BEACH MANAGEMENT PLAN REPORT

HASTINGS

2006

BMP 35 - Annex

24th October 2006
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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 Terrain and difference models**

The Digital Terrain 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 DTM 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:

$$\text{Grid}_1 - \text{Grid}_2$$

Eqn (2)

where Grid$_1$ = most recent baseline grid and 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 Terrain Models*
Annex C

Difference Models
Volume Data Discounted due to Bulverhythe Coastal Defence Works (See Figure 4.2)
Annex D

_Pevensey Bay WaveRider Buoy_

Pevensey Bay Waverider Buoy - July 2005 to June 2006

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 Buoy Mk III

Data Quality

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<th>C1(%)</th>
<th>Sample interval</th>
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Storm Analysis

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<tr>
<th>Date/Time</th>
<th>H_s (m)</th>
<th>T_p (s)</th>
<th>T_z (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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Table A1  Storm events during the reporting period, July 2005 to June 2006

A storm is defined using the Peaks-over-Threshold method (Figure A1). 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.

Figure A1  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.
At present, the threshold for an individual site is derived empirically, since the measurements span only 3 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 Pevensey Bay is 2.75m.

Figure A2 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 A3. Subsequent figures show a time series of the wave conditions for each of the storms listed in Table A1, together with the tidal conditions at the nearest tide gauge. Each graph is centred around the highest $H_s$ of the individual storm.

**Summary**

The year's storms were concentrated over the winter months (unlike the last 2 reporting years, when the storms tended to be distributed throughout the year) and, in particular, over a lengthy period of high waves in early and late December. The storms were, however, of lower magnitude than those experienced in the 2003/4 reporting year.

5 of the 6 highest storms occurred during spring tides. The height of the storm occurred in most cases within a couple of hours of High Water although the wave buoy is sited in comparatively shallow water at this site and therefore the highest waves are likely to occur in the deepest water i.e around High Water, due to shallow-water effects. There were no significant tidal surges associated with any of the storms, and little evidence of the long period swell waves which had been the precursor to some of the storms in during 2004/5.
Figure A2  Monthly time series of $H_s$ at Pevensey Bay. Storm threshold, shown in red, is 2.75m.
Figure A3  Incidence of storms during (a) reporting period and (b) since deployment
Figure A4  Highest storm of the reporting period

This was a high but short-lived storm, generated by local winds from the south ahead of a series of complex occluded fronts which were associated with a low pressure system tracking NW off the western UK coast. The tidal surge was negligible, and there was no evidence of swell waves ahead of the storm peak.
Figure A5  Second highest storm of the reporting period

This storm was the last but highest of a series, which saw waves in excess of 2.5m Hs for 36 hrs, generated by a slow-moving, deep depression off SW Ireland (central pressure 964mb), which tracked slowly NW across central southern Britain, filling gradually (see Figures A6 a and b).
Figure A6 (a) Surface Pressure chart for 0000Z 02 December 2005

Figure A6 (b) Surface Pressure chart for 0000Z 03 December 2005
Figure A7  Third highest storm of the reporting period

This was the build-up to the storm peak some 24 hours later (see Figure A5), again from locally-generated winds from the south.
Figure A8  Fourth highest storm of the reporting period

A short south-westerly storm peak, following over 36 hours of moderately high waves ($H_s \sim 2m$).
Figure A9  Fifth highest storm of the reporting period

A short-lived peak in a lengthy period of moderate south-westerly waves, during neap tides.
Figure A10  Sixth highest storm of the reporting period

This was the only storm which showed evidence of a long period swell ($T_p \sim 14s$), some 8 hours before the storm peak, and when the waves were below 1m $H_s$. The storm direction was consistent throughout the entire period (SWbS), as it was during the fifth highest storm (see Figure A9).