



**Cell 1 Regional Coastal Monitoring Programme
Analytical Report 2: 'Full Measures' Survey 2009**



**North Tyneside Council
Final Report**

March 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.

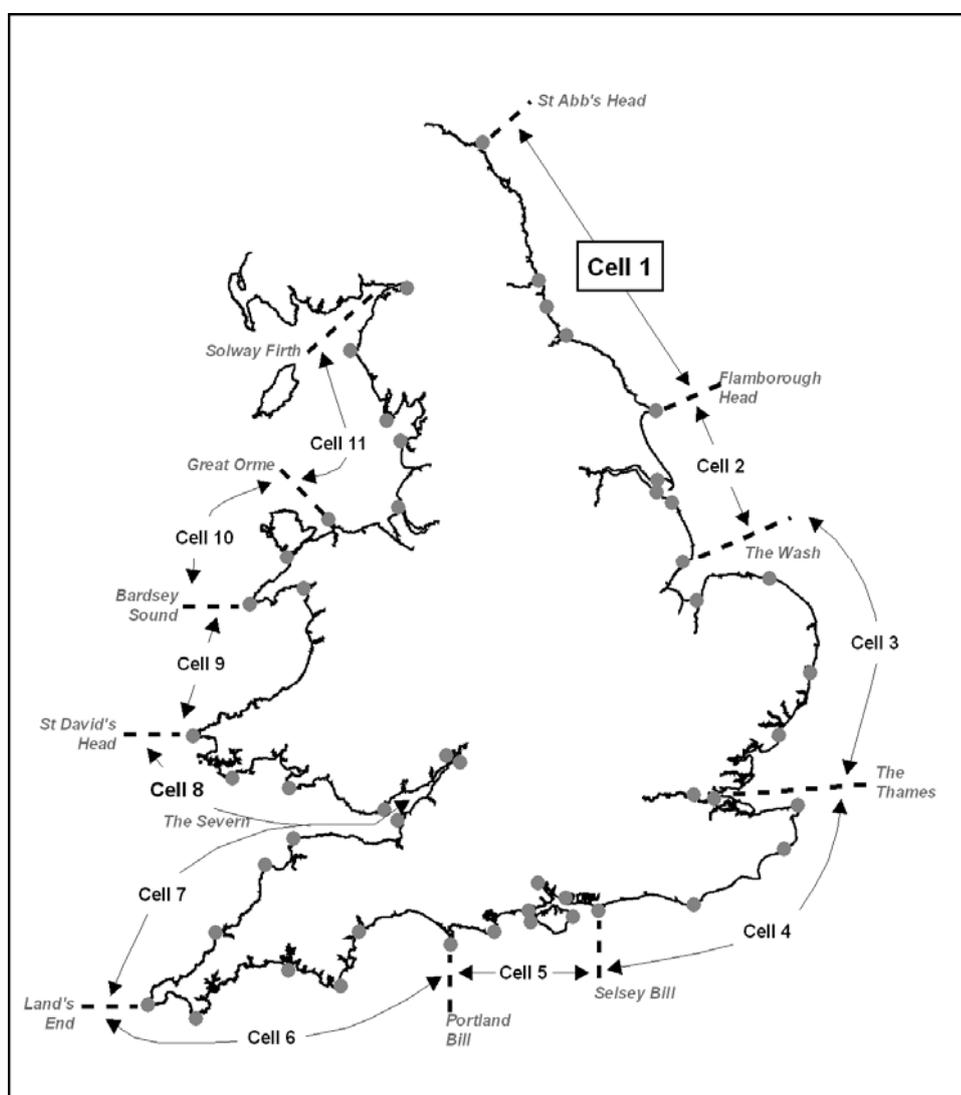


Figure 1 Sediment Cells in England and Wales

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 ^(*)			-

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

^(*) The present report is **Analytical Report 2** and provides an analysis of the 2009 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, Uppang 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)

The location of these surveys is shown in Figure 2. They have also previously been provided on a digital file which can be opened in Google Earth showing the locations of the surveys.

The Full Measures survey was undertaken along this frontage in October 2009, when weather conditions were generally fine and 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 1 - Map 1 North Tyneside Council Frontage

Analytical Report 2
'Full Measures' Survey 2009

Drawing Scale 1:35,000 at A4

Drawn by: TC Date: 07/12/2009
 Checked by: NC Date: 14/12/2009
 Approved by: NC Date: 14/12/2009

ROYAL HASKONING
 Royal Haskoning
 Marlborough House
 Marlborough Crescent
 Newcastle upon Tyne
 NE1 4EE

Tel: +44 (0)191 211 1300
 Fax: +44 (0)191 211 1313
 www.royalhaskoning.com

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2. Analysis of Survey Data

2.1 Whitley Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
10-2009	<p>Beach Profiles:</p> <p>Whitley Sands is covered by four beach profile lines (Appendix A). These have generally been surveyed annually each autumn since 2002.</p> <p>NTDC01 is located in the north of Whitley Sands, along the undefended cliffs just to the south of Trinity Road Car Park. Cliff top position remains unchanged since the previous (October 2008) survey, but there seems to have been a slumping of a protruding area midway down the cliff face and a cut-back of position at the cliff toe. Foreshore levels along the mid and upper profile are relatively high.</p> <p>NTDC02 to NTDC04 extend across the cliffs/slopes, promenade and seawall before progressing across the foreshore towards low water. All three of these profiles show significant changes since the previous surveys. Material has been removed from the lower beach (up to a level of around 1mODN) along all three transects and pushed up the profile to become deposited on the upper beach in the form of a large berm.</p>	<p>The general trend since 2002 along NTDC01 has been for the cliff form at this profile location to remain relatively stable, but with fluctuations observed in beach levels at the cliff toe and upper to mid beach, and with relatively stable levels remaining along the lower foreshore. Changes between October 2008 and October 2009 indicate that a small slump may have occurred in the cliff face, with material being deposited on the foreshore. There also appears to have been a net import of sediment to the foreshore because mid and upper beach levels were relatively healthy. There can be up to 2m variation in beach level 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 NTDC04, 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>

2.2 Cullercoats Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
10-2009	<p>Beach Profiles:</p> <p>Cullercoats Bay is covered by one beach profile line (Appendix A). This has been surveyed annually each autumn since 2002.</p> <p>The October 2009 survey along NTDC05 showed a notable change compared with earlier surveys. Whereas previous surveys depict an irregular (but stable) profile on the cliff face, the current survey shows a more constant gradient and seaward build up at the toe. Foreshore levels remain within the bounds of previous natural behaviour.</p>	<p>Upon first inspection there appears to have been a change in the cliff face, with a previously protruding section falling to the cliff base where it has accumulated. Upon clarification from the surveyors this has been confirmed as a survey error, due to poor GPS satellite coverage on the day and a 'shadow' effect from the cliff face resulting in an inability to capture information from the cliff face and direct toe. The surveyors have confirmed that the cliff remains stable.</p>

2.3 Tynemouth Long Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
10-2009	<p>Beach Profiles:</p> <p>Tynemouth Long Sands is covered by two beach profile lines (Appendix A). These have generally been surveyed annually each autumn since 2002.</p> <p>NTDC06 shows stability in the position and form of the dunes, and an accumulation of sand along the foreshore to relatively healthy levels.</p> <p>NTDC07 shows no change in dune or foreshore levels.</p>	<p>Measured profiles along Tynemouth Long Sands remain relatively stable and within previous bounds of natural change.</p>

2.4 King Edward's Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
10-2009	<p>Beach Profiles:</p> <p>King Edward's Bay is covered by one beach profile line (Appendix A). This has generally been surveyed annually each autumn since 2002.</p> <p>Profile NTDC08 shows a very distinct berm feature on the foreshore at around the level of MHWS and another, smaller, berm around level of HAT. The position of this berm has changed since previous surveys. Beach levels directly at the toe of the backing sea wall were lower than those recorded during the previous survey (October 2008) but within bounds of previous behaviour.</p>	<p>The general trend since 2004 along NTDC08 has been for minor fluctuations in beach level at the toe of the sea wall, but with more notable changes in the position and height of the upper beach berm. This suggests that King Edward's Bay is acting like a pocket beach within which the stored beach sediment is being redistributed by prevailing wave conditions.</p>

3. Problems Encountered and Uncertainty in Analysis

The only issue during analysis of the present survey data has been in relation to profile NTDC05 in Cullercoats Bay where it was initially difficult to identify whether the changes recorded in the cliff face were due to the surveyor omitting rock outcrops on the seaward face of the undefended cliff or instead were due to a true local rock fall. Further investigation with the surveyor has revealed that the apparent change is due to survey error caused by poor GPS satellite coverage on that day and a resulting 'shadow effect' at the direct toe of the cliff.

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

With effect from spring 2010, the North Tyneside profiles will be re-surveyed during future Partial Measures survey campaigns to give a 6-monthly understanding of changes. This will particularly help better understand storm-related changes that have been observed to date, especially along Whitley Sands.

Depending on results from the 6-monthly surveys, future consideration might also be given to covering Whitley Sands with an annual topographic survey to provide greater resolution along the length of that frontage.

No other changes are recommended at the present time.

5. Conclusions and Areas of Concern

- There appears to have been a small and localised slump in the cliff face along the undefended cliffs to the south of Trinity Road Car Park (as measured along NTDC01). Material released from the cliff face has been deposited on the foreshore. This has not resulted in a step-back in the position of the cliff top.
- There also appears to have been a net influx of sediment to the foreshore along NTDC01 because recorded beach levels were quite high, although this is a section of frontage where there can be up to 2m variation in beach level a short distance from the toe of the cliff between successive surveys.
- Along the defended sections of Whitley Sands, as measured by NTDC02 to NTDC04, there is a continuation of storm-related changes in the foreshore. At the time of the current survey, foreshore levels were high along the mid and upper beach due to berm formation, but quite low along the lower beach.
- There has been a survey error along profile NTDC05 in Cullercoats Bay caused by poor GPS satellite coverage and a resulting 'shadow effect' at the direct toe of the cliff.
- Measured profiles along Tynemouth Long Sands show relatively stable beaches and dunes.
- King Edward's bay continues to exhibit changes in the position and crest height of the foreshore berm, as dictated by prevailing wave conditions prior to the survey.

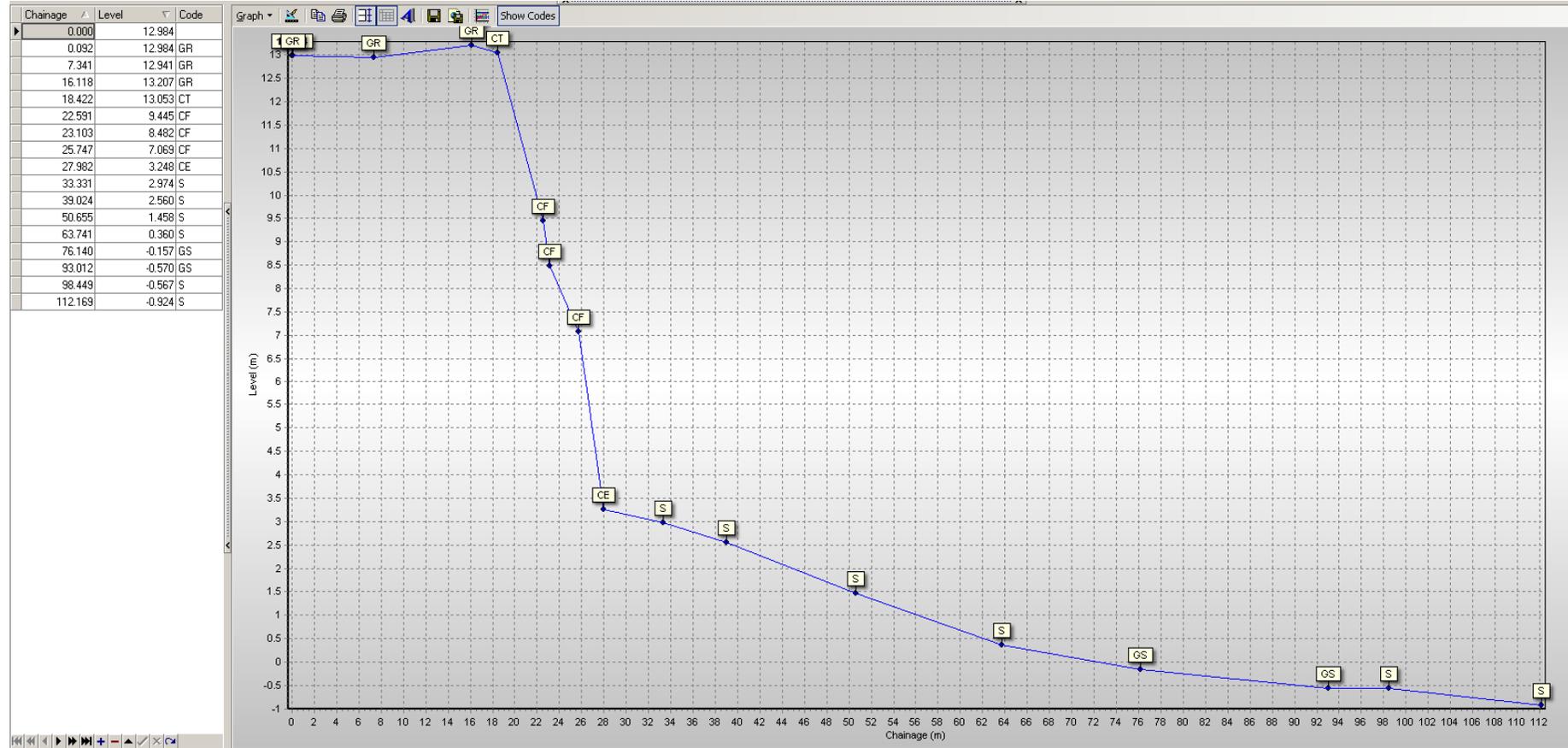
Appendices

Appendix A
Beach Profiles

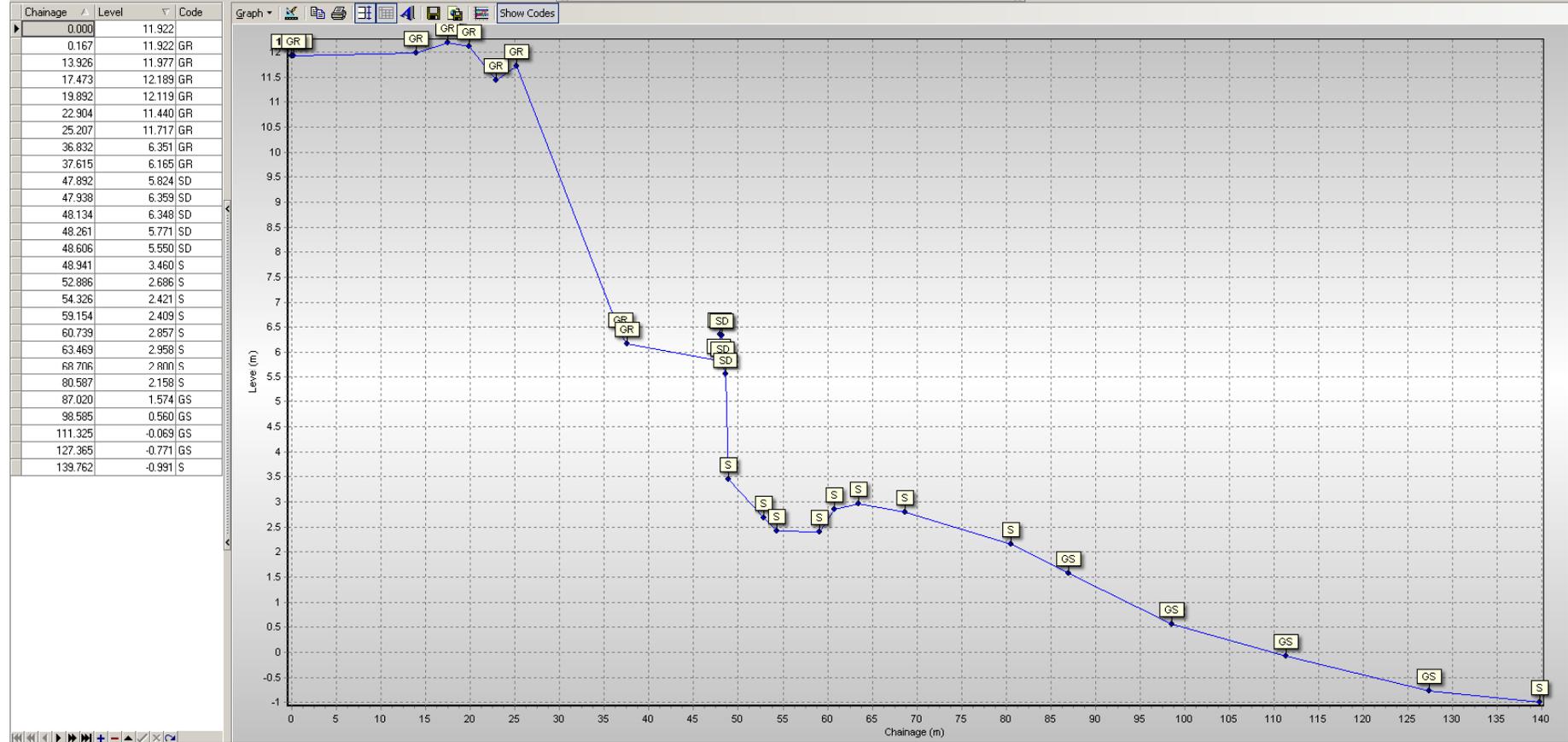
The following sediment feature codes are used on some profile plots:

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

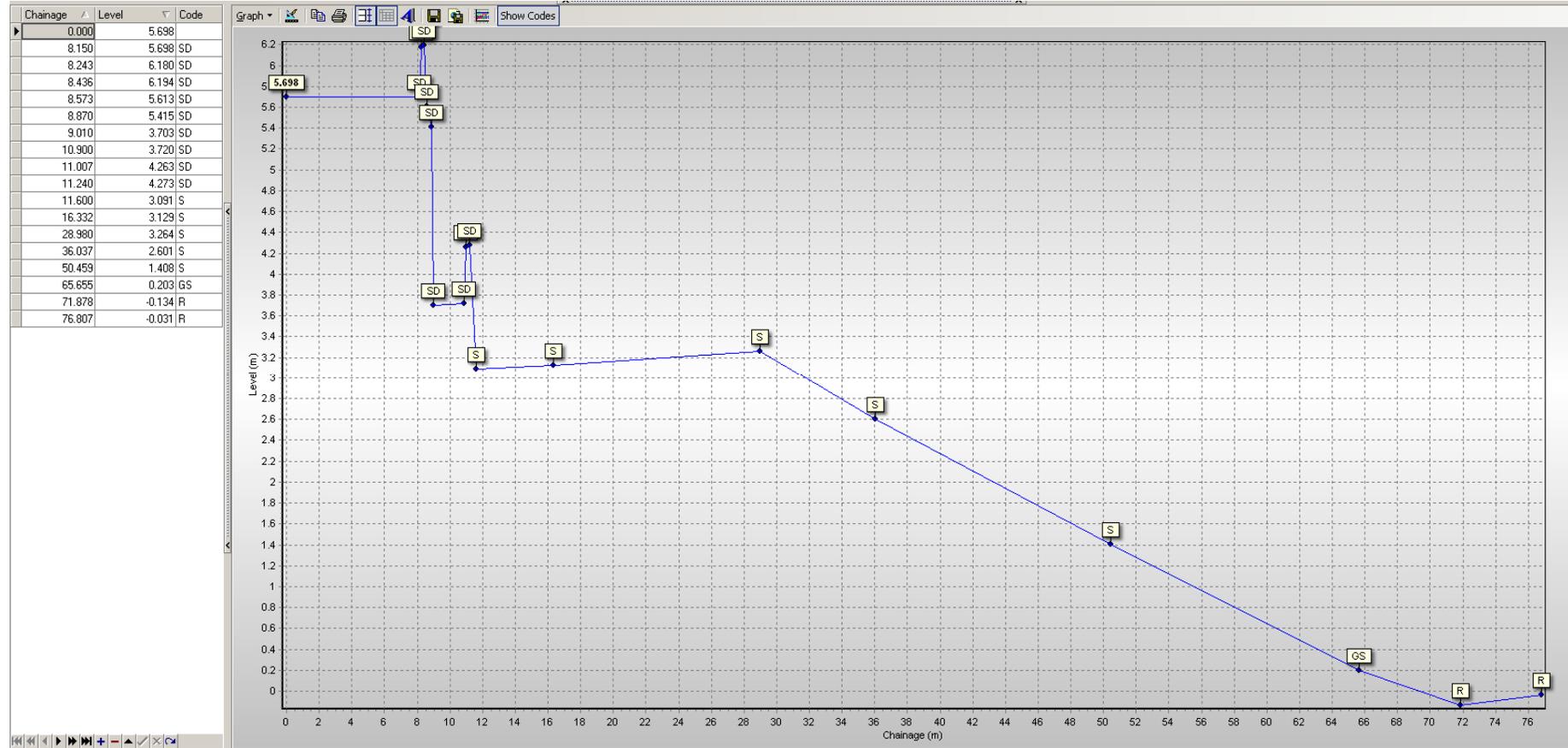
1aNTDC01 - 01/10/2009



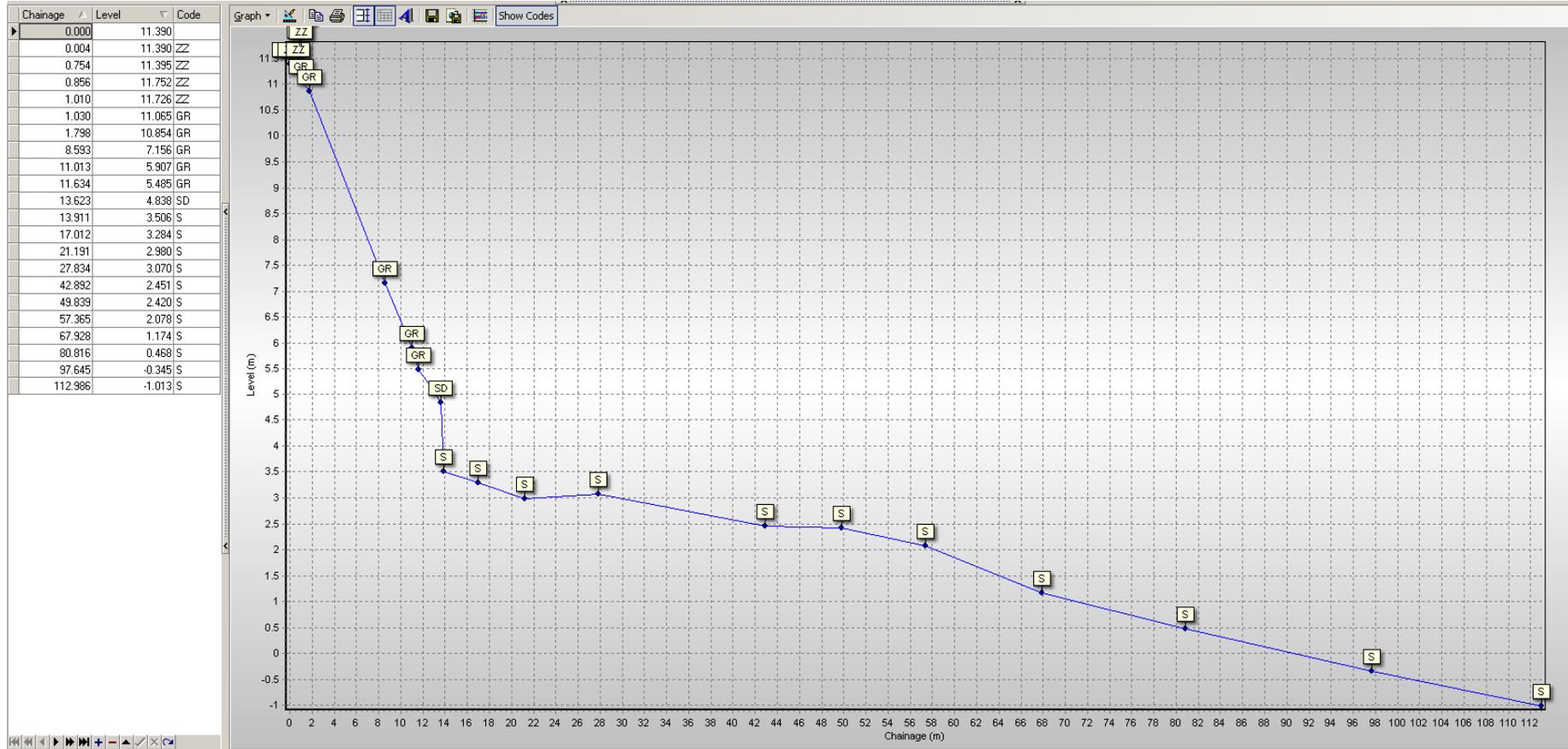
1aNTDC02 - 01/10/2009



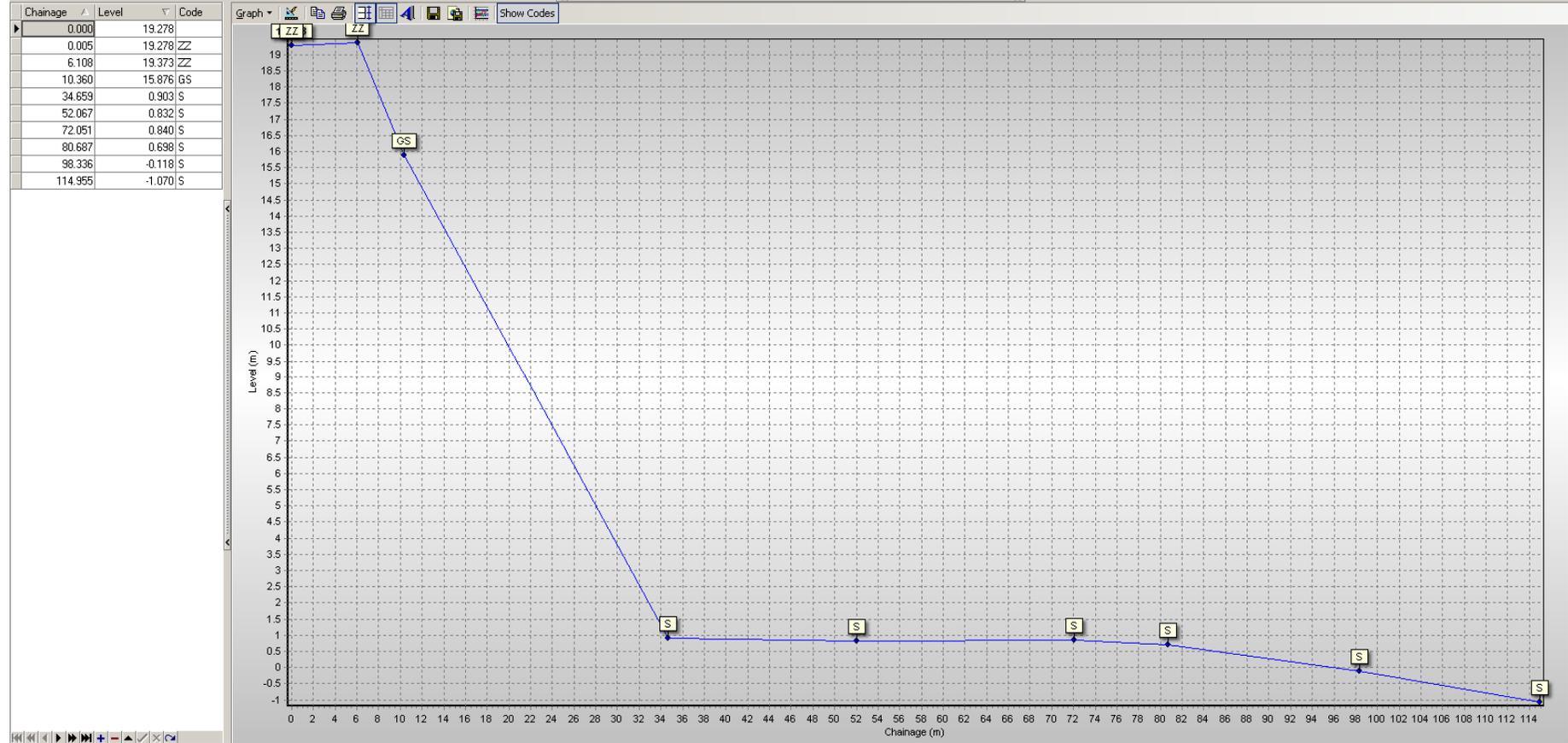
1aNTDC03 - 01/10/2009



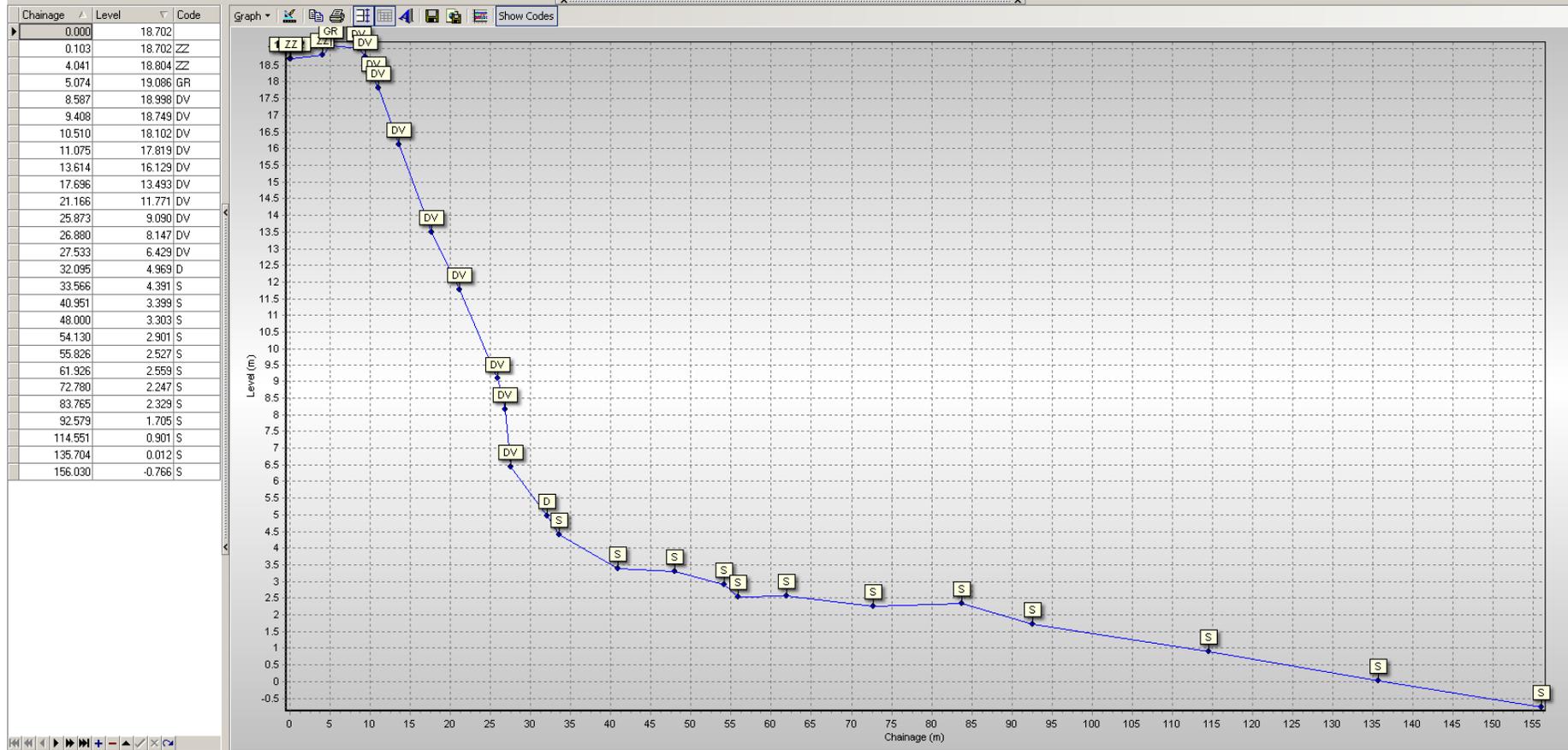
1aNTDC04 - 01/10/2009



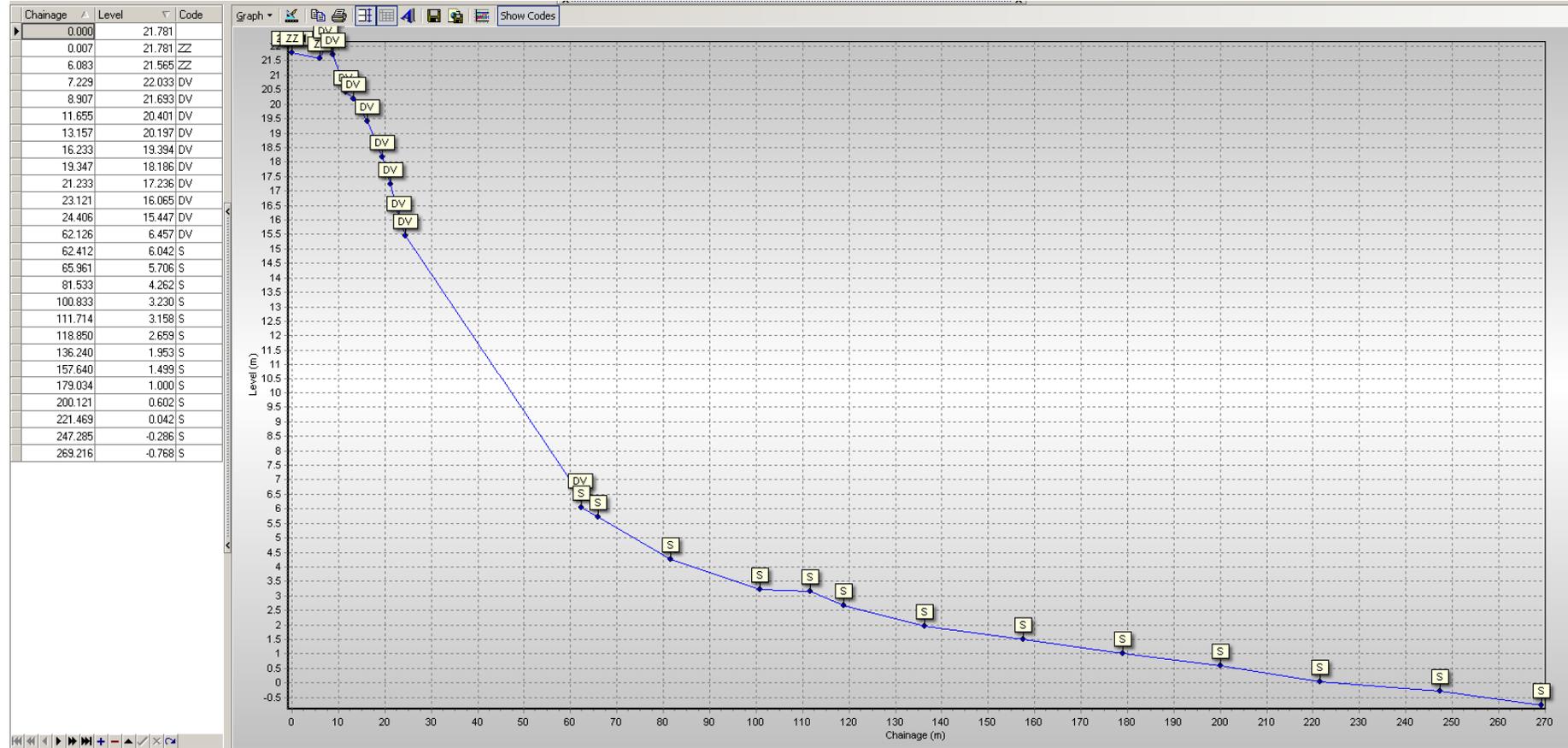
1aNTDC05 - 01/10/2009



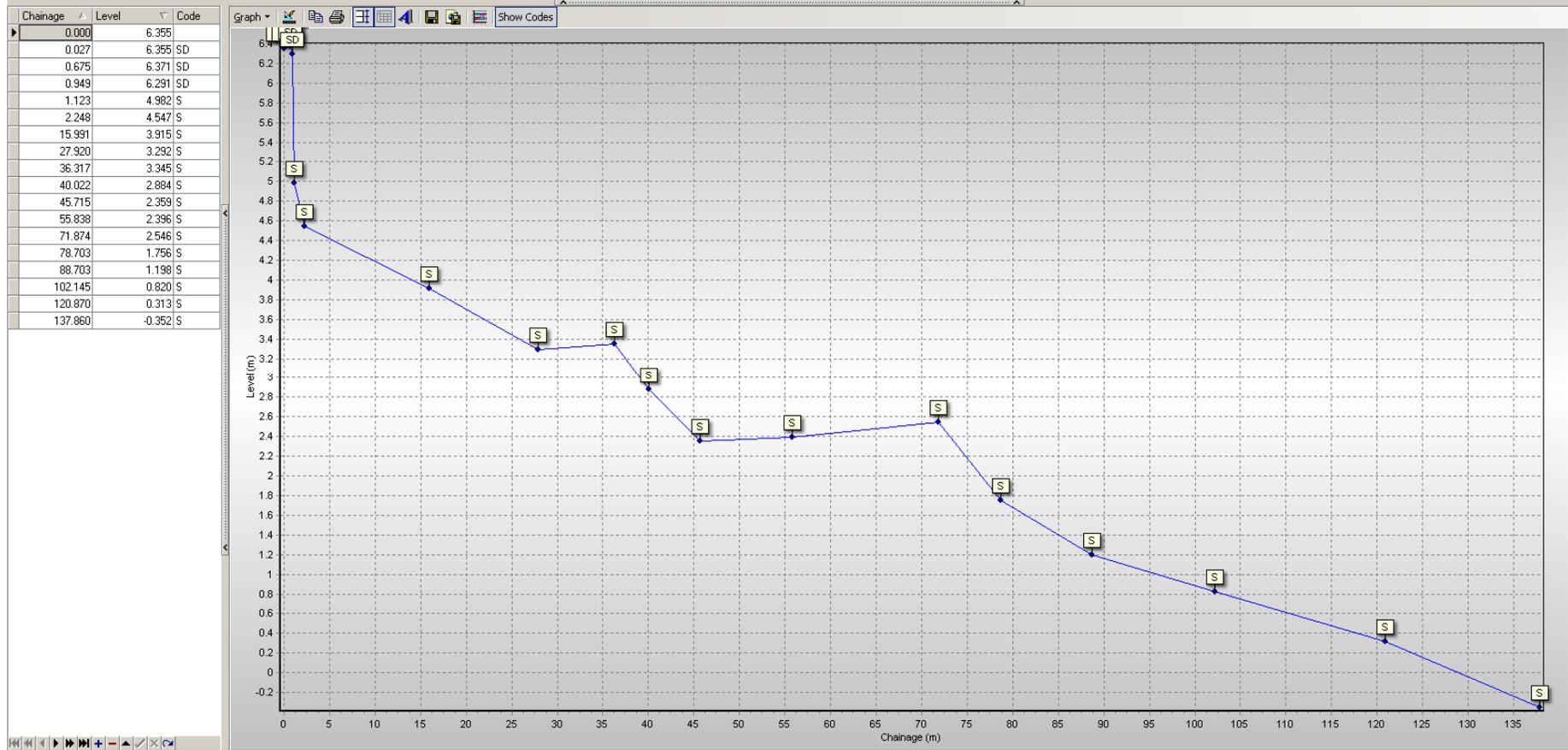
1aNTDC06 - 01/10/2009



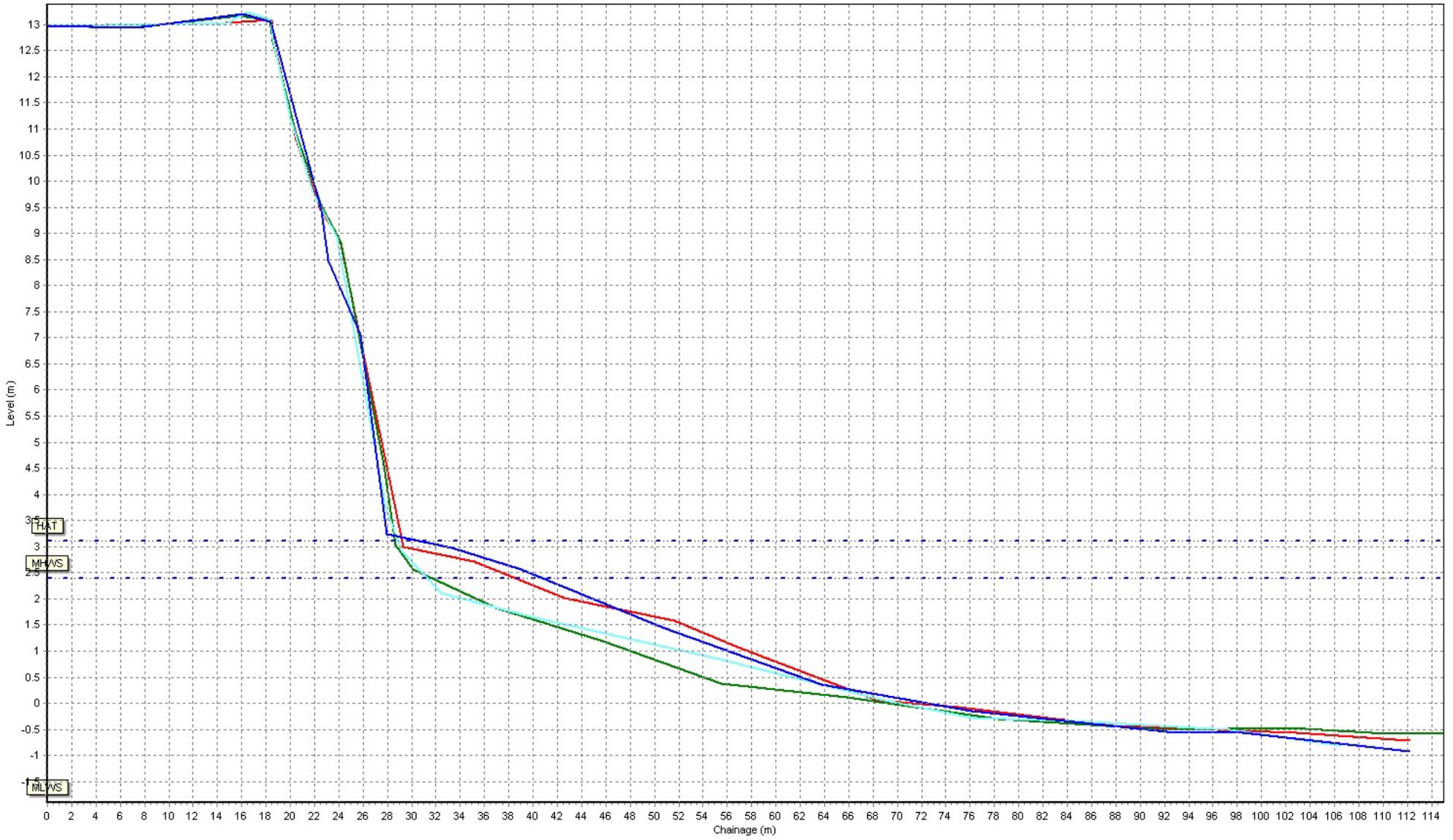
1aNTDC07 - 01/10/2009



1aNTDC08 - 01/10/2009

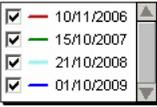


Beach Profiles: 1aNTDC01

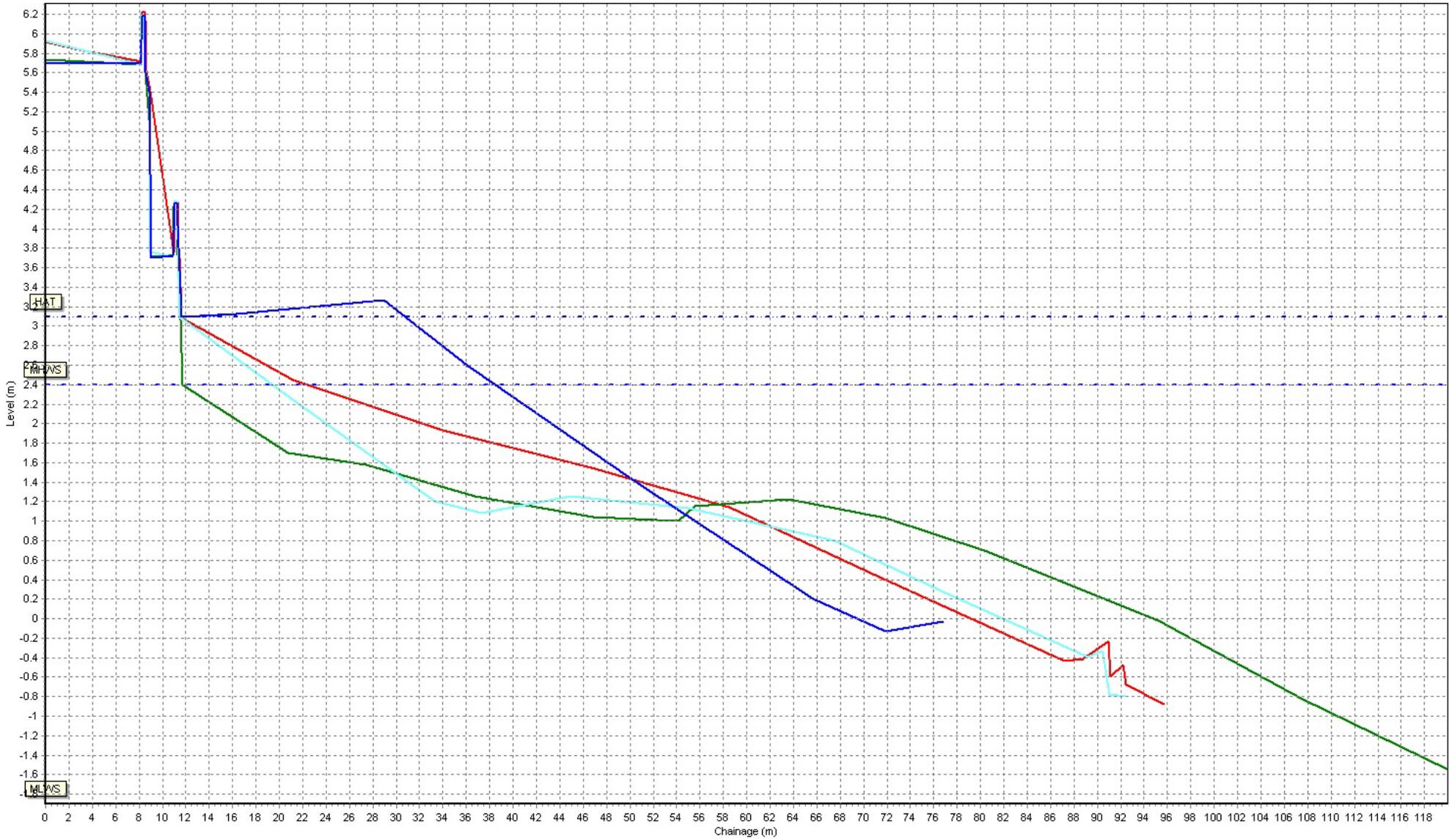


- 10/11/2006
- 15/10/2007
- 21/10/2008
- 01/10/2009

Beach Profiles: 1aNTDC02

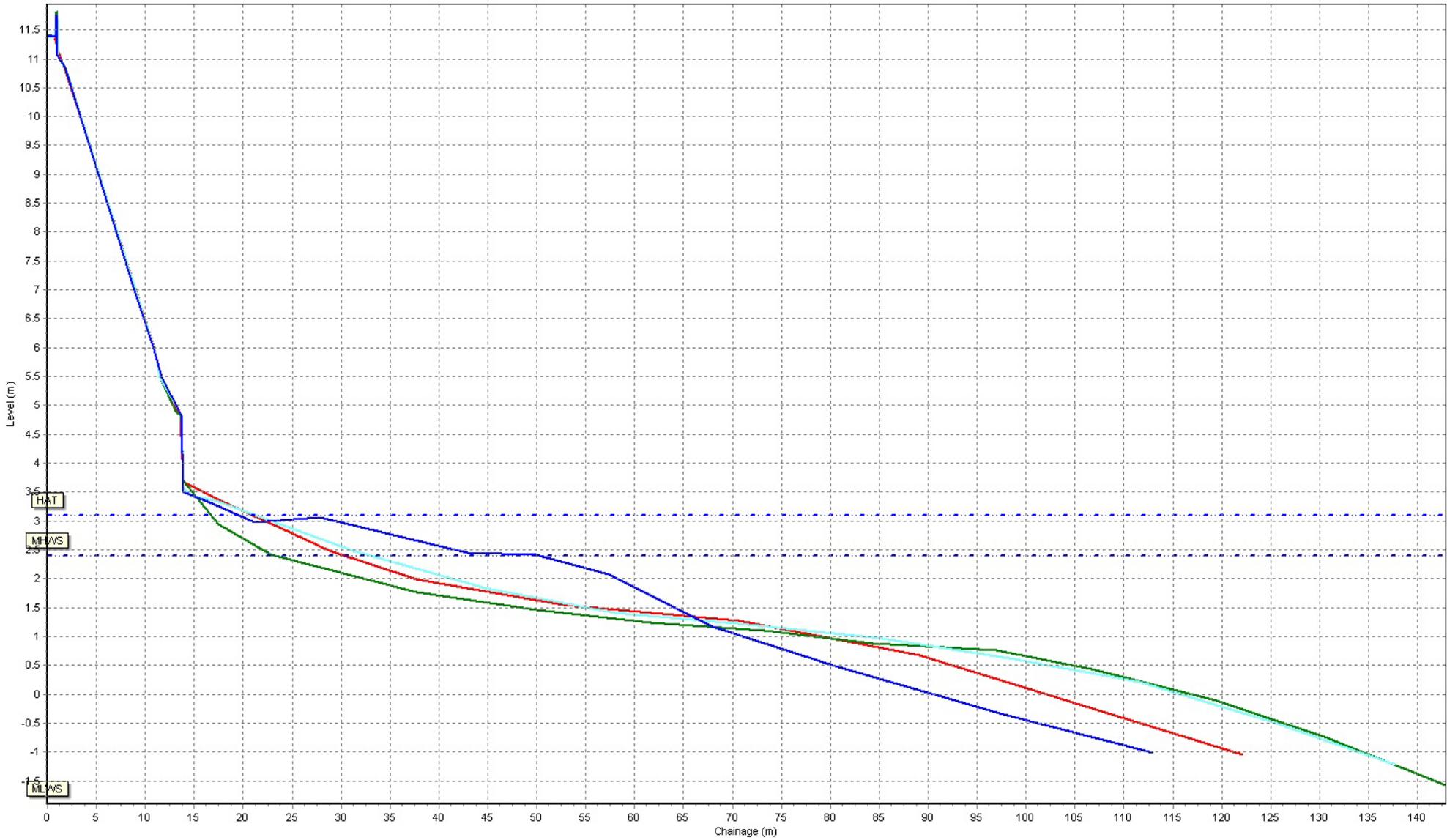


Beach Profiles: 1aNTDC03



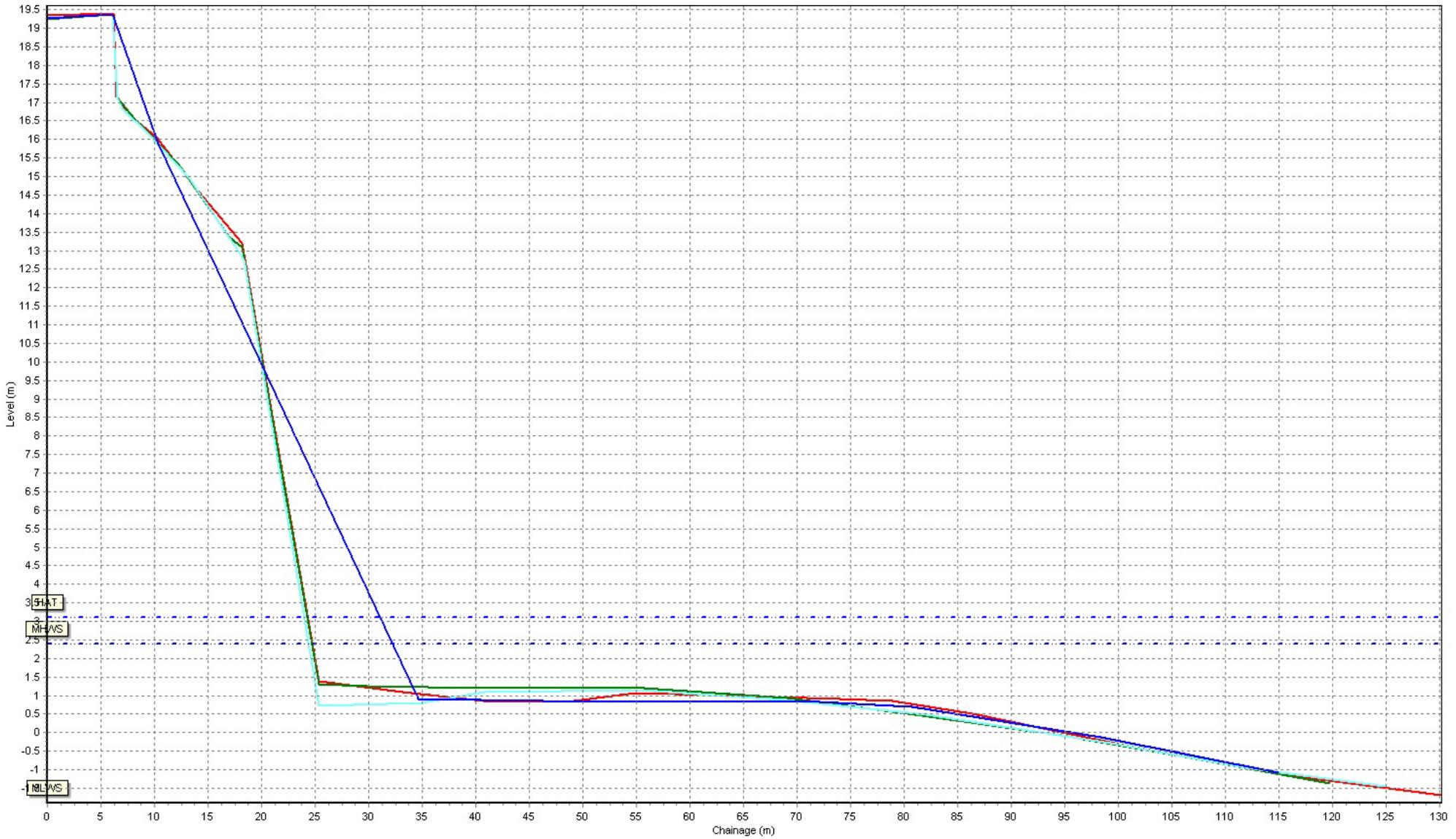
- 10/11/2006
- 15/10/2007
- 21/10/2008
- 01/10/2009

Beach Profiles: 1aNTDC04



- 10/11/2006
- 15/10/2007
- 21/10/2008
- 01/10/2009

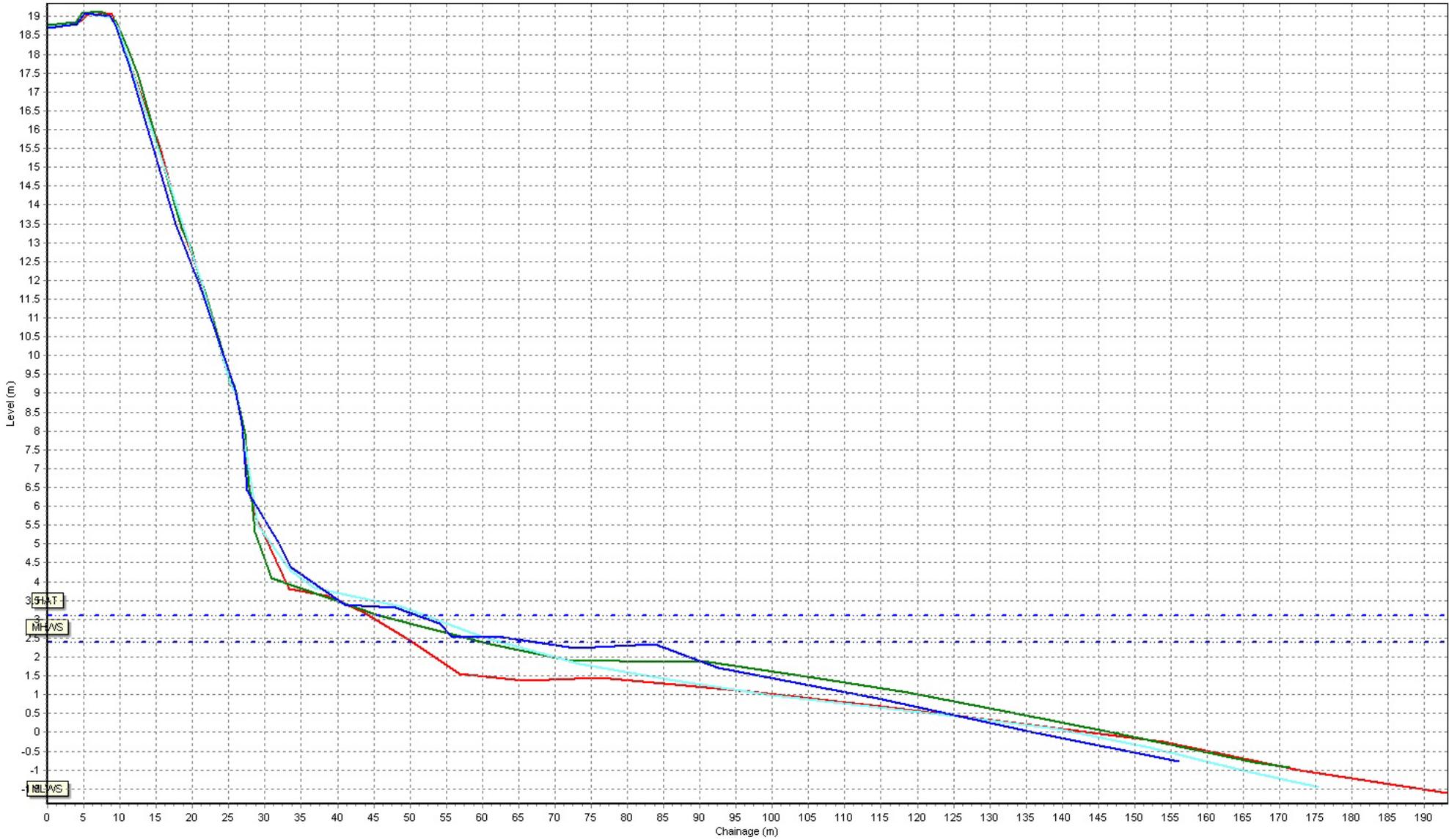
Beach Profiles: 1aNTDC05



- 10/11/2006
- 15/10/2007
- 21/10/2008
- 01/10/2009

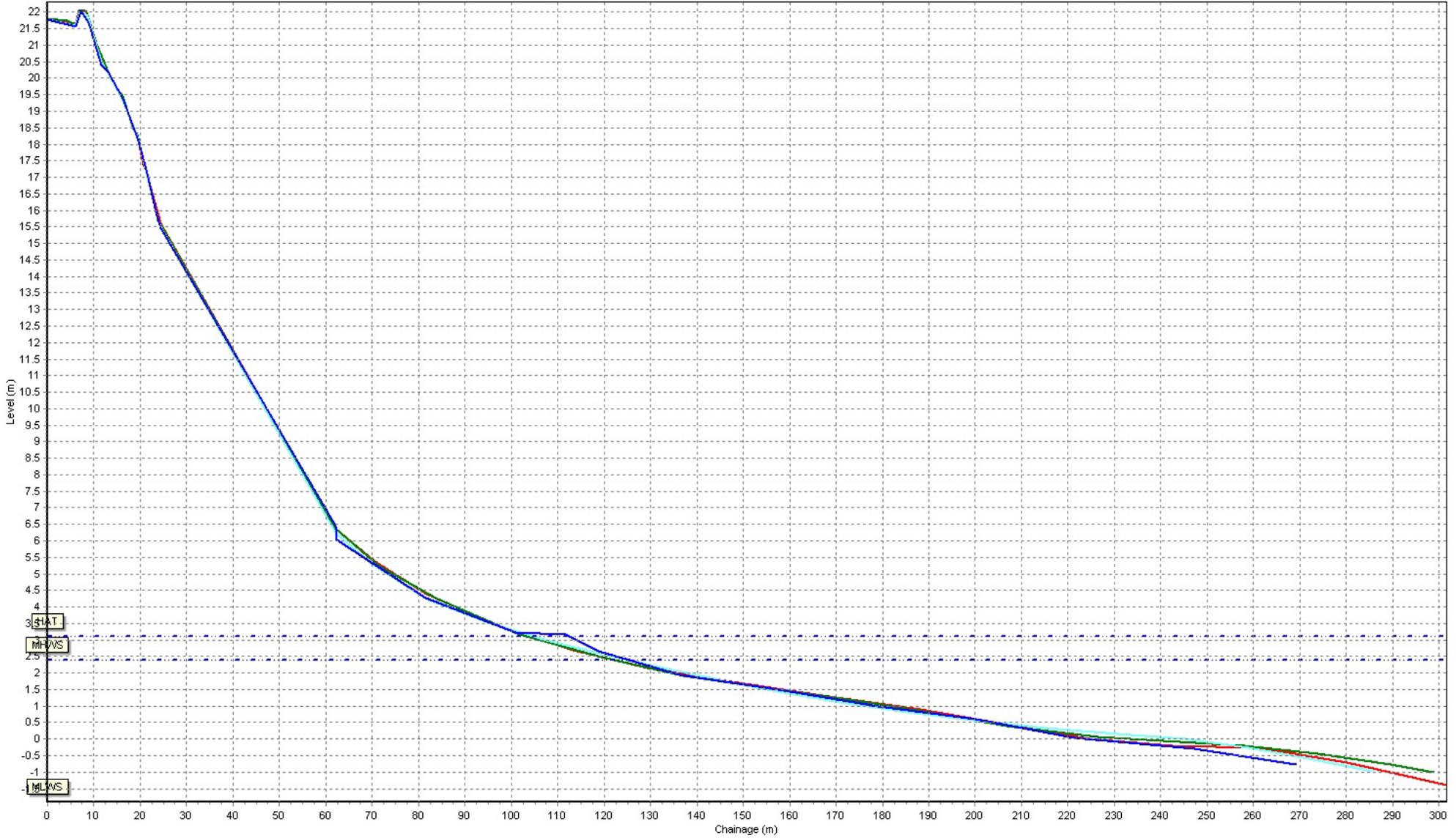
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M.H.W.S.
-1 M.L.W.S.

Beach Profiles: 1aNTDC06



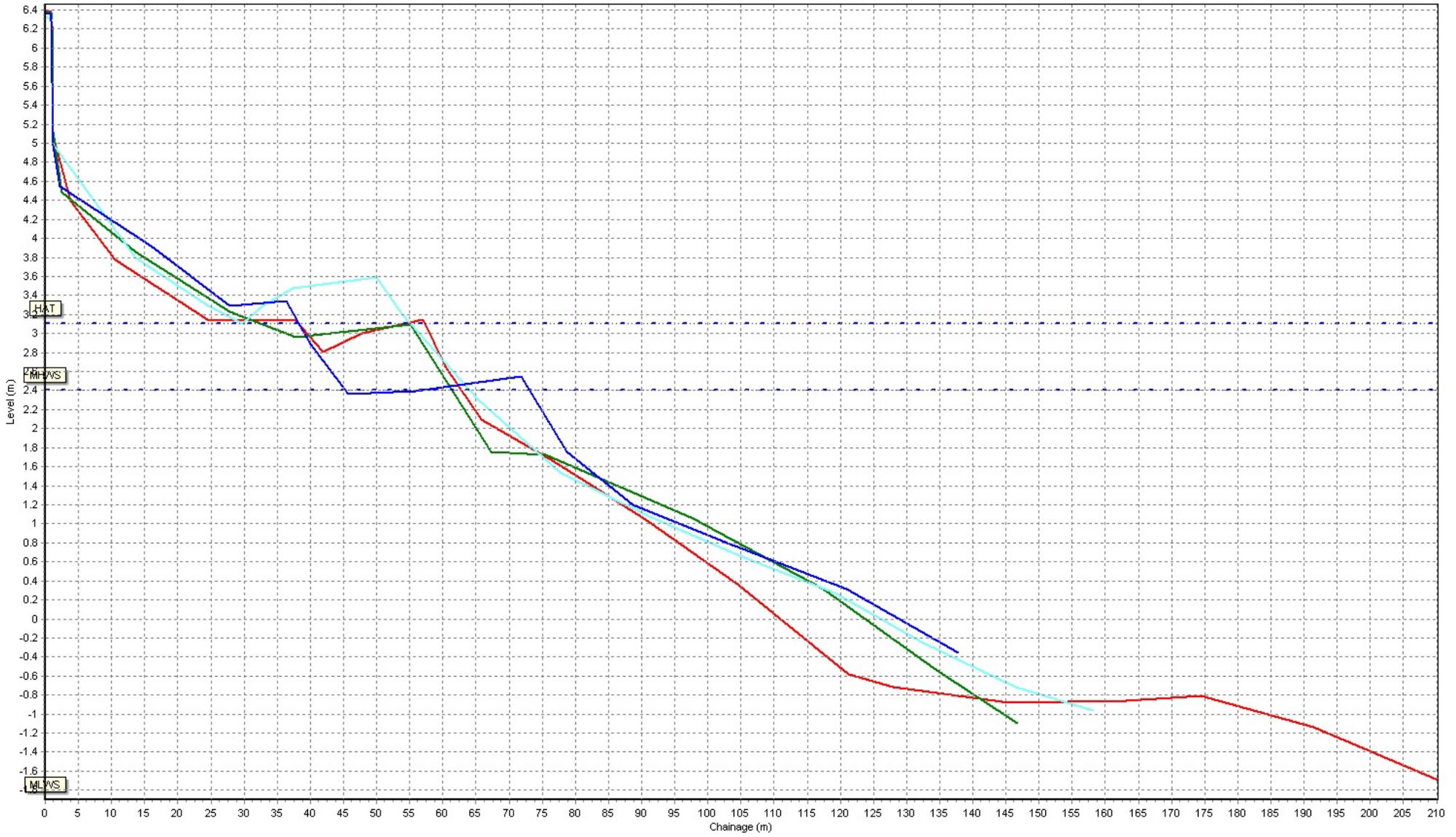
- 10/11/2006
- 15/10/2007
- 21/10/2008
- 01/10/2009

Beach Profiles: 1aNTDC07



- 10/11/2006
- 15/10/2007
- 21/10/2008
- 01/10/2009

Beach Profiles: 1aNTDC08



- 10/11/2006
- 15/10/2007
- 21/10/2008
- 01/10/2009