Halcrow
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Cell 1 Regional Coastal Monitoring Programme
Analytical Report 4: 'Full Measures' Survey 2011

North Tyneside Council

North Tyneside Council
Final Report

October 2012

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Authors	
Emma Allan	Halcrow
Dr Paul Fish – Review of Draft	Halcrow
Dr Andy Parsons – Approval of Draft Final	Halcrow

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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). Within this frontage the coastal landforms vary considerably, comprising low-lying tidal flats with fringing salt marshes, hard rock cliffs that are mantled with glacial sediment to varying thicknesses, softer rock cliffs and extensive landslide complexes.

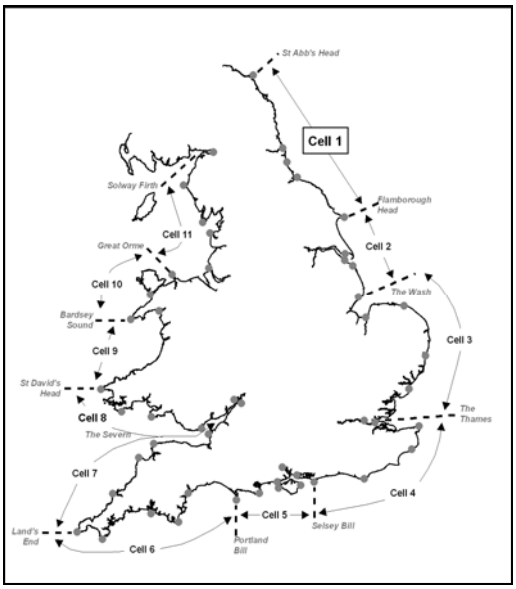


Figure 1 Sediment Cells in England and Wales

The work commenced with a three-year monitoring programme in September 2008 that was managed by Scarborough Borough Council on behalf of the North East Coastal Group. This initial phase has been followed by a five-year programme of work, which started in October 2011. The work is funded by the Environment Agency, working in partnership with the following organisations:

Northumberland County Council

Northumberland Coast AONB – Celebrating 50 Years – Area of Outstanding Natural Beauty

North Tyneside Council

South Tyneside Council

Sunderland City Council

Durham County Council

Redcar & Cleveland Borough Council

Hartlepool Borough Council

Whitby · Scarborough · Filey – Borough of Scarborough – A great place to live, work & play

East Riding of Yorkshire Council

Environment Agency

Natural England

The National Trust

The original three year programme of work was undertaken as a partnership between Royal Haskoning, Halcrow and Academy Geomatics. For the current five year programme of work the data collection associated with beach profiles, topographic surveys and cliff top surveys is being undertaken by Academy Geomatics. The analysis and reporting for the programme is being undertaken by Halcrow.

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.

Each year, an Analytical Report is produced for each individual authority, providing a detailed analysis and interpretation of the 'Full Measures' surveys. This is followed by a brief Update Report for each individual authority, providing ongoing findings from the 'Partial Measures' surveys.

Annually, a Cell 1 Overview Report is also produced. This provides a region-wide summary of the main findings relating to trends and interactions along the entire Cell 1 frontage.

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		-
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 11	Oct 12 (*)			

(*) The present report is **Analytical Report 4** and provides an analysis of the 2011 Full Measures survey for North Tyneside Council's frontage.

In addition, separate reports are produced for other elements of the programme as and when specific components are undertaken, such as wave data collection, bathymetric and sea bed sediment data collection, aerial photography, and walk-over visual inspections.

For purposes of analysis, the Cell 1 frontage has been split into the sub-sections listed in the Table 2.

Table 2 Sub-divisions of the Cell 1 Coastline

Authority	Zone
Northumberland County Council	Sandstell Point (Spittal A)
	Spittal (Spittal B)
	Goswick Sands
	Holy Island
	Bamburgh
	Beadnell Village
	Beadnell Bay
	Embelton Bay
	Boulmer
	Alnmouth Bay
	High Hauxley and Druridge Bay
	Lynemouth Bay
	Newbiggin Bay
	Cambois Bay
	Blyth South Beach
North Tyneside Council	Whitley Sands
	Cullercoats Bay
	Tynemouth Long Sands
	King Edward's Bay
South Tyneside Council	Littehaven Beach
	Herd Sands
	Trow Quarry (incl. Frenchman's Bay)
	Marsden Bay
Sunderland Council	Whitburn Bay
	Sunderland Harbour and Docks
	Hendon to Ryhope (incl. Halliwell Banks)
Durham County Council	Featherbed Rocks
	Seaham
	Blast Beach
	Hawthorn Hive
	Blackhall Colliery
Hartlepool Borough Council	North Sands
	Headland
	Middleton
	Hartlepool Bay
Redcar & Cleveland Borough Council	Coatham Sands
	Redcar Sands
	Marske Sands
	Saltburn Sands
	Cattersty Sands (Skinningrove)
Scarborough Borough Council	Staithes
	Runswick Bay
	Sandsend Beach, Upgang Beach and Whitby Sands
	Robin Hood's Bay
	Scarborough North Bay
	Scarborough South Bay
	Cayton Bay
	Filey Bay

1. Introduction

1.1 Study Area

North Tyneside Council's frontage extends from Hartley (just south of Blythe) 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/early winter comprising:
    - Beach profile surveys along 8 transect lines (commenced 2002)
    - Beach profile surveys along an additional 2 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 10 transect lines (commenced 2010)

The location of these surveys is shown in Figure 2. The baseline Full Measures survey was undertaken along this frontage on the 11th (Tynemouth Long Sands topographic survey) and 27th October 2011. During this time weather conditions varied considerably; refer to the survey reports for details of the weather conditions over this survey period.

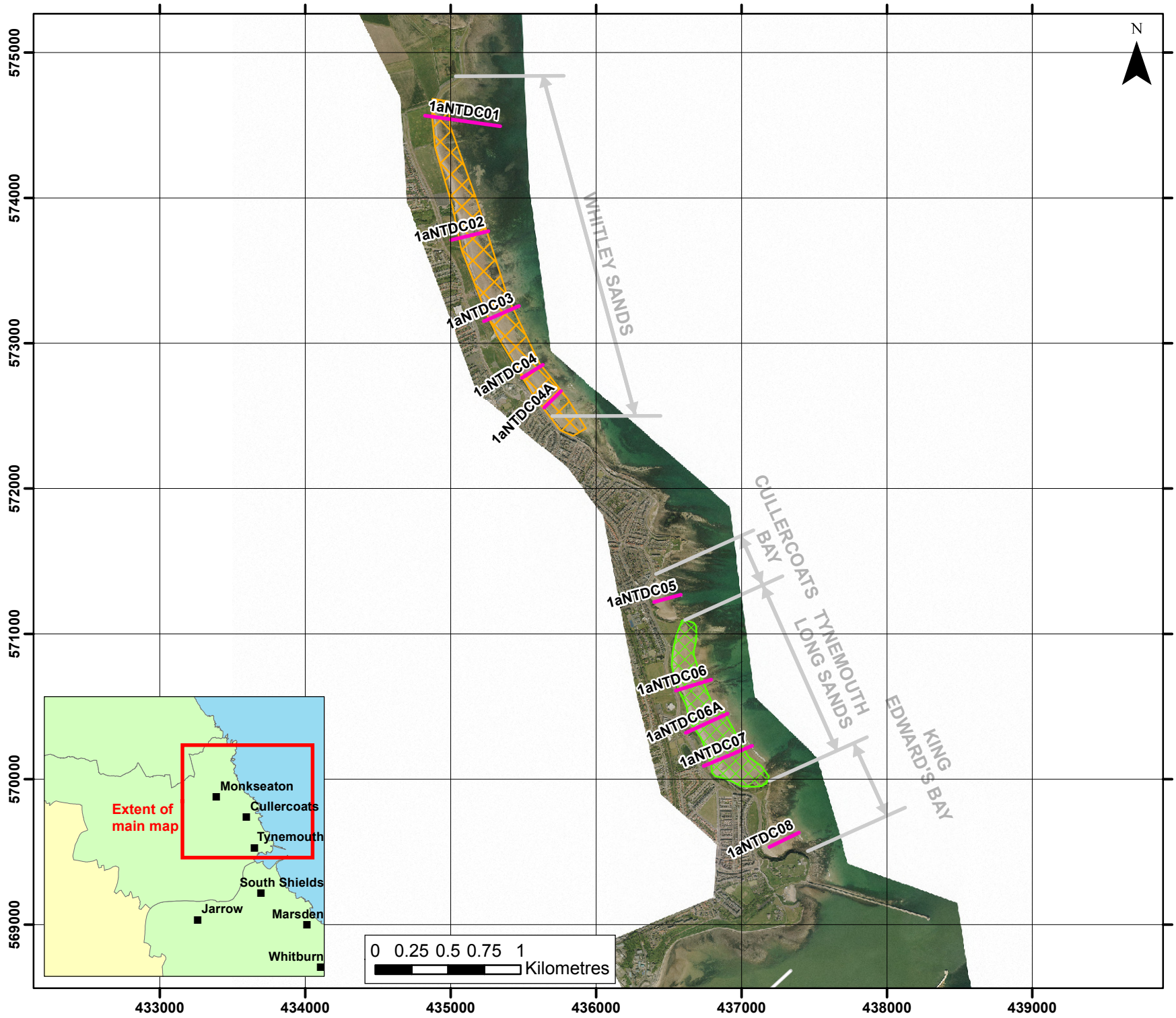
All data have been captured in a manner commensurate with the principles of the Environment Agency's *National Standard Contract and Specification for Surveying Services* and stored in a file format compatible with the software systems being used for the data analysis, namely SANDS and ArcGIS. This data collection approach and file format is comparable to that being used on other regional coastal monitoring programmes, such as in the South East and South West of England.

Upon receipt of the data from the survey team, they are quality assured and then uploaded onto the programme's website for storage and availability to others and also input to SANDS and GIS for subsequent analysis.

The Analytical Report is then produced following a standard structure for each authority. This involves:

- description of the changes observed since the previous survey and an interpretation of the drivers of these changes (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.



KEY

Topographic Profiles
- Annual
- 6 monthly

Topographic Surveys
- 6 monthly
- yearly
- 5 yearly

Cliff Top Monitoring Pegs
- 50m centres
- 100m centres
- 300m centres

(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 1
Survey Locations
Whitley Sands to Tynemouth
North Tyneside Council

Analytical Report 4
Full Measures Survey
Winter 2011

Halcrow
A CH2M HILL COMPANY
Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE
Tel: +44 (0)121 456 2345
Fax: +44(0)121 456 1569
www.halcrow.com

2. Analysis of Survey Data

2.1 Whitley Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2011	**Beach Profiles:** Whitley Sands is covered by five beach profile lines for the Full Measures survey (Appendix A). Four of these (1aNTDC01 to 1aNTDC04) were initially surveyed in April 2002 and surveyed annually to 2009 (full measures, winter 2009). Since then, 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. **1aNTDC01** is located in the north of Whitley Sands, along the undefended cliffs just to the south of Trinity Road Car Park. With the exception of a small length of the profile at a height of 2m and between a chainage of 55m and 75m, beach levels across the profile have increased by up to 0.5m out to the exposed rock at the lower end of the profile. The reduction in levels has occurred where a berm has formed a flatter profile that slopes gently from the cliff toe out to a chainage of 80m after which it steepens down to the exposed rock. Profile **1aNTDC02** is located to the north of Whitley Sands opposite the seawall. Since the last survey (partial measures, spring 2011), beach levels have largely remained the same, with the exception of a small increase at the toe of the seawall in the region of 0.3m and a small reduction at a chainage of 110m, where beach levels have fallen by approximately 0.1 to 0.2m. It is likely that the material has been redistributed across the profile from the middle to the upper beach. Profile **1aNTDC03** is located at the centre of Whitley Sands. The changes observed at this profile are larger than profiles to the north. Below MHWS, between a chainage of 10m and 40m, beach levels have increased by 0.2m. Between a chainage of 40m and 65m, beach levels have dropped since the last survey (partial measures, spring 2011) to form a concave profile. Seaward of this, beach levels have increased across the profile by approximately 0.6m, however, the profile has retained the same form. At profile **1aNDC04** there has been very little change across the profile. The only exception is a reduction in beach levels between a chainage of 35m and 75m where beach levels have dropped up to	The more northern section of Whitley Sands is relatively stable with a tendency to accrete over the last few years. **Longer term trends:** Beach levels on the upper beach at 1aNTDC01 and 1aNTDC02 are the highest recorded since 2009. The centre of Whitley Sands is more dynamic. Below an elevation of 1m, beach levels have increased and the beach has retained the same form. It is likely that the beach has prograded seaward, indicating a trend of accretion. **Longer term trends:** At profile 1aNTDC03 and 1aNTDC04, the position and form of the upper beach, between MHWS and a chainage of approximately 50m is the same as the full and partial surveys recorded in 2010. To the south of Whitley Sands, the profiles have demonstrated signs of beach flattening and accretion. The last survey report (partial measures, spring 2011) suggested that the beaches were recovering from post-storm erosion. The trends observed since then, show further signs of recovery as material previously drawn-down from the beach during storms is returned to the upper beach.

Survey Date	Description of Changes Since Last Survey	Interpretation
	1m. Here the berm has been flattened to formed a more gently sloping and concave profile. The survey photograph (Plate 1) shows an upper beach comprised of shingle and a lower beach comprised of sand. The position of the berm shown by the previous profile (4th March 2011) corresponds with the transition zone from one sediment type into another. The flattening of the berm and smoother profiles indicating some cross-shore transport of beach material and with that some sorting of the sediment since the last survey. Profile **1aNTDC04a** is located to the south of Whitley Sands. Since the last survey (partial measures, spring 2011), beach levels at the toe of seawall, immediately below MHWS and between a chainage of 0m and 15m, have increased up to 0.6m. Conversely, adjacent to this between a chainage of 15m and 40m, beach levels have fallen by up to 0.4m. Between 0m and 40m chainage, the beach profile has flattened. It is likely that beach material has been redistributed across the profile. From a chainage of 40m, out to the exposed rock at a chainage of 80m beach levels have increased by up to 0.5m.	
Oct 2011	**Topographic Survey:** Whitley Sands is covered by an annual topographic survey, which commenced in October 2010. Data from the most recent topographic survey (full measures, winter 2011)) have been used to create a DGM (Appendix B – Map 1a) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 1b) produced from the previous topographic survey (partial measures, spring 2011) and the present survey. In particular, the difference plot shows: (i) a liner zone of an increase in elevation along the entire length of the backshore and upper beach of Whitley Bay; and (ii) a linear zone of reduced beach elevation that runs parallel to that described in (i).	The trends observed from the beach profiles are replicated in the topographic survey. Given the two zones of erosion and accretion run parallel, there is a clear suggestion that beach material has been transported by cross-shore process from the middle beach to the upper beach by the migration of large shore-parallel sand bars. In addition, the survey report for Whitley Sands notes that the walled bay at south end of survey has filled in with sand and large amounts of seaweed have been deposited on the beach in front of Boardwalk Café. As suggested above this is likely to be post-storm recovery and the opposite is expected to occur between the present survey and the next partial measures survey (spring 2012).

Plate 1 – Survey photograph 1aNTDC04_20111027_Dwn.JPG

2.2 Cullercoats Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2011	**Beach Profiles:** Cullercoats 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 cliff top position along **1aNTDC05** has remained constant since surveys began in April 2002, but there are apparent changes along the cliff face where the toe has moved seawards by 0.25m. Overall this creates a profile that is of a shallower gradient. This suggests that cliff has destabilised with some slumping of the cliff face. The survey photograph (Plate 2) for this profile shows show a section of rock that could have become detached from the cliff face and slipped down. However, the survey report notes that '*cliff not measured at section 5 due to dangerous access*'. It is therefore more likely that the changes observed are related to the survey technique used rather than actual change. With the exception of a length of profile between a chainage of 85m and 105m, where beach levels have reduced by 0.1m, beach levels have remained stable since the last survey (partial measures, spring 2011).	As per the previous survey (partial measures, spring 2011), the surveyors report that the cliff top and large parts of the face have not been surveyed due to exposure. It is therefore unclear whether the apparent cut back / slippage near the toe of the cliff is an actual change or whether this is an artefact of the survey point locations. The beach at Cullercoats Bay has remained stable since the last survey (partial measures, spring 2011). This trend is a continuation of that observed since the full measures survey in February 2010 and as noted in the previous survey report (partial measures, spring 2011), this is because the beach is well sheltered by the Cullercoats piers.

Plate 2 – Survey photograph, cliff face at profile 1aNTDC05 (1aNTDC05_20111027_S1.JPG)

2.3 Tynemouth Long Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2011	**Beach Profiles:** Tynemouth Long Sands is covered by three beach profile lines for the Full Measures survey (Appendix A). Profiles 1aNTDC06 and 1aNTDC07 were initially surveyed annually each autumn between 2002 and 2009. A third profile, 1aNTDC06A, has been added in the centre of the frontage after that. From spring 2010 (partial measures) onwards, they have been surveyed bi-annually. **1aNTDC06** is located approximately 150m south of the access road/ramp towards the north of the bay. With the exception of a small increase in beach levels at the toe of dune-cliff, beach levels have not changed by more than 0.1m along the length of the profile. At profile **1aNTDC06A**, the dune face has not changed in form or position. Beach levels have not changed by more than 0.1m along the profile length. Between the toe and 100m chainage, beach levels increased by 0.1m, Seaward of 100m chainage, they reduced by 0.1m. This change is likely to represent a very weak signal of cross-shore processes as material is redistributed from the lower to middle and upper beach. Profile **1aNTDC07** is located approximately 50m south of the access route through the dunes towards the southern end of the bay. No change in form or position of the dune face or beach levels since the last survey (partial measures, spring 2011).	Since the last survey, the dunes have retained the same form and position. The survey photographs show that the dunes are well vegetated indicating stability. In addition, the photographs show the presence of dune fencing, which are used to help stabilise dunes. **Longer term trends:** The trends observed from the beach profile surveys since 2008 indicate that the dune fencing is a successful management technique. Recovery of the beach to the north at profile 1aNTDC06 has continued following significant erosion caused by storms during 2009/2010. **Longer term trends:** Overall, the beaches have remained stable. This is consistent with the surveys taken since the partial measures survey in spring 2010 that show only a very weak signal of cross-shore transport and redistribution of sediment across the profile.
Oct 2011	**Topographic Survey:** Tynemouth Long Sands is covered by a new survey. The survey was first undertaken as part of this present full measures survey in October 2011 and will be completed on a bi-annual basis thereafter. Data from the most recent topographic survey (full measures, winter 2011) have been used to create a DGM (Appendix B – Map 2a) using a Geographical Information System (GIS).	This is the first year of survey, so a difference plot has not been created. The survey report for Tynemouth Long Sands notes that there is '*terracing of sand at top of beach*'. This supports the findings of the beach profile analysis that beach levels have accreted at the dune-cliff toe since the last survey (partial measures, spring 2011).

2.4 King Edward's Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2011	**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. At profile **1aNTDC08**, beach levels have increased across the length of the profile. This increase in greatest around a chainage of 90m. As a result the beach profile gradient has become shallower at this location to give a more uniform profile.	The beach at King Edward's Bay has accreted since the last survey to form a flatter beach with no berms. **Longer term trends**: This is consistent with the last four surveys (i.e. since 15th February 2010, partial measures, spring 2010).

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles – problems with survey data collection:

At Tynemouth Long Sands (profiles 1aNTDC06 to 1aNTDC07), construction work around beach café meant access for the topographic survey was not possible.

At profile 1aNTDC05 the cliff was not measured due to dangerous access. The plot of the profile shows movement of the toe seawards by 0.25m. Overall this creates a profile that is of a shallower gradient. This suggests that cliff may have destabilised with some slumping of the cliff face. However as the survey report notes that '*cliff not measured at section 5 due to dangerous access*'. It is more likely that the changes observed are related to the survey technique used rather than actual change.

At profile 1aNTDC07, there was no access to the middle of the profile due to seed protection fences.

Topographic Surveys:

At Whitely Sand (profiles 1aNTDC01 to 1aNTDC04A) heavy swell onto the beach hampered low water surveying for the topographic survey.

At Tynemouth Long Sands (profiles 1aNTDC06 to 1aNTDC07) construction work around beach café restricted access to this part of the beach.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Whitley Sands, the cliffs to the north of Whiteland Sands have remained unchanged since 2009. To the south, the shoreline is fixed in position by a seawall. Since the last survey, to the north of the bay upper beach levels have increased. At the centre of the bay, upper beach kevels have changed very little. To the south of Whitley Sands, the profiles have demonstrated signs of beach flattening and accretion. To the centre and south of the bay, beach levels are generally consistent with those observed in the past. The recorded profiles and topographic survey present no causes for concern.
- At Cullercoats Bay, access to the cliffs has been limited, so it is difficult to determine on-the-ground changes. The beaches have remained fairly stable since the last survey and over the longer-term record. The recorded profiles present no causes for concern.
- At Tynemouth Long Sands, since the last survey and over the longer term, the dunes have retained the same form and position. Overall, the beaches have remained stable, which is consistent with the surveys taken since the partial measures survey in spring 2010, showing only a very weak signal of cross-shore transport and redistribution of sediment across the profile. The recorded profiles and topographic survey present no causes for concern.
- At King Edward's Bay, the steep cliffs that line the backshore are fixed in position by a seawall. The beach has accreted since the last survey to form a flatter beach with no berms. This is in line with trends observed over the longer term. The recorded profiles present no causes for concern.

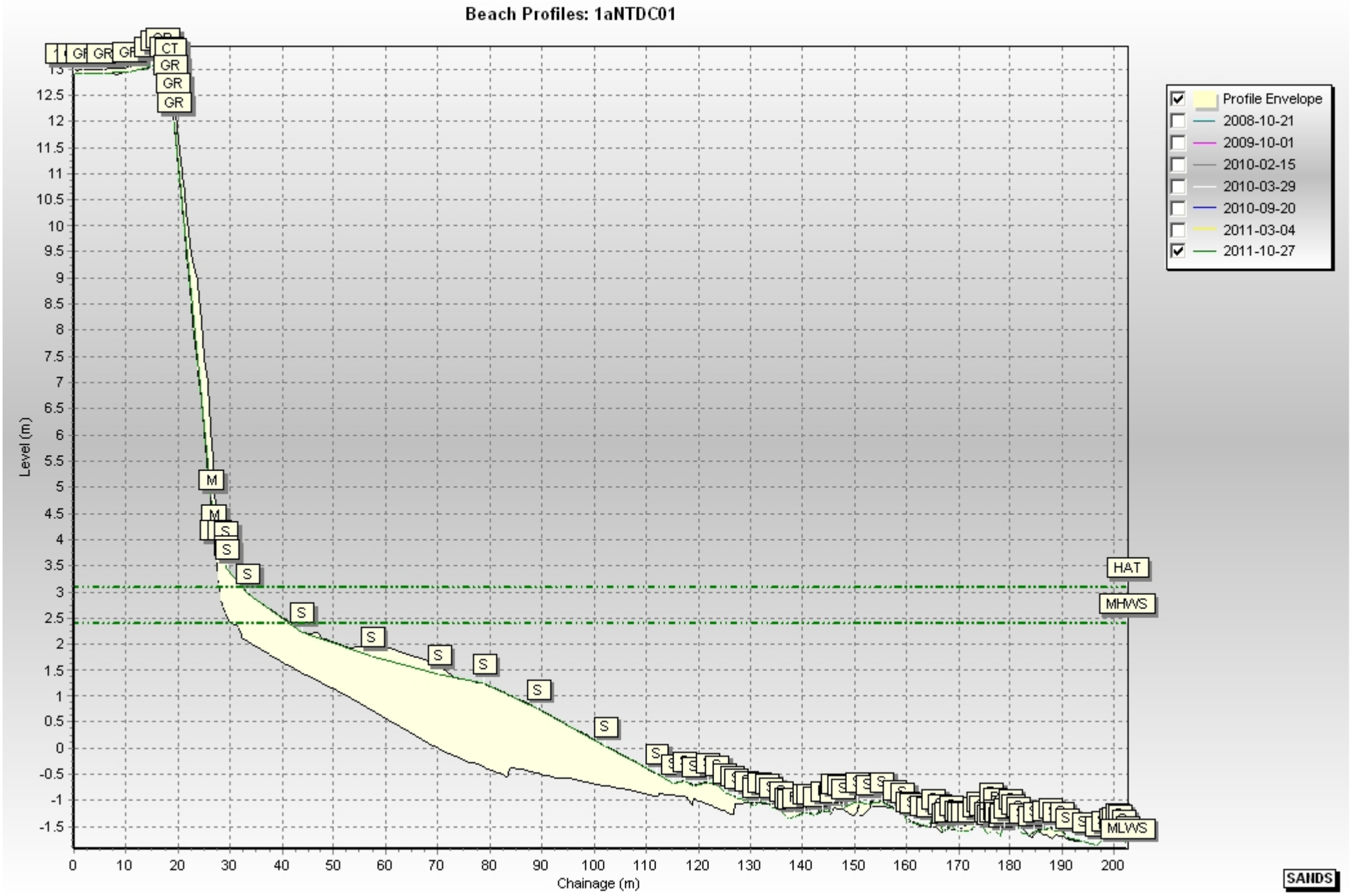
Appendices

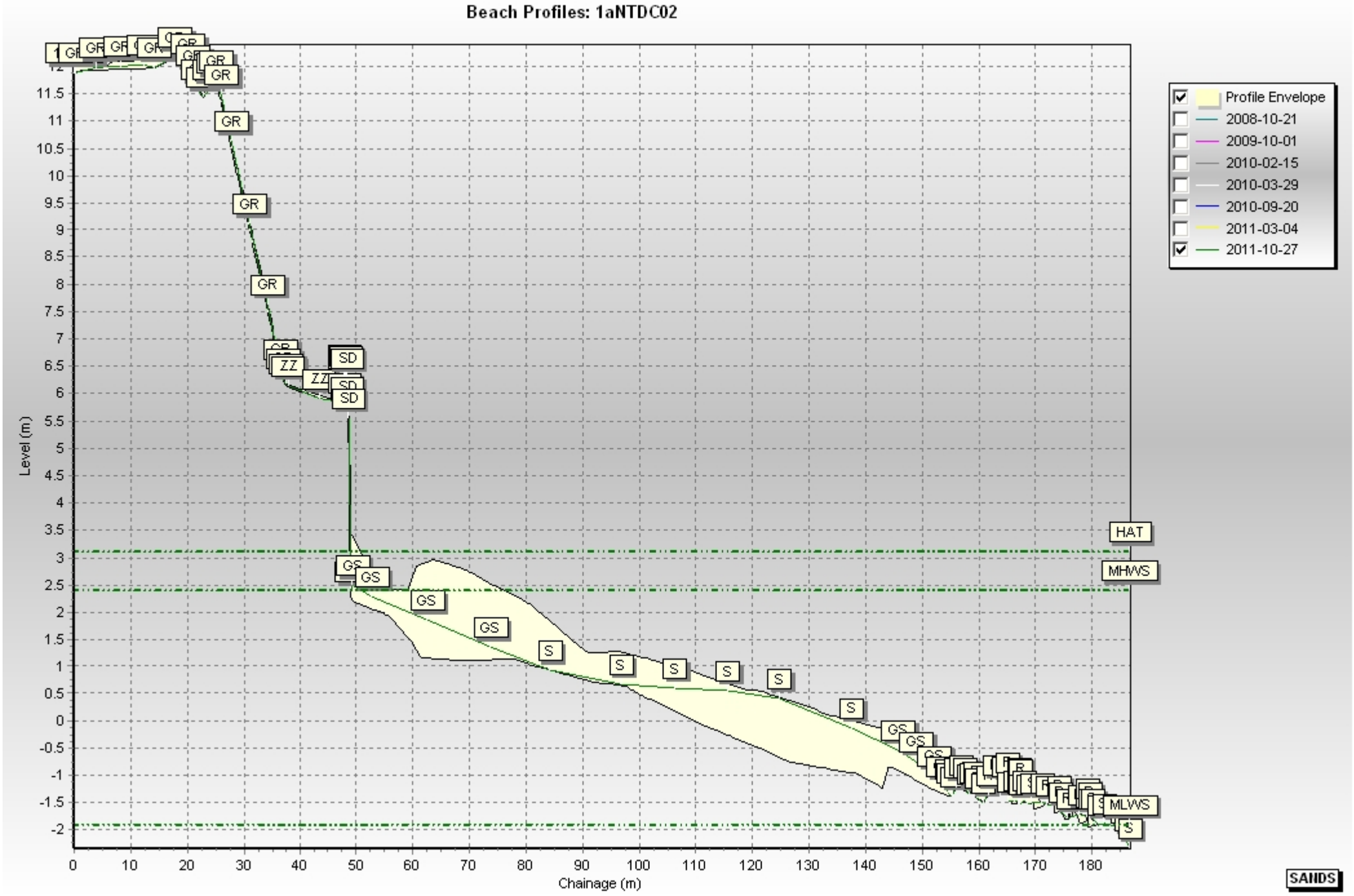
Appendix A

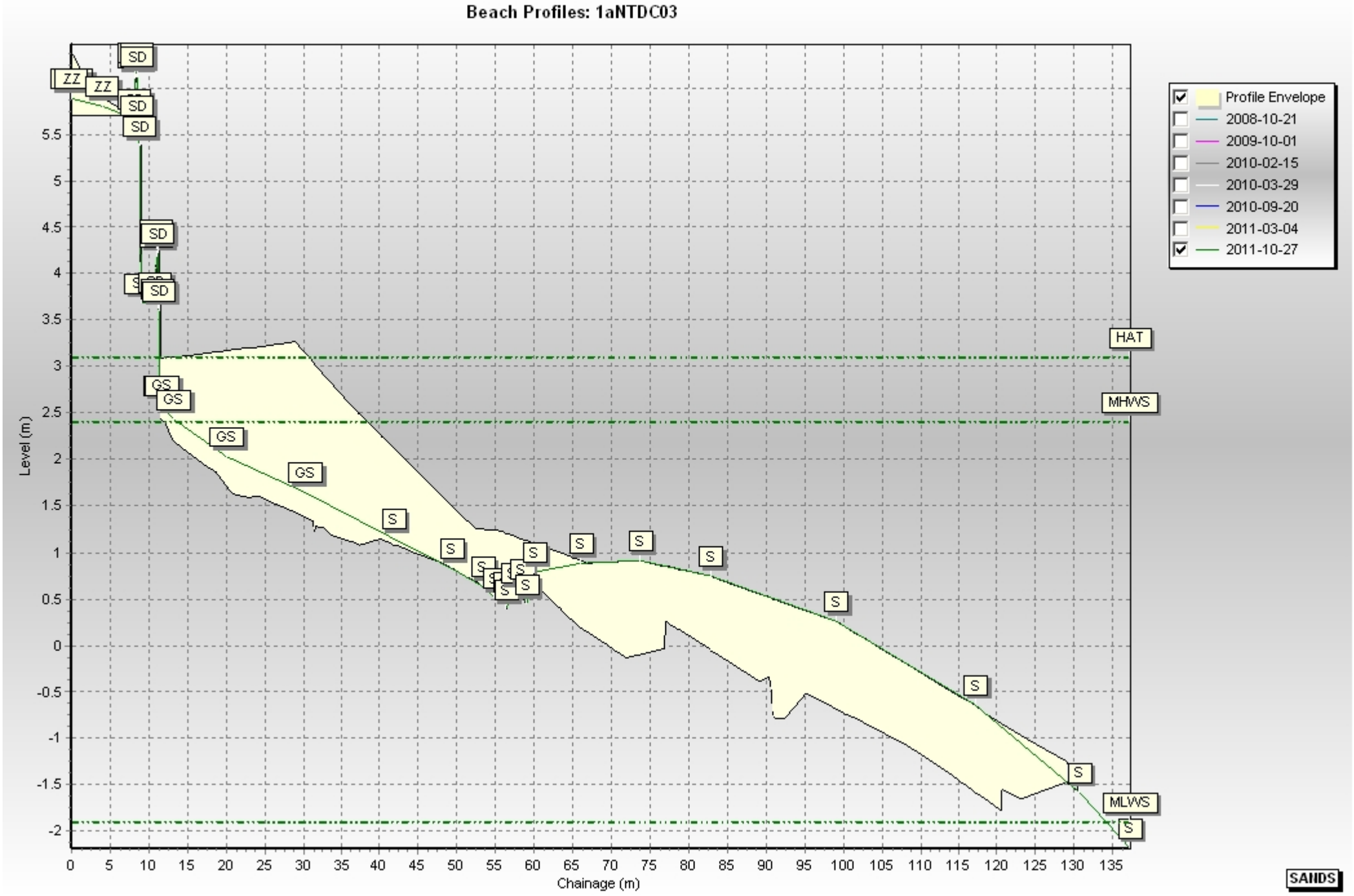
Beach Profiles

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


Beach Profiles: 1aNTDC01
Profile Envelope
2008-10-21
2009-10-01
2010-02-15
2010-03-29
2010-09-20
2011-03-04
2011-10-27
Level (m)
Chainage (m)
HAT
MHWS
MLWS
CT
GR
M
S
SANDS


Beach Profiles: 1aNTDC02
Profile Envelope
2008-10-21
2009-10-01
2010-02-15
2010-03-29
2010-09-20
2011-03-04
2011-10-27
Level (m)
Chainage (m)
HAT
MHWS
MLWS
GR
SD
ZZ
GS
S
SANDS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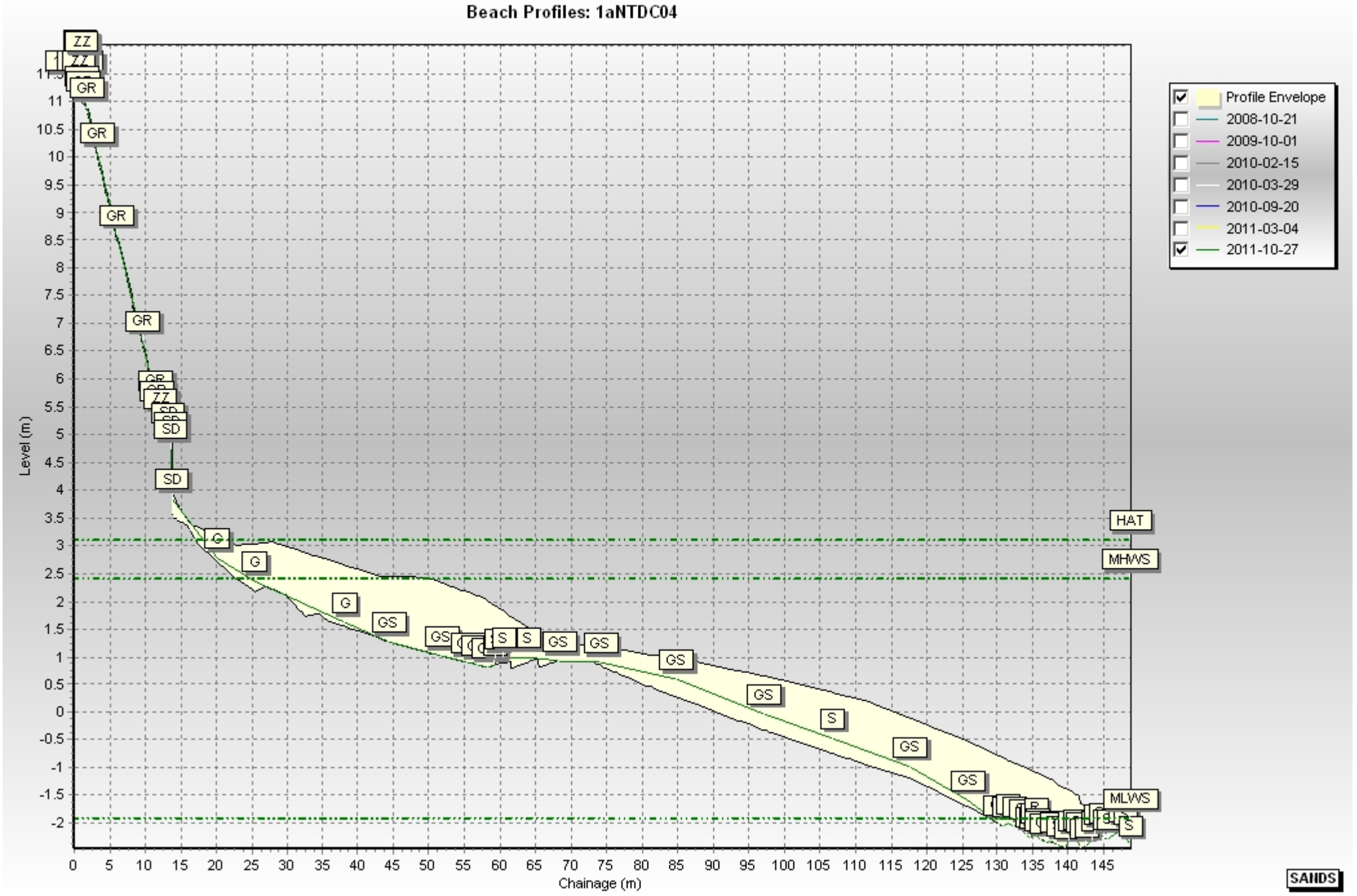
2009-10-01
2010-02-15
2010-03-29
2010-09-20
2011-03-04
2011-10-27
HAT
MHWS
MLWS
SD
ZZ
GS
S
Level (m)
Chainage (m)
SANDS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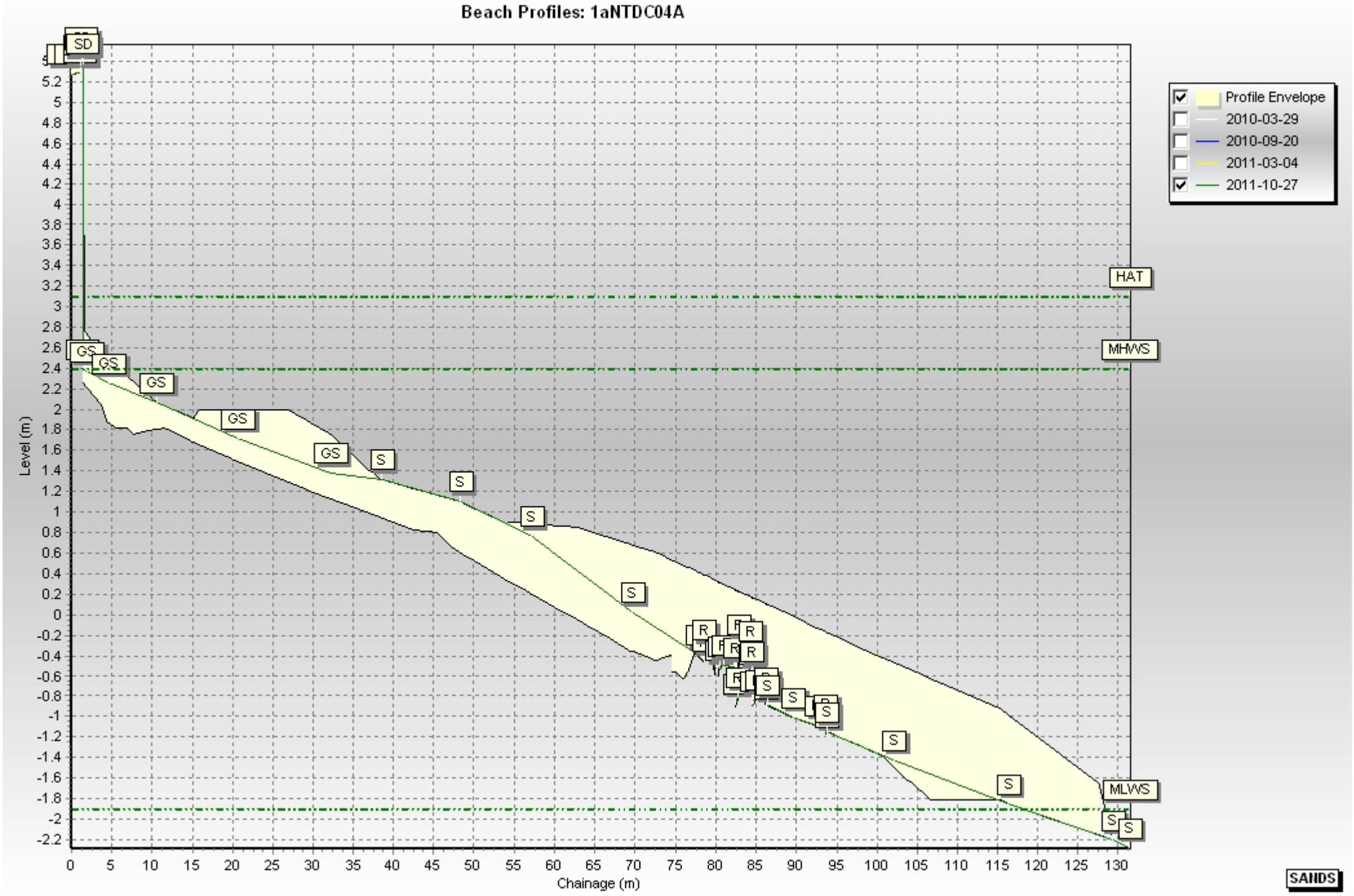
2010-09-20
2011-03-04
2011-10-27
Level (m)
Chainage (m)
HAT
MHWS
MLWS
SANDS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HAT
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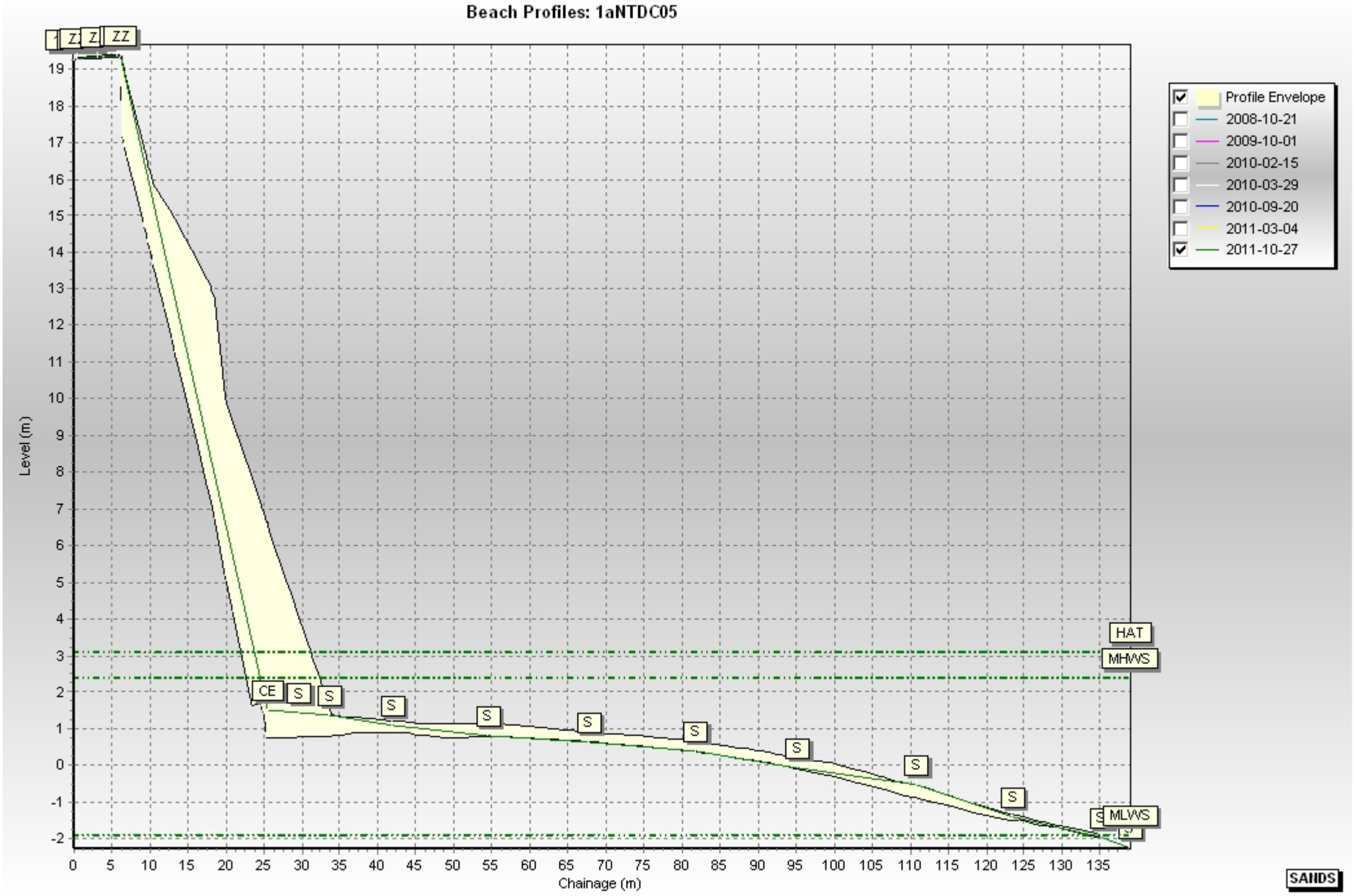
MLWS
SD
GS
S
R
Level (m)
Chainage (m)
SANDS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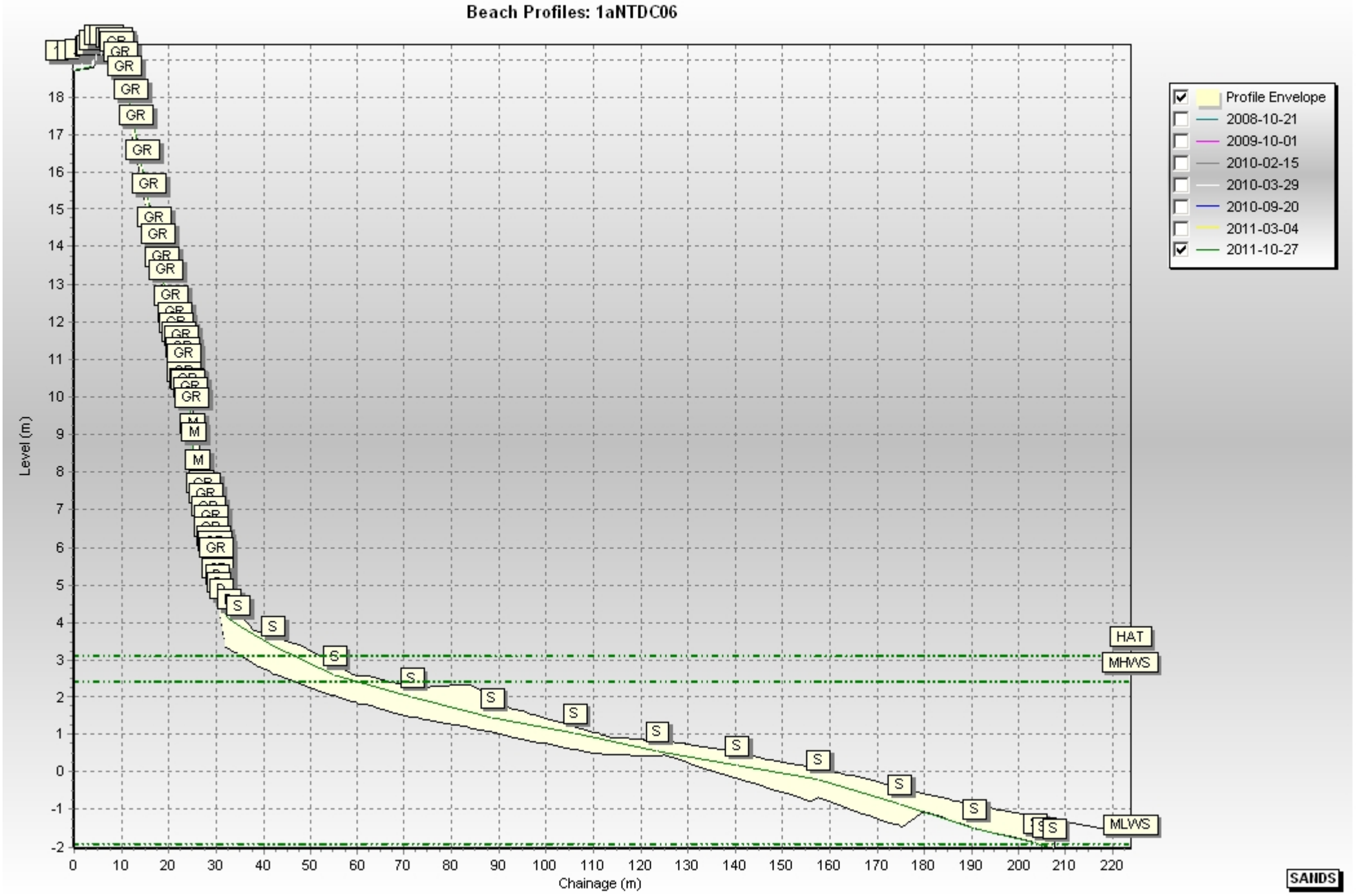
HAT
MHWS
MLWS
CE
S
Level (m)
Chainage (m)
SANDS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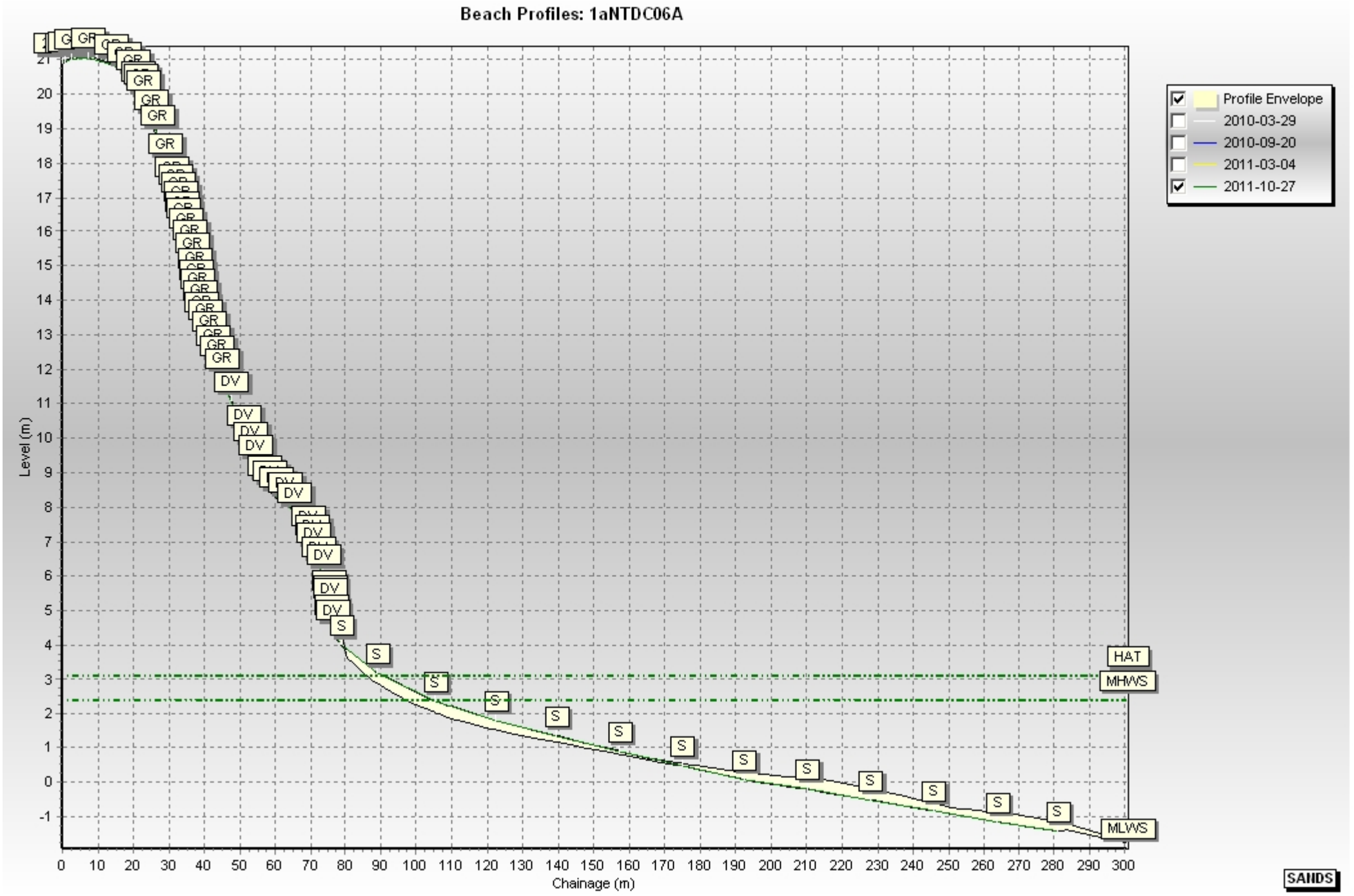
2011-03-04
2011-10-27
HAT
MHWS
MLWS
GR
M
S
SANDS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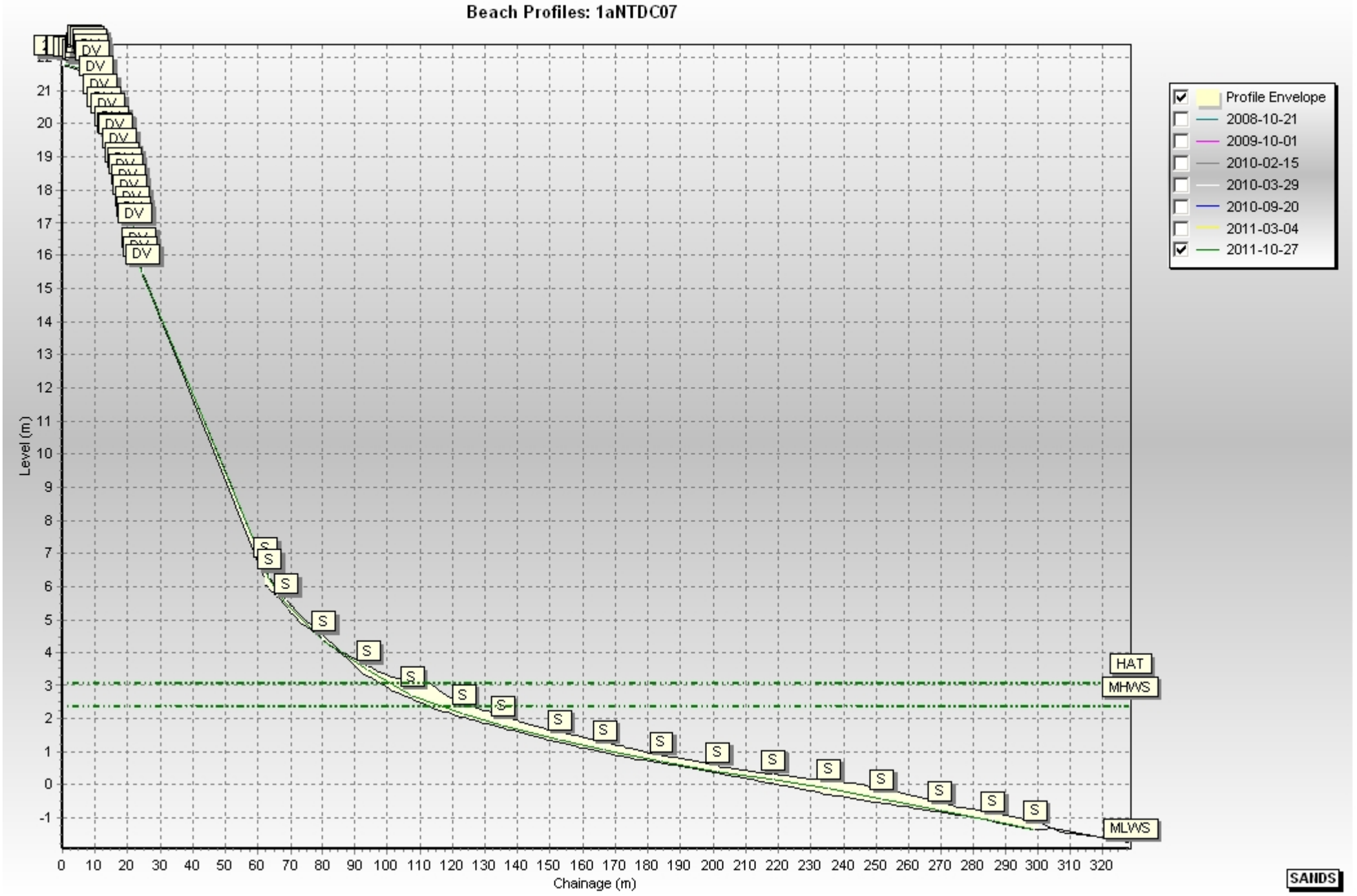
2010-09-20
2011-03-04
2011-10-27
Level (m)
Chainage (m)
HAT
MHWS
MLWS
GR
DV
S
SANDS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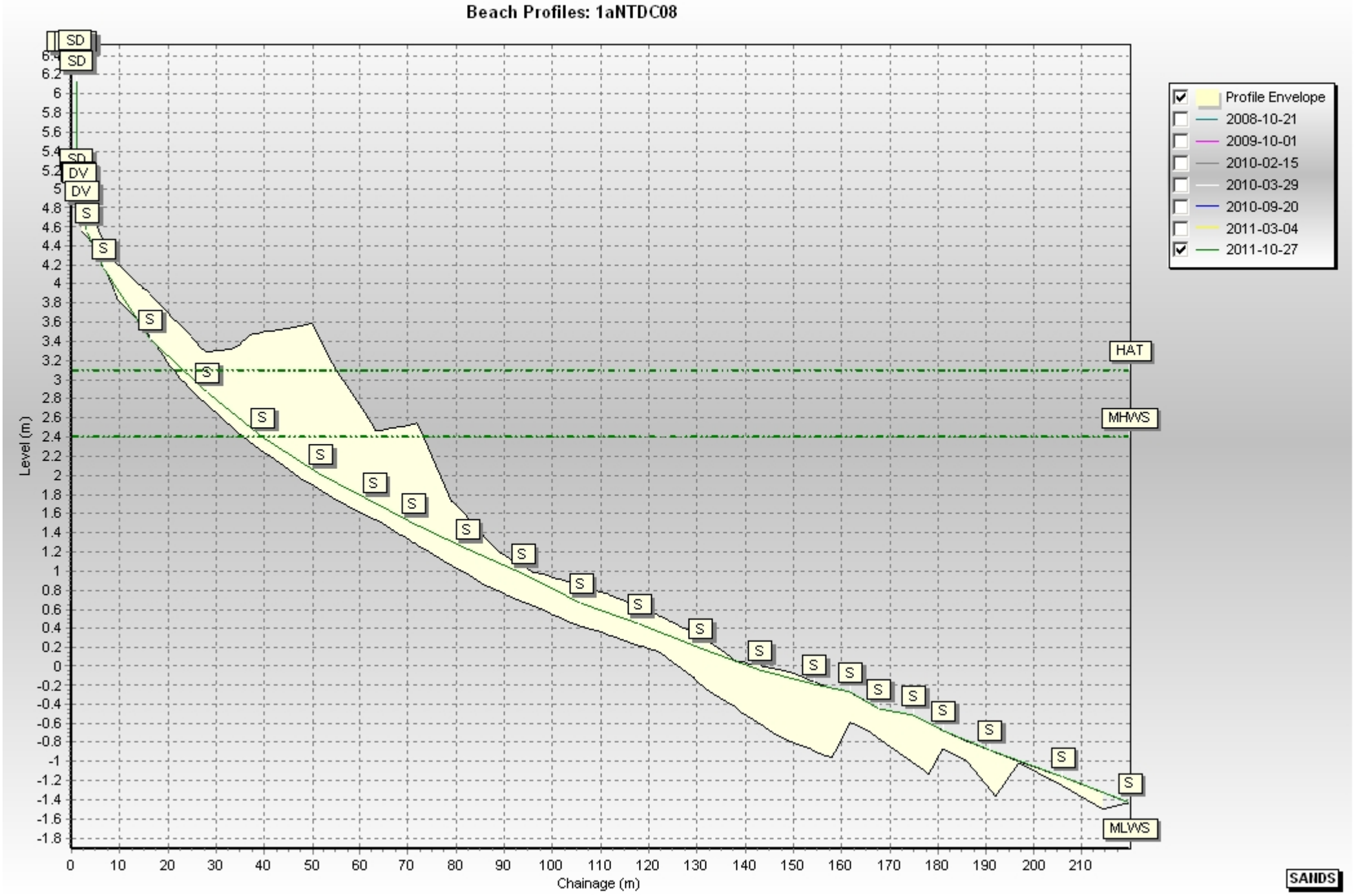
DV
S
HAT
MHWS
MLWS
Level (m)
Chainage (m)
SANDS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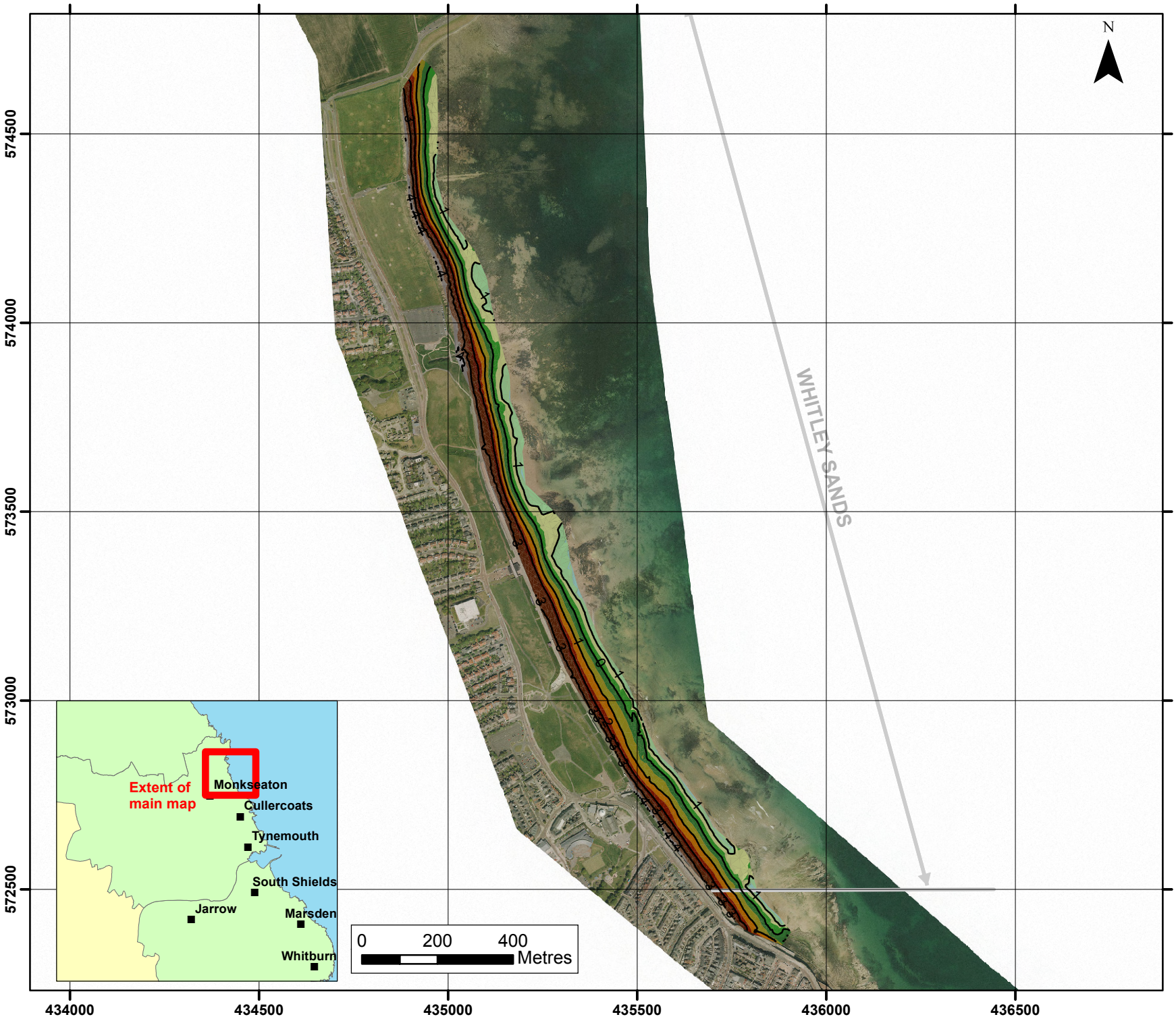
2010-03-29
2010-09-20
2011-03-04
2011-10-27
HAT
MHWS
MLWS
SD
DV
S
Level (m)
Chainage (m)
SANDS

Appendix B

Topographic Survey



KEY

Elevation (m OD)

- 4.5 - 5
- 4 - 4.5
- 3.5 - 4
- 3 - 3.5
- 2.5 - 3
- 2 - 2.5
- 1.5 - 2
- 1 - 1.5
- 0.5 - 1
- 0 - 0.5
- -0.5 - 0
- -1 - -0.5
- -1.5 - -1
- -2 - -1.5
- Contour (1m)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix B- Map 1a
Topographic Survey
Whitley Bay
North Tyneside Council

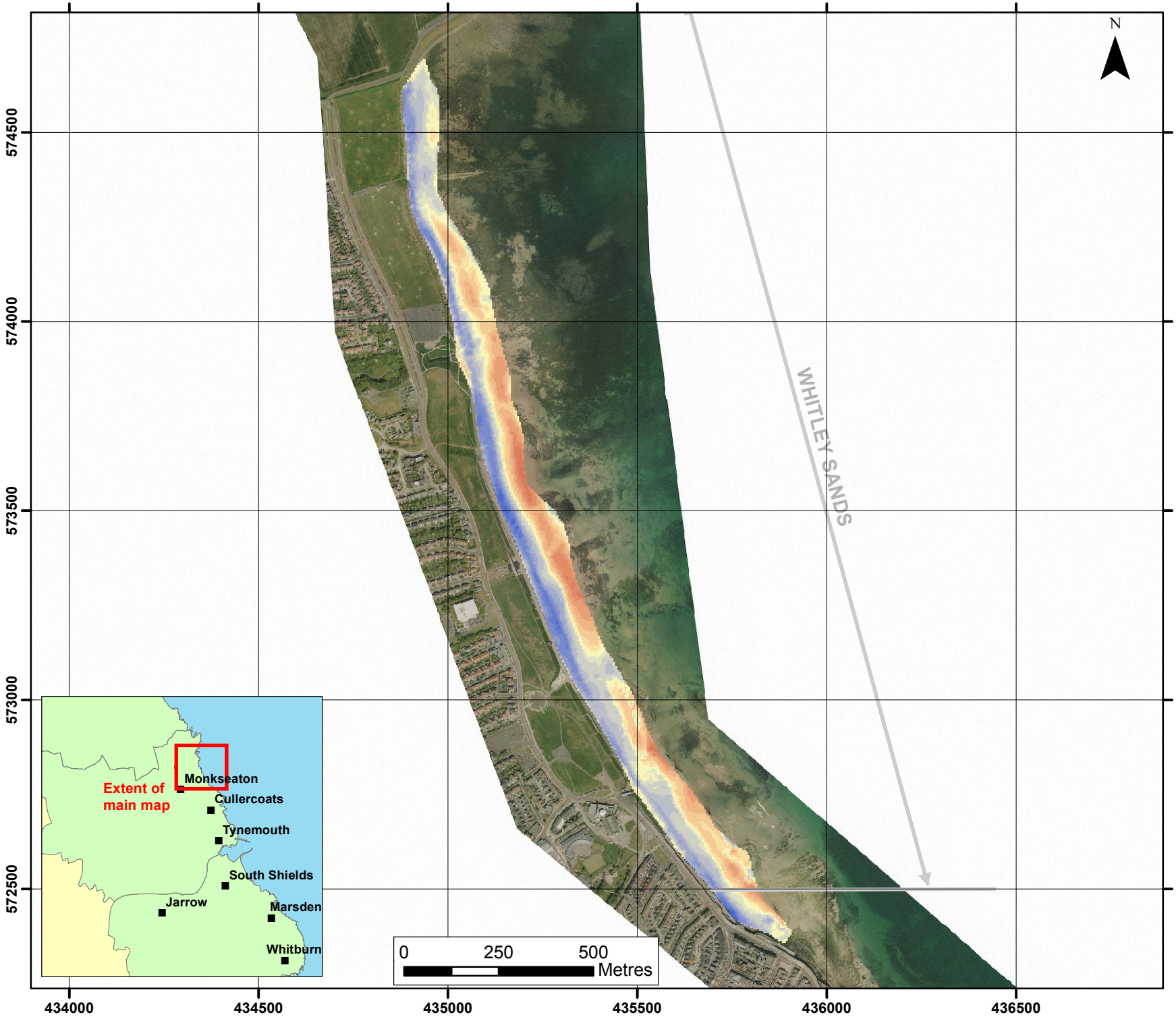
Analytical Report 4
Full Measures Survey
Winter 2011

Halcrow
A CH2M HILL COMPANY

Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE

Tel: +44 (0)121 456 2345
Fax: +44(0)121 456 1569
www.halcrow.com

Photography courtesy of North East Coastal Observatory
www.northeastcoastalobservatory.org.uk



KEY Winter 2010 and Winter 2011
Change in elevation (m OD)

<-2	Loss
-2 - -1.75	
-1.75 - -1.5	
-1.5- -1.25	
-1.25 - -1	
-1 - -0.75	
-0.75 - -0.5	
-0.5 - -0.25	
-0.25 - -0.1	
-0.1 - 0	Change < 0.1 m
0 - 0.1	
0.1 - 0.25	Gain
0.25 - 0.5	
0.5 - 0.75	
0.75 - 1	
1 - 1.25	
1.25 - 1.5	
1.5 - 1.75	
1.75 - 2	
>2	

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

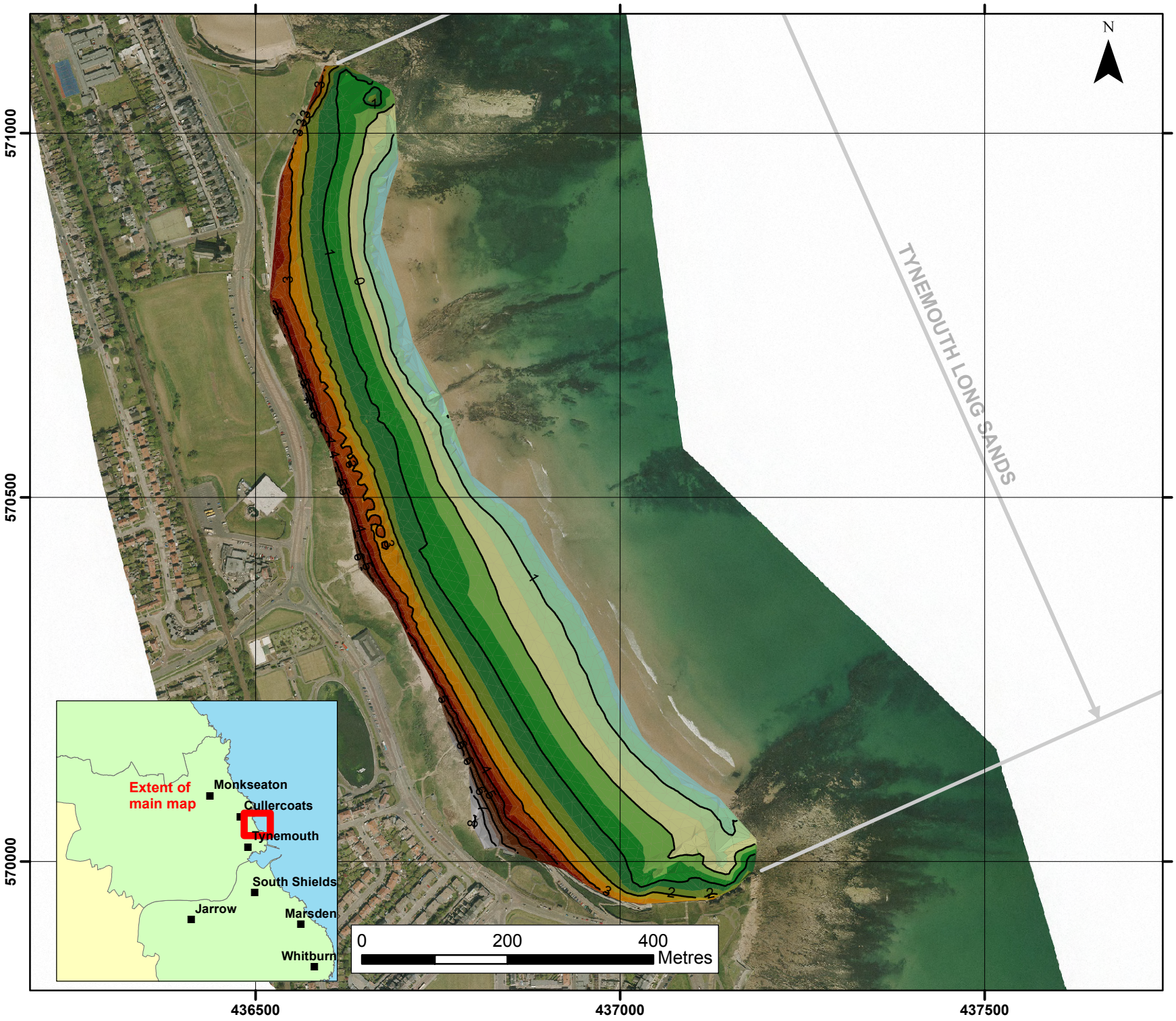
Appendix B - Map 1b
Topographic Difference
Whitley Sands
North Tyneside Council

Analytical Report 4
Full Measures Survey
Winter 2011

Halcrow
A CH2M HILL COMPANY

Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE

Tel: +44 (0)121 456 2345
Fax: +44(0)121 456 1569
www.halcrow.com



KEY

Elevation (m OD)

- 8 - 8.5
- 7.5 - 8
- 7 - 7.5
- 6.5 - 7
- 6 - 6.5
- 5.5 - 6
- 5 - 5.5
- 4.5 - 5
- 4 - 4.5
- 3.5 - 4
- 3 - 3.5
- 2.5 - 3
- 2 - 2.5
- 1.5 - 2
- 1 - 1.5
- 0.5 - 1
- 0 - 0.5
- -0.5 - 0
- -1 - -0.5
- -1.5 - -1
- -2 - -1.5
- 1m Contour

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix B - Map 2a
Topographic Survey
Long Sands
North Tyneside Council

Analytical Report 4
Full Measures Survey
Winter 2011

Halcrow
A CH2M HILL COMPANY

Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE

Tel: +44 (0)121 456 2345
Fax: +44(0)121 456 1569
www.halcrow.com