



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

Contents

| | |
|---------------------------------------------------------------------|----|
| Preamble | i |
| 1. Introduction | 1 |
| 1.1 Study Area | 1 |
| 1.2 Methodology | 1 |
| 2. Analysis of Survey Data | 6 |
| 2.1 Whitburn Bay | 6 |
| 2.2 Sunderland Harbour and Docks | 8 |
| 2.3 Hendon to Ryhope | 9 |
| 3. Problems Encountered and Uncertainty in Analysis | 12 |
| 4. Recommendations for 'Fine-tuning' the Monitoring Programme | 12 |
| 5. Conclusions and Areas of Concern | 13 |

Appendices

| | |
|------------|--------------------|
| Appendix A | Beach Profiles |
| Appendix B | Topographic Survey |
| Appendix C | Cliff Top Survey |

List of Figures

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

List of Tables

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

Authors

| | |
|--------------|-----------------|
| Nick Cooper | Royal Haskoning |
| Tanja Cooper | Royal Haskoning |

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 to Frenchman's Bay | Frenchman's Bay to Souter Point | Souter Point to Chourdon Point | Chourdon Point to Hartlepool Headland |
| 1 in 200 year | 3.41 | 3.44 | 3.66 | 3.91 |
| HAT | 2.85 | 2.88 | 3.18 | 3.30 |
| MHWS | 2.15 | 2.18 | 2.48 | 2.70 |
| MLWS | -2.15 | -2.12 | -1.92 | -1.90 |

| Water Level Parameter | Water Level (mODN) | | | |
|--------------------------|--------------------------------------------|--------------|------------------------------------|----------------------------------|
| | Hartlepool Headland to Saltburn Scar | Skinningrove | Hummersea Scar to Sandsend Ness | Sandsend Ness to Saltwick Nab |
| 1 in 200 year | 3.87 | 3.86 | 4.1 | 3.88 |
| HAT | 3.25 | 3.18 | 3.15 | 3.10 |
| MHWS | 2.65 | 2.68 | 2.65 | 2.60 |
| MLWS | -1.95 | -2.13 | -2.15 | -2.20 |

| Water Level Parameter | Water Level (mODN) | | | |
|--------------------------|----------------------------------|-------------------------------|-----------------------------|---------------------------------------|
| | Saltwick Nab to Hundale Point | Hundale Point to White Nab | White Nab to Filey Brigg | Filey Brigg to Flamborough Head |
| 1 in 200 year | 3.88 | 3.93 | 3.93 | 4.04 |
| HAT | 3.10 | 3.05 | 3.05 | 3.10 |
| MHWS | 2.60 | 2.45 | 2.45 | 2.50 |
| MLWS | -2.20 | -2.35 | -2.35 | -2.30 |

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

Glossary of Terms

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

Preamble

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

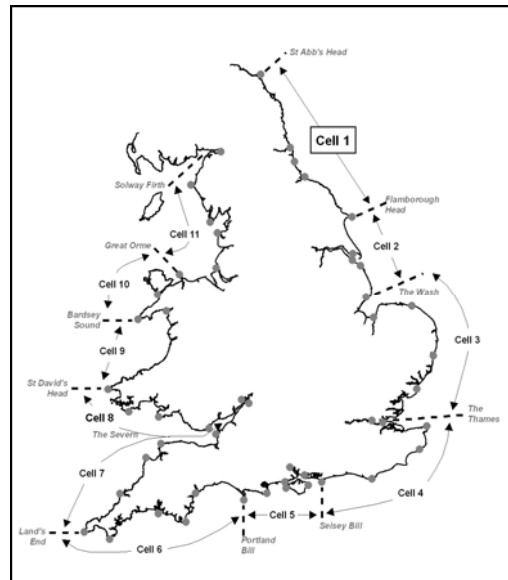


Figure 1 Sediment Cells in England and Wales

The 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
- 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.

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:

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 | Nov 08 | May 09 | Mar 09 | June 09 | - |
| 2 | 2009/10 | Sep 09 | Mar 10 | Mar 10 | June 10 | - |
| 3 | 2010/11 | Sep 10 | Nov 10 ^(*) | | | |

(*) The present report is **Analytical Report 3** and provides an analysis of the 2010 Full Measures survey for Sunderland City 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 Marsden Bay |
| Sunderland City Council | Whitburn Bay Harbour and Docks Hendon to Ryhope (incl. Halliwell Banks) |
| Durham County Council Hartlepool Borough Council Redcar & Cleveland Borough Council Scarborough Borough Council | Featherbed Rocks Seaham Blast Beach Hawthorn Hive Blackhall Colliery North Sands Headland Middleton Hartlepool Bay Coatham Sands Redcar Sands Marske Sands Saltburn Sands Cattersty Sands (Skinningrove) 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

Sunderland City Council's frontage extends from The Bents to Ryhope Dene. For the purposes of this report, it has been sub-divided into three areas, namely:

- Whitburn Bay (also referred to as Sunderland North or 'SNN')
- Sunderland Harbour and Docks (also referred to as Sunderland Central or 'SNC')
- Hendon to Ryhope (also referred to as Sunderland South or 'SNS')

1.2 Methodology

Along Sunderland City Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn/early winter comprising:
 - 58 no. beach profile lines
 - Topographic survey at Whitburn Bay
 - Topographic survey at Hendon to Ryhope
- Partial Measures survey annually each spring comprising:
 - 14 no. beach profile lines
- Cliff top survey bi-annually at:
 - Hendon to Ryhope

The location of these surveys is shown in Figure 2.

The Full Measures survey was undertaken along Whitburn Bay in September 2010, when weather conditions were wet with slight winds and a calm sea state. The Sunderland Harbour and Docks survey was undertaken in September 2010 under windy but dry conditions with a rough sea state. The Hendon to Ryhope frontage was surveyed in October 2010 when weather conditions were dry but breezy and the sea state was moderate with a heavy fret.

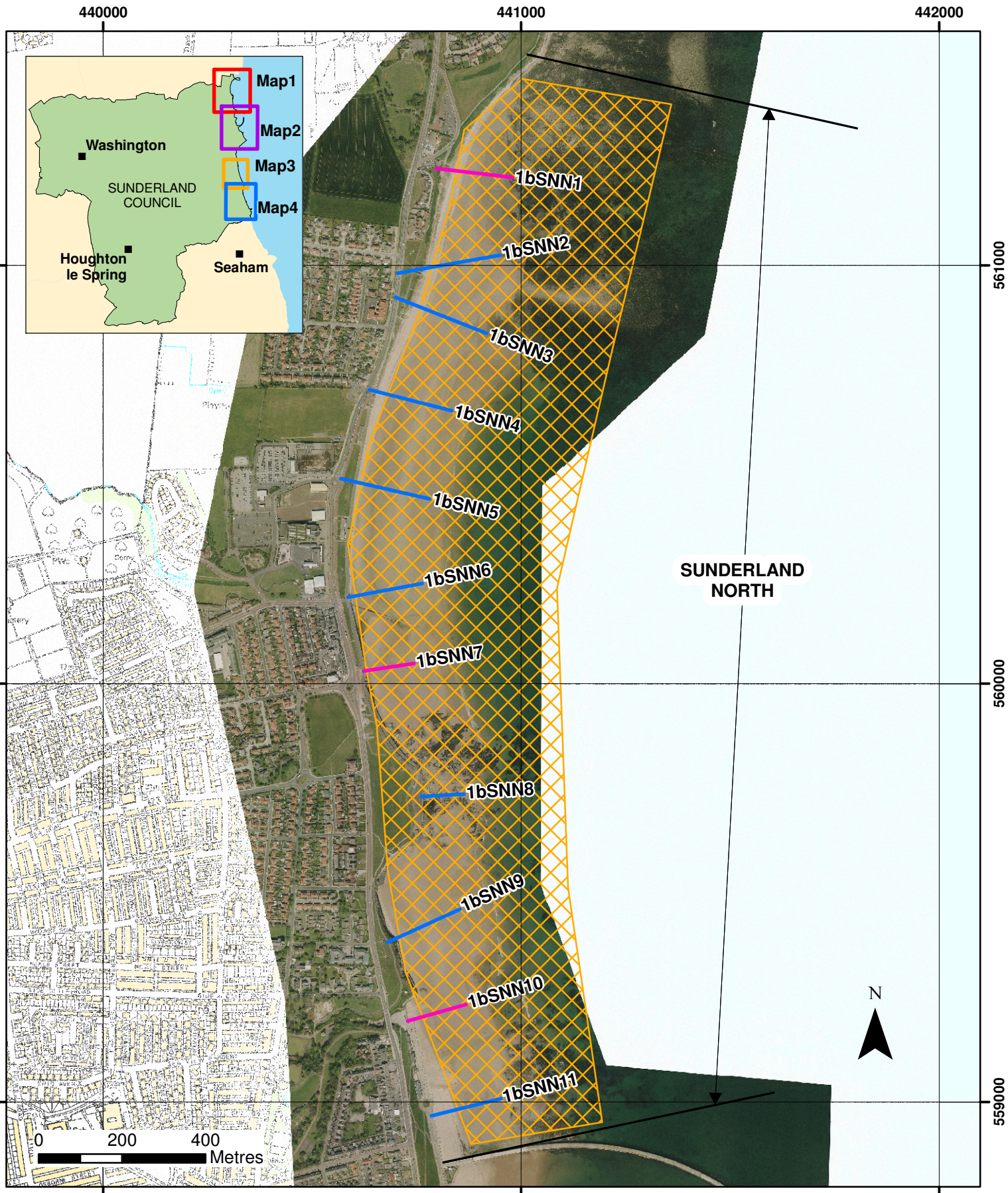
All data have been captured in a manner commensurate with the principles of the Environment Agency's *National Standard Contract and Specification for Surveying Services* and stored in a file format compatible with the software systems being used for the data analysis, namely SANDS and Arc-GIS. This 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.



TOPOGRAPHIC SURVEY LOCATIONS

- Annual Profile
 - Bi-Annual Profile
 - 6 monthly Survey
 - Yearly Survey
 - 5 yearly Survey
 - Cliff Top Survey @ 50 centres
 - Cliff Top Survey @ 100 centres
 - Cliff Top Survey @ 300 centres
- (Indicative Survey Extents shown)*

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

**Figure 2 - Map 1
 Sunderland
 Council Frontage**

Analytical Report 3
 'Full Measures' Survey 2010

Drawing Scale 1:12,000 at A4



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

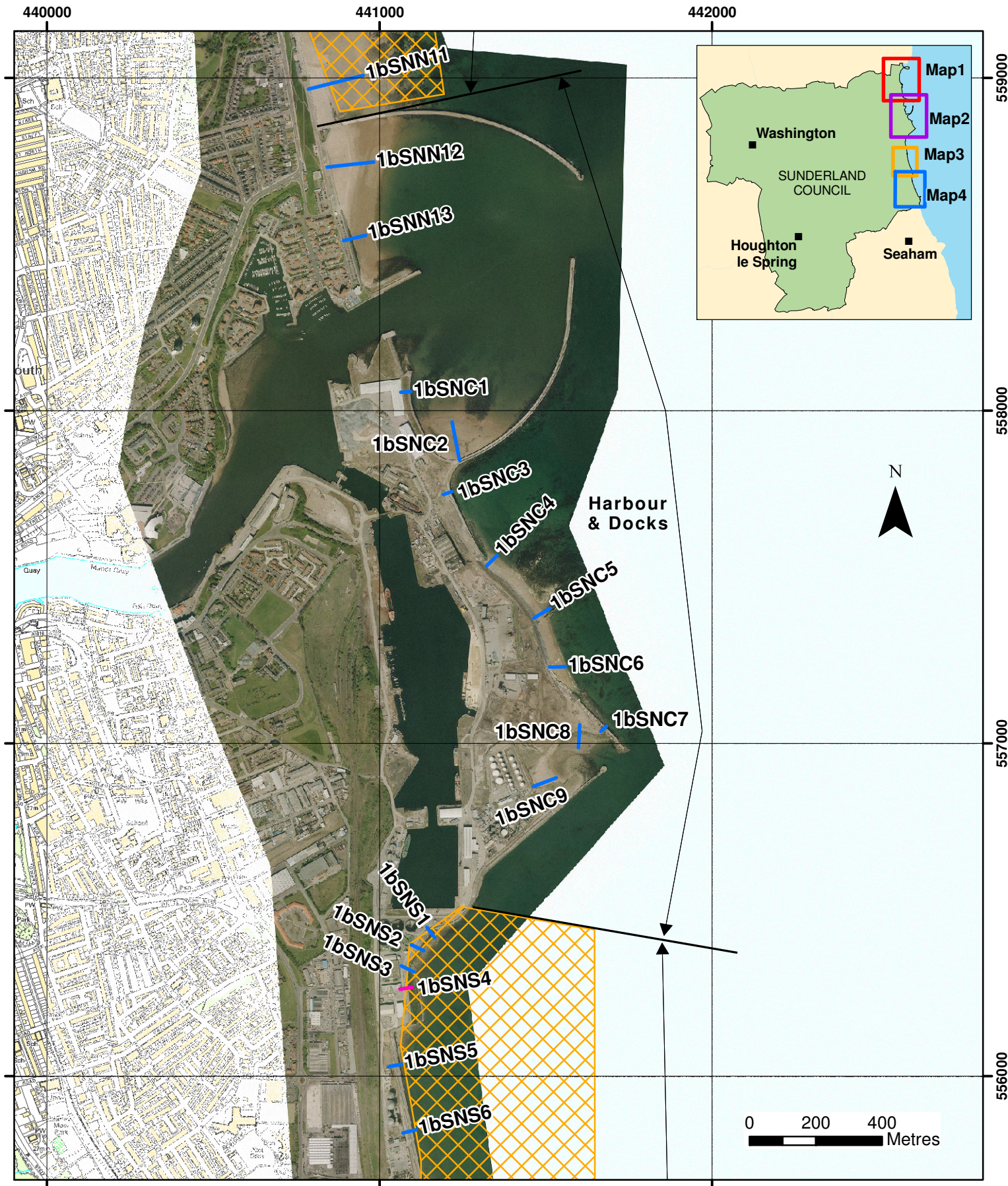


Halcrow Group Ltd
 Lyndon House
 62 Hagley Road
 Edgbaston
 Birmingham
 B16 8PE

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

Drawn by: TC Date: 27/10/2010
 Checked by: MD Date: 05/11/2010
 Approved by: NC Date: 05/11/2010

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



TOPOGRAPHIC SURVEY LOCATIONS

- Annual Profile
- Bi-Annual Profile
- 6 monthly Survey
- Yearly Survey
- 5 yearly Survey
- Cliff Top Survey @ 50 centres
- Cliff Top Survey @ 100 centres
- Cliff Top Survey @ 300 centres

(Indicative Survey Extents shown)

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

**Figure 2 - Map 2
 Sunderland
 Council Frontage**

Analytical Report 3
 'Full Measures' Survey 2010

Drawing Scale 1:15,000 at A4



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

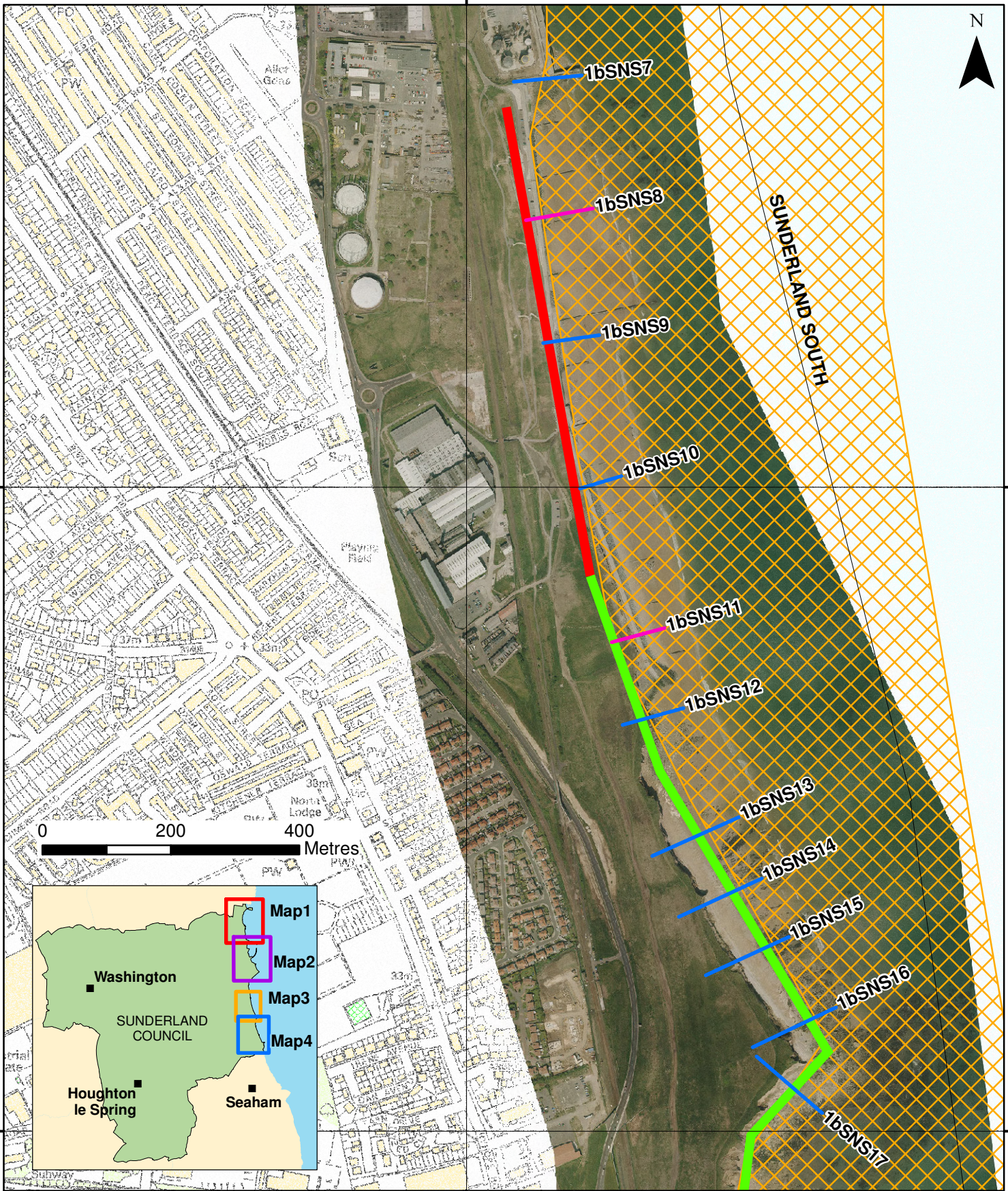


Halcrow Group Ltd
 Lyndon House
 62 Hagley Road
 Edgbaston
 Birmingham
 B16 8PE

Tel: +44 (0)191 211 1300 Tel: +44 (0)121 456 2345
 Fax: +44 (0)191 211 1313 Fax: +44 (0)121 456 1569
 www.royalhaskoning.com www.halcrow.com

| | |
|-----------------|------------------|
| Drawn by: TC | Date: 27/10/2010 |
| Checked by: MD | Date: 05/11/2010 |
| Approved by: NC | Date: 05/11/2010 |

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



555000

554000

TOPOGRAPHIC SURVEY LOCATIONS

- Annual Profile
- Bi-Annual Profile
- 6 monthly Survey
- Yearly Survey
- 5 yearly Survey
- Cliff Top Survey @ 50 centres
- Cliff Top Survey @ 100 centres
- Cliff Top Survey @ 300 centres

(Indicative Survey Extents shown)

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

**Figure 2 - Map 3
 Sunderland
 Council Frontage**

Analytical Report 3
 'Full Measures' Survey 2010

Drawing Scale 1:8,000 at A4

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

Halcrow
 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

Drawn by: TC Date: 27/10/2010
 Checked by: MD Date: 05/11/2010
 Approved by: NC Date: 05/11/2010

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

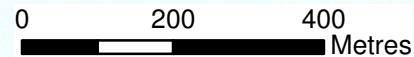
441000

442000

554000

553000

552000



TOPOGRAPHIC SURVEY LOCATIONS

- Annual Profile
 - Bi-Annual Profile
 - ⊗ 6 monthly Survey
 - ⊗ Yearly Survey
 - ⊗ 5 yearly Survey
 - Cliff Top Survey @ 50 centres
 - Cliff Top Survey @ 100 centres
 - Cliff Top Survey @ 300 centres
- (Indicative Survey Extents shown)*

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

**Figure 2 - Map 4
 Sunderland
 Council Frontage**

Analytical Report 3
 'Full Measures' Survey 2010

Drawing Scale 1:10,000 at A4



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



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

Drawn by: TC Date: 27/10/2010
 Checked by: MD Date: 05/11/2010
 Approved by: NC Date: 05/11/2010

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

2. Analysis of Survey Data

2.1 Whitburn Bay

| Survey Date | Description of Changes Since Last Survey | Interpretation |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 09-2010 | <p>Beach Profiles:</p> <p>Whitburn Bay is covered by eleven beach profile lines (Appendix A).</p> <p>Profiles SNN1, SNN2 and SNN3 are located towards the north of Whitburn Bay and extend across scrubland before reaching the upper gravel foreshore and then dropping across the lower sandy foreshore towards the rocky outcrop of Whitburn Steel.</p> <p>SNN1 shows a consistent profile form in the area of scrub between the low masonry wall by the boat yard and the upper beach gravel. However, the beach face, between the levels of MHWS and HAT, appears to have cut landwards by around 1m since the last survey in March 2010, with the material released being deposited in the slight trough just below MHWS level. Further down the profile, levels dropped slightly but remained well above the record low values that were recorded in November 2006. At the seaward end of the profile, rock outcrops remain exposed, with no sand coverage.</p> <p>Profile SNN2 experienced a general increase in beach levels along the length seaward of around HAT. Typically levels increased by around 0.15m, but in one location up to 0.3m increase occurred. Similarly, profile SNN3 also experienced a general increase in levels of around 0.15m, between HAT and a chainage of around 175m.</p> <p>Profiles SNN4 to SNN7 are between the southern edge of South Bents housing estate and just north of Parsons Rock. All profiles show that the position and alignment of the sea wall has not changed since the earlier November 2006 surveys. The surveys then drop from the wall to the generally sandy foreshore and extend down to low water.</p> <p>SNN4, SNN5, SNN6 and SNN7 all show a broadly similar trend of upper foreshore lowering, by around 0.4m, with increases in level observed along the lower foreshore since the September 2009 surveys (although SNN6 showed no further upper foreshore lowering to the already low levels from September 2009). The availability of March 2010 survey data along SNN7 enables the identification of a more severe lowering between September 2009 and March 2010 followed by a slight recovery to September 2010, although the water-filled trough appears to remain at the toe of the sea wall.</p> | <p>Beach level fluctuations of anything between 0.2m and 0.4m appear to be very common along the length of Whitburn Bay.</p> <p>Whilst the upper seaward face of SNN1 cut landwards by around 1m, the trend of beach response appears different to this along both SNN2 and SNN3. Previous surveys have shown both profiles simultaneously lowering, whilst the present survey shows both sections increasing in level.</p> <p>Common behaviour was observed along SNN4 to SNN7, with upper foreshore lowering (or pre-existing low levels remaining) and increases in lower foreshore levels.</p> |

| Survey Date | Description of Changes Since Last Survey | Interpretation |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 09-10 | <p>Profile SNN8 extends across Parsons Rock and generally shows that the sand veneer previously covering the rocks on the upper foreshore in the September 2009 survey had been stripped bare.</p> <p>Profile SNN9 drops from the cliff top to the foreshore at Roker and shows general consistency in cliff top and foreshore levels, albeit with a slight lowering of upper foreshore levels.</p> <p>Profiles SNN10 and SNN11 are between Roker Park and Roker Pier. SNN10 experienced lowering along most of its length between September 2009 and March 2010 and levels at the upper and mid sections of beach remained at these low levels to September 2009. Some accretion occurred seaward of a chainage of around 135m.</p> <p>SNN11 shows a considerably more varied form, with the berm previously recorded in September 2009 around HAT being pushed further up the profile by September 2010 and the second berm observed in September 2009 being flattened, with an increase in lower foreshore levels seaward of this position.</p> <p>Topographic Survey:</p> <p>Whitburn Bay is covered by an annual topographic survey between the Bents and Roker Pier. Data from the September 2010 survey have been used to create a DGM (Appendix B – Map 1a).</p> <p>From this DGM it can be seen that north of Parson’s Rock, the 2mODN beach level contour intercepts the sea wall around Seaburn. There appears to be a slight increase in general upper beach levels immediately adjacent to Roker Pier.</p> <p>The DGM from the present survey has been compared against that created from the previous survey in September 2009 using a GIS to identify areas of erosion and accretion between the surveys (Appendix B – Map 1b). This identifies notable loss of material from the upper beach along much of Whitburn Bay, especially in the very north and between Parson’s Rock and Roker Pier where the zone of lowering also extends across the mid beach. In these areas the material liberated from the upper (or upper and mid) beach has been largely deposited along the foreshore, where accretion has been recorded.</p> <p>The main exceptions are at the northern and central parts of the South Bents housing estate and immediately adjacent to Roker Pier. At the former location accretion has occurred along the upper and mid beaches of South Bents (as shown by profiles SNN2 and SNN3) with only a narrow strip of foreshore lowering towards the seaward edge of the profile. Adjacent to Roker Pier, the upper beach has increased in level along a short section of frontage, as the berm previously here around HAT has become flattened and the sediment pushed up-profile.</p> | <p>There appear to be episodes when a sand veneer covers the rocks along SNN8, and then further episodes when the sand is stripped off the platform, exposing the rocks.</p> <p>Beach levels remain relatively low along SNN10.</p> |
| 09-10 | <p>From this DGM it can be seen that north of Parson’s Rock, the 2mODN beach level contour intercepts the sea wall around Seaburn. There appears to be a slight increase in general upper beach levels immediately adjacent to Roker Pier.</p> <p>The DGM from the present survey has been compared against that created from the previous survey in September 2009 using a GIS to identify areas of erosion and accretion between the surveys (Appendix B – Map 1b). This identifies notable loss of material from the upper beach along much of Whitburn Bay, especially in the very north and between Parson’s Rock and Roker Pier where the zone of lowering also extends across the mid beach. In these areas the material liberated from the upper (or upper and mid) beach has been largely deposited along the foreshore, where accretion has been recorded.</p> <p>The main exceptions are at the northern and central parts of the South Bents housing estate and immediately adjacent to Roker Pier. At the former location accretion has occurred along the upper and mid beaches of South Bents (as shown by profiles SNN2 and SNN3) with only a narrow strip of foreshore lowering towards the seaward edge of the profile. Adjacent to Roker Pier, the upper beach has increased in level along a short section of frontage, as the berm previously here around HAT has become flattened and the sediment pushed up-profile.</p> | <p>With a few localised exceptions, the Whitburn Bay foreshore has generally experienced lowering of upper beach levels and accretion on the lower profile compared to the September 2009 survey.</p> |

2.2 Sunderland Harbour and Docks

| Survey Date | Description of Changes Since Last Survey | Interpretation |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 09-2010 | <p>Beach Profiles:</p> <p>Sunderland Harbour and Docks is covered by eleven beach profile lines (Appendix A).</p> <p>SNN12 and SNN13 are both located within the shelter of Roker Pier and both exhibited similar trends since the October 2009 surveys. Upper beach levels reduced significantly, in places by up to 0.8m, whilst lower beach levels increased.</p> <p>SNC1 and SNC2 are located within the shelter of New South Pier. SNC1 starts at the seaward edge of the dock building and extends across an earth mound before reaching the stepped landward face of the dock wall. The profile then drops from the wall crest directly into deep water. SNC2 starts at the crest of New South Pier and drops several metres to foreshore level. There is a small pocket of sand trapped adjacent to the structure, which reached a level of 0.2m at the toe of the structure, some 0.7m lower than during the previous survey in October 2009. The beach level recorded along SNC2 remained, however, around 0.4m higher than the lowest recorded level along this transect.</p> <p>SNC3 to SNC7 are on the seaward face of the dock. SNC3 extends from the dock yard across a back flood wall, which has a crest level of around 7.2mODN, and promenade to the main seaward dock wall, which has a crest level of 7.55mODN. The profile then extends down the seaward face of the wall into deep water. SNC4 and SNC5 extend from the rock armoured revetment across the short width of foreshore down to low water. Along SNC4 the levels were generally lower than those recorded in October 2010, and between around MSL and MLWS reached new record low values. Levels directly at the toe of the wall were, however, slightly healthier than in October 2010. In contrast, levels along SNC5 and SNC6 were generally healthier than those recorded in October 2010, although along SNC5 they were lower only a few metres seaward of the toe of the wall.</p> <p>SNC7 to SNC9 are within the shelter of North East Pier and South West Breakwater. SNC7 is a section across North East Pier and shows the terraced nature of the landward face of the pier wall, extending across rock to the small sheltered bay between the two structures. The foreshore levels showed a reduction of only around 0.1m compared with the October 2010 survey. SNC8 crosses the boulders and rubble, which reaches a level of around 6.2mODN, and then extends across the sandy but boulder-strewn foreshore. Levels along the foreshore were at their lowest level since surveying began, showing a slight reduction since October 2010. SNC9 starts near the dock facilities and crosses a short length of concrete wall before extending across the sand foreshore to reach and cross a large boulder mound that is towards the seaward end of the South West Breakwater. The foreshore in the lee of the mound experienced accretion, to new record high levels, between October 2009 and September 2010.</p> | <p>Foreshore levels along the beaches within the harbour arms were generally significantly lower than recorded in October 2010.</p> <p>Generally, the foreshore levels on the seaward face of the dock and within the shelter of North East Pier and South West Breakwater were only slightly different to those recorded in October 2009, with no consistent behaviour observed, although there was most notable change along SNC9 where accretion occurred in the lee of the large boulder mound.</p> |

2.3 Hendon to Ryhope

| Survey Date | Description of Changes Since Last Survey | Interpretation |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10-2010 | <p>Beach Profiles:</p> | |
| | <p>Hendon to Ryhope is covered by thirty six beach profile lines (Appendix A).</p> | |
| | <p>SNS1 to SNS6 are located along the sea wall protecting the Hendon Sewage Treatment Works. The profiles typically include a section along the concrete deck, wall crest (which varies in elevation between around 7.0mODN in the north and 7.6mODN in the south after the dog-leg in the wall position), near-vertical seaward face of the wall, and sloping rock armour revetment. The foreshore across SNS1, SNS2 and SNS3 was not surveyed because of difficult access and dangerous conditions whilst the profile of SNS5 and SNS6 drops directly from the structure into deep water. Along SNS4 a short patch of foreshore is surveyed at the toe of the revetment, and this showed minor redistribution of sediment.</p> | <p>SNS1 to SNS6 generally record the Hendon Sea Wall and not the foreshore.</p> |
| | <p>SNS7 to SNS10 are located along the defended coastal slopes along south Hendon, which rise in elevation to higher defended cliffs at SNS11. The profile form typically includes a short section of the backing coastal slope (or cliff at SNS11), a rear flood wall (crest levels typically around 7.0mODN), a concrete deck and a vertical sea wall. Rock revetment and natural boulders are present at the toe of the wall along most profiles, with the surveys then extending across the foreshore to low water.</p> | <p>Along the south Hendon frontage, profiles exhibited a mixed response, with some areas of general accretion (SNS7), some areas of modest redistribution of sediment (SNS8 and SNS9) and some areas of notable erosion of the mid and lower foreshore (SNS10 and SNS11).</p> |
| <p>Along SNS7, beach levels increased compared to the September 2009 surveys, resulting in an increase in level directly at the toe of the sea wall of around 1m. Along SNS8 and SNS9 foreshore levels experienced modest change, remaining mid-way between the envelope of previous recorded changes. Along SNS10 and SNS11 record low values were observed along the mid and lower profiles.</p> | | |
| <p>SNS12 to SNS36 are located along the undefended cliffs between Grangetown and Ryhope Dene. Profiles SNS12 to SNS16 are between the end of the Hendon sea wall and Salterfen Rocks. Cliff top levels are typically between 20m and 22mODN. They are highest along the profiles further north, dropping in the centre and then increasing again to the south. Beach levels at the toe of the cliffs adopt a similar trend and are around 5.0mODN in the north, 3.8mODN in the centre and 4.6mODN in the south. Generally, foreshore levels were at their lowest recorded values between the toe of the cliff and around MSL, but with a similar form adopted. The cliff erosion has been notable along profiles SNS13 (around 5m since November 2006), SNS14 ($\approx 3.5\text{m}$), SNS16 ($\approx 7\text{m}$). Along both SNS13 and SNS16 this has resulted in debris at the toe of the cliffs.</p> | <p>Profiles at SNS13, SNS14, SNS16 continue to remain actively eroding, with considerable further cut-back in cliff top position.</p> | |

| Survey Date | Description of Changes Since Last Survey | Interpretation |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <p>Profiles SNS17 to SNS36 extend between Salterfen Rock and Pincushion Rocks along Shirley Banks and Halliwell Banks.</p> <p>Profiles between SNS17 and SNS25 typically exhibit a characteristic cliff height of between 23m and 29mODN, with beaches at the toe typically at levels between 3.1m and 4.6mODN. SNS17 has cut back by around 1.4m in position of the cliff top, face and toe since November 2006. SNS19 has experienced similar cut-back at the cliff toe and SNS21 around 4m cut-back at the toe over the same timescale. The erosion recorded since November 2006 has also continued at SNS22 (≈4m), and since September 2009 it has also been observed along SNS24 (≈6m), and SNS25 (≈6m).</p> <p>Profiles SNS26 to SNS32 are all located at close spacings at Halliwell Banks specifically to assess risks from erosion at a former land fill. Cliff height is characteristically around 26m and 27mODN, with beaches at the toe typically at levels between 3.3m and 3.9mODN. Along profiles SNS26 and SNS27, however, beach levels are much lower at 2.1m and 2.9mODN, respectively. Along this sensitive frontage, cut-back at the toe of the cliff has occurred by up to 4m since March 2009, with changes also recorded in the cliff top position.</p> <p>Profiles between SNS33 and SNS36 typically exhibit a characteristic cliff height of between 25m and 27mODN, with beaches at the toe typically at levels between 3.3m and 3.9mODN. These frontages too have experienced cliff recession, with in places the cliff top retreating by 2.5m since September 2009.</p> <p>The surveyors report states “there have been some large retreats in the cliff top. The layer of sandy soil above the lower rock strata, is in a very poor state. Large holes are visible and a number of landslips were witnessed on site.”</p> <p>Topographic Survey:</p> <p>Hendon to Ryhope is covered by an annual topographic survey between the Hendon Sea Wall and Ryhope Dene. Data have been used to create a DGM (Appendix B – Maps 2a and 3a).</p> <p>From this DGM it can be seen that beach levels at the toe of the Hendon Sea Wall are relatively low; there is a general absence of topographic contours above 1mODN. In contrast, the undefended sections of frontage down to Ryhope Dene exhibit higher foreshore levels at the toe of the cliffs.</p> <p>The DGM from the present October 2010 survey has been compared against that created from the previous survey in September 2009 using a GIS to identify areas of erosion and accretion between the surveys (Appendix B – Maps 2b and 3b). This identifies that at the very northern end, just to the immediate south of Hendon Treatment Works, there is a small section where modest accretion occurred (as measured also along SNS7). South of this there is a frontage of around 600m where modest redistribution of sediment occurred from the upper beach to the lower foreshore (as measured by profiles SNS8 and SNS9).</p> | <p>The cliffs fronting the landfill area at Halliwell Banks (measured by profiles SNS26 to SNS32) have eroded notably in recent surveys. This erosion has been generally consistent along the undefended cliffs and is likely to have largely occurred during the severe winter of 2009/2010 between the September 2009 and October 2010 surveys. Changes in foreshore level were relatively modest.</p> |
| | | <p>The Hendon Sea Wall will come under increasing pressure due to the presence of low beach levels at the toe of the defence. It is along the sea wall that the beach levels showed the greatest change, with a loss of sediment from the frontage.</p> |

| Survey Date | Description of Changes Since Last Survey | Interpretation |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <p>There is then a section of around 600m to the end of the Hendon Sea Wall where more severe erosion occurred over much of the beach width, with no corresponding accretion on the lower foreshore (as measured by profiles SNS10 and SNS11).</p> <p>South of here, around Salterfen Rocks to around Maiden's Flat, there was again mostly modest redistribution of sediment from the upper beach to lower down the profile. South of Maiden's Flat the beach levels generally were slightly lower in October 2010 than they were in September 2009.</p> | <p>Slightly reduced foreshore levels along the frontage south of Maiden's Flat may have contributed to some of the cliff recession that was recorded in the profiles</p> |
| | <p>Cliff Top Survey:</p> <p>Thirty-two ground control points (numbered 1-32) were established along the cliff top between Hendon and Ryhope in March 2009, with a further three (28A, 28B and 28C) added in September 2009. Note: the numbering of ground control points is not intended to correlate with that of the beach profile lines and reference should be made to Appendix C - Figure 1 for the location of ground control points). Measurements are taken from each ground control point along a fixed bearing to the edge of the cliff top. The results from the cliff top monitoring are anticipated to have an accuracy of $\pm 0.2\text{m}$ due to the techniques being used. These cliff top surveys are undertaken bi-annually and are intended to inform on erosion rates of the sea cliffs extending from the defended industrial areas at Hendon southwards along the undefended cliffs to Ryhope Dene. Appendix C provides results from the October 2010 cliff top survey, showing the position from the ground control point to the edge of the cliff top along a defined bearing. Also shown is the change in measurement since the original (March 2009) and previous (March 2010) cliff top surveys.</p> <p>Results show that erosion has occurred at twenty of the thirty-five ground control points since surveys began in March 2009 (or September 2009 for 28A, 28B and 28C). Erosion at five of these stations presently remains within the assumed accuracy of the survey technique ($\pm 0.2\text{m}$), but at the other stations the higher values provide clear evidence of erosion trends. At nine of these stations the erosion since the March 2009 has been greater than 2m and must be classed as significant. At two of these the erosion is approaching 4m and at one location (point 25 at Halliwell Banks) it has exceeded 5m in the 19 months since surveys began. At six of the nine stations showing more than 2m of erosion, a large proportion of the erosion was recorded between March 2009 and October 2009. It is also significant that at points 24 to 32 (including 28A, 28B and 28C), which are spaced along Halliwell Banks (the cliffs fronting the former landfill), erosion has been recorded at all but two of the twelve stations since the baseline surveys. Furthermore all but three of these stations showed erosion activity between March 2009 and October 2010, indicating that the process remains ongoing. No change has been recorded at six of the thirty-five stations and whilst there is apparent accretion of the cliff top at the nine remaining stations, the values are within the stated accuracy of the survey technique at six of these locations (and may indeed be representative of the early stages of a toppling cliff failure), whilst the other three stations (all at the northern end of the surveyed section) there has been landscaping of the cliff, undertaken in 2009.</p> | <p>The benefits from monitoring of cliff top position will be truly derived when a longer term dataset is available, but even the short duration over which the surveys have already taken place shows, in places, significant erosion along some sections of cliffs between Hendon and Ryhope. Of particular note is the ongoing nature of this trend and the relatively high rates that have been observed in places along Halliwell Banks where a thin limestone cliff 'ridge' is the only barrier defending a former landfill area against erosion by the sea.</p> |

3. Problems Encountered and Uncertainty in Analysis

Cliff Top Surveys

Surveying any cliff top is difficult due to: (i) the Health and Safety risks posed to surveyors, especially during adverse weather; and (ii) the 'apparent' changes that can arise due to surveyors interpreting different points as the cliff edge on successive surveys.

For these reasons, it has been assumed that any changes of $\pm 0.2\text{m}$ may be considered as being within the accuracy of the surveying technique.

However, in addition to surveyor interpretation, the cliffs along this frontage have a characteristic tendency to heave seawards prior to a toppling failure, leading to apparent discrepancies in the data where the cliff edge can appear to 'grow' seawards.

It is also known that along cliff top monitoring points 1 – 4 the cliff top has been re-landscaped behind the coastal defences in 2009, giving rise to the apparent massive increase in distance to the cliff edge.

Rock Foreshores

Surveys of foreshore areas that are covered by inter-tidal rock outcrops present some problems to the surveyors. It is logistically difficult for staff to access across the foreshore but more importantly it is very difficult to ensure that identical rock features are re-surveyed on each occasion. Due to the fragmented, creviced and 'rocky' nature of the foreshore it is extremely likely that different features will be recorded on successive surveys due to this. It can be expected that the rock foreshore would not experience significant down-weathering over short timescales and therefore any apparent changes between successive surveys are likely to be due to surveying different features rather than erosion.

Notwithstanding this, the rock foreshore areas may periodically be covered with a thin veneer of beach sand, which due to its mobility, can be absent on subsequent surveys. Such changes are identified through inspection of the photographs that are taken by the surveyors along each transect line and analysis of the sediment coding that is included in the raw data file, depicting areas of 'sand' or 'rock'.

Hendon Sea Wall (north end)

The foreshore across SNS1, SNS2 and SNS3 was not surveyed because of difficult access conditions and dangerous conditions at the time of the survey.

Ryhope

Large scale earthworks were underway by Contractors around the area at the top of cliffs at the Ryhope outfall and the outfall was partly demolished at the time of the surveys.

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

Awareness of the issues associated with the cliff top surveys has aided the interpretation of changes and despite having only a relatively short term record (cliff top surveys commenced at most stations in March 2009, with three added in September 2009) the surveys are providing useful information on locations and rates of change and therefore should be continued.

No other changes are recommended at the present time.

5. Conclusions and Areas of Concern

- Along the Whitburn frontage beach level fluctuations of 0.2 to 0.4m are common and these are representative of natural changes between successive surveys. Along most beach sections, with a few local exceptions, there has been a general trend of upper foreshore lowering, with material being deposited on the lower profile to create a flatter gradient.
- Beach levels are particularly low along Seaburn, where the high water contour intercepts the sea wall. This places the structure at high exposure, leaving it vulnerable to damage and toe undermining.
- Despite the shelter provided by the pier and breakwater structures at Sunderland Harbour, variations in foreshore level can still be quite marked with up to 0.8m change in levels recorded.
- The outer wall of the dock is highly exposed, due to the presence of only a very narrow width of foreshore and along two profiles new record low foreshore levels were recorded.
- Between the North East Pier and the South West Breakwater foreshore levels were generally only slightly different to those recorded in September 2009.
- Along much of the Hendon to Ryhope frontage, there has been a general trend of upper foreshore lowering, with material being deposited on the lower profile to create a flatter gradient. However, along about a 600m frontage at the southern end of the Hendon sea wall, erosion affected the whole width of the beach section.
- Several sections of undefended cliffs between the end of the Hendon Sea Wall and Ryhope Dene have experienced significant cliff top recession, in one location over 7m, between an earlier profile survey in November 2006 and the current survey in October 2010. The cliffs continue to be actively eroding along much of this frontage.
- There continue to be significant changes particularly affecting the cliff top position in the area fronting the former landfill site at Halliwell Banks. In several places erosion has exceeded 2m since the cliff top survey began in March 2009, and in one location the erosion has been greater than 5m over this timescale.

Appendices

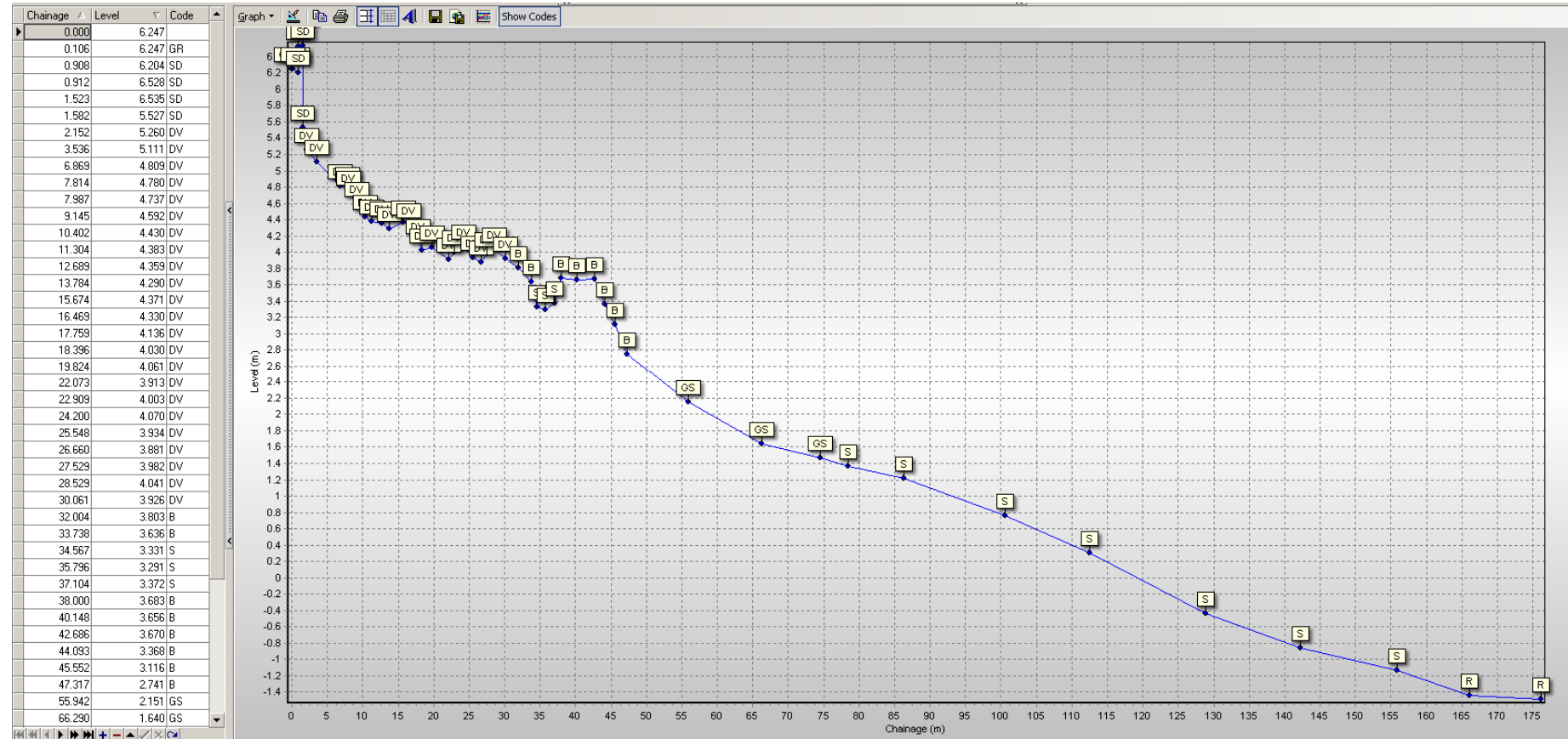
Appendix A
Beach Profiles

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

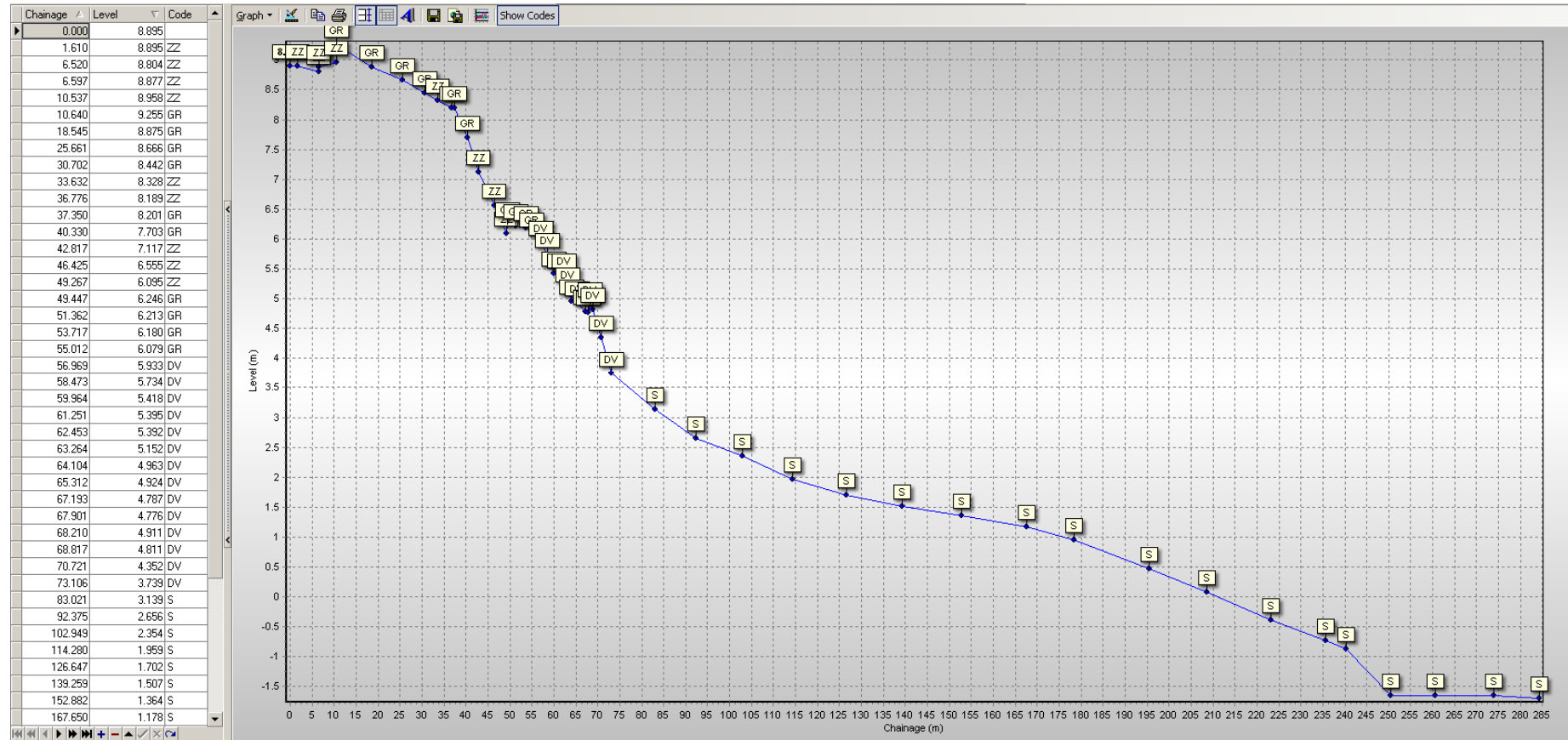
| Code | Description |
|-------------|----------------------|
| M | Mud |
| S | Sand |
| G | Gravel |
| GS | Gravel & Sand |
| GM | Gravel & Mud |
| MS | Mud & Sand |
| B | Boulders |
| R | Rock |
| SD | Sea Defence |
| SM | Salt Marsh |
| GR | Grass |
| D | Dune (non-vegetated) |
| DV | Dune (vegetated)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

Sunderland North

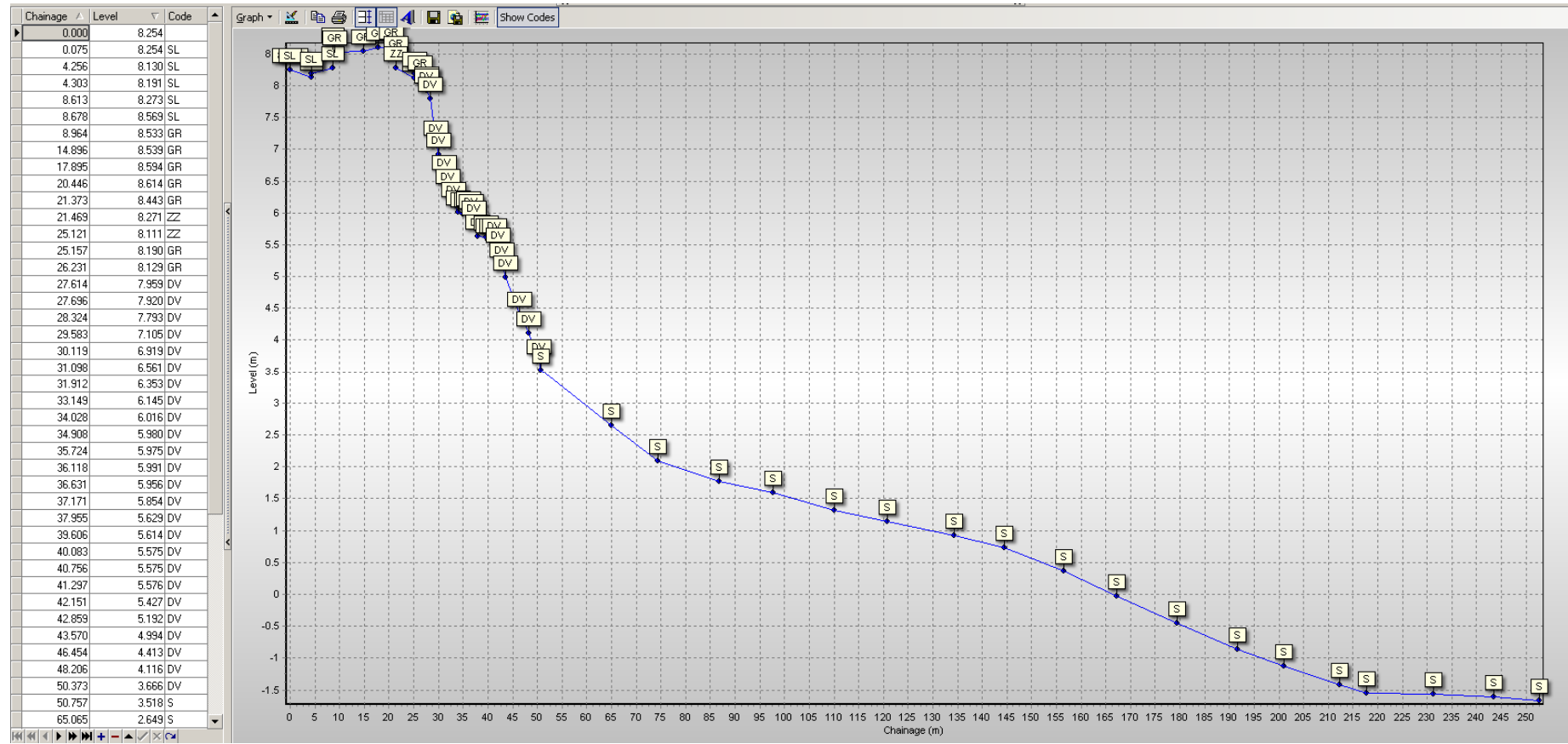
1bSNN1 - 28/09/2010



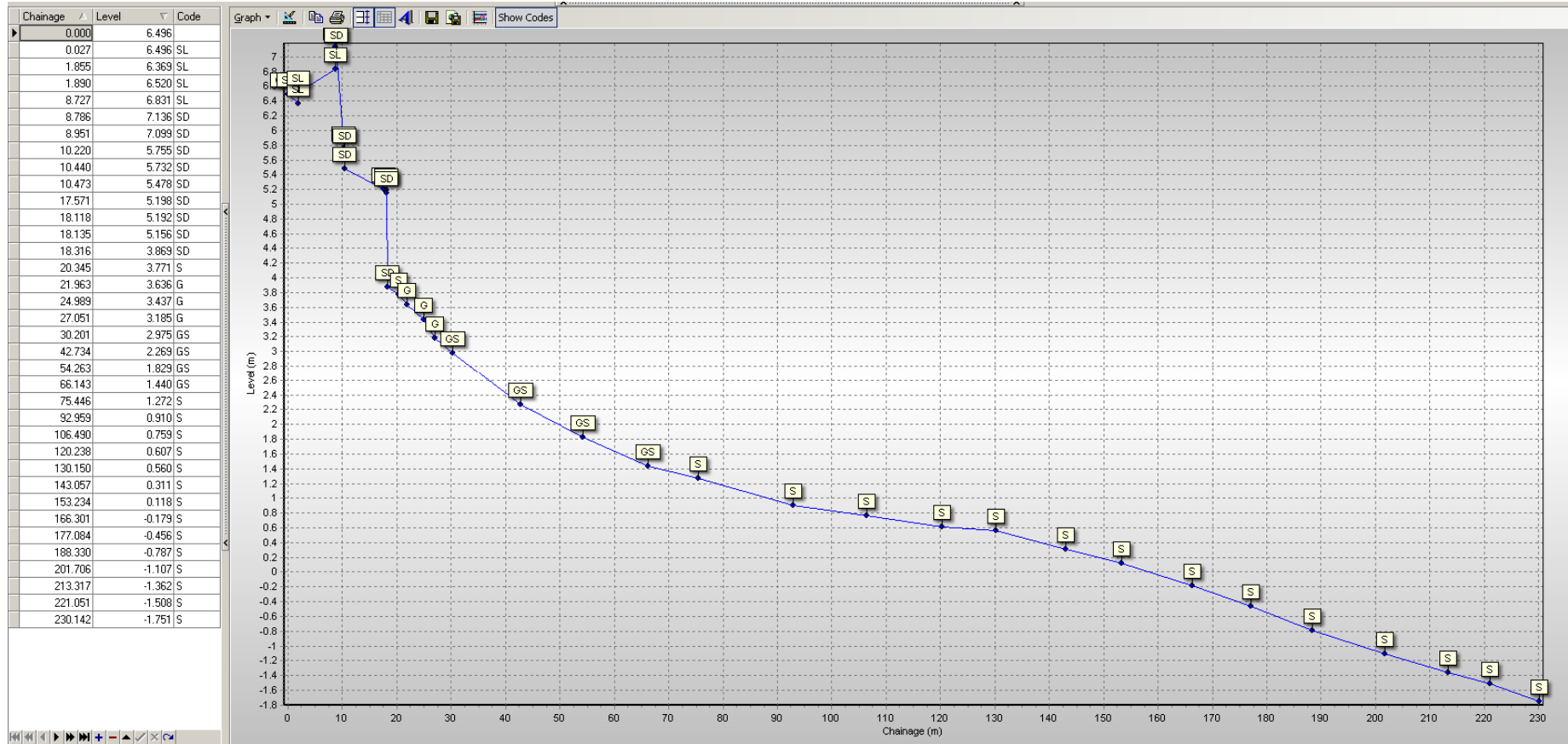
1bSNN2 - 28/09/2010



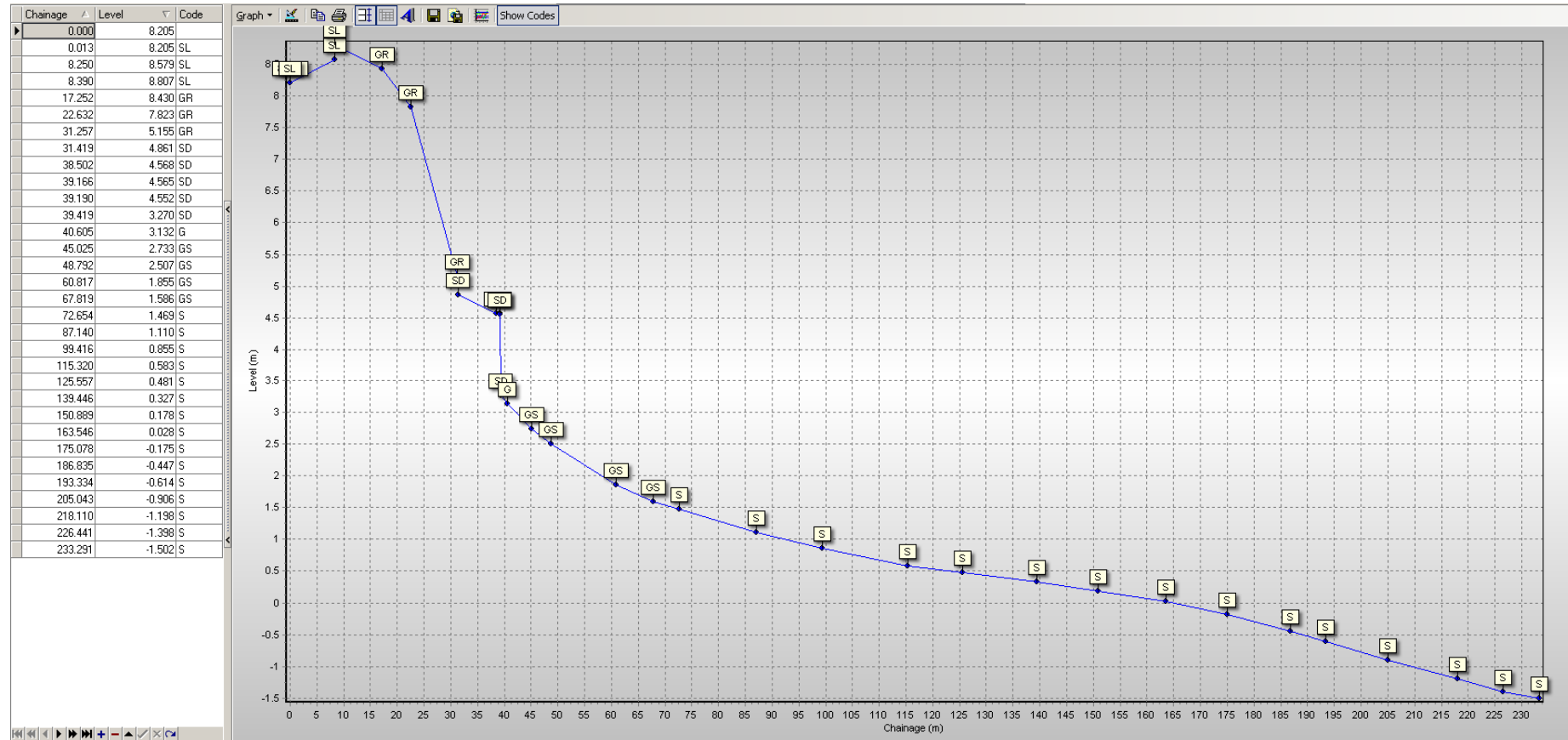
1bSNN3 - 28/09/2010



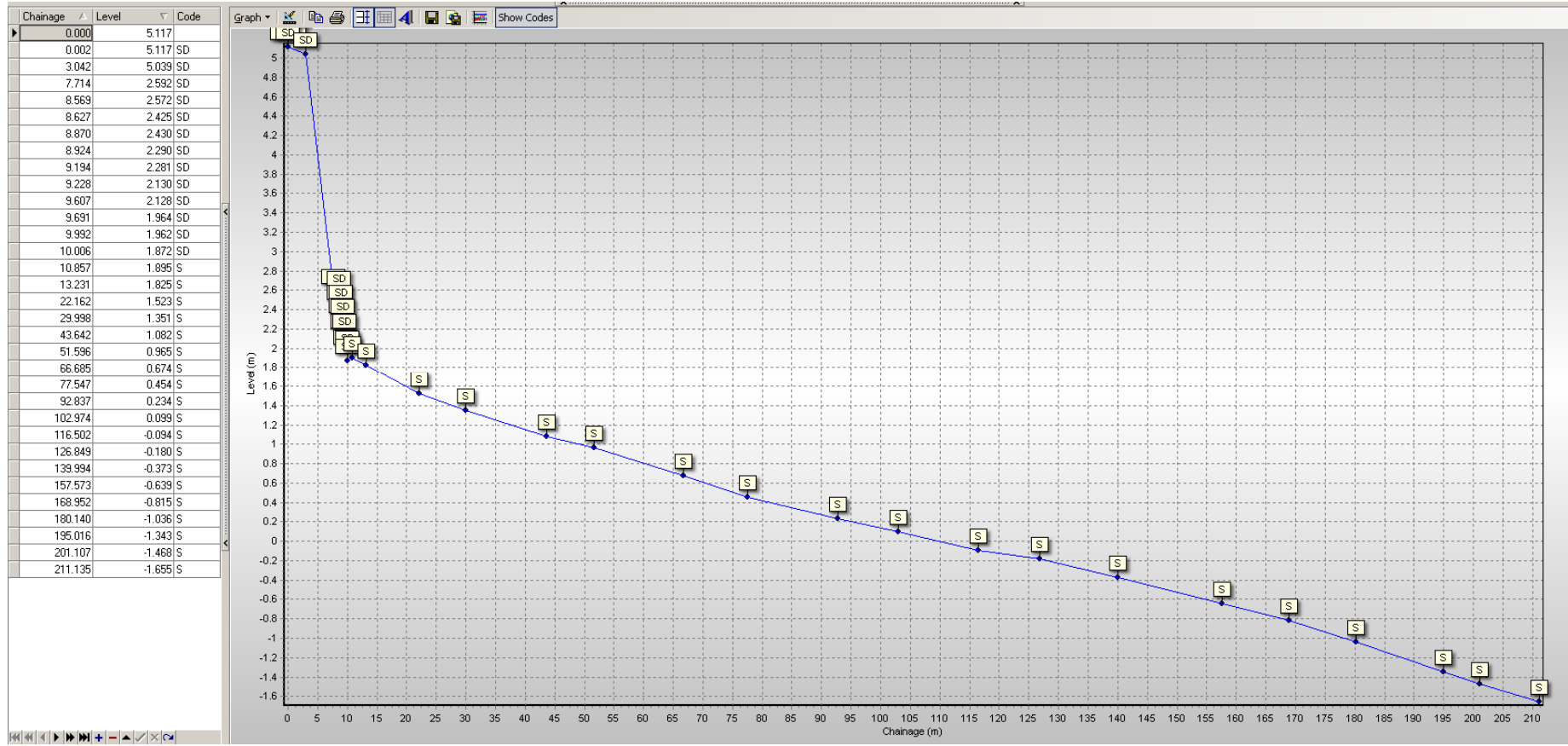
1bSNN4 - 28/09/2010



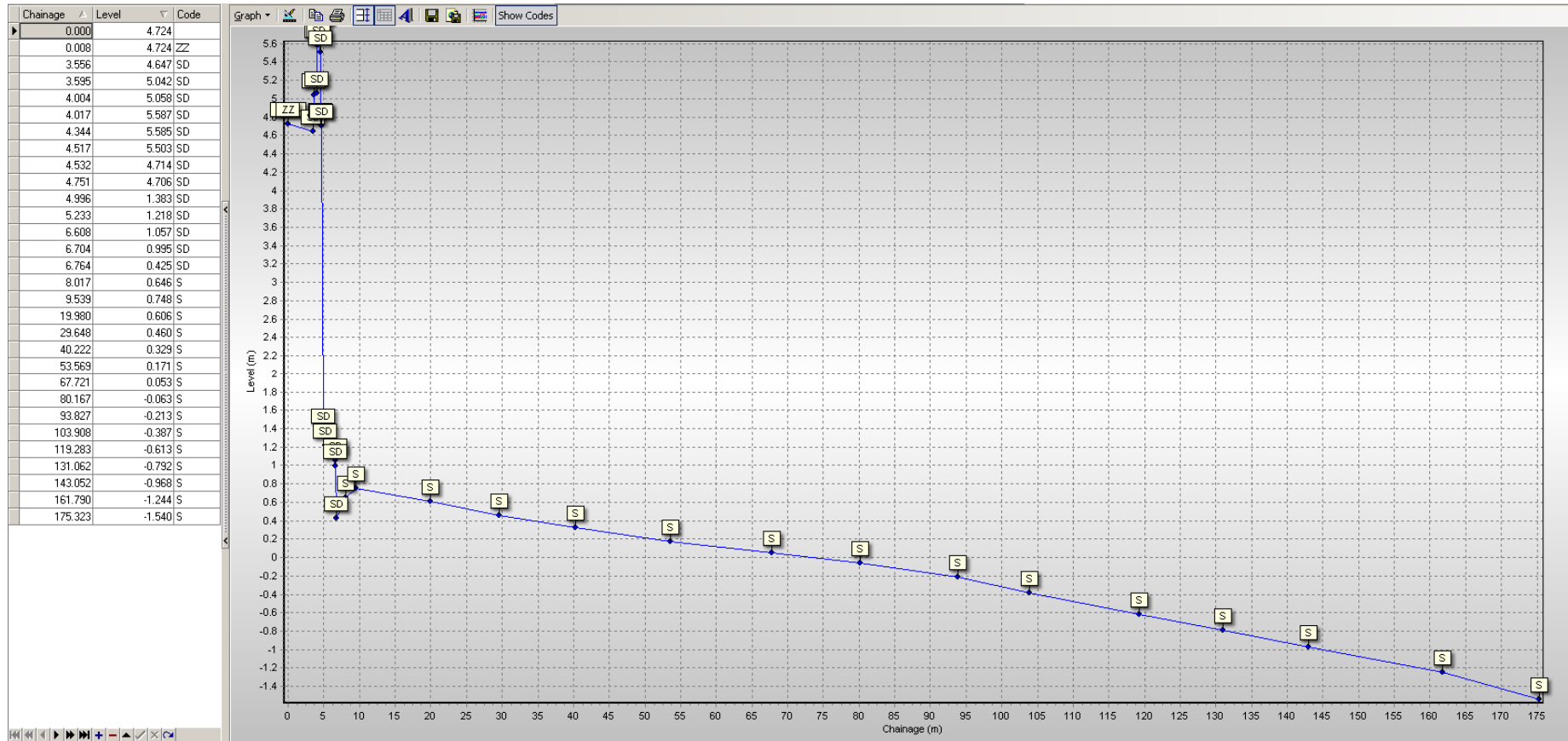
1bSNN5 - 28/09/2010



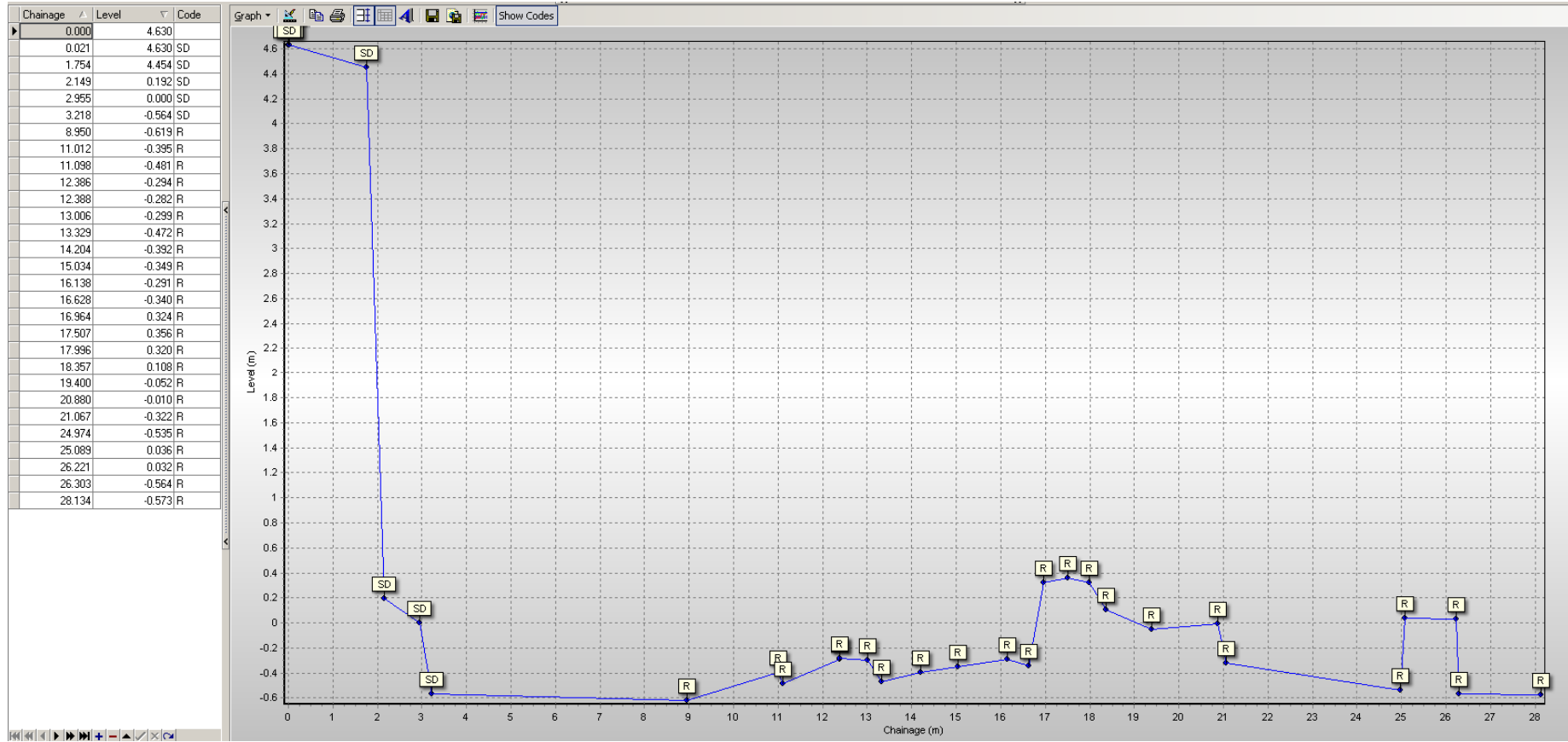
1bSNN6 - 28/09/2010



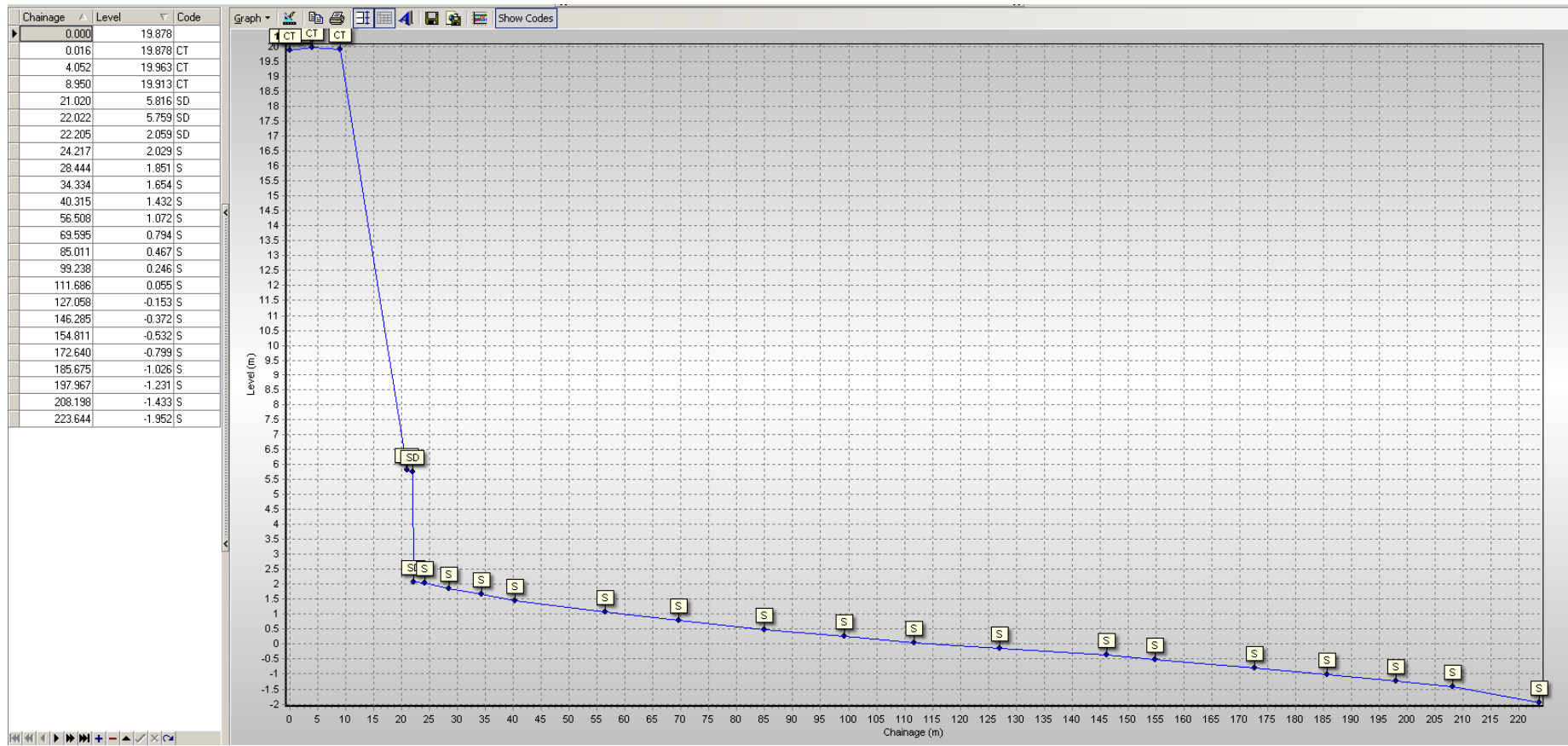
1bSNN7 - 28/09/2010



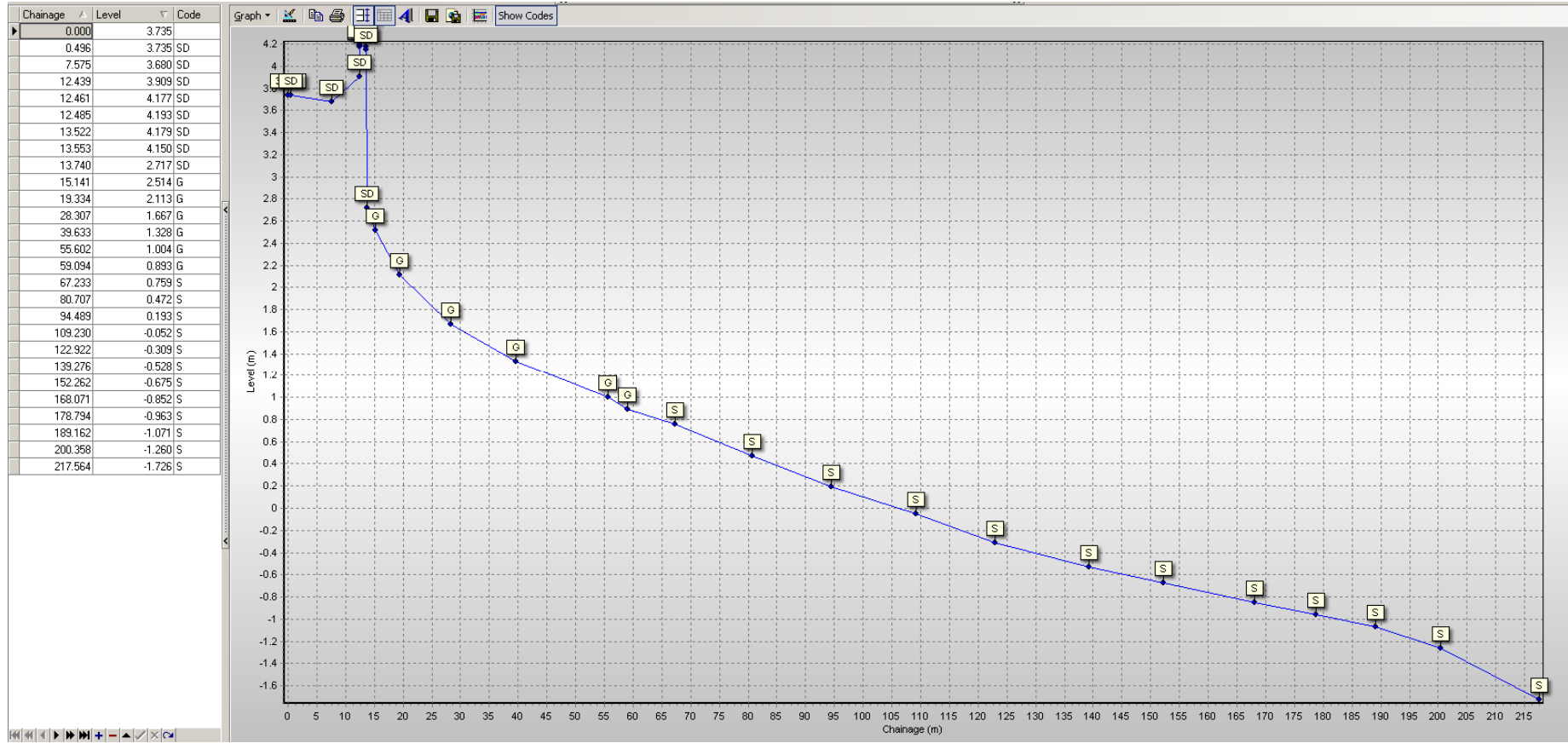
1bSNN8 - 28/09/2010



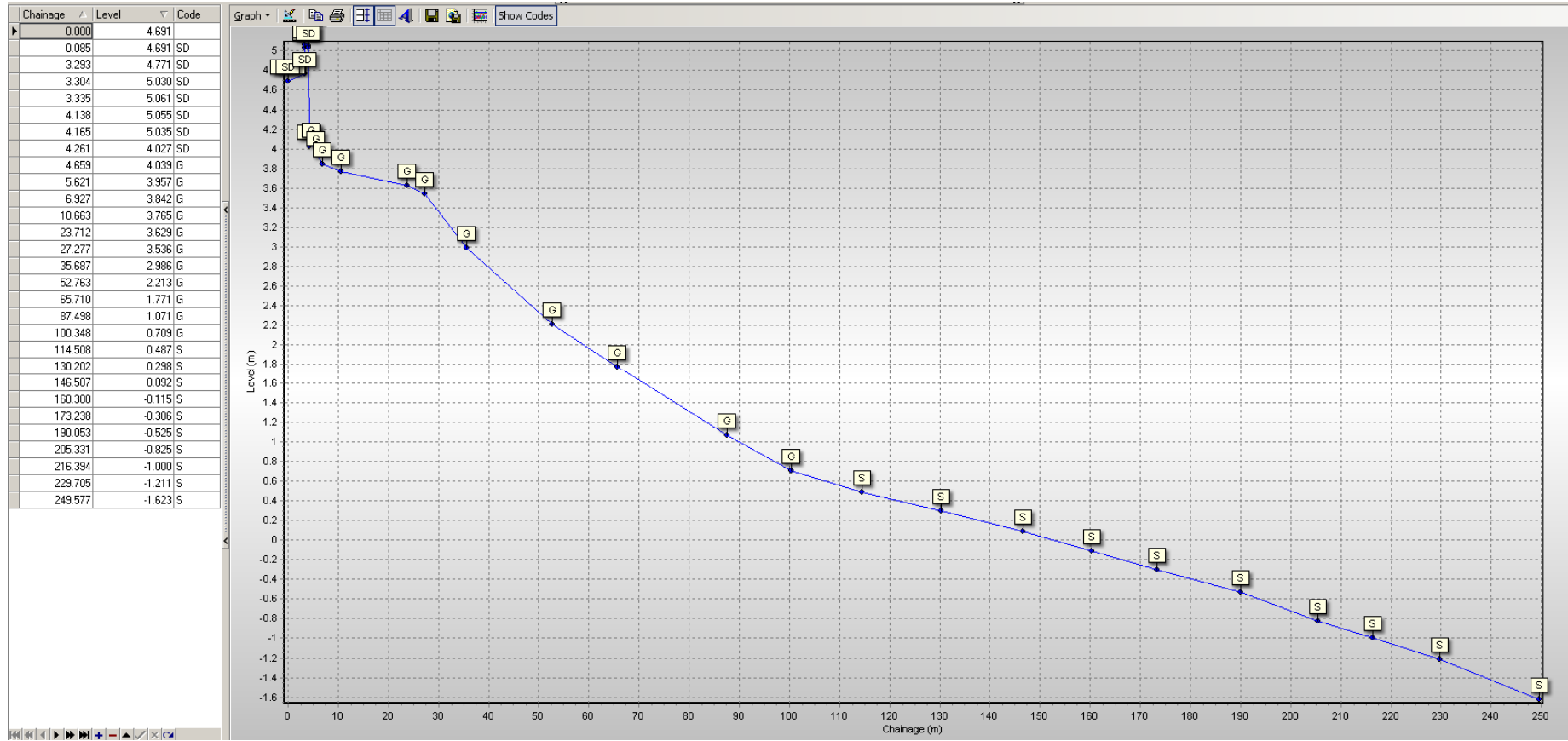
1bSNN9 - 28/09/2010



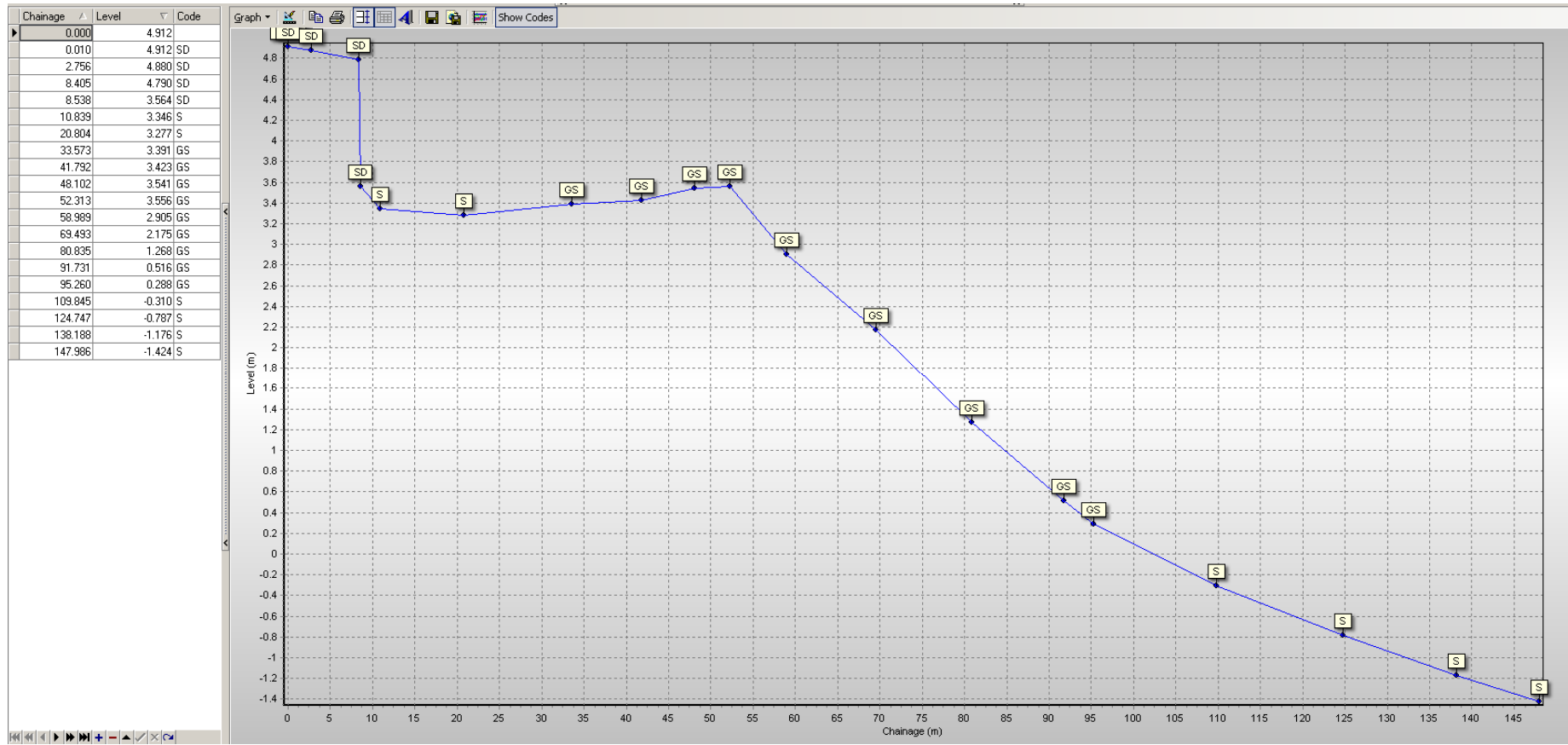
1bSNN10 - 28/09/2010



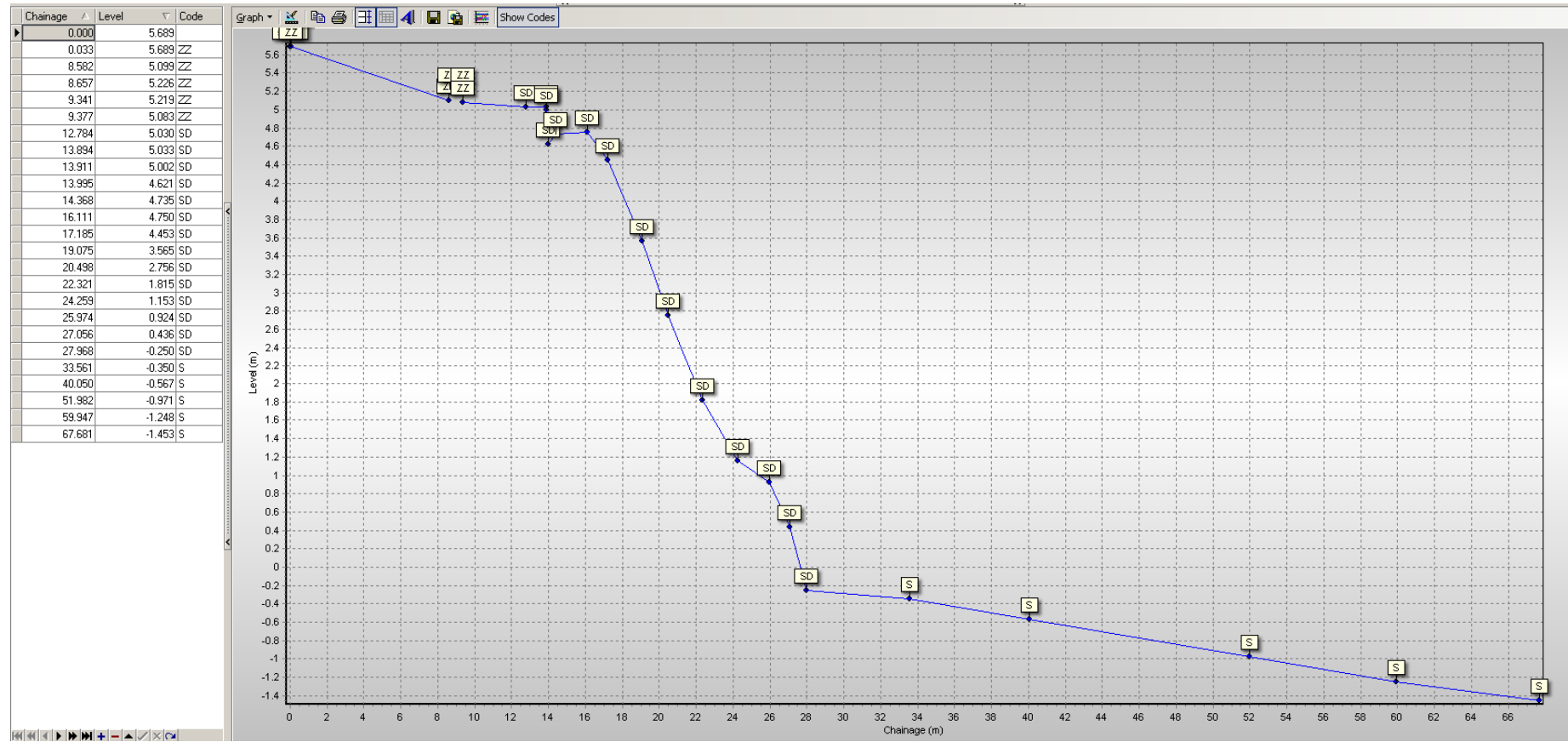
1bSNN11 - 28/09/2010



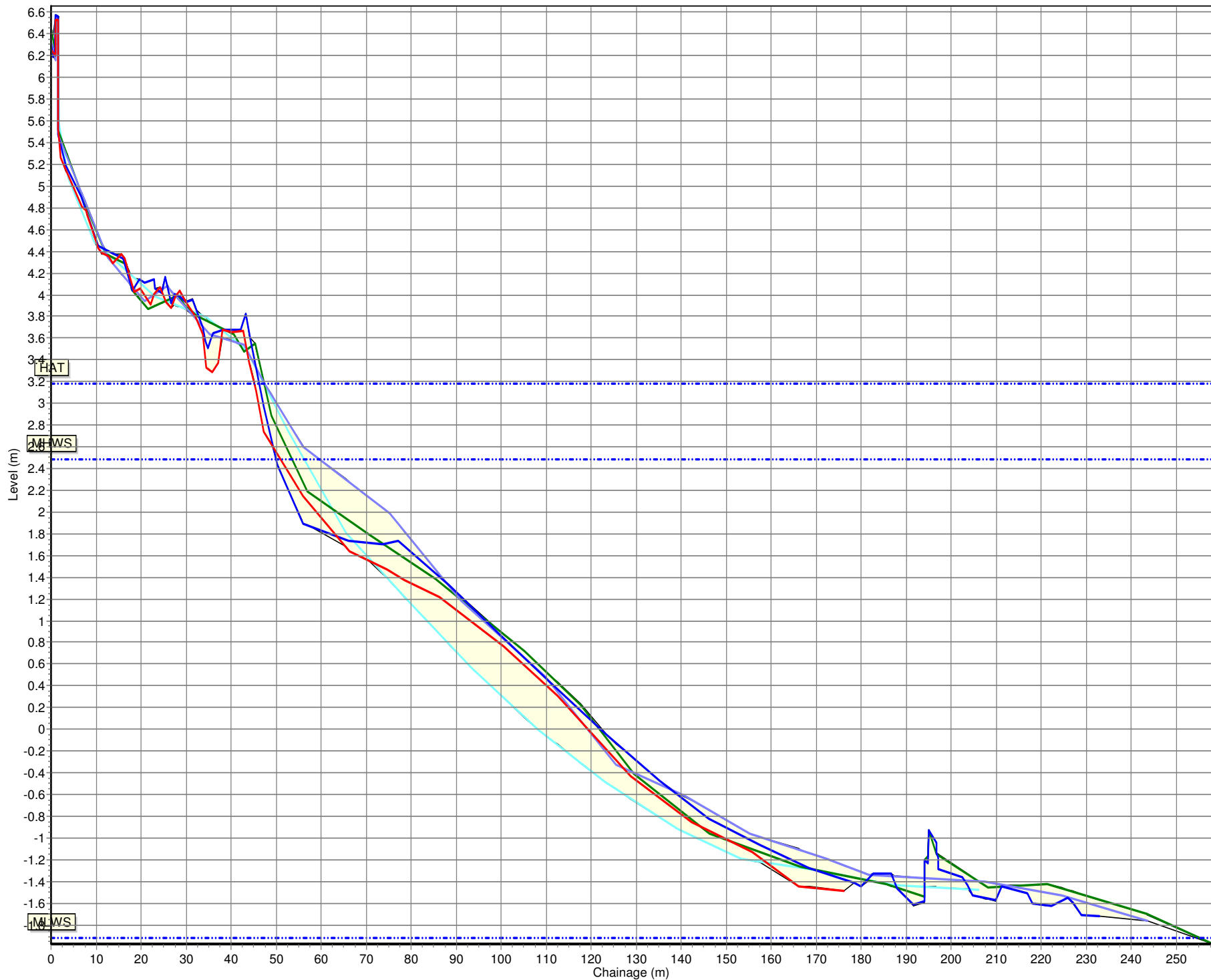
1bSNN12 - 28/09/2010



1bSNN13 - 28/09/2010

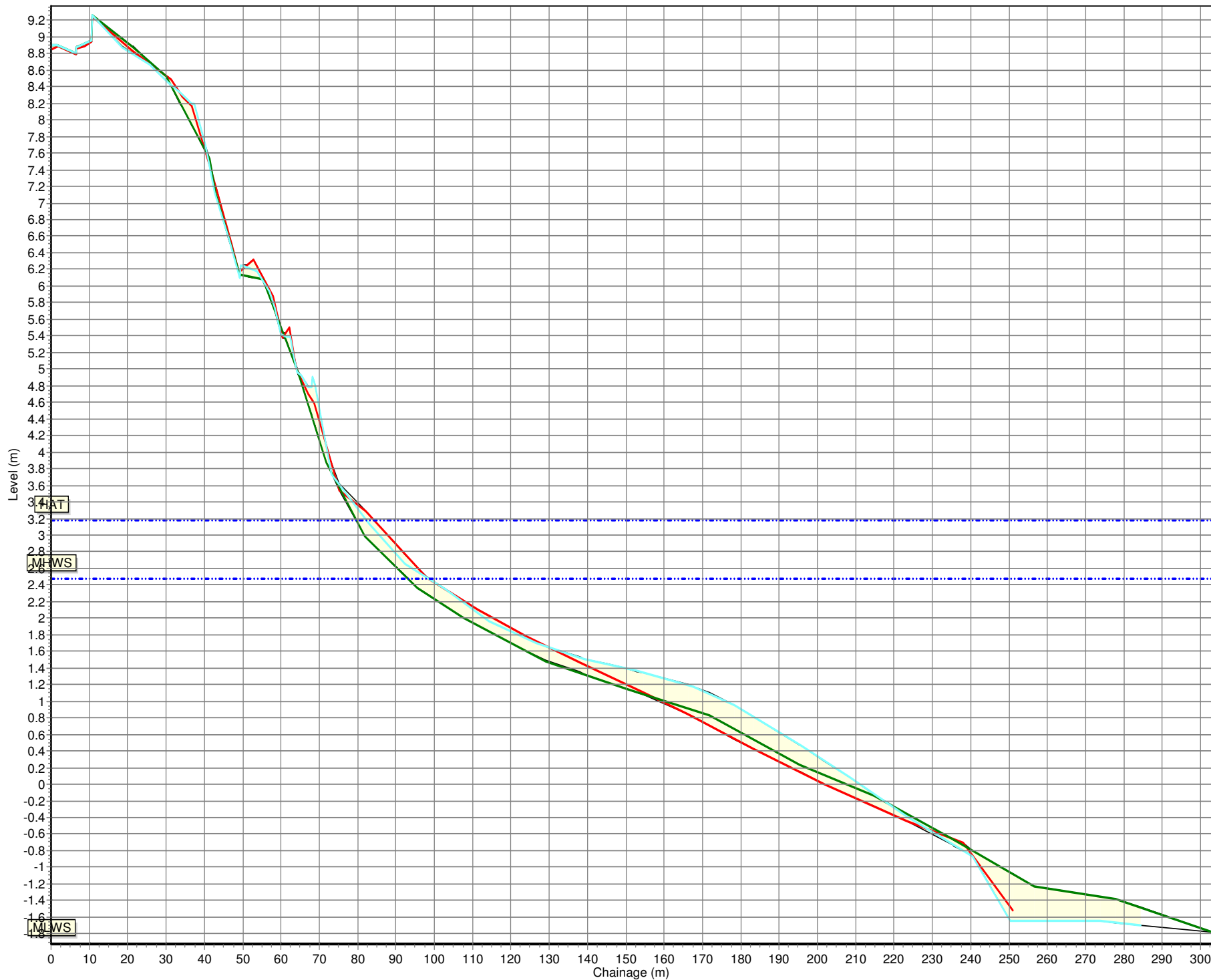


Beach Profiles: 1bSNN1



- Profiles Envelope
- 10/11/2006
- 27/04/2009
- 07/09/2009
- 18/03/2010
- 28/09/2010

Beach Profiles: 1bSNN2



- Profiles Envelope
- 10/11/2006
- 07/09/2009
- 28/09/2010

HAT

MWS

LWS

Beach Profiles: 1bSNN3



- Profiles Envelope
- 10/11/2006
- 07/09/2009
- 28/09/2010

MHW

MHW

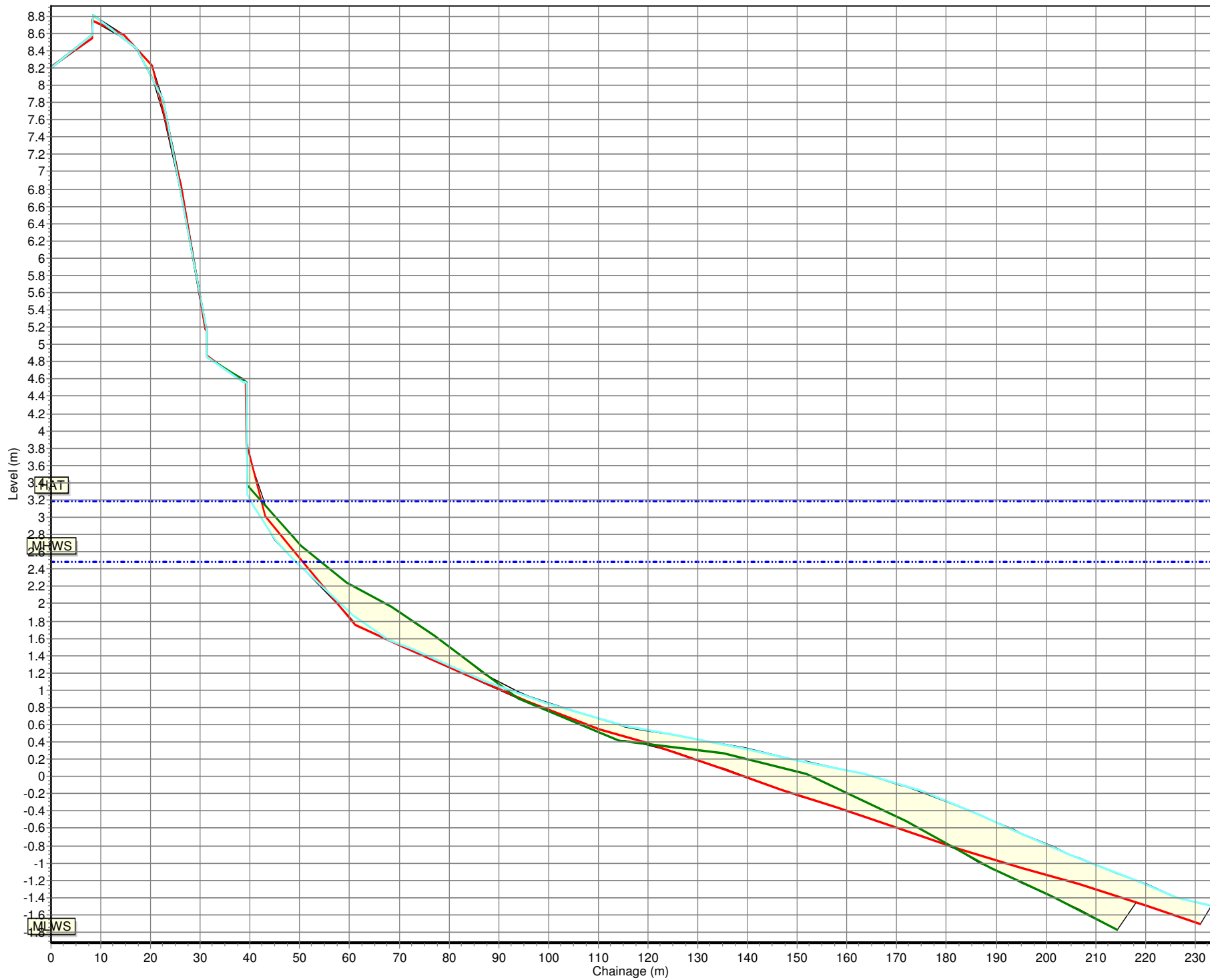
MLW

Beach Profiles: 1bSNN4



- Profiles Envelope
- 10/11/2006
- 07/09/2009
- 28/09/2010

Beach Profiles: 1bSNN5



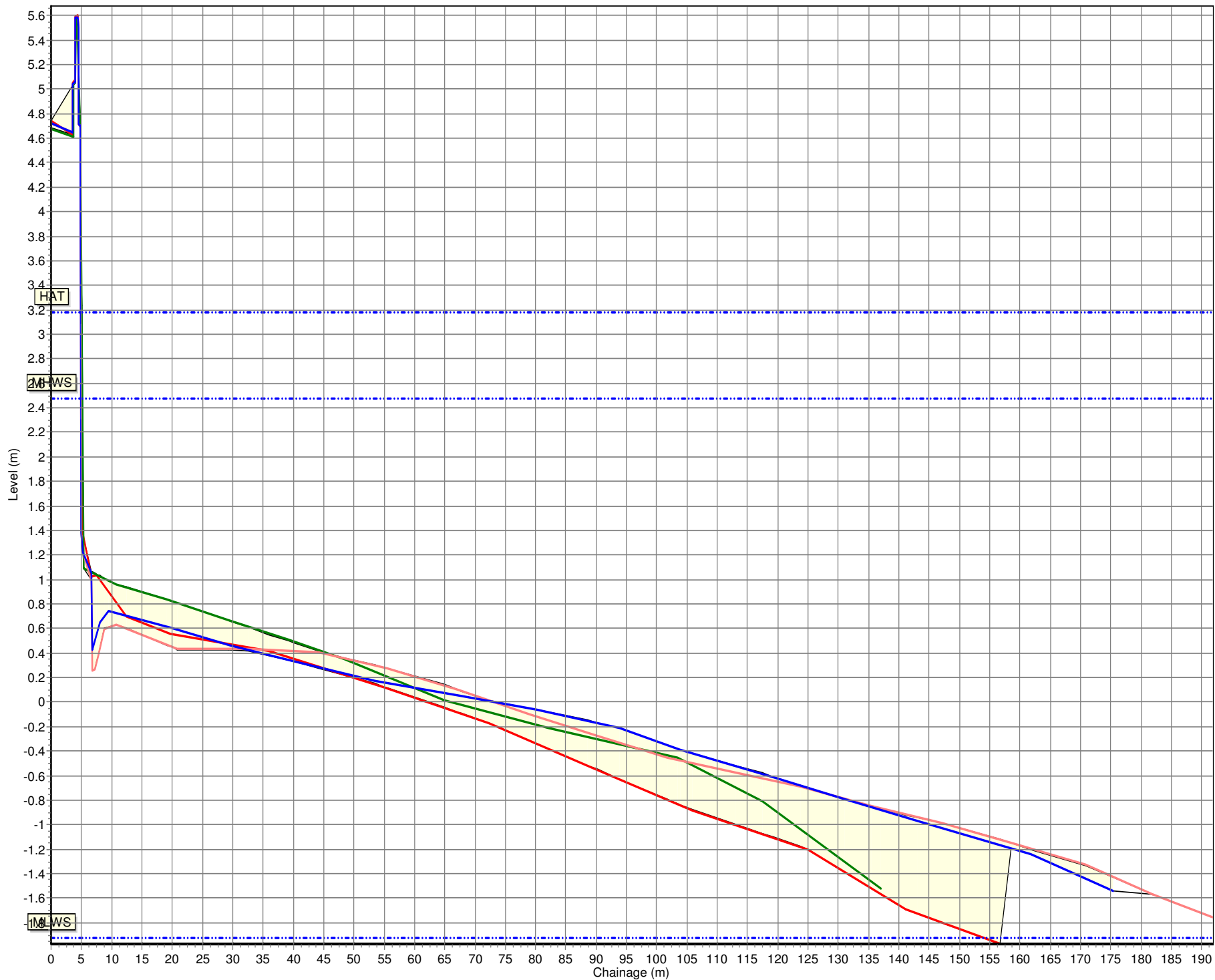
- Profiles Envelope
- 10/11/2006
- 07/09/2009
- 28/09/2010

Beach Profiles: 1bSNN6



- Profiles Envelope
- 10/11/2006
- 07/09/2009
- 28/09/2010

Beach Profiles: 1bSNN7



- Profiles Envelope
- 27/04/2009
- 07/09/2009
- 18/03/2010
- 28/09/2010

Beach Profiles: 1bSNN8



- Profiles Envelope
- 10/11/2006
- 07/09/2009
- 28/09/2010

HAT

MWS

LWS

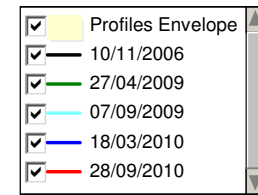
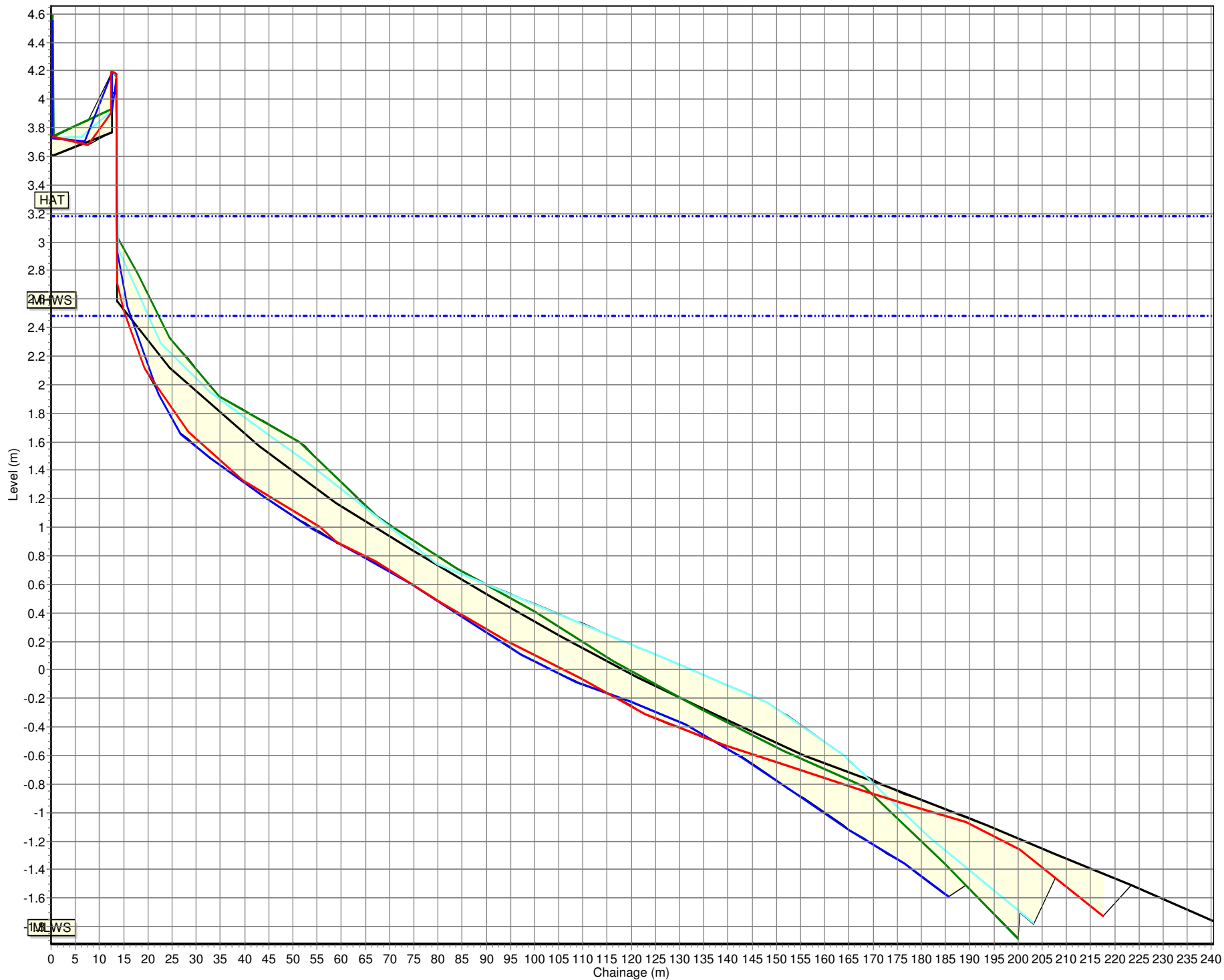
Beach Profiles: 1bSNN9



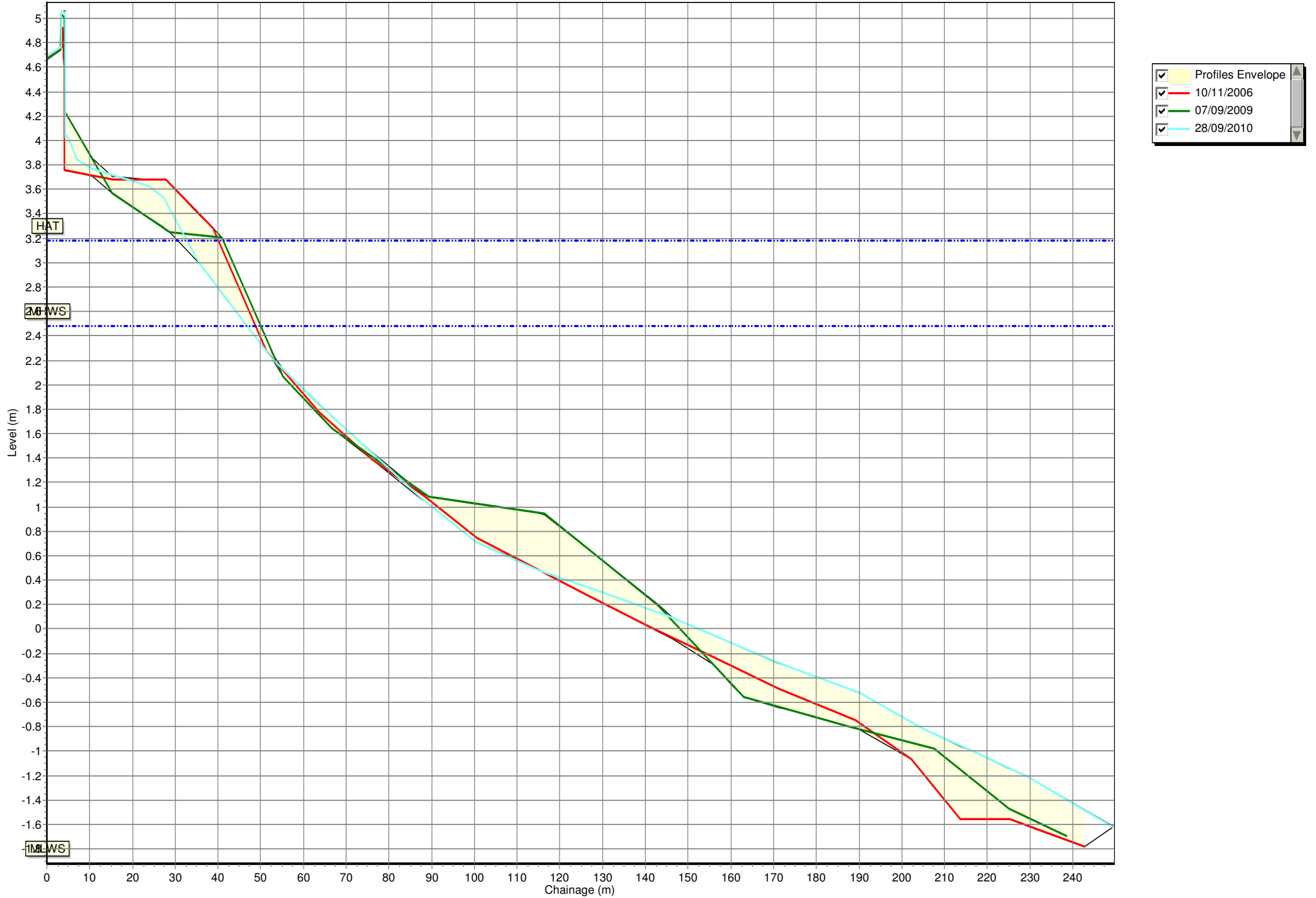
- Profiles Envelope
- 10/11/2006
- 02/12/2008
- 07/09/2009
- 28/09/2010

HAT
MWS
LWS

Beach Profiles: 1bSNN10



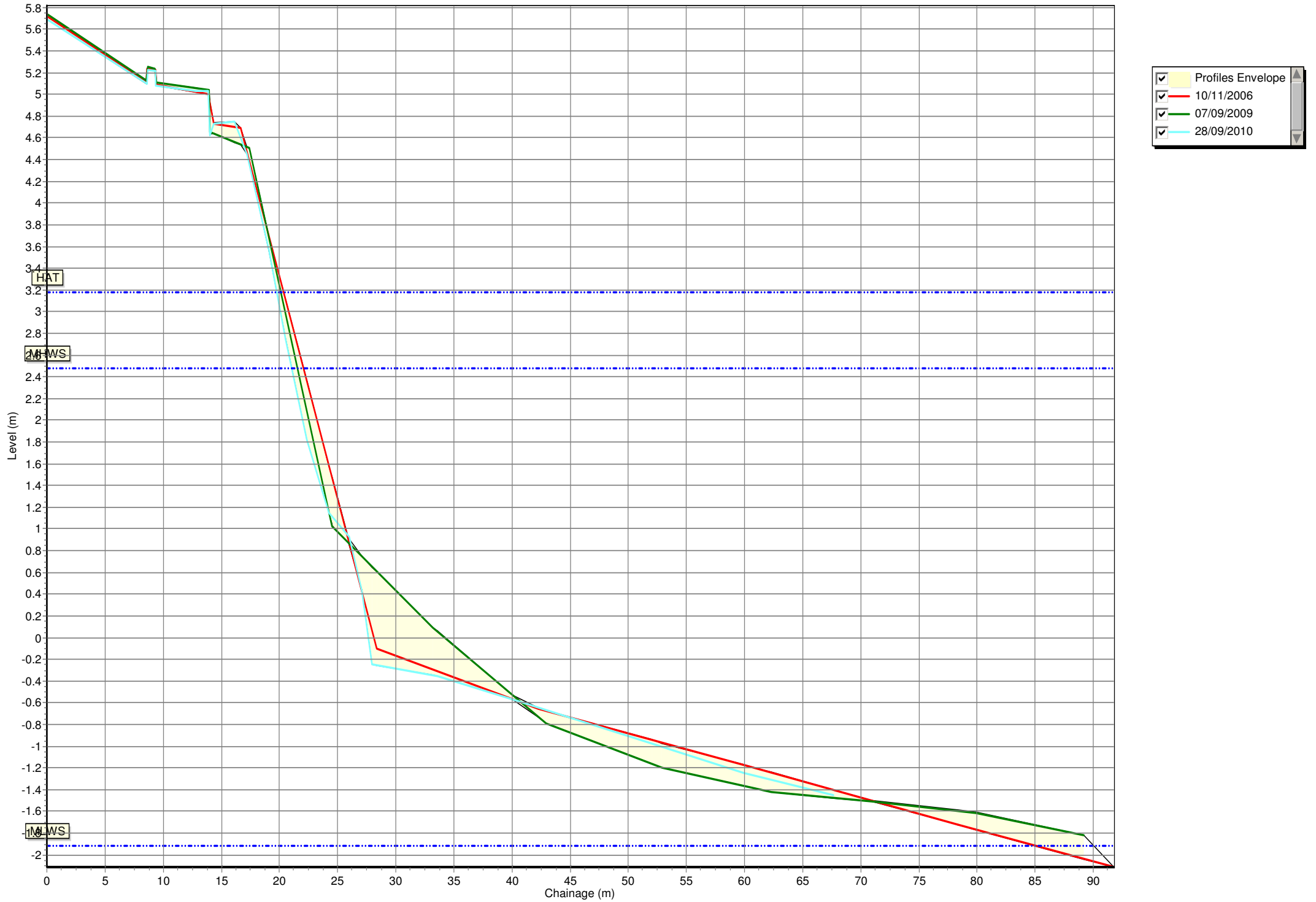
Beach Profiles: 1bSNN11



Beach Profiles: 1bSNN12

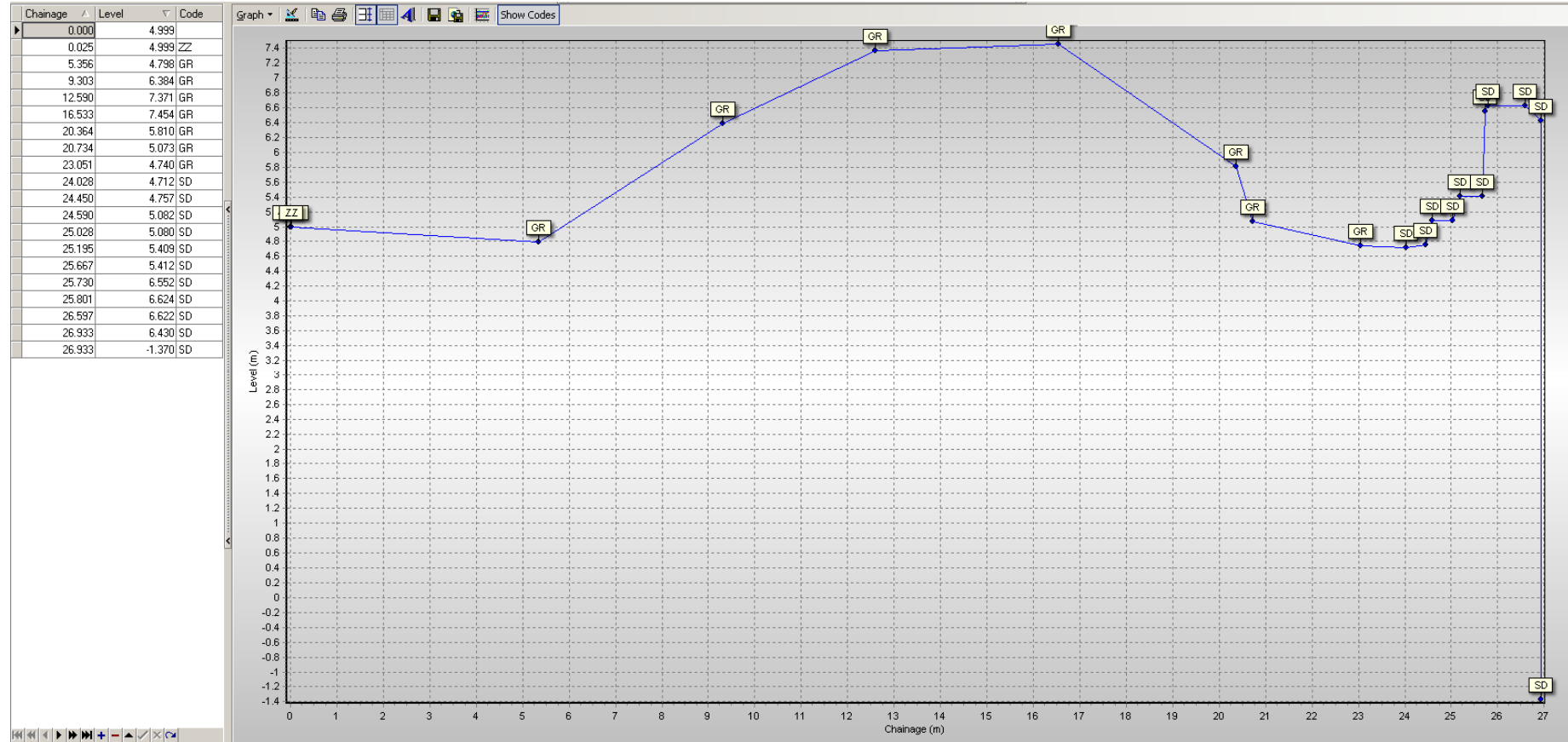


Beach Profiles: 1bSNN13

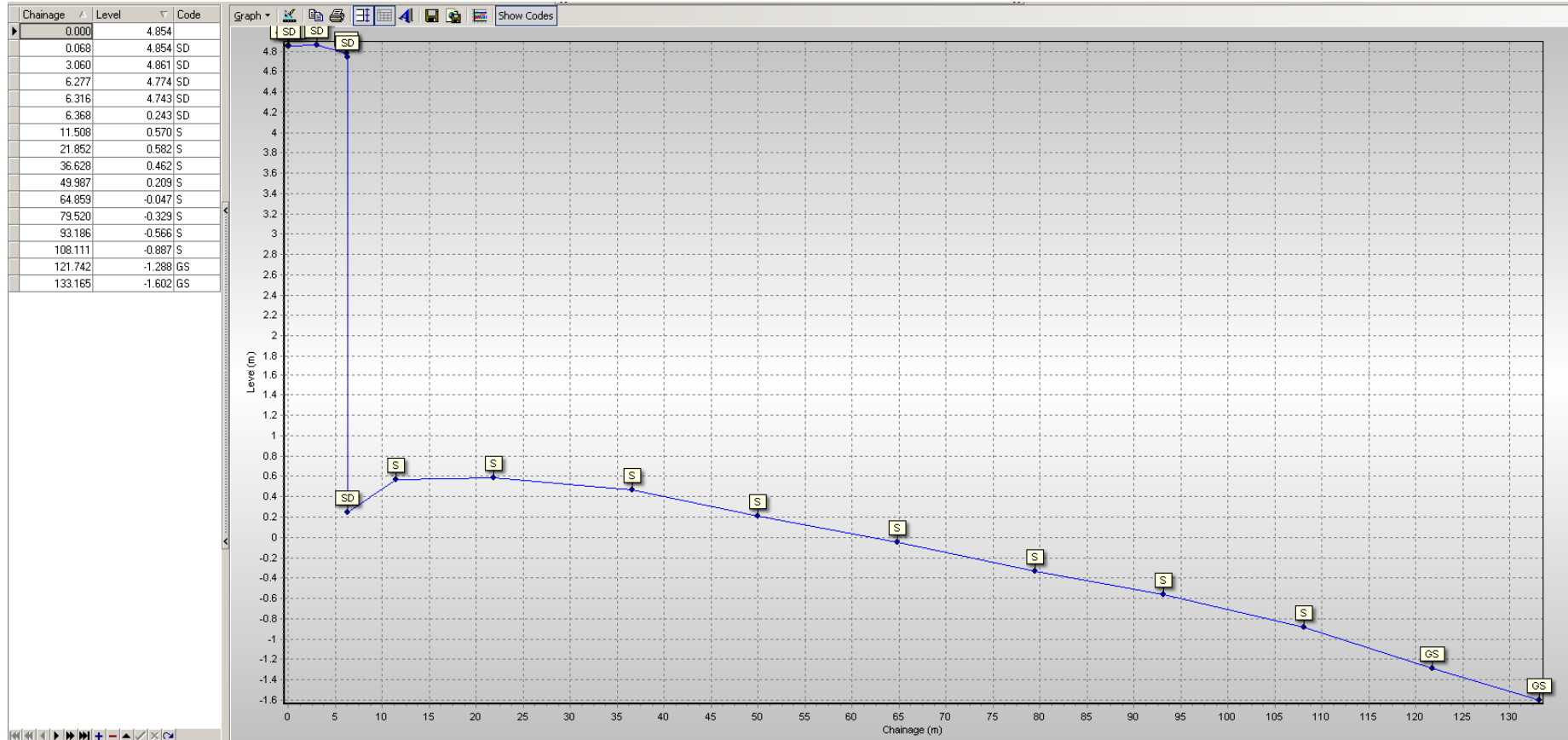


Sunderland Central

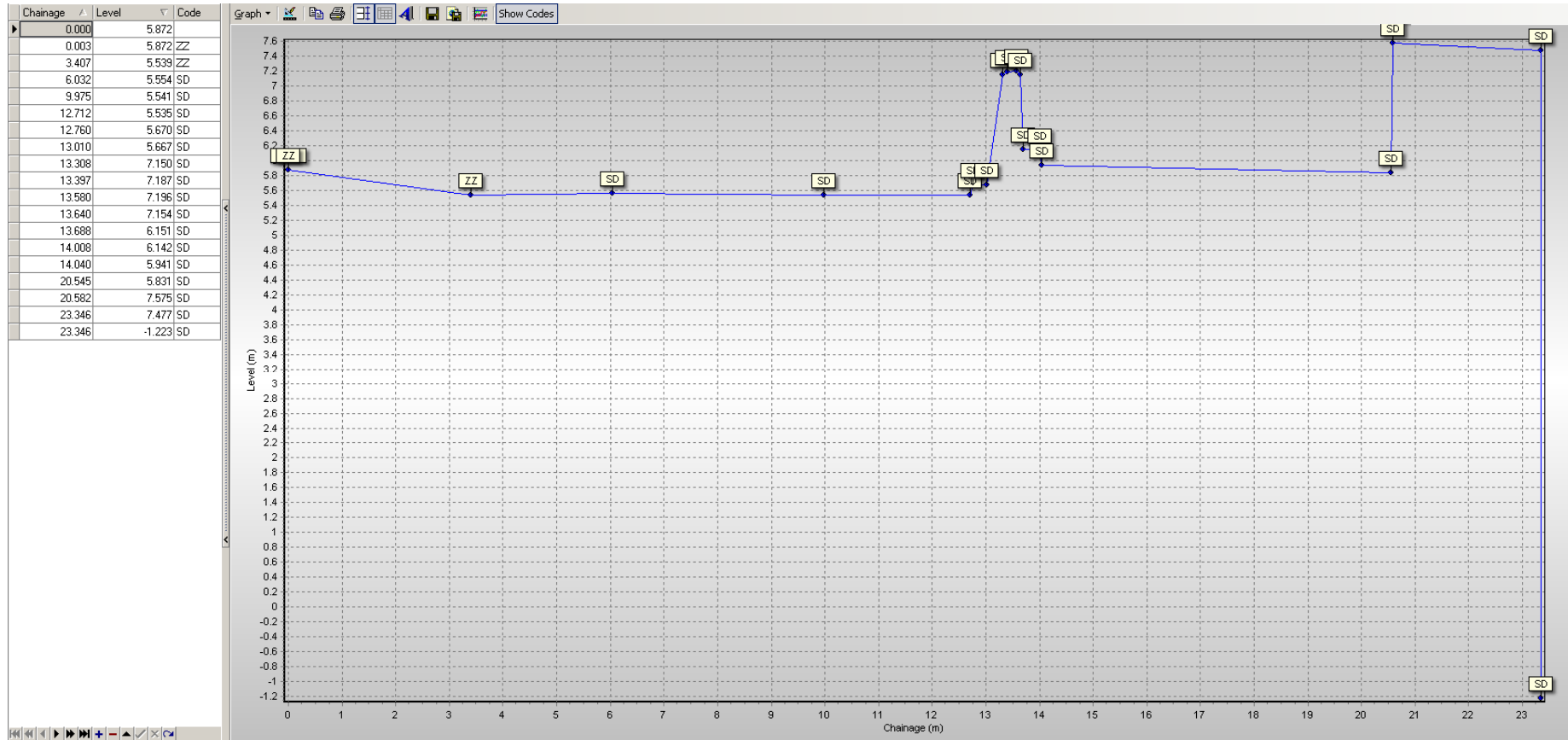
1bSNC1 – 06/09/2010



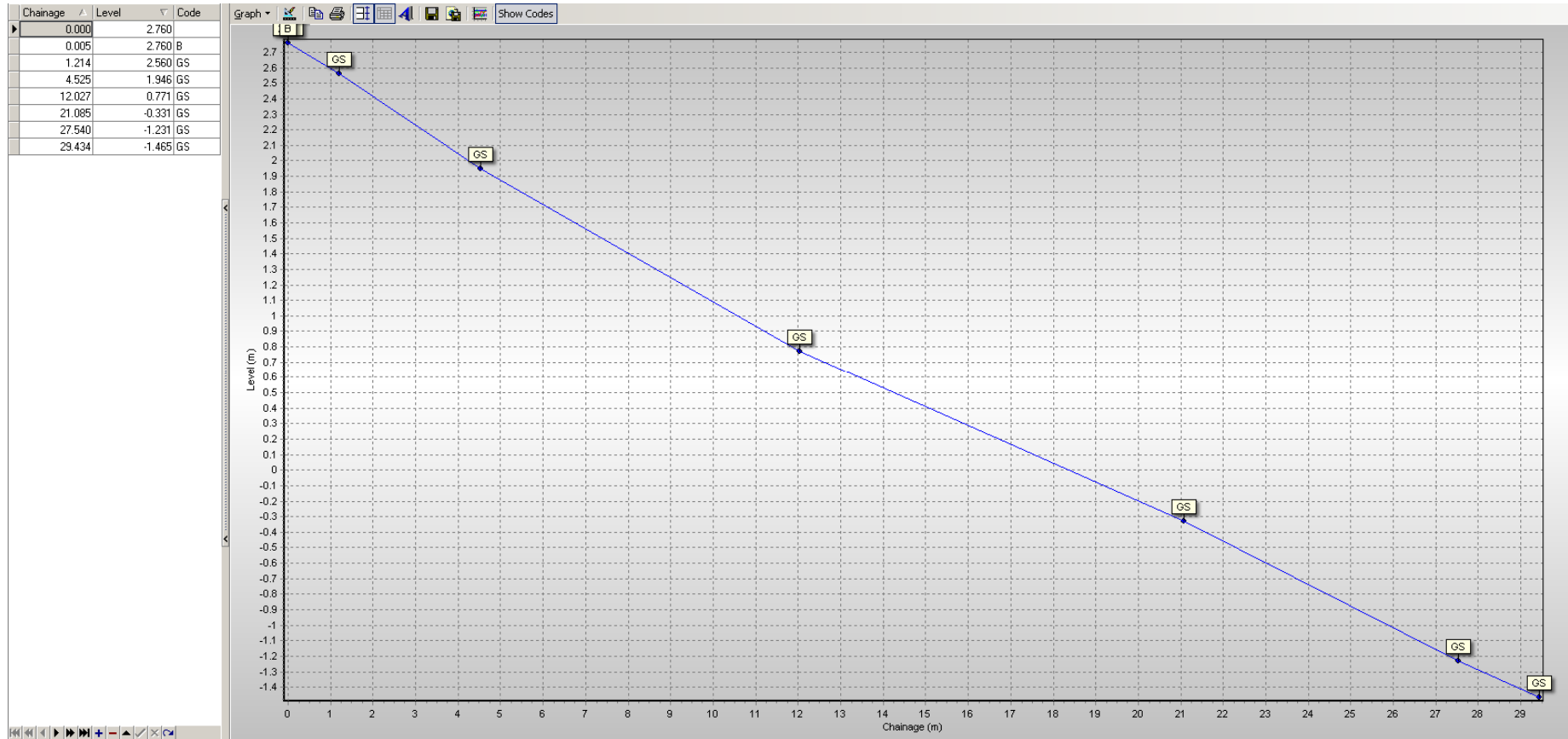
1bSNC2 – 06/09/2010



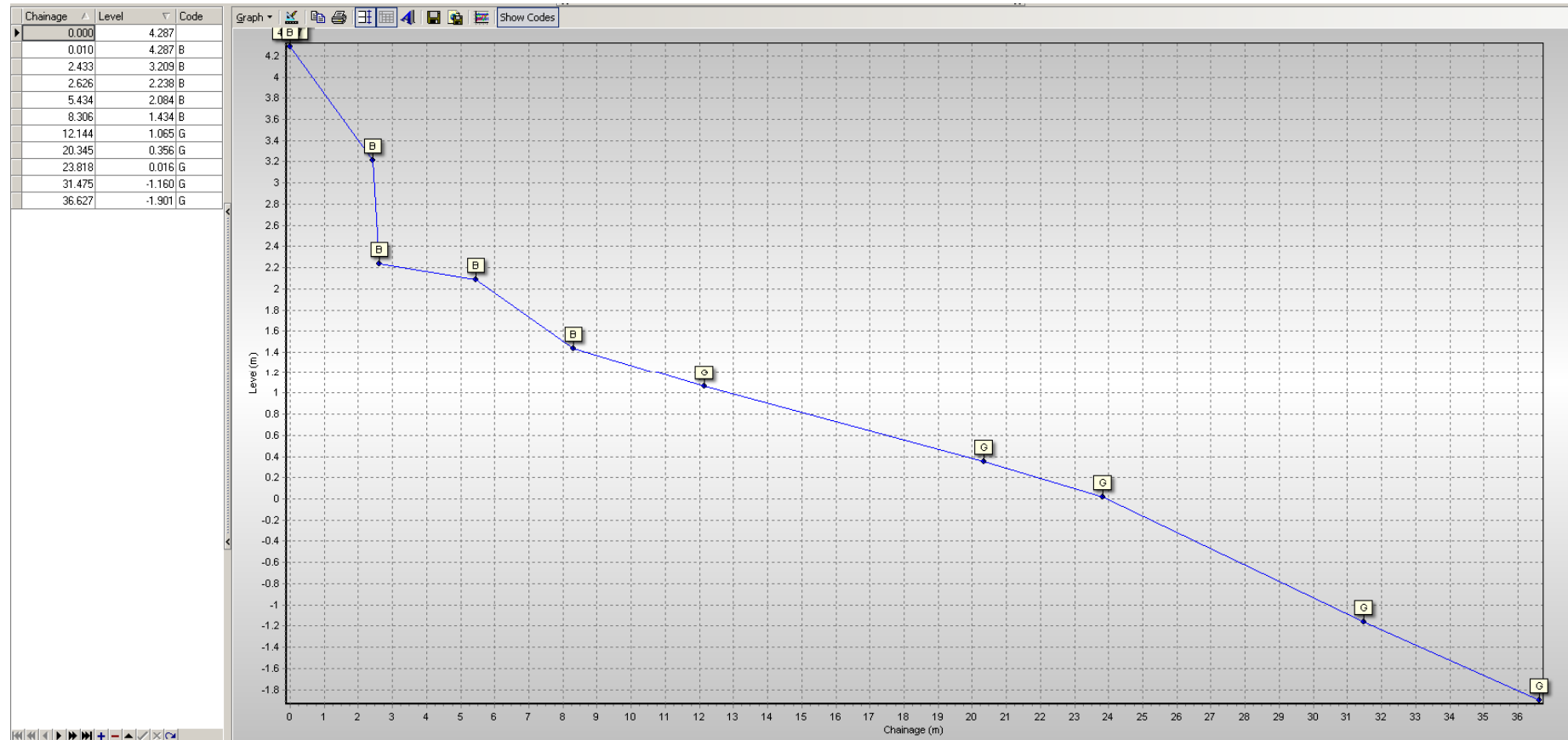
1bSNC3 – 06/09/2010



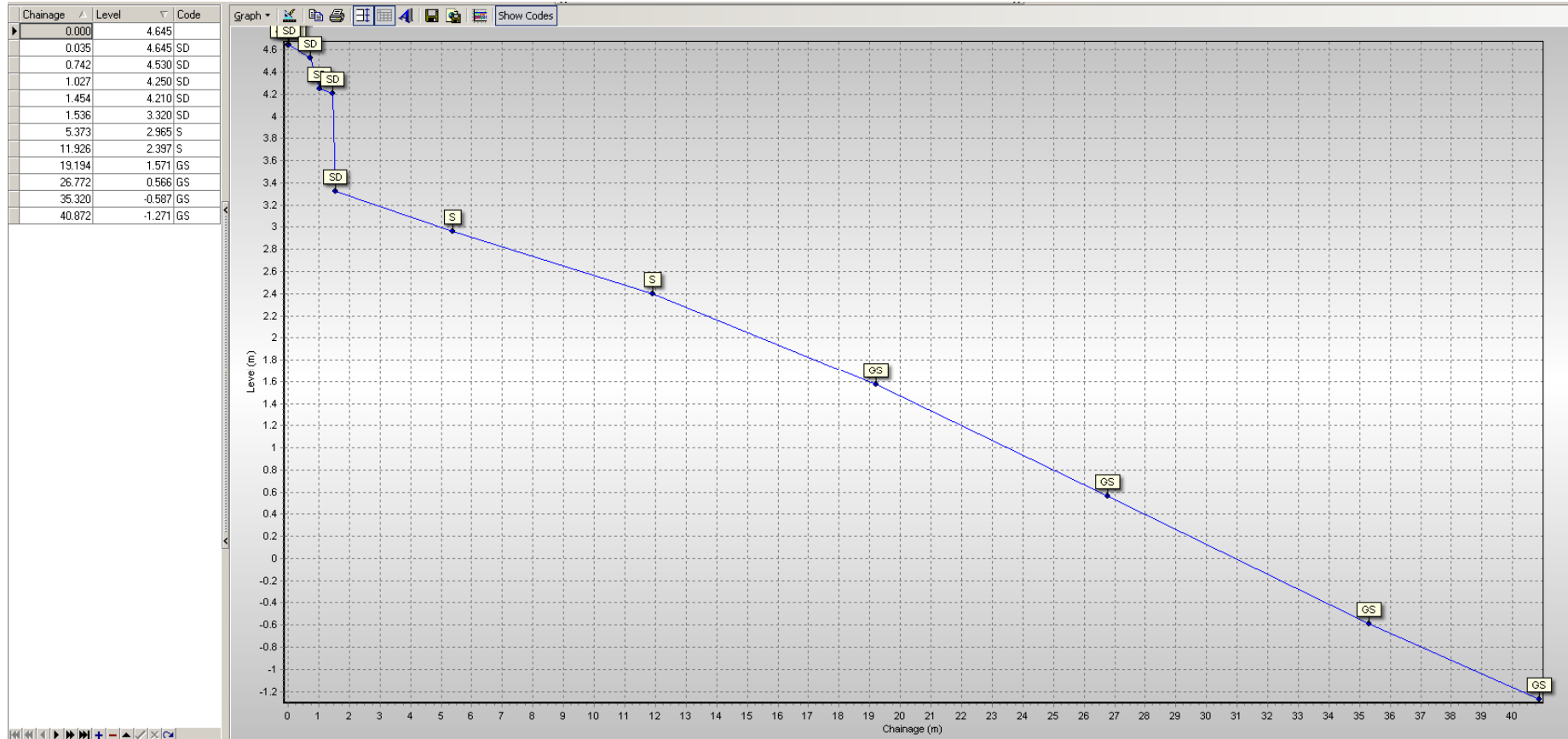
1bSNC4 – 06/09/2010



1bSNC5 – 06/09/2010

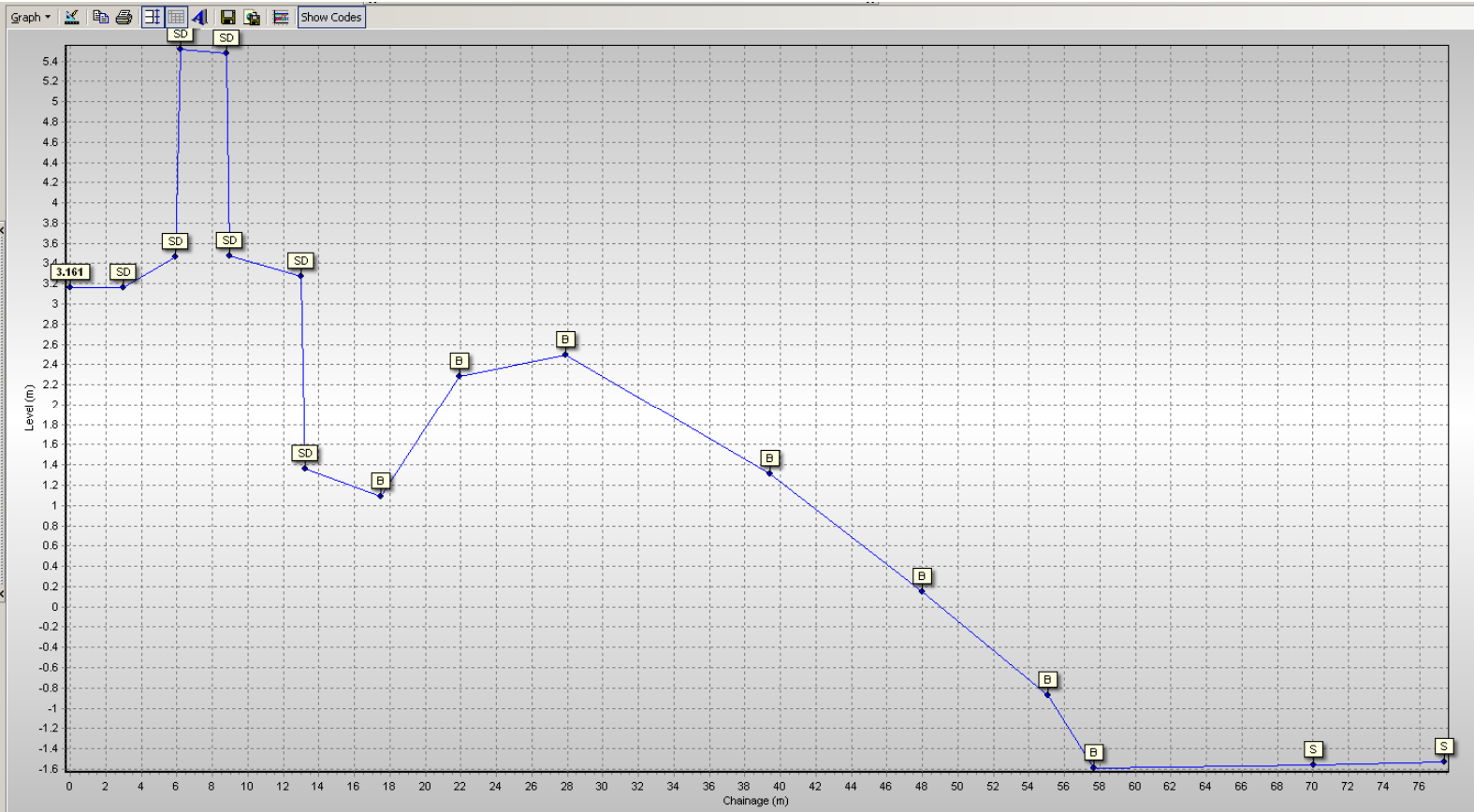


1bSNC6 – 06/09/2010

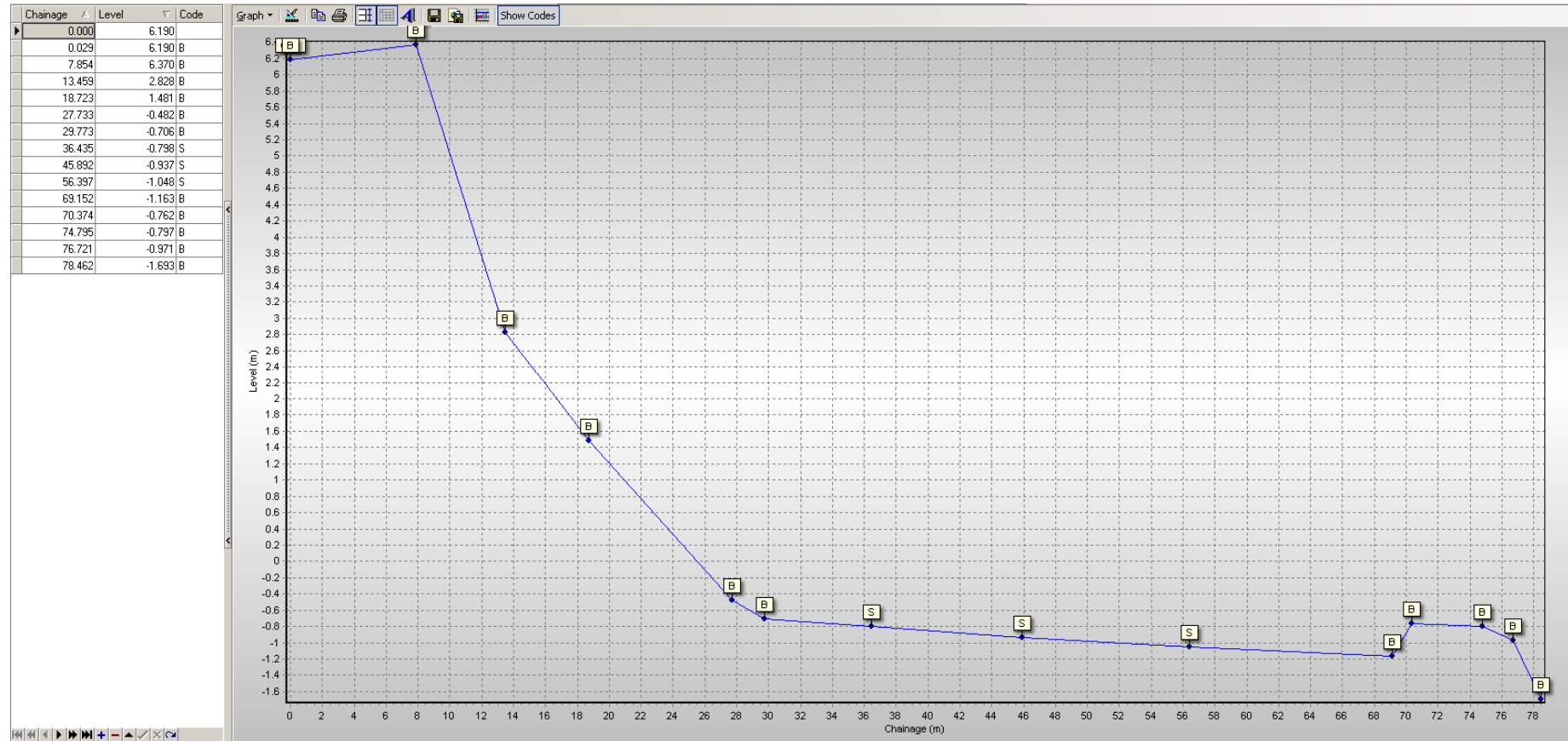


1bSNC7 - 06/09/2010

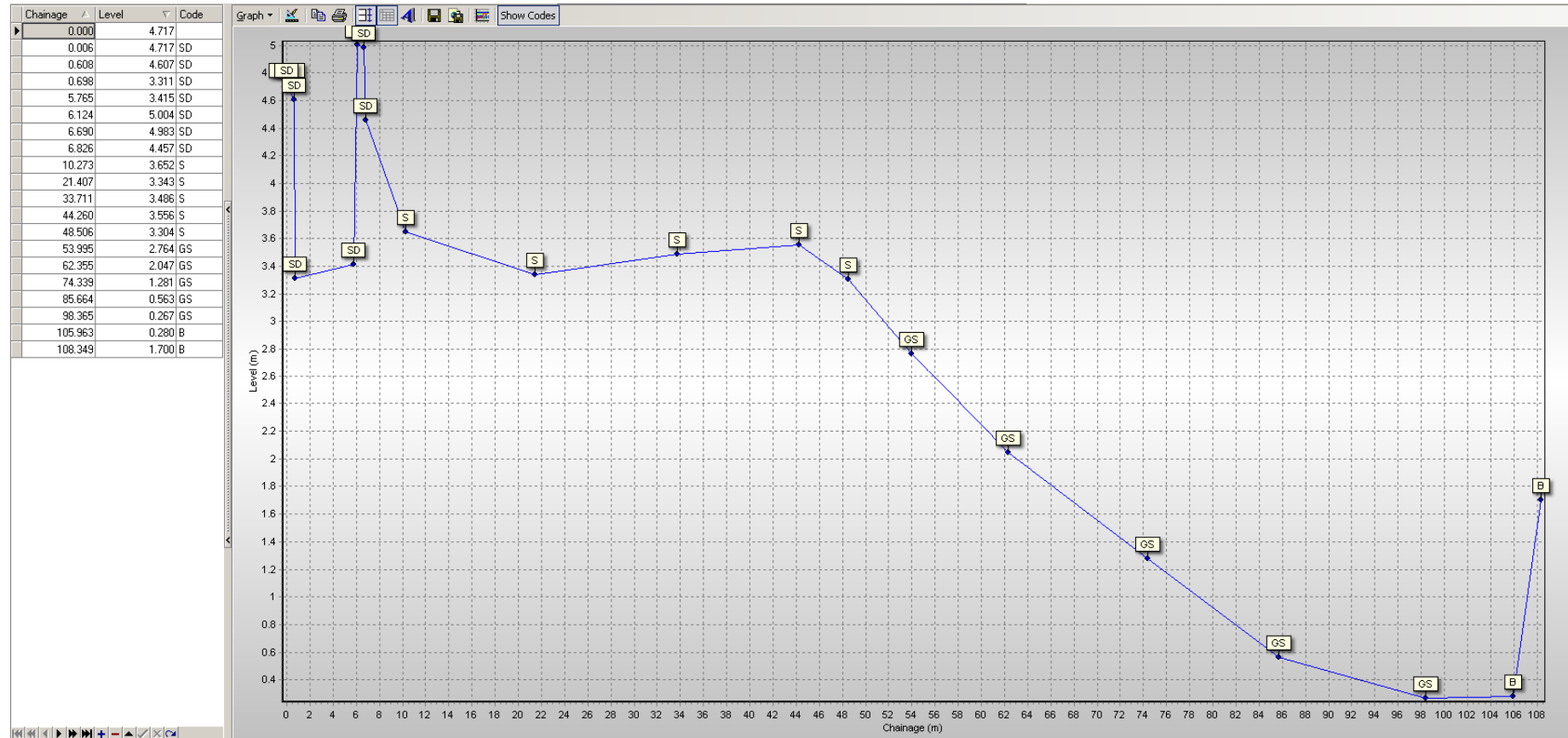
| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 3.161 | |
| 3.006 | 3.161 | SD |
| 5.899 | 3.464 | SD |
| 6.210 | 5.518 | SD |
| 8.830 | 5.482 | SD |
| 8.985 | 3.472 | SD |
| 12.984 | 3.268 | SD |
| 13.256 | 1.365 | SD |
| 17.486 | 1.091 | B |
| 21.925 | 2.282 | B |
| 27.893 | 2.496 | B |
| 39.447 | 1.311 | B |
| 47.986 | 0.152 | B |
| 55.059 | -0.870 | B |
| 57.652 | -1.591 | B |
| 70.064 | -1.557 | S |
| 77.402 | -1.527 | S |



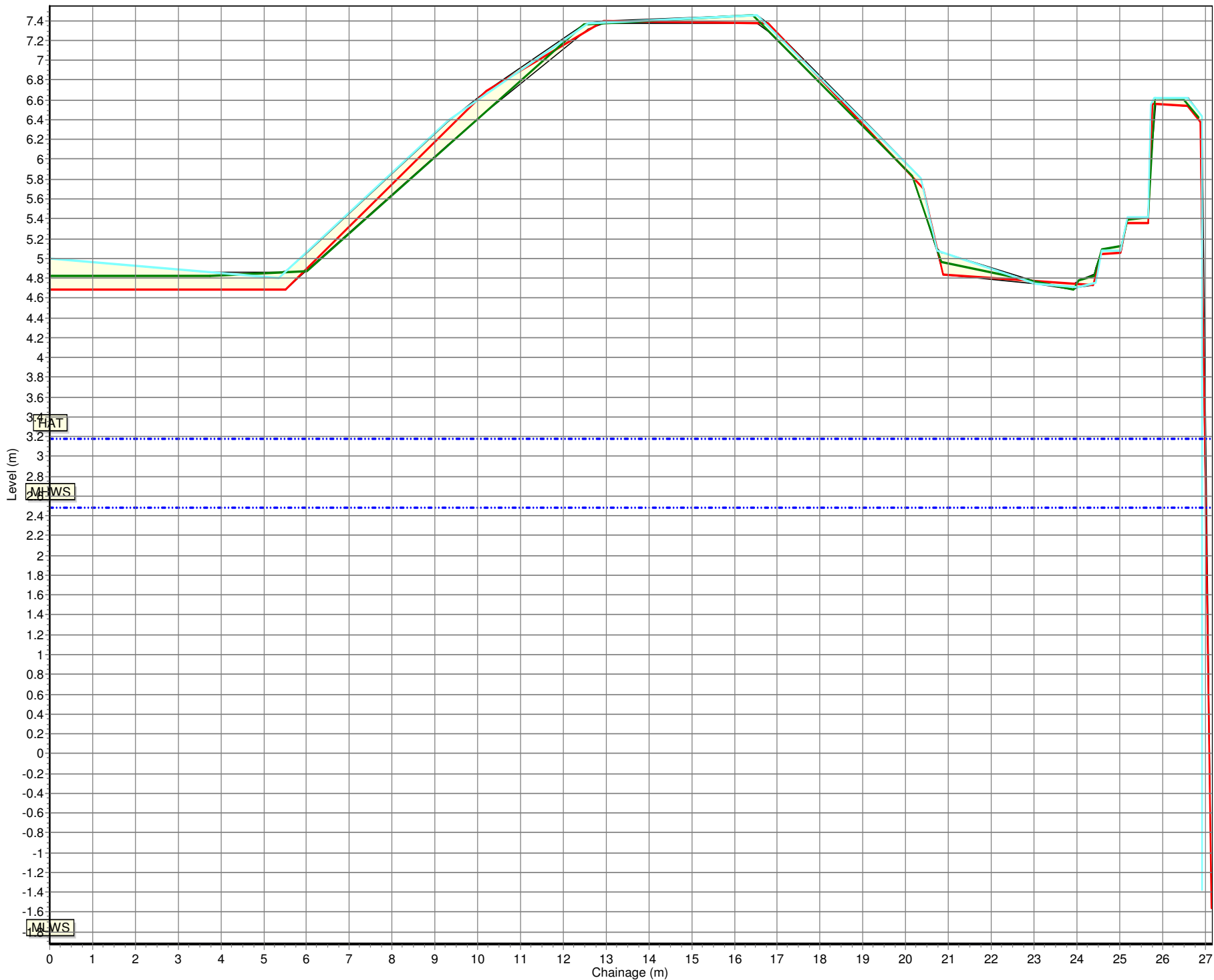
1bSNC8 - 06/09/2010



1bSNC9 – 06/09/2010



Beach Profiles: 1bSNC1



- Profiles Envelope
- 10/11/2006
- 05/10/2009
- 06/09/2010

HAT

MHW

MLW

Beach Profiles: 1bSNC2



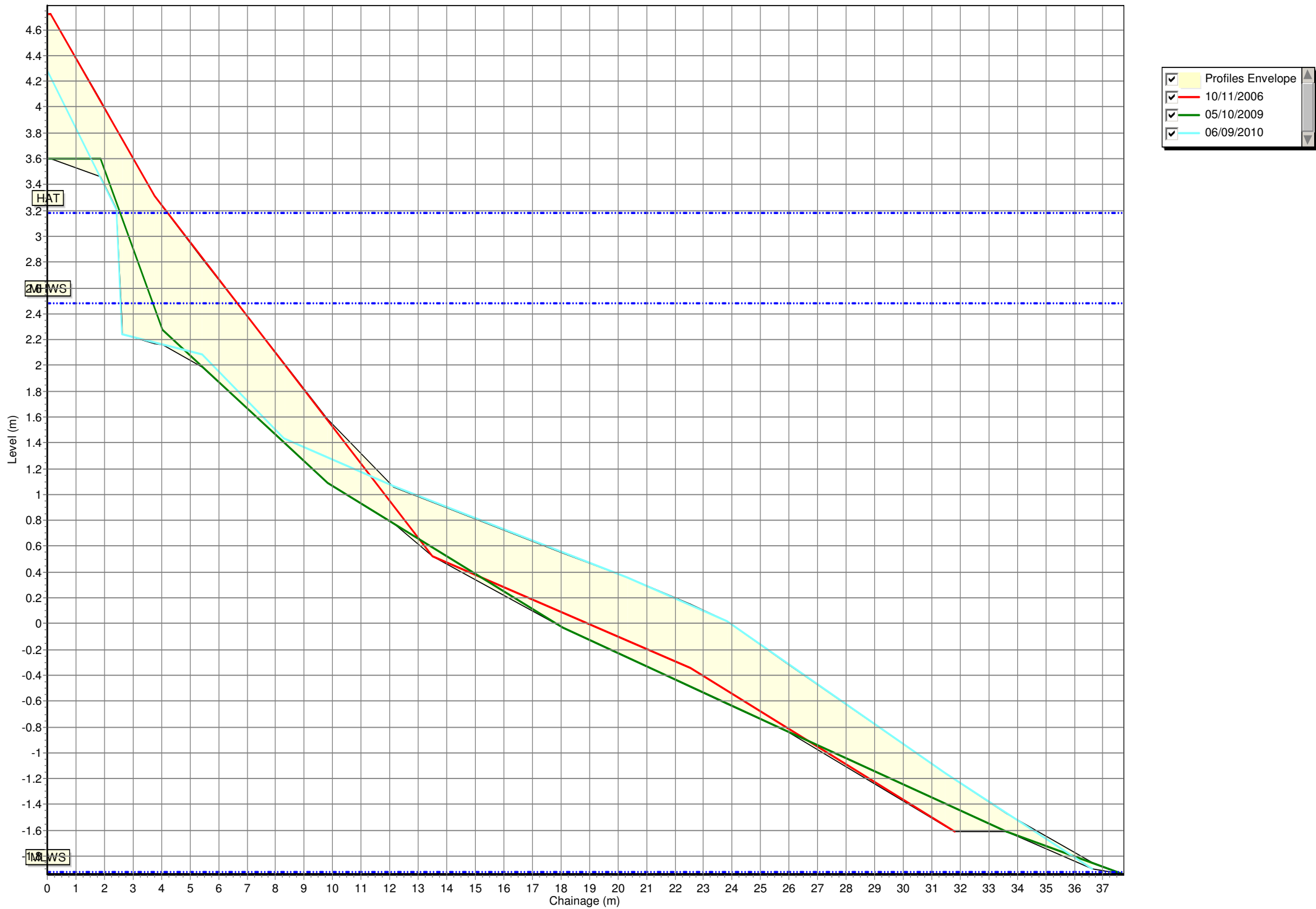
Beach Profiles: 1bSNC3



Beach Profiles: 1bSNC4



Beach Profiles: 1bSNC5



Beach Profiles: 1bSNC6



- Profiles Envelope
- 10/11/2006
- 05/10/2009
- 06/09/2010

HAT

MWS

MWS

Beach Profiles: 1bSNC7



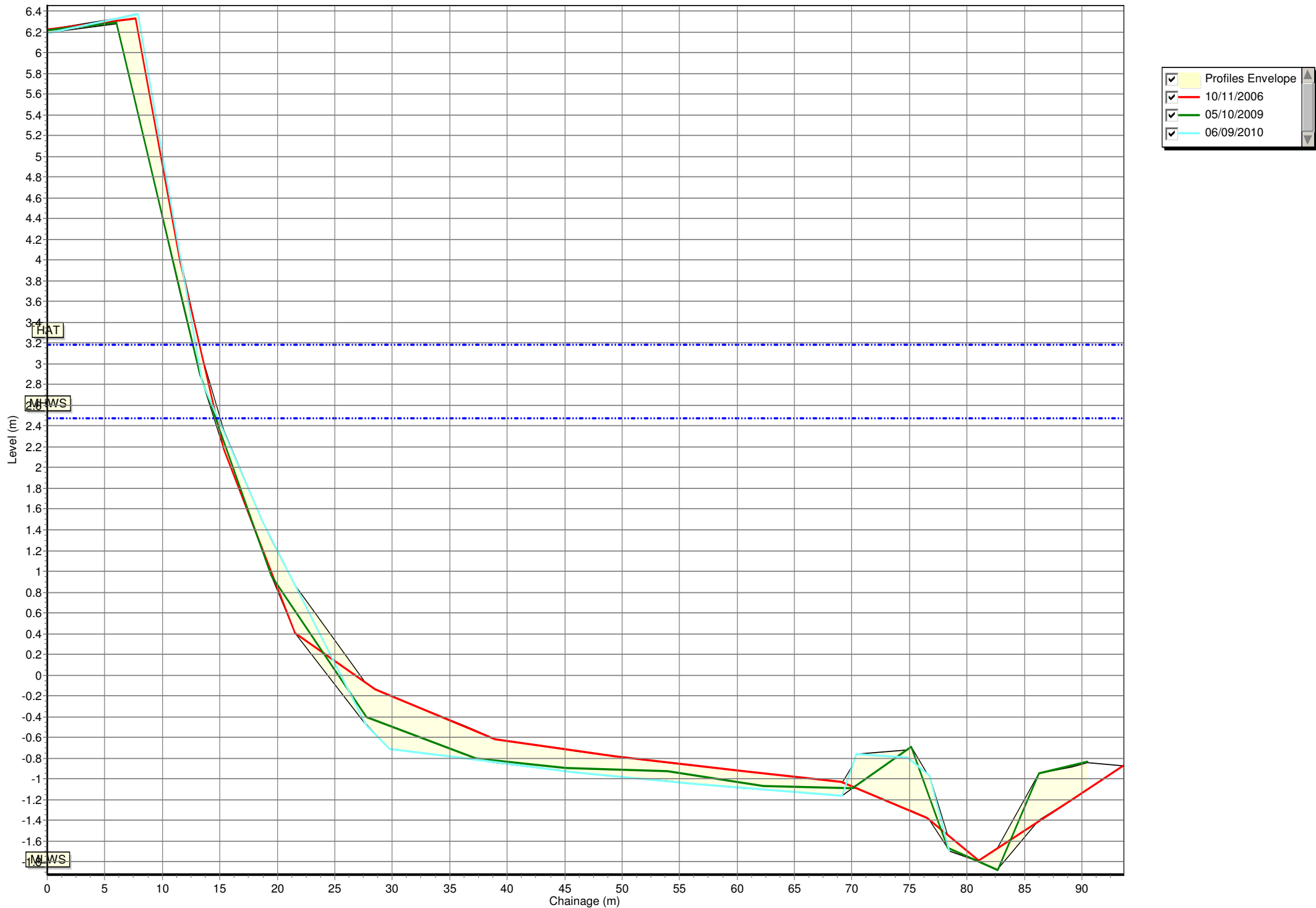
Profiles Envelope
 05/10/2009
 06/09/2010

HAT

MWS

MWS

Beach Profiles: 1bSNC8



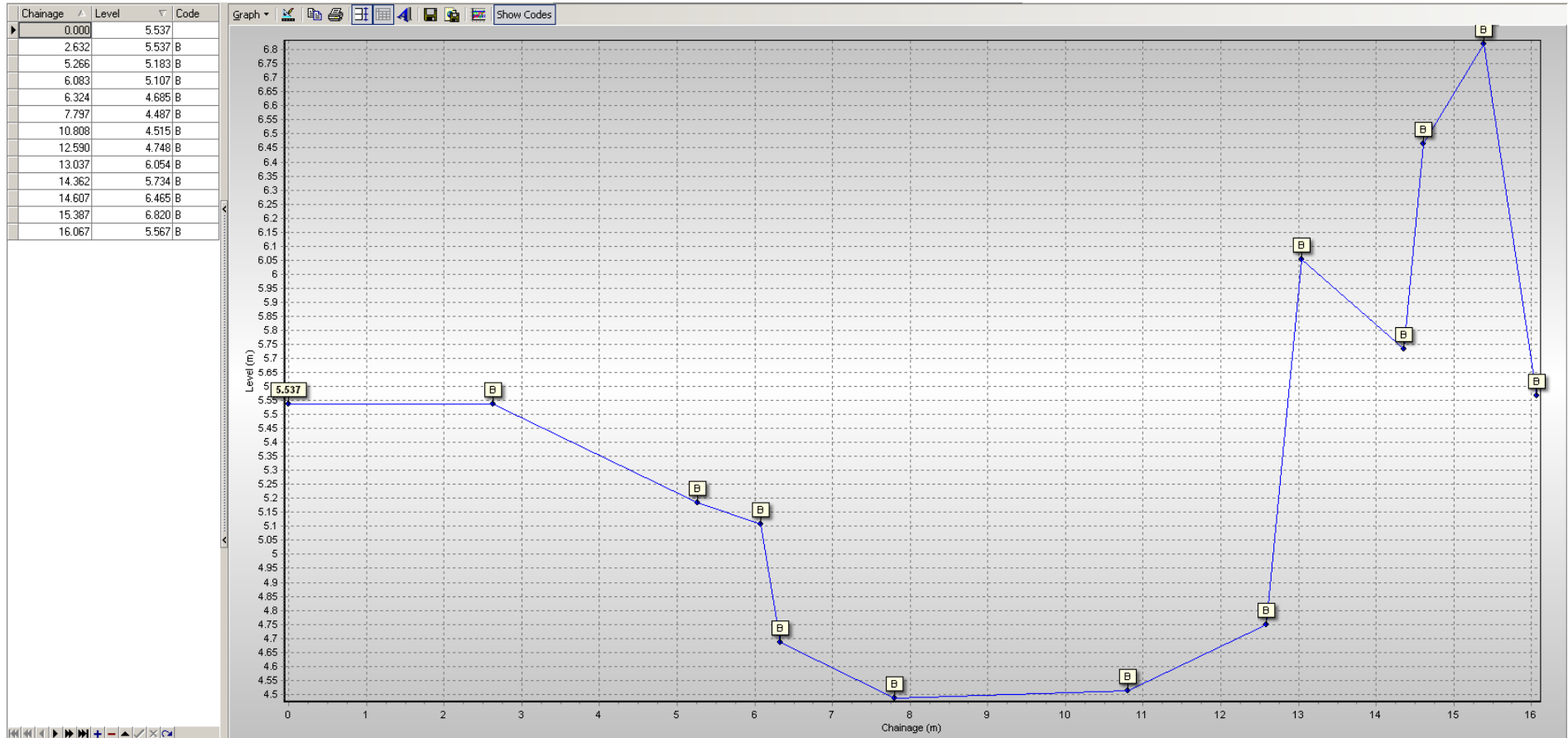
Beach Profiles: 1bSNC9



- Profiles Envelope
- 10/11/2006
- 03/12/2008
- 05/10/2009
- 06/09/2010

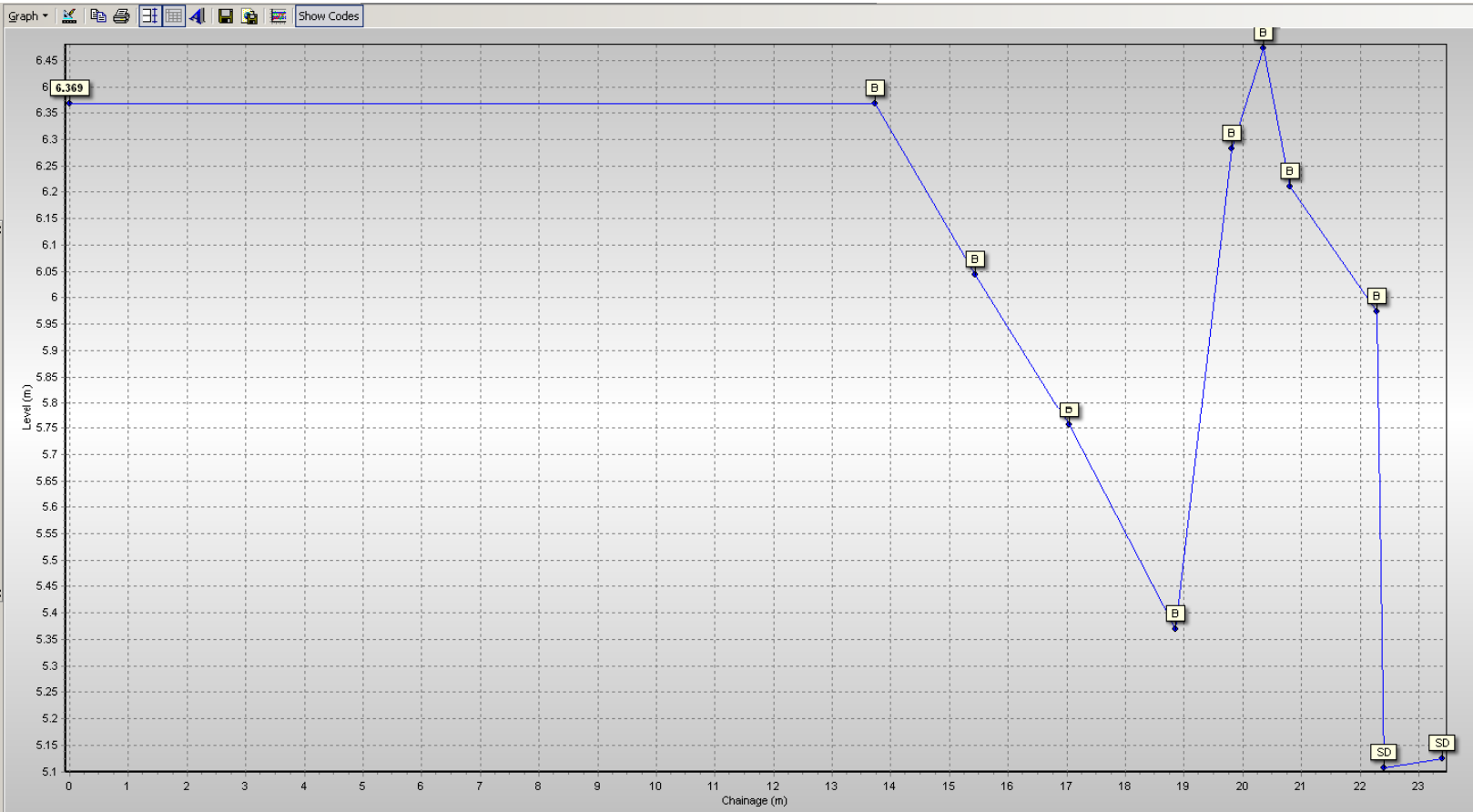
Sunderland South

1bSNS1 - 06/10/2010



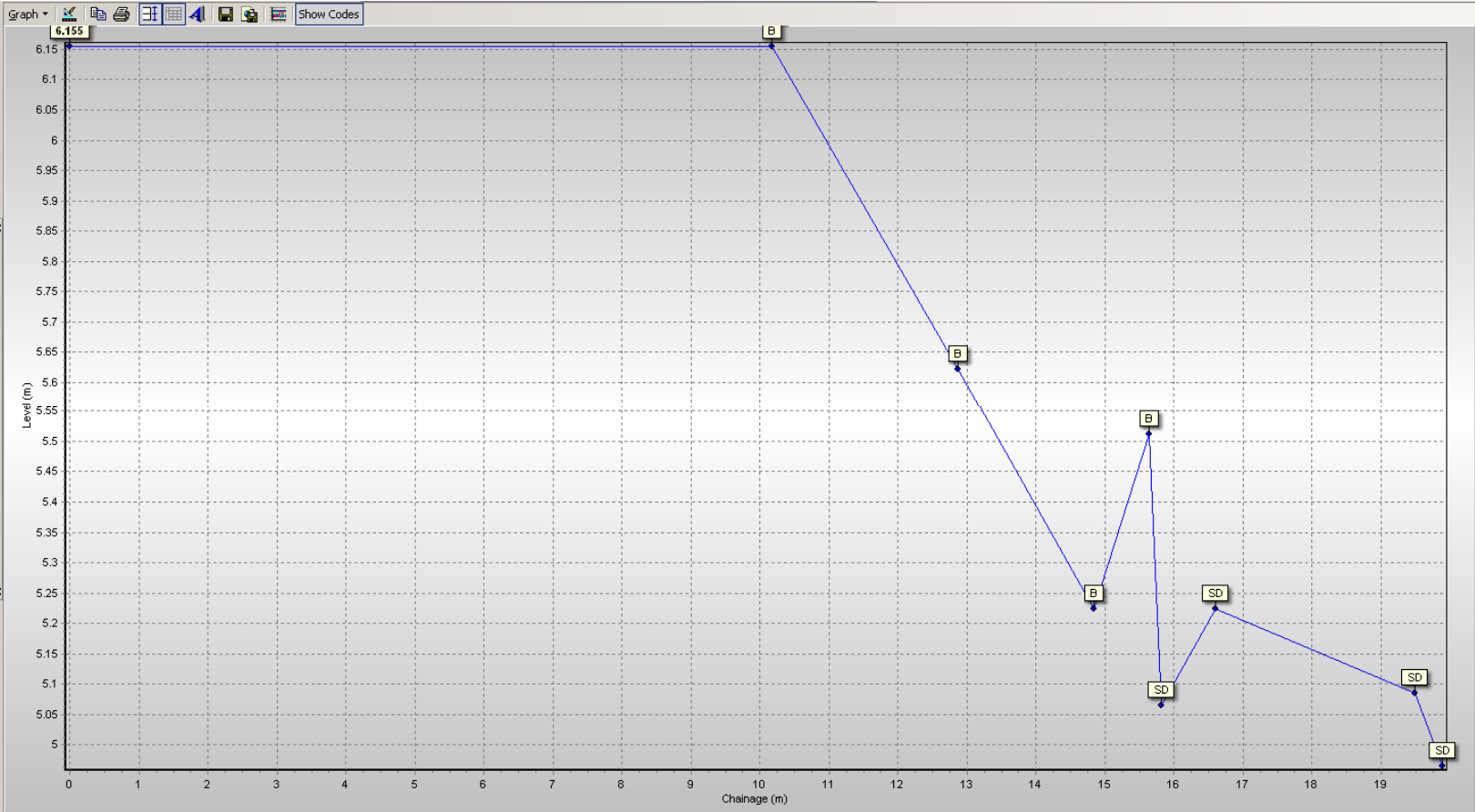
1bSNS2 - 06/10/2010

| Chainage | Level | Code |
|----------|-------|------|
| 0.000 | 6.369 | |
| 13.723 | 6.369 | B |
| 15.437 | 6.044 | B |
| 17.037 | 5.756 | B |
| 18.850 | 5.370 | B |
| 19.808 | 6.283 | B |
| 20.351 | 6.473 | B |
| 20.803 | 6.211 | B |
| 22.282 | 5.974 | B |
| 22.408 | 5.107 | SD |
| 23.401 | 5.125 | SD |



1bSNS3 - 06/10/2010

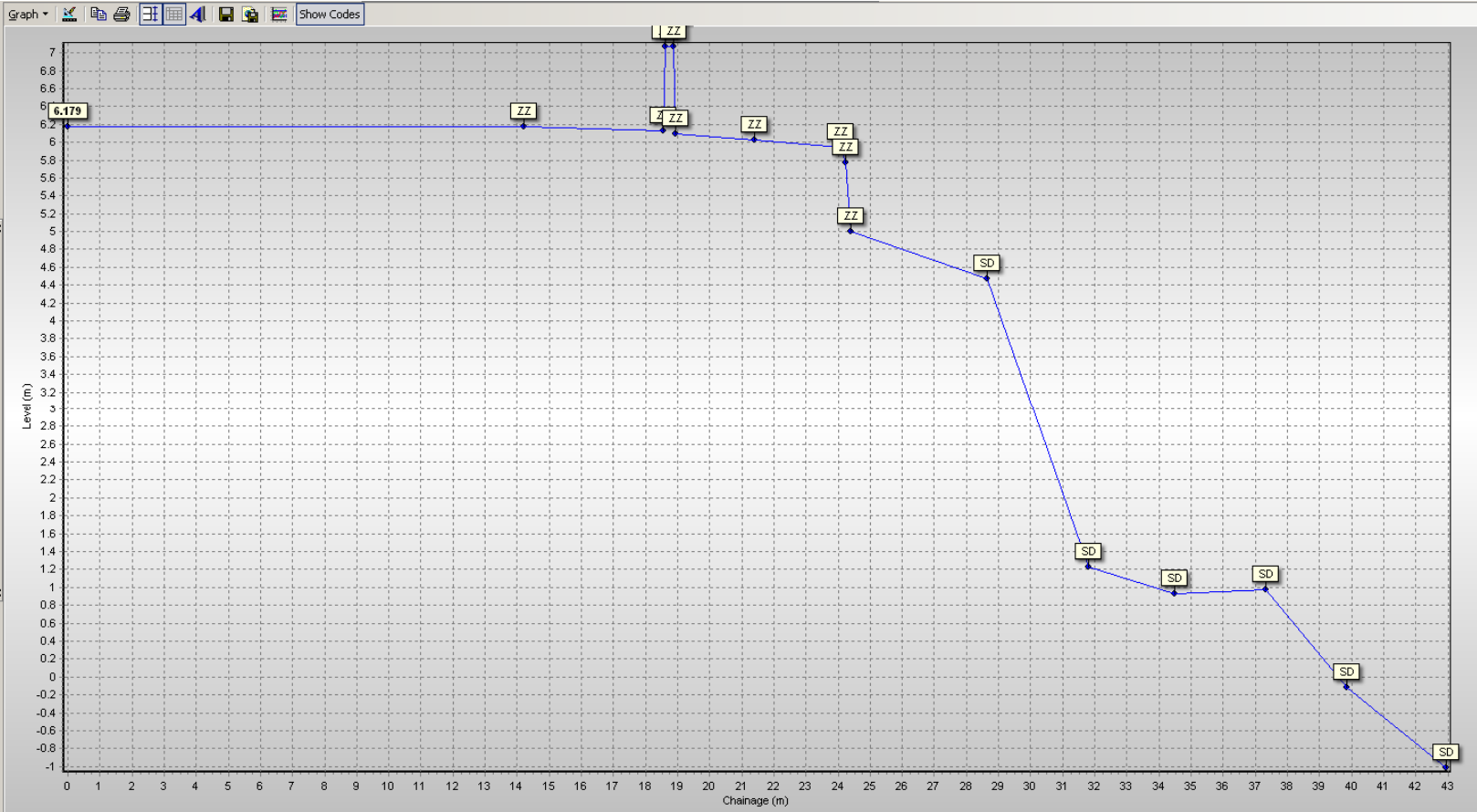
| Chainage | Level | Code |
|----------|-------|------|
| 0.000 | 6.155 | |
| 10.176 | 6.155 | B |
| 12.876 | 5.622 | B |
| 14.835 | 5.224 | B |
| 15.643 | 5.512 | B |
| 15.814 | 5.065 | SD |
| 16.596 | 5.224 | SD |
| 19.489 | 5.086 | SD |
| 19.891 | 4.965 | SD |



Navigation and control icons for the graph interface.

1bSNS4 - 06/10/2010

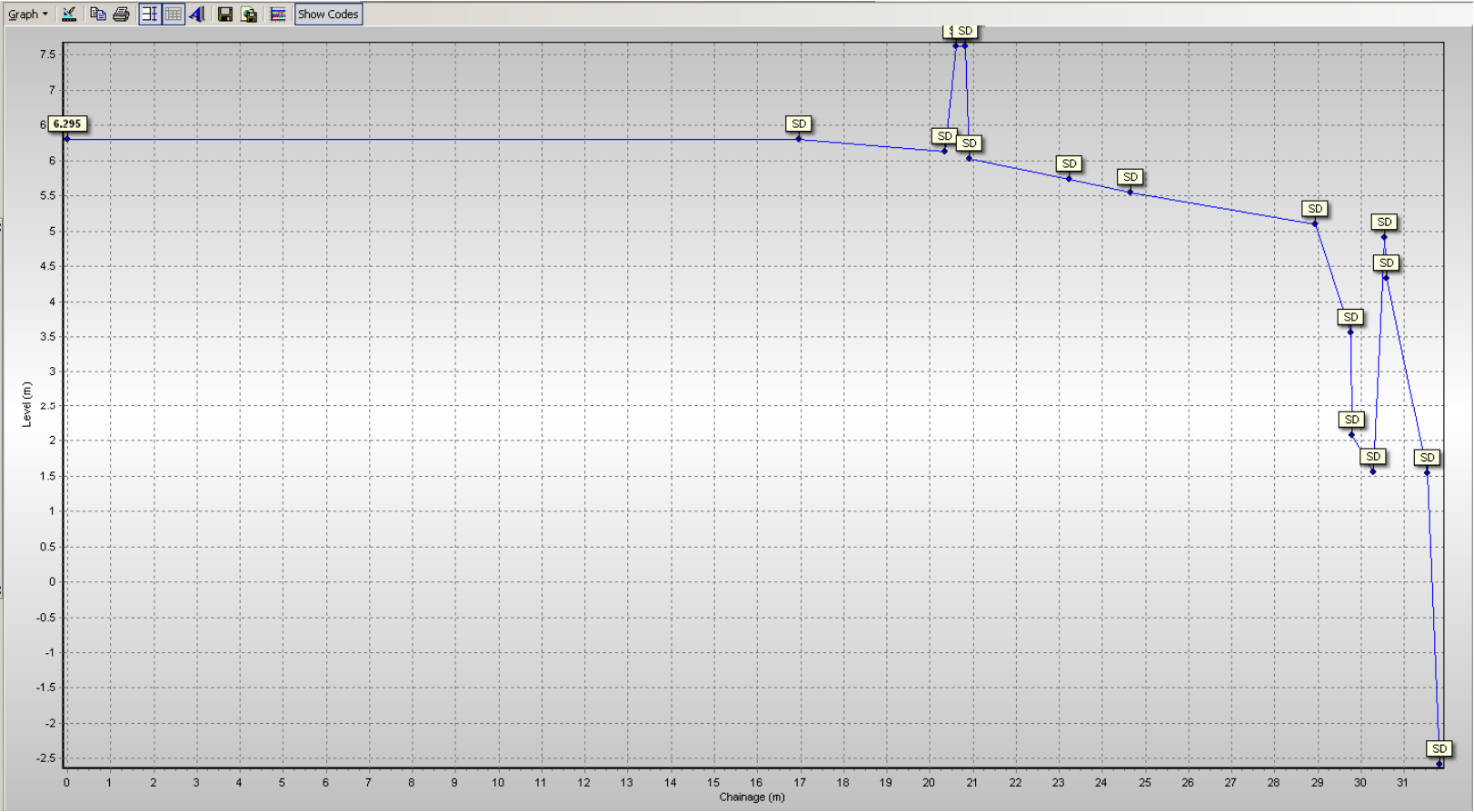
| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 6.179 | |
| 14.213 | 6.179 | ZZ |
| 18.560 | 6.126 | ZZ |
| 18.613 | 7.071 | ZZ |
| 18.862 | 7.069 | ZZ |
| 18.943 | 6.097 | ZZ |
| 21.408 | 6.020 | ZZ |
| 24.090 | 5.940 | ZZ |
| 24.243 | 5.771 | ZZ |
| 24.398 | 4.995 | ZZ |
| 28.645 | 4.469 | SD |
| 31.801 | 1.226 | SD |
| 34.491 | 0.929 | SD |
| 37.318 | 0.976 | SD |
| 39.859 | -0.117 | SD |
| 42.952 | -1.015 | SD |



Navigation and control icons for the graph interface.

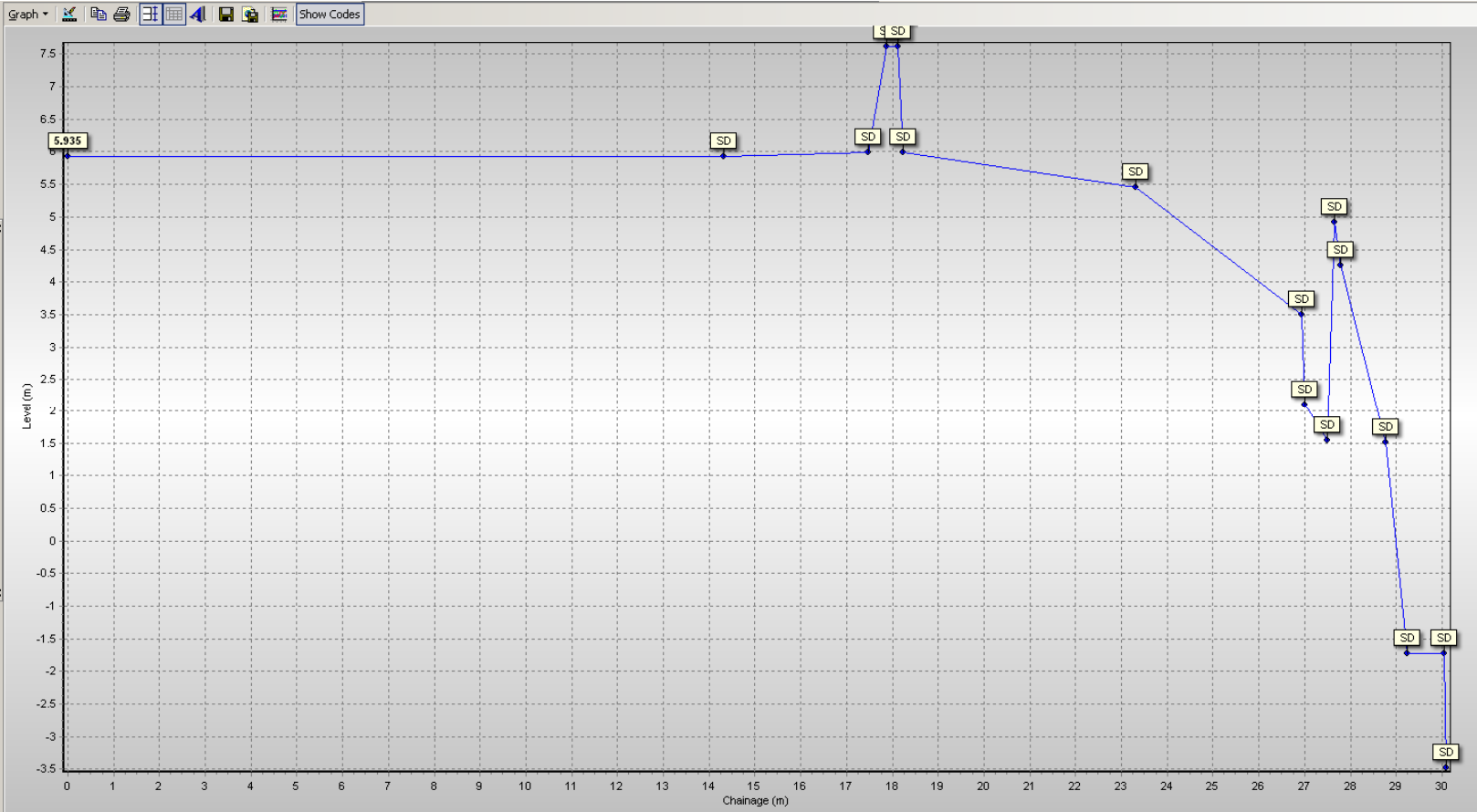
1bSNS5 - 06/10/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 6.295 | |
| 16.956 | 6.295 | SD |
| 20.348 | 6.130 | SD |
| 20.618 | 7.621 | SD |
| 20.810 | 7.622 | SD |
| 20.922 | 6.020 | SD |
| 23.229 | 5.742 | SD |
| 24.652 | 5.549 | SD |
| 28.932 | 5.097 | SD |
| 29.754 | 3.560 | SD |
| 29.789 | 2.080 | SD |
| 30.280 | 1.550 | SD |
| 30.552 | 4.910 | SD |
| 30.587 | 4.330 | SD |
| 31.531 | 1.540 | SD |
| 31.823 | -2.583 | SD |



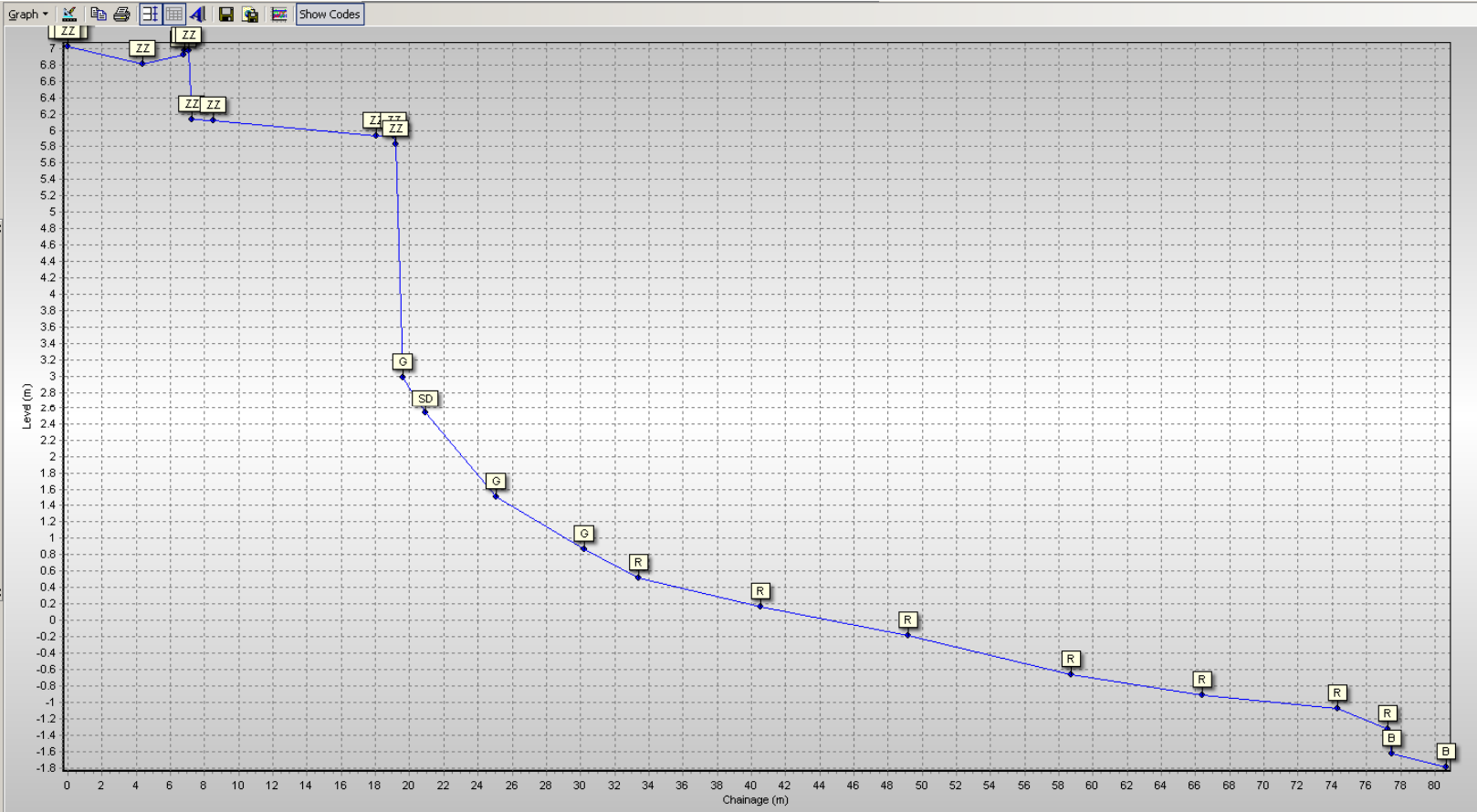
1bSNS6 - 06/10/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 5.935 | |
| 14.311 | 5.935 | SD |
| 17.475 | 5.995 | SD |
| 17.878 | 7.618 | SD |
| 18.123 | 7.613 | SD |
| 18.226 | 5.993 | SD |
| 23.305 | 5.455 | SD |
| 26.943 | 3.500 | SD |
| 27.007 | 2.110 | SD |
| 27.486 | 1.540 | SD |
| 27.642 | 4.920 | SD |
| 27.790 | 4.250 | SD |
| 28.760 | 1.510 | SD |
| 29.241 | -1.730 | SD |
| 30.041 | -1.730 | SD |
| 30.091 | -3.480 | SD |



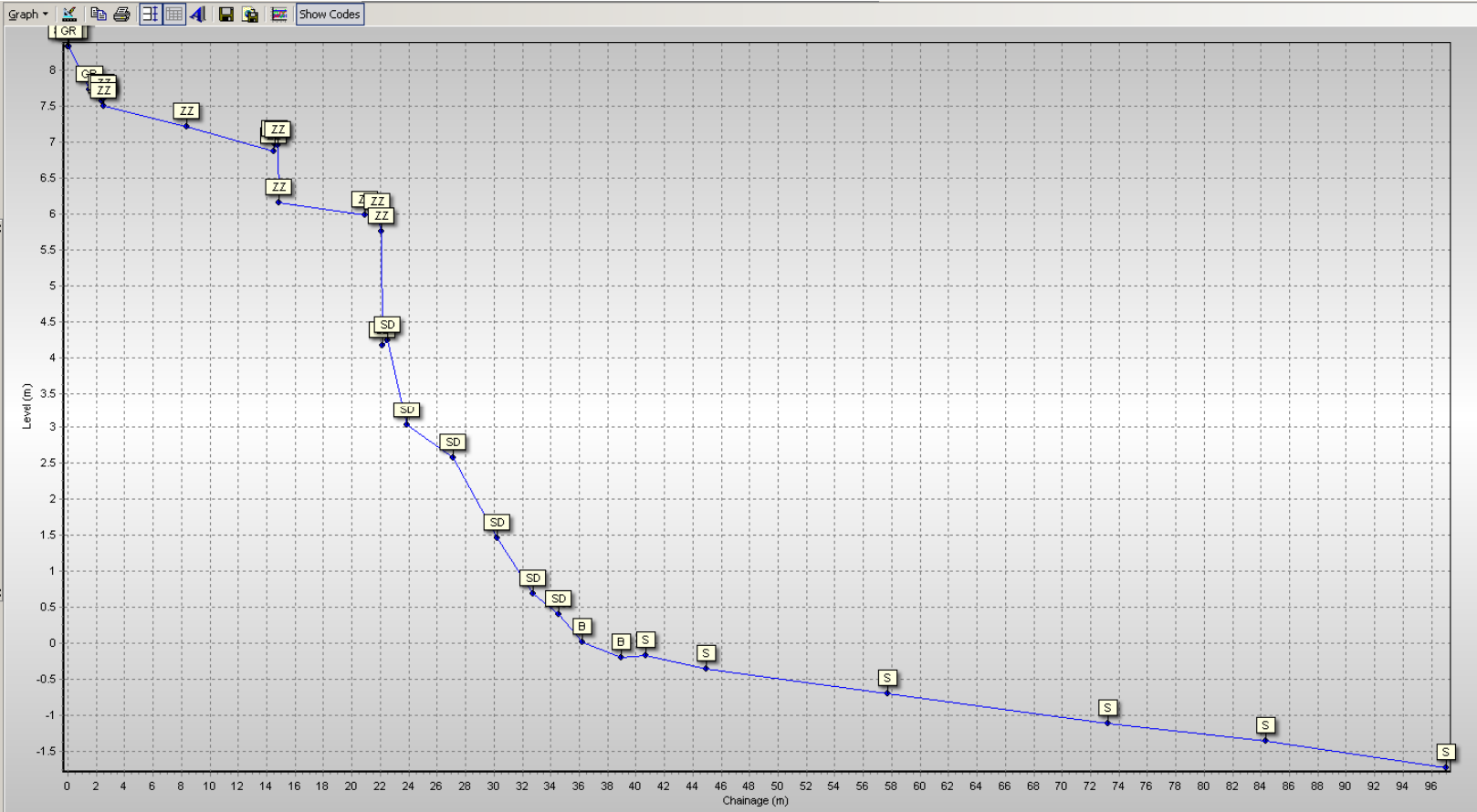
1bSNS7 - 06/10/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 7.022 | |
| 0.019 | 7.022 | ZZ |
| 4.397 | 6.804 | ZZ |
| 6.795 | 6.924 | ZZ |
| 6.834 | 6.966 | ZZ |
| 7.095 | 6.975 | ZZ |
| 7.273 | 6.134 | ZZ |
| 8.541 | 6.121 | ZZ |
| 18.054 | 5.937 | ZZ |
| 19.085 | 5.936 | ZZ |
| 19.177 | 5.833 | ZZ |
| 19.614 | 2.981 | G |
| 20.929 | 2.535 | SD |
| 25.057 | 1.507 | G |
| 30.205 | 0.869 | G |
| 33.402 | 0.519 | R |
| 40.519 | 0.164 | R |
| 49.161 | -0.182 | R |
| 58.712 | -0.663 | R |
| 66.397 | -0.910 | R |
| 74.340 | -1.081 | R |
| 77.279 | -1.332 | R |
| 77.483 | -1.630 | B |
| 80.668 | -1.791 | B |



1bSNS8 - 06/10/2010

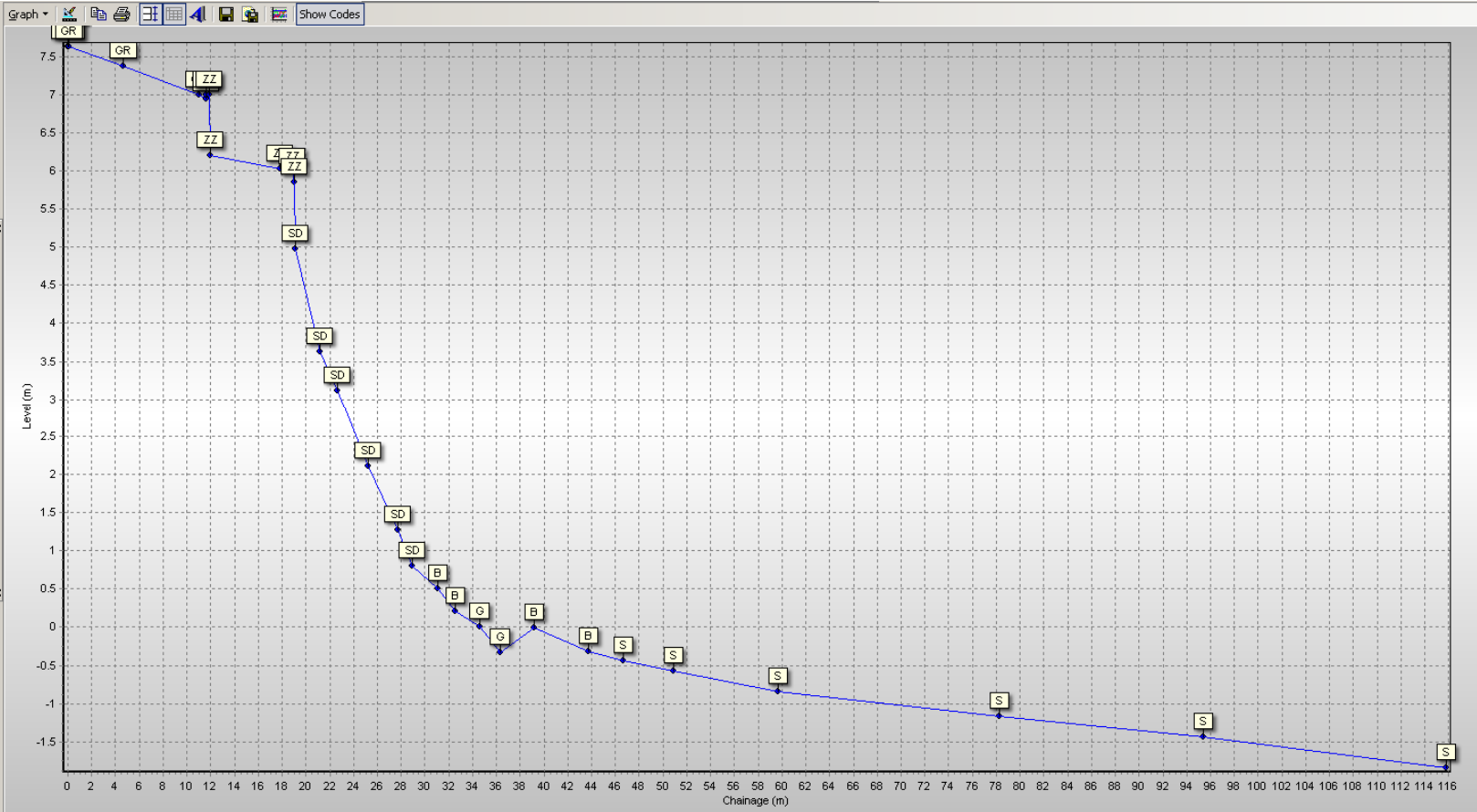
| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 8.328 | |
| 0.040 | 8.328 | GR |
| 1.511 | 7.725 | GR |
| 2.407 | 7.565 | GR |
| 2.415 | 7.606 | ZZ |
| 2.496 | 7.600 | ZZ |
| 2.558 | 7.501 | ZZ |
| 8.345 | 7.207 | ZZ |
| 14.520 | 6.872 | ZZ |
| 14.562 | 6.968 | ZZ |
| 14.818 | 6.954 | ZZ |
| 14.893 | 6.147 | ZZ |
| 20.935 | 5.980 | ZZ |
| 21.818 | 5.948 | ZZ |
| 22.059 | 5.747 | ZZ |
| 22.120 | 4.164 | SD |
| 22.492 | 4.230 | SD |
| 23.899 | 3.036 | SD |
| 27.102 | 2.579 | SD |
| 30.249 | 1.460 | SD |
| 32.772 | 0.690 | SD |
| 34.527 | 0.399 | SD |
| 36.249 | 0.016 | B |
| 38.961 | -0.192 | B |
| 40.714 | -0.173 | S |
| 44.938 | -0.359 | S |
| 57.698 | -0.705 | S |
| 73.254 | -1.113 | S |
| 84.305 | -1.349 | S |
| 97.038 | -1.728 | S |



Navigation and control icons for the graph interface.

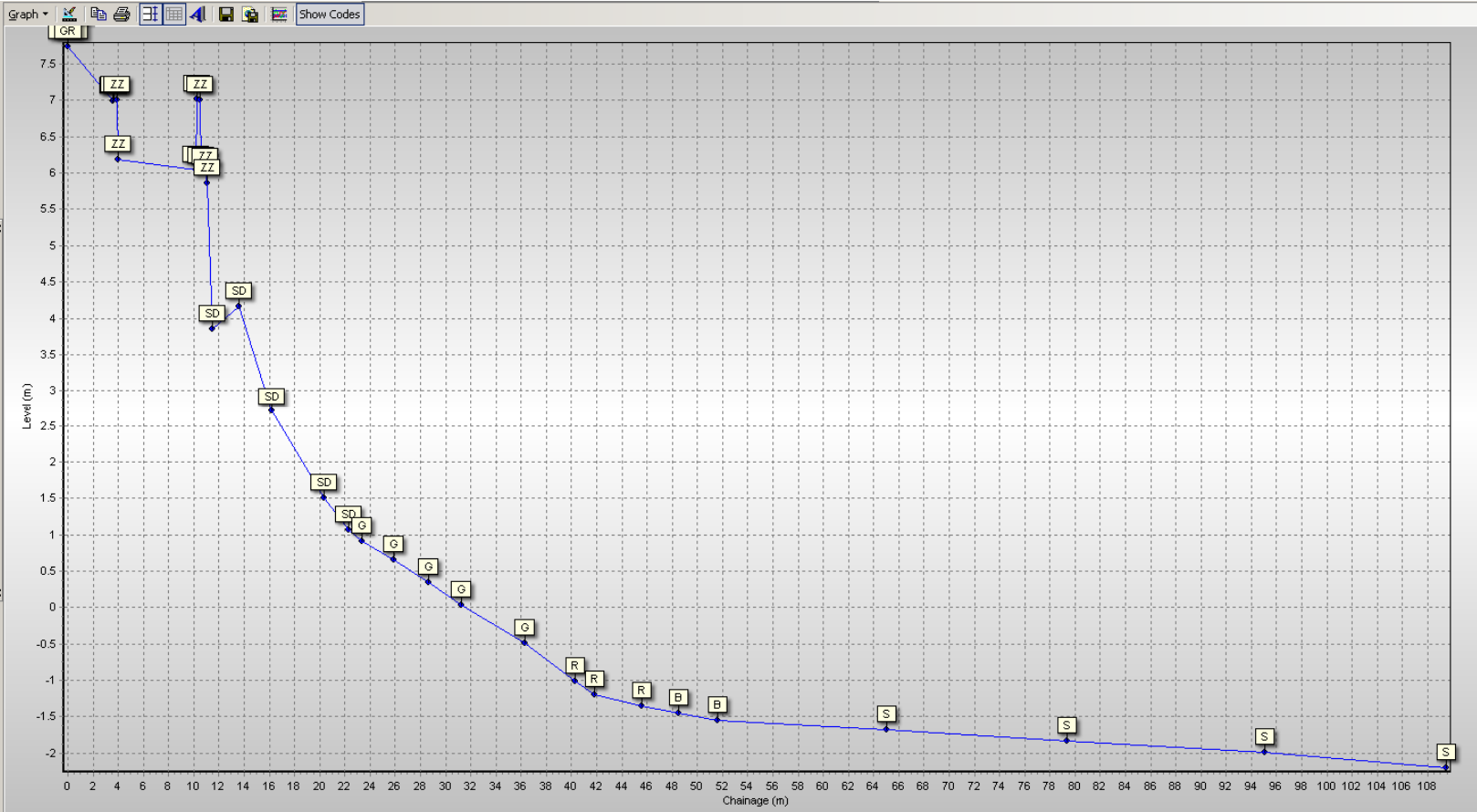
1bSNS9 - 06/10/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 7.630 | |
| 0.058 | 7.630 | GR |
| 4.643 | 7.377 | GR |
| 11.051 | 6.996 | GR |
| 11.588 | 6.949 | ZZ |
| 11.600 | 7.002 | ZZ |
| 11.872 | 6.996 | ZZ |
| 11.982 | 6.198 | ZZ |
| 17.844 | 6.032 | ZZ |
| 18.819 | 5.988 | ZZ |
| 19.011 | 5.852 | ZZ |
| 19.127 | 4.979 | SD |
| 21.219 | 3.627 | SD |
| 22.636 | 3.124 | SD |
| 25.220 | 2.114 | SD |
| 27.700 | 1.267 | SD |
| 28.956 | 0.795 | SD |
| 31.106 | 0.500 | B |
| 32.553 | 0.210 | B |
| 34.636 | 0.003 | G |
| 36.367 | -0.336 | G |
| 39.166 | -0.006 | B |
| 43.730 | -0.312 | B |
| 46.694 | -0.441 | S |
| 50.864 | -0.569 | S |
| 59.705 | -0.848 | S |
| 78.305 | -1.169 | S |
| 95.397 | -1.429 | S |
| 115.804 | -1.839 | S |



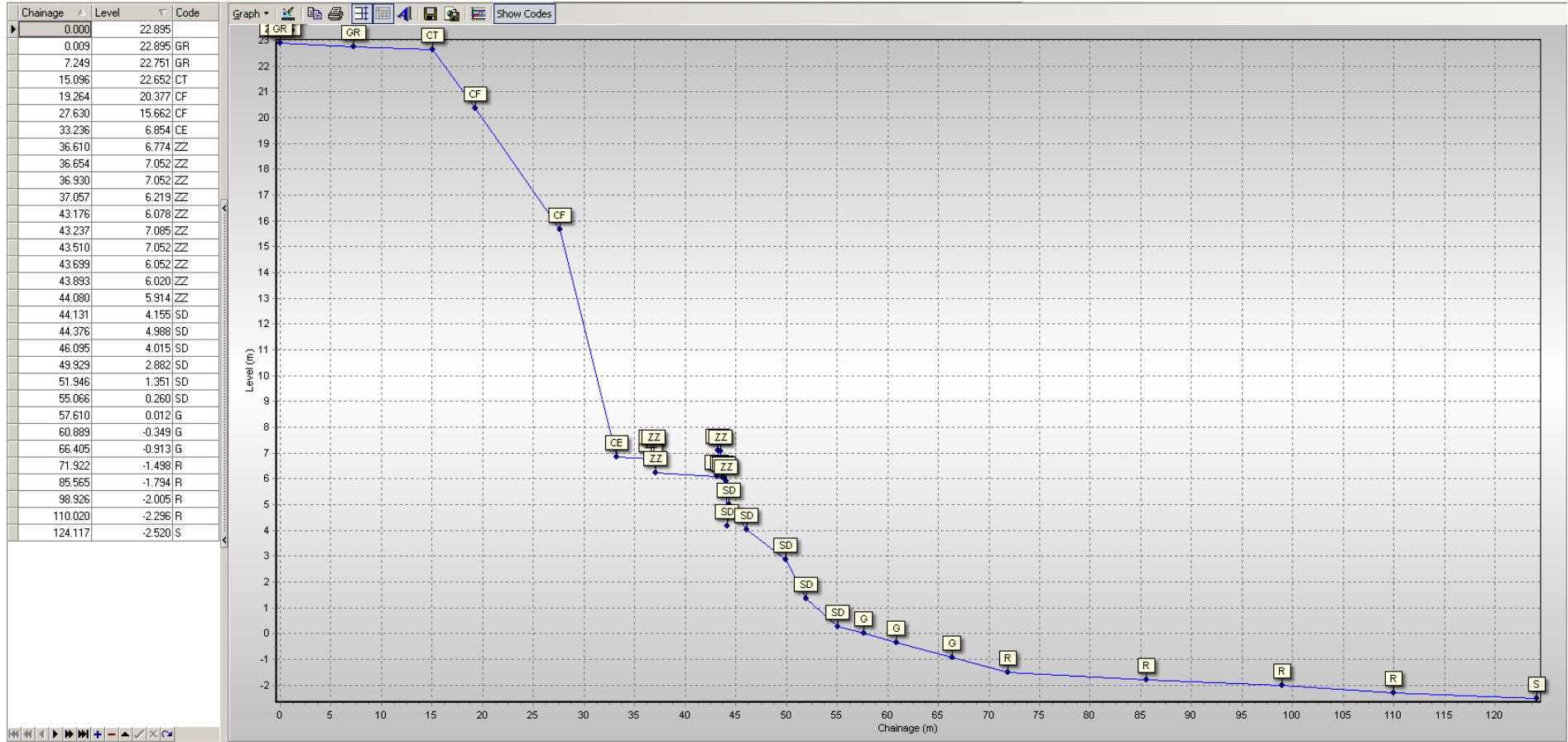
1bSNS10 - 06/10/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 7.741 | |
| 0.014 | 7.741 | GR |
| 3.583 | 6.994 | GR |
| 3.638 | 7.005 | ZZ |
| 3.896 | 7.004 | ZZ |
| 3.973 | 6.185 | ZZ |
| 10.181 | 6.045 | ZZ |
| 10.241 | 7.015 | ZZ |
| 10.532 | 7.001 | ZZ |
| 10.619 | 6.027 | ZZ |
| 10.921 | 6.011 | ZZ |
| 11.039 | 5.857 | ZZ |
| 11.457 | 3.896 | SD |
| 13.584 | 4.157 | SD |
| 16.230 | 2.705 | SD |
| 20.387 | 1.504 | SD |
| 22.270 | 1.062 | SD |
| 23.330 | 0.907 | G |
| 25.871 | 0.652 | G |
| 28.655 | 0.350 | G |
| 31.264 | 0.027 | G |
| 36.341 | -0.489 | G |
| 40.332 | -1.009 | R |
| 41.818 | -1.191 | R |
| 45.591 | -1.347 | R |
| 48.477 | -1.445 | B |
| 51.634 | -1.549 | B |
| 65.025 | -1.674 | S |
| 79.330 | -1.827 | S |
| 95.051 | -1.987 | S |
| 109.481 | -2.201 | S |



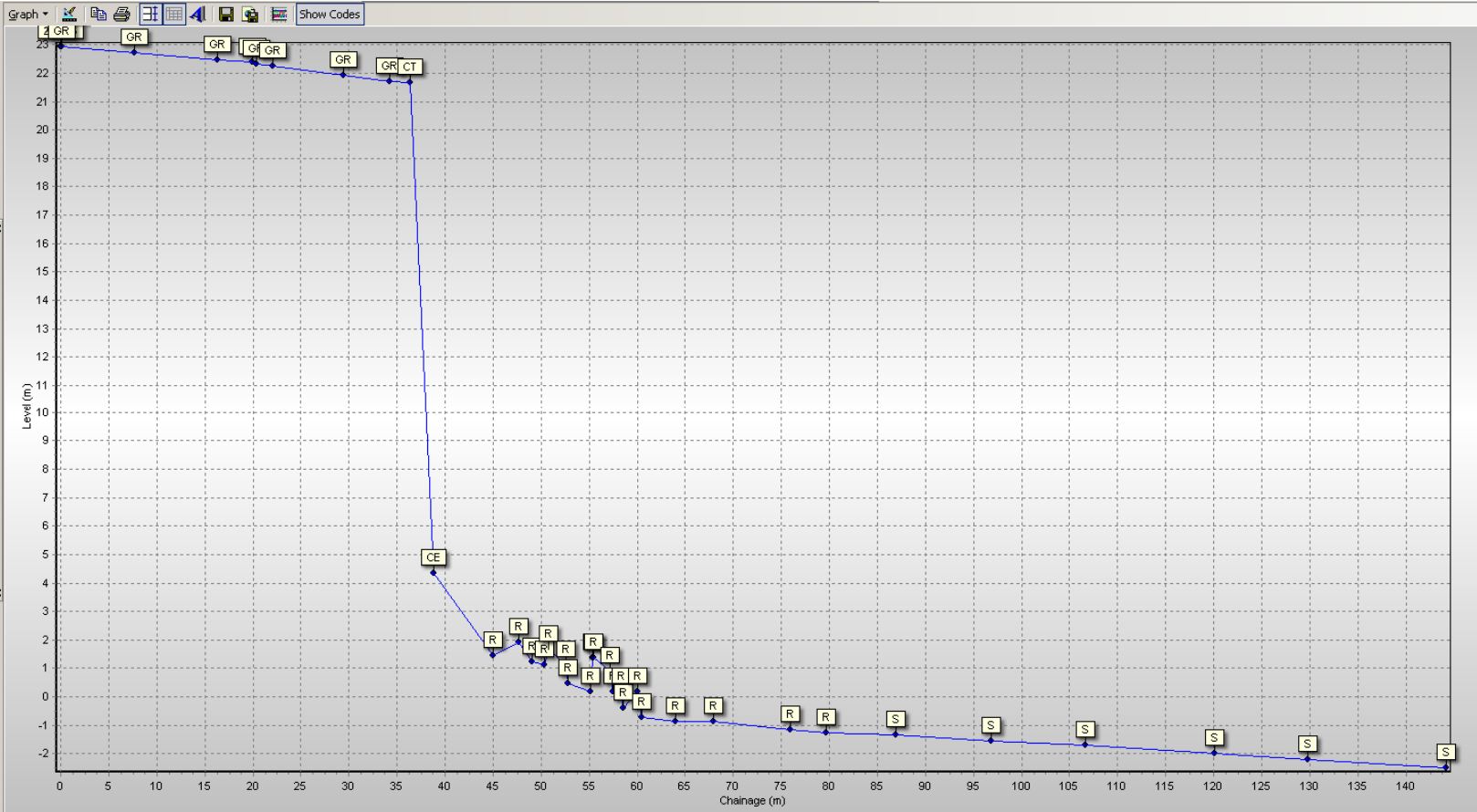
Navigation icons: back, forward, search, zoom, etc.

1bSNS11 - 06/10/2010



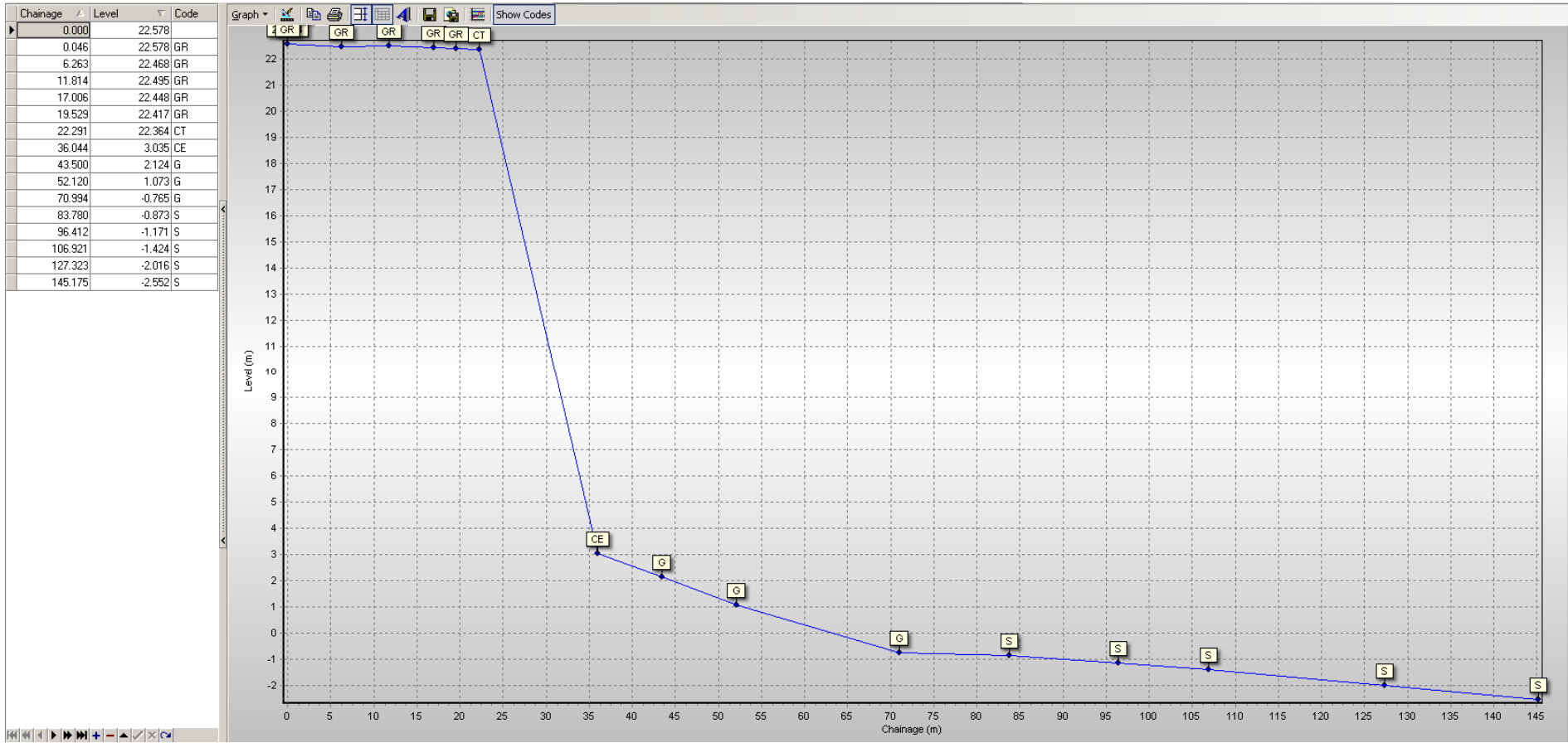
1bSNS12 - 06/10/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 22.936 | |
| 0.060 | 22.936 | GR |
| 7.703 | 22.725 | GR |
| 16.330 | 22.448 | GR |
| 19.905 | 22.381 | GR |
| 20.388 | 22.322 | GR |
| 22.061 | 22.236 | GR |
| 29.393 | 21.933 | GR |
| 34.289 | 21.699 | GR |
| 36.395 | 21.680 | CT |
| 38.778 | 4.330 | CE |
| 45.013 | 1.460 | R |
| 47.720 | 1.929 | R |
| 49.114 | 1.220 | R |
| 50.357 | 1.133 | R |
| 50.744 | 1.681 | R |
| 52.556 | 1.141 | R |
| 52.770 | 0.475 | R |
| 55.127 | 0.191 | R |
| 55.343 | 1.387 | R |
| 55.496 | 1.389 | R |
| 57.216 | 0.923 | R |
| 57.461 | 0.182 | R |
| 58.393 | 0.198 | R |
| 58.523 | -0.392 | R |
| 60.085 | 0.182 | R |
| 60.511 | -0.730 | R |
| 64.013 | -0.854 | R |
| 67.925 | -0.859 | R |
| 75.952 | -1.143 | R |
| 79.649 | -1.278 | R |
| 86.939 | -1.347 | S |
| 96.826 | -1.540 | S |
| 106.710 | -1.709 | S |
| 120.114 | -1.978 | S |
| 129.762 | -2.213 | S |
| 144.206 | -2.491 | S |



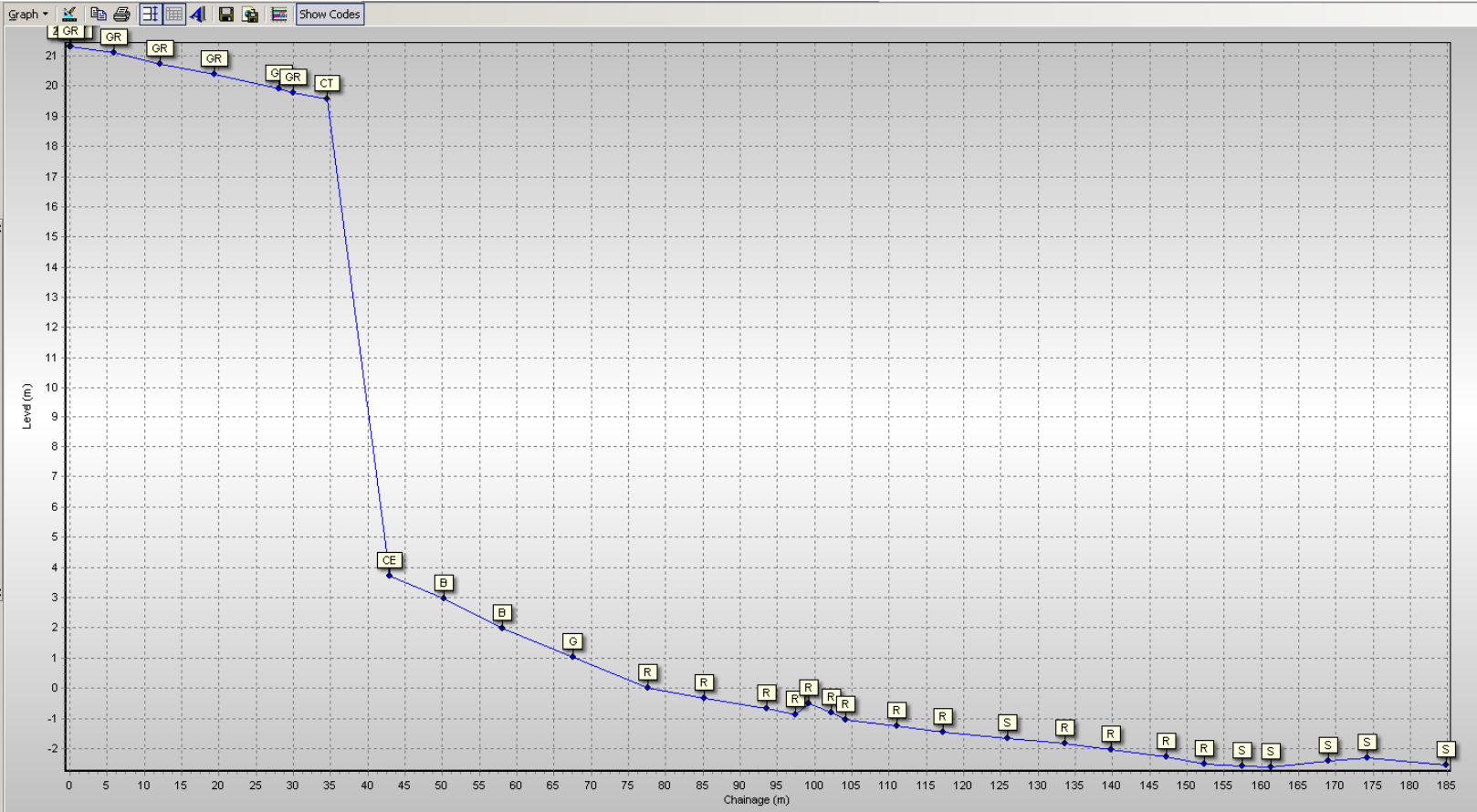
Navigation icons: back, forward, search, zoom, etc.

1bSNS13 - 06/10/2010



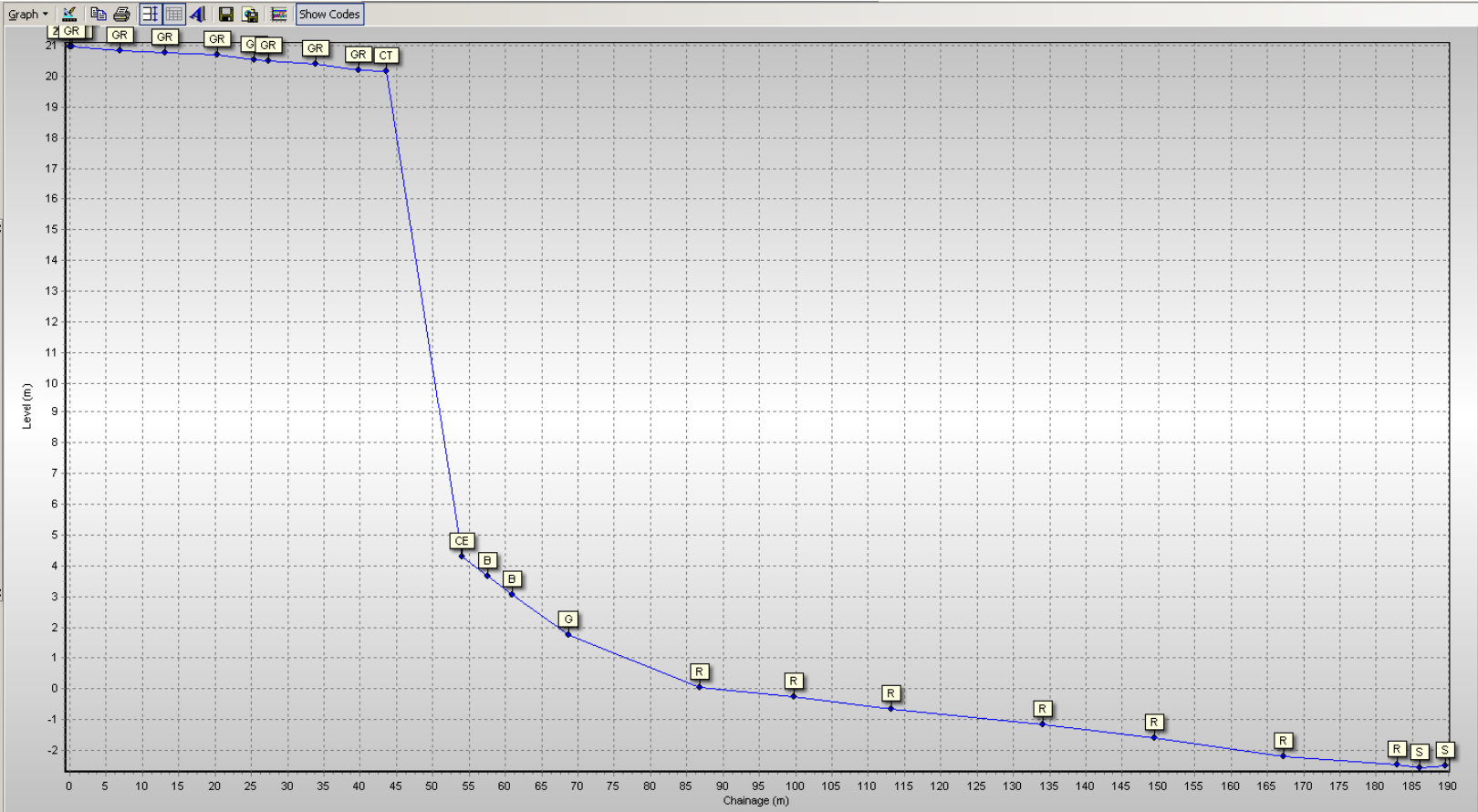
1bSNS14 - 06/10/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 21.307 | |
| 0.080 | 21.307 | GR |
| 5.947 | 21.087 | GR |
| 12.089 | 20.744 | GR |
| 19.403 | 20.374 | GR |
| 28.044 | 19.908 | GR |
| 30.018 | 19.791 | GR |
| 34.567 | 19.559 | CT |
| 42.960 | 3.706 | CE |
| 50.183 | 2.950 | B |
| 58.135 | 1.988 | B |
| 67.600 | 1.023 | G |
| 77.543 | 0.003 | R |
| 85.109 | -0.338 | R |
| 93.572 | -0.685 | R |
| 97.478 | -0.875 | R |
| 99.155 | -0.516 | R |
| 102.175 | -0.804 | R |
| 104.231 | -1.063 | R |
| 111.081 | -1.253 | R |
| 117.180 | -1.459 | R |
| 125.951 | -1.649 | S |
| 133.644 | -1.845 | R |
| 139.760 | -2.027 | R |
| 147.203 | -2.278 | R |
| 152.347 | -2.511 | R |
| 157.439 | -2.578 | S |
| 161.333 | -2.616 | S |
| 168.979 | -2.427 | S |
| 174.149 | -2.307 | S |
| 184.799 | -2.542 | S |



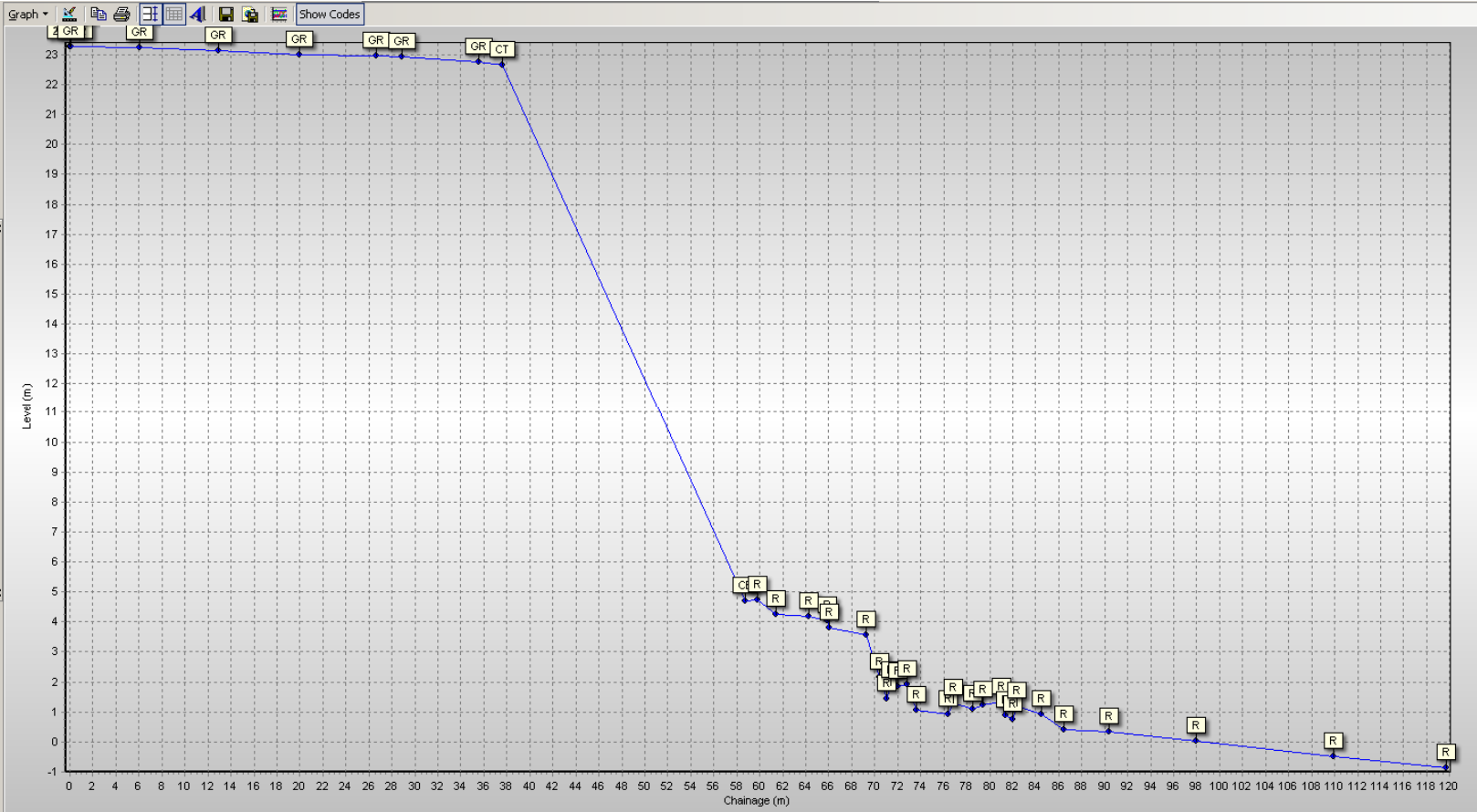
1bSNS15 - 06/10/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 20.967 | |
| 0.219 | 20.967 | GR |
| 6.923 | 20.824 | GR |
| 13.135 | 20.777 | GR |
| 20.282 | 20.690 | GR |
| 25.381 | 20.540 | GR |
| 27.356 | 20.508 | GR |
| 33.887 | 20.406 | GR |
| 39.760 | 20.192 | GR |
| 43.605 | 20.170 | CT |
| 54.112 | 4.290 | CE |
| 57.575 | 3.676 | B |
| 60.977 | 3.073 | B |
| 68.682 | 1.760 | G |
| 86.771 | 0.032 | R |
| 99.775 | -0.259 | R |
| 113.144 | -0.662 | R |
| 134.127 | -1.153 | R |
| 149.463 | -1.599 | R |
| 167.207 | -2.193 | R |
| 182.976 | -2.469 | R |
| 186.015 | -2.567 | S |
| 189.540 | -2.493 | S |



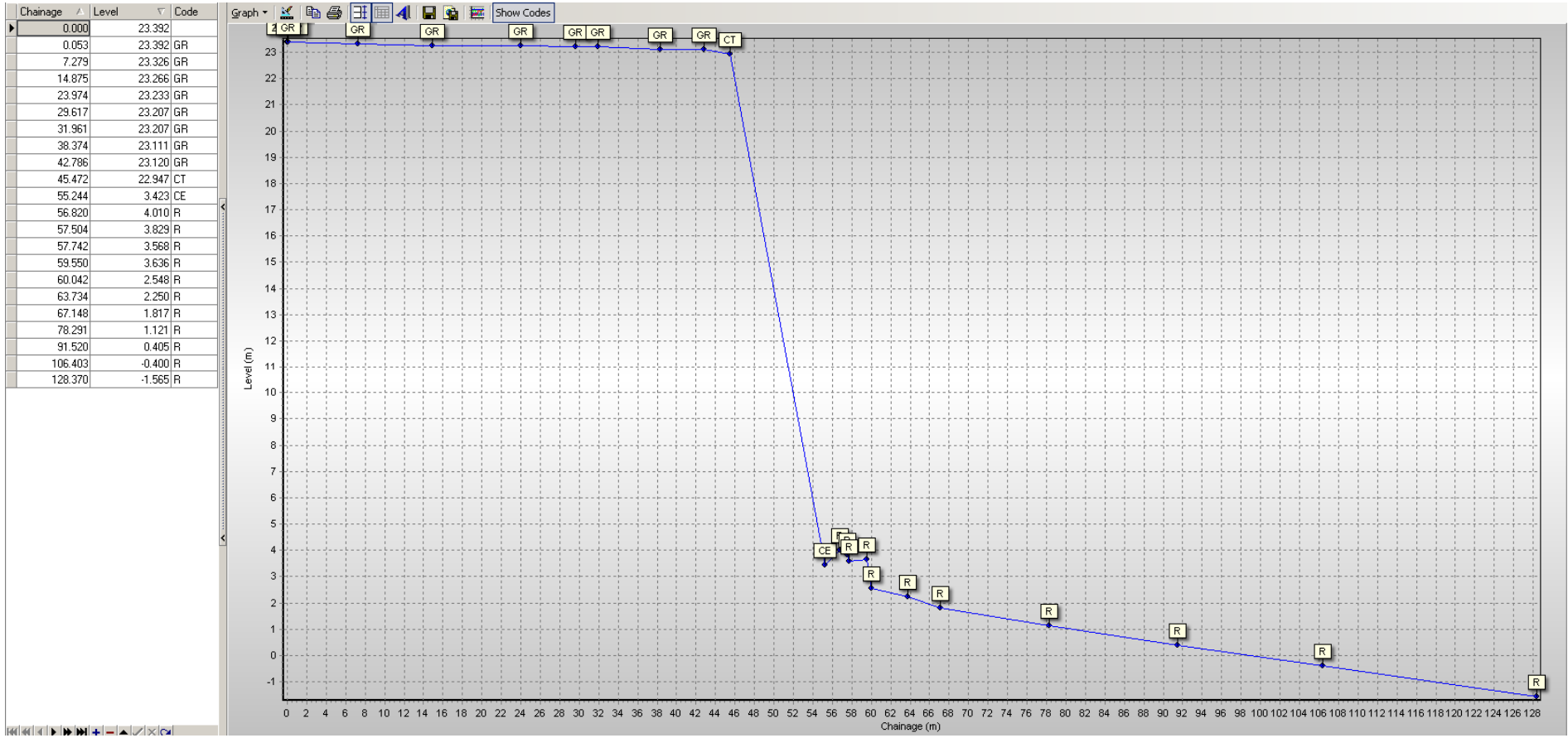
1bSNS16 - 06/10/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 23.272 | |
| 0.065 | 23.272 | GR |
| 6.083 | 23.235 | GR |
| 12.920 | 23.129 | GR |
| 19.963 | 23.000 | GR |
| 26.651 | 22.954 | GR |
| 28.901 | 22.915 | GR |
| 35.564 | 22.772 | GR |
| 37.613 | 22.665 | CT |
| 58.710 | 4.699 | CE |
| 59.845 | 4.726 | R |
| 61.392 | 4.237 | R |
| 64.283 | 4.172 | R |
| 65.866 | 4.045 | R |
| 66.004 | 3.812 | R |
| 69.278 | 3.567 | R |
| 70.456 | 2.157 | R |
| 71.012 | 1.424 | R |
| 71.374 | 1.887 | R |
| 72.045 | 1.834 | R |
| 72.789 | 1.930 | R |
| 73.612 | 1.071 | R |
| 76.384 | 0.924 | R |
| 76.823 | 1.301 | R |
| 78.551 | 1.100 | R |
| 79.435 | 1.233 | R |
| 81.063 | 1.317 | R |
| 81.334 | 0.888 | R |
| 81.970 | 0.757 | R |
| 82.342 | 1.202 | R |
| 84.535 | 0.919 | R |
| 86.451 | 0.394 | R |
| 90.353 | 0.327 | R |
| 97.993 | 0.027 | R |
| 109.894 | -0.493 | R |
| 119.704 | -0.864 | R |

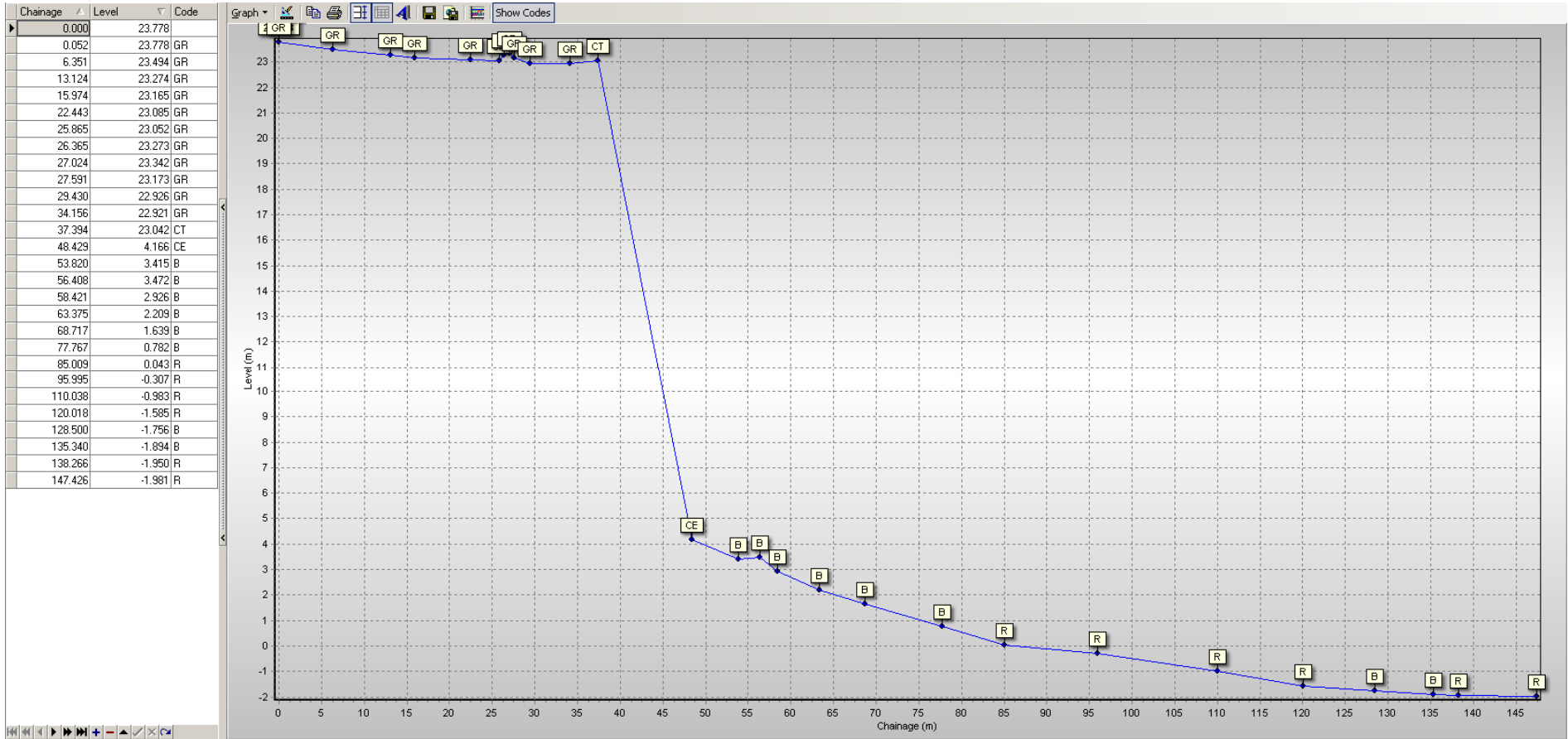


Navigation icons: back, forward, search, zoom, etc.

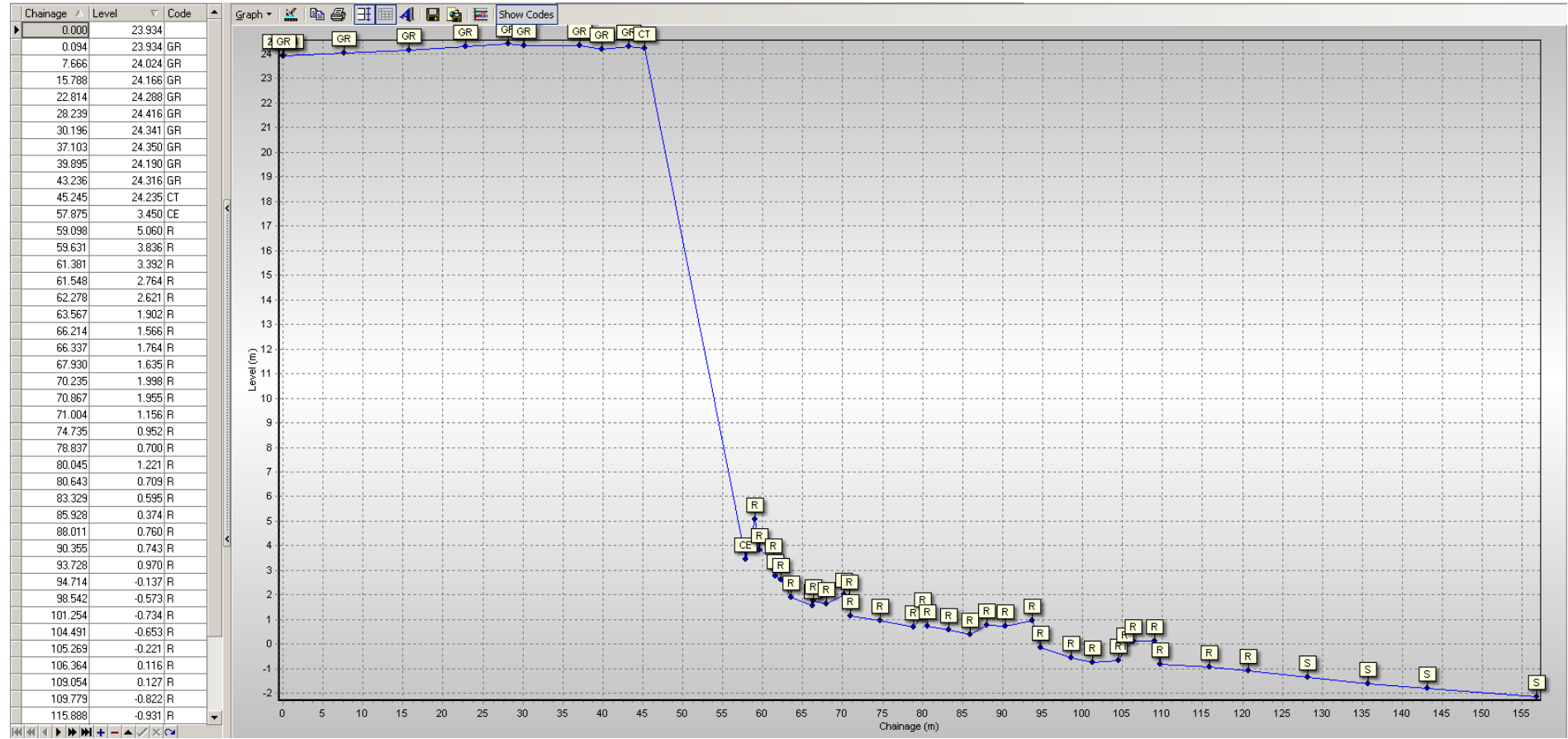
1bSNS17 - 06/10/2010



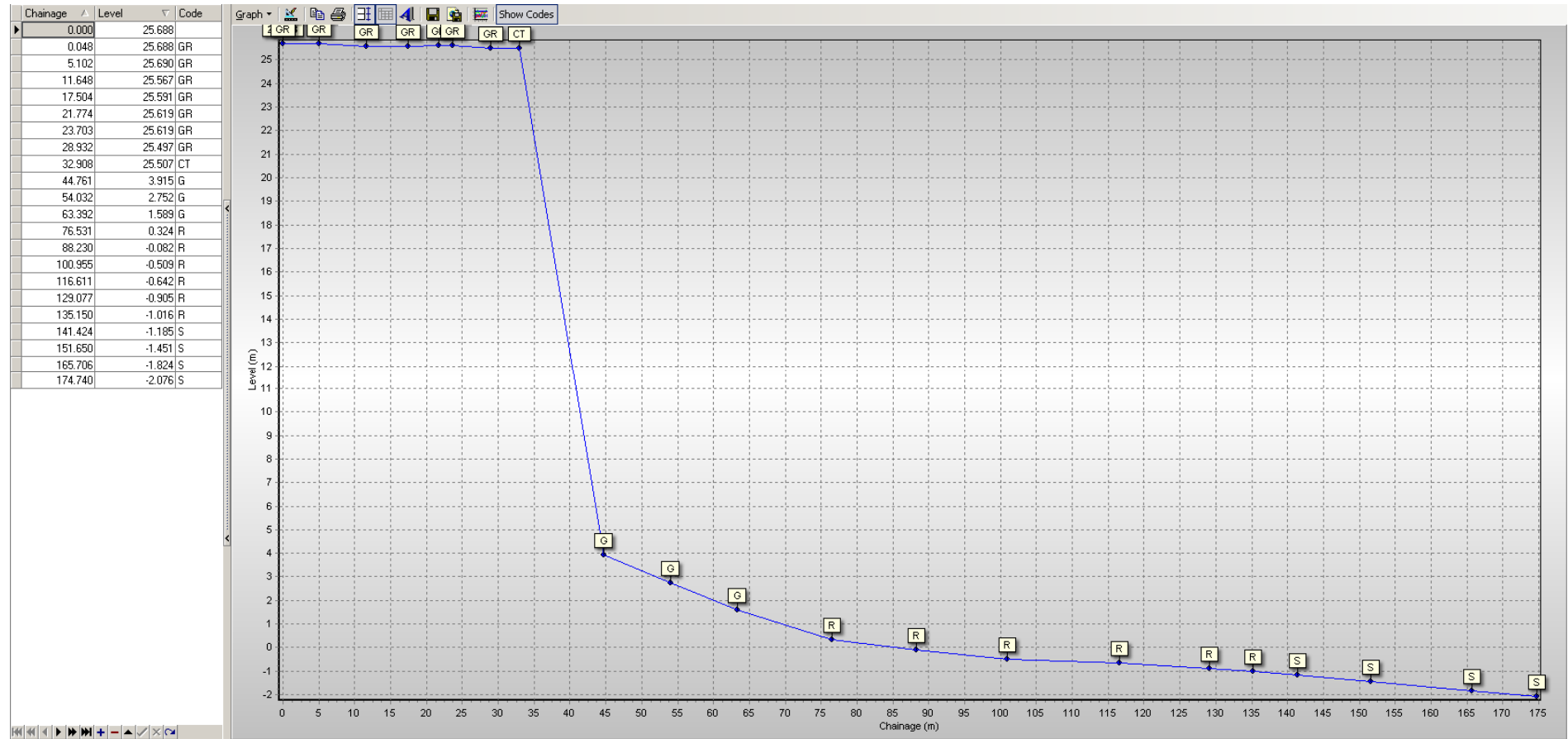
1bSNS18 - 06/10/2010



1bSNS19 - 06/10/2010

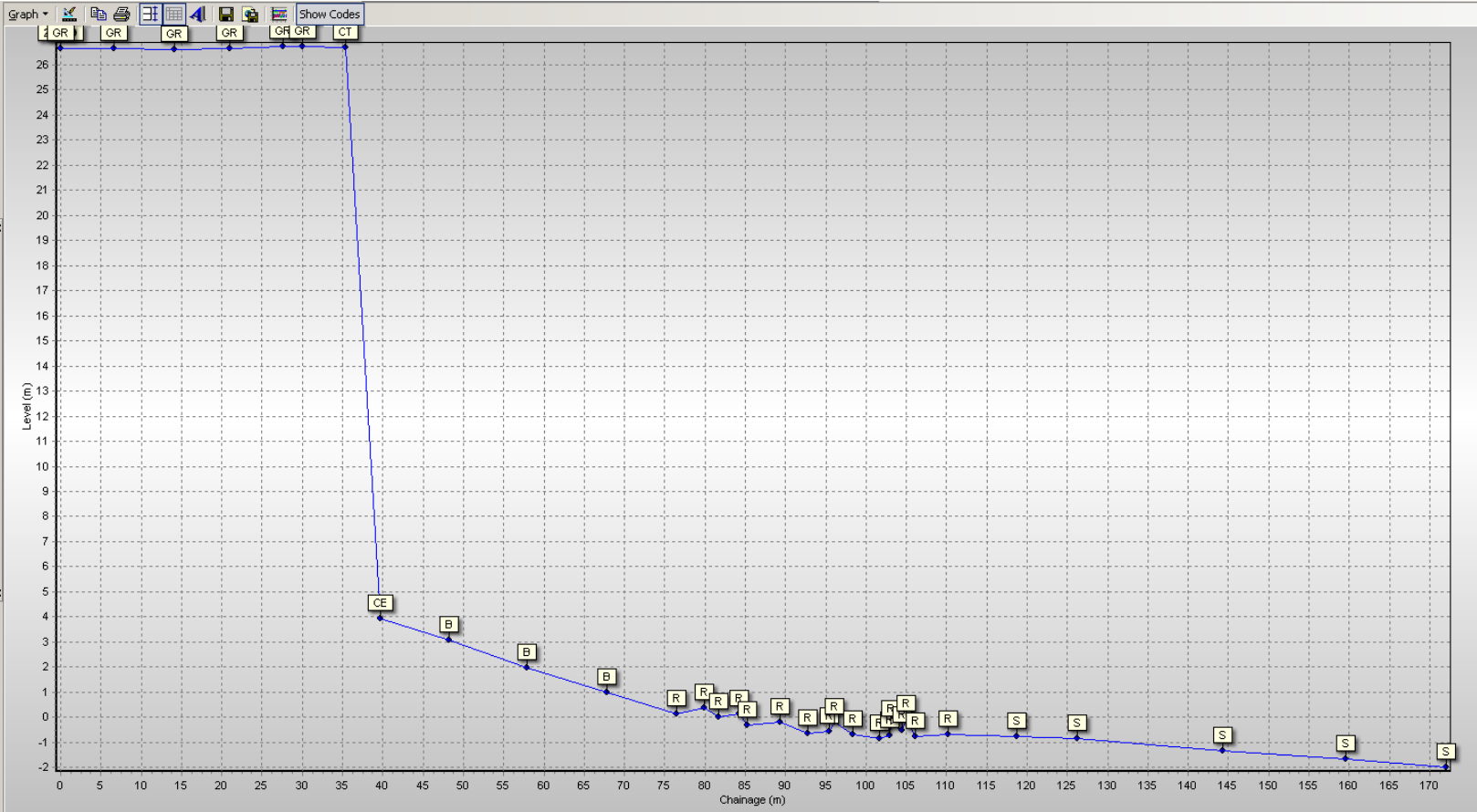


1bSNS20 - 06/10/2010



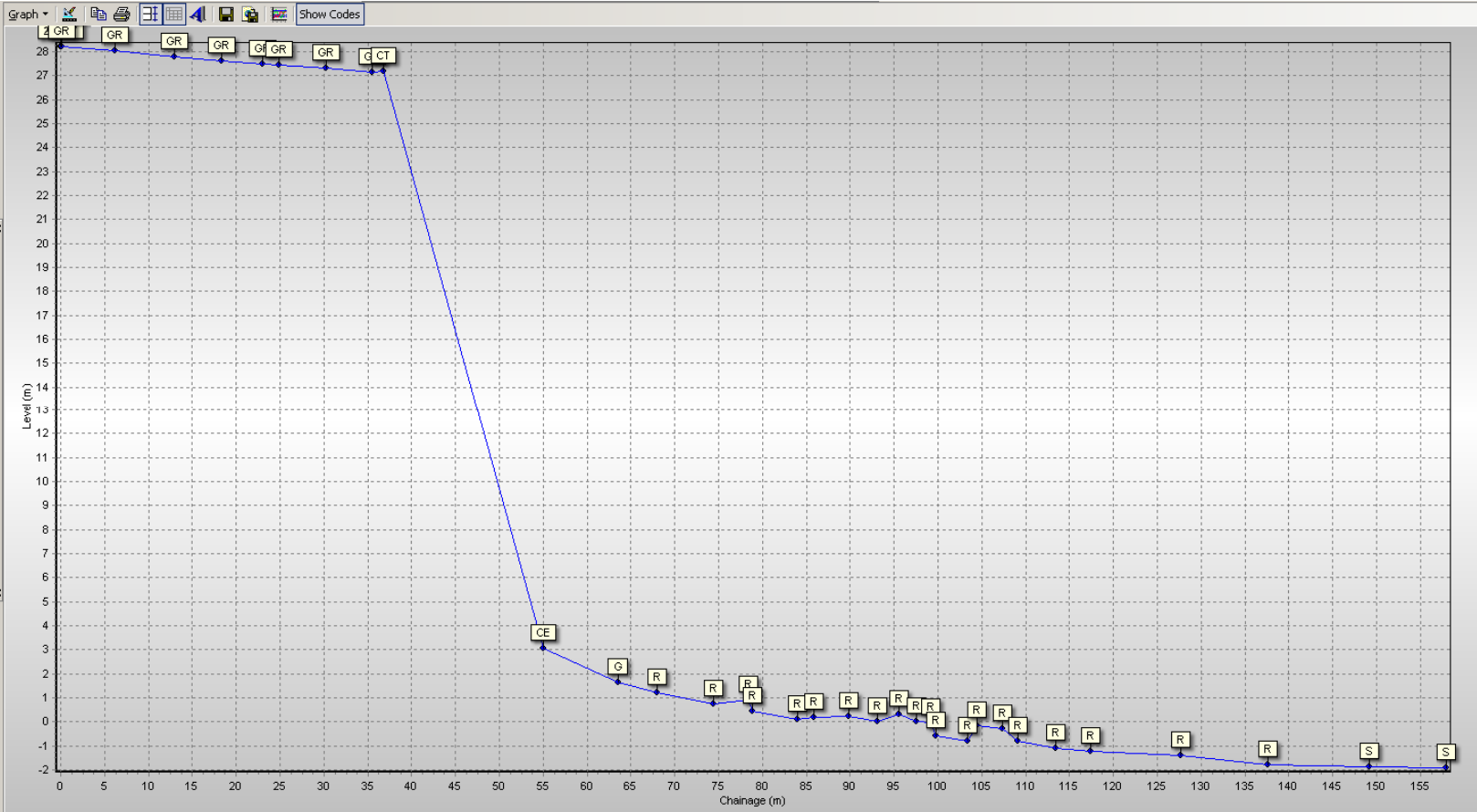
1bSNS21 - 06/10/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 26.639 | |
| 0.043 | 26.639 | GR |
| 6.619 | 26.628 | GR |
| 14.129 | 26.585 | GR |
| 21.044 | 26.649 | GR |
| 27.570 | 26.704 | GR |
| 30.014 | 26.715 | GR |
| 35.430 | 26.677 | CT |
| 39.711 | 3.932 | CE |
| 48.215 | 3.063 | B |
| 57.850 | 1.968 | B |
| 67.830 | 1.014 | B |
| 76.451 | 0.158 | R |
| 79.852 | 0.383 | R |
| 81.718 | 0.020 | R |
| 84.213 | 0.161 | R |
| 85.266 | -0.301 | R |
| 89.368 | -0.203 | R |
| 92.753 | -0.630 | R |
| 95.422 | -0.571 | R |
| 96.076 | -0.165 | R |
| 98.325 | -0.673 | R |
| 101.718 | -0.837 | R |
| 103.009 | -0.726 | R |
| 103.064 | -0.262 | R |
| 104.518 | -0.511 | R |
| 104.952 | -0.078 | R |
| 106.165 | -0.736 | R |
| 110.149 | -0.680 | R |
| 118.716 | -0.754 | S |
| 126.226 | -0.852 | S |
| 144.363 | -1.310 | S |
| 159.526 | -1.660 | S |
| 172.043 | -1.990 | S |

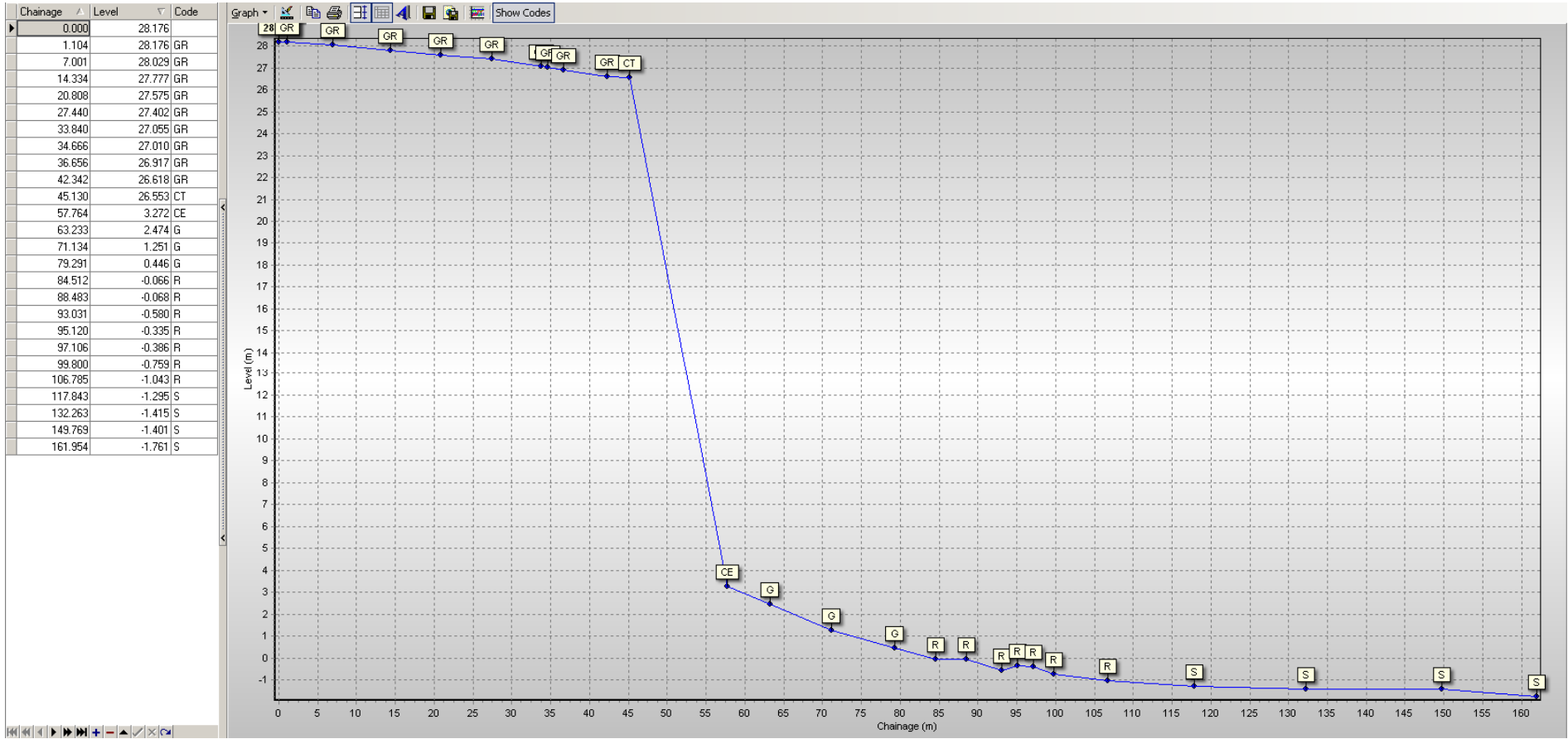


1bSNS22 - 06/10/2010

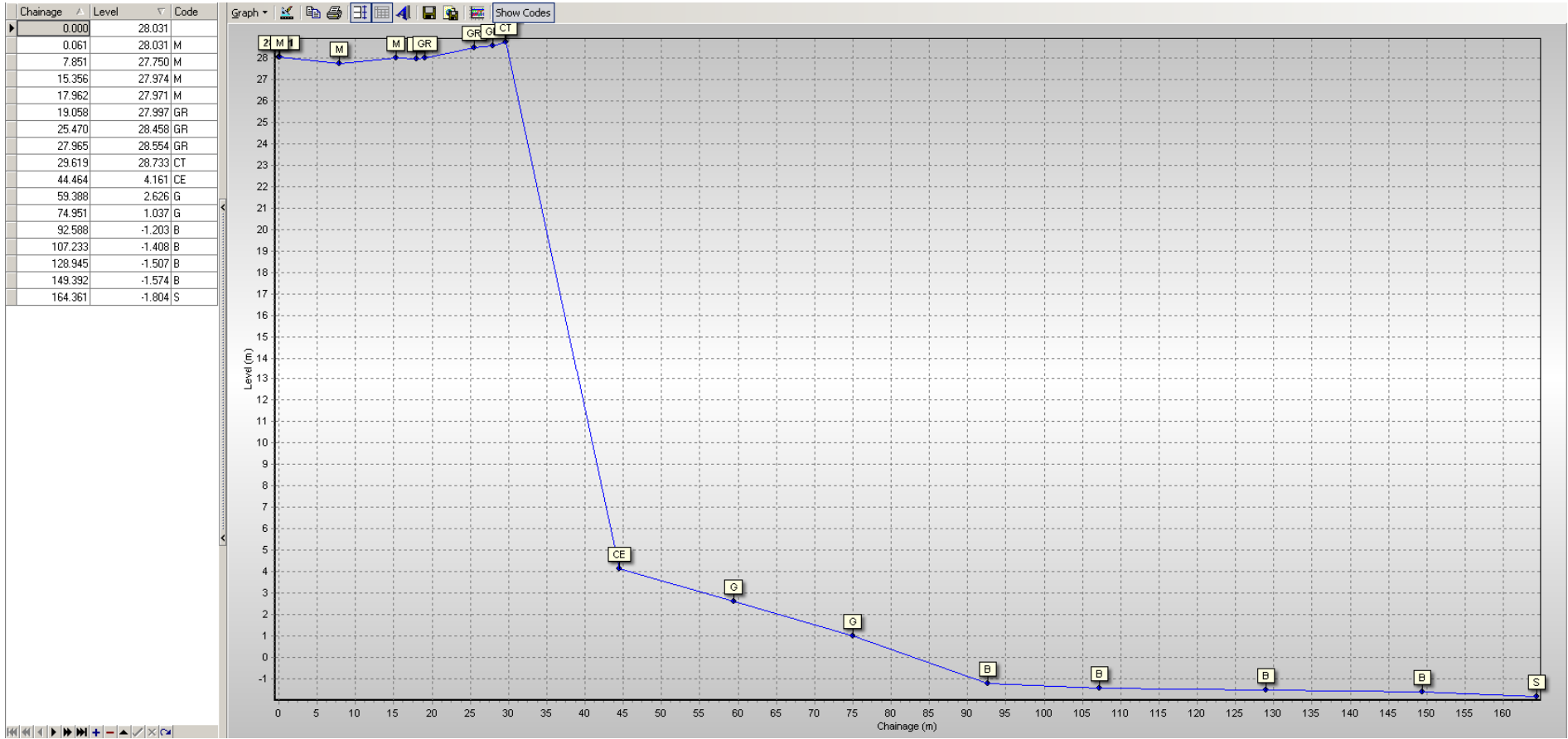
| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 28.217 | |
| 0.109 | 28.217 | GR |
| 6.133 | 28.028 | GR |
| 12.921 | 27.782 | GR |
| 18.342 | 27.596 | GR |
| 23.064 | 27.497 | GR |
| 24.881 | 27.443 | GR |
| 30.283 | 27.318 | GR |
| 35.533 | 27.132 | GR |
| 36.796 | 27.175 | CT |
| 55.021 | 3.054 | CE |
| 63.594 | 1.635 | G |
| 68.014 | 1.205 | R |
| 74.426 | 0.762 | R |
| 78.388 | 0.918 | R |
| 78.858 | 0.443 | R |
| 83.998 | 0.082 | R |
| 85.821 | 0.177 | R |
| 89.824 | 0.232 | R |
| 93.094 | -0.003 | R |
| 95.609 | 0.320 | R |
| 97.521 | 0.027 | R |
| 99.204 | -0.029 | R |
| 99.813 | -0.584 | R |
| 103.340 | -0.817 | R |
| 104.380 | -0.144 | R |
| 107.349 | -0.299 | R |
| 109.057 | -0.793 | R |
| 113.414 | -1.102 | R |
| 117.342 | -1.214 | R |
| 127.625 | -1.394 | R |
| 137.583 | -1.777 | R |
| 149.214 | -1.854 | S |
| 157.931 | -1.917 | S |



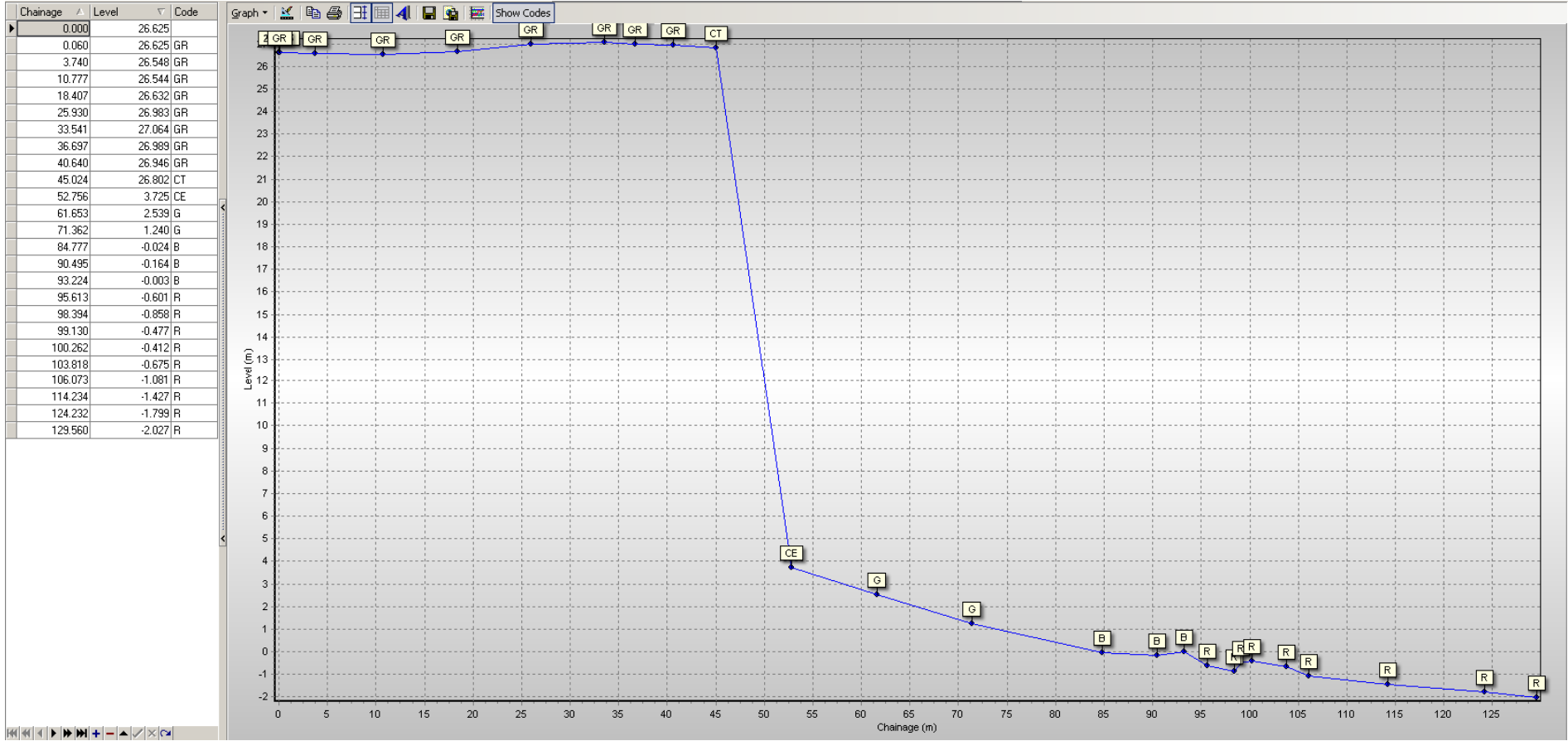
1bSNS23 - 06/10/2010



1bSNS24 - 06/10/2010

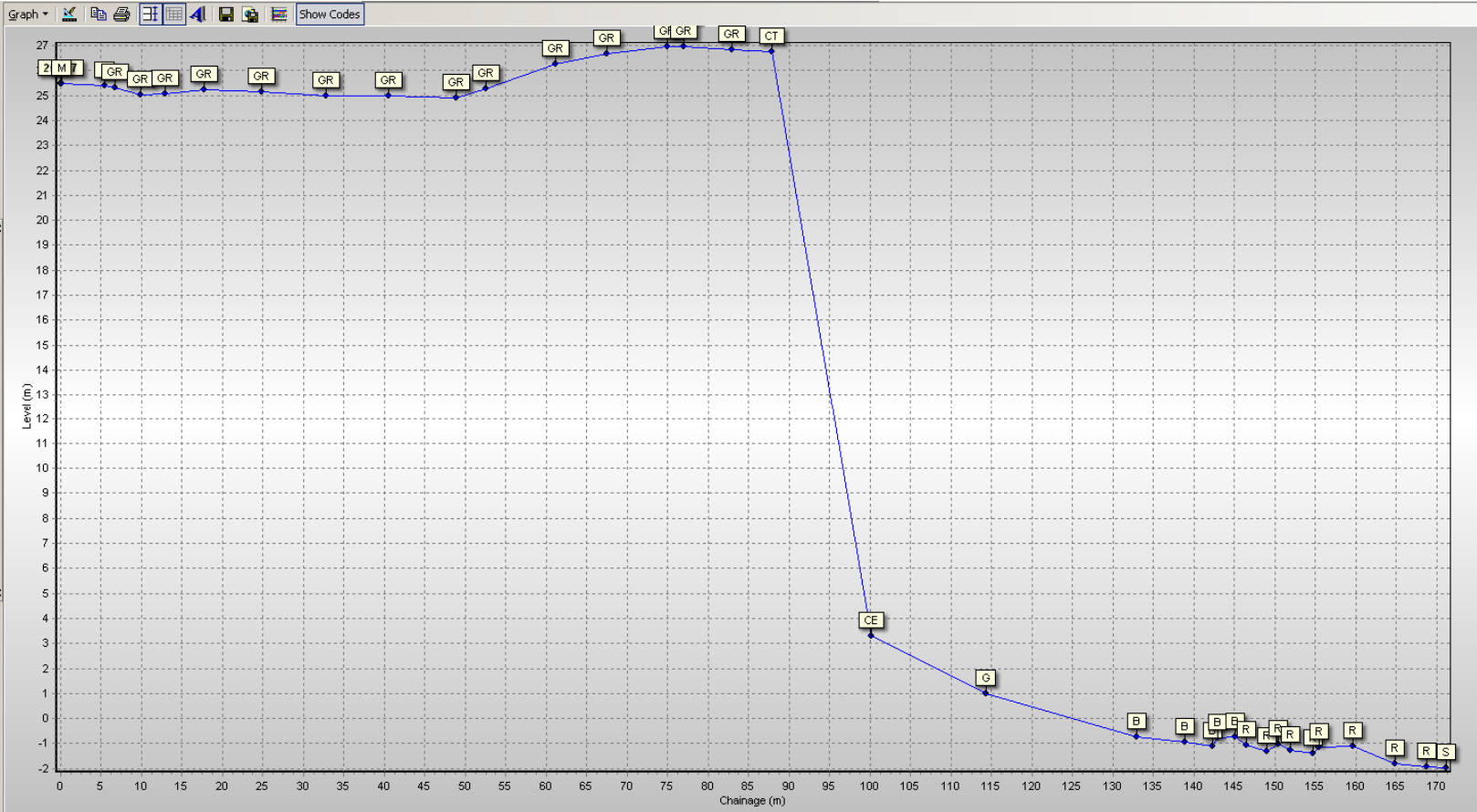


1bSNS25 - 06/10/2010

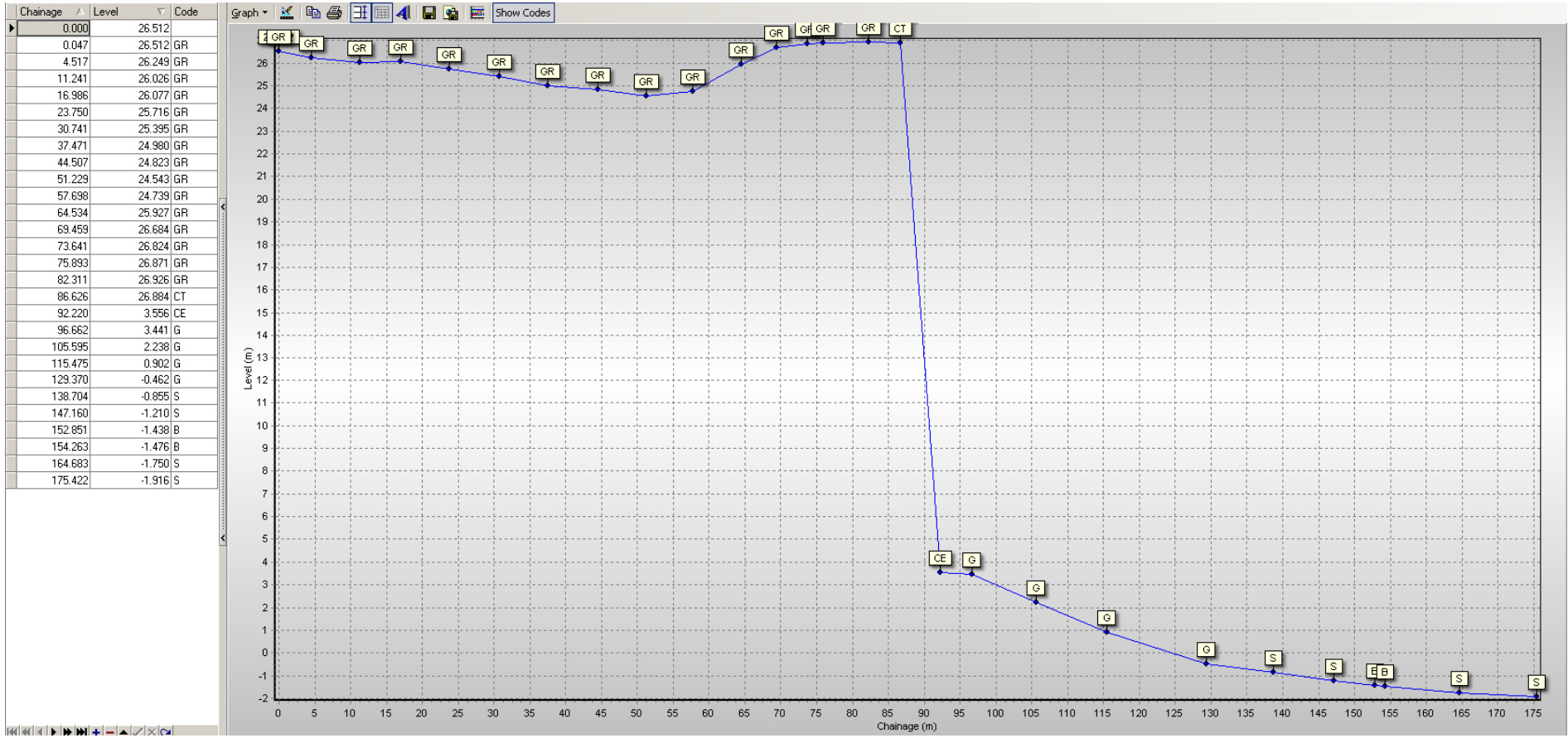


1bSNS26 - 06/10/2010

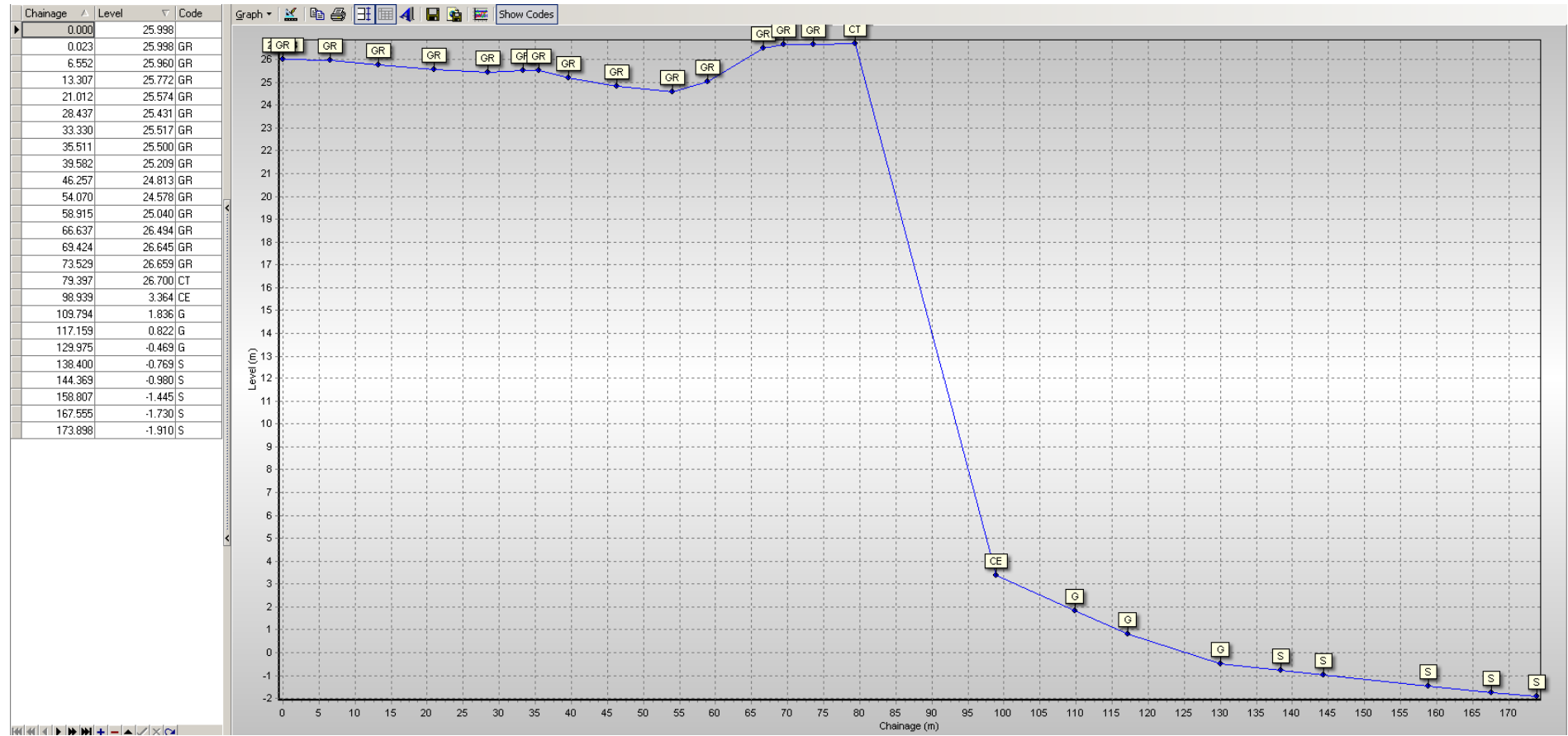
| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 25.477 | |
| 0.100 | 25.477 | M |
| 5.394 | 25.395 | M |
| 6.730 | 25.316 | GR |
| 9.873 | 25.023 | GR |
| 12.952 | 25.079 | GR |
| 17.709 | 25.229 | GR |
| 24.765 | 25.155 | GR |
| 32.756 | 24.982 | GR |
| 40.495 | 24.991 | GR |
| 48.927 | 24.894 | GR |
| 52.561 | 25.272 | GR |
| 61.144 | 26.268 | GR |
| 67.541 | 26.680 | GR |
| 75.014 | 26.963 | GR |
| 77.016 | 26.949 | GR |
| 82.982 | 26.895 | GR |
| 87.913 | 26.747 | CT |
| 100.133 | 3.288 | CE |
| 114.384 | 1.001 | G |
| 132.973 | -0.748 | B |
| 138.844 | -0.960 | B |
| 142.355 | -1.126 | B |
| 142.924 | -0.796 | B |
| 145.157 | -0.740 | B |
| 146.503 | -1.078 | R |
| 149.046 | -1.328 | R |
| 150.412 | -1.034 | R |
| 151.956 | -1.271 | R |
| 154.695 | -1.391 | R |
| 155.470 | -1.131 | R |
| 159.693 | -1.122 | R |
| 164.810 | -1.818 | R |
| 168.749 | -1.930 | R |
| 171.183 | -1.971 | S |



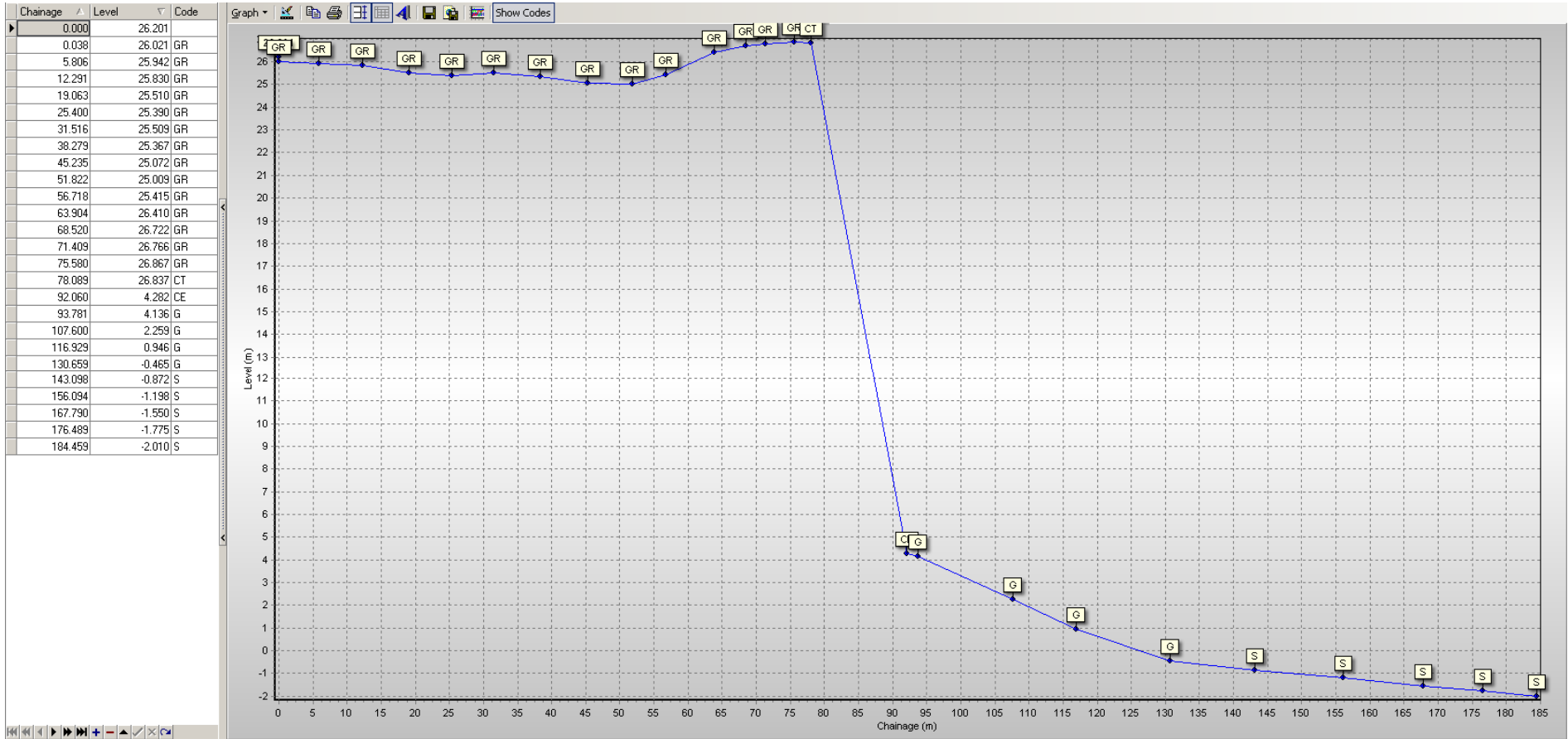
1bSNS27 - 06/10/2010



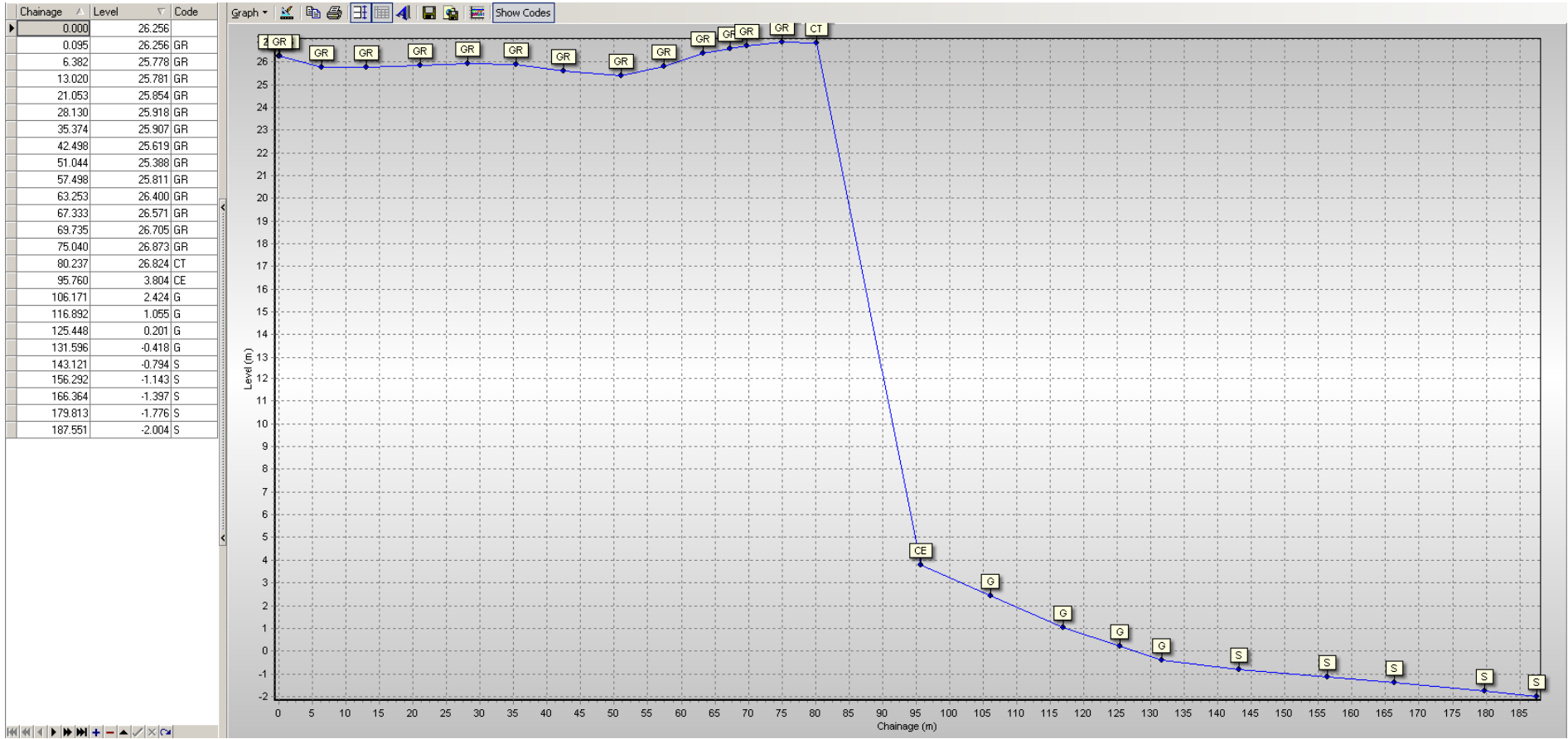
1bSNS28 - 06/10/2010



1bSNS29 - 06/10/2010

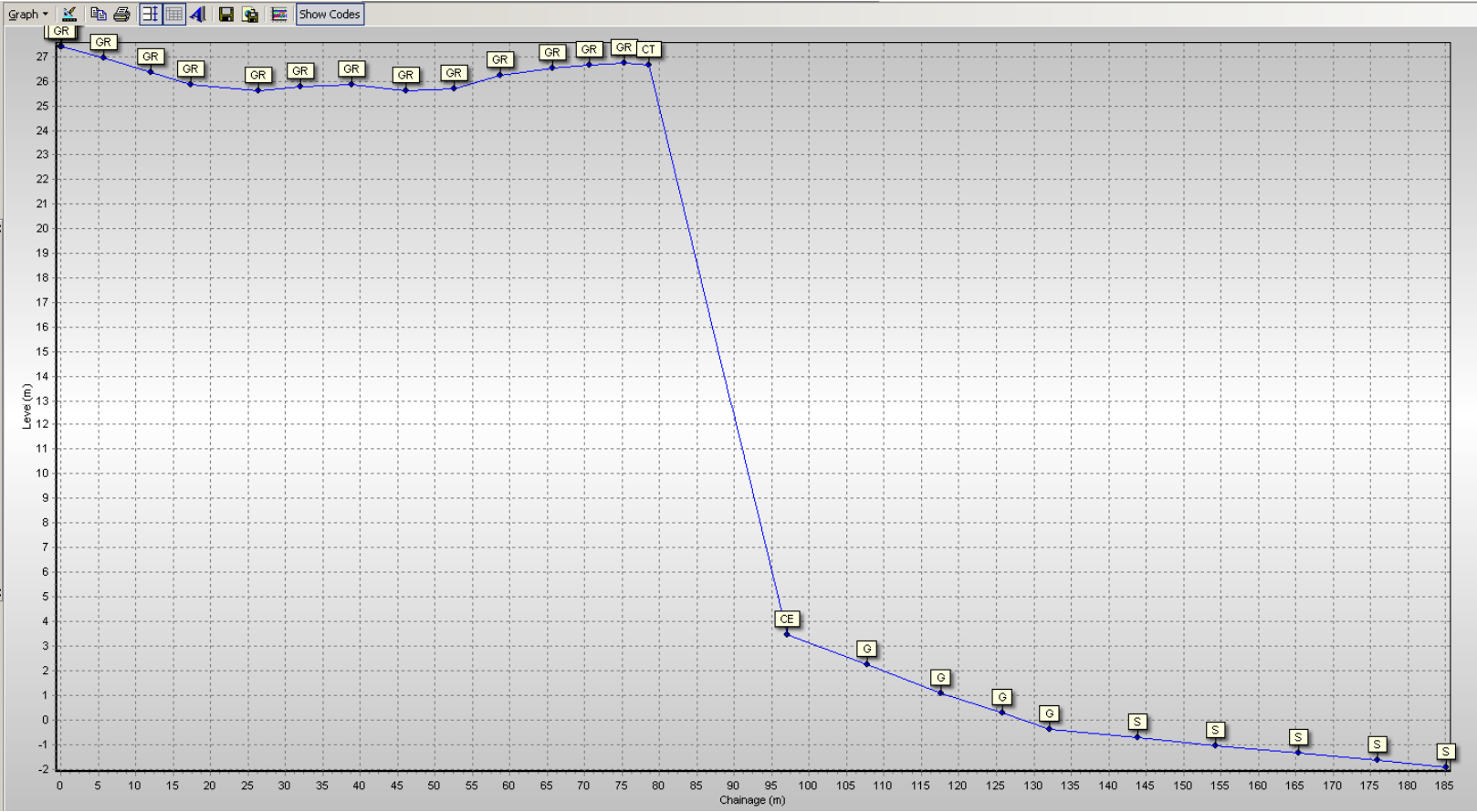


1bSNS30 - 06/10/2010

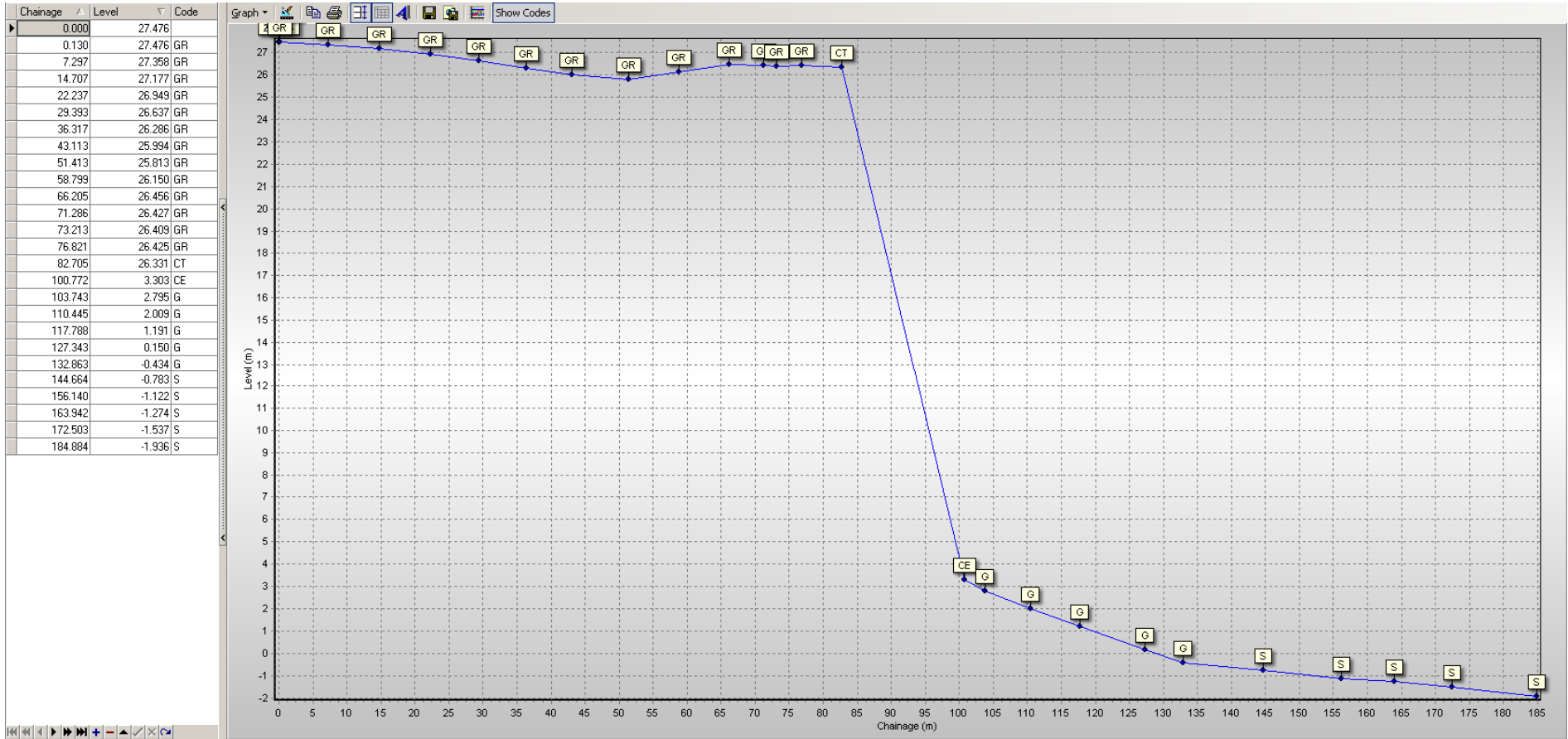


1bSNS31 - 06/10/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 27.400 | |
| 0.101 | 27.400 | GR |
| 5.761 | 26.956 | GR |
| 12.026 | 26.338 | GR |
| 17.413 | 25.843 | GR |
| 26.491 | 25.590 | GR |
| 31.995 | 25.788 | GR |
| 38.949 | 25.856 | GR |
| 46.123 | 25.626 | GR |
| 52.620 | 25.700 | GR |
| 58.788 | 26.236 | GR |
| 65.668 | 26.519 | GR |
| 70.692 | 26.634 | GR |
| 75.345 | 26.715 | GR |
| 78.630 | 26.649 | CT |
| 97.097 | 3.452 | CE |
| 107.680 | 2.235 | G |
| 117.567 | 1.097 | G |
| 125.783 | 0.281 | G |
| 132.180 | -0.378 | G |
| 143.901 | -0.719 | S |
| 154.364 | -1.031 | S |
| 165.412 | -1.336 | S |
| 175.927 | -1.647 | S |
| 185.101 | -1.926 | S |

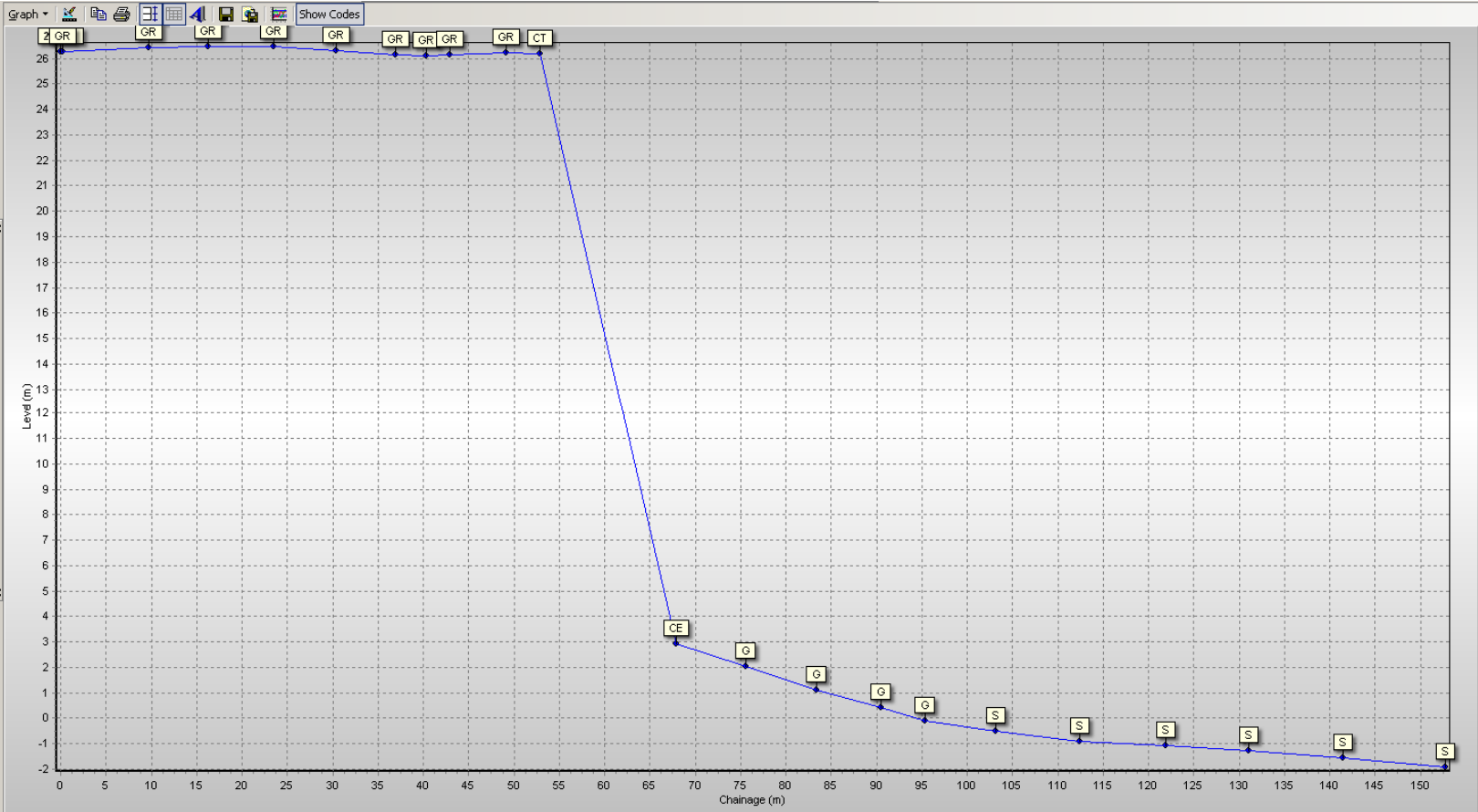


1bSNS32 - 06/10/2010



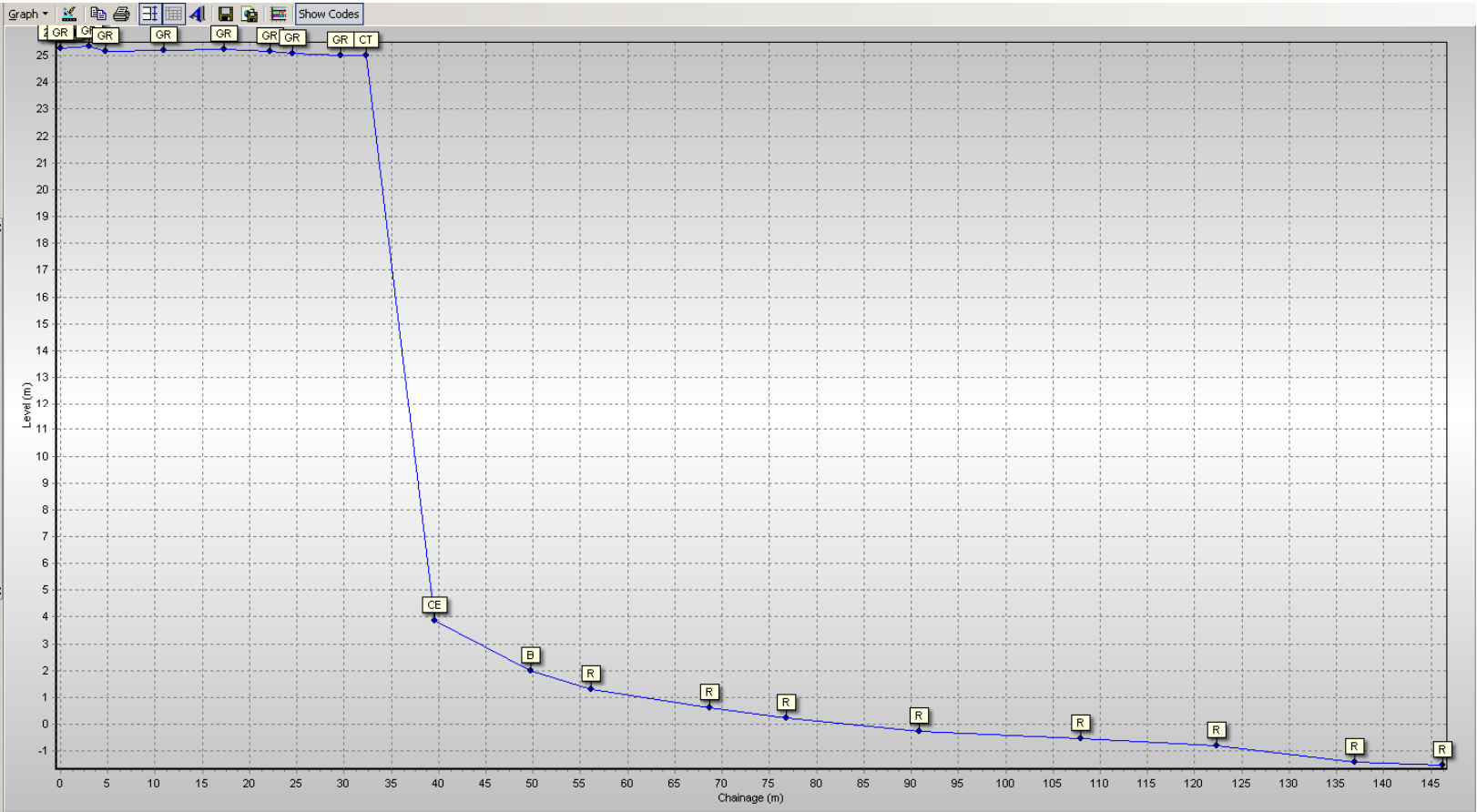
1bSNS33 - 06/10/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 26.255 | |
| 0.280 | 26.255 | GR |
| 9.738 | 26.429 | GR |
| 16.306 | 26.457 | GR |
| 23.453 | 26.473 | GR |
| 30.427 | 26.300 | GR |
| 36.908 | 26.170 | GR |
| 40.328 | 26.128 | GR |
| 42.975 | 26.160 | GR |
| 49.112 | 26.223 | GR |
| 52.840 | 26.208 | CT |
| 67.882 | 2.905 | CE |
| 75.542 | 2.035 | G |
| 83.379 | 1.091 | G |
| 90.508 | 0.424 | G |
| 95.334 | -0.104 | G |
| 103.139 | -0.497 | S |
| 112.440 | -0.929 | S |
| 121.926 | -1.081 | S |
| 131.103 | -1.288 | S |
| 141.457 | -1.576 | S |
| 152.751 | -1.923 | S |



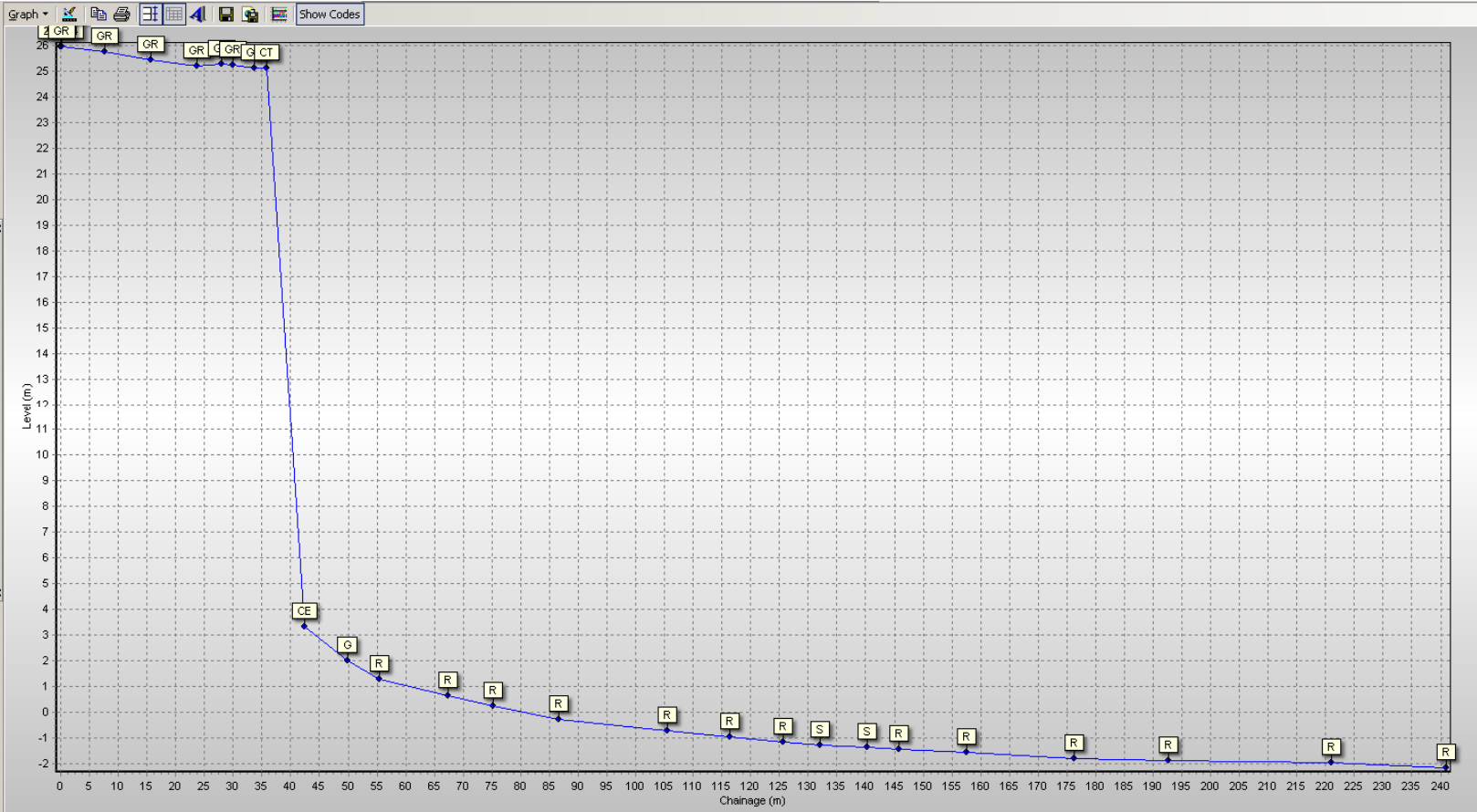
1bSNS34 - 06/10/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 25.288 | |
| 0.044 | 25.288 | GR |
| 3.075 | 25.348 | GR |
| 4.716 | 25.159 | GR |
| 10.890 | 25.205 | GR |
| 17.312 | 25.223 | GR |
| 22.177 | 25.143 | GR |
| 24.505 | 25.065 | GR |
| 29.663 | 25.007 | GR |
| 32.344 | 24.997 | CT |
| 39.540 | 3.852 | CE |
| 49.763 | 1.993 | B |
| 56.092 | 1.297 | R |
| 68.728 | 0.602 | R |
| 76.848 | 0.243 | R |
| 90.854 | -0.245 | R |
| 107.957 | -0.537 | R |
| 122.385 | -0.807 | R |
| 136.945 | -1.422 | R |
| 146.238 | -1.524 | R |



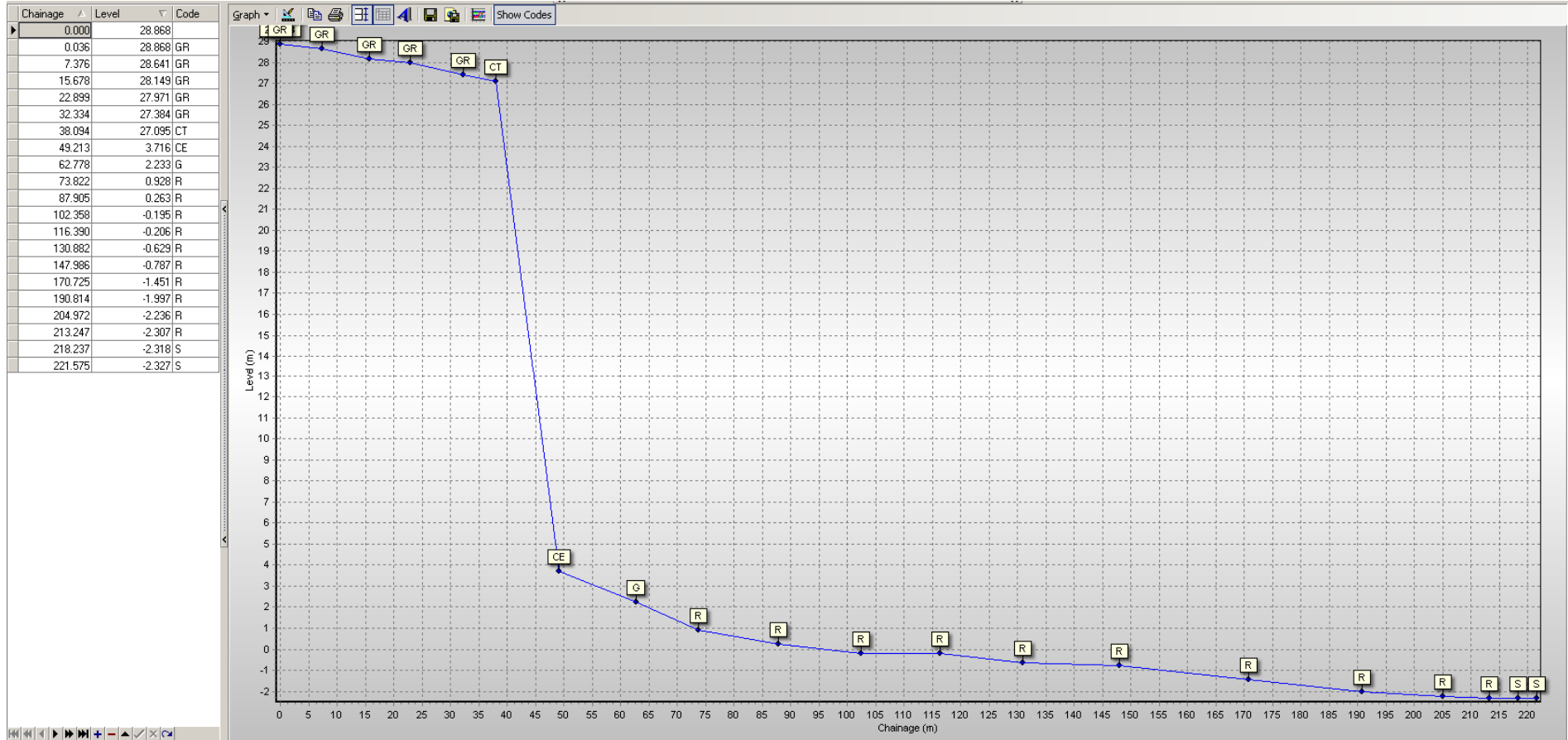
1bSNS35 - 06/10/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 25.974 | |
| 0.115 | 25.974 | GR |
| 7.650 | 25.781 | GR |
| 15.644 | 25.470 | GR |
| 23.739 | 25.221 | GR |
| 27.967 | 25.282 | GR |
| 29.920 | 25.262 | GR |
| 33.651 | 25.145 | GR |
| 35.758 | 25.141 | CT |
| 42.489 | 3.300 | CE |
| 49.843 | 1.985 | G |
| 55.441 | 1.295 | R |
| 67.461 | 0.626 | R |
| 75.246 | 0.226 | R |
| 86.676 | -0.271 | R |
| 105.507 | -0.735 | R |
| 116.368 | -0.964 | R |
| 125.648 | -1.156 | R |
| 132.021 | -1.267 | S |
| 140.324 | -1.376 | S |
| 145.713 | -1.447 | R |
| 157.585 | -1.568 | R |
| 176.224 | -1.810 | R |
| 192.663 | -1.898 | R |
| 221.070 | -1.953 | R |
| 240.973 | -2.166 | R |



Navigation icons: back, forward, search, and other controls.

1bSNS36 - 06/10/2010



Beach Profiles: 1bSNS1



- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

MHW

MLW

MHW

MLW

Beach Profiles: 1bSNS2



- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

Beach Profiles: 1bSNS3



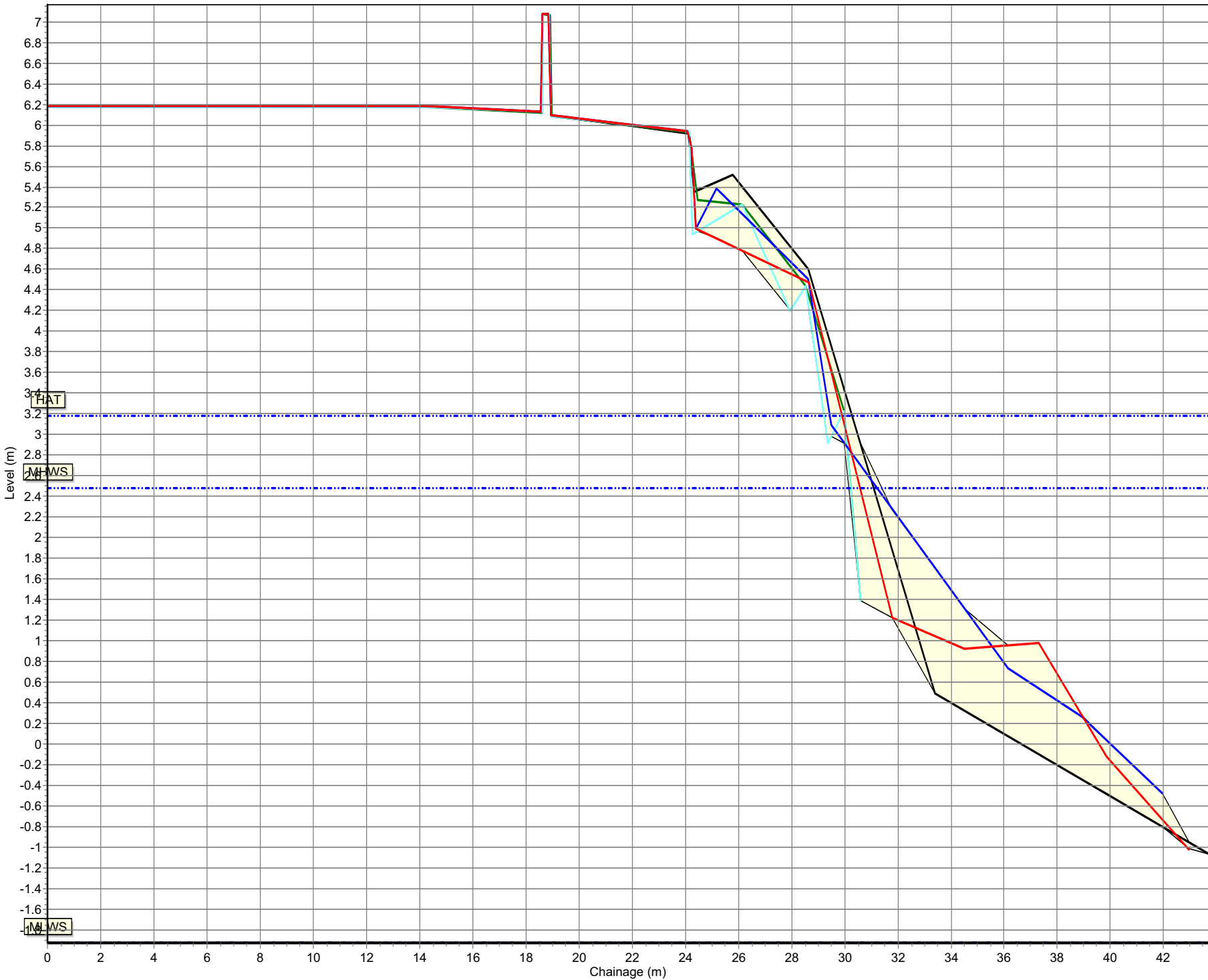
- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

MHW

MLW

MLW

Beach Profiles: 1bSNS4



- Profiles Envelope
- 10/11/2006
- 25/03/2009
- 16/09/2009
- 18/03/2010
- 06/10/2010

HAT

MWS

MWS

Beach Profiles: 1bSNS5



- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

Beach Profiles: 1bSNS6



- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

MHW

MLW

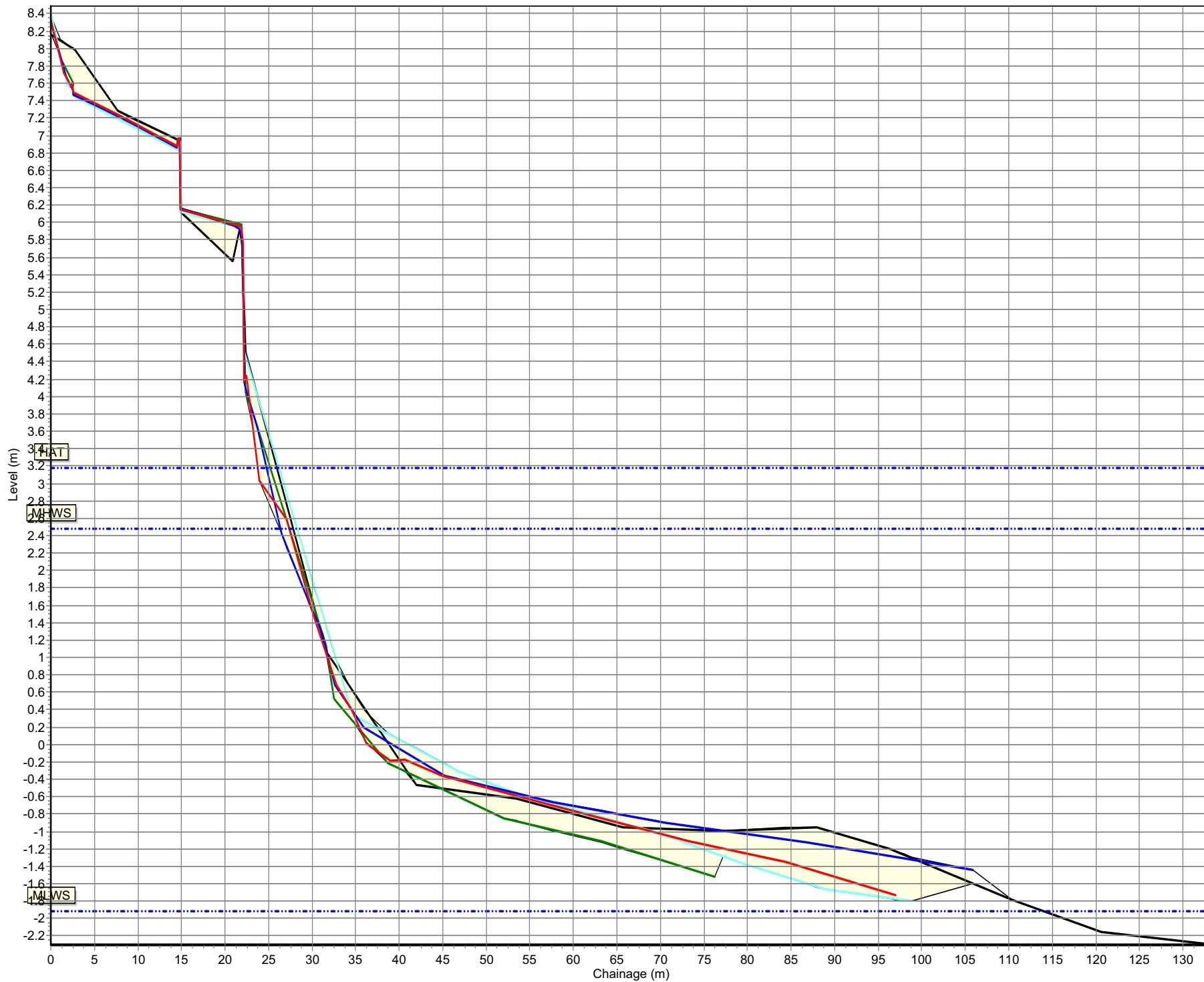
MLW

Beach Profiles: 1bSNS7



- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

Beach Profiles: 1bSNS8



- Profiles Envelope
- 10/11/2006
- 25/03/2009
- 16/09/2009
- 18/03/2010
- 06/10/2010

Beach Profiles: 1bSNS9



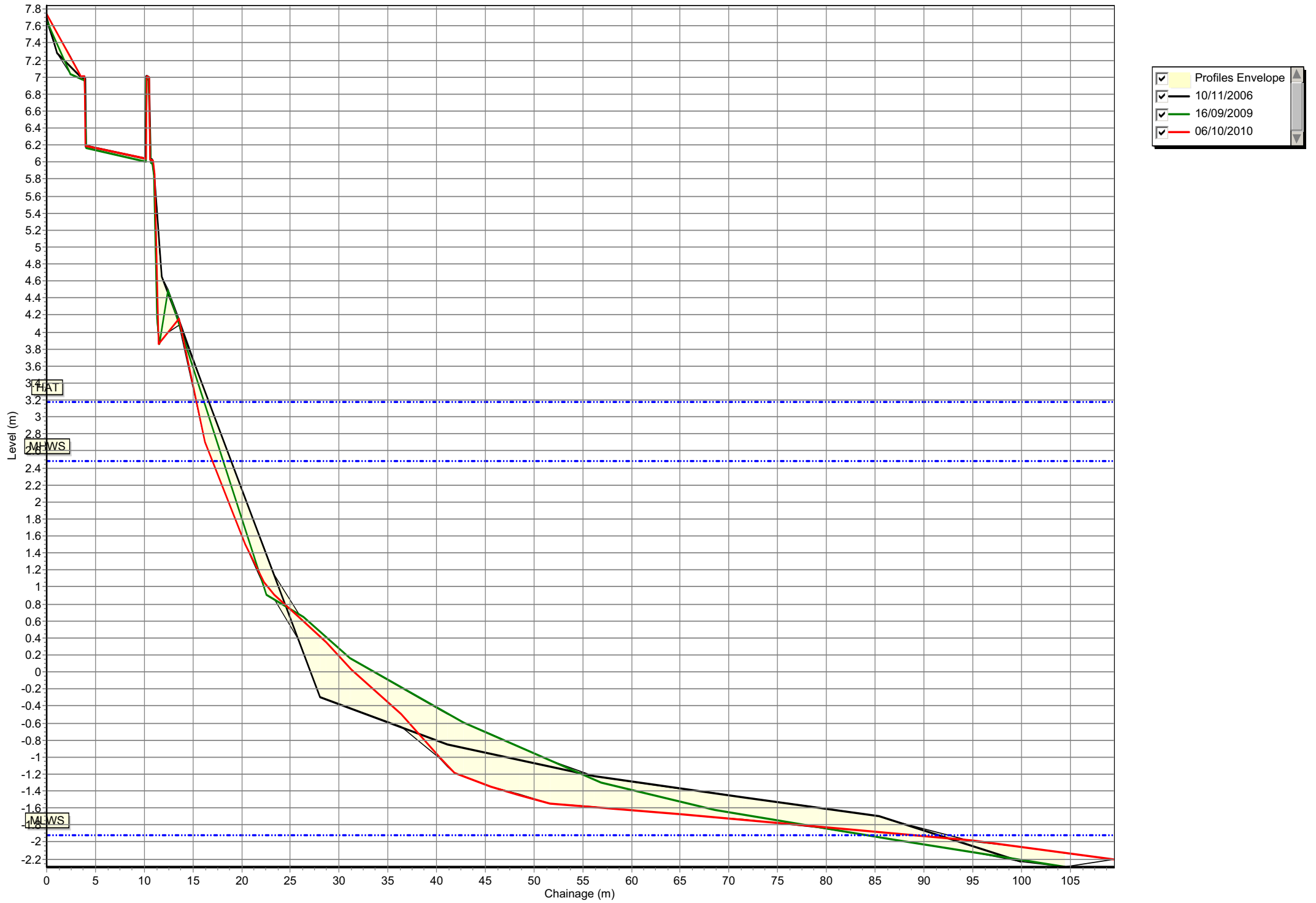
- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

HAT

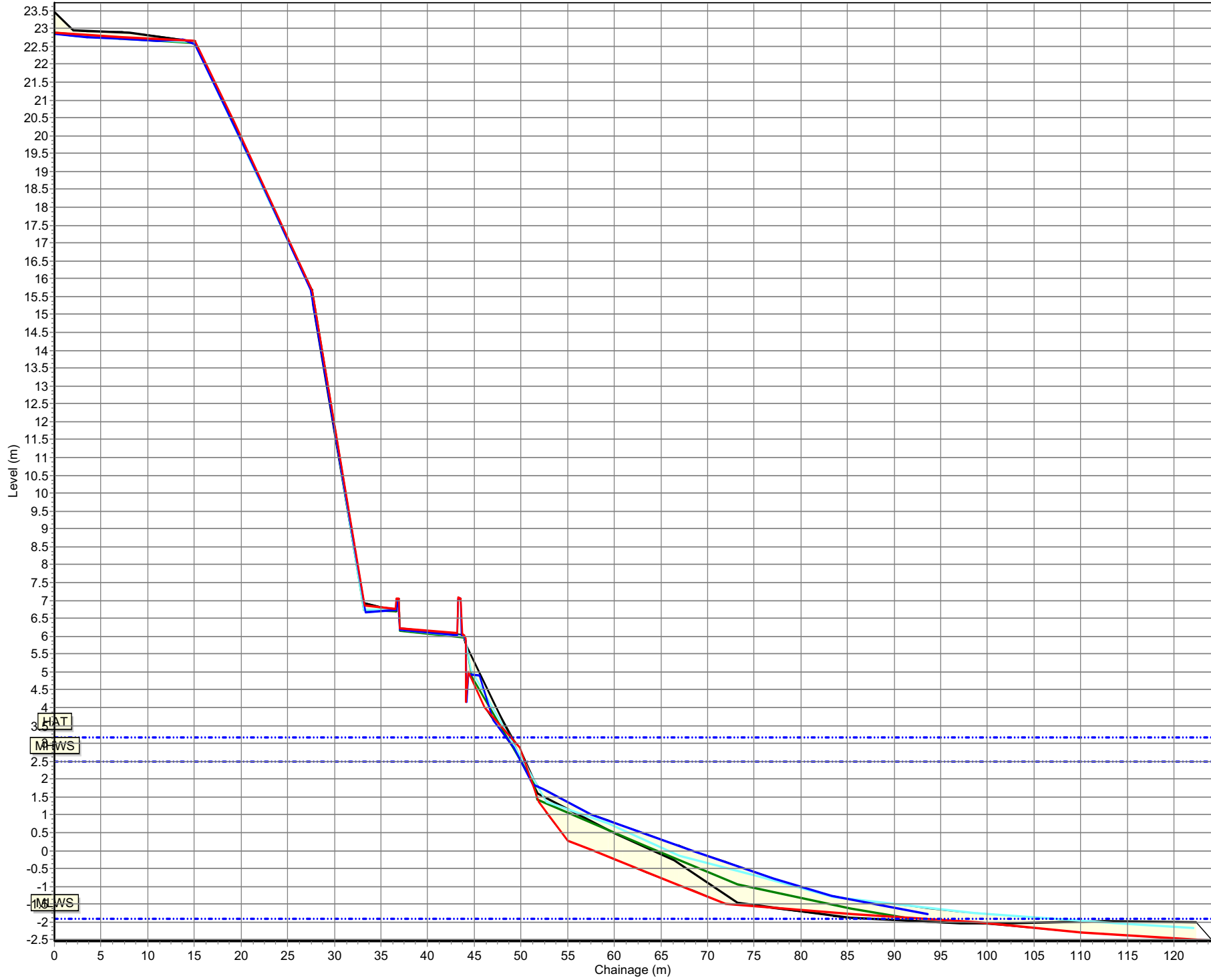
MWS

LWS

Beach Profiles: 1bSNS10



Beach Profiles: 1bSNS11



- Profiles Envelope
- 10/11/2006
- 25/03/2009
- 16/09/2009
- 18/03/2010
- 06/10/2010

HAT

MWS

LWS

Beach Profiles: 1bSNS12



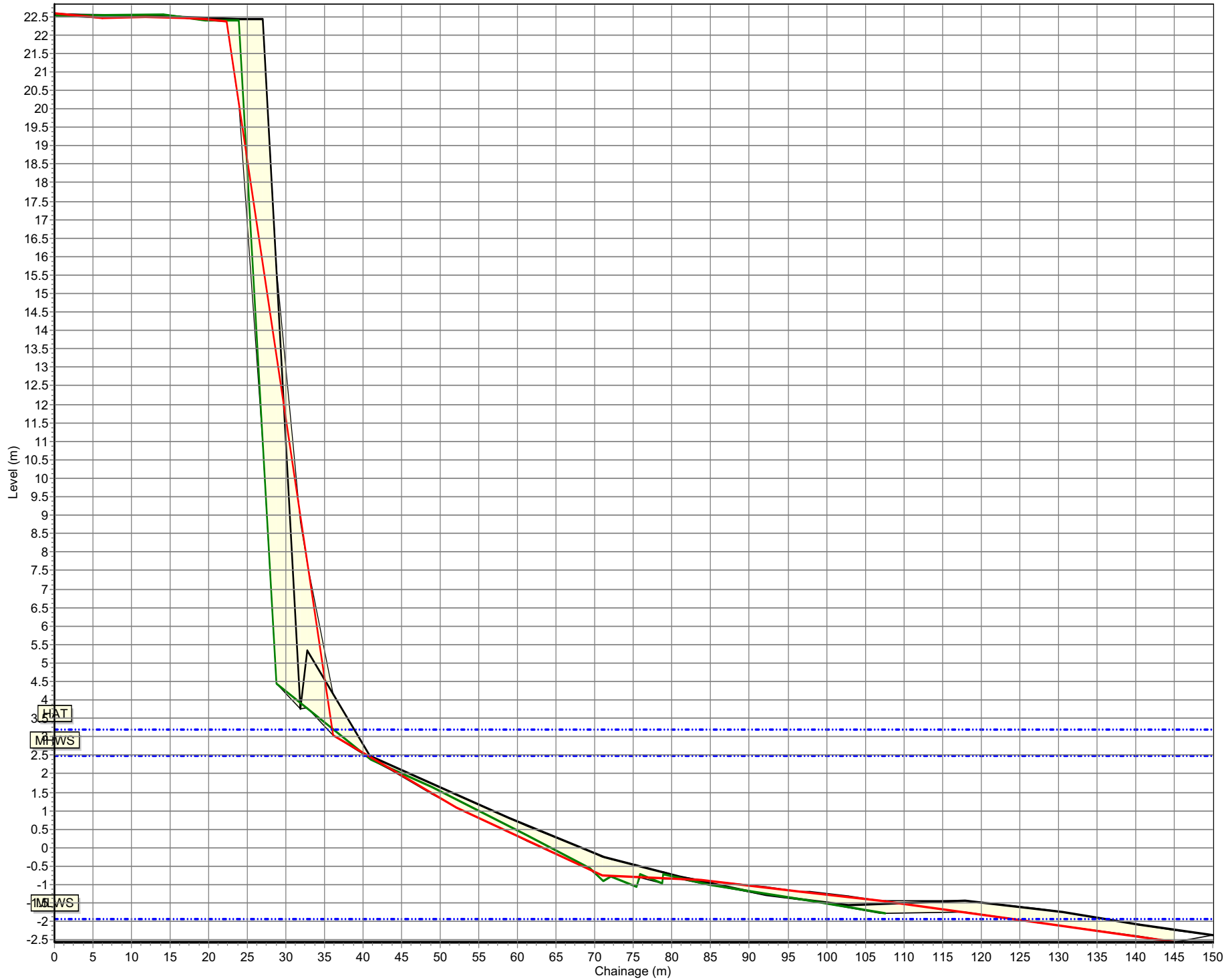
- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

HAT

MWS

LWS

Beach Profiles: 1bSNS13



- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

LAT

M+WS

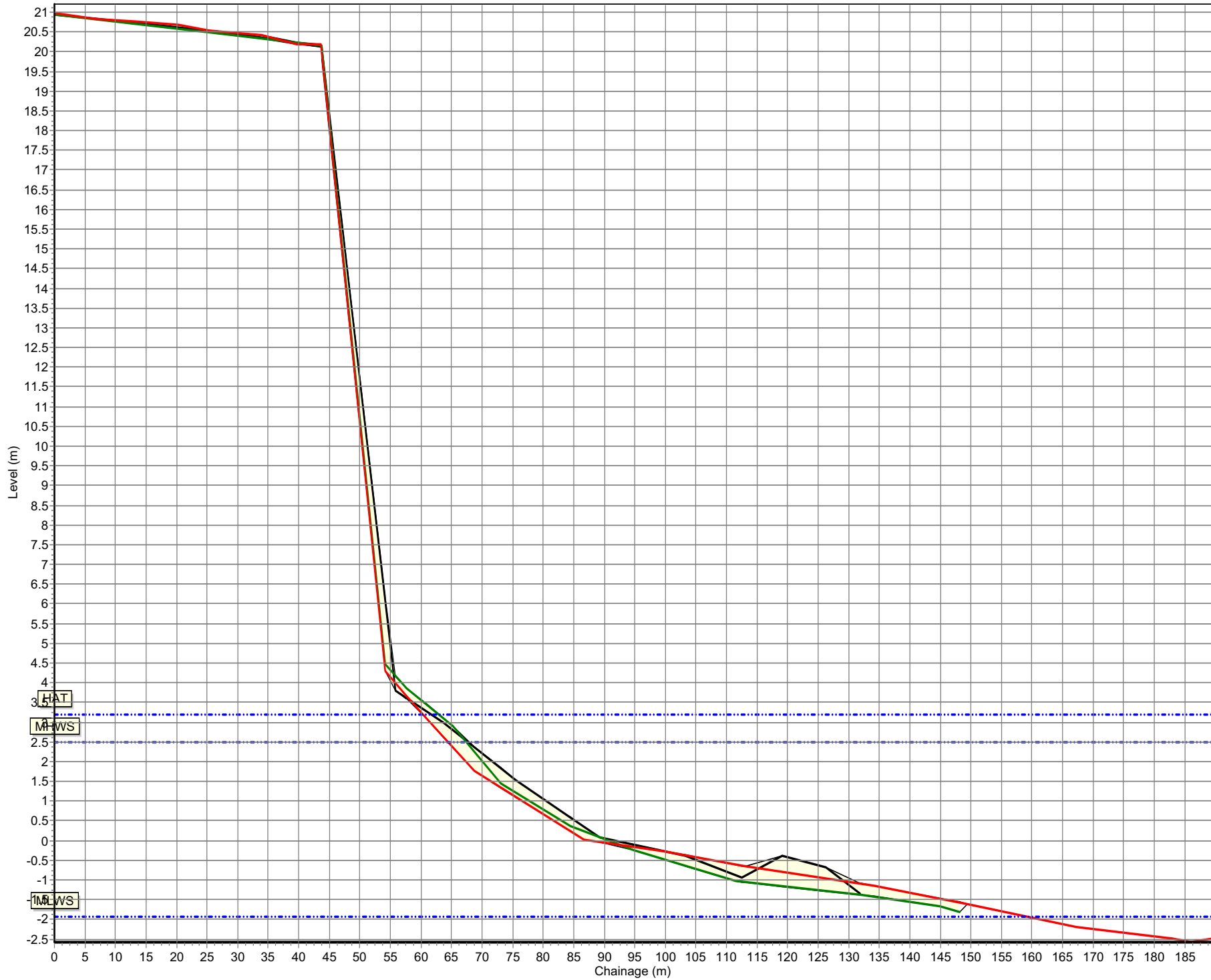
M-WS

Beach Profiles: 1bSNS14



- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

Beach Profiles: 1bSNS15



- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

HAT

MWS

LWS

Beach Profiles: 1bSNS16



Beach Profiles: 1bSNS17



- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

Beach Profiles: 1bSNS18



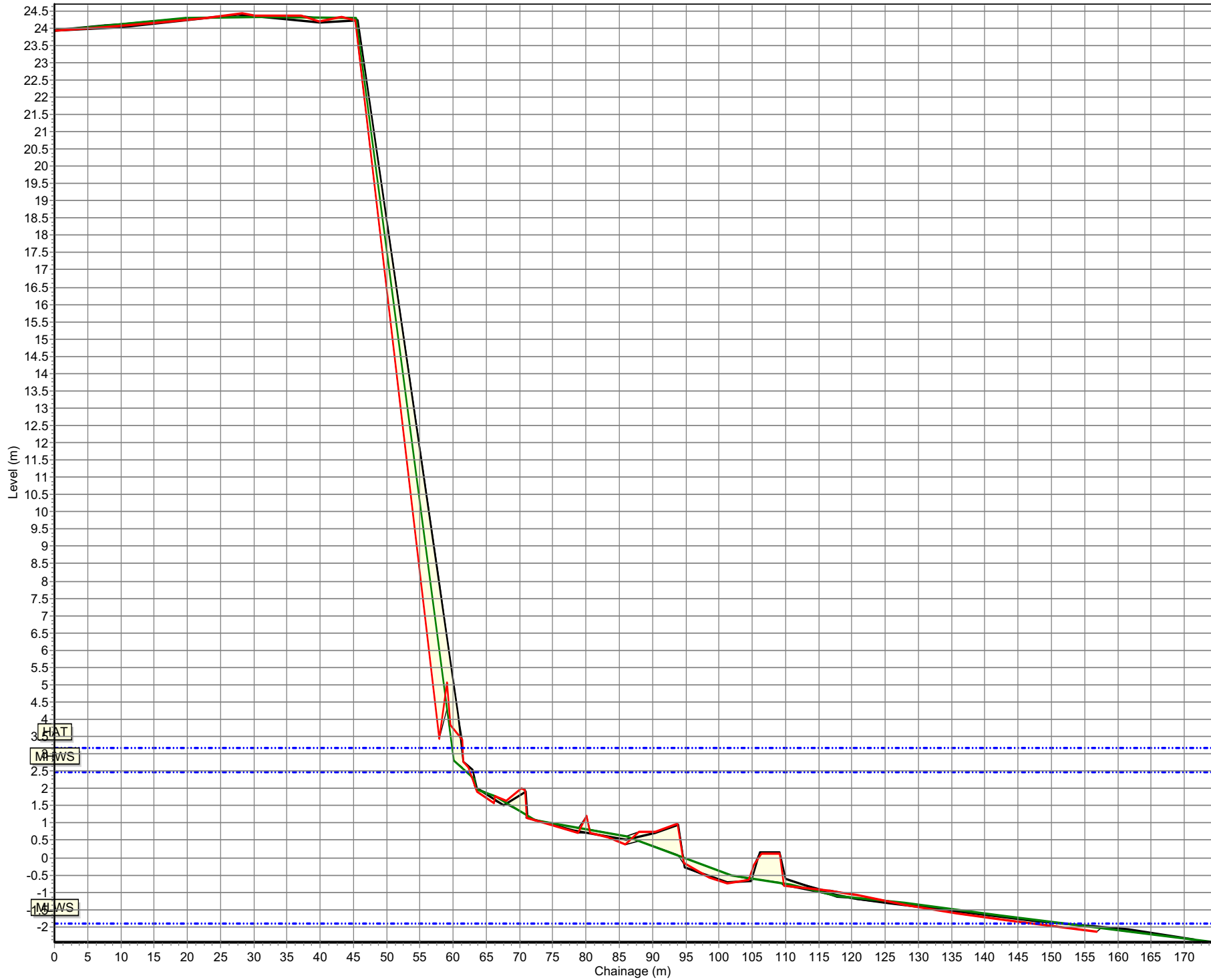
- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

HAT

MHW

MLW

Beach Profiles: 1bSNS19



- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

Beach Profiles: 1bSNS20



Beach Profiles: 1bSNS21



- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

HAT
MWS
MWS

Beach Profiles: 1bSNS22

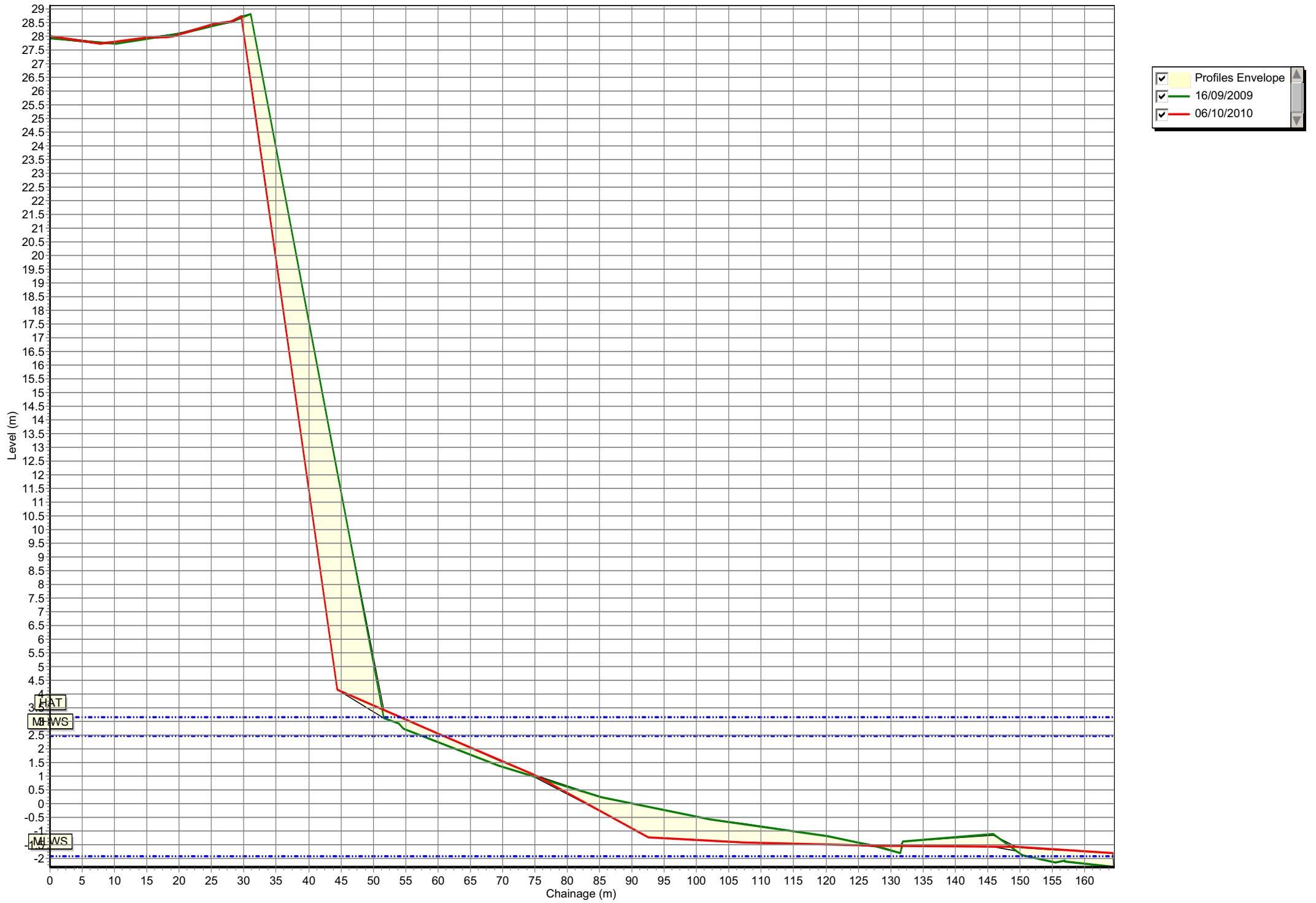


- Profiles Envelope
- 10/11/2006
- 16/09/2009
- 06/10/2010

Beach Profiles: 1bSNS23



Beach Profiles: 1bSNS24



Beach Profiles: 1bSNS25



- Profiles Envelope
- 16/09/2009
- 18/03/2010
- 06/10/2010

HAT

MWS

LWS

Beach Profiles: 1bSNS26



- Profiles Envelope
- 25/03/2009
- 16/09/2009
- 18/03/2010
- 06/10/2010

Beach Profiles: 1bSNS27



- Profiles Envelope
- 25/03/2009
- 16/09/2009
- 18/03/2010
- 06/10/2010

FAT

MHW

MLW

Beach Profiles: 1bSNS28



- Profiles Envelope
- 25/03/2009
- 16/09/2009
- 18/03/2010
- 06/10/2010

Beach Profiles: 1bSNS29



- Profiles Envelope
- 25/03/2009
- 16/09/2009
- 18/03/2010
- 06/10/2010

Beach Profiles: 1bSNS30



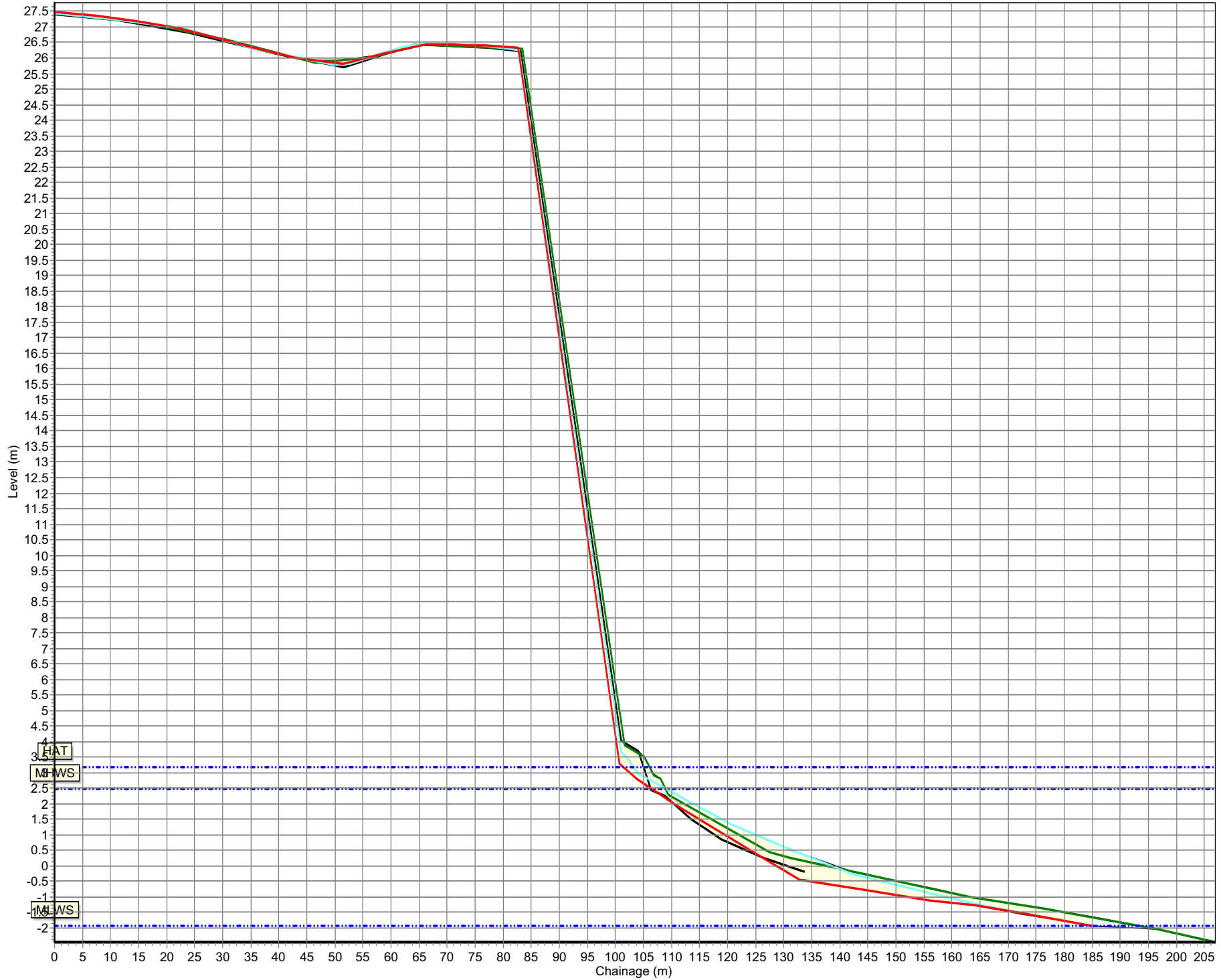
| | |
|-------------------------------------|-------------------|
| <input checked="" type="checkbox"/> | Profiles Envelope |
| <input checked="" type="checkbox"/> | 25/03/2009 |
| <input checked="" type="checkbox"/> | 16/09/2009 |
| <input checked="" type="checkbox"/> | 18/03/2010 |
| <input checked="" type="checkbox"/> | 06/10/2010 |

Beach Profiles: 1bSNS31



- Profiles Envelope
- 25/03/2009
- 16/09/2009
- 18/03/2010
- 06/10/2010

Beach Profiles: 1bSNS32



- Profiles Envelope
- 25/03/2009
- 16/09/2009
- 18/03/2010
- 06/10/2010

Beach Profiles: 1bSNS33



- Profiles Envelope
- 16/09/2009
- 18/03/2010
- 06/10/2010

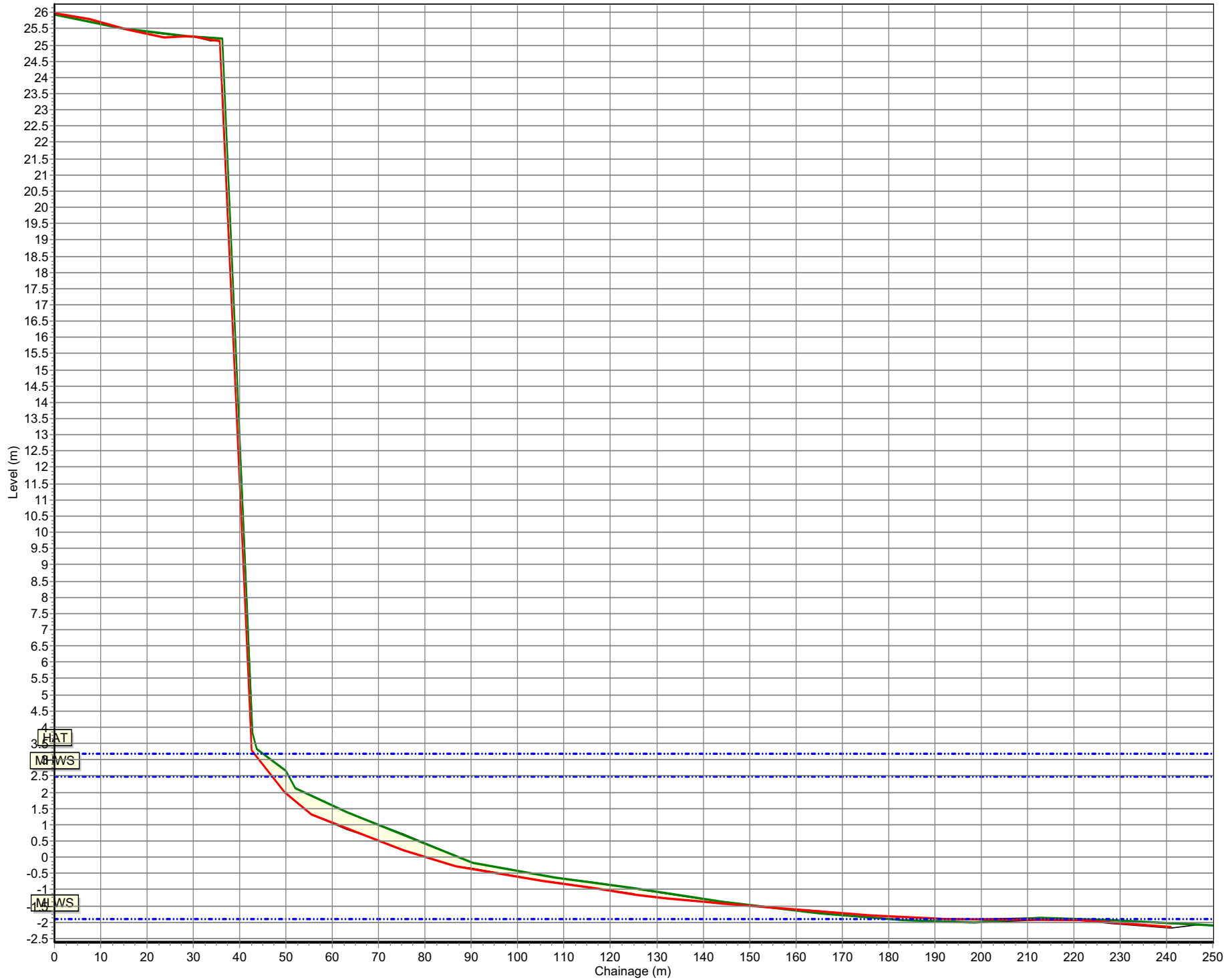
Beach Profiles: 1bSNS34



- Profiles Envelope
- 16/09/2009
- 06/10/2010

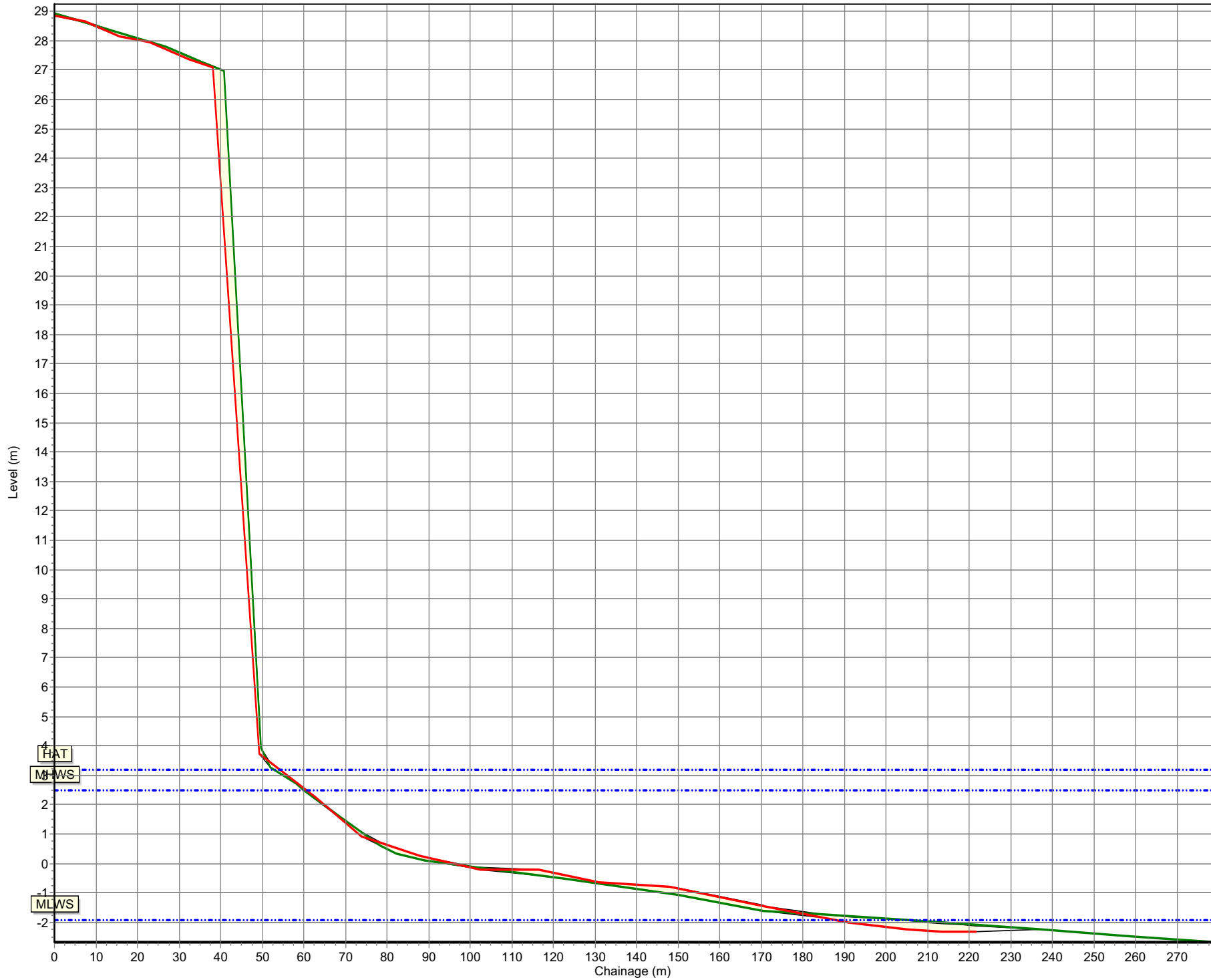
HAT
MWS
MLWS

Beach Profiles: 1bSNS35



- Profiles Envelope
- 16/09/2009
- 06/10/2010

Beach Profiles: 1bSNS36



- Profiles Envelope
- 16/09/2009
- 06/10/2010

HAT

MWS

MLWS

Appendix B
Topographic Survey

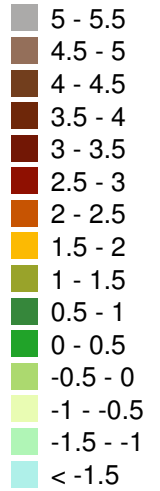
440000

441000



South Berths

TOPOGRAPHIC SURVEY
(Sept 2010)
Elevation (m OD)



561000

SUNDERLAND NORTH

560000



559000

— Topographic Contours
at 1 metre interval

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



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

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

Drawn by: TC Date: 27/10/2010
Checked by: MD Date: 05/11/2010
Approved by: NC Date: 05/11/2010

Appendix B - Map 1a
Sunderland
Council Frontage

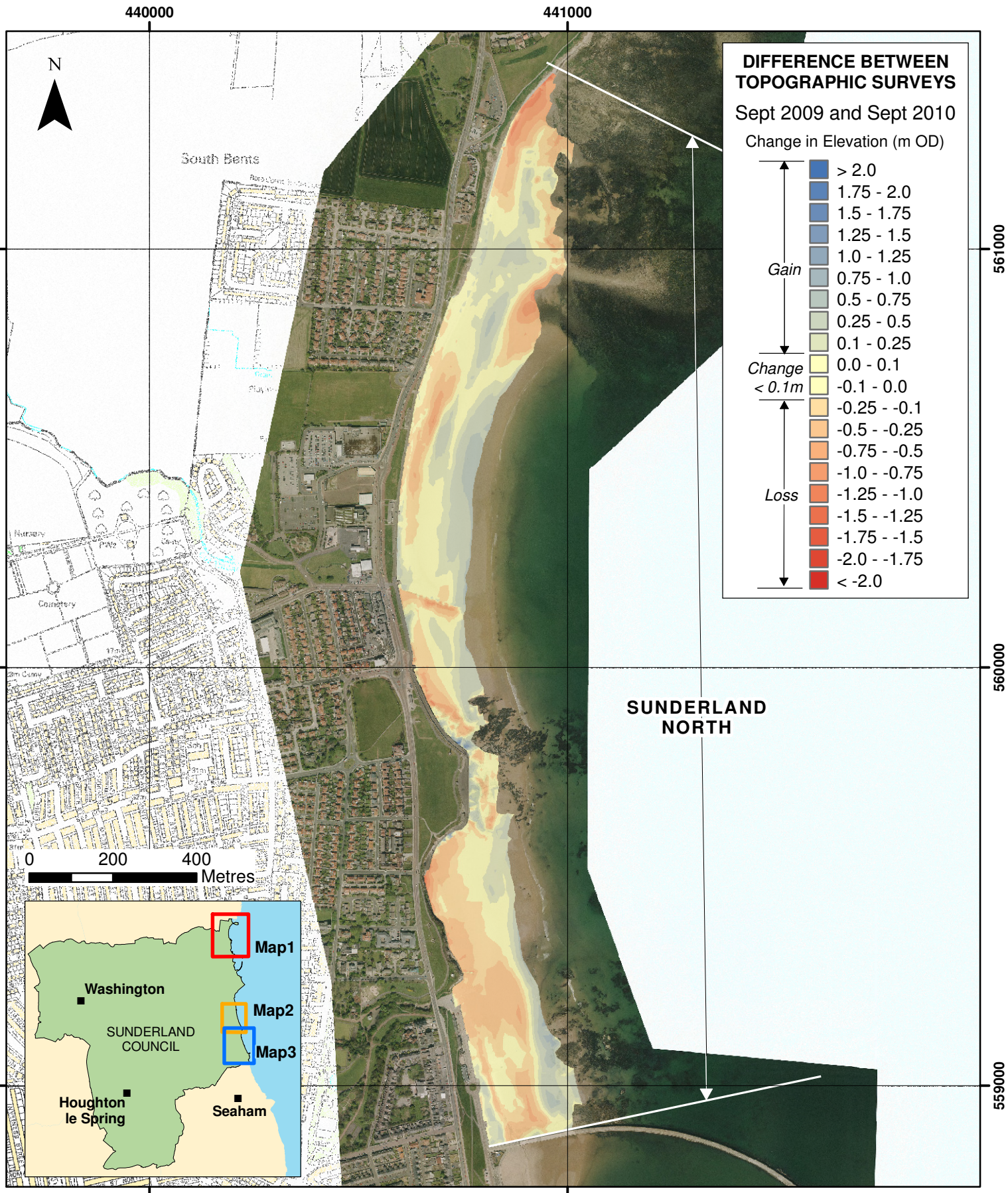
Analytical Report 3
'Full Measures' Survey 2010

Drawing Scale 1:15,000 at A4

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

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

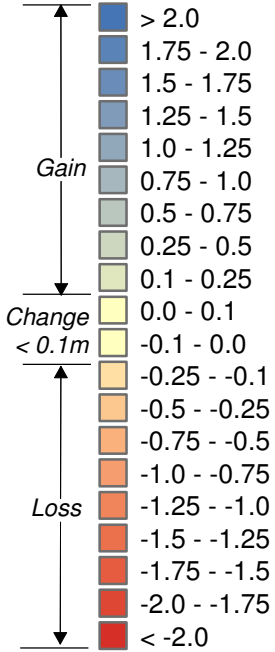
Photography courtesy of
North East Coastal Observatory
www.northeastcoastalobservatory.org.uk



DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS

Sept 2009 and Sept 2010

Change in Elevation (m OD)



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

**Appendix B - Map 1b
 Sunderland
 Council Frontage**

Analytical Report 3
 'Full Measures' Survey 2010

Drawing Scale 1:15,000 at A4



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



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

Drawn by: TC Date: 27/10/2010
 Checked by: MD Date: 05/11/2010
 Approved by: NC Date: 05/11/2010

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

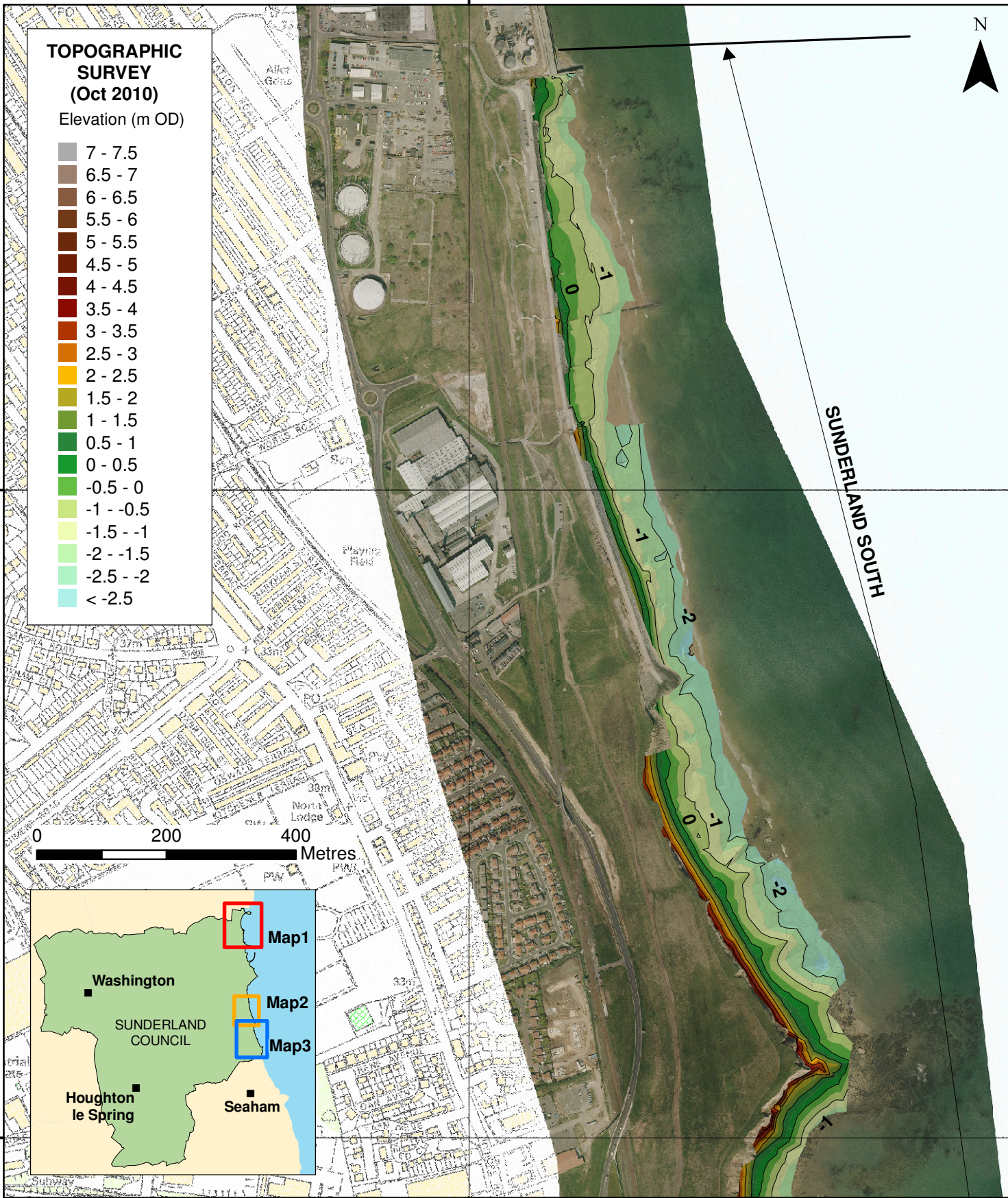


TOPOGRAPHIC SURVEY (Oct 2010)

Elevation (m OD)

- 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
- 2.5 - -2
- < -2.5

0 200 400 Metres



555000

554000

— Topographic Contours at 1 metre interval

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



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

Drawn by: TC Date: 22/11/2010
Checked by: MD Date: 29/11/2010
Approved by: NC Date: 29/11/2010

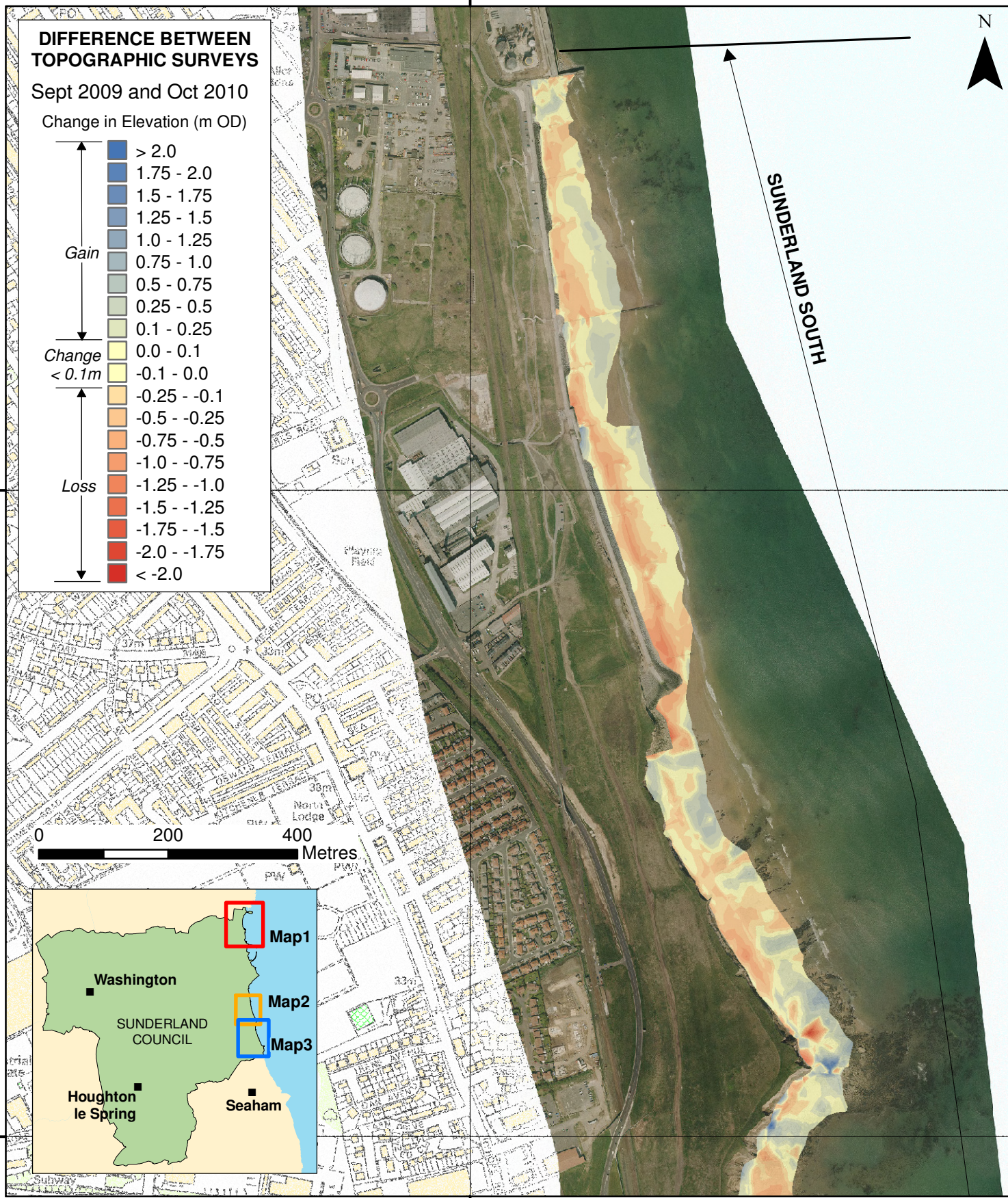
**Appendix B - Map 2a
Sunderland
Council Frontage**

Analytical Report 3
'Full Measures' Survey 2010

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

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

Drawing Scale 1:8,000 at A4



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

**Appendix B - Map 2b
 Sunderland
 Council Frontage**

Analytical Report 3
 'Full Measures' Survey 2010

Drawing Scale 1:8,000 at A4



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

Drawn by: TC Date: 22/11/2010
 Checked by: MD Date: 29/11/2010
 Approved by: NC Date: 29/11/2010

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

441000

442000

554000

553000

552000

TOPOGRAPHIC SURVEY (Oct 2010)

Elevation (m OD)

- 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
- 2.5 - -2
- < -2.5



— Topographic Contours at 1 metre interval

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



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

Drawn by: TC Date: 22/11/2010
 Checked by: MD Date: 29/11/2010
 Approved by: NC Date: 29/11/2010

Appendix B - Map 3a Sunderland Council Frontage

Analytical Report 3
 'Full Measures' Survey 2010

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

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

Drawing Scale 1:10,000 at A4

441000

442000

554000

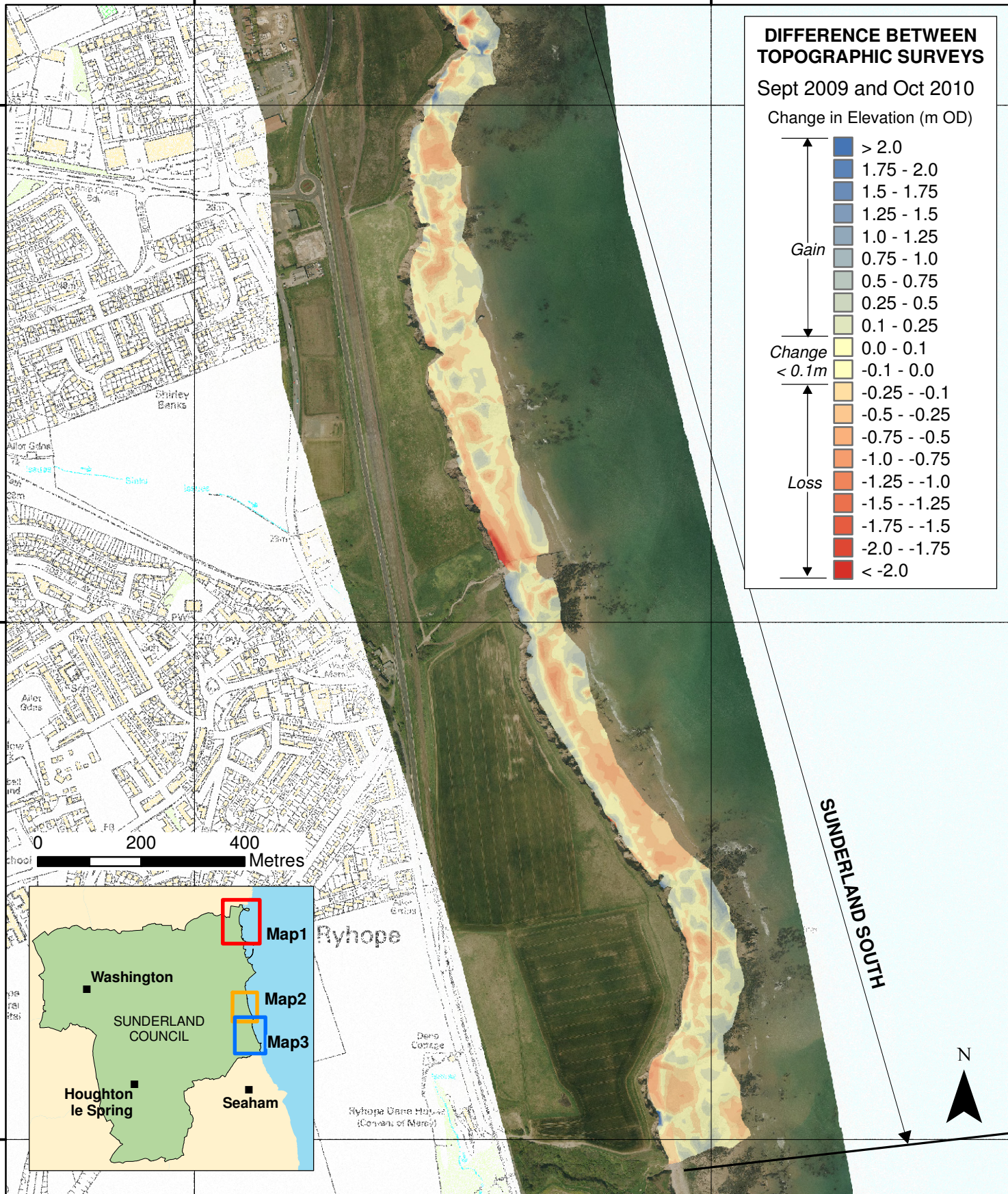
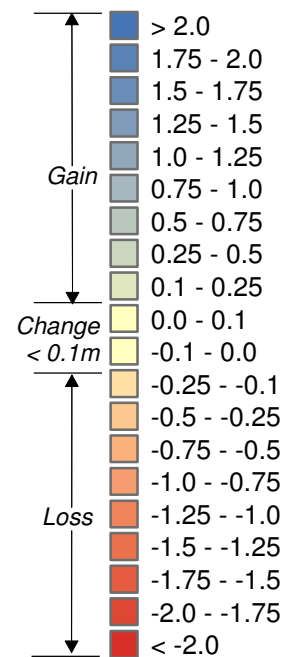
553000

552000

DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS

Sept 2009 and Oct 2010

Change in Elevation (m OD)



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

Appendix B - Map 3b Sunderland Council Frontage

Analytical Report 3
 'Full Measures' Survey 2010

Drawing Scale 1:10,000 at A4



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

Drawn by: TC Date: 22/11/2010
 Checked by: MD Date: 29/11/2010
 Approved by: NC Date: 29/11/2010

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

Appendix C
Cliff Top Survey

Cliff Top Survey

Hendon to Ryhope

Thirty-two ground control points have been established between Hendon and Ryhope (Figure C1). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

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

Table C1 provides baseline information about these ground control points and results from the 2008 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

Table C1 – Cliff Top Surveys between Hendon and Ryhope

| Ground Control Point Details | | | | | Distance to Cliff Top (m) | | | Total Erosion (m) | | Erosion Rate (m/year) |
|------------------------------|---------|----------|--------------|-------------|----------------------------|----------------------------|---------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|
| Ref | Easting | Northing | Level (mODN) | Bearing (°) | Baseline Survey (Mar 2009) | Previous Survey (Mar 2010) | Present Survey (Oct 2010) | Baseline (Mar 2009) to Present (Oct 2010) | Previous (Mar 2010) to Present (Oct 2010) | Baseline (Mar 2009) to Present (Oct 2010) |
| 1 | 441026 | 555571 | 18.9 | 75 | 8.2 | 7.8 | 8.9 | 0.7 | 1.0 | 0.4 |
| 2 | 441064 | 555355 | 17.3 | 85 | 7.1 | 7.2 | 6.8 | -0.3 | -0.3 | -0.2 |
| 3 | 441098 | 555124 | 17.9 | 82 | 10.0 | 10.4 | 10.6 | 0.6 | 0.1 | 0.4 |
| 4 | 441174 | 554939 | 17.0 | 65 | 10.3 | 10.0 | 10.6 | 0.3 | 0.6 | 0.2 |
| 5 | 441199 | 554861 | 20.0 | 65 | 7.7 | 7.5 | 7.9 | 0.2 | 0.4 | 0.1 |
| 6 | 441224 | 554774 | 22.4 | 71 | 10.8 | 10.7 | 10.8 | 0.0 | 0.1 | 0.0 |
| 7 | 441248 | 554690 | 22.8 | 74 | 10.2 | 10.4 | 10.4 | 0.2 | -0.1 | 0.1 |
| 8 | 441259 | 554597 | 22.5 | 101 | 10.1 | 10.1 | 10.0 | -0.1 | -0.1 | -0.1 |
| 9 | 441276 | 554513 | 23.0 | 66 | 10.5 | 10.5 | 7.0 | -3.5 | -3.5 | -2.2 |
| 10 | 441309 | 554421 | 22.0 | 58 | 8.8 | 9.0 | 6.5 | -2.3 | -2.5 | -1.5 |
| 11 | 441354 | 554346 | 19.9 | 68 | 8.2 | 8.2 | 8.2 | 0.0 | 0.0 | 0.0 |

| Ground Control Point Details | | | | | Distance to Cliff Top (m) | | | Total Erosion (m) | | Erosion Rate (m/year) |
|------------------------------|---------|----------|--------------|-------------|----------------------------|----------------------------|---------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|
| Ref | Easting | Northing | Level (mODN) | Bearing (°) | Baseline Survey (Mar 2009) | Previous Survey (Mar 2010) | Present Survey (Oct 2010) | Baseline (Mar 2009) to Present (Oct 2010) | Previous (Mar 2010) to Present (Oct 2010) | Baseline (Mar 2009) to Present (Oct 2010) |
| 12 | 441400 | 554248 | 20.5 | 56 | 6.2 | 6.1 | 6.1 | -0.1 | 0.0 | -0.1 |
| 13 | 441452 | 554175 | 22.9 | 63 | 11.6 | 11.7 | 11.8 | 0.2 | 0.0 | 0.1 |
| 14 | 441472 | 554081 | 23.3 | 127 | 7.3 | 7.5 | 7.2 | -0.1 | -0.3 | -0.1 |
| 15 | 441413 | 554005 | 22.9 | 122 | 7.8 | 7.9 | 7.9 | 0.1 | 0.0 | 0.0 |
| 16 | 441385 | 553913 | 23.6 | 90 | 9.9 | 10.0 | 9.9 | 0.0 | -0.1 | 0.0 |
| 17 | 441404 | 553815 | 21.2 | 93 | 6.3 | 6.4 | 6.4 | 0.1 | 0.0 | 0.0 |
| 18 | 441404 | 553724 | 24.6 | 119 | 8.1 | 8.2 | 7.9 | -0.2 | -0.2 | -0.1 |
| 19 | 441398 | 553633 | 25.4 | 78 | 8.2 | 8.4 | 6.2 | -2.1 | -2.2 | -1.3 |
| 20 | 441438 | 553453 | 26.8 | 71 | 10.1 | 10.2 | 7.6 | -2.5 | -2.7 | -1.6 |
| 21 | 441506 | 553256 | 27.7 | 62 | 8.6 | 8.6 | 7.7 | -0.9 | -0.9 | -0.6 |
| 22 | 441550 | 553159 | 26.5 | 103 | 6.6 | 6.7 | 6.6 | 0.0 | -0.1 | 0.0 |
| 23 | 441585 | 553076 | 18.7 | 64 | 8.1 | 8.3 | 8.2 | 0.1 | 0.0 | 0.1 |
| 24 | 441624 | 552871 | 28.1 | 69 | 7.5 | 7.4 | 5.7 | -1.9 | -1.7 | -1.2 |
| 25 | 441689 | 552758 | 28.0 | 70 | 14.6 | 9.4 | 9.3 | -5.3 | -0.2 | -3.4 |
| 26 | 441715 | 552713 | 28.0 | 54 | 12.9 | 12.9 | 12.8 | 0.0 | -0.1 | 0.0 |
| 27 | 441749 | 552674 | 27.4 | 62 | 14.6 | 10.4 | 10.7 | -3.9 | 0.3 | -2.5 |
| 28 | 441777 | 552630 | 26.9 | 57 | 8.6 | 5.0 | 4.8 | -3.8 | -0.2 | -2.4 |
| 28A | 441799 | 552586 | 26.8 | 56 | 13.6* | 13.2 | 13.0 | -0.6 | -0.2 | -0.4* |
| 28B | 441817 | 552542 | 26.5 | 64 | 12.3* | 11.9 | 12.0 | -0.3 | 0.2 | -0.2* |
| 28C | 441852 | 552503 | 26.3 | 52 | 13.1* | 13.1 | 13.0 | -0.1 | -0.1 | -0.1* |
| 29 | 441880 | 552472 | 26.1 | 83 | 15.5 | 15.5 | 15.4 | 0.0 | -0.1 | 0.0 |
| 30 | 441921 | 552269 | 25.1 | 97 | 8.6 | 7.9 | 7.9 | -0.6 | 0.0 | -0.4 |
| 31 | 441853 | 552094 | 26.4 | 75 | 11.2 | 9.0 | 8.7 | -2.5 | -0.4 | -1.6 |
| 32 | 441883 | 551988 | 27.4 | 96 | 9.8 | 9.6 | 7.6 | -2.3 | -2.0 | -1.4 |

* Baseline survey Sept 2009

Note: It is assumed that the accuracy of cliff top monitoring using this technique is $\pm 0.2\text{m}$.

441000

442000



0 200 400 Metres



● Cliff Top Monitoring Points

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

**Appendix C - Map 1
 Sunderland
 Council Frontage**

Analytical Report 3
 'Full Measures' Survey 2010

Drawing Scale 1:12,000 at A4



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



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

Drawn by: TC Date: 27/10/2010
 Checked by: MD Date: 05/11/2010
 Approved by: NC Date: 05/11/2010

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

441000

442000



● Cliff Top Monitoring Points

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

**Appendix C - Map 2
 Sunderland
 Council Frontage**

Analytical Report 3
 'Full Measures' Survey 2010

Drawing Scale 1:12,000 at A4



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



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

Drawn by: TC Date: 27/10/2010
 Checked by: MD Date: 05/11/2010
 Approved by: NC Date: 05/11/2010

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