SETBACK LINE STUDY FOR ERF 134 CAPE INFANTA

DRAFT REPORT SUBMITTED FOR COMMENT TO

Doug Jeffery Environmental Consultants (Pty) Ltd, (6 August 2012)

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1 INTRODUCTION

Erf134, located in Infanta, about 8 km east of Cape Infanta, lies on a unique portion of the Cape coast between San Sebastian Point and the Breede River estuary mouth (Figure 1). The Breede River mouth is wide and exhibits a sandbar which protrudes from the Witsand shoreline across most of the mouth of the river as it meanders to sea. In contrast with this mobile and dynamic river mouth area, Cape Infanta and San Sebastian Point provide rocky headlands which shelter a relatively hard and stable shoreline near Infanta.

Figure 1 : Location of Infanta and Erf 134

Erf 134 is 85 hectares and is located just north of developed residential areas at Infanta. The Erf lies about 1km south of the mobile estuary area with its seaward boundary bordering the rocky shoreline (Figure 2). The property is traversed by the main access road into Infanta Village (north west to south east direction). The portion lying east of the main road is the subject of a planning application for a proposed development.

To guide the development a setback line assessment was performed in 2010 by PBNS (PBNS 2010) at the request of Doug Jeffery Environmental Consultants (DJEC). Subsequently Geoff. Toms (Consultant) was requested to reappraise the setback line in terms of recently published standard methodologies (e.g. DEA&DP 2010). This report provides an assessment of the setback line for the development on Erf134 in terms of these methodologies.

Figure 2 : Erf 134 at Infanta – coastal portion

2 SITE DESCRIPTION

2.1 Topography and land type

In Figures 3a and 3b the site and its seaward edge are shown in more detail. The site is enclosed within a wire fence. On its seaward (eastern) edge the fence is separated from the “vegetation line” (the seaward limit of survival of natural vegetation) by a distance of 20-25m in the south narrowing to almost nothing in the north (in front of the building shown in the Figure). Seaward of the vegetation line is a small steep slope which falls to a rocky intertidal platform (exposed at low tide and flooded at high tide) which extends at least 50m seaward.

Swell waves approach this local portion of coast at a sharp angle and undergo significant breaking and dissipation of energy on the extensive shallow rocky area as shown in Figure 3b. Beach sand is absent being transported alongshore towards the estuary by the oblique wave attack or blow2n ashore by ESE onshore winds.

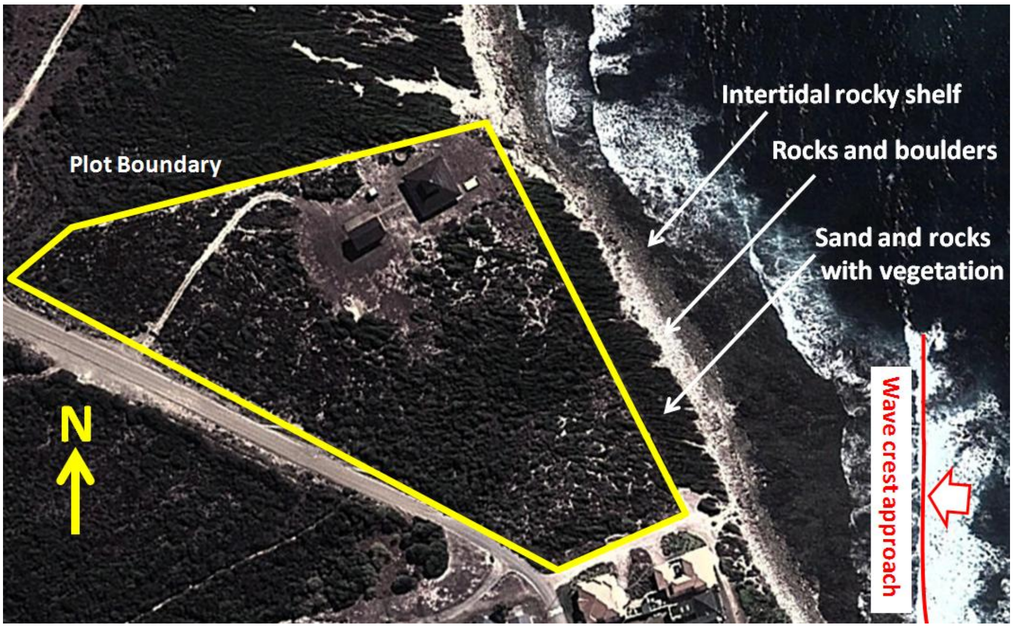

Figure 3a : Erf 134 showing angular wave crest approach and wide rocky intertidal area with vegetation seaward of the plot boundary

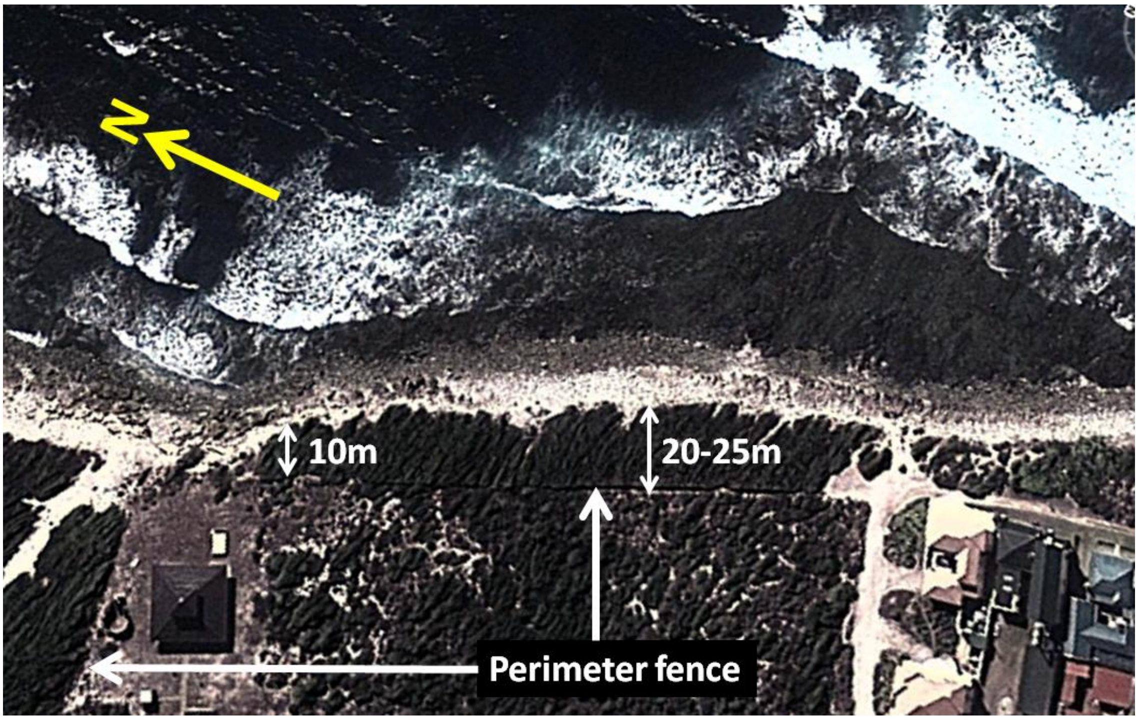

Figure 3b : Erf 134 (rotated view) showing perimeter fence and vegetated seaward buffer up to 25m wide beyond the fence-line

During a site visit, the author observed that the complete shoreline of Erf134 was rocky and strewn with boulders and shelly pockets with minimal sand. There was no sandy beach. The buffer zone outside the boundary fence of the plot was thickly vegetated on hard sandy ridges orientated in line with the onshore winds (from ESE). Just north of the site is evidence of a "blow-out" of sand travelling onshore but along Erf134 there are no soft or exposed sandy areas.

Photographs taken during the site visit are given in Annex A and demonstrate the hard nature of this shoreline.

Elevations of the shoreline were also examined using the data provided by DJEC.

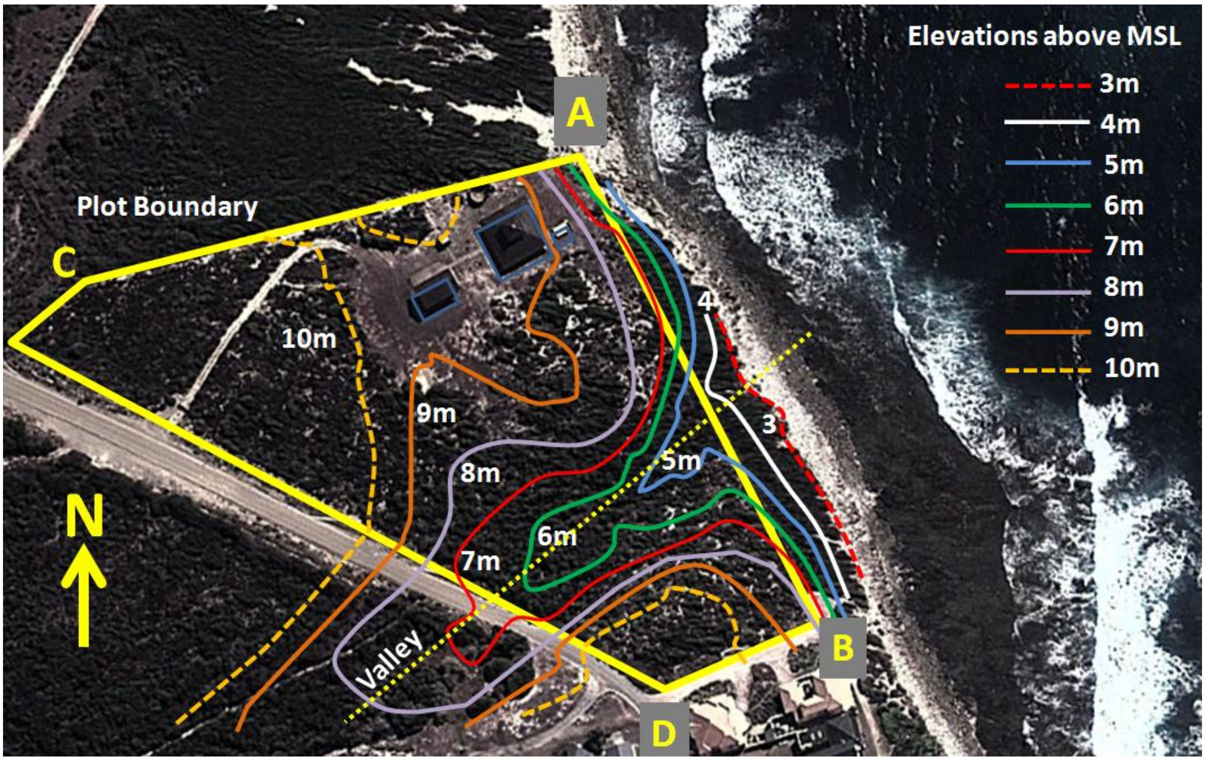

Figure 4 : Elevation contours (m) above MSL for Erf 134

To assist in visualising the elevations across the site, Figure 5 shows a plot of the elevations along boundaries AC and BD and along the valley shown by the dotted line in Figure 4. The elevations along the seaward boundary are shown in Figure 6.

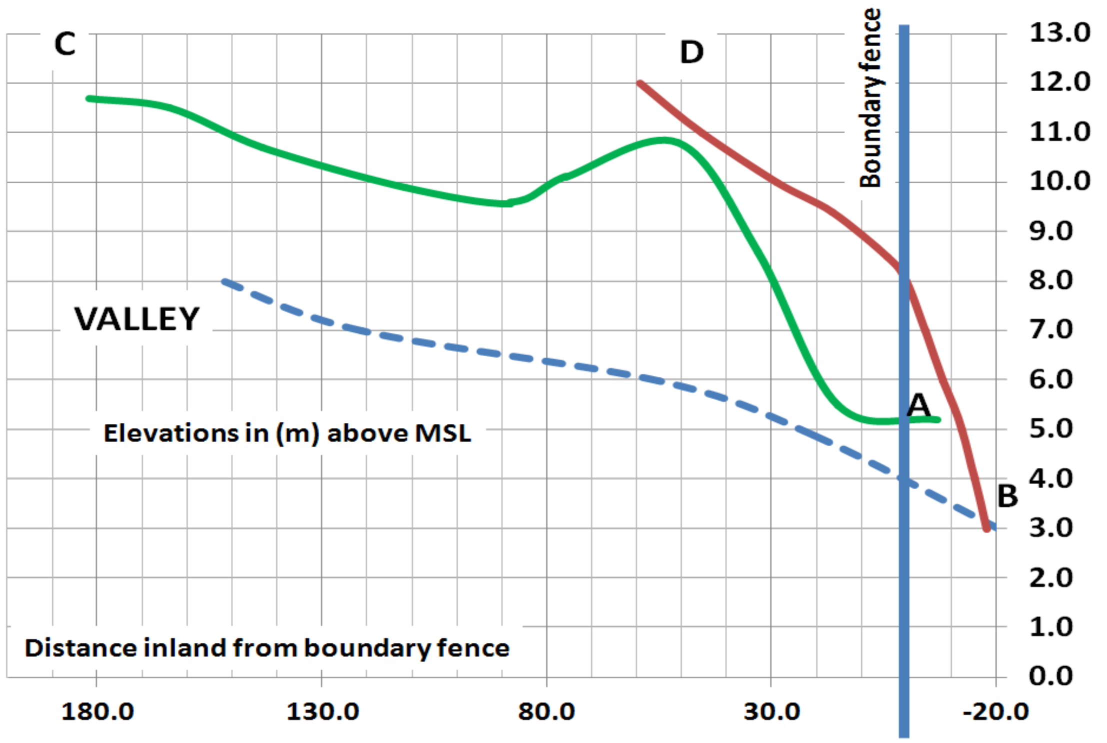

Figure 5 : Cross-section profiles in (m) above MSL (viewed from south with seaward side on the right of the boundary fence)

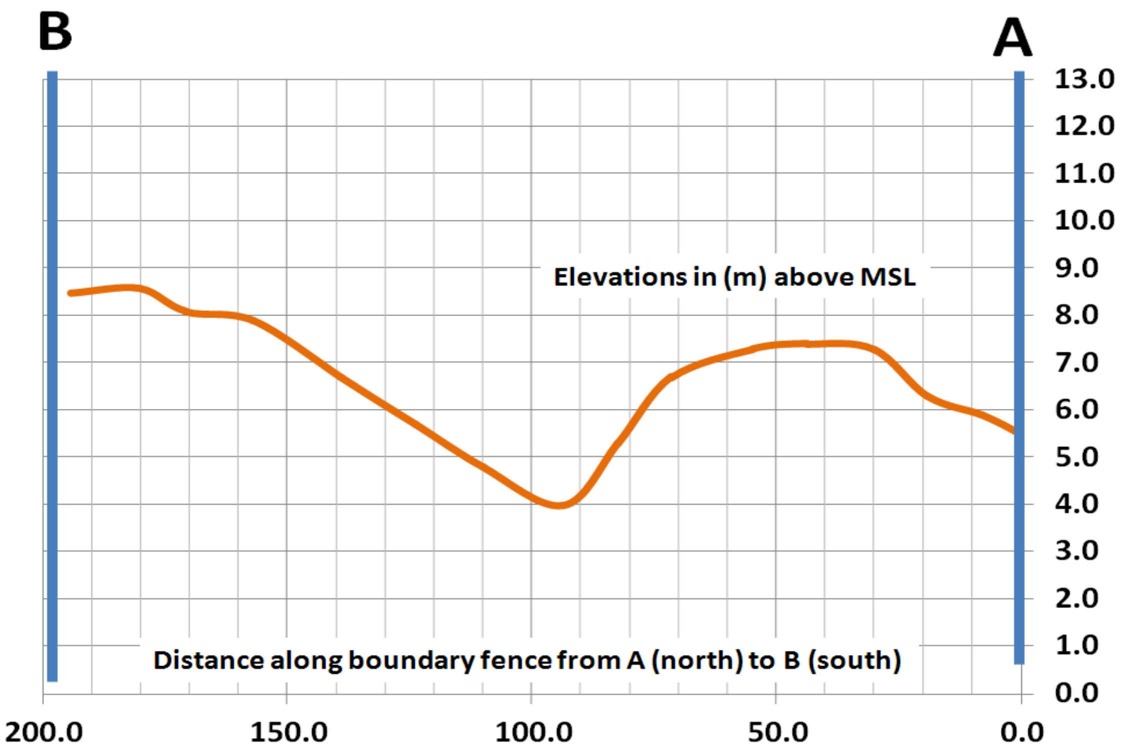

Figure 6 : Longshore profile along the seaward boundary fence in (m) above MSL (viewed from seaward side looking landward)

The key observations concerning elevations are the following :

- The vegetation line coincides well with the +3m elevation contour
- The northern boundary of the plot is 3m lower than the southern boundary at the boundary fence
- There is a valley running through the plot from NE to SW with elevations 3 to 5m lower than the rest of the plot
- The effect of the valley can be seen at the seaward boundary where elevations drop to +4m above MSL (1m above the present vegetation line)

NOTE :
(1) The elevations for the above information were derived from the survey supplied by DJEC (supplied by Dave Saunders Planner). The superposition on the Google Image has been done to demonstrate the elevations but is not precise and measurements should not be taken from Figures 4 to 6 but rather from the original data source.
(2) The datum for the surveys has been given as MSL (Mean Sea Level). It was confirmed by DJEC that the survey was based on MSL. It could not be confirmed whether the MSL refers to LLD (Land Levelling Datum) or ML (Mean Tide Level). The LLD is 34cm below ML at Hermanus and 23cm below ML at Mossel Bay (SANHO 2012).

2.2 Shoreline and nearshore seabed

From the data shown in Figure 7 the seabed depths (m below Chart Datum) are shown on a large scale map. There is a lack of good local bathymetry with a finer resolution.

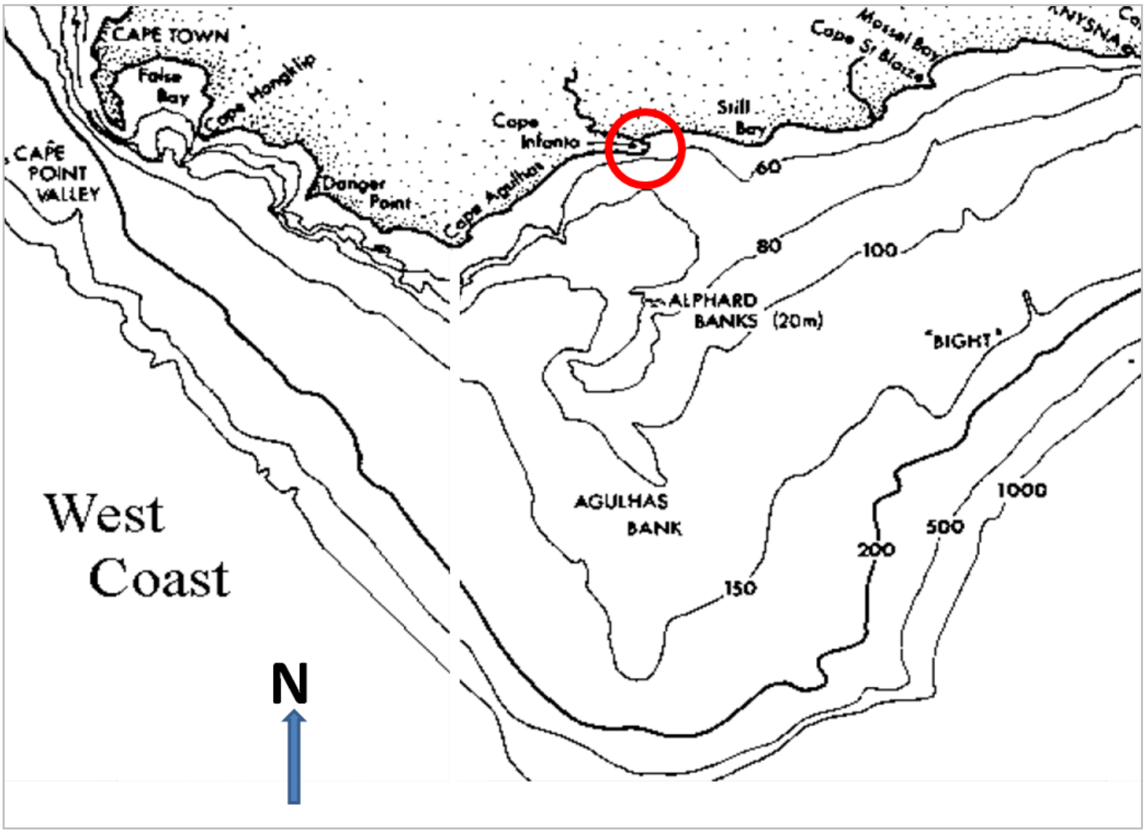

Figure 7 : Seabed depths below Chart Datum off the Southern Cape coast (ref. Hutchings 1994)

The main feature relevant to the site is the proximity of the -60m contour to the western side of Cape Infanta and the relatively wide shallow shelf over which storm swells (from the sectors south to west) will be refracted and partially dissipated. The sheltered location of Infanta and Erf134 east of Cape Infanta and Sebastian Point will result in a milder climate at the exposed coast of Erf134. The SANHO

Sailing Directions describe San Sebastian Bay as a sheltered bay within which vessels can find shelter from storm swells and that at about 500m offshore the seabed depth attains 15m below Chart Datum.

The bathymetry closer to the shore is less certain. The rocky platform and reefs are visible extending approximately 50 to 100m from the shore at intertidal levels (within 1m below MSL). The profile adopted will therefore be a depth of 1m below MSL at 100m from the MSL shoreline and 16m below MSL at 500m from the MSL shoreline.

The photographs in Annex A show the extensive wave breaking on the shallow rocks within at least 100m from the shoreline in moderate sea conditions.

2.3 Tides

Tides for the area are provided by SANHO (2012) in published tide tables. The tides are characterized as follows in (m) :

Highest astronomical tide	HAT	= +1.2m
Mean High Water Spring Tide	MHWS	= +0.9m
Mean Tide Level	ML	= +0.0 m

The Land Levelling Datum (LLD) is 29cm below Mean Tide Level (ML). In this report it has been assumed that MSL on survey drawings provided by the client refers to LLD.

The highest tide level (without taking account of winds, waves or atmospheric pressure influences) is the HAT level which is reached once in approximately 19 years while the high tide level will just exceed 1m above MSL on frequent spring tides each year and the mean high tide will be about 0.9m above MSL.

It will be seen in the coming Sections that significant water level additions are required to allow for wave set up, storm surge and sea level rise (global warming). In addition intermittent wave run-up on the shoreline will be significant in storms.

5 SETBACK COMPONENTS

5.1 General

The methodology being followed is similar to that reported in the DEA&DP document "Western Cape Coastal Development Set-Back Methodology" based on WSP(2010) (available via the Provincial Website). The same document was used for the determination of the "Coastal Processes / Erosion Line" setback line which has been announced by DEA&DP (Overberg District Municipality) as a result of recent studies by SSI Consultants for the Western Cape Department of Environmental Affairs & Development Planning, "The Establishment of Coastal Setback Lines for the Overberg District" (EADP4/2010), SSI(2012).

The setback line comprises the following components :

(1) Coastal erosion and flooding
- Storm water level
- Storm wave run up
- Coastal erosion allowance due to long term shoreline retreat
- Coastal erosion allowance due to short term storm retreat
- Coastal retreat due to sea level rise

(2) Other

- Allowance for Dune Integrity,
- Sediment Pathways
- Estuary Buffers

In general, there is often good agreement between authorities, researchers and Interested and Affected Parties (I&AP's) on the "Coastal erosion and flooding" components under Item (1) above. However the remaining "Other" allowances under Item (2) above are subject to interpretation and debate and present the largest challenge in the determination and implementation of setback lines. Unfortunately there is no subdivision of the announced "Coastal Processes / Erosion Line" to show which portions have been added for Items (1) or (2).

In this report, the focus will be on a detailed confrontation of the Hydraulic components with the Erf134 and a discussion, but no determination, of the "Other" components.

The announced "Coastal Processes / Erosion Line" has been provided by Provincial and District Municipality Authorities but it is not clear what the present statutory or legal status of the line is at the time of writing and it is recommended that this is followed-up with DEA&DP as a matter of urgency. The line is shown in Figure 8.

Figure 8 : Showing the Overberg Municipality setback line and the PBNS Setback Line superimposed onto Erf134.

Also shown on Figure 8 is the PBNS Setback Line which was provided in 2010 by PBNS in a report to DJEC. The PBNS setback line is based on an examination of marine conditions, historic aerial photography and a 25m buffer landward of the vegetation line (seaward limit of survival of land-base vegetation).

The discrepancy between the PBNS line and the Overberg Municipality Line is partly due to the new methodology and partly due to the inclusion of the "Other" factors listed above.

5.2 Assessment of "Coastal Erosion and Flooding" Factors

5.2.1 Storm water level (2012)

The mean water level (still water level without wave run up or wave set up) is assessed as follows :

MHWS + Storm surge (atmospheric pressure and wind set up)

The determination of the storm surge statistics in detail has not been conducted within the scope of this assessment. As a conservative judgment by the author a value of 0.5m has been adopted for 1 in 10 years and 1m for 1 in 100 years.

Therefore the mean water levels in storms (as at 2012) will be adopted as follows :
1 in 10 years : 0.9m + 0.5m = +1.4m above MSL
1 in 100 years : 0.9m + 1.0m = +1.9m above MSL

5.2.2 Storm water level (2112)

By 2112, in 100 years time it is required by setback line methodologies to take account of a sea level rise of 1m. This value can be debated but it is stipulated and used in the Province's approach.

In addition an increase in storm surge value due to an expectation of increased intensity of southerly winds can cause an added 10%. This addition is somewhat subjective and interpreted by the author but based on similar studies being conducted (ref. Luger 2011).

Therefore the mean water levels in storms (as at 2112) will be adopted as follows :
1 in 10 years : 0.9m + (0.5m)x1.1 + 1.0m = +2.5m above MSL
1 in 100 years : 0.9m + (1.0m)x1.1 + 1.0m = +3.0m above MSL

5.2.3 Wave set up

Wave set up is the result of waves breaking in storms and causing the mean level within the wave to raise as the wave approaches the shoreline. The wave set-up is well understood in literature with standard formulations. The range of wave set up normally varies from 0.3m to 1.m under most storm conditions. In the present study a reasonable conservative value of 0.3 to 0.5m can be used. This is considered acceptable given the uncertainty of the nearshore wave conditions and bathymetry.

5.2.4 Wave run-up

The wave run up component is the component which is intermittent and varies per individual wave. It is defined as the vertical distance of the tip of the wave reach from the mean water level within the wave. The degree of wave run up is theoretically dependent upon the wave properties (height, period), nearshore and beach slope, roughness of the nearshore and beach, permeability of the beach etc. Mather (2010) gave a general approach for computation of wave run based on studies in Natal and the Cape. In this report the method of Mather (2010) for sandy shores has been applied and compared with other methods for rock slopes to derive the following wave run estimates :

In 2012
1 in 10 years wave run up : 2.0m
1 in 100 years wave run up : 3.0m

In 2112 (increase by 10% due to increased southerly storm intensity)
1 in 10 years wave run up : 2.2m
1 in 100 years wave run up : 3.3m

If the wave run up is added to the other water level components it can be seen that the following additions are required :

1 in 10 years elevation limit of wave action on the shoreline (2012) :
Storm water level (2012) + Wave set up + Wave run up = 1.4m + 0.3m + 2m = +3.7m above MSL

Up to…..

1 in 100 years limit of wave action on the shoreline (2112) :
Storm water level (2012) + Wave set up + Wave run up = 1.9m + 0.55m + 3.3m = +5.8 above MSL

The Provincial Methodology for setback lines adopts the 1 in 10 years line as a "HWM". In Figure 4 it can be seen that the HWM defined in this way falls between the vegetation line and the boundary fence of Erf134. This correlates well because a 1 in 10 years storm will penetrate the vegetation line but the longer time line to which the vegetation will recover and survive will be more typical of a lesser storm event wave run up such as a 1 in 1 year event.

5.2.5 Coastal erosion allowance due to long term shoreline retreat

The analysis of long term coastal erosion by PBNS(2010) based on aerial photographs since 1942 showed no significant retreat and a value of 10m was proposed. This slow or negligible retreat process is in line with the observation of a hard coast and fact that Erf134 is not bordering the more dynamic shoreline of the estuary which is about 1km distant.

5.2.6 Coastal erosion allowance due to short term storm retreat

As a judgment, it is not necessary to make additional allowance for storm retreat in 2012 on this hard coast.

5.2.7 Coastal retreat due to sea level rise

It is not considered appropriate to add additional allowance on this hard shoreline given the allowances made under 5.2.6 and 5.2.7.

5.2.8 Summary – Coastal Erosion and Flooding Factors

The determined setback line factors can be summarized in terms of the Provincial Methodology as follows :

2012
Maximum flood level for inundation from the sea = 1.7m above MSL
Maximum vertical elevation of storm wave run up (1 in 10 years) = 3.7m above MSL
Allowance for erosion issues 10m additional setback

2112
Maximum flood level for inundation from the sea = 2.5m above MSL
Maximum vertical elevation of storm wave run up (1 in 100 years) = 5.8m above MSL
Allowance for erosion issues 10m additional setback

The interpretation of these results is that at present a setback 10m landward of the elevation of +4m above MSL, (rounded up from +3.7m), will provide reasonable protection from coastal flooding and erosion issues (1 in 10 year risk).

Taking sea level rise due to global warming into account, a setback 10m landward of +6m above MSL, (rounded up from +5.8m), will provide protection from coastal flooding and coastal erosion (1 in 100 year risk). This is the recommended approach for the "setback line" taking coastal flooding and coastal erosion into account. This line, shown in Figure 9 as "Setback line - flooding and erosion" excludes allowances for "other" issues (dune issues, sediment pathways and/or estuarine buffers).

Compared to the other setback lines this line (shown in white in Figure 9) makes allowance for the "valley" formation which traverses the site and lies between the PBNS and the Provincial lines. The proposed setback line merges at the plot boundaries with the PBNS line. Further there is agreement with the adjacent developed plots to the south which do not extend seaward of the +6m MSL land elevation contour with buildings at higher elevations (approx. +7m MSL).

Figure 9 : Erf134 - Composite of setback lines including "Setback line – flooding and erosion"

5.3 Assessment of "Other" Factors

5.3.1 Dune issues

The site is one of vegetated ridges with pockets of softer sand, probably historic wind blown sands aligned ESE to WNW. It is not a location of high soft sandy dunes. For this reason it is not expected that there will be any risk of dune collapse or dune erosion by waves which is more typical of larger softer features.

It is very much in the interest of the developer to ensure that access to the coast is given in a formal way with raised wooden walkways rather than in an informal way with multiple pedestrian or vehicular access points since the latter devastate even the harder coastal edges by de-stabilizing vegetation and loosely packed stone slopes. Also, during construction or vegetation clearing there should be a strong sensitivity to these issues and to retaining vegetation buffers where possible to traps and stabilize any sands which will blow across the harder substrate.

5.3.2 Sediment pathways

There are no apparent sediment pathway issues overland which will be disturbed by the development of Erf134. Referring to Figure 1, the plot is located in the lee of Cape Infanta and is not part of a mobile sandy passage of sediment. The examination of aerial photographs from 1943 in PBNS (2010) showed no evidence of sediment pathways in the area prior to development.

5.3.3 Estuarine buffer

Erf134 is located well clear of the estuarine coastal processes which take place 1km to the north. There is no danger to the site in this respect and no allowance is required.

6 CONCLUSIONS

The setback line for flooding and erosion has been derived in this report as 10m landward of the +6m MSL elevation contour. Using this guidance the line has been superimposed on a plan of the development in Figure 9. This highlights areas of potential conflict for the development of the seaward plots just north of the “valley” formation.

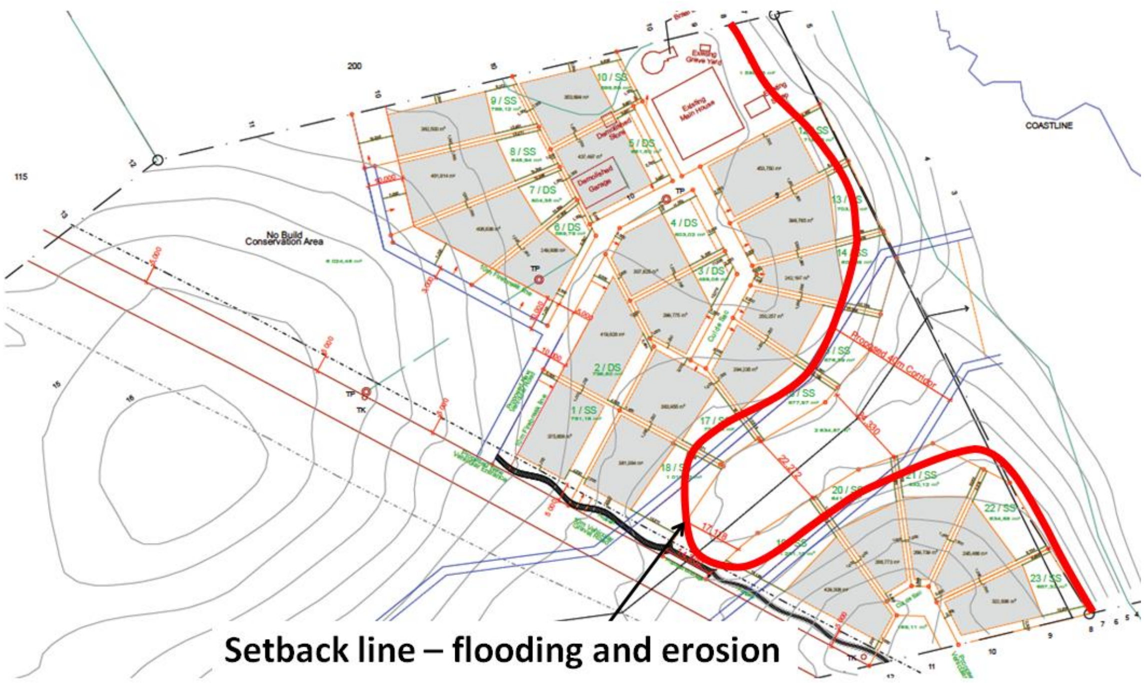

Figure 9 : The Setback Line - flooding and erosion as a result of the analyses in this report, superimposed on the proposed development

The precise positioning of the line can be made by DJEC based on a location 10m landward of the +6m MSL contour. The line should then be coordinated and drawn more accurately on the latest development plans to highlight potential conflicts.

The discussion of the precise location of the proposed line with the Provincial/Municipal authorities is recommended in view of the difference between the line proposed by this report and the Overberg Municipality Setback Line.

REFERENCES

DEA&DP (2010) Development of a Methodology for Defining and Adopting Coastal Development Setback Lines, Department of Environmental Affairs & Development Planning, Provincial Government of the Western Cape, May 2010

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SSI (2012), The Establishment of Coastal Setback Lines for the Overberg District, Department of Environmental Affairs & Development Planning, Provincial Government of the Western Cape, Report EADP4/2010, SSI, March 2012,

WSP (2010) Development of a Methodology for Defining and Adopting Coastal Development Setback Lines, WSP Consulting Engineers, May 2010 *(same basic document as DEA&DP (2010))*

ANNEX 1 : PHOTOGRAPHIC RECORD 29 JUNE 2010

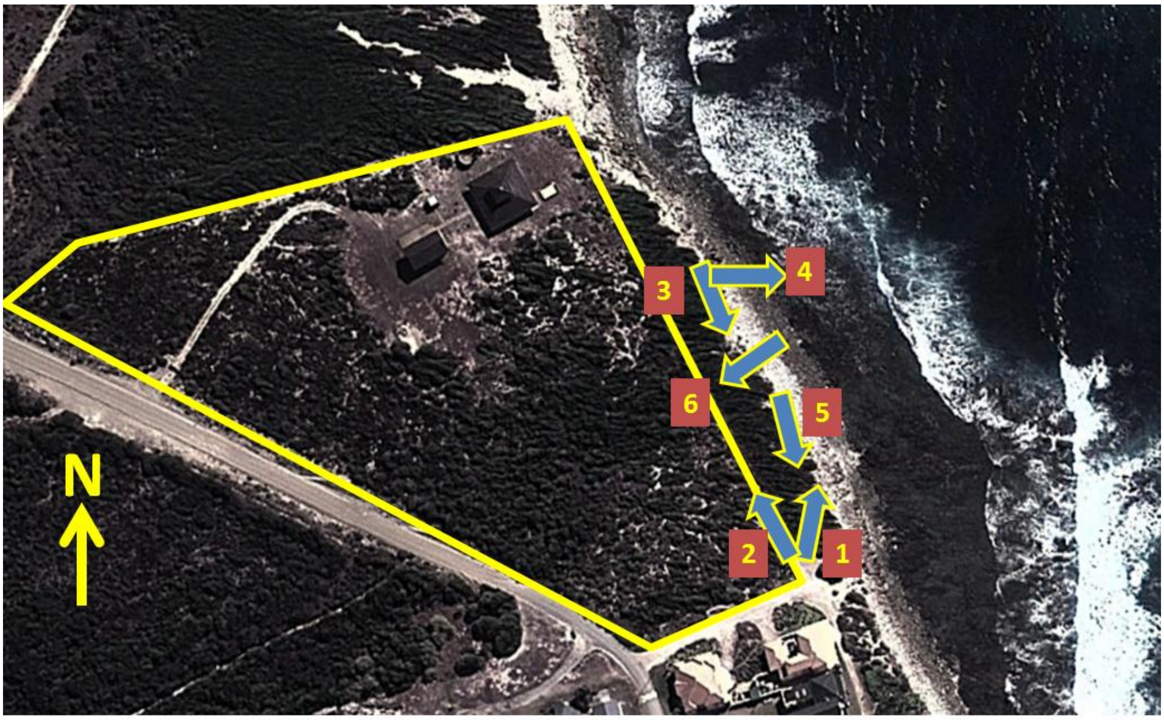

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PHOTO 1

PHOTO 2

PHOTO 3

PHOTO 4

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PHOTO 6