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Annex A

Explanatory Notes
1. Summary of method of conducting topographic and hydrographic surveys 
(based on the Environment Agency's National Specification Sections XII and XIII)

Topographic cross-shore (profile) measurements are made at the intercept of the beach and a hard structure, at all changes of beach slope, at changes in surface sediment and at maximum defined intervals (every 5 metres). Each measurement is feature-coded with the type of surface material. Profiles are 100-500m apart, depending on management status. The seaward limit to be achieved is Mean Low Water Springs or 50 metres from the beach toe.

Topographic spot height (baseline) surveys are carried out annually at Beach Management Plan sites. Profiles are measured at 50m intervals, with the addition of spot heights at the toe of hard structures, the beach surface surrounding structures, all beach ridge crests, all other changes in slope and sediment changes, plus contour lines at a maximum spacing of 5m. All measurements are feature-coded with sediment type. Sufficient data points must be measured to generate a reliable Digital Terrain Model.

Hydrographic surveys are conducted with a single beam echo-sounder, with the position fixing requirement relaxed to DGPS. Soundings are taken along cross-shore profile lines 50m apart and extend 1km offshore. A minimum of 4 shore parallel tie lines are required (including one near the landward and seaward boundaries). The landward limit varies slightly across the region, due to the variation in tidal range, but in general is landward of Mean Sea Level, thus providing overlap with the topographic surveys. Tidal control may be by RTK GPS or by correction from tide gauges which are tied to the survey control network.

2. Change in Cross-sectional Area (CSA)

The annual change in cross-sectional area is calculated as the difference in CSA between two surveys, expressed as a percentage change compared to the earlier CSA.

\[
\frac{CSA_1 - CSA_2}{CSA_2} \times 100
\]

Eqn (1)

where CSA1 = most recent springtime survey and CSA2 = spring survey previous year. Therefore an annual change of –14% represents erosion during the last year of 14% of the area of last year's survey.

3. Method of derivation of Digital Ground and difference models

The Digital Ground Model is created by interpolating the points of a topographic baseline survey collected by using RTK GPS system. The interpolation method used to create the SECG DGMs is specified as Triangulation with smoothing and is applied in MapInfo Vertical Mapper to create a 1 metre resolution grid.

Triangulation is a process of grid generation that is usually applied to data that requires no regional averaging, such as elevation readings. The surface created by triangulation passes through all of the original data points while generating some degree of "overshoot" above local high values and "undershoot" below local low values. Elevation is an example of point values that are best "surfaced" with a technique that predicts some degree of over- and under- estimation. In modeling a topographic surface from
scattered elevation readings, it is not reasonable to assume that data points were collected at the absolute top or bottom of each local rise or depression in the land surface.

Triangulation involves a process whereby all the original data points are connected in space by a network of triangular faces, drawn as equilaterally as possible. This network of triangular faces is referred to as a Triangular Irregular Network (TIN). Points are connected based on the nearest neighbour relationship (the Delaunay criterion) which states that a circumcircle drawn around any triangle will not enclose the vertices of any other triangle.

To visualise the resulting grid, the same colour scheme is applied, thus enabling comparison between grids of different geographic origin. The colour bands cover a elevation range between -4 to +12 metres OD with elevations lying between -2 and +5 metres OD are shown in 0.5 metres intervals, the remaining elevation bands shown in 1 metre intervals.

All difference models are created by using a grid calculator within the GIS system. For example the difference model of two baseline surveys is created by subtracting the earlier baseline grid from the most recent baseline grid:

\[ \text{Grid}_1 - \text{Grid}_2 \]  
\text{Eqn (2)}

where \( \text{Grid}_1 \) = most recent baseline grid and \( \text{Grid}_2 \) = previous baseline grid. Therefore an annual change of \(-14m^2\) represents erosion during the last year of \(14m^2\), whilst positive values represent accretion over the period.
Annex B

Digital Ground Models
Annex C

Pevensey Bay Waverider Buoy

July 2007 – June 2008
Pevensay Bay Waverider Buoy - July 2007 to June 2008

Location
OS: 569358E 99118N
WGS84: Latitude: 50° 47' 0.2"N  Longitude: 00° 25' 1.5"E

Water Depth
9.8m CD

Instrument Type
Datawell Directional Waverider Mk III

Data Quality

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<tr>
<th>C1(%)</th>
<th>Sample interval</th>
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<td>30 minutes</td>
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Storm Analysis

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<th>Date/Time</th>
<th>Hs  (m)</th>
<th>Tp  (s)</th>
<th>Tz  (s)</th>
<th>Dir. (°)</th>
<th>Water level elevation (OD)</th>
<th>Tidal stage (hours re. HW)</th>
<th>Tidal range (m)</th>
<th>Tidal surge* (m)</th>
<th>Max. surge* (m)</th>
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<td>6.3</td>
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Table F1 Storm events during the reporting period, July 2007 to June 2008

A storm is defined using the Peaks-over-Threshold method (Figure F1). Each storm is then examined in detail, and covers the period 16 hours either side of the storm peak, so as to include both the build-up and decay of the storm. This is the procedure recommended by the CIRIA Beach Management Manual since it covers the build-up and decay typical of a mid-latitudes depression.

At present, the threshold for an individual site is derived empirically, since the measurements span only 4 years and, therefore, errs on the low side. Once the record length exceeds 5 years, a more realistic value of the Threshold can be derived, so as to identify 3 or 4 storms in an average year. The threshold used for Pevensay Bay is 3m.

Figure F1 Storm definition

* Tidal information is obtained from the nearest recording tide gauge (the National Network gauge at Newhaven). The surge shown is the residual at the time of the highest $H_s$. The maximum tidal surge is the largest positive surge during the storm event.
Figure F2 shows the monthly time series of $H_s$, with the threshold shown in red. The occurrence of storm waves in the current reporting period is also compared with similar storm waves in previous years in Figure F3. Subsequent figures show a time series of the wave conditions for each of the storms listed in Table F1, together with the tidal conditions at the nearest tide gauge. Each graph is centred around the highest $H_s$ of the individual storm.

Summary

This reporting year was less stormy than the previous year, both in terms of storm magnitude and frequency, though it remained significantly stormier than prior to 2006. Storms were concentrated between November and March.

The storm of 10 March 2008, which affected much of the south coast, was accompanied by a storm surge of 0.80m at Newhaven and coincided with near-equinoctial spring tides (tidal elevation reached 3.7 OD). However, although this was the most significant event of the year for much of the south coast, it was only the second highest of the reporting year at Pevensey Bay. From the 5 years worth of measurements, there is now sufficient evidence to suggest that this site seldom experiences the long period Atlantic swell which is regularly measured at the wave sites further west (including Rustington), and hence wave conditions at Pevensey Bay are dominated by in situ, wind-driven waves associated with the passage of low pressure systems. During this reporting year, storm peak wave periods, $T_p$, remained less than 10s.

Tidal surges (at Newhaven) exceeded 0.5m during the three highest storms, with a similarly large surge (~0.8m) as accompanied the highest storm in the last reporting year. This, again, is in contrast to years prior to June 2006, when storms surges were generally negligible.

Acknowledgements

Tidal data were supplied by the British Oceanographic Data Centre as part of the function of the National Tidal and Sea Level Facility, hosted by the Proudman Oceanographic Laboratory and funded by DEFRA and the Natural Environment Research Council.
Figure F2  Monthly time series of $H_s$ at Pevensey Bay. Storm threshold, shown in red, is 3m.
Figure F3 Incidence of storms during (a) reporting period and (b) since deployment.
Figure F4  Highest storm of the reporting period

The highest storm of the year was characterised by a significant wave height (Hs) of 3.96 m from the SSW. The tidal surge measured at Newhaven was negligible at the peak of the storm.
Figure F5  Second highest storm of the reporting period

This storm was generated by the passage of a deep depression with a complex, frontal system (see figure F6). Although this was not the highest recorded event at this location, it was the major storm of the year at most other coastal wave sites in the English Channel. For example, at Boscombe and Hayling Island this storm was the largest recorded since deployment of the buoys in 2003. Storm direction was from SSW during the build up to the storm peak, but from the SW for the remainder of the storm period.

There was a considerable surge associated with the storm, which coincided with equinoctial spring tides, although the maximum surge of 0.8 m preceded the peak of the storm and occurred around Low Water.
Figure F6  Surface Pressure chart 10 March 2008 at 0001Z
This particular storm represents a “typical” storm sequence with wave height gradually increasing over a 12 hour period to reach a maximum $H_s$ of 3.79 m. Waves in excess of the 3m threshold were experienced for approximately 5 hours. Unusually, the storm was accompanied a minor negative surge, but followed by a lengthy positive surge of up to 0.5m.
This brief storm was linked to the rapid passage of a low pressure. The tidal surge was negligible.