The main elements of the Cell 1 Regional Coastal Monitoring Programme involve:

- beach profile surveys
- topographic surveys
- cliff top recession surveys
- real-time wave data collection
- bathymetric and sea bed characterisation surveys
- aerial photography
- walk-over surveys

The beach profile surveys, topographic surveys and cliff top recession surveys are undertaken as a 'Full Measures' survey in autumn/early winter every year. Some of these surveys are then repeated the following spring as part of a 'Partial Measures' survey. To date the following reports have been produced:

Table 1 Analytical, Update and Overview Reports Produced to Date

Year		Full Measures		Partial Measures		Cell 1 Overview Report
		Survey	Analytical Report	Survey	Update Report	
1	2008/09	Sep-Dec 08	May 09	Mar-May 09		-
2	2009/10	Sep-Dec 09	Mar 10	Feb-Mar 10	Jul 10	-
3	2010/11	Aug-Nov 10	Feb 11	Feb-Apr 11	Aug 1	Sep 11
4	2011/12	Sep 11	Aug 12	Mar-May 12	Feb 13	-
5	2012/13	Sep 12	Feb 13	Mar-Apr 13	May 13	-
6	2013/14	Oct 13	Feb 14	Mar-Apr 14	Jul 14	-
7	2014/15	Nov 14	Feb 15	Mar 15	Jun 15	-
8	2015/16	Nov 15	Feb 16	Apr 16	Jul 16	Jun 16
9	2016/17	Aug-Sep 16	Jan 17	Mar 17	Jul 17	
10	2017/18	Sep 17	Feb 18	Apr 18	Jun 18 (*)	

(*) The present report is **Update Report 10** and provides an analysis of the 2018 Partial Measures survey for Durham Council's frontage.

1. Introduction

1.1 Study Area

Durham Council's frontage extends from Ryhope Dene to Crimdon Beck. For the purposes of this report, it has been sub-divided into five areas, namely:

- Featherbed Rocks
- Seaham (Dawdon)
- Blast Beach
- Hawthorn Hive
- Blackhall Colliery

1.2 Methodology

Along Durham County Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn/early winter comprising:
 - Beach profile surveys along nine transect lines
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along six transect lines
- Cliff top survey bi-annually at:
 - Seaham (Dawdon)

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage on 30th April 2018. During the survey the weather was sunny and dry, with a force 3 wind from the south-west and a rough sea state.

Data from the present survey are presented in a processed form in the Appendices.

2. Analysis of Survey Data

2.1 Featherbed Rocks

Survey Date	Description of Changes Since Last Survey	Interpretation
30 th April 2018	<p>Beach Profiles:</p> <p>Featherbed Rocks is monitored by one beach profile line (EA1) during the Partial Measures survey (Appendix A). The previous survey was September 2017.</p> <p>Profile 1bEA1 has changed very little to 55m chainage, which covers the cliff and promenade. The uneven profile at the base of the sea wall between 55m and 80m is due to the rock armour. Beyond 80m there has been little change over the winter of 2017/18, the beach profiles reflect the rocky nature of the foreshore and that there is no beach over the shore platform.</p>	<p>The rocky nature of the foreshore means it is unlikely to undergo significant changes in morphology unless sediment is deposited. Previous monitoring indicates that a veneer beach tends to accumulate over the summer and is stripped off by winter storms, giving rise to small and localised changes in profile. The upper part of the profile, which covers the cliff promenade and rock armour remains unchanged, as does the lower part of the profile which covers the beach.</p> <p>Longer term trends:</p> <p>The level of the beach in April 2018 was comparable with the lowest beach levels recorded in March 2010, April 2013 and October 2013. The shore platform is exposed and as a result any apparent changes are likely to be due to differences in the survey point locations and the way that survey points are joined to show an interpolated surface.</p>

2.2 Seaham (Dawdon)

Survey Date	Description of Changes Since Last Survey	Interpretation
30 th April 2018	<p>Cliff-top Survey:</p> <p>Three ground control points have been established along the cliff top at Dawdon (Figure B1). The separation between any two points is nominally 300m. These cliff top surveys are intended to inform on erosion rates of the undefended sea cliffs extending south of the rock armour revetment to the south of Seaham Harbour. The cliff top surveys at Dawdon are undertaken bi-annually.</p> <p>Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top. Appendix B provides results from the April 2018 survey showing the position from the ground control point to the edge of the cliff top along the defined bearing and changes since the November 2008 baseline survey.</p> <p>The cliff monitoring data shows that there has been very little change over the winter of 2017/18, with no recession greater than the survey error of 0.1m.</p>	<p>There has been no change over the winter of 2017/18. Overall ground control point numbers 1 and 3 showed erosion of 1.2m since November 2014. Point 2 has shown little change.</p> <p>Longer term trends:</p> <p>There is more confidence in the long-term pattern of change, where the cumulative measured erosion is greater than the error inherent in the technique.</p> <p>Ground control points 1 and 3 have both shown an average recession rate of 0.1m/yr, since monitoring began in 2008.</p>

2.3 Blast Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
30 th April 2018	<p>Beach Profiles:</p> <p>Blast Beach is covered by four beach profile lines during the Partial Measures survey (Appendix A). Two of these commenced in November 2008, with 1bSH1a being added in October 2009, and 1bSH1b added in October 2015.</p> <p>Profile 1bSH1b is adjacent to the sewage works south of Seaham. The profile is cliff to chainage 30m and then gravel beach between 30m and 60m chainage, which has shown a decrease in level of up to 0.6m since September 2017, with the small upper beach berm moving landwards by around 5m to chainage 35m. There are two concrete blocks which have been upturned on the beach and are shown on the profiles as a protrusion in the profile between 60m and 65m chainage. Below this point the rocks are exposed to the end of the survey at 100m. Profile appears to show winter drawdown followed by summer build-up, however only three years of survey is available.</p> <p>At 1bSH1a there has been apparent recession of the cliff toe by around 10m, however the survey photographs do not support this, and the cliff toe is at a similar position to that recorded in March 2017 and April 2016. There has been some slumping of the eroding face of the spoil at chainage 141m. The upper beach berm previously recorded at chainage 149m has been eroded with loss of 0.7m. The rest of the upper beach between chainage 152m and 175m there has been accretion of up to 0.8m. From chainage 175m rock is exposed. Overall the profile is at a low-medium level compared to the range recorded from previous surveys.</p> <p>At 1bSH1 there has been very little change to the beach crest at chainage 65m. The upper beach between chainage 75m and 97m has dropped in level by up to 0.7m. Beach levels from chainage 97m to the exposed rock at chainage 140m have increased by up to 0.8m. The upper beach between chainage 75m and 83m is at its lowest recorded levels, whilst the rest of the beach levels are at a medium level compared to the range recorded from previous surveys. The beach crest is in its most landwards position.</p>	<p>Through the winter there has been erosion of the upper beach across the bay with accretion across the mid-beach to the exposed rock platforms. The profiles remained a similar gradient to the spring and autumn profiles.</p> <p>All the profiles show the beach levels are generally in the range of previous profiles.</p> <p>Longer term trends:</p> <p>The beach at SH2 shows an overall pattern of erosion since October 2008. However, SH1 and SH1a show much more fluctuation in beach level, whereas SH2 is almost progressive recession.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>At 1bSH2 there has been very little change to the berm's crest at chainage 110m, up to ± 0.2m. From chainage 120m to the exposed rock at 190m there has been a drop in beach level by up to 1.0m, but more typically 0.4m. The face of the beach crest at chainage 120m to 125m has been steepened, whilst the berm previously recorded at chainage 150m has been removed. Overall the beach is at a medium level compared to the range recorded from previous surveys, except where the face of the beach crest has been steepened, which shows the lowest levels on record.</p>	

2.4 Hawthorne Hive

Survey Date	Description of Changes Since Last Survey	Interpretation
30 th April 2018	<p>Beach Profiles:</p> <p>Hawthorne Hive is covered by one beach profile line 1cEA2 during the Partial Measures survey (Appendix A). The survey report notes “unable to measure start of Section EA2 as the vegetation has choked out the section line and route over cliff faces” and therefore all surveys following October 2012 start at 95m chainage.</p> <p>Until the partial measures survey in April 2013, a channel was present between 95m and 105m chainage, but it has infilled.</p> <p>The majority of the beach, between 95m chainage and 145m chainage shows a drop in beach level of up to 0.5m compared to the September 2017 survey. The berm previously recorded at chainage 115m dropped in height by 0.3m, and a second, more pronounced, berm has formed at chainage 105m. From 145m chainage to the end of the survey at 260m chainage the boulders at the bottom of the beach remain exposed. Overall the beach is at a medium-low level compared to the range recorded from previous surveys.</p>	<p>The beach has recovered since the low level in April and November 2014. The profile is towards the middle of the range of previous profiles.</p> <p>Longer term trends:</p> <p>The profiles show the beach is undergoing progressive erosion.</p> <p>The infilling and incision of the channel seems to be an episodic process and is likely to reflect a combination of annual and seasonal variations in the flow of Hawthorn Burn and storm events which move sediment onshore to block the outflow of the burn.</p>

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

The surveyor noted difficulties accessing the cliff top and edge at SH1 SH1A and SH2 due to dense vegetation.

At Hawthorne Hive the surveyor was unable to measure start of Section EA2 due to vegetation cover.

Cliff Top Surveys

While there is low confidence in the short-term erosion rates due to the error in the method, longer-term data are more reliable and suggest erosion rates of up to 0.12m/yr.

4. Recommendations for 'Fine-tuning' the Monitoring Programme

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- The level of the beach at Featherbed Rocks in April 2018 was comparable with the lowest beach levels recorded in March 2010, April 2013 and October 2013. The shore platform is exposed on the lower beach
- At Seaham Cliffs, the survey data indicates that the average recession rate since monitoring began in 2008 is 0.1m/yr. Point 2 shows little change over the monitoring period.
- At Blast Beach colliery spoil still prevents the sea from actively eroding the cliffs. However, there have been significant changes in the beach profile. There is a periodic shift in the direction of sediment transport through the winter, this winter the profiles generally show erosion on the upper beach but accretion in the mid-beach.
- At Hawthorn Hive the beach level was low in April and November 2014. The beach has now recovered slightly and is close to the middle of the previous range of results. However, it is likely that the long-term trend of progressive erosion will continue on this profile.

Appendices

Appendix A
Beach Profiles

The following sediment feature codes are used on some profile plots:

Code	Description
S	Sand
M	Mud
G	Gravel
GS	Gravel & Sand
MS	Mud & Sand
B	Boulders
R	Rock
SD	Sea Defence
SM	Saltmarsh
W	Water Body
GM	Gravel & Mud
GR	Grass
D	Dune (non-vegetated)
DV	Dune (vegetated)
F	Forested
X	Mixture
FB	Obstruction
CT	Cliff Top
CE	Cliff Edge
CF	Cliff Face
SH	Shell
ZZ	Unknown

Appendix B
Cliff Top Survey

Cliff Top Survey

Seaham (Dawdon)

Three ground control points have been established at Dawdon (Figure B1). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys at Dawdon are undertaken bi-annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top.

Table B1 provides baseline information about these ground control points and results from the 2008 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

Table B1 – Cliff Top Surveys at Dawdon

Ground Control Points				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing	Baseline Survey	Previous Survey	Present Survey	Baseline to Present	Previous to Present	Baseline to Present
			(°)	Nov 2008	Sep 2017	Apr 2018	Nov 2008 - Apr 2018	Sep 2017 - Apr 2018	Nov 2008 - Apr 2018
1	443515.4	548421.7	70	16.1	14.93	14.93	1.17	0.00	0.12
2	443607.8	548136.3	90	13.3	13.26	13.33	-0.03	-0.07	0.00
3	443756.1	547858.5	95	14.8	13.6	13.6	1.20	0.00	0.12