Analysis of the low-pressure event (14/11/2020-15/11/2020) along with the impact on Dawlish Warren: 6bSU16-3

1. Introduction

This report briefly identifies the impact of the low-pressure event on Dawlish Warren (6bSU16-3). The low-pressure event spanned over a two-day period, between the 14th and 15th of November, brining wind speeds of up to 64.9 km/h and pressures as low as 993hPA to the SW coast of England.

Data obtained for this report includes topographic profile data for an autumn interim survey, collected on the 20/10/2020 and a post storm survey, collected on the 17/11/2020. Analysis and comparisons within this report is only undertaken on the profiles which were captured in the post-storm survey for consistency.

The following sections will provide a background into the hydrodynamics occurring during this low-pressure period and an analysis into the changes to the beach's morphology.

2. Hydrodynamics

During the period of low-pressure, the significant wave height (H_S) averaged 1.25 m (*Table 1*) and the maximum wave height (H_{Max}) averaged 1.98 m. When compared to the November average, the low-pressure period under analysis recorded a ~70% increase in H_S and a more southerly average wave direction (*Table 1*). There was one distinct peak throughout the period under analysis whereby the storm threshold (2.64m) was exceeded by H_{Max} (*Table 1*) which lasted for a duration of 14 hours, coinciding with the spring high tide on 14/11/2020 at 17:41 (4.5 m, recorded from Dawlish) as demonstrated in *Figure 1*.

Table 1 - Hydrodynamic statistics recorded from Dawlish directional wave rider. H_S is wave height (m), Tp is peak wave period (s), Tz is mean wave period and Dir. is wave direction (°).

	Hs (m)	Tp (s)	Tz (s)	Dir. (°)
Low Pressure Event Average (14/11-15/11)	1.25	6.8	4.1	173
November Average (2010-2019)	0.73	6.9	3.9	159
Low Pressure Peak (14/11/2020 12:30-17:00)	2.14	6.7	4.8	172

The two-day period under analysis recorded a maximum wave height of 3.62 m and a maximum H_S of 2.32 m. The maximum values of H_S and H_{Max} can been seen to exceed the November average by threefold. The timings of the autumn interim survey and post-storm survey sufficiently captured either side of the low-pressure event and its effect on Dawlish Warren.

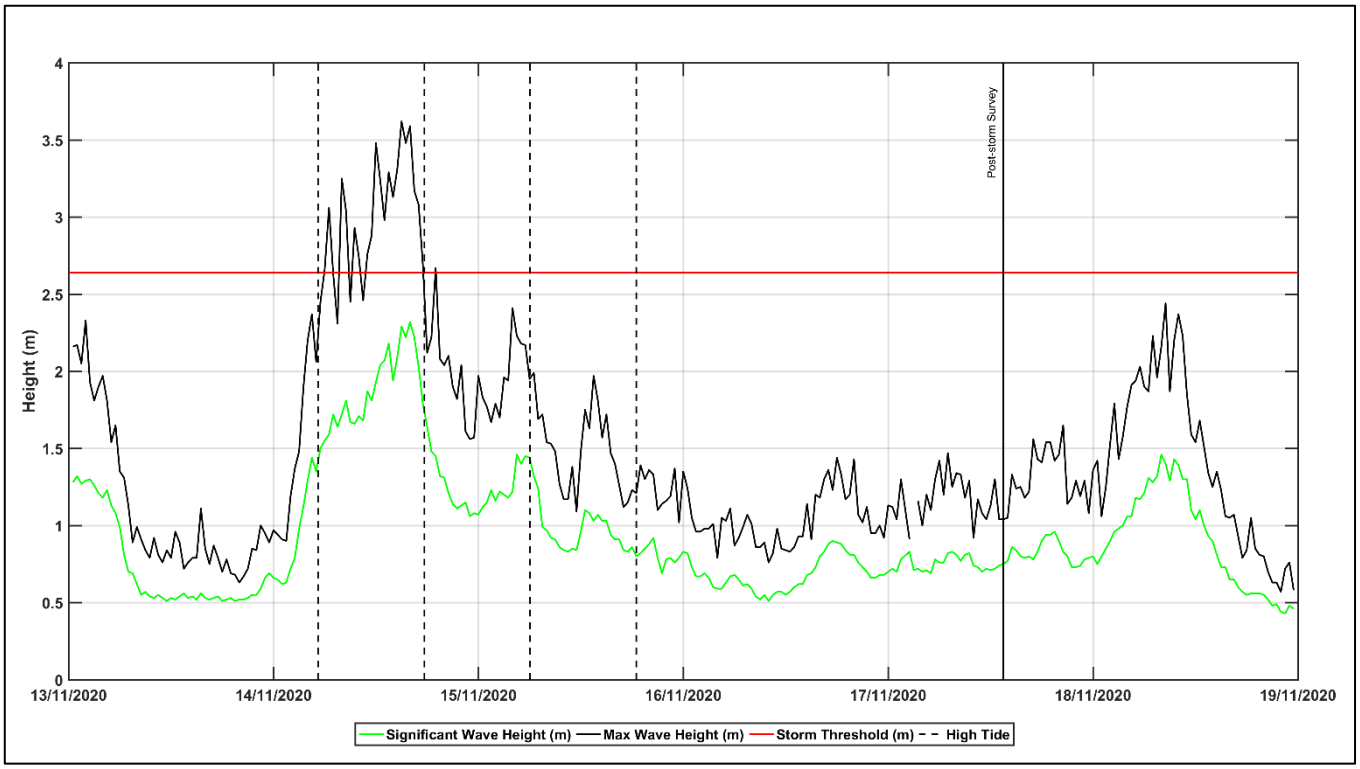
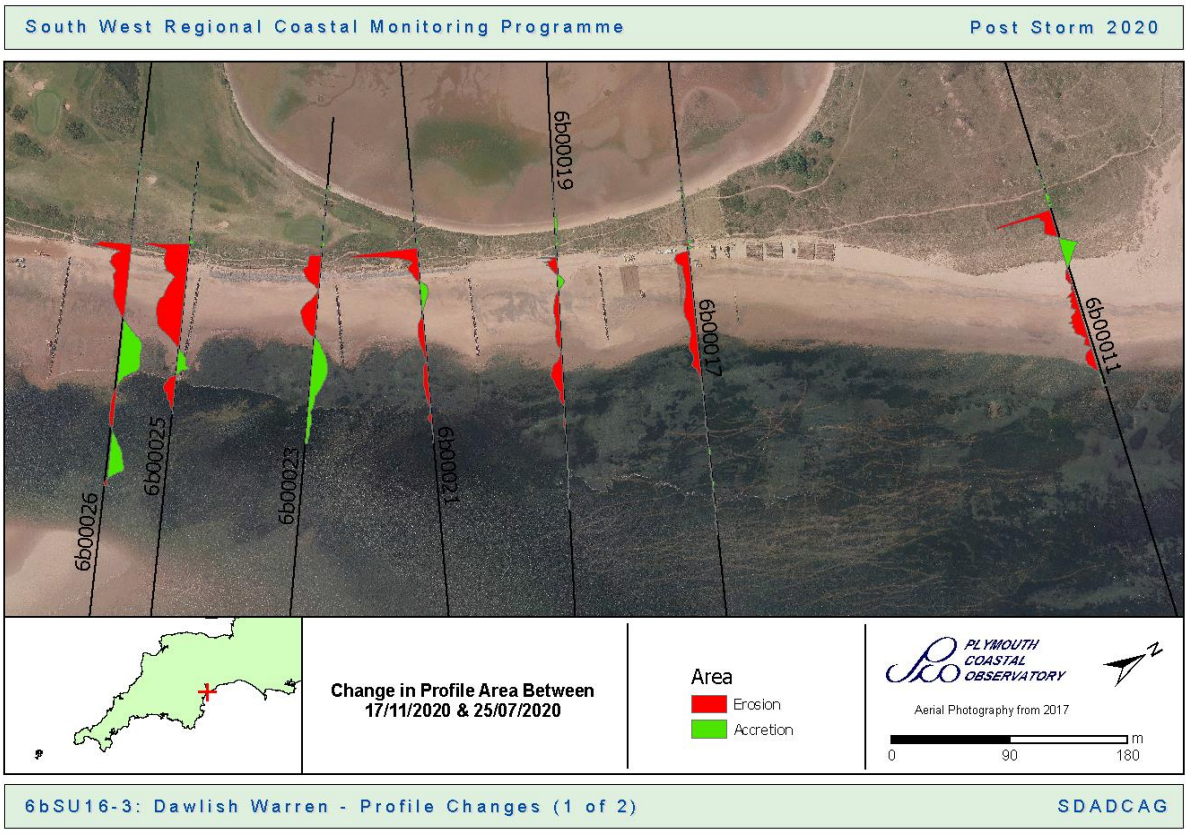


Figure 1 - Plot showing the significant wave height (H_S) and maximum wave height (H_{Max}) over a six day period, including the low-pressure event. High tide times during the study period are indicated with a dashed vertical black line. Data obtained from Dawlish DWR.

3. Beach Morphology Change

The post-storm survey consisted of thirteen survey lines which in this report are directly compared against the autumn interim survey; see Figure 2.



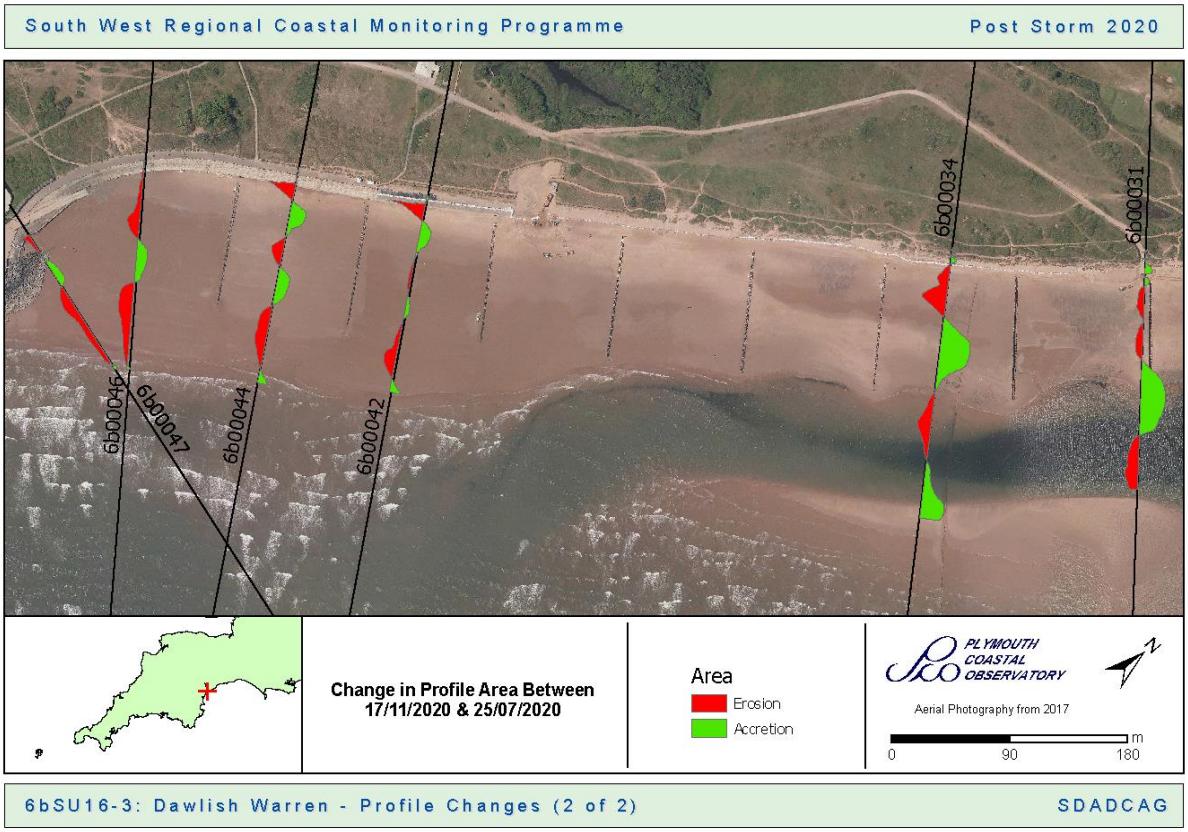


Figure 2 – Plot indicating the location of Dawlish Warren and the post storm profiles, along with an exaggerated overlay depicted where there has been erosion (red) and accretion (green) across each of the profiles since the previous interim survey (27/07/2020).

Erosion & Accretion Overview

Dawlish Warren, as a whole, lost -151.62 m^2 of material and gained 39.23 m^2 since the autumn interim survey. When comparing the cross-sectional area of the thirteen survey lines, overall, profiles 6b00011, 6b00017, 6b000179, 6b00021, 6b00025, 6b00042, 6b00044, 6b00046 and 6b00047 saw an loss in material between the interim and post-storm survey ranging from -53.45 m^2 to -14.23 m^2 whereas profiles 6b00023, 6b00026, 6b00031 and 6b00034 saw an overall gain in material ranging from 2.41 m^2 to 46.66 m^2 (see *Table 2*; see *Appendix 1*).

Profile Erosion & Accretion

Profiles 6b00011, 6b00017 and 6b00019 show a clear loss of material from the low tide terrace and/or upper beach face. In comparison, profiles 6b00023, 6b00026 and 6b00024 show the most expected change of material, with a loss from the beach face and minor gains along the low tide terrace (see Appendix A). The location along the profiles, where accretion outweighs erosion, generally occurs around the lower beach – around ~120-160 m chainage (see Appendix A).

Table 2- Overview of accretion and erosion rates at each post storm profile line, calculated from Topographic surveys between 17/11/2020 and 25/07/2020.

	Accretion (m^2)	Erosion (m^2)	Total (m^2)
6b00011	8.15	-23.61	-15.46

6b00017	2.41	23.83	-21.42
6b00019	3.82	-16.83	-13.02
6b00021	4.30	-22.35	-18.04
6b00023	20.57	-19.84	0.74
6b00025	5.17	-53.45	-48.27
6b00026	32.48	-28.15	4.33
6b00031	32.95	-20.30	12.65
6b00034	46.66	-25.15	21.51
6b00042	9.23	-14.23	-5.00
6b00044	17.45	-21.42	-3.97
6b00046	7.96	-24.49	-16.52
6b00047	4.35	-14.27	-9.92

Recharge Event & GeoTube

In August 2017, a 470 m GeoTube defence was installed at the Warren's narrowest point within the dunes, spanning from profile 6b0019 to 6b0026. The GeoTube's aim was to reduce wave impact thus reducing effect and consequent risk to property and infrastructure. Alongside the GeoTube instillation, a beach recharge and dredging operation took place. The effects of these projects can be seen in *Figure 3* where the Combined Profile Area (CPA) increases from 10,200 m^2 to 12,300 m^2 between the 2017 spring survey and 2017 autumn survey.

As seen in Figure 3, the CPA of the first survey in 2008, pre-scheme levels, was the highest recorded (14,600 m^2). The following years saw a routine decline of the CPA to 10,200 m^2, until the recharge and GeoTube project. The CPA momentarily saw an increase of 2,100 m^2, however, levels continue to drop as they did pre-scheme. CPA levels in the Autumn 2020 survey can be seen to drop below pre-scheme levels. The scatter plot depicted in *Figure 3* illustrates a general trend, however, it does not include the 2020 low-pressure event survey data as different survey lines were analysed. In light of this we cannot make a direct comparison with the other data but we can predict that the CPA would have followed the trend and dropped from the last survey.

As mentioned above, the GeoTube was aimed at reducing wave impact and to help retain beach stability. As seen in Appendix A, all the profiles along the GeoTube show the beach to be receding, the crest of the beach moves between ~10 m and ~40 m landward. The rate of retreat becomes larger around profiles 6b00025 and 6b00026. In recent surveys, the crest of the beach can be seen to have positioned itself above the GeoTube (see Appendix A).

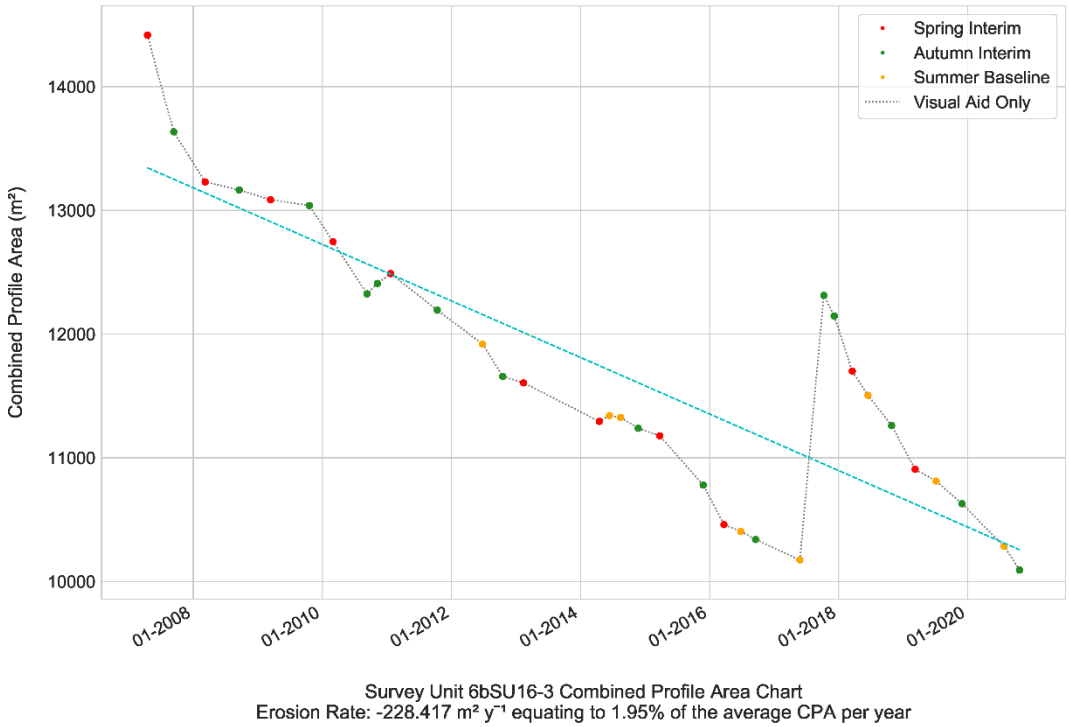


Figure 3 – Scatter plot showing the Combined Profile Area (CPA) for survey unit 6bSU16-3: Dawlish Warren, including spring (red), autumn (green) and summer (yellow) surveys between 2007 and 2020.

Appendix 1 – Cross-sectional area change plots

Each profile highlighted in figure 3 is shown below, comparing the interim and post-storm survey cross-sectional areas. Each plot has an accompanying profile change plot, displaying green as accretion and red as erosion for ease of visualisation.