Cell 1 Regional Coastal Monitoring Programme
Update Report 6: 'Partial Measures' Survey 2014

North Tyneside Council
Final Report

July 2014

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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
HAT	3.1
MHWS	2.4
MLWS	-1.9

Source: *Scottish Border to River Tyne Shoreline Management Plan 2.*
Royal Haskoning, May 2009.

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).

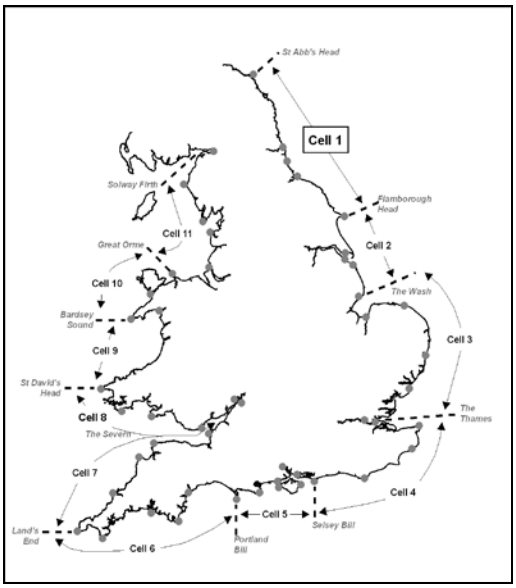

Figure 1 Sediment Cells in England and Wales

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 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	Sept-Dec 08	May 09	Mar-May 09	June 09	
2	2009/10	Sept-Dec 09	Mar 10	Feb-Mar 10	Jul 10	
3	2010/11	Aug-Nov 10	Feb 11	Feb-Apr 11	Aug 11	Sept 11
4	2011/12	Oct-Nov 11	Oct 12	Mar-May 12	Feb 13	
5	2012/13	Sept-Oct 12	Mar 13	Mar-Apr 13	Jun 13	
6	2013/14	Sept-Oct 13	Feb 14	Mar-Apr 14	Jul 14 (*)	

(*) The present report is **Update Report 6** and provides an analysis of the 2014 Partial Measures survey for North Tyneside Council's frontage.

1. Introduction

1.1 Study Area

North Tyneside Council's frontage extends from Hartley (just south of Blyth) in the north to River Tyne in the south. For the purposes of this report and for consistency with previous reporting, it has been sub-divided into four areas, namely:

- Whitley Sands
- Cullercoats Bay
- Tynemouth Long Sands
- King Edward's Bay

1.2 Methodology

Along North Tyneside Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn comprising:
    - Beach profile surveys along eight transect lines (commenced 2002)
    - Beach profile surveys along an additional two transects (commenced 2010)
    - Topographic survey along Whitley Sands (commenced 2010)
    - Topographic survey along Tynemouth Long Sands (commenced 2011)

- Partial Measures survey annually each spring comprising:
    - Beach profile surveys along all ten transect lines (commenced 2010)

The location of these surveys is shown in Figure 2. The Partial Measures 2013 surveys were undertaken along this frontage between 2nd April and 3rd April 2014. During this time weather conditions were foggy with rain, the sea state was moderate and the wind force was 2-4 from the east/ south east; refer to the survey reports for further detail of the conditions over this survey period.

On 5th December 2013 a significant storm surge, driven by strong northerly winds, coincided with one of the highest astronomical tides of the year. A comparison of the recorded water level data for the December 2013 storm surge at North Shields, Whitby and Scarborough has been provided in the second wave Data analysis report covering the period 2013 to 2014. Recorded surge residuals from that report show a similar signature at the three sites, with the maximum surge height occurring before high water and the surge increasing in height as it progressed down the coast, from around 1.3m above predicted water level at North Shields to around 1.8m at Whitby and Scarborough. Based on the EA (2011) Coastal Flood Boundary Condition extreme water level data the surge had the follow chance of occurrence each year:

- North Shields: between 1 in 200 and 1 in 500
- Whitby: between 1 in 100 and 1 in 500
- Scarborough between 1 in 150 and 1 in 500

The Update Report presents the following:

- description of the changes observed since the previous survey and an interpretation of the drivers of these changes. Particular attention is paid to determining any residual impacts of the storm surge that occurred in December 2013 (Section 2);
- documentation of any problems encountered during surveying or uncertainties inherent in the analysis (Section 3);
- recommendations for 'fine-tuning' the programme to enhance its outputs (Section 4); and
- providing key conclusions and highlighting any areas of concern (Section 5).

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

2. Analysis of Survey Data

2.1 Whitley Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2014	**Beach Profiles:** Whitley Sands is covered by five beach profile lines for the Partial Measures survey (Appendix A). Four of these (1aNTDC01 to 1aNTDC04) were initially surveyed in April 2002 and were then re-surveyed annually to 2009 (Full Measures, autumn 2009) after which time they have been surveyed bi-annually. From March 2010 (Partial Measures, spring 2010) onwards, an additional beach profile line (NTDC04A) has been surveyed at the southern end of the frontage for the same time periods listed above. All profiles were last surveyed in autumn 2013 for the Full Measures survey. **1aNTDC01** is located in the north of Whitley Sands, along the undefended cliffs immediately south of Trinity Road car park. The cliff has remained stable since the previous survey (Full Measures, autumn 2013). Beach levels have increased by up to 1m across the profile Profile **1aNTDC02** is located to the north of Whitley Sands opposite the seawall. Along this profile some material has been moved landwards creating a more consistent profile slope with less gradient changes. Beach levels have increased by approximately 0.4m from the toe of the seawall down to about 92m chainage, Seawards of this, however, beach levels have decreased by up to 0.8. The toe of the beach (160m chainage and seawards) has remained stable. Profile **1aNTDC03** is located at the centre of Whitley Sands. Beach levels have generally reduced across the length of this profile by up to 0.6m, the exception being a short-length of the upper beach between a chainage of 12m and 35m where beach levels have increased by 0.1m. Profile **1aNDC04** is located to the south of Whitley Sands. The beach at 1aNDC04 has behaved similarly to 1aNTDC03, with a general drop in beach levels across the length of this profile by almost 1m in places, the exception being along the upper beach between a chainage of 14m and 38m where beach levels have increased by 0.6m. Where the underlying rock was previously exposed (at about 60m chainage) the beach has not lowered as there was no material to be removed. There has been a notable change in sediment type on the beach, with a switch from sand to coarse shingle, as shown by	Since the last survey, along the length of Whitley Sands, beach levels have changed considerably: at Profile 1aNTDC01 beach levels have increased; at Profile1aNTDC02 the profile has steepened with erosion of the lower beach but accretion of the upper beach; across profiles 1aNTDC03, 1aNTDC04 and 1aNTDC04A beach levels have lowered. These changes indicate the occurrence of significant storms over the winter months, which have resulted in drawdown of material and lowering of beach levels. Accretion at the northernmost profile indicates some northerly transport of sediment with transported sediment building up behind the headland. **Longer term trends:** The data show that profiles are within the bounds of previous surveys. However, along the frontage many profiles are near the lowest or highest historical positions, indicating dynamic behaviour with no clear trend.

Survey Date	Description of Changes Since Last Survey	Interpretation
	the survey photographs in Plates 1 and 2. The previous spring survey (Partial Measure 2013) also noted the presence of coarse shingle indicating that this may be a seasonal change. Profile **1aNTDC04a** is located to the south of Whitley Sands. Beach levels have fallen across the profile by approximately 0.5m, with the exception of some sections seawards of 50m chainage where the underlying rock had previously been exposed and there was no loose material present to erode	

Plate 1 – Survey photograph 1aNTDC04_20140402_N14.JPG

Plate 2 – Survey photograph 1aNTDC04_20131017_N4.jpg

2.2 Cullercoats Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2014	**Beach Profiles:** Cullercoats Bay is covered by one beach profile line for the Partial Measures survey (Appendix A). This was surveyed annually each autumn between 2002 and 2009. From spring 2010 onwards, it has been surveyed bi-annually. The last survey was the autumn 2013 Full Measures survey. The cliff top position along **1aNTDC05** has remained constant since surveys began in April 2002, but there have been apparent changes along the cliff face. The survey report notes '*cliff not measured at section 5 due to dangerous access*'. It is therefore likely that the changes observed are related to the survey technique used rather than actual change. From the cliff toe to a chainage of 48m beach levels have increased by almost 0.5m and the rock previously exposed (Full Measures 2013) now has a covering of sand (Plate 3 and Plate 4). Seaward of 48m chainage, beach levels have remained stable down to 95m chainage. Seawards of this the large toe berm observed in the previous survey (Full Measures, autumn 2013) is no longer present and the profile is now flatter with a drop in beach level of approximately 1.4m. Although the upper beach levels have increased slightly, visual observations indicate that the increase in area is likely to be smaller than the area of material lost from the toe berm. This suggests that storm waves may have moved this store of material further offshore. The berm was a new feature in the Full Measures 2013 survey and has not been observed in any other surveys. The profile has therefore retuned to a similar form to those measured in spring 2013 and earlier.	As in previous surveys, the surveyors report that access to the cliff has not been possible. The upper beach has accreted to cover the underlying rock exposed in the previous survey. The berm previously observed at the toe of the beach is no longer present resulting in a significant reduction in level at the beach toe (up to 1.4m). Although the upper beach levels have increased slightly, visual observations indicate that the increase in area is likely to be smaller than the area of material lost from the toe berm. This suggests that storm waves may have moved this store of material further offshore. **Longer term trends:** The beach levels observed are within the bounds of previous surveys.

Plate 3 – Survey photograph 1aNTDC05_20140403_Up3.JPG

Plate 4 – Survey photograph 1aNTDC05_20131018_Up3.jpg

2.3 Tynemouth Long Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2014	**Beach Profiles:** Tynemouth Long Sands is covered by three beach profile lines for the Partial Measures survey (Appendix A). Profiles 1aNTDC06 and 1aNTDC07 were initially surveyed annually each autumn between 2002 and 2009. A third profile, 1aNTDC06A, was later added in the centre of the frontage. From spring 2010 (Partial Measures) onwards, they have been surveyed bi-annually. The last survey was the autumn 2013 Full Measures survey. **1aNTDC06** is located approximately 150m south of the access road/ramp towards the north of the bay. The profile for the dune-cliff face is limited due to a lack of data points in the profile plot. The survey report notes ‘’*no access to middle of section 6 due to seed protection fences’*. The beach levels fluctuate across the profile with a small amount of erosion (<0.5m) on the upper beach and slight accretion on the middle of the profile. The beach toe has moved seawards slightly. Overall this has led to a smoother profile with no prominent berm features. The magnitude of change is in the order of. 0.5m across the profile, suggesting a cross-shore movement of material. At profile **1aNTDC06A**, the profile for the dune-cliff face is a straight line; a result of a lack of data points in the profile plot. This is explained by the note in the survey report; which states ‘*no access to middle of section 6A due to seed protection fences*’. The upper beach has eroded since the previous survey and the toe of the dunes has been cut back (see Plate 5 and Plate 6). The toe of the beach has accreted, indicating that material has been moved down the beach by storm waves over the winter period. Profile **1aNTDC07** is located approximately 50m south of the access route through the dunes towards the southern end of the bay. As with the other profiles the dune-cliff face is a straight line; a result of a lack of data points in the profile plot. As at 1aNTDC06A the upper beach has decreased slightly in level and the lower beach has increased, indicating movement of material down the beach by storm waves over the winter period.	At Tynemouth Long Sands, the dune-cliff face was not surveyed due to access constraints, but survey photographs suggest that erosion of the dunes has occurred, probably associated with the storm surge. Beach levels along the length of coastline here have fallen on the upper beach and increased on the lower beach. This indicates that material has been moved seawards by wave action over the winter period. At Profile 1aNTDC06A the toe of the dunes have been undercut, further indicating the impacts of storm waves and the storm surge experienced over the 2013/2014 winter period. **Longer term trends:** Overall, the beaches have retained a similar form and are within the bounds of previous surveys, although they are towards the lower bound. The exception is 1aNTD06A which exhibits the lowest levels recorded to date on the upper beach, from the toe of the dunes which have been undercut down to a chainage of 170m.

Survey Date	Description of Changes Since Last Survey	Interpretation
Mar 2014	**Topographic Survey:** Tynemouth Long Sands is a new survey area. The first survey was undertaken for the Full Measures survey in October 2010. Data from the current topographic survey have been used to create a digital ground model (DGM) (Appendix B – Map 1a) using a Geographical Information System (GIS). A difference plot has also been produced by comparing the current DGM (Appendix B – Map 1b) with that produced from the last topographic survey. In particular the difference plot shows (i) a general reduction in beach levels along the upper beach of between 0m and 0.5m, in particular to the south of Tynemouth Long Sands; (ii) a general increase in beach level of between 0m and 1m, along the lower beach and to the north of Tynemouth Long Sands. These changes indicate the migration of sand bars and also a northerly transport of material. These findings correspond well to the beach profile surveys, which show alternating changes in beach levels in a cross-shore direction.	Since the last survey, the beach at Tynemouth Long Sands has been dynamic, with shore parallel sand bars moving seawards in response to storm waves. There is also evidence of a northerly movement of sediment with material accumulating behind the headland to the north of the bay.

Plate 5 – Survey photograph 1aNTDC06a_20140403_Up2.JPG

Plate 6 – Survey photograph 1aNTDC06A_20131018_Up1.JPG

2.4 King Edward's Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2014	**Beach Profiles:** King Edward's Bay is covered by one beach profile line for the Full Measures survey (Appendix A). This was surveyed annually each autumn between 2002 and 2009. From spring 2010 onwards, it has been surveyed bi-annually. The last survey was the autumn 2013 Full Measures survey. At profile **1aNTDC08** beach levels have reduced considerably at the top of the profile (by over 1m) and it is noted in the survey report that the sand level is low at the base of the sea wall (Plate 7). At 18m chainage (just above HAT) a berm has developed resulting in an increase in beach level, peaking at an increase of 0.6m. Seawards of the berm the beach level has increased across the profile down to a chainage of 128m and a second berm has formed at about 0.8m elevation. Seawards of 128m the beach steepens compared to the previous measured profile. The change in beach form is likely to be the result of storm waves over the winter period eroding the top of the beach and moving material down the beach.	Since the last survey, the beach at King Edward's Bay beach has dropped significantly at the toe of the seawall. A berm has developed at around HAT and another smaller berm at around 0.8m elevation. **Longer term trends:** From the toe of the seawall (1m chainage) to about 18m chainage the beach levels are the lowest recorded to date by up to 0.6m. The remainder of the profile is, however, within the bounds of previous surveys, with historic surveys being both higher and lower when compared to present levels.

Plate 7 – Survey photograph 1aNTDC08_20140403_Up2.JPG

Plate 8 – Survey photograph 1aNTDC08_20131018_N2.JPG.

3. Problems Encountered and Uncertainty Analysis

Individual Profiles

At profile 1aNTDC05 the cliff was not measured due to dangerous access. Access to this profile is noted to have been dangerous in the previous partial measures and full measures reports, and therefore consideration should be given to changing the location of this survey.

At Tynemouth Long Sands (profiles 1aNTDC06, 1aNTDC06A and 1aNTDC07) there was no access to the dunes in the middle of the profile due to seedling protection fences. This means it has not been possible to monitor the effectiveness of the dune stabilisation scheme

Topographic Survey

At Tynemouth Long Sands, the topographic survey report notes:

- New wooden beach access platform at 436780, 571170.
- Slips evident on face of dunes.
- Spring at south end of beach in deep channel.

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

It is recommended that access to the stabilised dunes at Tynemouth Long Sands be attempted in future surveys in order to monitor the effectiveness of the stabilisation fences.

5. Conclusions and Areas of Concern

- At Whitley Sands, the beach levels at the middle and southern parts of the bay (1aNTDC3, 1aNTDC4 and 1aNTDC4A) are the lowest recorded to date across the lower beach.
- At the north of Whitley Bay the recorded profiles present no causes for concern.
- At Cullercoats Bay, at profile 1aNTDC05, the cliff was not measured due to dangerous access. Access to this profile is noted to have been dangerous in the previous Partial Measures and Full Measures reports, and therefore consideration should be given to changing the location of this survey.
- At Tynemouth Long Sands, at profile 1aNTDC06A, the upper beach has eroded and the toe of the dunes have cut back. The upper beach exhibits the lowest level recorded to date. These effects are likely to be due to the storm surge.
- Elsewhere along Tynemouth Long Sands, the recorded profiles and topographic survey present no causes for concern.
- At King Edward's Bay, the recorded profile is the lowest level recorded to date at the toe of the sea wall and across the upper 18m of the beach 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

Topographic Survey