



**Cell 1 Regional Coastal Monitoring Programme
Analytical Report 3: 'Full Measures' Survey 2010**



**North Tyneside Council
Final Report**

December 2010

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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
m	metres
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
MLWN	Mean Low Water Neap
MLWS	Mean Low Water Spring
MSL	Mean Sea Level
ODN	Ordnance Datum Newlyn

Water Levels Used in Interpretation of Changes

Water Level Parameter	Water Level (mODN)
	River Tyne
1 in 200 year	3.7
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 Northumbrian Coastal Authorities Group (NCAG¹) Monitoring Programme began in April 2002 with a survey of beach profile lines along various sections of the coastline between Berwick-upon-Tweed and the River Tyne. These were fully repeated in September 2002 and since then annual surveys of all profiles have been 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.

In September 2008 the monitoring became incorporated within the wider Cell 1 Regional Coastal Monitoring Programme. This 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 till to varying thicknesses, softer rock cliffs, and extensive landslide complexes.

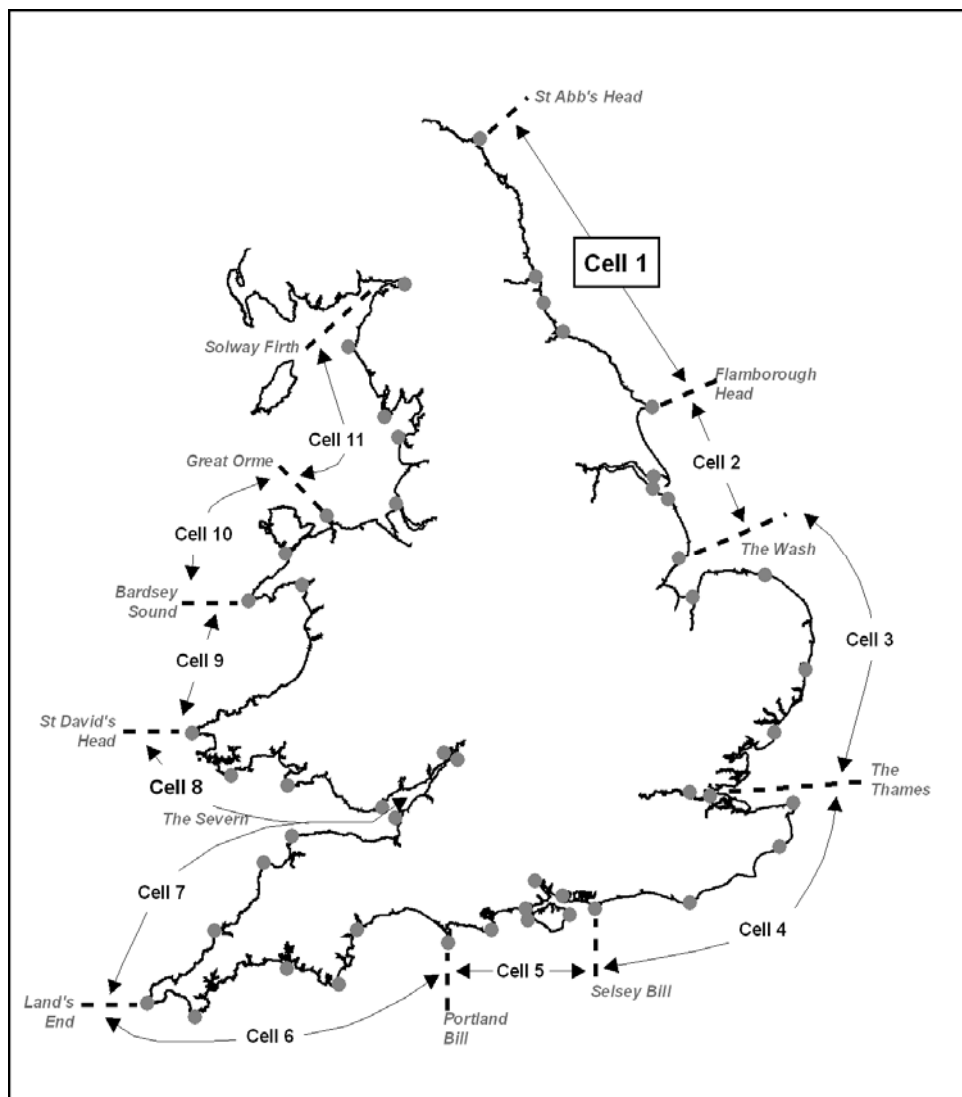


Figure 1 Sediment Cells in England and Wales

¹ NCAG become part of the wider North East Coastal Group (NECG) in September 2008.

The Cell 1 programme commenced in its present guise in September 2008 and is managed by Scarborough Borough Council on behalf of the North East Coastal Group. It is funded by the Environment Agency, working in partnership with the following organisations.



The data collection, analysis and reporting is being undertaken as a partnership between the following organisations:



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

- beach profile surveys (as before for Northumberland)
- topographic surveys (as before for Northumberland)
- cliff top recession surveys (as before for Northumberland)
- real-time wave data collection
- bathymetric and sea bed characterisation surveys south of the River Tyne
- 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.

A Cell 1 Overview Report will also be produced periodically. This will provide a region-wide summary of the main findings relating to trends and interactions along the entire Cell 1 frontage within distinct time phases of the programme, defined by specific funding allocations. The first such report is expected to be produced in spring 2011 (covering 2008 – 2011) when the initial three year funding allocation comes towards an end.

To date the following reports have been produced since incorporation within the Cell 1 Regional Coastal Monitoring Programme:

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	June 09 ^(^)	N/A	N/A	-
2	2009/10	Sep-Dec 09	Mar 10	Mar-May 10	May 10	-
3	2010/11	Sep-Nov 10	Dec 10 ^(*)			

^(^) Combined report for Northumberland County Council and North Tyneside Council; subsequent reports are separate.

^(*) The present report is **Analytical Report 3** and provides an analysis of the 2010 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	Spittal A
	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
	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, Uppgang 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 in the north to the River Tyne in the south. For the purposes of this report, 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 no. transect lines (since 2002)
 - Beach profile surveys along an additional 2 no. transects (since 2010)
 - Topographic survey along Whitley Sands (commenced in 2010)
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along all 10 no. transect lines (since 2010)

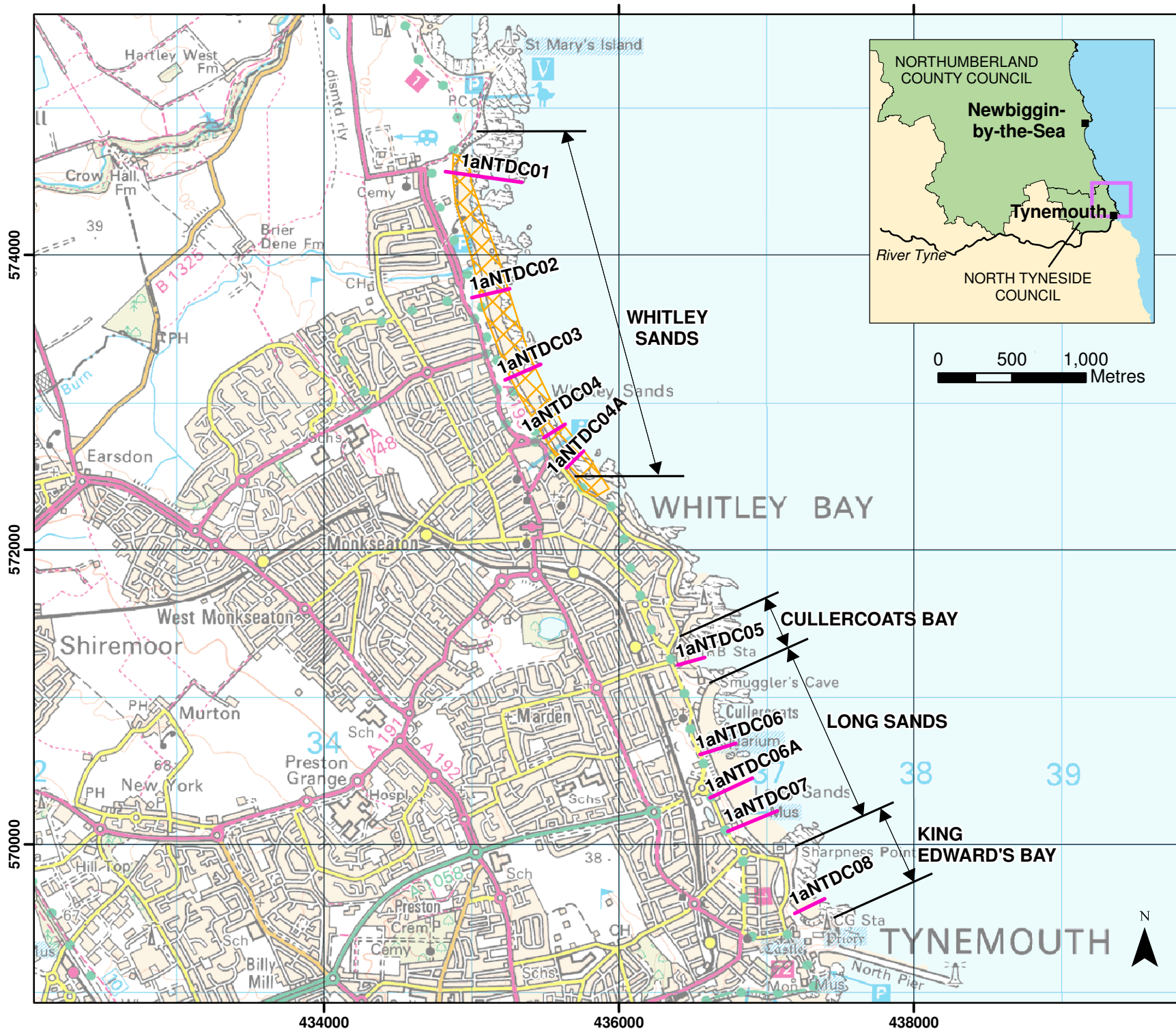
The location of these surveys is shown in Figure 2.

The Full Measures survey was undertaken along this frontage in October 2010, when weather conditions were gloomy but the sea state was mostly calm.

This Analytical Report presents the following:

- 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.



SURVEY LOCATIONS

Topographic Profiles

- Annual
- Bi-Annual

Topographic Surveys

- 6 monthly
- yearly
- 5 yearly

— Cliff Top Edge Survey
(Indicative Survey Extents shown)

Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 2 - Map 1
 North Tyneside Council Frontage**

Analytical Report 3
 'Full Measures' Survey 2010

Drawing Scale 1:35,000 at A4

Drawn by: TC	Date: 22/10/2010
Checked by: NC	Date: 29/10/2010
Approved by: NC	Date: 29/10/2010

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2. Analysis of Survey Data

2.1 Whitley Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
10-2010	<p>Beach Profiles:</p> <p>Whitley Sands is covered by five beach profile lines (Appendix A). Four of these (NTDC01 – NTDC04) were initially surveyed annually each autumn between 2002 and 2009. From spring 2010 onwards, they have been surveyed 6-monthly and a fifth profile (NTDC04A) was added at this time at the southern end of the frontage.</p> <p>NTDC01 is located in the north of Whitley Sands, along the undefended cliffs just to the south of Trinity Road Car Park. The cliff top and cliff face cut back notably between the October 2009 and February 2010 surveys but then generally stabilised to the October 2010 survey. The foreshore levels were at a record low value around February 2009, but then slightly recovered to March 2010. By the time of the October 2010 surveys, they reduced again to match the record low values at the toe of the cliffs. Just below MHWs level, a berm feature was identified and seaward of this level the lower foreshore generally accreted.</p> <p>NTDC02 to NTDC04A extend across the cliffs/slopes, promenade and seawall before progressing across the foreshore towards low water. All four of these profiles showed similar trends of minor accretion (or stability in the case of NTDC04) within about 15-20m of the toe of the wall on the upper beach, lowering on the mid beach to create (NTDC03) or equal NTDC04 previous record low values, and accretion on the lower foreshore.</p>	<p>The general trend between 2002 and 2008 along NTDC01 was that the cliff form remained relatively stable, despite fluctuations in beach levels at the cliff toe and upper to mid beach commonly occurring. Changes, indicative of a small slump in the cliff face, with erosion debris being deposited on the foreshore, were then observed between October 2008 and October 2009. More marked changes were then observed to February 2010 with up to 1.5m cut-back in the cliff face. The cliff top does not seem to have eroded as much as the cliff face, leading to over-steepened conditions that made it unsafe for the surveyors to approach the cliff edge in late March 2010 and again in October 2010. This suggests that a further slump in the cliff top could be imminent. Foreshore levels here can be volatile, with an envelope of up to 2m variation in beach level being recorded a short distance from the toe of the cliff along this profile.</p> <p>Along the defended sections of Whitley Sands, as measured by NTDC02 to NTDC04A, there has been a history of successive berm formation and removal on the upper beach with associated foreshore lowering and recovery, respectively. This has previously been interpreted as storm-related changes in the foreshore and this trend has continued to the current survey.</p>
10-2010	<p>Topographic Survey:</p> <p>Whitley Sands is covered by an annual topographic survey, the first of which commenced during the present surveys in October 2010. Data from this survey have been used to create a Digital Ground Model (DGM) using a Geographic Information System (GIS) computer software package (Appendix B – Map 1).</p>	<p>The annual topographic survey will help to identify whether the seasonal changes observed in the beach profile surveys are occurring in addition to an underlying trend of erosion or accretion along the beach. At present, even with data available from 2002, the seasonal variations are masking any underlying trend that may be present and therefore the topographic surveys will be of value.</p>

2.2 Cullercoats Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
10-2010	<p>Beach Profiles:</p> <p>Cullercoats Bay is covered by one beach profile line (Appendix A). This was surveyed annually each autumn between 2002 and 2009. From spring 2010 onwards, it has been surveyed 6-monthly.</p> <p>The cliff face and cliff top along NTDC05 appears similar in position to the March 2010 survey, which in itself is cut back compared to the earlier surveys. This, however, is due to the small 'ledge' near the cliff top not being surveyed in the last two surveys due to high exposure and slippery conditions at the cliff top. On the foreshore, the upper beach experience accretion and the lower beach lower erosion but these were minor changes.</p>	<p>The foreshore continues to exhibit only minor changes between successive surveys, showing the importance of the Cullercoats Piers in sheltering the bay against direct wave attack.</p>

2.3 Tynemouth Long Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
10-2010	<p>Beach Profiles:</p> <p>Tynemouth Longsands is covered by three beach profile lines (Appendix A). Two of these (NTDC06 and NTDC07) were initially surveyed annually each autumn between 2002 and 2009. From spring 2010 onwards, they have been surveyed 6-monthly and a third profile (NTDC06A) has been added in the centre of the frontage.</p> <p>During the surveys in February and March 2010, profile NTDC06 showed very low levels along the upper foreshore and cut-back at the toe of the dunes. To October 2010, the foreshore levels have recovered somewhat, although the near vertical 'clifflet' at the toe of the dunes remains. Some modest slumping about a third of the way up the dune face occurred.</p>	<p>Profile NTDC06 shows some foreshore recovery since the dune damage that occurred over the winter of 2009/2010, but the cliffing at the toe of the dunes remains.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
10-2010	<p>Profile NTDC06A was surveyed for only the second time, and showed a little curtailment at the toe of the dunes, with the sand released from this elevating upper foreshore levels. Further seaward along the profile, the levels dropped slightly.</p> <p>Parts of the dune along NTDC07 were not surveyed during the October 2010 survey (not for that matter during several of the earlier surveys) due to re-seeding and fencing. The low foreshore levels recorded in the previous survey in March 2010 remained and had not yet recovered.</p>	<p>The changes observed along the relatively new profile NTDC06A are likely to be well within the limits of natural change.</p> <p>Although beach levels remained low along NTDC07, there tends to be less volatility along this section and therefore the low levels do not presently cause a major concern.</p>

2.4 King Edward's Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
10-2010	<p>Beach Profiles:</p> <p>King Edward's Bay is covered by one beach profile line (Appendix A). This was surveyed annually each autumn between 2002 and 2009. From spring 2010 onwards, it has been surveyed 6-monthly.</p> <p>The considerable redistribution of sediment that occurred between October 2009 and February and March 2010 caused quite low upper beach levels which remained to October 2010. Further seaward along the profile, however, beach levels on all three recent surveys tended to be relatively high and new record high values were recorded in October 2010 at the seaward-most section.</p>	<p>Relatively low beach levels remain along the upper beach, but the lower beach has accreted notable volumes of sediment.</p>

3. Problems Encountered and Uncertainty in Analysis

Along profile NTDC05 in Cullercoats Bay the surveyors have not surveyed a slight 'ledge' in the upper cliff face during recent surveys due to slippery underfoot conditions and the very steep profile. At all times the safety of the surveyors is paramount and surveying this ledge adds no major value to the analysis. The surveyors have now been instructed to survey the cliff top and cliff toe in further surveys and not attempt to survey the ledge.

Along profile NTDC07 a section of the dune face remains fenced off as it is being re-seeded. This section has therefore not been surveyed during the October 2010 survey (and also some earlier surveys).

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

Recently, the North Tyneside profiles have been added to the Partial Measures surveys (since there appear to be notable seasonal variations in form) and a topographic survey at Whitley Bay has been added to the Full Measures surveys. Given these changes, there are no other changes recommended at the present time.

5. Conclusions and Areas of Concern

- Following the measureable changes between October 2009 and February/March 2010, the coastline in North Tyneside has been somewhat more stable to October 2010.
- The undefended cliffs along NTDC01 at the northern end of Whitley Sands appear to remain over-steepened and local slumps may continue.
- Along the defended sections of Whitley Sands, there has been a history of successive berm formation and removal on the upper beach with associated foreshore lowering and recovery. To the recent survey, there has been minor redistribution of sediment, with upper foreshore accretion, mid foreshore lowering and lower foreshore accretion.
- Profile NTDC05 in Cullercoats Bay remains relatively stable, exhibiting only minor foreshore changes.
- Measured profiles along Tynemouth Long Sands show some slight foreshore recovery in places (NTDC06), but elsewhere (such as NTDC07) the upper levels remained low.
- King Edward's Bay had relatively low beach levels along the upper beach, but the lower beach accreted notable volumes of sediment.

Appendices

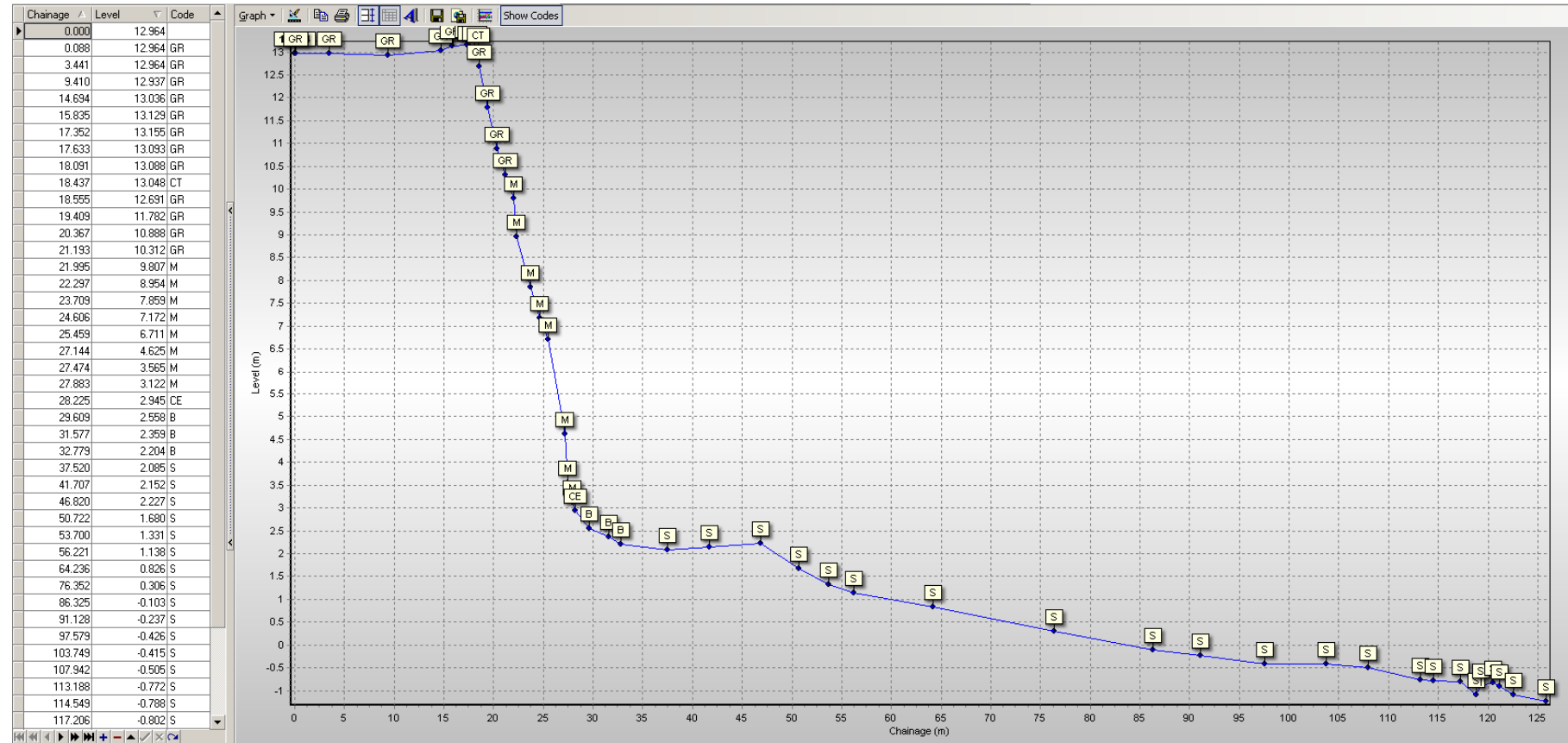
Appendix A
Beach Profiles

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

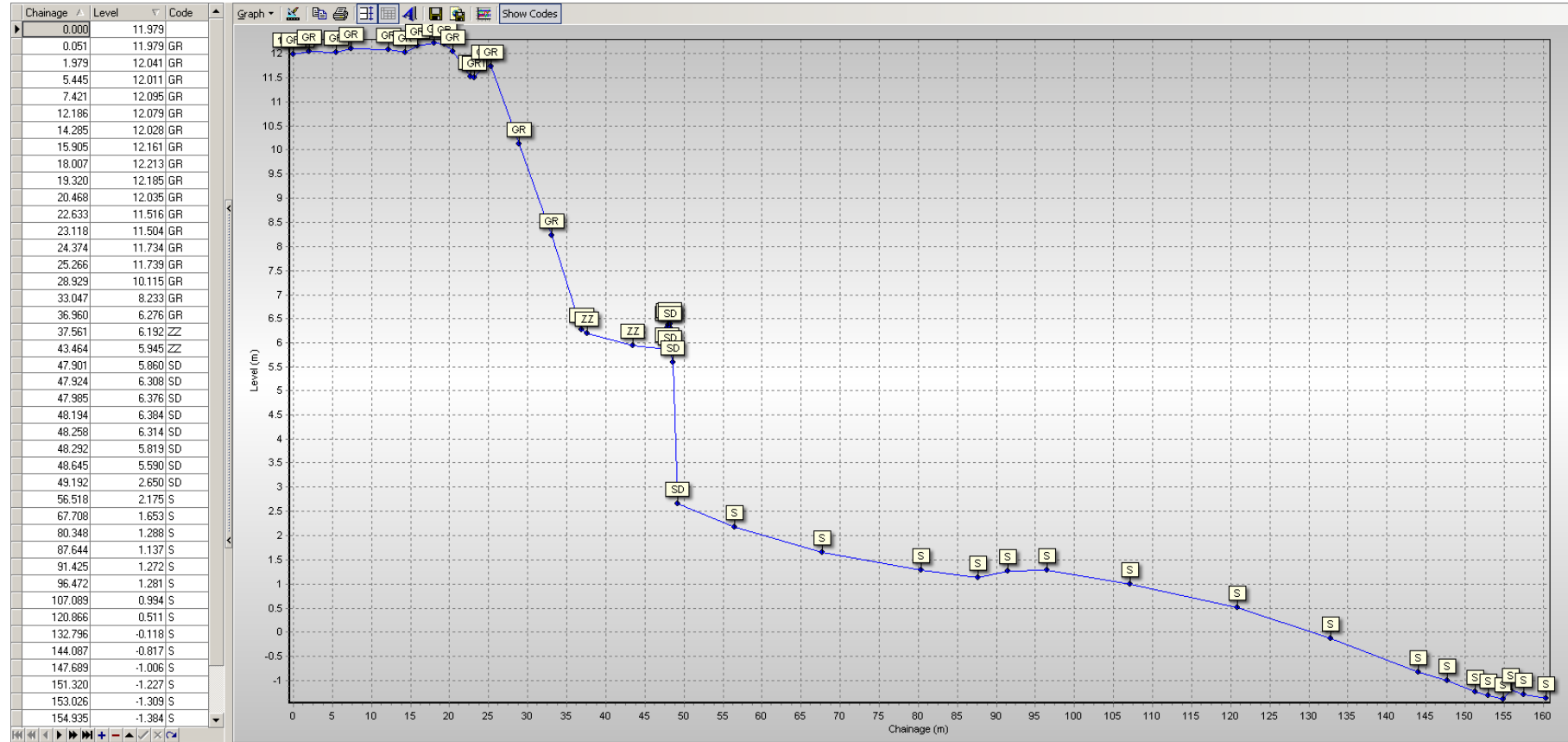
Code	Description
M	Mud
S	Sand
G	Gravel
GS	Gravel & Sand
GM	Gravel & Mud
MS	Mud & Sand
B	Boulders
R	Rock
SD	Sea Defence
SM	Salt Marsh
GR	Grass
D	Dune (non-vegetated)
DV	Dune (vegetated)
F	Forested
X	Mixture
FB	Obstruction
CT	Cliff Top
CE	Cliff Edge
CF	Cliff Face
SH	Shell
W	Water Body
ZZ	Unknown

North Tyneside

1aNTDC01 - 20/09/2010

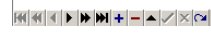
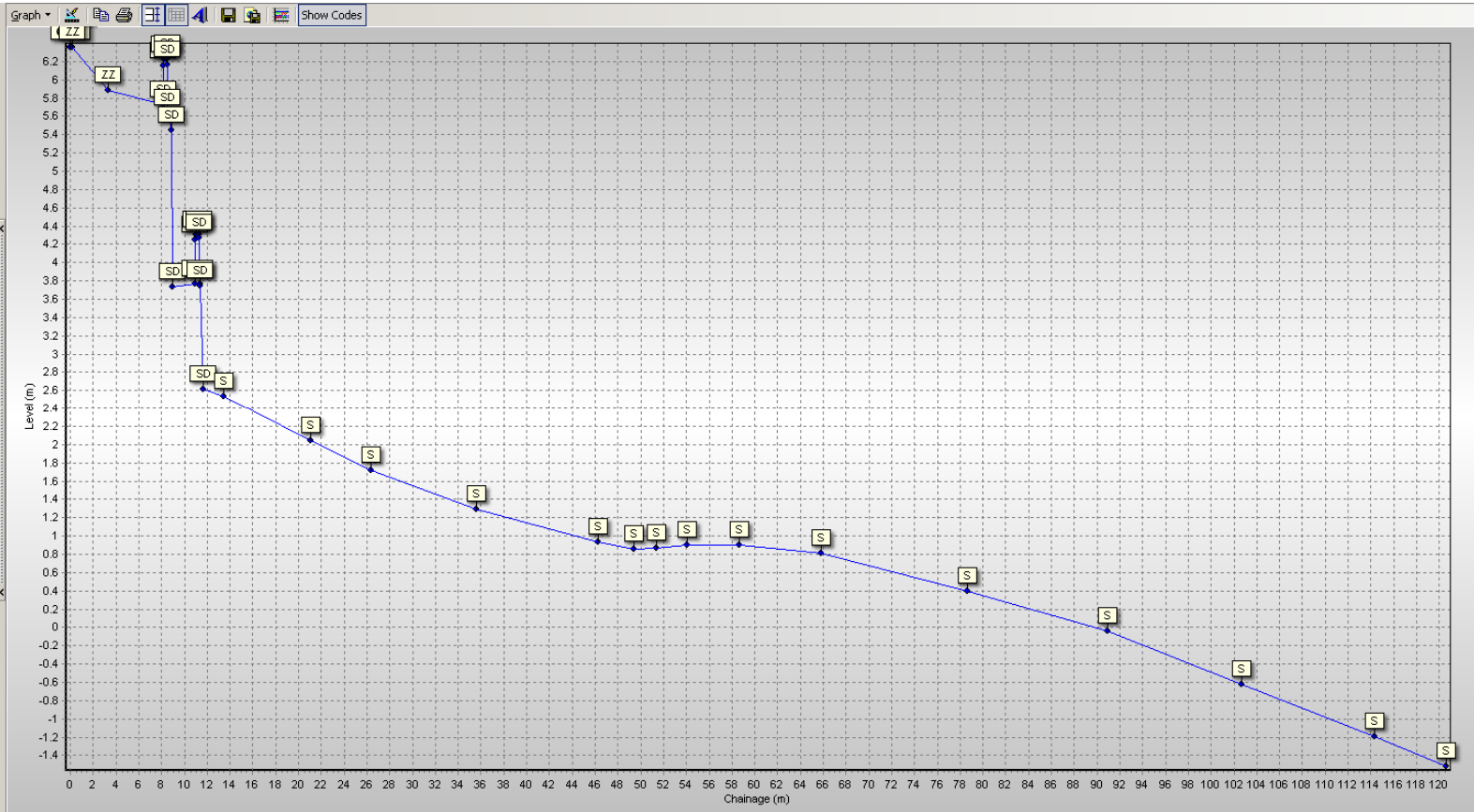


1aNTDC02 - 20/09/2010



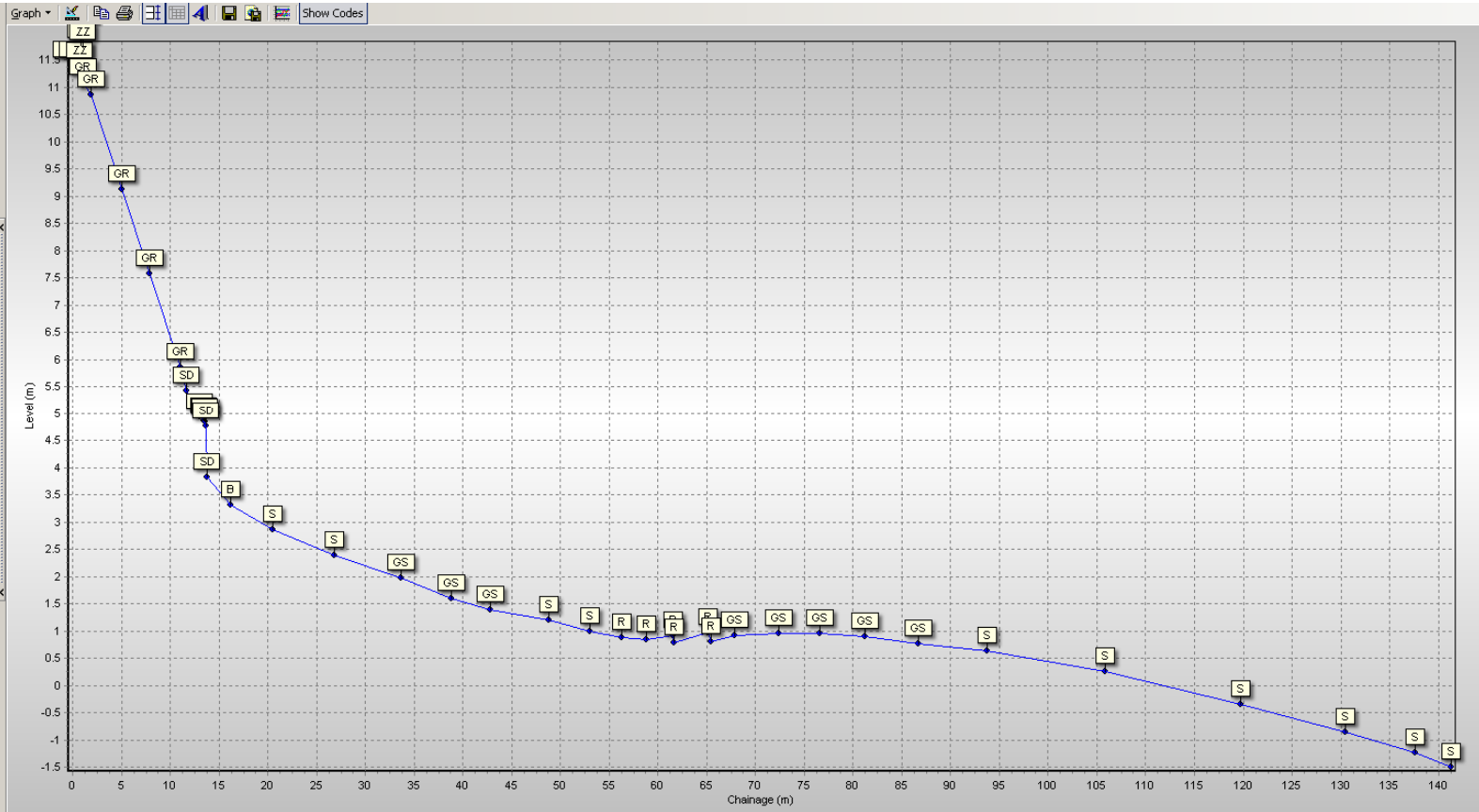
1aNTDC03 - 20/09/2010

Chainage	Level	Code
0.000	6.355	
0.219	6.355	ZZ
3.291	5.882	ZZ
8.174	5.724	SD
8.204	6.155	SD
8.272	6.217	SD
8.475	6.230	SD
8.524	6.168	SD
8.545	5.637	SD
8.856	5.443	SD
9.005	3.731	SD
10.924	3.771	SD
10.978	4.245	SD
10.997	4.310	SD
11.281	4.309	SD
11.306	4.267	SD
11.348	3.768	SD
11.430	3.740	SD
11.688	2.613	SD
13.442	2.532	S
21.077	2.038	S
26.321	1.713	S
35.609	1.292	S
46.248	0.932	S
49.365	0.861	S
51.355	0.864	S
54.025	0.898	S
58.677	0.900	S
65.780	0.813	S
78.677	0.392	S
90.944	-0.039	S
102.662	-0.624	S
114.353	-1.196	S
120.603	-1.519	S



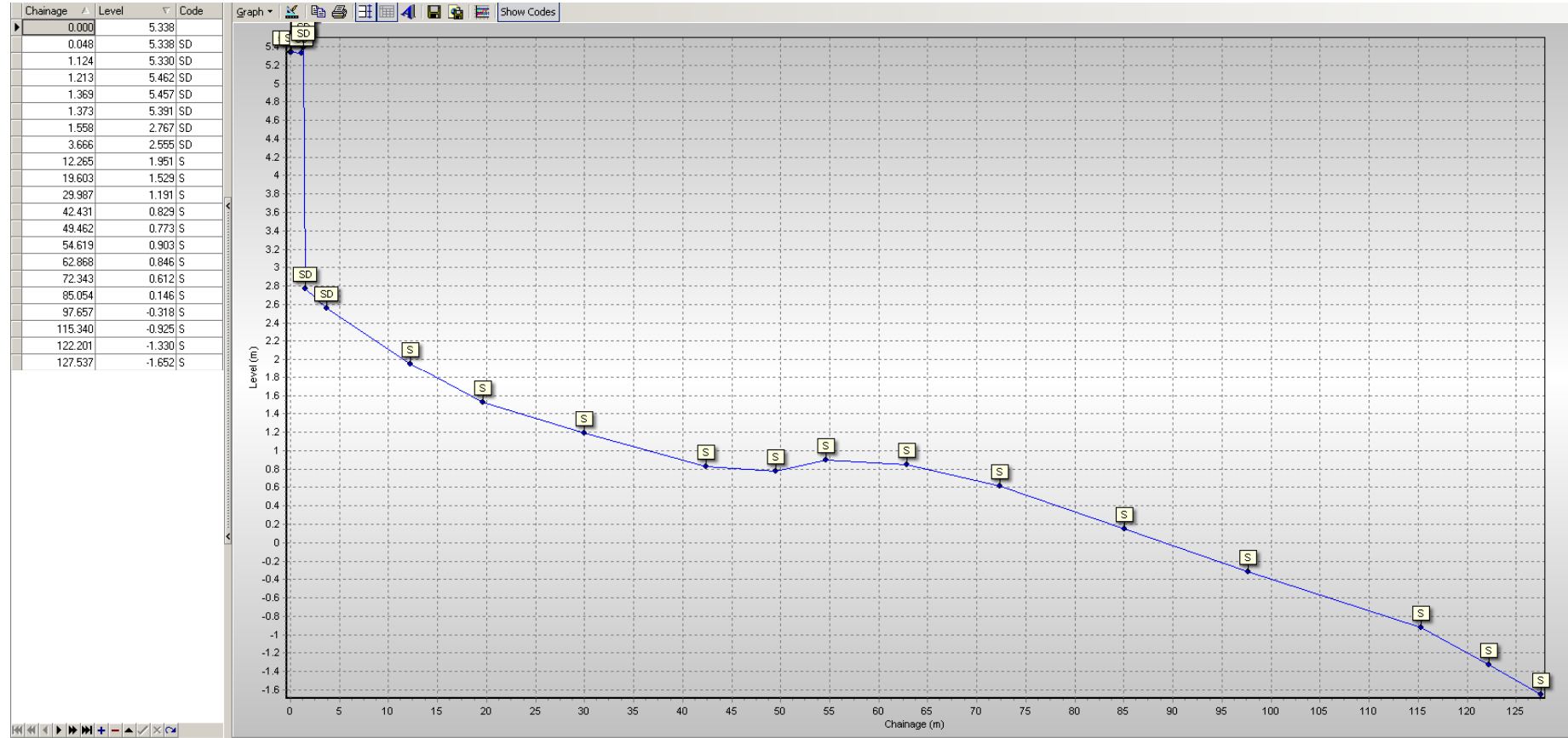
1aNTDC04 - 20/09/2010

Chainage	Level	Code
0.000	11.410	
0.019	11.410	ZZ
0.752	11.386	ZZ
0.869	11.769	ZZ
1.032	11.735	ZZ
1.043	11.086	GR
1.917	10.857	GR
5.020	9.134	GR
7.905	7.580	GR
11.096	5.869	GR
11.711	5.436	SD
13.060	4.945	SD
13.519	4.869	SD
13.600	4.846	SD
13.627	4.775	SD
13.831	3.824	SD
16.218	3.308	B
20.552	2.872	S
26.874	2.399	S
33.620	1.970	GS
38.855	1.604	GS
42.875	1.400	GS
48.826	1.196	S
53.030	1.003	S
56.317	0.882	R
58.828	0.842	R
61.548	0.917	R
61.617	0.783	R
65.139	0.973	R
65.442	0.813	R
67.815	0.913	GS
72.400	0.953	GS
76.620	0.962	GS
81.245	0.893	GS
86.689	0.774	GS
93.747	0.641	S
105.892	0.252	S
119.756	-0.351	S
130.440	-0.858	S
137.637	-1.231	S
141.305	-1.496	S

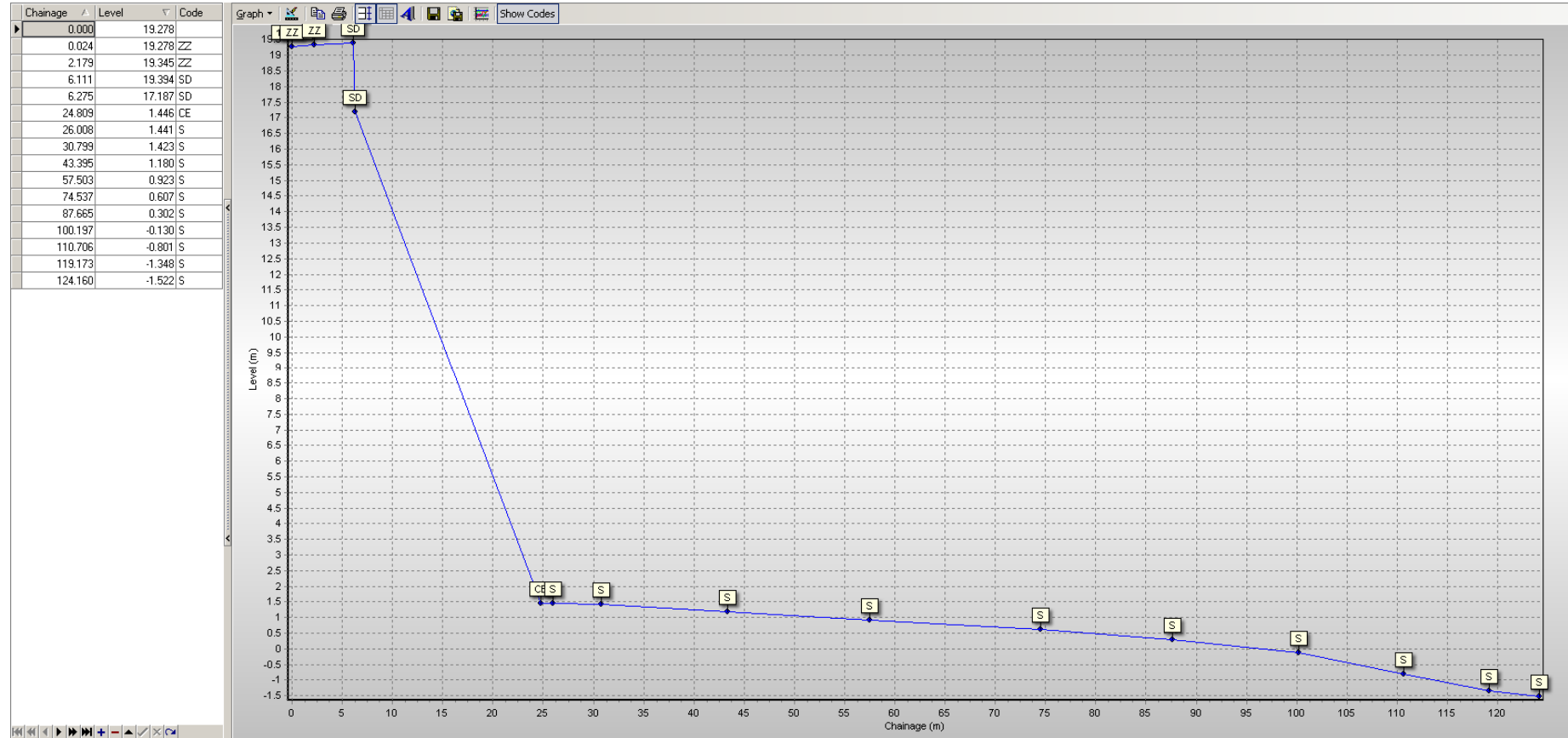


Navigation icons: back, forward, search, zoom, etc.

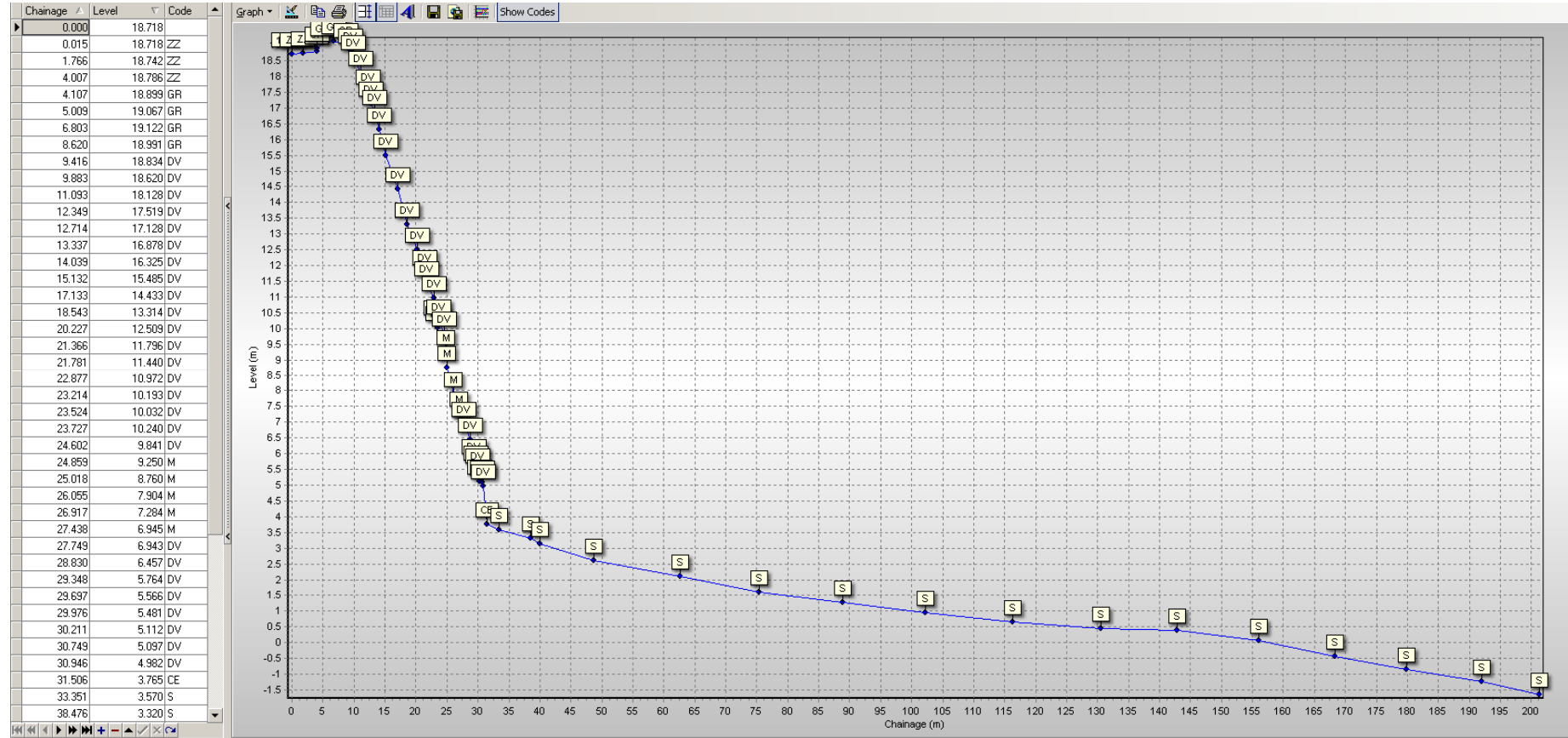
1aNTDC04A - 20/09/2010



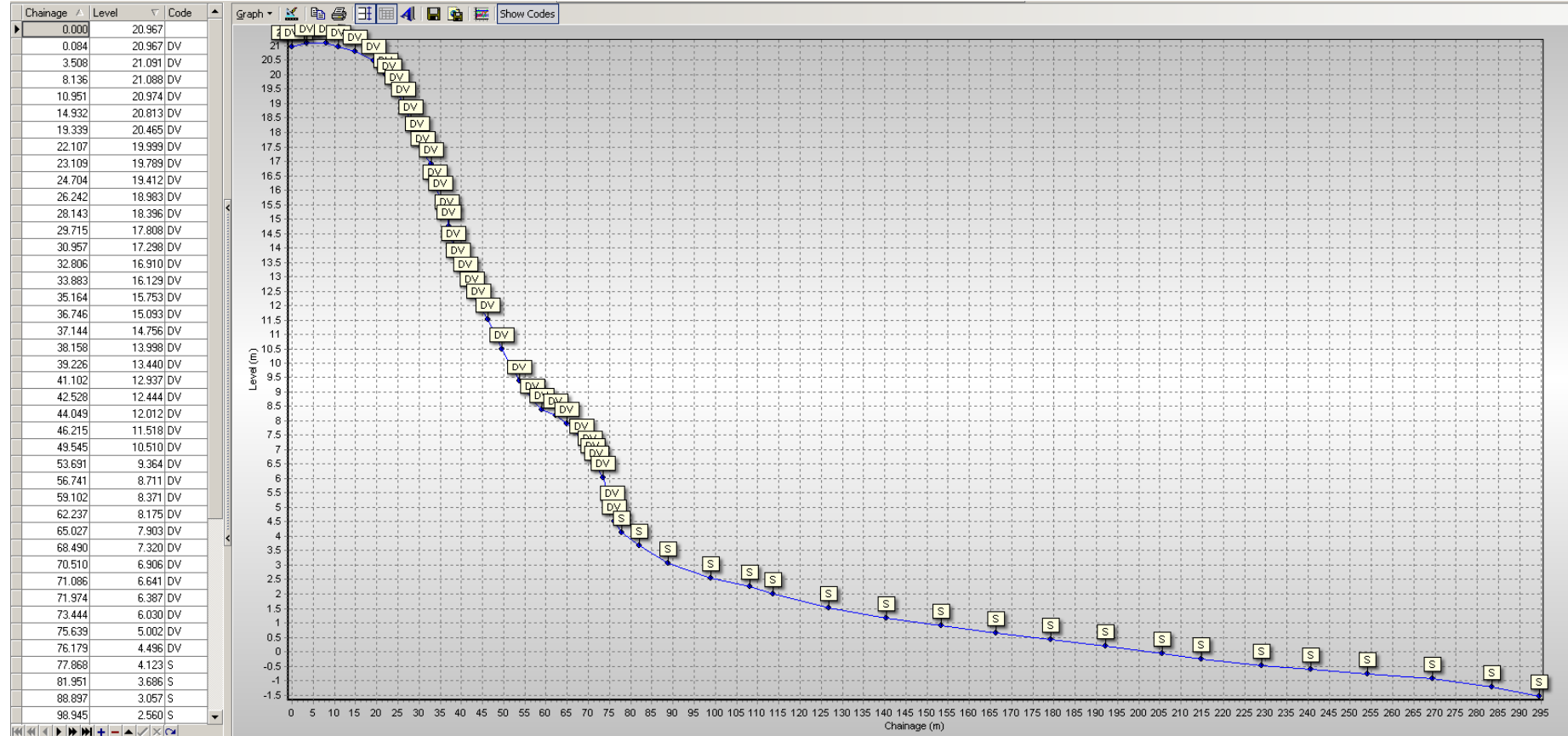
1aNTDC05 - 20/09/2010



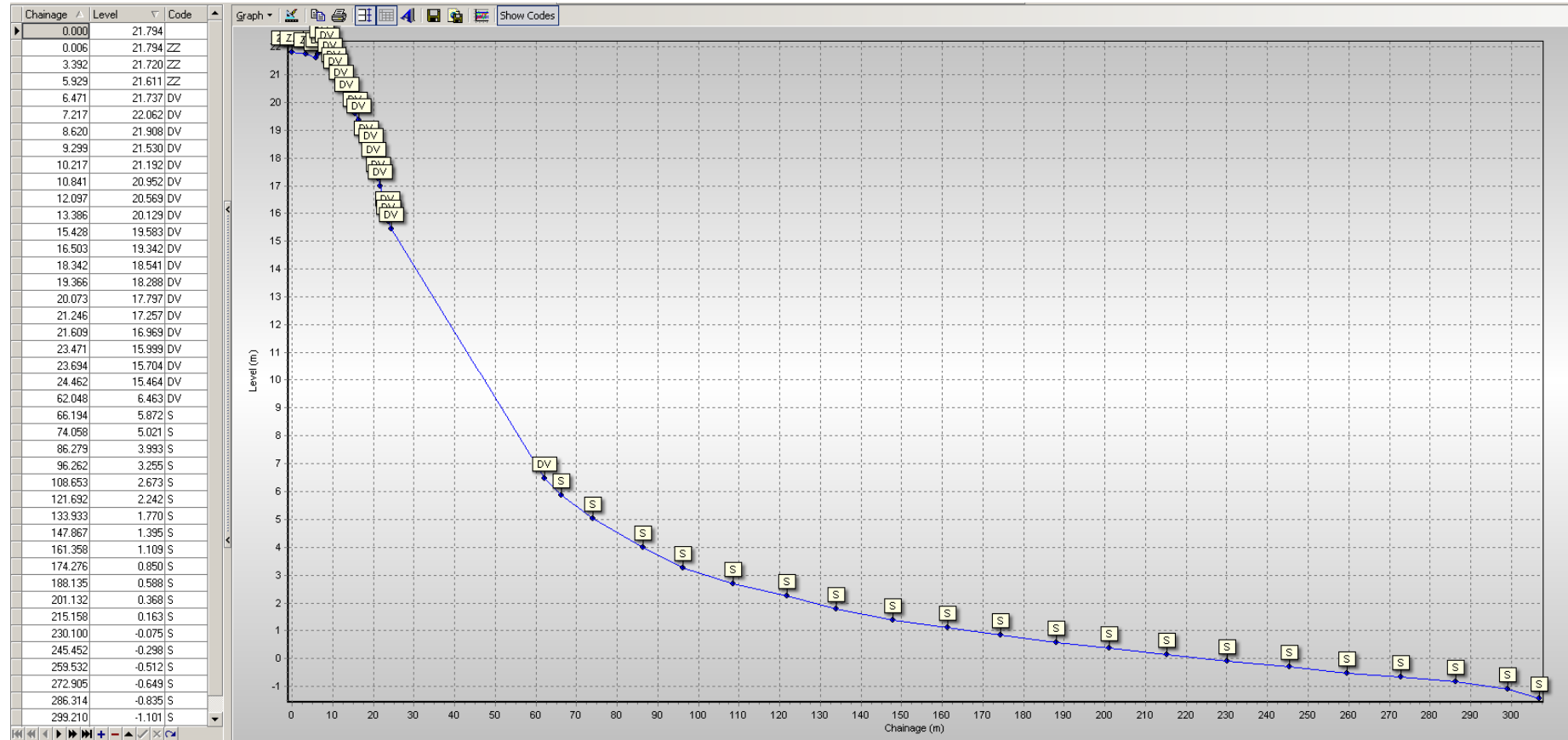
1aNTDC06 - 20/09/2010



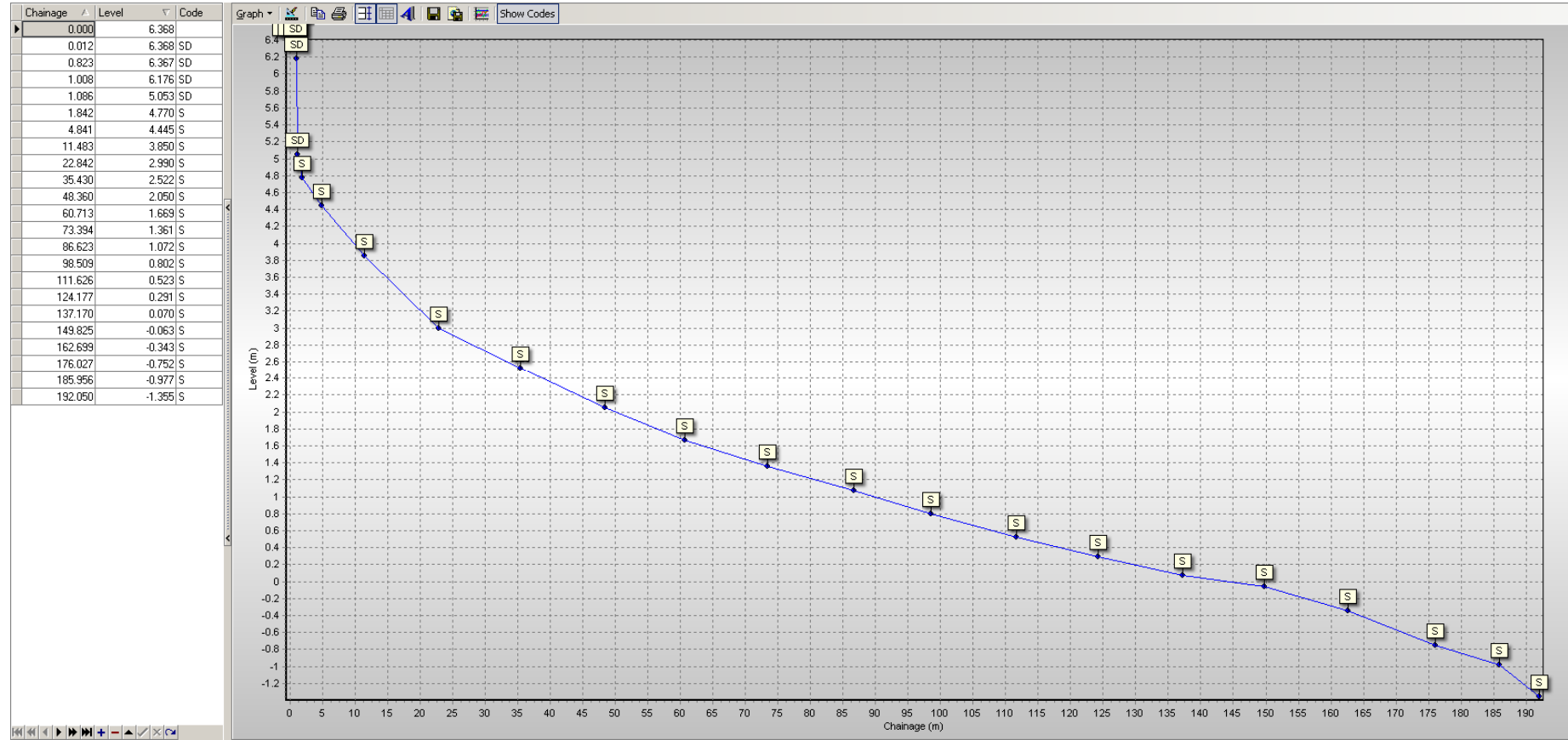
1aNTDC06A - 20/09/2010



1aNTDC07 - 20/09/2010



1aNTDC08 - 20/09/2010



Beach Profiles: 1aNTDC01



- Profiles Envelope
- 01/04/2002
- 01/10/2009
- 15/02/2010
- 29/03/2010
- 20/09/2010

Beach Profiles: 1aNTDC02



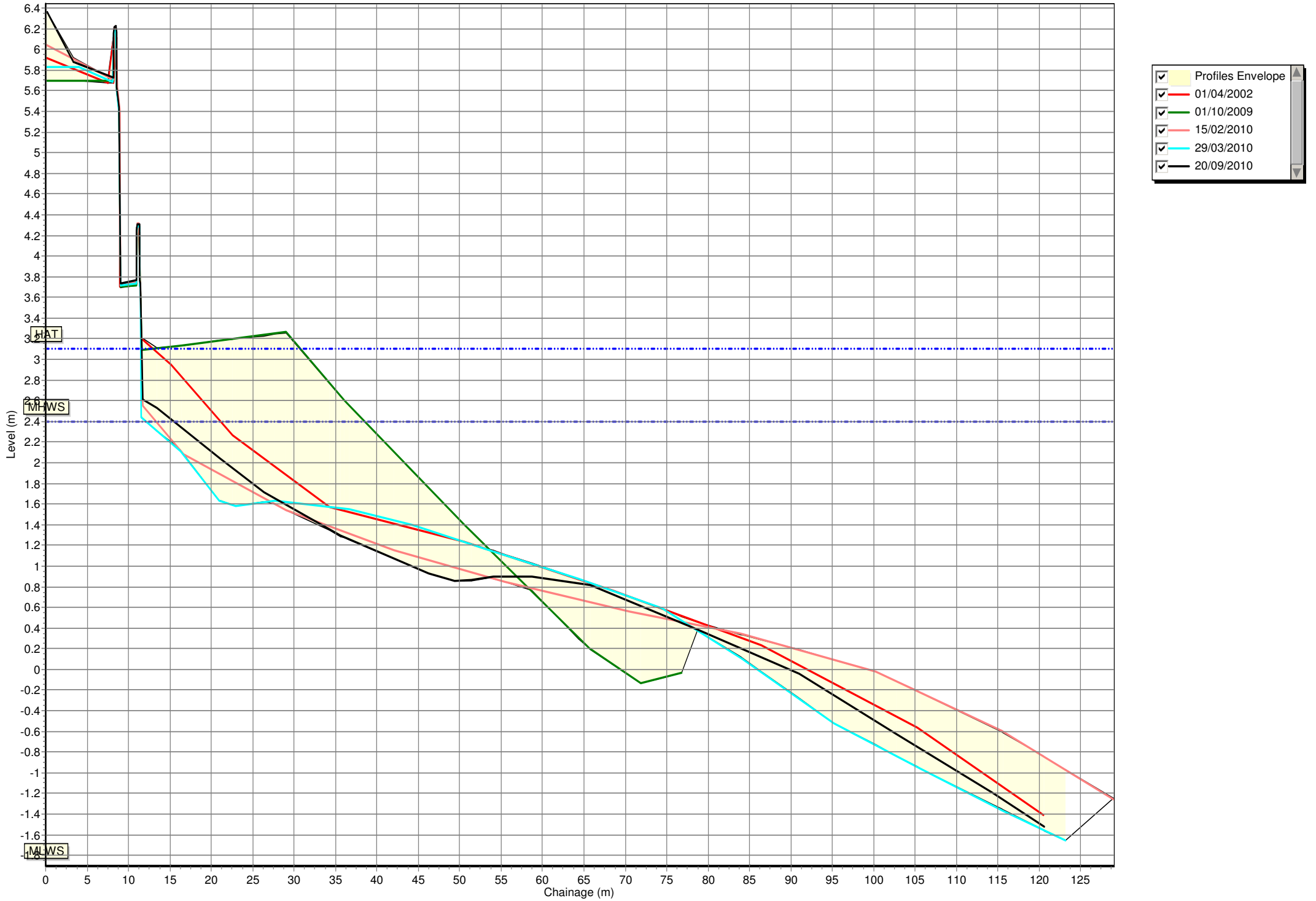
- Profiles Envelope
- 01/04/2002
- 01/10/2009
- 15/02/2010
- 29/03/2010
- 20/09/2010

HAT

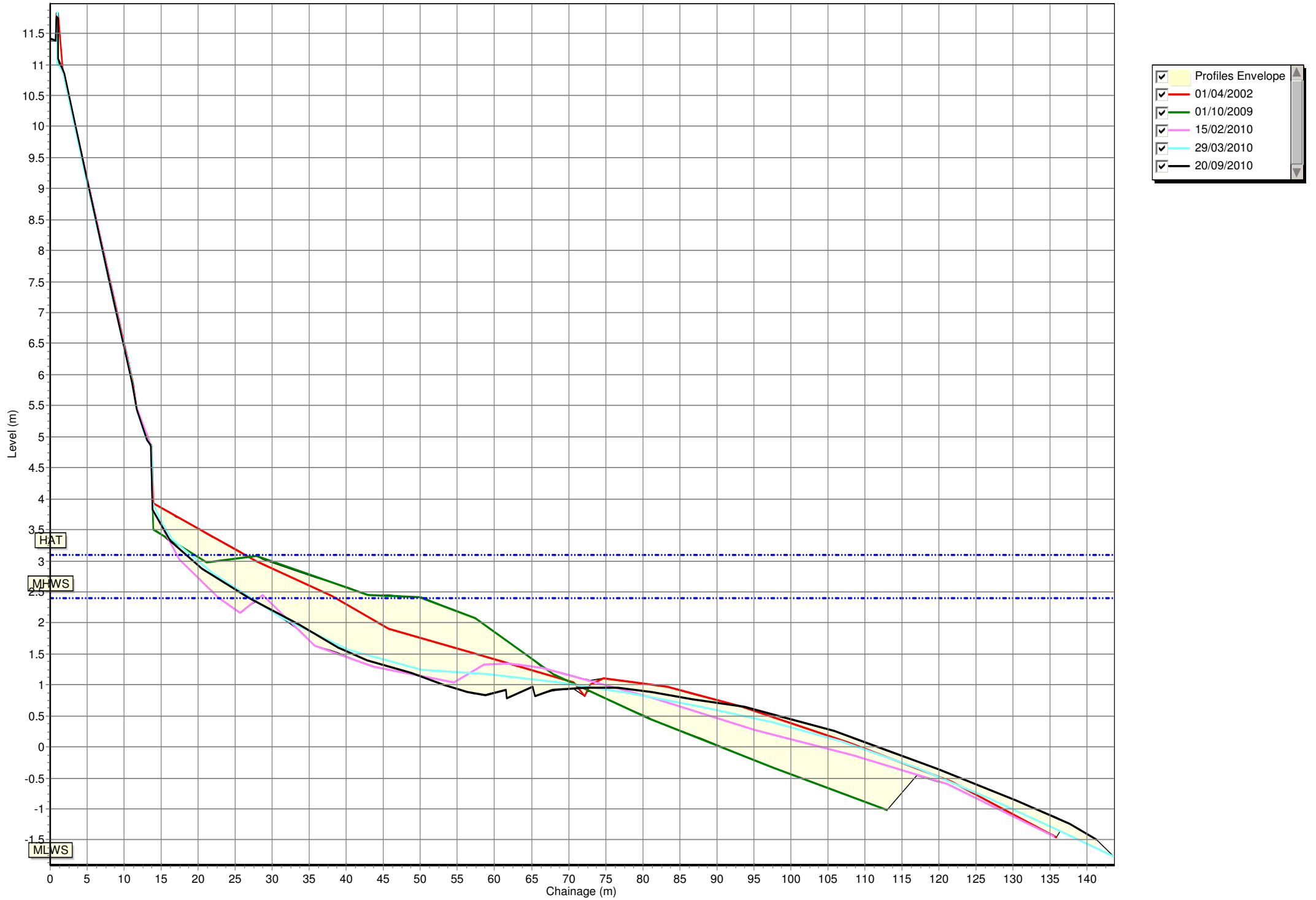
MHWS

MLWS

Beach Profiles: 1aNTDC03



Beach Profiles: 1aNTDC04

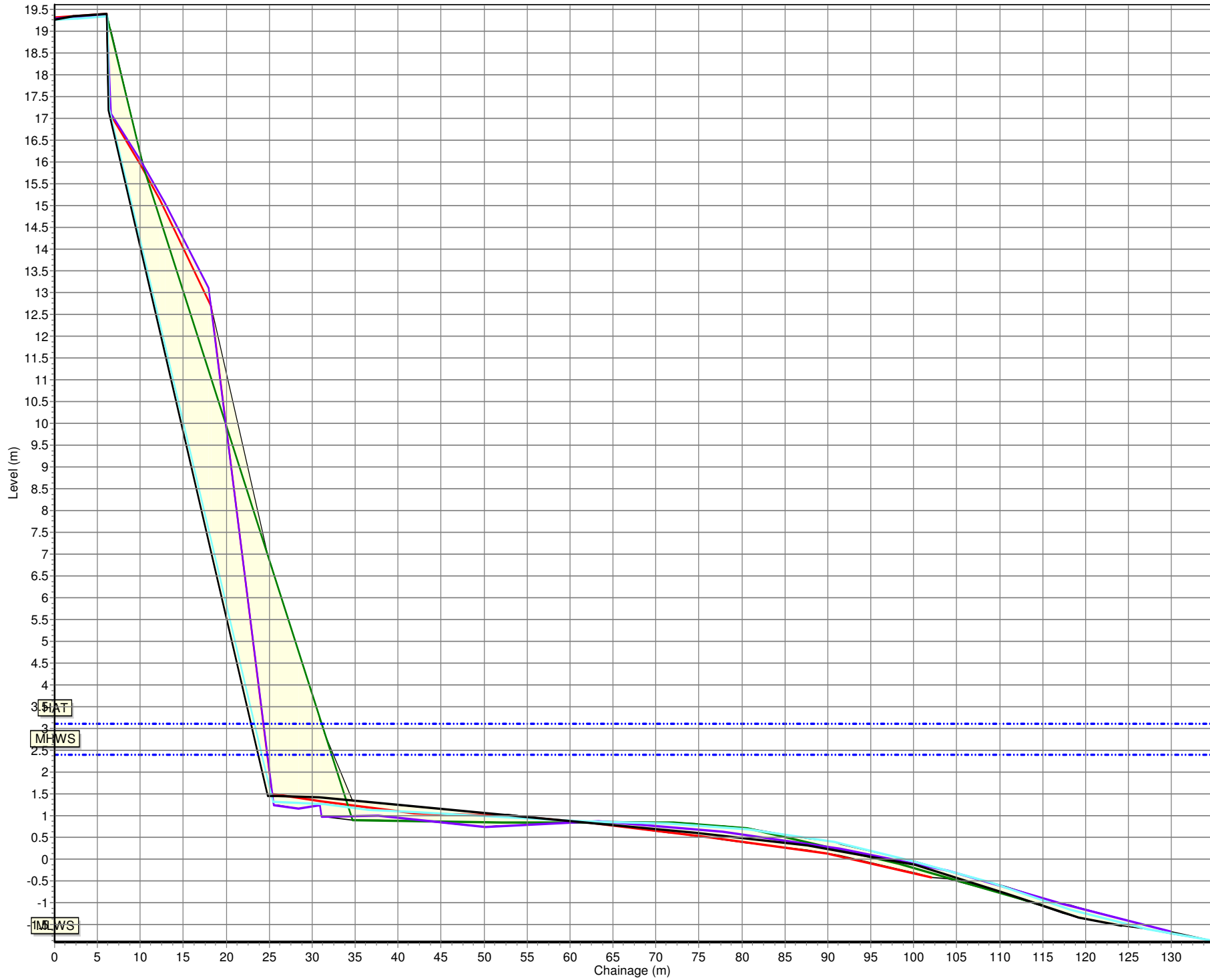


Beach Profiles: 1aNTDC04A



- Profiles Envelope
- 29/03/2010
- 20/09/2010

Beach Profiles: 1aNTDC05



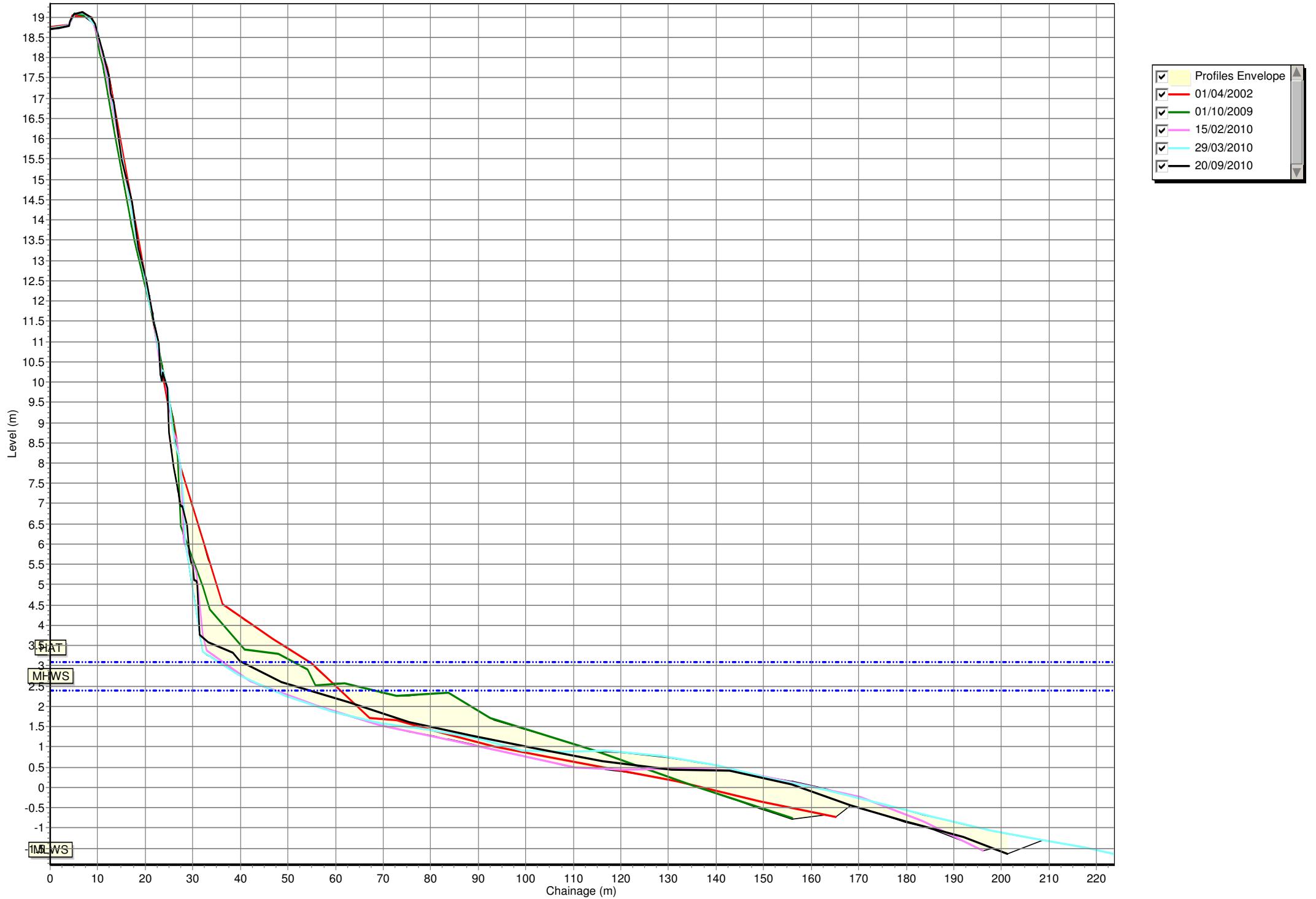
- Profiles Envelope
- 01/04/2002
- 01/10/2009
- 15/02/2010
- 29/03/2010
- 20/09/2010

3.5 MHW

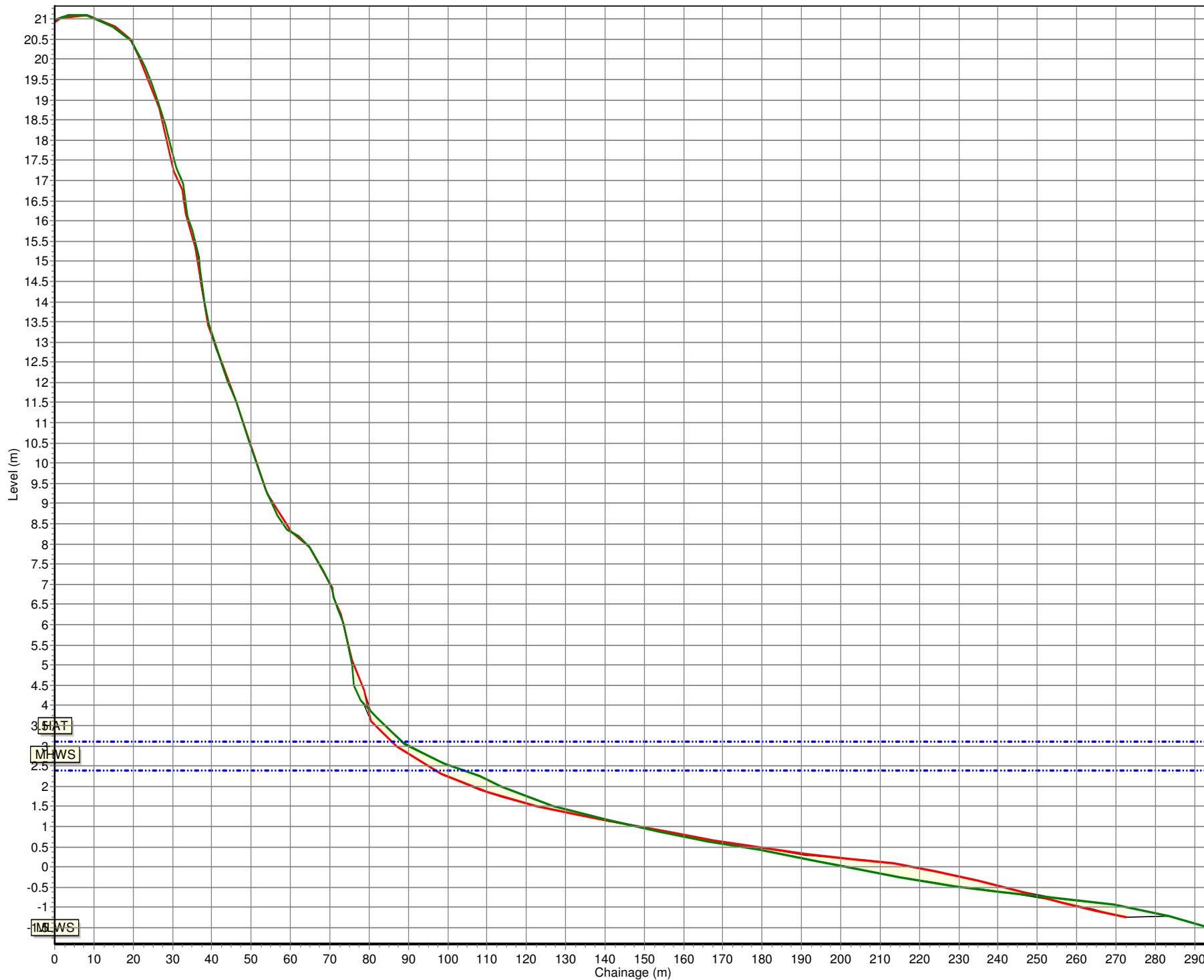
2.5 MLW

1.5 MLWS

Beach Profiles: 1aNTDC06



Beach Profiles: 1aNTDC06A



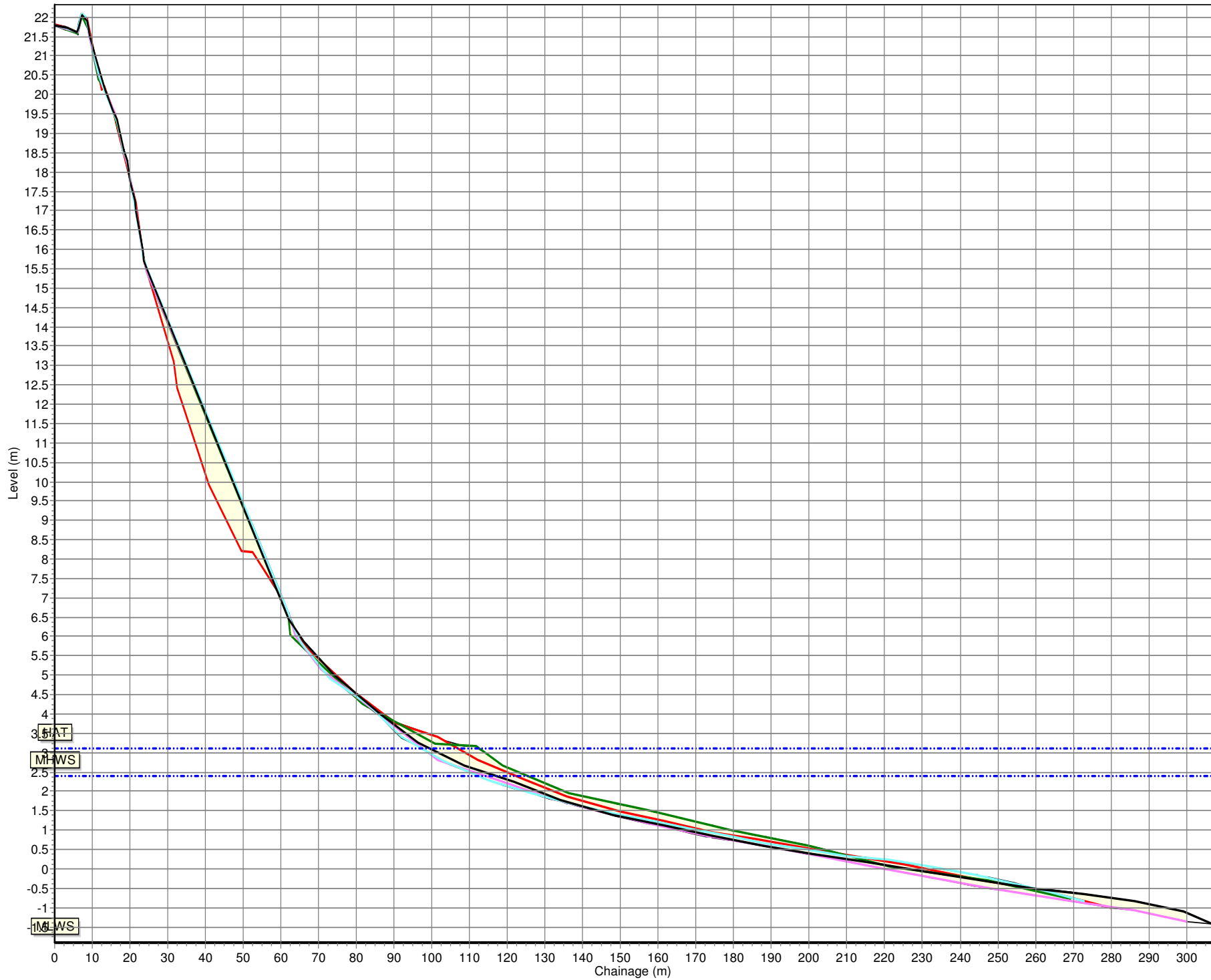
- Profiles Envelope
- 29/03/2010
- 20/09/2010

SLAT

MHWS

MLWS

Beach Profiles: 1aNTDC07



- Profiles Envelope
- 01/04/2002
- 01/10/2009
- 15/02/2010
- 29/03/2010
- 20/09/2010

Beach Profiles: 1aNTDC08



- Profiles Envelope
- 01/04/2002
- 01/10/2009
- 15/02/2010
- 29/03/2010
- 20/09/2010

MHW

MHW

MLW

Appendix B
Topographic Survey

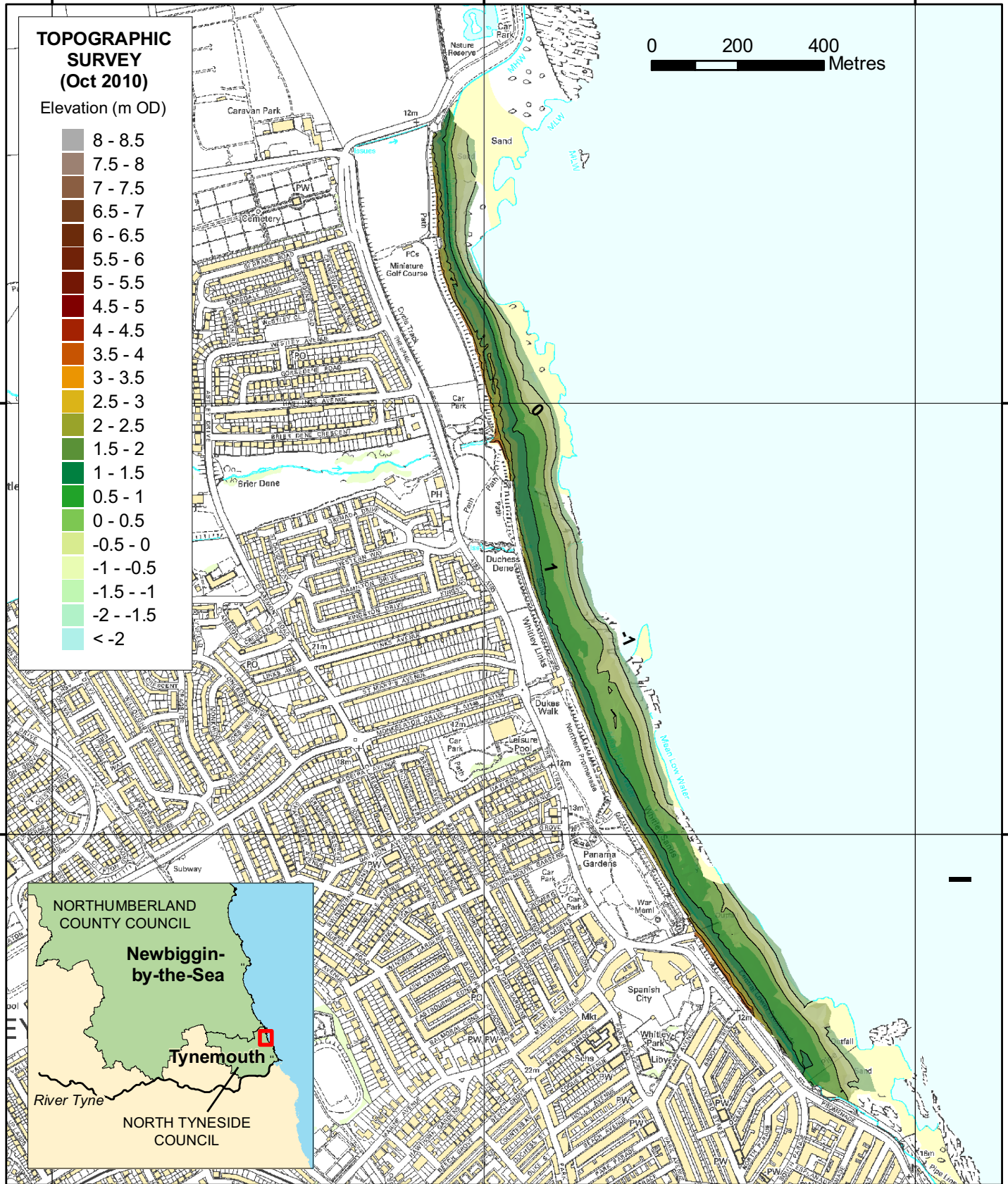
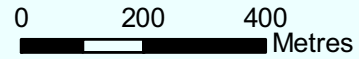
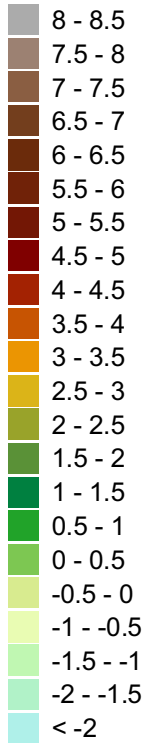
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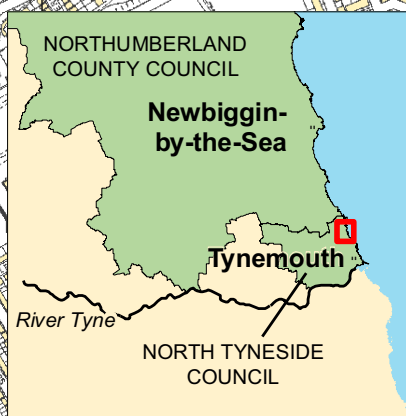
TOPOGRAPHIC SURVEY (Oct 2010)

Elevation (m OD)



574000

573000



— Topographic Contours at 1 metre interval

Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 1
 North Tyneside Council Frontage**

Analytical Report 3
 'Full Measures' Survey 2010

Drawing Scale 1:12,000 at A4

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Drawn by: TC Date: 22/10/2010
 Checked by: MD Date: 29/10/2010
 Approved by: NC Date: 29/10/2010

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