Environment Agency

Anglian Coastal Monitoring

Wash SMP Coastal Trends Report 2020

Gibraltar Point to Old Hunstanton

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Wash Trends Report

Contents

1. Executive Summary

This report follows the previous trends report for The Wash in 2007 (Environment Agency, 2007), providing updated trends analysis with data from 1992 to December 2020. Analysis has been completed using topographic beach profiles and Lidar data to assess changes in cross sectional area, elevation change and saltmarsh extent. In addition, positional trends are provided, showing the movements of tidal levels for each topographic profile over time. The report provides a high-level overview of observed trends for coastal managers, and highlights areas which could benefit from more in-depth assessment.

This summary aims to provide a non-technical overview of the trends at the Shoreline Management Plan (SMP) level in the context of local observations and on-going schemes within The Wash.

The Wash has been split into monitoring cells for the purpose of providing more in-depth analysis and reporting on smaller local areas. Trends are reported across two time periods: Long-term trends, with data extending to the 1990's (2012/13 for Lidar) and Current phase trends from 2016 to 2020. The general trends of The Wash can be summarised into the north-western flank, dominated by saltmarsh which shows stable, slightly accreting frontages, and the south-western flank with more complex interactions along sandy beaches. Hydrodynamic data from the North Well buoy between 2006 to 2019 shows that the wave climate is characterised by wave heights under 1 m in both a north-easterly or south westerly direction. 2013 and 2017 had particularly large or frequent storms, with maximum wave heights exceeding 3 m, likely to contribute to higher than usual erosion for these years.

Monitoring cells Wash Banks, Holbeach and Nene to Wolferton show the same broad trends of stable sediment volume or steady accretion. Cross Sectional Area (CSA) analysis shows the average rate of accretion to be between 6% and 10% since the mid-late 1990's. As a result, saltmarsh has advanced in most areas which further stabilises the deposited material. Lidar shows that any erosion in these cells is generally associated with the seaward fringe of the beach or movement of sand bars, particularly in the Nene estuary. Additionally, notable erosion is seen at the northern edge of Wash Banks where a spit has been heavily eroded. The current phase and longer-term baselines show very similar patterns suggesting that this region is stable.

A section of embankment within the Wash Banks monitoring cell was raised by 0.5m in 2018 to provide a greater quality of flood protection to 3,500 Hectares of important agricultural land and 460 properties (Witham Fourth IDB, 2019).The long term trends in saltmarsh extent show that the saltmarsh in this area is accreting throughout the monitoring cell. This dissipates wave energy and reduces erosion on the seaward face of the embankment. An accreting saltmarsh also has the added benefit of acting as an effective first defence against coastal flooding whilst providing important habitat.

The Hunstanton to Heacham cell shows more variable change. The area southwest of Snettisham Scalp shows similar trends to the three cells discussed previously with stable or slightly increasing sediment volumes. A small area of erosion can be seen on the landward edge of the Scalp with accretion on the crest of the Scalp suggesting that the beach is being reprofiled rather than losing sediment entirely. This area of erosion is less visible in the long-term trends than in the current phase trends suggesting that this may be attributable to natural variation and should be monitored going forwards. Although the volume of sediment used in the recycling scheme was slightly increased over the current phase from 3556m3 in 2016 to 7630m3 in 2019 (Jacobs, 2019), the results of this analysis show that this had little impact on the overall trends. These finding concur with the Hunstanton to Heacham Beach Management report, which indicates that sediment volumes at the scalp remain relatively stable (Jacobs, 2019).

The Hunstanton to Heacham stretch of beach shows areas of erosion in the Lidar data along the backshore. This erosion is particularly intense on Heacham North Beach and surrounding the pier building in Hunstanton as seen in the Hunstanton to Heacham Elevation change map between 2012/13 and 2019/20. Despite this, the CSA trends show no significant change in overall beach volume suggesting that

material lost from the backshore is being deposited on to the foreshore and that the recycling scheme is effectively reducing the overall erosion observed, through re-profiling. In both the Lidar and CSA, the current phase trends (2016-2020) show an increase in erosion across the monitoring cell when compared to the long-term trend. As the Lidar shows winter changes and the CSA compares changes in the summer beach levels, this suggest material is being lost from the system. While the erosion is currently under 5% for all profiles and so unlikely to cause immediate issues, this may be of concern if the trend continues and may influence beach management in this area going forwards. It should be noted that there are also areas of accretion found between Hunstanton and Heacham, such as profile HH145 which has seen 3.37% accretion in CSA since 2016.

The North Hunstanton monitoring cell shows a long-term trend of erosion in the results of CSA analysis. The maximum erosion for strategic profiles was at W062 with erosion of 25.6% since 1992 and 15.9% since 2010. This monitoring cell is located at the outer edge of The Wash, therefore may be more exposed to hydrodynamic impacts e.g. wave action which may lead to the higher rate of erosion observed. A complex pattern of geomorphological change is presented by the Lidar analysis, showing the movement of dune systems north of Hunstanton and increased sediment mobility compared with observations in the other monitoring cells. Both Lidar change images show elevation gain at the landward extent of analysis which may be related to sediment input from cliff erosion. The erosion of the Hunstanton cliffs and subsequent sediment input to the system has been analysed by the British Geological Survey. The current phase CSA show an average change of 0.63% indicating no significant change in volume over the cell as a whole. However, individual profiles such as W062, near Hunstanton pier building, show approximately 4% erosion in CSA during the current phase which may be a signal of accelerating erosion in recent years. The Lidar maps included in this report may be more useful to show the variation in volume change which is hidden within the average figures.

A study into the effectiveness of the groynes in Hunstanton is due to be undertaken in 2021. The findings of this trends report highlight the need for the undertaking of this study to address the erosion observed in the North Hunstanton cell, which may be starting to accelerate. This will assess whether the existing groyne design are effective in holding sediment or whether re-designing would provide more sediment stability.

2. Introduction

This report has been prepared by the Anglian Coastal Monitoring Programme as a tool to assist coastal managers in a variety of their functions for example strategic planning, capital engineering works and maintenance programmes. For more information on the Anglian Coastal Monitoring Programme please visit: www.coastalmonitoring.org.

This report presents an overview of beach changes in the Wash SMP area from Gibraltar Point to Old Hunstanton (Coastal Process cell 2d). For the purpose of reporting The Wash is divided into five Monitoring Cells, (Wash Banks, Holbeach, Nene - Wolfterton, Hunstanton – Heacham and North Hunstanton), the boundaries of these cells were designed to align with natural changes in the coastline or physical structures. The alignment of the monitoring cells and the associated SMP policy decision units are described in Figure 2 and Table 1.

Background

The Wash is a macrotidal rectangular embayment open at its northern end to the North Sea. It has a surface area of 615km^2 and possesses approximately 10% of the UK saltmarsh and mudflat designated habitat (Environment Agency, 2007). The western and southern shores consist of low-lying farmland protected by earth embankments, which are fronted by a sequence of saltmarsh then mudflats leading to the main channels. In some places the saltmarsh is extensive stretching several kilometre's in a seaward direction beyond the sea defences. Generally, this provides the embankments protection from wave attack with the exception of extreme high water levels, particularly during storm surges.

The eastern shore, however, possesses different characteristics. The coast here is cliffed to the north near Hunstanton with wide sandy beaches. To the south of Heacham the ground level of the hinterland lowers and the coast returns to saltmarsh and mudflat with extensive off shore sandbanks near the delta system of the River Great Ouse, which enters The Wash near Kings Lynn. With the exception of the shoreline north of Heacham, the entire stretch of coast is of artificial origin having been subject to progressive land claim projects over the centuries.

The Wash has several special designated areas with the whole SMP designated a Special Site of Scientific Interest. Some areas have additional designations due to the unique habitat and wildlife present. These areas are shown in Figure 1.

Figure 1. The Wash SMP area and designated areas. The whole of The Wash is designated as a SSSI

Context

For context, a summary of the recent and on-going coastal management works for The Wash are as follows:

- The Wrangle Sea Bank scheme led by Witham Fourth IDB was completed in December 2018. This scheme raised and re-profiled 5.8km of sea defences following the identification of areas high risk. The scheme provided better protection for 438 properties and 3,400 hectares of prime farmland.

- Works arising from the Wash East Coastal Management Strategy, published in 2015, includes a continuation of annual beach recycling along Unit C (South Hunstanton – Wolferton Creek).

- The Hunstanton Coastal Management Plan was published in October 2019 which details planned maintenance and repairs for Unit B (Hunstanton Town) and an on-going monitoring regime for Unit A (Hunstanton Cliffs) over 5 years (2019/20 – 2023/24).

Table 1. List of the ACM designated Monitoring Cells in the Wash and the associated CCO Survey Unit, SMP Policy Decision Unit and the SMP policy Decision for Epoch 1. *NB. The CCO Survey Unit reflects the code assigned to each monitoring cell for the purposes of the topographic survey database and is listed here for clarity.*

ACM Monitoring Cell (abbr.)	CCO Survey Unit	SMP Policy Decision Units (PDUs)	Policy Decision Epoch 1
Wash Banks (WB)	2dSU01WB	PDZ1	HTL
Holbeach (HO)	2dSU02HO	PDZ1	HTL
Nene to Wolferton (NW)	2dSU03NW	PDZ1	HTL
Hunstanton to Heacham (HH)	2dSU04HH	PDZ2, PDZ3	HTL
North Hunstanton (NH)	2dSU05NH	PDZ3, PDZ4	HTL, NAI

Figure 2. Wash SMP (Coastal Process cell 2d) area covered by this report. Includes ACM Monitoring Cells and SMP policy decision units.

3. Methodology

This report shows trends in coastal change over two time periods. Firstly, baseline to present trends which show the long-term trends over the widest range of reliable data available. Secondly, the recent trends show changes since the beginning of the current phase (2016). A summary of hydrodynamic data from annual reports produced by the Channel Coastal Observatory (CCO) has also been included.

3.1 Lidar Analysis

The ACM routinely collects 1m spatial resolution Lidar data in the Wash during the winter season, beginning in winter 2012/13. This study uses Lidar from various years, as displayed in table 2. The 2012/13 data is considered the baseline for long term Lidar analysis, and the 2016/17 dataset is used as the baseline for recent trend analysis. Additional Lidar was available covering Hunstanton to Heacham for the 2018/19 season. This data has been used to provide analysis of changes in a single year between 2018/19 and 2019/20.

Table 2. Details of Lidar data acquisition dates and the areas covered each year.

Lidar Season	Dates Acquired	Monitoring Cell(s) covered
2012/13	13/11/2012 – 14/03/2013	All
2016/17	02/11/2016 – 14/02/2017	All
2018/19	04/11/2018	Hunstanton to Heacham
2019/20	14/12/2019 – 10/01/2020	All

The Lidar data has a spatial resolution of 1m, this means that each pixel value represents the elevation from one square meter of land. Analysis of error in the data found mean error to be less than 0.1m when comparing the different Lidar datasets at known constant locations.

This report defined analysis extents for the Lidar to prevent the risk of comparing 'no data' values with measured values, which would falsely suggest change. The landward extent of analysis is the Highest Astronomical Tide (HAT) line, modified to create a smooth line. The seaward extent of analysis is the Mean Low Water (MLW). change analysis was performed by subtracting each image from the 2019/20 image to calculate the difference in elevation. This process is demonstrated in Figure 3, where each pixel value from InRas2 (the earlier Lidar image) is subtracted from the corresponding pixel value from InRas1 (the 2019/20 Lidar) to produce a continuous surface of change values (OutRas).

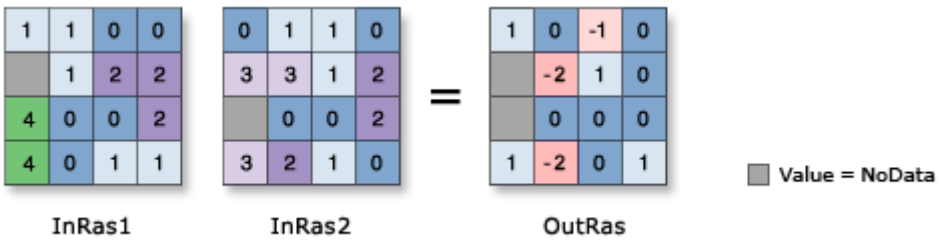


Figure 3. Visual representation of the Lidar change analysis method.

Image: https://pro.arcgis.com/en/pro-app/help/data/imagery/minus.htm

3.2. Topographic profile analysis

Strategic profiles were selected for analysis due to having a longer history of reliable data. In higher risk areas, or where there were limited strategic profiles in a monitoring cell, additional scheme profiles were included. The details of selected profiles are seen in Table 3. Summer profiles were used for trend analysis as they exhibit less variation caused by short term events such as storms. This analysis reports change in two key metrics as described below.

Table 3. Details of topographic profiles used in analysis

Monitoring Cell	Profiles used	Baseline Year	Notes
Wash Banks	W001 - W024	1999	
Holbeach	W025 - W037	1997	
Nene to Wolferton	W038 - W050	1997	
Hunstanton to Heacham	W051 - W061	1992	Strategic unit
	W051, HH006, HH010, HH014, W052, HH025, HH029, HH033, W053, HH044, HH048, HH052, W054, W055, HH063, HH067, HH071, W056, HH082, HH086, HH090, W057, HH101, HH105, HH111, W058, HH120, HH128, W059, HH137, HH141, HH145, HH149, W060, HH156, HH160, HH164, HH168, W061	1992	Analysis Unit
North Hunstanton	W062 - W063	1992	Strategic unit
	NH002, NH004, NH006, NH008, NH010, W062, NH013, NH015, NH017, NH019, NH021, NH023, NH025, W063, NH028, NH029, NH031, NH033, NH035, NH037, NH039, NH041, NH043	2010	Analysis Unit

Cross-Sectional Area (CSA):

Cross-sectional area measures the area between a master profile and the surveyed beach profile. The use of a master profile limits the extent of analysis to the mobile sediment on the beach. The elevation of the master profile, section B in Figure 4, has been kept the same for all profiles in a monitoring cell to make comparisons between local profiles easier. Changes in this figure are calculated for each time period and presented in meters squared.

A separate master profile was used for each time period analysed to take advantage of longer datasets which were collected more recently. This measure is likely to be more useful to coastal engineers and decision makers.

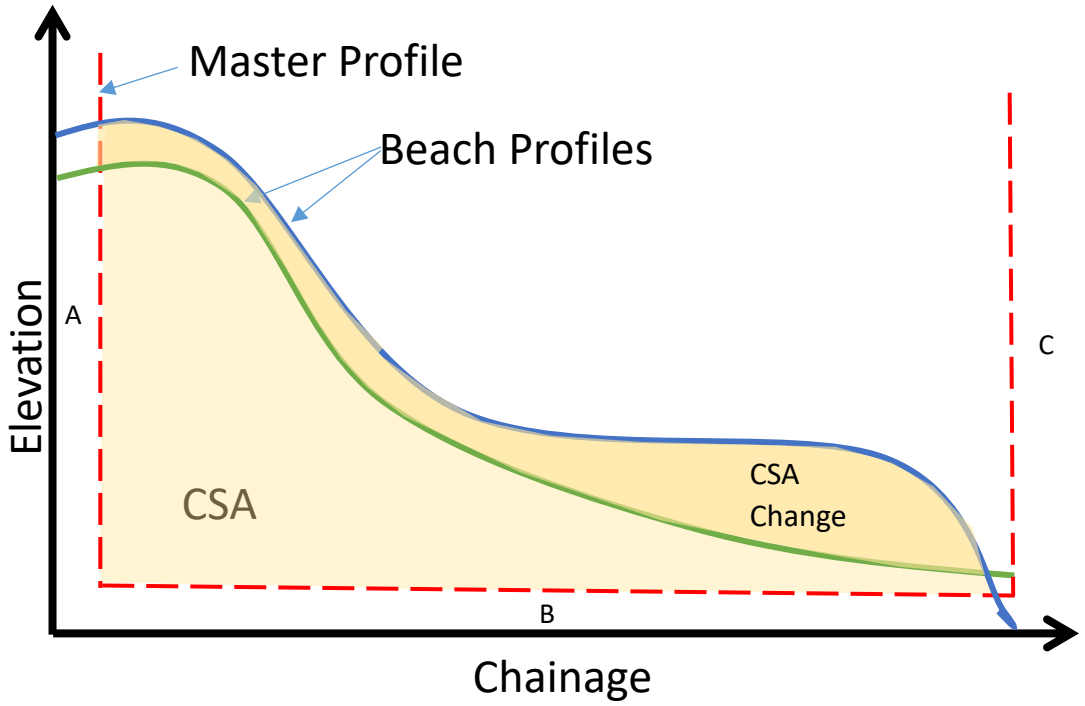
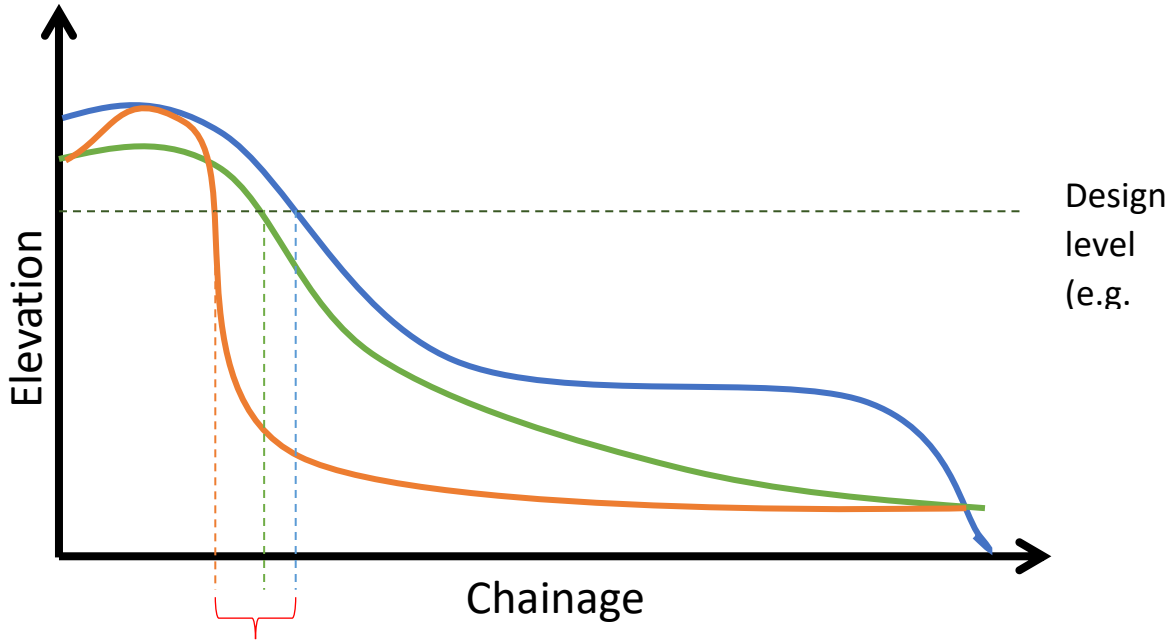


Figure 4. Example of a master profile

Positional Trends

This analysis measures the distance between the chainage at which profiles from each year intersect a design level (e.g. HAT). From this, total change since a baseline, in meters, can be calculated. Additionally, the maximum, minimum and mean rates of change are reported in meters per year. This process is repeated for several design levels with the results shown in a table similar to the one presented in Figure 5.

The “Min Change” value can represent two meanings depending on its value. Where Min Change is positive, this is the lowest rate of accretion between two surveys. Where Min Change is negative, the value given is the highest rate of erosion observed between two surveys. At least two surveys must record data at a given design level for change to be calculated. Where this has not been achieved the cells for the design level are left blank. Where no change has occurred, but data has been collected, the cell will show 0.0.



Location:	W001	HAT	MHWS	MSL	MLWS	LAT
Baseline:	1999	4.20m	3.26m	0.13m	-2.94m	-3.76m
Total Change		705.17	482.82			
Min Change		-1.08	-14.53			
Max Change		705.16	535.23			
Mean Change		33.58	22.99			
Sdt Dev Change		150.17	114.7			

No profiles reach these levels at this location so cells are left empty

Figure 5. Example of positional trends analysis

Saltmarsh Analysis

In addition to this, trends in the extent of saltmarsh has been reported for relevant locations. This analysis plots the chainage of the extent of saltmarsh in a profile, defined by substrate codes which are collected during topographic surveys. Assessing the stability of saltmarsh allows management of the important habitat but is also a useful indicator of sediment movement patterns more widely. A limitation of this method is the reliance on the profile extending far enough to capture all the saltmarsh at a given location every time it is surveyed. This may not be possible due to tidal constraints or other safety/ access factors. Most saltmarsh occurs above the MLWS level that surveys aim to meet and so this limitation is likely to affect only individual surveys. For this reason, the saltmarsh analysis should be used to observe general trends over time rather than to plot the exact extent of saltmarsh on a specific date.

4. Results

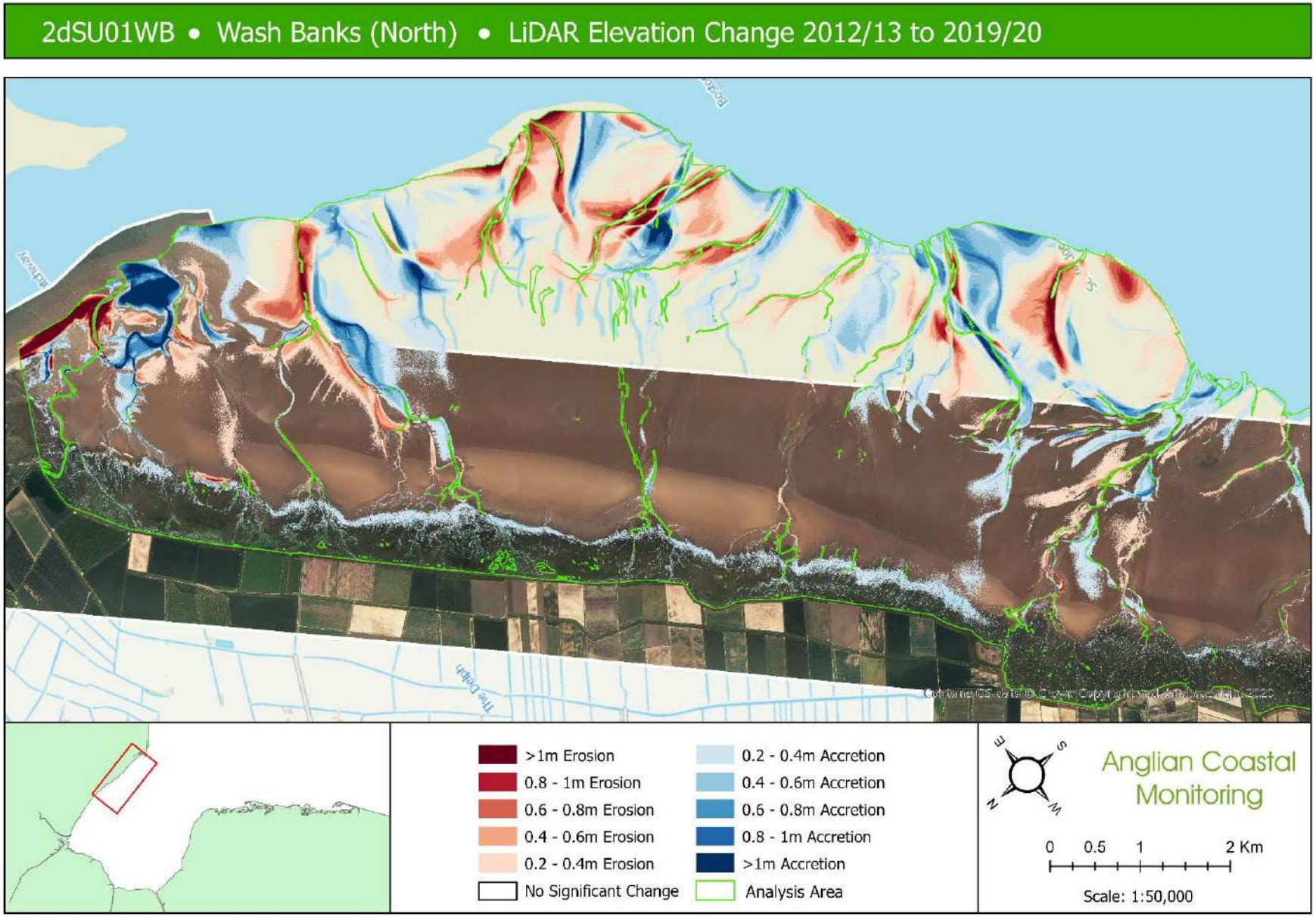
4.1. Wash Banks – 2dSU01WB

Topographic profiles in this monitoring cell range from W001 at the northern edge of The Wash to W024 in the south, where The Haven river channel joins The Wash. The results of CSA analysis show a long-term trend of slight accretion for all profiles with a maximum change of 10.73% since 1999. No significant change is noted in the current phase however the positive CSA differences at all locations suggest that the long-term trends continue. Lidar analysis shows that change is distributed unevenly, with the biggest changes in sediment balance occurring further offshore. However, accretion is also seen along the seaward edge of the saltmarsh. Saltmarsh extent has generally remained stable in most areas with some accretion in W005, W014, W020. The greater extent of saltmarsh is likely to have stabilised incoming sediment, promoting further accretion.

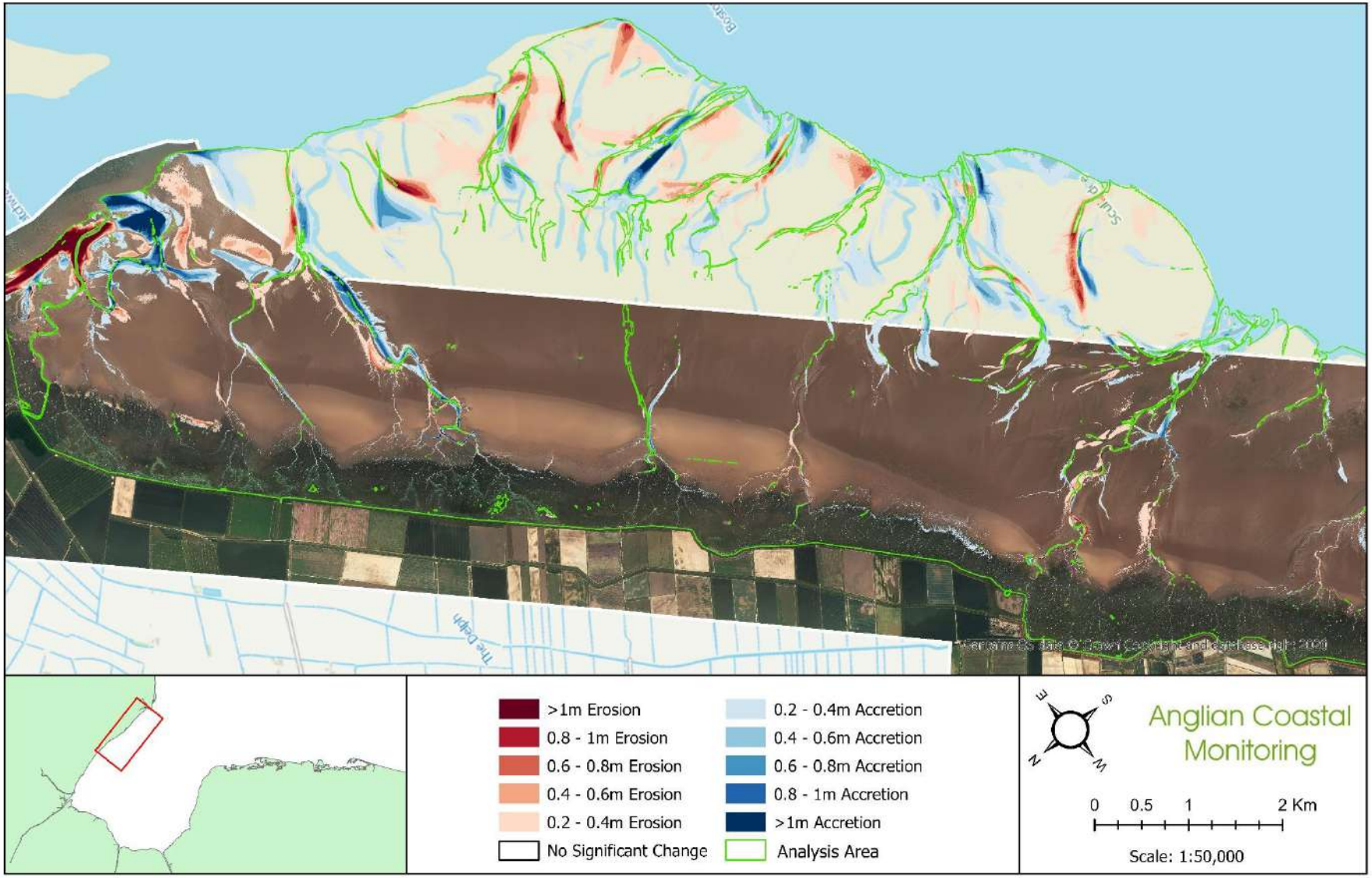
CSA Table

	Baseline to Present		**Current Phase - Present**	
	1999-S to 2020-S		2016-S to 2020-S	
Location	CSA Diff (m2)	% Change	CSA Diff (m2)	% Change
2d00016 [W001]	202.22	5.94	113.48	2.54
2d00031 [W002]	156.68	6.19	53.14	1.17
2d00051 [W003]	191.38	5.41	54.13	1.47
2d00067 [W004]	197.81	6.15	4.29	0.13
2d00083 [W005]	299.19	7.72	67.92	1.65
2d00104 [W006]	231.68	6.29	52.3	1.35
2d00120 [W007]	154.45	4.32	55.73	1.52
2d00138 [W008]	325.43	8.38	99.59	2.42
2d00164 [W009]	174.77	6.18	63.96	2.18
2d00184 [W010]	183.49	7.00	72.78	2.67
2d00206 [W011]	230.21	9.34	69.07	2.63
2d00225 [W012]	340.04	7.46	153.55	3.22
2d00245 [W013]	214.77	6.31	93.78	2.66
2d00264 [W014]	221.97	6.59	54.47	1.54
2d00283 [W015]	206.50	6.59	58.11	1.77
2d00302 [W016]	191.00	7.39	66.42	2.45
2d00321 [W017]	99.92	3.73	33.73	1.23
2d00343 [W018]	105.08	4.48	44.01	1.83
2d00361 [W019]	235.76	8.65	45.62	1.56
2d00379 [W020]	273.21	8.50	41.78	1.21
2d00396 [W021]	181.69	7.87	70.21	1.35
2d00420 [W022]	185.33	5.88	58	1.77
2d00437 [W023]	273.78	10.73	51.51	1.86
2d00456 [W024]	171.23	7.01	36.45	1.41
	Av=210.32	Av=6.84%	Av=63.08	Av=1.82%

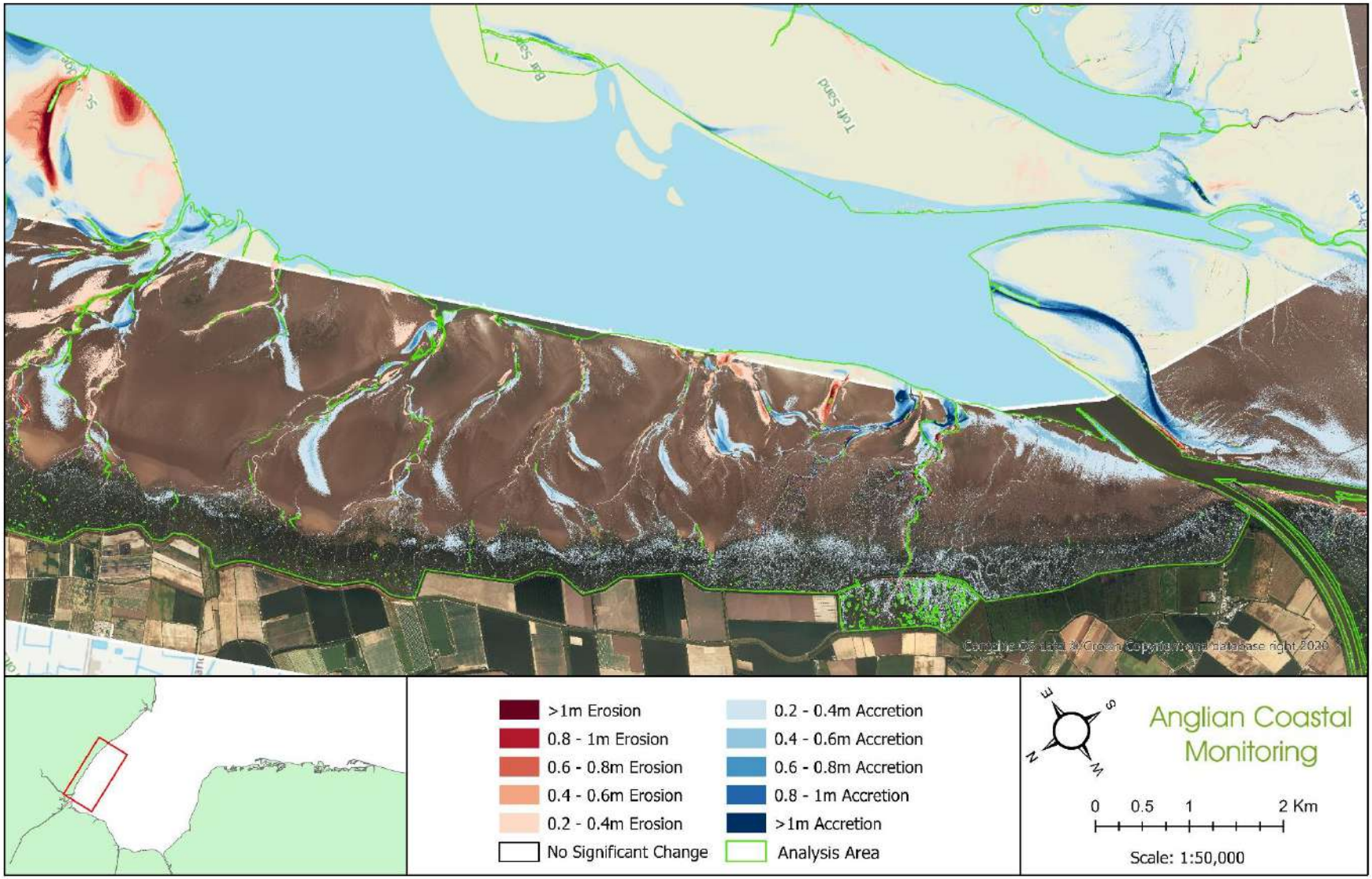
	Min=99.92	Min=3.73%	Min=4.29	Min=0.13%
	Max=340.04	Max=10.73%	Max=153.55	Max=3.22%


2dSU01WB • Wash Banks (North) • LiDAR Elevation Change 2012/13 to 2019/20
>1m Erosion
0.8 - 1m Erosion
0.6 - 0.8m Erosion
0.4 - 0.6m Erosion
0.2 - 0.4m Erosion
No Significant Change
0.2 - 0.4m Accretion
0.4 - 0.6m Accretion
0.6 - 0.8m Accretion
0.8 - 1m Accretion
>1m Accretion
Analysis Area
Anglian Coastal Monitoring
0 0.5 1 2 Km
Scale: 1:50,000

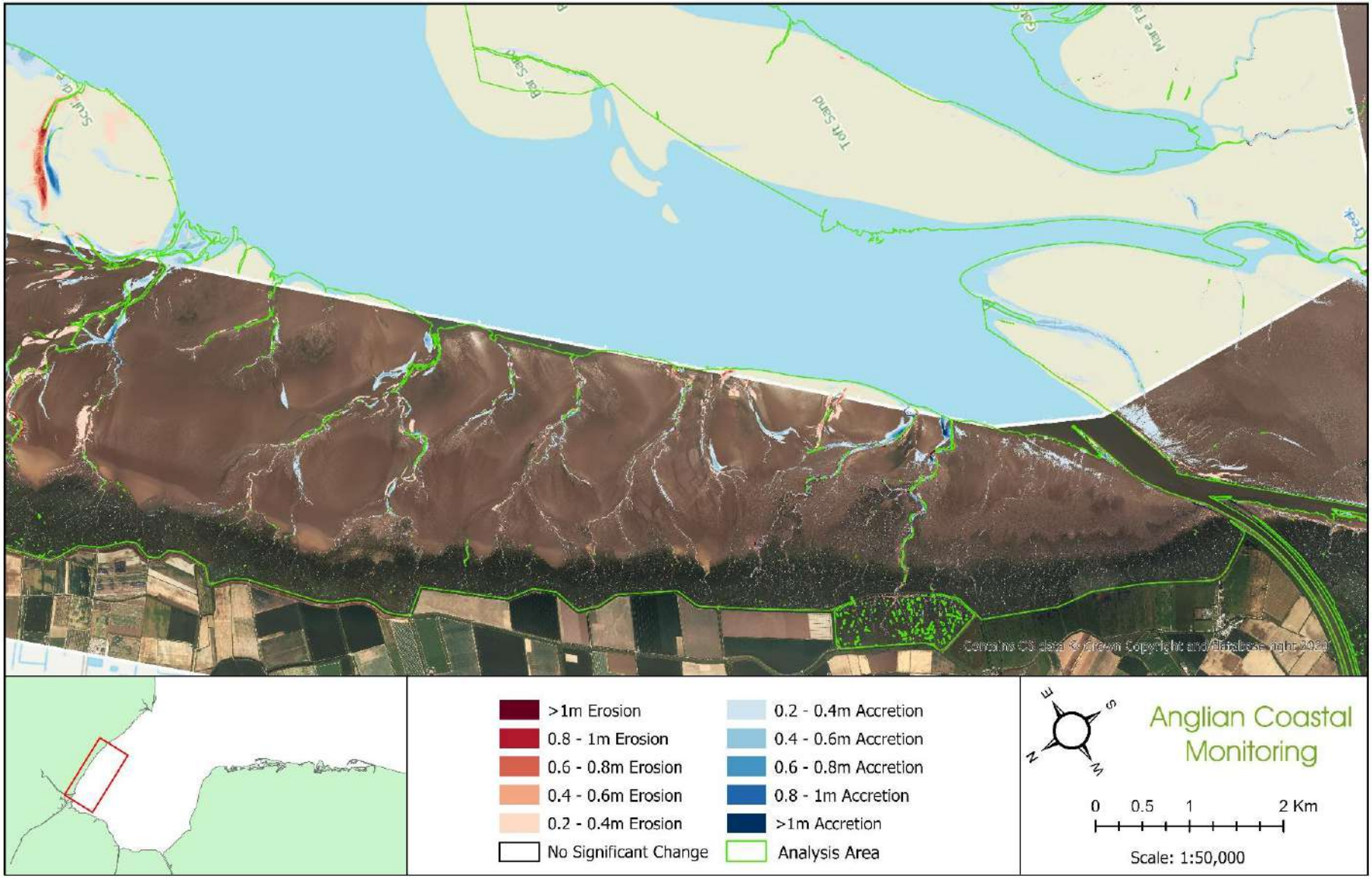
2dSU01WB • Wash Banks (North) • LiDAR Elevation Change 2016/17 to 2019/20

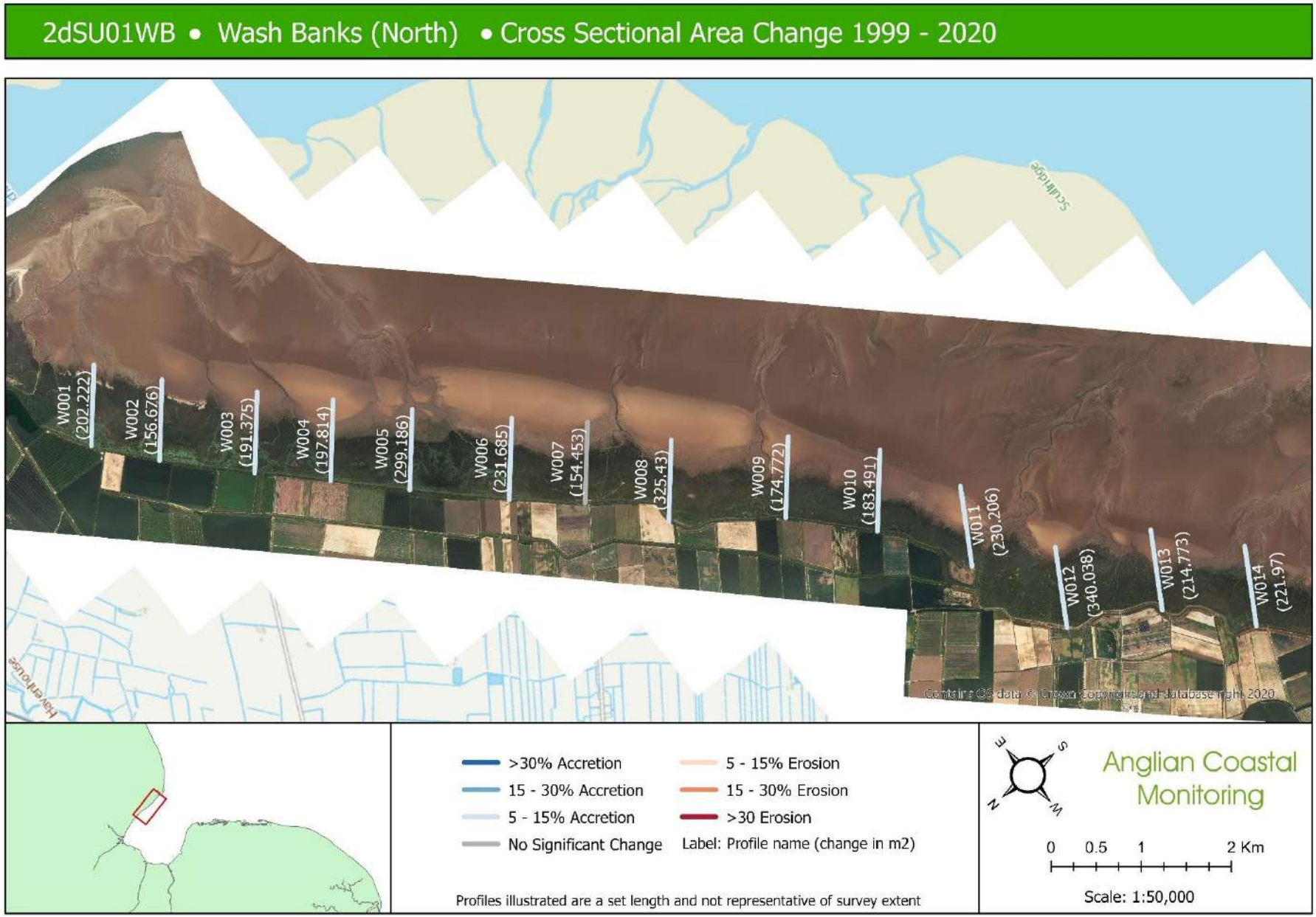


2dSU01WB • Wash Banks (South) • LiDAR Elevation Change 2012/13 to 2019/20

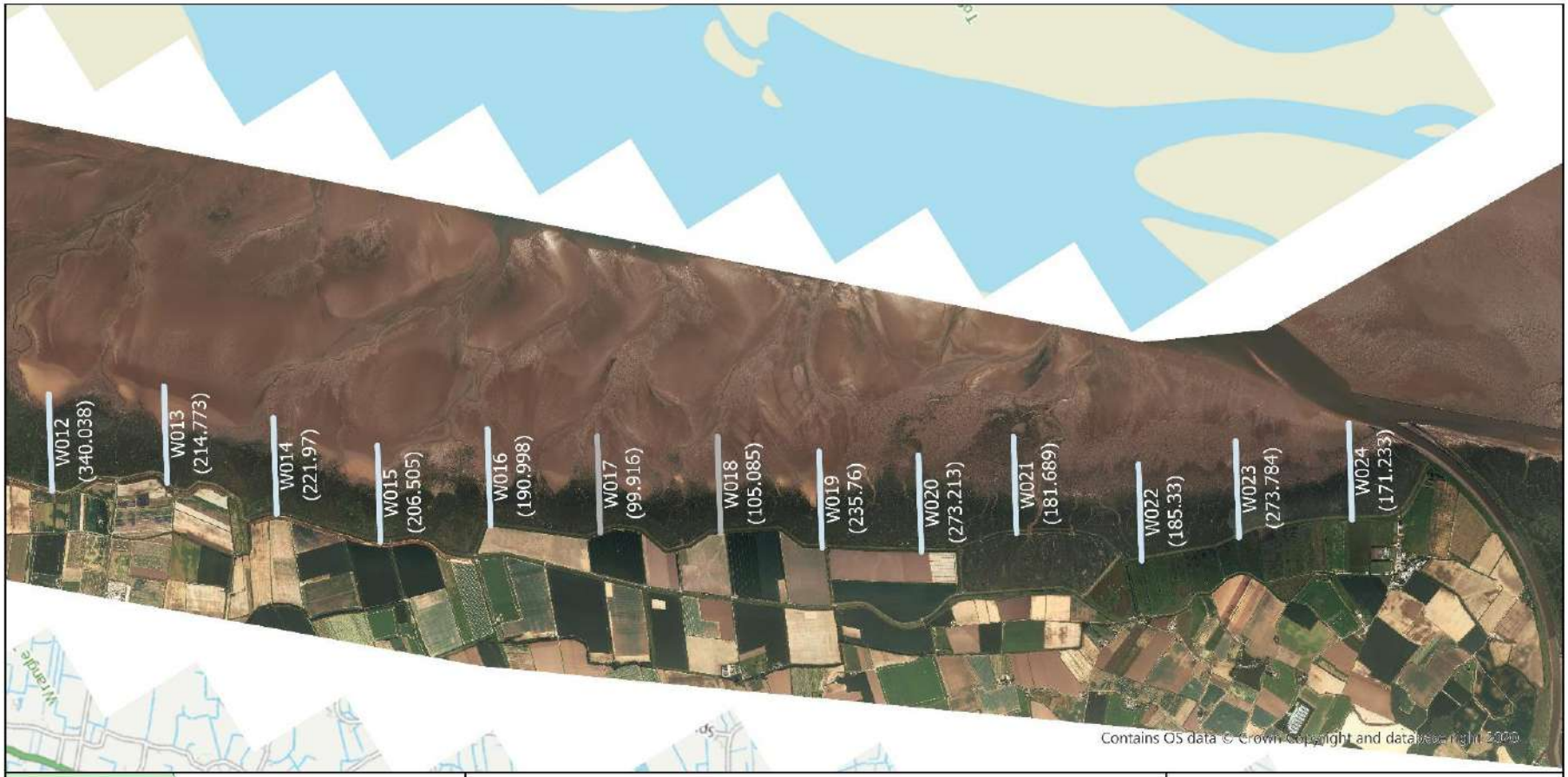


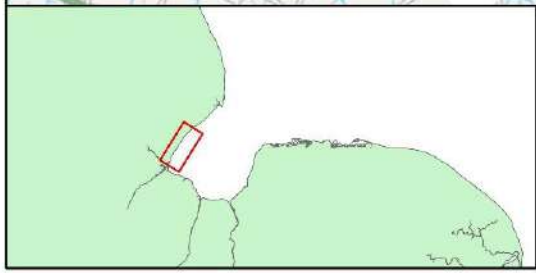
2dSU01WB • Wash Banks (South) • LiDAR Elevation Change 2016/17 to 2019/20




2dSU01WB • Wash Banks (North) • Cross Sectional Area Change 1999 - 2020
W001 (202.222)
W002 (156.676)
W003 (191.375)
W004 (197.814)
W005 (299.186)
W006 (231.685)
W007 (154.453)
W008 (325.43)
W009 (174.772)
W010 (183.491)
W011 (230.206)
W012 (340.038)
W013 (214.773)
W014 (221.97)
Contains OS data © Crown copyright and database right 2020
>30% Accretion
15 - 30% Accretion
5 - 15% Accretion
No Significant Change
5 - 15% Erosion
15 - 30% Erosion
>30 Erosion
Label: Profile name (change in m2)
Profiles illustrated are a set length and not representative of survey extent
Anglian Coastal Monitoring
0 0.5 1 2 Km
Scale: 1:50,000

2dSU01WB • Wash Banks (South) • Cross Sectional Area Change 1999 - 2020





>30% Accretion
15 - 30% Accretion
5 - 15% Accretion
No Significant Change
5 - 15% Erosion
15 - 30% Erosion
>30 Erosion
Label: Profile name (change in m2)

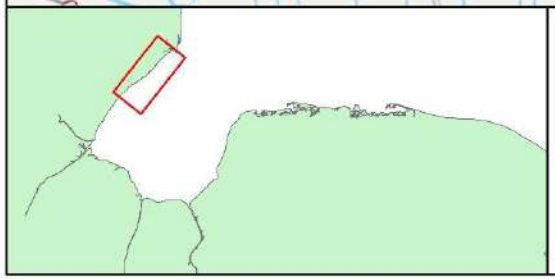
Profiles illustrated are a set length and not representative of survey extent

Anglian Coastal Monitoring

0 0.5 1 2 Km

Scale: 1:50,000

2dSU01WB • Wash Banks (North) • Cross Sectional Area Change 2016 - 2020



>30% Accretion
15 - 30% Accretion
5 - 15% Accretion
No Significant Change

5 - 15% Erosion
15 - 30% Erosion
>30 Erosion

Label: Profile name (change in m2)

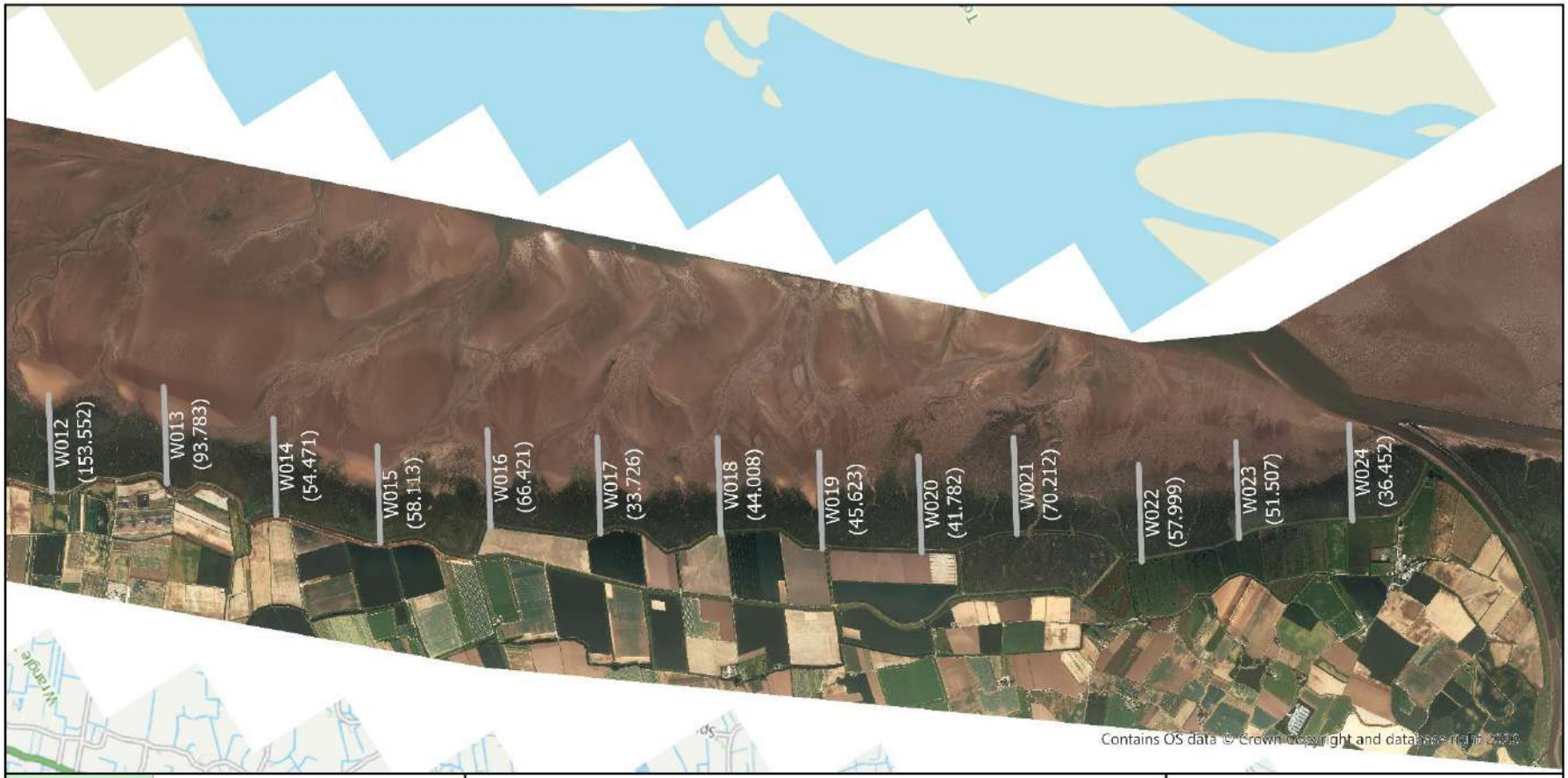
Profiles illustrated are a set length and not representative of survey extent

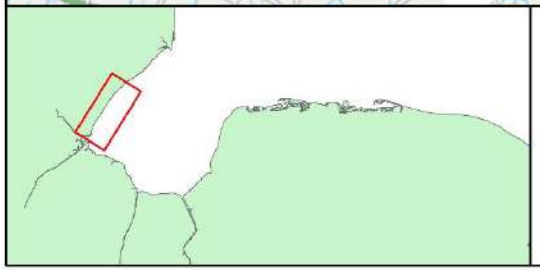
Anglian Coastal Monitoring

0 0.5 1 2 Km

Scale: 1:50,000

2dSU01WB • Wash Banks (South) • Cross Sectional Area Change 2016 - 2020





>30% Accretion
15 - 30% Accretion
5 - 15% Accretion
No Significant Change
5 - 15% Erosion
15 - 30% Erosion
>30 Erosion
Label: Profile name (change in m2)

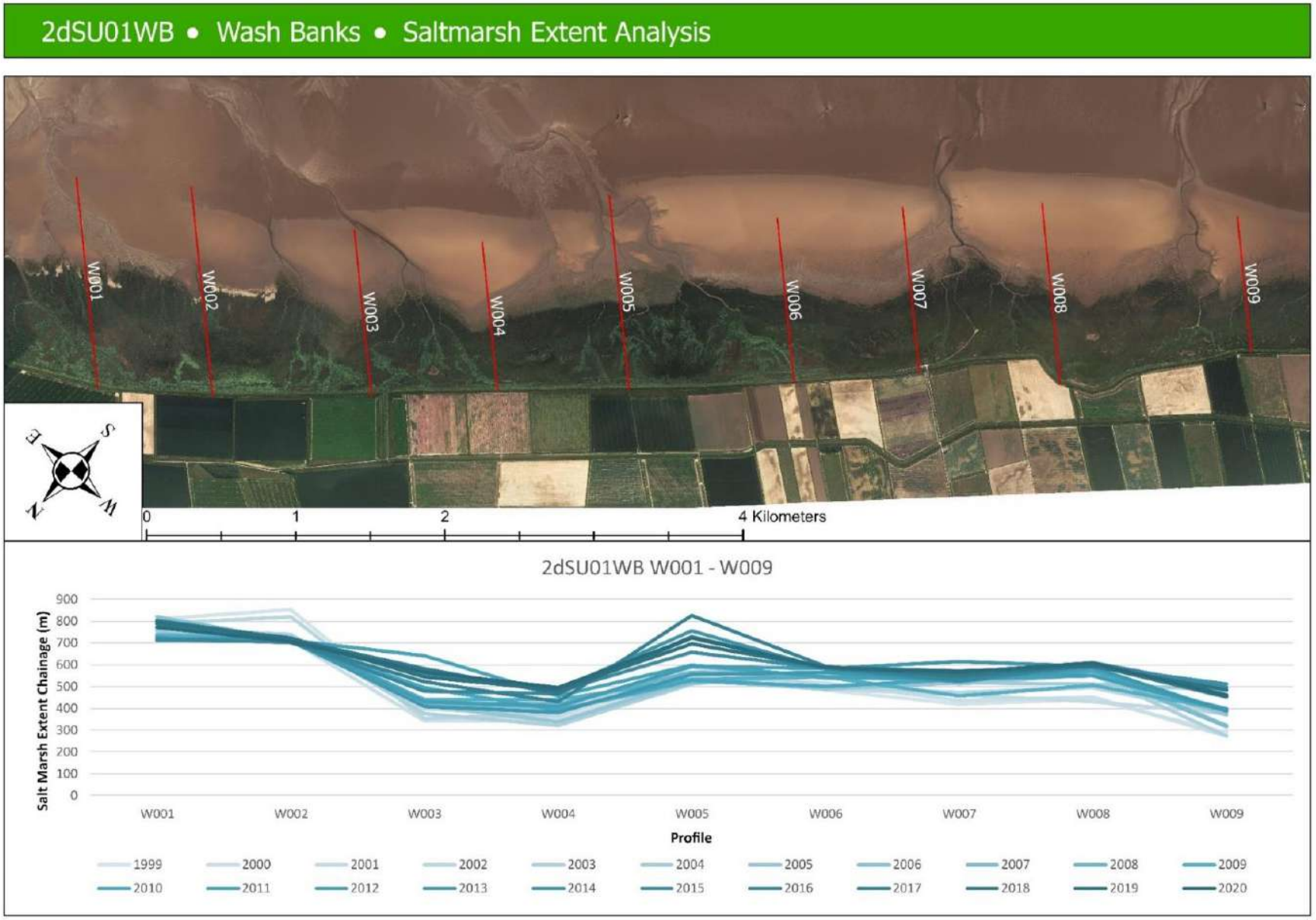
Profiles illustrated are a set length and not representative of survey extent

Anglian Coastal Monitoring

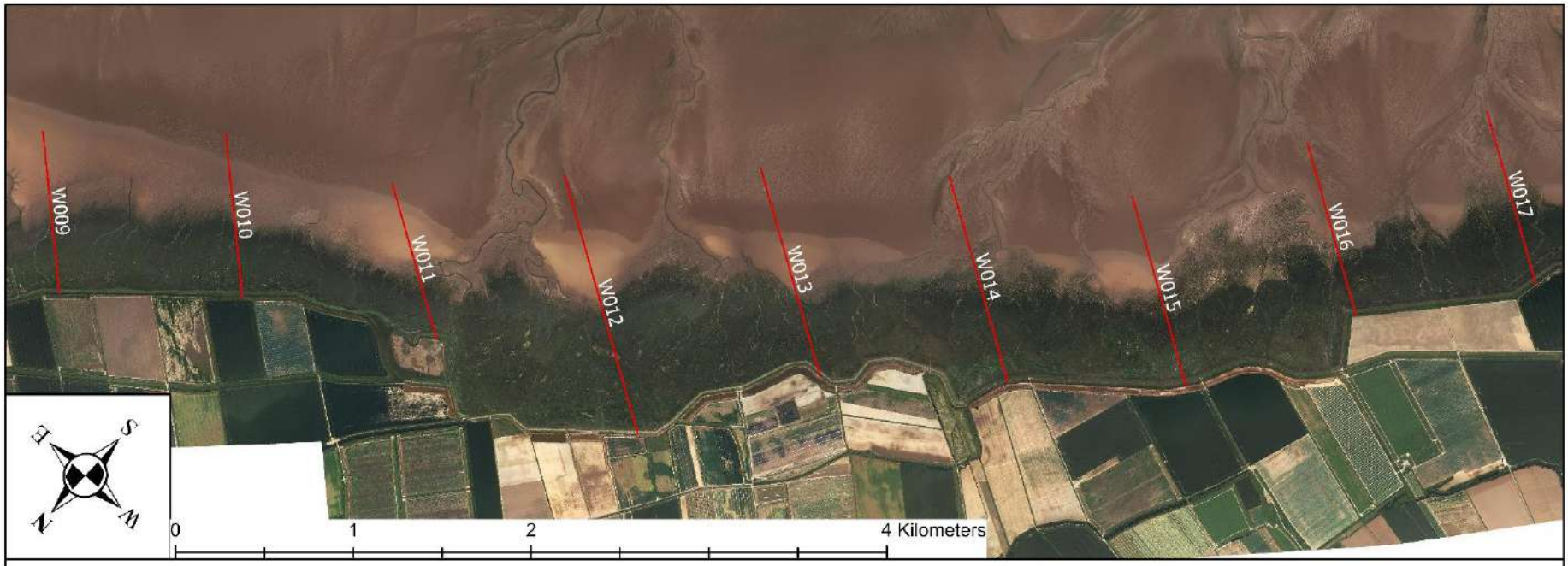
0 0.5 1 2 Km

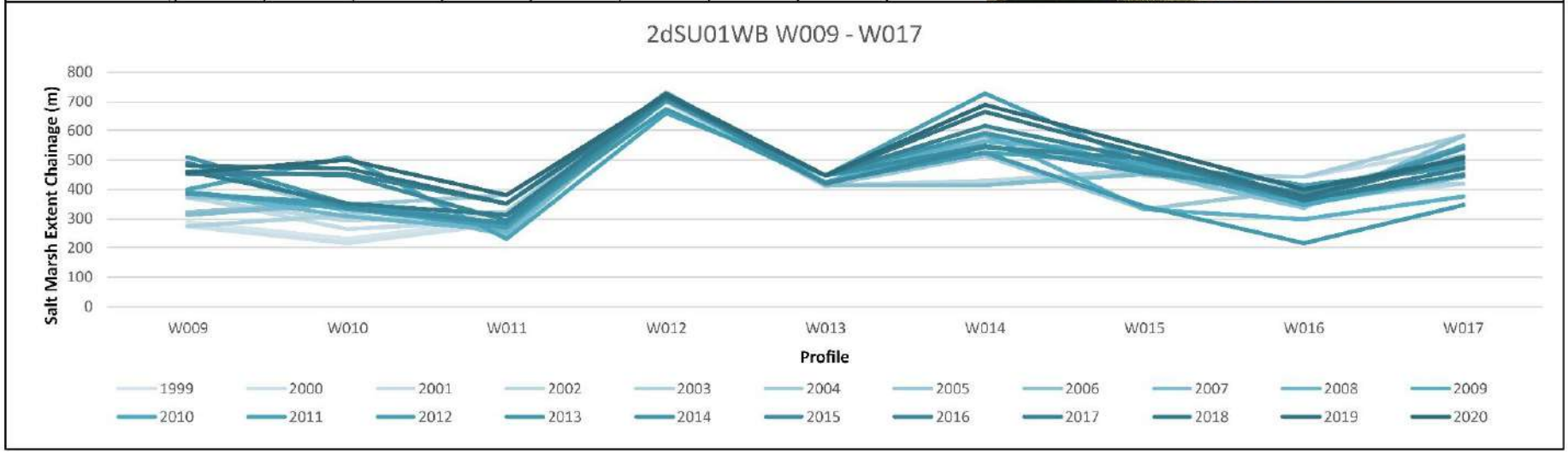
Scale: 1:50,000

Saltmarsh Position

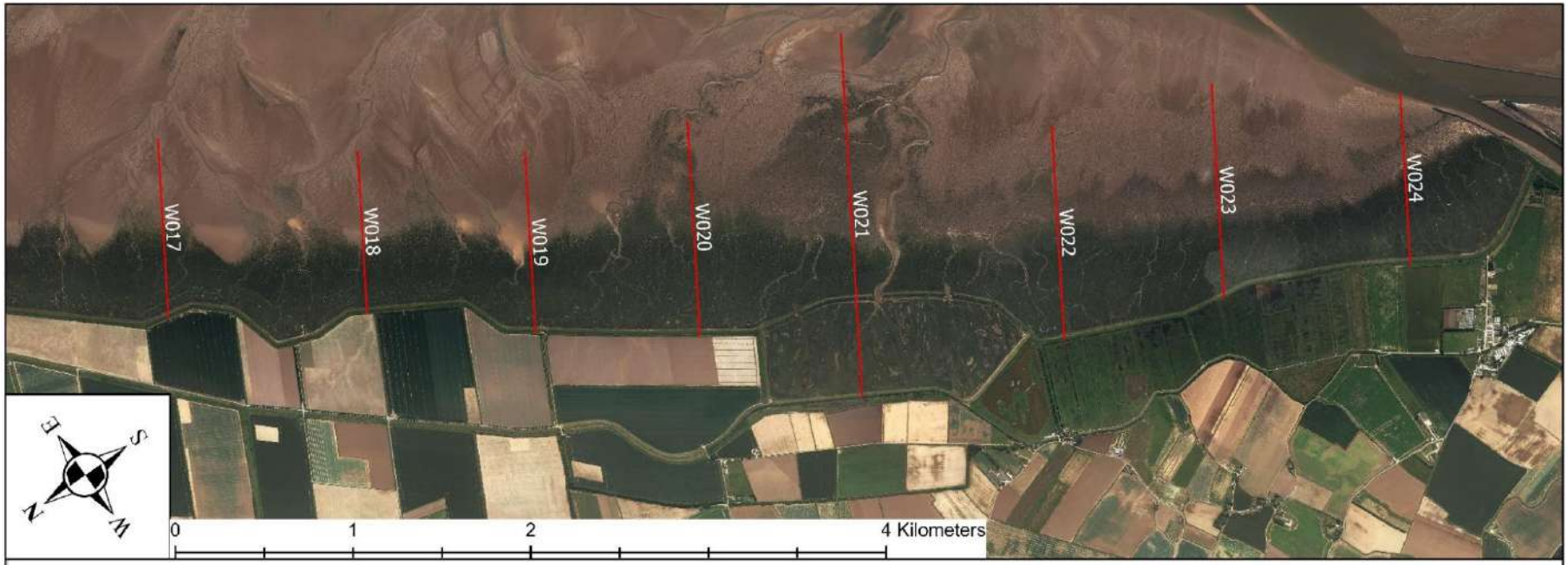


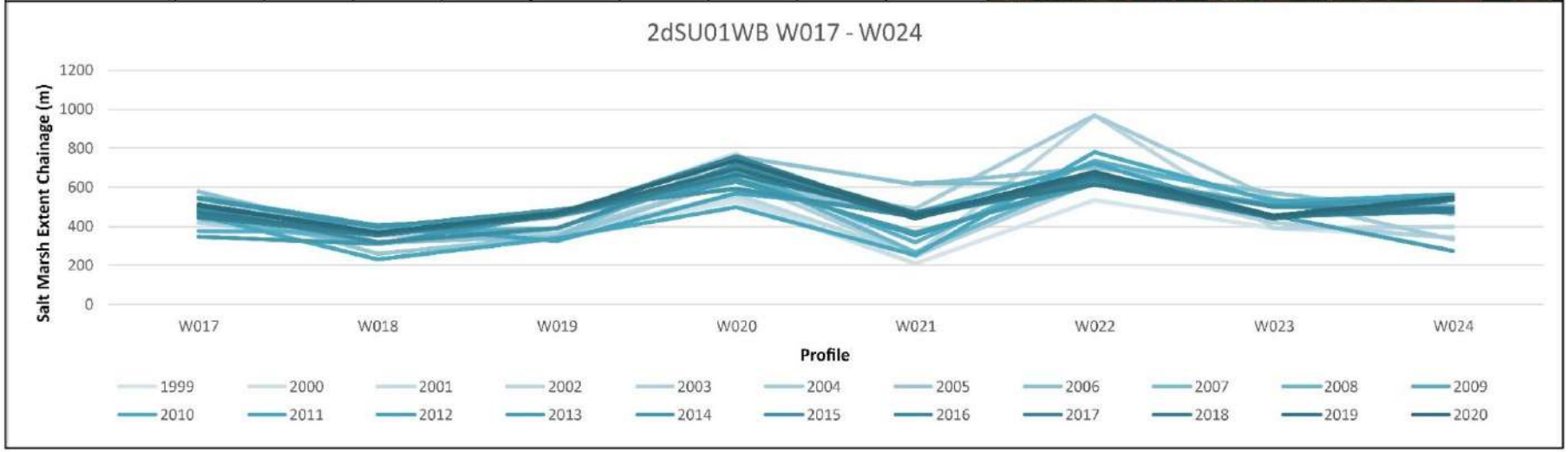
2dSU01WB • Wash Banks • Saltmarsh Extent Analysis



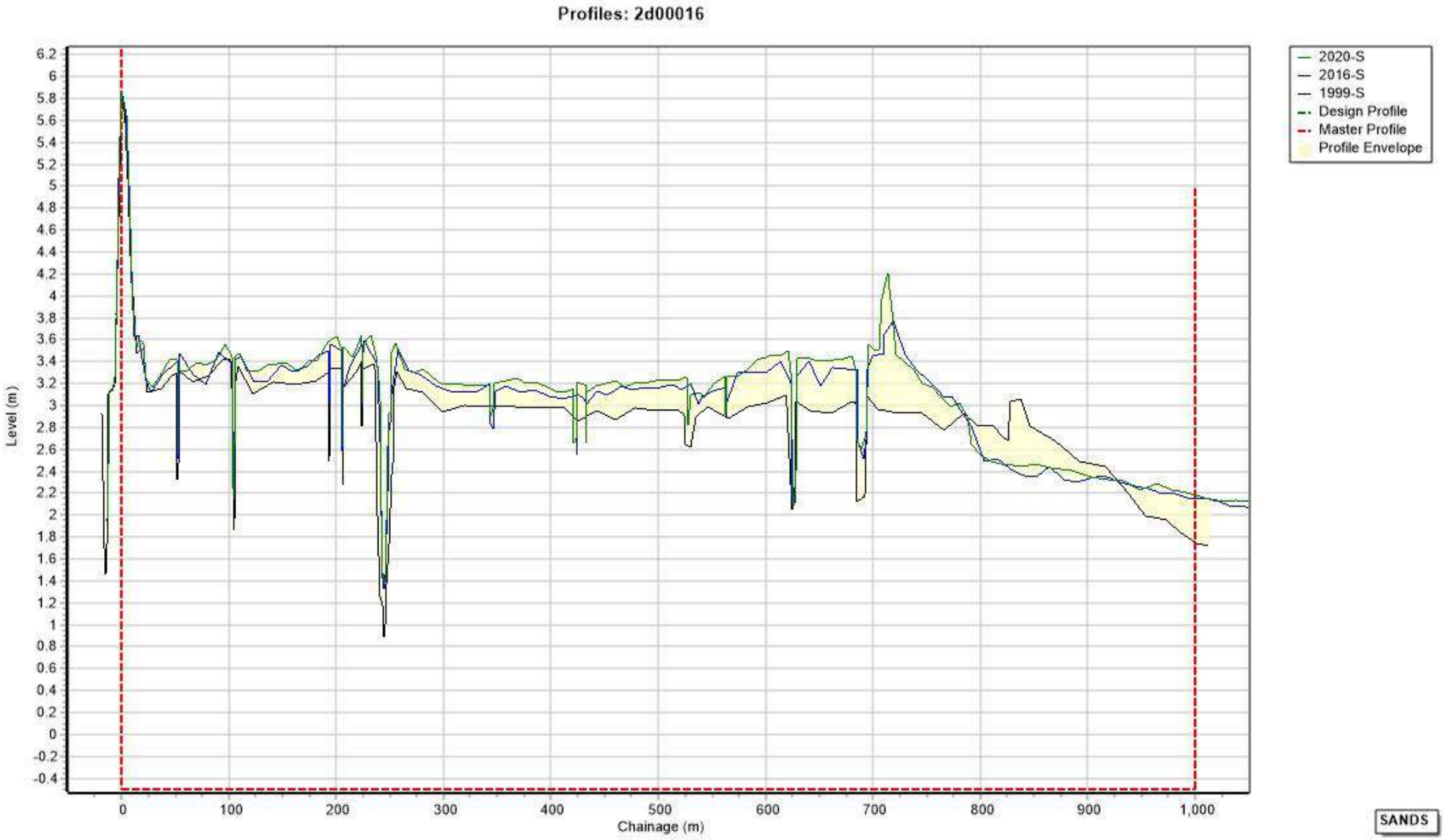


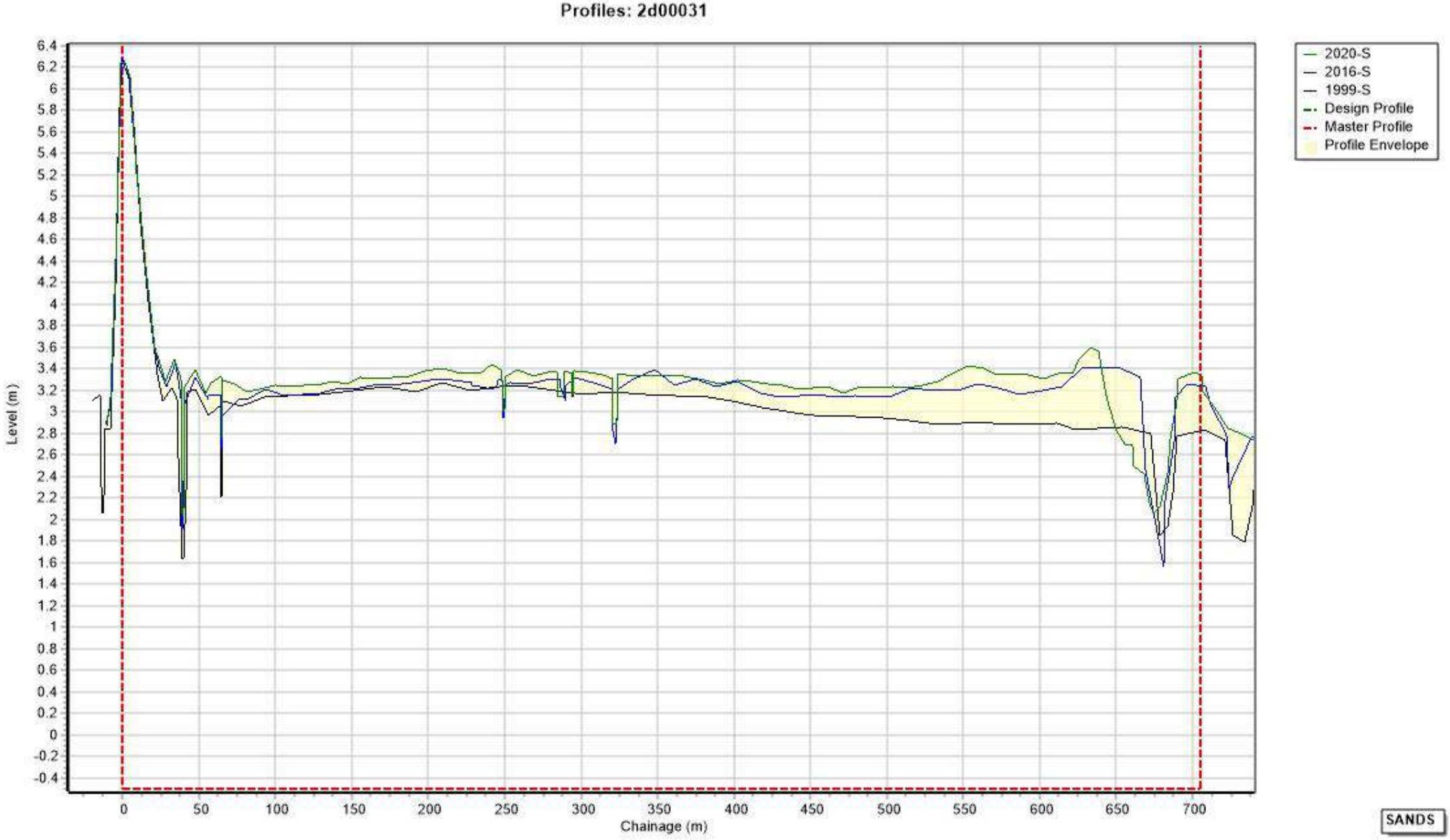
2dSU01WB • Wash Banks • Saltmarsh Extent Analysis





Profile Graphs

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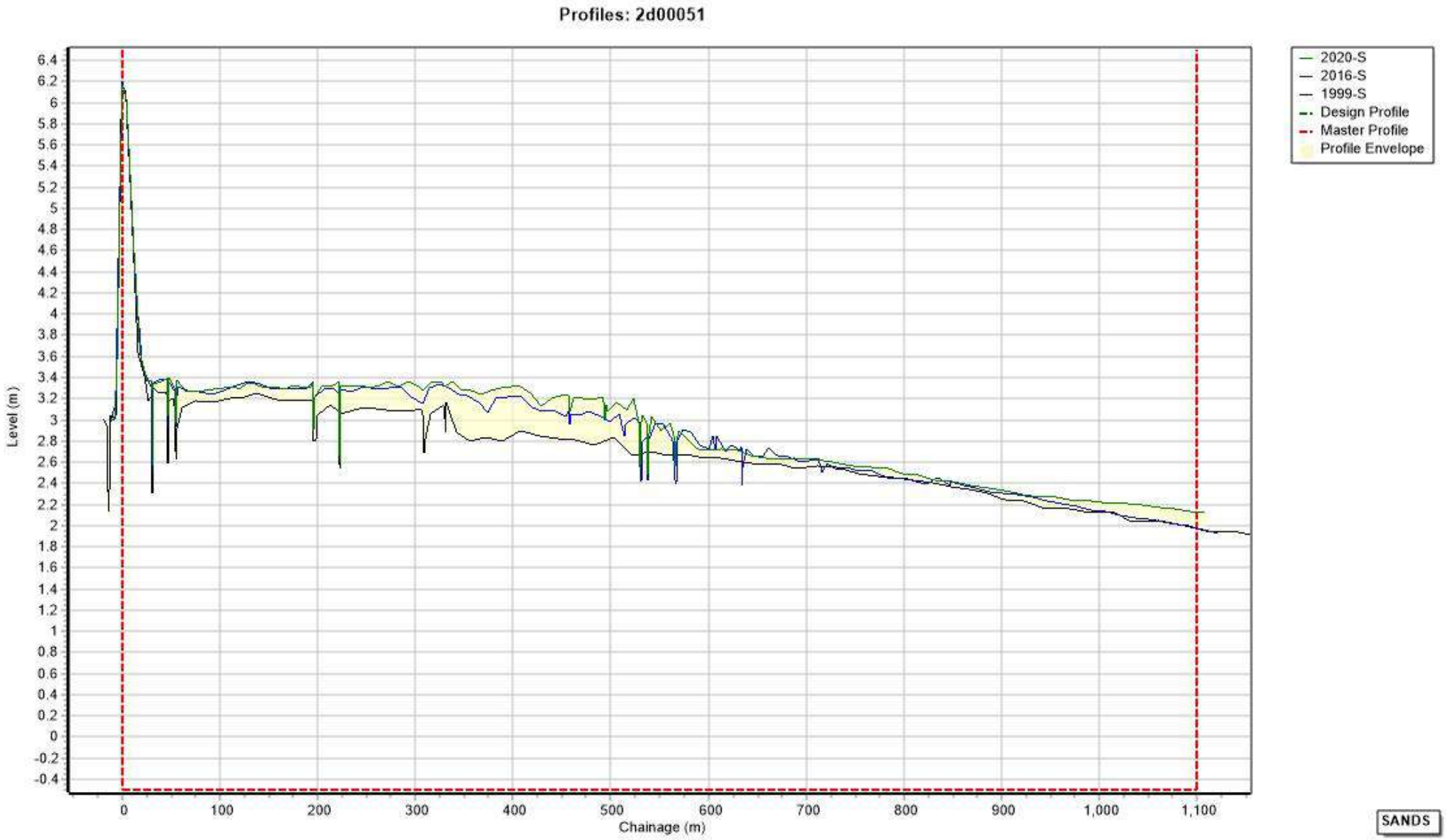
SANDS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Chainage (m)
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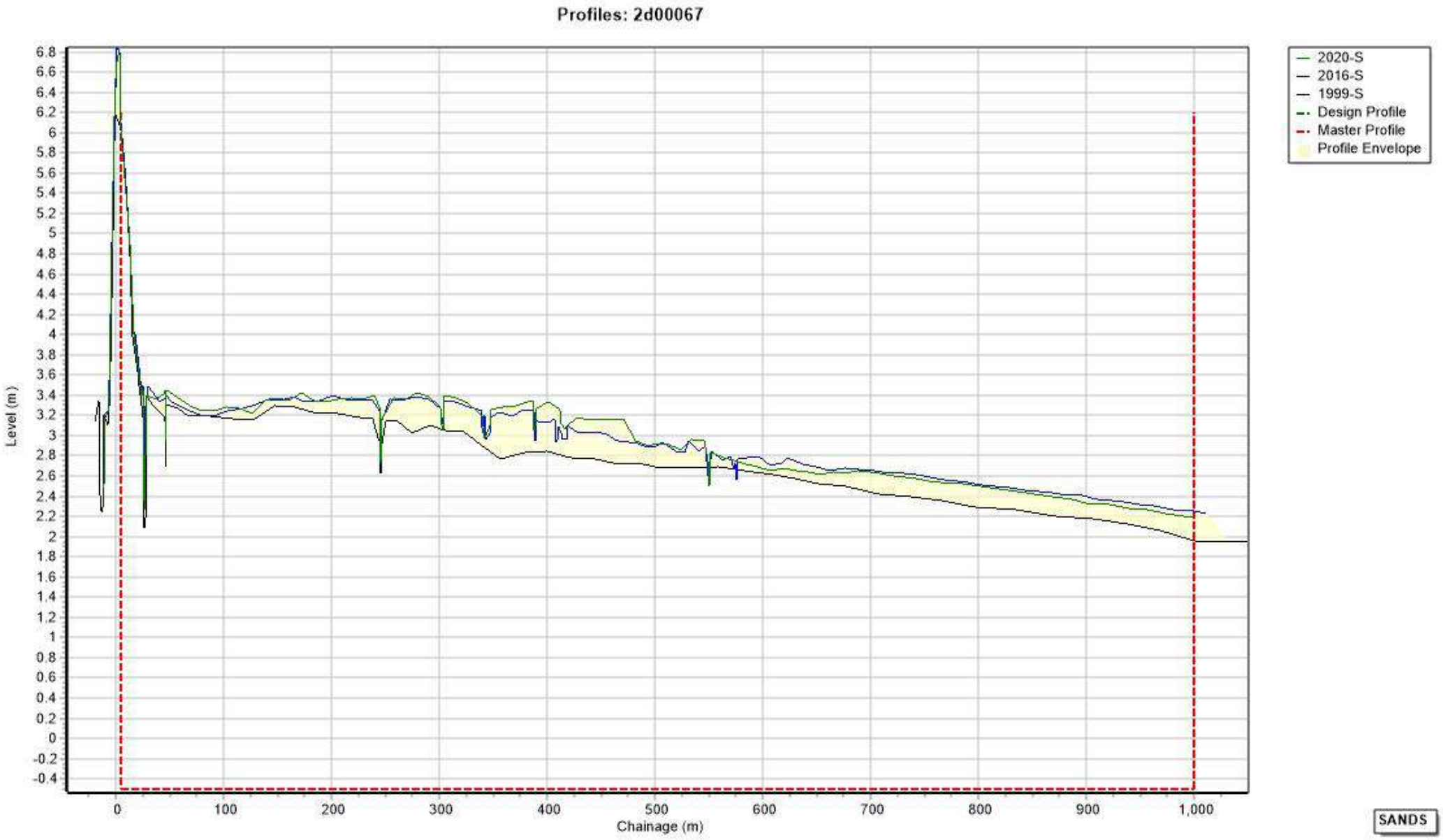
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Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
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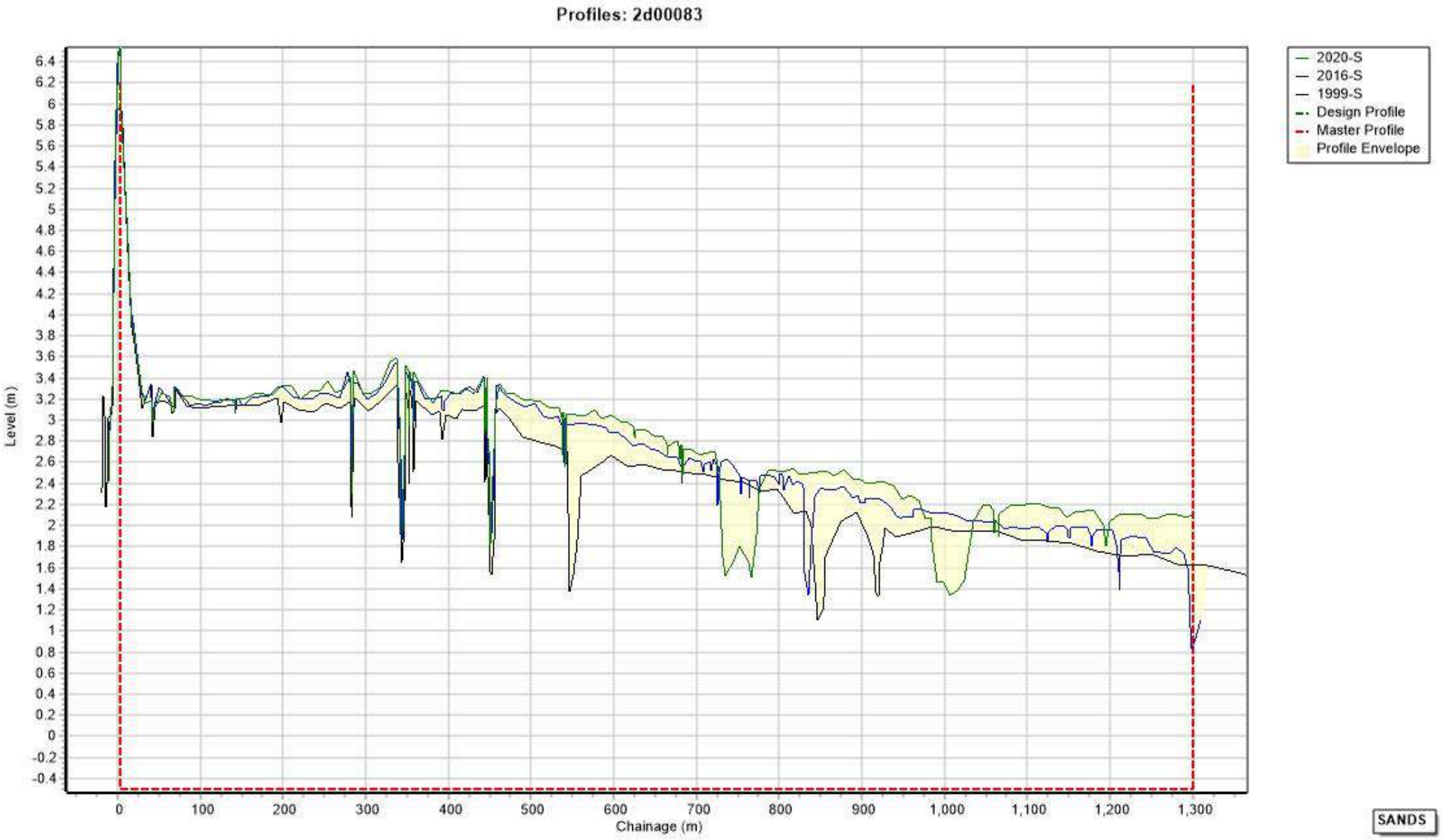
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Level (m)
Chainage (m)
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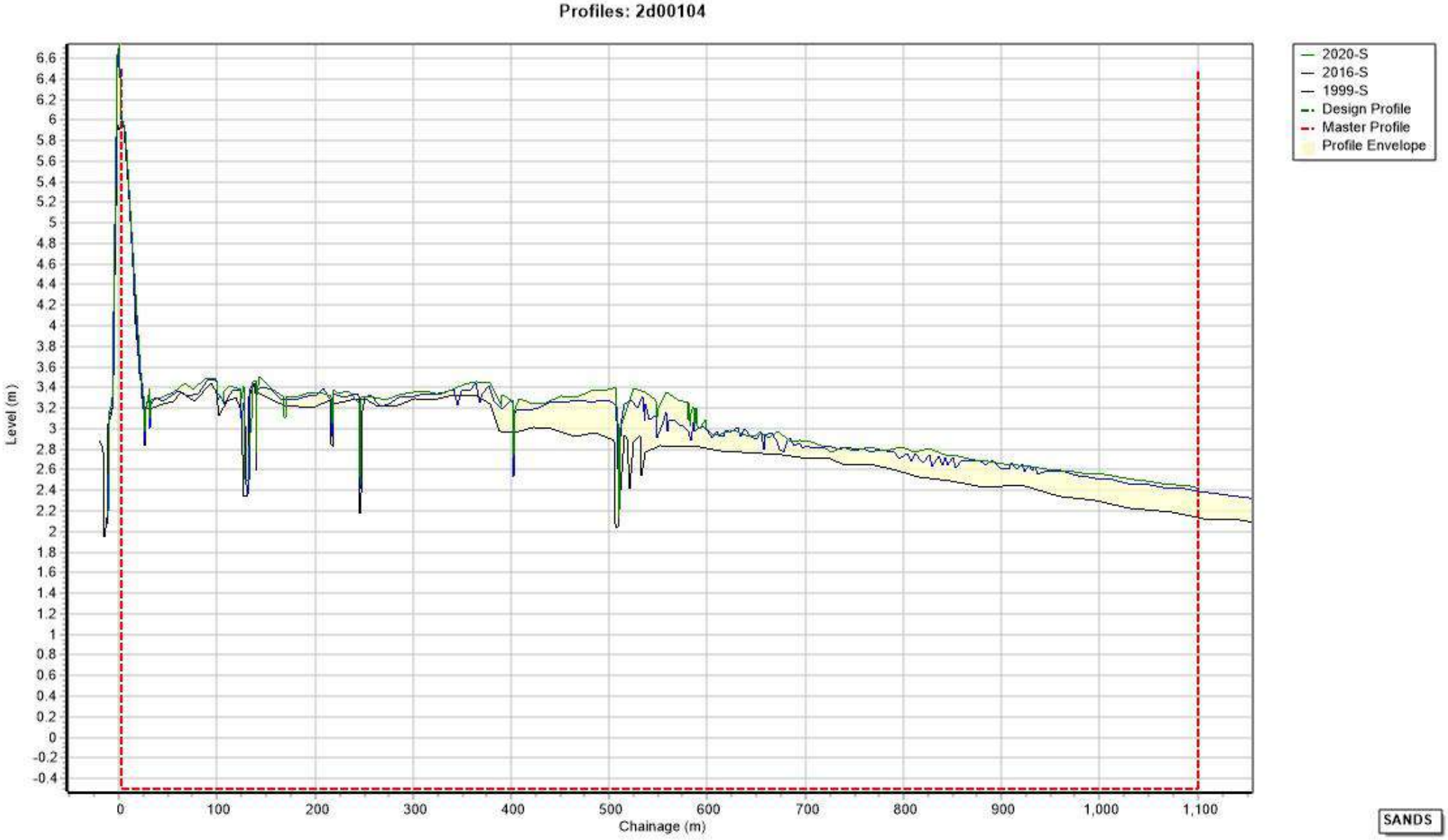
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Master Profile
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Level (m)
Chainage (m)
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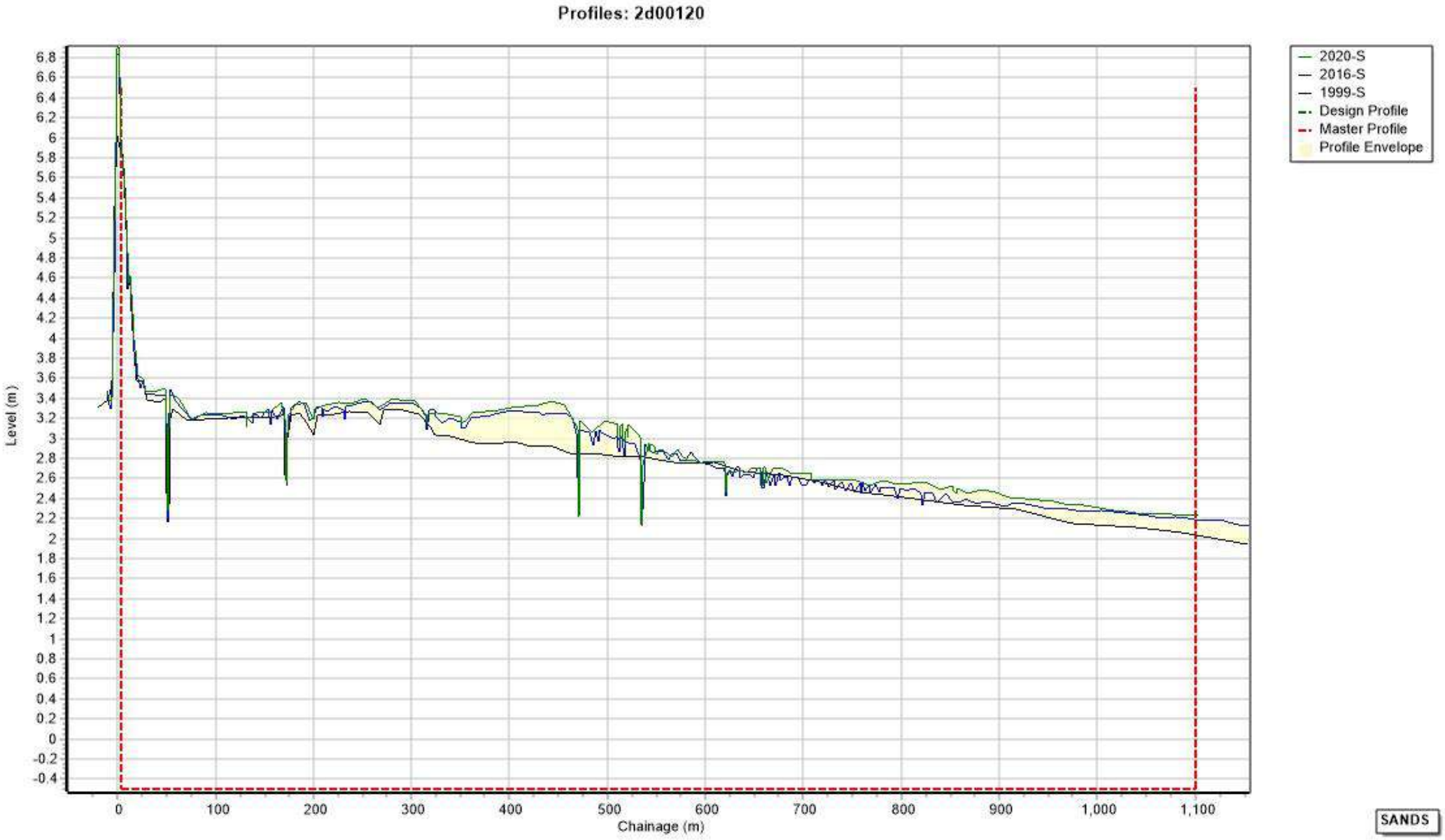
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Master Profile
Profile Envelope
Level (m)
Chainage (m)
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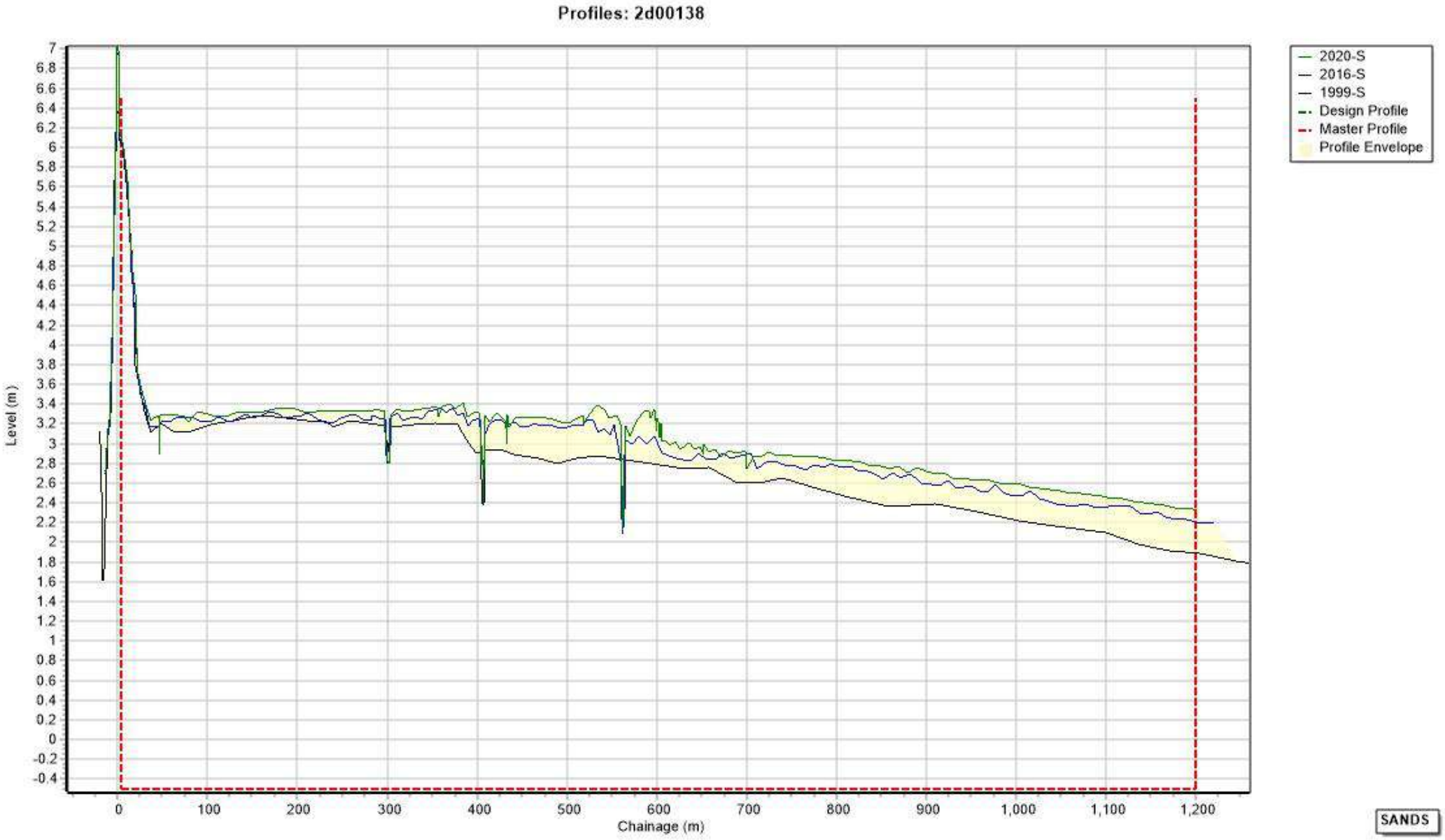
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Master Profile
Profile Envelope
Level (m)
Chainage (m)
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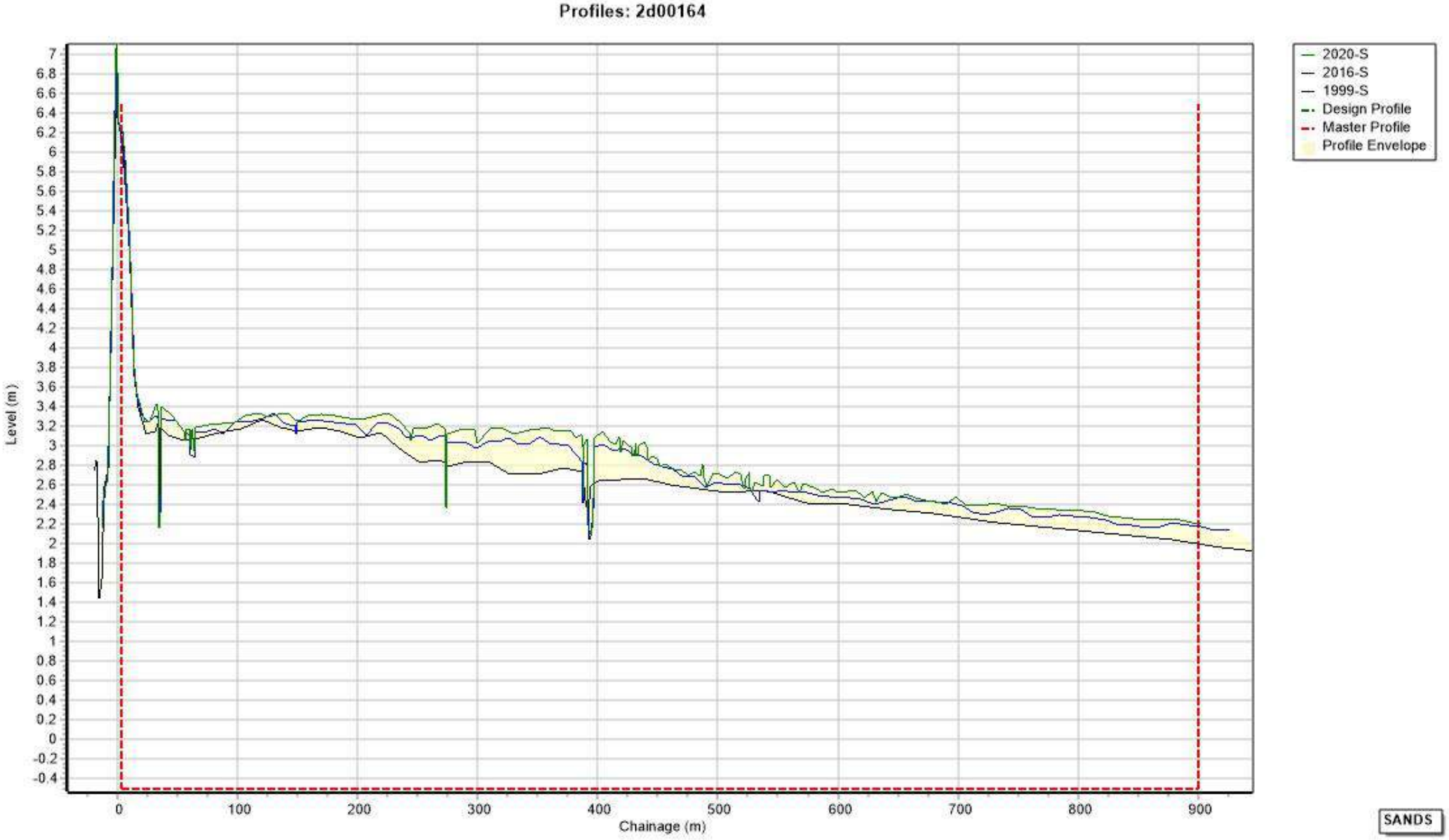
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Master Profile
Profile Envelope
Level (m)
Chainage (m)
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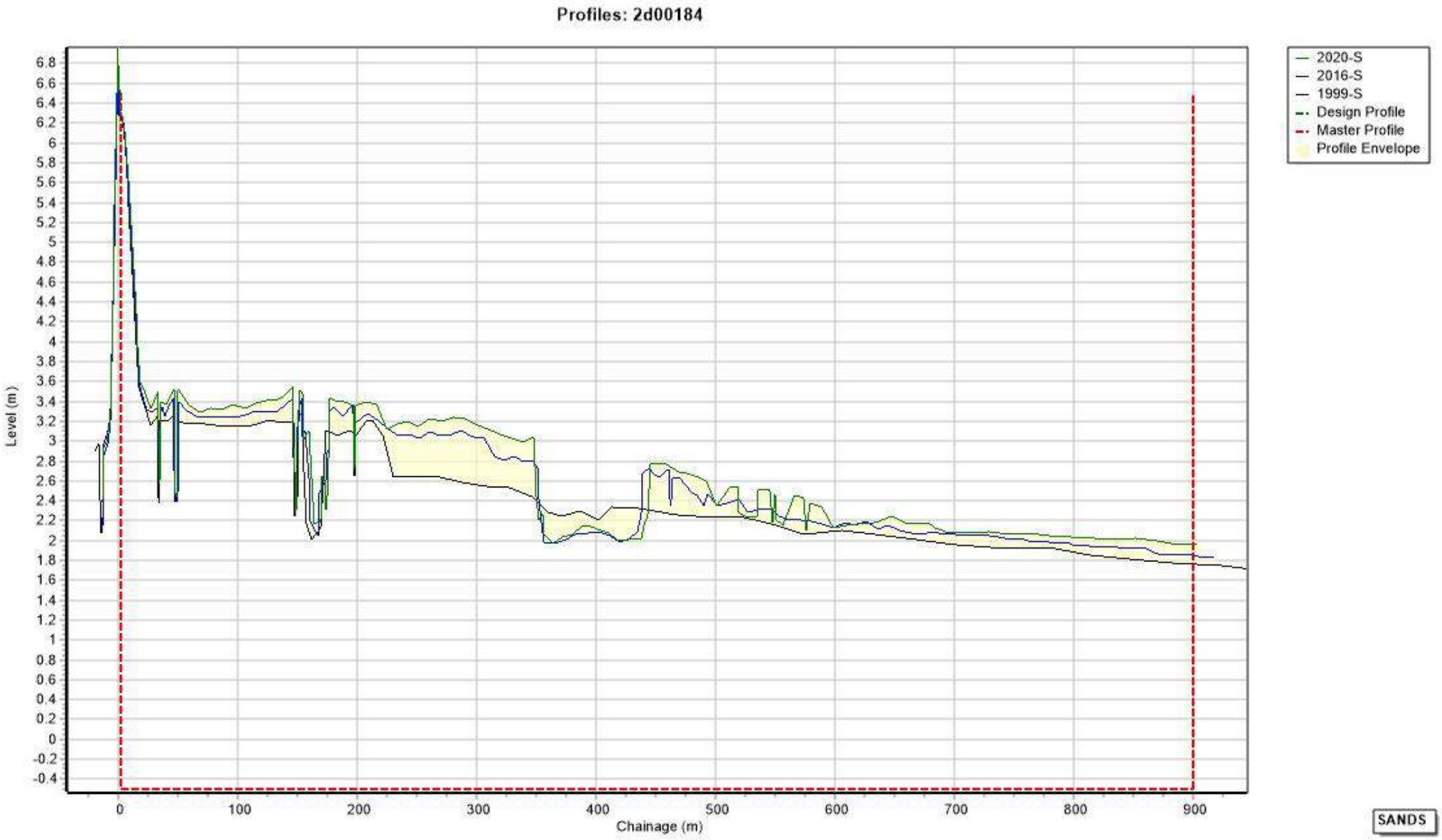
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Master Profile
Profile Envelope
Level (m)
Chainage (m)
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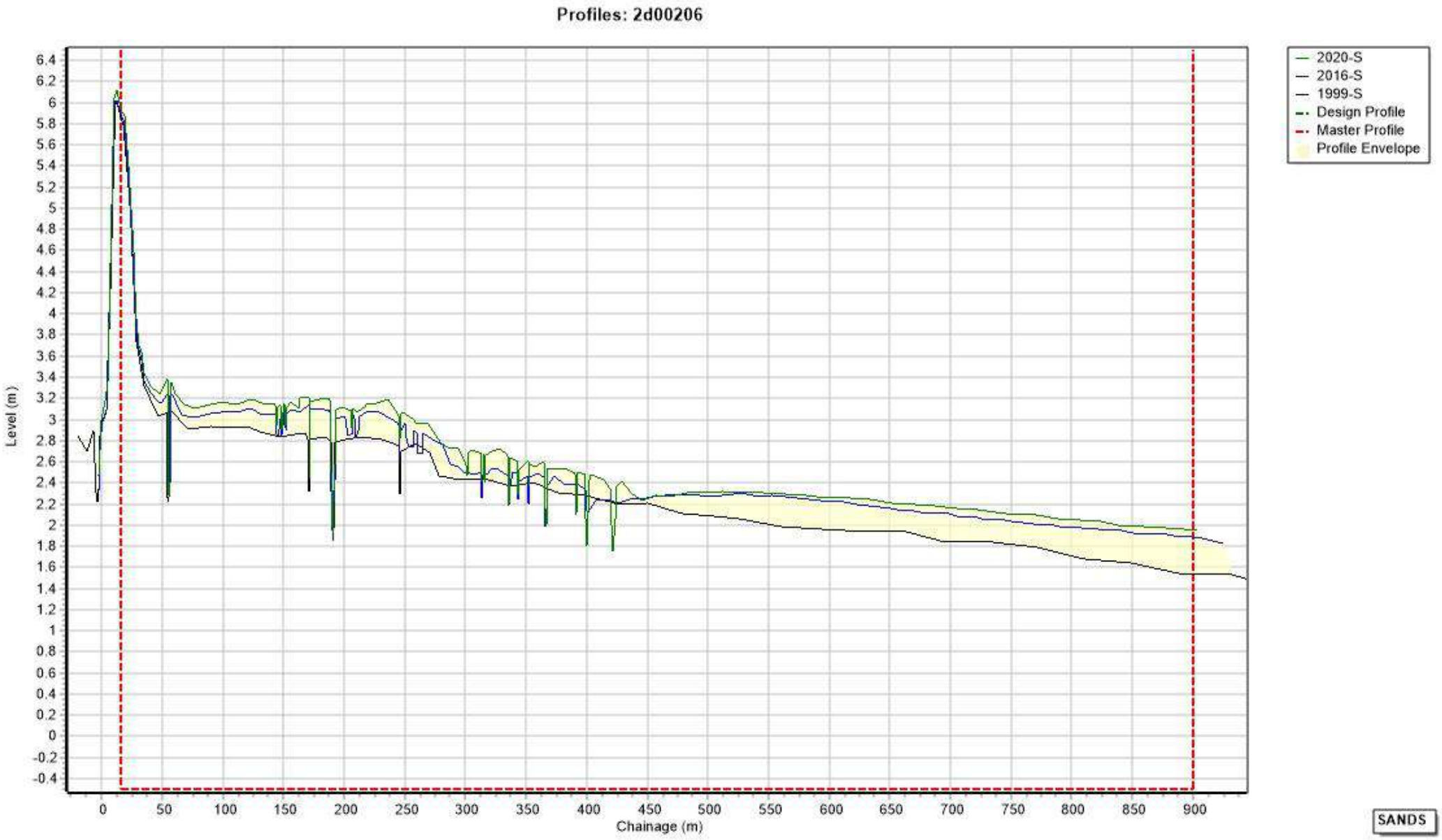
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Master Profile
Profile Envelope
Level (m)
Chainage (m)
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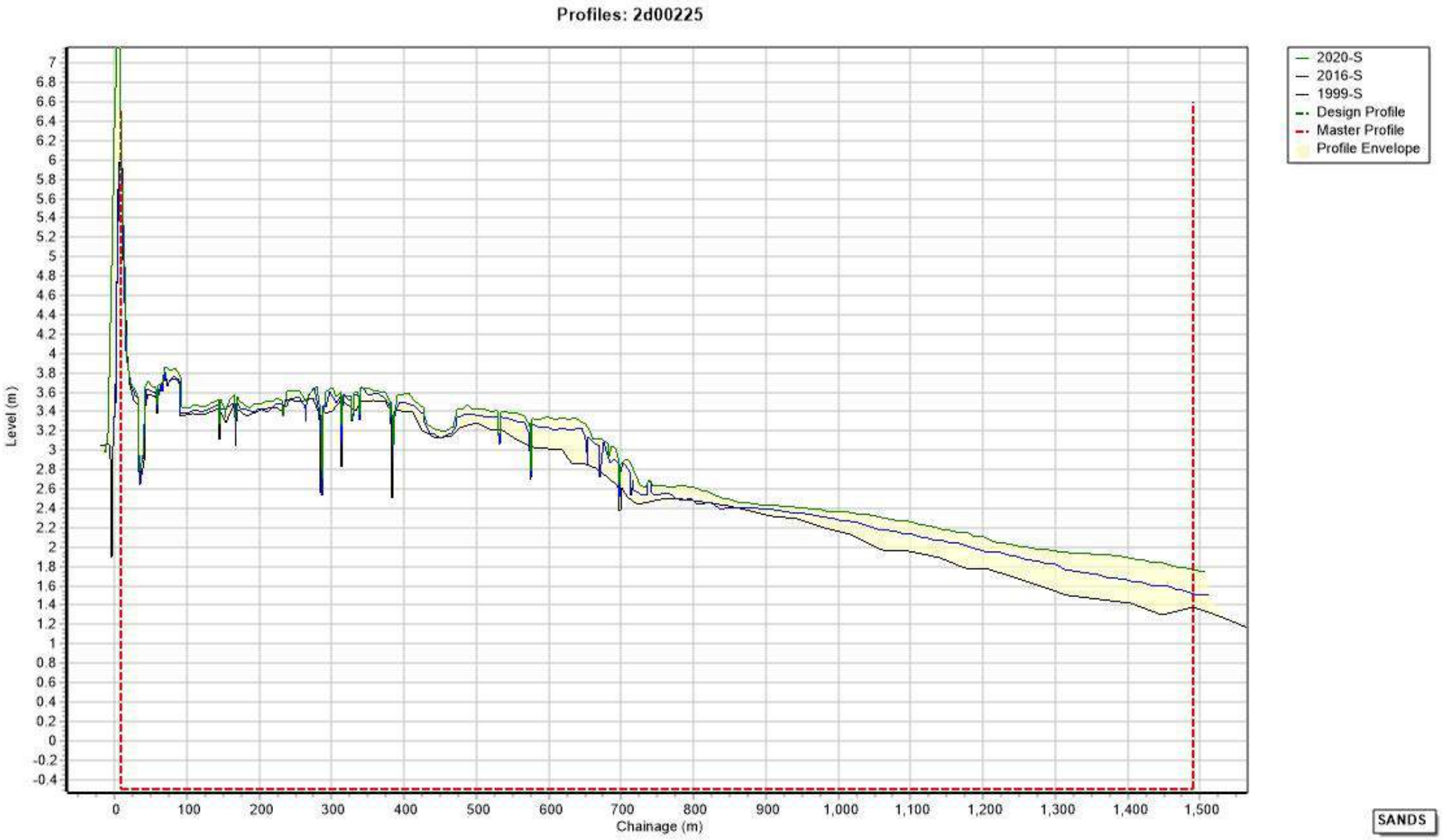
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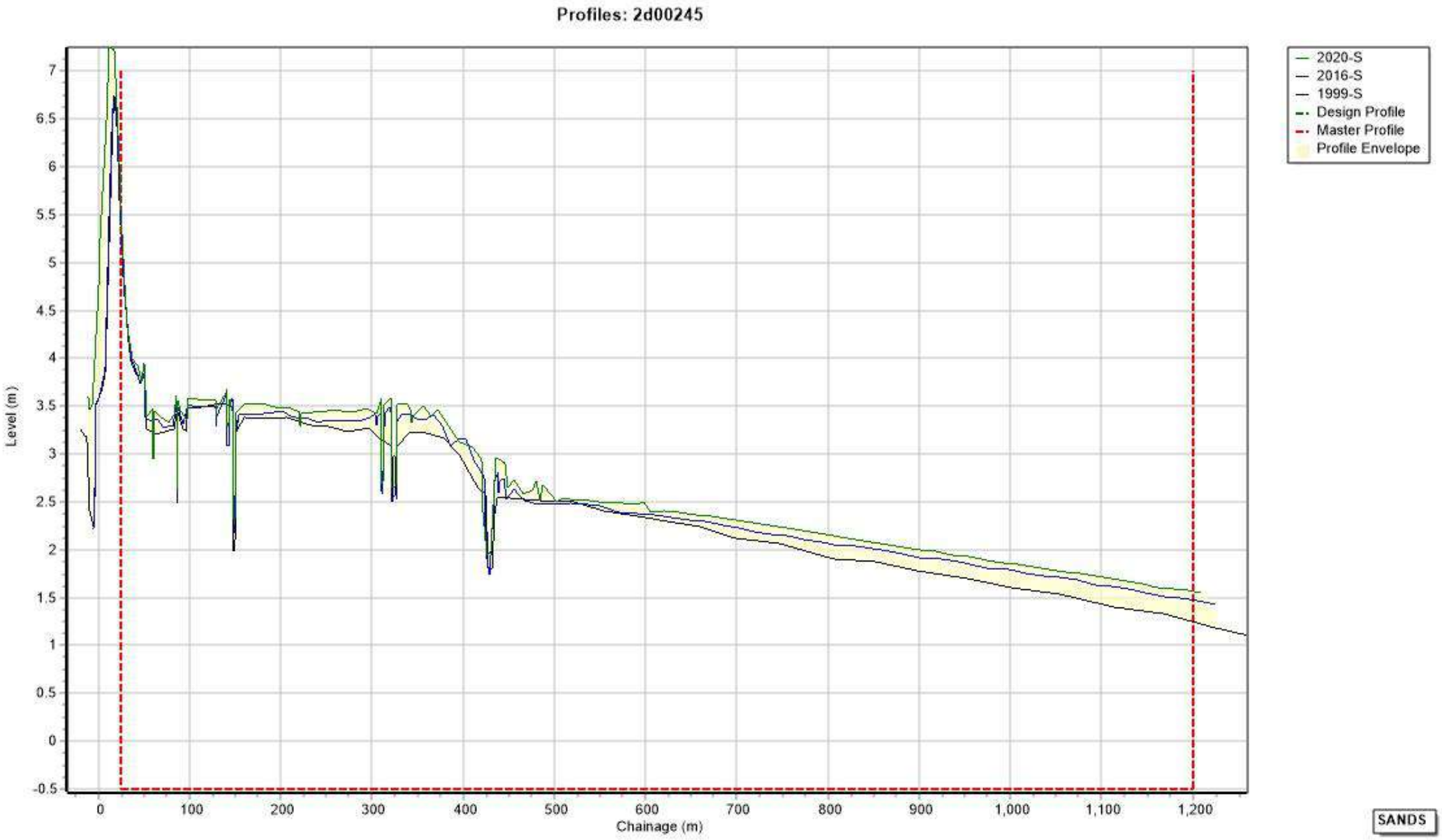
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS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Master Profile
Profile Envelope
Level (m)
Chainage (m)
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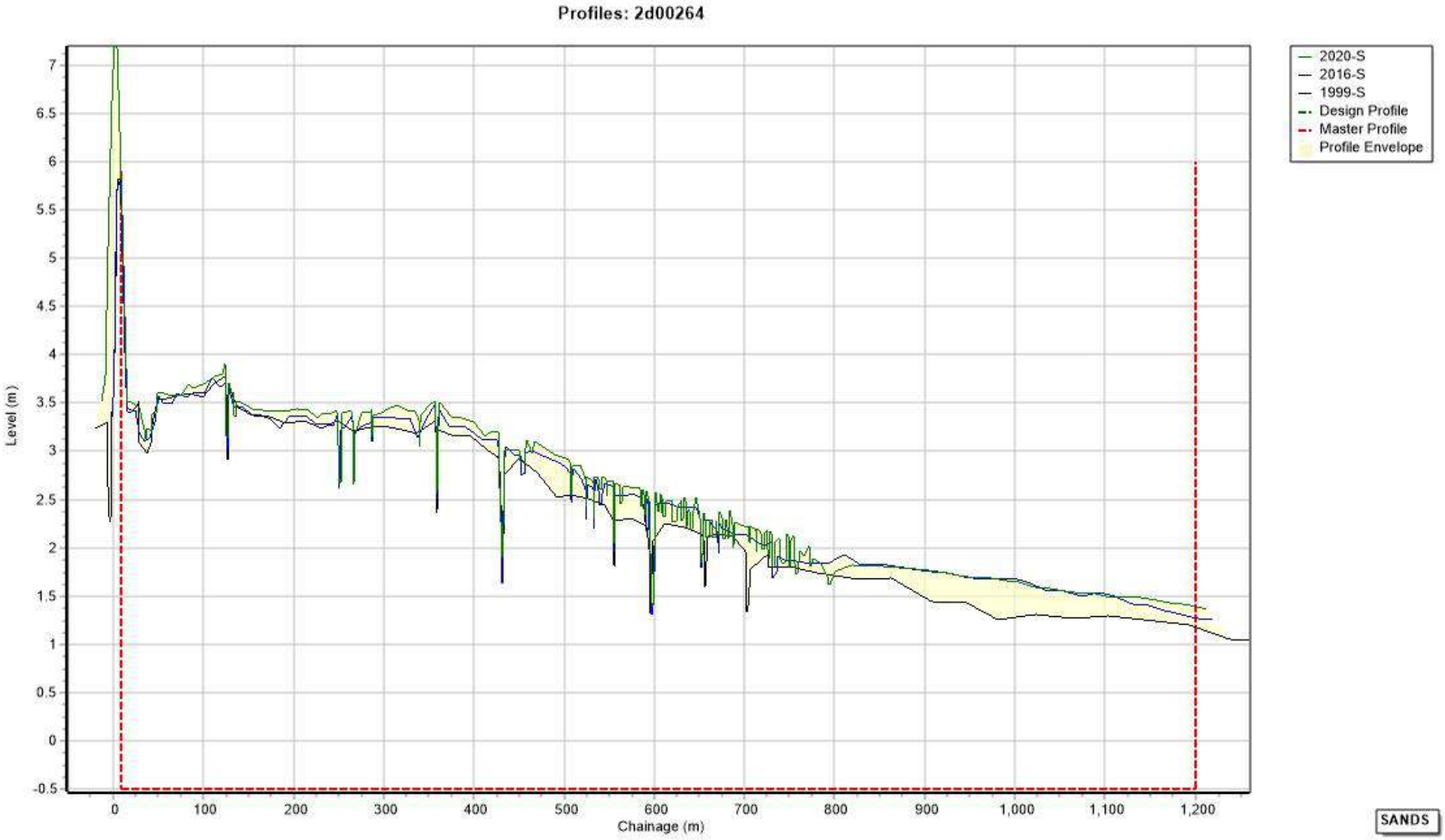
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Master Profile
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Level (m)
Chainage (m)
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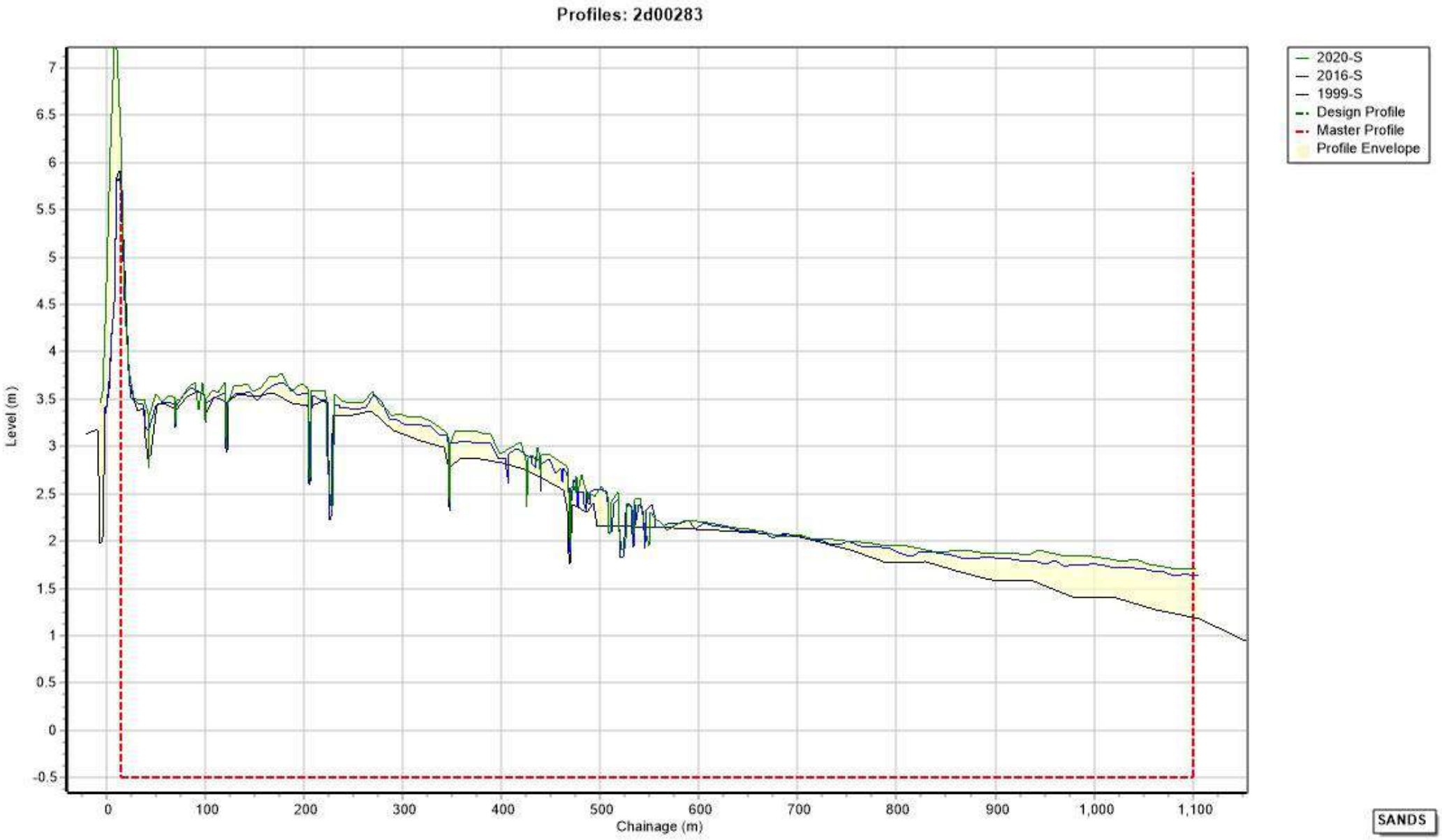
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Master Profile
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Level (m)
Chainage (m)
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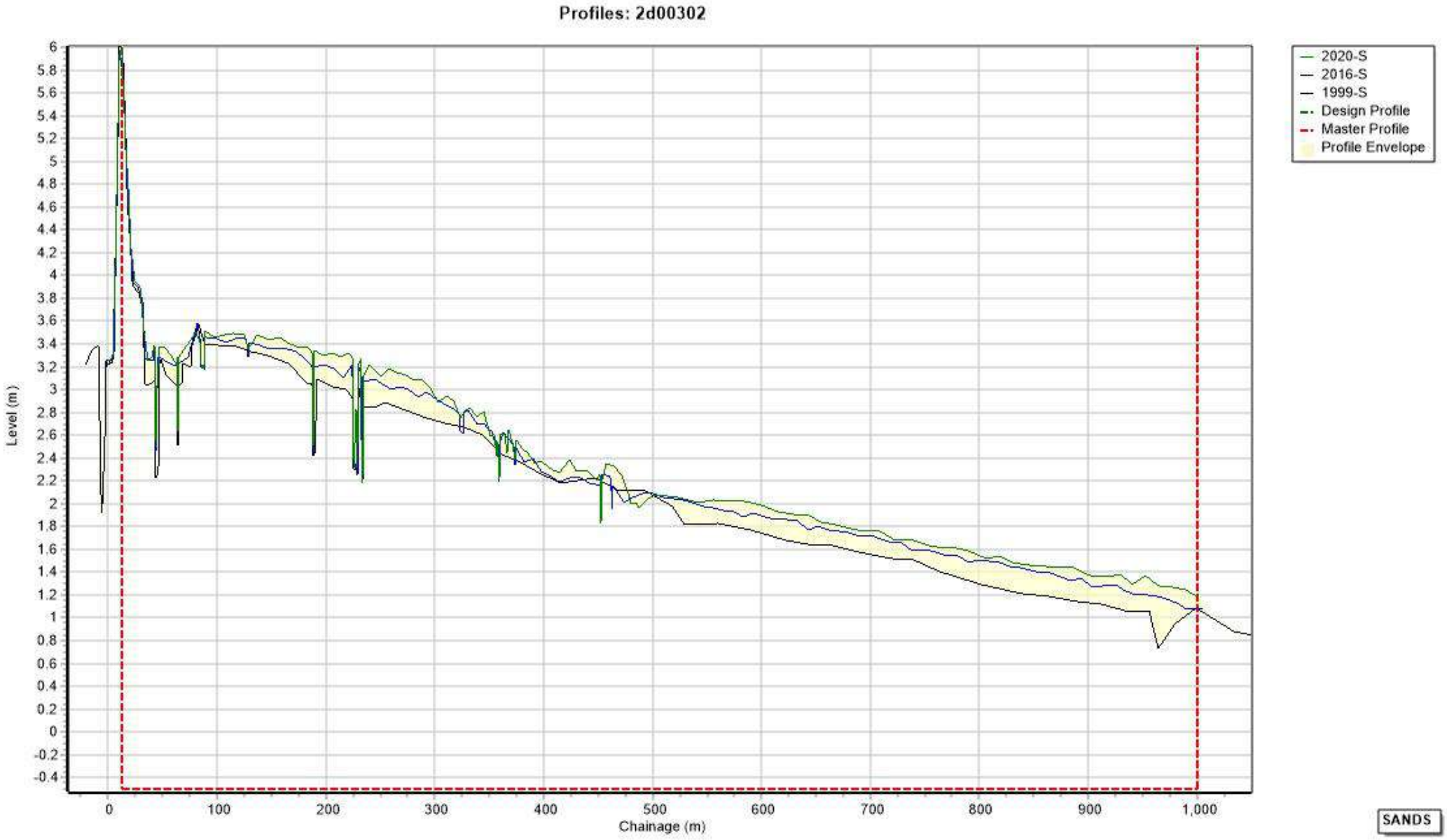
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Profile Envelope
Level (m)
Chainage (m)
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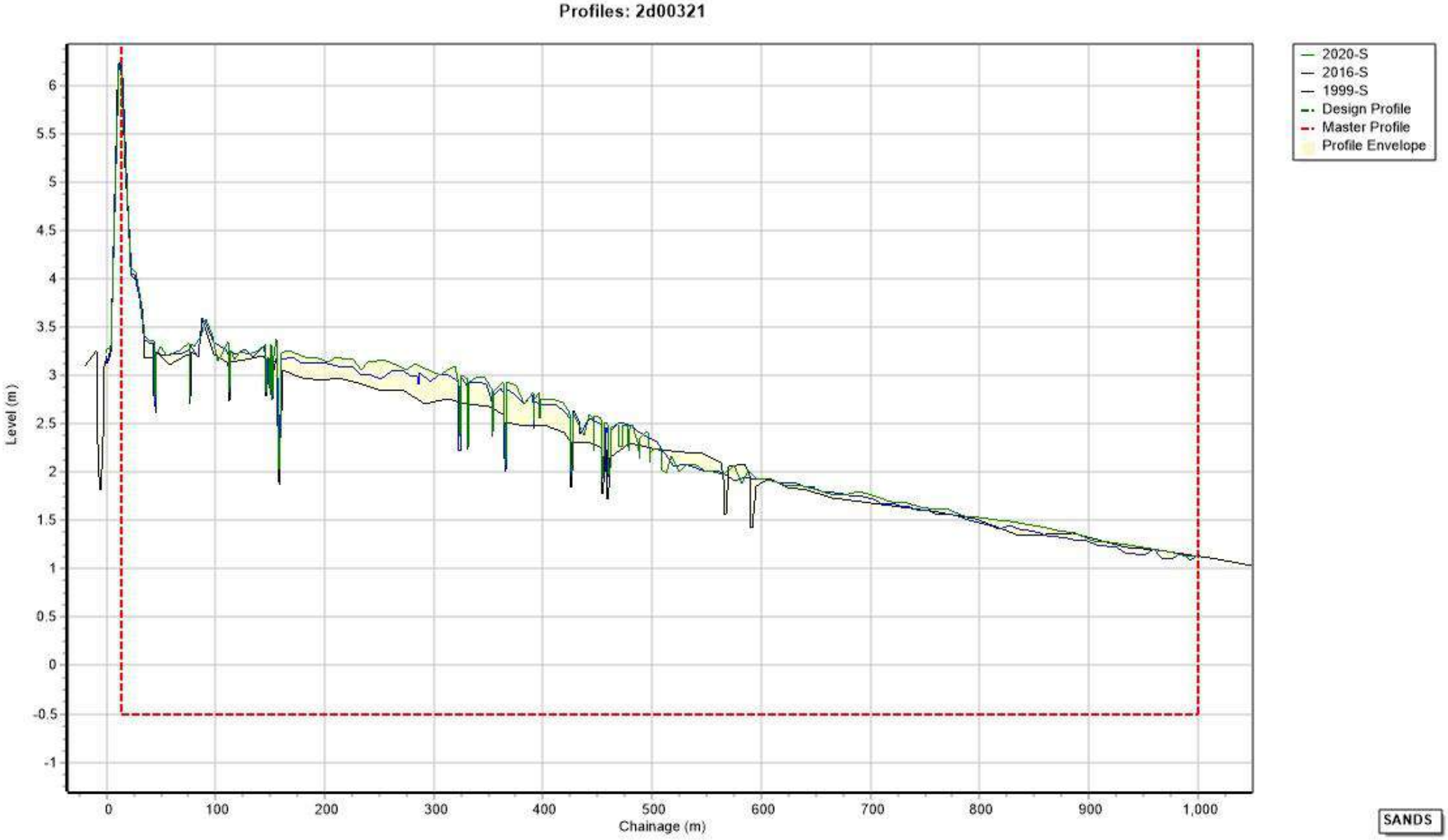
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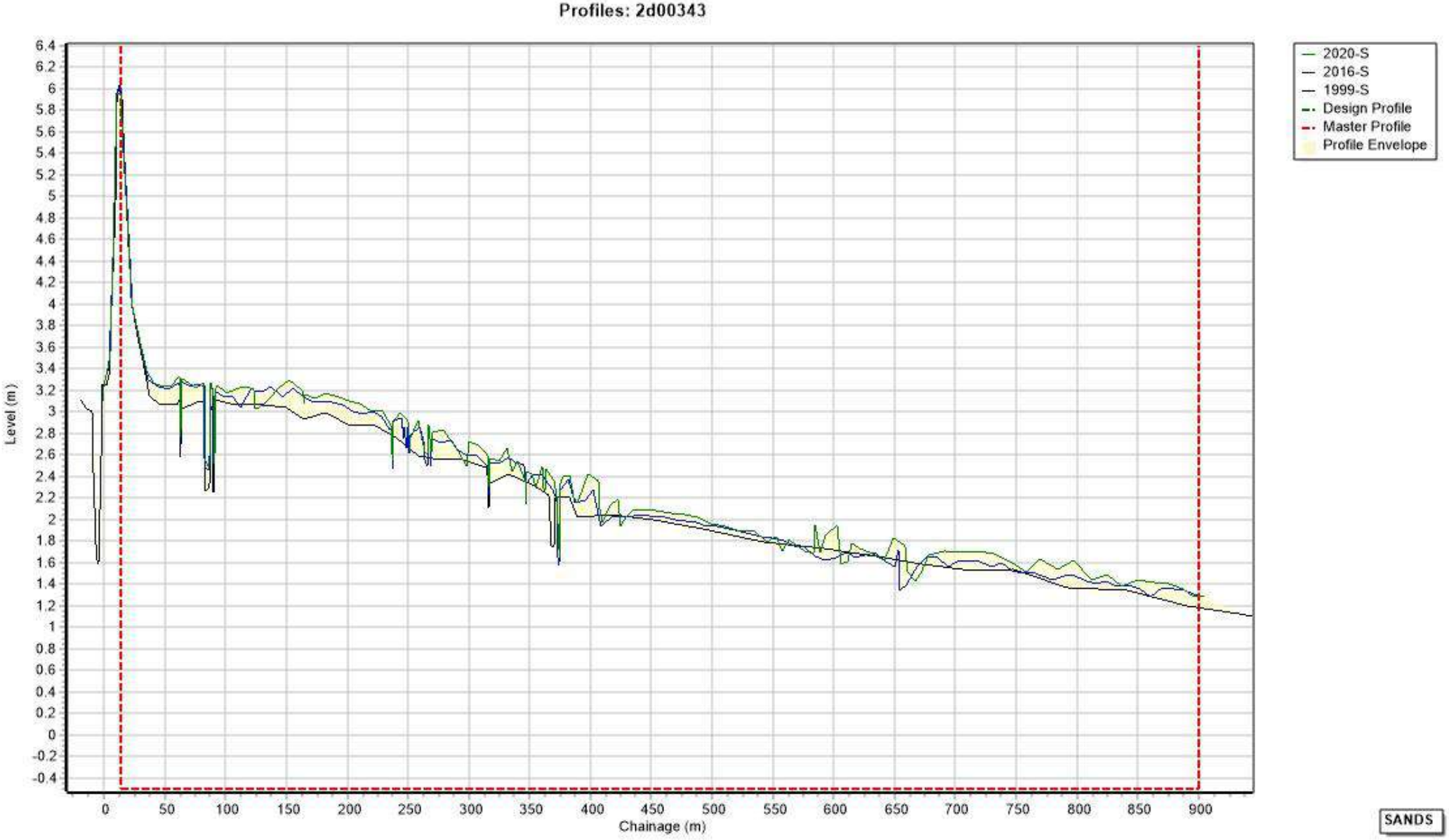
500
600
700
800
900
1,000
Chainage (m)
SANDS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Design Profile
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Profile Envelope
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Chainage (m)
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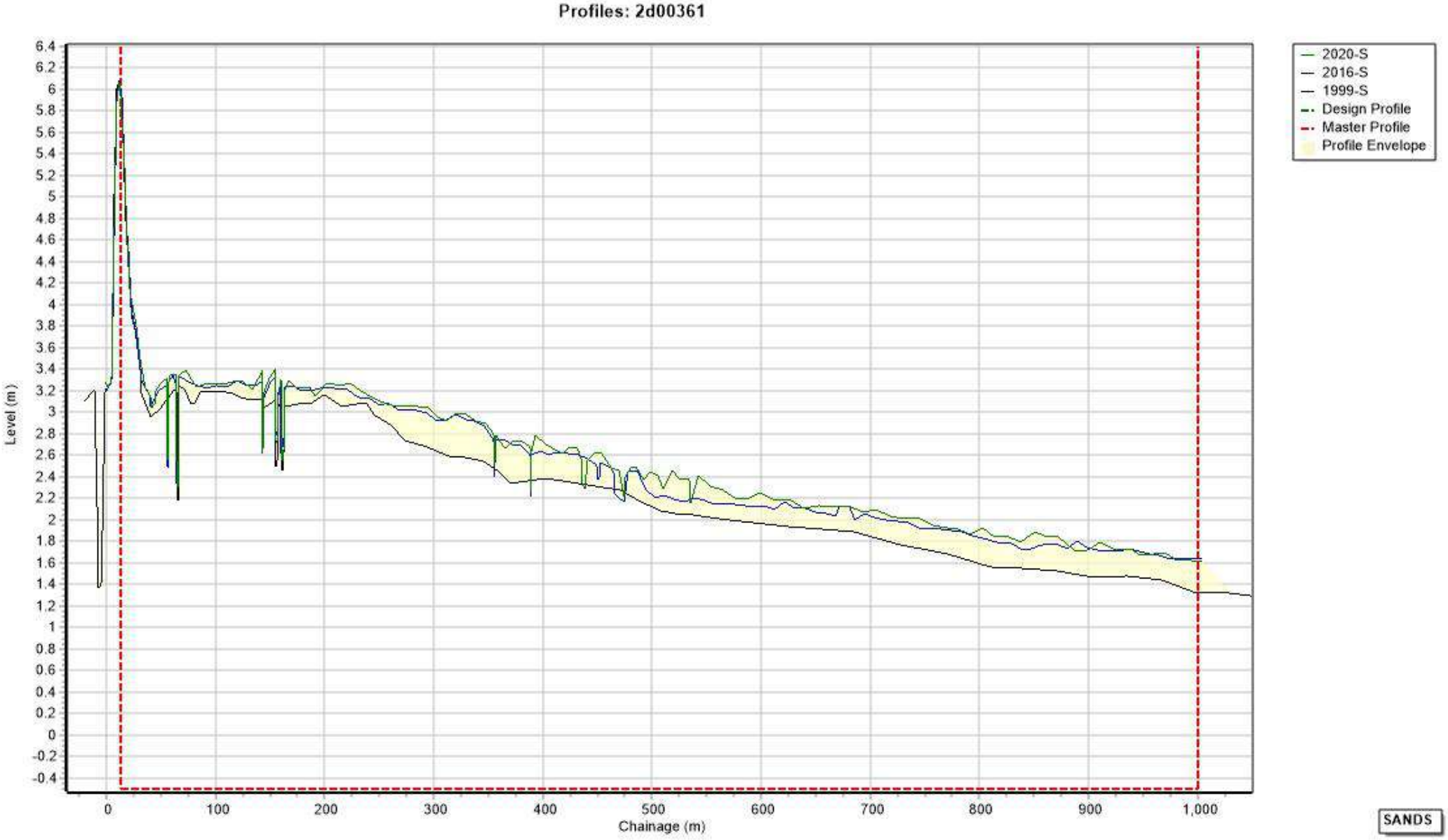
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Level (m)
Chainage (m)
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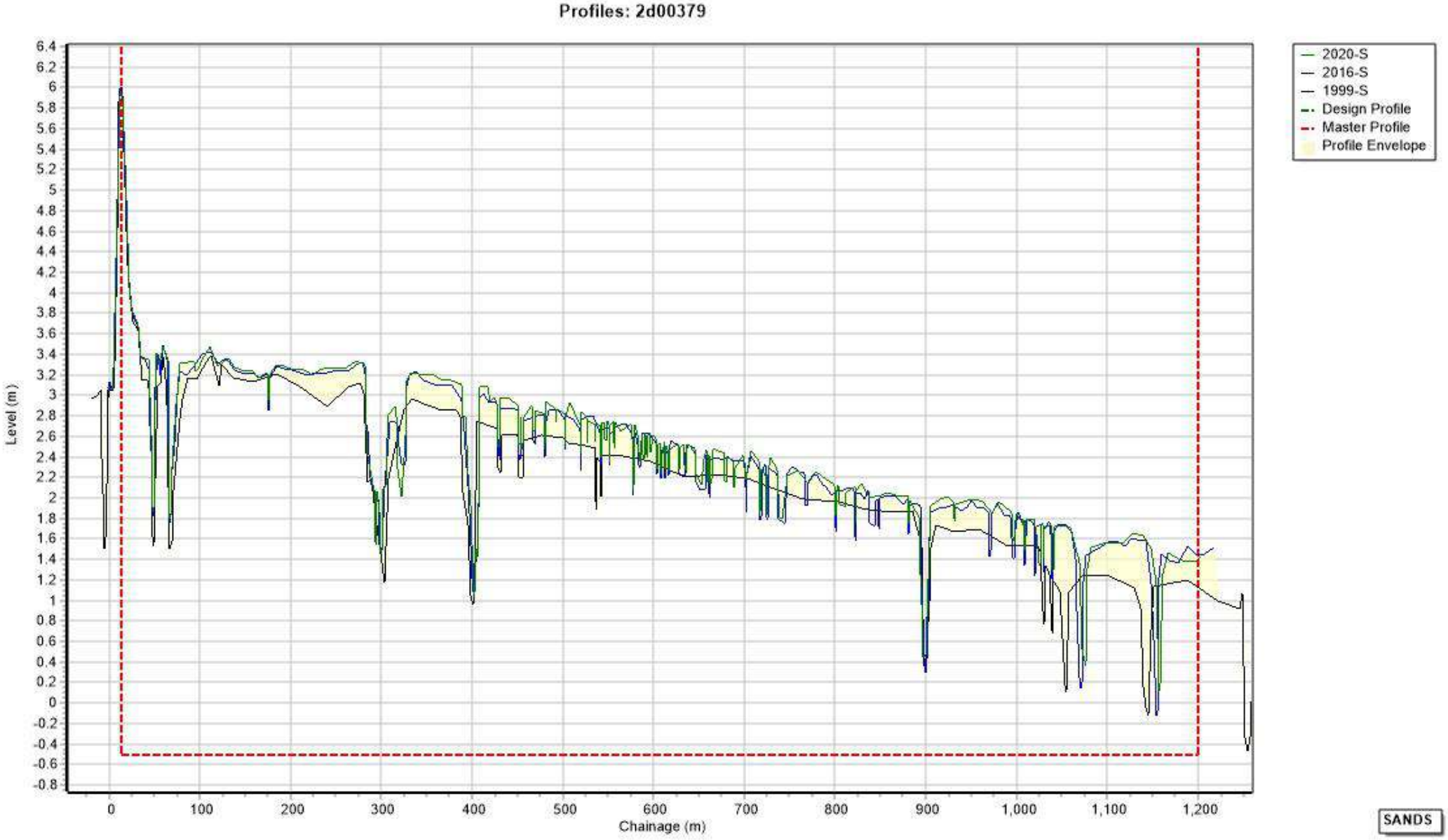
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Profile Envelope
Level (m)
Chainage (m)
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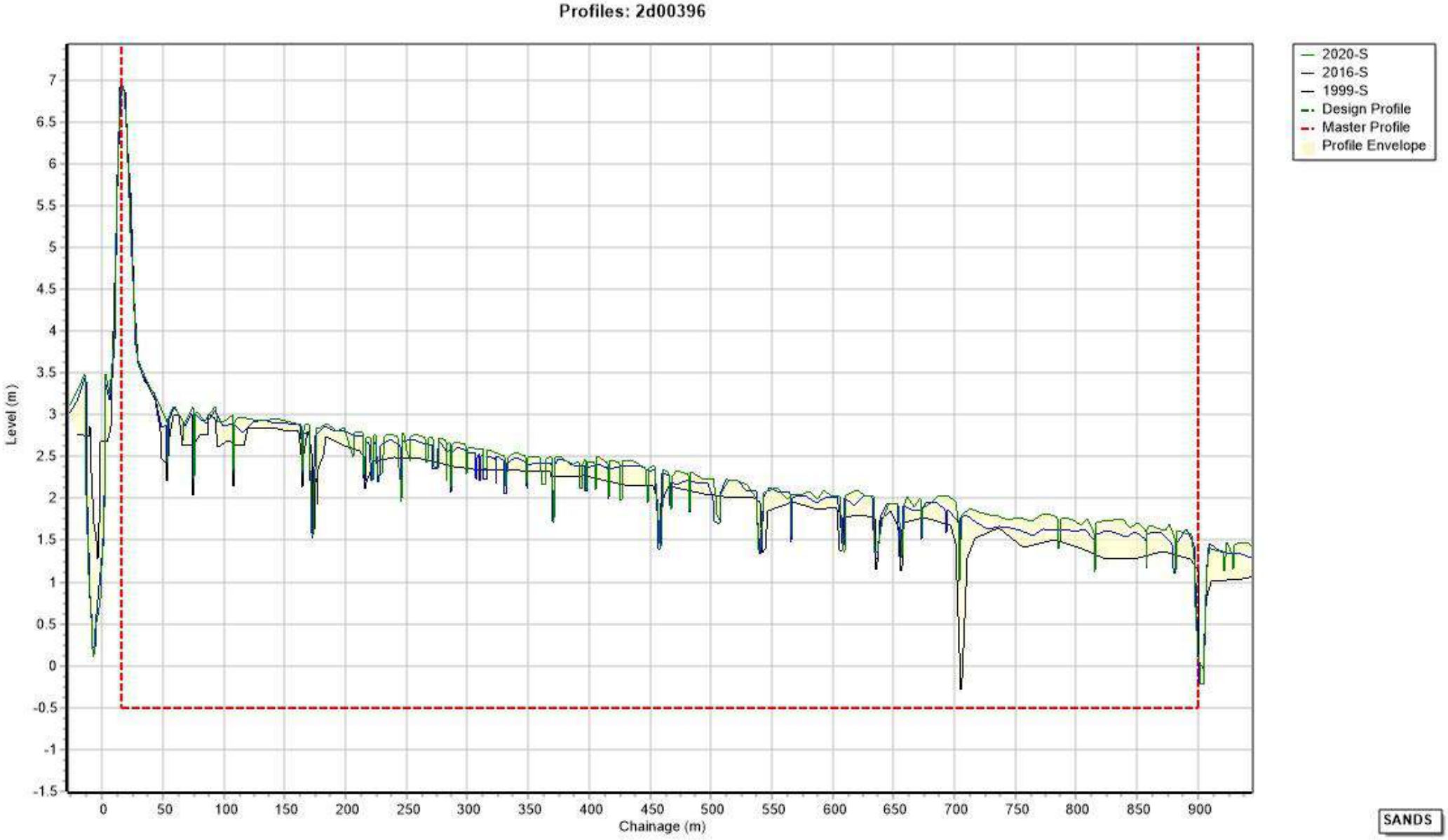
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Master Profile
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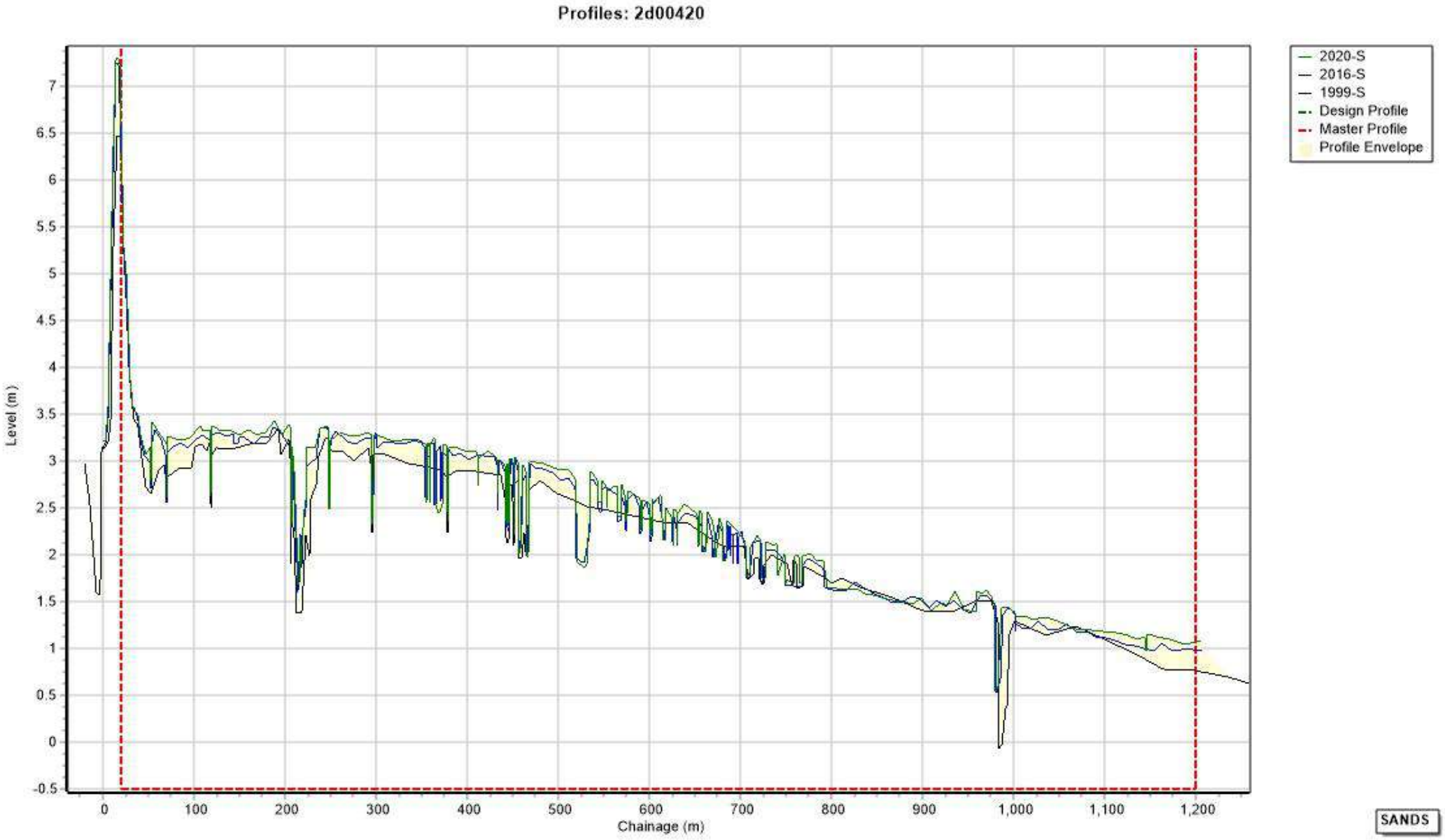
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Master Profile
Profile Envelope
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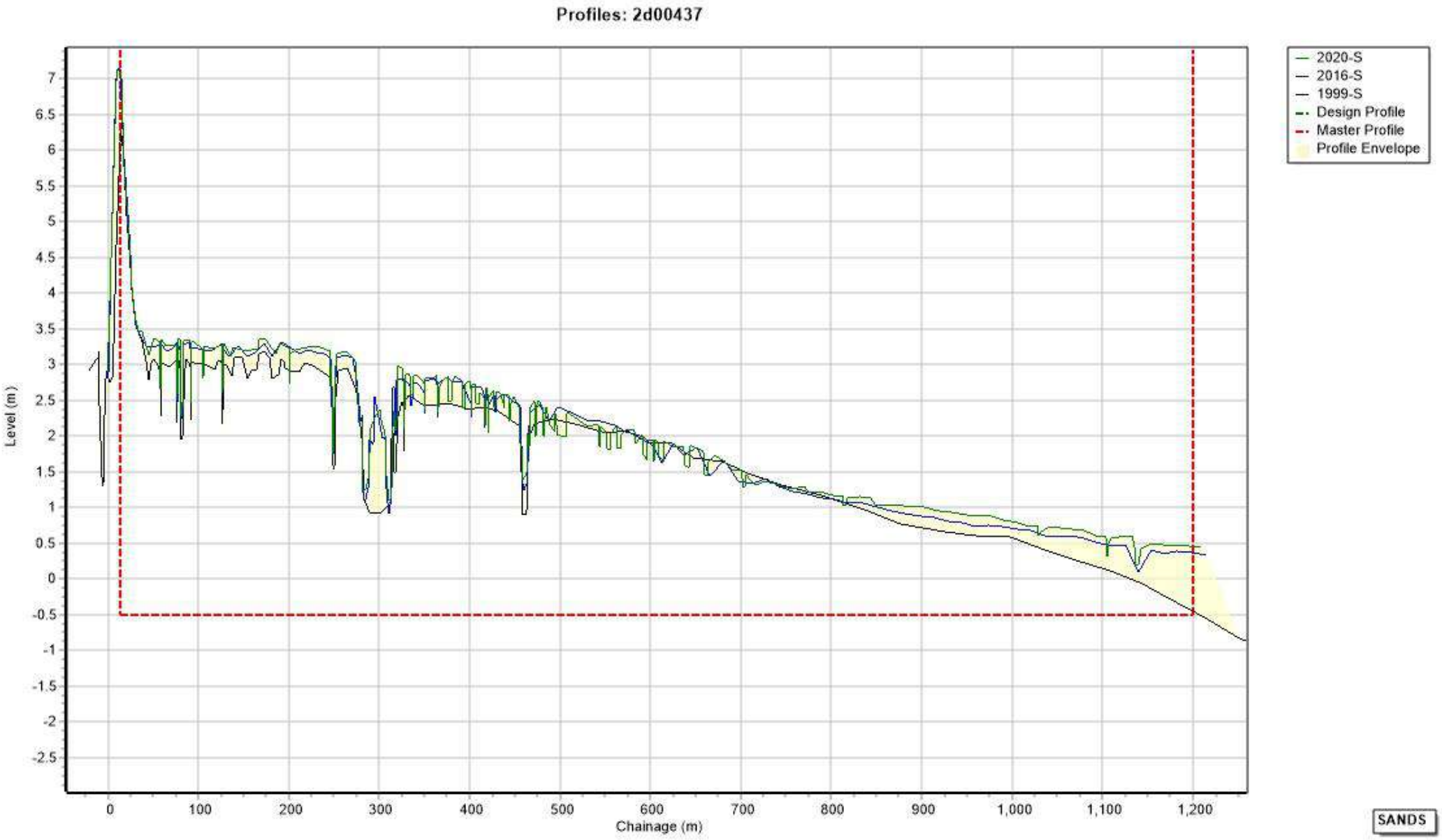
Chainage (m)
SANDS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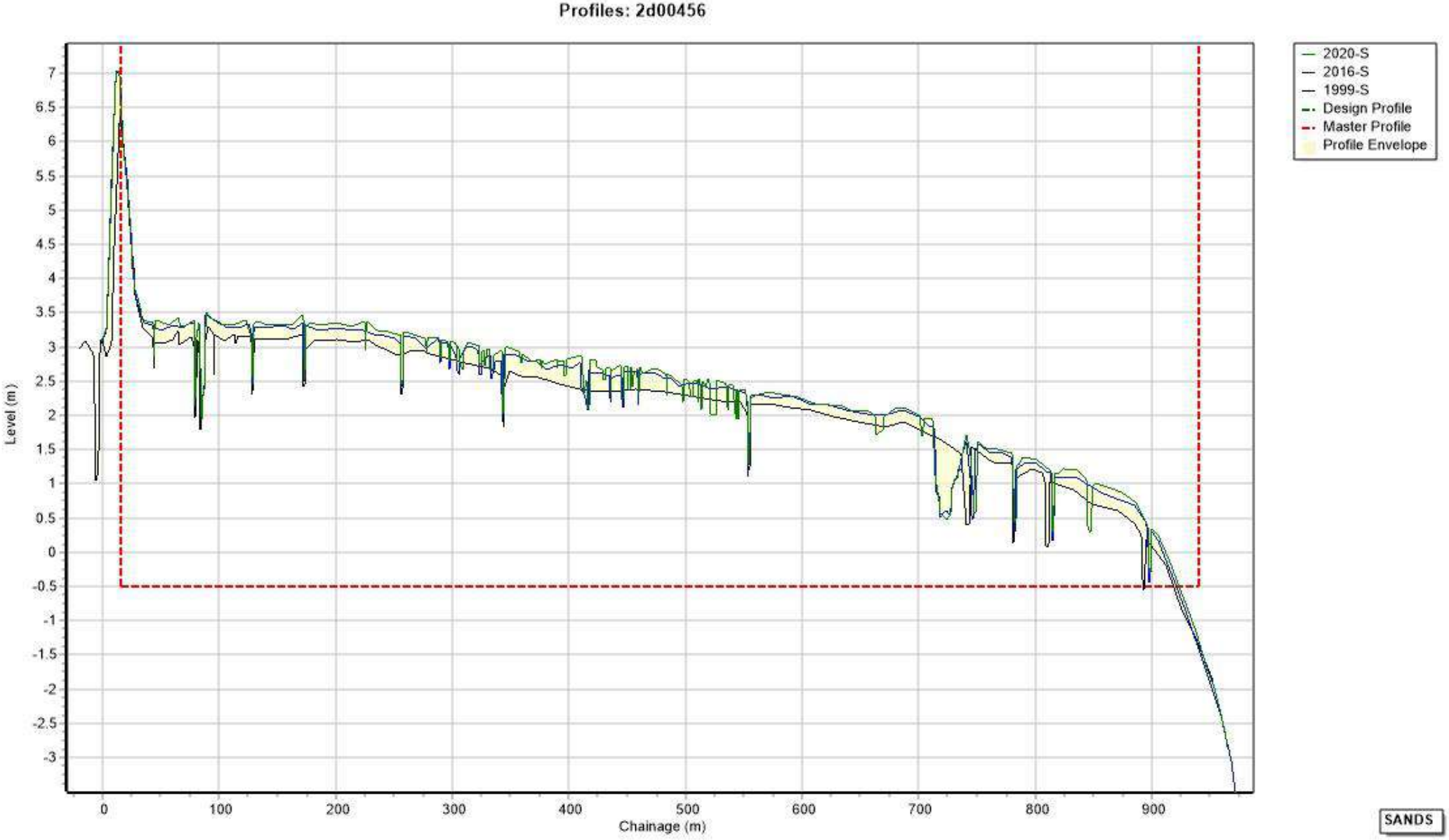
Chainage (m)
SANDS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2016-S
1999-S
Design Profile
Master Profile
Profile Envelope
Level (m)
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800
900
Chainage (m)
SANDS

Positional Trends

Location: W001	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1999	4.20m	3.26m	0.13m	-2.94m	-3.76m
Total Change	705.17	482.82			
Min Change	-1.08	-14.53			
Max Change	705.16	535.23			
Mean Change	33.58	22.99			
Sdt Dev Change	150.17	114.7			

Location: W001	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.20m	3.26m	0.13m	-2.94m	-3.76m
Total Change	705.22	-5.16			
Min Change	-0.17	-5.26			
Max Change	705.16	0.95			
Mean Change	176.31	-1.29			
Sdt Dev Change	305.34	2.36			

Location: W002	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1999	4.21m	3.26m	0.12m	-2.94m	-3.76m
Total Change	0.38	495.98			
Min Change	-0.68	-423.38			
Max Change	0.66	612.22			
Mean Change	0.02	23.62			
Sdt Dev Change	0.31	203.29			

Location: W002	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.21m	3.26m	0.12m	-2.94m	-3.76m
Total Change	0.29	40.16			
Min Change	-0.15	-1.68			
Max Change	0.46	42.55			
Mean Change	0.07	10.04			
Sdt Dev Change	0.24	18.78			

Location: W003	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1999	4.24m	3.30m	0.13m	-2.93m	-3.74m
Total Change	0.9	377.91	-123.38		
Min Change	-0.77	-143.2	-78.99		
Max Change	0.63	279.61	28.58		
Mean Change	0.04	18	-30.84		
Sdt Dev Change	0.37	96.67	38.47		

Location: W003 Baseline: 2016	HAT 4.24m	MHWS 3.30m	MSL 0.13m	MLWS -2.93m	LAT -3.74m
Total Change	0.25	75.22			
Min Change	-0.37	3.88			
Max Change	0.44	56.63			
Mean Change	0.06	18.8			
Sdt Dev Change	0.29	21.92			

Location: W004 Baseline: 1999	HAT 4.26m	MHWS 3.32m	MSL 0.13m	MLWS -2.94m	LAT -3.74m
Total Change	0.55	369.77	-152.26		
Min Change	-1.13	-73.26	-60.82		
Max Change	1.34	192.22	-35.52		
Mean Change	0.03	17.61	-50.75		
Sdt Dev Change	0.57	54.07	10.96		

Location: W004 Baseline: 2016	HAT 4.26m	MHWS 3.32m	MSL 0.13m	MLWS -2.94m	LAT -3.74m
Total Change	-0.54	84.97			
Min Change	-0.39	-2.04			
Max Change	0.16	61.42			
Mean Change	-0.13	21.24			
Sdt Dev Change	0.21	24.1			

Location: W005 Baseline: 1999	HAT 4.27m	MHWS 3.34m	MSL 0.13m	MLWS -2.94m	LAT -3.74m
Total Change	0.48	421.59	690.97		
Min Change	-0.94	-309.38	11.43		
Max Change	0.73	311.28	595.44		
Mean Change	0.02	20.08	230.32		
Sdt Dev Change	0.45	118.78	259.88		

Location: W005 Baseline: 2016	HAT 4.27m	MHWS 3.34m	MSL 0.13m	MLWS -2.94m	LAT -3.74m
Total Change	0.1	14.28			
Min Change	-0.11	-4.83			
Max Change	0.21	15.79			
Mean Change	0.03	3.57			
Sdt Dev Change	0.12	7.62			

Location: W006	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1999	4.29m	3.36m	0.13m	-2.95m	-3.74m
Total Change	0.69	393.9	252.14		
Min Change	-1.35	-340.51	-94.9		
Max Change	0.75	279.33	262.81		
Mean Change	0.03	17.9	84.05		
Sdt Dev Change	0.41	141.87	146.03		

Location: W006	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.29m	3.36m	0.13m	-2.95m	-3.74m
Total Change	0.68	154.41			
Min Change	-0.08	1.76			
Max Change	0.5	126.3			
Mean Change	0.17	38.6			
Sdt Dev Change	0.21	50.85			

Location: W007	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1999	4.30m	3.39m	0.13m	-2.95m	-3.73m
Total Change	0.66	236.87	371.33		
Min Change	-1.89	-150.58	82.74		
Max Change	3.13	241.17	171.03		
Mean Change	0.03	11.28	123.78		
Sdt Dev Change	0.9	70.74	36.31		

Location: W007	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.30m	3.39m	0.13m	-2.95m	-3.73m
Total Change	0.95	227.17			
Min Change	-0.08	-150.58			
Max Change	0.71	241.17			
Mean Change	0.24	56.79			
Sdt Dev Change	0.29	151.53			

Location: W008	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1999	4.32m	3.42m	0.12m	-2.96m	-3.73m
Total Change	1.64	356.98	-9.12		
Min Change	-1.87	-262.05	-40.6		
Max Change	1.94	356.11	25.46		
Mean Change	0.08	17	-3.04		
Sdt Dev Change	0.76	111.05	27.72		

Location: W008	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.32m	3.42m	0.12m	-2.96m	-3.73m
Total Change	0.38	356.55			
Min Change	-0.07	-262.05			
Max Change	0.27	356.11			
Mean Change	0.09	89.14			
Sdt Dev Change	0.13	241.46			

Location: W009	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1999	4.33m	3.45m	0.12m	-2.97m	-3.73m
Total Change	0.75	1.41	106.93		
Min Change	-0.91	-32.52	11.87		
Max Change	0.87	33.14	57.01		
Mean Change	0.04	0.07	35.64		
Sdt Dev Change	0.45	11.31	18.51		

Location: W009	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.33m	3.45m	0.12m	-2.97m	-3.73m
Total Change	0.70	0.88			
Min Change	-0.04	-32.52			
Max Change	0.64	33.14			
Mean Change	0.17	0.22			
Sdt Dev Change	0.27	25.55			

Location: W010	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1999	4.33m	3.46m	0.12m	-2.98m	-3.73m
Total Change	0.65	135.31	116.58		
Min Change	-0.69	-8.47	5.46		
Max Change	0.76	133.27	75.08		
Mean Change	0.03	6.44	38.86		
Sdt Dev Change	0.39	28.56	28.49		

Location: W010	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.33m	3.46m	0.12m	-2.98m	-3.73m
Total Change	0.45	134.86			
Min Change	0.00	-8.47			
Max Change	0.36	133.27			
Mean Change	0.11	33.72			
Sdt Dev Change	0.15	57.81			

Location: W011 Baseline: 1999	HAT 4.35m	MHWS 3.49m	MSL 0.13m	MLWS -2.98m	LAT -3.72m
Total Change	0.91	2.34			
Min Change	-0.7	-0.87			
Max Change	0.67	1.44			
Mean Change	0.04	0.11			
Sdt Dev Change	0.35	0.53			

Location: W011 Baseline: 2016	HAT 4.35m	MHWS 3.49m	MSL 0.13m	MLWS -2.98m	LAT -3.72m
Total Change	0.40	0.75			
Min Change	-0.12	-0.77			
Max Change	0.34	1.44			
Mean Change	0.10	0.19			
Sdt Dev Change	0.19	0.89			

Location: W012 Baseline: 1999	HAT 4.36m	MHWS 3.51m	MSL 0.13m	MLWS -2.98m	LAT -3.72m
Total Change	0.27	51.83	-106.32		
Min Change	-0.28	-59.31	-124.28		
Max Change	0.28	59.54	88.53		
Mean Change	0.01	2.47	-35.44		
Sdt Dev Change	0.16	29.58	90.36		

Location: W012 Baseline: 2016	HAT 4.36m	MHWS 3.51m	MSL 0.13m	MLWS -2.98m	LAT -3.72m
Total Change	0.41	38.70			
Min Change	-0.03	-4.00			
Max Change	0.24	42.81			
Mean Change	0.10	9.68			
Sdt Dev Change	0.10	19.21			

Location: W013 Baseline: 1999	HAT 4.37m	MHWS 3.53m	MSL 0.13m	MLWS -2.99m	LAT -3.72m
Total Change	0.46	270.1	-23.82		
Min Change	-0.83	-89.46	-92.07		
Max Change	0.77	172.98	44.5		
Mean Change	0.02	12.86	-7.94		
Sdt Dev Change	0.45	49.63	60.09		

Location: W013 Baseline: 2016	HAT 4.37m	MHWS 3.53m	MSL 0.13m	MLWS -2.99m	LAT -3.72m
Total Change	0.27	175.26			
Min Change	-0.74	-9.32			
Max Change	0.66	172.98			
Mean Change	0.07	43.82			
Sdt Dev Change	0.51	74.86			

Location: W014 Baseline: 1999	HAT 4.39m	MHWS 3.55m	MSL 0.12m	MLWS -2.99m	LAT -3.72m
Total Change	0.29	0.30	150.49		
Min Change	-0.75	-10.30	-5.03		
Max Change	0.40	13.90	96.13		
Mean Change	0.01	0.01	30.10		
Sdt Dev Change	0.24	4.91	35.24		

Location: W014 Baseline: 2016	HAT 4.39m	MHWS 3.55m	MSL 0.12m	MLWS -2.99m	LAT -3.72m
Total Change	0.50	2.72			
Min Change	-0.01	-1.37			
Max Change	0.26	2.77			
Mean Change	0.12	0.68			
Sdt Dev Change	0.10	1.49			

Location: W015 Baseline: 1999	HAT 4.39m	MHWS 3.57m	MSL 0.12m	MLWS -3.00m	LAT -3.72m
Total Change	0.29	176.18	142.48		
Min Change	-0.42	-55.88	-13.39		
Max Change	0.64	85.64	82.36		
Mean Change	0.01	8.81	35.62		
Sdt Dev Change	0.23	31.03	41.59		

Location: W015 Baseline: 2016	HAT 4.39m	MHWS 3.57m	MSL 0.12m	MLWS -3.00m	LAT -3.72m
Total Change	0.34	68.42			
Min Change	-0.16	-55.88			
Max Change	0.21	68.74			
Mean Change	0.08	17.11			
Sdt Dev Change	0.15	50.15			

Location: W016 Baseline: 1999	HAT 4.41m	MHWS 3.59m	MSL 0.12m	MLWS -3.00m	LAT -3.71m
Total Change	0.53	0.08	374.23		
Min Change	-0.60	-50.90	-24.71		
Max Change	0.61	51.19	187.14		
Mean Change	0.03	0.00	31.19		
Sdt Dev Change	0.28	31.36	63.31		

Location: W016 Baseline: 2016	HAT 4.41m	MHWS 3.59m	MSL 0.12m	MLWS -3.00m	LAT -3.71m
Total Change	0.26	-0.15			
Min Change	-0.43	-50.35			
Max Change	0.61	51.19			
Mean Change	0.07	-0.04			
Sdt Dev Change	0.37	35.91			

Location: W017 Baseline: 1999	HAT 4.42m	MHWS 3.60m	MSL 0.12m	MLWS -3.01m	LAT -3.71m
Total Change	-0.23	0.56	228.1		
Min Change	-0.39	-56.43	-46.77		
Max Change	0.43	58.38	149.47		
Mean Change	-0.01	0.03	19.01		
Sdt Dev Change	0.22	30.12	57.71		

Location: W017 Baseline: 2016	HAT 4.42m	MHWS 3.60m	MSL 0.12m	MLWS -3.01m	LAT -3.71m
Total Change	0.03	0.69			
Min Change	-0.11	-56.43			
Max Change	0.14	58.38			
Mean Change	0.01	0.17			
Sdt Dev Change	0.12	40.60			

Location: W018 Baseline: 1999	HAT 4.42m	MHWS 3.62m	MSL 0.12m	MLWS -3.01m	LAT -3.71m
Total Change	0.10	0.91	133.30		
Min Change	-0.20	-1.58	-152.18		
Max Change	0.28	1.61	89.70		
Mean Change	0.00	0.04	12.12		
Sdt Dev Change	0.14	0.98	59.97		

Location: W018 Baseline: 2016	HAT 4.42m	MHWS 3.62m	MSL 0.12m	MLWS -3.01m	LAT -3.71m
Total Change	-0.06	0.07			
Min Change	-0.15	-0.75			
Max Change	0.28	0.66			
Mean Change	-0.02	0.02			
Sdt Dev Change	0.17	0.54			

Location: W019 Baseline: 1999	HAT 4.44m	MHWS 3.65m	MSL 0.12m	MLWS -3.02m	LAT -3.71m
Total Change	-0.25	0.66	-100.88		
Min Change	-0.53	-0.88	-88.93		
Max Change	0.56	1.22	-5.34		
Mean Change	-0.01	0.03	-33.63		
Sdt Dev Change	0.26	0.63	39.11		

Location: W019 Baseline: 2016	HAT 4.44m	MHWS 3.65m	MSL 0.12m	MLWS -3.02m	LAT -3.71m
Total Change	-0.24	1.03			
Min Change	-0.53	-0.88			
Max Change	0.56	1.22			
Mean Change	-0.06	0.26			
Sdt Dev Change	0.47	0.82			

Location: W020 Baseline: 1999	HAT 4.45m	MHWS 3.66m	MSL 0.12m	MLWS -3.02m	LAT -3.71m
Total Change	0.13	1.74	-13.02		
Min Change	-0.47	-1.89	-14.19		
Max Change	0.62	2.07	5.78		
Mean Change	0.01	0.09	-4.34		
Sdt Dev Change	0.28	0.91	8.15		

Location: W020 Baseline: 2016	HAT 4.44m	MHWS 3.65m	MSL 0.12m	MLWS -3.02m	LAT -3.71m
Total Change	-0.24	1.03			
Min Change	-0.53	-0.88			
Max Change	0.56	1.22			
Mean Change	-0.06	0.26			
Sdt Dev Change	0.47	0.82			

Location: W021 Baseline: 1999	HAT 4.47m	MHWS 3.67m	MSL 0.12m	MLWS -3.02m	LAT -3.71m
Total Change	-0.11	0.41	-6.14		
Min Change	-0.53	-2.14	-17.92		
Max Change	0.41	1.87	10.72		
Mean Change	-0.01	0.02	-2.05		
Sdt Dev Change	0.24	1.11	11.90		

Location: W021 Baseline: 2016	HAT 4.47m	MHWS 3.67m	MSL 0.12m	MLWS -3.02m	LAT -3.71m
Total Change	0.05	0.19			
Min Change	-0.43	-1.33			
Max Change	0.41	1.12			
Mean Change	0.01	0.05			
Sdt Dev Change	0.31	0.96			

Location: W022 Baseline: 1999	HAT 4.49m	MHWS 3.70m	MSL 0.11m	MLWS -3.02m	LAT -3.71m
Total Change	0.37	0.56	117.16		
Min Change	-0.64	-1.88	1.01		
Max Change	0.55	2.01	80.77		
Mean Change	0.02	0.03	29.29		
Sdt Dev Change	0.31	0.92	30.53		

Location: W022 Baseline: 2016	HAT 4.49m	MHWS 3.70m	MSL 0.11m	MLWS -3.02m	LAT -3.71m
Total Change	0.21	0.24			
Min Change	-0.06	-0.28			
Max Change	0.26	0.34			
Mean Change	0.05	0.06			
Sdt Dev Change	0.13	0.26			

Location: W023 Baseline: 1999	HAT 4.49m	MHWS 3.71m	MSL 0.11m	MLWS -3.03m	LAT -3.71m
Total Change	0.56	0.52	117.63		
Min Change	-0.63	-1.52	-2.09		
Max Change	0.68	1.66	48.63		
Mean Change	0.03	0.03	13.07		
Sdt Dev Change	0.43	0.70	14.77		

Location: W023 Baseline: 2016	HAT 4.49m	MHWS 3.71m	MSL 0.11m	MLWS -3.03m	LAT -3.71m
Total Change	0.41	0.36			
Min Change	-0.53	-0.01			
Max Change	0.57	0.23			
Mean Change	0.10	0.09			
Sdt Dev Change	0.40	0.10			

Location: W024 Baseline: 1999	HAT 4.51m	MHWS 3.73m	MSL 0.11m	MLWS -3.03m	LAT -3.71m
Total Change	0.36	0.96	6.62		
Min Change	-0.62	-1.76	-2.65		
Max Change	0.79	1.53	3.68		
Mean Change	0.02	0.05	0.37		
Sdt Dev Change	0.33	0.80	1.80		

Location: W024 Baseline: 2016	HAT 4.51m	MHWS 3.73m	MSL 0.11m	MLWS -3.03m	LAT -3.71m
Total Change	0.04	0.63	1.78		
Min Change	-0.16	-0.09	-0.61		
Max Change	0.26	0.27	1.54		
Mean Change	0.01	0.16	0.44		
Sdt Dev Change	0.16	0.15	0.89		

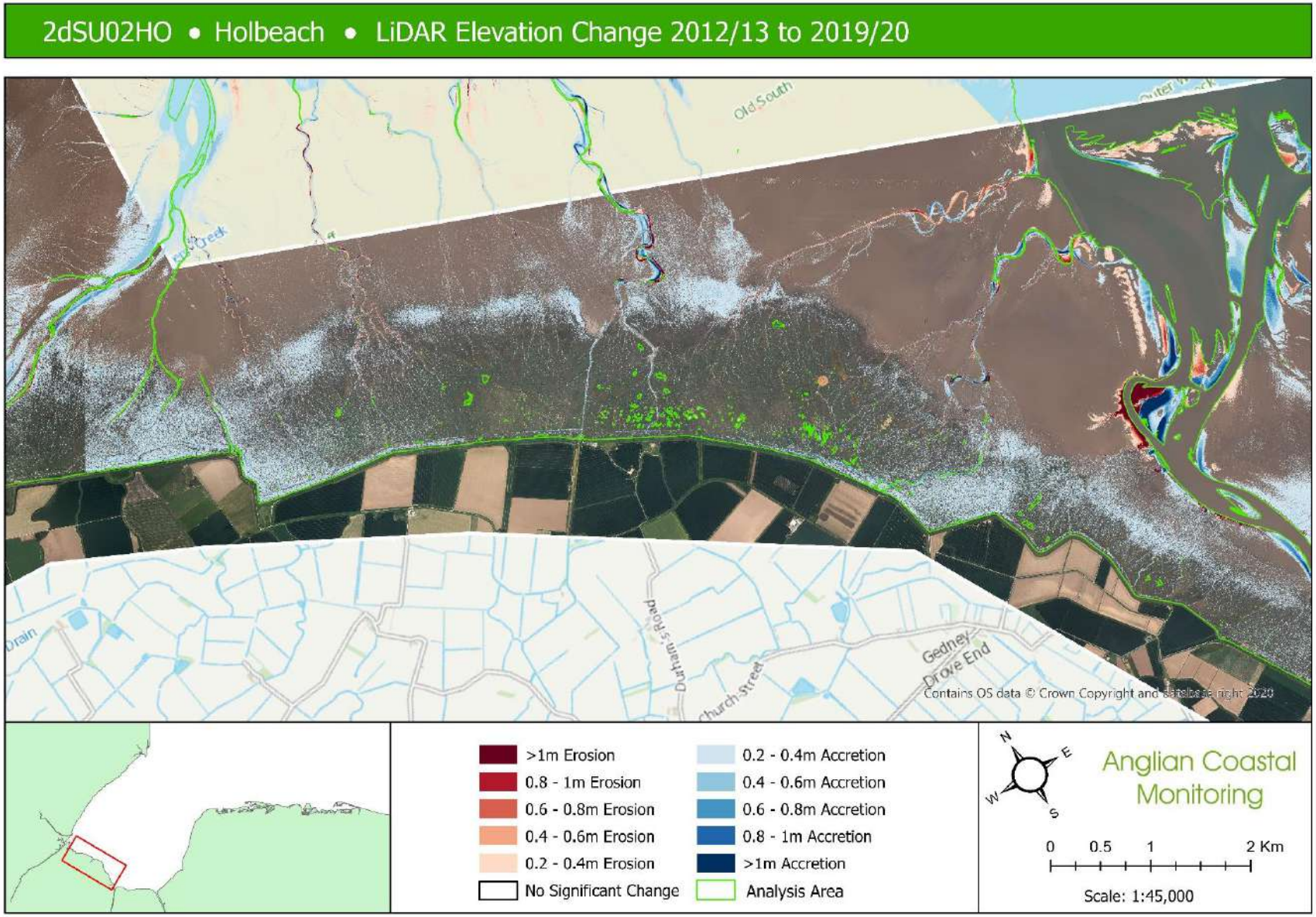
4.2. Holbeach - 2dUS02HO

Topographic profiles in this monitoring cell range from W025, on the south side of the River Wellend, to W037, on the north bank of the River Nene. The results of CSA analysis show a long-term trend of slight accretion for all profiles with a maximum change of 9.07% since 1997. No significant change is noted in the current phase however the positive CSA differences at all locations suggest that the long-term trends continue.

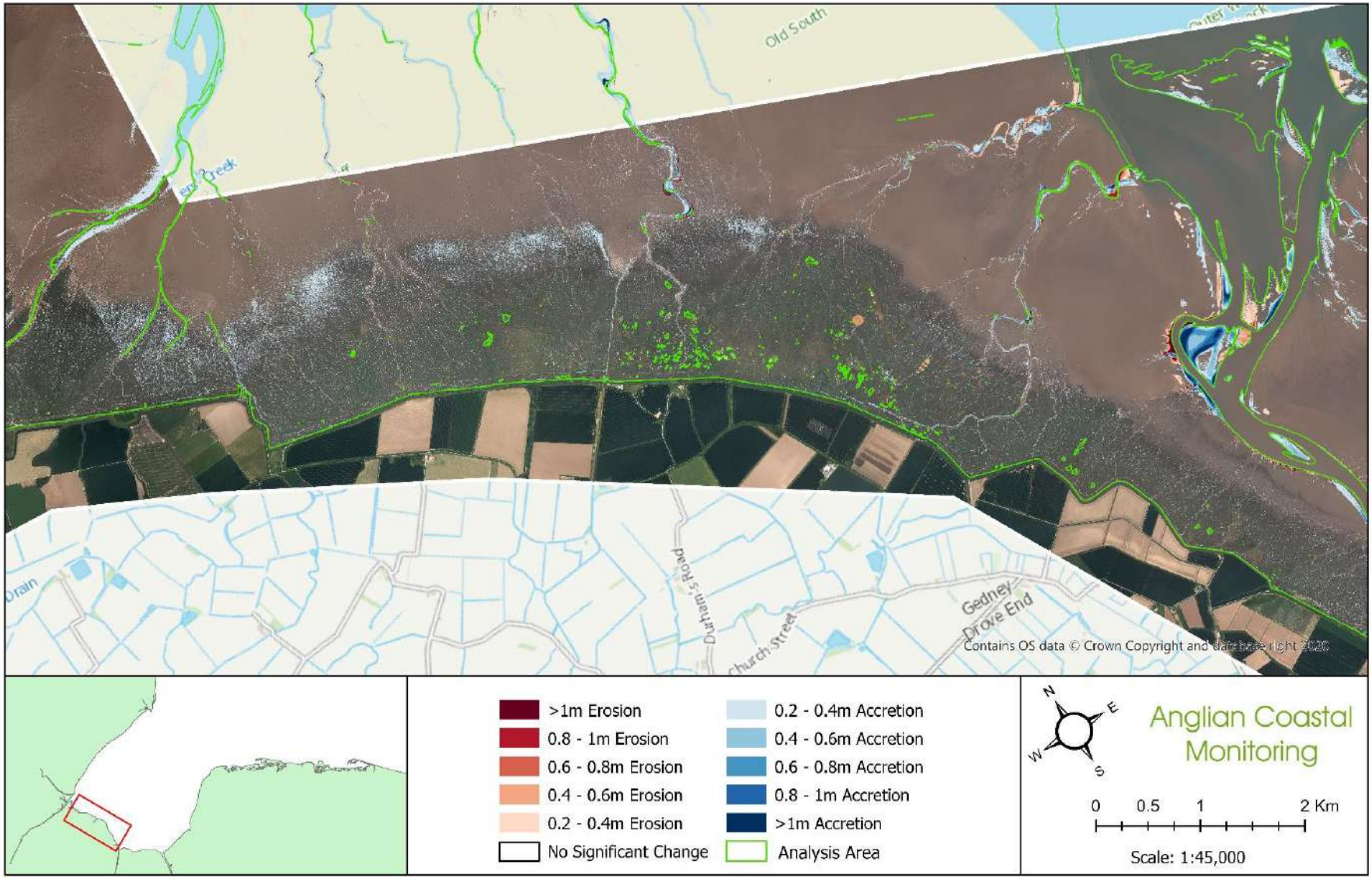
Lidar analysis shows that change is distributed unevenly, with the biggest changes in sediment balance occurring further offshore. However, accretion is also seen along the seaward edge of the saltmarsh. Despite this, little change is seen in the extent of salt marsh with the most active transect being W031.

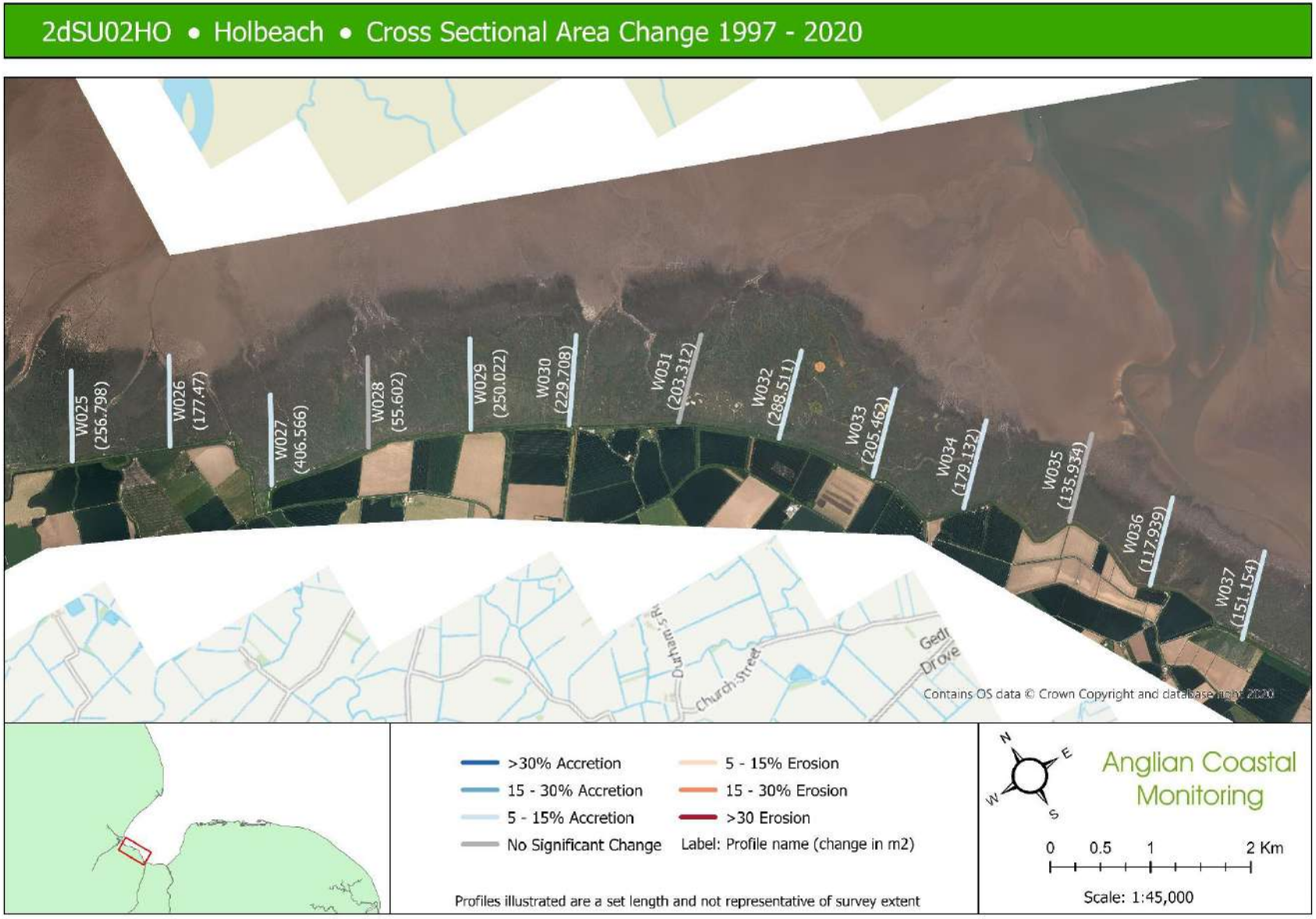
CSA Table

Locations	Baseline to Present		Current Phase - Present	
	1997-S to 2020-S		2016-S to 2020-S	
Location	CSA Diff (m2)	% Change	CSA Diff (m2)	% Change
2d00466 [W025]	256.8	9.07	175.49	2.8
2d00486 [W026]	177.47	8.4	125.69	2.52
2d00506 [W027]	406.57	9.24	150.85	1.97
2d00526 [W028]	55.6	2.31	110.13	1.45
2d00547 [W029]	250.02	5.28	101.3	1.32
2d00567 [W030]	229.71	5.25	137.96	1.82
2d00589 [W031]	203.31	4.67	223.3	2.69
2d00609 [W032]	288.51	5.12	142.01	1.61
2d00629 [W033]	205.46	5.12	152.32	1.98
2d00648 [W034]	179.13	6.35	149.24	2.34
2d00669 [W035]	135.93	4.87	41.68	0.9
2d00690 [W036]	117.94	5.24	108.28	2.65
2d00711 [W037]	151.15	6.89	95.29	2.19
	Av=204.43	Av=5.99%	Av=131.81	Av=2.02%
	Min=55.60	Min=2.31%	Min=41.68	Min=0.90%
	Max=406.57	Max=9.24%	Max=223.30	Max=2.80%

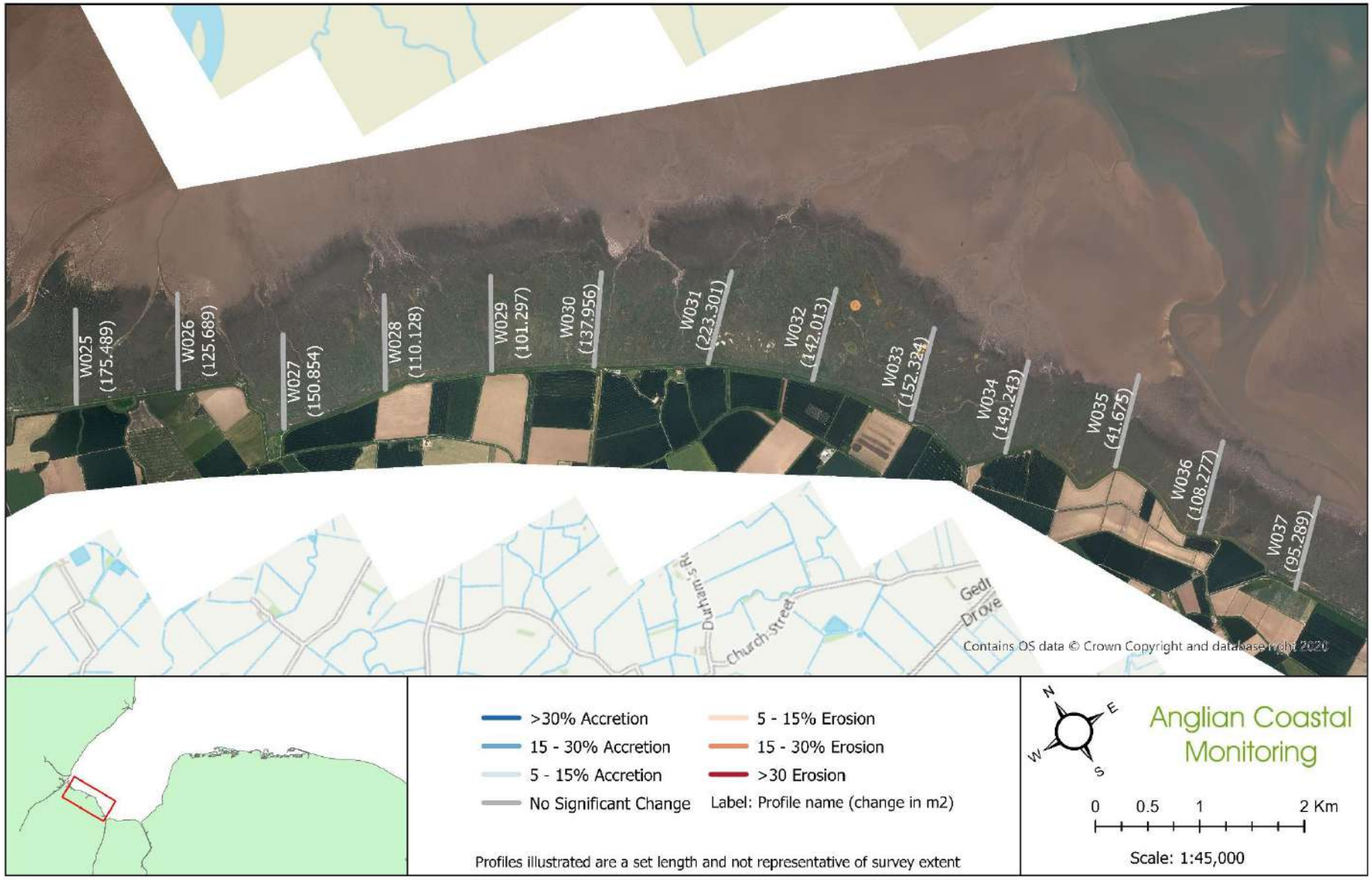

2dSU02HO • Holbeach • LiDAR Elevation Change 2012/13 to 2019/20
Old South
Gedney Drove End
Church Street
Contains OS data © Crown Copyright and database right 2020
>1m Erosion
0.8 - 1m Erosion
0.6 - 0.8m Erosion
0.4 - 0.6m Erosion
0.2 - 0.4m Erosion
No Significant Change
0.2 - 0.4m Accretion
0.4 - 0.6m Accretion
0.6 - 0.8m Accretion
0.8 - 1m Accretion
>1m Accretion
Analysis Area
N
E
S
W
Anglian Coastal Monitoring
0 0.5 1 2 Km
Scale: 1:45,000

2dSU02HO • Holbeach • LiDAR Elevation Change 2016/17 to 2019/20



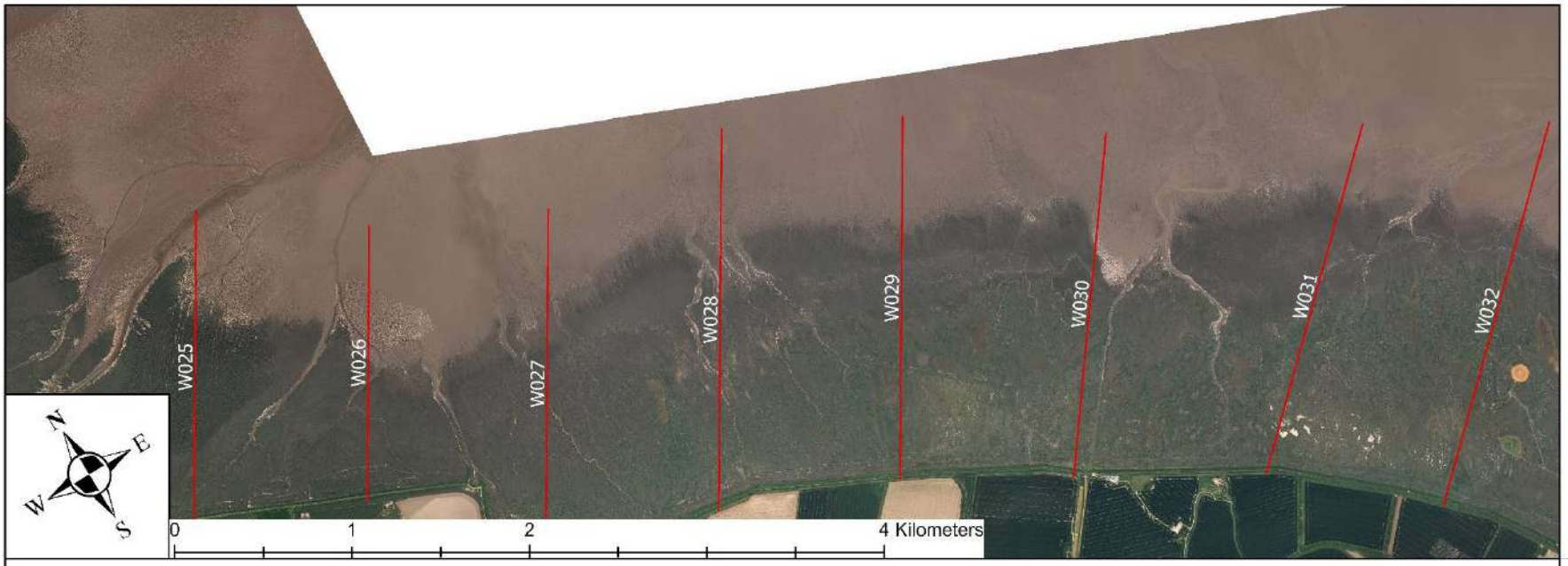

2dSU02HO • Holbeach • Cross Sectional Area Change 1997 - 2020
W025 (256.798)
W026 (177.47)
W027 (406.566)
W028 (55.602)
W029 (250.022)
W030 (229.708)
W031 (203.312)
W032 (288.511)
W033 (205.462)
W034 (179.132)
W035 (135.934)
W036 (117.939)
W037 (151.154)
Church Street
Gedney Drove
Contains OS data © Crown Copyright and database right 2020
>30% Accretion
15 - 30% Accretion
5 - 15% Accretion
No Significant Change
5 - 15% Erosion
15 - 30% Erosion
>30 Erosion
Label: Profile name (change in m2)
Profiles illustrated are a set length and not representative of survey extent
N
E
S
W
Anglian Coastal Monitoring
0 0.5 1 2 Km
Scale: 1:45,000

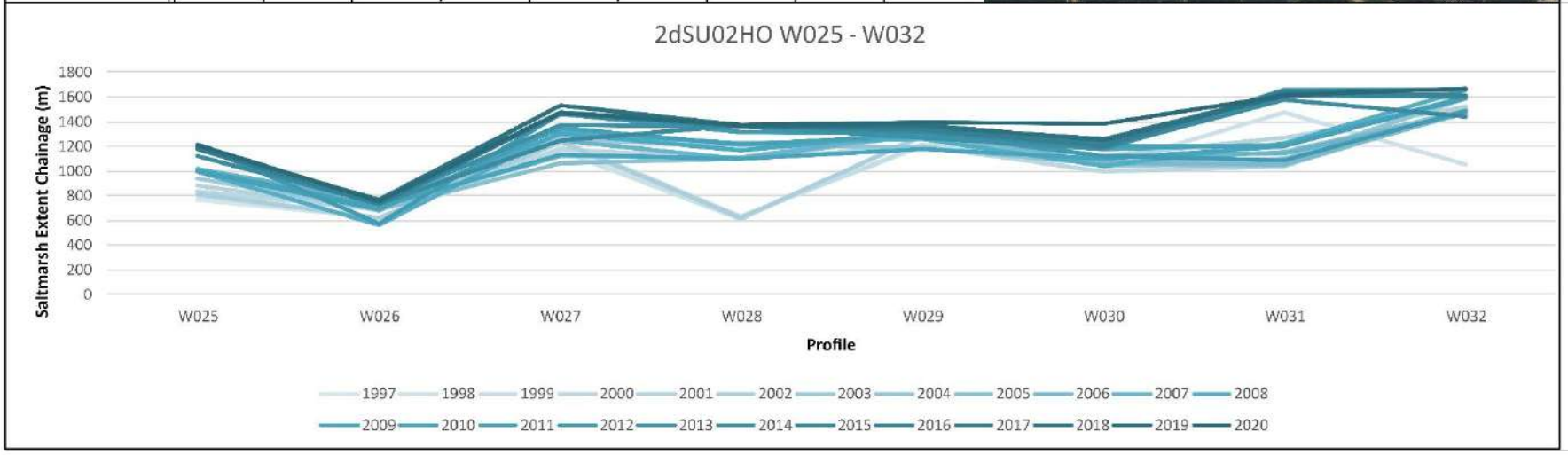
2dSU02HO • Holbeach • Cross Sectional Area Change 2016 - 2020



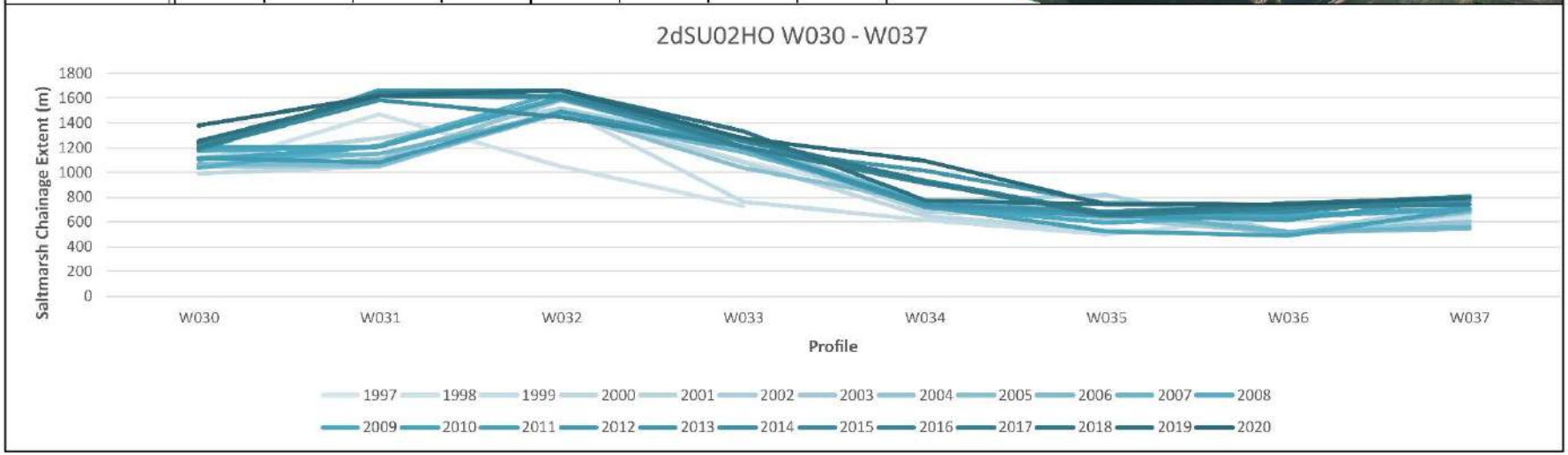
Saltmarsh Position

2dSU02HO • Holbeach • Saltmarsh Extent Analysis

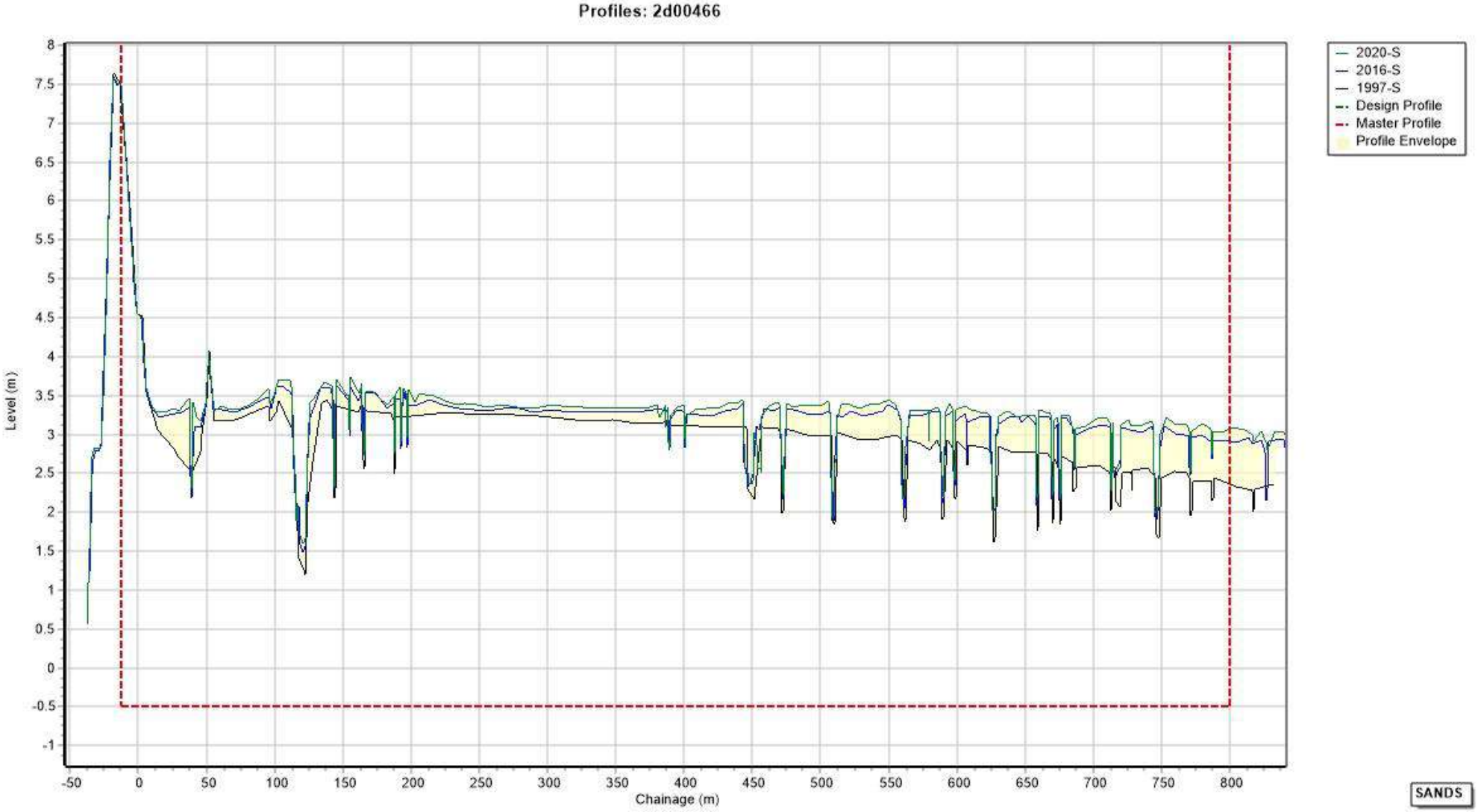


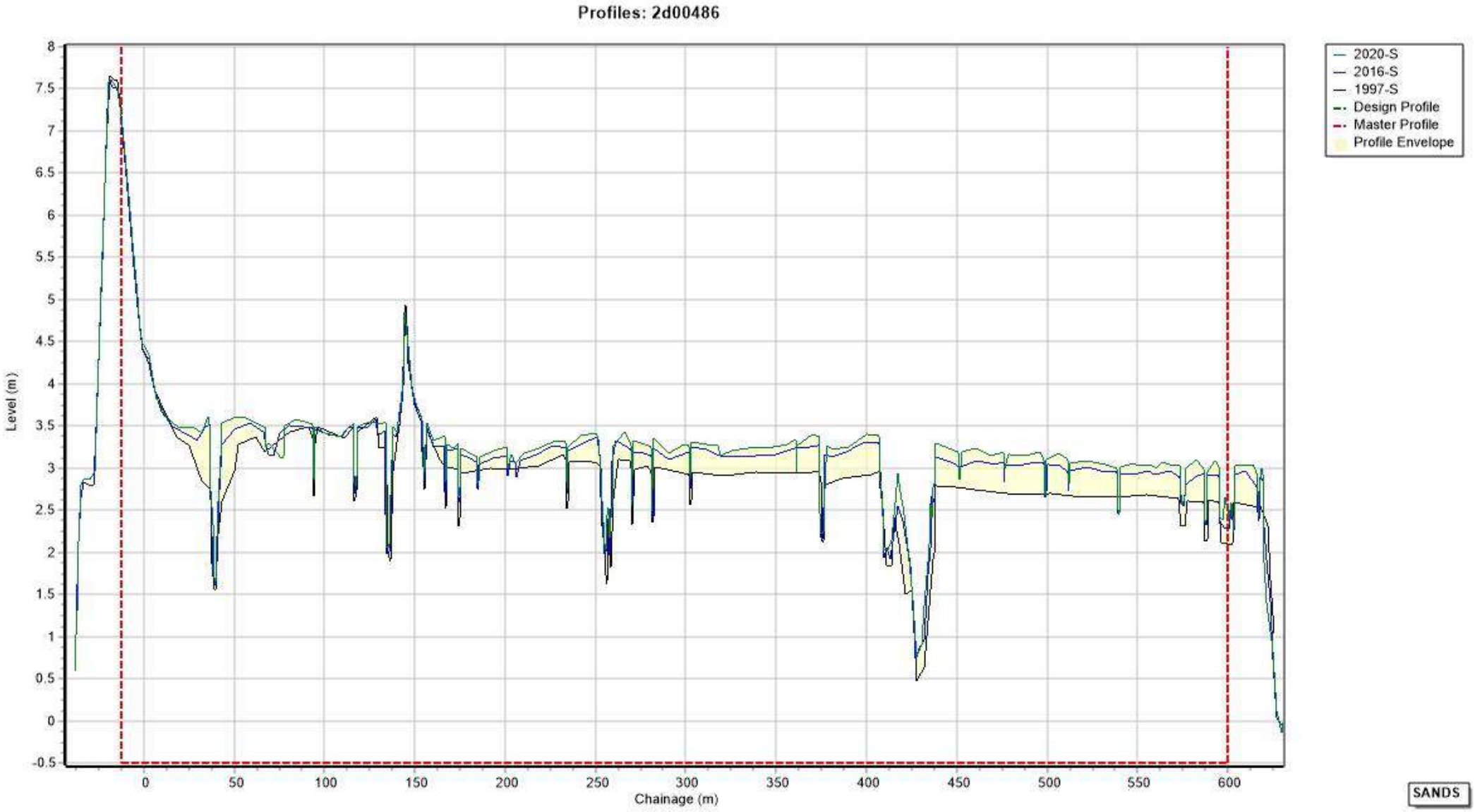


2dSU02HO • Holbeach • Saltmarsh Extent Analysis



Profile Graphs

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2016-S
1997-S
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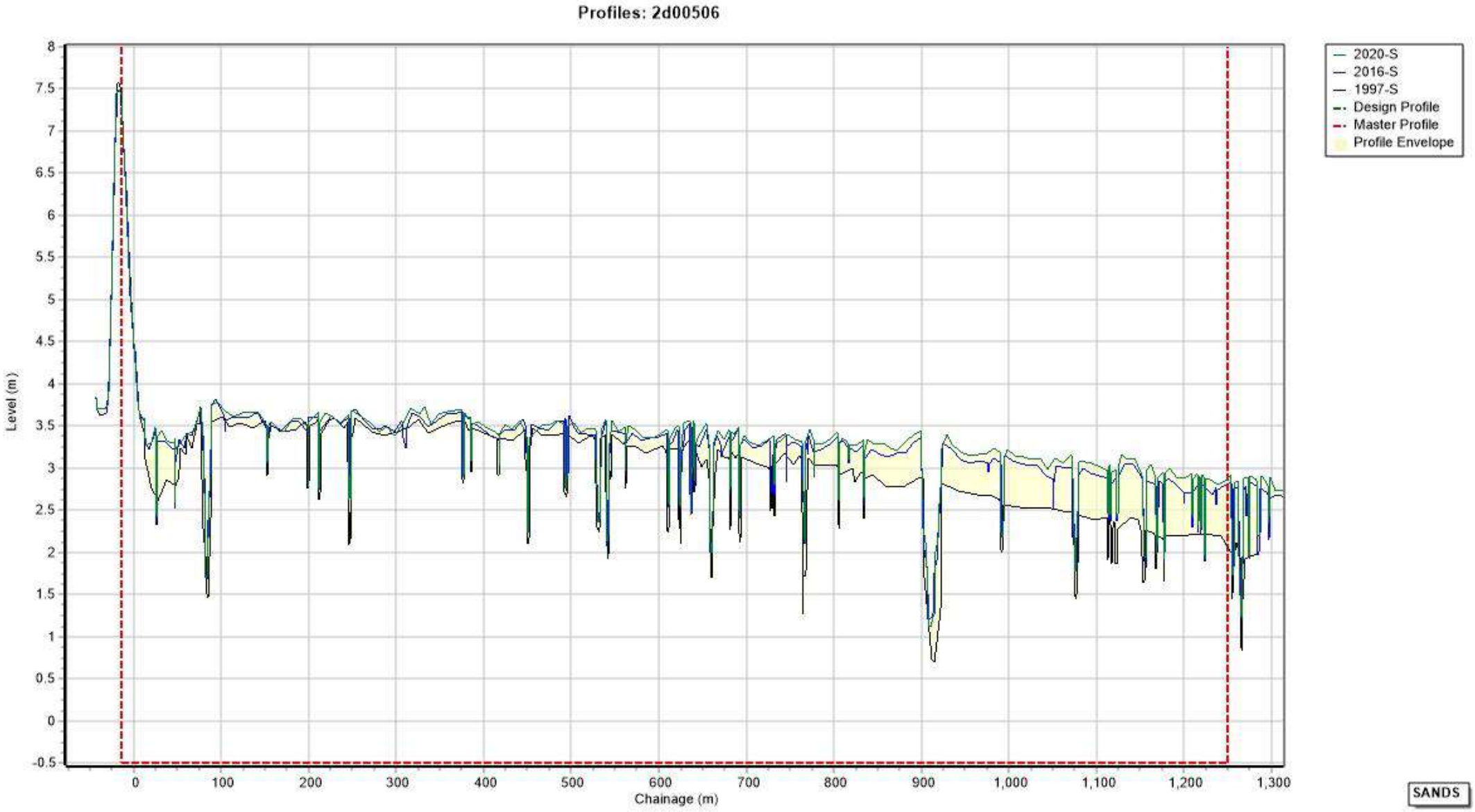
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS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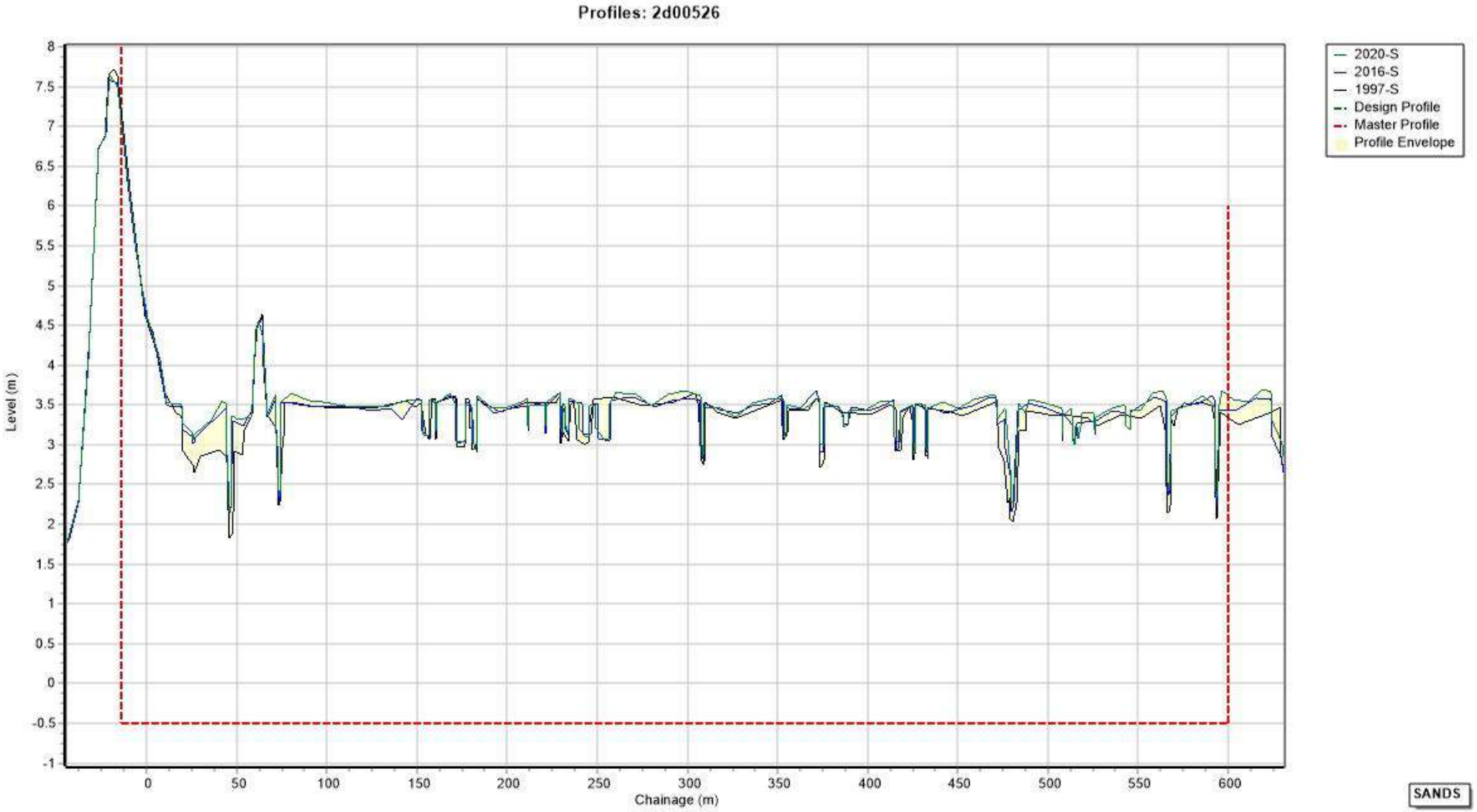
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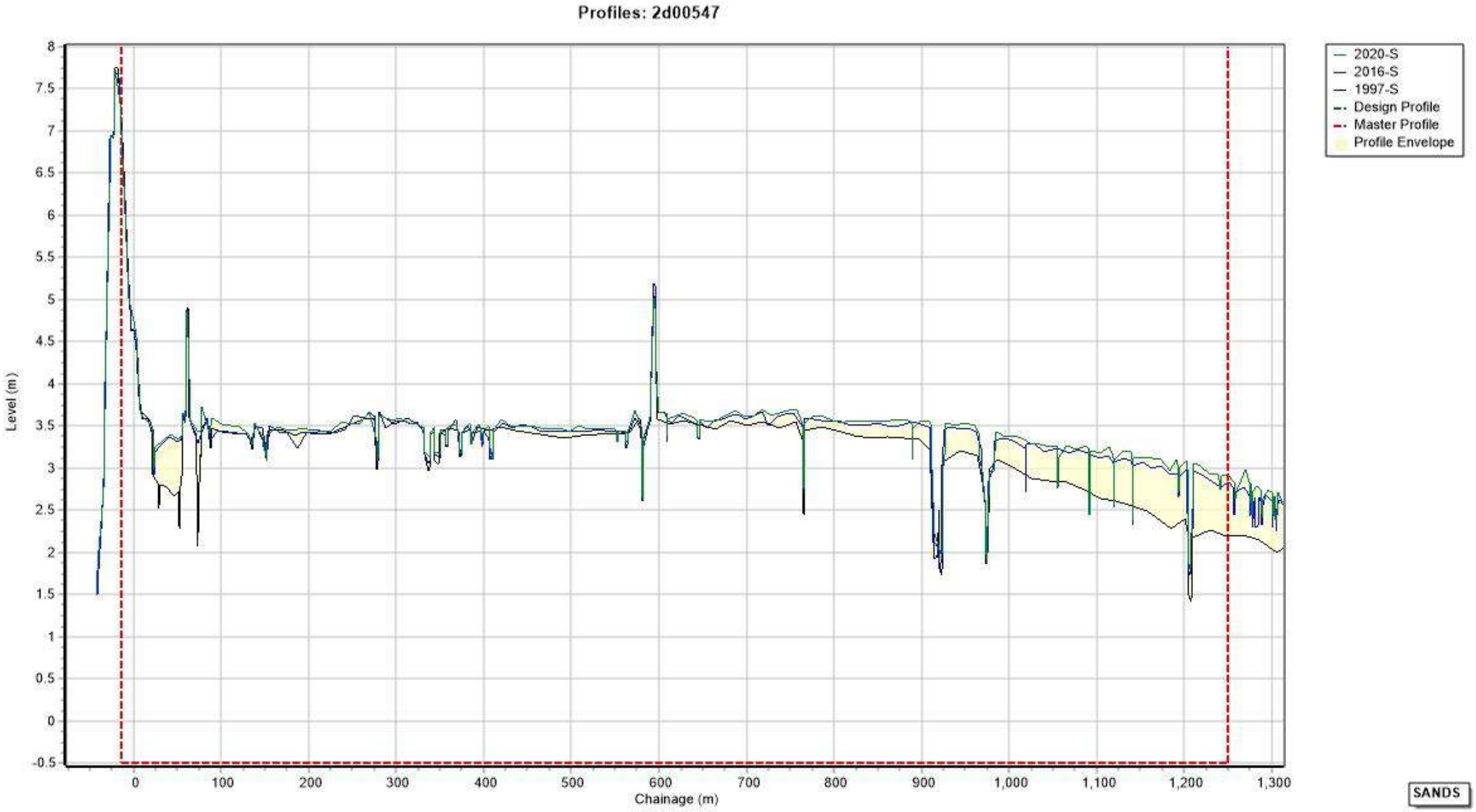
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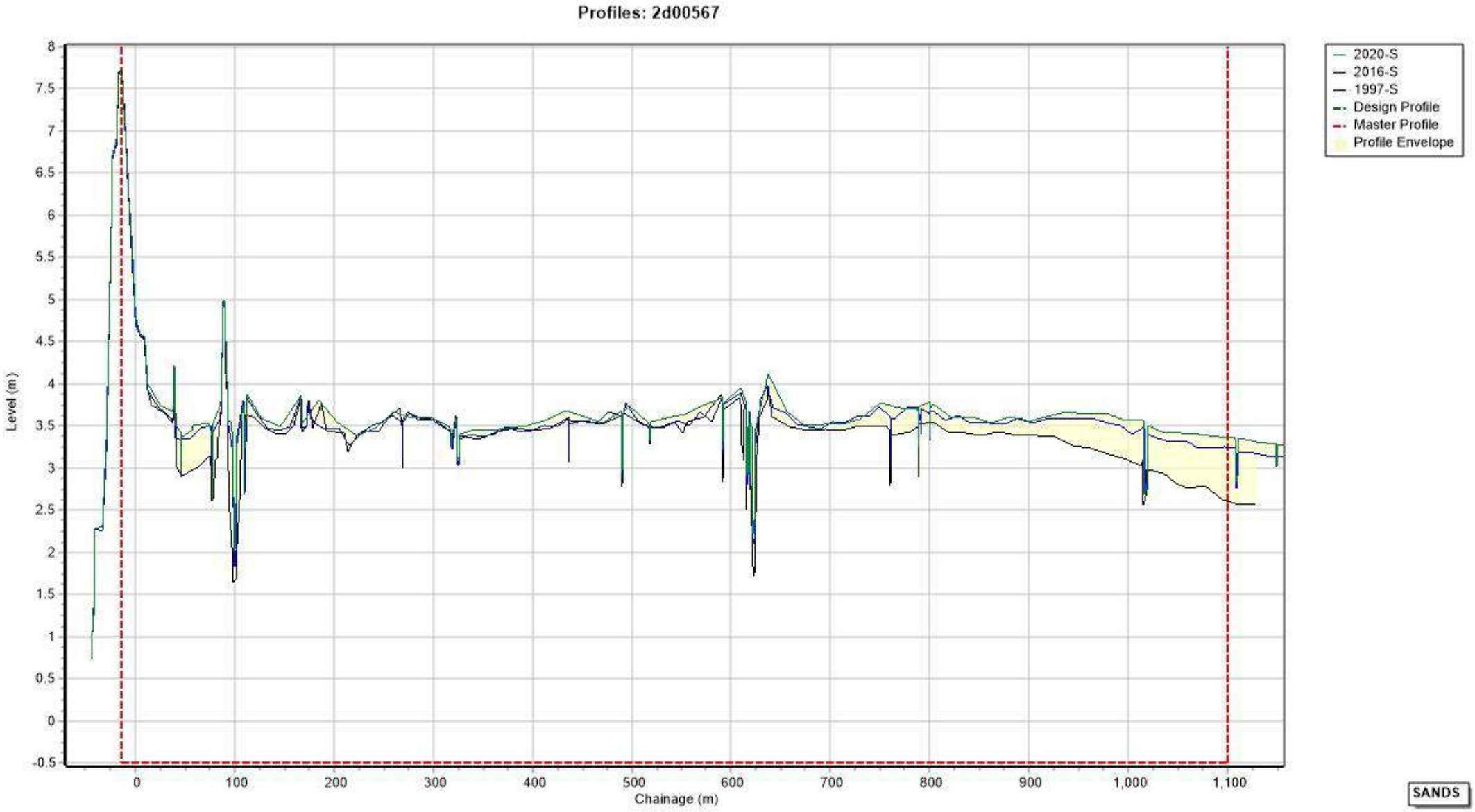
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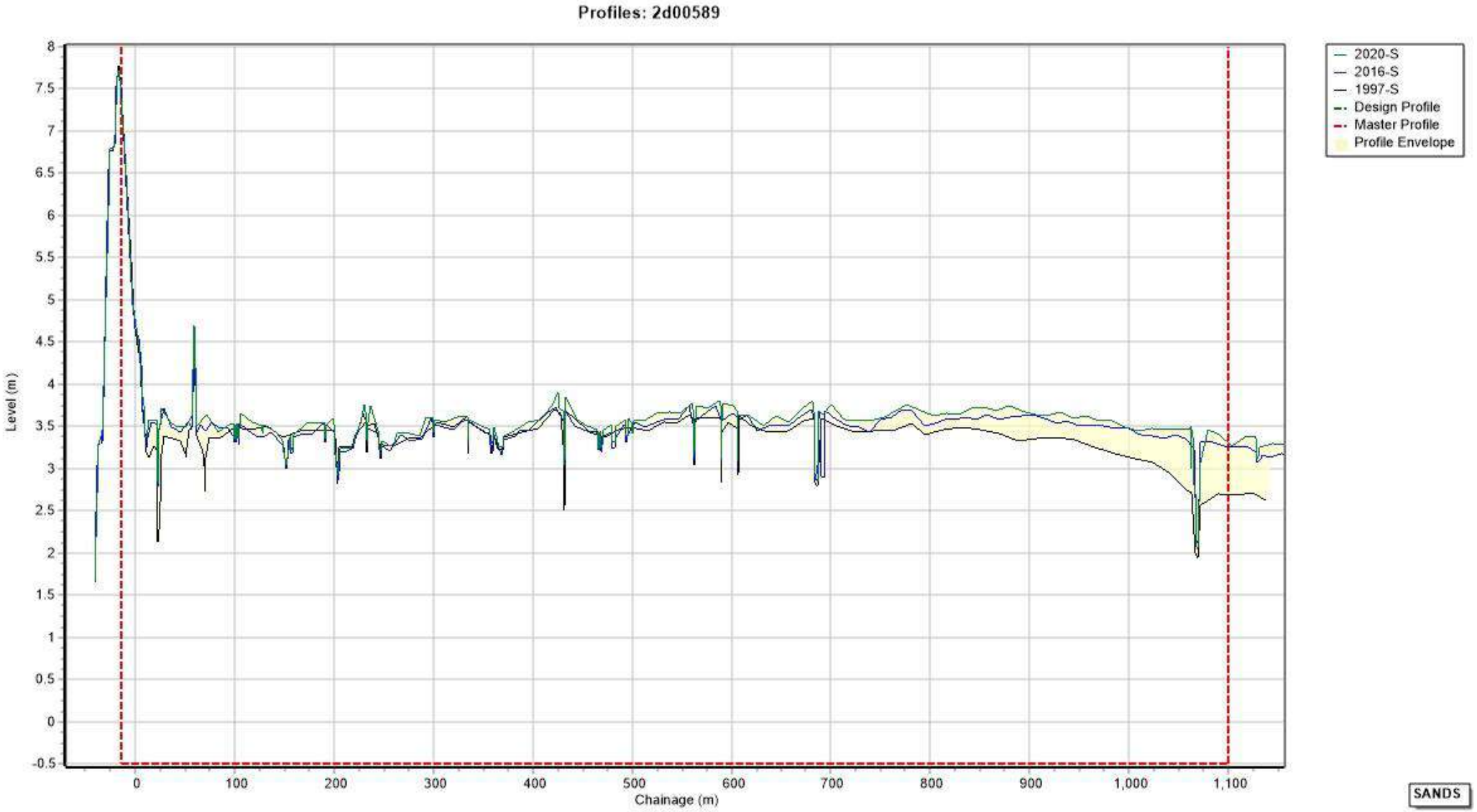
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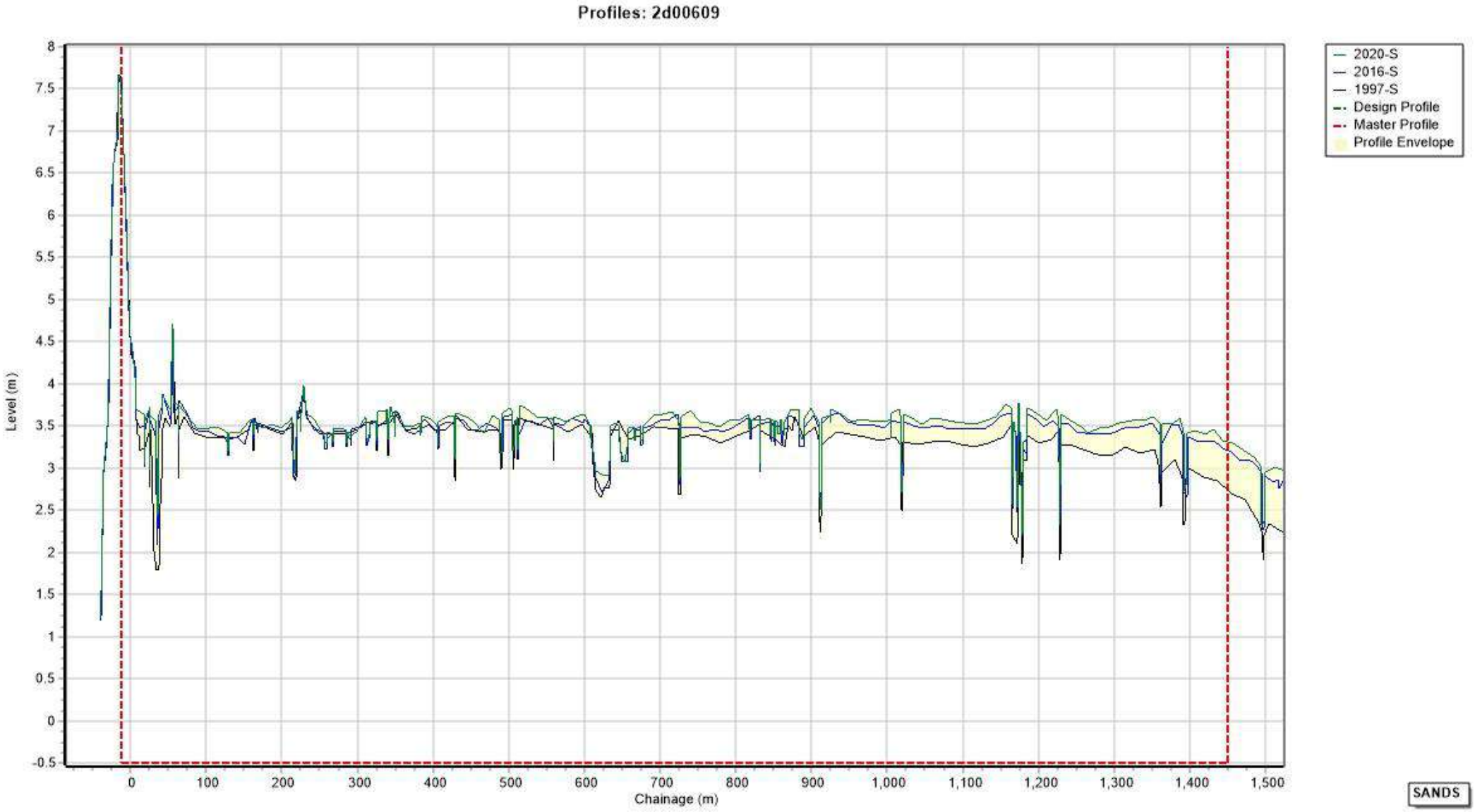
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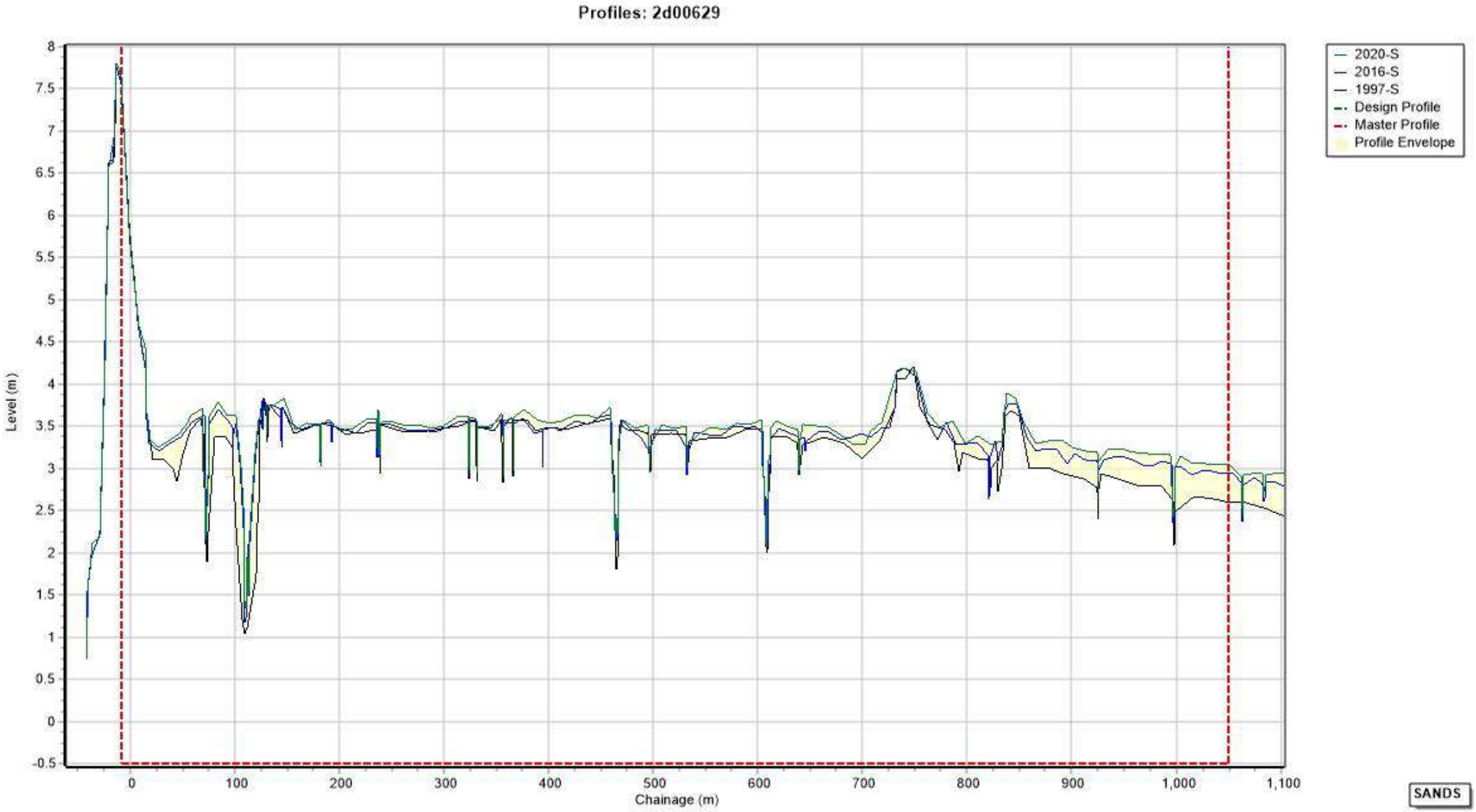
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4.5
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2.5
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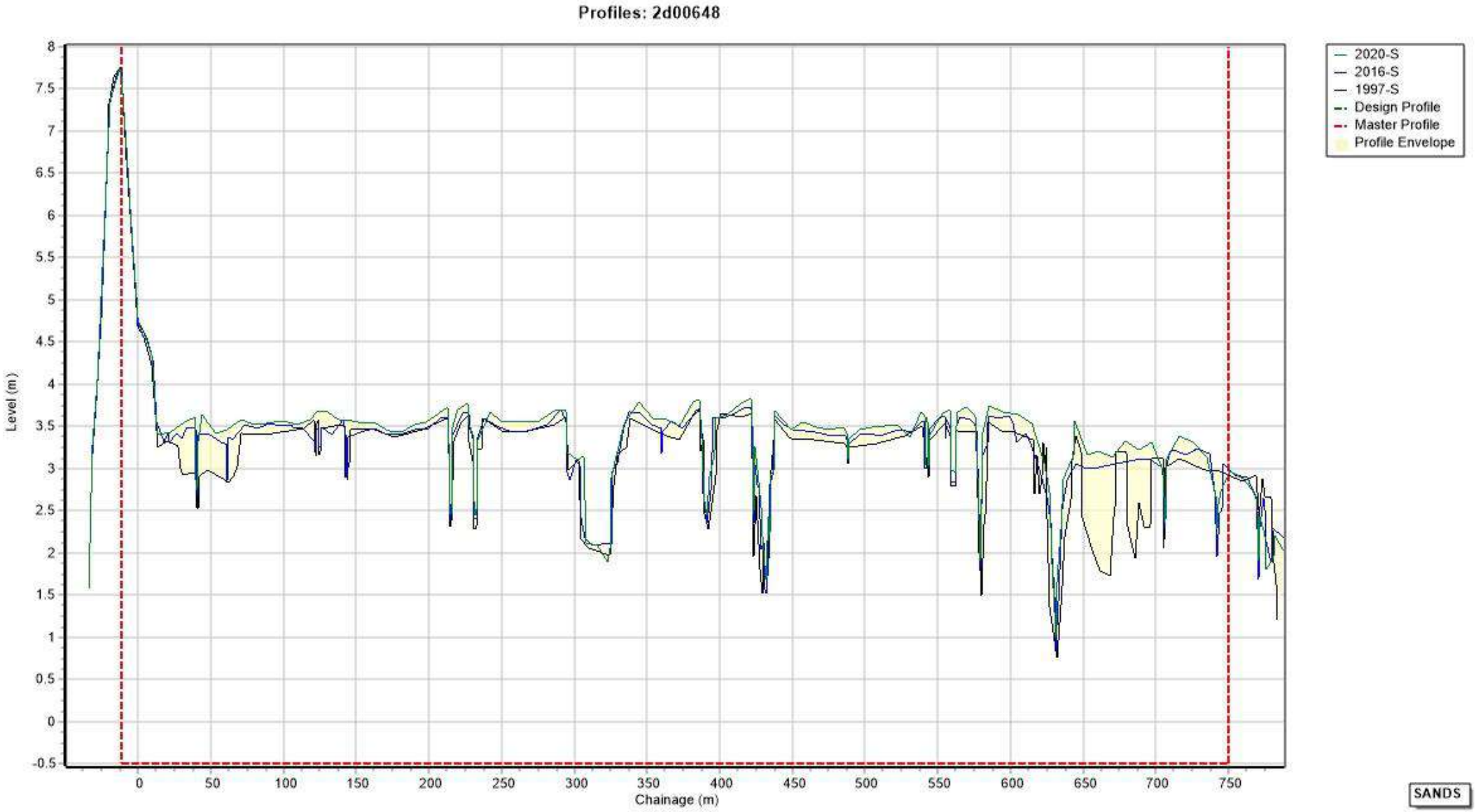
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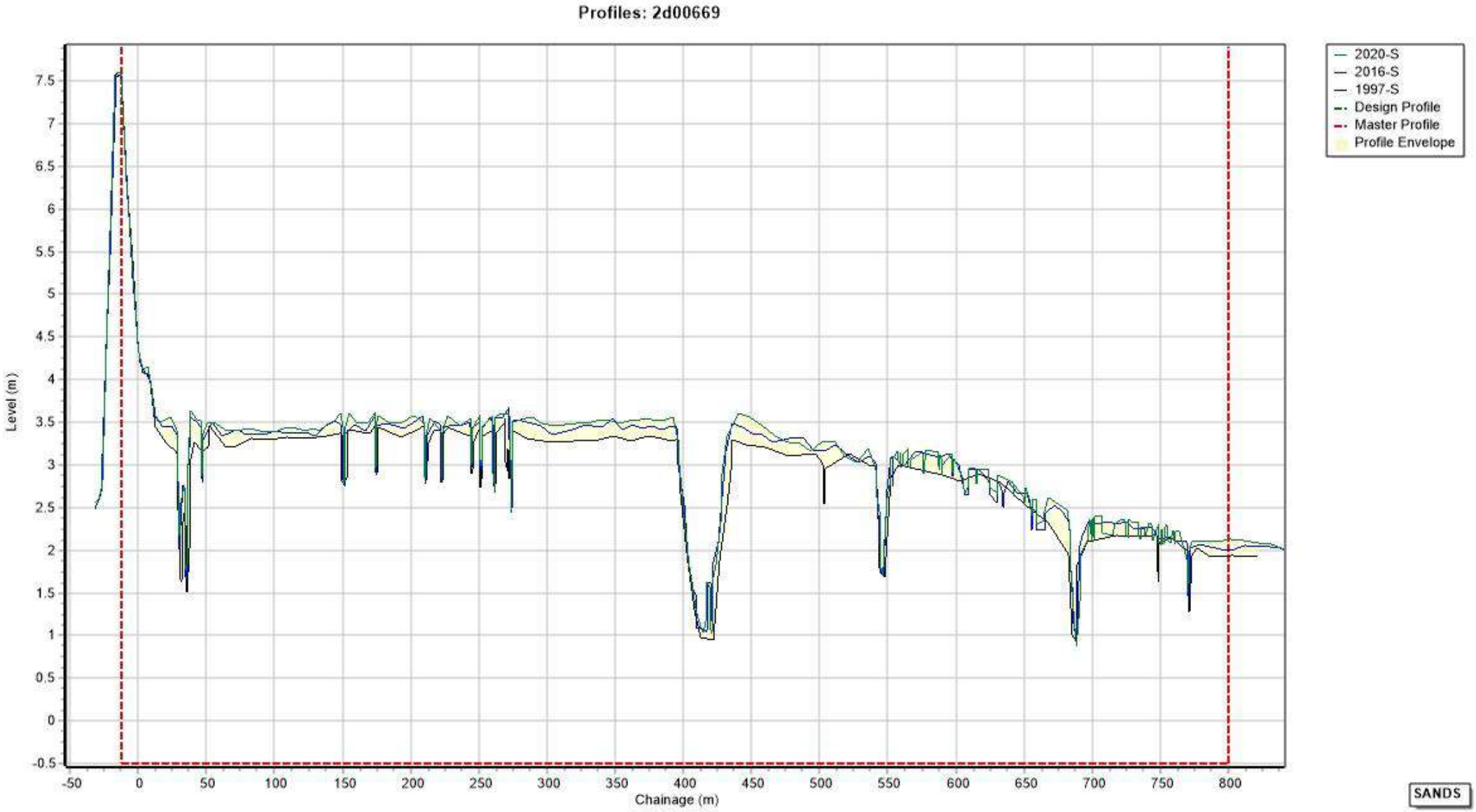
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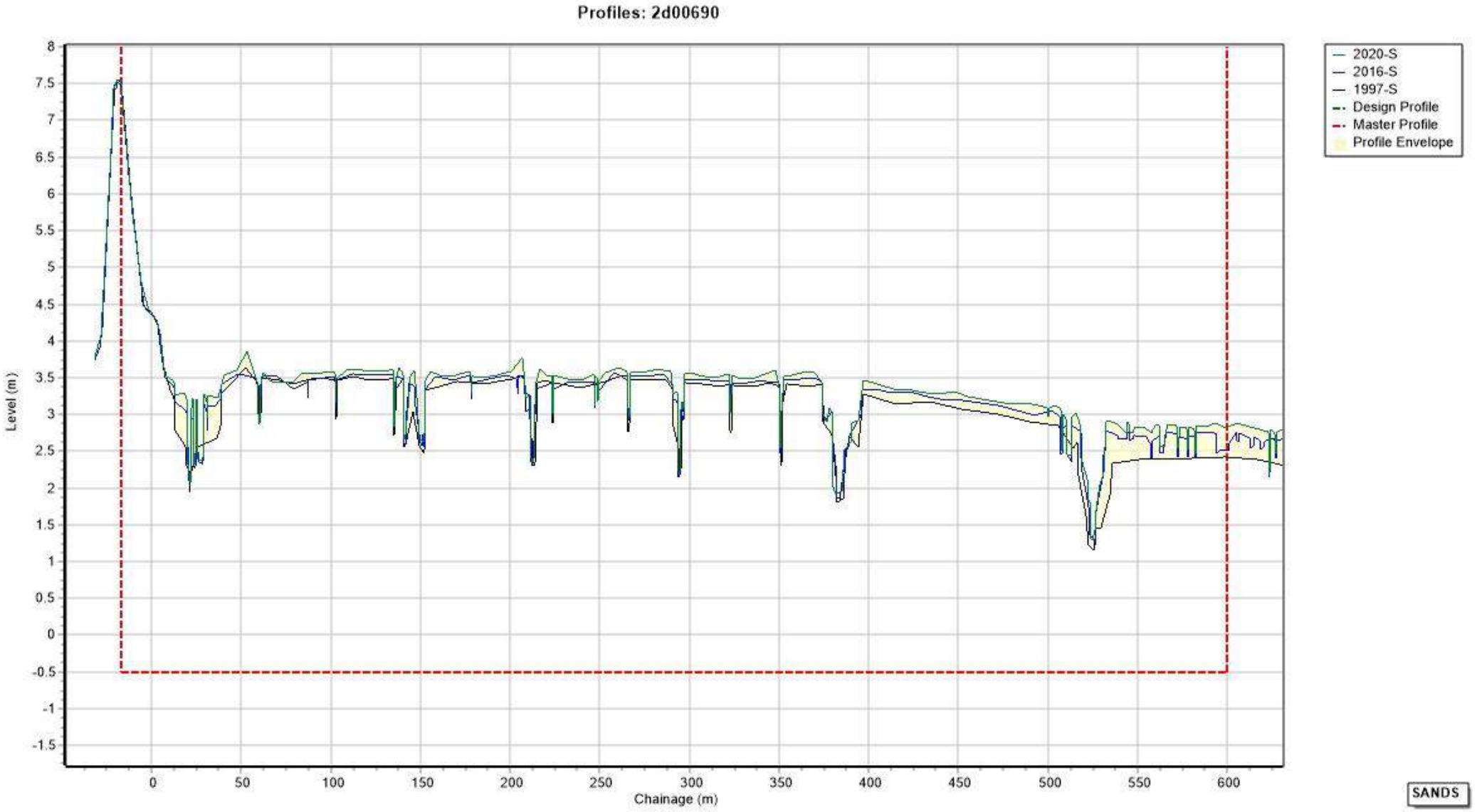
SANDS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2016-S
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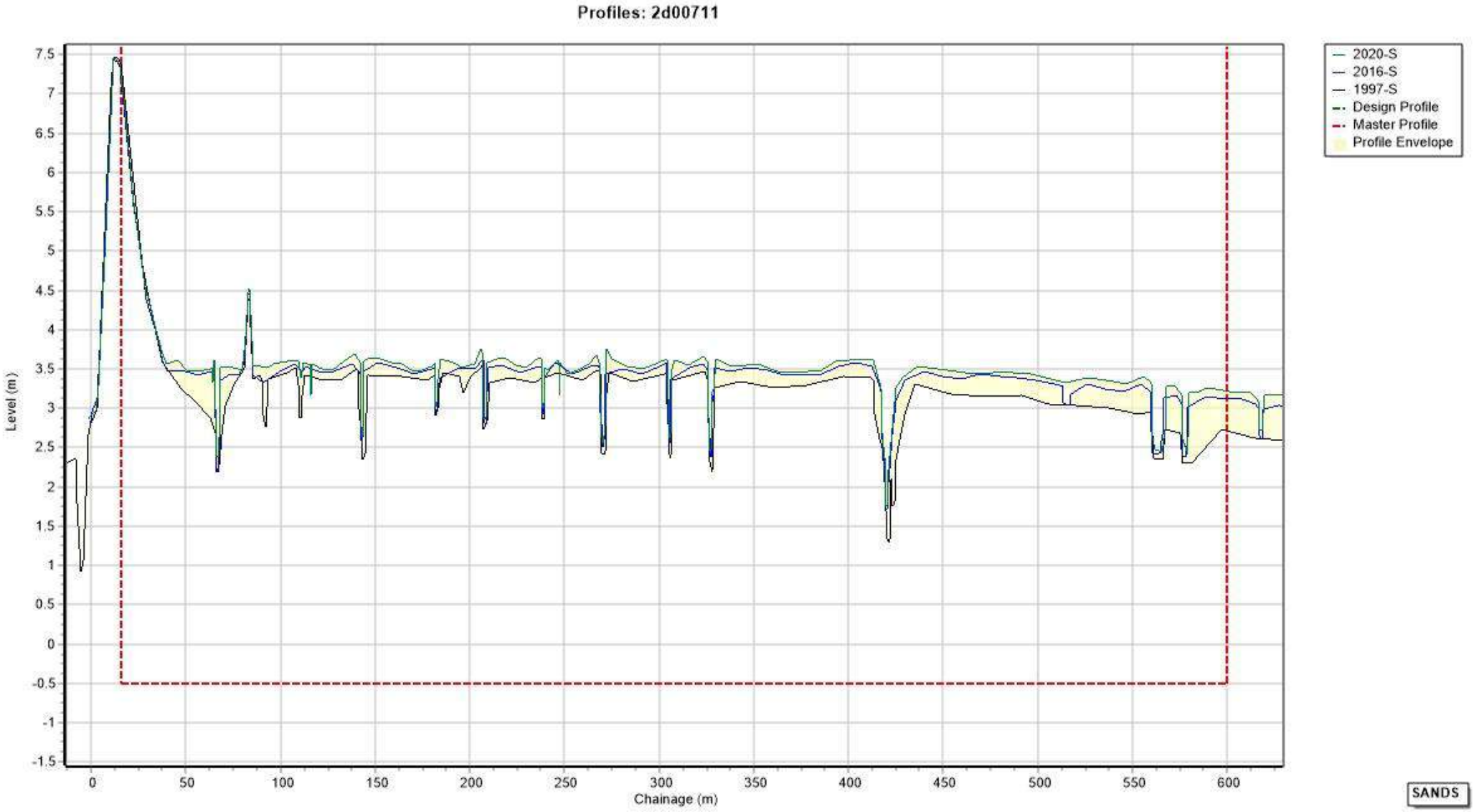
Level (m)
Chainage (m)
SANDS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1997-S
Design Profile
Master Profile
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Level (m)
Chainage (m)
SANDS

Positional Trends

Location: W025 Baseline: 1997	HAT 4.54m	MHWS 3.75m	MSL 0.10m	MLWS -3.02m	LAT -3.70m
Total Change	0.15	0.14	15.51		
Min Change	-3.05	-0.29	0.95		
Max Change	2.92	0.72	4.03		
Mean Change	0.01	0.01	2.59		
Sdt Dev Change	1.94	0.2	1.14		

Location: W025 Baseline: 2016	HAT 4.54m	MHWS 3.75m	MSL 0.10m	MLWS -3.02m	LAT -3.70m
Total Change	0.40	0.18	7.80		
Min Change	-2.87	-0.14	0.95		
Max Change	1.59	0.20	2.81		
Mean Change	0.10	0.04	1.95		
Sdt Dev Change	1.80	0.13	0.84		

Location: W026 Baseline: 1997	HAT 4.53m	MHWS 3.74m	MSL 0.10m	MLWS -3.01m	LAT -3.69m
Total Change	-0.02	0.23			
Min Change	-0.61	-1.50			
Max Change	0.50	2.19			
Mean Change	0.00	0.01			
Sdt Dev Change	0.28	0.71			

Location: W026 Baseline: 2016	HAT 4.53m	MHWS 3.74m	MSL 0.10m	MLWS -3.01m	LAT -3.69m
Total Change	0.00	0.91			
Min Change	-0.48	-0.60			
Max Change	0.41	0.55			
Mean Change	0.00	0.23			
Sdt Dev Change	0.35	0.48			

Location: W027 Baseline: 1997	HAT 4.52m	MHWS 3.73m	MSL 0.10m	MLWS -3.00m	LAT -3.69m
Total Change	0.37	23.38			
Min Change	-1.03	-226.96			
Max Change	1.18	224.13			
Mean Change	0.02	1.02			
Sdt Dev Change	0.35	73.9			

Location: W027 Baseline: 2016	HAT 4.52m	MHWS 3.73m	MSL 0.10m	MLWS -3.00m	LAT -3.69m
Total Change	0.33	1.73			
Min Change	-1.03	-226.96			
Max Change	1.18	224.13			
Mean Change	0.08	0.43			
Sdt Dev Change	0.80	159.50			

Location: W028 Baseline: 1997	HAT 4.52m	MHWS 3.72m	MSL 0.11m	MLWS -2.99m	LAT -3.67m
Total Change	-1.46	0.35			
Min Change	-63.63	-1.38			
Max Change	63.38	1.47			
Mean Change	-0.06	0.02			
Sdt Dev Change	41.6	0.49			

Location: W028 Baseline: 2016	HAT 4.52m	MHWS 3.72m	MSL 0.11m	MLWS -2.99m	LAT -3.67m
Total Change	-1.55	0.01			
Min Change	-1.21	-0.30			
Max Change	0.22	0.20			
Mean Change	-0.39	0.00			
Sdt Dev Change	0.52	0.19			

Location: W029 Baseline: 1997	HAT 4.49m	MHWS 3.69m	MSL 0.10m	MLWS -2.98m	LAT -3.67m
Total Change	0.4	120.96			
Min Change	-0.44	-97.18			
Max Change	0.37	120.29			
Mean Change	0.02	5.26			
Sdt Dev Change	0.22	37.78			

Location: W029 Baseline: 2016	HAT 4.49m	MHWS 3.69m	MSL 0.10m	MLWS -2.98m	LAT -3.67m
Total Change	-0.12	120.07			
Min Change	-0.42	-97.18			
Max Change	0.24	120.29			
Mean Change	-0.03	30.02			
Sdt Dev Change	0.25	86.22			

Location: W030 Baseline: 1997	HAT 4.50m	MHWS 3.69m	MSL 0.10m	MLWS -2.96m	LAT -3.66m
Total Change	-0.14	170.89			
Min Change	-0.53	-33.79			
Max Change	0.31	155.78			
Mean Change	-0.01	7.77			
Sdt Dev Change	0.24	35.73			

Location: W030 Baseline: 2016	HAT 4.50m	MHWS 3.69m	MSL 0.10m	MLWS -2.96m	LAT -3.66m
Total Change	-0.24	19.14			
Min Change	-0.20	-12.89			
Max Change	0.06	31.92			
Mean Change	-0.06	4.79			
Sdt Dev Change	0.10	16.79			

Location: W031 Baseline: 1997	HAT 4.48m	MHWS 3.67m	MSL 0.10m	MLWS -2.95m	LAT -3.66m
Total Change	-0.23	461.87			
Min Change	-57.46	-360.74			
Max Change	57.53	526.44			
Mean Change	-0.01	20.08			
Sdt Dev Change	16.96	203.44			

Location: W031 Baseline: 2016	HAT 4.48m	MHWS 3.67m	MSL 0.10m	MLWS -2.95m	LAT -3.66m
Total Change	-0.09	112.39			
Min Change	-0.17	-47.55			
Max Change	0.16	121.77			
Mean Change	-0.02	28.10			
Sdt Dev Change	0.13	65.18			

Location: W032 Baseline: 1997	HAT 4.49m	MHWS 3.66m	MSL 0.10m	MLWS -2.94m	LAT -3.65m
Total Change	-0.05	991.96			
Min Change	-0.41	-943.20			
Max Change	0.45	1115.21			
Mean Change	0.00	43.13			
Sdt Dev Change	0.22	491.27			

Location: W032	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.49m	3.66m	0.10m	-2.94m	-3.65m
Total Change	-0.02	50.13			
Min Change	-0.23	-60.96			
Max Change	0.10	59.57			
Mean Change	-0.01	12.53			
Sdt Dev Change	0.13	45.27			

Location: W033	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1997	4.49m	3.66m	0.11m	-2.92m	-3.64m
Total Change	3.14	6.55			
Min Change	-1.85	-5.38			
Max Change	2.83	3.77			
Mean Change	0.14	0.30			
Sdt Dev Change	0.95	2.37			

Location: W033	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.49m	3.66m	0.11m	-2.92m	-3.64m
Total Change	2.80	1.40			
Min Change	-0.72	-1.94			
Max Change	2.83	3.18			
Mean Change	0.70	0.35			
Sdt Dev Change	1.33	1.95			

Location: W034	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1997	4.50m	3.65m	0.10m	-2.91m	-3.63m
Total Change	1.26	177.75			
Min Change	-3.33	-409.96			
Max Change	3.90	409.83			
Mean Change	0.05	7.73			
Sdt Dev Change	1.69	132.58			

Location: W034	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.50m	3.65m	0.10m	-2.91m	-3.63m
Total Change	0.03	177.80			
Min Change	-2.19	-2.21			
Max Change	2.44	177.01			
Mean Change	0.01	44.45			
Sdt Dev Change	1.82	76.55			

Location: W035 Baseline: 1997	HAT 4.51m	MHWS 3.64m	MSL 0.10m	MLWS -2.89m	LAT -3.63m
Total Change	-0.22	0.37			
Min Change	-0.63	-267.46			
Max Change	0.74	267.33			
Mean Change	-0.01	0.02			
Sdt Dev Change	0.30	114.99			

Location: W035 Baseline: 2016	HAT 4.51m	MHWS 3.64m	MSL 0.10m	MLWS -2.89m	LAT -3.63m
Total Change	-0.22	-260.35			
Min Change	-0.15	-267.46			
Max Change	-0.02	267.33			
Mean Change	-0.05	-65.09			
Sdt Dev Change	0.06	220.16			

Location: W036 Baseline: 1997	HAT 4.52m	MHWS 3.64m	MSL 0.10m	MLWS -2.88m	LAT -3.63m
Total Change	1.41	153.07	7.29		
Min Change	-2.12	-48.18	-1.4		
Max Change	2.35	152.46	4.39		
Mean Change	0.07	7.29	0.91		
Sdt Dev Change	0.89	41.2	1.56		

Location: W036 Baseline: 2016	HAT 4.52m	MHWS 3.64m	MSL 0.10m	MLWS -2.88m	LAT -3.63m
Total Change	1.58	201.04	1.95		
Min Change	-0.70	-0.35	-0.05		
Max Change	1.17	152.46	1.08		
Mean Change	0.40	50.26	0.49		
Sdt Dev Change	0.81	61.71	0.47		

Location: W037 Baseline: 1997	HAT 4.53m	MHWS 3.64m	MSL 0.10m	MLWS -2.86m	LAT -3.62m
Total Change	-0.85	238.94	14.39		
Min Change	-3.80	-86.53	-0.98		
Max Change	2.98	218.97	4.37		
Mean Change	-0.04	10.39	1.80		
Sdt Dev Change	1.29	52.57	1.64		

Location: W037 Baseline: 2016	HAT 4.53m	MHWS 3.64m	MSL 0.10m	MLWS -2.86m	LAT -3.62m
Total Change	-0.20	238.92	5.36		
Min Change	-0.56	-86.53	0.34		
Max Change	0.51	218.97	2.24		
Mean Change	-0.05	59.73	1.34		
Sdt Dev Change	0.41	113.76	0.70		

4.3. Nene to Wolferton – 2dSU03NW

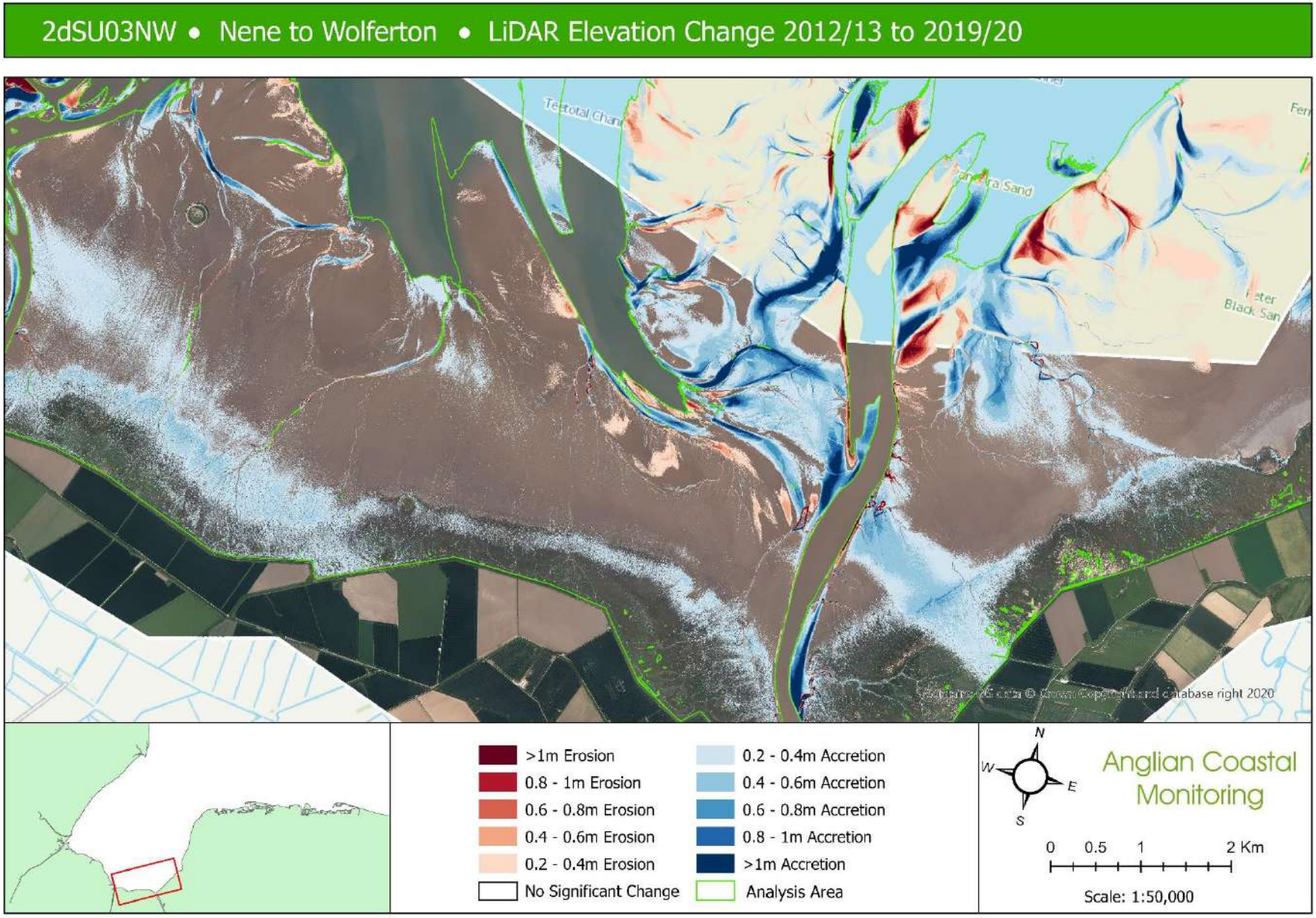
Topographic profiles in this cell are numbered W038 to W050, moving west to east from the River Nene to Wolferton. CSA analysis and Lidar analysis both show moderate long-term accretion in this monitoring cell with more accretion towards the west. The greatest change occurs at W041 with 16.86% accretion since 1997. The same pattern is seen in the current phase with the highest change in the west of the cell and all locations remaining stable.

Lidar shows movement of estuarine channels further offshore however there appears to be little to no change in overall sediment balance.

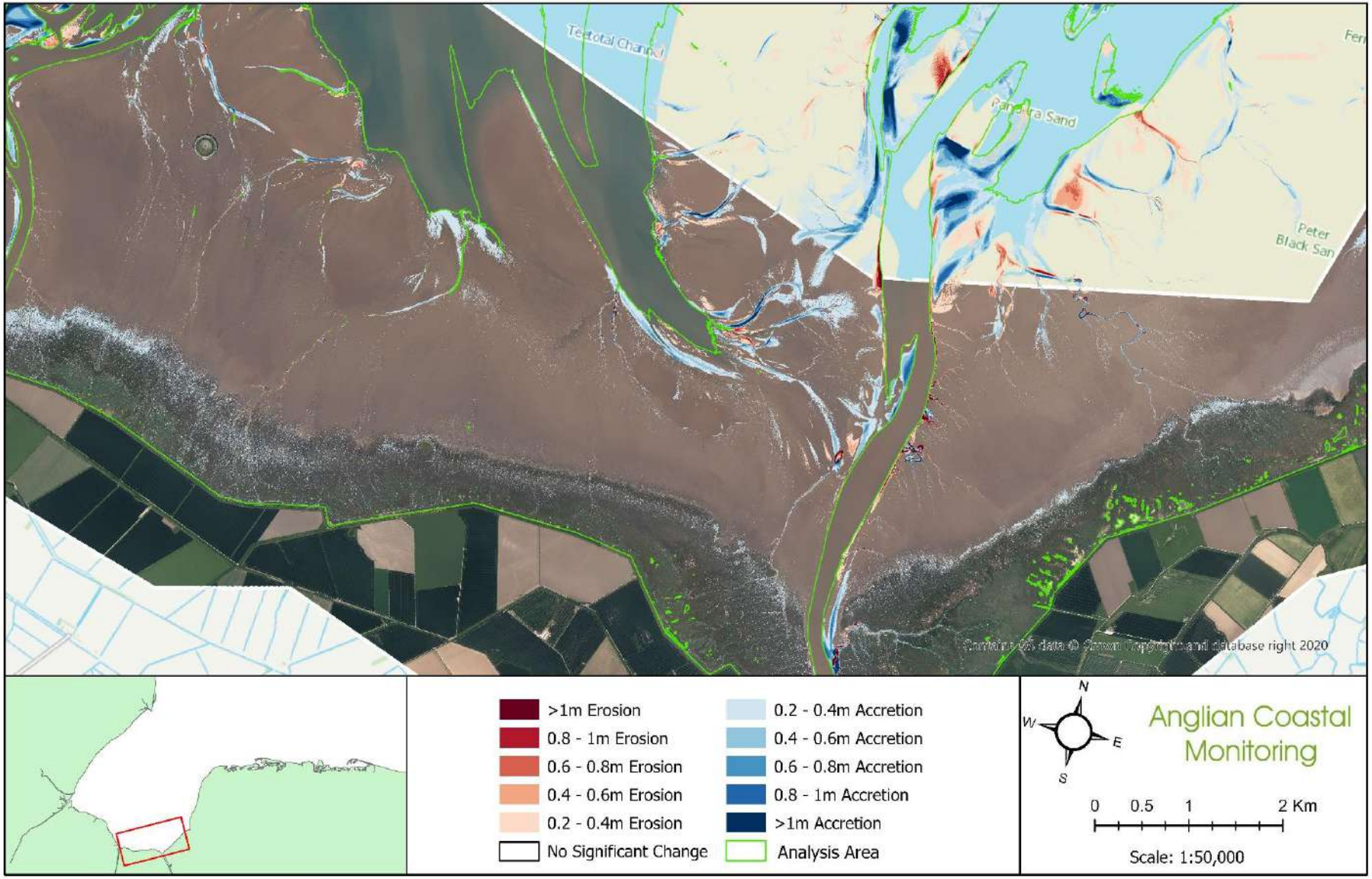
Saltmarsh is shown to be advancing across all locations, however at a greater rate in the west in a similar trend to that seen in CSA analysis. This suggests that positive feedback is promoting the growth of this habitat whereby the marsh stabilises incoming sediment which then enables the saltmarsh to advance further.

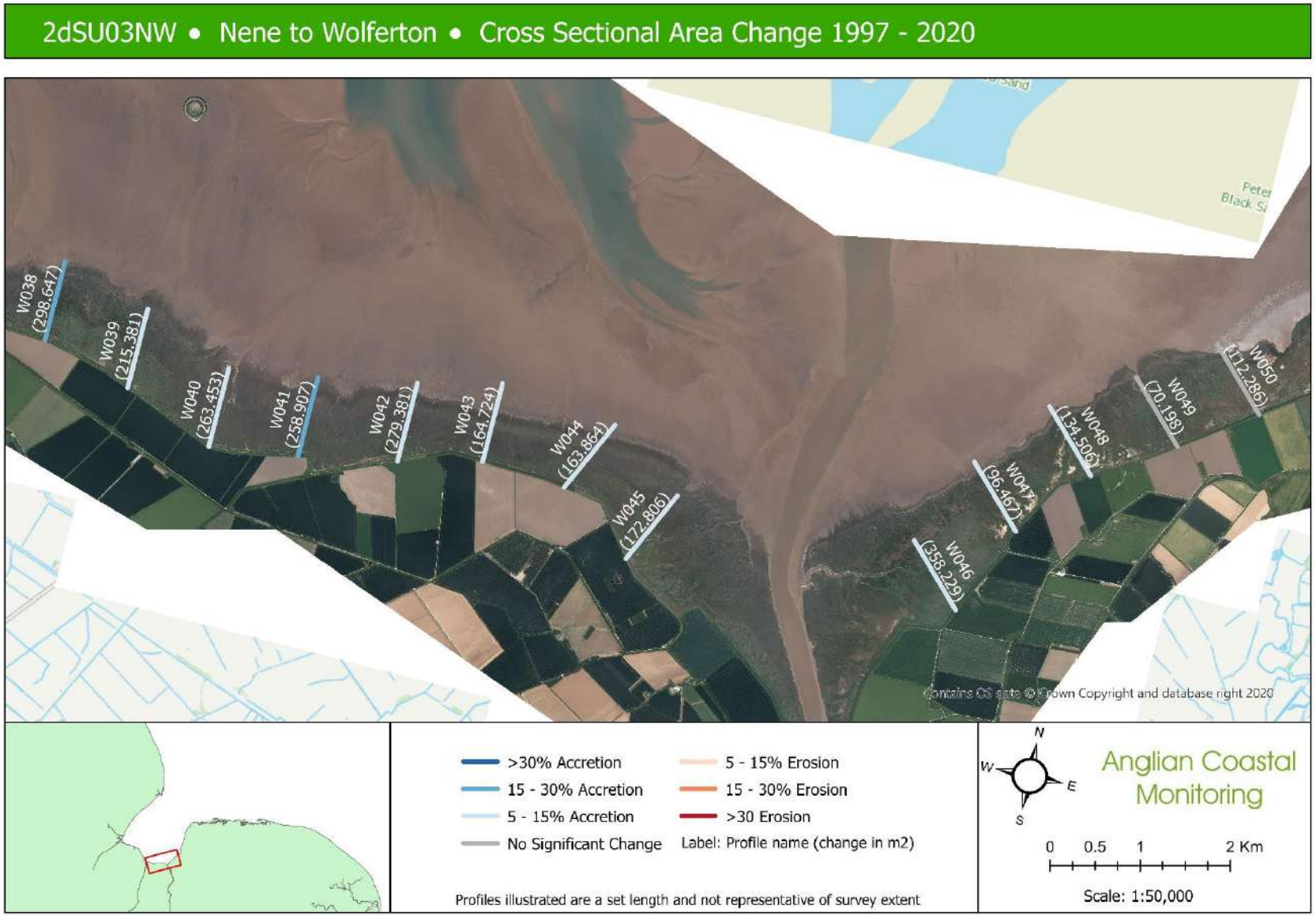
CSA Table

Locations	Baseline to Present		Current Phase to Present	
	1997-S to 2020-S			
Location	CSA Diff (m2)	% Change	CSA Diff (m2)	% Change
2d00765 [W038]	298.65	16.8	79.61	2.23
2d00786 [W039]	215.38	11.78	78.95	1.92
2d00808 [W040]	263.45	13.58	110.92	2.87
2d00828 [W041]	258.91	16.86	83	2.53
2d00850 [W042]	279.38	14.05	58.88	1.71
2d00869 [W043]	164.72	14.81	66.92	2.6
2d00888 [W044]	163.86	10.52	17.88	0.57
2d00908 [W045]	172.81	8.22	57.49	1.57
2d00980 [W046]	358.23	10.88	7.86	0.15
2d01002 [W047]	96.47	5.12	11.2	0.31
2d01023 [W048]	134.51	6.35	37.32	1.05
2d01043 [W049]	70.2	4.12	29.76	0.77
2d01062 [W050]	112.29	4.86	-2.83	-0.07
	Av=199.14	Av=10.61%	Av=49.00	Av=1.40%
	Min=70.20	Min=4.12%	Min=-2.83	Min=-0.07%
	Max=358.23	Max=16.86%	Max=110.92	Max=2.87%

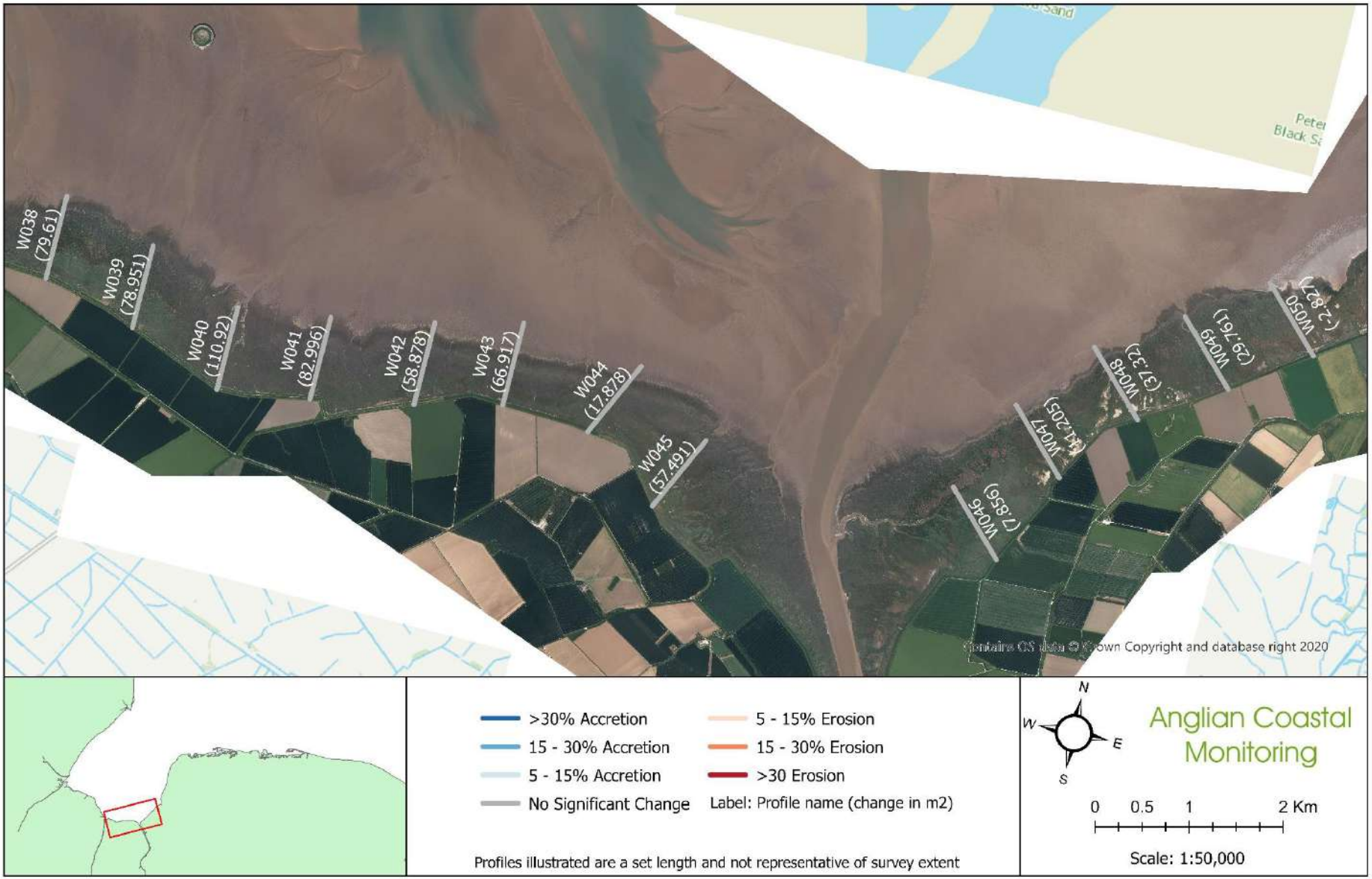

2dSU03NW • Nene to Wolferton • LiDAR Elevation Change 2012/13 to 2019/20
>1m Erosion
0.8 - 1m Erosion
0.6 - 0.8m Erosion
0.4 - 0.6m Erosion
0.2 - 0.4m Erosion
No Significant Change
0.2 - 0.4m Accretion
0.4 - 0.6m Accretion
0.6 - 0.8m Accretion
0.8 - 1m Accretion
>1m Accretion
Analysis Area
N
W
E
S
Anglian Coastal Monitoring
0 0.5 1 2 Km
Scale: 1:50,000

2dSU03NW • Nene to Wolferton • LiDAR Elevation Change 2016/17 to 2019/20



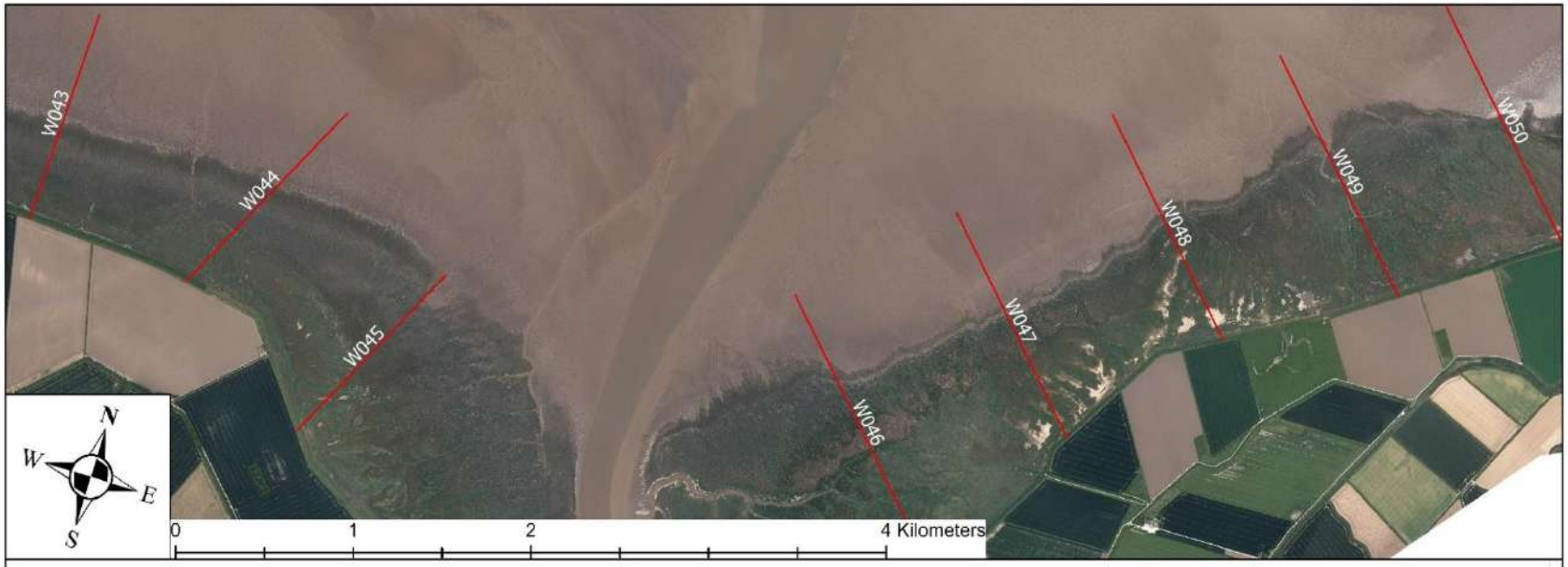

2dSU03NW • Nene to Wolferton • Cross Sectional Area Change 1997 - 2020
W038 (298.647)
W039 (215.381)
W040 (263.453)
W041 (258.907)
W042 (279.381)
W043 (164.724)
W044 (163.864)
W045 (172.806)
W046 (358.229)
W047 (96.462)
W048 (134.506)
W049 (70.198)
W050 (112.286)
Contains OS data © Crown Copyright and database right 2020
>30% Accretion
15 - 30% Accretion
5 - 15% Accretion
No Significant Change
5 - 15% Erosion
15 - 30% Erosion
>30 Erosion
Label: Profile name (change in m2)
Profiles illustrated are a set length and not representative of survey extent
N
W
E
S
Anglian Coastal Monitoring
0 0.5 1 2 Km
Scale: 1:50,000

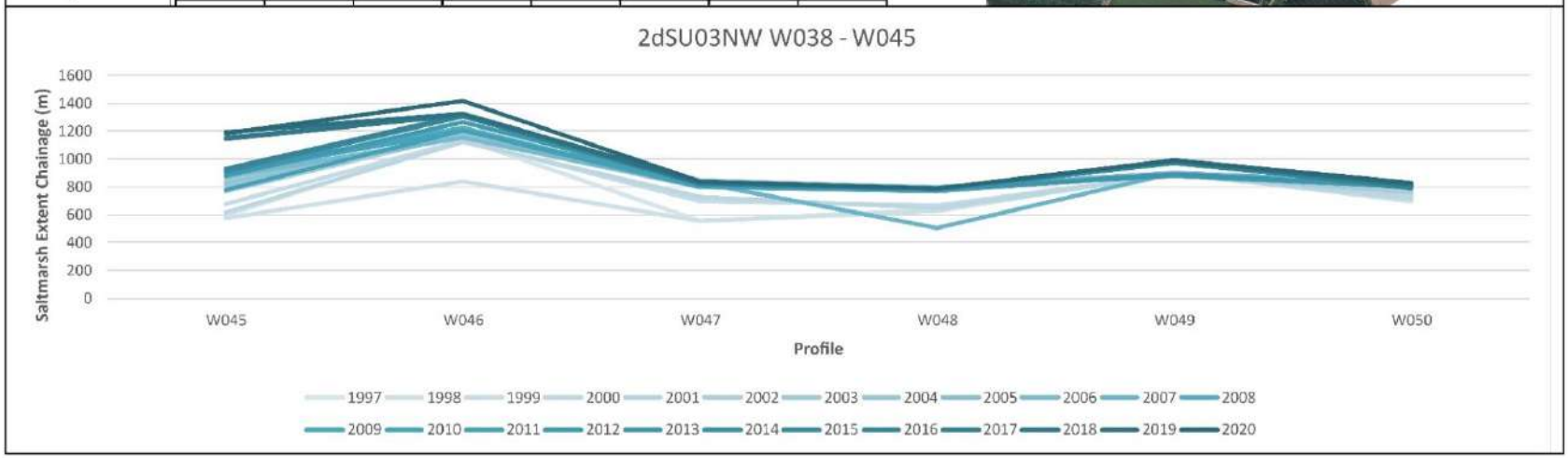
2dSU03NW • Nene to Wolferton • Cross Sectional Area Change 2016 - 2020



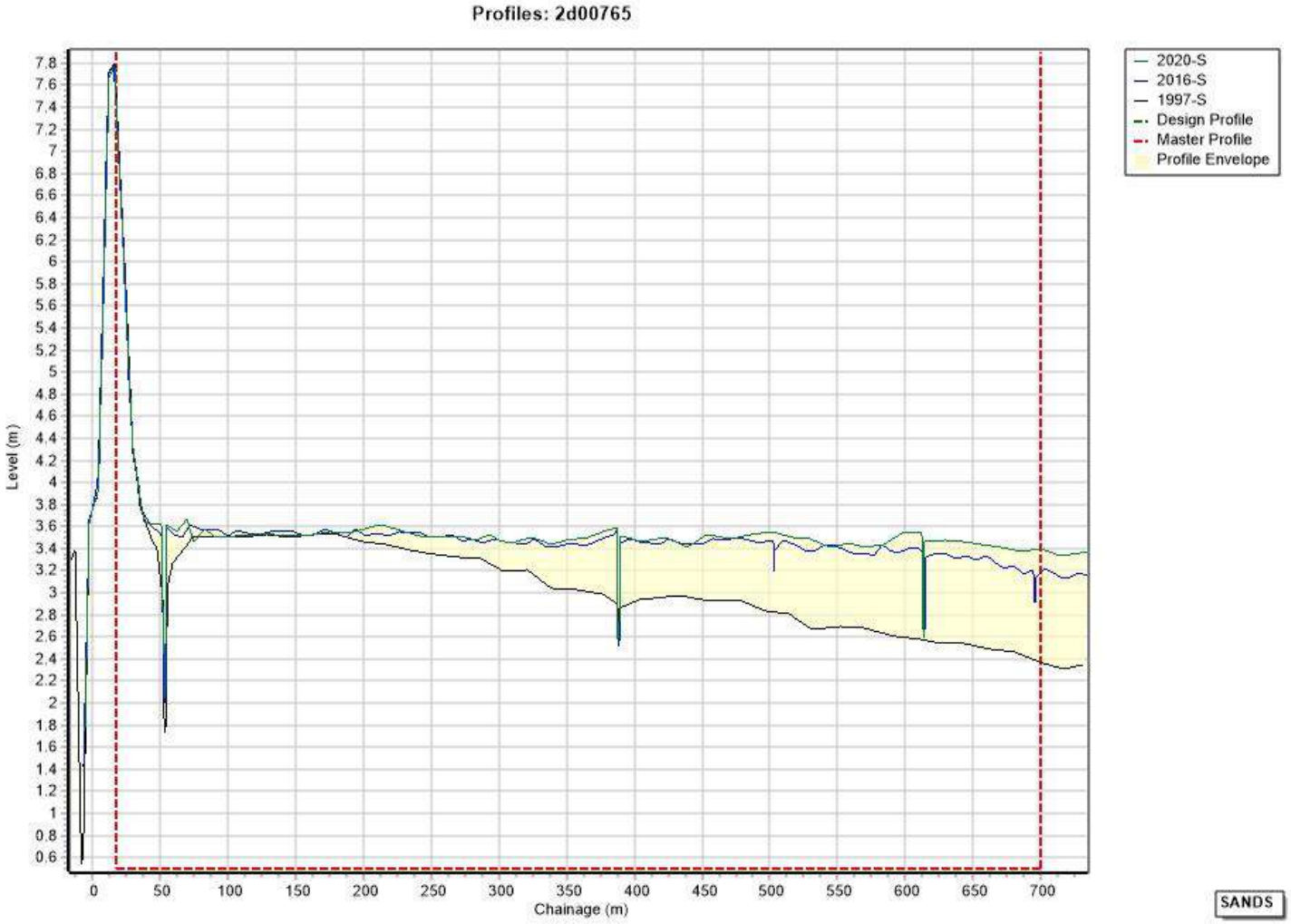
Saltmarsh Position

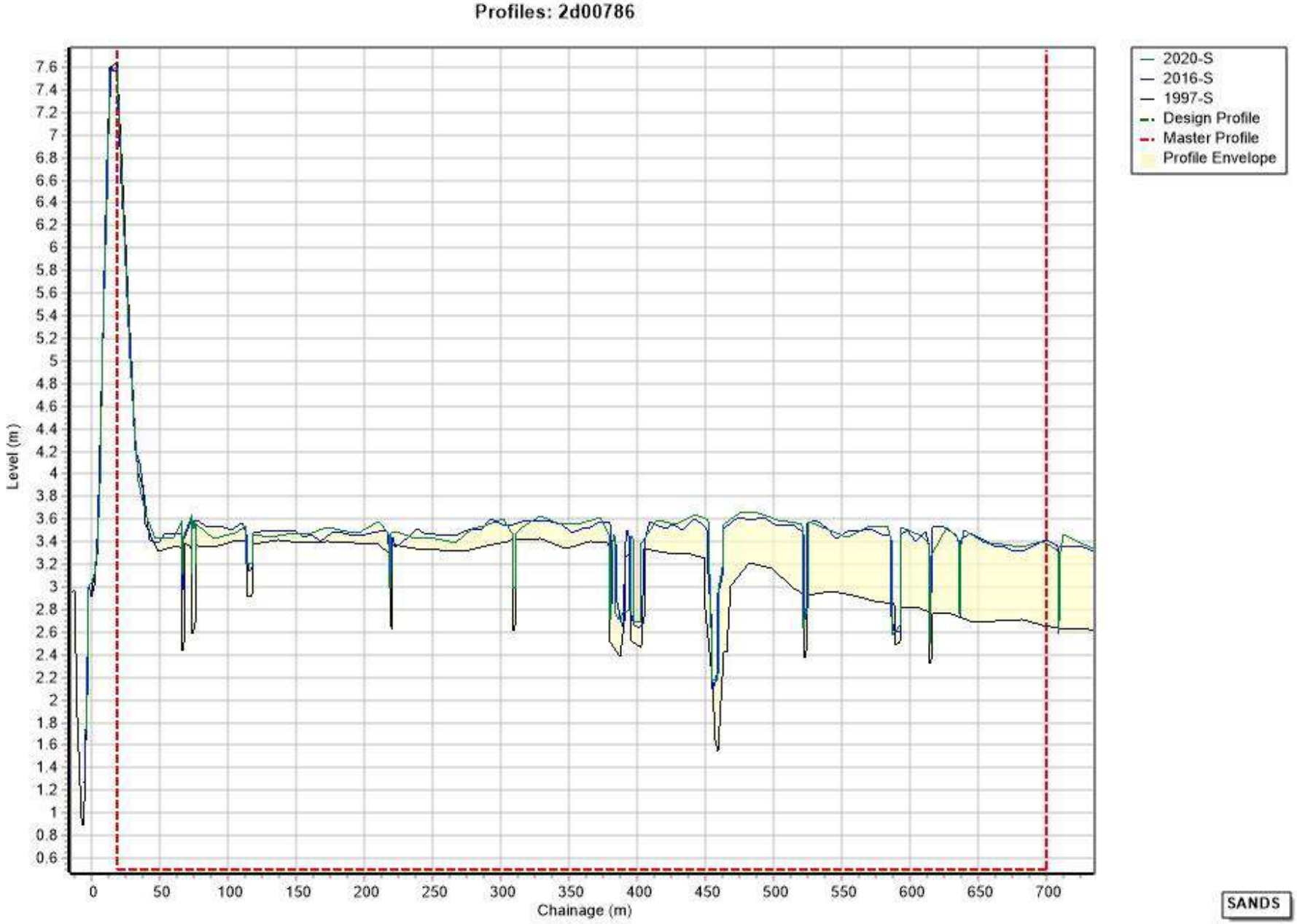
2dSU03NW • Nene to Wolferton • Saltmarsh Extent Analysis





Profile Graphs

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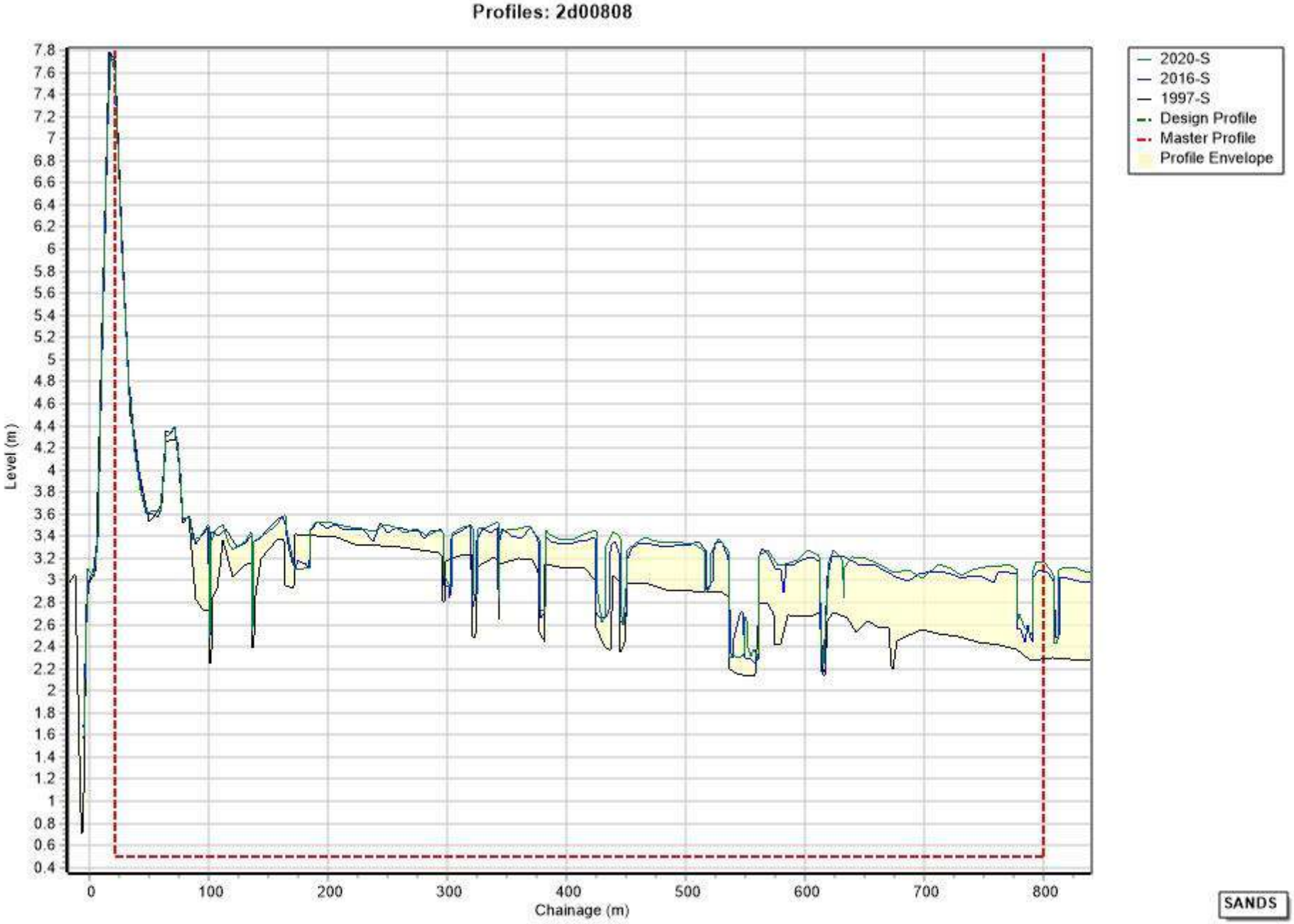
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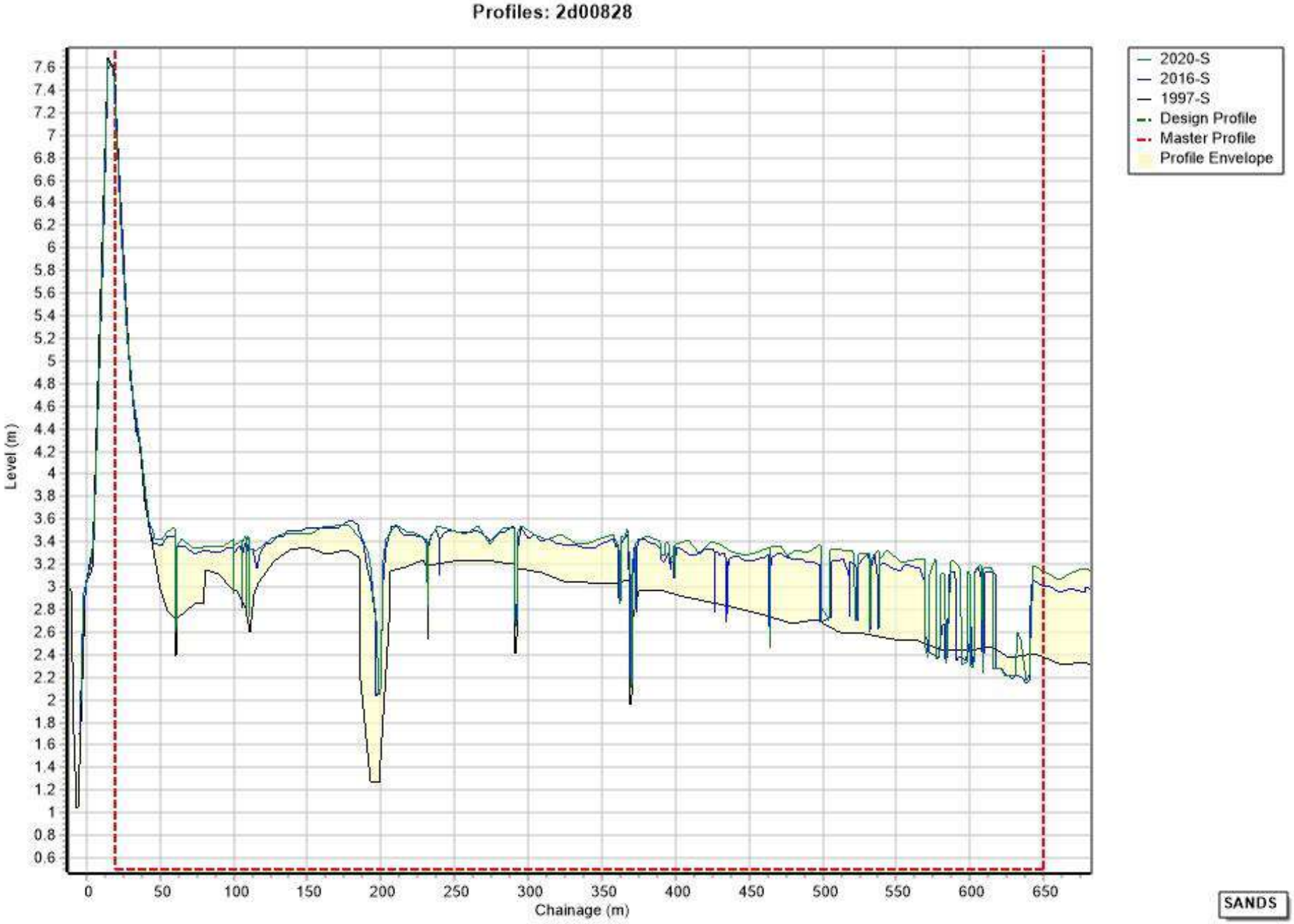
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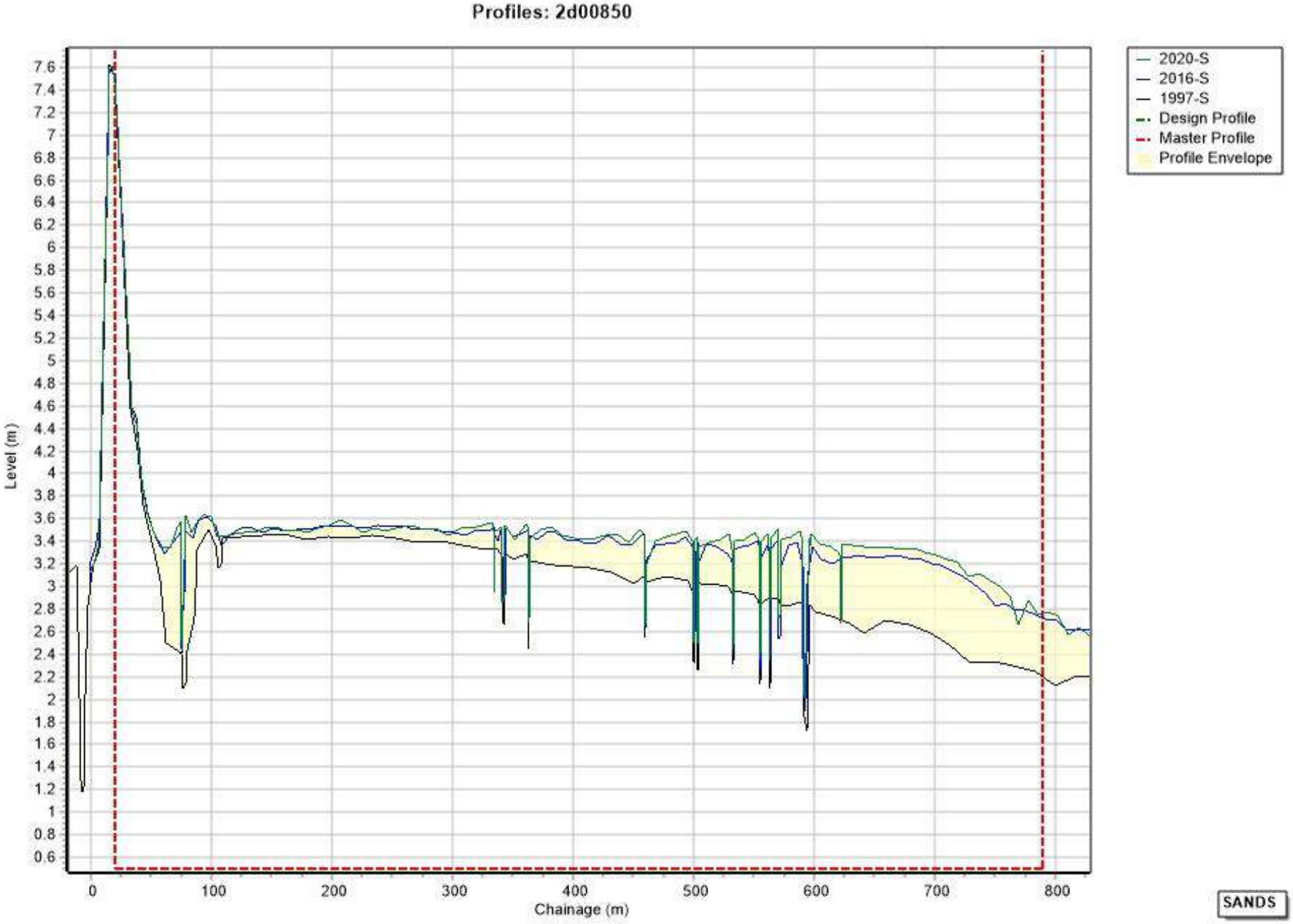
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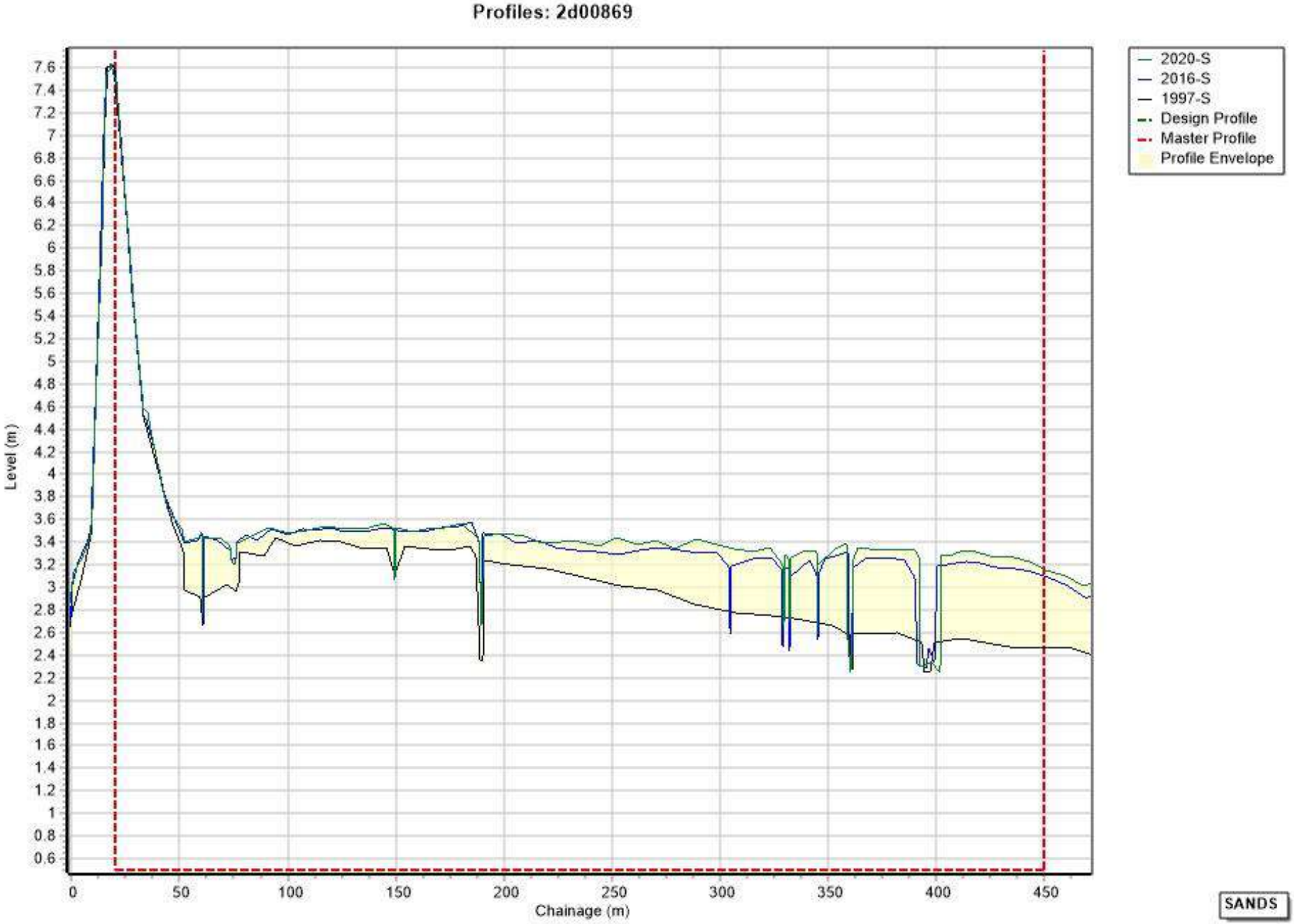
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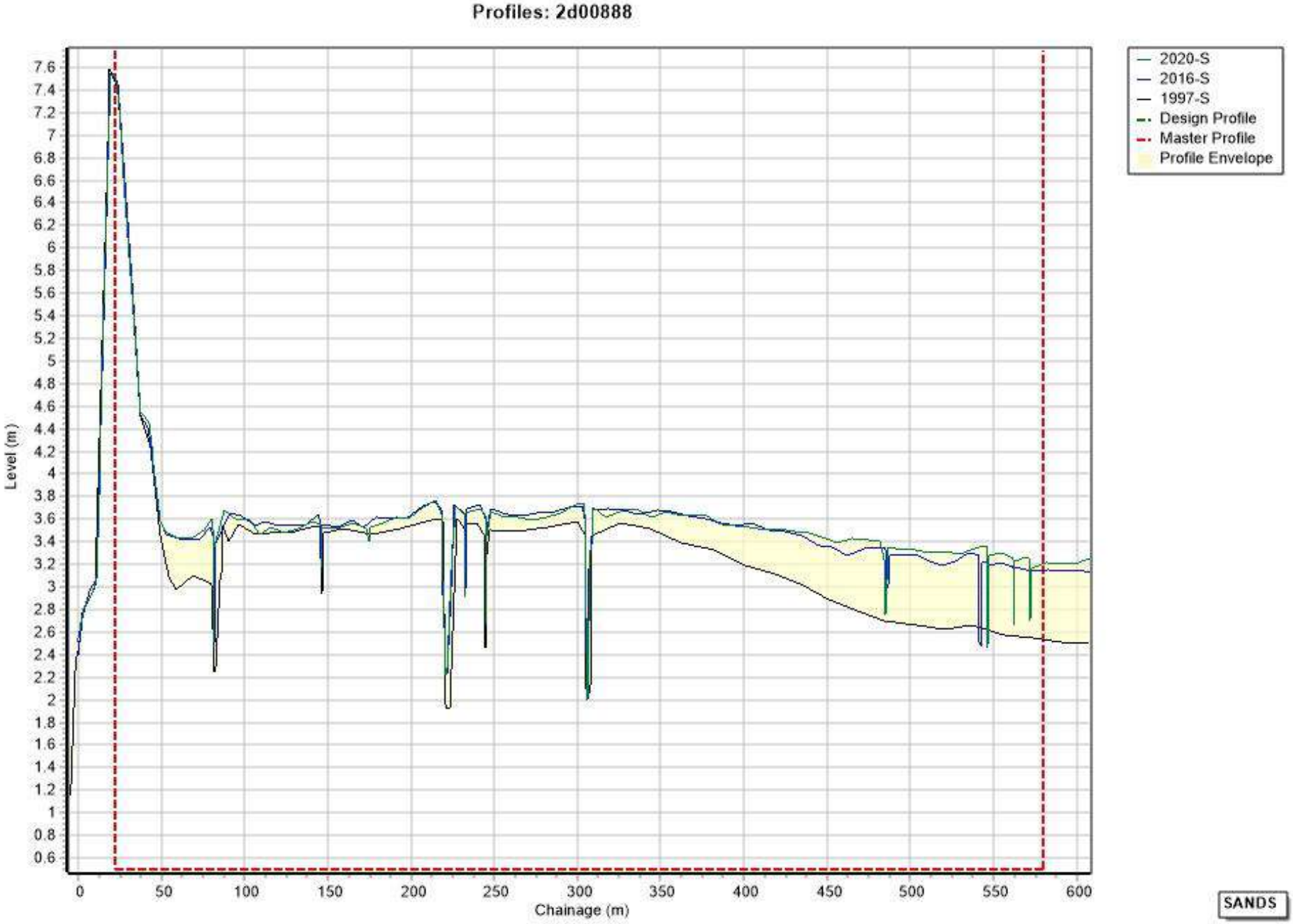
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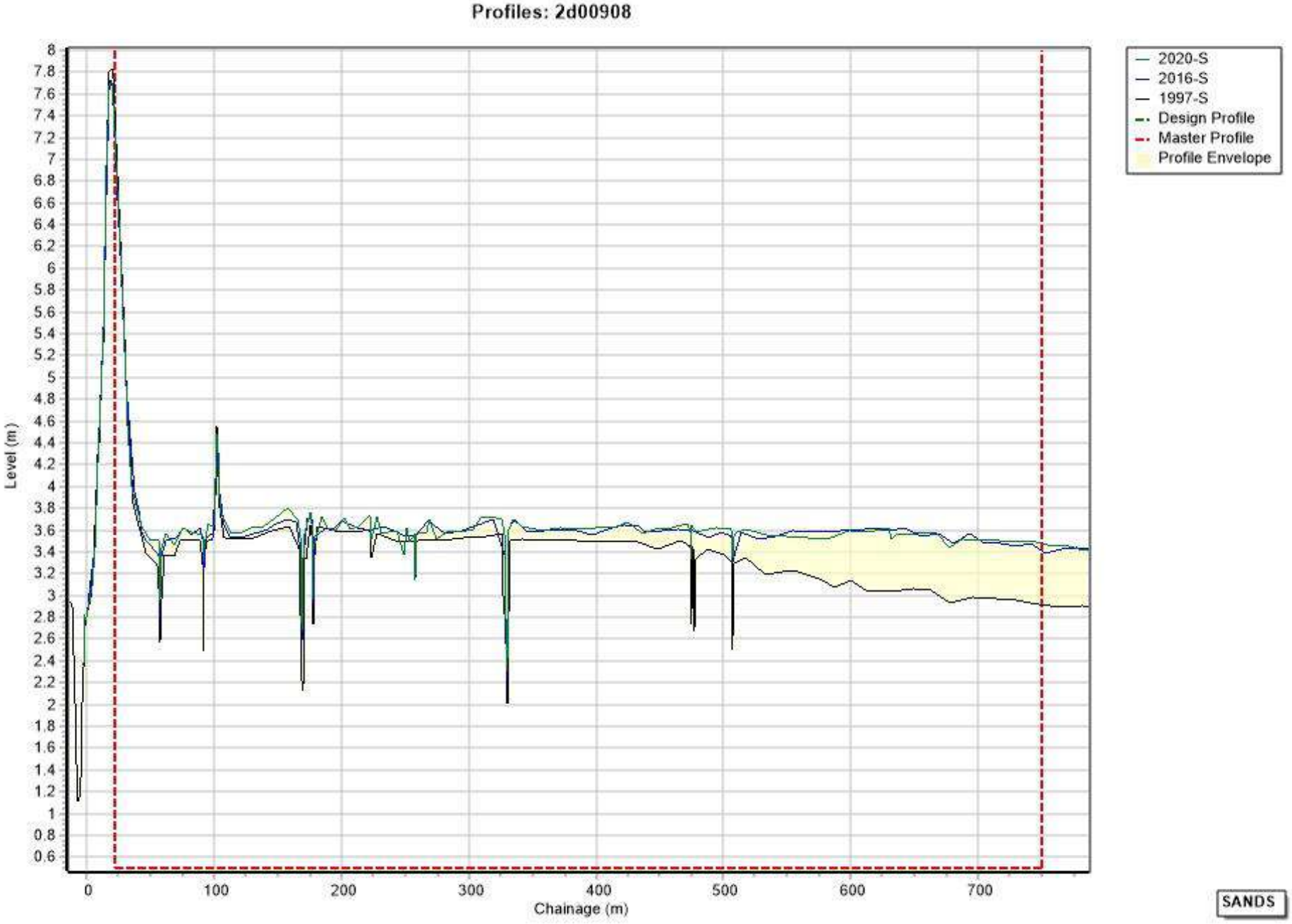
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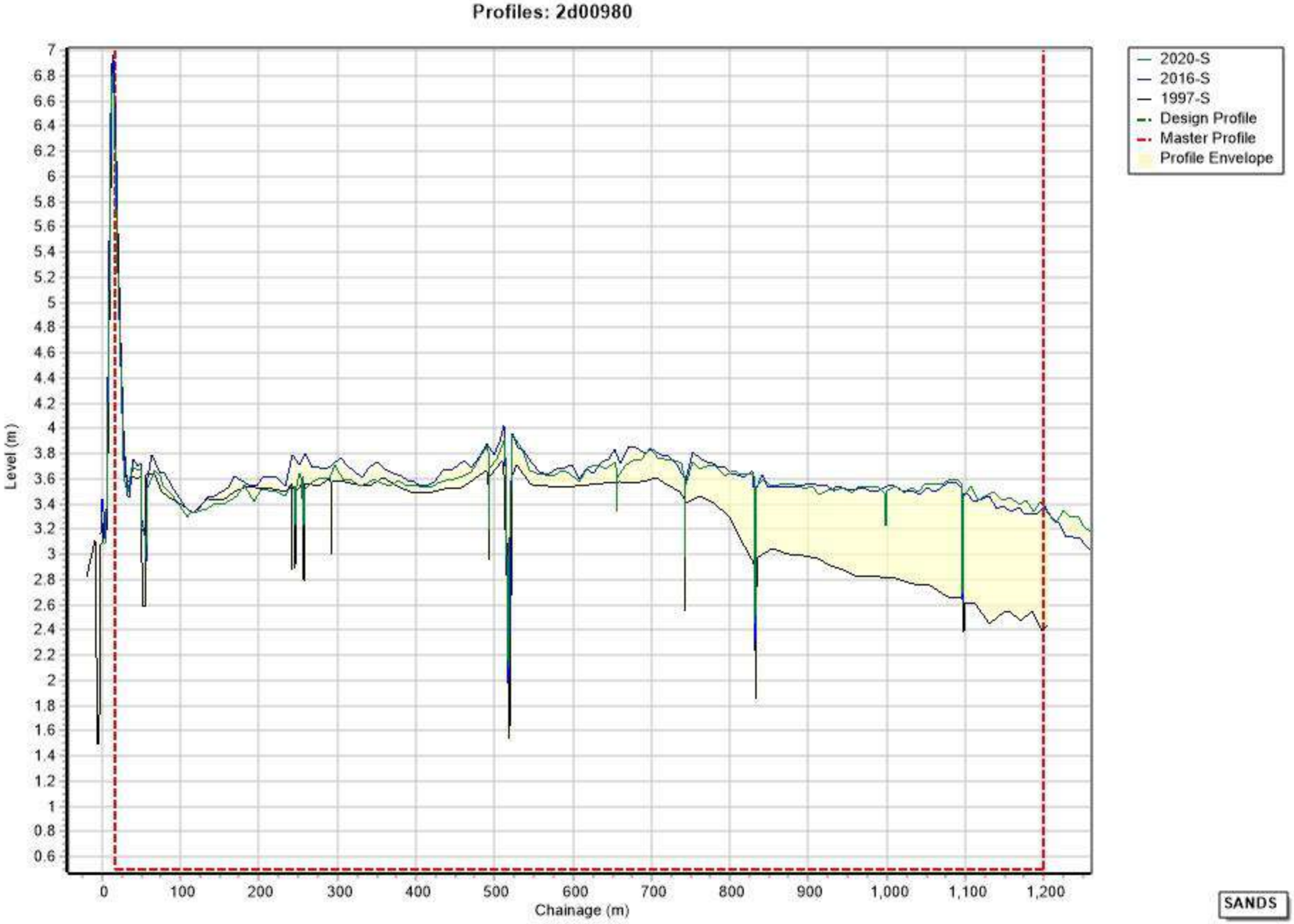
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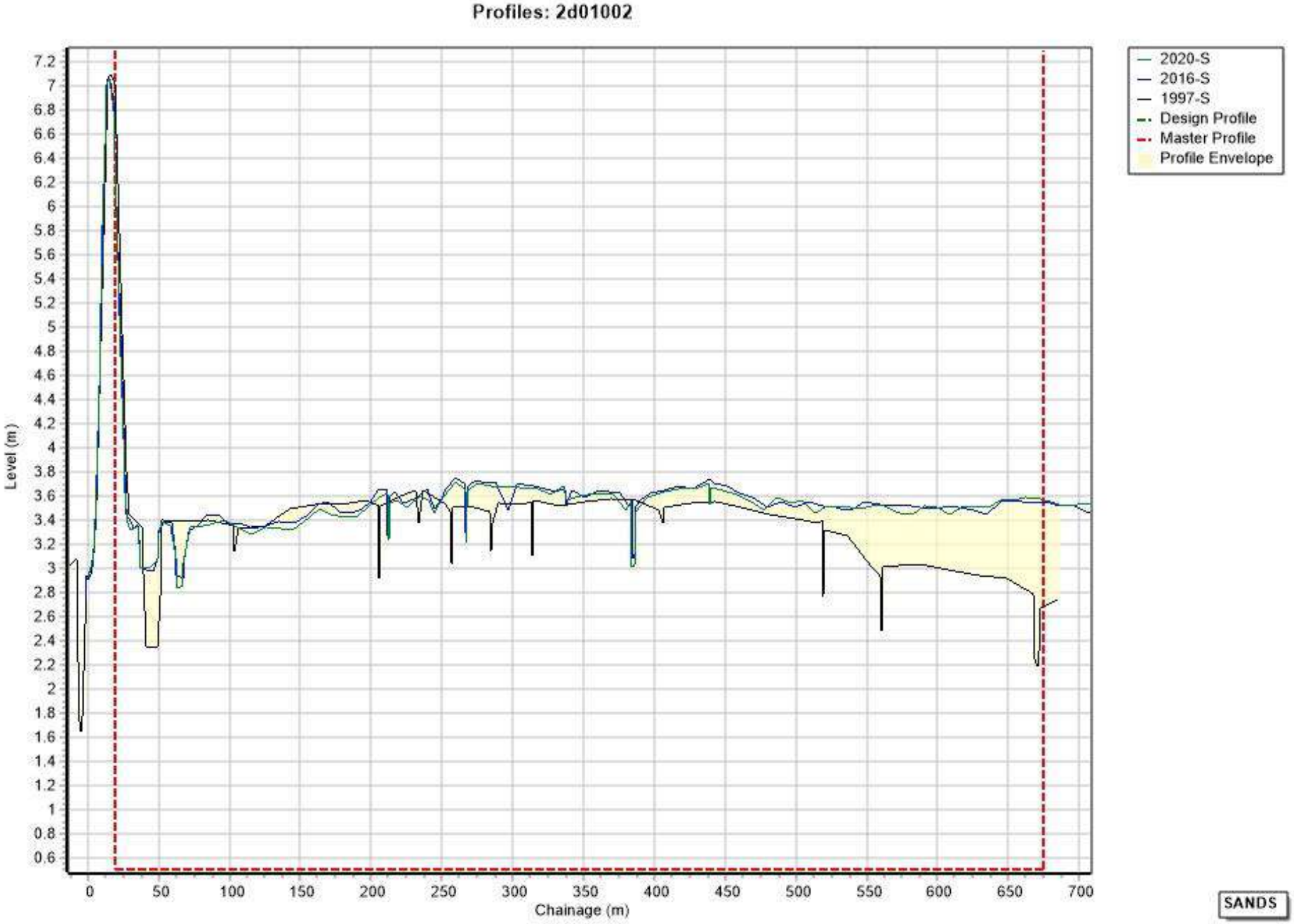
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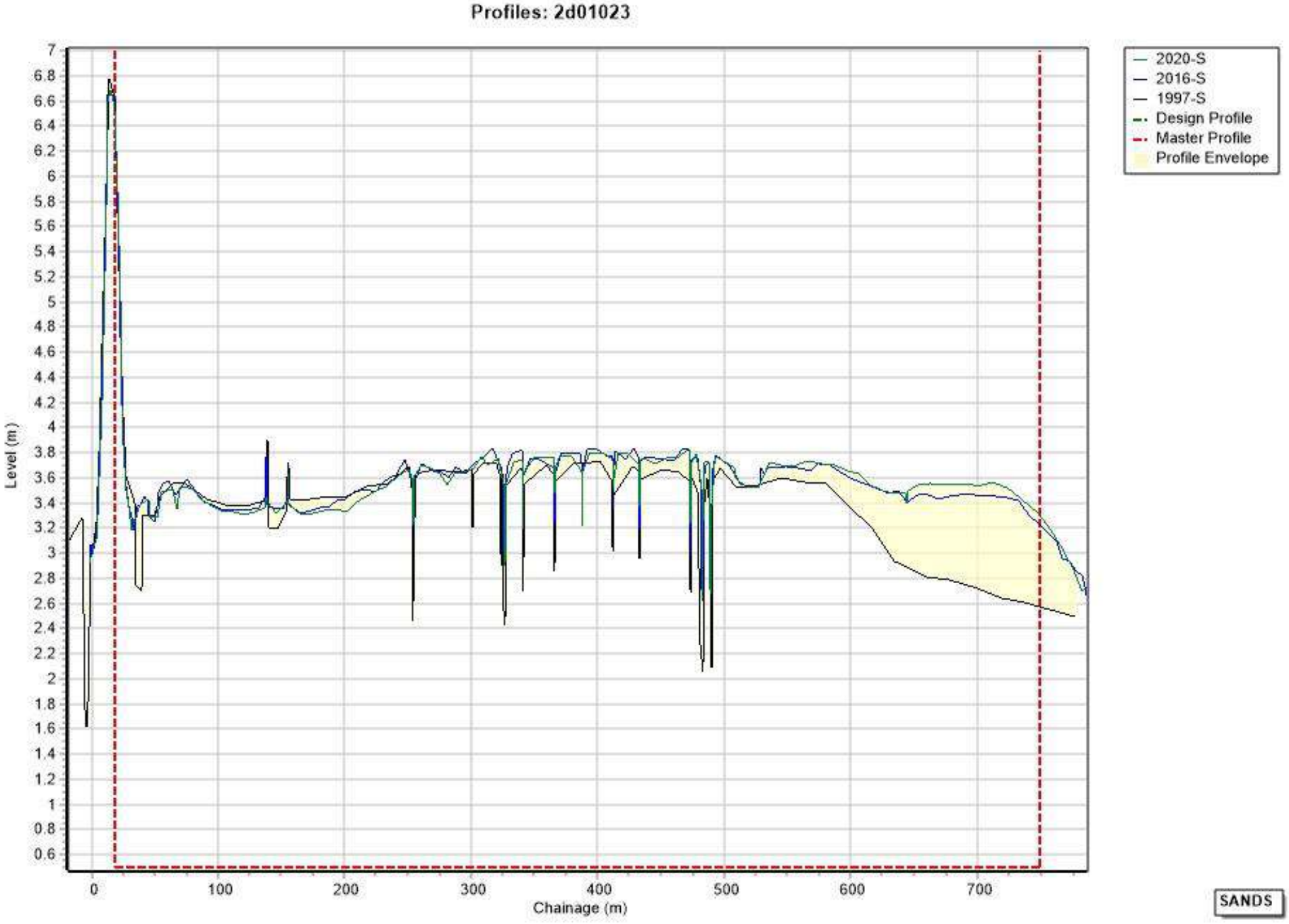
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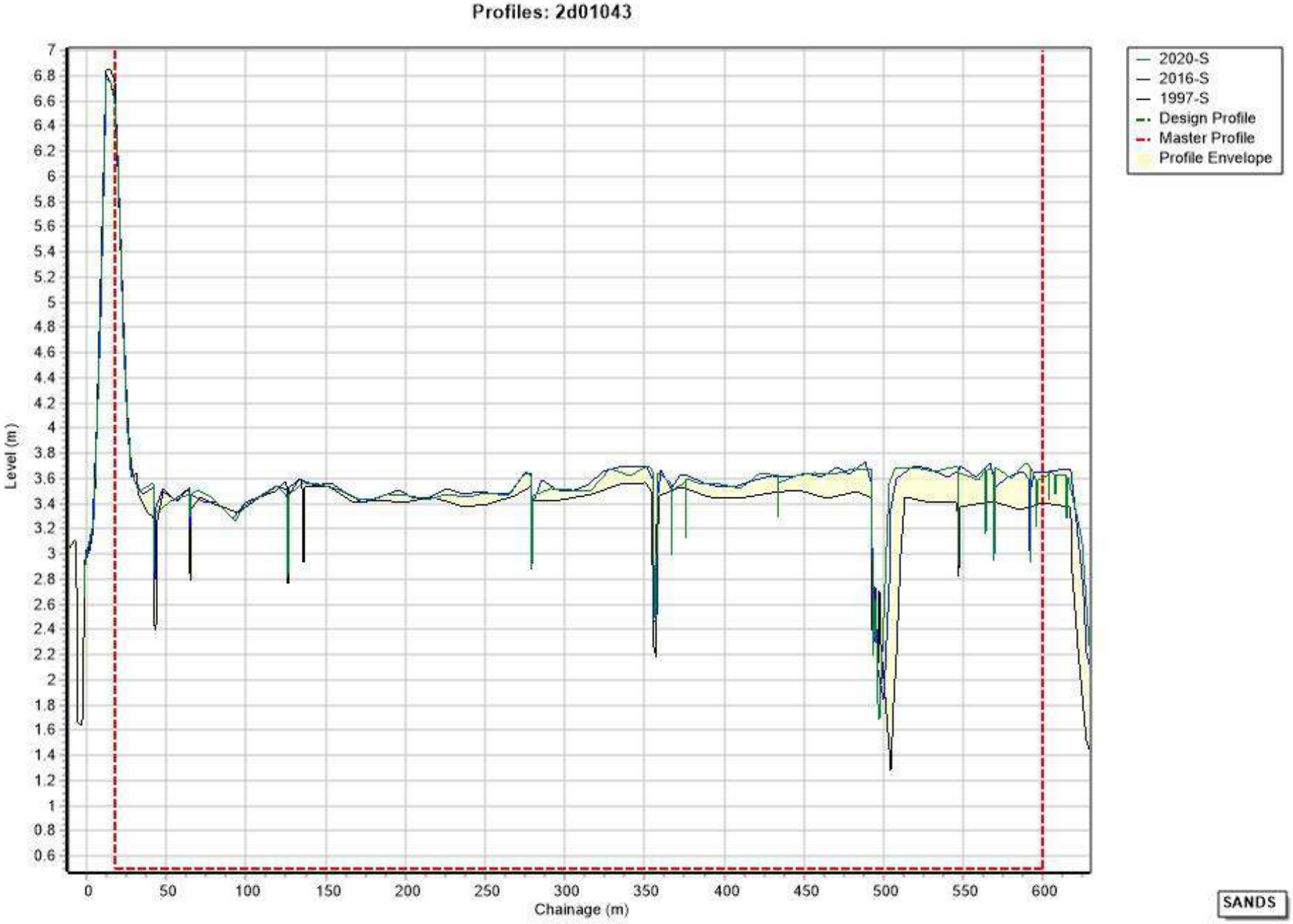
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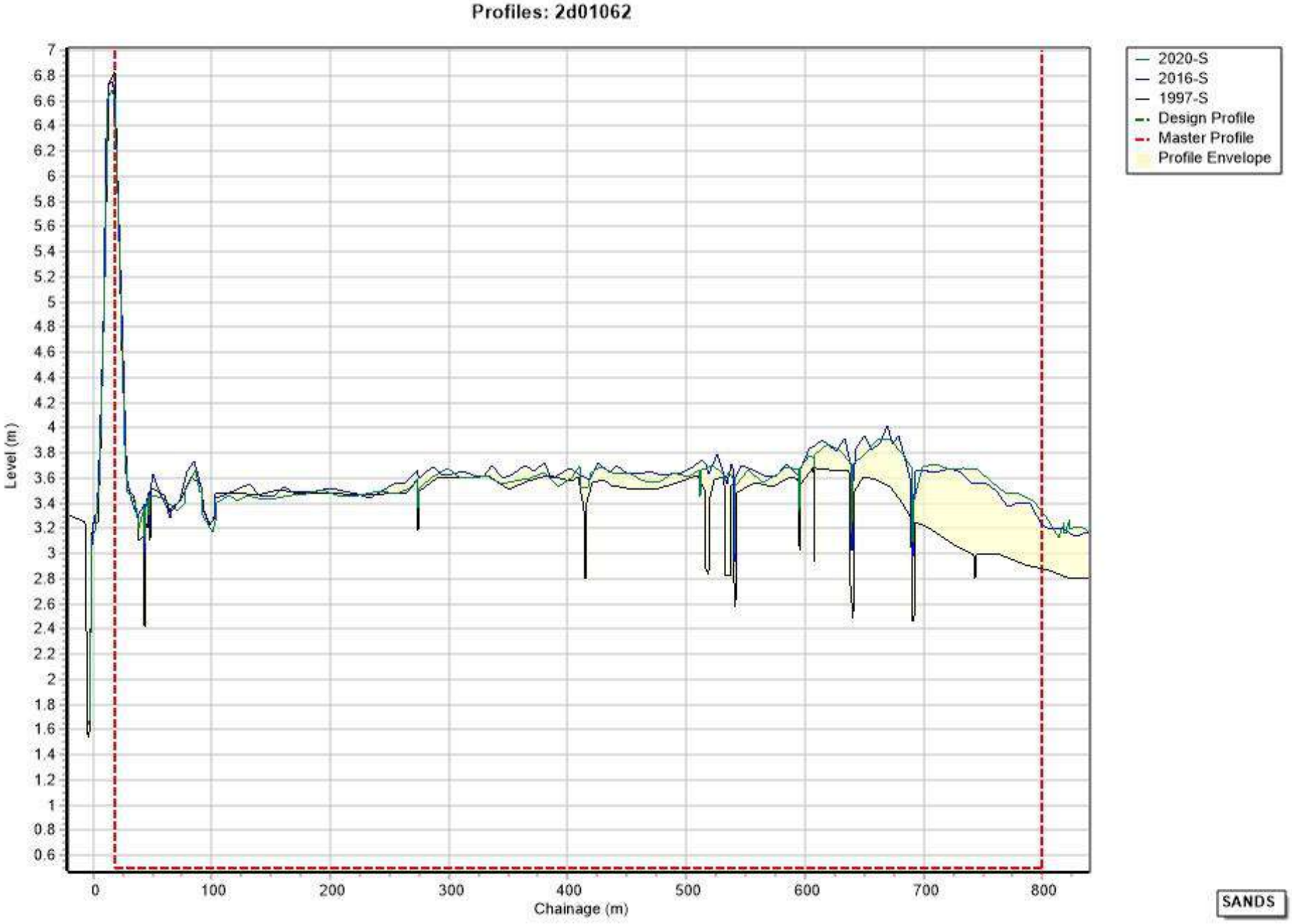
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2016-S
1997-S
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Master Profile
Profile Envelope
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200
300
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500
600
700
800
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1.4
1.6
1.8
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7

SANDS

Positional Trends

Location: W038 Baseline: 1997	HAT 4.53m	MHWS 3.62m	MSL 0.09m	MLWS -2.85m	LAT -3.63m
Total Change	0.15	30.86			
Min Change	-0.83	-8.30			
Max Change	0.79	26.79			
Mean Change	0.01	1.34			
Sdt Dev Change	0.31	6.46			

Location: W038 Baseline: 2016	HAT 4.53m	MHWS 3.62m	MSL 0.09m	MLWS -2.85m	LAT -3.63m
Total Change	0.18	-1.49			
Min Change	-0.03	-8.30			
Max Change	0.14	4.86			
Mean Change	0.04	-0.37			
Sdt Dev Change	0.06	5.25			

Location: W039 Baseline: 1997	HAT 4.54m	MHWS 3.59m	MSL 0.10m	MLWS -2.83m	LAT -3.63m
Total Change	0.32	461.83			
Min Change	-1.44	-154.26			
Max Change	2.29	454.56			
Mean Change	0.01	20.08			
Sdt Dev Change	0.66	102.42			

Location: W039 Baseline: 2016	HAT 4.54m	MHWS 3.59m	MSL 0.10m	MLWS -2.83m	LAT -3.63m
Total Change	0.29	6.05			
Min Change	-0.25	-154.26			
Max Change	0.40	138.75			
Mean Change	0.07	1.51			
Sdt Dev Change	0.26	104.74			

Location: W040 Baseline: 1997	HAT 4.55m	MHWS 3.57m	MSL 0.10m	MLWS -2.80m	LAT -3.63m
Total Change	0.65	80.74			
Min Change	-1.16	-110.34			
Max Change	0.86	110.31			
Mean Change	0.03	3.51			
Sdt Dev Change	0.55	44.6			

Location: W040	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.55m	3.57m	0.10m	-2.80m	-3.63m
Total Change	-0.25	1.68			
Min Change	-0.40	-110.34			
Max Change	0.58	110.31			
Mean Change	-0.06	0.42			
Sdt Dev Change	0.40	98.64			

Location: W041	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1997	4.56m	3.56m	0.10m	-2.78m	-3.63m
Total Change	-0.34	0.43			
Min Change	-1.19	-138.91			
Max Change	1.24	140.54			
Mean Change	-0.01	0.02			
Sdt Dev Change	0.59	41.87			

Location: W041	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.56m	3.56m	0.10m	-2.78m	-3.63m
Total Change	0.09	-140.35			
Min Change	-0.26	-138.91			
Max Change	0.31	24.99			
Mean Change	0.02	-35.09			
Sdt Dev Change	0.24	62.48			

Location: W042	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1997	4.56m	3.53m	0.10m	-2.77m	-3.64m
Total Change	0.53	334.25			
Min Change	-1.79	-52.18			
Max Change	1.83	102.41			
Mean Change	0.02	14.53			
Sdt Dev Change	0.83	41.35			

Location: W042	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.56m	3.53m	0.10m	-2.77m	-3.64m
Total Change	-0.76	120.47			
Min Change	-0.55	-12.00			
Max Change	0.39	66.93			
Mean Change	-0.19	30.12			
Sdt Dev Change	0.35	31.54			

Location: W043 Baseline: 1997	HAT 4.56m	MHWS 3.51m	MSL 0.10m	MLWS -2.75m	LAT -3.64m
Total Change	1.13	135.75			
Min Change	-1.80	-95.95			
Max Change	1.94	138.05			
Mean Change	0.05	5.90			
Sdt Dev Change	0.91	40.08			

Location: W043 Baseline: 2016	HAT 4.56m	MHWS 3.51m	MSL 0.10m	MLWS -2.75m	LAT -3.64m
Total Change	1.06	-2.99			
Min Change	0.03	-5.52			
Max Change	0.61	4.11			
Mean Change	0.26	-0.75			
Sdt Dev Change	0.24	4.00			

Location: W044 Baseline: 1997	HAT 4.57m	MHWS 3.48m	MSL 0.09m	MLWS -2.73m	LAT -3.66m
Total Change	0.29	85.99			
Min Change	-0.94	-23.67			
Max Change	1.64	43.01			
Mean Change	0.01	3.74			
Sdt Dev Change	0.49	12.70			

Location: W044 Baseline: 2016	HAT 4.57m	MHWS 3.48m	MSL 0.09m	MLWS -2.73m	LAT -3.66m
Total Change	-0.13	6.83			
Min Change	-0.55	-18.47			
Max Change	0.30	19.70			
Mean Change	-0.03	1.71			
Sdt Dev Change	0.32	13.54			

Location: W045 Baseline: 1997	HAT 4.59m	MHWS 3.46m	MSL 0.09m	MLWS -2.72m	LAT -3.66m
Total Change	-0.42	284.30			
Min Change	-1.13	-18.48			
Max Change	0.94	77.35			
Mean Change	-0.02	12.36			
Sdt Dev Change	0.48	23.93			

Location: W045	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.59m	3.46m	0.09m	-2.72m	-3.66m
Total Change	-0.89	14.39			
Min Change	-1.13	-18.48			
Max Change	0.61	21.20			
Mean Change	-0.22	3.60			
Sdt Dev Change	0.64	14.22			

Location: W046	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1997	4.60m	3.45m	0.09m	-2.70m	-3.67m
Total Change	-0.14	392.80			
Min Change	-0.86	-17.04			
Max Change	0.75	195.09			
Mean Change	-0.01	17.08			
Sdt Dev Change	0.50	41.30			

Location: W046	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.60m	3.45m	0.09m	-2.70m	-3.67m
Total Change	-0.23	27.64			
Min Change	-0.57	-17.04			
Max Change	0.45	31.28			
Mean Change	-0.06	6.91			
Sdt Dev Change	0.37	18.27			

Location: W047	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1997	4.59m	3.44m	0.09m	-2.70m	-3.67m
Total Change	-1.77	292.29			
Min Change	-1.75	-62.15			
Max Change	0.33	157.68			
Mean Change	-0.08	12.71			
Sdt Dev Change	0.39	43.43			

Location: W047	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.59m	3.44m	0.09m	-2.70m	-3.67m
Total Change	-0.36	18.36			
Min Change	-0.27	-21.70			
Max Change	0.12	43.10			
Mean Change	-0.09	4.59			
Sdt Dev Change	0.16	23.74			

Location: W048 Baseline: 1997	HAT 4.59m	MHWS 3.45m	MSL 0.09m	MLWS -2.71m	LAT -3.68m
Total Change	0.00	140.53			
Min Change	-0.53	-8.26			
Max Change	0.51	35.13			
Mean Change	0.00	6.11			
Sdt Dev Change	0.25	10.34			

Location: W048 Baseline: 2016	HAT 4.59m	MHWS 3.45m	MSL 0.09m	MLWS -2.71m	LAT -3.68m
Total Change	0.16	14.92			
Min Change	-0.26	-8.26			
Max Change	0.36	13.91			
Mean Change	0.04	3.73			
Sdt Dev Change	0.27	7.93			

Location: W049 Baseline: 1997	HAT 4.59m	MHWS 3.45m	MSL 0.09m	MLWS -2.71m	LAT -3.68m
Total Change	-0.12	275.20			
Min Change	-0.67	-77.15			
Max Change	1.16	101.75			
Mean Change	-0.01	11.97			
Sdt Dev Change	0.43	35.30			

Location: W049 Baseline: 2016	HAT 4.59m	MHWS 3.45m	MSL 0.09m	MLWS -2.71m	LAT -3.68m
Total Change	-0.20	6.35			
Min Change	-0.13	-2.02			
Max Change	0.02	3.78			
Mean Change	-0.05	1.59			
Sdt Dev Change	0.07	2.19			

Location: W050 Baseline: 1997	HAT 4.59m	MHWS 3.46m	MSL 0.10m	MLWS -2.71m	LAT -3.68m
Total Change	-0.20	106.76			
Min Change	-0.97	-11.66			
Max Change	0.88	29.60			
Mean Change	-0.01	4.64			
Sdt Dev Change	0.33	9.14			

Location: W050 Baseline: 2016	HAT 4.59m	MHWS 3.46m	MSL 0.10m	MLWS -2.71m	LAT -3.68m
Total Change	-0.61	19.40			
Min Change	-0.30	-2.15			
Max Change	-0.01	16.93			
Mean Change	-0.15	4.85			
Sdt Dev Change	0.12	7.34			

4.4. Hunstanton to Heacham – 2dSU04HH

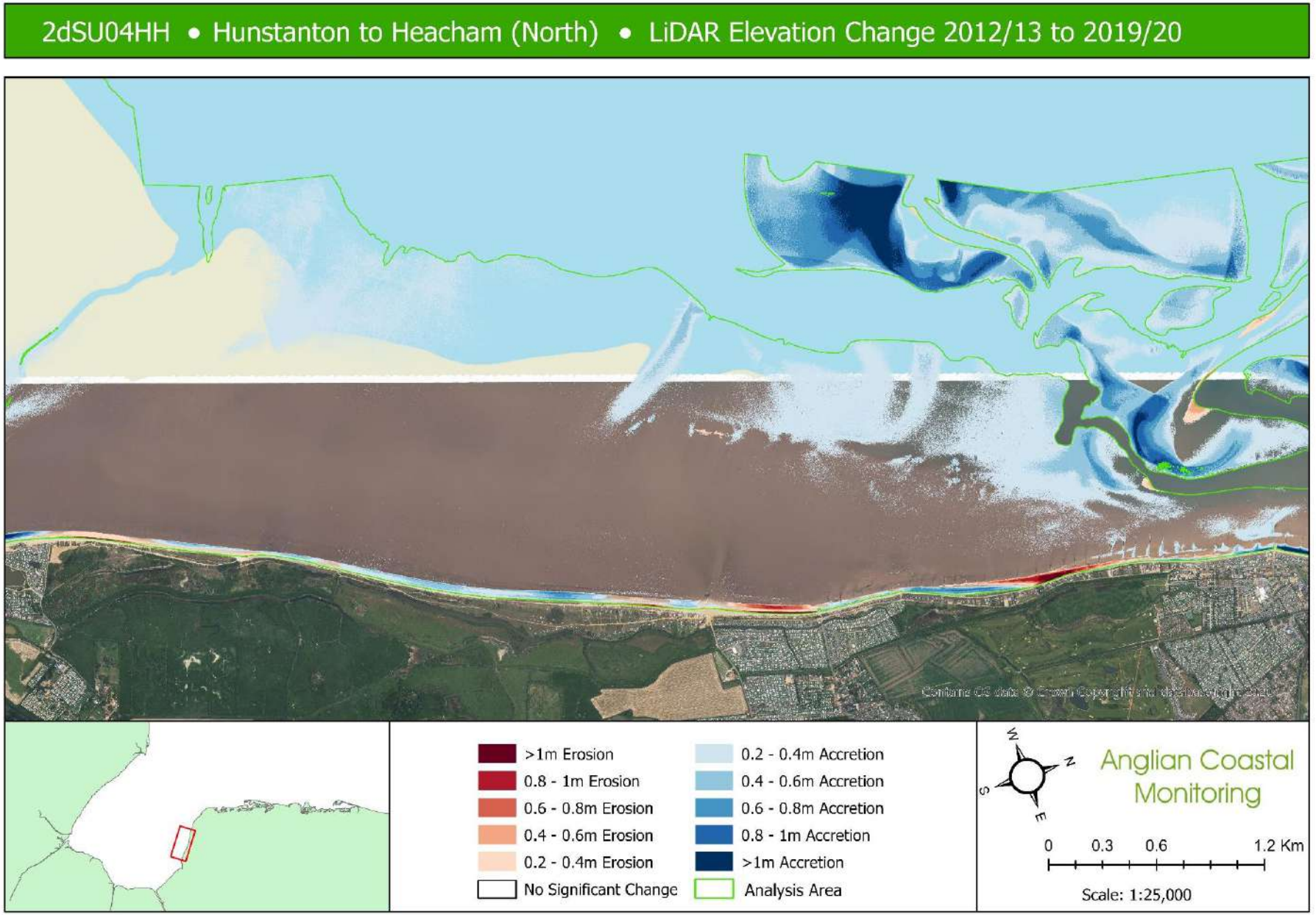
Topographic profiles in this monitoring cell increase from W051, to the north of Wolferton, to W061, adjacent to Hunstanton boat ramp. The CSA analysis shows that change in CSA varies significantly through the monitoring cell. No locations show significant erosion although the greatest loss of area occurs at W056 with 4.13% erosion observed since 1992. The greatest positive change is at W052 with 24.21% change since 1992. Most locations showing any level of negative change are in in the centre of the monitoring cell, north of Heacham. The current phase trends show no significant change however there is a greater level of erosion seen across the monitoring cell which may be of concern if the trend continues.

Lidar shows greater spatial variation in patterns of erosion and accretion. Heavy erosion is seen in the upper beach areas surrounding Hunstanton with significant accretion seen further offshore. These changes appear to balance resulting in the low levels of change seen across a whole transect in the CSA change table.

CSA Table

Locations	Baseline to present		Current Phase to Present	
	1992-S to 2020-S		2016-S to 2020-S	
Location	CSA Diff (m2)	% Change	CSA Diff (m2)	% Change
2d01099 [W051]	16.53	0.43	25.08	0.19
2d01105 [HH006]	86.18	4.94	12.54	0.55
2d01109 [HH010]	136.1	10.48	18.86	1.02
2d01113 [HH014]	143.84	9.59	13.86	0.62
2d01119 [W052]	149.73	9.91	50.53	0.42
2d01125 [HH025]	205.96	15.05	23.93	1.37
2d01129 [HH029]	237.34	19.69	23.98	1.3
2d01133 [HH033]	204.98	18.09	25.3	1.68
2d01139 [W053]	256.35	23.06	128.78	2.44
2d01145 [HH044]	-58.19	-2.92	63.25	2.8
2d01149 [HH048]	118.57	10.75	34.74	1.98
2d01153 [HH052]	225.72	24.21	26.6	1.57
2d01159 [W054]	61.99	3.34	39.75	1.54
2d01160 [W055]	394.34	13.37	97.76	2.23
2d01166 [HH063]	-28.55	-2.91	-3.74	-0.3
2d01170 [HH067]	22.8	2.04	4.13	0.25
2d01174 [HH071]	115.11	10.52	-7.78	-0.51
2d01180 [W056]	-96.45	-4.13	-9.81	-0.32
2d01186 [HH082]	-31.87	-3.94	-18.44	-1.62
2d01190 [HH086]	-8.67	-0.98	-5.37	-0.46
2d01194 [HH090]	-8.44	-0.86	-2.08	-0.17
2d01200 [W057]	-34.75	-1.53	-4.59	-0.17
2d01206 [HH101]	180.5	19.69	28.44	2.22
2d01210 [HH105]	174.77	15.17	50.83	2.11
2d01216 [HH111]	75.99	8.68	17.26	1.63
2d01220 [W058]	43.18	2.55	46.69	2.11
2d01226 [HH120]	78.88	9.52	-15.7	-1.31
2d01234 [HH128]	17.64	2.33	21.98	2.16
2d01240 [W059]	172.42	12.89	69.23	3.37
2d01244 [HH137]	-5.96	-0.96	12.61	1.51
2d01248 [HH141]	55.09	8.85	30.97	3.5
2d01252 [HH145]	125.55	18.99	33.34	3.37

2d01256 [HH149]	59.19	9.33	-22.69	-2.4
2d01260 [W060]	-6.16	-0.91	87.29	6.47
2d01264 [HH156]	-2.65	-0.54	4.71	0.7
2d01268 [HH160]	11.84	2.76	4.43	0.72
2d01272 [HH164]	21.66	4.34	24.56	3.56
2d01276 [HH168]	38.14	6.96	23.42	3.21
2d01280 [W061]	34.62	5.62	27.94	3.49
	Av=75.79	Av=6.75%	Av=25.27	Av=1.50%
	Min=-96.45	Min=-4.13%	Min=-22.69	Min=-2.40%
	Max=394.34	Max=24.21%	Max=128.78	Max=6.47%


2dSU04HH • Hunstanton to Heacham (North) • LiDAR Elevation Change 2012/13 to 2019/20
>1m Erosion
0.8 - 1m Erosion
0.6 - 0.8m Erosion
0.4 - 0.6m Erosion
0.2 - 0.4m Erosion
No Significant Change
0.2 - 0.4m Accretion
0.4 - 0.6m Accretion
0.6 - 0.8m Accretion
0.8 - 1m Accretion
>1m Accretion
Analysis Area
N
S
E
Anglian Coastal Monitoring
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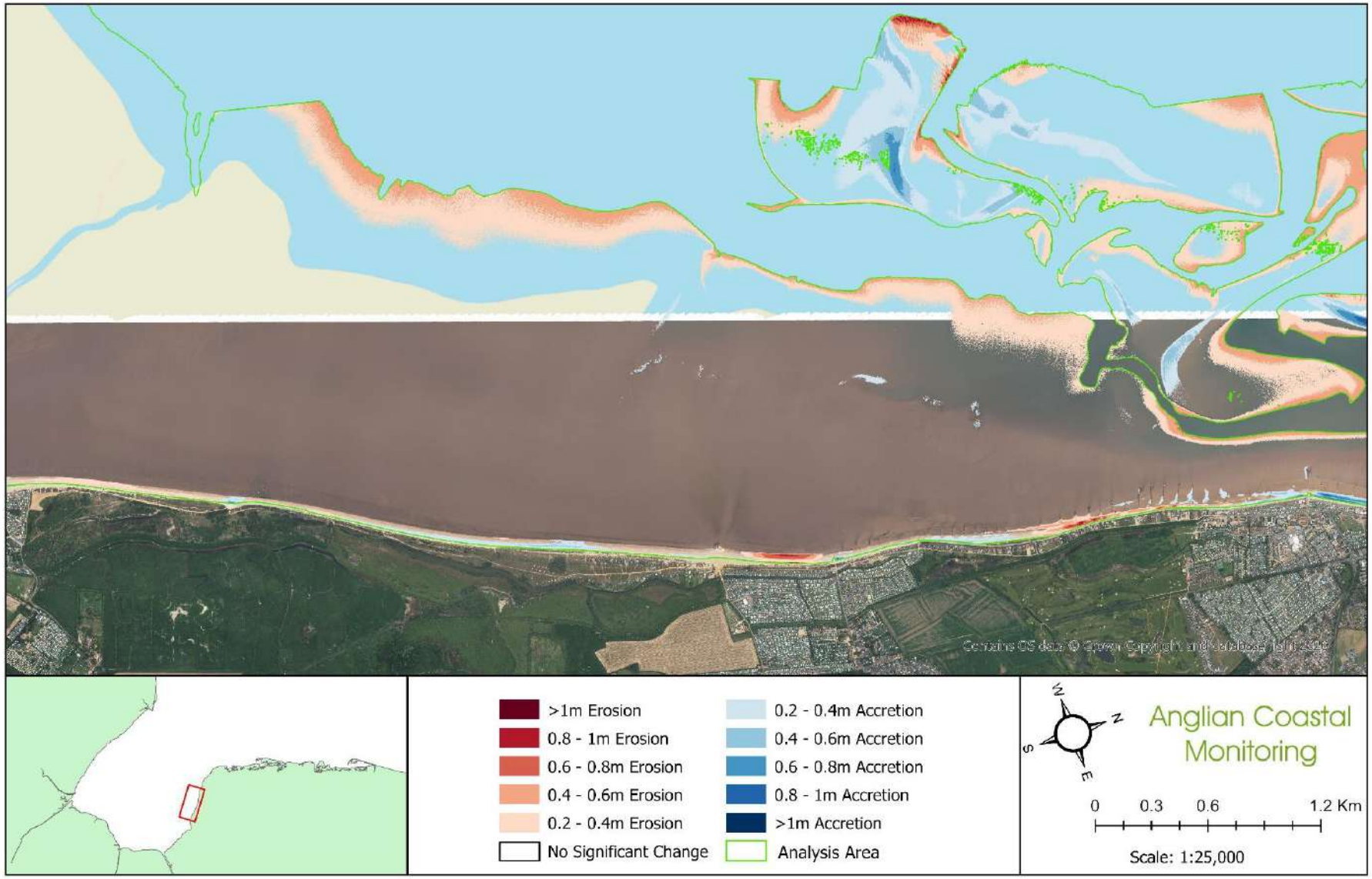
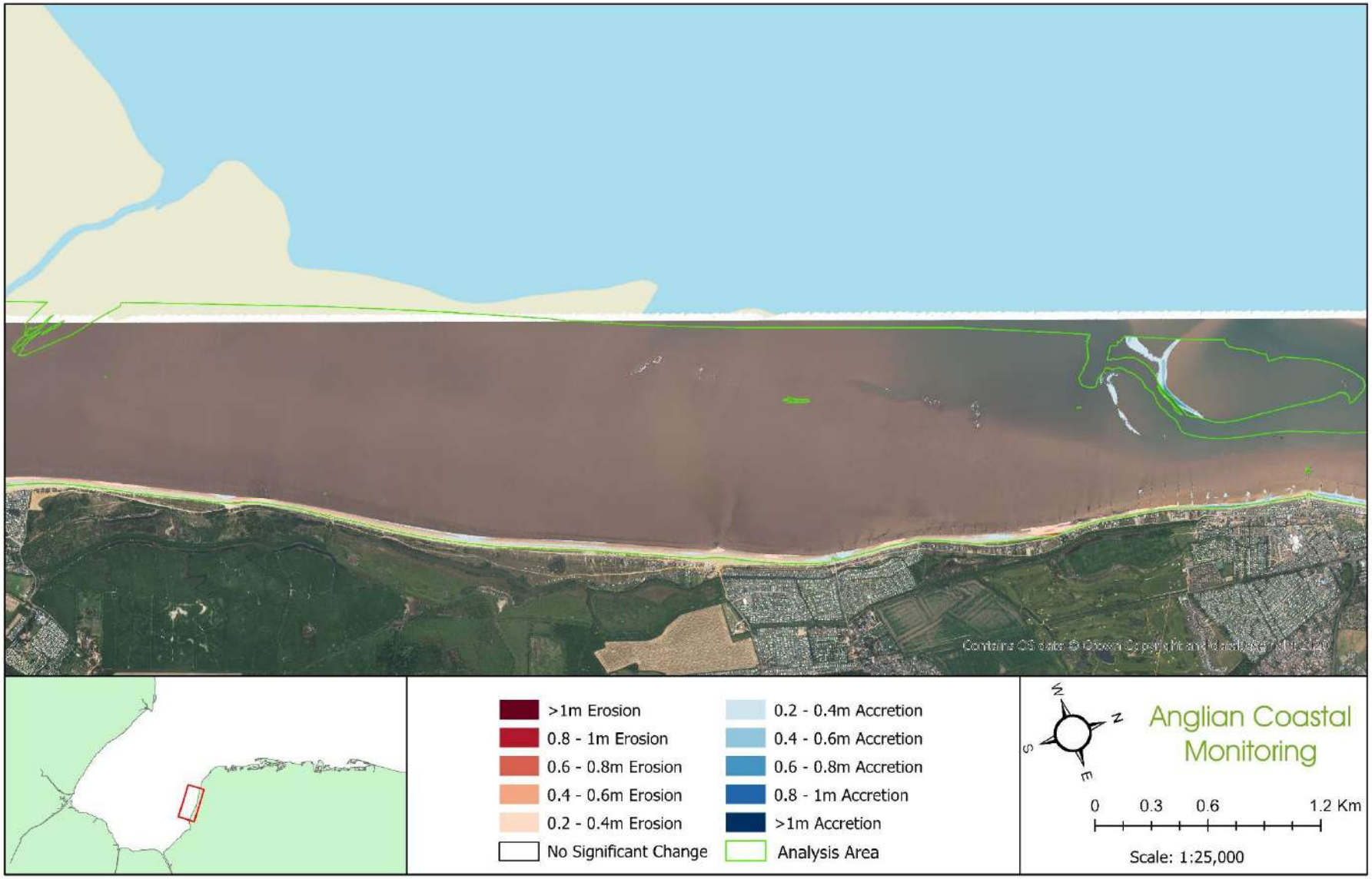
Scale: 1:25,000

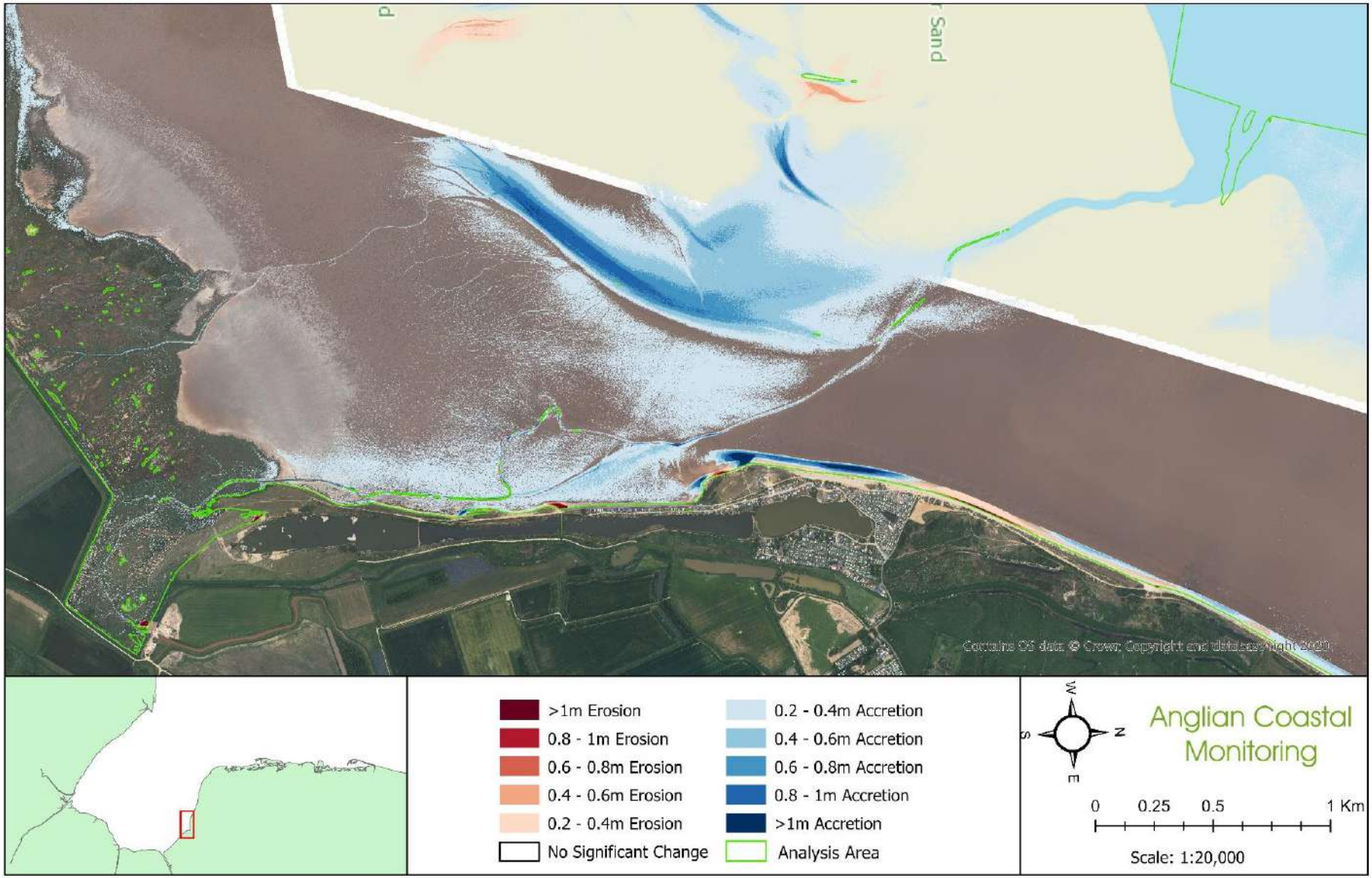
2dSU04HH • Hunstanton to Heacham (North) • LiDAR Elevation Change 2016/17 to 2019/20



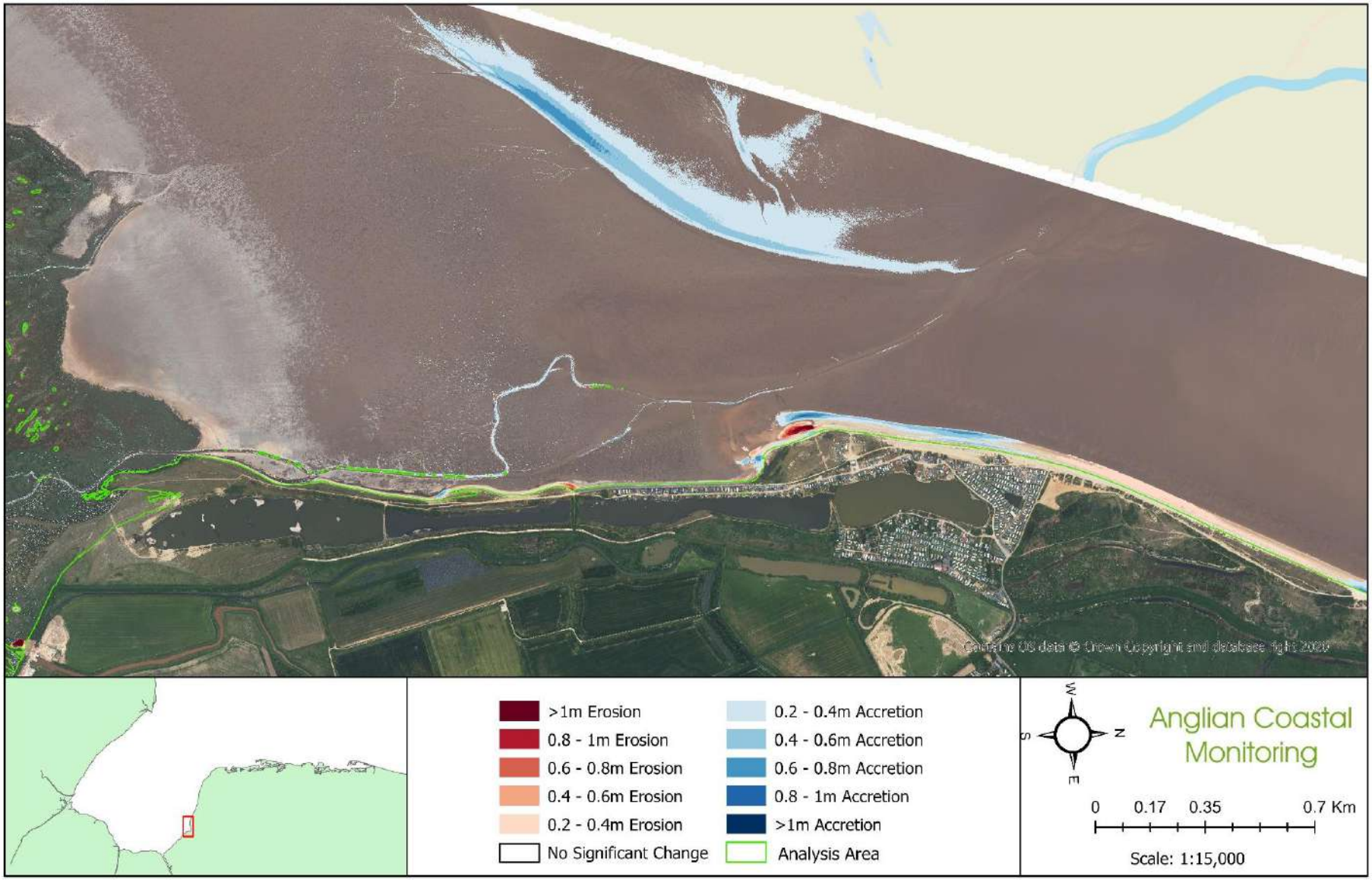
2dSU04HH • Hunstanton to Heacham (North) • LiDAR Elevation Change 2018/19 to 2019/20



2dSU04HH • Hunstanton to Heacham (South) • LiDAR Elevation Change 2012/13 to 2019/20



2dSU04HH • Hunstanton to Heacham (South) • LiDAR Elevation Change 2016/17 to 2019/20



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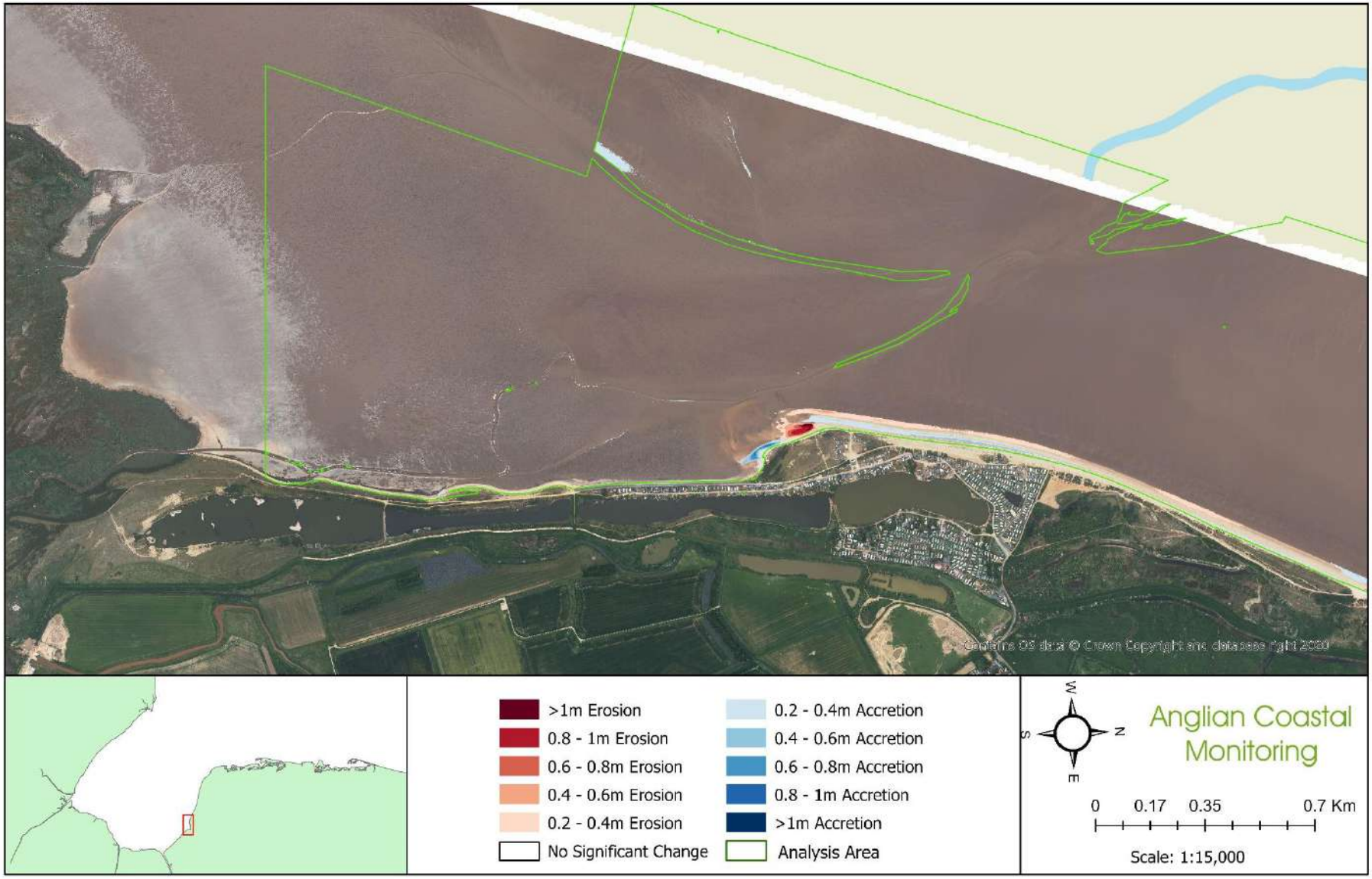

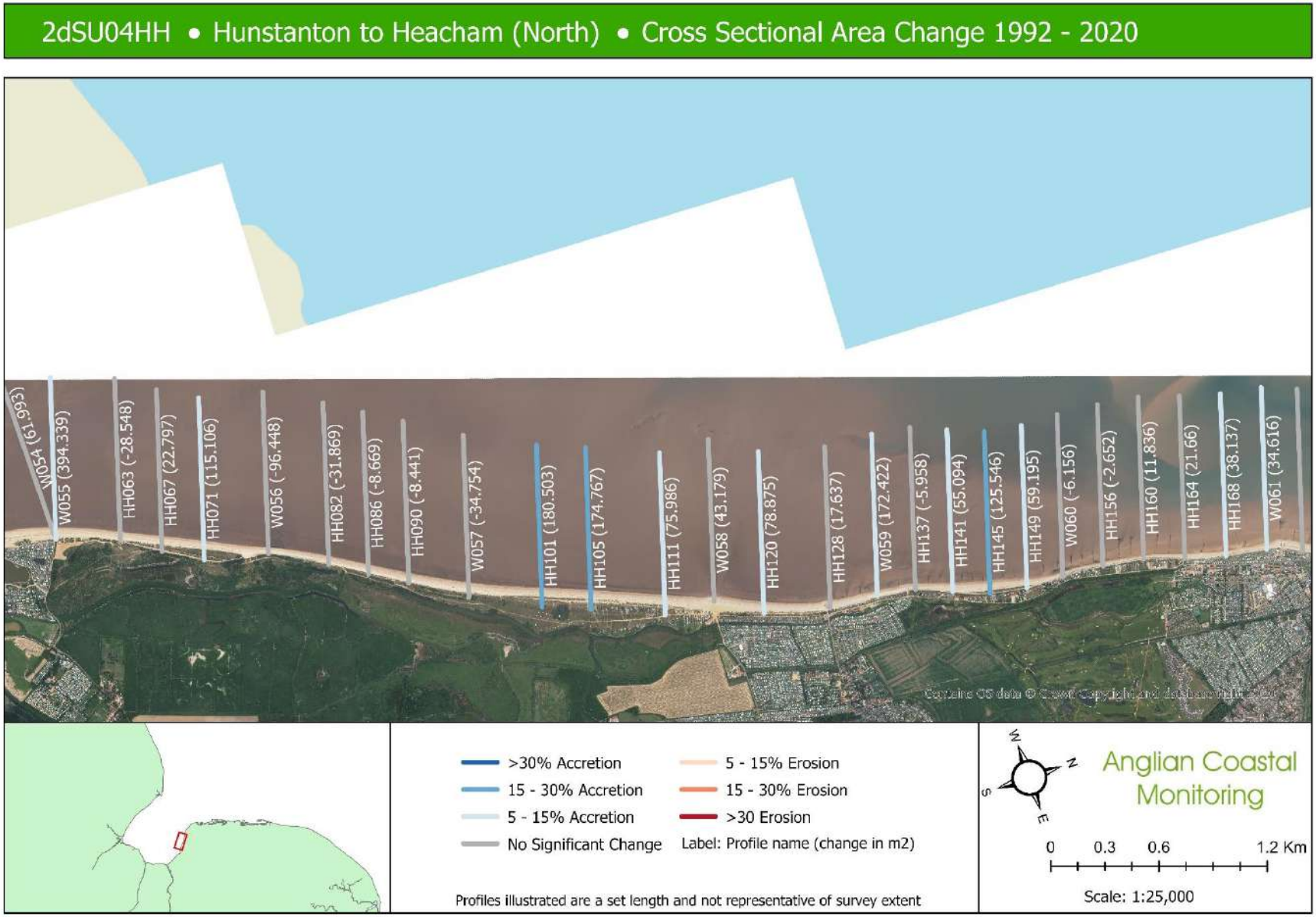
2dSU04HH • Hunstanton to Heacham (North) • Cross Sectional Area Change 1992 - 2020
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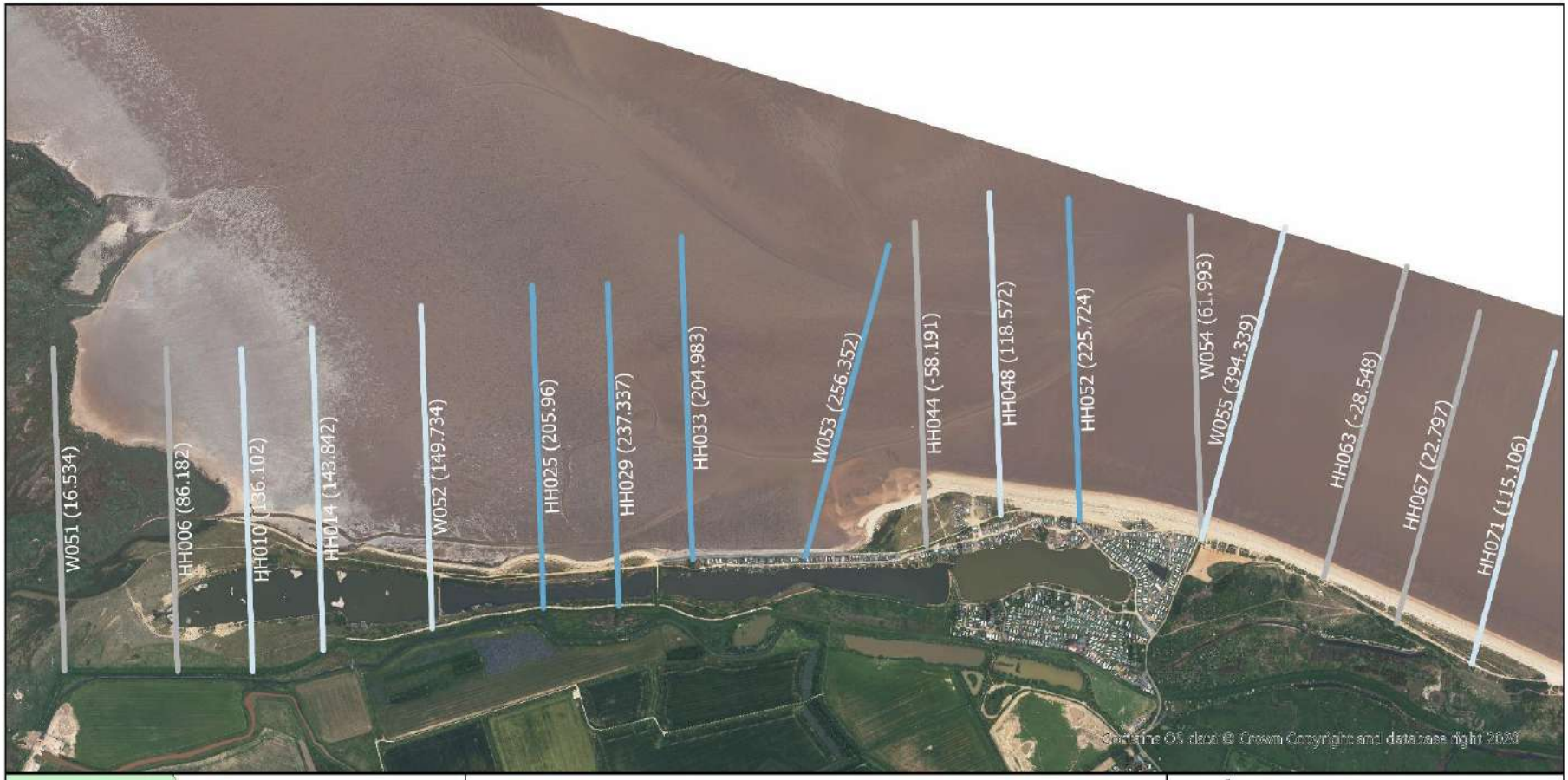
W055 (394.339)
HH063 (-28.548)
HH067 (22.797)
HH071 (115.106)
W056 (-96.448)
HH082 (-31.869)
HH086 (-8.669)
HH090 (-8.441)
W057 (-34.754)
HH101 (180.503)
HH105 (174.767)
HH111 (75.986)
W058 (43.179)
HH120 (78.875)
HH128 (17.637)
W059 (172.422)
HH137 (-5.958)
HH141 (55.094)
HH145 (125.546)
HH149 (59.195)
W060 (-6.156)
HH156 (-2.652)
HH160 (11.836)
HH164 (21.66)
HH168 (38.137)
W061 (34.616)
>30% Accretion
15 - 30% Accretion
5 - 15% Accretion
No Significant Change
5 - 15% Erosion
15 - 30% Erosion
>30 Erosion
Label: Profile name (change in m2)
Profiles illustrated are a set length and not representative of survey extent
N
S
E
Anglian Coastal Monitoring
0
0.3
0.6
1.2 Km
Scale: 1:25,000

2dSU04HH • Hunstanton to Heacham (South) • Cross Sectional Area Change 1992 - 2020



>30% Accretion
15 - 30% Accretion
5 - 15% Accretion
No Significant Change

5 - 15% Erosion
15 - 30% Erosion
>30 Erosion

Label: Profile name (change in m2)

Profiles illustrated are a set length and not representative of survey extent

Anglian Coastal Monitoring

0 0.17 0.35 0.7 Km

Scale: 1:15,000

2dSU04HH • Hunstanton to Heacham (North) • Cross Sectional Area Change 2016 - 2020

>30% Accretion
15 - 30% Accretion
5 - 15% Accretion
No Significant Change

5 - 15% Erosion
15 - 30% Erosion
>30 Erosion

Label: Profile name (change in m2)

Profiles illustrated are a set length and not representative of survey extent

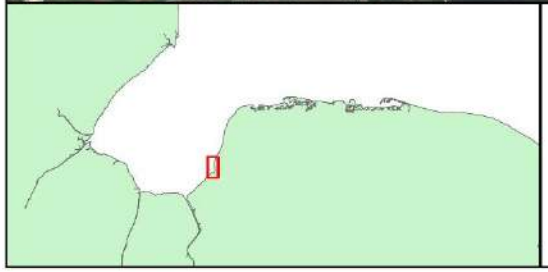
N S E

Anglian Coastal Monitoring

0 0.3 0.6 1.2 Km

Scale: 1:25,000

2dSU04HH • Hunstanton to Heacham (South) • Cross Sectional Area Change 2016 - 2020



>30% Accretion
15 - 30% Accretion
5 - 15% Accretion
No Significant Change

5 - 15% Erosion
15 - 30% Erosion
>30 Erosion

Label: Profile name (change in m2)

Profiles illustrated are a set length and not representative of survey extent

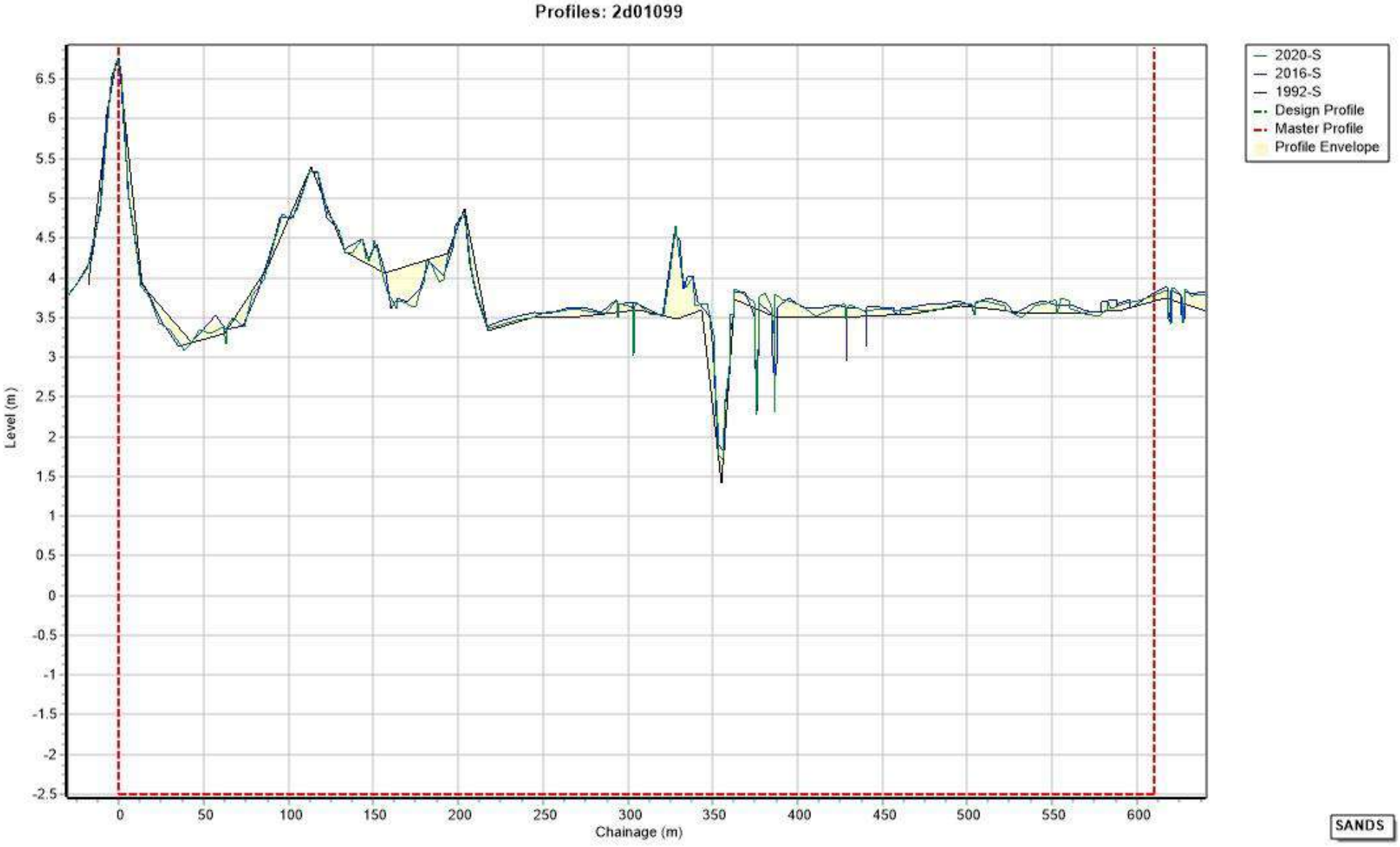
W
S
N
E

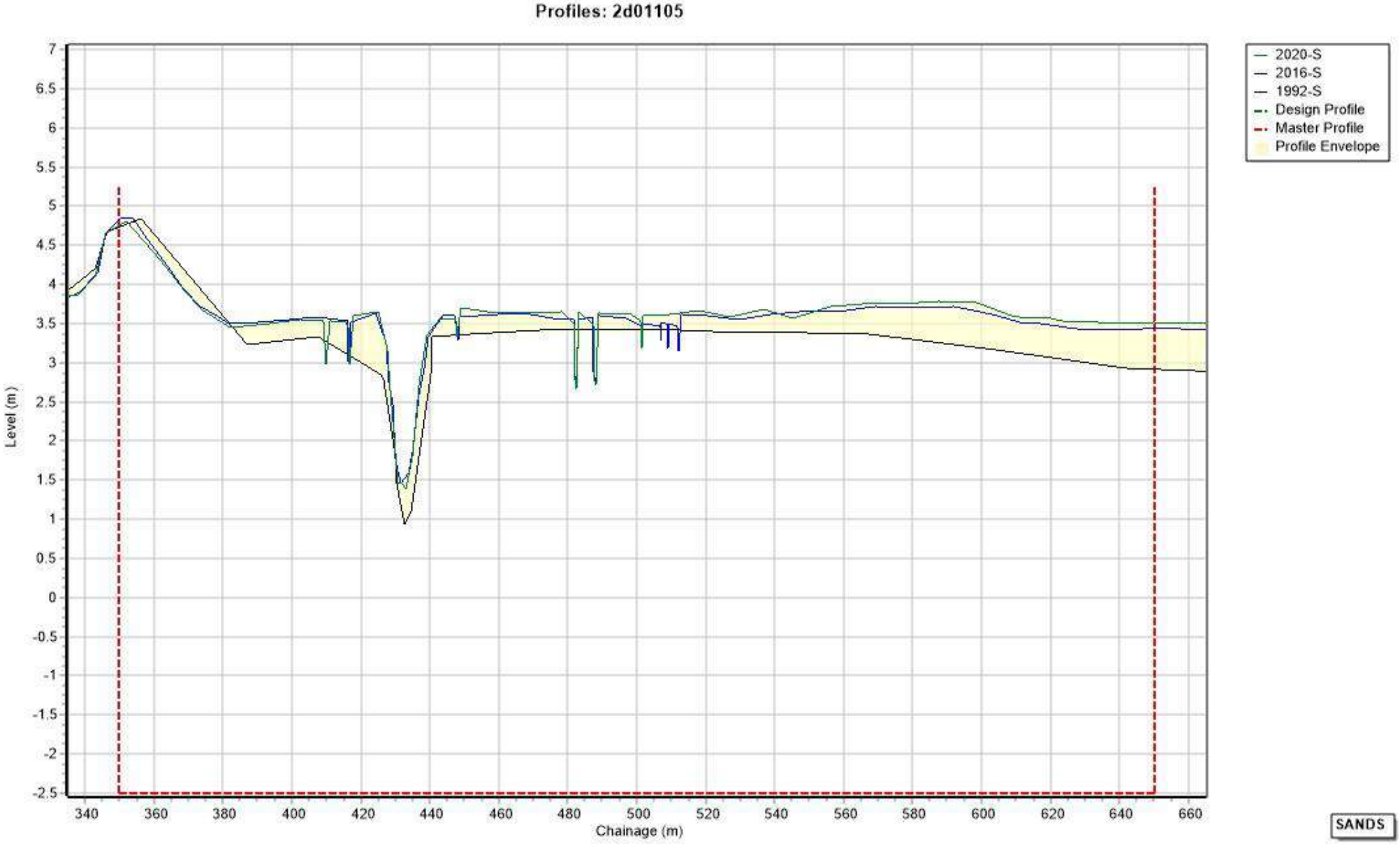
Anglian Coastal Monitoring

0 0.17 0.35 0.7 Km

Scale: 1:15,000

Profile Graphs

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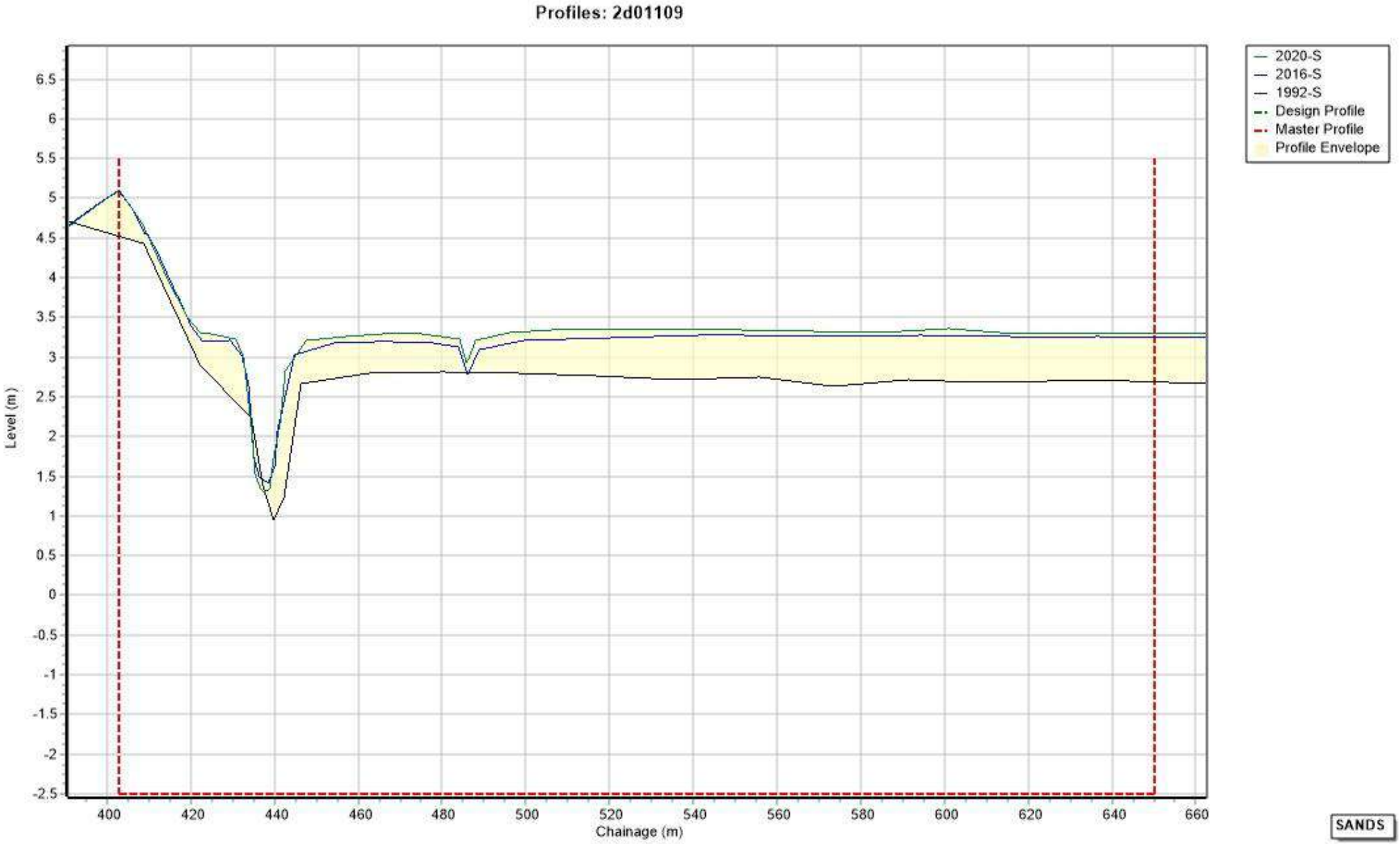
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS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2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
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-1
-1.5
-2
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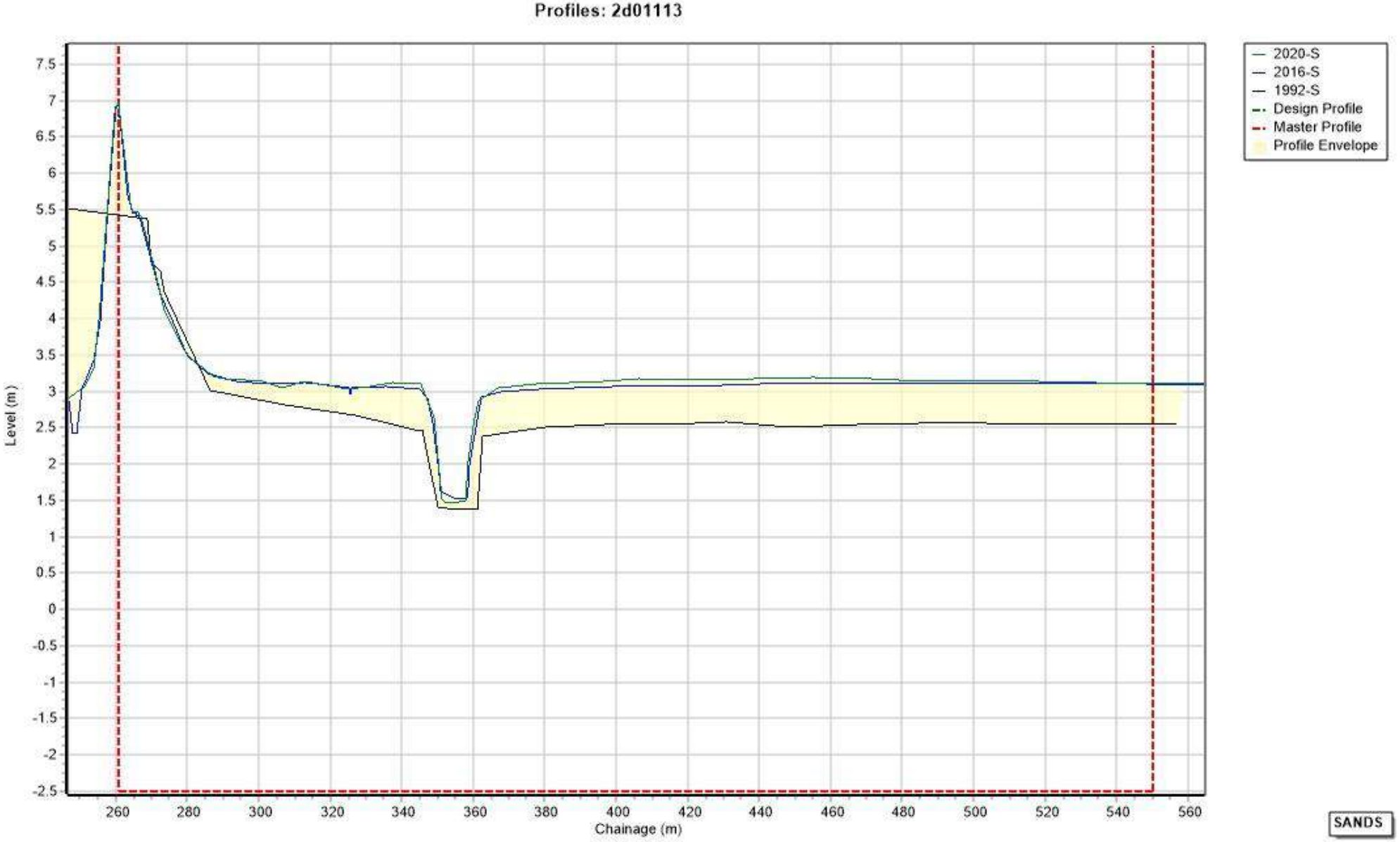
600
620
640
660
Chainage (m)
SANDS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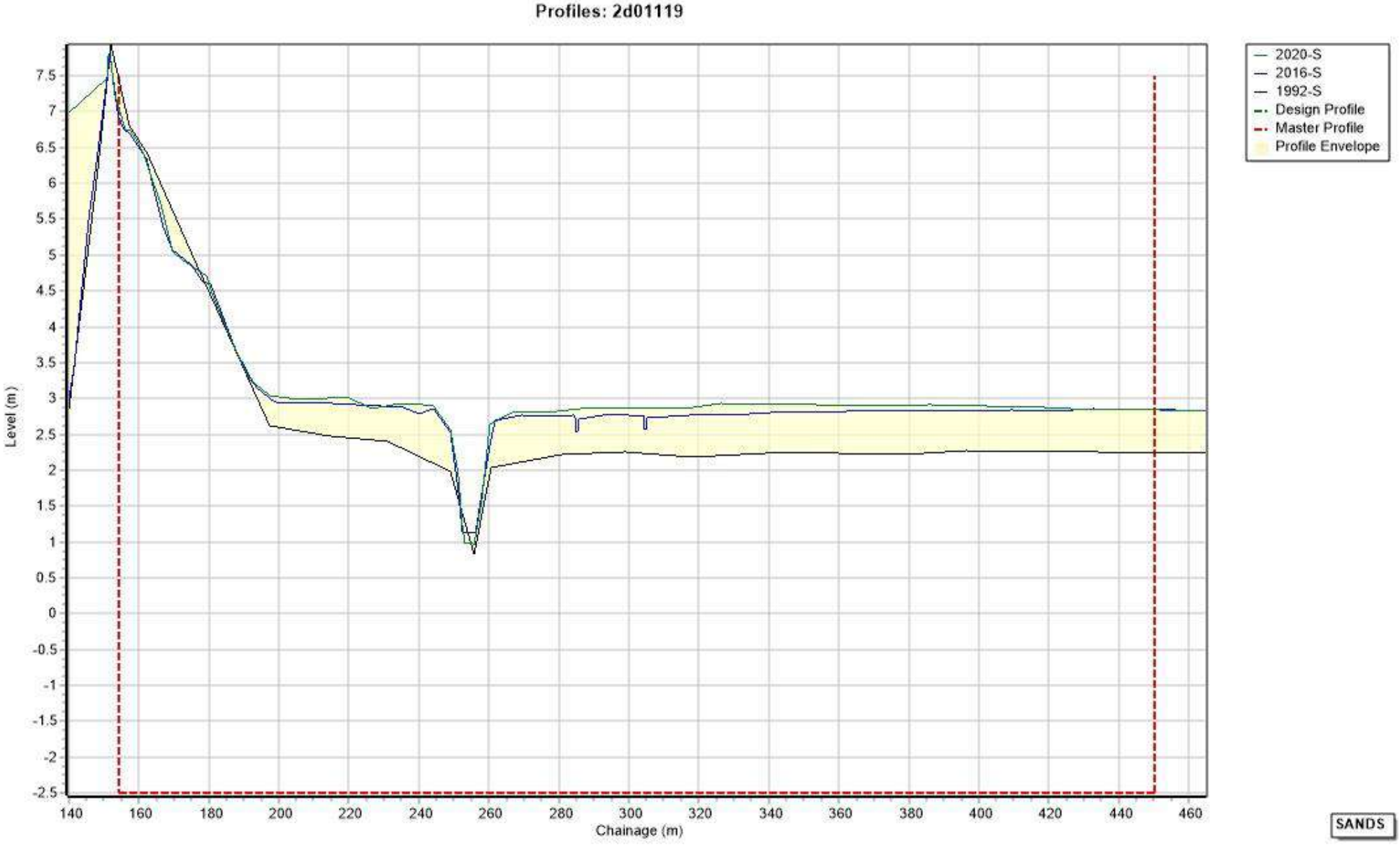
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS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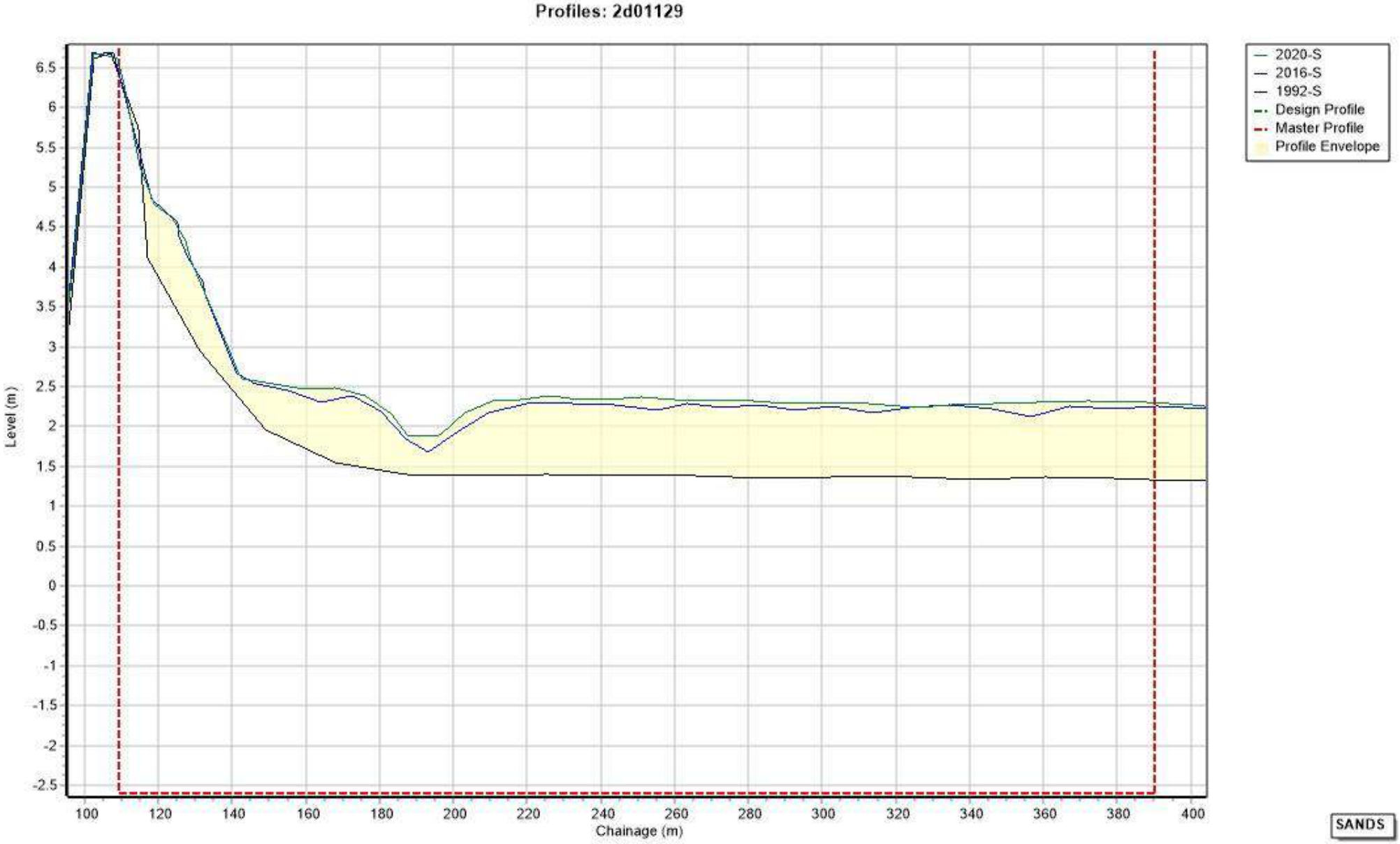
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01125
2020-S
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
Chainage (m)
SANDS


Profiles: 2d01129
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1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
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5.5
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4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
100
120
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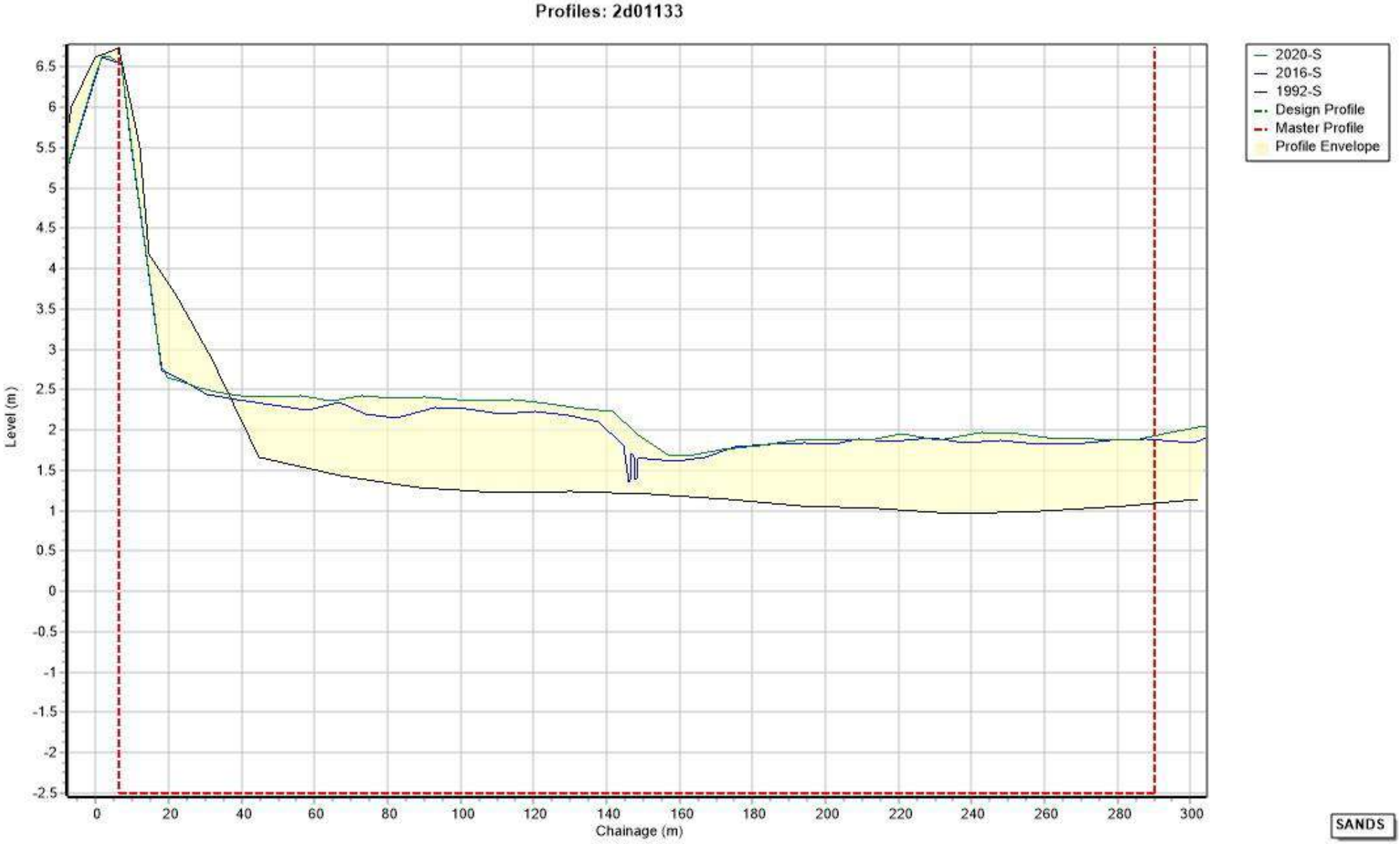
160
180
200
220
240
260
280
300
320
340
360
380
400
Chainage (m)
SANDS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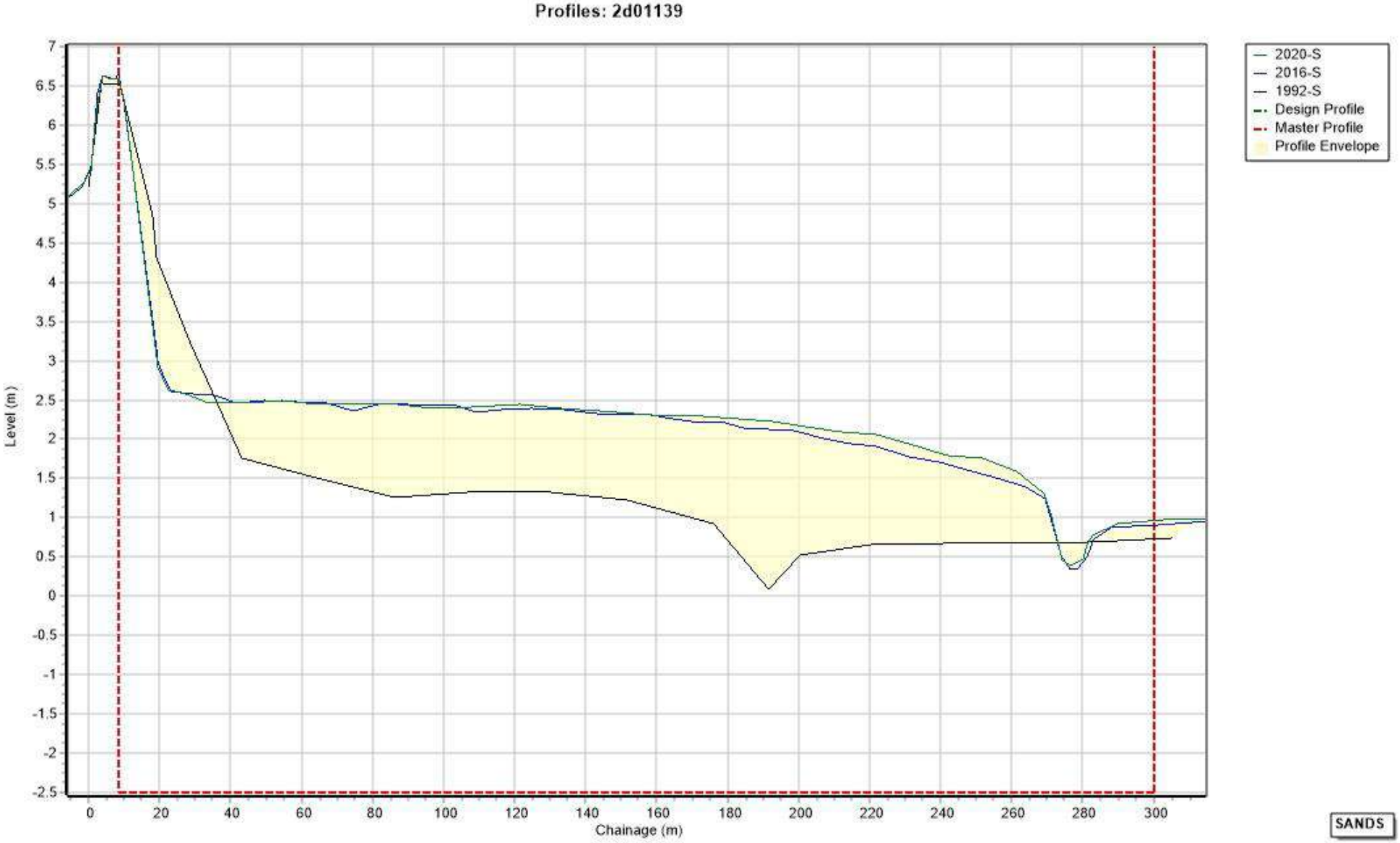
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS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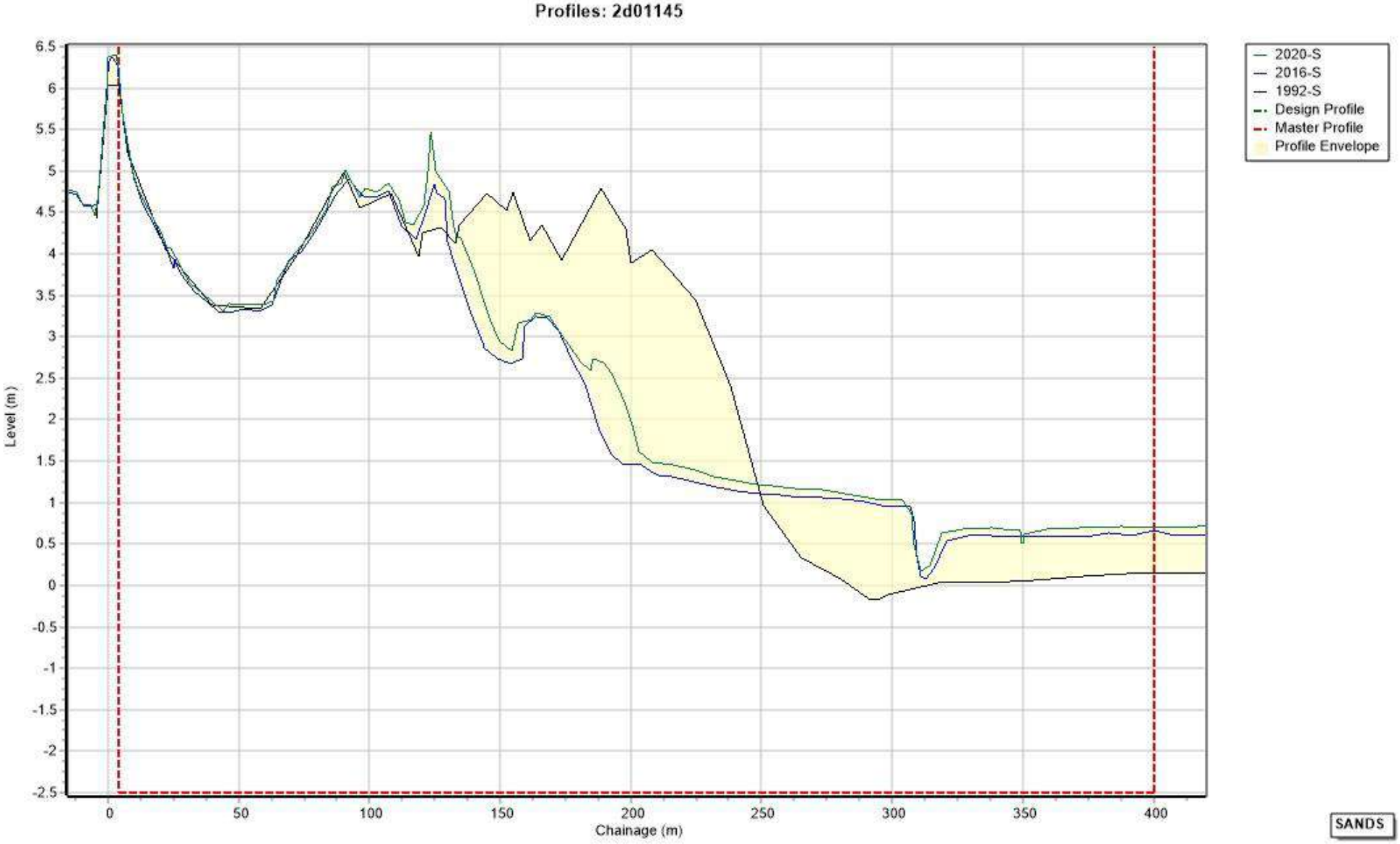
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS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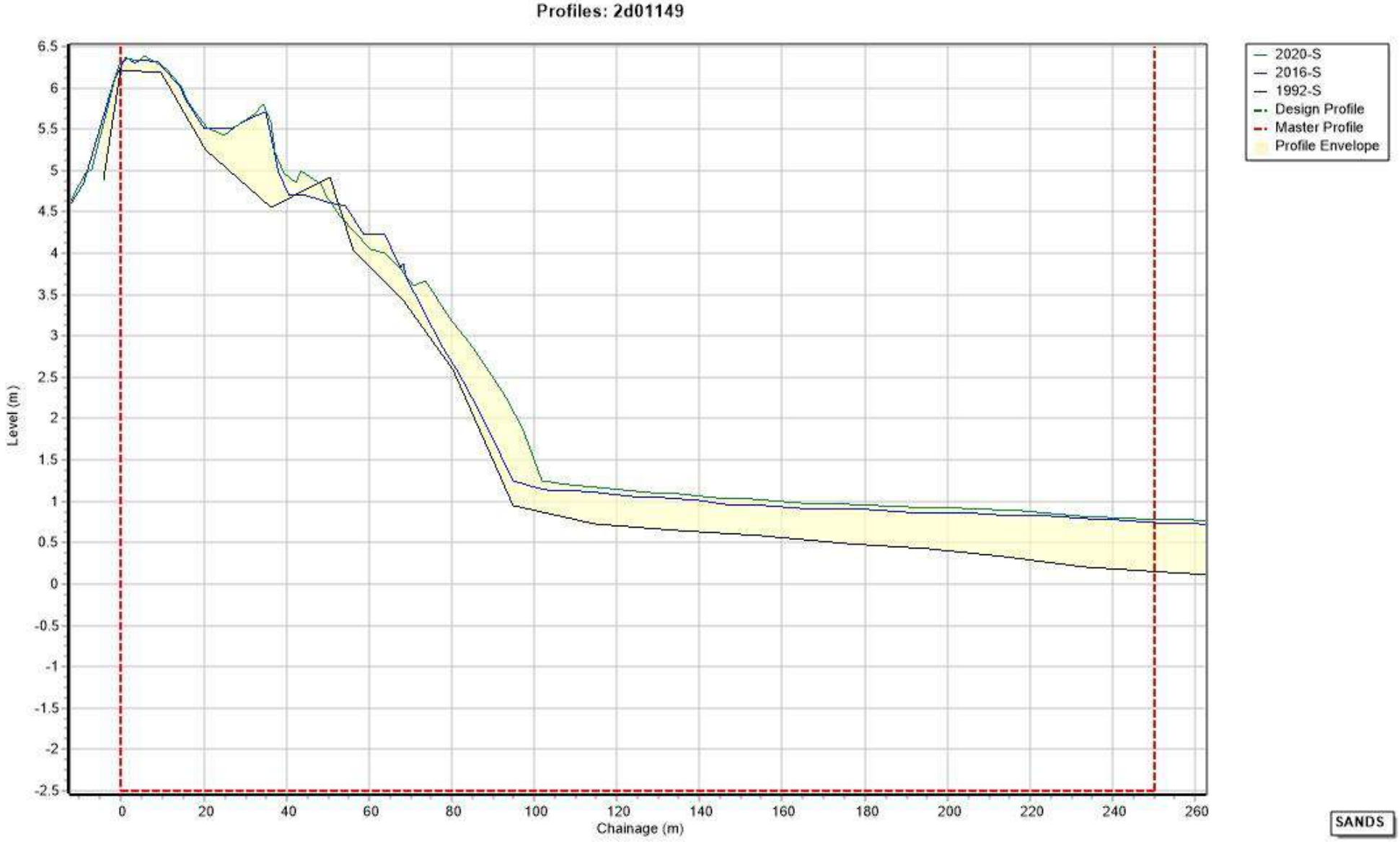
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS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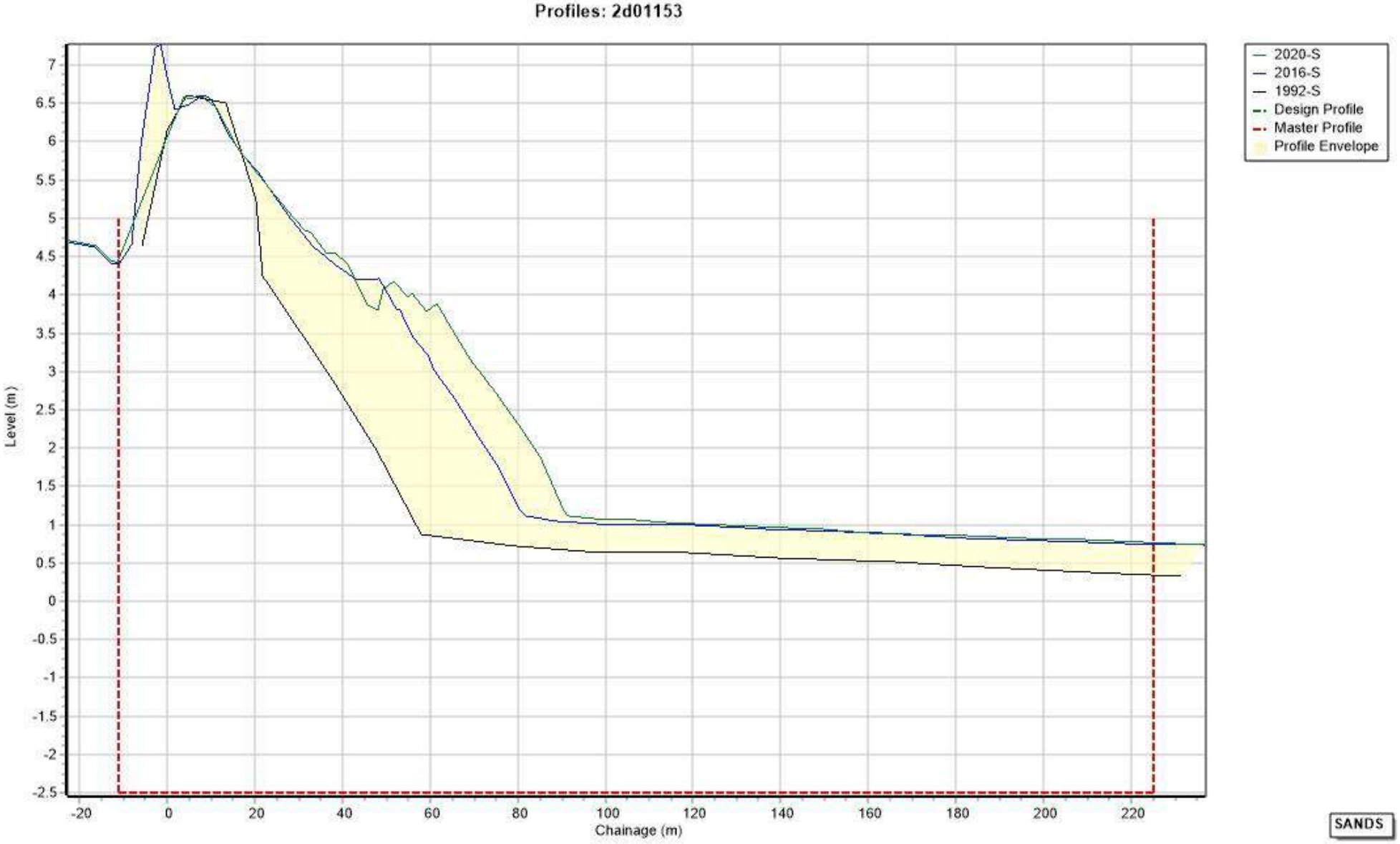
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS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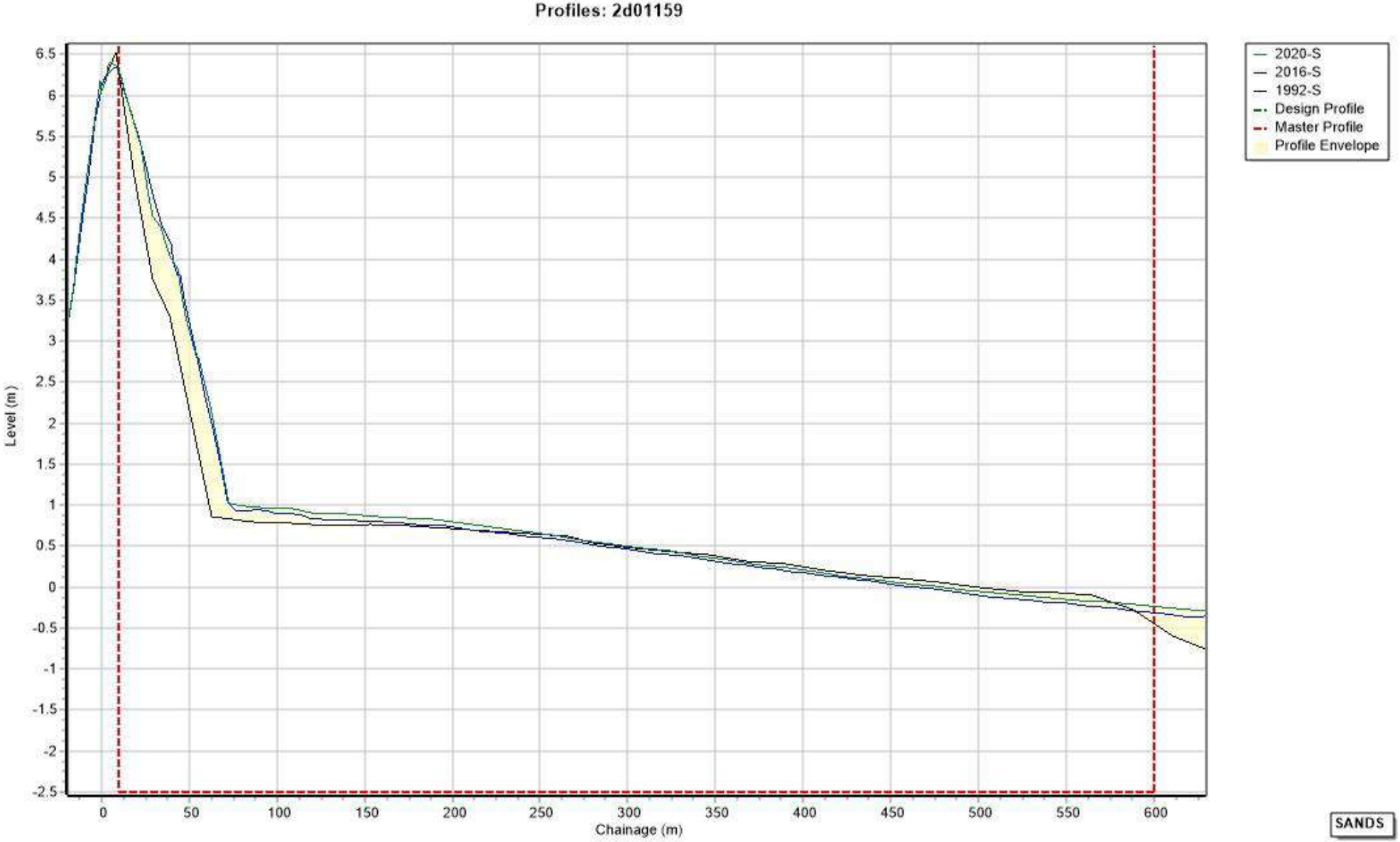
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01159
2020-S
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
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4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
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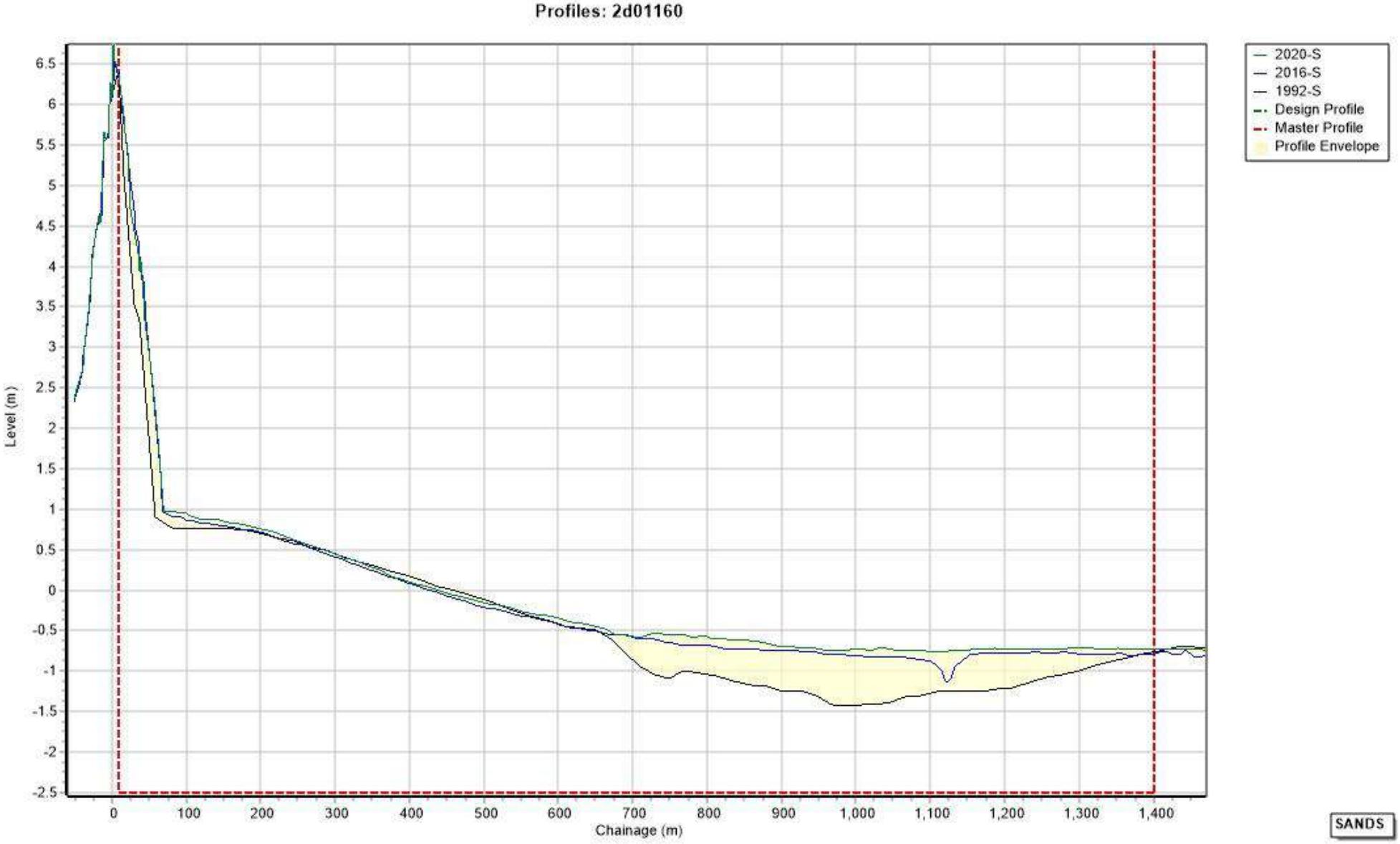
0
50
100
150
200
250
300
350
400
450
500
550
600
SANDS


Profiles: 2d01160
2020-S
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
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4.5
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3.5
3
2.5
2
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-0.5
-1
-1.5
-2
-2.5
0
100
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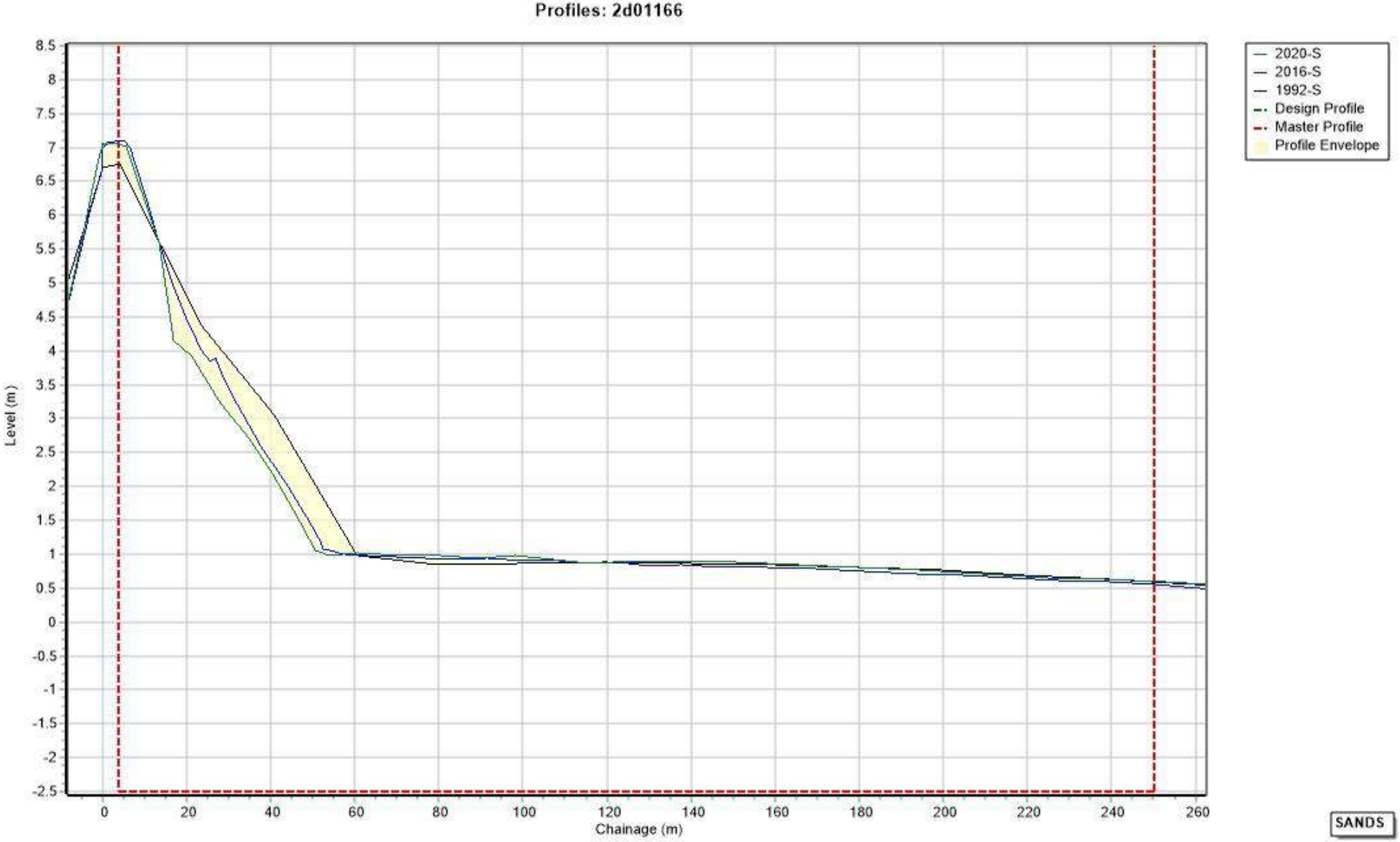
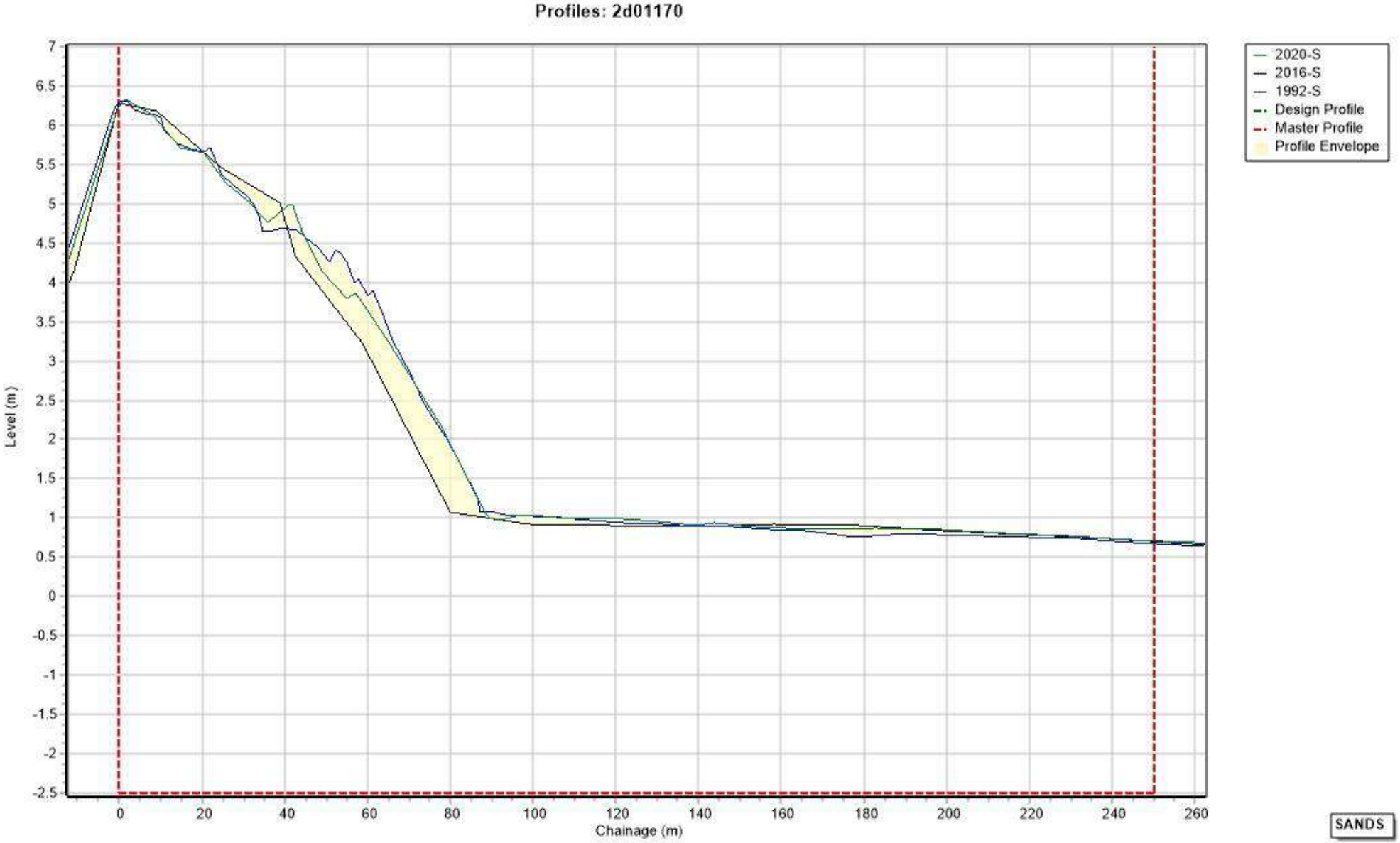
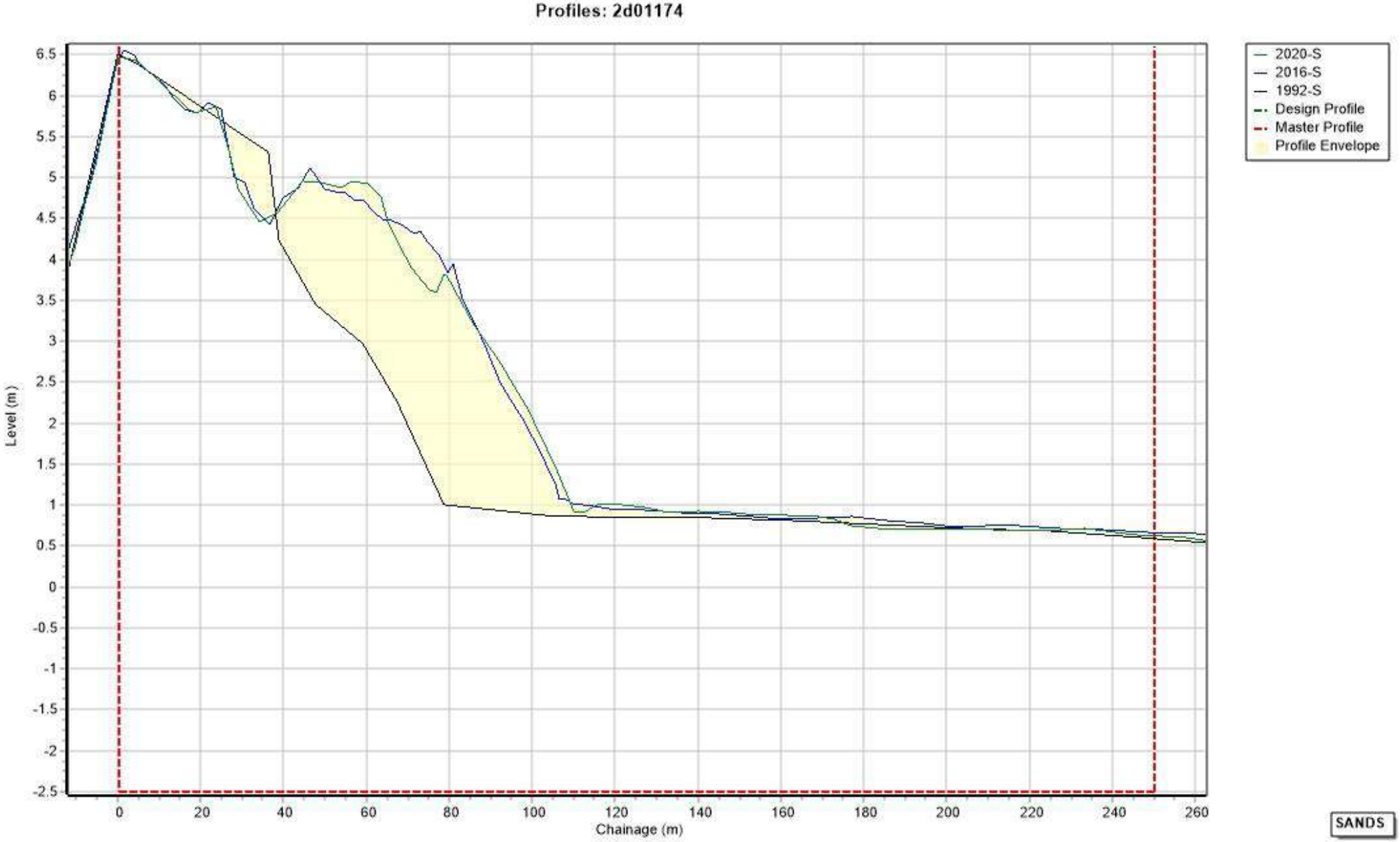
600
700
800
900
1,000
1,100
1,200
1,300
1,400
Chainage (m)
SANDS


Profiles: 2d01166
2020-S
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01170
2020-S
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01174
2020-S
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
6.5
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5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
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0
20
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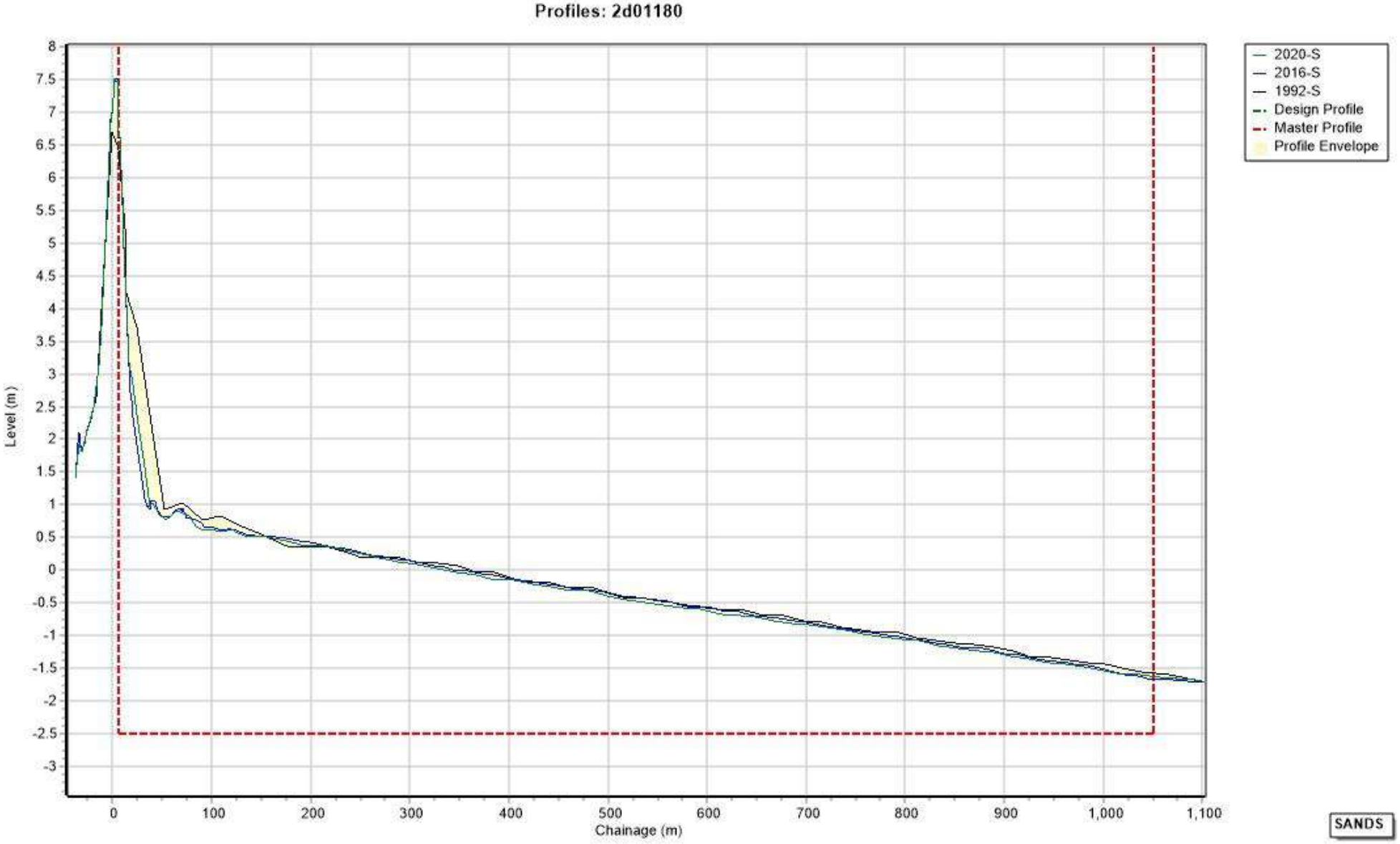
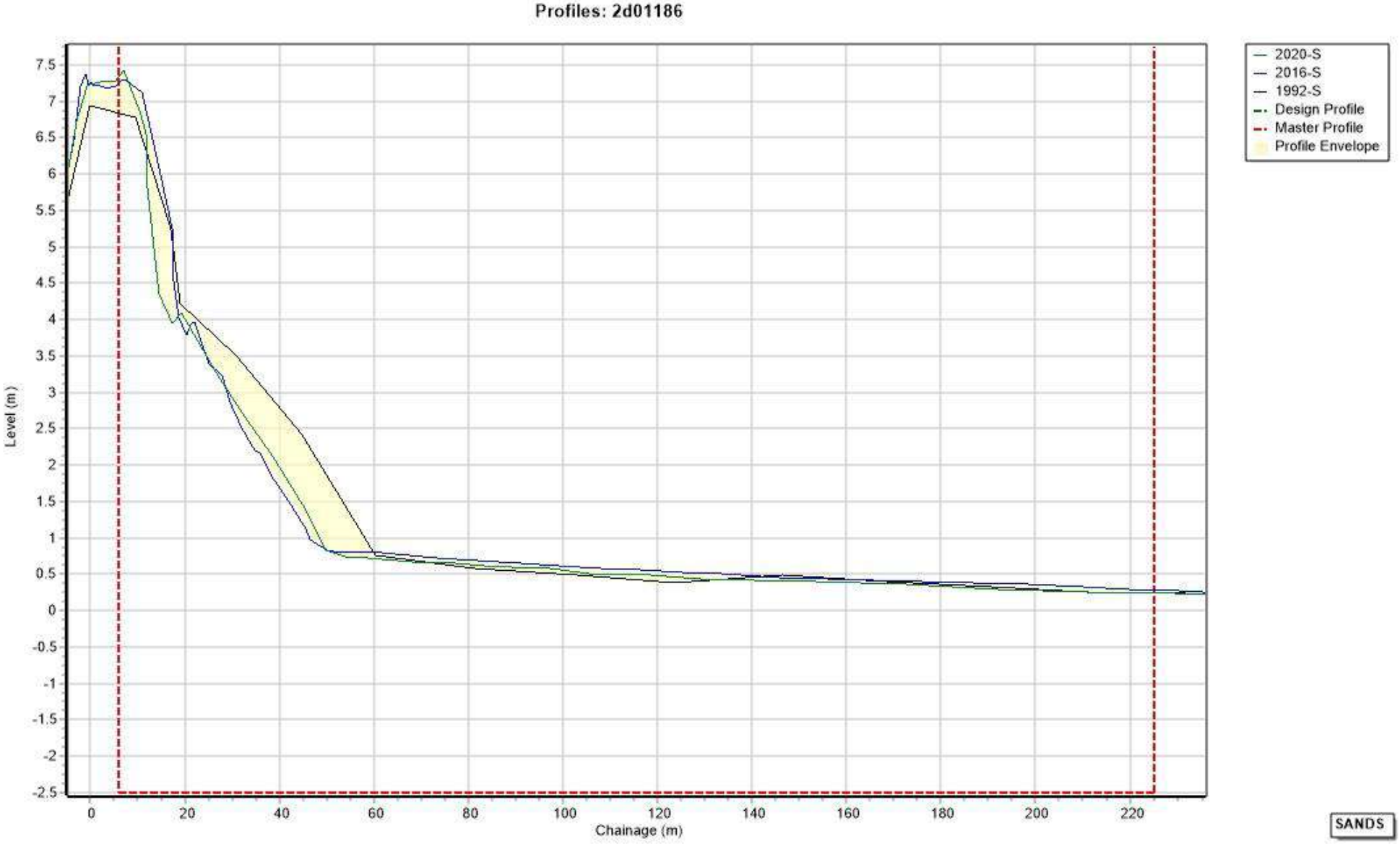
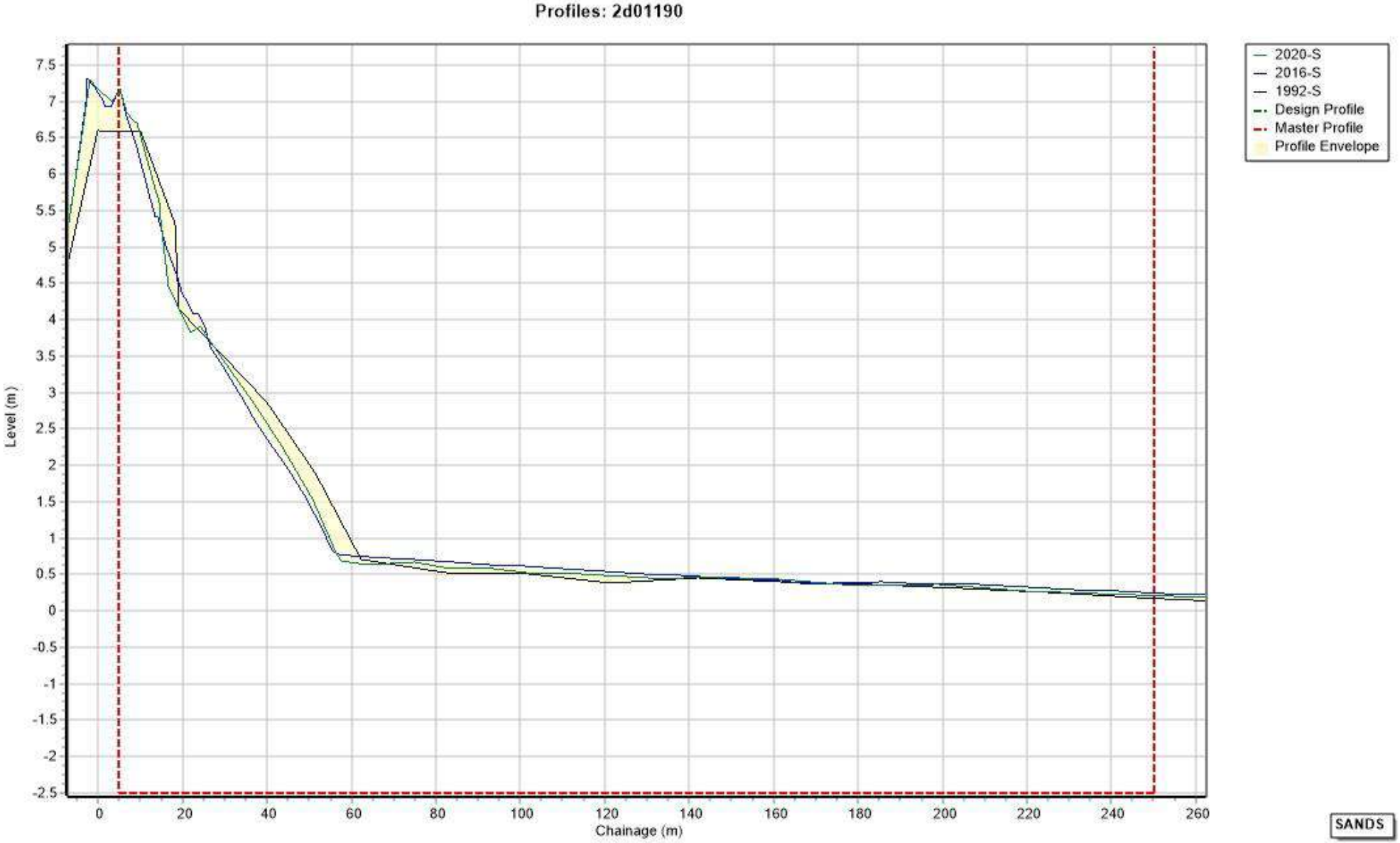
60
80
100
120
140
160
180
200
220
240
260
SANDS


Profiles: 2d01180
2020-S
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01186
2020-S
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01190
2020-S
2016-S
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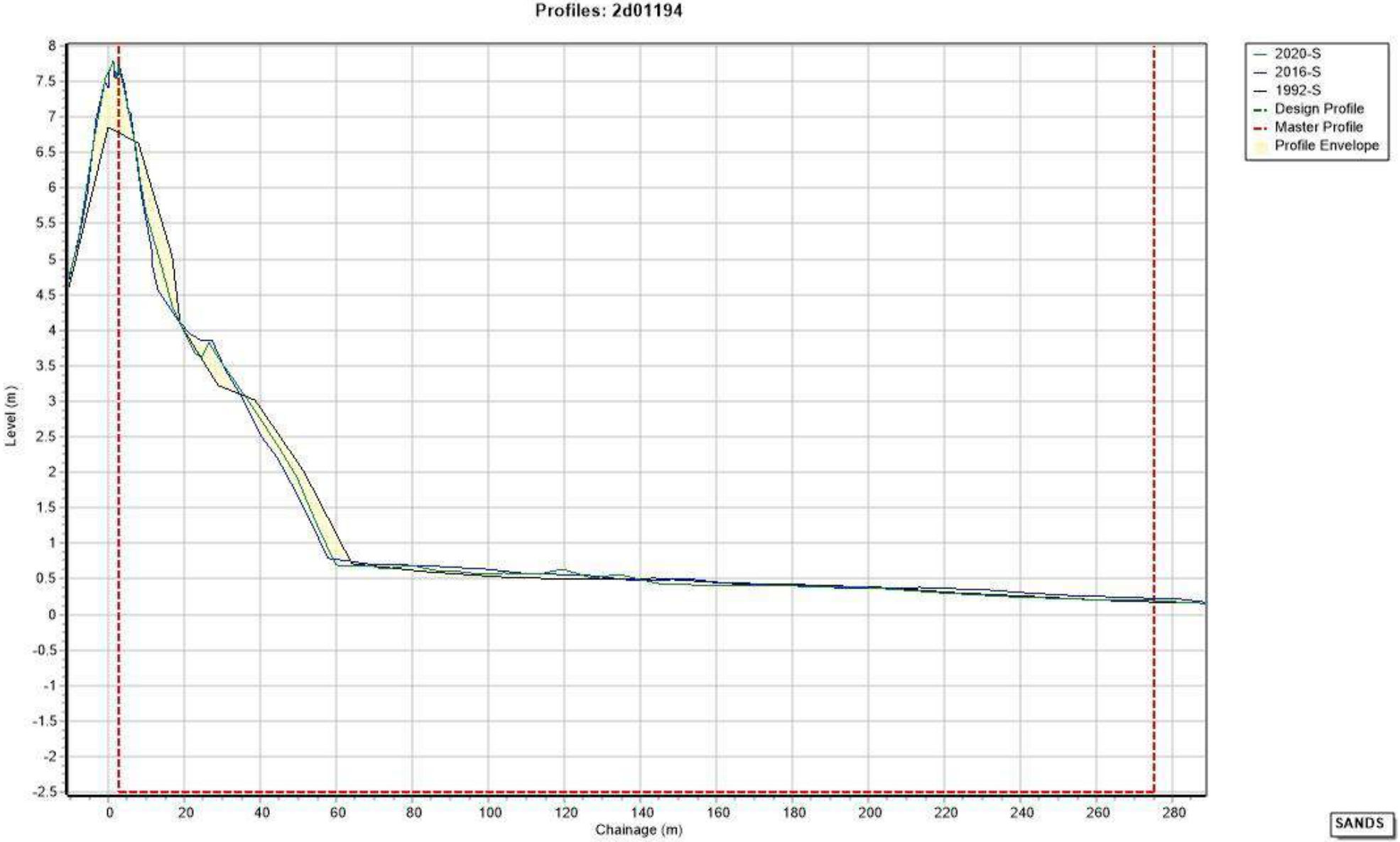
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01194
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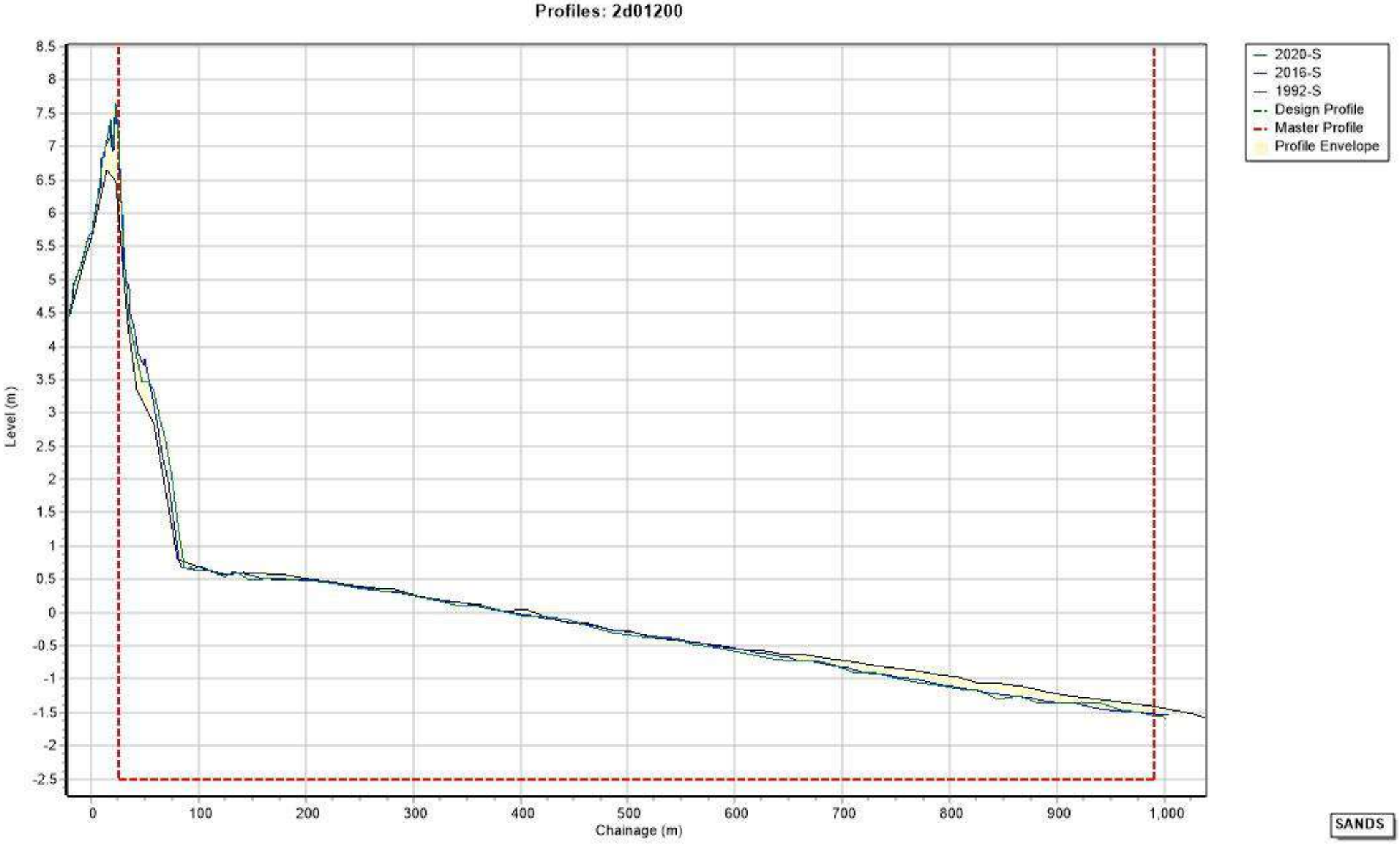
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01200
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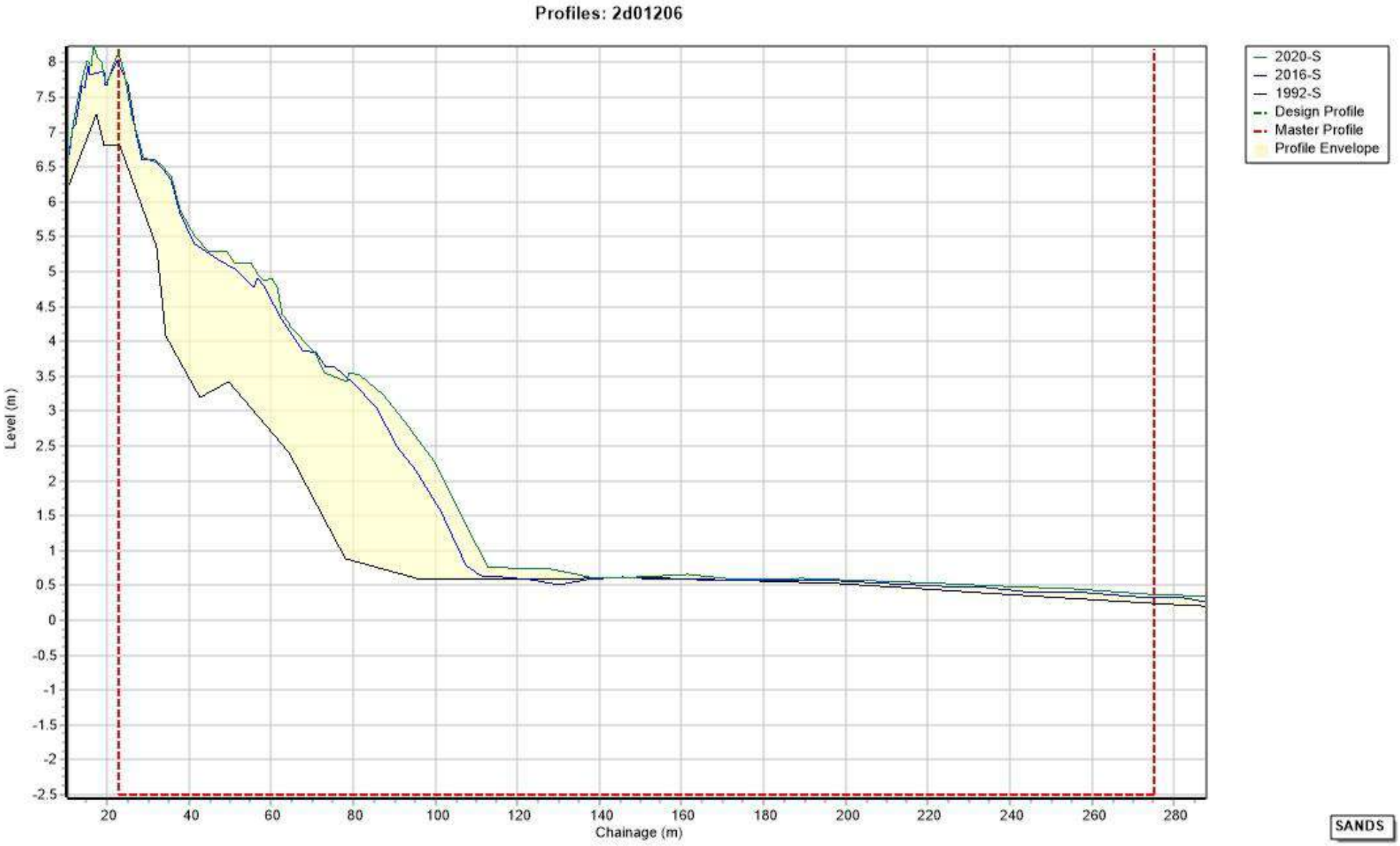
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01206
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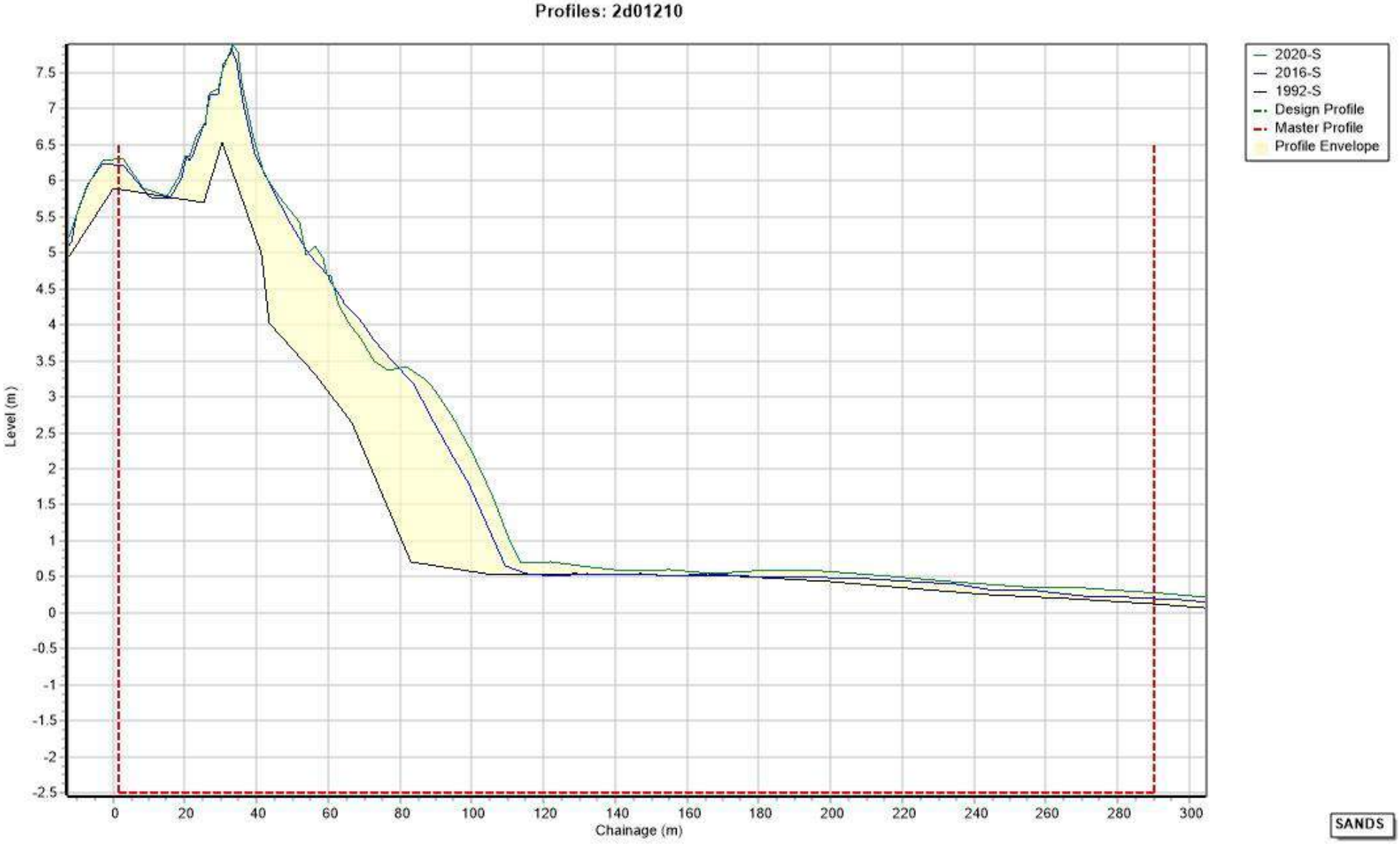
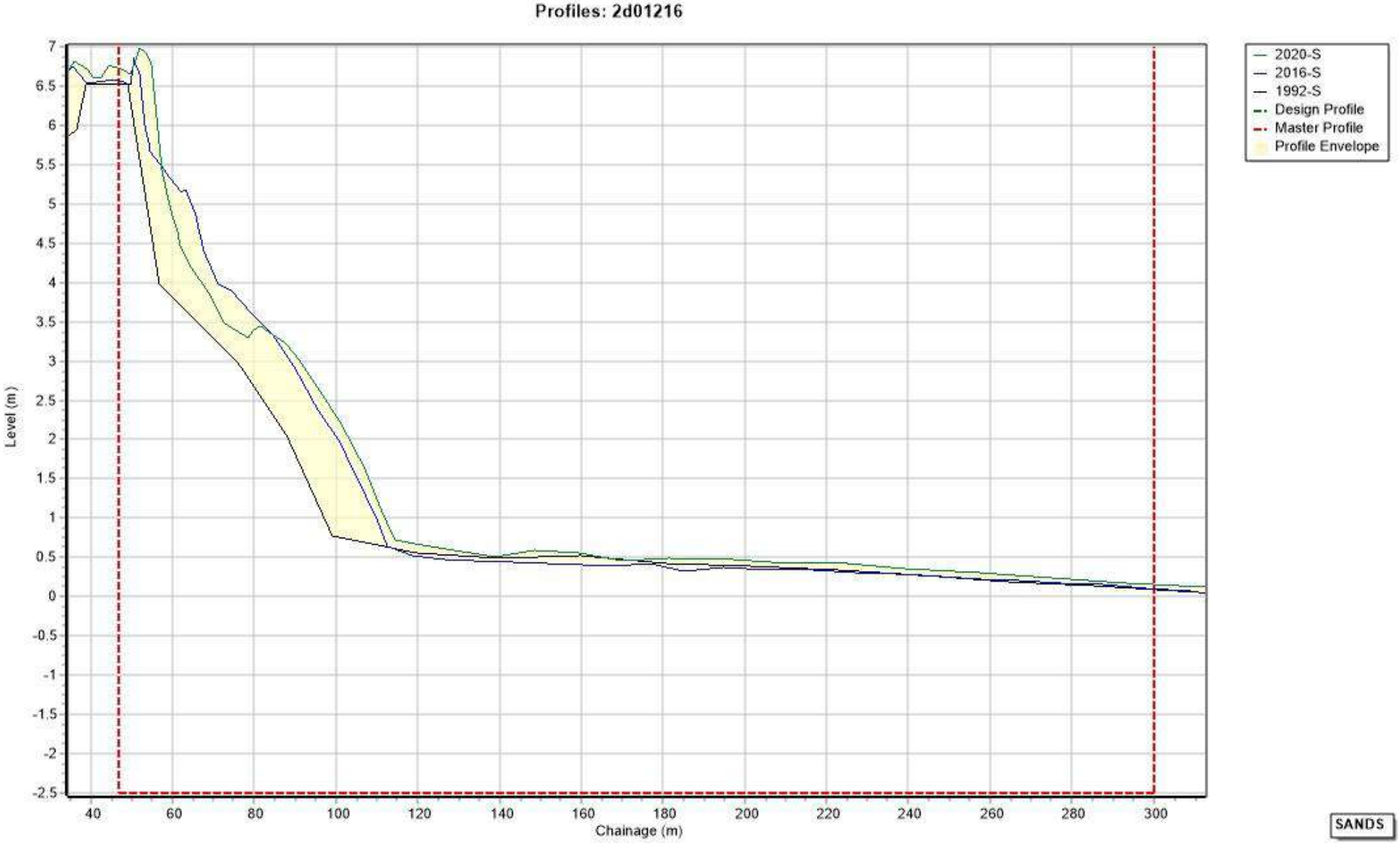
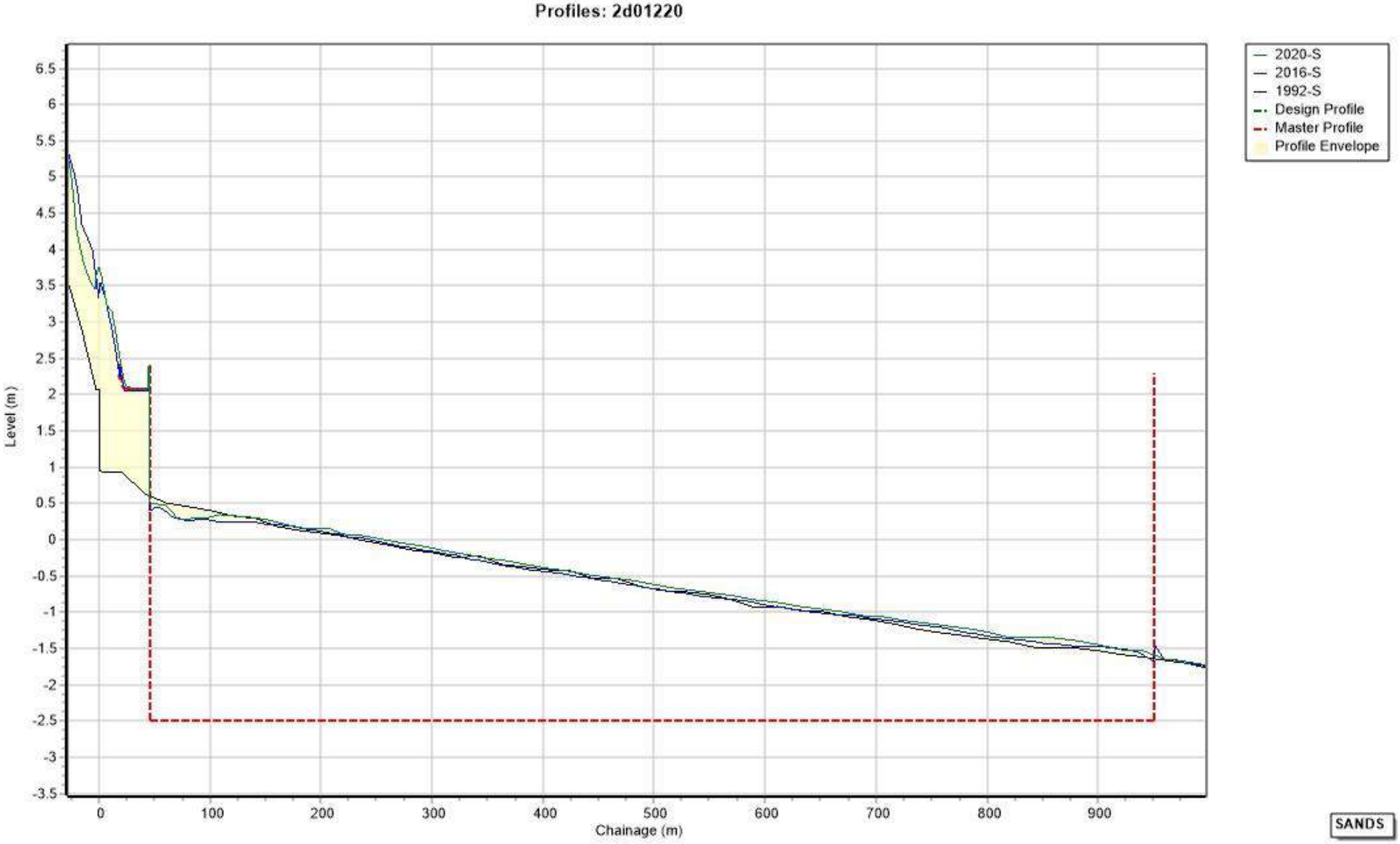
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01210
2020-S
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01216
2020-S
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01220
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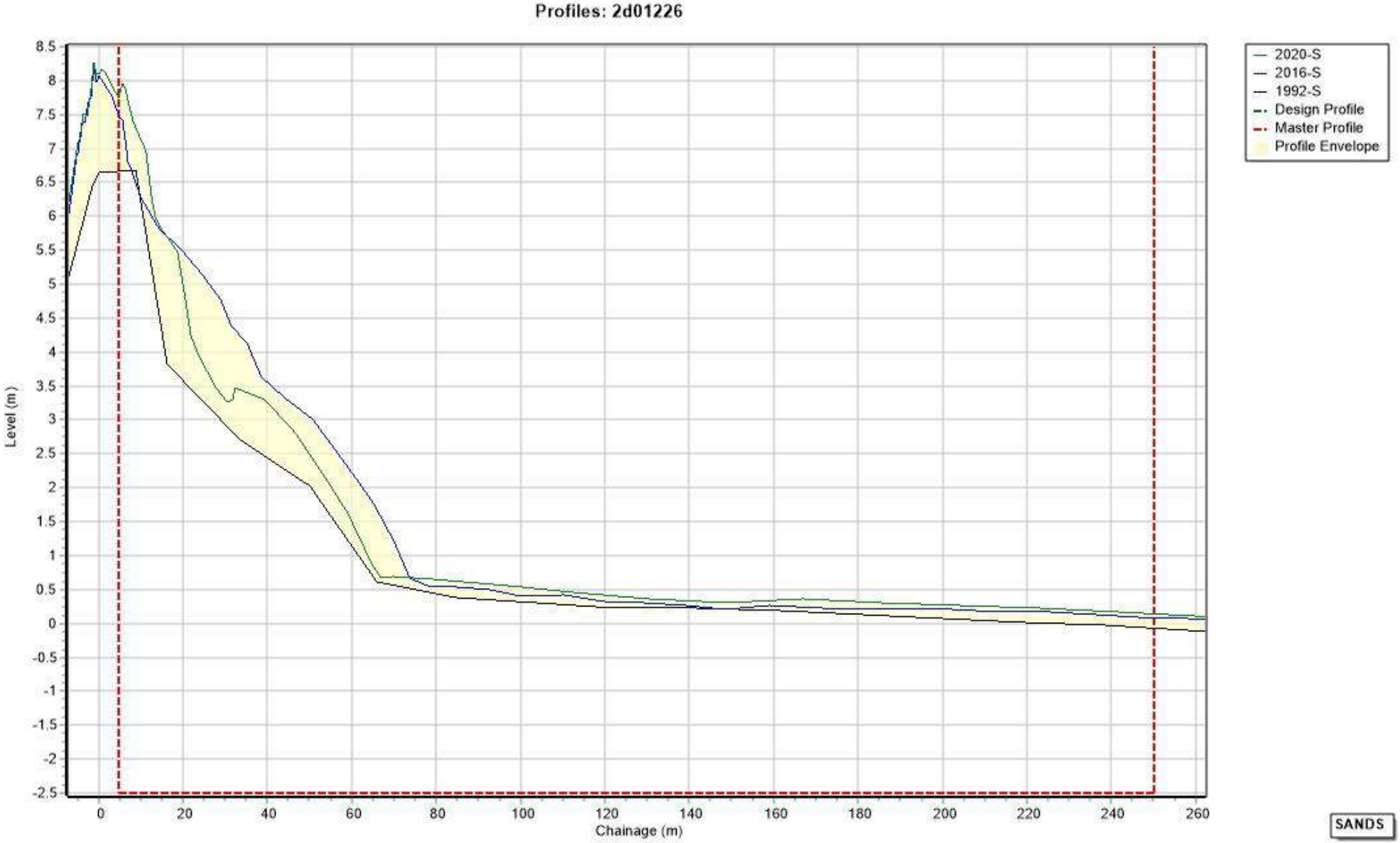
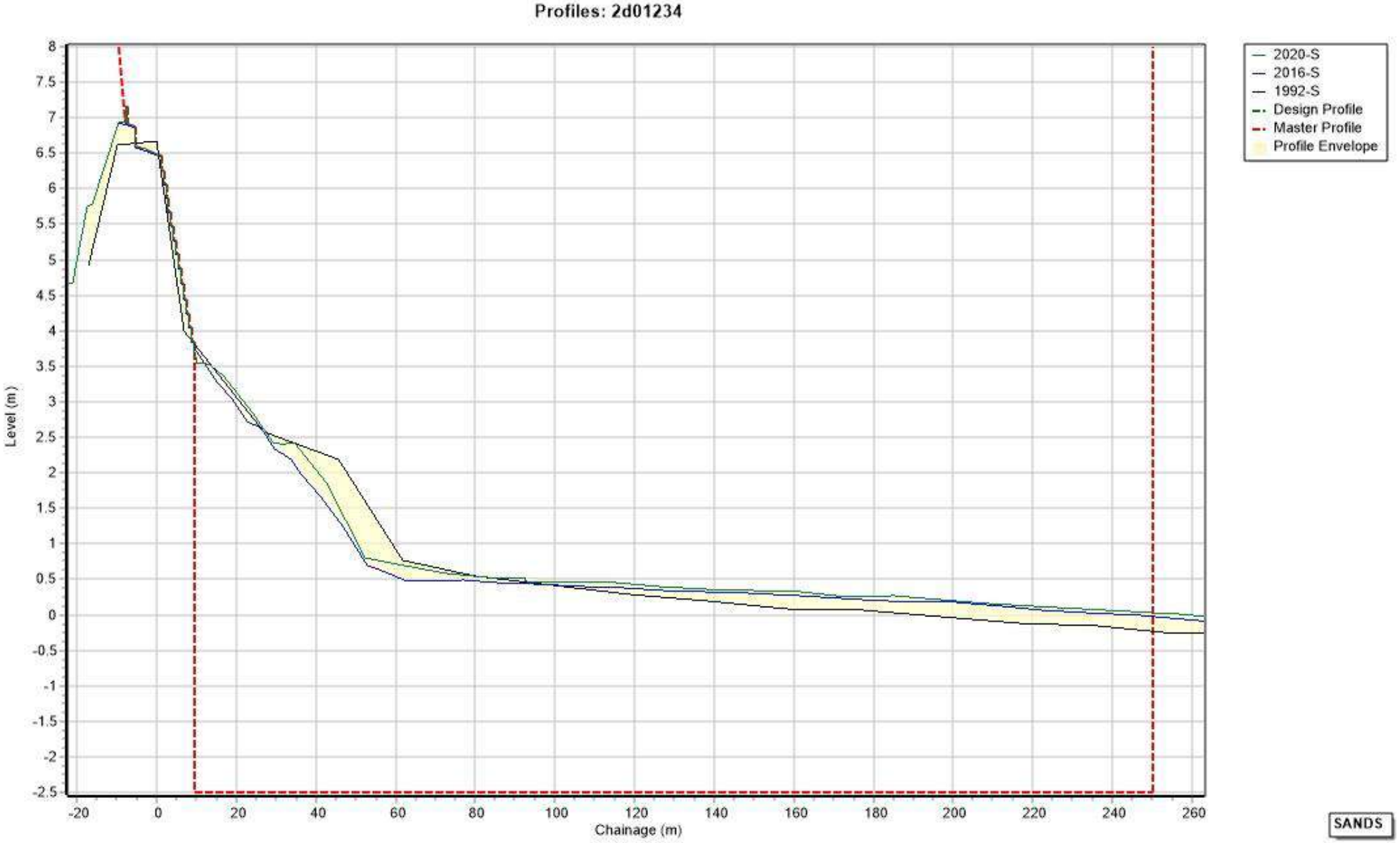
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01226
2020-S
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01234
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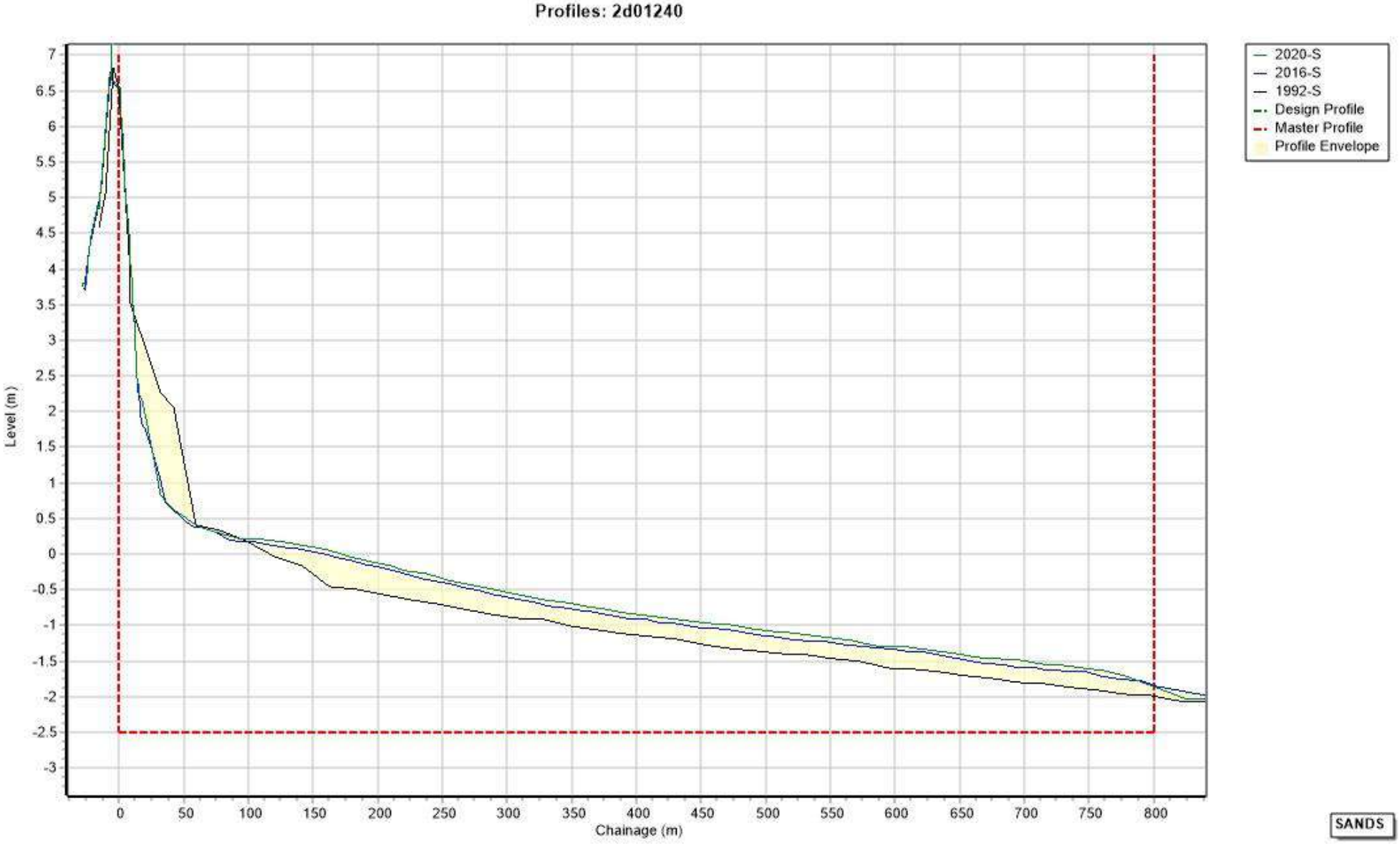
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01240
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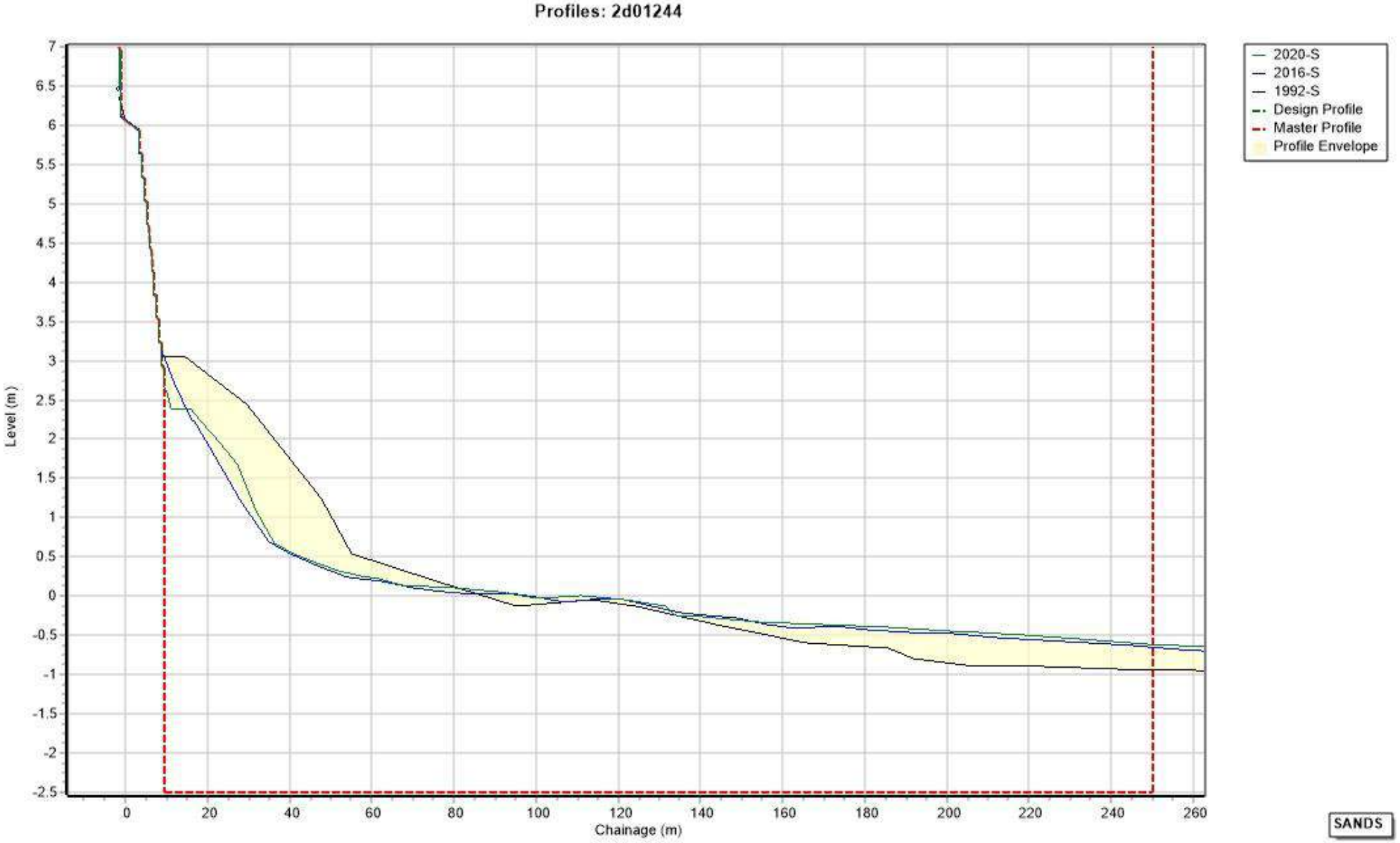
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS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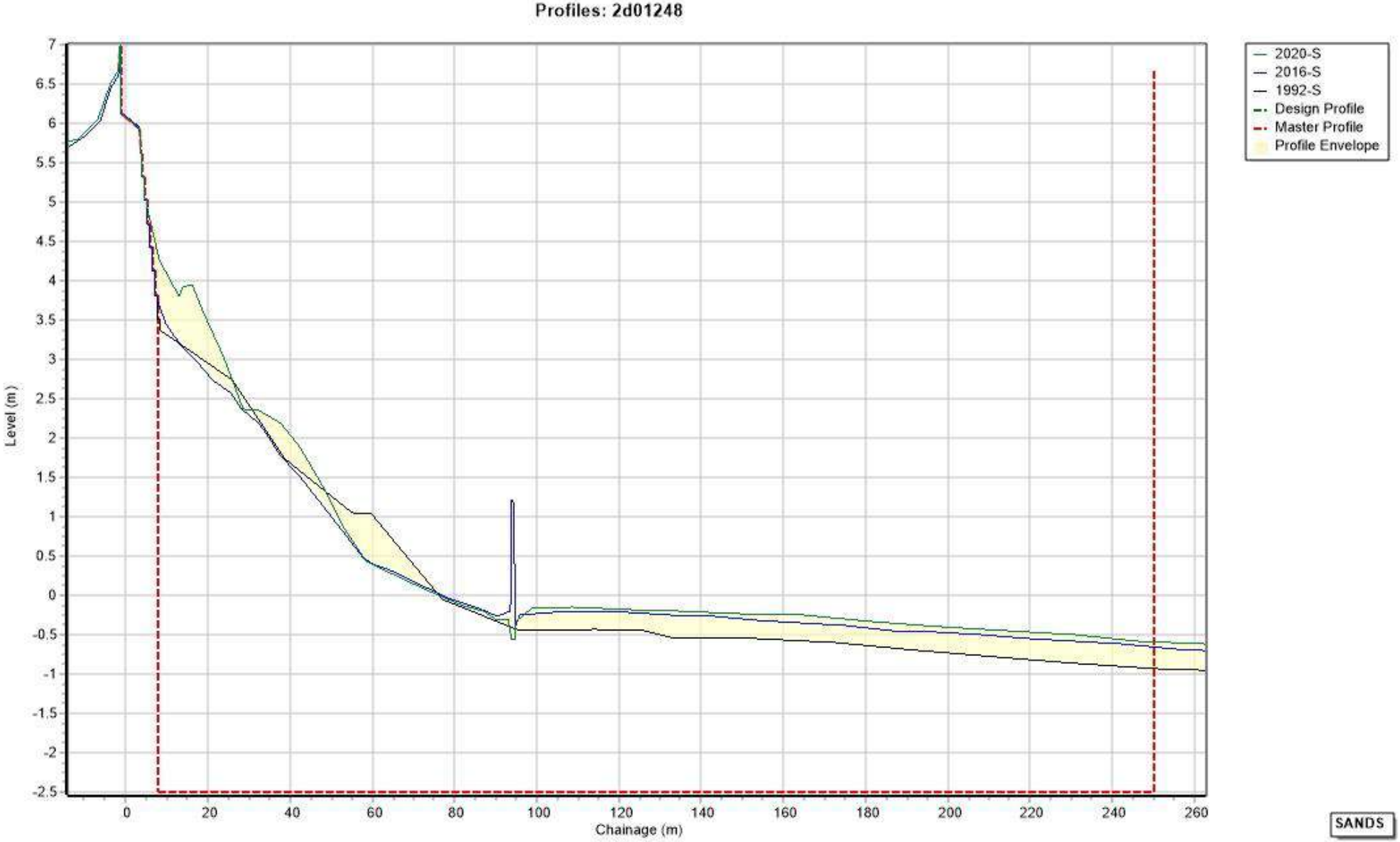
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS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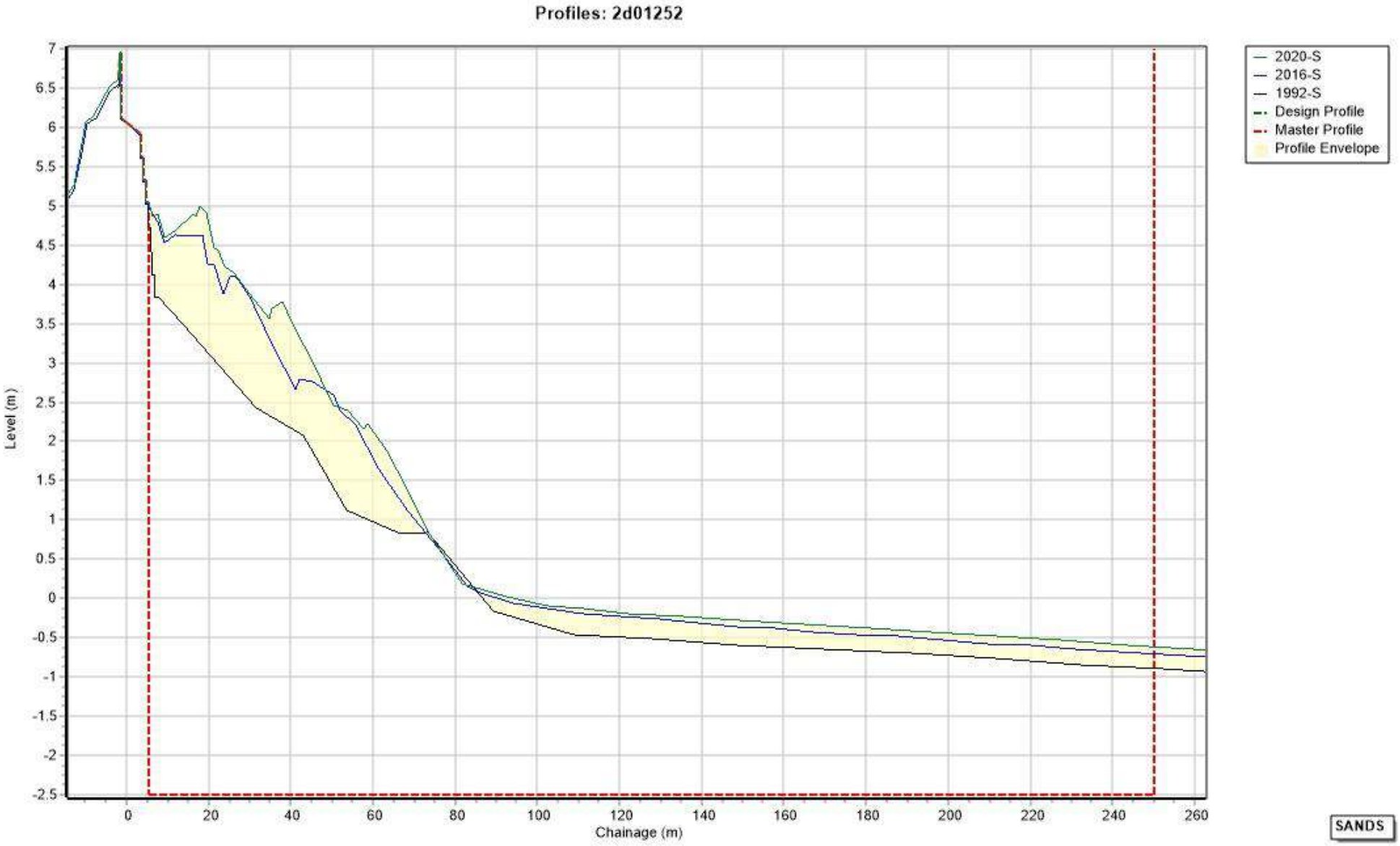
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01252
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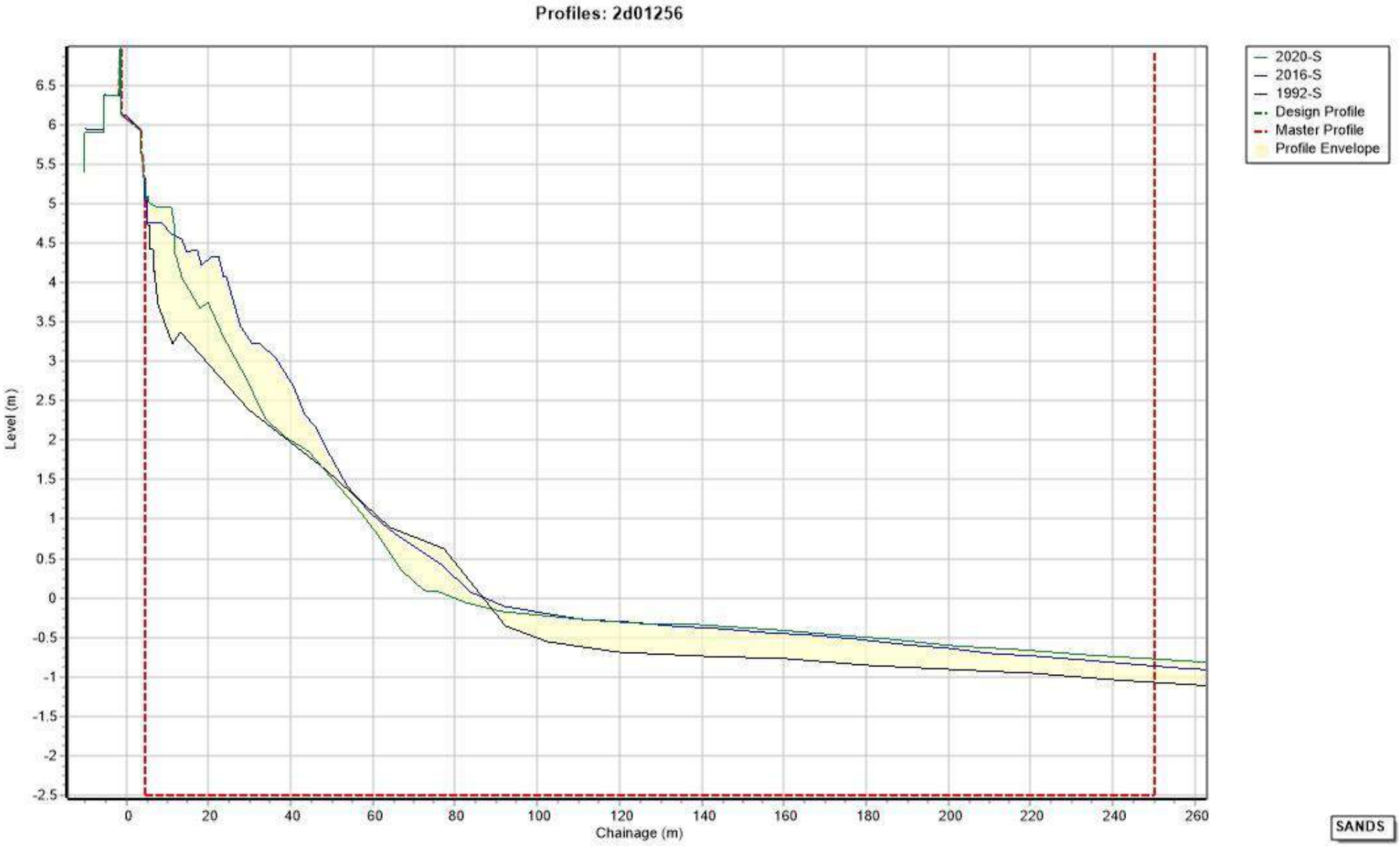
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS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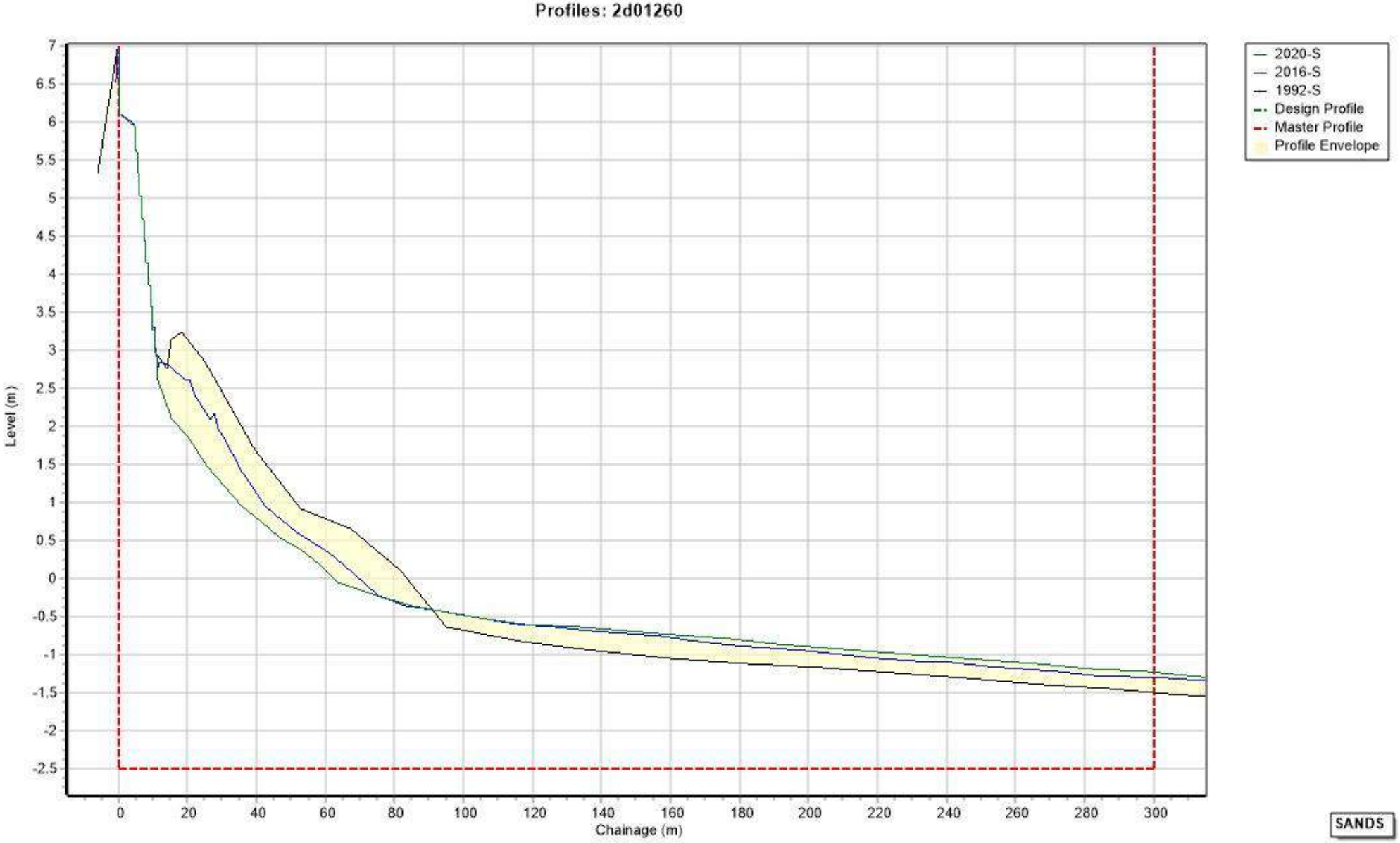
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01260
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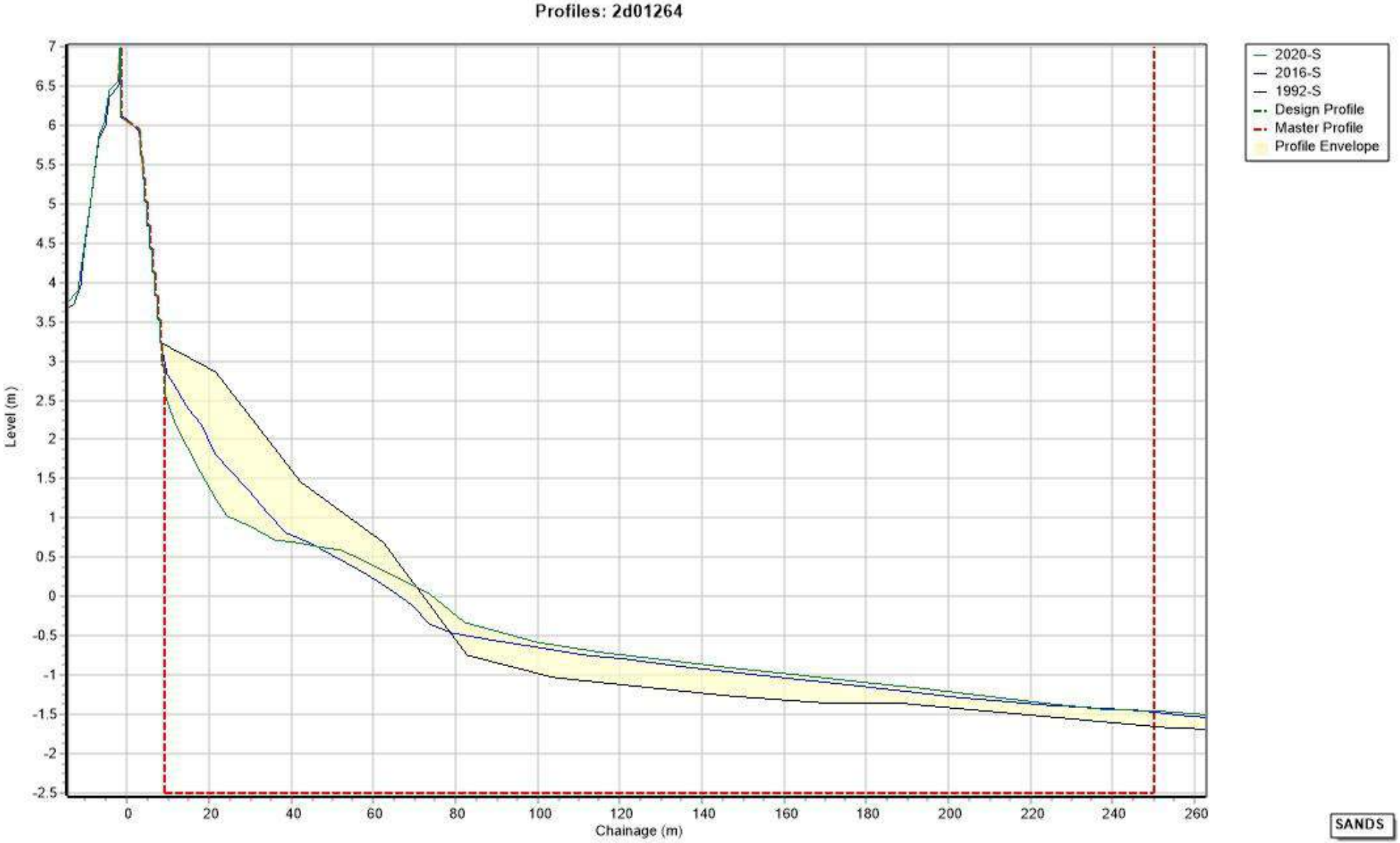
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS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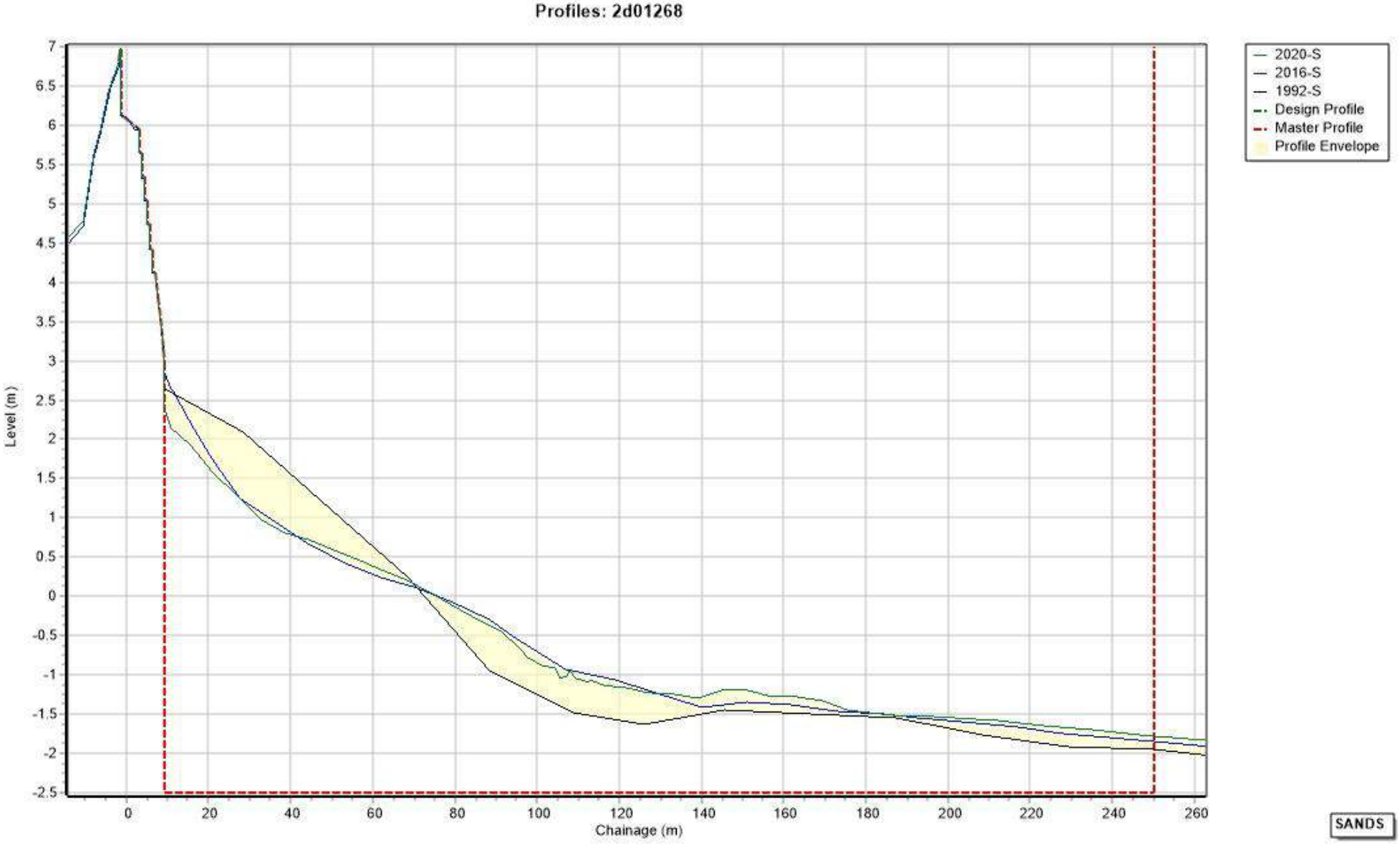
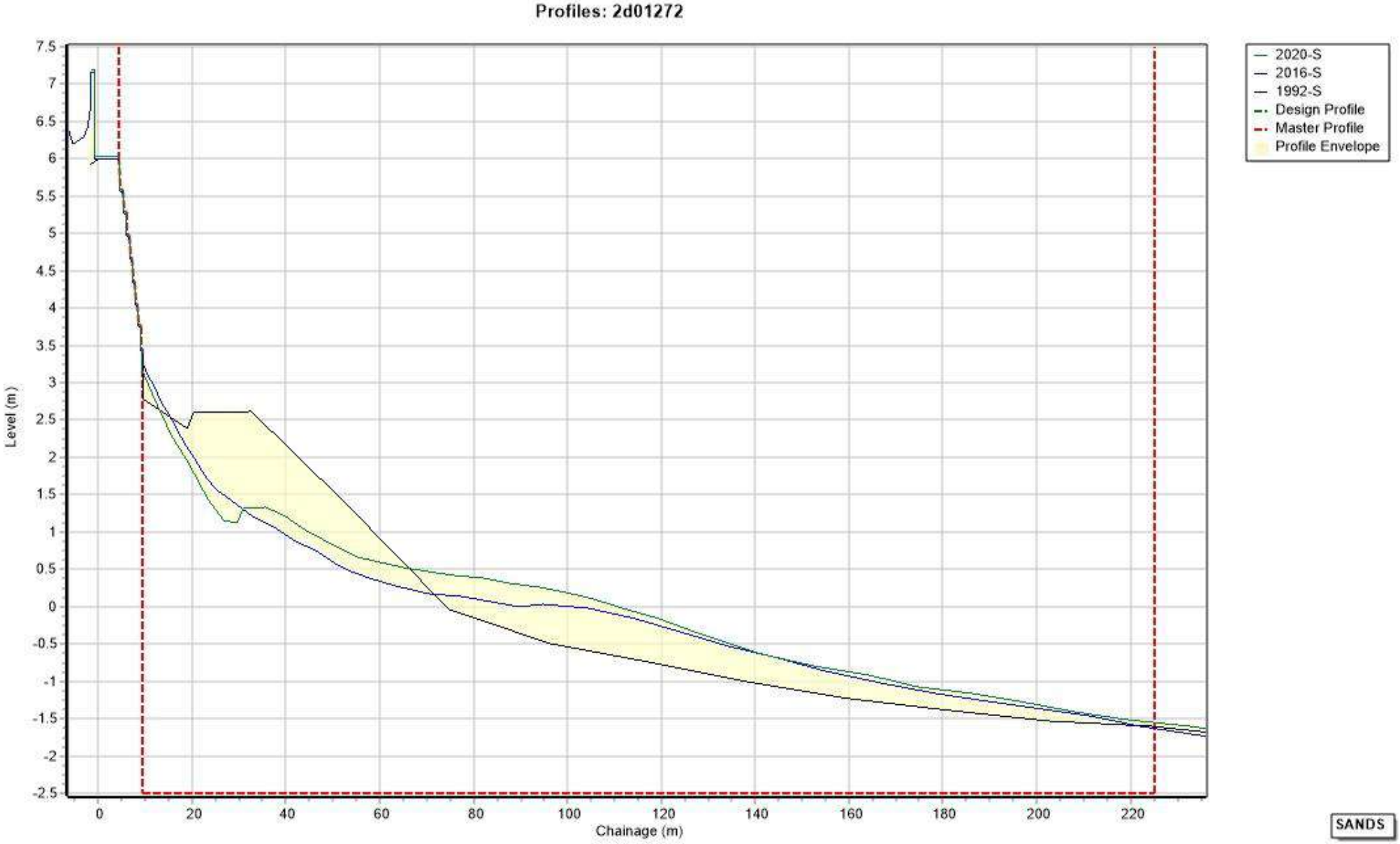
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01268
2020-S
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01272
2020-S
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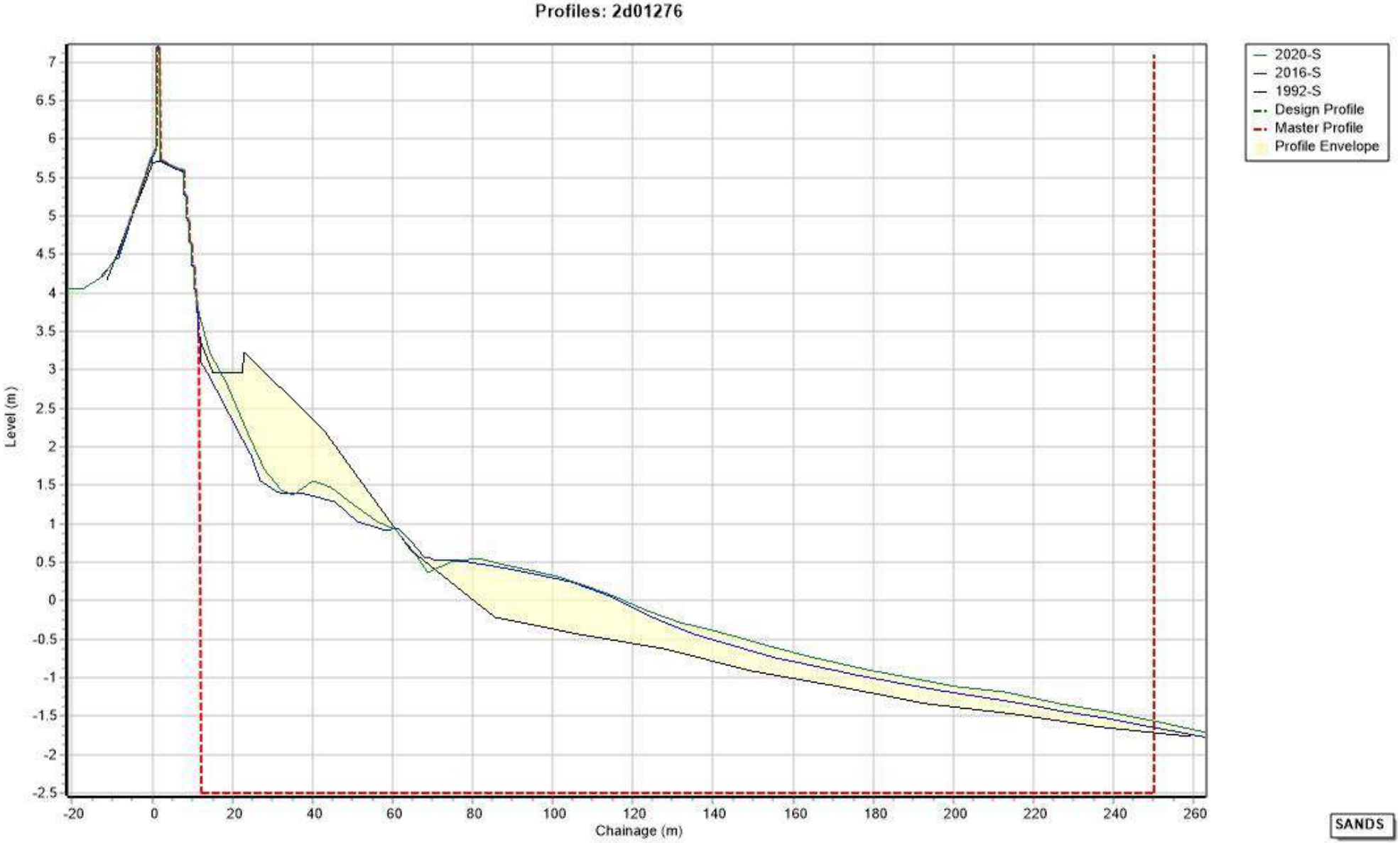
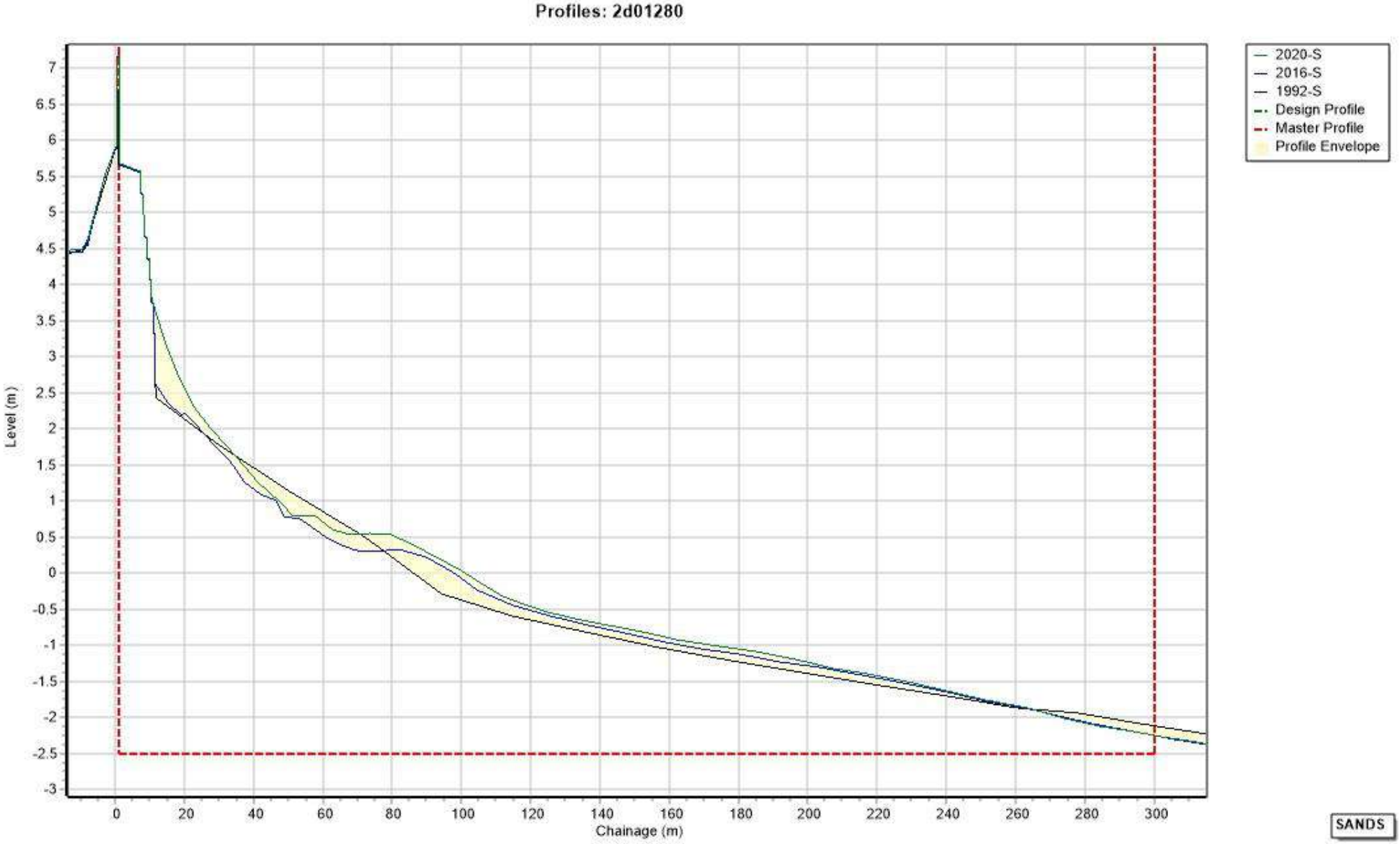
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01276
2020-S
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS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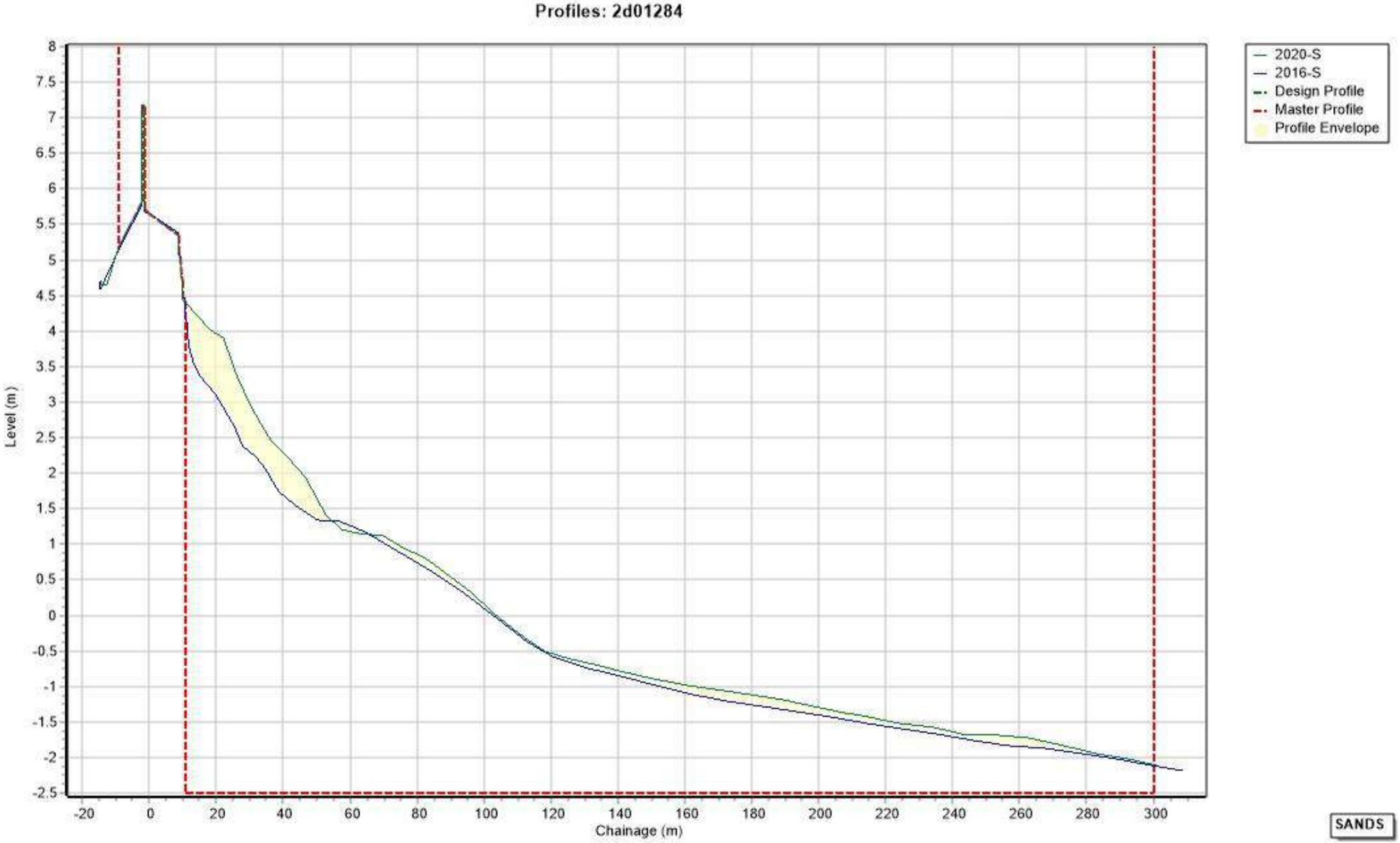
2020-S
2016-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01284
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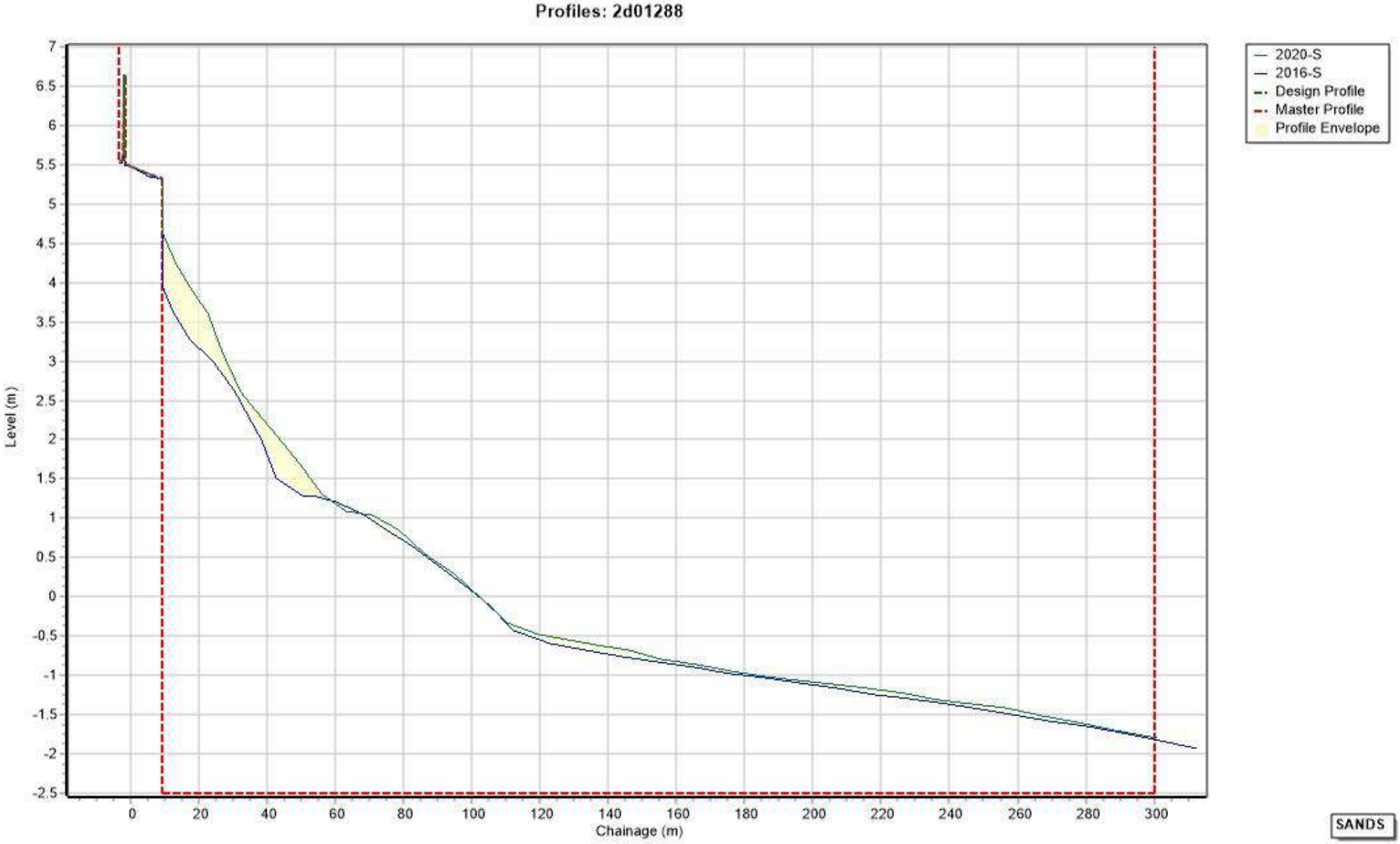
2016-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS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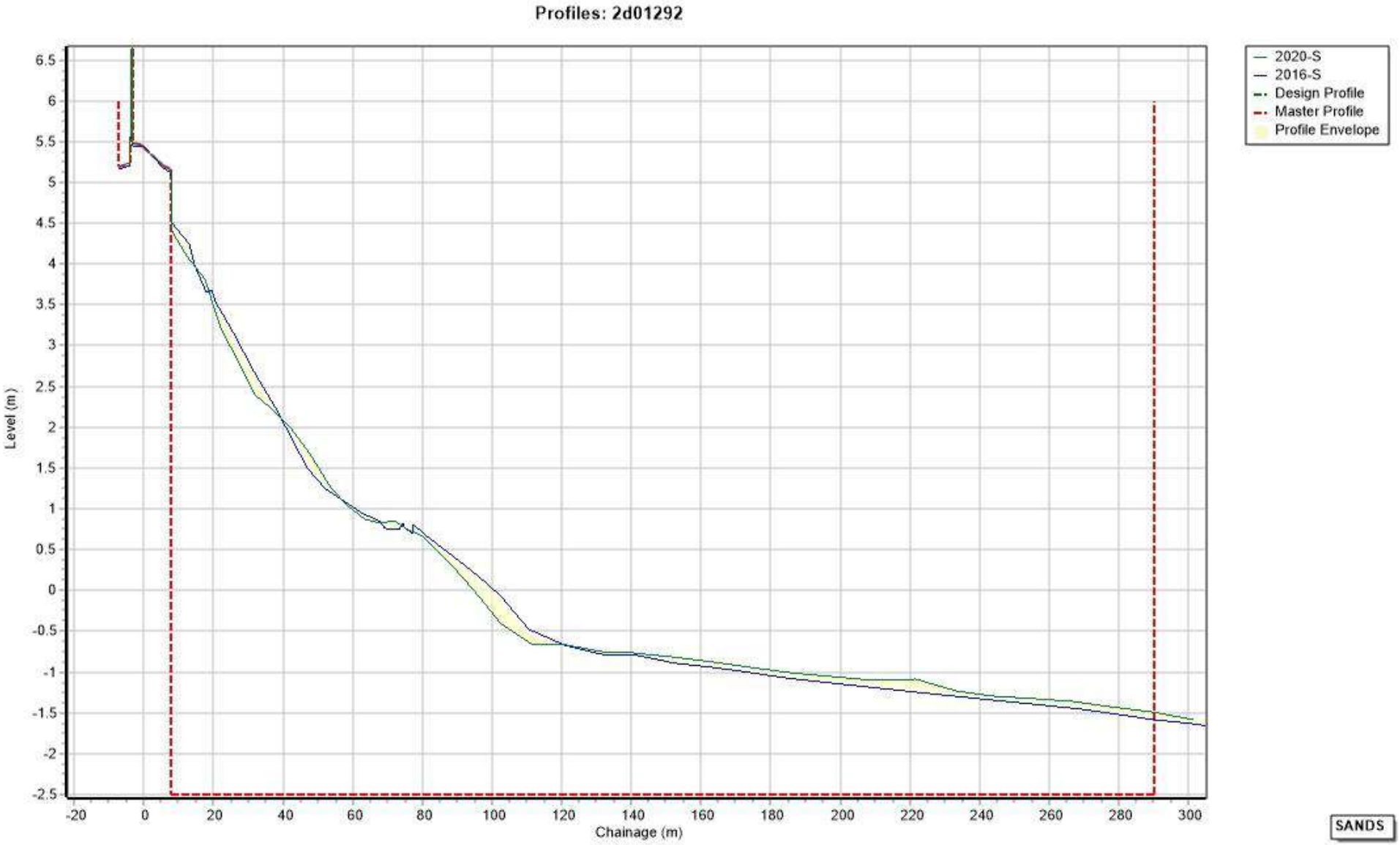
2016-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01292
2020-S
2016-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS

Positional Trends

Location: W051 Baseline: 1992	HAT 4.59m	MHWS 3.46m	MSL 0.10m	MLWS -2.72m	LAT -3.69m
Total Change	122.37	-12.38			
Min Change	-124.4	-169.58			
Max Change	124.54	130.39			
Mean Change	4.37	-0.62			
Sdt Dev Change	52.22	49.06			

Location: W051 Baseline: 2016	HAT 4.59m	MHWS 3.46m	MSL 0.10m	MLWS -2.72m	LAT -3.69m
Total Change	123.65	1.00			
Min Change	-123.88	-24.40			
Max Change	124.54	20.22			
Mean Change	30.91	0.25			
Sdt Dev Change	102.77	17.78			

Location: HH006 Baseline: 1992	HAT 4.57m	MHWS 3.46m	MSL 0.09m	MLWS -2.73m	LAT -3.70m
Total Change	-4.63	333.84			
Min Change	-4.53	-45.09			
Max Change	3.26	147.15			
Mean Change	-0.17	12.84			
Sdt Dev Change	1.34	35.76			

Location: HH006 Baseline: 2016	HAT 4.57m	MHWS 3.46m	MSL 0.09m	MLWS -2.73m	LAT -3.70m
Total Change	-1.49	93.40			
Min Change	-1.93	39.65			
Max Change	0.78	53.75			
Mean Change	-0.37	46.70			
Sdt Dev Change	1.11	7.05			

Location: HH010 Baseline: 1992	HAT 4.57m	MHWS 3.46m	MSL 0.09m	MLWS -2.73m	LAT -3.70m
Total Change	9.87	2.58			
Min Change	-1.13	-0.66			
Max Change	6.23	0.90			
Mean Change	0.35	0.09			
Sdt Dev Change	1.32	0.42			

Location: HH010 Baseline: 2016	HAT 4.57m	MHWS 3.46m	MSL 0.09m	MLWS -2.73m	LAT -3.70m
Total Change	0.55	0.44			
Min Change	-0.40	-0.33			
Max Change	0.55	0.64			
Mean Change	0.14	0.11			
Sdt Dev Change	0.39	0.34			

Location: HH014 Baseline: 1992	HAT 4.58m	MHWS 3.47m	MSL 0.10m	MLWS -2.72m	LAT -3.69m
Total Change	-1.36	-1.23			
Min Change	-2.04	-1.80			
Max Change	1.82	1.76			
Mean Change	-0.05	-0.04			
Sdt Dev Change	0.86	0.89			

Location: HH014 Baseline: 2016	HAT 4.58m	MHWS 3.47m	MSL 0.10m	MLWS -2.72m	LAT -3.69m
Total Change	0.07	0.09			
Min Change	-0.70	-0.91			
Max Change	0.63	1.07			
Mean Change	0.02	0.02			
Sdt Dev Change	0.51	0.70			

Location: W052 Baseline: 1992	HAT 4.58m	MHWS 3.46m	MSL 0.10m	MLWS -2.72m	LAT -3.69m
Total Change	0.94	0.04			
Min Change	-2.06	-3.07			
Max Change	3.01	1.55			
Mean Change	0.03	0.00			
Sdt Dev Change	1.16	0.86			

Location: W052 Baseline: 2016	HAT 4.58m	MHWS 3.46m	MSL 0.10m	MLWS -2.72m	LAT -3.69m
Total Change	-0.64	-0.47			
Min Change	-0.88	-0.34			
Max Change	0.27	0.00			
Mean Change	-0.16	-0.12			
Sdt Dev Change	0.45	0.13			

Location: HH025 Baseline: 1992	HAT 4.57m	MHWS 3.46m	MSL 0.09m	MLWS -2.73m	LAT -3.70m
Total Change	17.82	7.45			
Min Change	-13.35	-9.54			
Max Change	20.80	9.48			
Mean Change	0.64	0.27			
Sdt Dev Change	6.62	4.52			

Location: HH025 Baseline: 2016	HAT 4.57m	MHWS 3.46m	MSL 0.09m	MLWS -2.73m	LAT -3.70m
Total Change	-0.54	1.13			
Min Change	-2.11	-0.31			
Max Change	2.11	1.07			
Mean Change	-0.14	0.28			
Sdt Dev Change	1.50	0.51			

Location: HH029 Baseline: 1992	HAT 4.58m	MHWS 3.47m	MSL 0.10m	MLWS -2.72m	LAT -3.69m
Total Change	7.88	9.62			
Min Change	-3.43	-2.39			
Max Change	5.02	3.82			
Mean Change	0.28	0.34			
Sdt Dev Change	1.88	1.12			

Location: HH029 Baseline: 2016	HAT 4.58m	MHWS 3.47m	MSL 0.10m	MLWS -2.72m	LAT -3.69m
Total Change	-0.19	0.39			
Min Change	-2.23	-1.02			
Max Change	2.29	1.19			
Mean Change	-0.05	0.10			
Sdt Dev Change	1.60	0.89			

Location: HH033 Baseline: 1992	HAT 4.58m	MHWS 3.47m	MSL 0.09m	MLWS -2.73m	LAT -3.69m
Total Change	-1.21	-8.75			
Min Change	-2.30	-6.90			
Max Change	1.87	1.18			
Mean Change	-0.04	-0.31			
Sdt Dev Change	0.94	1.40			

Location: HH033	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.58m	3.47m	0.09m	-2.73m	-3.69m
Total Change	0.08	0.08			
Min Change	0.00	0.00			
Max Change	0.08	0.08			
Mean Change	0.02	0.02			
Sdt Dev Change	0.03	0.03			

Location: W053	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.57m	3.46m	0.09m	-2.74m	-3.70m
Total Change	-3.62	-8.45			
Min Change	-2.33	-2.57			
Max Change	3.09	4.12			
Mean Change	-0.13	-0.30			
Sdt Dev Change	1.04	1.31			

Location: W053	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.57m	3.46m	0.09m	-2.74m	-3.70m
Total Change	-0.06	-0.15			
Min Change	-0.26	-0.14			
Max Change	0.25	0.07			
Mean Change	-0.02	-0.04			
Sdt Dev Change	0.18	0.08			

Location: HH044	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.56m	3.47m	0.09m	-2.74m	-3.70m
Total Change	-61.97	-80.59			
Min Change	-33.65	-37.83			
Max Change	19.46	22.46			
Mean Change	-2.21	-2.88			
Sdt Dev Change	9.41	11.12			

Location: HH044	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.56m	3.47m	0.09m	-2.74m	-3.70m
Total Change	1.99	6.86			
Min Change	-3.17	-21.55			
Max Change	3.20	22.46			
Mean Change	0.50	1.72			
Sdt Dev Change	2.45	15.63			

Location: HH048 Baseline: 1992	HAT 4.56m	MHWS 3.46m	MSL 0.09m	MLWS -2.74m	LAT -3.70m
Total Change	-1.33	8.36	9.70		
Min Change	-8.61	-7.54	-0.70		
Max Change	6.71	8.64	10.40		
Mean Change	-0.05	0.30	4.85		
Sdt Dev Change	2.87	3.27	5.55		

Location: HH048 Baseline: 2016	HAT 4.56m	MHWS 3.46m	MSL 0.09m	MLWS -2.74m	LAT -3.70m
Total Change	-2.90	4.64			
Min Change	-4.20	-2.82			
Max Change	0.77	8.64			
Mean Change	-0.73	1.16			
Sdt Dev Change	2.03	4.42			

Location: HH052 Baseline: 1992	HAT 4.56m	MHWS 3.47m	MSL 0.10m	MLWS -2.74m	LAT -3.70m
Total Change	14.76	34.76			
Min Change	-4.92	-3.52			
Max Change	11.43	12.30			
Mean Change	0.53	1.24			
Sdt Dev Change	2.75	2.96			

Location: HH052 Baseline: 2016	HAT 4.56m	MHWS 3.47m	MSL 0.10m	MLWS -2.74m	LAT -3.70m
Total Change	0.99	9.85			
Min Change	-0.36	-1.82			
Max Change	0.91	12.30			
Mean Change	0.25	2.46			
Sdt Dev Change	0.56	5.71			

Location: W054 Baseline: 1992	HAT 4.56m	MHWS 3.47m	MSL 0.10m	MLWS -2.74m	LAT -3.70m
Total Change	6.31	11.01	16.06		
Min Change	-3.20	-2.11	-32.80		
Max Change	6.45	8.76	42.40		
Mean Change	0.23	0.39	0.59		
Sdt Dev Change	2.33	2.48	14.33		

Location: W054 Baseline: 2016	HAT 4.56m	MHWS 3.47m	MSL 0.10m	MLWS -2.74m	LAT -3.70m
Total Change	-3.82	-0.95	12.93		
Min Change	-2.75	-2.11	-11.78		
Max Change	0.07	3.06	13.09		
Mean Change	-0.95	-0.24	3.23		
Sdt Dev Change	1.07	2.08	9.94		

Location: W055 Baseline: 1992	HAT 4.55m	MHWS 3.47m	MSL 0.10m	MLWS -2.75m	LAT -3.70m
Total Change	7.13	12.48	-19.16		
Min Change	-3.69	-2.01	-44.75		
Max Change	6.63	9.16	39.07		
Mean Change	0.25	0.45	-0.68		
Sdt Dev Change	2.19	2.36	17.77		

Location: W055 Baseline: 2016	HAT 4.55m	MHWS 3.47m	MSL 0.10m	MLWS -2.75m	LAT -3.70m
Total Change	-3.18	-1.40	9.43		
Min Change	-3.04	-1.71	-4.24		
Max Change	0.47	2.03	7.85		
Mean Change	-0.80	-0.35	2.36		
Sdt Dev Change	1.35	1.52	4.78		

Location: HH063 Baseline: 1992	HAT 4.54m	MHWS 3.46m	MSL 0.09m	MLWS -2.76m	LAT -3.71m
Total Change	-6.17	-9.81			
Min Change	-8.68	-3.89			
Max Change	13.78	17.07			
Mean Change	-0.22	-0.35			
Sdt Dev Change	3.47	3.73			

Location: HH063 Baseline: 2016	HAT 4.54m	MHWS 3.46m	MSL 0.09m	MLWS -2.76m	LAT -3.71m
Total Change	-3.53	-4.17			
Min Change	-3.05	-3.89			
Max Change	3.88	3.84			
Mean Change	-0.88	-1.04			
Sdt Dev Change	2.81	2.93			

Location: HH067	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.55m	3.47m	0.10m	-2.75m	-3.71m
Total Change	3.78	6.93			
Min Change	-4.73	-3.68			
Max Change	6.28	5.34			
Mean Change	0.14	0.25			
Sdt Dev Change	2.54	2.07			

Location: HH067	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.55m	3.47m	0.10m	-2.75m	-3.71m
Total Change	-0.41	-2.35			
Min Change	-1.50	-3.68			
Max Change	0.91	5.06			
Mean Change	-0.10	-0.59			
Sdt Dev Change	0.91	3.41			

Location: HH071	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.54m	3.47m	0.10m	-2.76m	-3.71m
Total Change	26.36	35.59			
Min Change	-4.84	-1.48			
Max Change	19.94	4.92			
Mean Change	0.94	1.27			
Sdt Dev Change	4.61	1.85			

Location: HH071	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.54m	3.47m	0.10m	-2.76m	-3.71m
Total Change	1.97	-0.49			
Min Change	-2.66	-1.48			
Max Change	3.62	3.11			
Mean Change	0.49	-0.12			
Sdt Dev Change	2.25	1.87			

Location: HH082	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.53m	3.47m	0.10m	-2.77m	-3.71m
Total Change	-4.25	-6.42	-14.16		
Min Change	-5.95	-5.05	-26.86		
Max Change	6.83	4.47	48.23		
Mean Change	-0.15	-0.23	-0.64		
Sdt Dev Change	2.38	1.72	15.22		

Location: HH082 Baseline: 2016	HAT 4.53m	MHWS 3.47m	MSL 0.10m	MLWS -2.77m	LAT -3.71m
Total Change	-3.58	0.04	-22.71		
Min Change	-2.50	-2.36	-13.00		
Max Change	1.09	1.42	-9.71		
Mean Change	-0.89	0.01	-11.35		
Sdt Dev Change	1.37	1.42	1.64		

Location: HH086 Baseline: 1992	HAT 4.53m	MHWS 3.47m	MSL 0.10m	MLWS -2.77m	LAT -3.71m
Total Change	-2.39	-0.91	-14.74		
Min Change	-4.63	-3.64	-14.66		
Max Change	5.35	3.36	18.01		
Mean Change	-0.09	-0.03	-0.92		
Sdt Dev Change	2.35	1.65	9.51		

Location: HH086 Baseline: 2016	HAT 4.53m	MHWS 3.47m	MSL 0.10m	MLWS -2.77m	LAT -3.71m
Total Change	-2.60	0.88			
Min Change	-3.49	-1.03			
Max Change	3.17	3.36			
Mean Change	-0.65	0.22			
Sdt Dev Change	2.52	1.83			

Location: HH090 Baseline: 1992	HAT 4.53m	MHWS 3.47m	MSL 0.10m	MLWS -2.77m	LAT -3.71m
Total Change	-2.04	4.72	-27.16		
Min Change	-4.98	-3.60	-41.23		
Max Change	4.62	8.00	12.21		
Mean Change	-0.07	0.17	-6.79		
Sdt Dev Change	2.06	2.25	21.76		

Location: HH090 Baseline: 2016	HAT 4.53m	MHWS 3.47m	MSL 0.10m	MLWS -2.77m	LAT -3.71m
Total Change	2.36	0.26			
Min Change	-0.12	-1.17			
Max Change	1.13	1.86			
Mean Change	0.59	0.06			
Sdt Dev Change	0.53	1.12			

Location: W057	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.53m	3.47m	0.10m	-2.77m	-3.71m
Total Change	1.45	12.56	-0.39		
Min Change	-5.66	-11.56	-73.92		
Max Change	6.40	9.75	76.24		
Mean Change	0.05	0.45	-0.01		
Sdt Dev Change	2.88	3.73	27.92		

Location: W057	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.53m	3.47m	0.10m	-2.77m	-3.71m
Total Change	-1.92	0.16	8.13		
Min Change	-3.93	-1.85	-9.23		
Max Change	3.78	1.08	15.86		
Mean Change	-0.48	0.04	2.03		
Sdt Dev Change	3.16	1.18	8.98		

Location: HH101	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.52m	3.47m	0.10m	-2.78m	-3.71m
Total Change	28.81	42.47	42.93		
Min Change	-3.26	-10.77	2.38		
Max Change	8.08	14.09	23.71		
Mean Change	1.03	1.52	14.31		
Sdt Dev Change	2.32	4.41	8.89		

Location: HH101	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.52m	3.47m	0.10m	-2.78m	-3.71m
Total Change	1.64	3.87			
Min Change	-3.26	-1.97			
Max Change	3.20	3.79			
Mean Change	0.41	0.97			
Sdt Dev Change	2.33	2.04			

Location: HH111	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.52m	3.47m	0.10m	-2.78m	-3.71m
Total Change	6.73	6.57	-9.63		
Min Change	-6.14	-11.68	-72.34		
Max Change	11.87	22.47	34.35		
Mean Change	0.24	0.23	-0.46		
Sdt Dev Change	3.36	5.09	21.30		

Location: HH111 Baseline: 2016	HAT 4.52m	MHWS 3.47m	MSL 0.10m	MLWS -2.78m	LAT -3.71m
Total Change	-5.43	-8.67			
Min Change	-3.25	-11.68			
Max Change	0.29	3.41			
Mean Change	-1.36	-2.17			
Sdt Dev Change	1.54	5.77			

Location: W058 Baseline: 1992	HAT 4.51m	MHWS 3.47m	MSL 0.10m	MLWS -2.79m	LAT -3.72m
Total Change	15.02	30.47	20.14		
Min Change	-6.14	-6.25	-37.48		
Max Change	9.07	14.30	35.68		
Mean Change	0.54	1.09	0.72		
Sdt Dev Change	3.21	4.36	19.50		

Location: W058 Baseline: 2016	HAT 4.51m	MHWS 3.47m	MSL 0.10m	MLWS -2.79m	LAT -3.72m
Total Change	-4.38	1.58	12.83		
Min Change	-2.41	-4.89	-10.99		
Max Change	0.73	4.11	13.50		
Mean Change	-1.10	0.40	3.21		
Sdt Dev Change	1.22	3.52	8.92		

Location: HH120 Baseline: 1992	HAT 4.50m	MHWS 3.47m	MSL 0.10m	MLWS -2.80m	LAT -3.72m
Total Change	6.78	6.11	71.89		
Min Change	-7.56	-10.94	-50.05		
Max Change	11.15	20.35	59.38		
Mean Change	0.24	0.22	2.57		
Sdt Dev Change	3.42	5.11	24.16		

Location: HH120 Baseline: 2016	HAT 4.50m	MHWS 3.47m	MSL 0.10m	MLWS -2.80m	LAT -3.72m
Total Change	-9.47	-13.85	21.42		
Min Change	-2.98	-10.94	-3.45		
Max Change	-1.35	2.86	18.14		
Mean Change	-2.37	-3.46	5.36		
Sdt Dev Change	0.64	5.04	9.23		

Location: HH128	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.51m	3.48m	0.10m	-2.79m	-3.71m
Total Change	1.44	0.14	71.16		
Min Change	-6.36	-11.27	-15.64		
Max Change	6.36	10.96	28.25		
Mean Change	0.05	0.01	2.64		
Sdt Dev Change	2.09	6.09	9.18		

Location: HH128	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.51m	3.48m	0.10m	-2.79m	-3.71m
Total Change	0.00	1.62	11.27		
Min Change	0.00	-6.73	-5.30		
Max Change	0.00	10.96	14.92		
Mean Change	0.00	0.40	2.82		
Sdt Dev Change	0.00	6.55	7.56		

Location: W059	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.50m	3.47m	0.10m	-2.80m	-3.72m
Total Change	0.74	2.25	41.20		
Min Change	-1.63	-5.47	-24.51		
Max Change	2.27	11.75	31.60		
Mean Change	0.03	0.08	1.47		
Sdt Dev Change	0.58	2.79	13.57		

Location: W059	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.50m	3.47m	0.10m	-2.80m	-3.72m
Total Change	0.00	0.00	20.30		
Min Change	0.00	0.00	-3.75		
Max Change	0.00	0.00	17.41		
Mean Change	0.00	0.00	5.07		
Sdt Dev Change	0.00	0.00	8.18		

Location: HH137	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.50m	3.47m	0.10m	-2.80m	-3.72m
Total Change	0.00	0.00	-0.80		
Min Change	-0.02	-2.85	-27.96		
Max Change	0.02	2.85	20.33		
Mean Change	0.00	0.00	-0.03		
Sdt Dev Change	0.01	1.25	11.49		

Location: HH137 Baseline: 2016	HAT 4.50m	MHWS 3.47m	MSL 0.10m	MLWS -2.80m	LAT -3.72m
Total Change	0.00	0.00	10.66		
Min Change	0.00	-1.17	-27.96		
Max Change	0.00	0.67	20.33		
Mean Change	0.00	0.00	2.67		
Sdt Dev Change	0.00	0.70	19.05		

Location: HH141 Baseline: 1992	HAT 4.49m	MHWS 3.47m	MSL 0.10m	MLWS -2.80m	LAT -3.72m
Total Change	1.25	11.48	-3.09		
Min Change	-0.49	-6.23	-18.95		
Max Change	1.24	7.89	17.78		
Mean Change	0.04	0.41	-0.11		
Sdt Dev Change	0.27	3.41	6.99		

Location: HH141 Baseline: 2016	HAT 4.49m	MHWS 3.47m	MSL 0.10m	MLWS -2.80m	LAT -3.72m
Total Change	1.25	10.23	-23.05		
Min Change	0.00	-0.63	-18.95		
Max Change	1.24	7.89	-0.17		
Mean Change	0.31	2.56	-5.76		
Sdt Dev Change	0.54	3.27	7.65		

Location: HH145 Baseline: 1992	HAT 4.50m	MHWS 3.47m	MSL 0.10m	MLWS -2.80m	LAT -3.72m
Total Change	15.16	26.58	2.25		
Min Change	-0.98	-7.84	-7.25		
Max Change	4.88	13.78	8.92		
Mean Change	0.54	0.95	0.08		
Sdt Dev Change	1.13	4.88	3.49		

Location: HH145 Baseline: 2016	HAT 4.50m	MHWS 3.47m	MSL 0.10m	MLWS -2.80m	LAT -3.72m
Total Change	2.03	7.29	2.59		
Min Change	-0.98	-0.62	-0.04		
Max Change	3.04	7.32	1.22		
Mean Change	0.51	1.82	0.65		
Sdt Dev Change	1.59	3.25	0.49		

Location: HH149 Baseline: 1992	HAT 4.49m	MHWS 3.47m	MSL 0.10m	MLWS -2.80m	LAT -3.72m
Total Change	5.80	12.79	-12.76		
Min Change	-12.43	-6.04	-9.09		
Max Change	12.43	13.33	5.17		
Mean Change	0.21	0.46	-0.46		
Sdt Dev Change	3.51	5.23	3.59		

Location: HH149 Baseline: 2016	HAT 4.49m	MHWS 3.47m	MSL 0.10m	MLWS -2.80m	LAT -3.72m
Total Change	-2.02	-5.43	-10.52		
Min Change	-3.21	-6.04	-9.09		
Max Change	2.56	7.04	2.63		
Mean Change	-0.51	-1.36	-2.63		
Sdt Dev Change	2.10	5.20	4.83		

Location: W060 Baseline: 1992	HAT 4.49m	MHWS 3.47m	MSL 0.10m	MLWS -2.80m	LAT -3.72m
Total Change	0.00	-0.03	-21.59	56.57	
Min Change	-0.85	-10.04	-5.33	-15.47	
Max Change	0.85	7.36	4.40	33.66	
Mean Change	0.00	0.00	-0.77	6.29	
Sdt Dev Change	0.23	3.32	2.03	14.26	

Location: W060 Baseline: 2016	HAT 4.49m	MHWS 3.47m	MSL 0.10m	MLWS -2.80m	LAT -3.72m
Total Change	0.00	-0.03	-7.20		
Min Change	0.00	-1.51	-3.36		
Max Change	0.00	1.48	0.90		
Mean Change	0.00	-0.01	-1.80		
Sdt Dev Change	0.00	1.06	1.65		

Location: HH156	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.48m	3.47m	0.10m	-2.80m	-3.72m
Total Change	0.00	0.00	0.65		
Min Change	-0.05	-10.88	-3.47		
Max Change	0.05	10.07	6.35		
Mean Change	0.00	0.00	0.02		
Sdt Dev Change	0.02	3.53	2.46		

Location: HH156	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.48m	3.47m	0.10m	-2.80m	-3.72m
Total Change	0.00	0.00	7.59		
Min Change	0.00	0.00	0.04		
Max Change	0.00	0.00	3.97		
Mean Change	0.00	0.00	1.90		
Sdt Dev Change	0.00	0.00	1.39		

Location: HH160	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.48m	3.47m	0.10m	-2.81m	-3.72m
Total Change	0.00	0.03	1.09		
Min Change	0.00	-5.67	-6.43		
Max Change	0.00	6.23	6.64		
Mean Change	0.00	0.00	0.04		
Sdt Dev Change	0.00	1.60	3.13		

Location: HH160	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.48m	3.47m	0.10m	-2.81m	-3.72m
Total Change	0.00	0.02	0.56		
Min Change	0.00	0.00	-3.59		
Max Change	0.00	0.02	2.11		
Mean Change	0.00	0.01	0.14		
Sdt Dev Change	0.00	0.01	2.22		

Location: HH164	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.47m	3.47m	0.10m	-2.81m	-3.72m
Total Change	0.02	-0.10	33.19		
Min Change	-0.08	-11.92	-20.68		
Max Change	0.08	13.24	23.08		
Mean Change	0.00	0.00	1.19		
Sdt Dev Change	0.03	3.62	9.43		

Location: HH164	HAT	MHWS	MSL	MLWS	LAT

Baseline: 2016	4.47m	3.47m	0.10m	-2.81m	-3.72m
Total Change	0.02	0.00	24.90		
Min Change	0.00	0.00	-4.95		
Max Change	0.02	0.00	21.52		
Mean Change	0.00	0.00	6.23		
Sdt Dev Change	0.01	0.00	9.78		

Location: HH168 Baseline: 1992	HAT 4.47m	MHWS 3.47m	MSL 0.10m	MLWS -2.81m	LAT -3.72m
Total Change		1.52	35.42		
Min Change		-8.50	-9.46		
Max Change		9.11	21.38		
Mean Change		0.05	1.27		
Sdt Dev Change		3.04	5.81		

Location: HH168 Baseline: 2016	HAT 4.47m	MHWS 3.47m	MSL 0.10m	MLWS -2.81m	LAT -3.72m
Total Change	0.00	1.47	1.41		
Min Change	0.00	0.00	-4.53		
Max Change	0.00	1.47	3.50		
Mean Change	0.00	0.37	0.35		
Sdt Dev Change	0.00	0.64	3.00		

Location: W061 Baseline: 1992	HAT 4.47m	MHWS 3.47m	MSL 0.10m	MLWS -2.81m	LAT -3.72m
Total Change	0.00	1.65	14.08	-2.03	
Min Change	-0.37	-1.98	-6.10	-3.62	
Max Change	0.39	3.05	11.30	5.19	
Mean Change	0.00	0.06	0.50	-0.13	
Sdt Dev Change	0.13	0.70	3.60	2.37	

Location: W061 Baseline: 2016	HAT 4.47m	MHWS 3.47m	MSL 0.10m	MLWS -2.81m	LAT -3.72m
Total Change	0.00	1.65	3.32	5.61	
Min Change	0.00	-1.98	-1.29	-0.99	
Max Change	0.00	3.05	5.73	4.62	
Mean Change	0.00	0.41	0.83	1.40	
Sdt Dev Change	0.00	1.78	2.84	2.19	

4.5. North Hunstanton – 2dSU05NH

The topographic profiles in this monitoring cell are situated between Hunstanton's Pier building (W062) and Golf course (NH043) with profile number increasing from north to south.

The North Hunstanton monitoring cell shows a long-term trend of erosion in the results of CSA analysis. The maximum erosion for strategic profiles was at W062 with erosion of 25.58% since 1992 and 15.9% since 2010. The heavy erosion is also seen in some parts of the Lidar analysis.

The Lidar elevation change analysis shows a complex pattern of erosion and accretion. This is most likely due to the movement of sand dunes, with cliff erosion potentially adding to the increase in elevation at the landward extent of analysis. There is heavier and more widespread erosion in the current phase image, particularly in the upper beach area to the South of the cell. This could be of concern as there are no dunes in the south of this cell where material lost from the upper beach is likely to be deposited, meaning material could be lost from the system entirely.

CSA Table

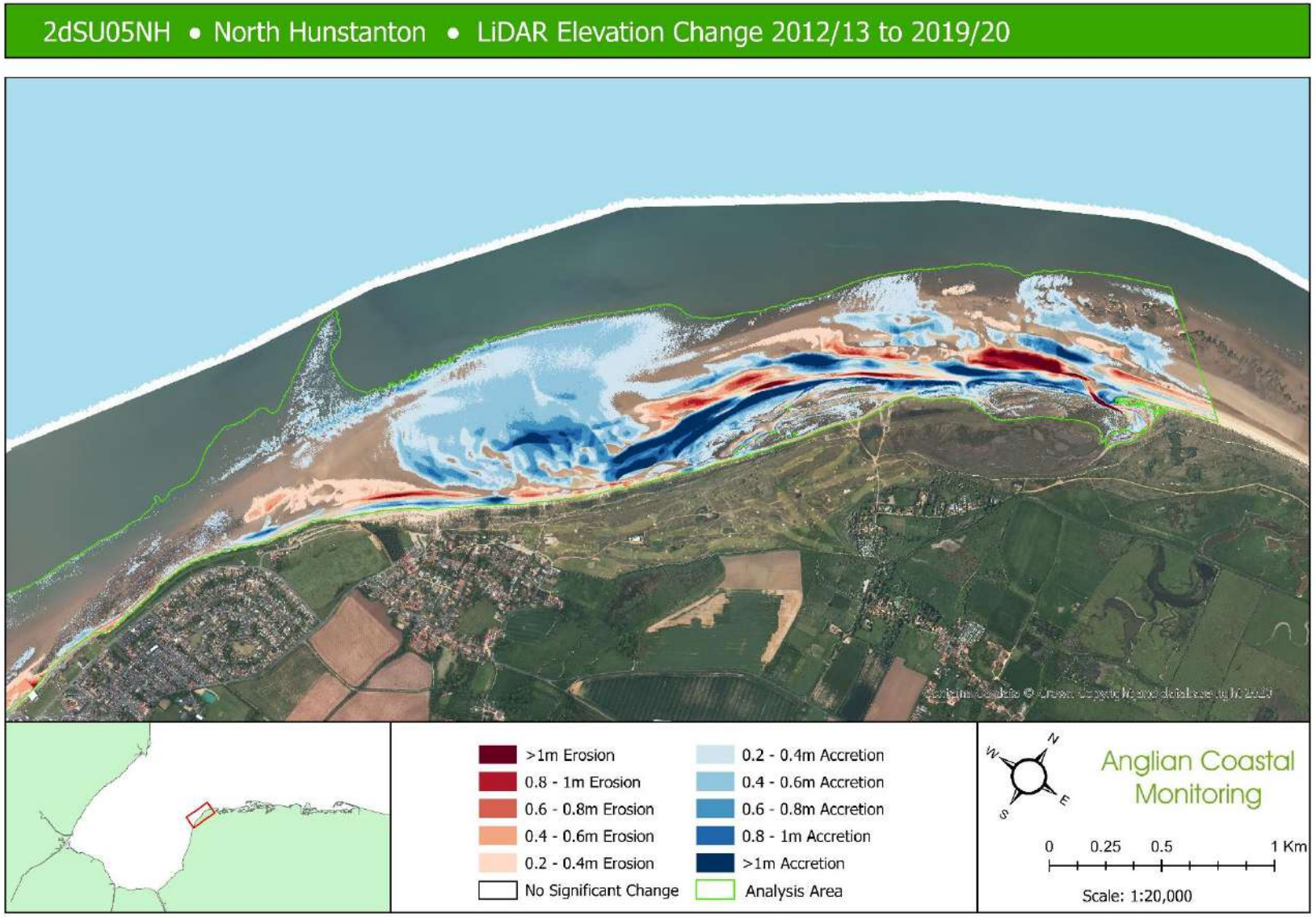
Strategic profiles

Locations	Baseline to present		Current Phase to Present	
	1992-S to 2020-S		2016-S to 2020-S	
Location	CSA Diff (m2)	% Change	CSA Diff (m2)	% Change
2d01304 [W062]	-112.5	-25.58	-27.82	-4.03
2d01320 [W063]	-39.74	-6.84	37.83	5.72
	Av=-76.12	Av=-16.21%	Av=5.01	Av=0.85%
	Min=-112.50	Min=-25.58%	Min=-27.82	Min=-4.03%
	Max=-39.74	Max=-6.84%	Max=37.83	Max=5.72%

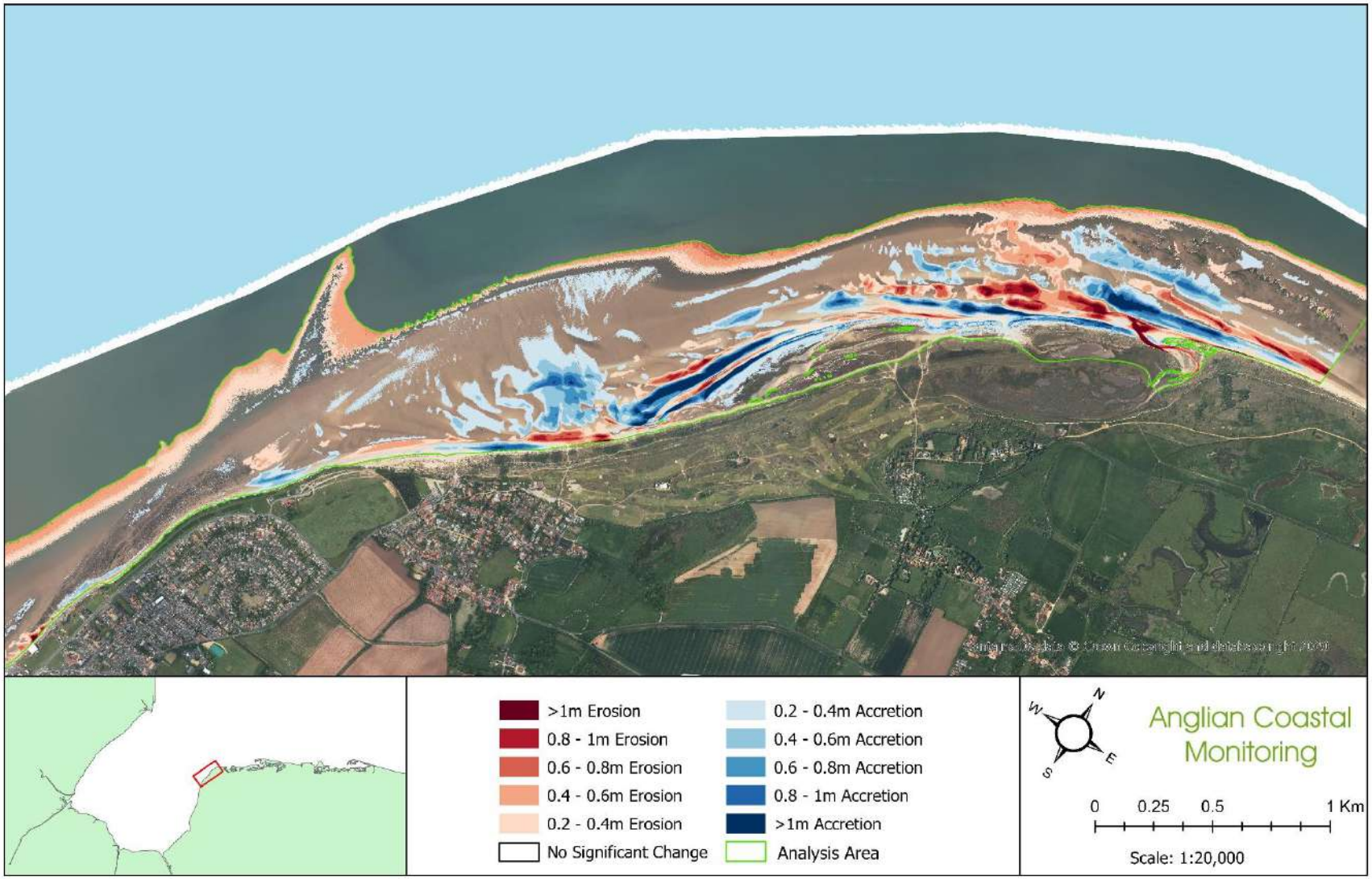
Analysis Profiles

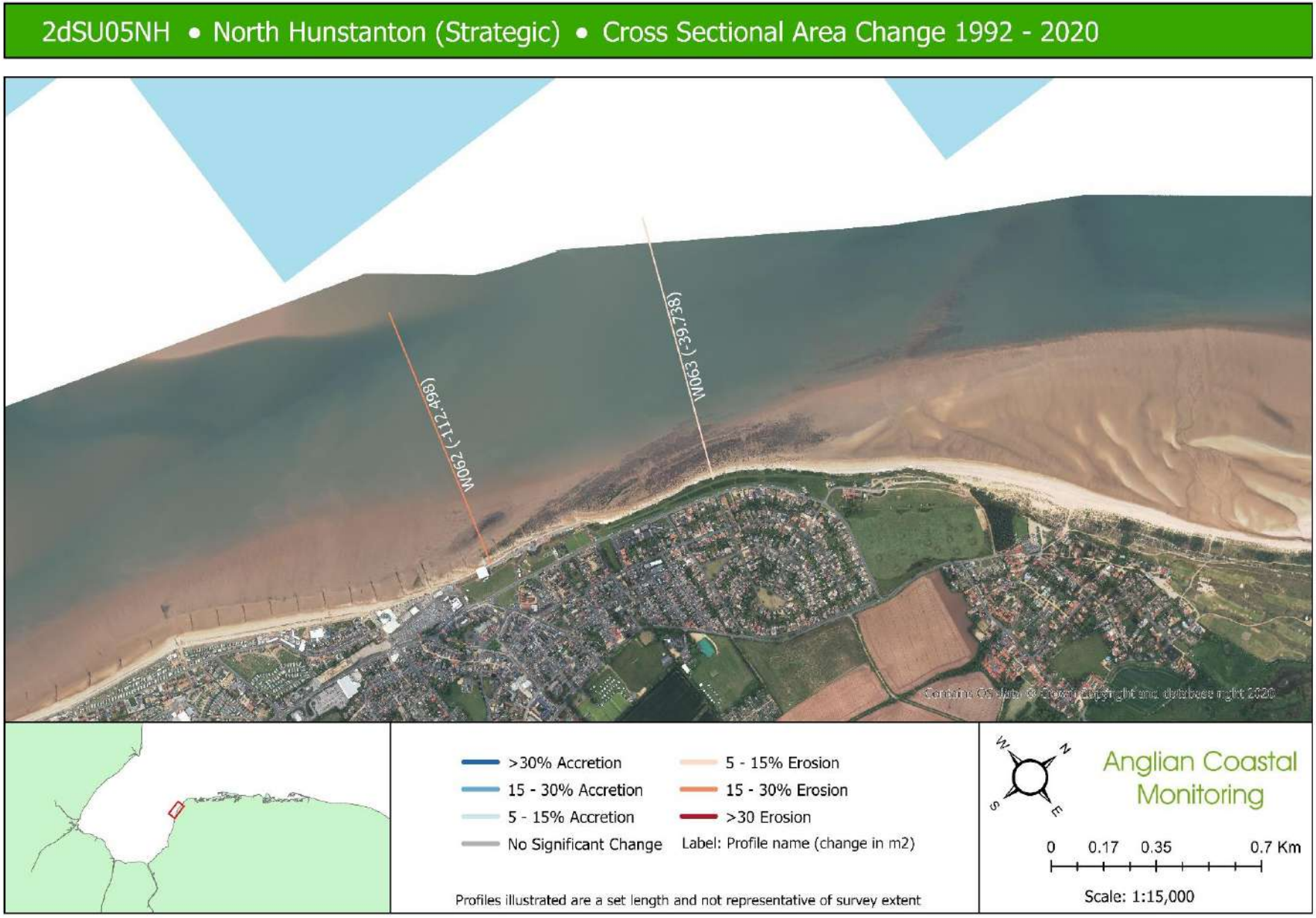
Locations	Baseline to present		Current Phase to Present	
	2010-S to 2020-S		2016-S to 2020-S	
Location	CSA Diff (m2)	% Change	CSA Diff (m2)	% Change
2d01294 [NH002]	22.63	2.99	8.69	0.9
2d01296 [NH004]	-43.18	-6.27	-8.82	-1
2d01298 [NH006]	-85.7	-12.25	0.25	0.03
2d01300 [NH008]	-94.26	-15.77	-10.37	-1.34
2d01302 [NH010]	-74.52	-13.74	-3.68	-0.49
2d01304 [W062]	-61.87	-15.9	-27.82	-4.03
2d01306 [NH013]	-33.41	-7.78	0.32	0.06
2d01308 [NH015]	-32.93	-7.6	8.7	1.62
2d01310 [NH017]	-32.93	-7.52	8.56	1.61
2d01312 [NH019]	-18.27	-2.53	14.29	1.71
2d01314 [NH021]	-17.61	-2.55	2.57	0.33
2d01316 [NH023]	-28.85	-4.31	13.82	1.81
2d01318 [NH025]	-32.83	-5.34	11.14	1.6
2d01320 [W063]	3.75	0.7	37.83	5.72
2d01322 [NH028]	-10.34	-1.88	17.75	2.64
2d01324 [NH029]	-44.31	-6.65	2.92	0.37
2d01326 [NH031]	-17.52	-2.53	20.85	2.48
2d01328 [NH033]	-75.8	-9.01	-6.55	-0.66

2d01330 [NH035]	-90.35	-10.02	10.19	0.97
2d01332 [NH037]	-85.43	-8.52	12.5	1.09
2d01334 [NH039]	-84.53	-7.63	-10.53	-0.82
2d01336 [NH041]	-84.45	-6.29	13.21	0.81
2d01338 [NH043]	-98.28	-6.13	-17.59	-0.95
	Av=-48.74	Av=-6.81%	Av=4.27	Av=0.63%
	Min=-98.28	Min=-15.90%	Min=-27.82	Min=-4.03%
	Max=22.63	Max=2.99%	Max=37.83	Max=5.72%

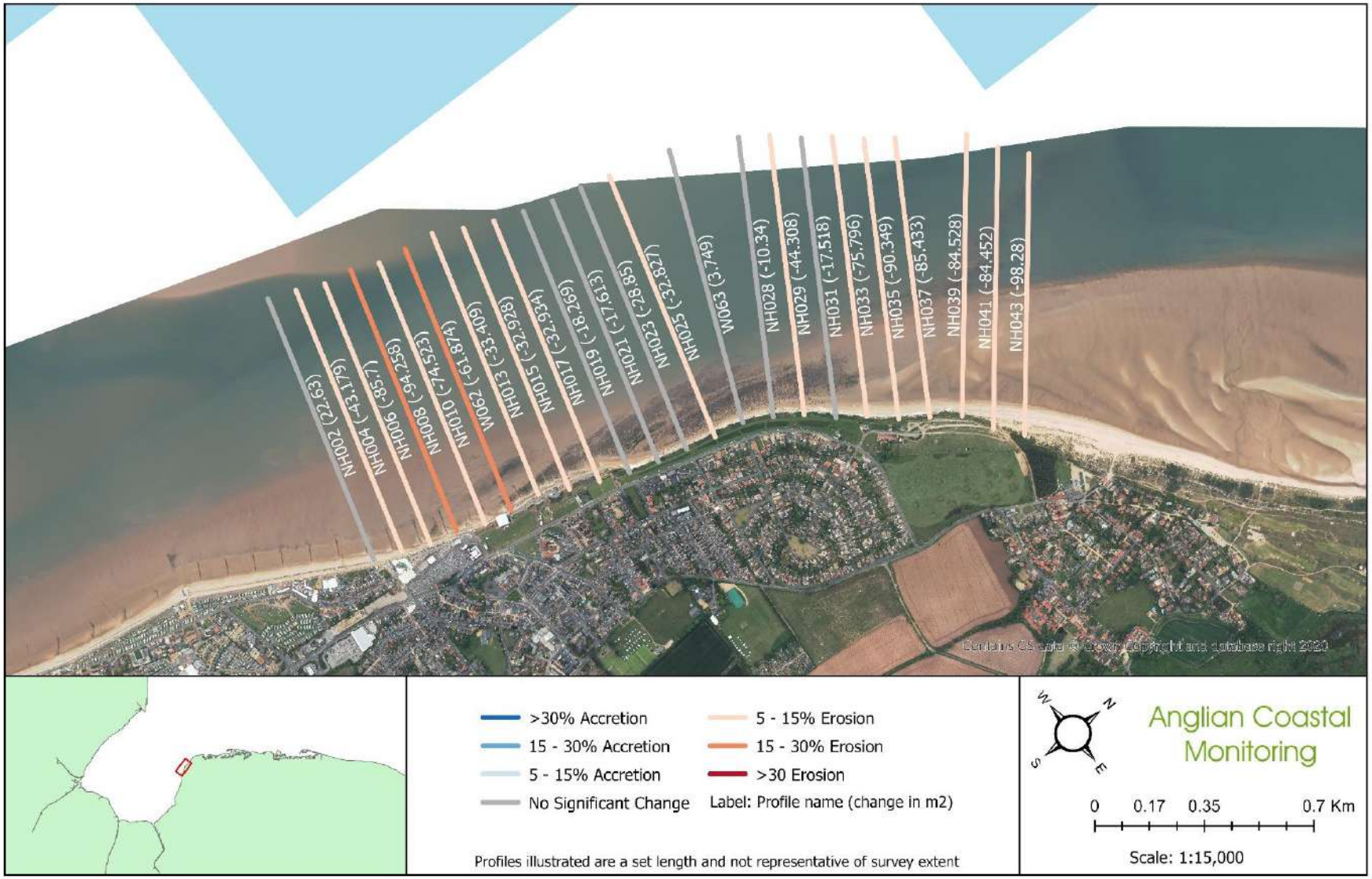

2dSU05NH • North Hunstanton • LiDAR Elevation Change 2012/13 to 2019/20
>1m Erosion
0.8 - 1m Erosion
0.6 - 0.8m Erosion
0.4 - 0.6m Erosion
0.2 - 0.4m Erosion
No Significant Change
0.2 - 0.4m Accretion
0.4 - 0.6m Accretion
0.6 - 0.8m Accretion
0.8 - 1m Accretion
>1m Accretion
Analysis Area
N
W
E
S
Anglian Coastal Monitoring
0 0.25 0.5 1 Km
Scale: 1:20,000

2dSU05NH • North Hunstanton • LiDAR Elevation Change 2016/17 to 2019/20

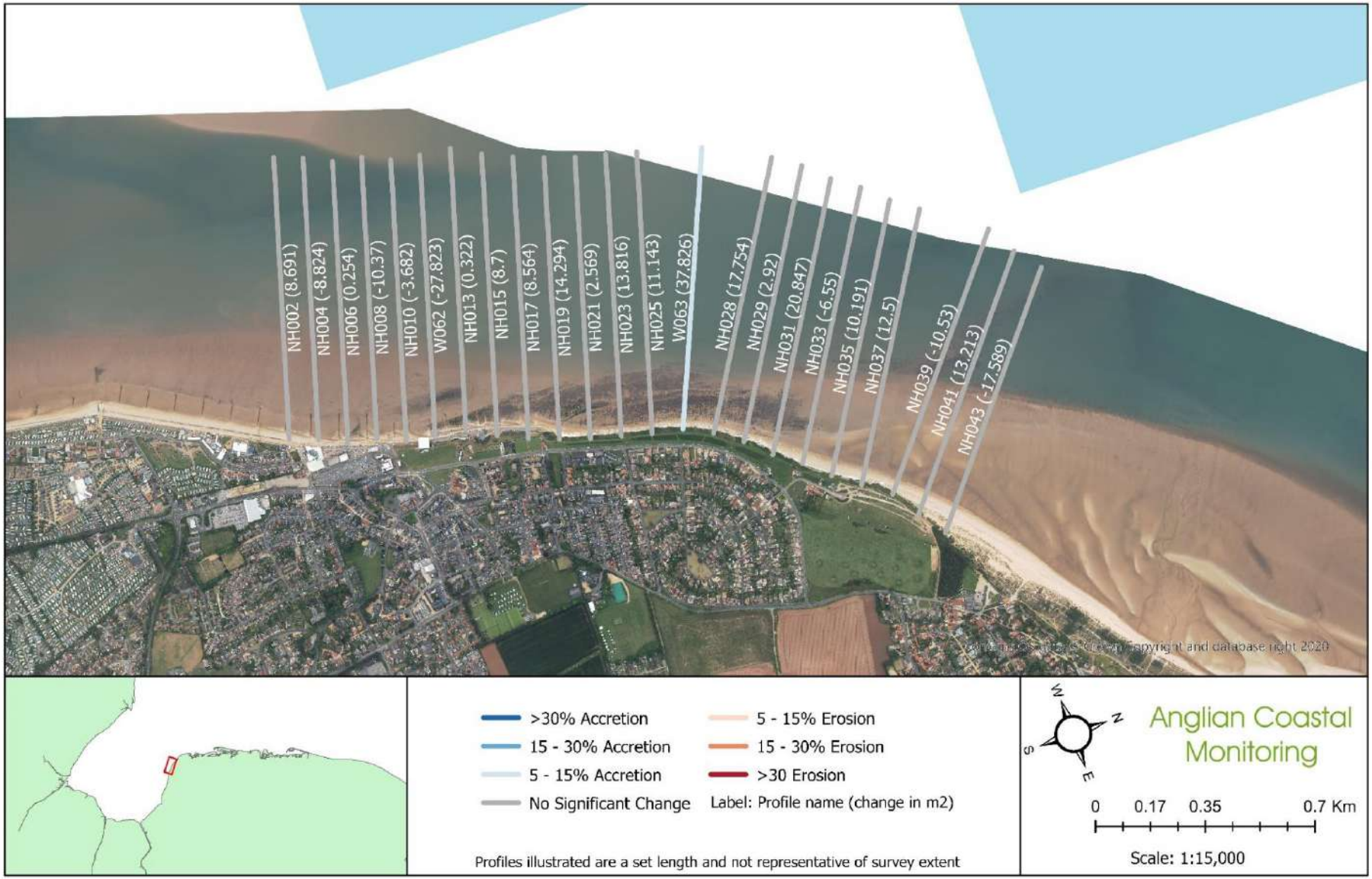



2dSU05NH • North Hunstanton (Strategic) • Cross Sectional Area Change 1992 - 2020
W062 (-1124.98)
W063 (-739.38)
>30% Accretion
15 - 30% Accretion
5 - 15% Accretion
No Significant Change
5 - 15% Erosion
15 - 30% Erosion
>30 Erosion
Label: Profile name (change in m2)
Profiles illustrated are a set length and not representative of survey extent
Anglian Coastal Monitoring
0 0.17 0.35 0.7 Km
Scale: 1:15,000

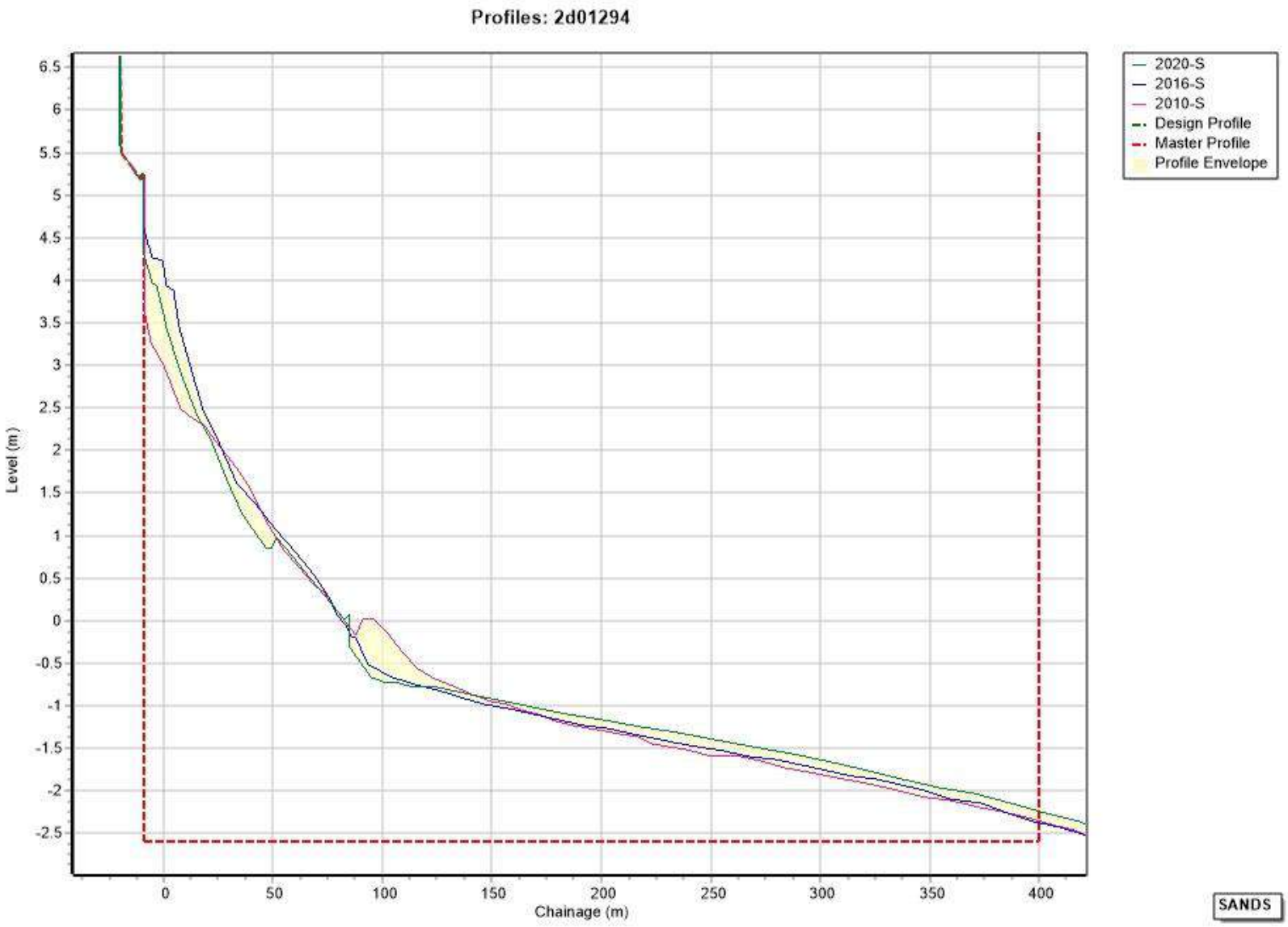
2dSU05NH • North Hunstanton (Analysis) • Cross Sectional Area Change 2010 - 2020

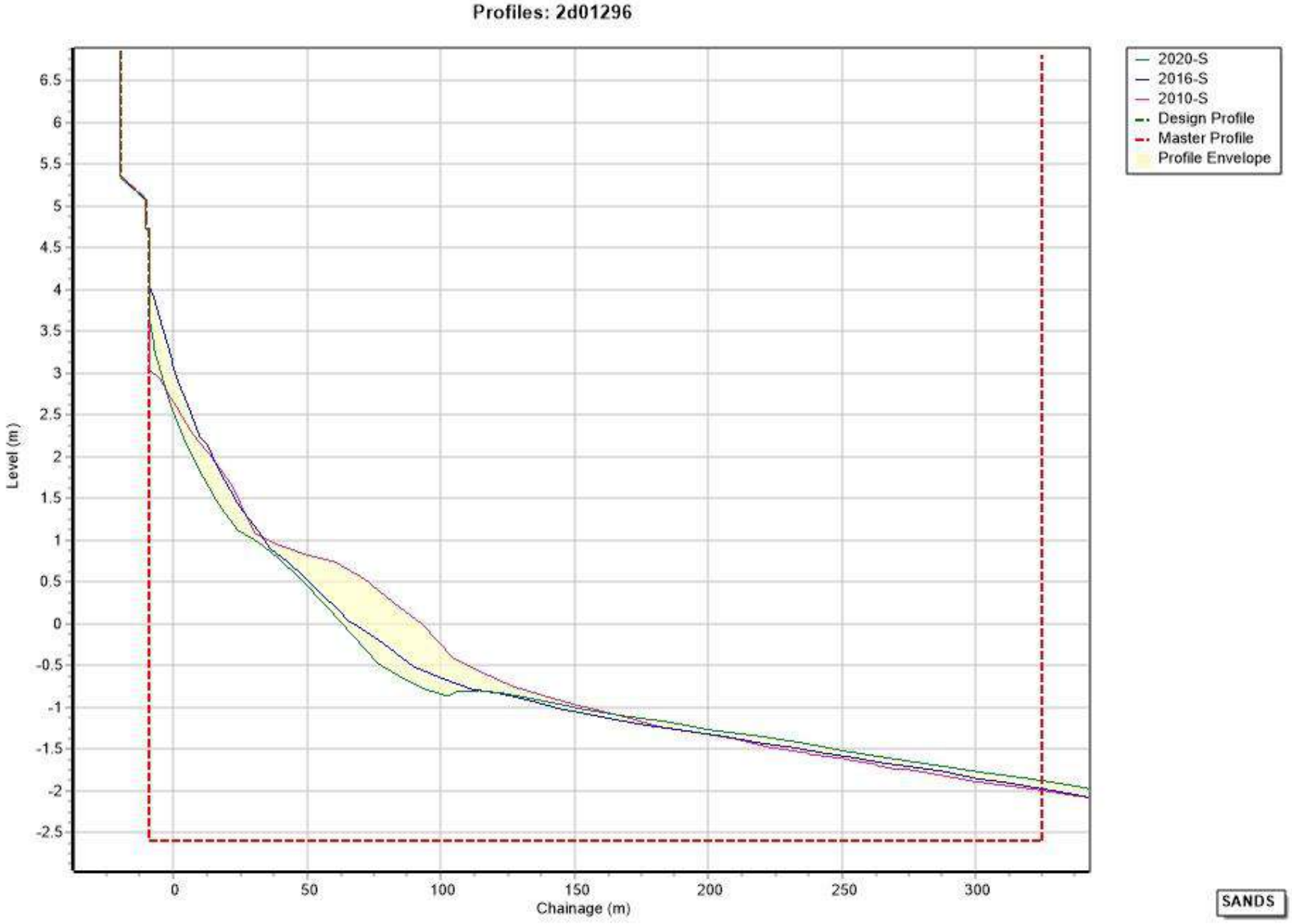


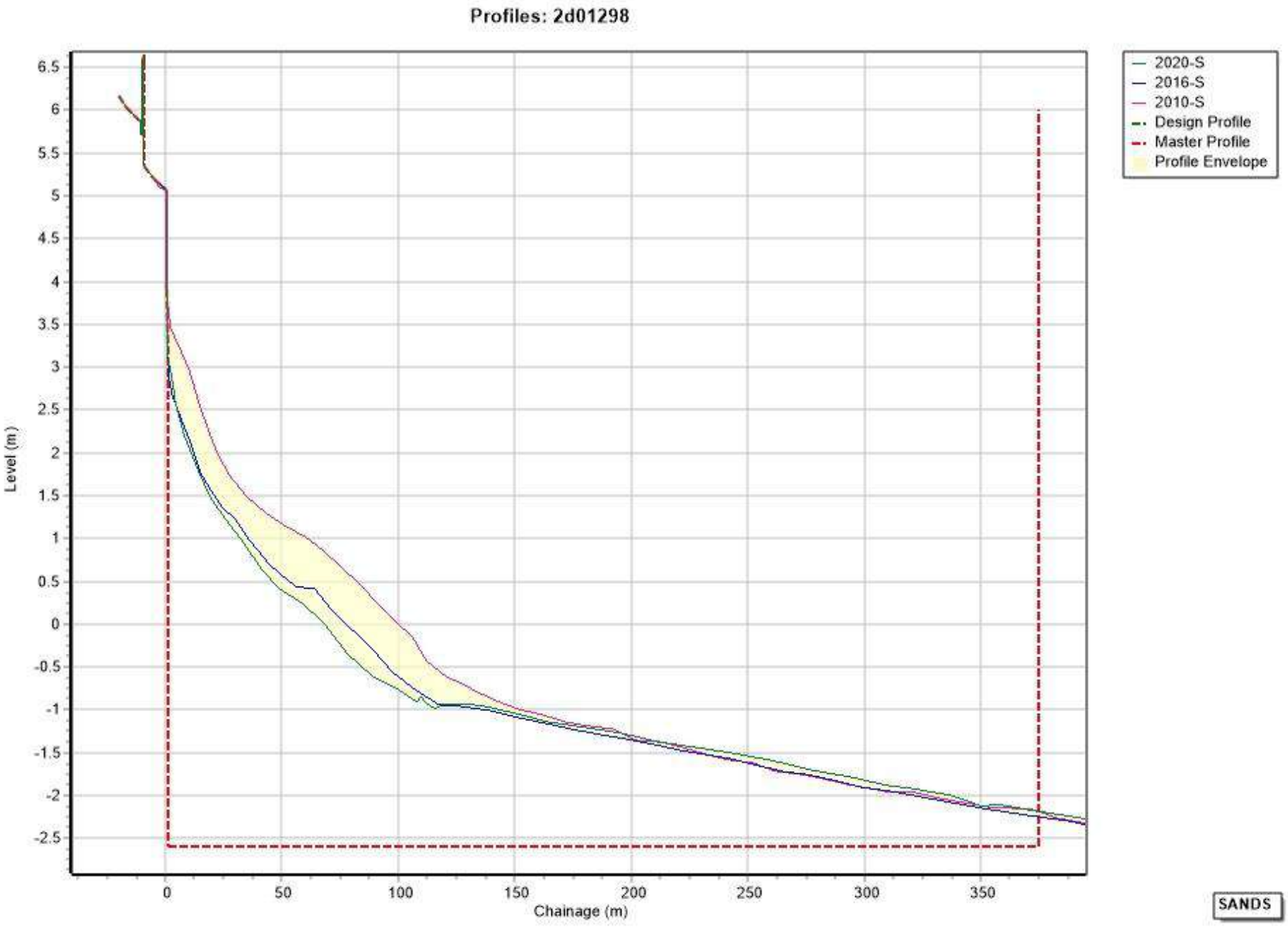
2dSU05NH • North Hunstanton • Cross Sectional Area Change 2016 - 2020



Profile Graphs




Profiles: 2d01296
2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
0
50
100
150
200
250
300
Chainage (m)
SANDS


Profiles: 2d01298
2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
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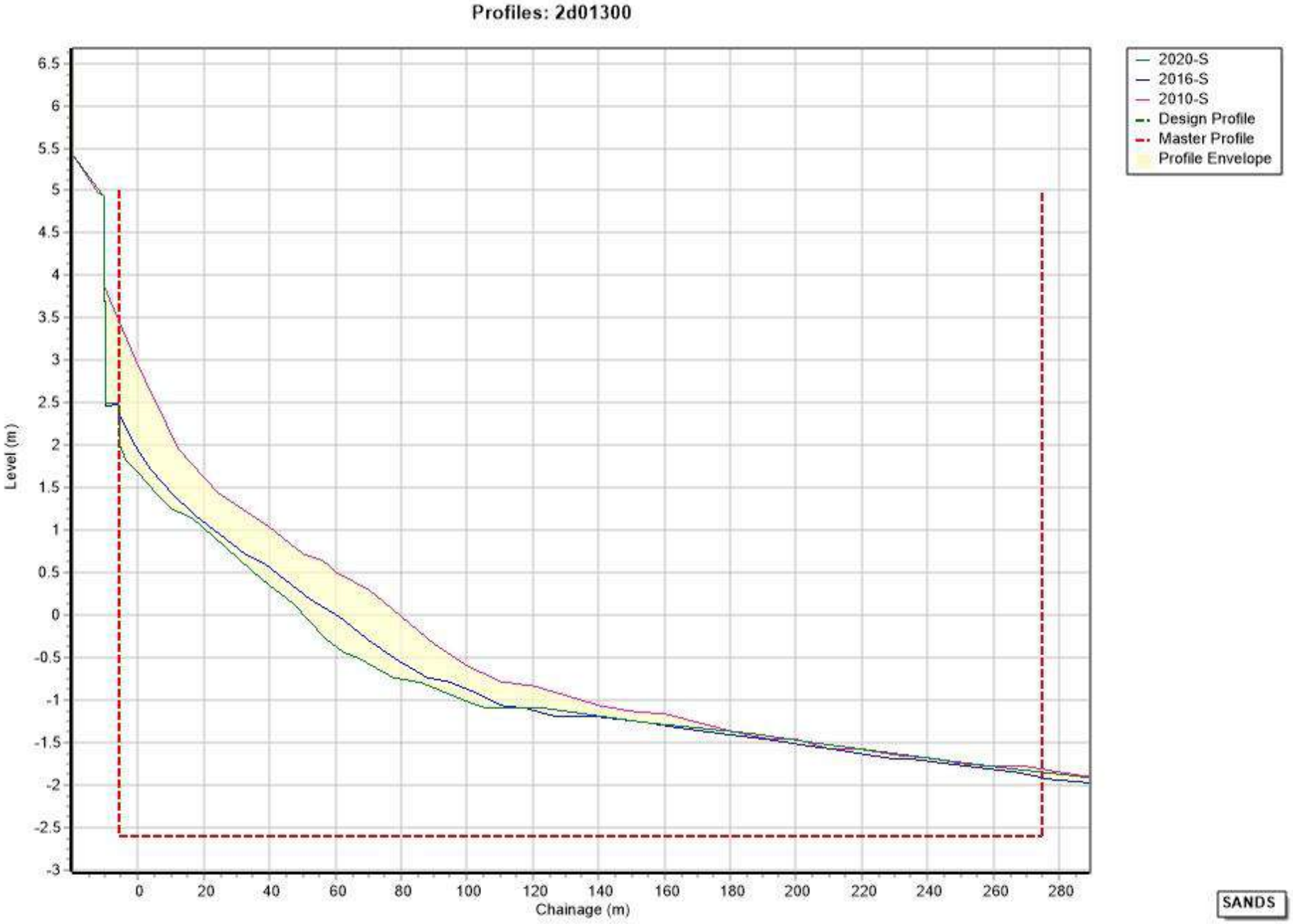
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
0
50
100
150
200
250
300
350

SANDS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2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
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5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
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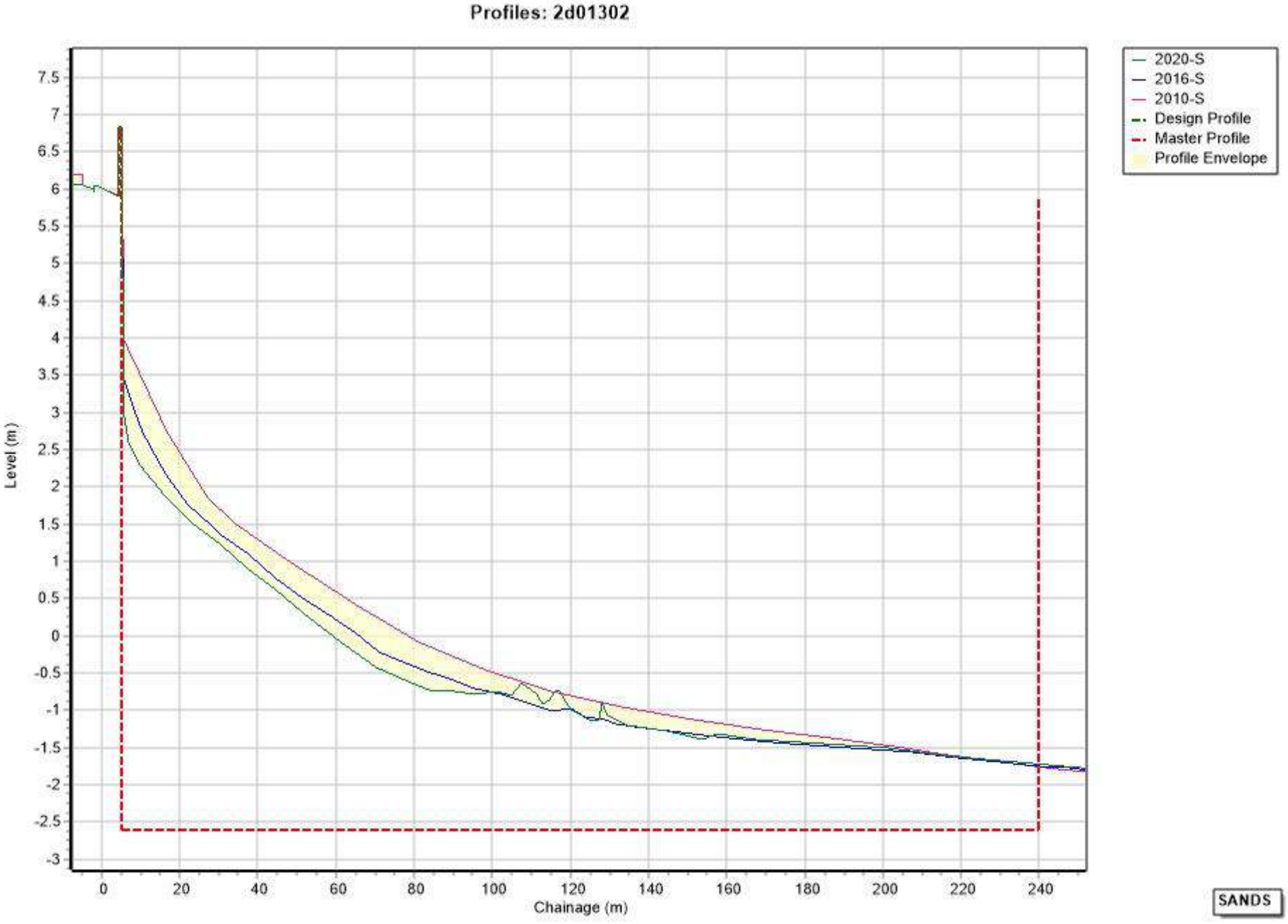
260
280
SANDS


Profiles: 2d01302
2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
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-3
0
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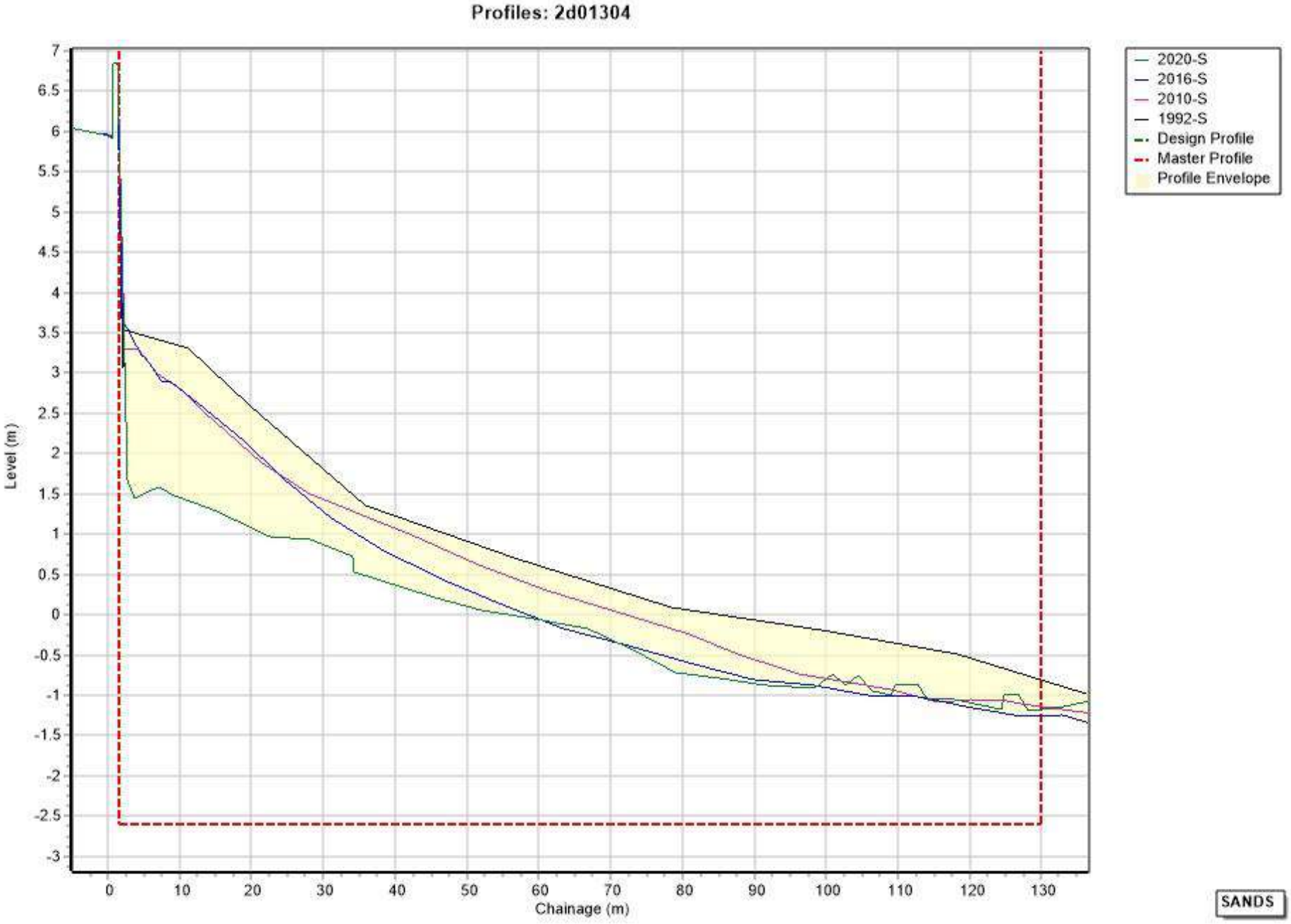
220
240

SANDS


Profiles: 2d01304
2020-S
2016-S
2010-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
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6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
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-3
0
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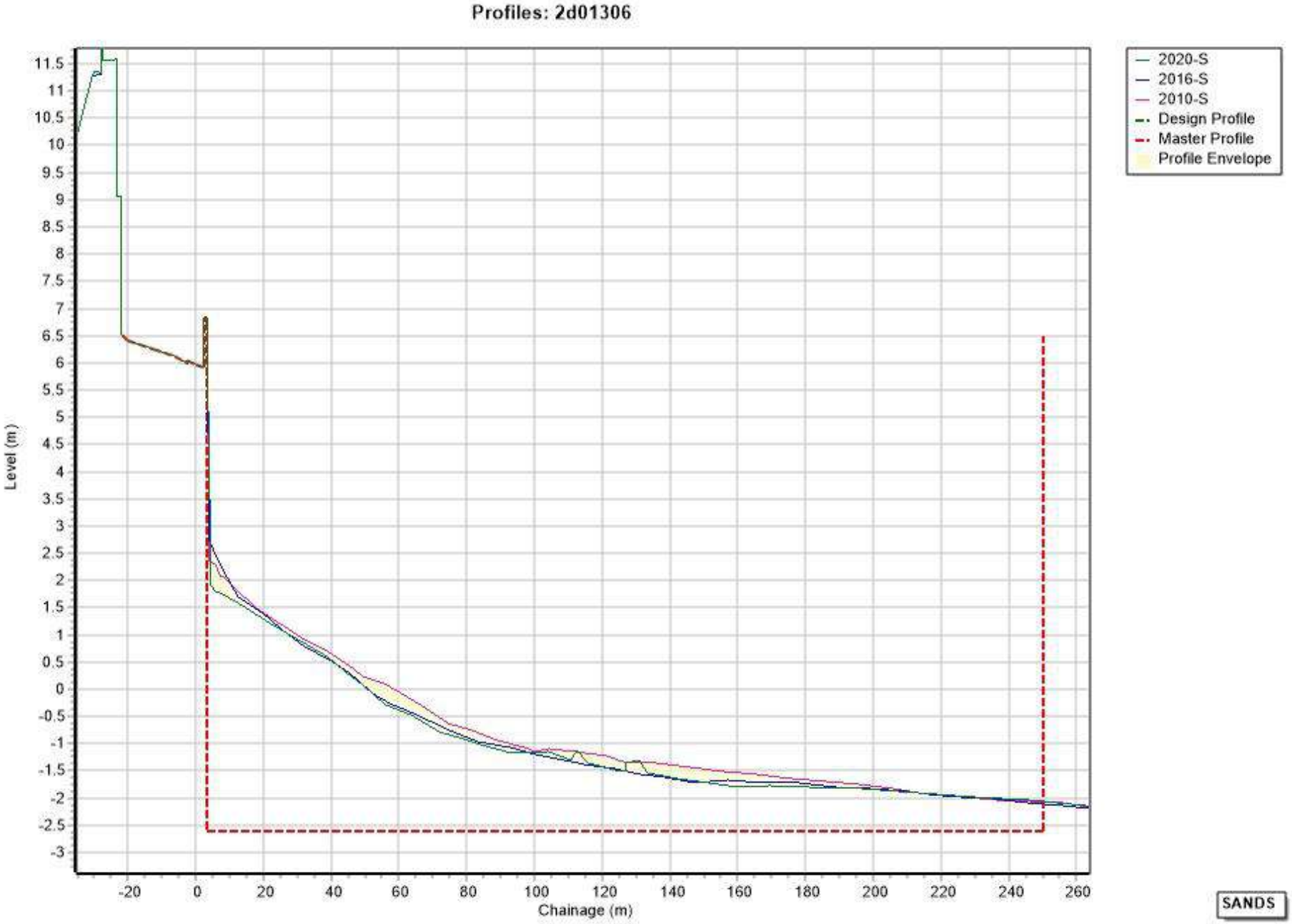
20
30
40
50
60
70
80
90
100
110
120
130

SANDS


Profiles: 2d01306
2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
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11
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-20
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20
40
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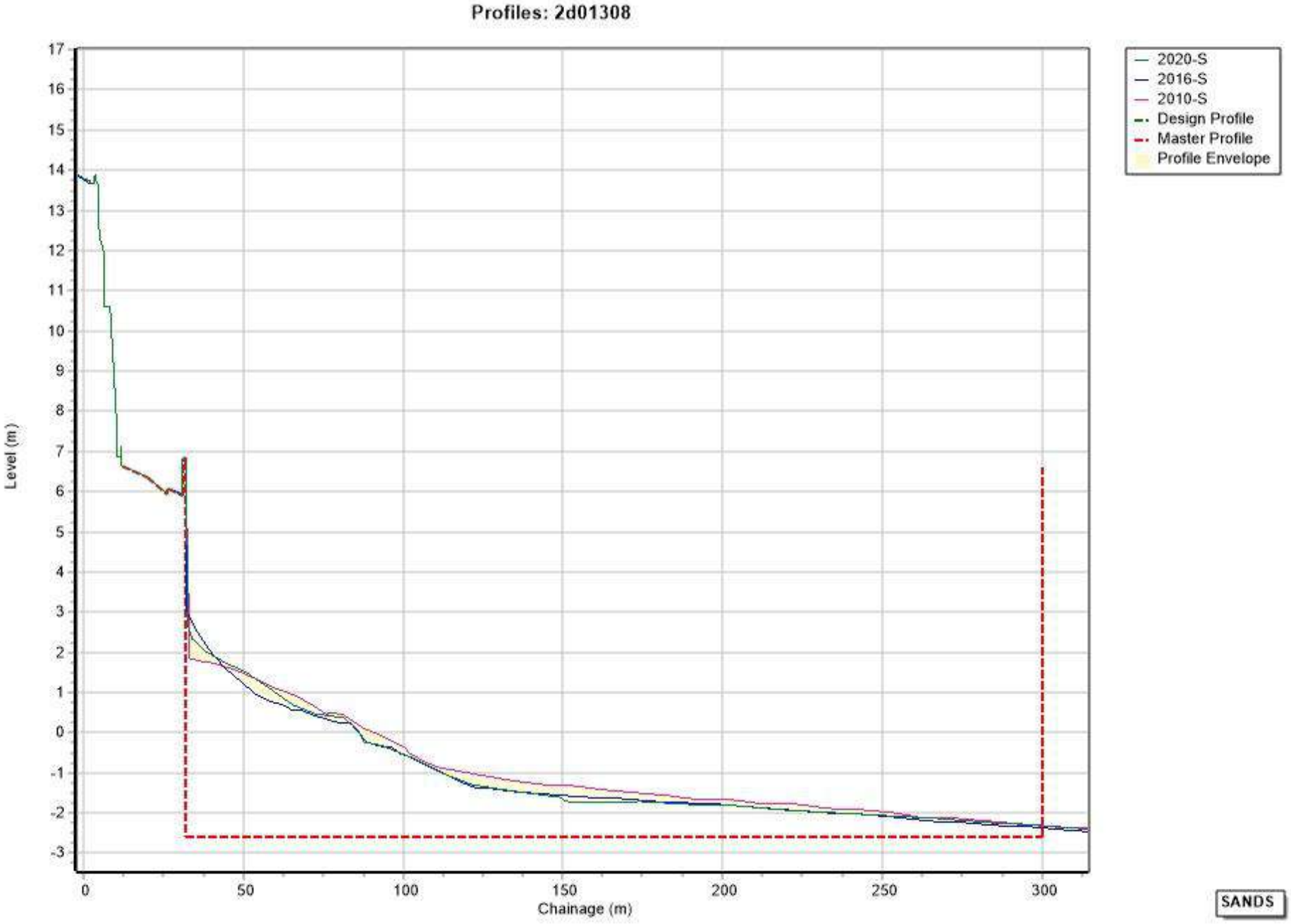
80
100
120
140
160
180
200
220
240
260
SANDS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2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
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16
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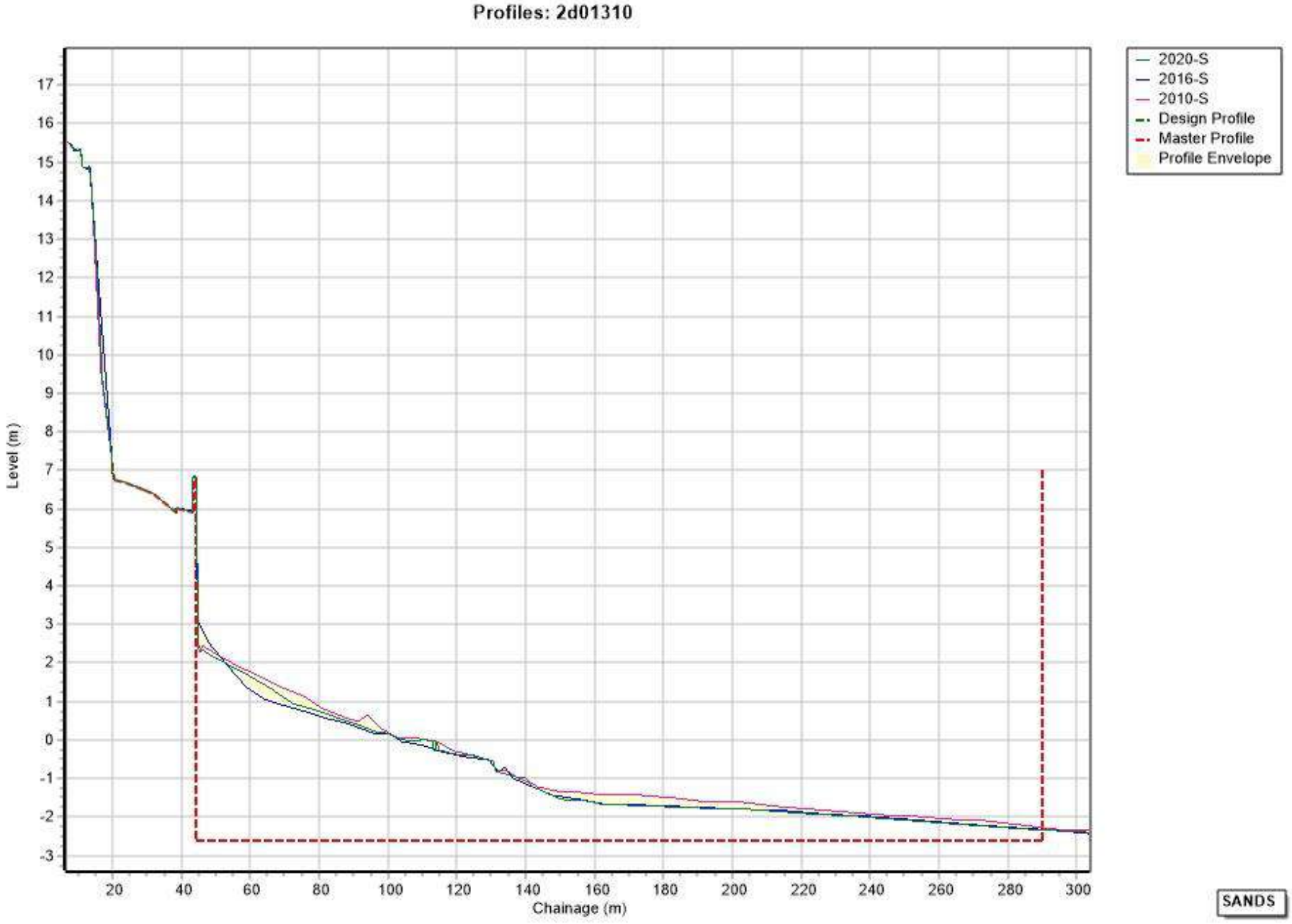
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
0
50
100
150
200
250
300

SANDS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2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
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15
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-1
-2
-3
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100
120
140
160
180
200
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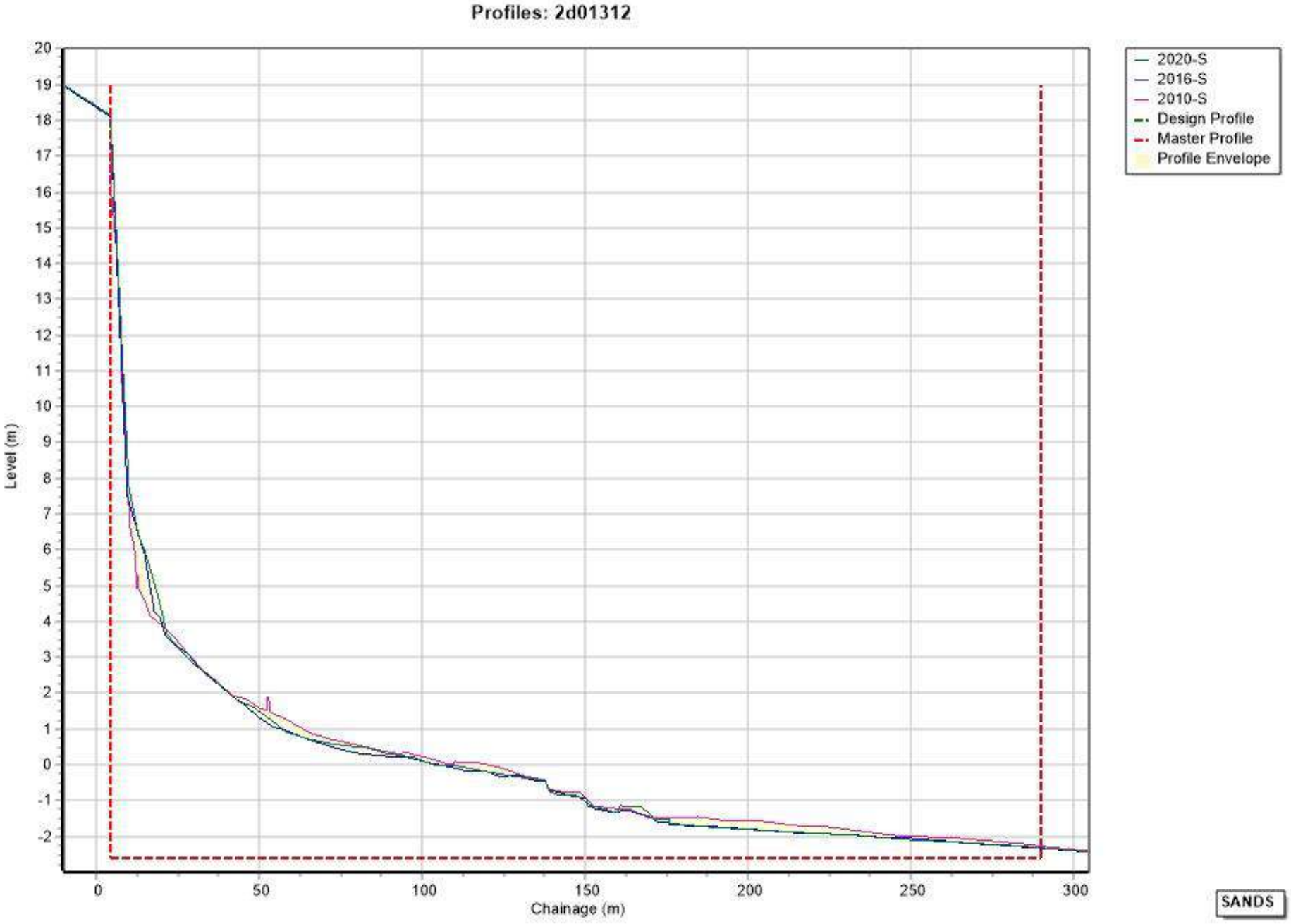
240
260
280
300
Chainage (m)
SANDS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2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
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17
16
15
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12
11
10
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-1
-2
0
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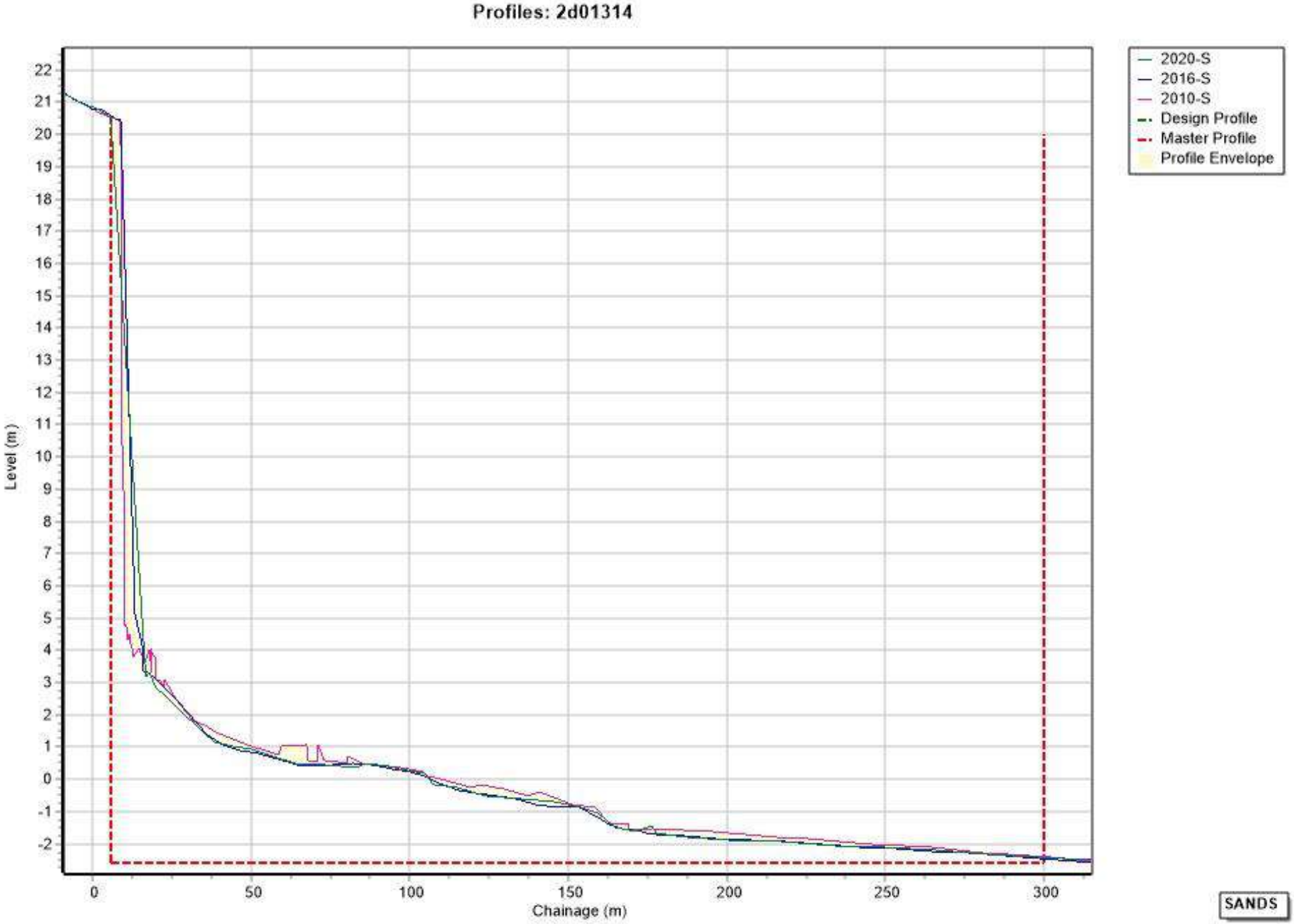
300

SANDS


Profiles: 2d01314
2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
22
21
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17
16
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14
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11
10
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4
3
2
1
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-1
-2
0
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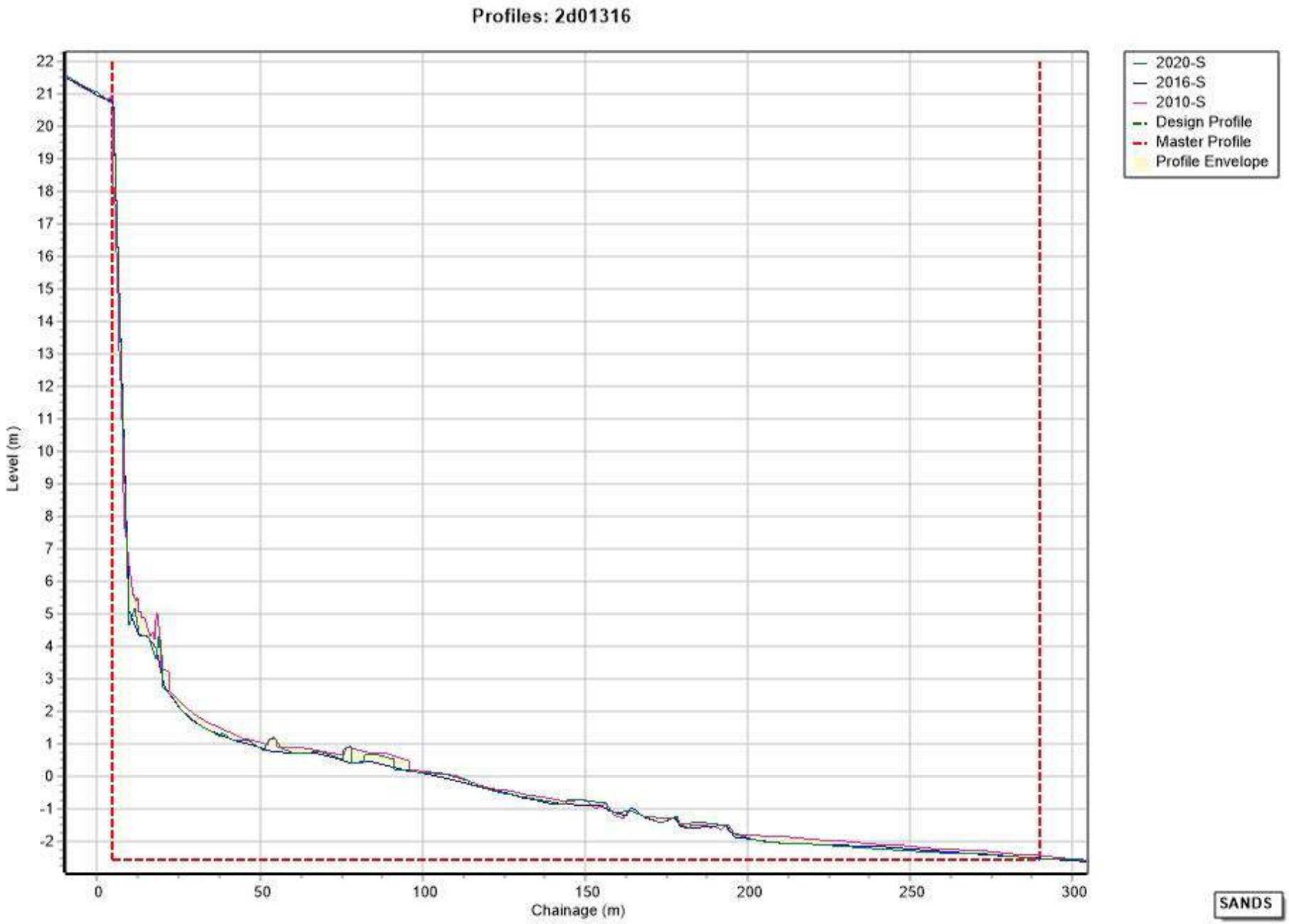
100
150
200
250
300

200

SANDS


Profiles: 2d01316
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2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
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17
16
15
14
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12
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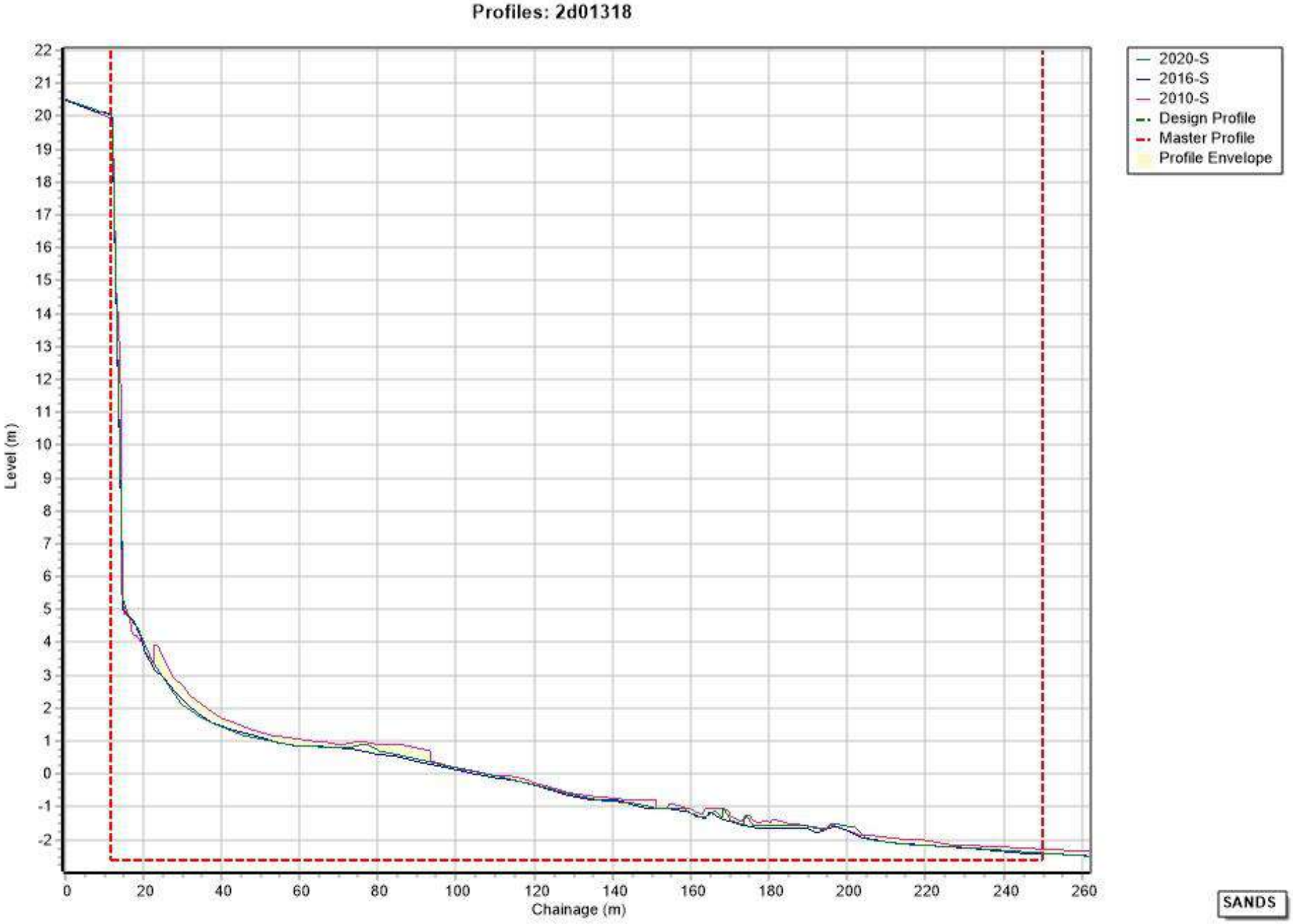
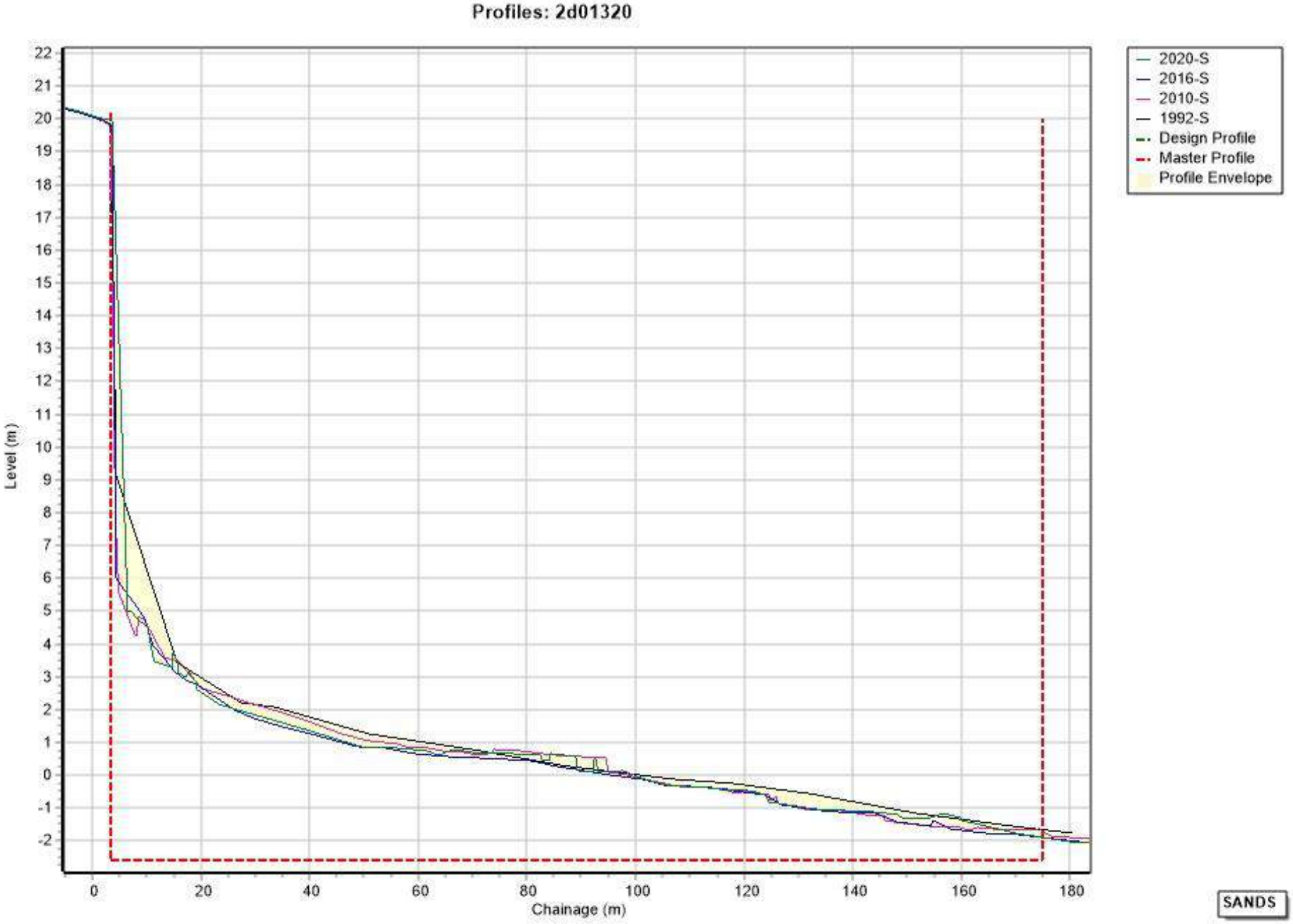

Profiles: 2d01318
2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01320
2020-S
2016-S
2010-S
1992-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
22
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19
18
17
16
15
14
13
12
11
10
9
8
7
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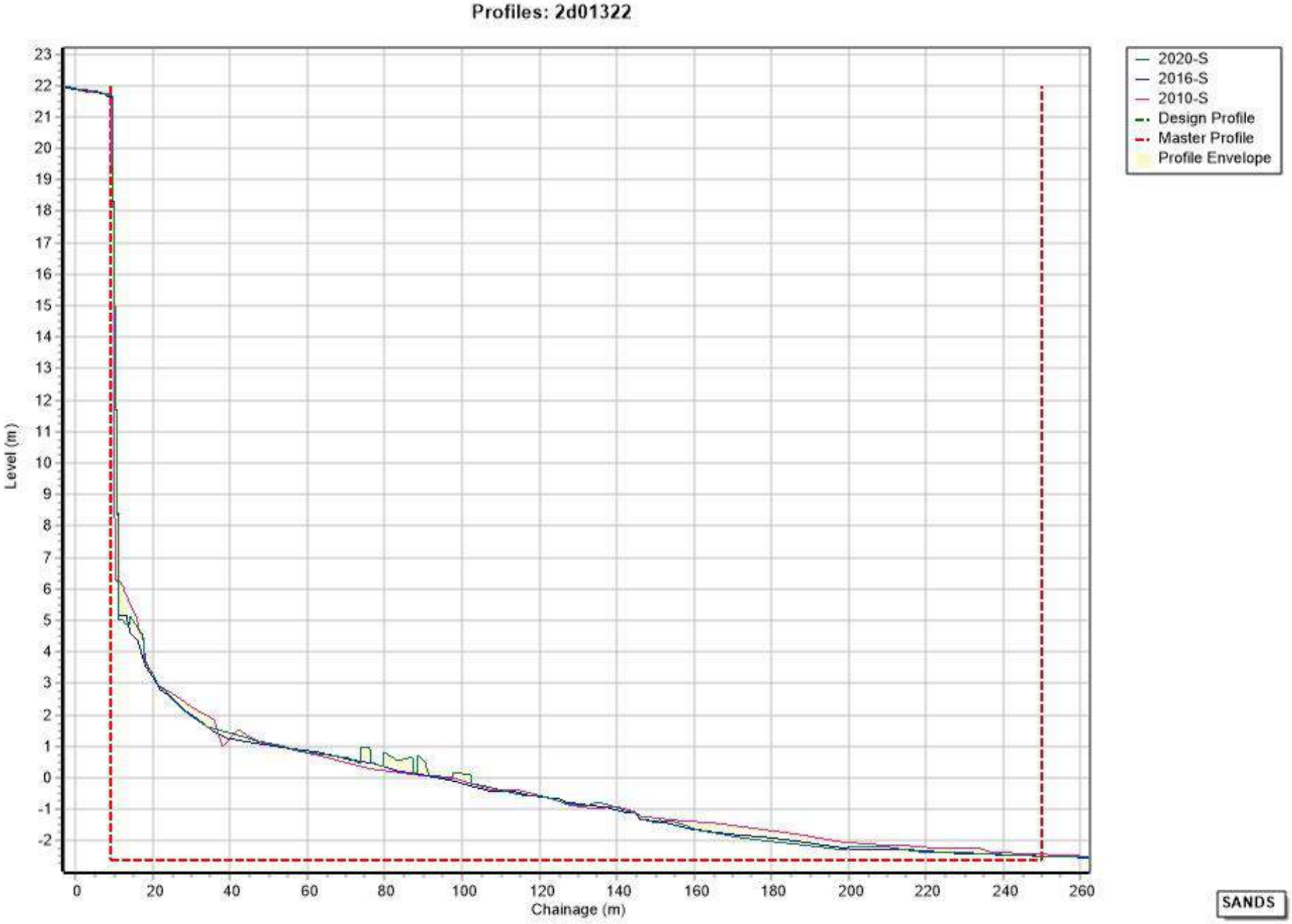
160
180

SANDS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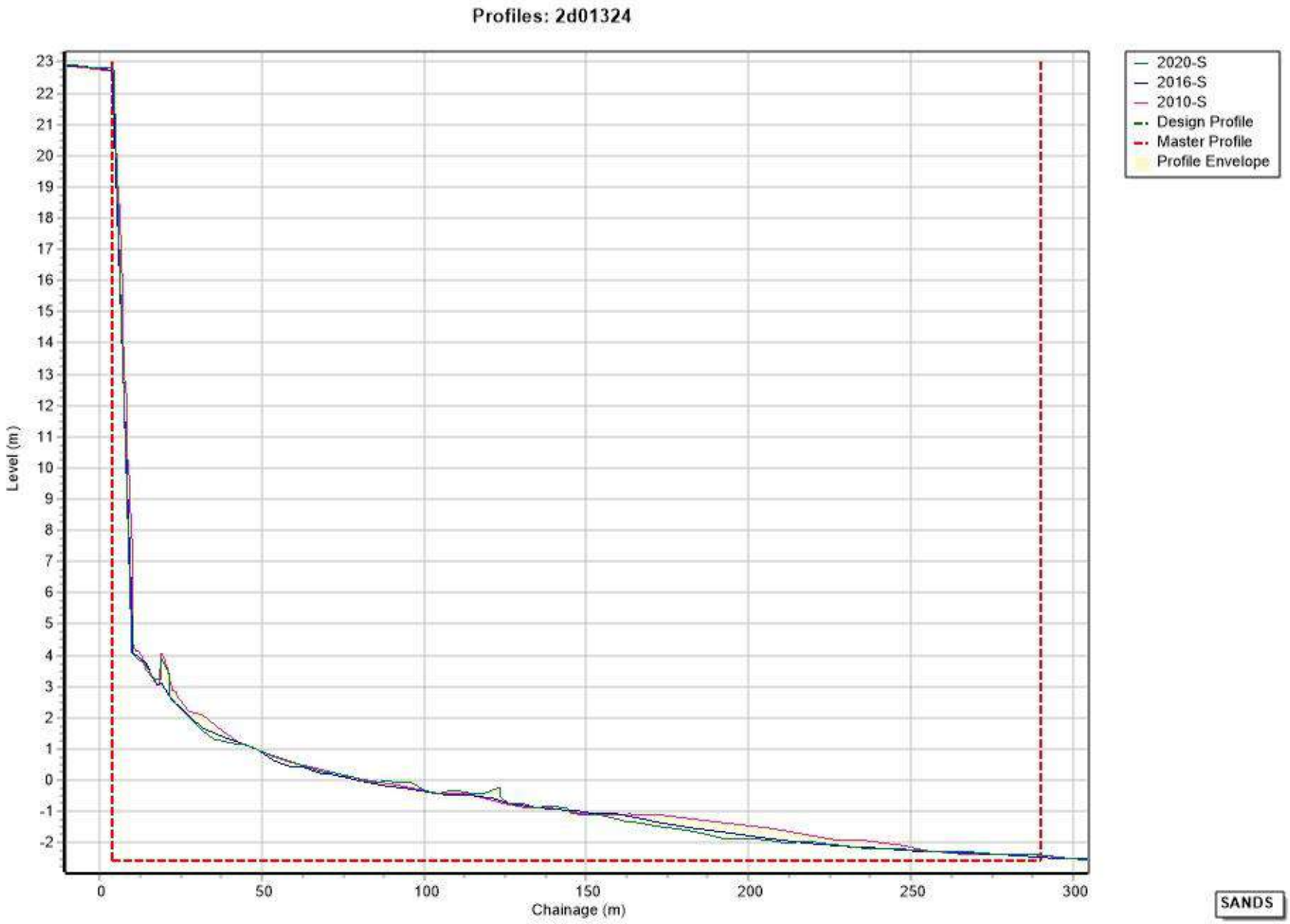
2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01324
2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
23
22
21
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19
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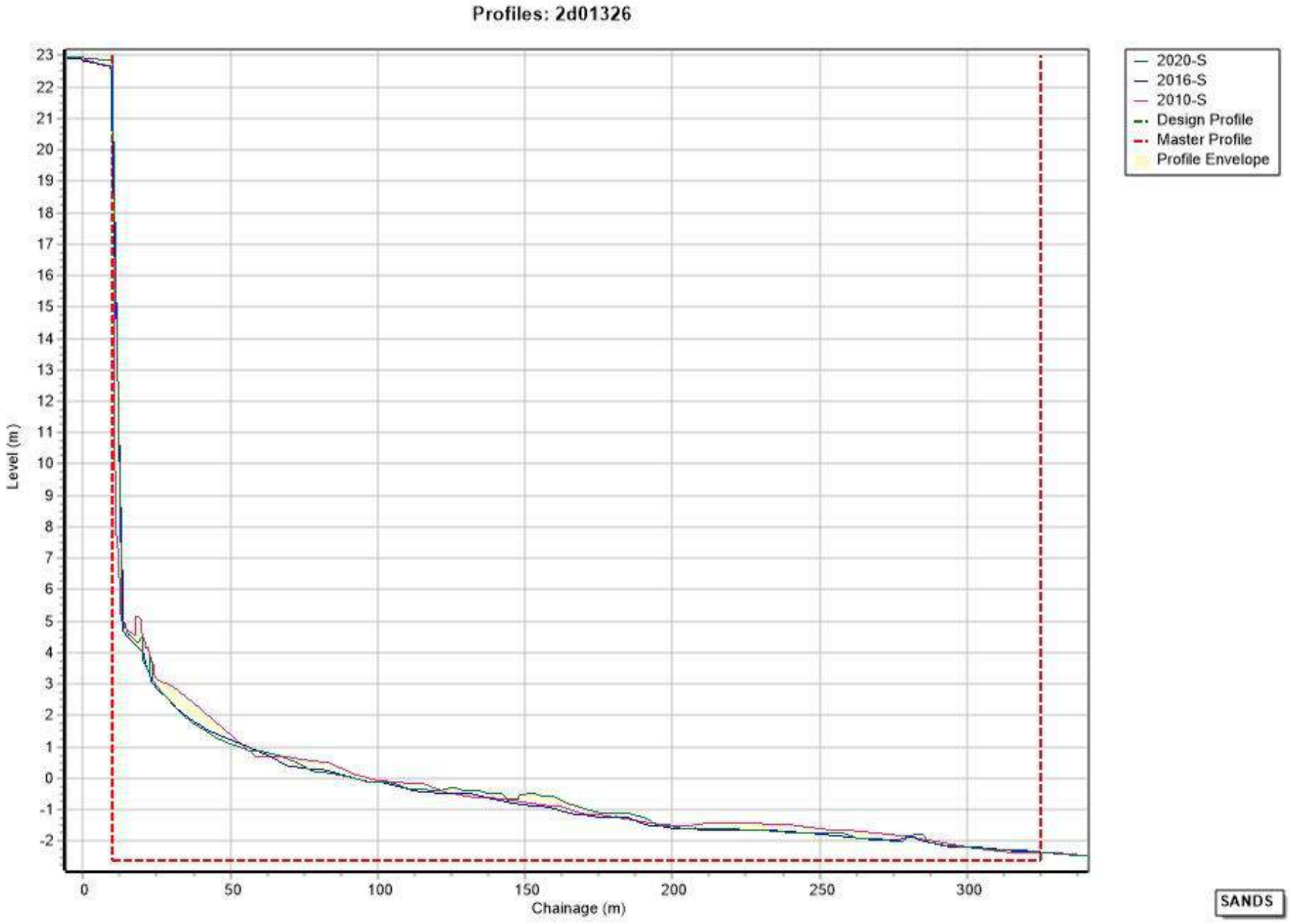
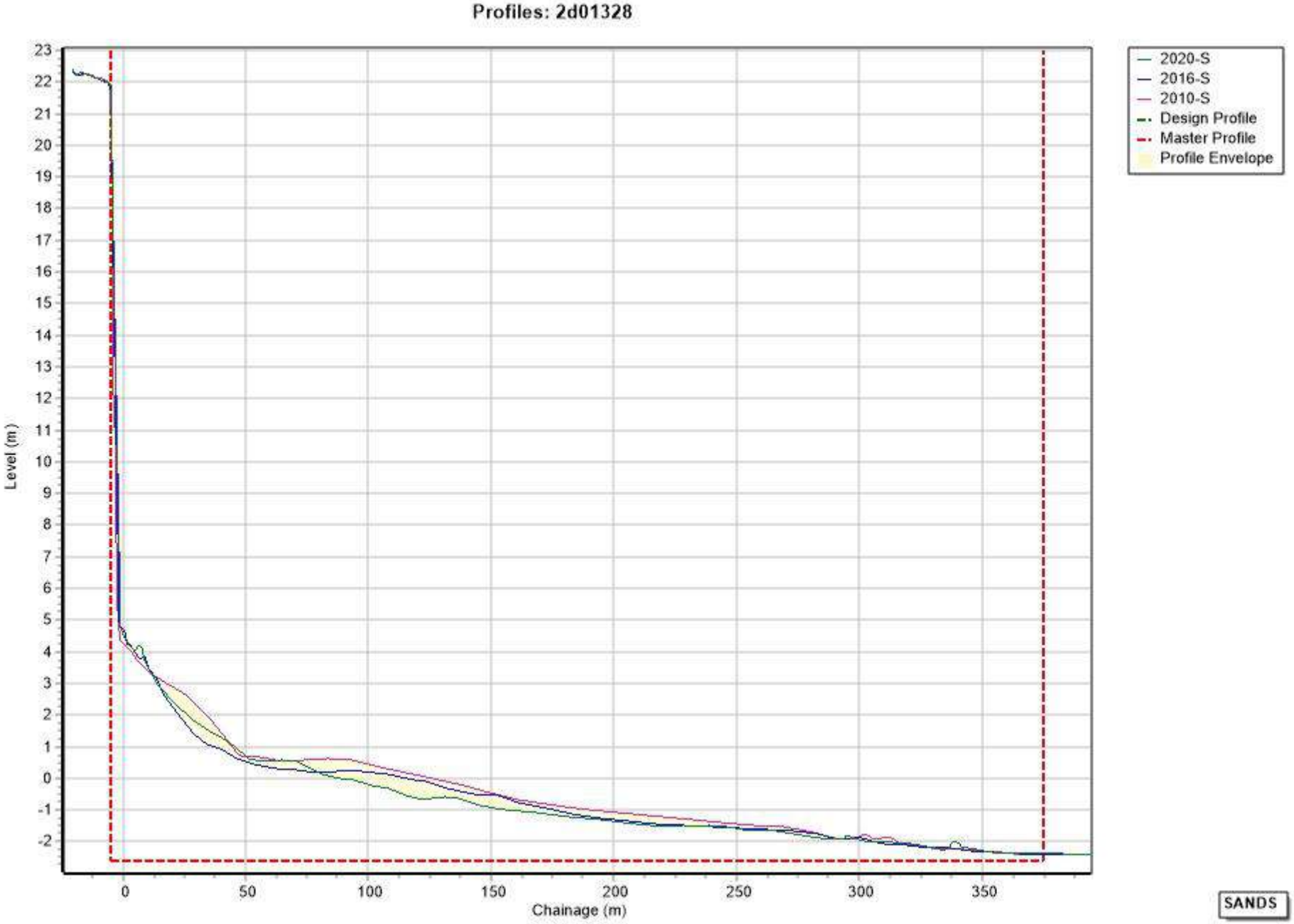
300

SANDS


Profiles: 2d01326
2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
SANDS


Profiles: 2d01328
2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
23
22
21
20
19
18
17
16
15
14
13
12
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7
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-1
-2
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100
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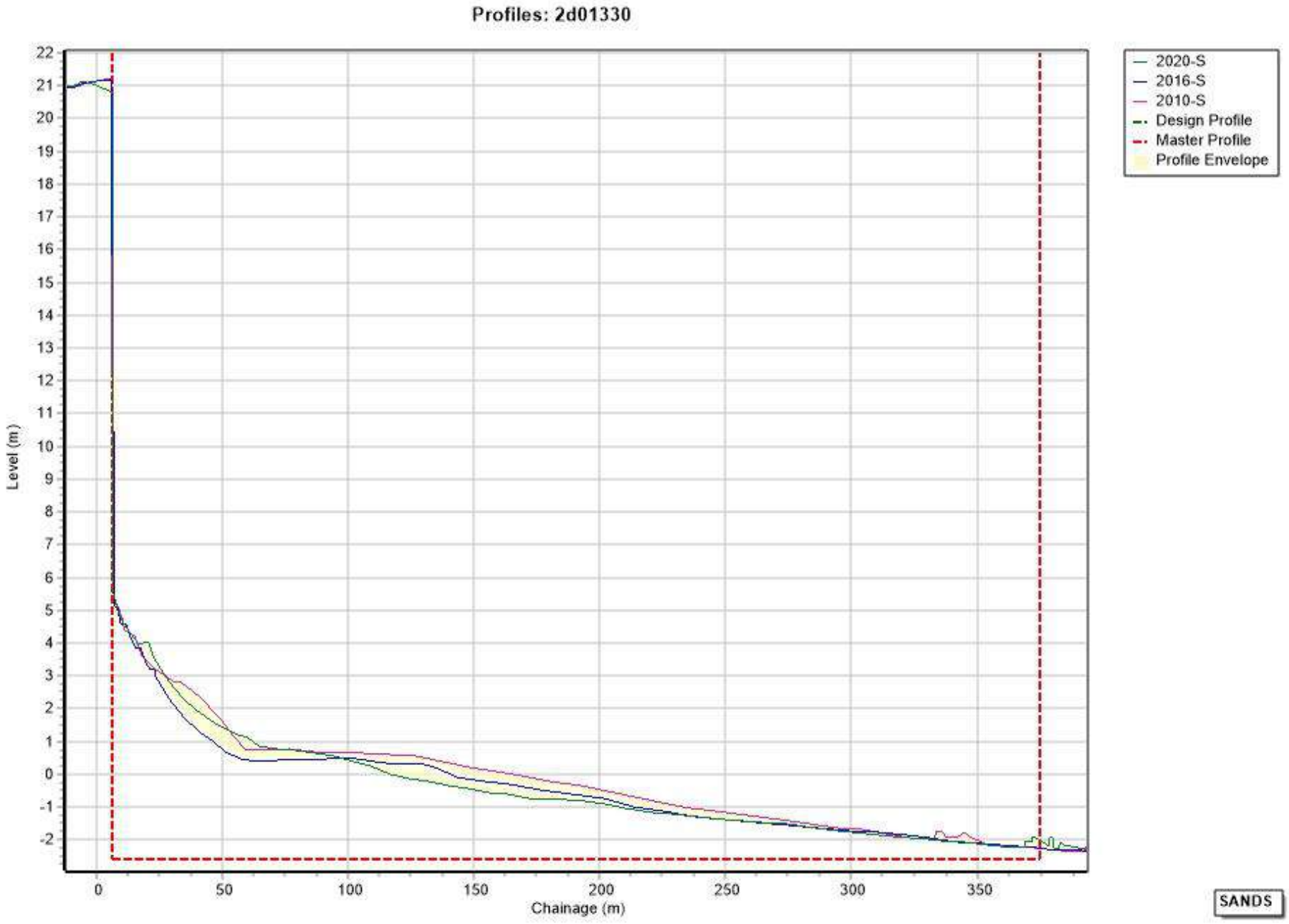
300
350
SANDS


Profiles: 2d01330
2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
22
21
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11
10
9
8
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-1
-2
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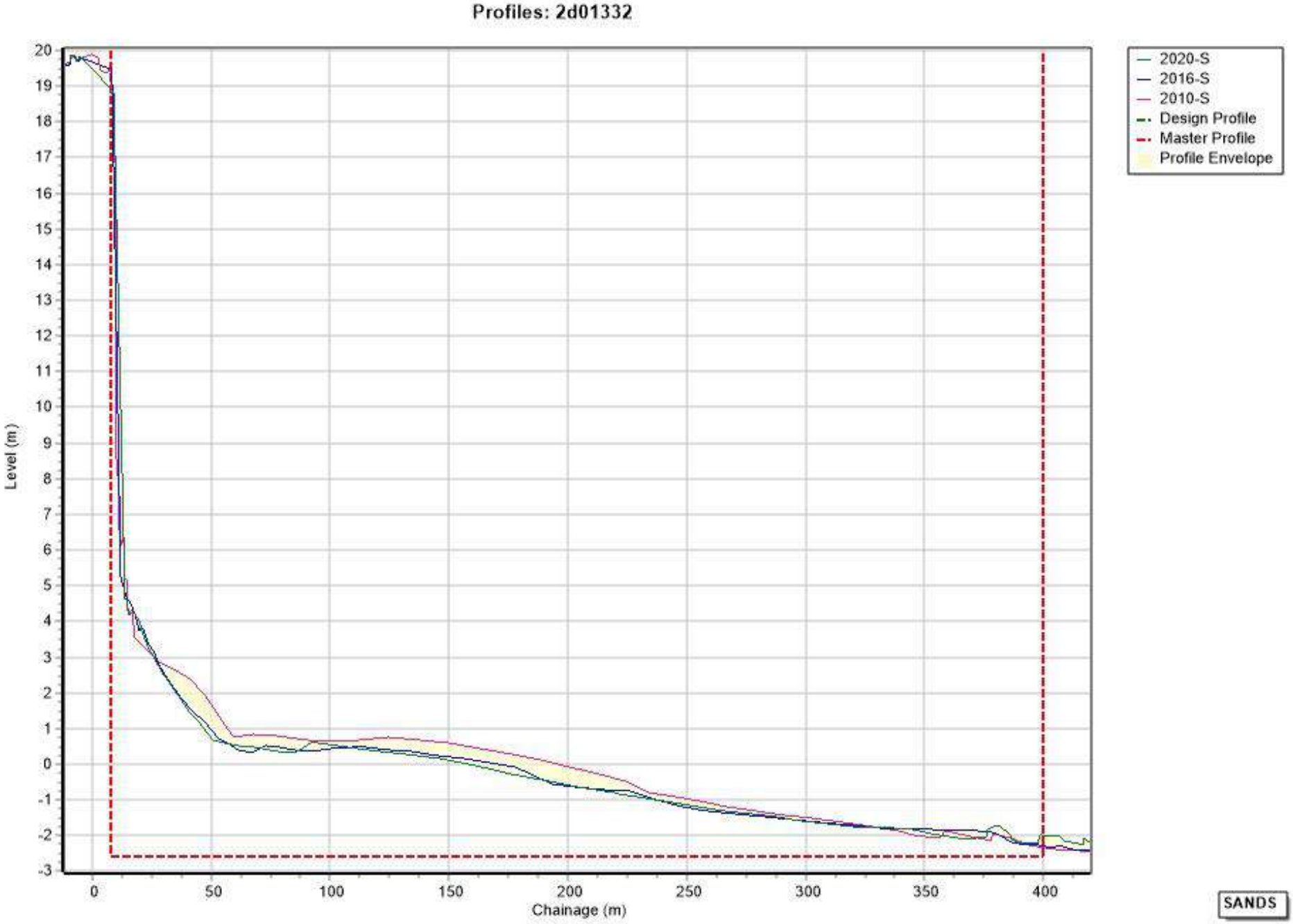
50
100
150
200
250
300
350

SANDS


Profiles: 2d01332
2020-S
2016-S
2010-S
Design Profile
Master Profile
Profile Envelope
Level (m)
Chainage (m)
20
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17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
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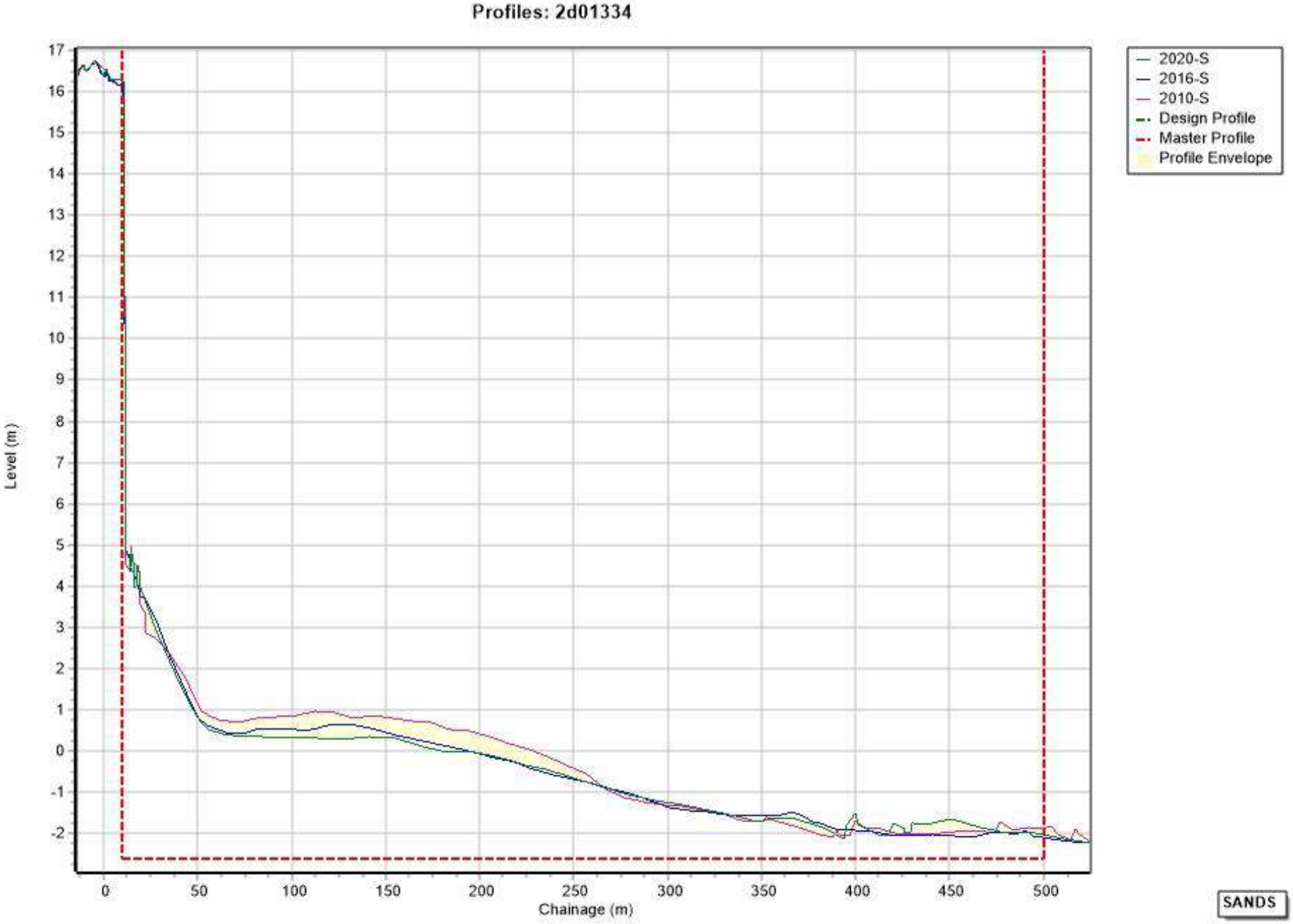
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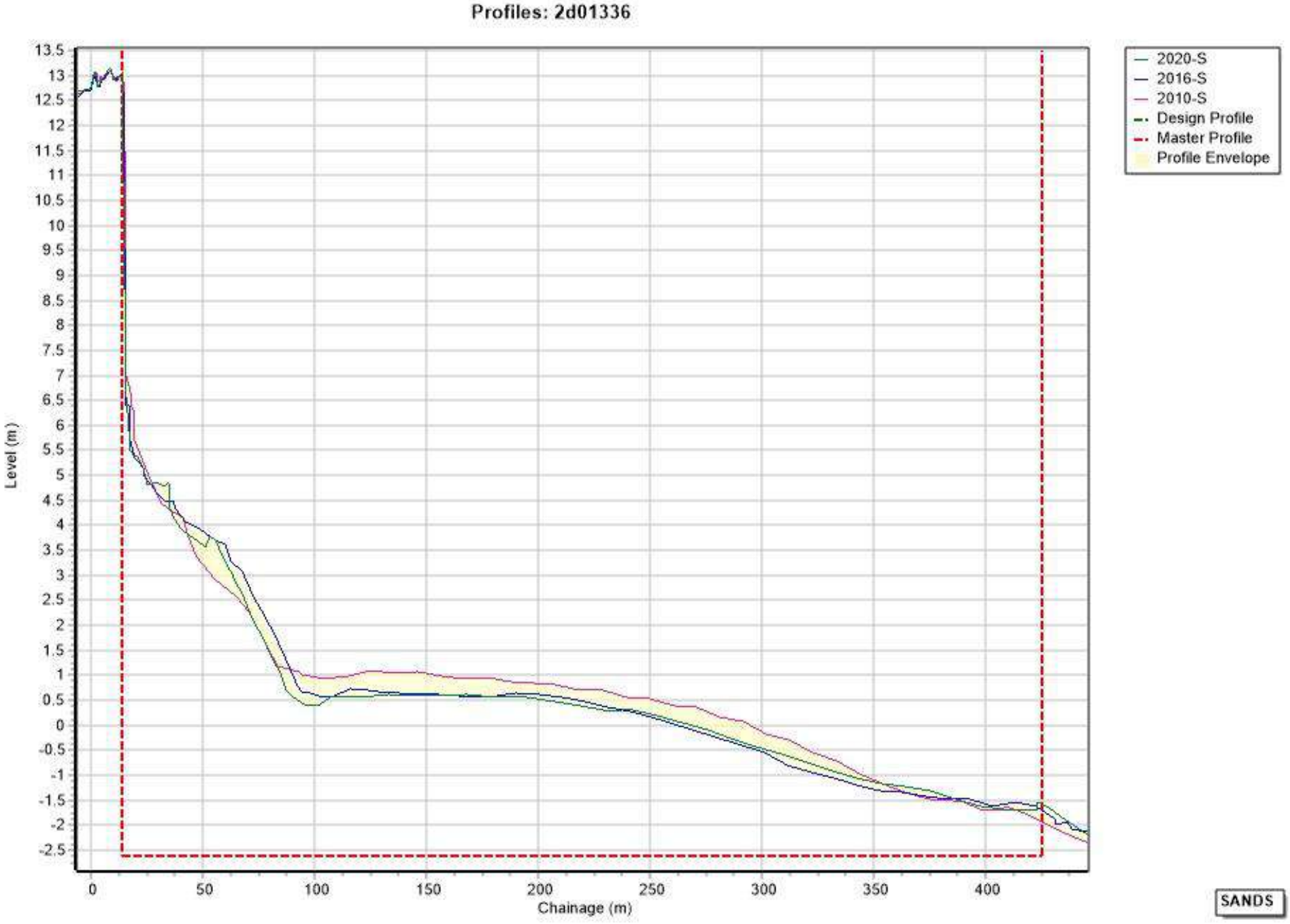
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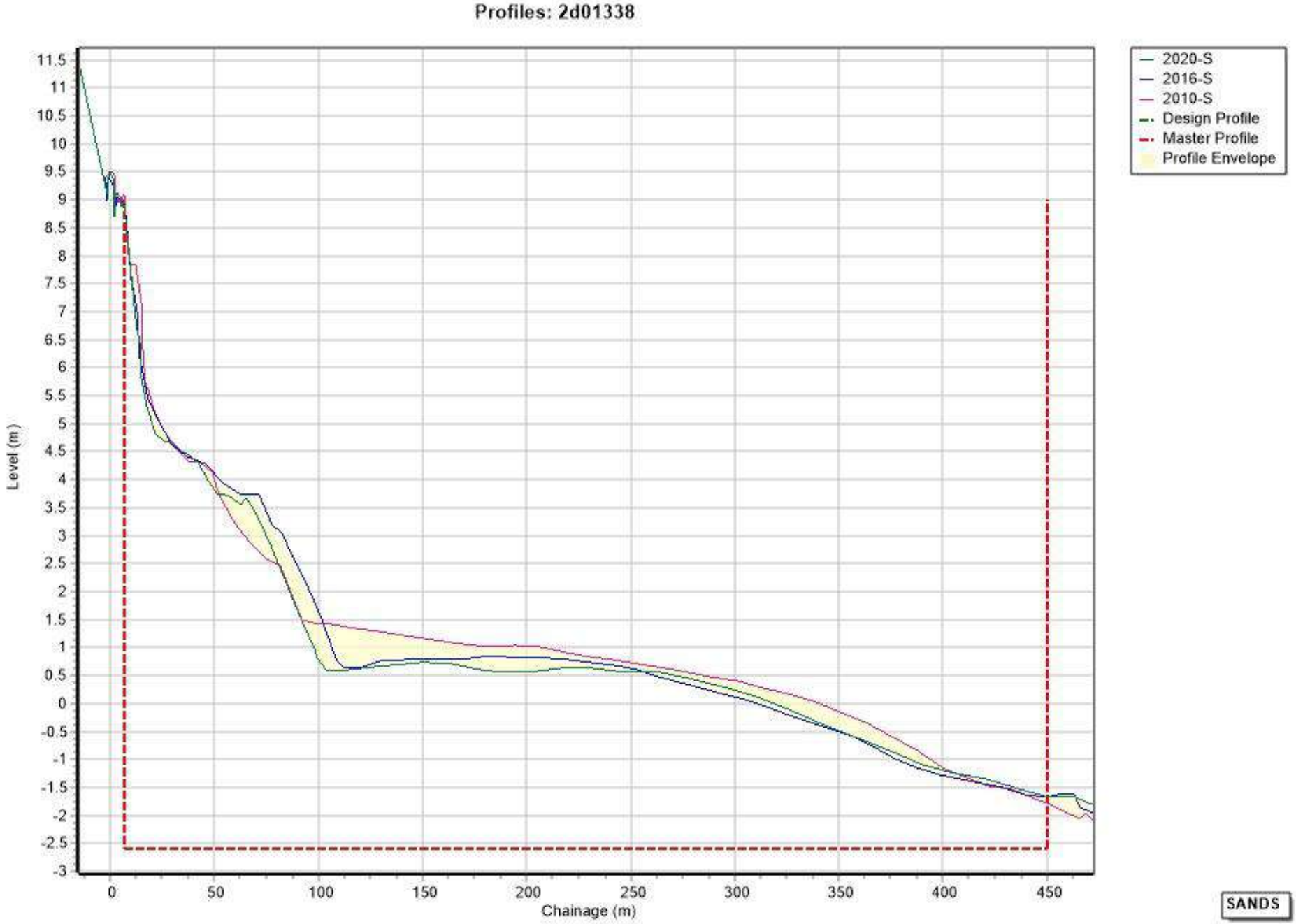
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150
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250
300
350
400
450

SANDS

Positional Trends

Location: NH002	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.46m	3.46m	0.11m	-2.81m	-3.71m
Total Change	-0.90	8.47	-0.90	7.53	
Min Change	-2.58	-4.27	-3.86	-4.54	
Max Change	2.32	8.20	5.94	8.21	
Mean Change	-0.10	0.85	-0.10	1.88	
Sdt Dev Change	1.35	3.36	3.24	4.57	

Location: NH002	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.46m	3.46m	0.11m	-2.81m	-3.71m
Total Change	-1.43	-6.32	1.60	7.53	
Min Change	-2.58	-4.27	-3.14	-4.54	
Max Change	1.50	2.33	3.86	8.21	
Mean Change	-0.36	-1.58	0.26	1.88	
Sdt Dev Change	1.64	2.46	3.14	4.57	

Location: NH004	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.46m	3.46m	0.11m	-2.81m	-3.71m
Total Change	-0.22	0.63	-28.13	-6.70	
Min Change	-0.25	-7.12	-12.81	-13.81	
Max Change	0.25	4.72	2.42	7.74	
Mean Change	-0.20	0.60	-2.81	-3.30	
Sdt Dev Change	0.15	3.61	5.21	1.77	

Location: NH004	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.46m	3.46m	0.11m	-2.81m	-3.71m
Total Change	0.00	-4.65	-3.80	-6.70	
Min Change	-0.40	-7.12	-5.46	-13.81	
Max Change	0.30	2.68	2.26	7.74	
Mean Change	0.00	-1.16	-0.77	-3.30	
Sdt Dev Change	0.30	3.85	2.90	1.77	

Location: NH006	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.46m	3.46m	0.11m	-2.81m	-3.71m
Total Change	0.10	-1.46	-31.55	-2.36	
Min Change	-0.13	-2.33	-9.11	-5.20	
Max Change	0.70	2.95	1.90	8.15	
Mean Change	0.00	-0.15	-3.16	-0.59	
Sdt Dev Change	0.60	1.30	3.22	5.14	

Location: NH006	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.46m	3.46m	0.11m	-2.81m	-3.71m
Total Change	0.40	0.10	-8.99	-2.36	
Min Change	0.00	-0.80	-5.23	-5.20	
Max Change	0.40	0.10	0.72	8.15	
Mean Change	0.10	0.00	-2.25	-0.59	
Sdt Dev Change	0.20	0.70	2.25	5.14	

Location: NH008	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.45m	3.46m	0.11m	-2.81m	-3.71m
Total Change	0.40	-4.31	-28.37	-0.87	
Min Change	-0.20	-4.33	-8.78	-11.17	
Max Change	0.40	2.42	2.91	7.56	
Mean Change	0.00	-0.43	-2.84	-0.22	
Sdt Dev Change	0.20	1.60	3.49	7.13	

Location: NH008	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.45m	3.46m	0.11m	-2.81m	-3.71m
Total Change	0.00	0.10	-8.24	-0.87	
Min Change	-0.10	-0.40	-4.71	-11.17	
Max Change	0.10	0.40	0.84	7.56	
Mean Change	0.00	0.00	-2.60	-0.22	
Sdt Dev Change	0.10	0.30	2.57	7.13	

Location: NH010	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.45m	3.46m	0.11m	-2.81m	-3.71m
Total Change	-0.14	-4.61	-18.23	3.11	
Min Change	-0.15	-4.63	-7.19	-13.25	
Max Change	0.16	1.72	0.83	6.40	
Mean Change	-0.10	-0.46	-1.82	0.78	
Sdt Dev Change	0.11	1.60	2.67	8.11	

Location: NH010	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.45m	3.46m	0.11m	-2.81m	-3.71m
Total Change	0.70	0.11	-6.18	3.11	
Min Change	-0.30	-1.75	-5.45	-13.25	
Max Change	0.80	1.72	0.63	6.40	
Mean Change	0.20	0.30	-1.55	0.78	
Sdt Dev Change	0.40	1.23	2.34	8.11	

Location: W062	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.46m	3.46m	0.11m	-2.81m	-3.71m
Total Change	0.70	-3.60	-28.37	2.44	
Min Change	-0.21	-4.10	-9.24	-17.96	
Max Change	0.32	4.25	1.21	2.85	
Mean Change	0.00	-0.11	-1.10	0.41	
Sdt Dev Change	0.12	2.40	3.99	13.80	

Location: W062	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.46m	3.46m	0.11m	-2.81m	-3.71m
Total Change	0.50	-1.20	-6.30	1.85	
Min Change	-0.20	-1.24	-7.25	-17.96	
Max Change	0.30	0.50	0.90	2.85	
Mean Change	0.10	-0.30	-1.51	2.71	
Sdt Dev Change	0.20	0.54	3.34	15.48	

Location: NH013	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.45m	3.46m	0.11m	-2.81m	-3.71m
Total Change	0.60	0.80	-6.25	0.31	
Min Change	-0.12	-0.17	-5.25	-12.95	
Max Change	0.14	0.20	5.18	6.46	
Mean Change	0.10	0.10	-0.62	0.80	
Sdt Dev Change	0.90	0.13	2.59	7.81	

Location: NH013	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.45m	3.46m	0.11m	-2.81m	-3.71m
Total Change	0.11	0.15	-0.20	0.31	
Min Change	-0.60	-0.80	-1.78	-12.95	
Max Change	0.14	0.20	0.92	6.46	
Mean Change	0.30	0.40	-0.10	0.80	
Sdt Dev Change	0.70	0.10	1.60	7.81	

Location: NH015	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.45m	3.46m	0.11m	-2.81m	-3.71m
Total Change	0.30	0.40	-1.96	17.65	
Min Change	-0.10	-0.14	-3.20	-0.15	
Max Change	0.15	0.21	2.40	15.31	
Mean Change	0.00	0.00	-0.20	4.41	
Sdt Dev Change	0.90	0.12	1.73	6.38	

Location: NH015	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.45m	3.46m	0.11m	-2.81m	-3.71m
Total Change	0.14	0.21	0.12	17.65	
Min Change	-0.20	-0.40	-2.63	-0.15	
Max Change	0.15	0.21	2.40	15.31	
Mean Change	0.40	0.50	0.30	4.41	
Sdt Dev Change	0.70	0.90	1.85	6.38	

Location: NH017	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.45m	3.46m	0.11m	-2.81m	-3.71m
Total Change	0.30	0.40	0.56	1.27	
Min Change	-0.15	-0.22	-3.90	-2.13	
Max Change	0.12	0.17	3.23	15.44	
Mean Change	0.00	0.00	0.60	2.57	
Sdt Dev Change	0.70	0.10	2.70	7.44	

Location: NH017	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.45m	3.46m	0.11m	-2.81m	-3.71m
Total Change	0.90	0.13	0.37	1.27	
Min Change	-0.30	-0.50	-3.90	-2.13	
Max Change	0.12	0.17	2.71	15.44	
Mean Change	0.20	0.30	0.90	2.57	
Sdt Dev Change	0.60	0.90	2.90	7.44	

Location: NH019	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.44m	3.46m	0.11m	-2.81m	-3.71m
Total Change	4.30	-1.35	-4.82	4.95	
Min Change	-0.59	-3.94	-6.77	-4.90	
Max Change	2.10	3.40	2.99	12.18	
Mean Change	0.43	-0.14	-0.48	0.99	
Sdt Dev Change	0.83	2.20	2.97	6.30	

Location: NH019	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.44m	3.46m	0.11m	-2.81m	-3.71m
Total Change	2.26	0.56	0.27	9.40	
Min Change	-0.20	-1.92	-1.38	-2.95	
Max Change	2.10	1.46	2.13	12.18	
Mean Change	0.57	0.14	0.70	2.26	
Sdt Dev Change	0.86	1.41	1.37	6.11	

Location: NH021	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.44m	3.45m	0.11m	-2.82m	-3.72m
Total Change	4.10	-3.49	-0.33	15.56	
Min Change	-3.90	-4.66	-3.65	-3.67	
Max Change	5.40	2.97	4.14	15.84	
Mean Change	0.41	-0.35	-0.30	3.89	
Sdt Dev Change	2.25	2.10	2.25	7.36	

Location: NH021	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.44m	3.45m	0.1m	-2.82m	-3.72m
Total Change	0.76	0.54	0.40	15.56	
Min Change	-1.00	-0.96	-2.94	-3.67	
Max Change	1.34	1.81	1.68	15.84	
Mean Change	0.19	0.14	0.10	3.89	
Sdt Dev Change	1.40	1.12	1.87	7.36	

Location: NH023	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.44m	3.45m	0.1m	-2.82m	-3.72m
Total Change	-6.81	0.11	-2.16	1.34	
Min Change	-4.13	-1.18	-3.88	-8.57	
Max Change	3.70	2.21	2.16	12.20	
Mean Change	-0.68	0.10	-0.22	2.70	
Sdt Dev Change	2.11	0.93	2.00	7.37	

Location: NH023	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.44m	3.45m	0.1m	-2.82m	-3.72m
Total Change	0.24	1.40	2.87	1.25	
Min Change	-0.37	-0.60	-1.80	-8.57	
Max Change	0.72	2.21	2.16	12.20	
Mean Change	0.60	0.26	0.72	2.56	
Sdt Dev Change	0.42	1.14	1.54	8.16	

Location: NH025	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.43m	3.45m	0.1m	-2.82m	-3.72m
Total Change	1.58	-3.16	-0.30	7.71	
Min Change	-0.97	-4.45	-8.18	-2.44	
Max Change	1.20	1.67	5.97	14.58	
Mean Change	0.16	-0.32	0.00	1.54	
Sdt Dev Change	0.65	1.70	3.46	6.53	

Location: NH025	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.43m	3.45m	0.1m	-2.82m	-3.72m
Total Change	0.27	0.76	2.71	9.28	
Min Change	-0.55	-0.41	-0.68	-2.44	
Max Change	0.78	0.50	2.59	14.58	
Mean Change	0.70	0.19	0.68	2.32	
Sdt Dev Change	0.58	0.36	1.21	7.90	

Location: W063	HAT	MHWS	MSL	MLWS	LAT
Baseline: 1992	4.43m	3.45m	0.1m	-2.82m	-3.72m
Total Change	-3.54	-0.20	1.68	-1.91	
Min Change	-5.71	-6.36	-4.28	-14.29	
Max Change	6.91	6.42	11.80	29.39	
Mean Change	-0.13	0.00	0.60	-0.27	
Sdt Dev Change	2.28	2.53	3.39	14.25	

Location: W063	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.43m	3.45m	0.1m	-2.82m	-3.72m
Total Change	-0.40	1.96	6.40	25.31	
Min Change	-1.49	-2.21	-2.51	-14.29	
Max Change	1.11	2.98	8.20	29.39	
Mean Change	-0.10	0.49	1.60	6.33	
Sdt Dev Change	0.95	1.95	4.29	15.63	

Location: NH028	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.42m	3.44m	0.1m	-2.82m	-3.72m
Total Change	-0.14	-0.10	12.74	4.25	
Min Change	-1.99	-3.22	-6.84	-12.60	
Max Change	1.84	4.31	11.75	27.23	
Mean Change	-0.10	0.00	1.27	0.85	
Sdt Dev Change	1.29	1.94	4.79	14.15	

Location: NH028	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.42m	3.44m	0.1m	-2.82m	-3.72m
Total Change	2.90	0.69	11.69	11.26	
Min Change	-0.14	-0.52	-6.84	-12.60	
Max Change	1.37	1.33	11.75	27.23	
Mean Change	0.52	0.17	2.92	2.82	
Sdt Dev Change	0.54	0.76	6.87	15.20	

Location: NH029	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.42m	3.44m	0.1m	-2.82m	-3.72m
Total Change	-0.56	-0.60	0.49	15.67	
Min Change	-0.46	-5.75	-16.20	-12.80	
Max Change	0.25	5.36	16.78	24.64	
Mean Change	-0.60	-0.10	0.50	3.13	
Sdt Dev Change	0.21	2.51	1.93	12.29	

Location: NH029	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.42m	3.44m	0.1m	-2.82m	-3.72m
Total Change	-0.30	5.52	4.15	1.13	
Min Change	-0.46	-0.67	-16.20	-12.80	
Max Change	0.25	5.36	15.41	24.64	
Mean Change	-0.70	1.38	1.40	2.53	
Sdt Dev Change	0.26	2.36	11.45	13.67	

Location: NH031	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.43m	3.45m	0.11m	-2.81m	-3.71m
Total Change	-0.26	-0.62	-5.98	1.48	
Min Change	-5.76	-2.29	-15.34	-13.71	
Max Change	5.94	2.98	14.81	15.62	
Mean Change	-0.30	-0.60	-0.60	0.30	
Sdt Dev Change	3.17	1.67	8.55	9.75	

Location: NH031	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.43m	3.45m	0.11m	-2.81m	-3.71m
Total Change	4.43	1.79	-2.25	-3.74	
Min Change	0.10	-1.17	-15.34	-13.71	
Max Change	3.34	1.98	14.81	15.62	
Mean Change	1.11	0.45	-0.56	-0.93	
Sdt Dev Change	1.30	1.19	11.36	1.55	

Location: NH033	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.42m	3.44m	0.11m	-2.81m	-3.71m
Total Change	2.14	1.30	-37.39	1.30	
Min Change	-1.74	-4.90	-29.46	-11.60	
Max Change	2.95	5.67	31.20	12.24	
Mean Change	0.21	0.13	-3.74	0.26	
Sdt Dev Change	1.46	3.30	15.36	8.53	

Location: NH033	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.42m	3.44m	0.11m	-2.81m	-3.71m
Total Change	-0.18	0.50	-25.14	2.53	
Min Change	-1.74	-2.52	-14.21	-11.60	
Max Change	0.58	5.67	9.36	12.24	
Mean Change	-0.50	0.10	-6.28	0.63	
Sdt Dev Change	0.98	3.33	9.58	9.50	

Location: NH035	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.42m	3.44m	0.11m	-2.81m	-3.71m
Total Change	1.18	3.43	-43.19	0.30	
Min Change	-2.89	-6.36	-18.96	-9.52	
Max Change	3.89	6.79	23.11	8.27	
Mean Change	0.12	0.34	-4.32	0.10	
Sdt Dev Change	1.59	4.14	11.78	6.14	

Location: NH035	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.42m	3.44m	0.11m	-2.81m	-3.71m
Total Change	-0.50	4.41	-25.14	9.55	
Min Change	-0.81	-2.16	-18.96	-3.10	
Max Change	0.73	5.24	23.11	8.27	
Mean Change	-0.10	1.10	-6.29	2.39	
Sdt Dev Change	0.55	2.91	17.80	4.33	

Location: NH037	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.42m	3.44m	0.11m	-2.81m	-3.71m
Total Change	-0.17	2.99	-38.65	12.42	
Min Change	-1.83	-3.75	-1.87	0.30	
Max Change	2.24	7.20	16.81	6.70	
Mean Change	-0.20	0.30	-3.87	3.11	
Sdt Dev Change	1.5	3.73	8.12	3.40	

Location: NH037	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.42m	3.44m	0.11m	-2.81m	-3.71m
Total Change	-1.85	-0.77	-1.11	12.42	
Min Change	-1.83	-3.75	-1.87	0.30	
Max Change	2.70	1.86	16.81	6.70	
Mean Change	-0.46	-0.19	-2.53	3.11	
Sdt Dev Change	1.52	2.12	11.38	3.40	

Location: NH039	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.41m	3.43m	0.1m	-2.81m	-3.72m
Total Change	0.70	3.20	-49.31	9.61	
Min Change	-3.33	-5.40	-12.48	-1.14	
Max Change	3.29	7.18	4.19	9.83	
Mean Change	0.10	0.30	-4.93	2.40	
Sdt Dev Change	2.17	3.70	4.94	4.36	

Location: NH039	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.41m	3.43m	0.1m	-2.81m	-3.72m
Total Change	3.20	-1.00	-14.46	9.61	
Min Change	-0.12	-5.40	-1.98	-1.14	
Max Change	3.23	1.91	0.67	9.83	
Mean Change	0.80	-0.25	-3.62	2.40	
Sdt Dev Change	1.40	2.99	4.41	4.36	

Location: NH041	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2010	4.42m	3.44m	0.11m	-2.81m	-3.71m
Total Change	3.75	11.77	-27.18	3.88	
Min Change	-2.25	-1.14	-16.40	-3.17	
Max Change	4.58	7.70	19.20	4.46	
Mean Change	0.37	1.18	-2.72	0.97	
Sdt Dev Change	2.11	4.95	1.46	3.17	

Location: NH041	HAT	MHWS	MSL	MLWS	LAT
Baseline: 2016	4.42m	3.44m	0.11m	-2.81m	-3.71m
Total Change	-1.70	-2.87	6.47	3.88	
Min Change	-2.25	-1.14	-8.60	-3.17	
Max Change	1.23	6.48	19.20	4.46	
Mean Change	-0.43	-0.72	1.62	0.97	
Sdt Dev Change	1.29	6.23	1.83	3.17	

Location: NH043 Baseline: 2010	HAT 4.41m	MHWS 3.44m	MSL 0.11m	MLWS -2.81m	LAT -3.71m
Total Change	3.15	12.51	-2.85	-1.26	
Min Change	-2.80	-1.52	-23.62	-2.74	
Max Change	4.73	12.18	22.36	2.70	
Mean Change	0.31	1.25	-2.90	-0.42	
Sdt Dev Change	2.51	5.92	11.83	1.97	

Location: NH043 Baseline: 2016	HAT 4.41m	MHWS 3.44m	MSL 0.11m	MLWS -2.81m	LAT -3.71m
Total Change	1.72	-5.49	1.19	-1.26	
Min Change	-2.80	-1.52	-9.30	-2.74	
Max Change	4.73	8.55	22.36	2.70	
Mean Change	0.43	-1.37	2.55	-0.42	
Sdt Dev Change	3.14	6.80	12.45	1.97	

4.6. Hydrodynamics

The 2019 Annual report from the North Well Waverider Buoy is included in this report to provide hydrodynamic information which may add context to some of the trends observed in the coastal data. Some key parameters shown in the report are described below:

Significant wave height (Hm0) – A statistical calculation from the spectral analysis to describe the mean wave height. This is very similar to Hs, which is the mean wave height of the highest one third of waves in a record.

Maximum wave height (Hmax) – A statistic of the maximum wave height recorded in a period of time.

Wave direction (Mdir) – The prominent wave direction (also known as Pdir), or main wave direction at the peak frequency from which waves have come, measured over a period of time. In sea state reporting a modal statistic showing the most frequent wave direction is used.

Directional spread (Sprd) – The directional spread of waves at the peak frequency.

Peak period (Tp) - Also known as the dominant wave period or Tpeak, it describes the frequency with the highest energy. This is the wave period (time for two successive waves to pass a point) associated with the largest waves, obtained from the spectral 'peak frequency'.

Mean wave period (Tz) – Also referred to as the zero upcross period, a description of the average wave period over duration of time.

Temperature (°C) - A measurement of sea surface temperature (SST).

Further information on hydrodynamics can be found at
https://coastalmonitoring.org/anglian/

North Well Directional Waverider Buoy

Location	
OS	565972 E 354111 N
WGS84	*Latitude:* 53° 03.51' N *Longitude:* 00° 28.51' E
Instrument type	
Datawell Directional Waverider Mk III	
Water depth	~31m CD

Example buoy in situ.
Photo courtesy of Fugro Marine GB Limited

Location of buoy (Google mapping, image ©2019 Landsat / Copernicus)

Recovery rate (%)	Sample interval
95	30 minutes

Monthly Averages - 2019

All times are GMT

Month	H_s (m)	T_p (s)	T_z (s)	Dir. (°)	SST (°C)	Bimodal seas (%)	No. of days
January	0.71	4.7	3.5	112	6.2	-	29
February	0.48	4.5	3.2	142	5.4	-	27
March	0.67	4.5	3.4	144	6.9	-	30
April	0.65	4.8	3.4	73	8.7	-	29
May	0.54	5.0	3.6	70	11.4	-	24
June	0.56	4.1	3.2	124	14.8	-	29
July	0.48	4.6	3.4	102	17.6	-	31
August	0.54	3.7	3.0	169	18.2	-	30
September	0.58	4.3	3.3	138	16.3	-	29
October	0.68	4.3	3.3	134	13.4	-	30
November	0.75	5.5	3.7	78	9.6	-	29
December	0.62	3.9	3.1	168	7.3	-	30

Monthly Averages - All Years (September 2006 – December 2019)

Month	H_s (m)	T_p (s)	T_z (s)	Dir. (°)	SST (°C)	Bimodal seas (%)
January	0.72	4.6	3.4	135	5.6	-
February	0.64	4.8	3.5	117	5.1	-
March	0.62	4.7	3.5	113	6.0	-
April	0.59	4.7	3.4	97	8.5	-
May	0.61	4.5	3.4	101	11.5	-
June	0.55	4.5	3.4	96	14.4	-
July	0.50	4.2	3.2	124	16.9	-
August	0.53	4.0	3.1	140	17.6	-
September	0.59	4.4	3.3	125	16.1	-
October	0.67	4.5	3.3	131	13.6	-
November	0.76	4.7	3.5	134	10.3	-
December	0.75	4.6	3.4	149	7.2	-

Storm Analysis

Date/Time	H_s (m)	T_p (s)	T_z (s)	Dir. (°)	Water level elevation* (OD)	Tidal stage (hours re. HW)	Tidal range (m)	Tidal surge* (m)	Max. surge* (m)
11-Jun-2019 02:00:00	2.52	7.4	5.6	69	1.35	HW -2	4.70	-	-
10-Aug-2019 12:00:00	2.42	6.2	5.6	245	1.85	HW +1	3.50	-	-
09-Feb-2019 07:00:00	2.24	6.7	5.6	226	0.35	HW -3	3.00	-	-

** Tidal information is obtained from the predicted tide levels (Admiralty Total Tide).*

Annual Statistics

Year	Annual H_s exceedance** (m)						Annual Maximum H_s	
	0.05%	0.5%	1%	2%	5%	10%	Date	A_{max} (m)
2006	2.24	1.86	1.68	1.59	1.38	1.16	07-Dec-2006 20:00:00	2.38
2007	2.53	2.20	1.98	1.73	1.45	1.19	18-Jan-2007 15:00:00	3.03
2008	2.62	2.03	1.83	1.69	1.44	1.17	22-Mar-2008 04:00:00	2.94
2009	2.83	2.01	1.83	1.65	1.38	1.12	17-Dec-2009 21:00:00	3.19
2010	2.41	2.05	1.94	1.79	1.51	1.22	01-Dec-2010 16:30:00	2.48
2011	2.00	1.61	1.51	1.40	1.22	1.05	13-Dec-2011 20:00:00	2.27
2012	2.36	2.03	1.82	1.56	1.31	1.08	27-Oct-2012 05:00:00	2.58
2013	2.59	2.13	1.89	1.70	1.36	1.15	10-Oct-2013 21:00:00	3.01
2014	2.33	1.91	1.70	1.50	1.22	1.04	15-Feb-2014 06:00:00	2.40
2015	2.57	1.84	1.69	1.52	1.26	1.07	21-Nov-2015 08:30:00	3.21
2016	2.44	2.00	1.88	1.60	1.33	1.08	31-May-2016 09:30:00	2.61
2017	3.08	2.73	2.59	2.39	2.05	1.76	01-Dec-2017 03:30:00	3.13
2018	2.24	1.86	1.70	1.56	1.27	1.04	21-Sep-2018 01:30:00	2.28
2019	2.33	1.86	1.74	1.53	1.27	1.07	11-Jun-2019 02:00:00	2.52

*** i.e. 5 % of the H_s values measured in 2006 exceeded 1.38 m*

Significant wave height return periods

Return periods for significant wave height can be calculated since the buoy has been deployed for more than 5 years. The return periods are based on 0.5 hourly records and are calculated for periods up to 10 times the record length using a peaks-over-threshold method and Generalised Pareto Distribution (GPD).

Observation period	September 2006 to December 2019	
Return period (years)	**Significant wave height (m)**	**Comments**
0.25	2.18	No depth limitation
1	2.60	
2	2.79	
5	3.01	
10	3.17	
20	3.31	
50	3.47	
100	3.59	

Distribution plots

The distribution of wave parameters are shown in the accompanying graphs/tables of:

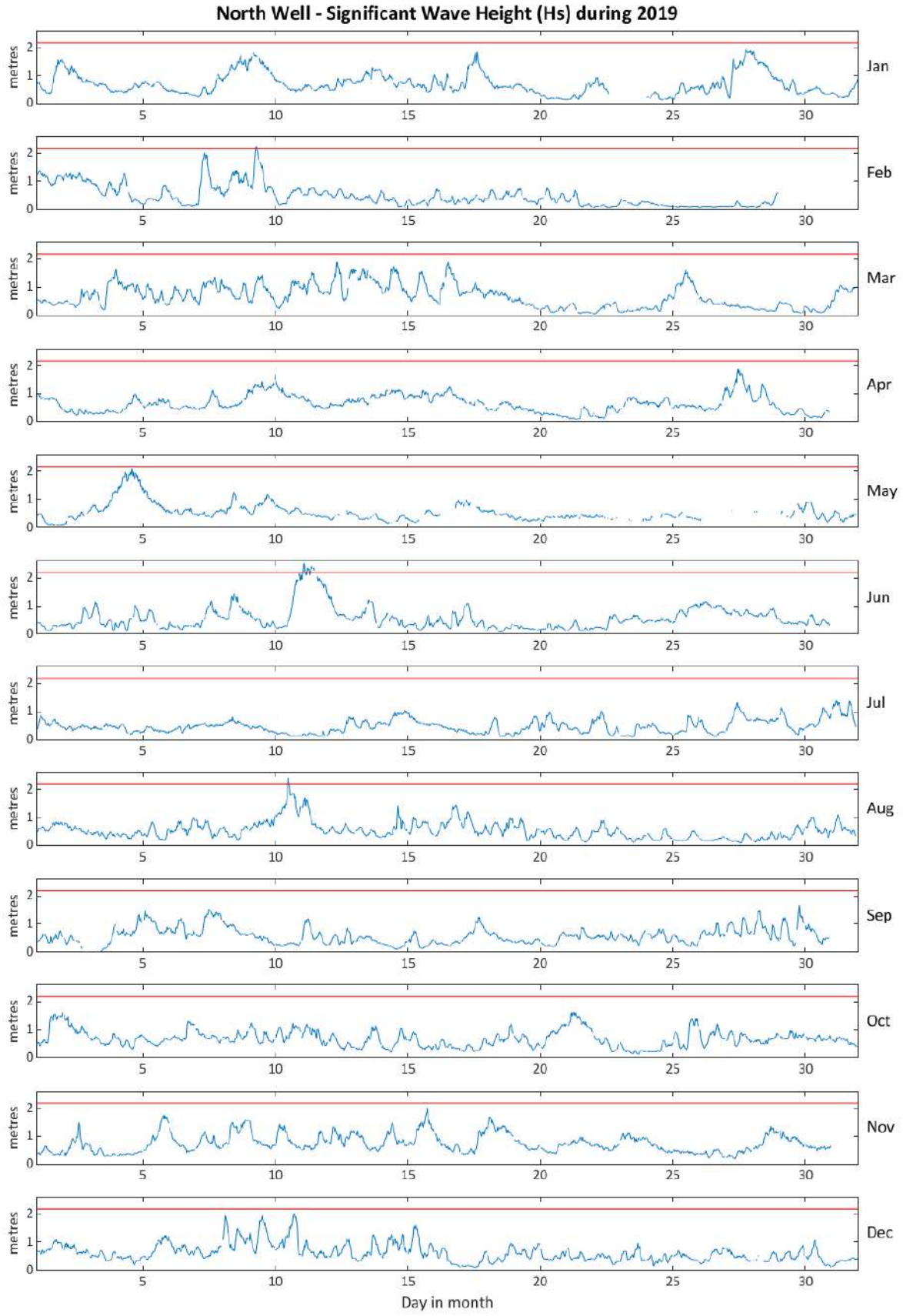
- Annual time series of H_s (red line is 2.18 m storm threshold)
- Incidence of storm waves for 2019. Storm events are defined using the Peaks-over-Threshold method. The highest H_s of each storm event is shown
- Wave height exceedance each year since deployment
- Percentage of occurrence of H_s, T_p, T_z and Direction for 2019
- Wave rose (percentage of occurrence of direction vs. H_s) for all measured data
- Joint distribution of all parameters for all measured data, given as percentage of occurrence

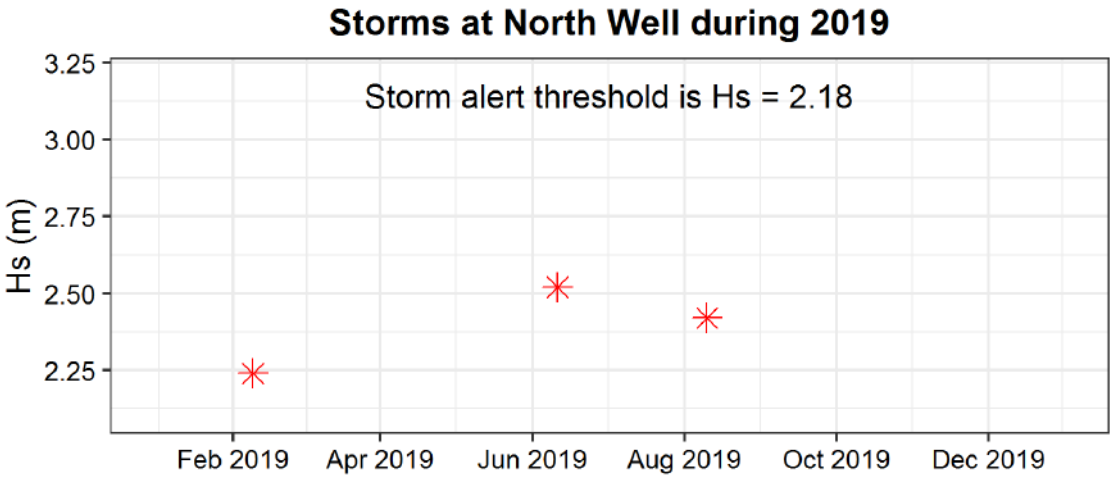
General

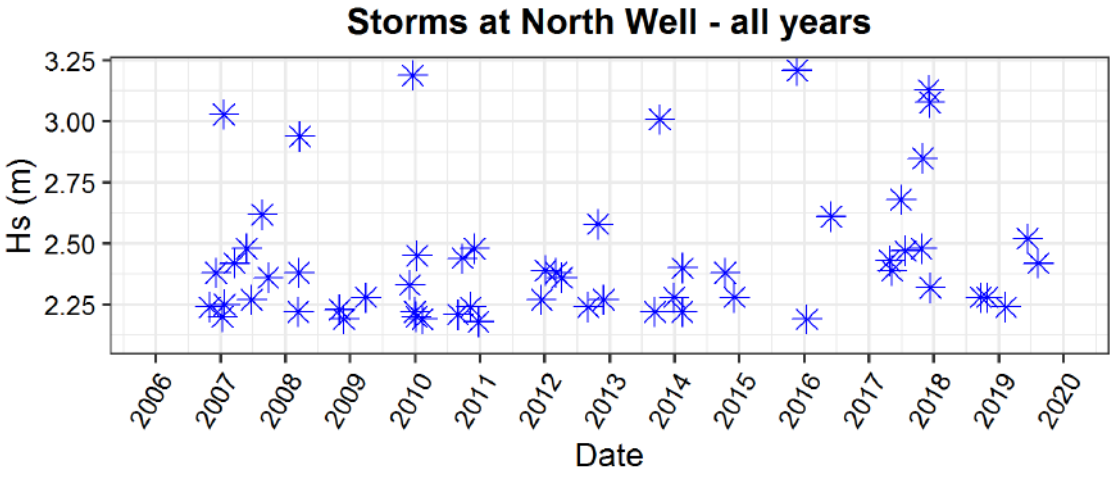
The buoy, owned by the Environment Agency, was first deployed on 25 September 2006, at which time the magnetic declination at the site was 2.38° west, changing by 0.14° east per year.

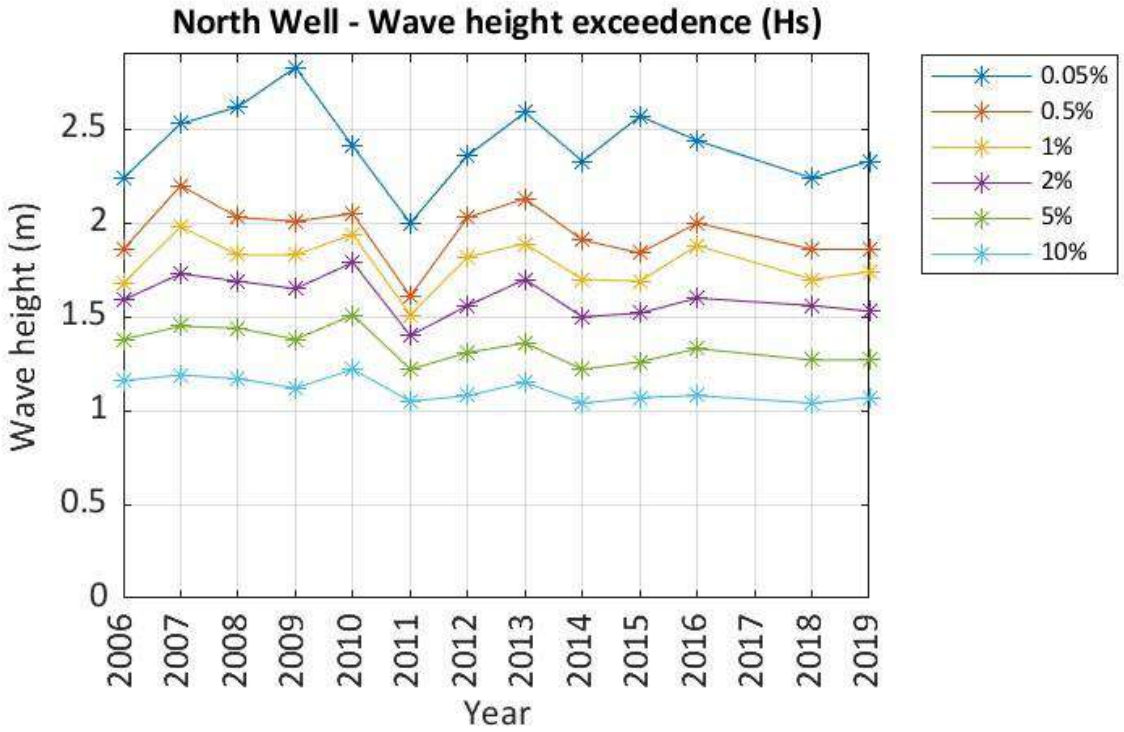
Acknowledgements

The shore station is kindly hosted by Mablethorpe RNLI Lifeboat Station.

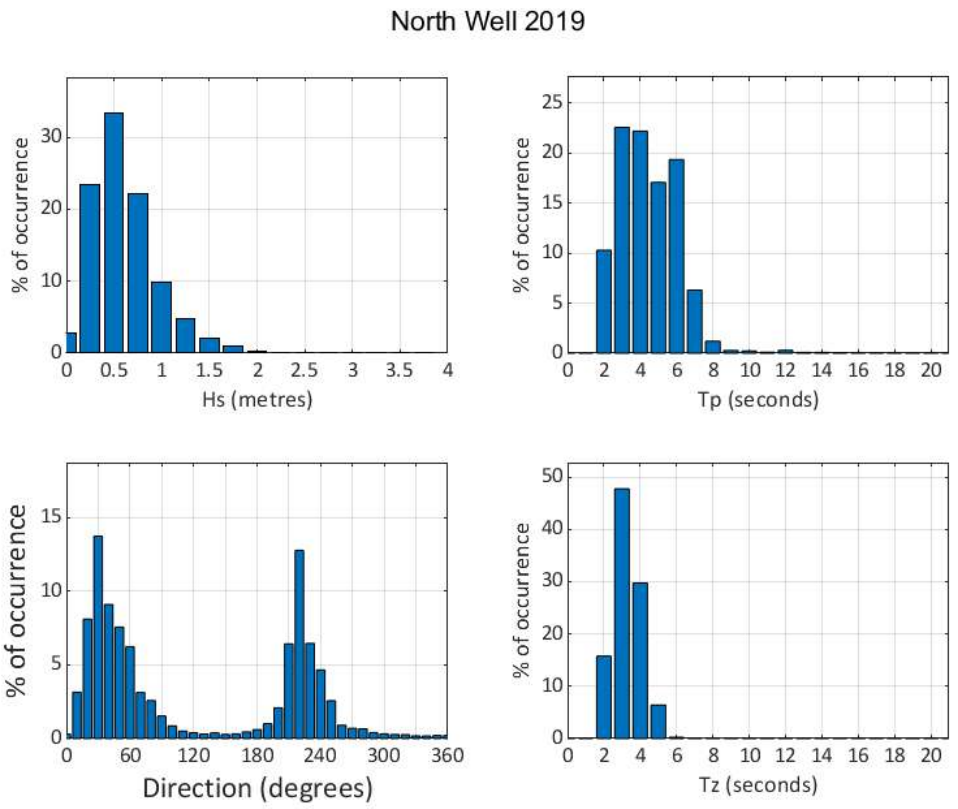

North Well - Significant Wave Height (Hs) during 2019
metres
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
0
1
2
5
10
15
20
25
30
Day in month

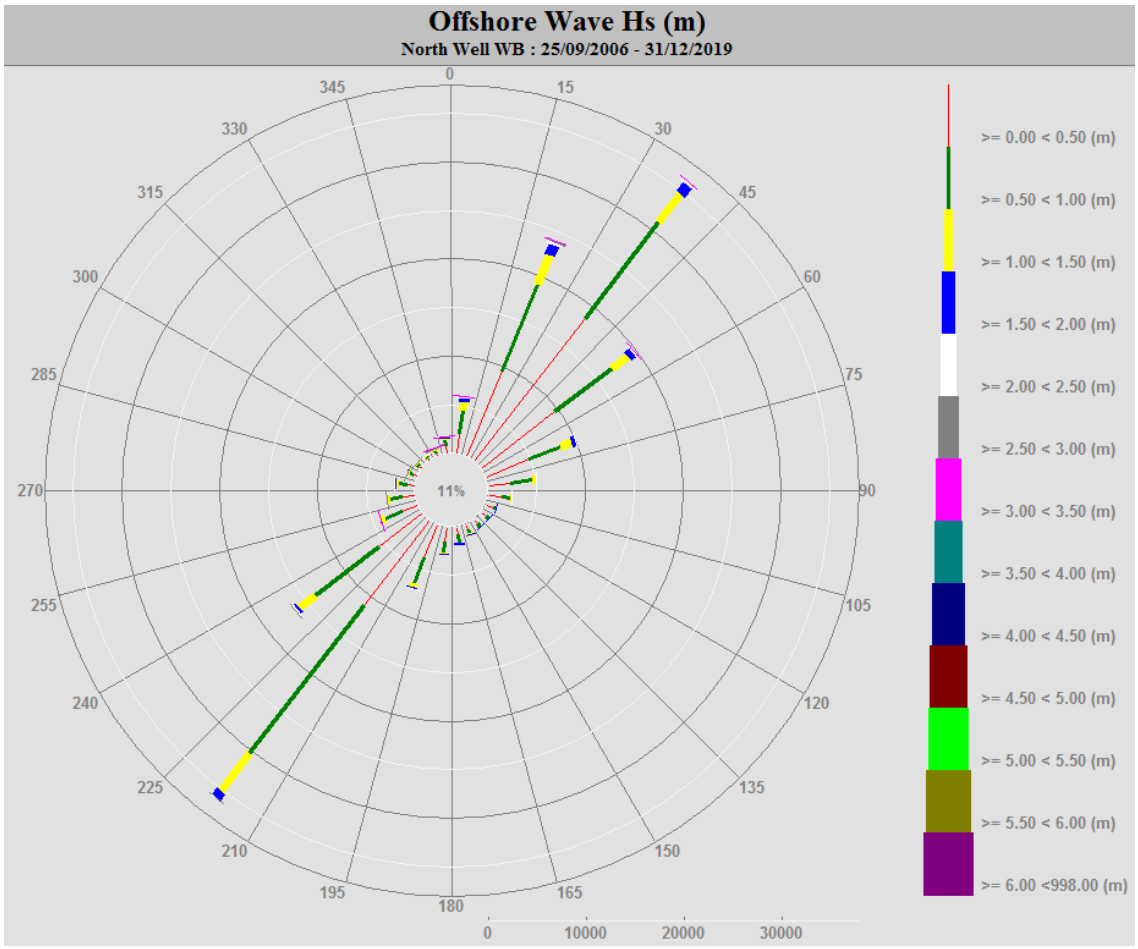


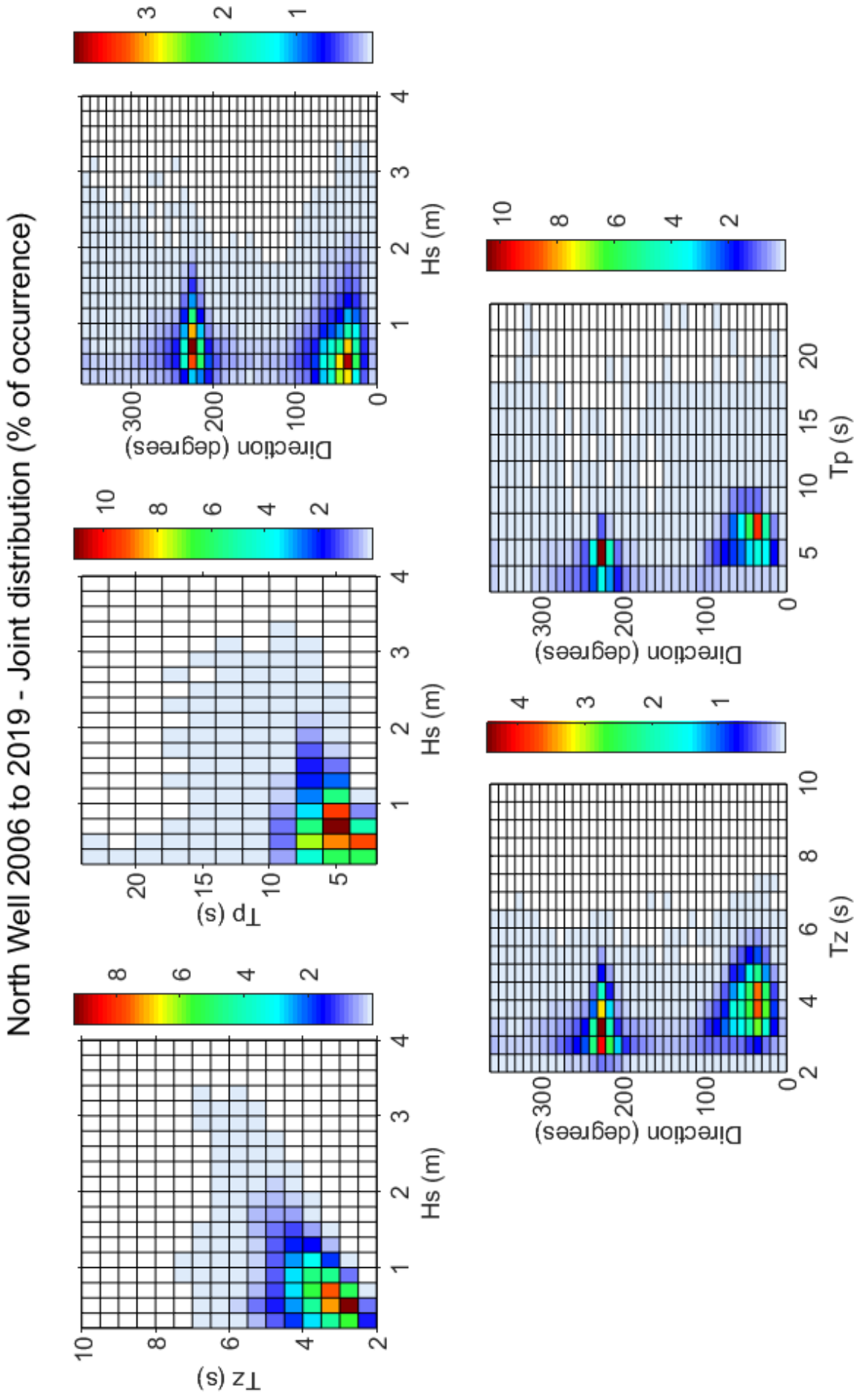




2017 was excluded from the wave height graph. During this year, a large number of storms (12) that exceeded the storm alert threshold were recorded, while only 30% of the total annual dataset was recovered, resulting in a very skewed picture. Nonetheless, 2017 should be considered as a year with very high wave heights.


North Well 2019
% of occurrence
Hs (metres)
Tp (seconds)
Direction (degrees)
Tz (seconds)


Offshore Wave Hs (m)
North Well WB : 25/09/2006 - 31/12/2019
11%
>= 0.00 < 0.50 (m)
>= 0.50 < 1.00 (m)
>= 1.00 < 1.50 (m)
>= 1.50 < 2.00 (m)
>= 2.00 < 2.50 (m)
>= 2.50 < 3.00 (m)
>= 3.00 < 3.50 (m)
>= 3.50 < 4.00 (m)
>= 4.00 < 4.50 (m)
>= 4.50 < 5.00 (m)
>= 5.00 < 5.50 (m)
>= 5.50 < 6.00 (m)
>= 6.00 <998.00 (m)


North Well 2006 to 2019 - Joint distribution (% of occurrence)
Direction (degrees)
Hs (m)
Tp (s)
Tz (s)

5. Summary of Wash Trends

The overall trends of The Wash SMP fit into two overall patterns. Some areas are stable with slight accretion. These areas are usually dominated by saltmarsh. Accretion was strongest in the Nene to Wolferton monitoring cell with an average change in CSA of 10.6% between 1997 and 2020. Saltmarsh is advancing in most places, helping to stabilise the beach sediment. Any erosion in these areas tends to be on the intertidal mud flats which are not protected by saltmarsh and are less likely to be of concern.

More complex changes are seen in beach fronted areas with a general trend towards erosion. The area between Hunstanton and Heacham show patches of erosion and accretion with erosion primarily focused on the backshore and accretion on the foreshore. This has resulted in stable CSA values but highlights the importance of the beach recycling scheme in place here. More recent trends indicate a move towards more erosion with erosion of up to 2.4% over the current phase compared with 4.13% since 1992. The surrounding Hunstanton pier building and the North Hunstanton monitoring cell show a greater level of erosion and more mobile sediment. Profile W062, at Old Hunstanton, shows over 25% erosion since 1992. This area is likely to benefit from further investigations to identify the causes and precise trends of sediment movement.

6. Glossary

ACM – Anglian Coastal Monitoring Programme

CSA – Cross-sectional Area

IDB – Internal Drainage Board

Lidar – Light Detection and Ranging

SMP – Shoreline Management Plan

7. References

All base mapping provided by Ordnance Survey. © Crown copyright and database rights 2020 Ordnance Survey 100024198.

Witham Fourth IDB, 2019. Wrangle Sea Banks Project Summary. [Accessed March 10th 2021]. www.w4idb.co.uk/2019/05/wrangle-sea-bank-project-summary

Environment Agency, 2007. Coastal Trends Report The Wash (Gibraltar Point to Old Hunstanton) March 2007 (RP002W2007).

Environment Agency, 2012. Wash Banks Performance Review.

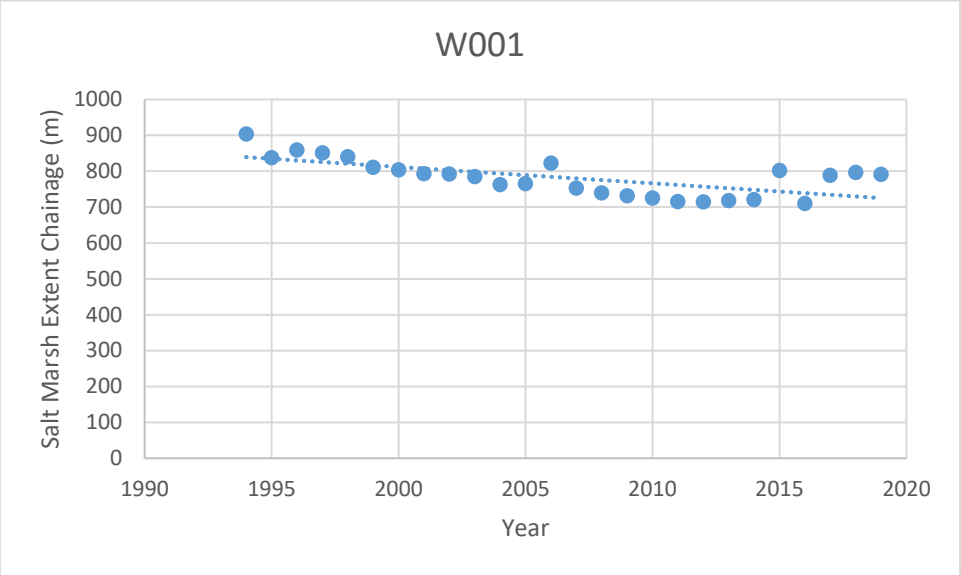
Jacobs, 2019. Hunstanton to Heacham Beach Management: Beach Survey Annual Report 2018/2019

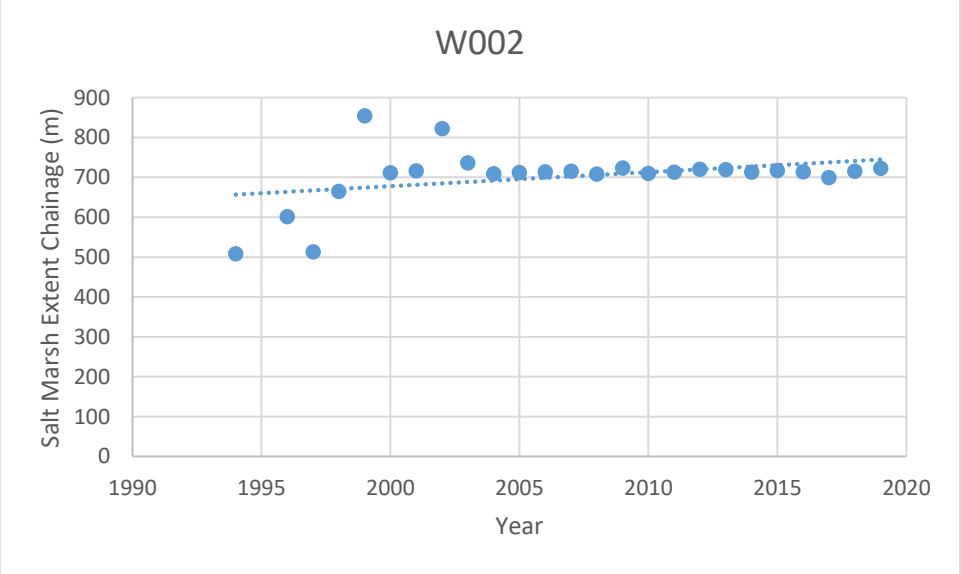
British Geological Survey, 2020. Hunstanton Cliffs: Baseline Terrestrial LiDAR Survey. Multi-Hazards & Resilience Programme Commercial Report CR/20/003

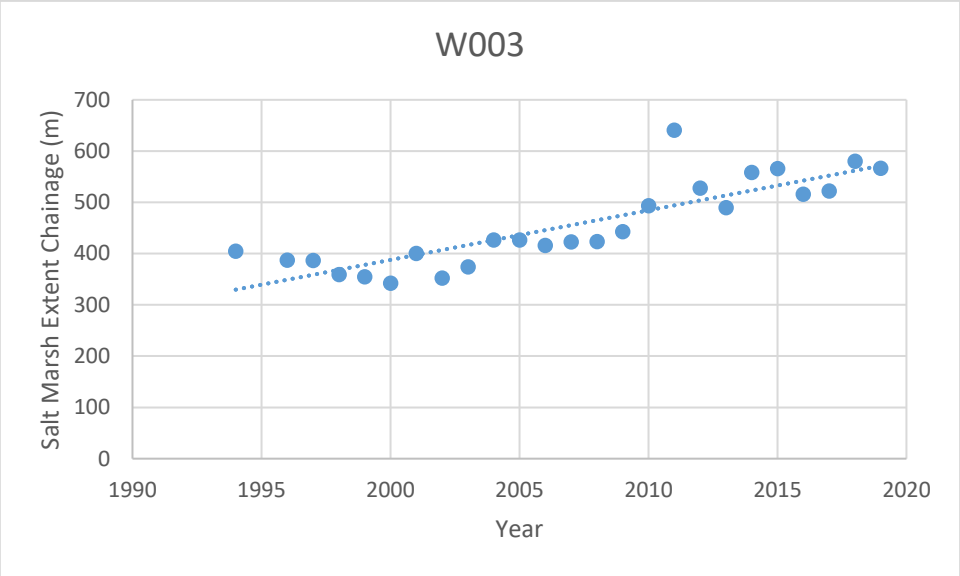
8. Appendix 1 – Saltmarsh Analysis for individual profiles

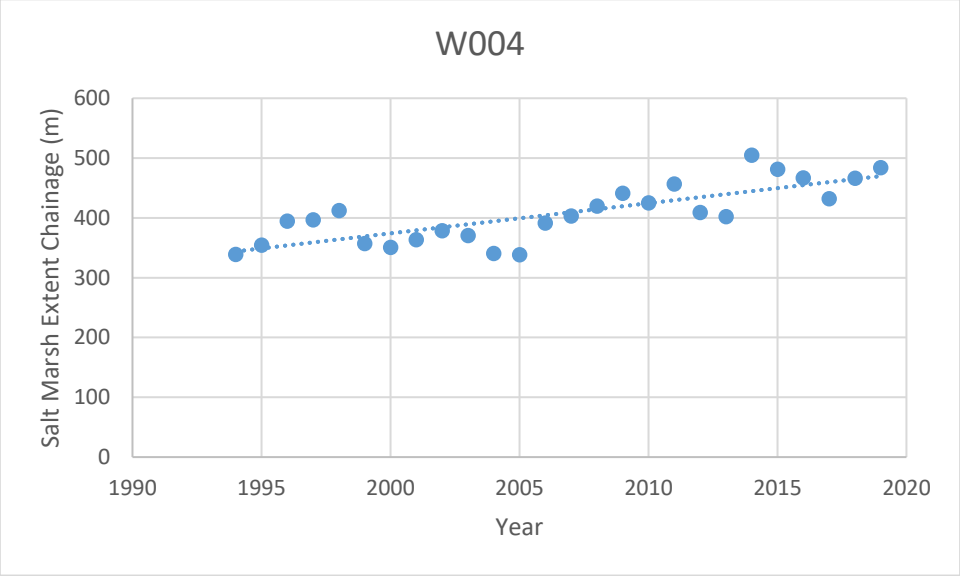
The graphs below show the advance and retreat of each profile included in the aggregate results shown in each monitoring cell. The profiles are ordered from north to south, starting at the northern end of the Wash Banks monitoring cell.

Wash Banks - 2dSU01WB






W003
Salt Marsh Extent Chainage (m)
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year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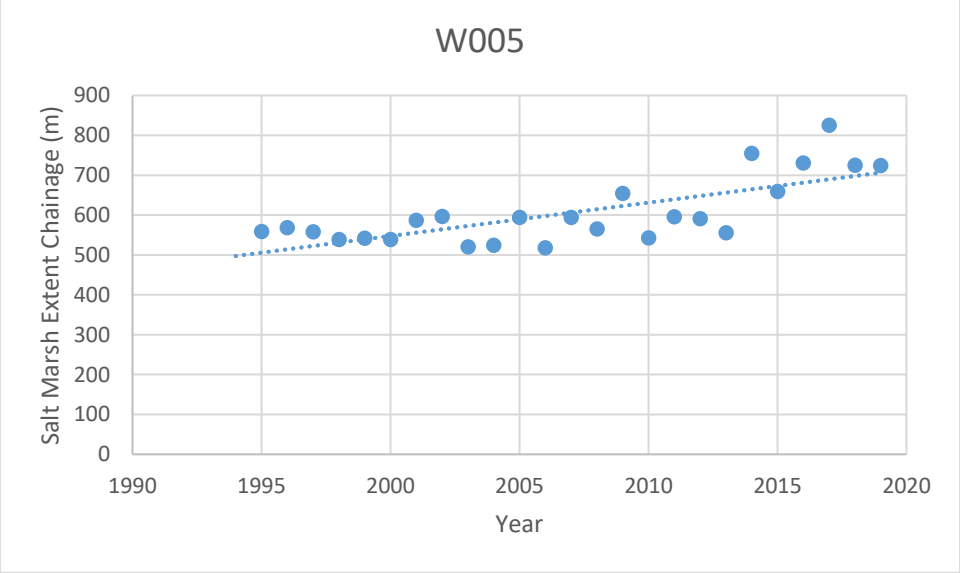
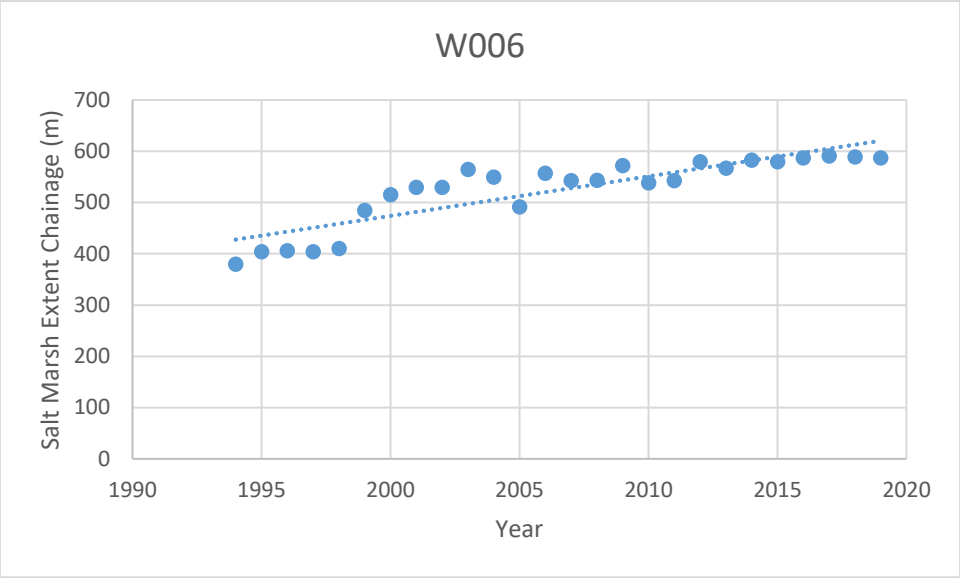
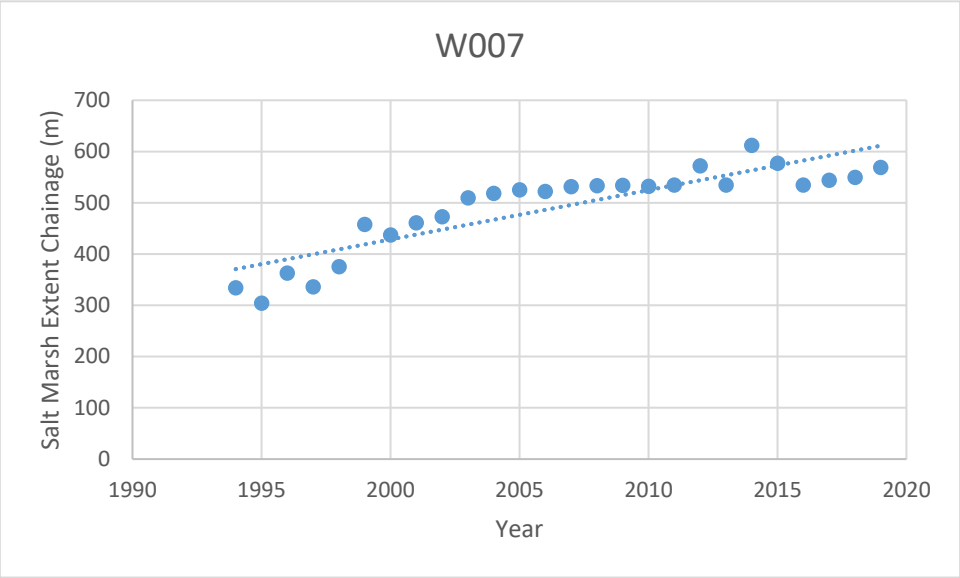
Salt Marsh Extent Chainage (m)
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year


W005
Salt Marsh Extent Chainage (m)
900
800
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year


W006
Salt Marsh Extent Chainage (m)
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year


W007
Salt Marsh Extent Chainage (m)
700
600
500
400
300
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100
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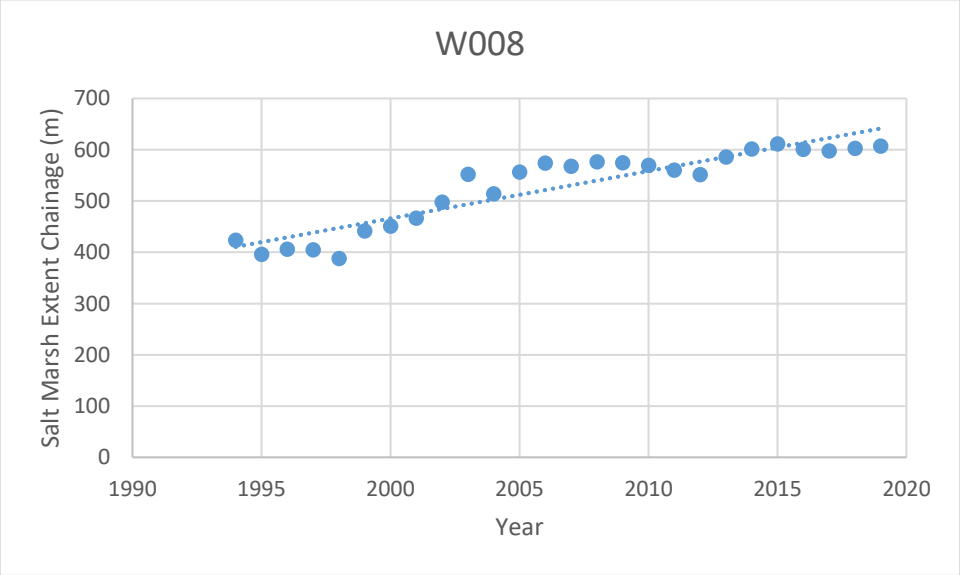
1990
1995
2000
2005
2010
2015
2020
Year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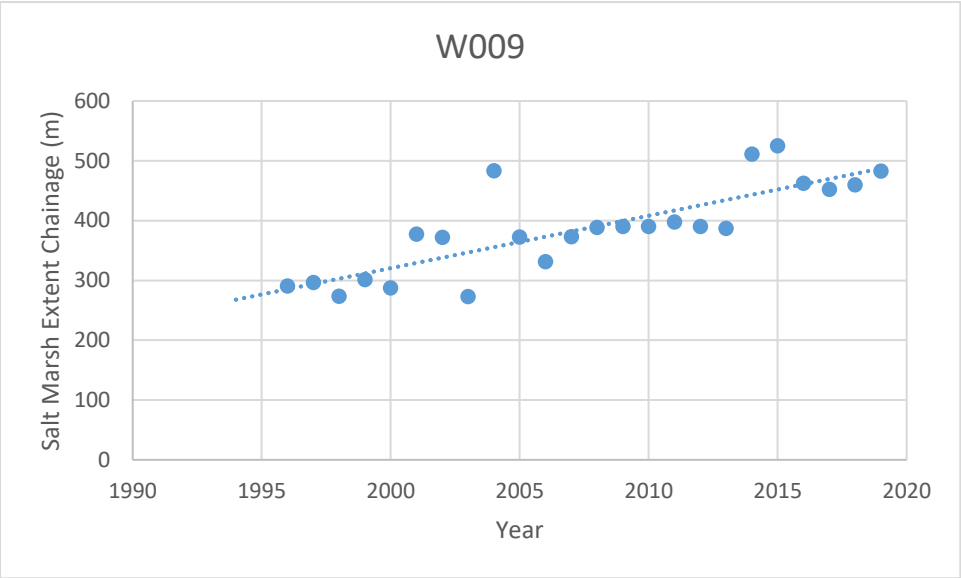
Salt Marsh Extent Chainage (m)
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year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Salt Marsh Extent Chainage (m)
600
500
400
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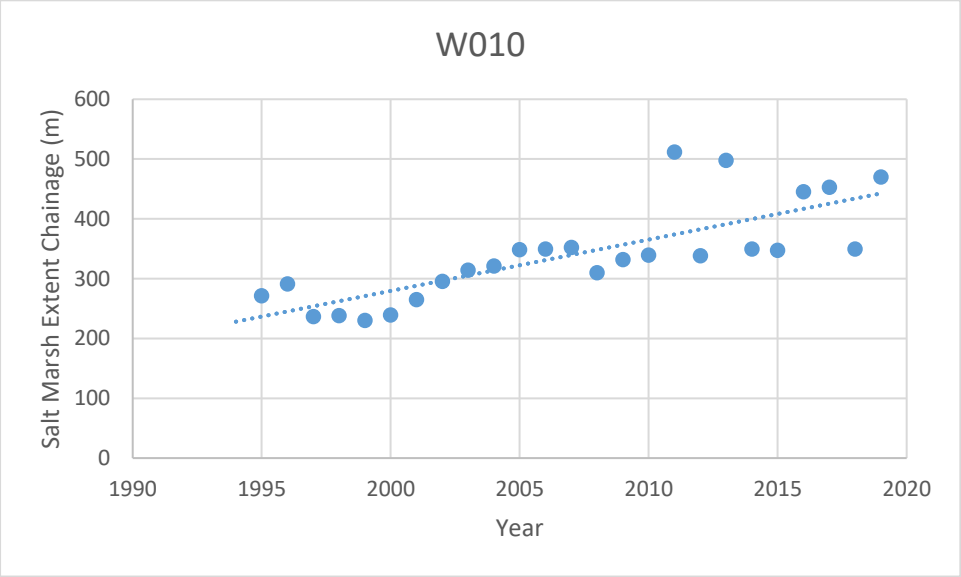
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year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Salt Marsh Extent Chainage (m)
600
500
400
300
200
100
0
1990
1995
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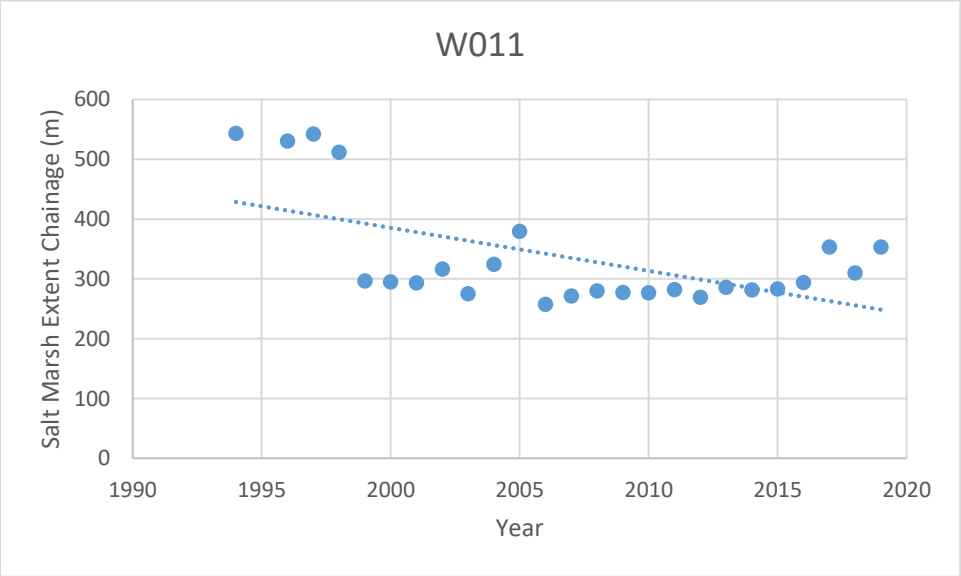
2005
2010
2015
2020
Year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Salt Marsh Extent Chainage (m)
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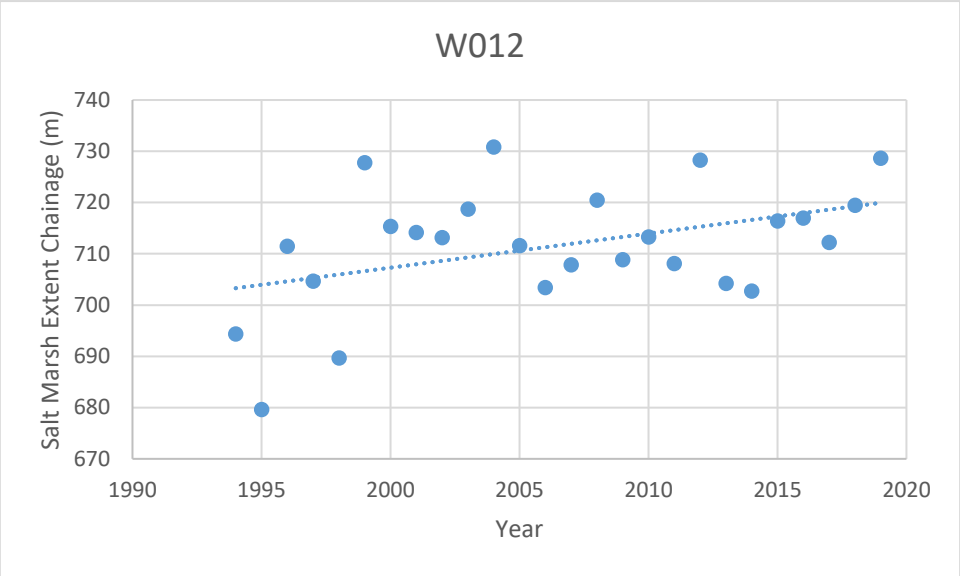
2010
2015
2020
Year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Salt Marsh Extent Chainage (m)
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730
720
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700
690
680
670
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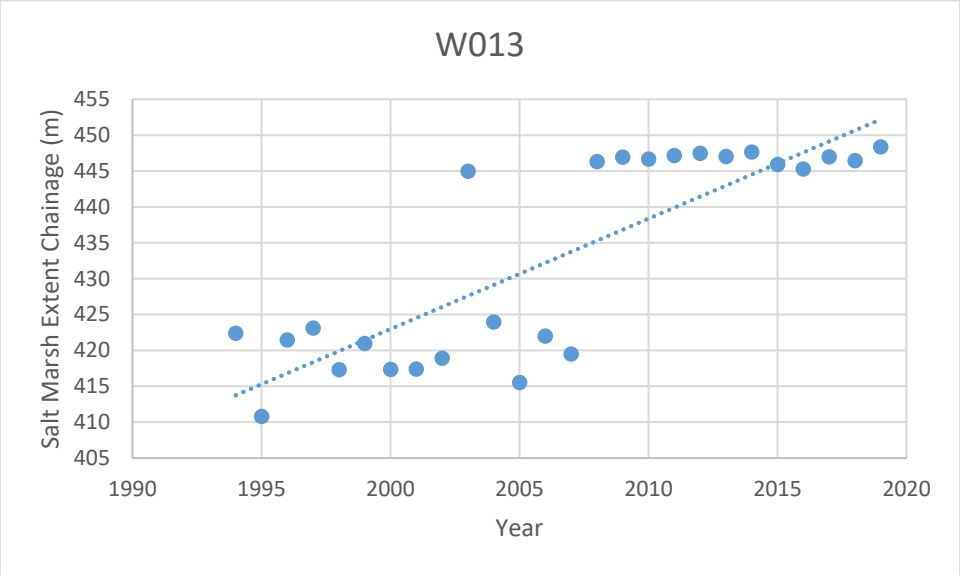
1995
2000
2005
2010
2015
2020
Year


W013
Salt Marsh Extent Chainage (m)
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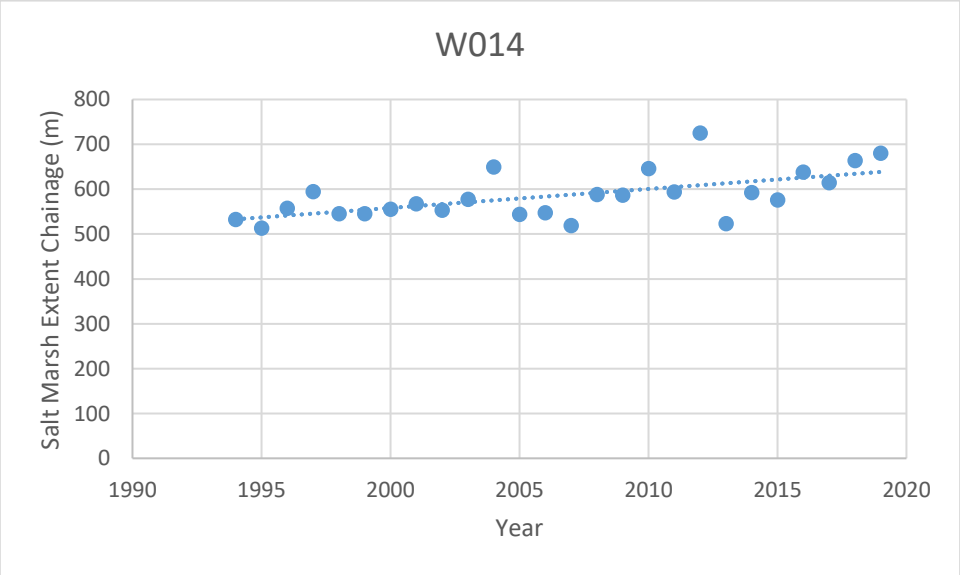
450
445
440
435
430
425
420
415
410
405
1990
1995
2000
2005
2010
2015
2020
Year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Salt Marsh Extent Chainage (m)
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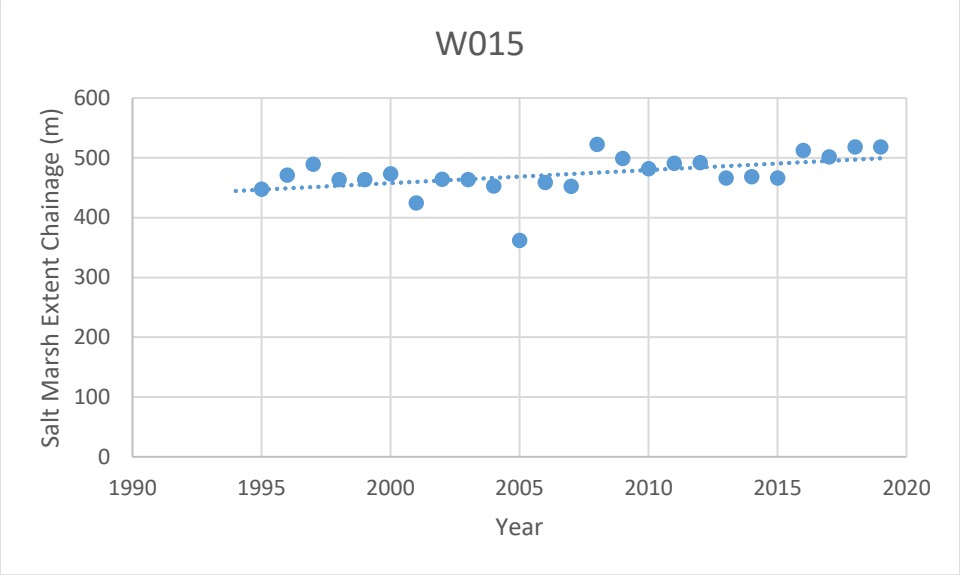
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year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Salt Marsh Extent Chainage (m)
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200
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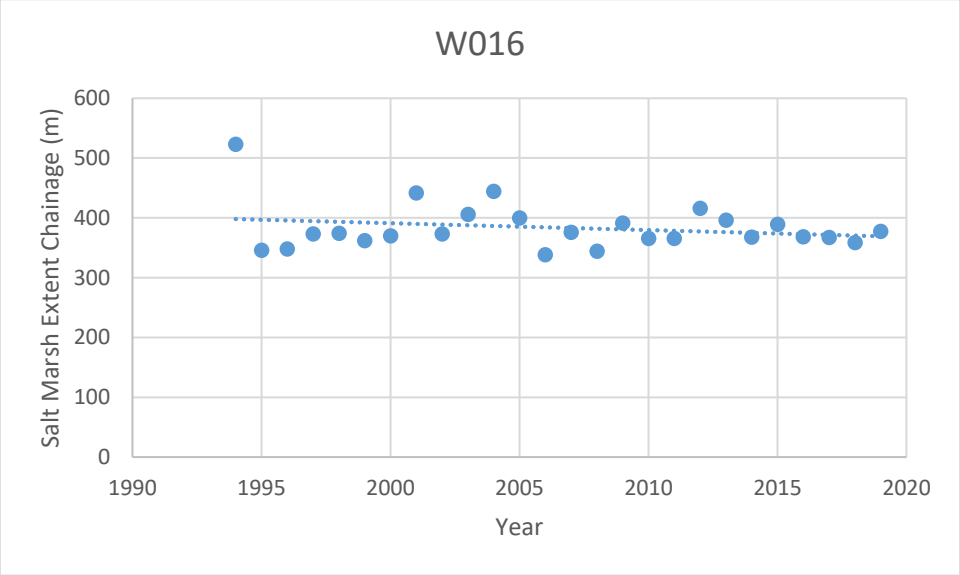
0
1990
1995
2000
2005
2010
2015
2020
Year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Salt Marsh Extent Chainage (m)
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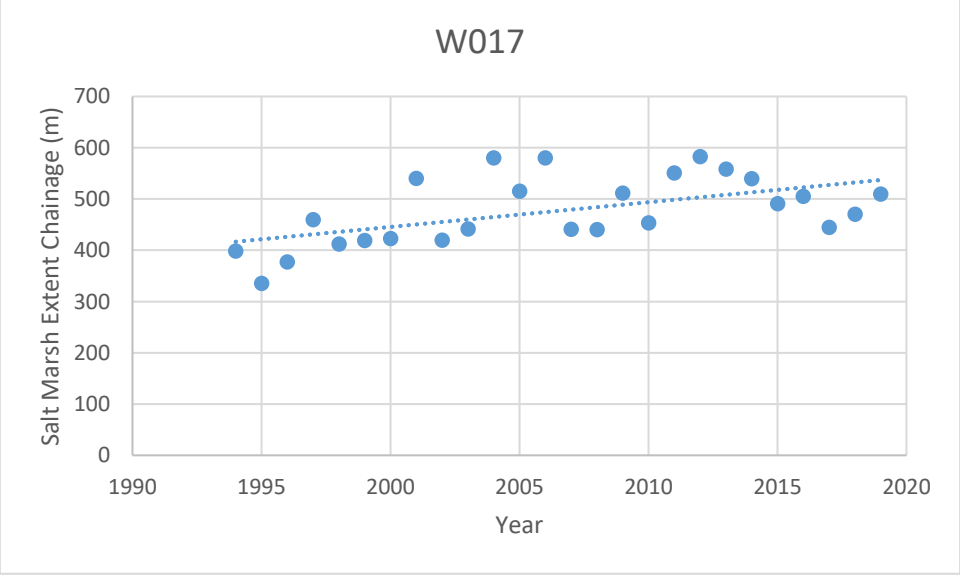
1990
1995
2000
2005
2010
2015
2020
Year


W017
Salt Marsh Extent Chainage (m)
700
600
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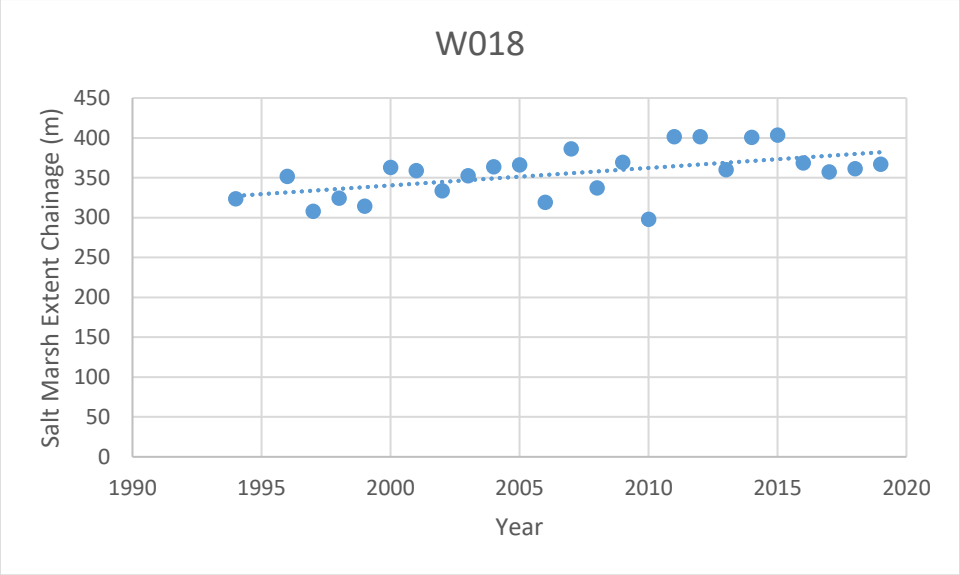
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year


W018
Salt Marsh Extent Chainage (m)
450
400
350
300
250
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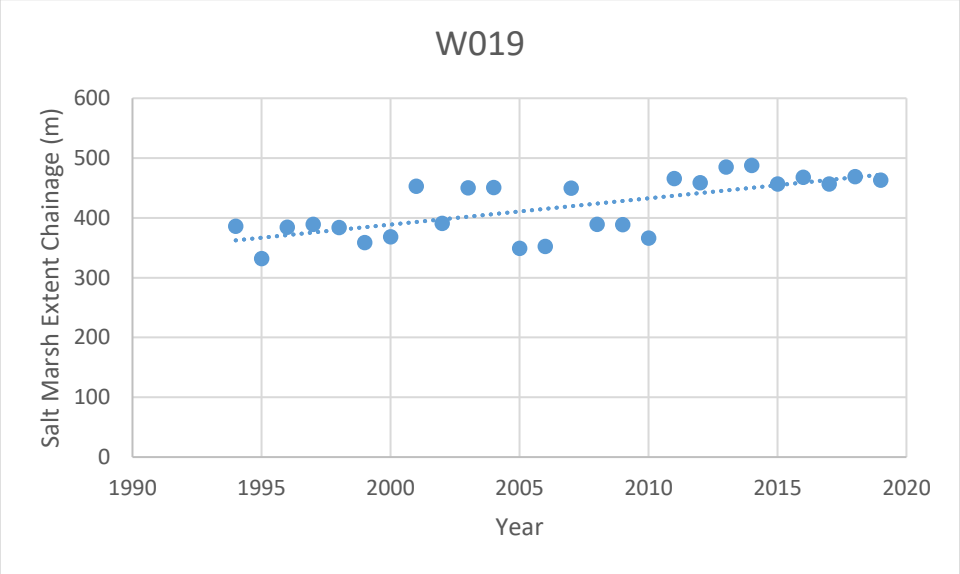
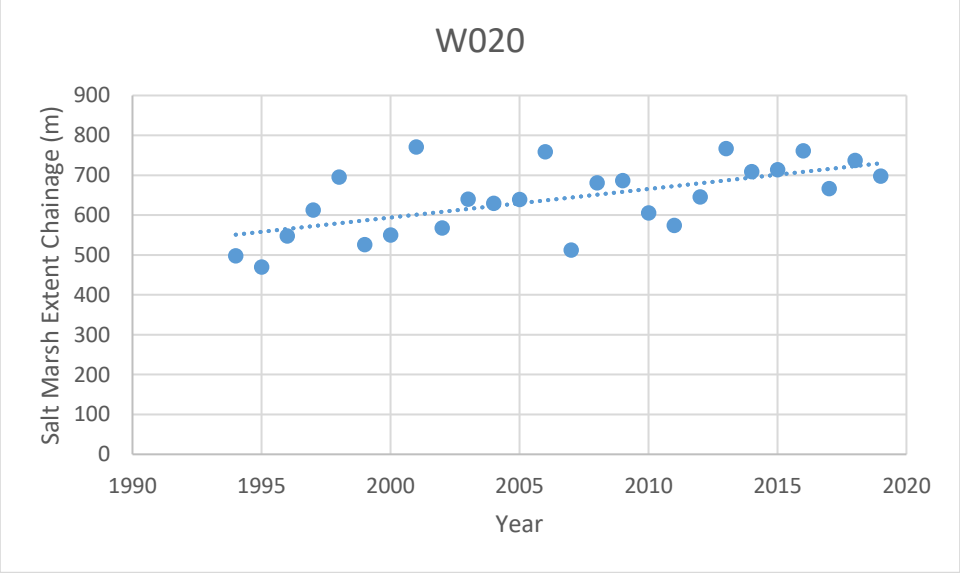
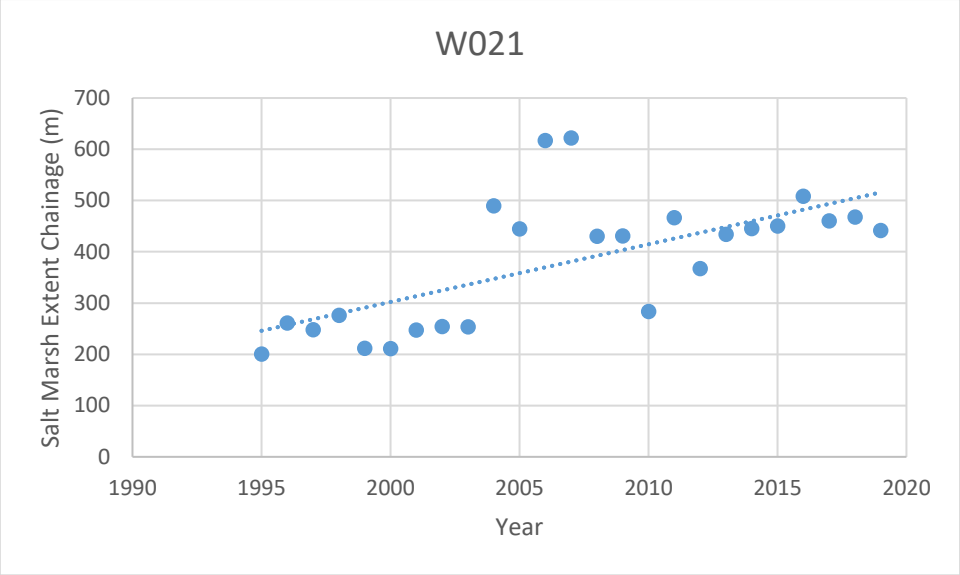
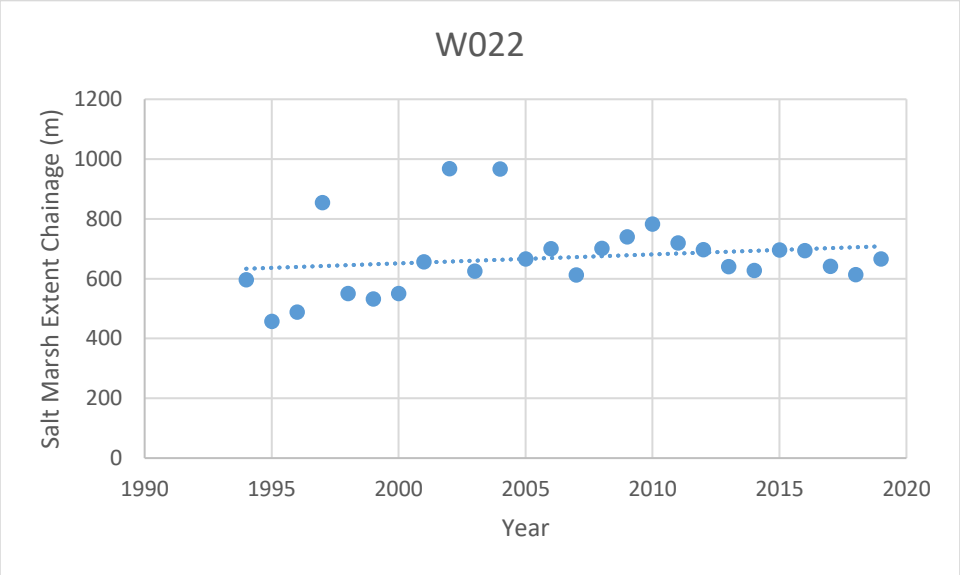
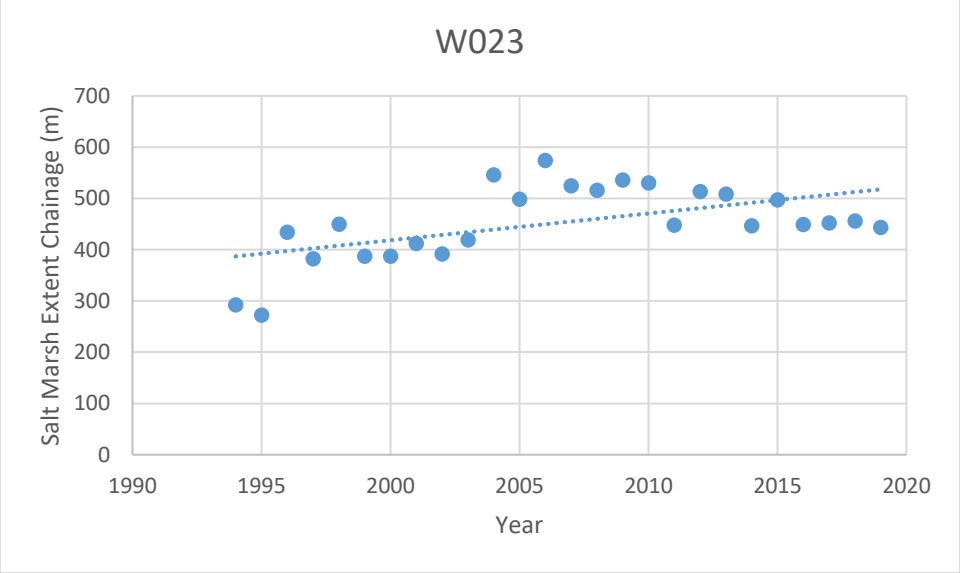
150
100
50
0
1990
1995
2000
2005
2010
2015
2020
Year

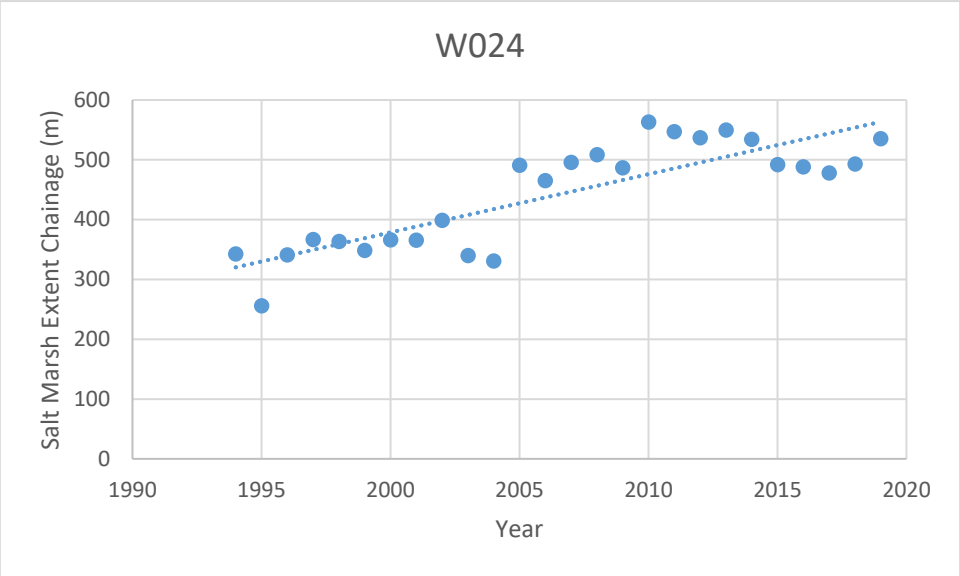

W019
Salt Marsh Extent Chainage (m)
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year


W020
Salt Marsh Extent Chainage (m)
900
800
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year

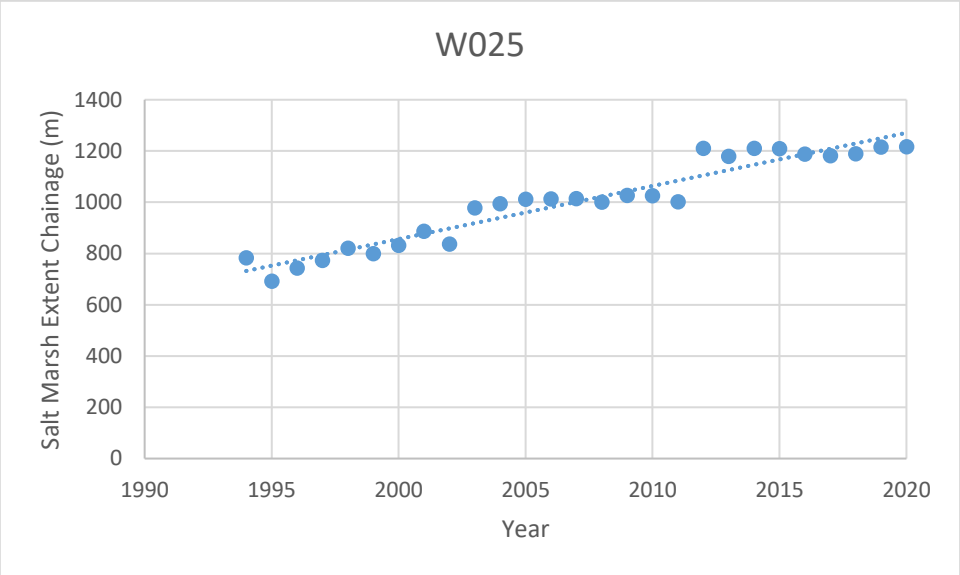

W021
Salt Marsh Extent Chainage (m)
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year

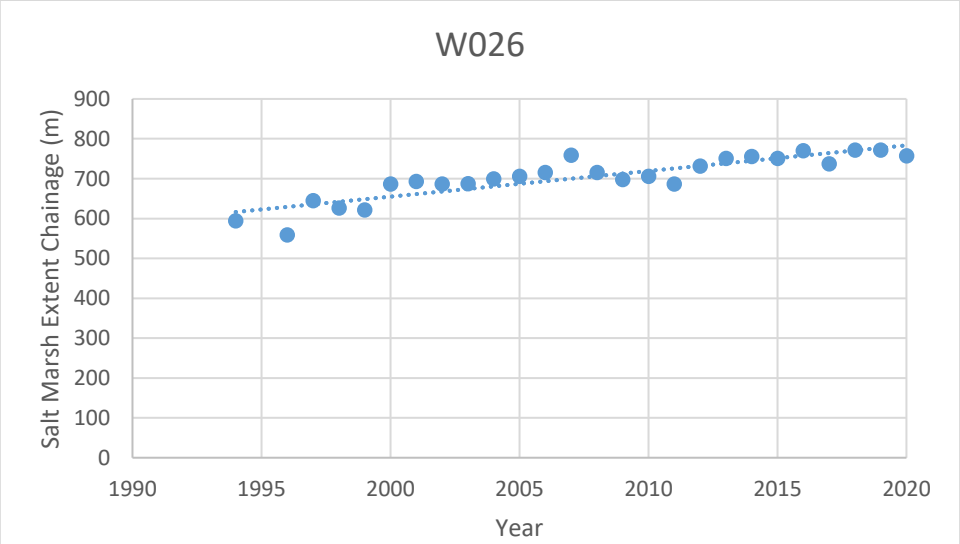

W022
Salt Marsh Extent Chainage (m)
1200
1000
800
600
400
200
0
1990
1995
2000
2005
2010
2015
2020
Year

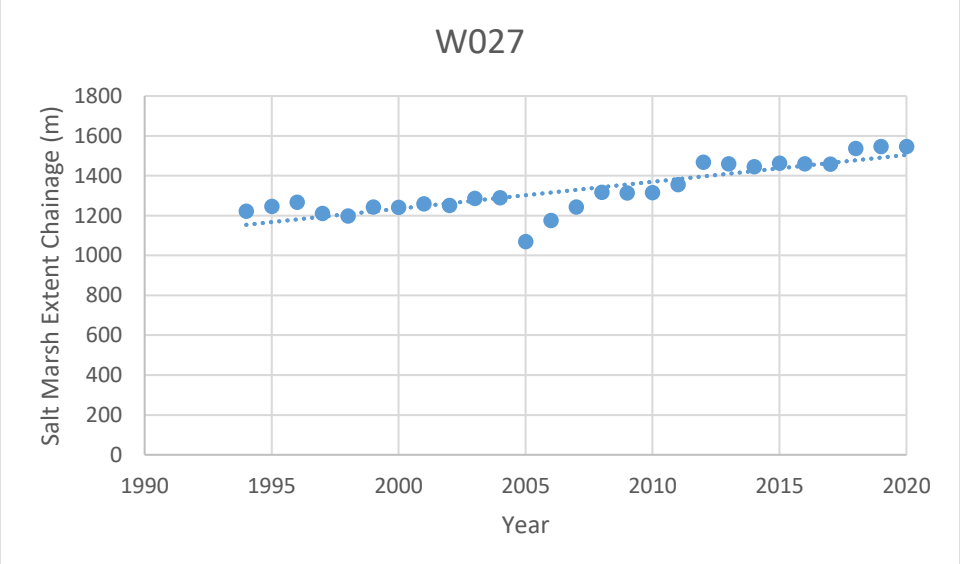

W023
Salt Marsh Extent Chainage (m)
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year

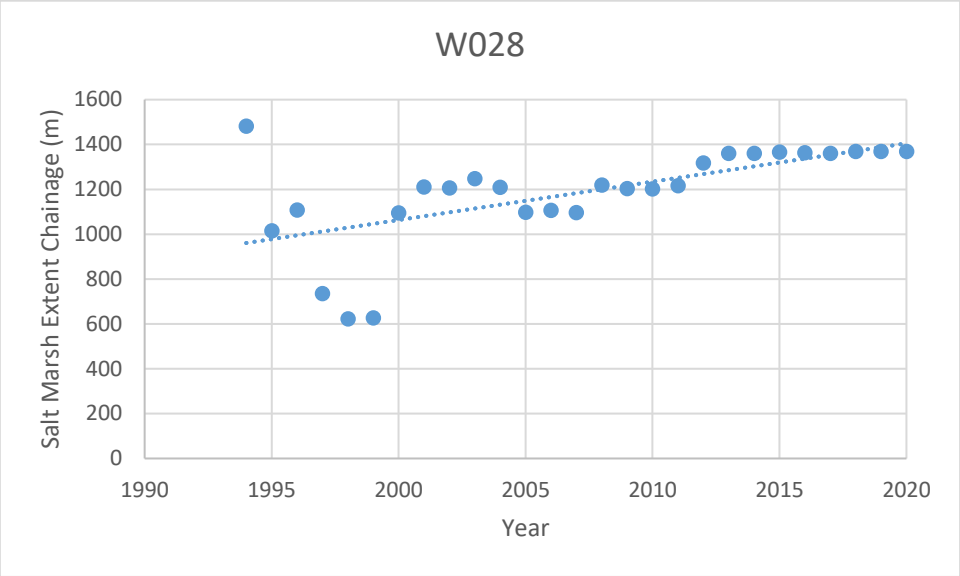

W024
Salt Marsh Extent Chainage (m)
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year

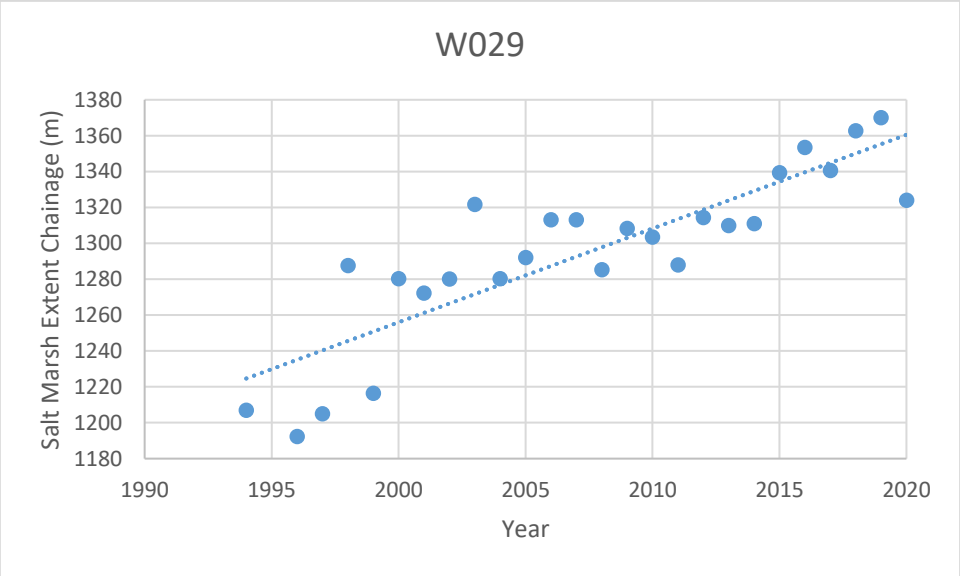
Holbeach – 2dSU02HO

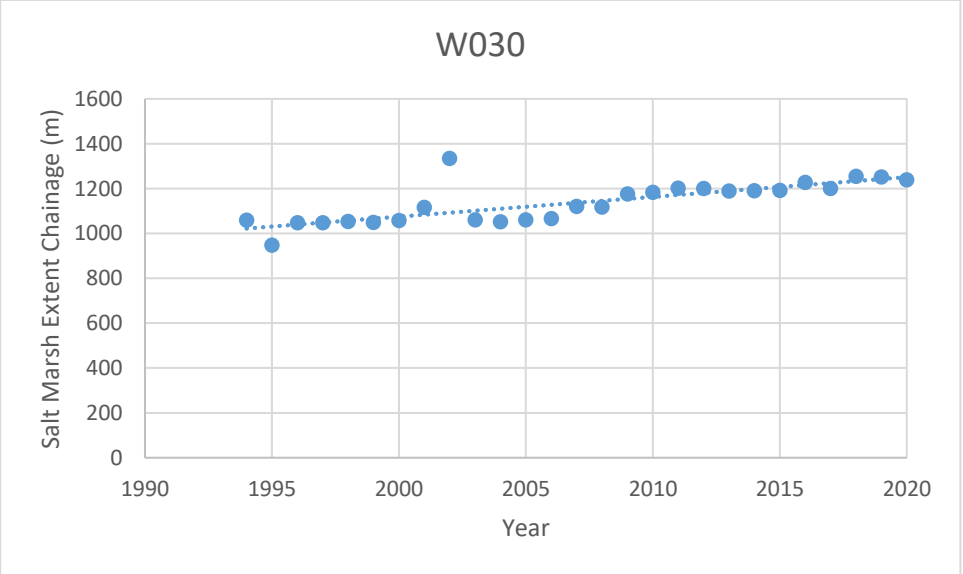


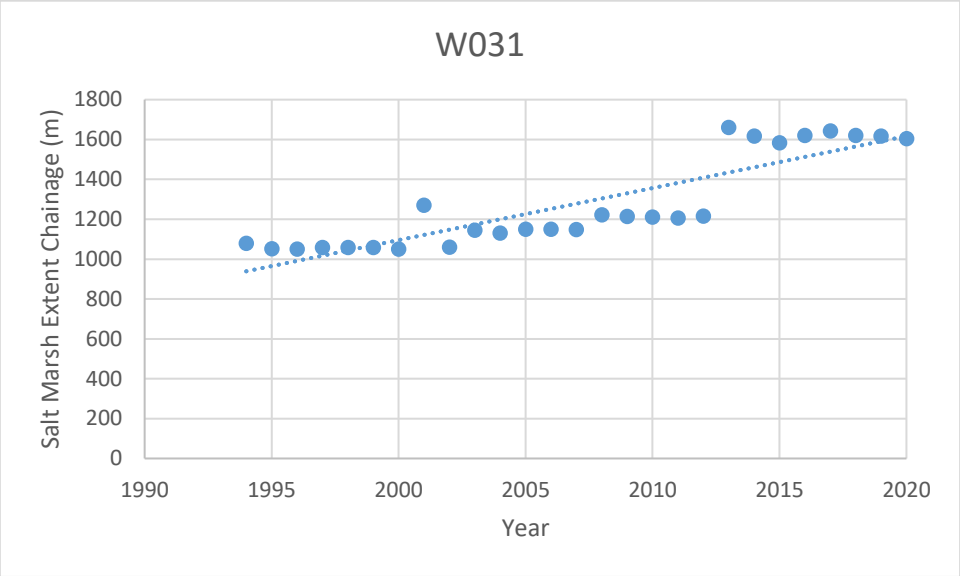


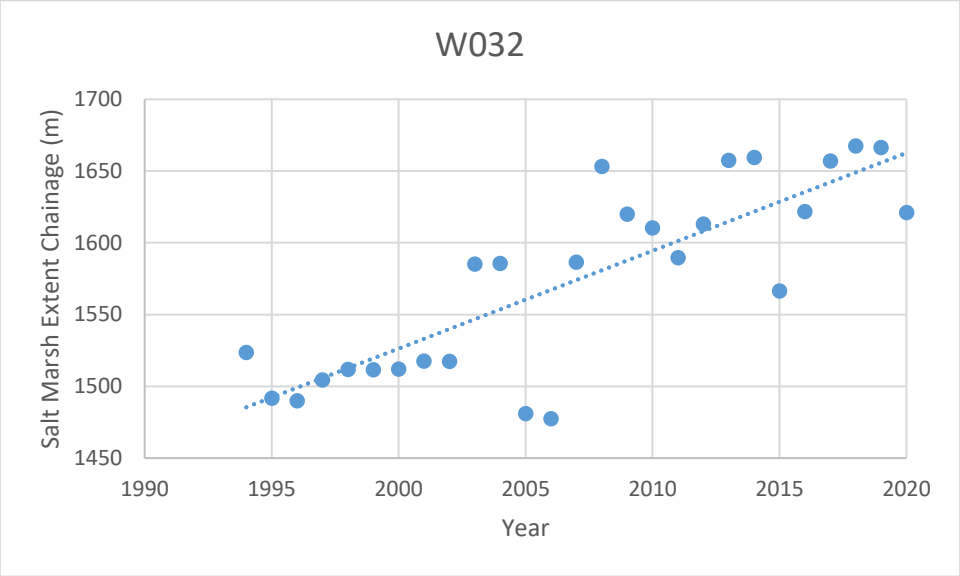


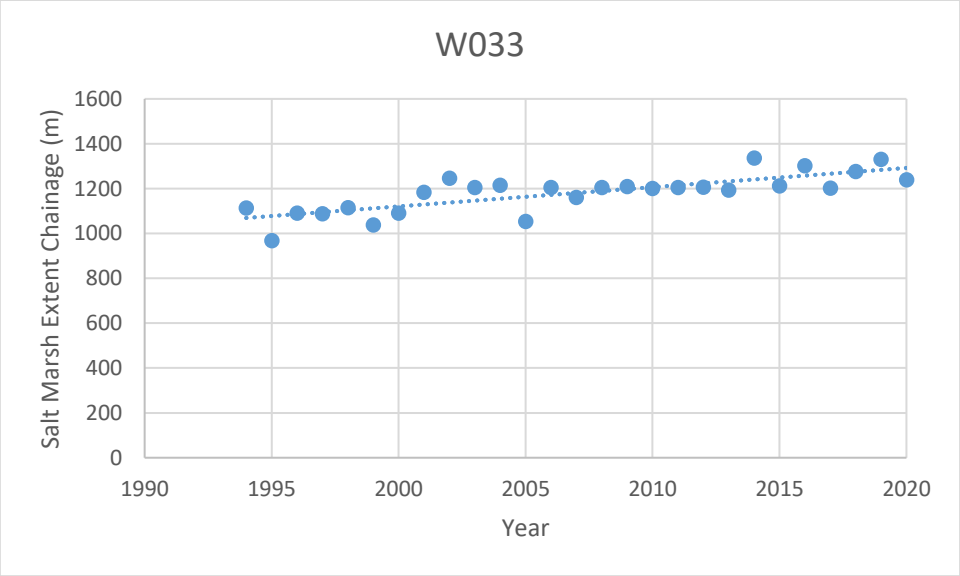

W028
Salt Marsh Extent Chainage (m)
1600
1400
1200
1000
800
600
400
200
0
1990
1995
2000
2005
2010
2015
2020
Year

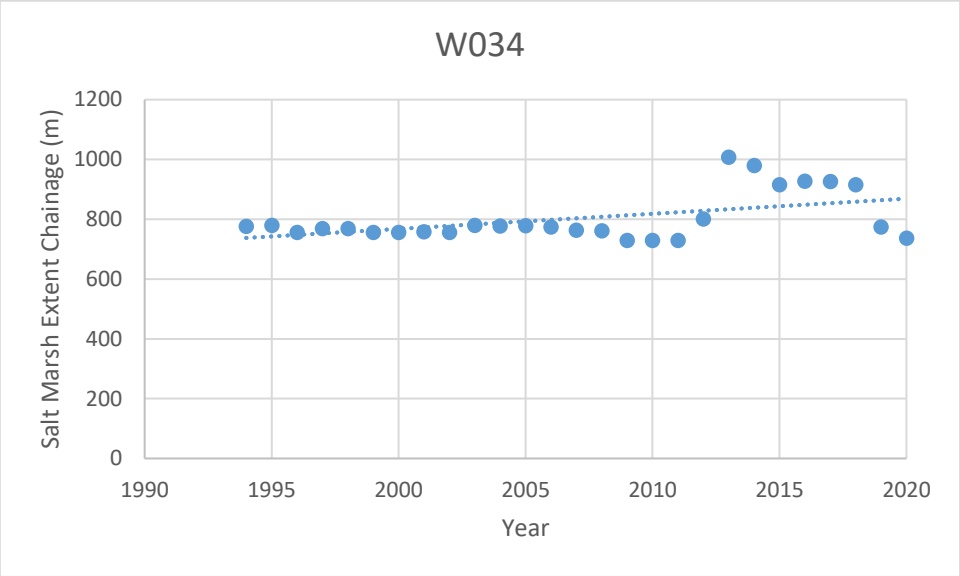

W029
Salt Marsh Extent Chainage (m)
1380
1360
1340
1320
1300
1280
1260
1240
1220
1200
1180
1990
1995
2000
2005
2010
2015
2020
Year

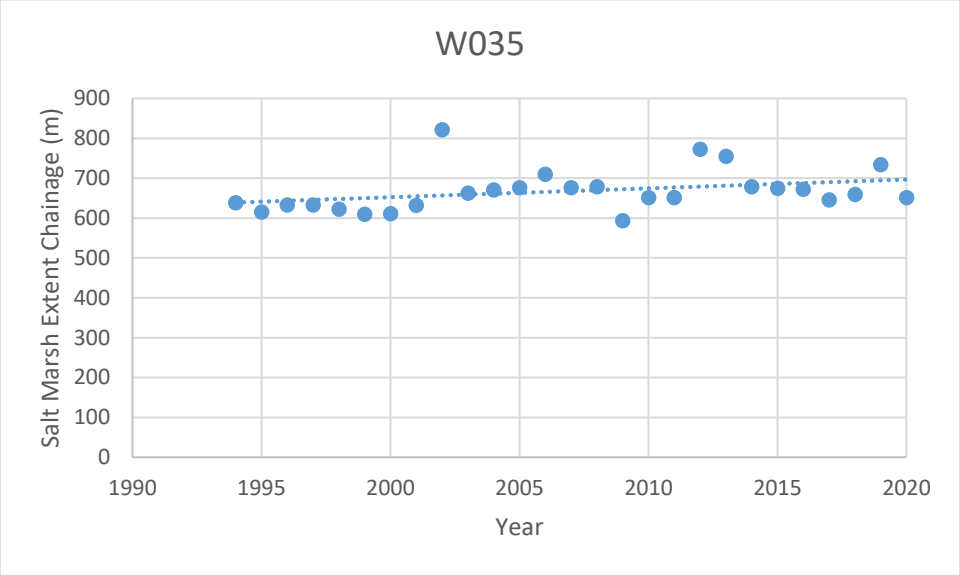

W030
Salt Marsh Extent Chainage (m)
1600
1400
1200
1000
800
600
400
200
0
1990
1995
2000
2005
2010
2015
2020
Year

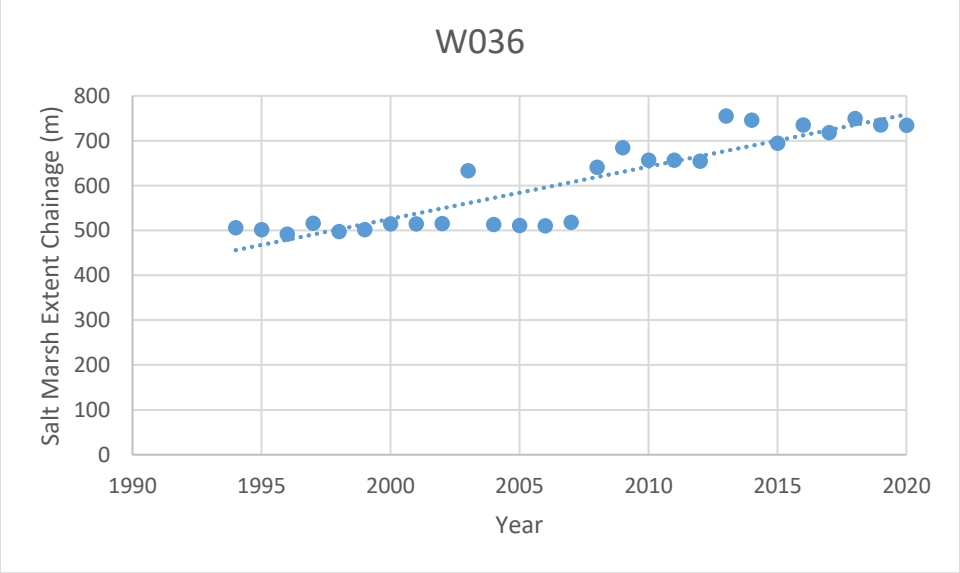

W031
Salt Marsh Extent Chainage (m)
1800
1600
1400
1200
1000
800
600
400
200
0
1990
1995
2000
2005
2010
2015
2020
Year

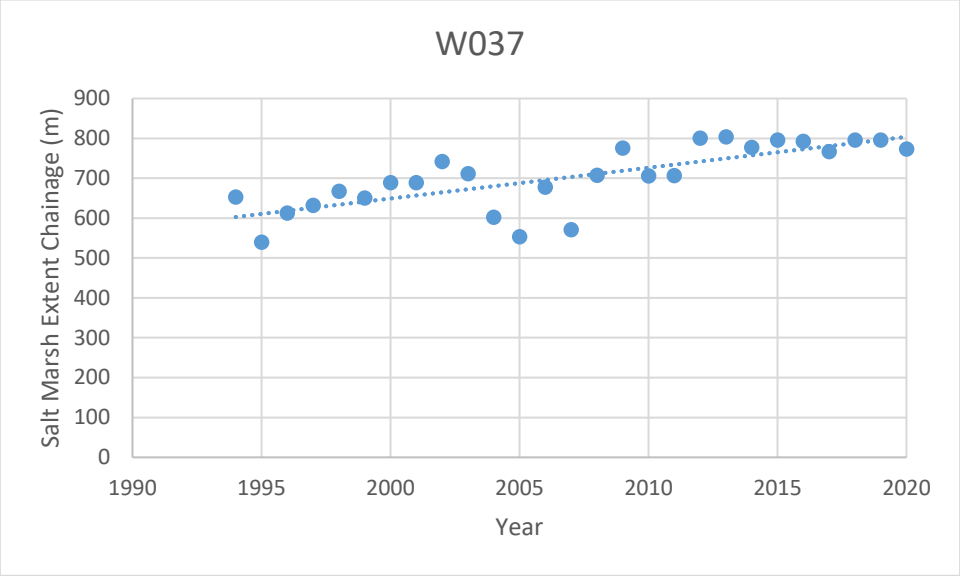

W032
Salt Marsh Extent Chainage (m)
1700
1650
1600
1550
1500
1450
1990
1995
2000
2005
2010
2015
2020
Year


W033
Salt Marsh Extent Chainage (m)
1600
1400
1200
1000
800
600
400
200
0
1990
1995
2000
2005
2010
2015
2020
Year

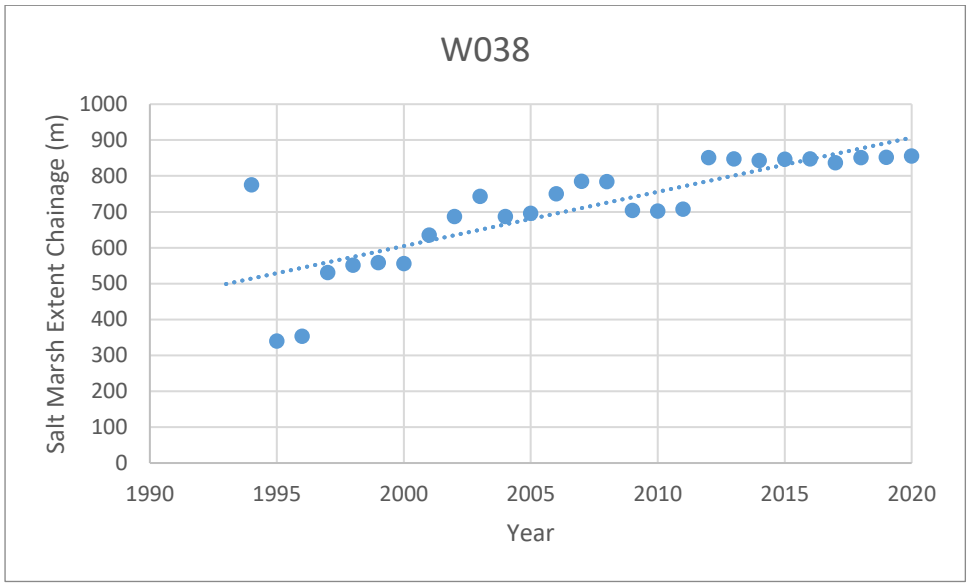

W034
Salt Marsh Extent Chainage (m)
1200
1000
800
600
400
200
0
1990
1995
2000
2005
2010
2015
2020
Year

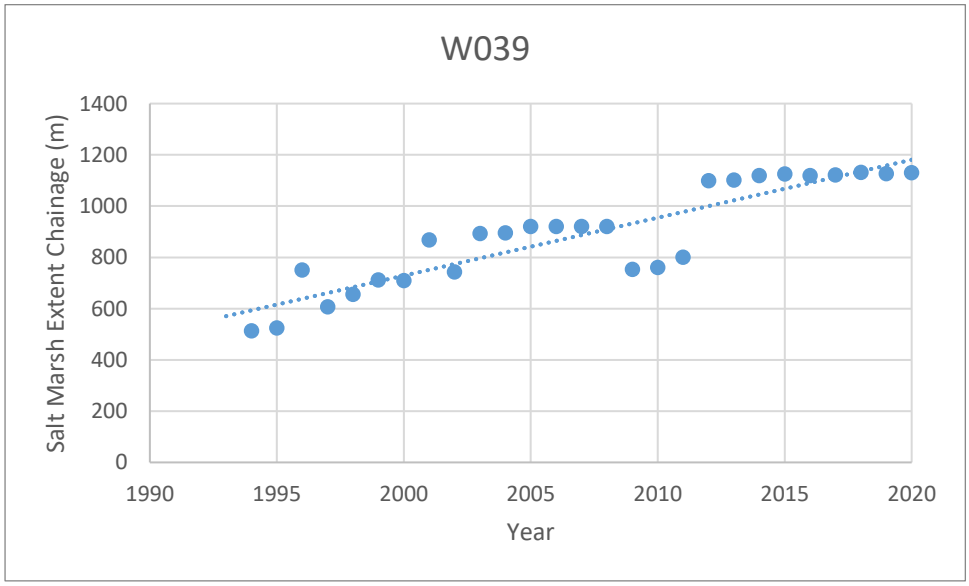

W035
Salt Marsh Extent Chainage (m)
900
800
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year

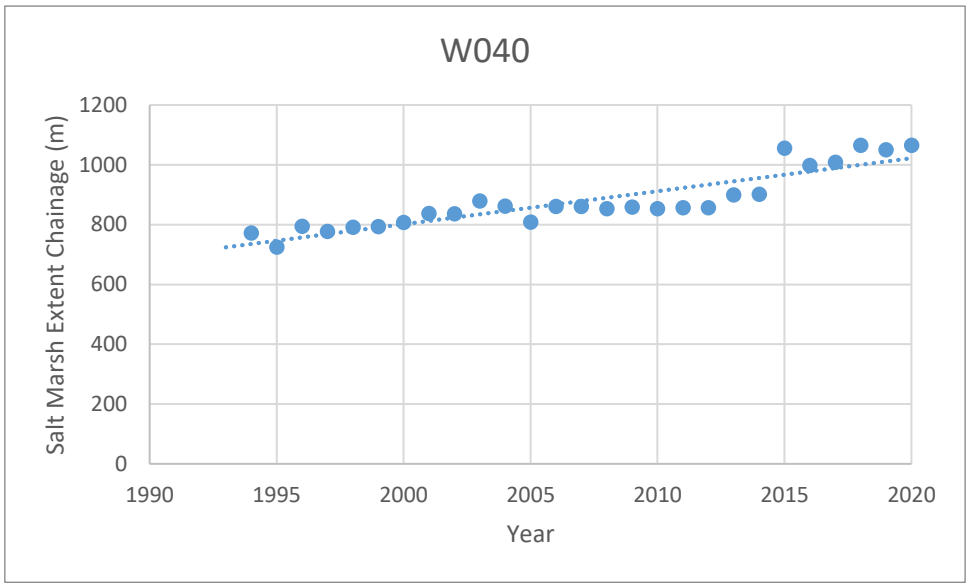

W036
Salt Marsh Extent Chainage (m)
800
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year

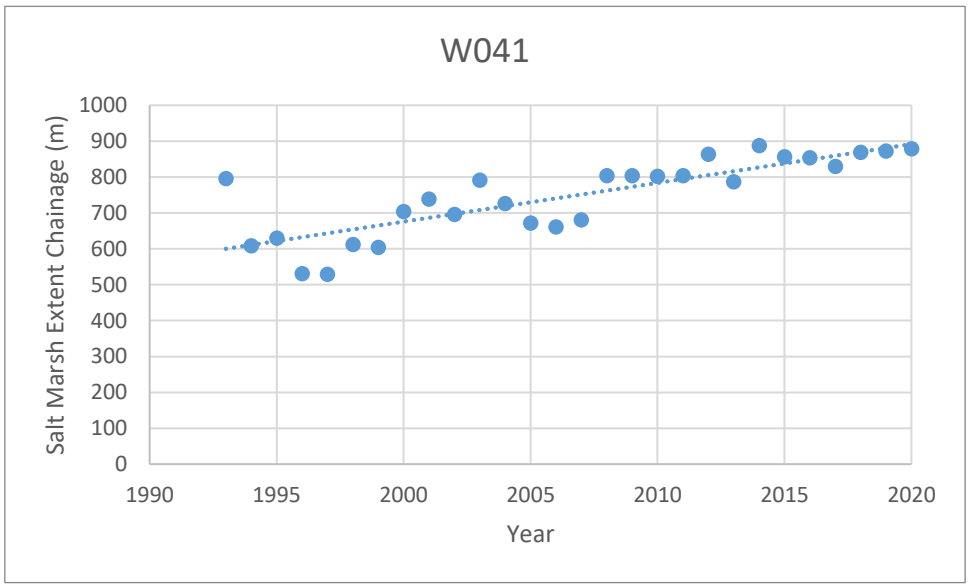

W037
Salt Marsh Extent Chainage (m)
900
800
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year

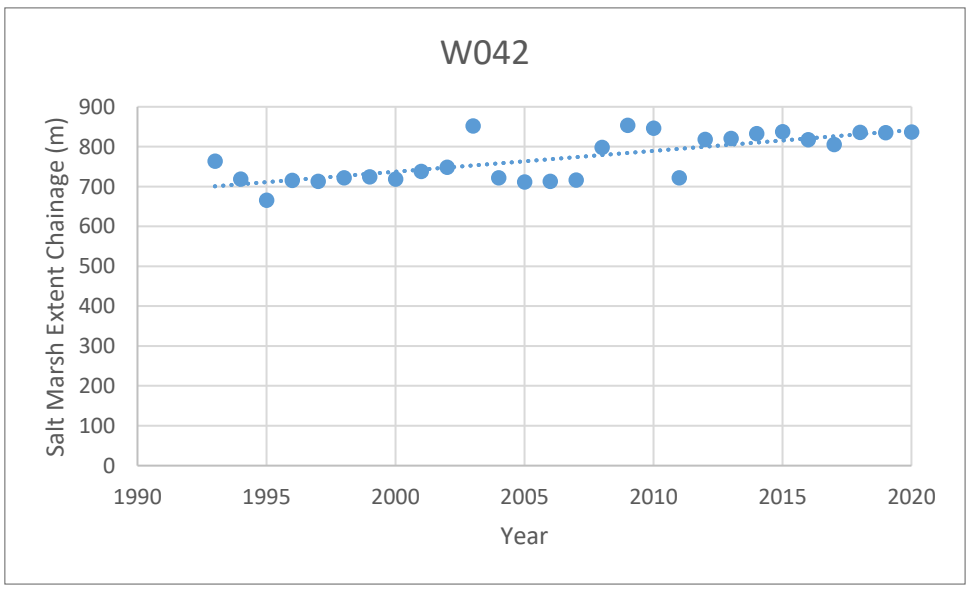
Nene to Wolferton – 2dSU03NW

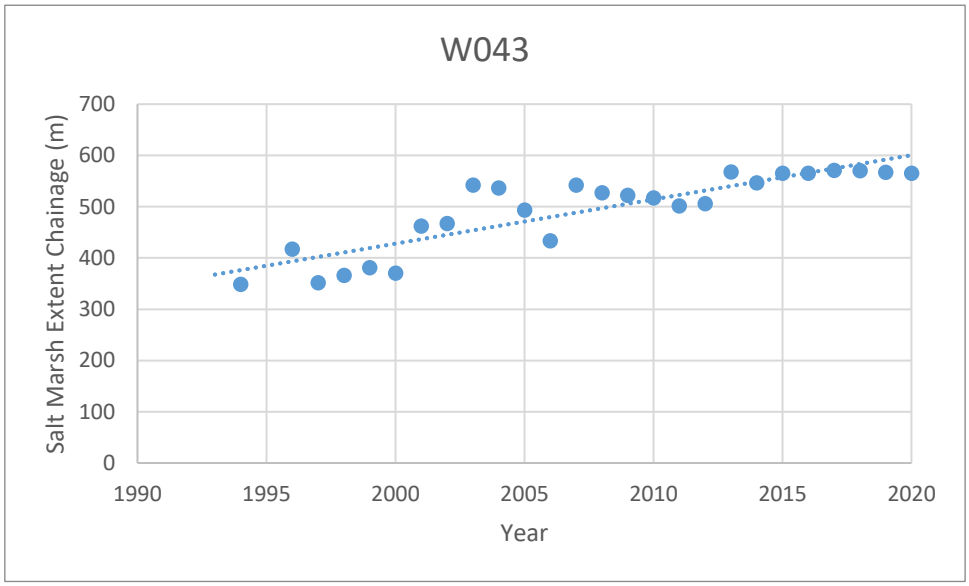


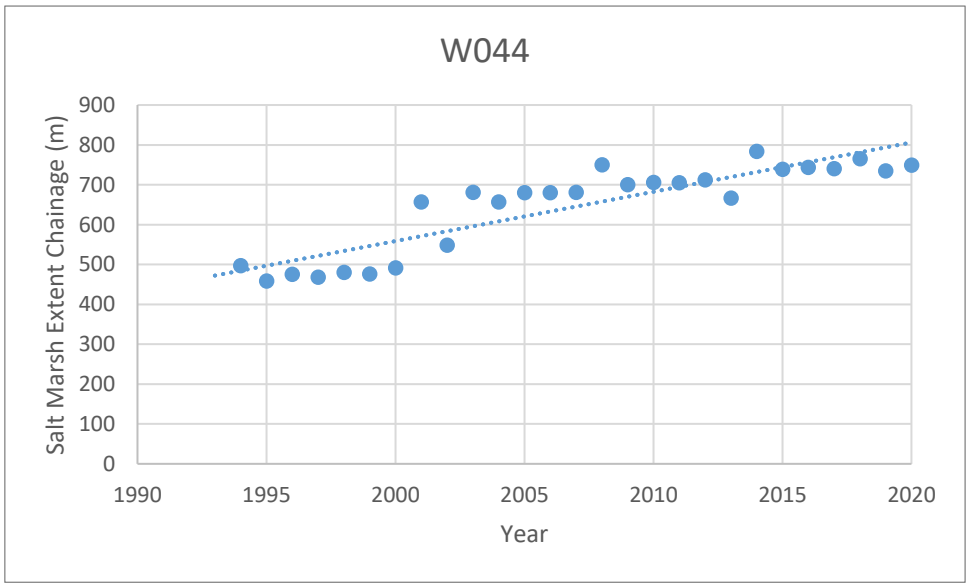


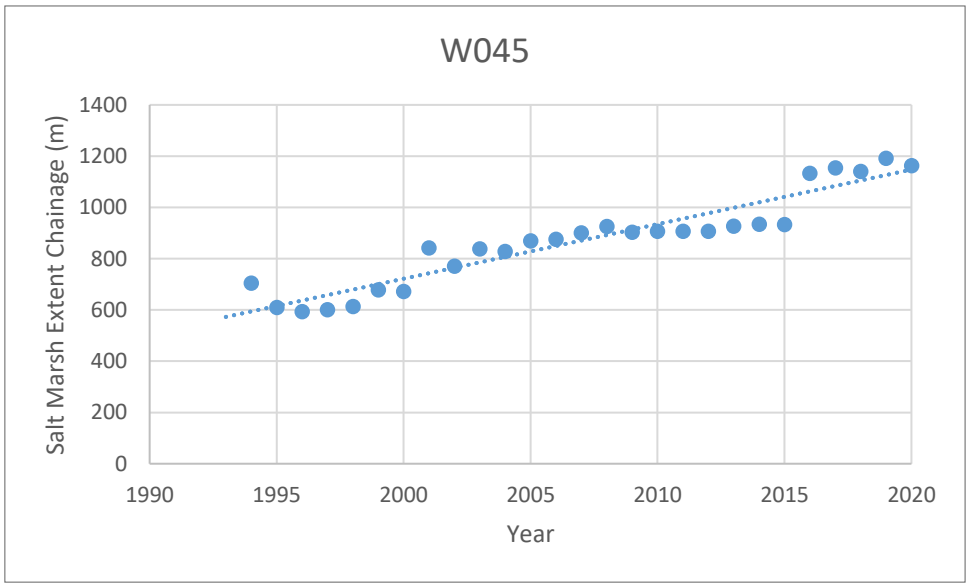

W040
Salt Marsh Extent Chainage (m)
1200
1000
800
600
400
200
0
1990
1995
2000
2005
2010
2015
2020
Year

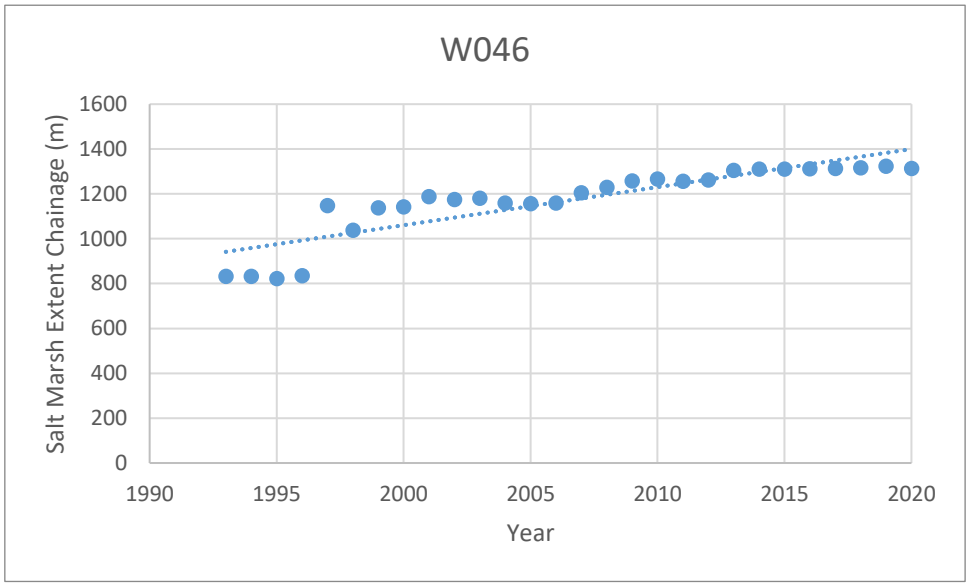

W041
Salt Marsh Extent Chainage (m)
1000
900
800
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year

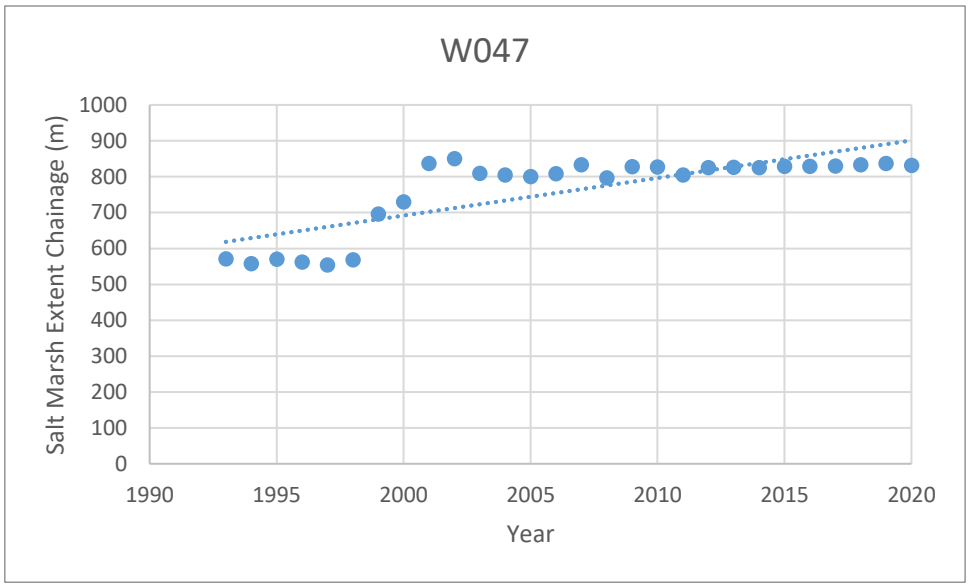

W042
Salt Marsh Extent Chainage (m)
900
800
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year

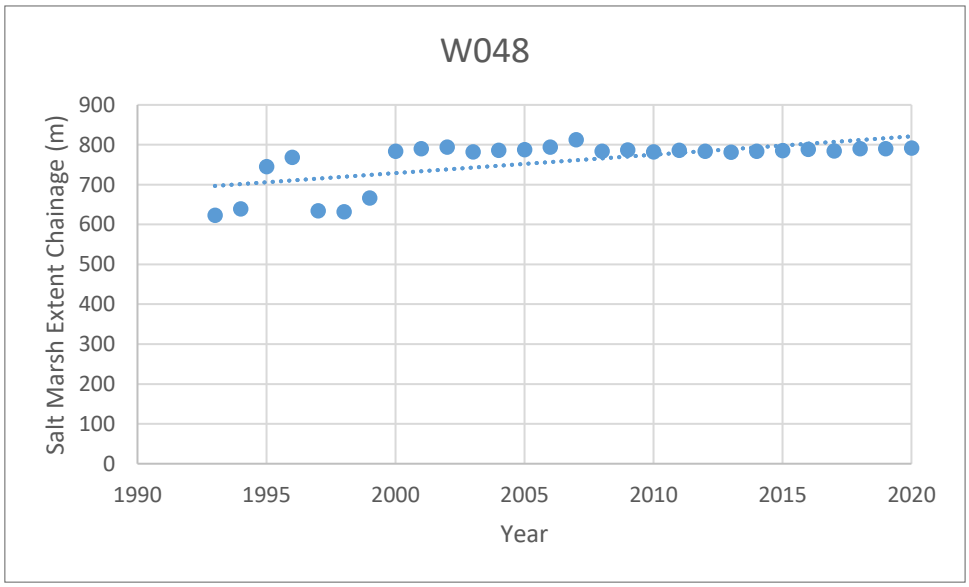

W043
Salt Marsh Extent Chainage (m)
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year

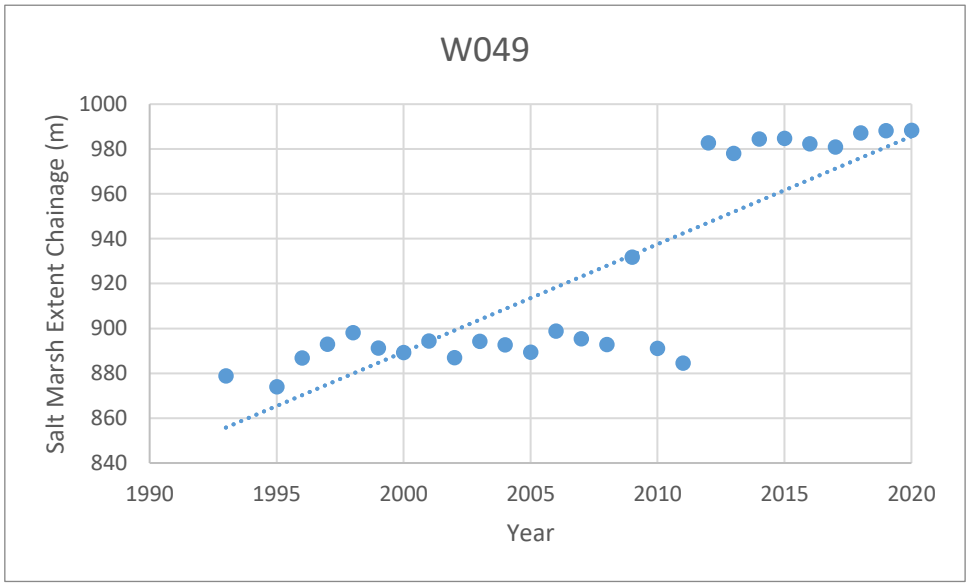

W044
Salt Marsh Extent Chainage (m)
900
800
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year

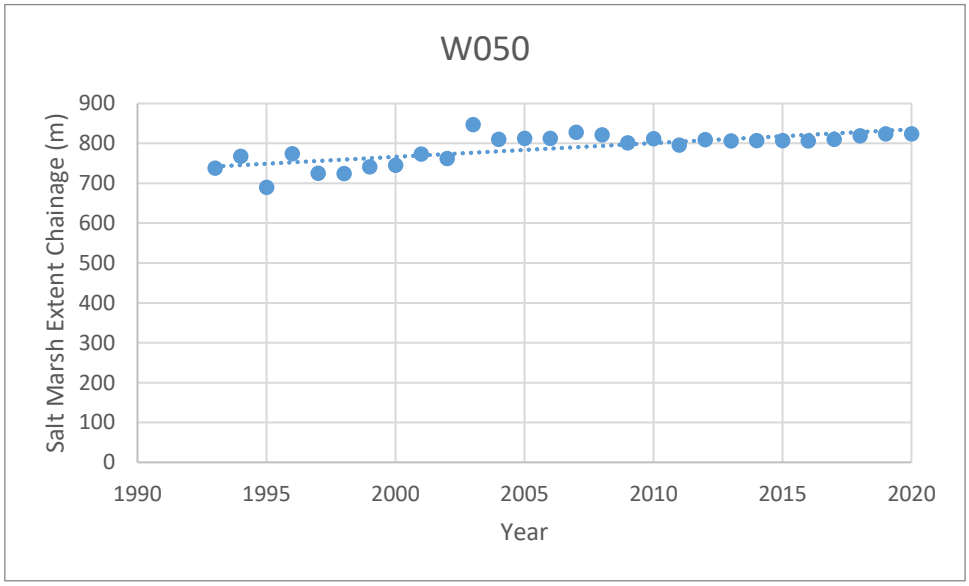

W045
Salt Marsh Extent Chainage (m)
1400
1200
1000
800
600
400
200
0
1990
1995
2000
2005
2010
2015
2020
Year


W046
Salt Marsh Extent Chainage (m)
1600
1400
1200
1000
800
600
400
200
0
1990
1995
2000
2005
2010
2015
2020
Year

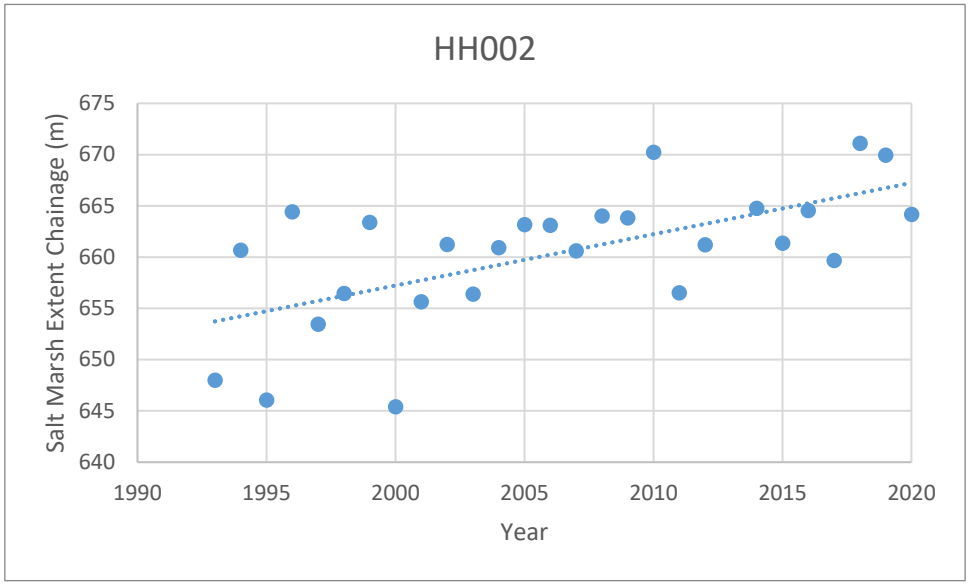

W047
Salt Marsh Extent Chainage (m)
1000
900
800
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year

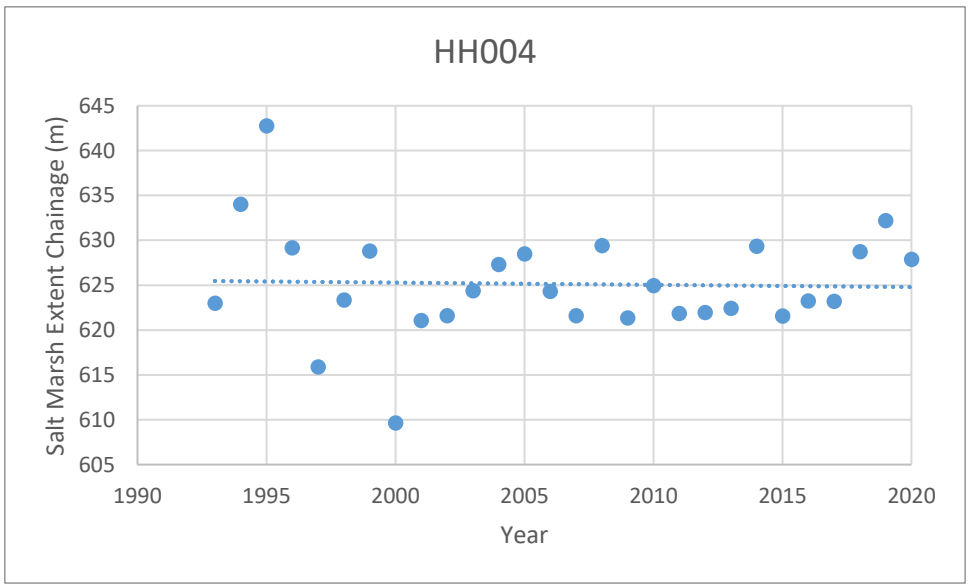

W048
Salt Marsh Extent Chainage (m)
900
800
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year

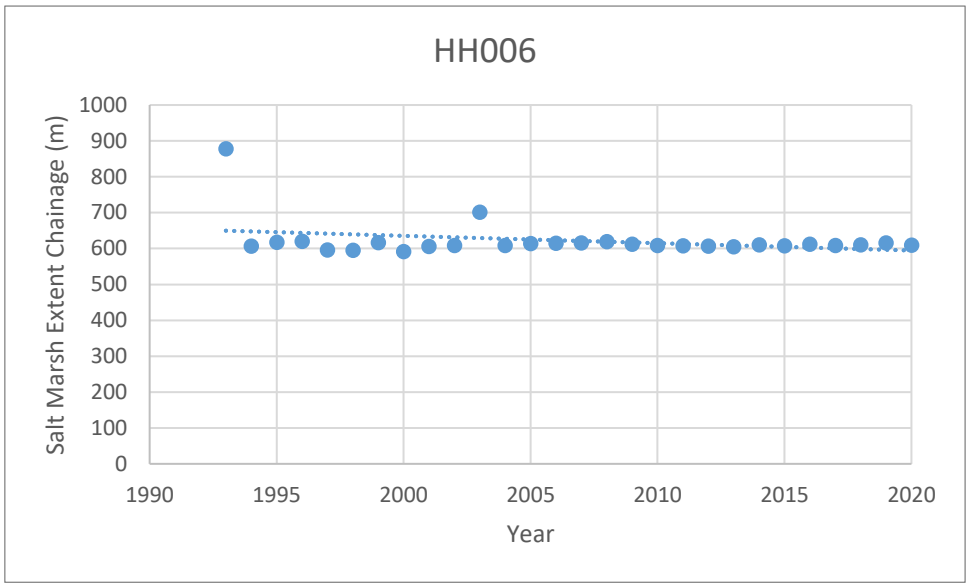

W049
Salt Marsh Extent Chainage (m)
1000
980
960
940
920
900
880
860
840
1990
1995
2000
2005
2010
2015
2020
Year

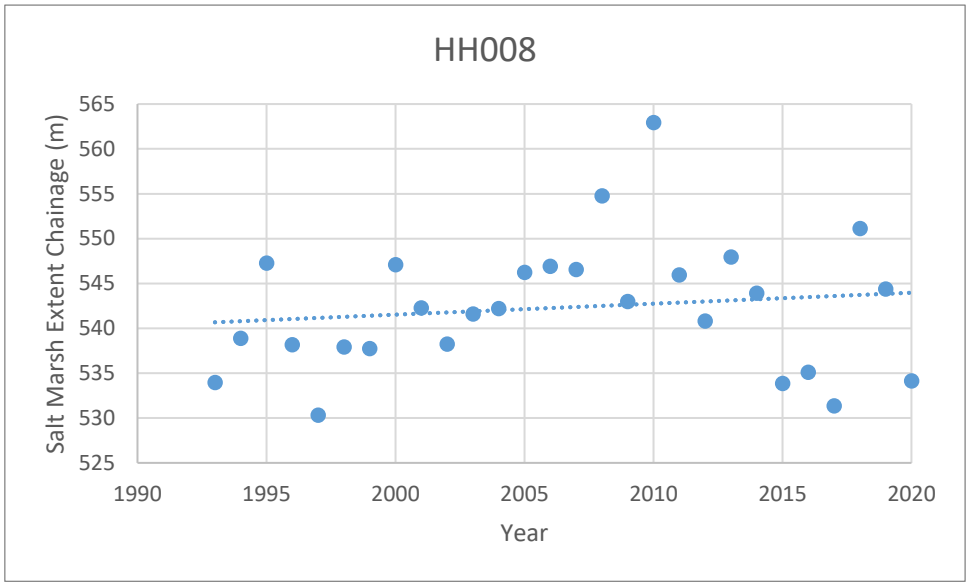

W050
Salt Marsh Extent Chainage (m)
900
800
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year

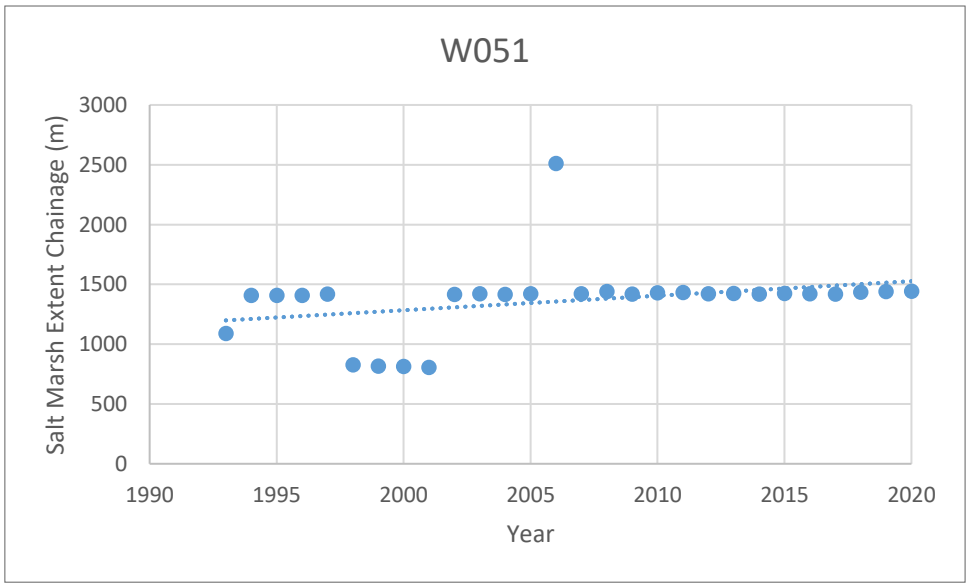
Hunstanton to Heacham – 2dSU04HH






HH006
Salt Marsh Extent Chainage (m)
1000
900
800
700
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
Year


HH008
Salt Marsh Extent Chainage (m)
565
560
555
550
545
540
535
530
525
1990
1995
2000
2005
2010
2015
2020
Year


W051
Salt Marsh Extent Chainage (m)
3000
2500
2000
1500
1000
500
0
1990
1995
2000
2005
2010
2015
2020
Year