SOUTH WEST COASTAL MONITORING

making space for sand



Making Space for Sand – Marazion Beach Report

Topographic and LiDAR Data Analysis

SWCM TBR13 15/04/2024

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Taken by: Joseff Saunders

Summary

This report utilises Light Detection and Ranging (LiDAR, topography and aerial imagery data collected by the South West Coastal Monitoring (SWCM) Programme to analyse beach and dune volume at Marazion. The aim is to highlight coastal change at Marazion using SWCM data since 2007, focusing on beach and dune areas categorised into four zones: Beach, Mobile, Fixed, and Developed. Marazion is a large, southwest-facing sandy beach with a low tide terrace formation, forming the eastern extent of Mount's Bay, backed by a series of sea defences and a small dune system. Topographic data collected bi-annually along fixed cross-shore profile lines are presented to indicate change of the intertidal beach area over time. LiDAR data is compared from each available flight to show difference models of the intertidal area, to compare volumetric data over time and to show change in Mean Seal Level and Dune Toe contours over time.

Since 2007, 34 topographic surveys were conducted at Marazion, including 4 baselines and 30 interim surveys. Analysis of topographic data suggests the survey unit has gradually and consistently accreted between 2007 and 2023. Notable fluctuations were observed, with the lowest combined area recorded in 2007 and in 2014 following the 2013/14 winter, however the highest combined area was recently recorded in the autumn of 2022.

Beach volume extracted from 8 LiDAR flights between 2008 and 2022 within the Mobile Zone showed no significant trend for accretion or erosion despite large fluctuations (<8%) between surveys. Unlike many Mobile Zones around Cornwall, the highest volume recorded was following the 2013/14 storms, however there was considerable loss of beach material and vegetation from isolated areas of the fore dune. Beach Zone change between 2008 and 2022 showed a similar trend of gradual accretion as the topographic data, despite showing large fluctuations between surveys. The lowest volume, recorded in September 2009, saw a 22% loss from the previous survey in December 2008. The MSL and dune toe contours have remained stable, with fluctuations mainly attributable to fluvial influence.

Overall Marazion beach has seen gradual accretion between 2007 and 2023, however there have been losses of dune vegetation following the 2013/14 and 2019/20 winters.

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1.0 Introduction

The aim of this report is to highlight beach and dune change at Marazion using data collected as part of the South West Coastal Monitoring (SWCM) Programme since 2007. Four zones have been identified to define the beach/dune area and are defined as:

- **Beach Zone** – The wet beach area has been defined using Mean Low Water Spring (MLWS) and Mean High Water Spring (MHWS) contours extracted from all LiDAR data captured by SWCM. The Beach Zone will therefore encompass the area between the MHWS and MLWS contours, with volumes for this area extracted from each LiDAR surface.
- **Mobile Zone** – This area is defined as the active dune face and embryo dune[1] from MHWS +1 m to the back of the mobile area, often distinguished by vegetation depth or urban development. The Mobile Zone has been defined using aerial imagery from 2007 to 2021 and historic OS maps and has been verified through site visits.
- **Fixed Zone** – This area is defined by permanent dune vegetation that may also include scrub or invasive species, effectively denoting vegetation atop sandy soil.
- **Developed Zone** – This is defined as urban development areas (i.e., car parks, unnatural grassy areas, roads, houses etc.) which have been built atop previously present dune systems.

1.1 Study Site

Marazion is a southwest facing low tide terrace formation, forming the eastern extent of Mount's Bay, backed by a series of sea defences and a small dune system to the northwest (Fig.1). The beach is confined by St. Michael's Mount to the southeast and by Mounts Bay beach to the northwest and has a cross-shore distance of 270 m and longshore distance of 860 m with an average Spring tidal range of 4.8 m.

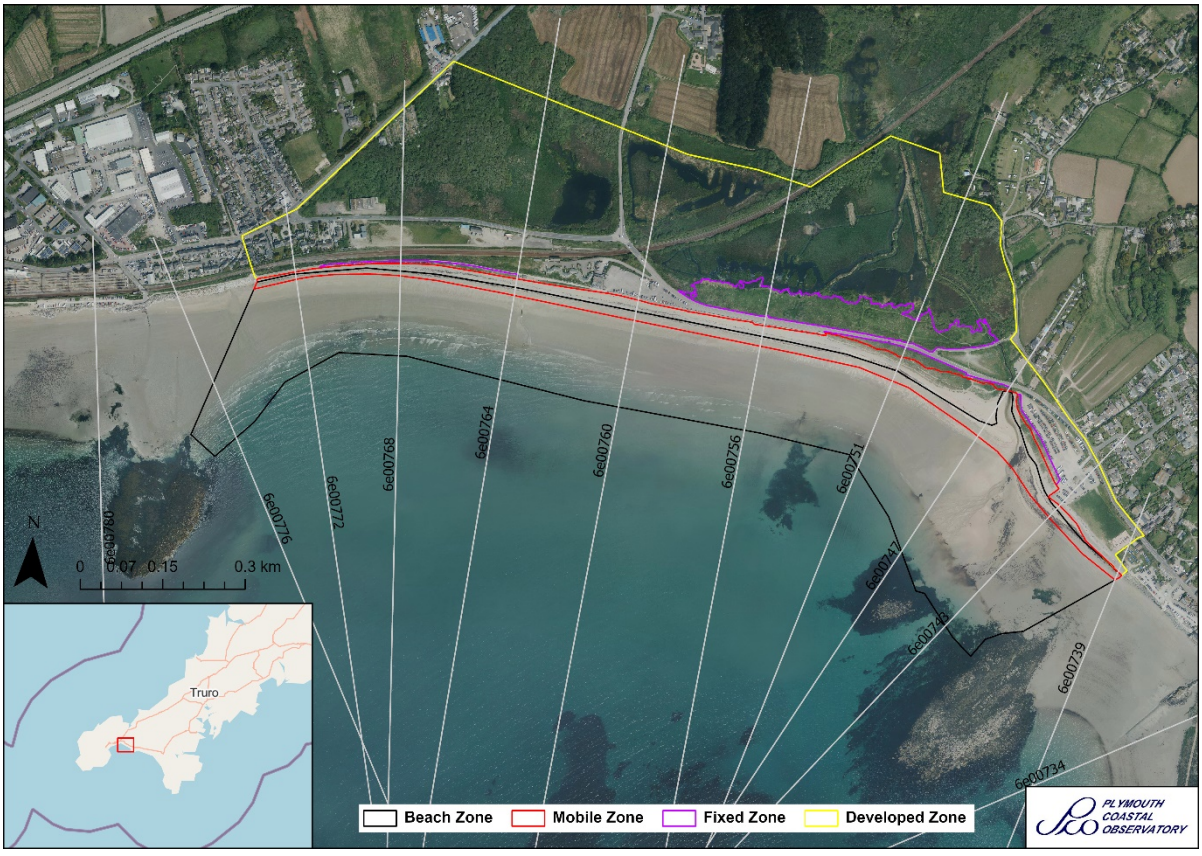


Figure 1 - Location Map of Marazion Beach and Dune System, indicating the four defined zones outlined in section 1.0. Interim topographic profiles are also overlain to show their location, as detailed in section 2.1

[1] An embryo dune, or yellow dune, is the earliest stage of dune growth, usually found along the seaward extent of a dune system or newly formed dune.

2.0 Methods

Data utilised in this report was collected by SWCM between 2007 and 2024. Information on topographic and LiDAR data collection and specifications can be found on the Website for the National Network of Coastal Monitoring Programmes.

2.1 Topographic Data

SWCM have undertaken routine topographic beach surveys at 34 of the 40 MS4S sites since 2006. All surveys are conducted from the MLWS contour to the backshore. On average, each surveyed beach receives two interim surveys a year and one full coverage survey every 5 years:

- Interim - Conducted twice a year in the spring (conducted between January and April), and autumn (conducted between September and December). An interim survey consists of collecting data points at 5m intervals along pre-defined profiles; these are outlined in Figure 1.
- Full coverage – Conducted once per phase (6 years), or annually at more vulnerable sites (conducted between May and September). Full coverage surveys include a full profile survey at 50 m intervals and continuous spot height data collected across a 5 m grid covering the whole beach.

Analysis of the Cross-Sectional Area (CSA) change is conducted for each individual profile between each separate survey. Changes in CSA are measured relative to the fixed master profile which is defined by a pre-determined stable landward position and the MLWS level in reference to Ordnance Datum.

2.1.1 Topographic Data Analysis

Topographic data is presented as the following, where applicable:

Trend Analysis Plot - The combined profile trend in CSA is presented for each survey unit (example shown in Fig.2). The sum of all interim profile CSA is combined for each survey conducted to date to provide a survey unit with a single 'beach area' value, known hence-forth as the Combined Profile Area (CPA). CPA is compared using linear trend analysis over a temporal scale (Fig.2).

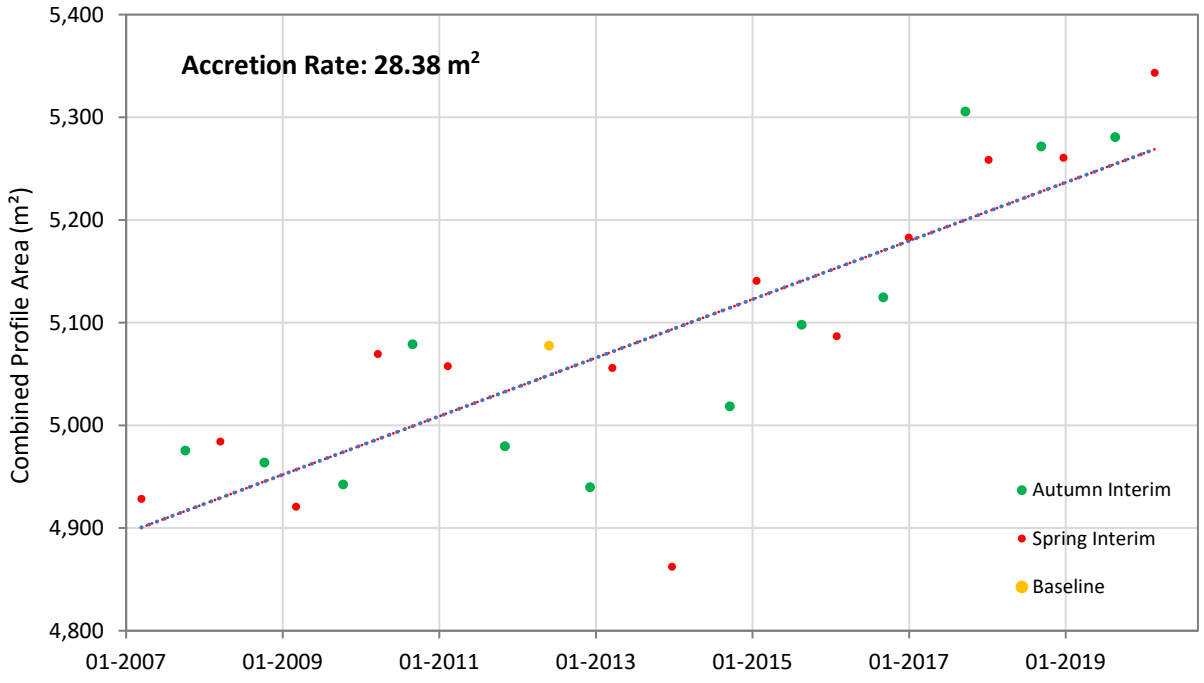


Figure 2 - Example of trend analysis for CPA for each survey with a linear trend rate highlighted at 28.4 m^2 y^{-1} equating to the increase of 0.56% of the average CPA per year.

If a profile has been omitted from a particular survey, for reasons of obstruction or similar, the average CSA of that profile from all available surveys is taken to ensure a consistent 'beach area'; if fewer than 75% of surveys have been conducted for a particular profile, the profile is omitted.

Profile Extremes Analysis - This plot displays the range of CSA values recorded throughout the duration of data collection (2006-2024) for each individual interim profile; the most recent survey is represented as a green dot. An example is given in figure 3. This plot provides the reader with information on how the CSA for each interim profile from the most recent survey corresponds to the entire dataset range.

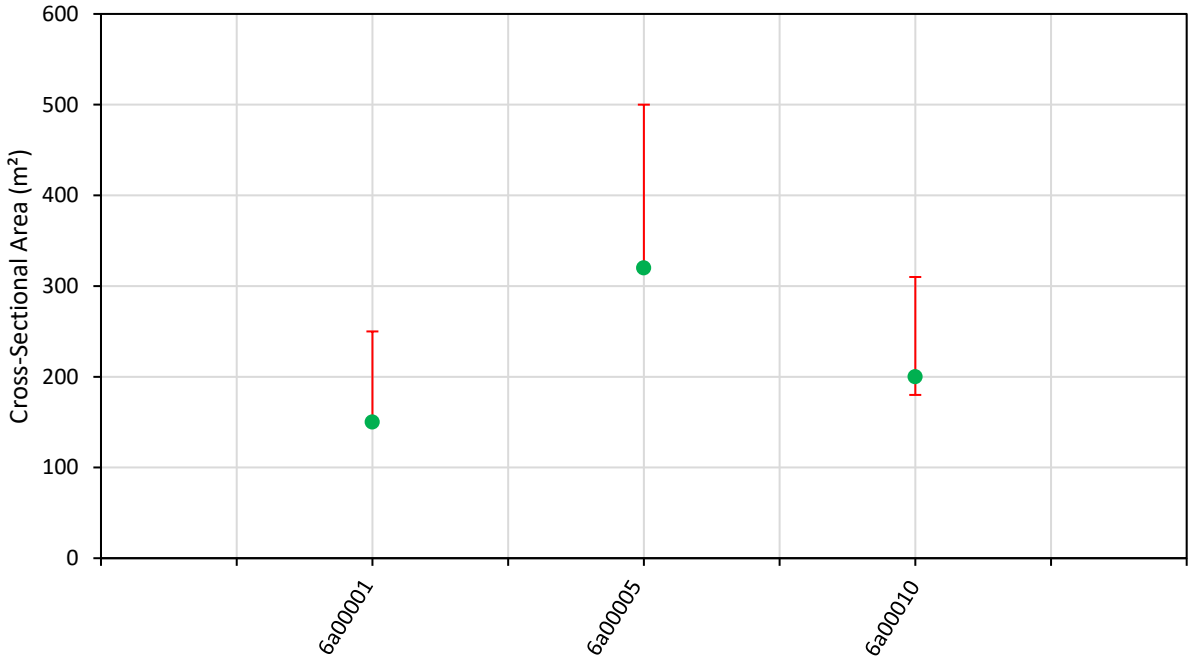


Figure 3 - Example plot showing the most recent CSA value recorded for three separate profile lines (green dots). The error bars represent the range of CSA recorded by each profile throughout the topographic dataset.

CSA Time Series Plot - CSA measurements for each interim profile are displayed on a separate plot representing values from each interim and full coverage survey conducted to date (example shown in Fig.4). This provides the reader with information on each interim profile's CSA evolution through time.

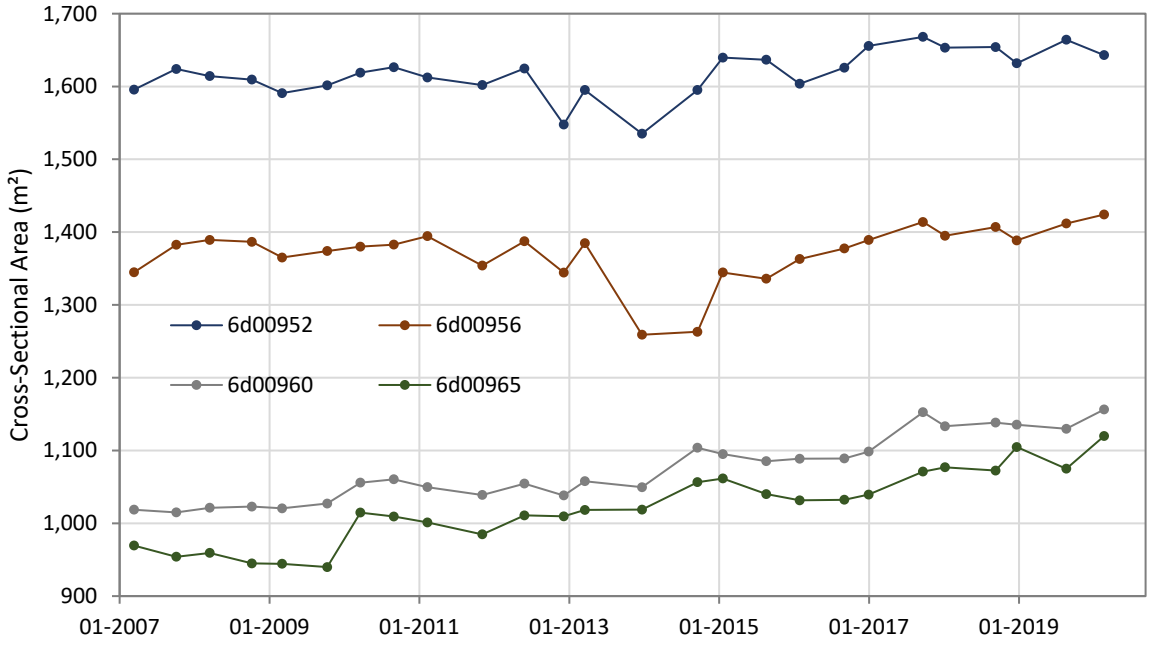


Figure 4 - Example of a cross-sectional area plot showing each of the interim profiles recorded for every survey since the 2007 baseline.

Individual Profile Charts - Each interim profile is portrayed as a cross-sectional profile comparing the most recent spring interim (blue), the previous spring interim (green) and the original full coverage survey (red). Profiles are displayed against the master profile (dotted red line) and are presented in the Appendices.

The 2013/2014 Storms – The winter period between September 2013 and April 2014 was, for many beaches in Cornwall, the most destructive period since SWCM records began in 2007. An abnormal number of significant storms, occurring in quick succession, heavily impacted many beaches, causing the loss of sediment from the intertidal area and dune face. This period is extensively discussed throughout this report and will hereinafter be referred to as the 2013/2014 winter period.

2.2 LiDAR Data

Airborne Light Detection and Ranging (LiDAR) data have been captured as part of the SWCM since 2007. Products include a point clouds, from which filtered and unfiltered 1 m^2 gridded surface models are derived:

- Unfiltered (Digital Elevation Model) representing the earth's surface including natural and artificial features such as trees and buildings.
- Filtered (Digital Terrain Model) representing the bare earth surface, with trees, buildings, cars etc. removed.

LiDAR is captured between September and March to minimise vegetation capture. Data is captured between MLWS and up to approximately 500 m inland. This report utilises "filtered" LiDAR data.

2.2.1 LiDAR Data Analysis

LiDAR data analysis is presented as the following:

Difference Modelling – Separate LiDAR surfaces are compared to produce a difference model of change based on gridded spot height elevations. The raw spot height data is processed into a gridded digital terrain model (DTM) and successive models are subtracted from one another to produce a difference model for the survey unit. Change in elevation is shown for values +/- 0.25 m and is represented by a colour scale bar.

Volume Extraction - Net sediment volume (m^3) is extracted for each LiDAR surface from the Beach Zone above MLWS and Mobile Zone above MHWS for trend comparison over time.

Contour Analysis – Contours are mapped from four LiDAR epochs spanning from 2007 to 2023, representing Mean Sea Level (MSL) and dune toe (calculated using the Stockdon equation by UoP, 2023[2]).

2.3 Accuracy Statement

Topographic Data – All survey points recorded along profiles have a measurement accuracy of +/- 0.03 m RMSE[3] in the horizontal and +/-0.03 m RMSE in the vertical.

LiDAR Data – Each LiDAR point cloud dataset has an average point density of 1.5 points per square metre. The digital terrain surfaces provide a minimum accuracy in elevation data of +/- 0.10 m RMSE with a minimum horizontal standard deviation as < 0.05 m. Please note that while every endeavour has been made to capture LiDAR as far seaward as MLWS, tidal and weather restrictions may in some instances have precluded this and coverage may be slightly reduced.

[2] Please refer to the following for Dune Toe elevation calculation: UoP, 2023. MS4S: Contemporary Dune Evolution and Future Predictions, Report, University of Plymouth, 33 pp.

[3] RMSE – Root-Mean-Square Error

3.0 Results

3.1 Topographic Data Analysis

There has been a total of 34 topographic surveys at Marazion since 2007, 4 of which are baseline surveys and 30 are interim surveys. Exact dates of each survey for Marazion are available to view on our survey record. Analysis of the CPA indicates the survey unit has been accreting at 11 m^2 y^{-1} equating to a 0.16% increase of the average beach area per year (Fig.5). The second lowest recorded combined area was during the 2014 spring interim, following the highly energetic winter period, which saw a 5% loss from the previous 2013 survey (Fig.5). The beach had recovered to pre-2014 levels by 2018 and has since continued to accrete, recording the highest combined area in autumn 2022 (Fig.5).

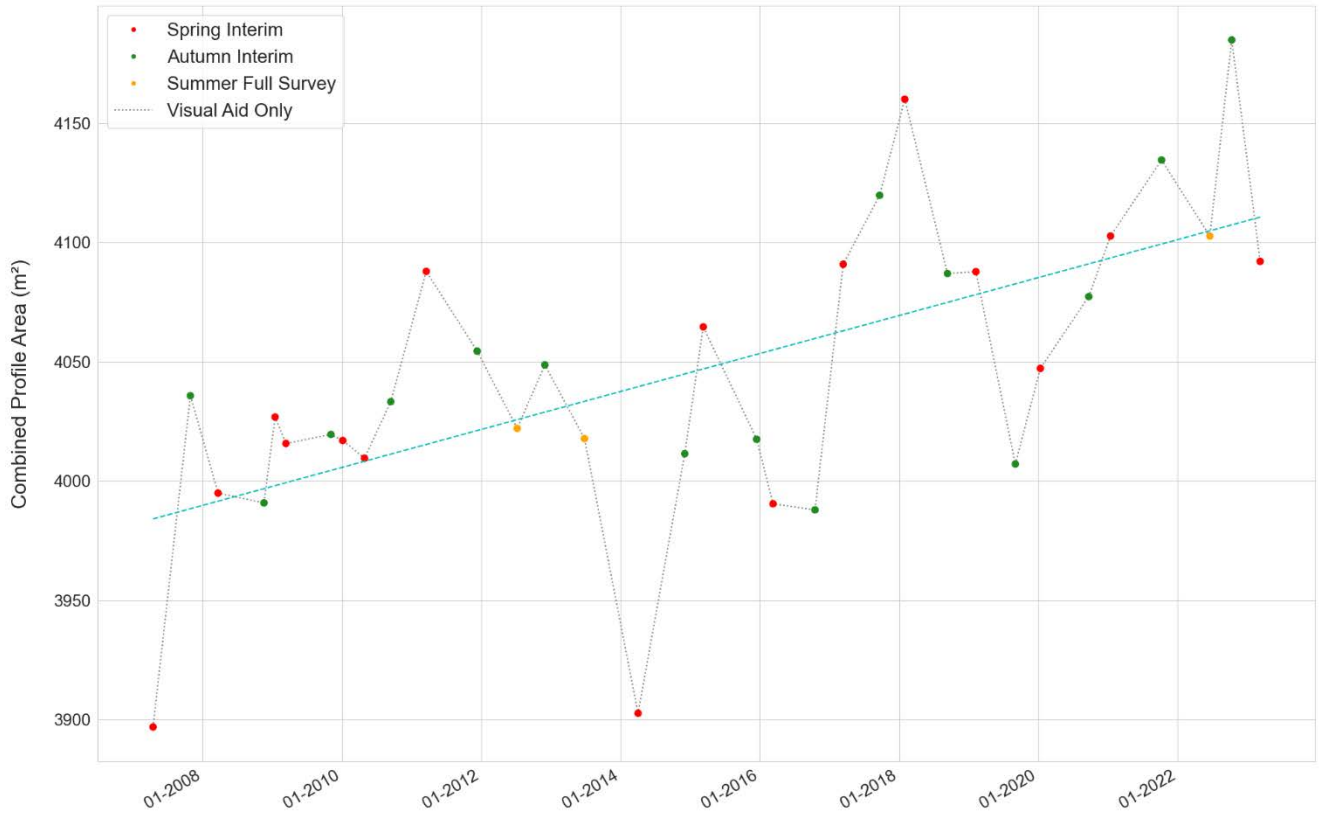


Figure 5 - The Combined Profile Area (CPA) for Marazion, including every spring (red), summer (yellow) and autumn (green) survey completed between 2007 and 2023.

When comparing to the entire dataset (Fig.6), during the 2023 spring interim the majority of Marazion profiles were very healthy with 6e00734, 6e00756 and 6e00768 displaying the highest cross-sectional area to date, only profiles 6e000743 and 6e000780 showed below average areas.

When comparing profile cross-sectional areas to the entire time series (Fig.7a&b), most profiles have displayed continual a gradual accretion of area since 2007 with minimal seasonal variation apparent in any profile. Profiles 6e00776 and 6e000780 showed the highest impact following the 2013/14 winter season, losing considerable material (Fig.7).

Profile Charts for Marazion can be found in Appendix 1, these display the cross-sections of each profile for the initial baseline survey conducted in 2007 along with the two most recent interim surveys.

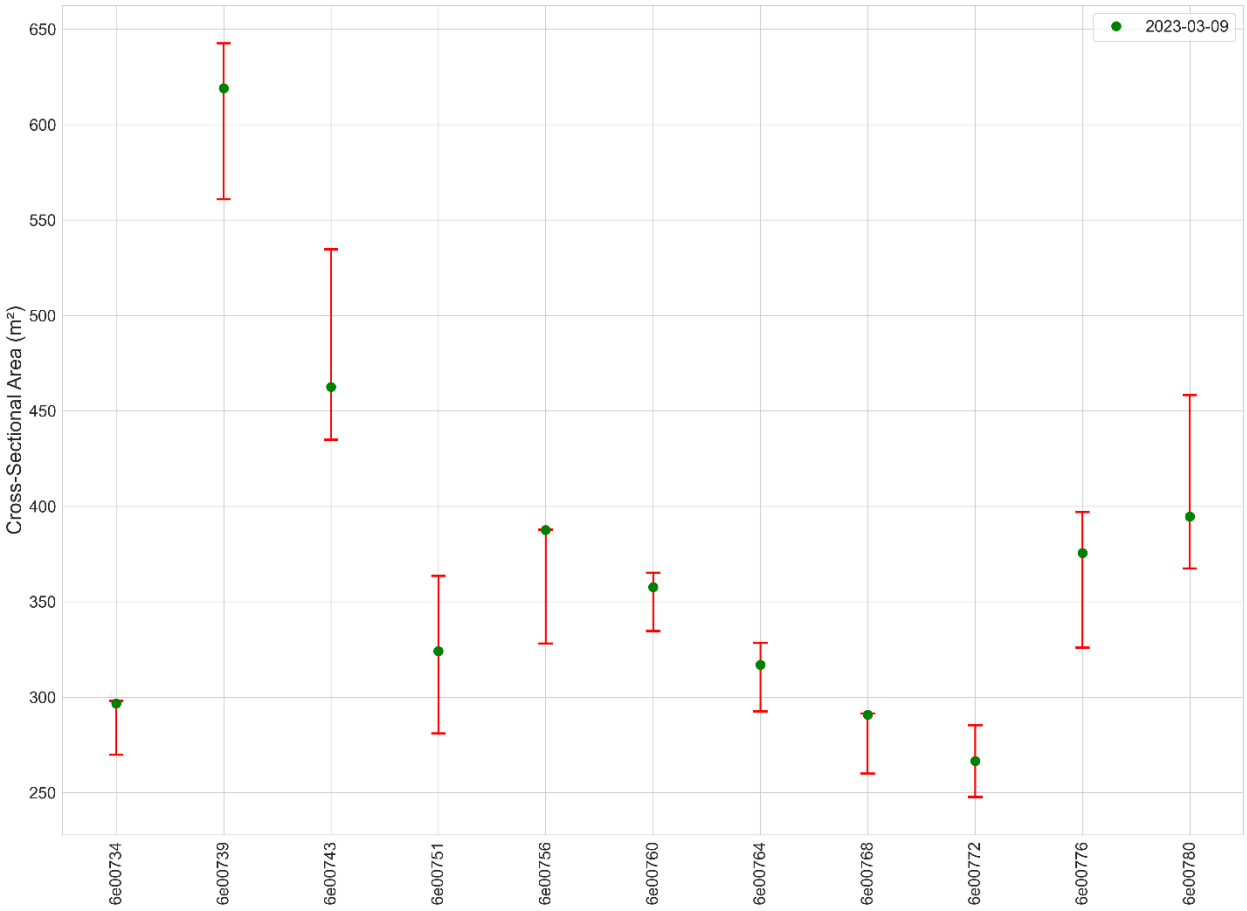


Figure 6 - Cross-sectional area of each interim profile, comparing the current area of the profile (green dot), with the maximum and minimum values (red error bar) recorded between 2007 and 2023.

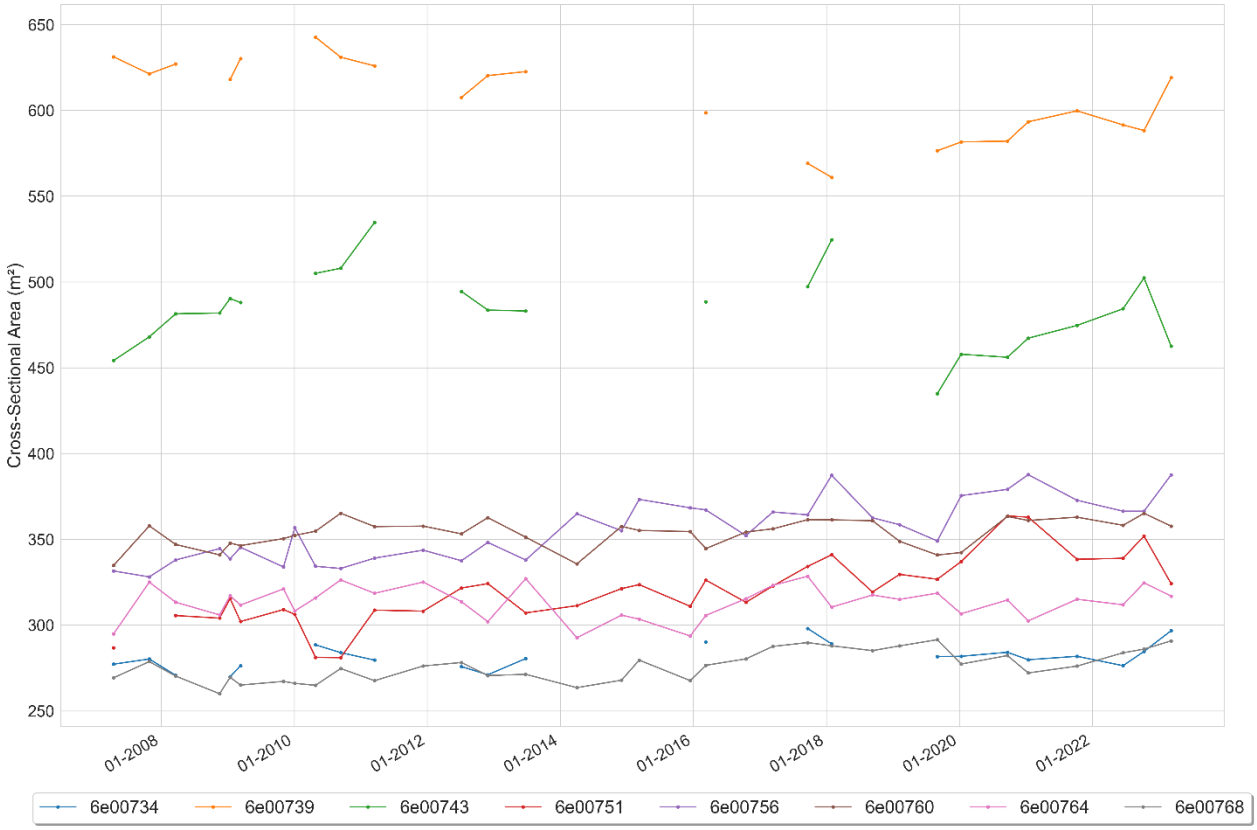


Figure 7a - Cross-sectional area of each interim profile, comparing the values recorded during each interim and baseline survey between 2007 and 2023.

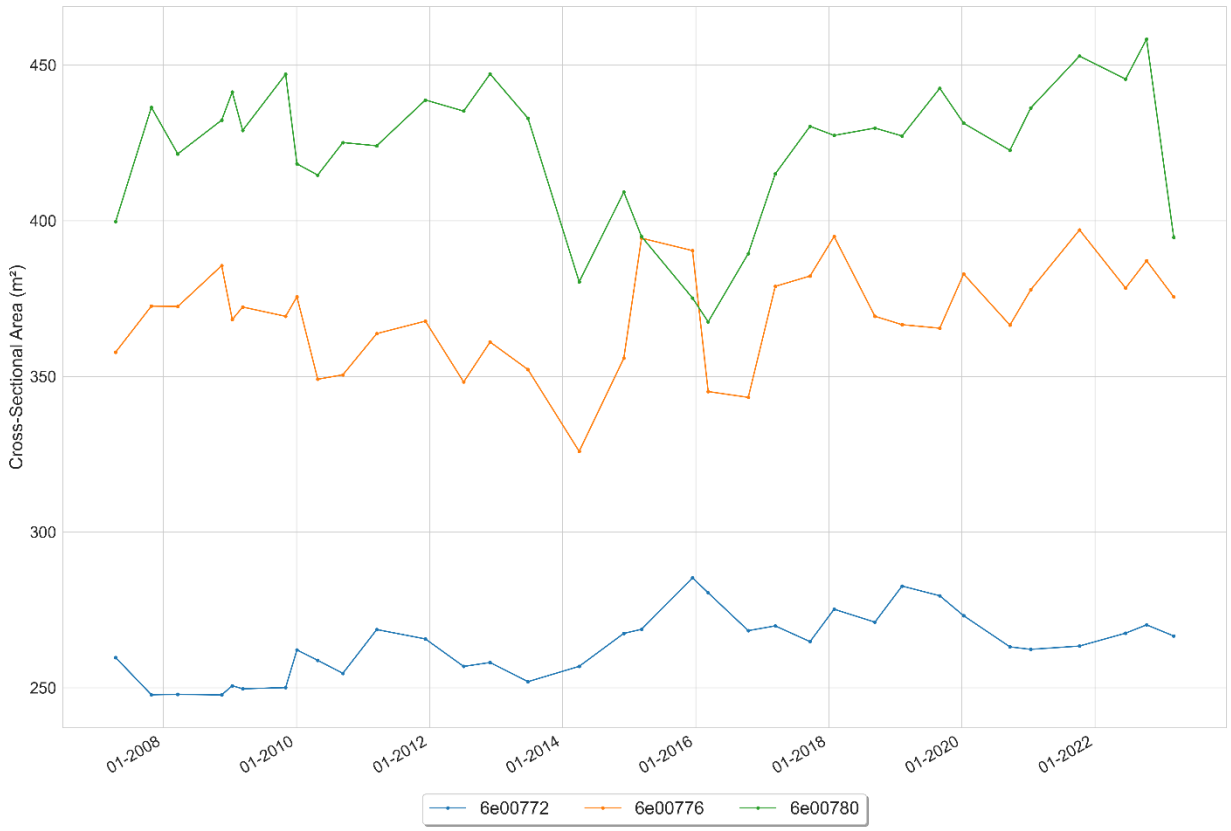


Figure 7b - Cross-sectional area of each interim profile, comparing the values recorded during each interim and baseline survey between 2007 and 2023.

3.2 LiDAR Data Analysis

There has been a total of 8 LiDAR flights captured at Marazion since 2007.

3.2.1 Difference Models

Difference models depicting each epoch of LiDAR are presented here. Accretion and erosion values observed behind the dune system can be attributable to noise in the filtered LiDAR data or man-made changes in elevation and should be dismissed as such.

Figure 8 shows the difference in elevation between the first filtered LiDAR data from April 2007 compared to the most recent, captured in October 2022. The beach is dominated by accretion of up to 1.5 m in elevation, which is predominantly concentrated in front of the dune system to the east. There is substantial erosion observed along the dune toe to the east of the beach, and a considerable amount of the dune system has retreated to the west of the small stream, losing up to 2.5 m in elevation in places.

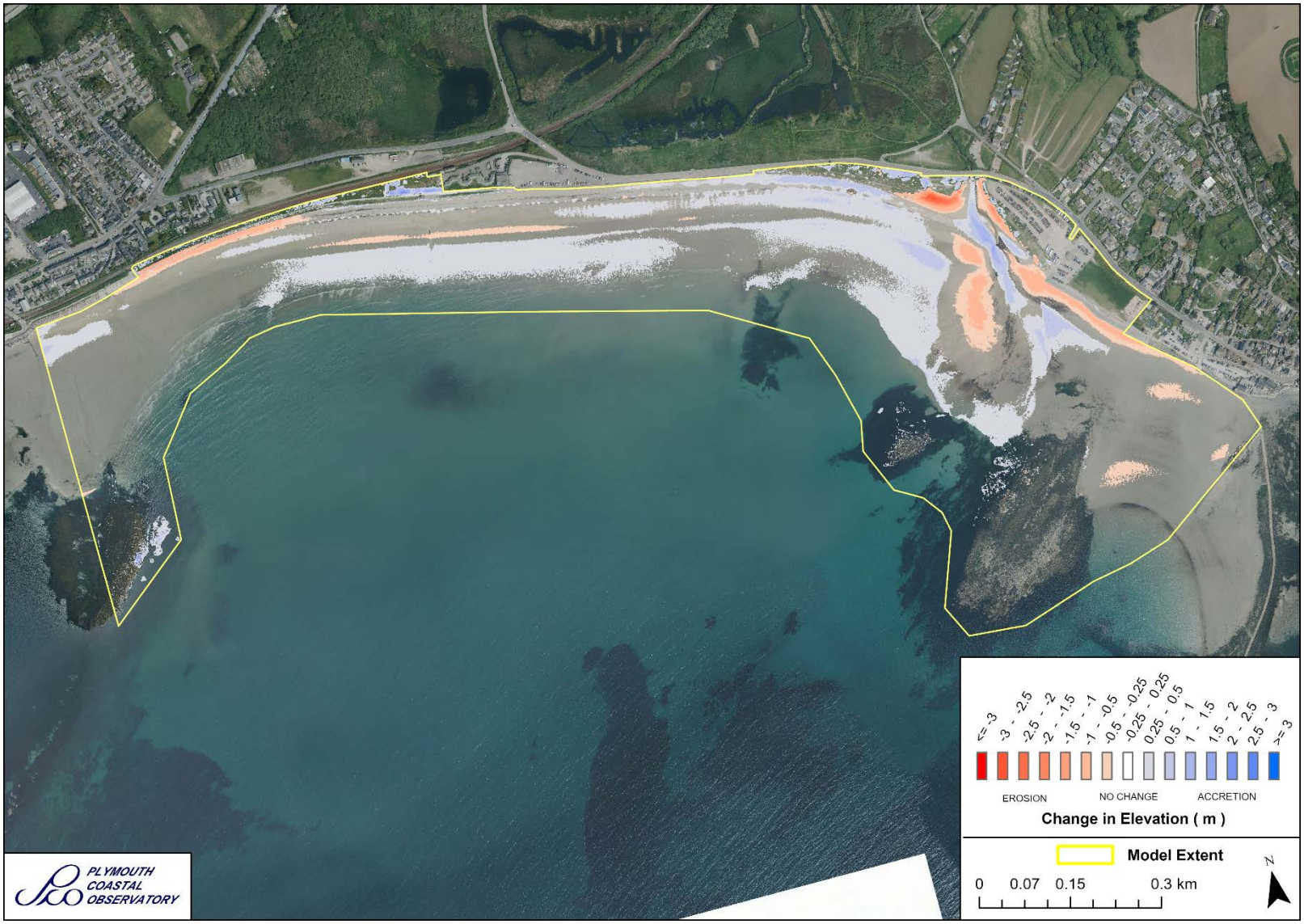


Figure 8 – Difference model indicating the changes in elevation observed between the April 2007 and October 2022 filtered LiDAR datasets within the yellow model extent.

Figure 9 shows differences in elevation between filtered LiDAR data from April 2007 compared to September 2007. As expected from the relatively short period between datasets, there is limited change observed between the spring and autumn of 2007 with the primary changes occurring near the stream exit which can be attributed to fluvial influence.

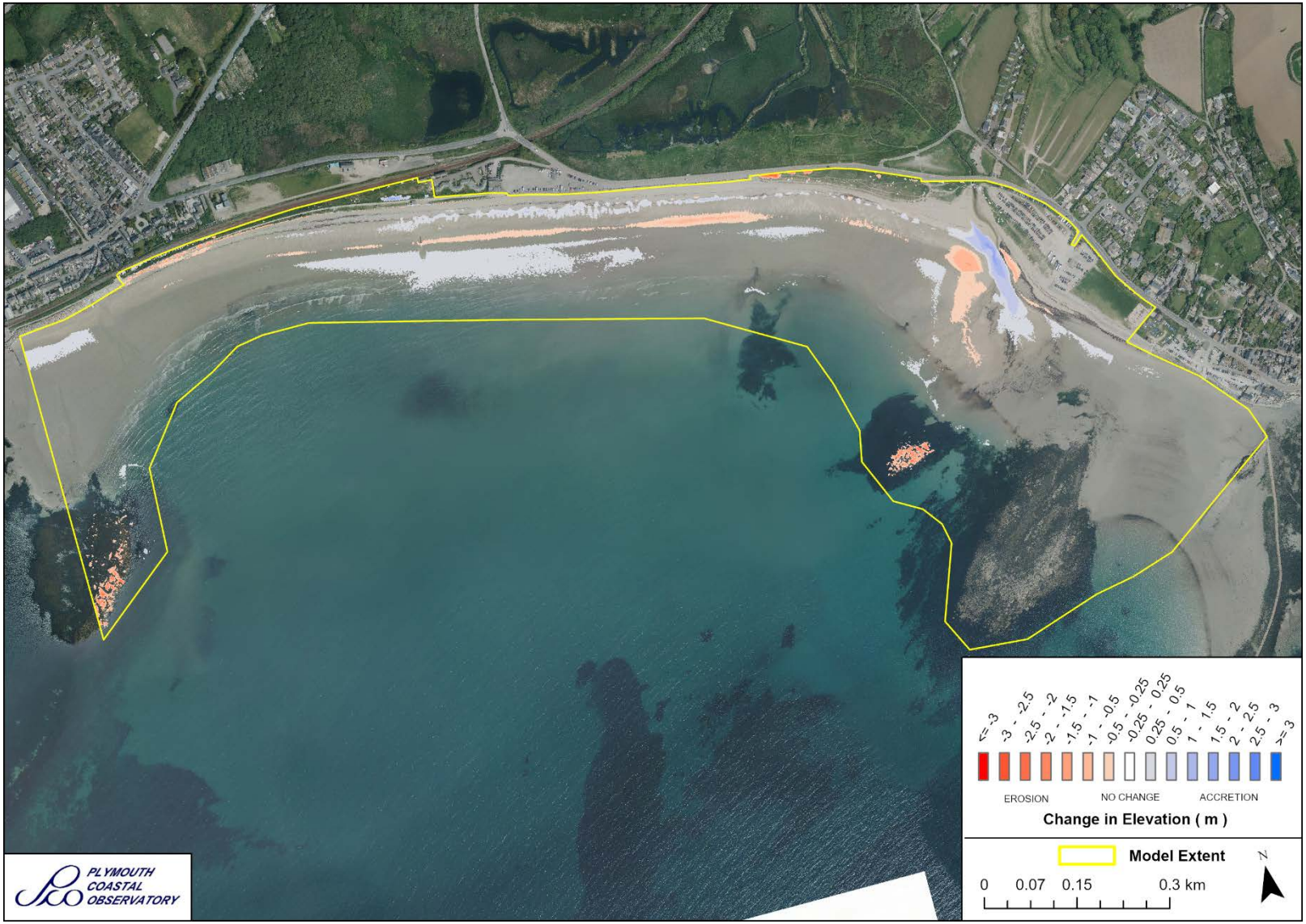


Figure 9 - Difference model indicating the changes in elevation observed between the April 2007 and September 2007 filtered LiDAR datasets within the yellow model extent.

Figure 10 shows differences in elevation between filtered LiDAR data from September 2007 compared to December 2008. Again, there is limited accretion or erosion noticeable with the primary areas of change associated with the stream. A narrow and inconsistent band of erosion can also be observed along the upper beach face across most of the beach to the west of the dune system.

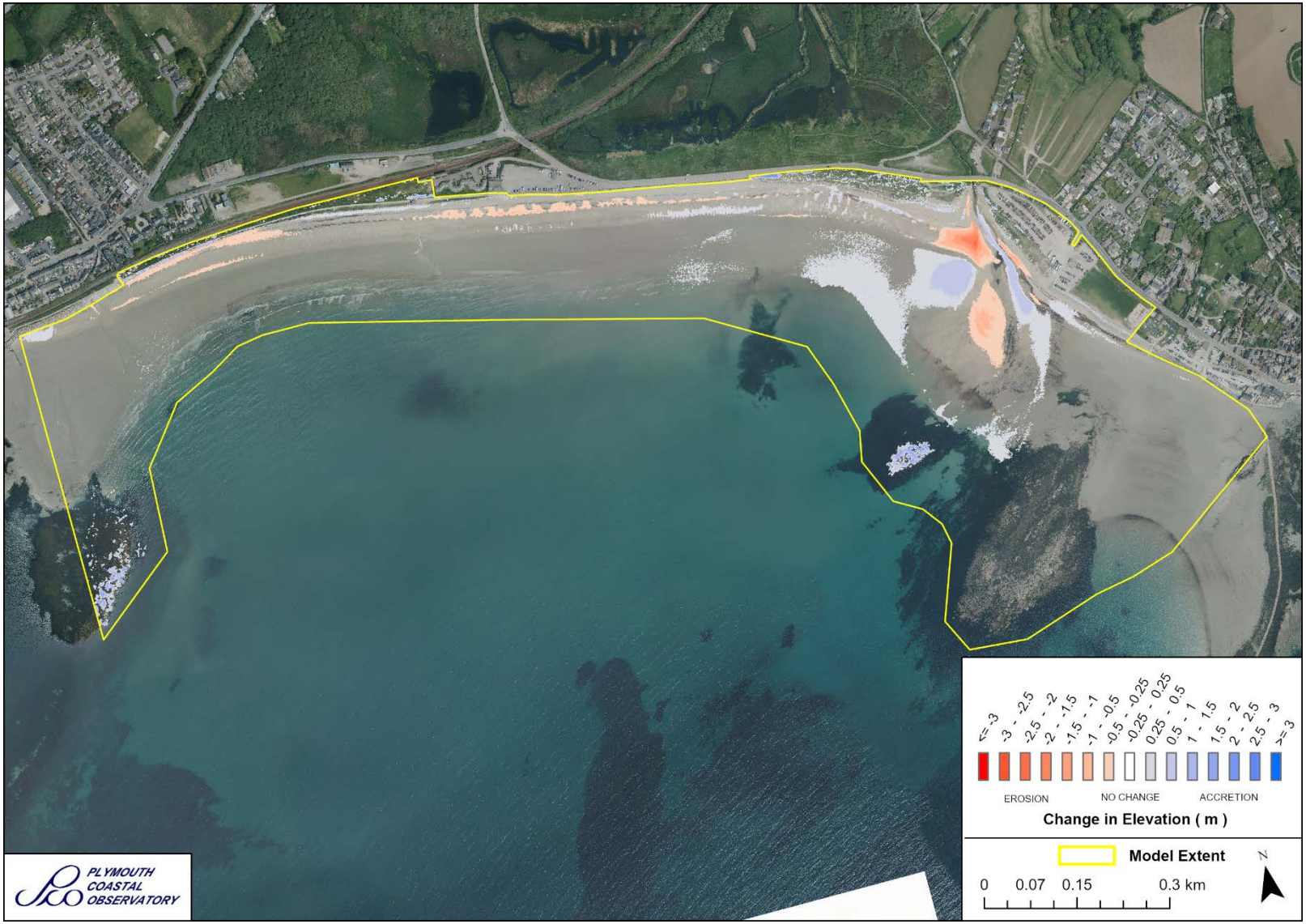


Figure 10 - Difference model indicating the changes in elevation observed between the September 2007 and December 2008 filtered LiDAR datasets within the yellow model extent.

Figure 11 shows differences in elevation between filtered LiDAR data from December 2008 compared to September 2009. The difference model suggests the beach is dominated by erosion, with considerable material lost from the beach toe, in front of the car park and more importantly, from the dune toe and dune face. Moderate levels of accretion can be observed at the mouth of the stream, again attributable to fluvial processes.

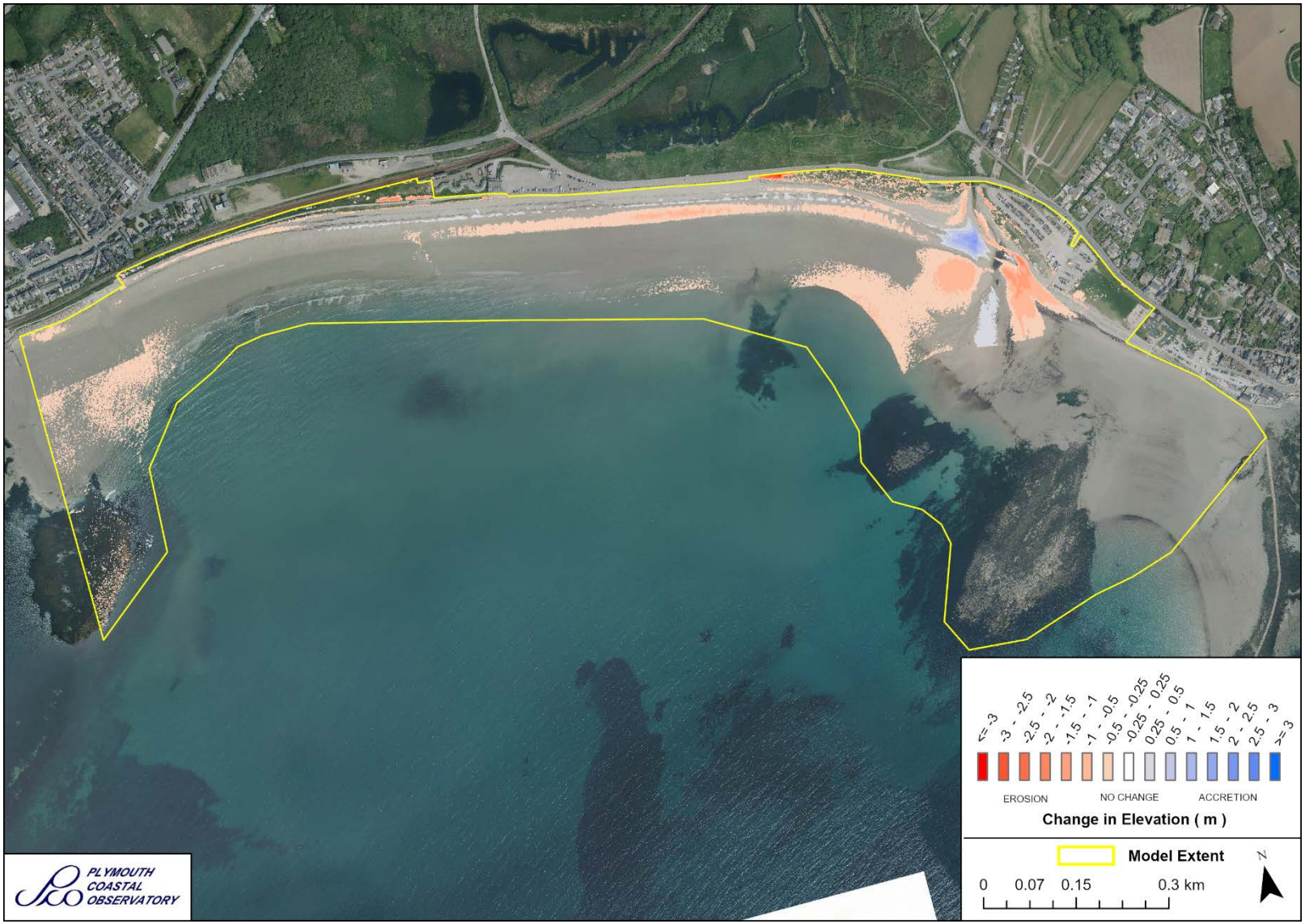


Figure 11 – Difference model indicating the changes in elevation observed between the December 2008 and September 2009 filtered LiDAR datasets within the yellow model extent.

Figure 12 shows differences in elevation between filtered LiDAR data from September 2009 compared to January 2011. Again, the beach is dominated predominantly be areas of erosion, with up to a 3 m loss in elevation at the mouth of the stream which forms a larger band of material loss across most of the beach face. Comparatively lower areas of accretion are observed to the east of the beach, with a build-up of material in front of the car park and near the stream mouth.

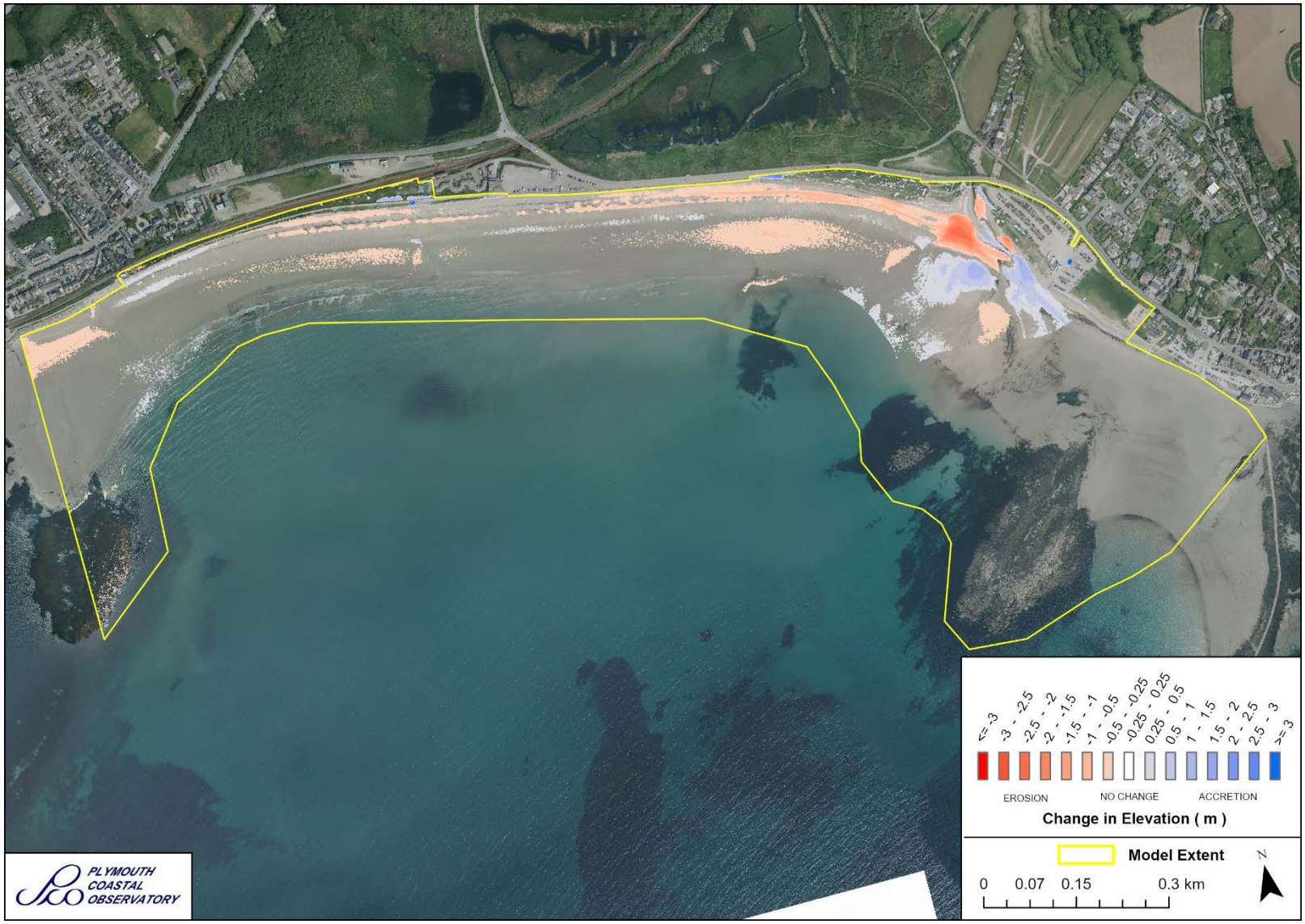


Figure 12 - Difference model indicating the changes in elevation observed between the September 2009 and January 2011 filtered LiDAR datasets within the yellow model extent.

Figure 13 shows differences in elevation between filtered LiDAR data from January 2011 compared to May 2014. Despite the impact of the 2013/14 storms around the coastline, the difference model suggests Marazion was dominated by accretion along the upper beach face and around the low tide terrace area for the centre of the beach. There is however considerable loss of the dune toe and face to the centre of the beach, as suggested by the up to 2 m loss in elevation adjacent to the stream mouth.

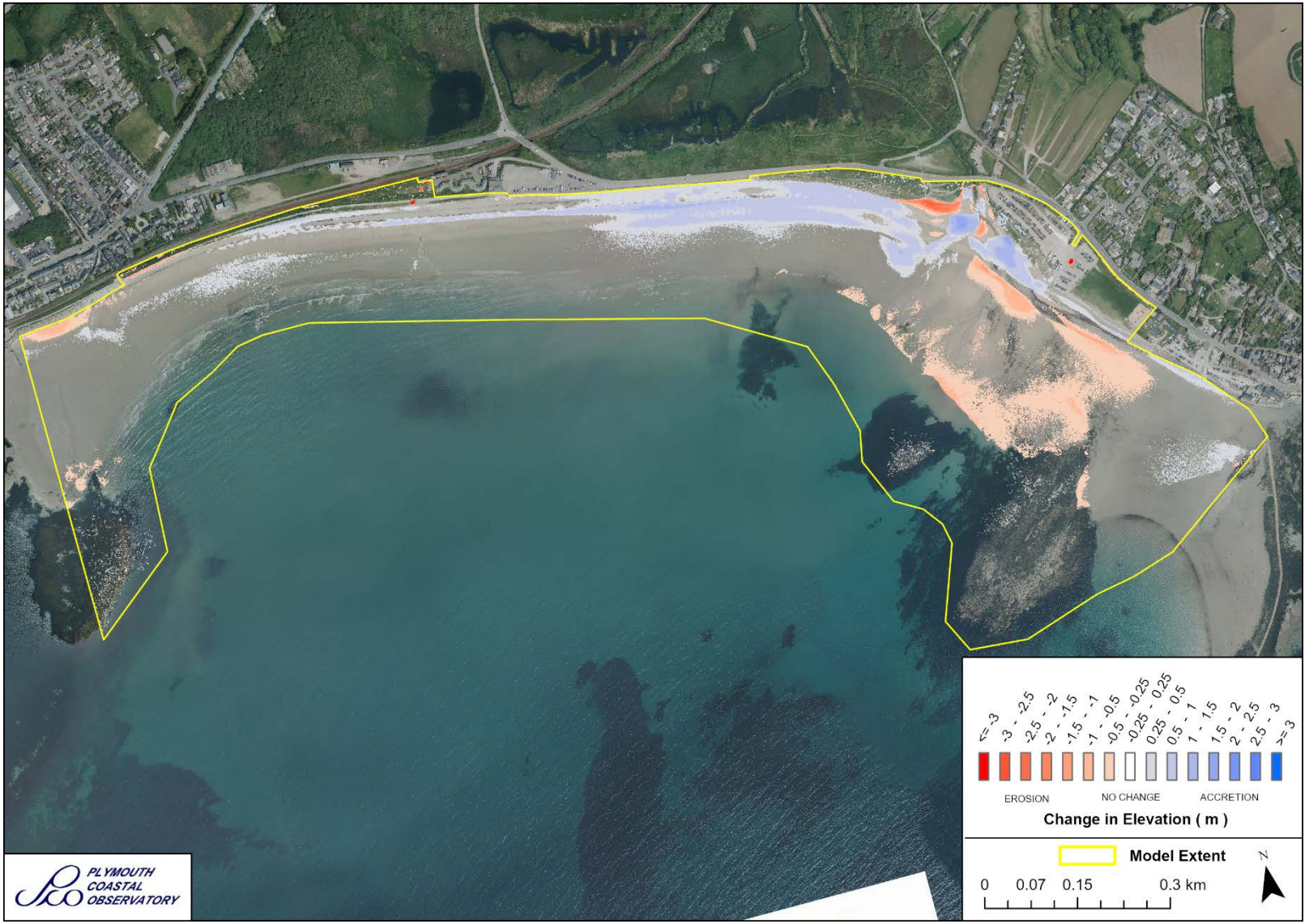


Figure 13 - Difference model indicating the changes in elevation observed between the January 2011 and May 2014 filtered LiDAR datasets within the yellow model extent.

Figure 14 shows differences in elevation between filtered LiDAR data from May 2014 compared to February 2019. The difference model suggests the beach has undergone some recovery following the 2013/14 storm season, with accretion by up to 2 m in elevation apparent along the dune toe to the west of the stream. There is also further erosion observed across the upper beach face for most of the beach and considerable loss of material in the region of 2 m elevation change directly in front of the car park to the east of the dune system.

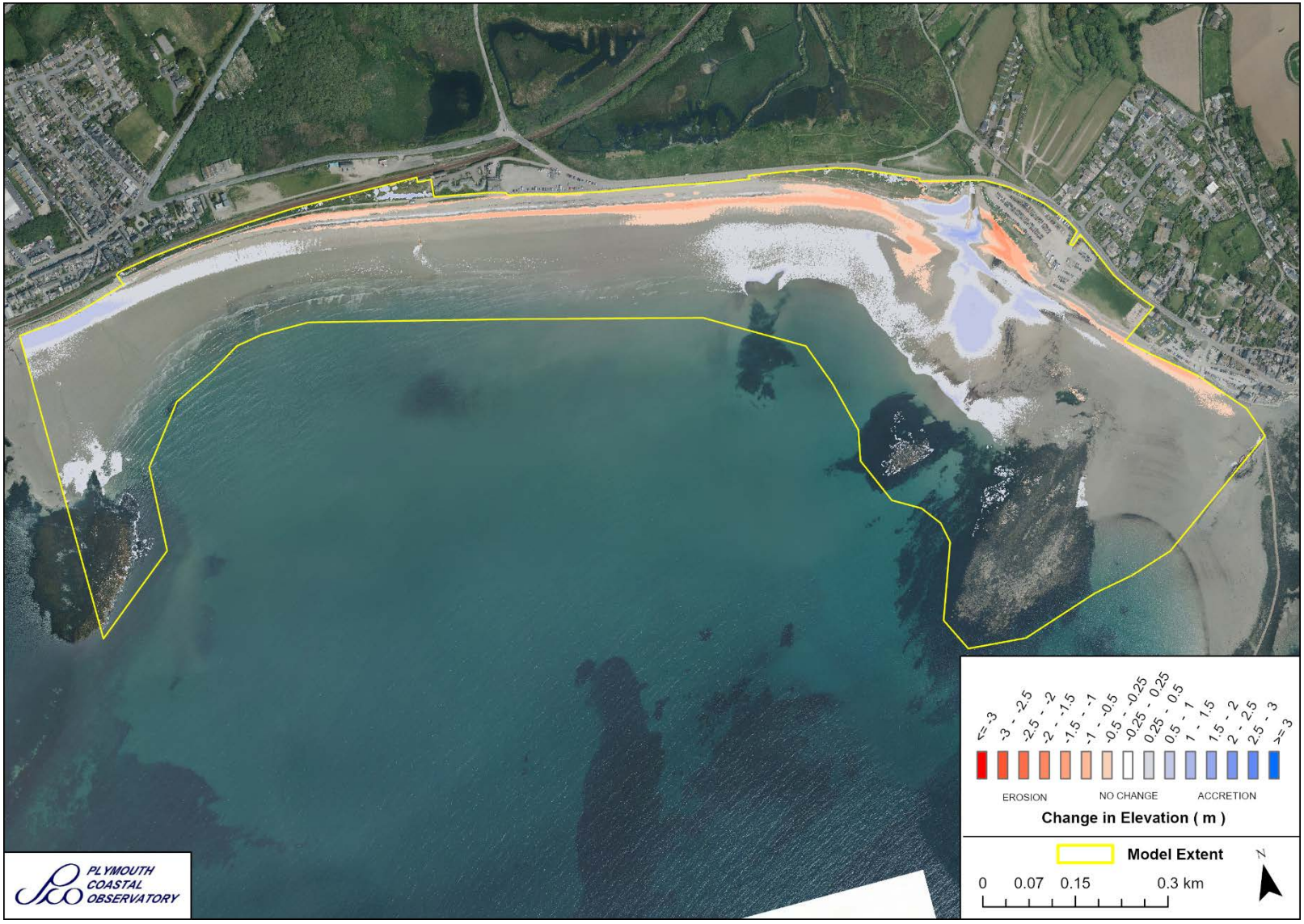


Figure 14 - Difference model indicating the changes in elevation observed between the May 2014 and February 2019 filtered LiDAR datasets within the yellow model extent.

Figure 15 shows differences in elevation between filtered LiDAR data from February 2019 compared to October 2022. The difference model is dominated by erosion occurring around the stream mouth both along the dune toe and upper beach face. There was comparatively small accretion found along the upper beach face to the east of the survey unit in front of the dune system.

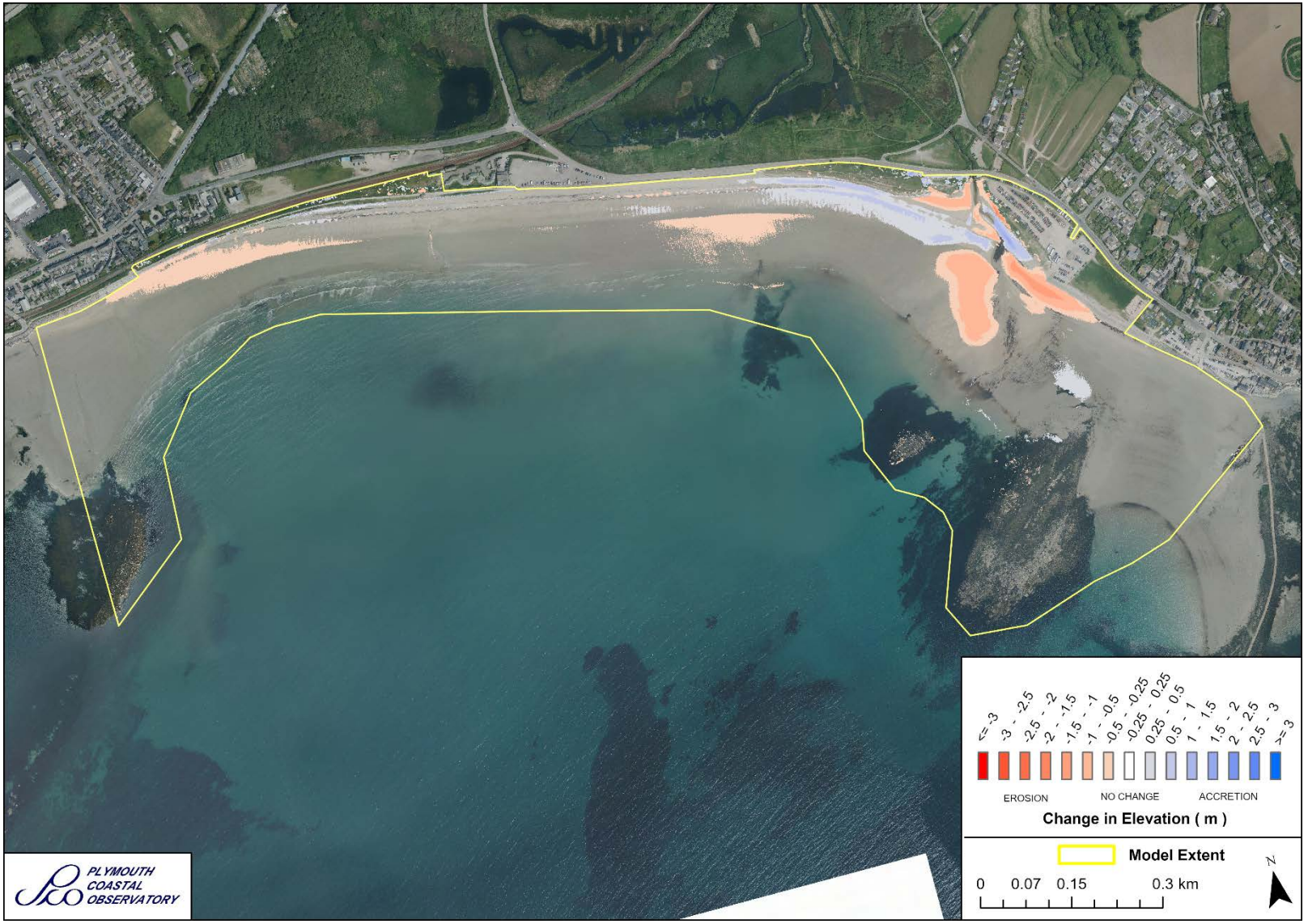


Figure 15 - Difference model indicating the changes in elevation observed between the May 2014 and February 2019 filtered LiDAR datasets within the yellow model extent.

3.2.2 Beach and Dune Volume Extraction

Surface volume extracted from each available LiDAR dataset from the Mobile Zone above the MHWS contour (2.95 m OD) are shown in Table 1 and Figure 16. Volume from the Mobile Zone has remained stable between 2007 and 2022, except for the 2011 survey which saw the lowest volume on record, the Mobile Zone has only fluctuated in volume by <8% between each individual dataset (Fig.16). In contrast to most Cornwall beach responses the Mobile Zone at Marazion recorded the highest volume during the 2014 survey at 79,044 m^3, following the 2013/14 winter season.

Surface volume extracted from each LiDAR dataset from the Beach Zone above the MLWS contour (-2.2 m OD) are shown in Table 1 and Figure 17. The Beach Zone volume has followed a similar trend to that observed in the topographic data showing gradual accretion between 2008 and 2022 despite large fluctuations in volume, where the lowest recorded volume during the 2009 survey, which saw a 22% loss in volume from the previous 2008 survey (Fig.17).

Table 1 – Surface volume values (m^3) extracted from all available filtered LiDAR datasets for the Mobile Zone above MHWS (2.95 m OD) and for the Beach Zone above MLWS (-2.25 m OD).

Date	Mobile Zone Volume (m^3)	Beach Zone Volume (m^3)
04/2007	74,245	452,538
09/2007	76,910	468,325
12/2008	77,097	496,259
09/2009	72,749	385,738
01/2011	66,207	468,111
05/2014	79,044	488,300
02/2019	72,962	514,385
10/2022	74,051	496,961

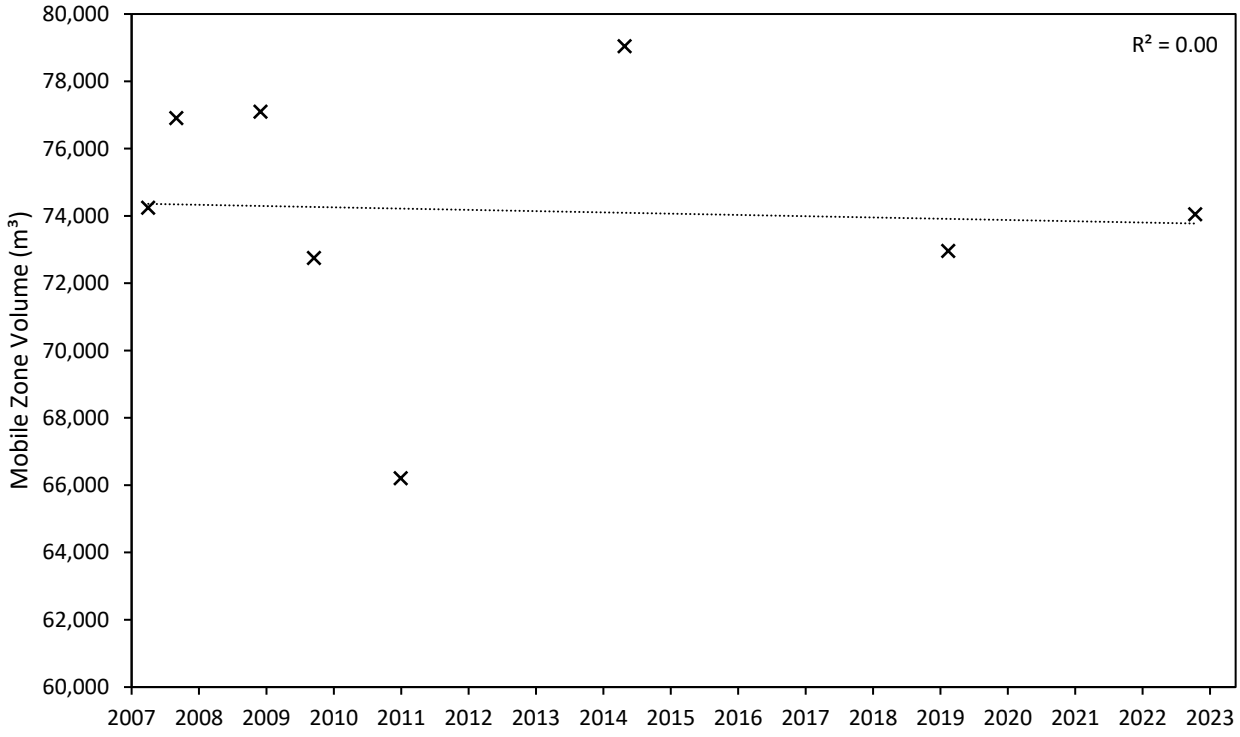


Figure 16 – Plot indicating beach volume (m^3) recorded in the Mobile Zone above MHWS (2.95 m OD) for each filtered LiDAR datasets between 2007 and 2022.

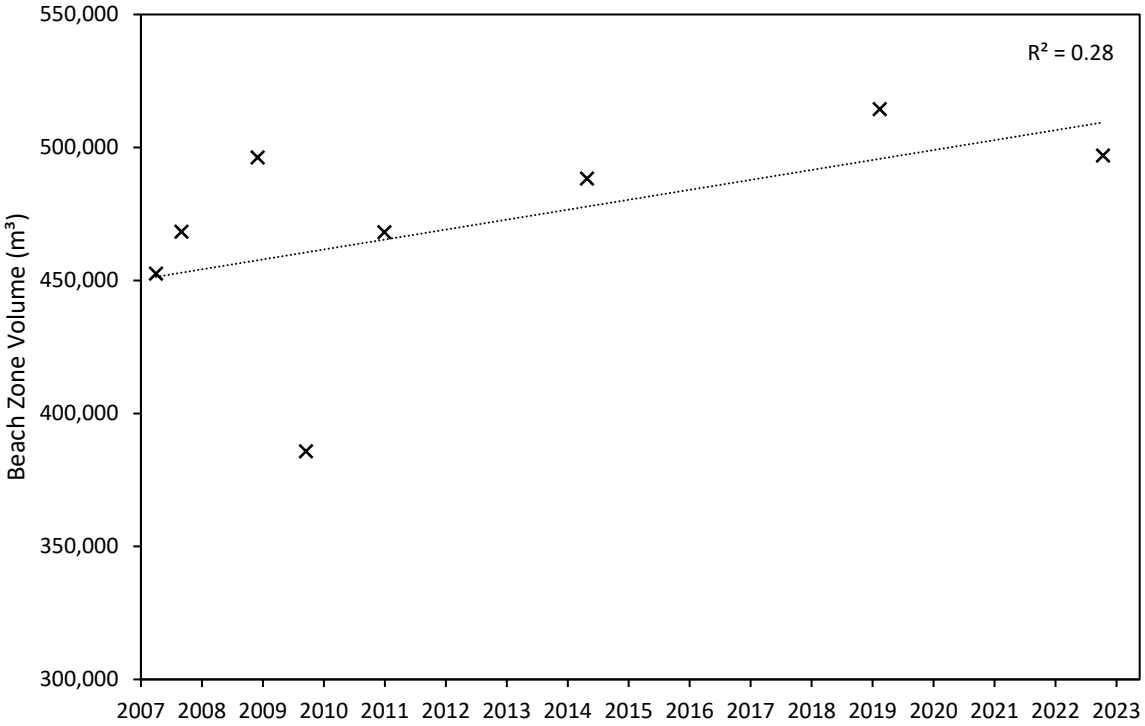


Figure 17 - Plot indicating beach volume (m^3) recorded in the Beach Zone above MLWS (-2.25 m OD) for each filtered LiDAR datasets between 2007 and 2022.

3.2.3 Contour Comparison

Figure 18 indicates the Mean Sea Level (MSL) and dune toe contours from the 2007, 2014, 2019 and 2022 LiDAR datasets. When observing each of the four datasets, the MSL and dune toe contours have remained stable throughout, with the only primary widening and narrowing of the beach occurring as a result of the fluvial dynamics of the small stream (Fig.18).

3.3 Historic Aerial Maps

Historic aerial photography captured in 1947 by the RAF, in 2001 by the Environment Agency (Figs. 19 and 20) and from 2007 onwards by the SWCM (Figs. 21-are presented here.



Figure 18 – Contour map indicating Mean Sea Level (solid line) and Dune Toe (dashed line) extracted from 2007, 2014, 2019 and 2022 LiDAR datasets.



Figure 19 – Aerial imagery from 1947.



Figure 20 – Aerial imagery from 2001.



Figure 21 – Aerial imagery from 2007.



Figure 22 – Aerial imagery from 2009.



Figure 23 – Aerial imagery from 2014.



Figure 23 – Aerial imagery from 2018.



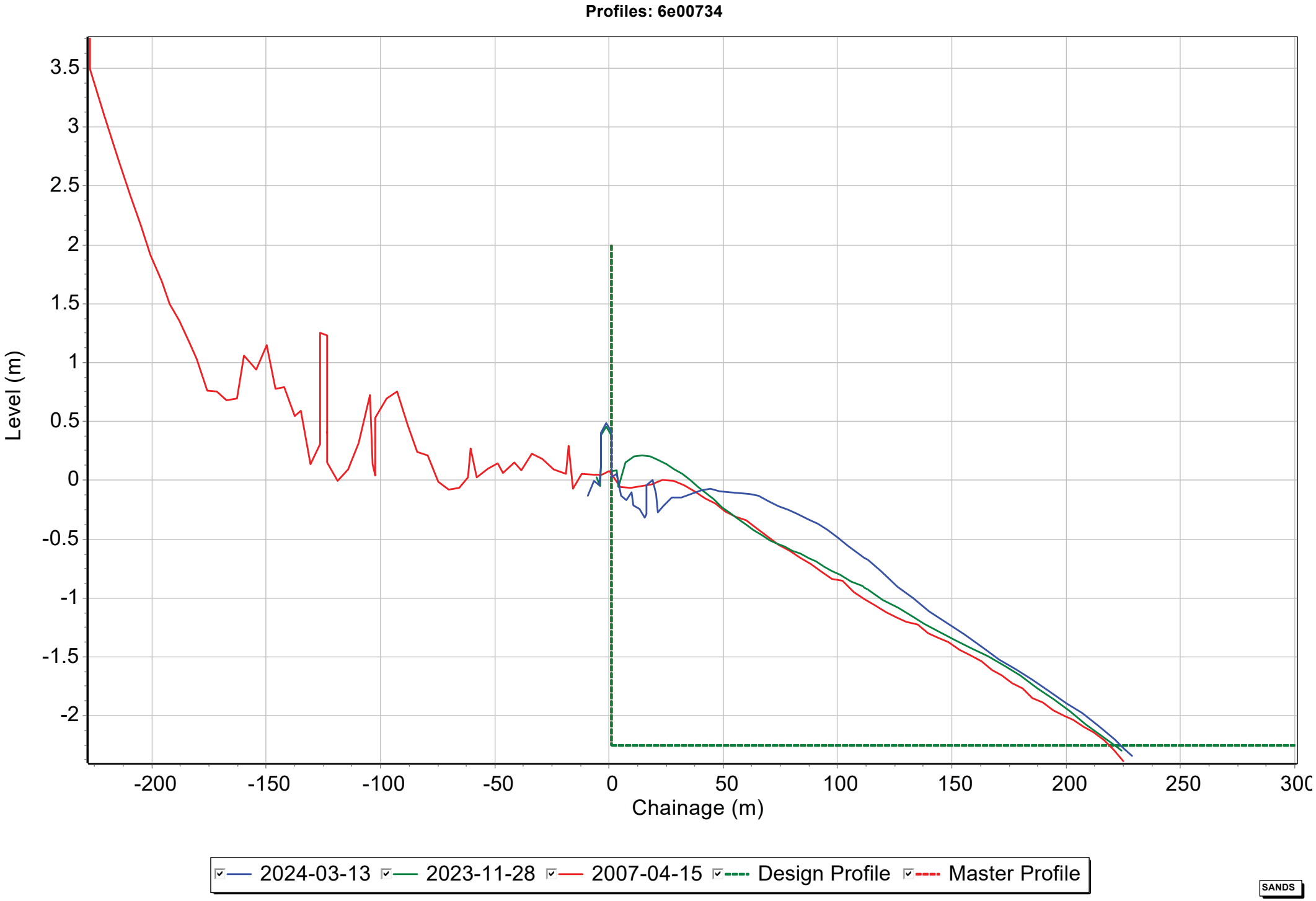
Figure 24 – Aerial imagery from 2022.

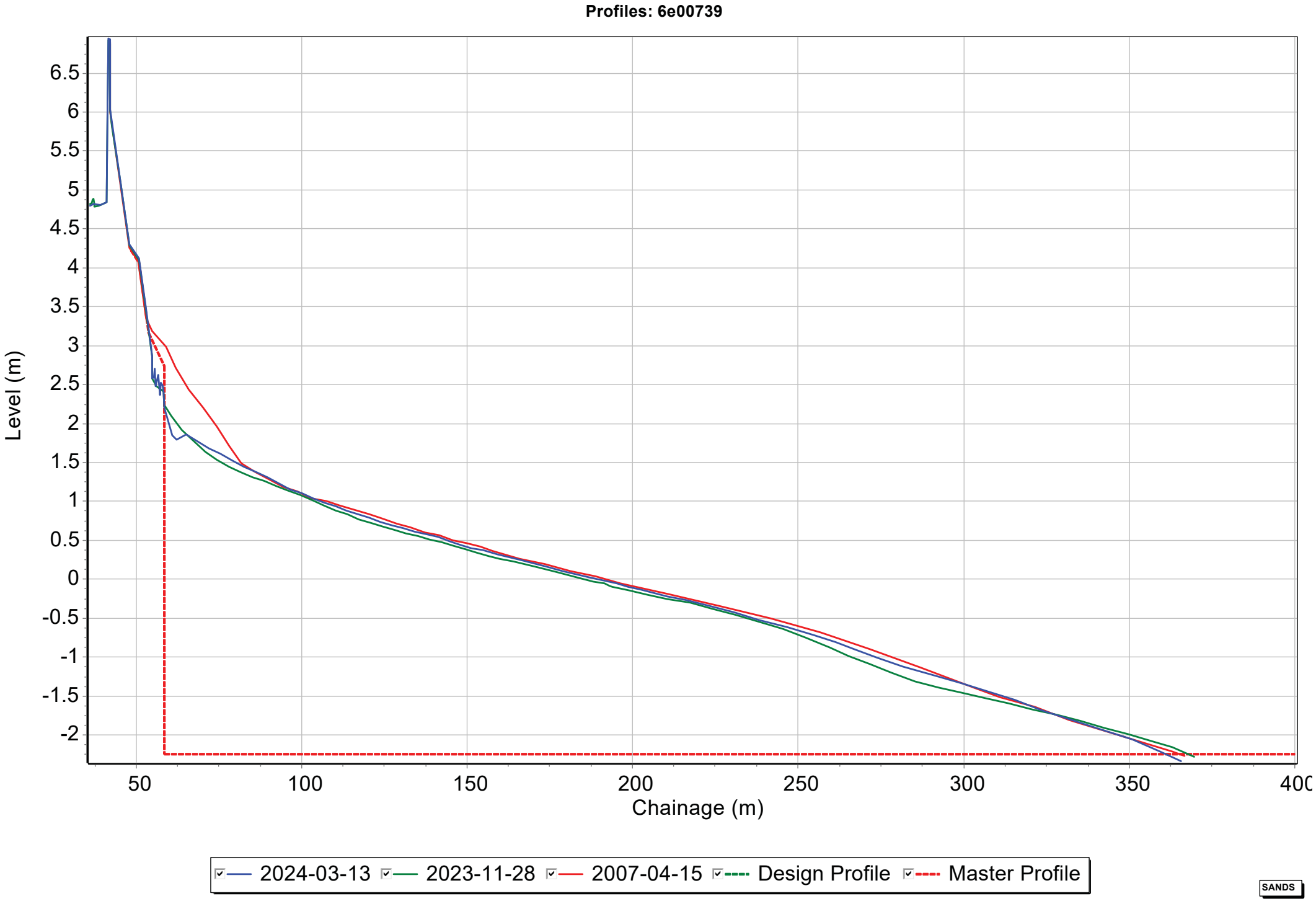
Glossary

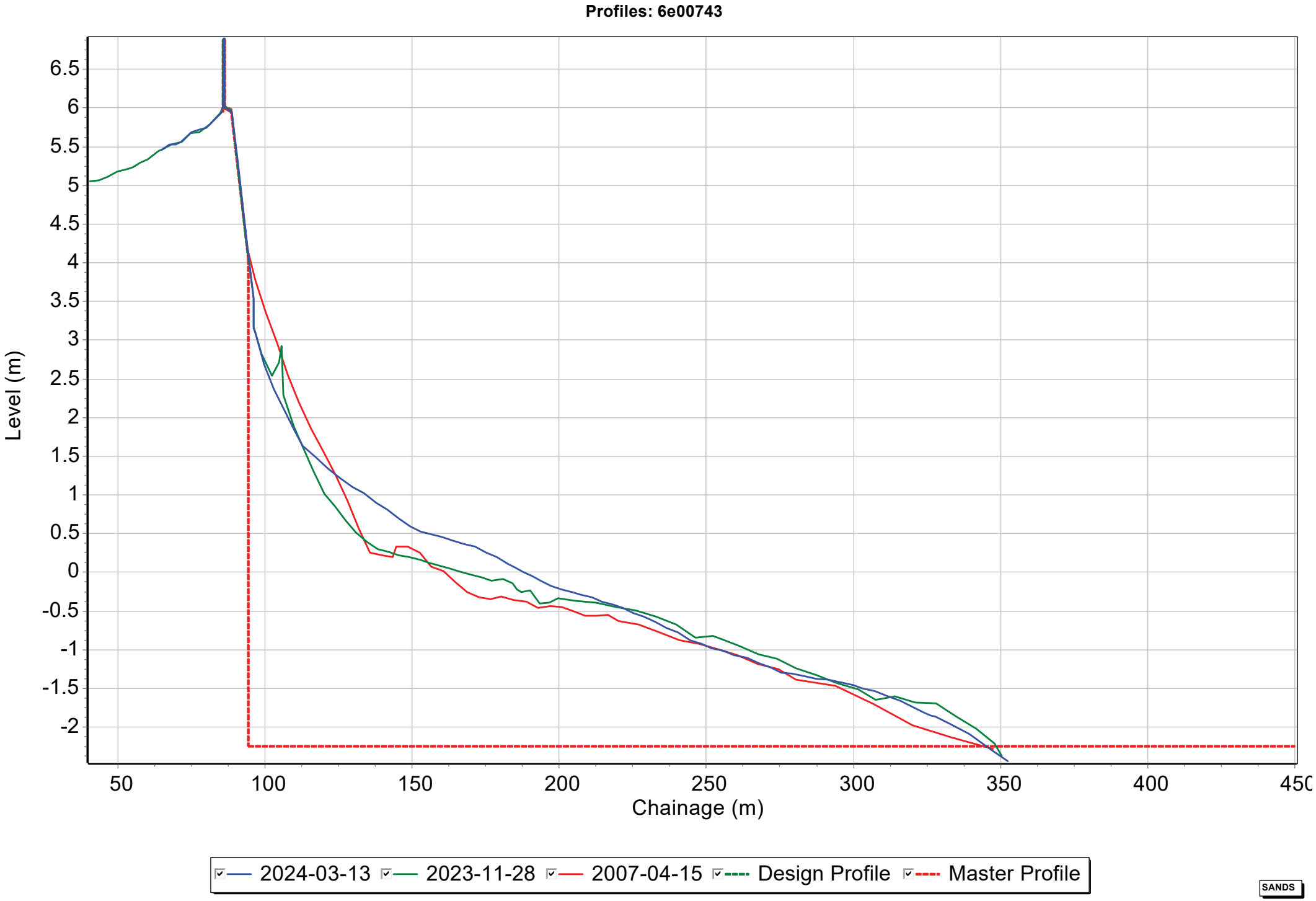
1. Accretion: The net accumulation of deposited sediment, deposited by waves, tides or current.
2. Coastal Morphodynamics: The study of changes in coastal landforms and landscapes over time.
3. Contour Analysis: Mapping of contours from LiDAR datasets to represent Mean Sea Level (MSL) and Dune Toe elevations.
4. Cross-Sectional Area (CSA): The area of a two-dimensional cross-section of a cross-shore beach profile, running between Mean Low Water Spring and the back of the beach.
5. Developed Zone: Areas of urban development built atop previously present dune systems.
6. Difference Modelling: Comparison of separate LiDAR surfaces to produce a difference model of change based on gridded spot height elevations.
7. Digital Elevation Model (DEM) and Digital Terrain Model (DTM): DEM represents the Earth's surface with all features, while DTM represents the bare earth surface, excluding vegetation and structures.
8. Embryo Dune: The earliest stage of dune growth, typically found along the seaward extent of a dune system or newly formed dune.
9. Erosion: The process by which local sea level rise, strong wave action, and coastal flooding wear down or carry away rocks, soils, and sands along the coast.
10. Fixed Zone: Area defined by permanent dune vegetation, including scrub or invasive species, denoting vegetation atop sandy soil.
11. Intertidal Bar: A ridge or mound of sand, gravel, or other sediment deposited in the intertidal zone along a shoreline.
12. LiDAR: Light Detection and Ranging, a remote sensing method that uses light in the form of a pulsed laser to measure variable distances to the Earth.
13. Mean High Water Spring (MHWS): The height of mean high-water springs is the average throughout the year of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest.
14. Mean Low Water Spring (MLWS): The height of the mean low-water springs is the average height obtained by the two successive low waters during the same period.
15. Mobile Zone: The area including the active dune face and embryo dune that is in motion due to wind action or other factors.
16. Root-Mean-Square Error (RMSE): A measure of the differences between values predicted by a model and the observed values.
17. Tidal Range: The vertical difference between high tide and low tide during a tidal cycle.

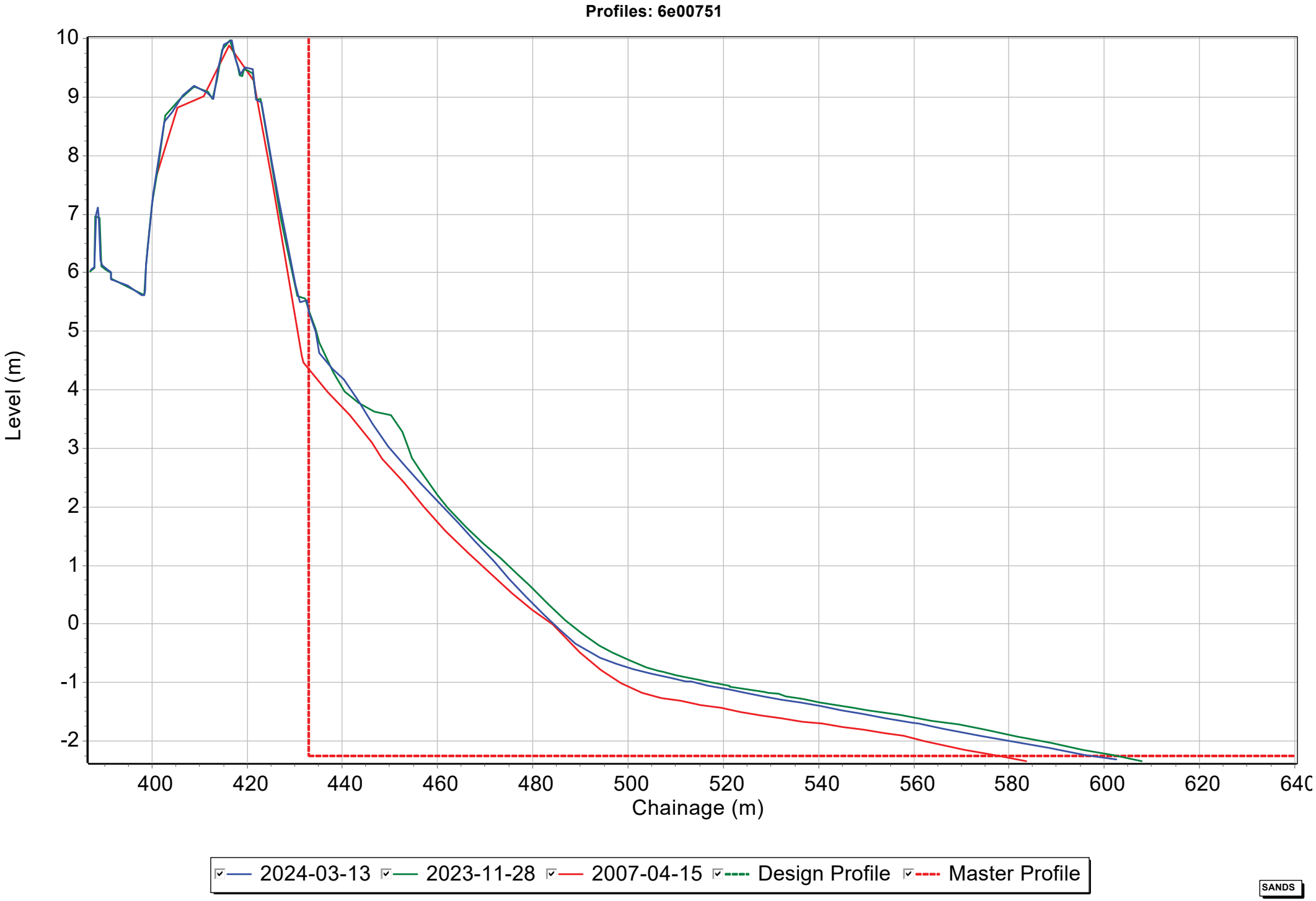
Appendices

Appendix 1 – Profile charts showing the cross-shore area of each interim profile from the most recent survey (blue), the preceding survey (green) and first full coverage survey, also known as the baseline (red) at Marazion are presented below.

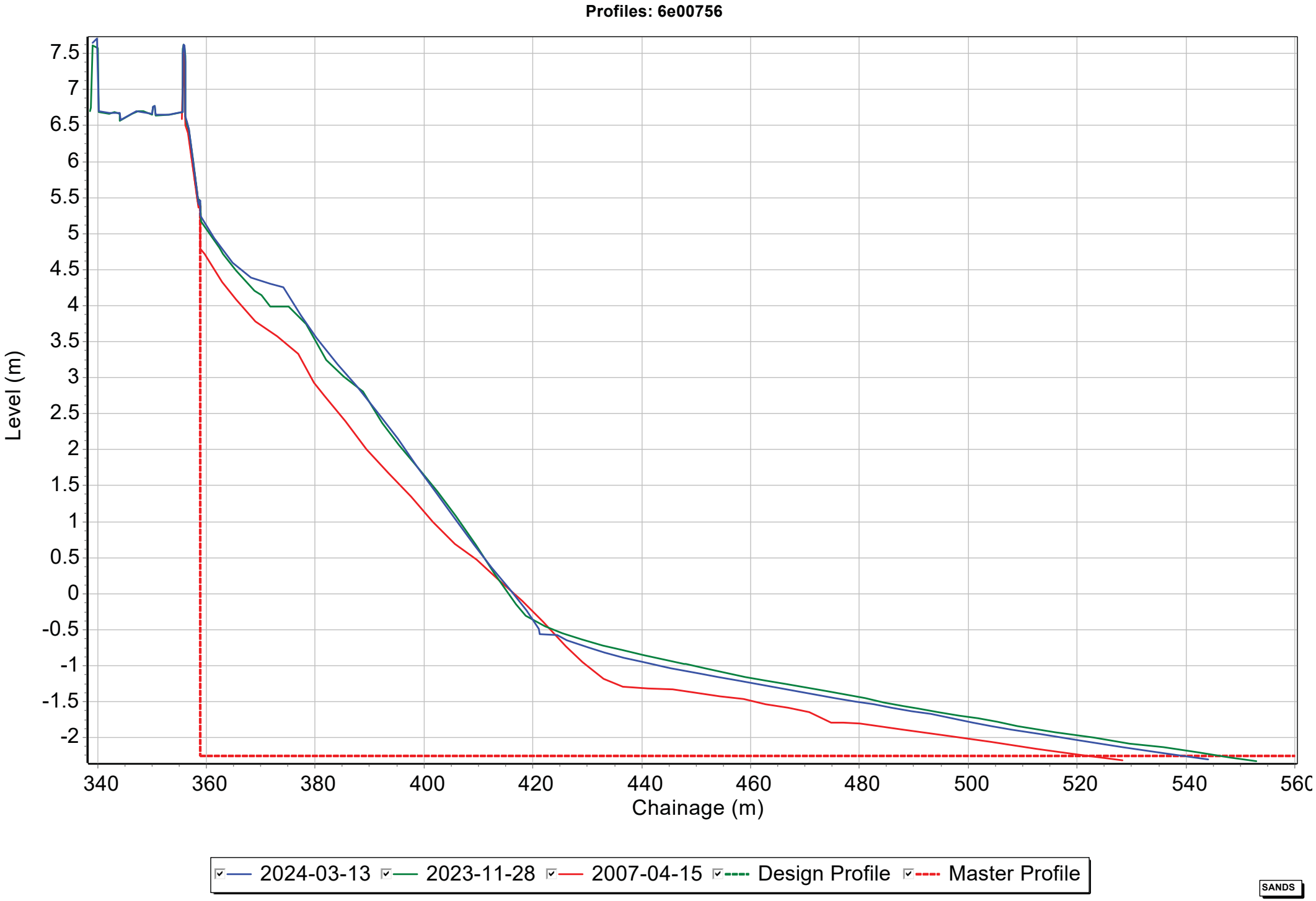

Profiles: 6e00734
Level (m)
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-200
-150
-100
-50
0
50
100
150
200
250
300
Chainage (m)
2024-03-13
2023-11-28
2007-04-15
Design Profile
Master Profile

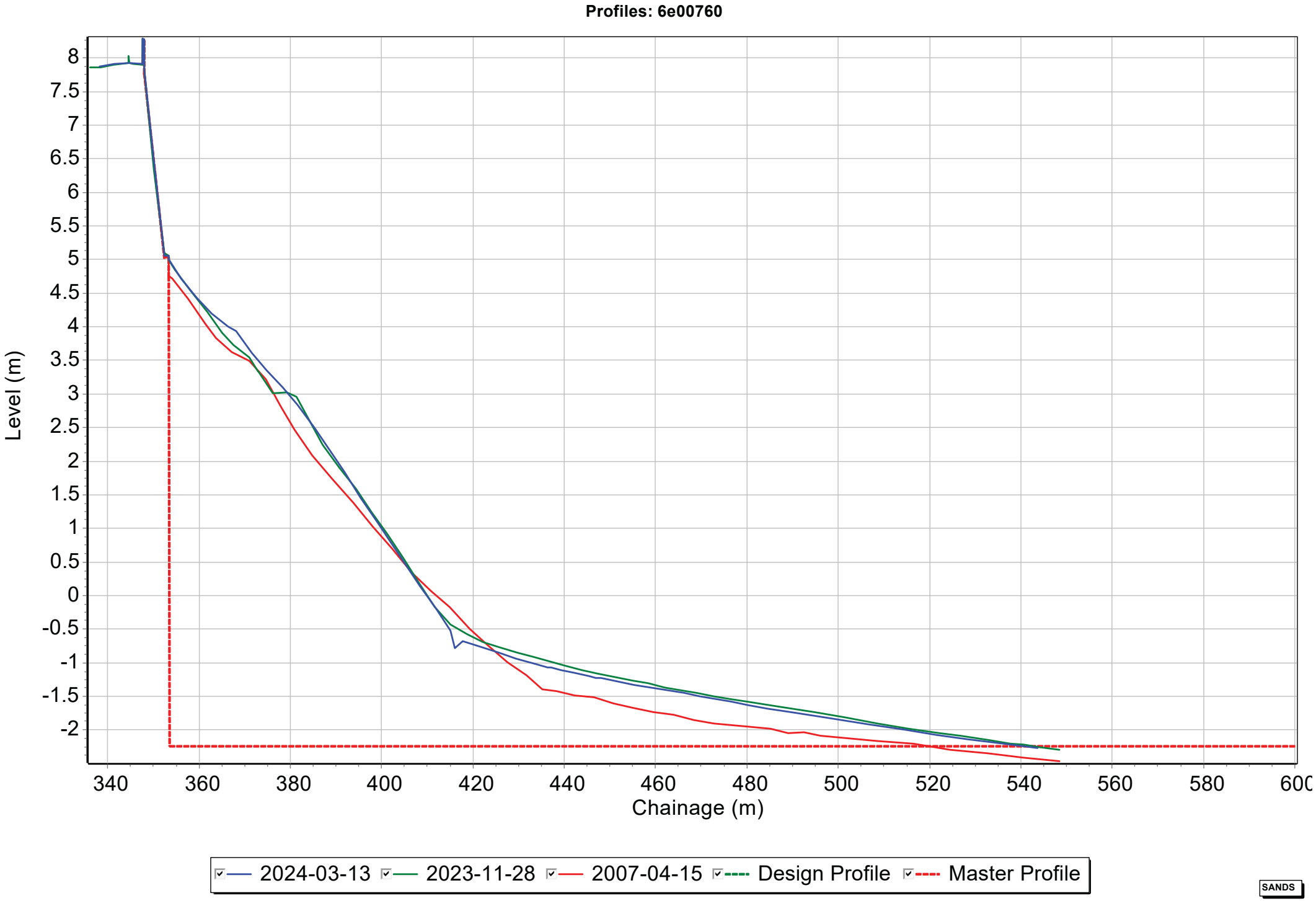

Profiles: 6e00739
Level (m)
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5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
50
100
150
200
250
300
350
400
Chainage (m)
2024-03-13
2023-11-28
2007-04-15
Design Profile
Master Profile
SANDS

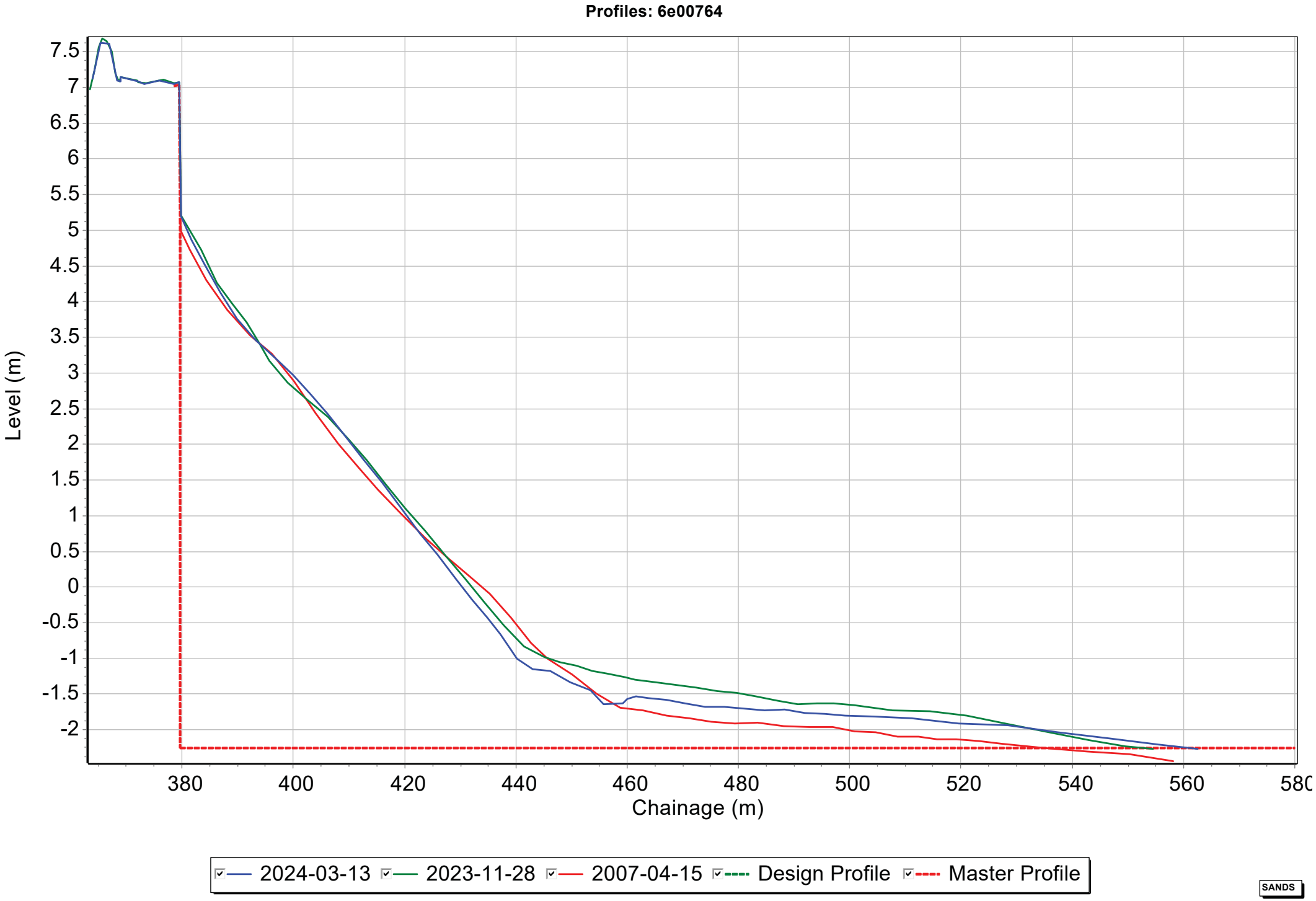

Profiles: 6e00743
Level (m)
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6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
50
100
150
200
250
300
350
400
450
Chainage (m)
2024-03-13
2023-11-28
2007-04-15
Design Profile
Master Profile


Profiles: 6e00751
Level (m)
10
9
8
7
6
5
4
3
2
1
0
-1
-2
400
420
440
460
480
500
520
540
560
580
600
620
640
Chainage (m)
2024-03-13
2023-11-28
2007-04-15
Design Profile
Master Profile

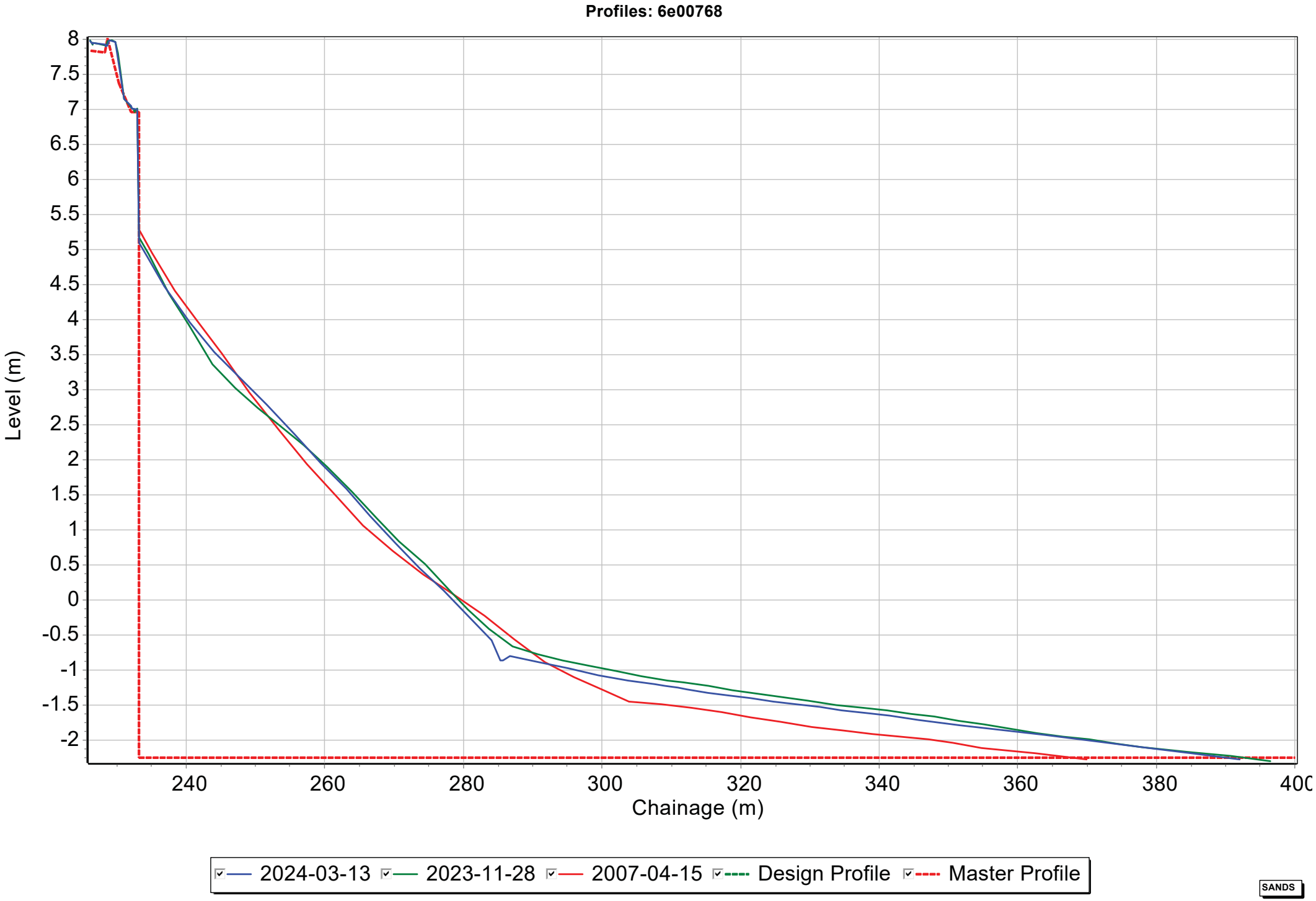
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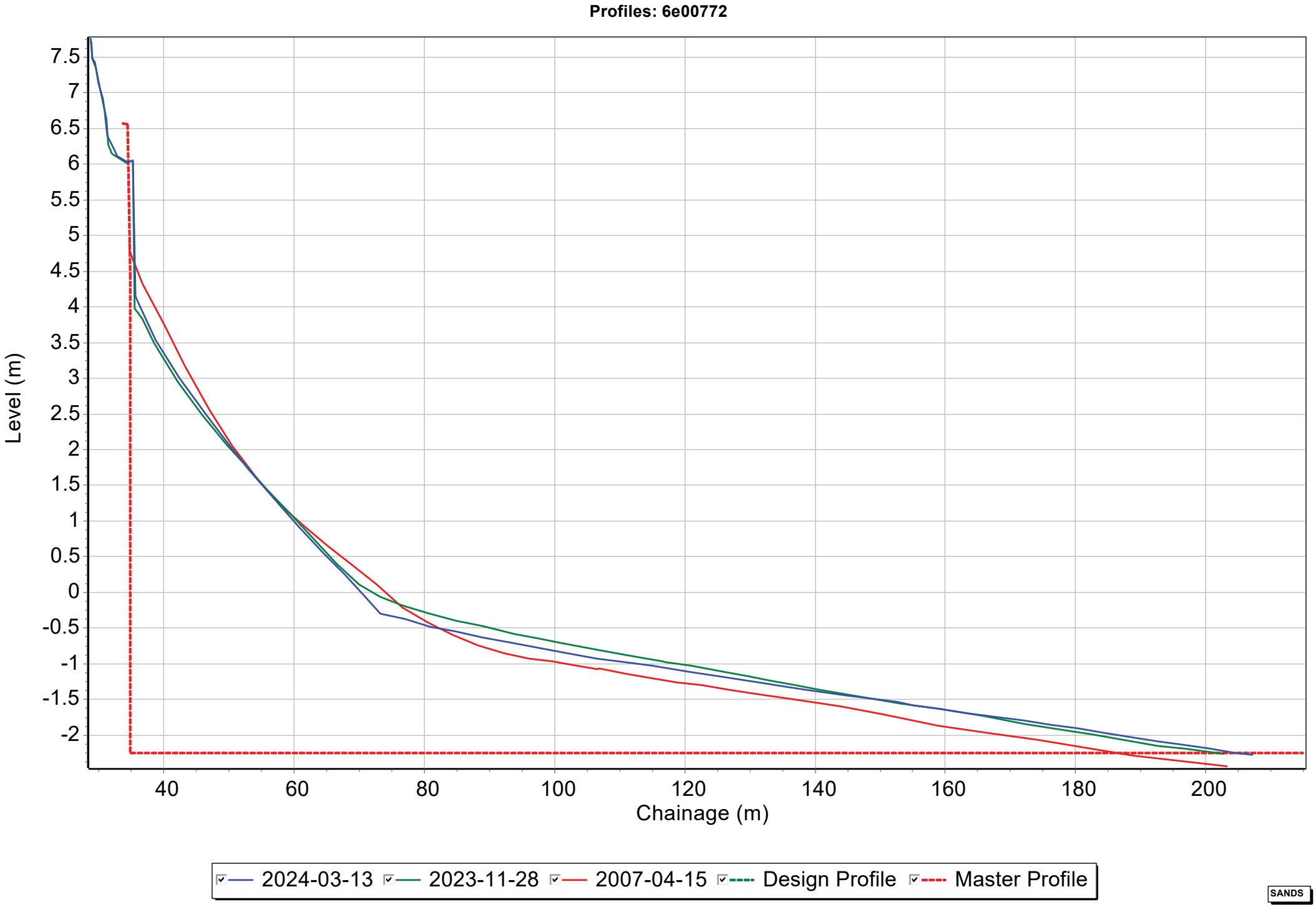

Profiles: 6e00756
Level (m)
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
340
360
380
400
420
440
460
480
500
520
540
560
Chainage (m)
2024-03-13
2023-11-28
2007-04-15
Design Profile
Master Profile
SANDS

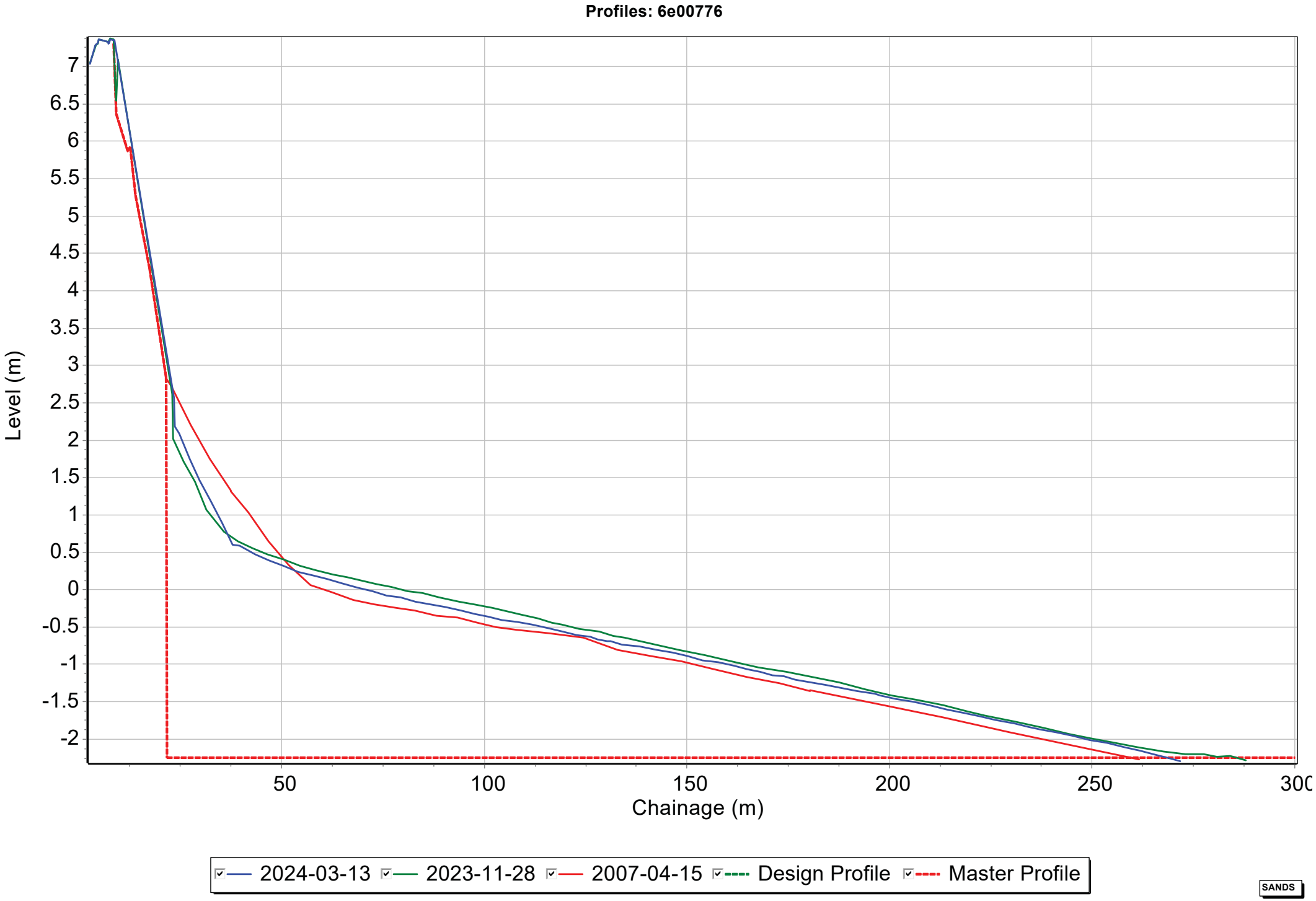

Profiles: 6e00760
Level (m)
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
340
360
380
400
420
440
460
480
500
520
540
560
580
600
Chainage (m)
2024-03-13
2023-11-28
2007-04-15
Design Profile
Master Profile

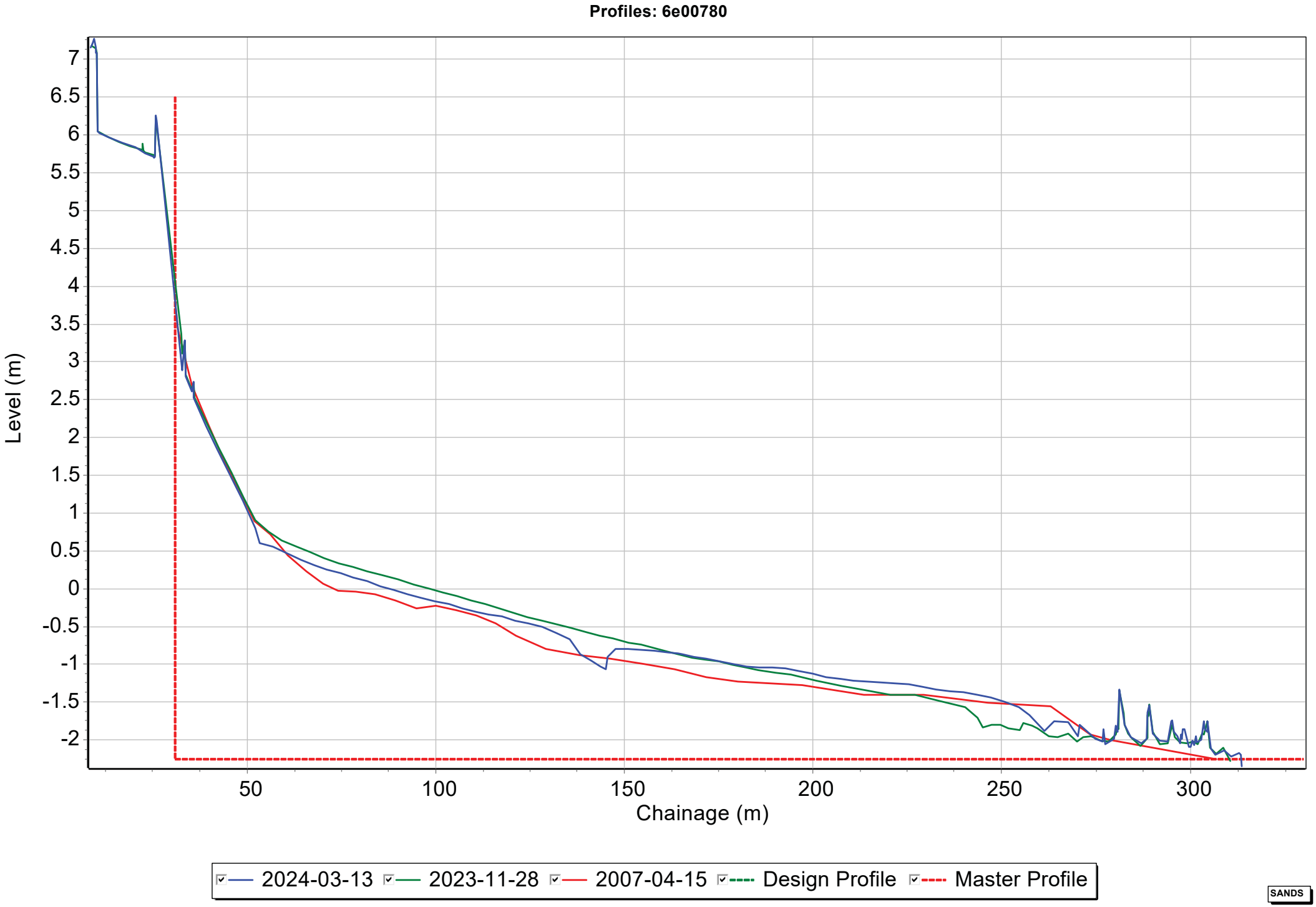

Profiles: 6e00764
Level (m)
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
380
400
420
440
460
480
500
520
540
560
580
Chainage (m)
2024-03-13
2023-11-28
2007-04-15
Design Profile
Master Profile

SANDS


Profiles: 6e00768
Level (m)
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
240
260
280
300
320
340
360
380
400
Chainage (m)
2024-03-13
2023-11-28
2007-04-15
Design Profile
Master Profile


Profiles: 6e00772
Level (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
40
60
80
100
120
140
160
180
200
Chainage (m)
2024-03-13
2023-11-28
2007-04-15
Design Profile
Master Profile
SANDS


Profiles: 6e00776
Level (m)
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
50
100
150
200
250
300
Chainage (m)
2024-03-13
2023-11-28
2007-04-15
Design Profile
Master Profile


Profiles: 6e00780
Level (m)
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
50
100
150
200
250
300
Chainage (m)
2024-03-13
2023-11-28
2007-04-15
Design Profile
Master Profile