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Coastal Management (Set-back) Lines for the Overberg District

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ABBREVIATIONS

amsl	Above mean sea level
CBA	Critical Biodiversity Area
CML	Coastal Management Line
CMP	Coastal Management Programme
CPZ	Coastal Protection Zone
DEADP	Western Cape Government's Department of Environmental Affairs & Development Planning
EIA	Environmental Impact Assessment
HWM	High-water mark
I&AP	Interested and Affected Party
ICM Act	National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008) as amended by the National Environmental Management: Integrated Coastal Management Amendment Act (Act No. 36 of 2014)
LIDAR	Light detection and ranging
LUMS	Land Use Management Scheme
MEC	Member of the Executive Council
NEMA	National Environmental Management Act (Act No. 107 of 1998)
PSDF	Western Cape Provincial Spatial Development Framework
SLR	Sea level rise
SPLUMA	Spatial Planning and Land Use Management Act (Act No. 16 of 2013)
WCG	Western Cape Government

GLOSSARY

(dynamic) coastal processes	as defined by the ICM Act means all natural processes continually reshaping the shoreline and near shore seabed and includes — (a) wind action; (b) wave action; (c) currents; (d) tidal action; and (e) river flows.
coastal management	as defined by the ICM Act: (a) the regulation, management, protection, conservation and rehabilitation of the coastal environment; (b) the regulation and management of the use and development of the coastal zone and coastal resources; (c) monitoring and enforcing compliance with laws and policies that regulate human activities within the coastal zone; and (d) planning in connection with the activities referred to in paragraphs (a), (b) and (c).
coastal management line	means a line determined in accordance with section 25 of the ICM Act, as amended, in order to demarcate an area within which development will be prohibited or controlled in order to achieve the objects of the Act or coastal management objectives.
coastal planning scheme	as defined by the ICM Act a scheme that — (a) reserves defined areas within the coastal zone to be used exclusively or mainly for a specified purpose; and (b) prohibits or restricts any use of these areas in conflict with the terms of the scheme.
coastal protection zone	as contemplated in sections 16 and 17 of the ICM Act, a zone established for enabling the use of land that is adjacent to coastal public property or that plays a significant role in a coastal ecosystem to be managed, regulated and/or restricted.
coastal public property	means coastal public property referred to in section 7 of the ICM Act.
coastal risk	risks specifically related to the coastline as informed by events such as coastal erosion, storm surges, sea level rise and storm wave run-up, as well as certain dynamic ecological processes such as active littoral zones (e.g. mobile dune systems).
coastal set-back line	see 'coastal management line' – ICM Act terminology changed to 'coastal management line' as per the 2014 amendment.

development	as defined by the ICM Act in relation to a place, means any process initiated by a person to change the use, physical nature or appearance of that place, and includes— (a) the construction, erection, alteration, demolition or removal of a structure or building; (b) a process to rezone, subdivide or consolidate land; (c) changes to the existing or natural topography of the coastal zone; and (d) the destruction or removal of indigenous or protected vegetation.
estuary	as defined by the ICM Act means a body of surface water — (a) that is permanently or periodically open to the sea; (b) in which a rise and fall of the water level as a result of the tides is measurable at spring tides when the body of surface water is open to the sea; or (c) in respect of which the salinity is higher than fresh water as a result of the influence of the sea, and where there is a salinity gradient between the tidal reach and the mouth of the body of surface water.
existing development rights	executable rights for activities or development on properties, as allocated through zoning schemes and approvals in terms of applicable regulatory schemes.
high risk	coastal risk (i.e. risks emanating from sea level rise, storms, waves, wind, erosion etc.) with a 20 year return period – i.e. therefore with a 5 % chance of taking place in any given year during the ensuing 100 years.
LIDAR	a remote sensing technology that measures distance by illuminating a target with a laser and analysing the reflected light in order to produce high resolution topographical maps.
littoral active zone	as defined by the ICM Act means any land forming part of, or adjacent to, the seashore that is — (a) unstable and dynamic as a result of natural processes; and (b) characterised by dunes, beaches, sand bars and other landforms composed of unconsolidated sand, pebbles or other such material which is either un-vegetated or only partially vegetated.
low risk	coastal risk (i.e. risks emanating from sea level rise, storms, waves, wind, erosion etc.) with a 100 year return period – i.e. therefore with a 1% chance of taking place in any given year during the ensuing 100 years.
medium risk	coastal risk (i.e. risks emanating from sea level rise, storms, waves, wind, erosion etc.) with a 50 year return period – i.e. therefore with a 2% chance of taking place in any given year during the ensuing 100 years.
overlay zone	planning zones superimposed on a base property zoning to increase or decrease the level of regulation over development on the site.

public facilities	<p>facilities developed and owned by government in the public interest, such as:</p> <ul style="list-style-type: none"> - Buildings or structures or systems related to ablutions or public resorts - Buildings or structures or systems related to educational or cultural purposes - Buildings or structures or systems related to roads and utility services, including water, sewerage and electricity reticulation - Coastal defence structures and flood control structures - Public open space
public open space	a piece of land formally zoned as such in the applicable town planning scheme
sea level rise	a rise in mean sea level as a consequence of global climate change, and driven by the melting of glaciers, the expansion of ocean volume through temperature rise and changes to the amount of water stored on land.

EXECUTIVE SUMMARY

The Western Cape Government commenced in 2010 with an initiative to establish coastal management lines (then known as coastal set-back lines) along the Western Cape coastline, as required by the National Environmental Management: Integrated Coastal Management Act (Act 107 of 2008), as amended. In 2010 a limited exploratory project at two sites in Langebaan and Milnerton defined a standardised approach to the determination of coastal risk and associated development of regulatory schemes. This project approach was tested on a larger scale with a pilot project covering the Overberg District in 2011/2012. A final refined approach, informed by a parallel process run by the City of Cape Town Metropolitan Municipality and based on more detailed risk projections and a more pragmatic regulatory scheme, was rolled out in for the West Coast District in 2014.

Concluding the process started in 2011, the successful outcome of the West Coast project is now being applied in the Overberg. The current process refines the risk projections of 2011/2012 and creates the necessary spatial information for use in an overlay zoning based regulatory scheme.

For the purposes of the project, four distinct spatially defined features are derived:

- A **Coastal Risk Assessment** for **20, 50 and 100 year horizons**
- A **development limit** or 'coastal management line'
- Risk-based '**Overlay Zones**' and accompanying **development parameters** to be used in **Town Planning Schemes**
- The demarcation of the **Coastal Protection Zone** to broadly identify the 'coastal area' for planning purposes

Current (1:10 year), short term (1:20 year storm event and a 20cm prediction of sea level rise), medium term (1:50 year storm event and a 50cm prediction of sea level rise) and long term (1:100 year storm event, a 100cm prediction of sea level rise and any additional littoral active zones) risk projections were modelled using a high resolution LIDAR based topographical map, bathymetric information, information on offshore and inshore wave heights and aerial photography.

Future risks were considered in terms of:

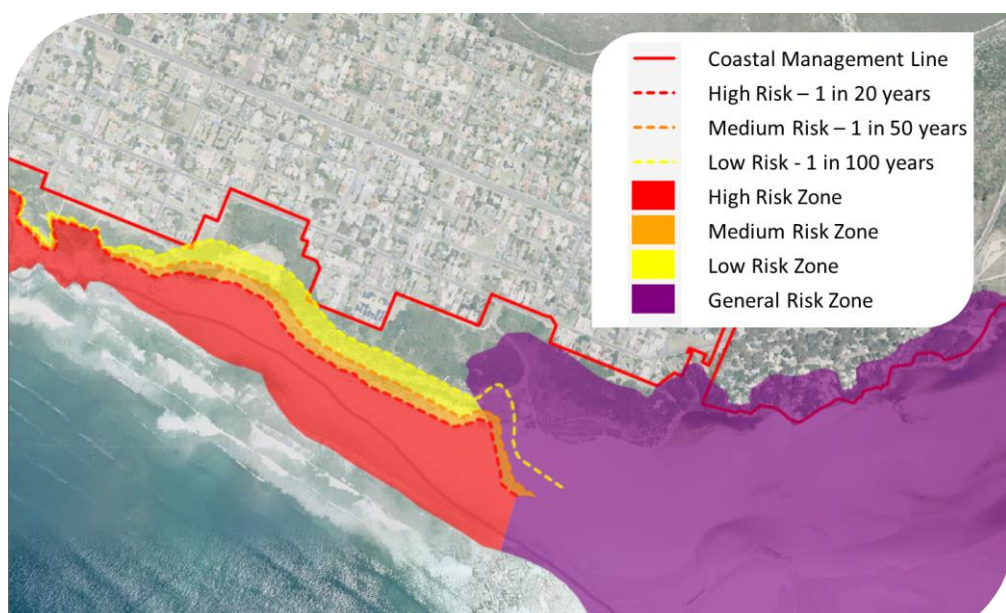
- natural coastal regression or accretion
- littoral active zones (mobile sand)
- projected sea level rise
- storm-driven coastal inundation
- projections of storm-driven coastal erosion
- inundation levels in estuaries

An example of the risk projections are shown in the figure below.



The risk areas informed the demarcation of a coastal management (set-back) line and risk zones, as a way of highlighting natural coastal processes and risks, and accompanying draft management controls / development parameters. The coastal management (set-back) line is informed by the risk projections, but is aligned seaward of existing developed areas or properties with executable rights, and landward of sensitive coastal features. The risk zones, on the other hand, are aligned with the three risk projections in urban areas, the low risk projection for undeveloped areas, and the 5m above mean sea level contour around estuaries.

In the image below, the coastal management (set-back) line (edge of development) is shown as a red line, the three urban risk zones respectively as red, orange and yellow, and the generalised risk zone for rural areas or estuaries in purple.



In some locations or contexts the standard demarcations were not practical, and required unique resolutions. Usually, this involves the demarcation of a coastal management line (set-back) around development footprints where such developments (or properties) are located within the identified risk zones with the intention of restricting the expansion of the development footprint further into the at-risk area. Typical situations where this occurs are found in rural areas or within the floodplains adjoining estuaries.

The last component, the demarcation of a Coastal Protection Zone, refines the national default for demarcation of the zone. This is done by adding all coastal sensitivities identified during the course of the project to the *'100m from the high-water mark in urban areas and 1km from the high-water mark in rural areas'* default specified in the Integrated Coastal Management Act to demarcate a broad area adjacent to coastal public property that *"plays a significant role in a coastal ecosystem"* and within which activities and development should be managed, regulated or restricted in a way that differs from non-coastal areas.

1 INTRODUCTION

The coastline is the focal point of not only sea level rise (SLR), but the impacts of continued economic development, population growth and changes to the climatic regime come sharply into focus on the coastline. The coastal zone also represents a desirable location for settlement, industry, harvesting of natural resources as well as recreational activities. This places the sensitive, vulnerable, often highly dynamic and stressed ecosystems found along the coast, right in the middle of a growing conflict between the need for human habitation and natural resource protection. As a consequence, coastal areas require specific attention in management and planning, in order to preserve coastal resources, protect coastal quality and reduce coastal-related risks.

The Western Cape Government's Department of Environmental Affairs & Development Planning (WCG) established draft coastal set-back lines for the Overberg District Municipality in 2011/2012 along with draft regulations applicable to such coastal set-back lines (WCG, 2012). The study involved the refinement of a methodology for determining coastal set-back lines in the Western Cape and the determination of a coastal physical processes line or no development line and a limited or controlled development line¹. As a pilot study, the outcome of the assessment raised many questions surrounding the practical application of these set-back lines and development control and the resultant impact on property rights. For this reason, the proposed coastal set-back lines and associated regulations were never formally adopted and promulgated.

Through this project, the WCG reviewed and updated the coastal set-back or coastal management lines² previously prepared for the Overberg District, and developed a recommended implementation strategy focussed on implementation through existing Local Authority Town Planning Schemes. This project forms part of a larger initiative to determine such development controls for the entire Western Cape coastline and mirrors similar efforts underway in the other coastal provinces of South Africa. It will replace the previous draft coastal set-back lines delineated and regulations proposed for the Overberg District, and follow on from similar work completed for the West Coast District.

1.1 The Overberg Coastline

Located within the Western Cape Province, the Overberg District Municipal area is characterised by 12 241 km² of beautiful, biodiversity rich landscapes falling entirely within the Cape Floristic Region. It stretches from the Hottentots-Holland mountain range in the west to the Breede River mouth in the east, and up towards the Rivieronsderend Mountains and Barrydale region in the north.

¹ Refer to section 3 on page 9 for an explanation on how these management tools were developed and with what intention.

² Recent amendments to the ICM Act rename 'coastal set-back lines' to 'coastal management lines'.

This municipality is comprised of four local municipalities, namely Swellendam, Overstrand, Cape Agulhas and Theewaterskloof. Of these local municipalities, the first three are bounded by the coastline which extends from Rooiels in the west to Cape infant on the Breede River in the east, as shown on Figure 1.

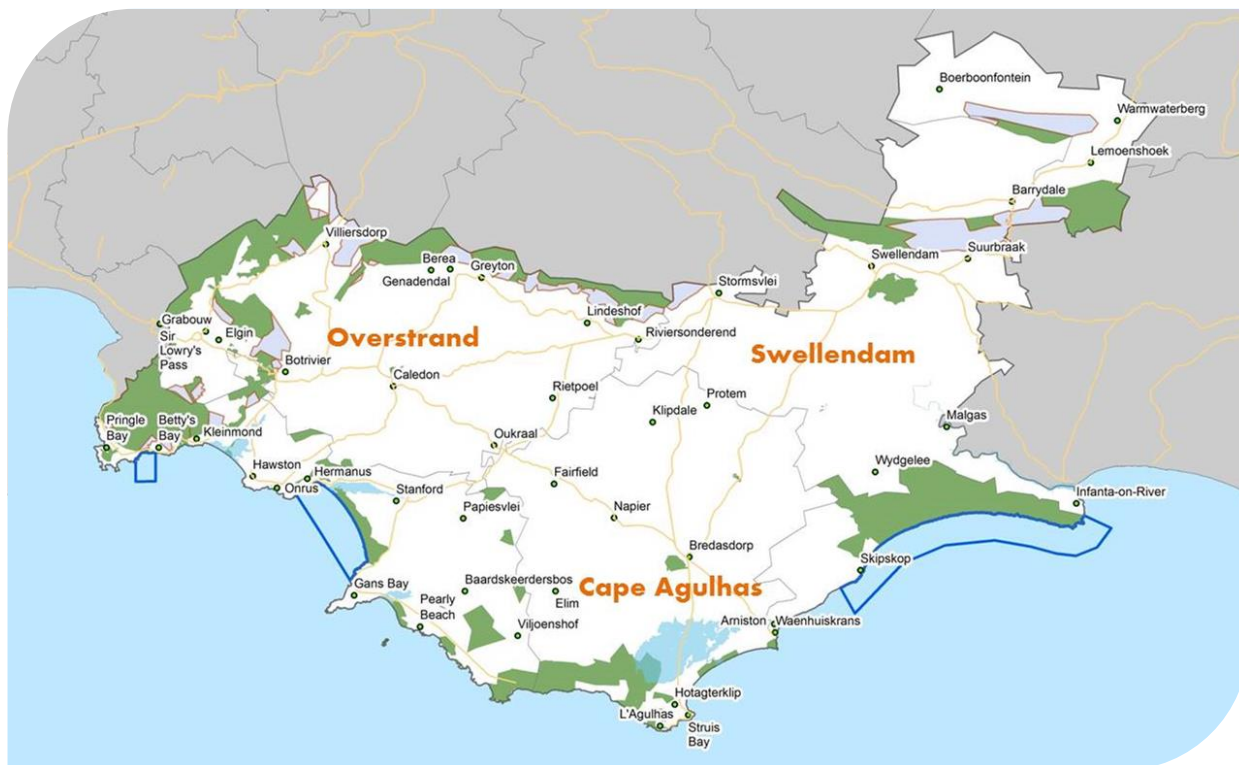


Figure 1: Overview of the Overberg District

The shoreline areas of the coastline are rugged and characterised by a range of habitats including rocky headlands, boulder beaches, wave-cut platforms, sandy beaches, subtidal soft sediment habitats, pocket beaches, kelp forests, estuaries, sub-tidal reefs and pelagic habitat. This can be broadly categorized into the following four types of shoreline: small sandy embayments where urban development has taken place; large open sandy stretches of coastline; steep rocky shorelines; and, rocky promontories.

The district also includes the southernmost point of Africa – Cape Agulhas - the meeting point of the Atlantic oceanic system and Indian oceanic system. These converging systems create ideal conditions for a remarkable ecotone of highly diverse fauna and flora, including numerous endemic species.

In terms of coastal management initiatives the Overberg District is in the process of developing a District Coastal Management Programme (CMP). The final version of this document should be available in May 2016. It will include a status quo analysis, situational and needs assessment; as well as a vision and specific objectives for the management of the municipality's coastal zone which will be both strategic and operational in nature.

Accompanying the CMP will be Coastal Management by-laws for the enforcement of locally appropriate and specific coastal management requirements. These by-laws will

act as a mechanism of implementation and enforcement of the specific objectives identified in the CMP.

1.2 Coastal Management (Set-back) Lines

The use of coastal management (set-back) lines is a particularly important response to the effects of climate change, as it involves both a quantification of risks and pro-active planning for future development. Although it cannot address historical decisions that have locked in development investment along potentially at-risk coastal areas, coastal management (set-back) lines can influence how existing development is maintained over time and how new development will be allowed to proceed.

Delineation of coastal management (set-back) lines must be undertaken in accordance, or in alignment with, a number of legislative tools. This includes the National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008) and the National Environmental Management: Integrated Coastal Management Amendment Act (Act No. 36 of 2014) (together referred to as the 'ICM Act'), the National Environmental Management Act (Act No. 107 of 1998) (NEMA), NEMA Environmental Impact Assessment (EIA) Regulations, 2014, the Draft Western Cape Provincial CMP as well as the Western Cape Provincial Spatial Development Framework (PSDF).

Furthermore, coastal management zones are proposed as a means to facilitate improved planning and management of sensitive and often vulnerable coastal areas. The process outcomes will therefore need to filter into municipal planning through Integrated Development Plans and Land Use Management Schemes (LUMS).

1.3 Prescriptions in the ICM Act

Coastal management (set-back) lines, as detailed in the ICM Act, are prescribed boundaries that indicate the limit of development along ecologically sensitive or vulnerable areas, or an area where dynamic natural processes pose a hazard or risk to humans. Amendments to the ICM Act now refer to 'coastal management lines' and not 'coastal set-back lines' to avoid continued confusion with EIA development set-back lines.

The ICM Act allows coastal management (set-back) lines to demarcate areas where authorities can prohibit or restrict the building, alteration or extension of structures that are either wholly or partly seaward of the coastal management (set-back) line. It is noted that the location of immovable property and the ownership and zonation of vacant land must be taken into consideration when delineating coastal management (set-back) lines. The ultimate intention of the coastal management (set-back) line is to:

- protect coastal public property, private property and public safety
- determine features that should be protected under the coastal protection zone
- preserve the aesthetic values of the coastal zone

While the establishment of coastal management (set-back) lines is a provincial responsibility, the Minister, after consultation with the relevant provincial Member of the Executive Council (MEC), must establish such lines if the following applies: the area is part of a national protected area as defined in the Protected Areas Act; straddles a coastal

boundary between two provinces; or extends up to, or straddles, the borders of the Republic.

The relevant MEC, however, may only declare coastal management (set-back) line(s) after consultation with Municipalities and interested and affected parties (I&AP's). The MEC must communicate this by publishing a notice in the *Government Gazette*. Once determined, this line must be delineated on the map(s) that forms part of municipal zoning schemes. This is done to ensure consistency and to properly inform the public about the position of the coastal management (set-back) line in relation to existing cadastral boundaries.

The coastal management (set-back) line and accompanying management zones are proposed to give specific direction in respect to both the management of property with existing land use rights, and with the planning of proposed activities and land uses. Coastal governance institutional structures should ensure that future decision making is in line with the National CMP, the Provincial CMP, the District/Local CMP(s) and relevant proposed norms and standards and management strategies. If these are to be effective, the structures must assist decision makers in respect to the application of best practice coastal management principles, integrate and align regulatory and management prescriptions in order to reduce duplication and uncertainty, and mobilise limited resources in a way that stimulates sustainable interventions.

Coastal management (set-back) lines may be established for various reasons and there may be more than one management line in any given area. For example, one line may relate to anticipated erosion, while another may be aimed at issues of aesthetics to control the height of buildings in a specific scenic landscape.

1.4 Project details

This project consists of three main components, as indicated in Figure 2, namely inception and the modelling of dynamic coastal processes, the determination of a coastal management (set-back) line (CML) and coastal protection zone (CPZ) and finally recommendations regarding management guidelines and project finalisation.



Figure 2: Project phases

The first phase, project inception and technical modelling³, took place between November 2014 and January 2015, and included the modelling and delineation of short (1:20 year storm event and a 20cm prediction of sea level rise), medium (1:50 year storm event and a 50cm prediction of sea level rise) and long (1:100 year storm event and a 100cm prediction of sea level rise) term risk. Future risks were considered in terms of:

- natural coastal regression or accretion
- littoral active zones (mobile sand)
- projected sea level rise
- storm-driven coastal inundation
- projections of storm-driven coastal erosion

These designated risk areas informed the demarcation of risk zones, as a way of highlighting natural coastal processes and risks, and accompanying draft management controls / development parameters. The default CPZ delineation specified in the ICM Act

³ More detail on the risk modelling process is provided in Appendix A: Coastal Processes and Risk Modelling

was also refined in accordance with the improved understanding of local coastal dynamics and sensitivities.

The CML, final risk zones, proposed management guidelines and CPZ are based on the technical risk projections. In addition, these are informed by local knowledge obtained via local authority input and stakeholder engagement and takes cognisance of agreed-upon principles.

Three rounds of public consultation and engagement are to inform the project direction and outputs. An initial notification undertaken in phase 1 informed the public and I&AP's about the process. Local authorities were thereafter specifically engaged between the 21st and 22nd of January 2015 in a workshop where they collectively delineated a draft CML based on the projections of coastal risk and local understanding of spatial planning, development zoning and other factors influencing coastal development. The involvement of relevant authorities in the study area, namely the three Local Municipalities and the District Municipality, CapeNature and the National Department of Environmental Affairs was deemed a critical part of the stakeholder engagement process. A high level of agreement and buy-in is necessary as municipalities will ultimately be jointly responsible for the implementation of the development controls in the management zones.

A second round of consultation allowed the public to review the draft management lines and the methodology used for the delineation of the draft CML and CPZ. This engagement included four public meetings and specific engagement with conservancies and estuary management forums. The focus was on the review of the proposed CML and associated overlay zones/controls, and verification that the proposals are fair, practical, appropriate and responsive to the public comments raised during the preceding study undertaken in 2011/2012. A third and final round of consultation will afford stakeholders the opportunity to comment on the final report and amended lines, zones and recommended controls.

It is important to recognise that the projections of risk and associated coastal management measures are based on the best available information at the time, and that this information will change and improve over time. All controls and delineations referred to in this report consequently relate specifically to the risk projections compiled for the 2014/2015 CML project on the basis of the best information available at the time. The project and its deliverables are specifically designed to allow for updating of both the risk projections and the designation of management features, as knowledge of coastal risk improve.

2 IDENTIFICATION OF PHYSICAL PROCESSES

The determination of specific risk zones or areas where dynamic coastal processes are active along the Overberg coastline is based on the application of a consistent delineation methodology applied along the study area. The process, as it unfolded, is described in more detail in Appendix A: "Coastal Processes and Risk Modelling".

The outcome of the risk modelling process is a set of risk projections for the coastline as related to events such as coastal erosion, storm surges, sea level rise and storm wave run-up, as well as dynamic ecological processes such as identified active littoral zones (e.g. mobile dune systems). Littoral active zones are identified based the presence of windblown sand furrows indicating currently active sand belts on aerial photographs. The combined risks are then projected for short (1:20 year, or High Risk), medium (1:50 year, or Medium Risk) and long (1:100 year, or Low Risk) term time horizons (Figure 3).



Figure 3: Example of modelled risk projections

The risk modelling is based on high resolution LIDAR data, aerial photography, as well as wind and wave data for the region. The modelling itself followed the method described by Mather *et al.* (2010) as refined for the similar preceding coastal management line project undertaken in the West Coast district in 2013/2014. It does not account for extreme events such as anomalous ocean conditions (e.g. tsunamis) or man-made disasters (e.g. the failure of a dam wall upstream of an estuary). A simplified visualisation of the method is shown in Figure 4, whilst a more detailed explanation of the modelling is provided as **Appendix A**.

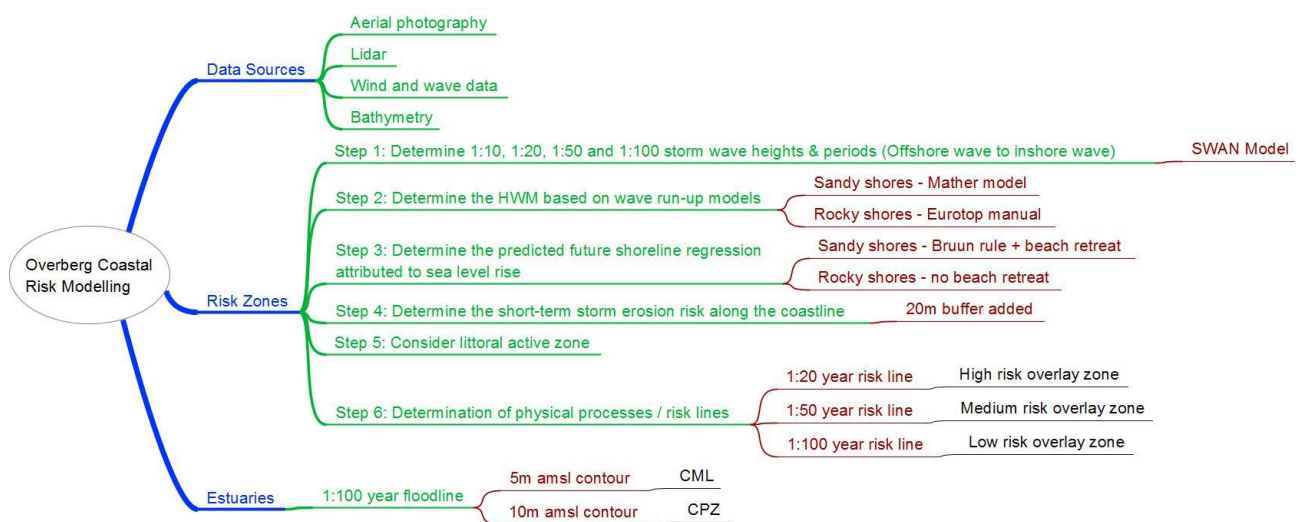


Figure 4: Simplified visualisation of the risk modelling methodology

Estuaries are particularly dynamic ecological systems that display characteristics of both terrestrial and marine systems. This makes estuaries extremely complex and sensitive, and consequently also challenging to manage. Nevertheless, degradation of estuaries often results from increasing coastal development and the impact of human activities. In order to preserve the remaining ecological functioning, biodiversity, and sustainable use of these sensitive coastal resources, effective co-operative and integrated management is essential.

Since inundation in estuaries represents the primary risk, floodline determination that can anticipate flood events with different return periods is key to understanding how flood dynamics will impact on existing and future development. Unfortunately, to generate the necessary information within the scope of a regional CML demarcation project is prohibitively expensive. Consequently an approach is adopted that uses a simple contour height line as approximation of the functional estuarine zone to inform management lines for estuaries. This can be supplemented by good quality local ecological sensitivity information or indications of recurring inundation gleaned from an assessment of the vegetation surrounding estuaries. In all cases though, future refinement of the CML must defer to fine-scale management plans or floodline determinations where such have or will be prepared.

Estuary Management Plans have been prepared for the Bot, Klein, Uilkraals and Heuningnes estuaries. Within these estuaries, the local fine-scale planning being undertaken by Municipalities, through the guidance and assistance of bodies such as estuary advisory forums or CapeNature, was taken into consideration when determining the management lines. In other estuaries, it is recommended that the 5m or 10m above mean sea level (amsl) contour be used as a reference line to determine or inform development management lines, until such time as an adopted Estuary Management Plan and zonation plan or detailed floodline determinations can indicate an appropriate coastal development line for individual estuaries. It is noted that for this project, LIDAR imagery is used to determine the 5m asml and 10m amsl contour lines at a resolution of 50cm.

3 DETERMINING COASTAL MANAGEMENT (SET-BACK) LINES AND COASTAL MANAGEMENT OVERLAY ZONES

The intended outcome of this project is a proposed management scheme for the Overberg District coastal area that identifies a coastal management overlay zone consisting of three sub-zones related to the projected coastal risk horizons, as well as a coastal management (set-back) line designating an area where no development, or no further development should take place.

This study represents the third full-scale set of coastal set-back/management lines determined by the WCG. It is preceded by a study conducted during 2010 at Milnerton and Langebaan to devise a standard methodology for the delineation of coastal set-backs in the province (DEADP, 2010); the initial determination of coastal set-backs along the coastline of the Overberg District during 2011/12 (WCG, 2012); and more recently, the development of coastal set-back/management lines for the West Coast (WCG, 2014). It also takes into consideration the need for national (National Coastal Committee discussions, i.e. Working Group 8 forum) and local alignment (similar work by the City of Cape Town).

3.1 2010 Provincial methodology for the delineation of coastal set-back lines

The 2010 Western Cape Coastal Development Set-back Lines Methodology project differentiated between a coastal 'erosion' set-back and a development set-back, and described a methodology for the determination of a coastal processes/hazard line and a management line that combines the erosion and development set-backs. In terms of the WCG's initial Coastal Development Set-back Lines Methodology two coastal set-back lines were therefore envisaged:

- A **physical process / hazard line** is proposed to define the limit of the coastal area seaward of which any development is likely to experience unacceptable risk of erosion, flooding by wave action and/or unacceptable maintenance of wind-blown sand accumulations
- A management (**limited/controlled development**) '**set-back**' line. This line proposed to define areas where some limited and/or controlled development could occur that accommodates requirements of biodiversity, heritage and other aspects not related directly to coastal processes. This line was situated on or landward of the hazard/coastal processes line

Conceptually, this designated a hazard zone adjacent to the water's edge as a 'no development zone', a managed development area immediately outside the risk zone, and lastly, a zone of minimum regulation beyond that (Figure 5):

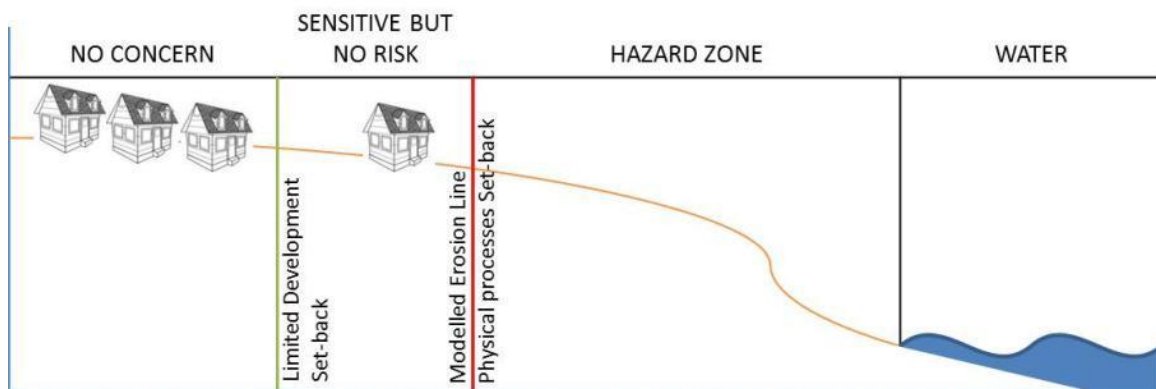


Figure 5: Conceptual structure of coastal set-back lines

3.2 Overberg District (as a pilot study)

The reality of existing legal coastal development in the Overberg District meant that coastal set-back lines had to make provision for existing developments and development planning that already extended into the hazard zone. Decisions regarding development in this zone are particularly difficult as they affect existing or assumed property rights as well as development precedents, and are relative to planning horizons. For example, a partly developed residential area within the hazard zone is unlikely to be removed or relocated, and approval for infill development is unlikely to be refused.

By implication, the conceptualization of a development-free hazard zone, determined on the basis of a coastal erosion and coastal inundation threat, needed to be refined to accommodate existing development. A management response was required that differentiated between a modelled long-term erosion hazard and a pragmatic development control. The solution recommended by the Overberg Coastal Set-backs project involved delineating realistic coastal set-back line(s) in addition to the modelled maximum risk line. The management lines would then translate long term (e.g. 100 year) natural processes modelling into guidance that relates to pragmatic planning horizons (e.g. 50 year structural life expectancy).

The project culminated in the designation of three conceptual lines or zones:

- A broad Coastal Protection Zone extending to the landward boundary of sensitive coastal features in addition to the maximum modelled coastal risk zone, within which limited management control was required
- A Physical Processes Zone which demarcated the output of the rigorous scientific modelling process used to project future coastal risk
- A Draft Overberg Coastal Set-back Line which designated a narrow band of high risk area along the shoreline within which strict management controls are to be applied

As compared to the theoretical concept described in the Provincial Methodology (Figure 5), the revised concept can be schematically represented as is shown in Figure 6.

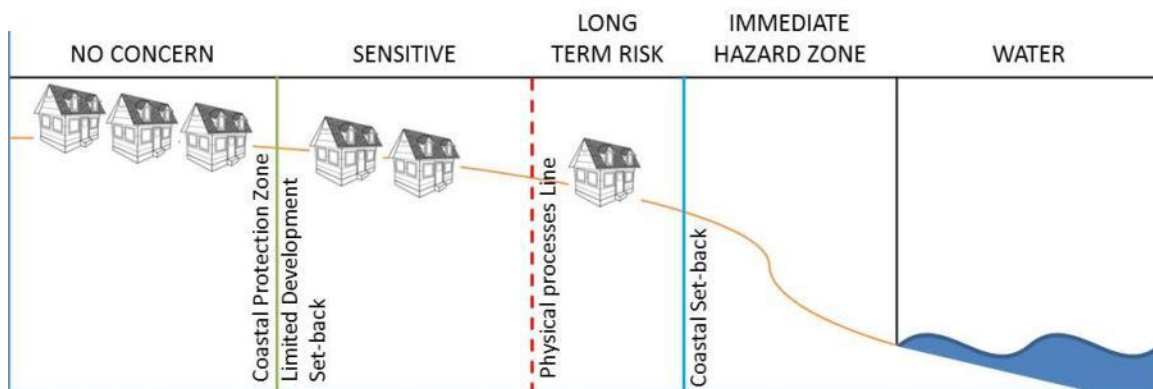


Figure 6: Overberg District Coastal Set-Back Lines concept

3.3 Key recommendations emanating from the Overberg District pilot project

3.3.1 Realistic development controls

In practice it was found that the application of coastal set-back lines, as conceptualised by the original WCG's Coastal Set-back Lines Methodology, was not fully compatible with the diversity and dynamics of long sections of coastline or with the current level of development encroachment into the conceived 'hazard zone'. In particular, it was found that in assuming that the 'no development' zone should equate to land seaward of the modelled coastal erosion set-back line, the provincial Set-back Lines Methodology failed to fully accommodate the reality that development and developed areas had already encroached beyond the physical processes / erosion line.

The most practical solution recommended placing more emphasis on the use of local knowledge and planning considerations to determine development restrictions rather than a rigid line based solely on mathematical modelling.

3.3.2 Link proposed activities to realistic planning horizons

An additional recommendation related to considering the nature of proposed development activities in relation to the planning horizon applied in decision making. For this purpose, modelling was recommended to be undertaken for three proposed sea level rise scenarios, namely – low (20 years or 200mm), medium (50 years or 500mm) and high (100 years or 1000mm). Decisions regarding land use and development could then be based on either the proposed value of the proposed development or activity, or the nature of the proposed activity

3.3.3 Use of physical processes modelling

For the reasons outlined above, it was recommended that the scientifically modelled physical processes lines should not become the legally promulgated Coastal management/set-back Line. Physical processes modelling must simply inform regulatory zones as well as future decision making in the Coastal Zone in current and future development areas.

3.3.4 The nature of regulatory controls

The use of coastal set-back line regulations, as provided for in the 2008 ICM Act, was contemplated for the Overberg District. As such, a set of regulations was drafted that defined compatible and incompatible developments and activities in the different set-back areas. The regulations were intended for official promulgation through gazetting by the Provincial Minister responsible for environmental matters.

However, it was found that the nature of such strict regulatory control was less than palatable to the general public and especially to property owners and developers along the coast. Regulations are absolute – in terms of not offering space for negotiation, mitigation and discretion – and are consequently viewed as a top-down form of governance. The regulations would also create multiple layers of authority control, which could lead to conflicting decision-making and overlapping mandates. Formal regulations from a Provincial level of governance were therefore abandoned for the time being in favour of more practical and locally customisable form of development control.

3.4 City of Cape Town

Independently, the City of Cape Town undertook a process to determine two management lines, namely the CPZ (as per the definition from the ICM Act) and a set-back line seaward of existing development or properties with existing development rights. The two coastal zones determined by these lines (i.e. between the high-water mark (HWM) and Coastal Edge Line, and between the Coastal Edge Line and the CPZ) are proposed to be managed in a manner appropriate to the level of existing or desired development through means of zoning schemes. The locations of the two management lines are informed by the profiling of different points along the coastline which considered risk from storm damage, possible inundation under storm surge scenarios, biophysical processes and public access issues.

General zoning schemes are proposed to be used as a base management system of land-use decisions to control commercial, residential, industrial, and agricultural construction, with coast-specific 'overlay zones' that are superimposed on the baseline plan to increase or decrease the level of regulation. Each coastal management overlay zone is assigned specific regulatory requirements based on land use that include resilient building designs, set-backs and ecological buffers.

3.5 The West Coast District

3.5.1 Three risk horizons modelled

On the basis of lessons learnt, the WCG undertook a project to delineate coastal set-back lines for the West Coast District Municipality. Project components included, in contrast to the original Overberg project, the modelling three risk horizons in addition to the HWM, a coastal set-back or management line and a refined delineation of the CPZ. A more holistic and comprehensive engagement process was also undertaken which improved the participation from public stakeholders whilst at the same time avoiding conflict over the placing of the demarcated lines.

3.5.2 Methodology amended and overlay zones applied

In late 2013, as a result of contextual changes related to the alignment of Provincial, Local and National planning processes, the WCG coastal set-back line methodology was adjusted. National agreement on coastal set-back line delineation, as discussed at the National Coastal Committee coordinated by the national Department of Environmental Affairs, required the demarcation of risk zones as opposed to mere lines. In addition, proposed management controls / development parameters for the risk zones or overlay zones were required to align with established Town Planning mechanisms.

3.5.3 Confirmation of use of contour heights in respect to Estuaries

A further amendment made was in respect to the delineation of coastal set-back lines in estuaries. In order to verify whether the use of a 5m and 10m contour height around estuaries was an accurate enough proxy indicator of coastal risk in estuarine zones, it was necessary to compare the risk projections to actual floodlines. In this instance, floodline information was procured for the Berg River Estuary, and the results were found to compare favourably with the 5m and 10m contour heights.

3.6 2014 Amendments to the ICM Act

The National Environmental Management: Integrated Coastal Management Amendment Act 36 of 2014, amends the National Environmental Management: Integrated Coastal Management Act 24 of 2008 and comes into operation on the 30th of April 2015. Three amendments are of particular relevance:

- It reduces confusion with EIA development set-back lines by renaming coastal set-back lines as coastal management lines
- It gives the MEC the power to establish or change a CML simply by publishing a notice in the Gazette
- It requires the MEC to consider the location of immovable property and the ownership and zonation of vacant land when establishing a CML

4 COASTAL MANAGEMENT (SET-BACK) LINE, RISK BASED OVERLAY ZONES AND COASTAL PROTECTION ZONE FOR THE OVERBERG DISTRICT

4.1 COASTAL MANAGEMENT (SET-BACK) LINE AND OVERLAY ZONES FOR THE OVERBERG DISTRICT

4.1.1 Proposed coastal management scheme

The use of coastal management (set-back) lines and coastal management zones need to reflect management principles or criteria suggested by affected authorities as well as the public stakeholders participating in the stakeholder consultation process facilitated by the WCG.

These principles are:

- Legal development with existing rights (including zoning) must be allowed to proceed as long as public (i.e. government) liability and the quality of the coastline are not compromised
- Management controls / development parameters must allow for private acceptance of liability
- Controls must allow for discretion in decision-making by authorities based on appropriate motivations and information
- Provision must be made for areas where the local municipalities propose growth, as long as the development proposals are responsive towards coastal risk and ICM Act principles
- Coastal defences, if constructed, must be constructed and managed in an integrated manner and in accordance with legislative requirements
- Delineation must avoid the uncertainties surrounding the position of the HWM
- Management control must recognise that 'land use' and physical activities are distinct

The need for a graduated management approach is therefore evident, especially considering the recommendations flowing from implementation in the West Coast District. As a result, this project proposes a management scheme consisting of a coastal management (set-back) line and coastal management 'overlay zones'.

4.1.2 Coastal management (set-back) line

A CML, as envisaged by the amended ICM Act is informed by the projections of risk generated in the first phase of the study, information on ecological or other sensitivities adjacent to the coast, as well as the location and extent of existing development and existing executable development rights. The CML is intended as a clear guideline for the management of development within risk areas, and the protection of coastal public property. The Overberg CML therefore differentiates between areas along the coastline with existing development rights and/or part of future municipal development, and those

areas that should be left undeveloped due to a high risk from dynamic coastal processes or as coastal public property.

To determine the CML, coastal features are considered alongside coastal risk zones, based on observed and available information:

- Environmental buffers required inland from the HWM to maintain a functional coastal ecosystem under future sea level rise scenarios.
- Social buffers required along the coast, for example, allowance for public beach access through and along the coastal frontage, areas which have cultural significance and that will need to be preserved from development, or heritage resources and historically sensitive locations that require specific management.
- Economic requirements for the coast, for example, allowance for new beach facilities that will need to be placed closer than normal development to serve the public. Economic demands often require a trade-off against environmental aspects at a particular site.

The resultant zone is conceptualised as the area below the CML. It includes all sensitive areas along the coast, both in terms of biophysical sensitivity and socio-economic value (Figure 7).

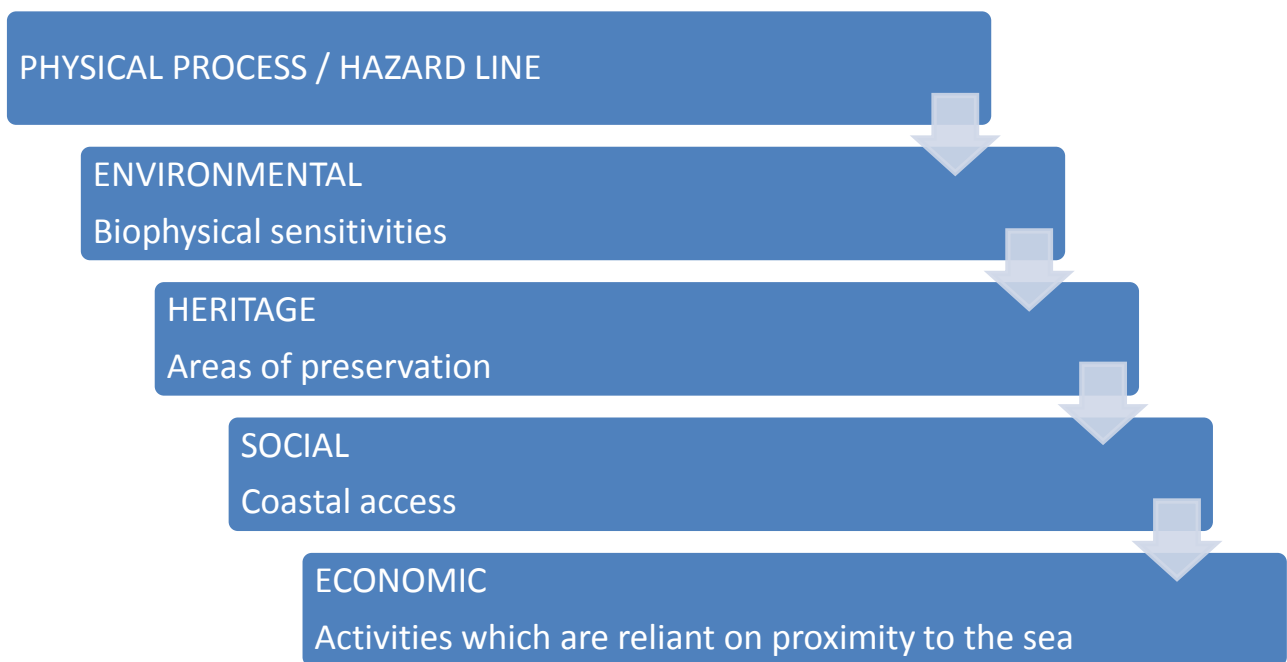


Figure 7: Aspects to consider when determining the coastal management (set-back) line

Demarcation of the actual CML is different for developed and undeveloped areas, and is a combination of the two around estuaries.

In **rural areas**, the CML follows the landward boundary of the long term risk projections or areas identified as sensitive from a coastal perspective. These sensitive areas include Critical Biodiversity Areas (CBA) and Ecological Support Areas (ESA) related to coastal processes, as well as large wetland areas functionally part of the coastal zone. Examples of the inclusion of such wetlands are found just south of Pringle Bay and inland of Quoin

Point. Where necessary, a separate line is drawn around existing development and development rights within the risk zone in order to protect the development rights within a 'development island'.

As the intention is not to use the CML to impact on existing development rights, the line is drawn seaward of properties abutting the shoreline with existing development or development rights in **'urban' or 'developed' areas**. These are areas where clustered development is present, and where the density is significantly higher than in rural or undeveloped areas where single residential units on farm properties dominate the land use pattern. Due to considerations related to practical implementation, the CML is aligned with defined property boundaries or distinct landmarks. This allows an exact demarcation to take place, and reduces the likelihood of subsequent arguments over its location. An example of the demarcation of the CML along the property boundaries in urban areas is shown in Figure 8.



Figure 8: Example of the location of the coastal management (set-back) line in urban areas

The CML also extends along **estuaries**, and in developed areas along the banks of the estuary is aligned with the lower (water side) boundary of properties with existing development or development rights. In rural areas, the CML runs along the 5m amsl contour around estuaries or landward of identified coastal (estuarine) sensitivities (Figure 9). Where the watercourse is defined by cadastral lines as a linear property which is wider than the 5m amsl contour, the property boundary is used.



Figure 9: Example of the location of the coastal management (set-back) line in developed parts of estuaries

4.1.3 Coastal management overlay zones

As piloted in the City of Cape Town's municipal area, the use of Overlay Zones is considered as a universal mechanism for administration of coastal management (set-back) lines within the ambit of town planning regulation and management in the Western Cape.

The overlay zones will be used within the ambit of existing town planning schemes on all properties and development subject to town planning scheme regulation, as an *add-on to existing zonation*. Exceptions do exist, but are limited to public (e.g. government, harbours and defence force) development that is governed by other relevant management controls / development parameters such as management plans for protected areas or management and maintenance plans for harbours.

Coastal management overlay zones are collectively envisaged as the area close to the sea within which development should be managed in order to preserve coastal quality and protect property and lives. Development in these zones is possible under certain circumstances and after appropriate environmental and risk assessments have been undertaken. Restrictions in this area can be applied strictly and consistently, since it is informed by information on the level of risk gleaned from scientifically modelled coastal processes or hazard zones.

Three Coastal Management Overlay Zones are proposed for **urban areas**:

- High risk zone** - 20 year horizon - 0m amsl to high risk line
- Medium risk zone** - 50 year horizon - High risk line to medium risk line
- Low risk zone** - 100 year horizon - Medium risk line to low risk line

The overlay zones therefore refer to areas designated by risk modelling as subject to short term (1:20 year), medium term (1:50 year) or long term (1:100 year) risk emanating from coastal processes such as coastal erosion, storm surges, sea level rise and storm wave run-up (Figure 10).

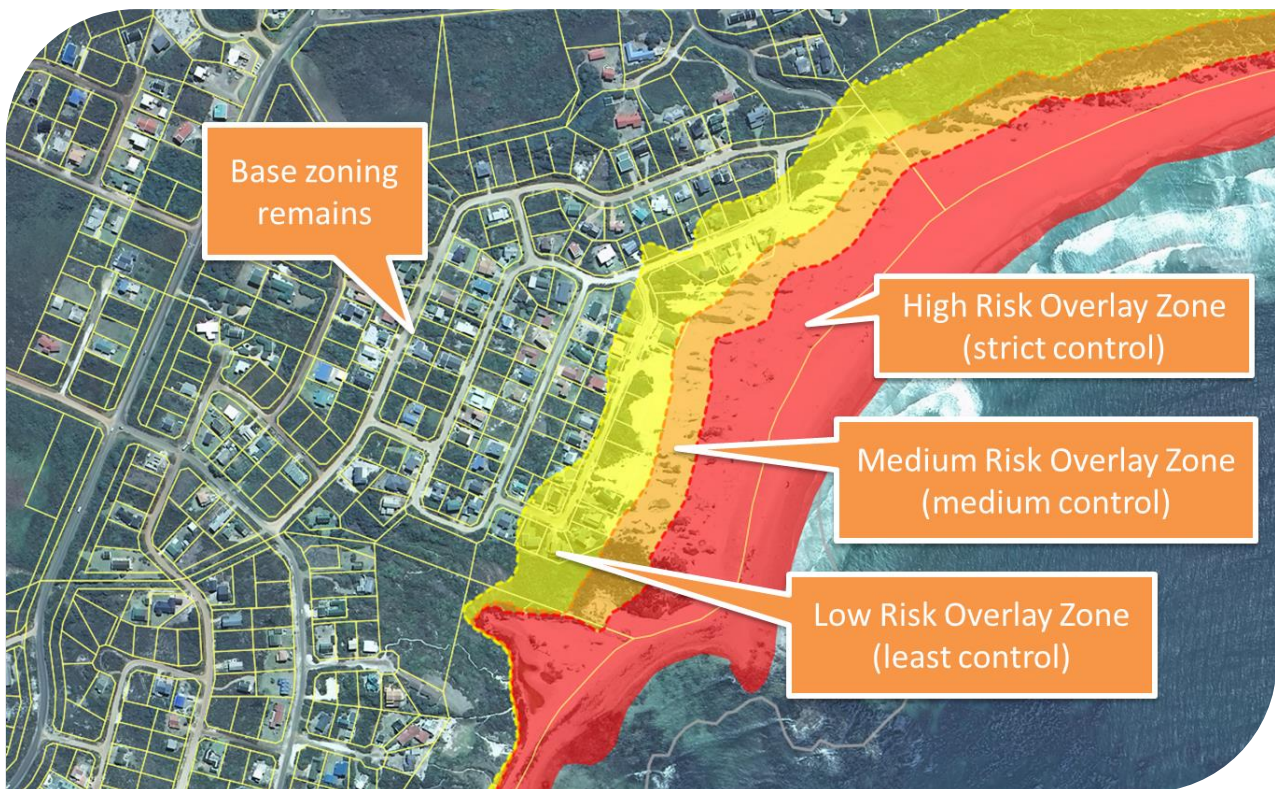


Figure 10: Example of the application of risk zone overlays as part of the local municipal zoning scheme

In **rural areas**, the risk grading from low to high is not necessary, and hence only a single 'risk' zone is indicated as the entire area between the 0m amsl and landward boundary of the low risk (long term risk) zone. The risk zone is expanded in places where littoral active zones are present, as these contribute to the risk of exposure to possible future coastal erosion. This is shown in Figure 11.

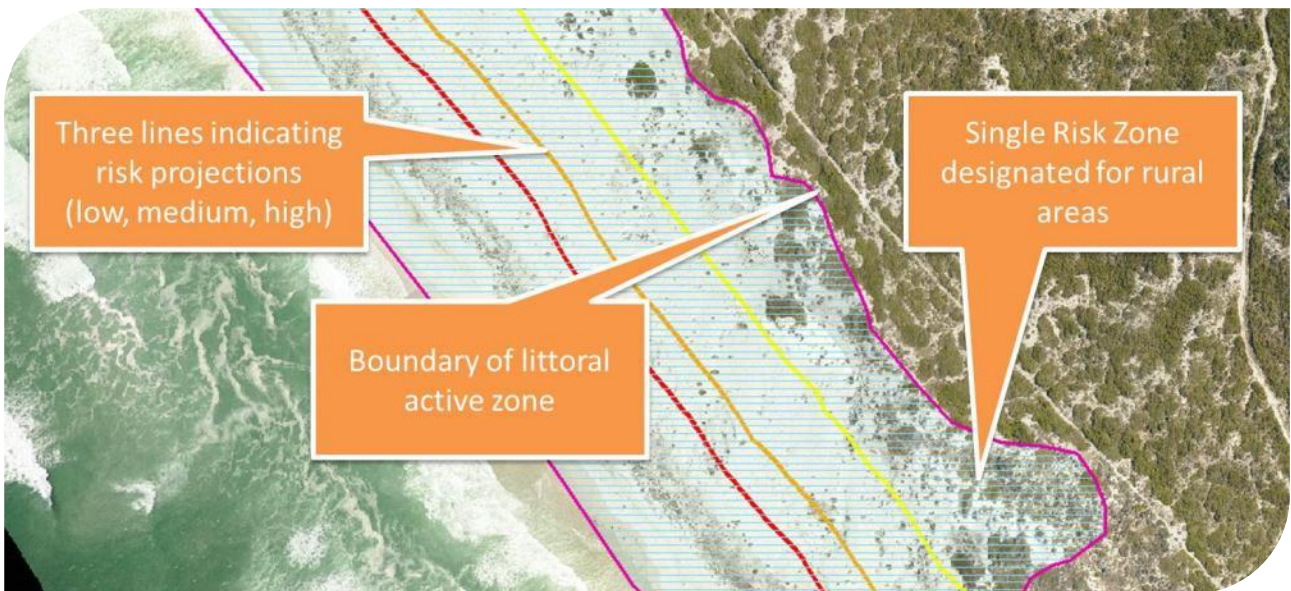


Figure 11: Example of the single risk zone designated for rural or undeveloped areas

With regards to **estuaries**, the risk-based zoning needs to be amended in order to accommodate the limited availability of information on localised estuarine dynamics. Consequently, it is proposed that a similar approach be taken as for rural areas, i.e. a single risk zone. This risk zone is, however, determined on the basis of inundation levels rather than wave impact risk. Consequently, the risk zone is considered to be the area below the 10m amsl contour around estuaries. Where a clearly defined contour is not available, the nationally accepted SANBI demarcation of the estuarine boundaries is used.

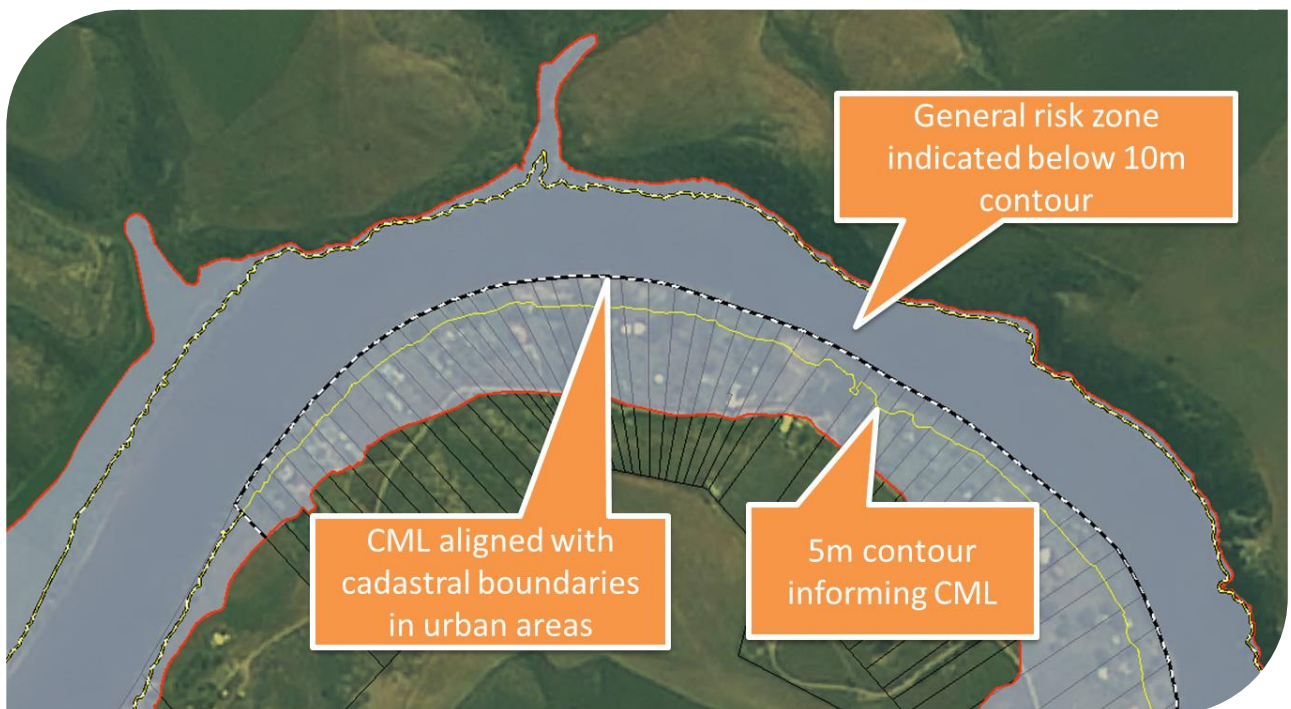


Figure 12: Example of the Risk Zone designated for estuaries

4.1.4 Combined coastal management (set-back) line and overlay zones

Combined, the CML and coastal management overlay zones depict a management scheme along the shore that guides where development should and shouldn't take place (i.e. the CML) and how it needs to be undertaken in order to protect property, lives and the integrity of the coast (i.e. the overlay zones).

Figure 13 below shows an example of what the final combined management scheme looks like in a **developed or built-up area**. With the CML in place, development can be prevented from encroaching onto coastal public property, whilst the risk based overlay zones will determine the nature of development in close proximity to the shoreline.

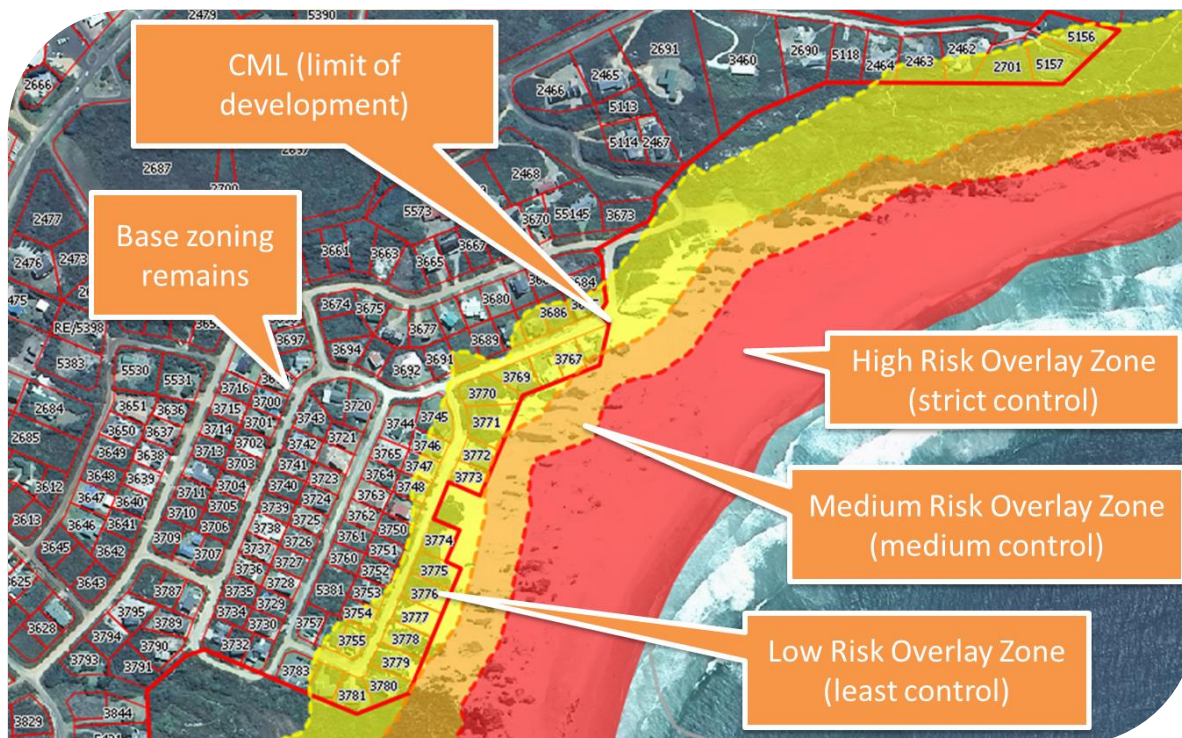


Figure 13: Example of the combined coastal management (set-back) line and overlay zones (urban or developed area)

In **rural areas**, the CML follows the landward boundary of the single rural areas risk zone.

The same differentiation between rural and urban areas is applied in **estuaries**. Whereas in urban areas the CML follows the water-side boundary of properties with existing development or executable development rights, in rural areas the line follows the 5m amsl contour around the estuary. It should be noted that in contrast to general rural areas, while the CML and risk zones generally overlap completely, in estuaries the CML will follow the 5m amsl contour and the estuary risk zone the 10m amsl contour.

In cases where the generalised estuary risk zone (below 10m amsl) overlaps with the differentiated risk zones on the open coastline, both sets of risks are applied to the area. This means that both types of risk – wave action related erosion *and* inundation risk in the estuary - will need to be taken into consideration for development proposals and coastal management.

In both rural and urban coastal areas, there are cases where existing development lies seaward of the CML, or effectively within the area where no further development/encroachment should be allowed. To prevent an unfair limitation of the rights to develop, a boundary is drawn around existing legal development or properties with existing executable development rights, which creates a limited 'island' of developable area within a larger area of restriction. Figure 14 shows the concept graphically.

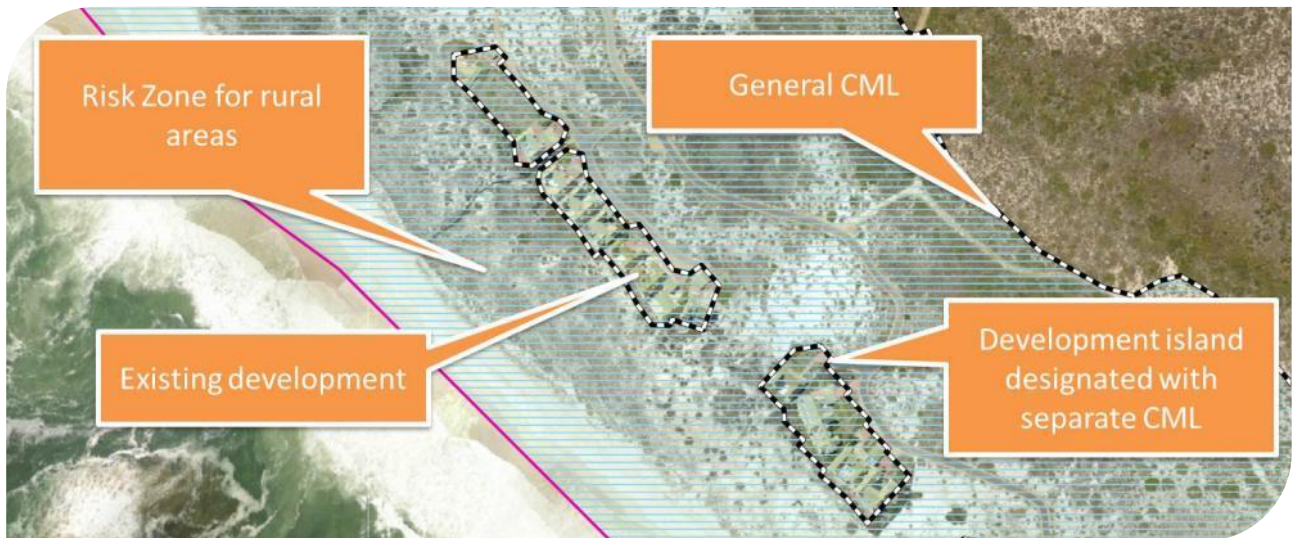


Figure 14: Example of development islands within the general area of restriction

4.2 COASTAL PROTECTION ZONE

The ICM Act makes provision for the demarcation of a zone adjacent to coastal public property that “*plays a significant role in a coastal ecosystem*”. The demarcation allows the area to be managed, regulated or restricted in a way that differs from non-coastal areas, in order to⁴:

- a) protect the ecological integrity, natural character and the economic, social and aesthetic value of coastal public property
- b) avoid increasing the effect or severity of natural hazards in the coastal zone
- c) protect people, property and economic activities from risks arising from dynamic coastal processes, including the risk of sea-level rise
- d) maintain the natural functioning of the littoral active zone
- e) maintain the productive capacity of the coastal zone by protecting the ecological integrity of the coastal environment
- f) make land near the seashore available to organs of state and other authorised persons for
 - i) performing rescue operations

⁴ Section 17 of the ICM Act

-
- ii) temporarily depositing objects and materials washed up by the sea or tidal waters

The ICM Act defines a default CPZ which, in essence, consists of a continuous strip of land, starting from the HWM and extending 100m inland in developed urban areas zoned as residential, commercial, or public open space, or 1 000m inland in areas that remain undeveloped or that are commonly referred to as rural areas. It also includes certain sensitive or at-risk land such as estuaries, littoral active zones and protected areas. These default boundaries may only be changed through a formal process of adjustment by the relevant Provincial MEC or National Minister.

The investigations and risk projections of this project allows for a concurrent recommendation on refinement of the CPZ in the Overberg District. Consequently, it is recommended that except for completely developed areas, where the CPZ follows the CML, the CPZ in the Overberg District includes the following elements:

- the long term (100yr) risk projection
- littoral active zones
- properties that should form part of the Coastal Public Property, such as the Admiralty Reserve
- harbour areas if they remain enclosed by sensitive natural areas
- all ecologically sensitive areas directly linked to the shoreline
- areas or features of social, economic and heritage value linked to the coast
- the designated coastal risk zone (i.e. 10m amsl) in estuaries

In areas where considerable development has occurred and where there is no longer any functional natural environment or social, economic or heritage aspects that need special consideration, the CPZ can therefore be relocated closer to the HWM or behind developments at direct risk from active dynamic coastal processes. For the purposes of this project, however, a minimum width of 100m was retained as a conservative buffer in urban areas and 1 000m in rural areas. Where a functional natural environment exists, for example a declared nature reserve, the inland boundary of the natural environment should, however, still be recognised as forming part of the CPZ.

4.3 SUMMARY OF THE DELINEATION CRITERIA FOR THE CML AND CPZ

Figure 15 below provides a summary of the criteria used to inform a consistent delineation of both the CML and CPZ for the Overberg District in the form of a decision tree. The decision tree differentiates between rural (undeveloped) and urban (developed) areas, and specifies specific criteria for estuaries and protected areas.

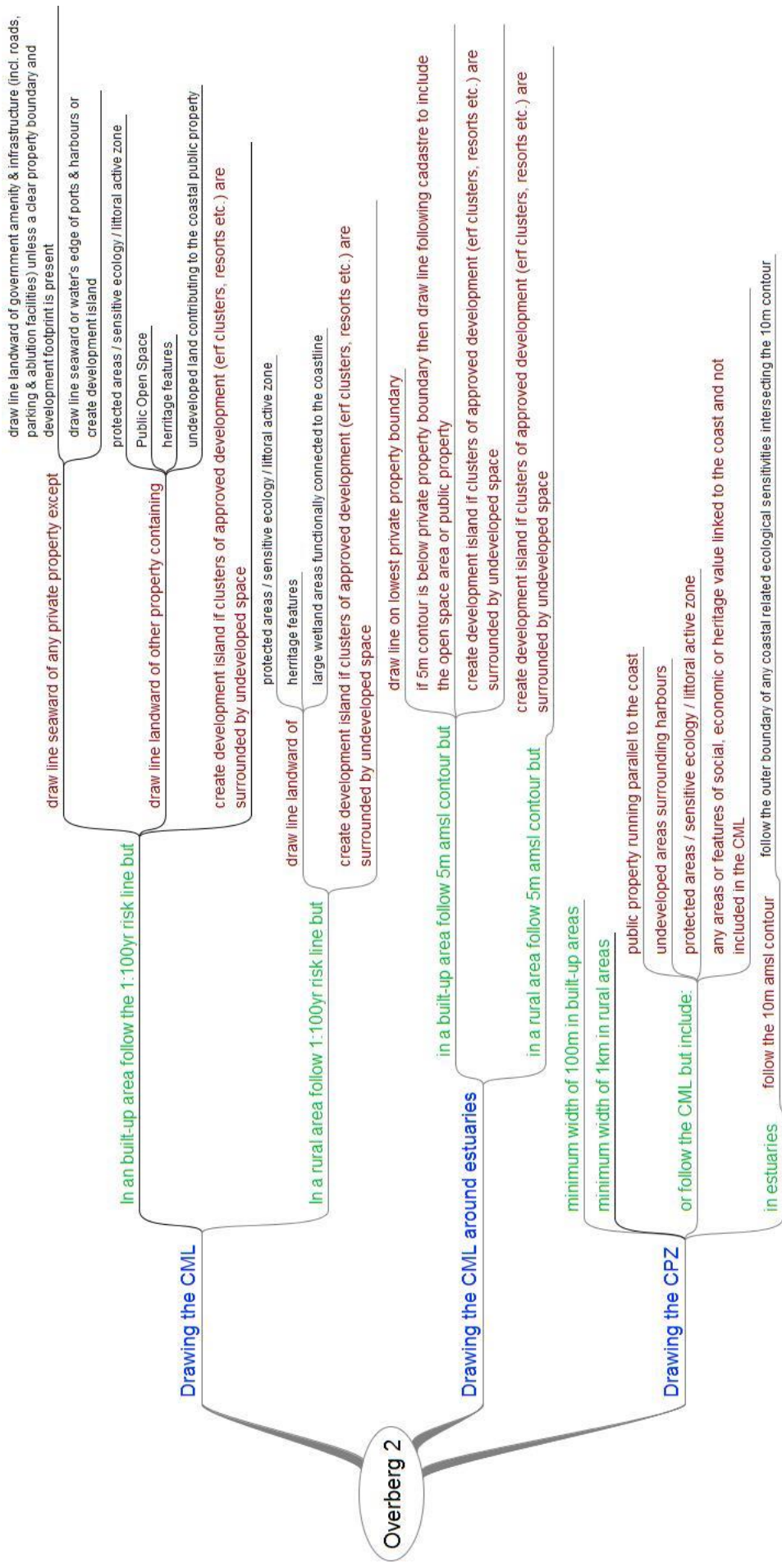


Figure 15: Decision tree

5 COASTAL DEVELOPMENT MANAGEMENT PARAMETERS FOR THE OVERBERG DISTRICT

With the coastal management line, overlay zones and associated CPZ established, it becomes important to define what the zones mean and the implications thereof on future development. If the intention of these lines/zones is to protect existing property, infrastructure and ecology, and ensure that only responsible and sustainable development takes place in high risk areas (where current existing development rights are in place), then various management tools need to be implemented and subsequently enforced.

While progress has been made towards achieving these goals, further intervention is required to ensure integration of coastal sensitivities into all applicable planning decisions within coastal regions. This demands integration of tools embedded in the ICM Act, EIA Regulations, local level spatial planning and resources management. With coastal property in high demand and coastal urban areas growing rapidly, the determination of appropriate development parameters for different layers of management is an important aspect that needs to be implemented with great expediency and through streamlined and effective process.

Specific development management parameters are the most basic form of regulation and can be imposed relative to the different projections of coastal risk, in order to reduce risks to public and private property or human life. Accordingly, such controls should satisfy one or more of the following objectives:

- reduce public liability
- reduce risk to human life
- prevent intensification of development in risk zone, but allow exercising of existing rights
- maintain coastal environmental quality and amenity
- prevent encroachment that will impact on the integrity of the shoreline ecology
- inform planned retreat
- prevent densification of rural areas

The identification of such parameters should only follow once clear determinations of development zoning and management control structures have been finalised.

In the interim, and specifically aimed to facilitate discussion, the tables below present some development management parameters **for consideration**. These controls can be used to inform further refined and localised schemes to be implemented by Local Authorities. The recommended parameters in the tables can be implemented as scheme controls, by-laws or building controls.

Table 1: Suggested development management parameters for High Risk Urban areas

HIGH RISK COASTAL URBAN OVERLAY ZONE		
ZONE	ZONE INTENTION	MAP REFERENCE
High Risk	<ul style="list-style-type: none"> • Limit public and private liability • Increase public awareness of the potential risks to property and human life • Prevent intensification of development in high risk zone, but allow exercising of existing rights albeit with the knowledge of the associated risks • Maintain coastal quality • Prevent encroachment that will impact on the integrity of the shoreline ecology and exacerbate negative impacts • Enable safe evacuation in an emergency 	
Primary Use	With special consent	Not supported
As per base land use controls	<ul style="list-style-type: none"> • Where buildings lie partly in two coastal risk overlay zones, the higher risk zone will apply • In-fill sub-divisions • Public resorts 	Industry, schools, libraries, health facilities, refuse sites & WWTW
Zone Additional Controls		
<ul style="list-style-type: none"> • All structures on properties larger than 400m² in the high risk zone require approval from a professionally registered engineer. Structures on smaller properties may obtain similar design approval based on predetermined standard conditions. • Structures must preferably be elevated on pilings, posts, piers-and-joists, column or similar foundations – with the lowest floor of habitable structures/buildings constructed above a pre-determined risk level. • Lower unhabitable floors (i.e. garages, basements) of structures/buildings must be permeable – i.e. have openings to allow for the entry and exist of flood waters – to allow effective interior and exterior hydrostatic pressure equalisation during and post inundation. • Habitable basements or rooms will only be permitted if an engineer has made the necessary design arrangements to ensure that coastal risk is addressed and reduced by implementing responsible mitigation measures to the satisfaction of the Municipality. • Consideration during conceptual building design must be given to issues of privacy, overshadowing and visual impact and the apportionment and positioning of higher risk site areas for parking, open space and recreational areas. • Any new development must be designed and positioned within reason to limit potential flood damage and risk to human life, including but not limited to positioning buildings in suitably acceptable elevated portions of properties. • Development must be designed and constructed, within the framework of applicable building controls, in such a way that buildings and structures are positioned furthest from the foreshore whether limited by rear space, side space or the building line (up to the maximum allowed in the applicable scheme). • Building design must demonstrate reasonable risk reduction measures and should include innovative solutions (adaptable buildings, re-locatable buildings, flood-proofed buildings, flood resistant and resilient construction etc.) without increasing and transferring risks to adjacent properties. • Key mechanical and electrical services/structures (e.g. substations, transformers, generators, geysers and DB boards) must be located above a pre-determined risk 		

level.

- After construction, any exposed ground area must be stabilised by the use of ground covering plants or mulches to minimise the risk of erosion.
- On request from the municipality, a storm water management plan might be required to be submitted along with building plans.
- Hardened surfaces to be minimised and suitable permeable alternative utilised to maximise natural infiltration and reduce overland flow and associated velocities with concomitant risk of erosion and damage.
- Only fully enclosed / self-contained effluent storage and treatment systems will be permitted if links to sewer mains are not possible. These must be located either on the landward side of structures or either side of structures, and recommended by Registered Engineer to ensure suitable sealing and safety.
- Development should be sited to minimise the removal of trees and endemic vegetation.
- Existing coastal processes, including dune migration and littoral drift should not be impeded and indigenous vegetation must be maintained.
- Dunes must be protected and rehabilitated where necessary to reinforce and strengthen natural barriers
- Exotic species of vegetation should be limited to feature trees or shrubs within an indigenous setting.
- Fencing or other barriers must be permeable to accommodate storm events and limit structural damage and associated negative impacts on the environment.

Issues Proposed To Be Included In By-Laws

- Consolidated access points / paths to the beach preferably on raised wooden / recyclable plastic boardwalks to reduce negative impact on dunes and associated vegetation.
- Limit and preferably avoid expansion of existing footpaths and volumes of existing structures and buildings within the risk zone.
- Municipal engineering infrastructure (e.g. WWTW, Substation, Pumps and Reservoirs) to be located outside overlay zone, unless related to public amenity (e.g. playground).
- Collective/integrated response by adjacent properties or developments to optimise resources and prevent spill over effect

Table 2: Suggested development management parameters for Medium Risk Urban areas

MEDIUM RISK COASTAL URBAN OVERLAY ZONE		
ZONE	ZONE INTENTION	MAP REFERENCE
Medium Risk	<ul style="list-style-type: none"> • Reduce public and private liability • Minimise risk to human life • Prevent intensification of development in medium risk zone, but allow exercising of existing right. 	
Primary Use	With special consent	Not supported
As per base land use controls	<ul style="list-style-type: none"> • Where buildings lie partly in two coastal risk overlay zones, the higher risk zone will apply • In-fill sub-divisions • Public resorts 	Industry, schools, libraries, health facilities, refuse sites & WWTW
Zone Additional Controls		
<ul style="list-style-type: none"> • All structures on properties larger than 400m² in the medium risk zone require approval 		

from a professionally registered engineer. Structures on smaller properties may obtain similar design approval based on predetermined standard conditions.

- Structures must preferably be elevated on pilings, posts, piers-and-joists, column or similar foundations – with the lowest floor of the structure to be above a pre-determined risk level.
- Lower floors of structures/buildings must be permeable – i.e. have openings to allow for the entry and exist of flood waters – to allow effective interior and exterior hydrostatic pressure equalisation during and post inundation.
- Consideration during conceptual building design must be given to issues of privacy, overshadowing and visual impact and the apportionment and positioning of higher risk site areas for parking, open space and recreational areas.
- Any new development must be designed and positioned within reason to limit potential flood damage and risk to human life, including but not limited to positioning buildings in suitably acceptable elevated portions of properties.
- Development must be designed and constructed, within the framework of applicable building controls, in such a way that buildings and structures are positioned furthest from the foreshore whether limited by rear space, side space or the building line (up to the maximum allowed in the applicable scheme).
- Building design must demonstrate reasonable risk reduction measures and should include innovative solutions (adaptable buildings, re-locatable buildings, flood-proofed buildings, flood resistant and resilient construction etc.) without increasing and transferring risks to adjacent properties.
- Key mechanical and electrical services/structures (e.g. substations, transformers, generators, geysers and DB boards) must be located above a pre-determined risk level.
- After construction, any exposed ground area must be stabilised by the use of ground covering plants or mulches to minimise the risk of erosion.
- On request from the municipality, a storm water management plan might be required to be submitted along with building plans.
- Hardened surfaces to be minimised and suitable permeable alternative utilised to maximise natural infiltration and reduce overland flow and associated velocities with concomitant risk of erosion and damage.
- Only fully enclosed / self-contained effluent storage and treatment systems will be permitted if links to sewer mains are not possible. These must be located either on the landward side of structures or either side of structures, and recommended by Registered Engineer to ensure suitable sealing and safety.
- Development should be sited to minimise the removal of trees and endemic vegetation.
- Existing coastal processes, including dune migration and littoral drift should not be impeded and indigenous vegetation must be maintained.
- Exotic species of vegetation should be limited to feature trees or shrubs within an indigenous setting.
- Fencing or other barriers must be permeable to accommodate storm events and limit structural damage and associated negative impacts on the environment.

Issues Proposed To Be Included In By-Laws

- Municipal engineering infrastructure (e.g. WWTW, Substation, Pumps and Reservoirs) to be located outside overlay zone, unless related to public amenity (e.g. playground).

Table 3: Suggested development management parameters for Low Risk Urban areas

LOW RISK URBAN COASTAL OVERLAY ZONE		
ZONE	ZONE INTENTION	MAP REFERENCE
Low Risk	<ul style="list-style-type: none"> • Reduce public liability • Avoid reasonable risk to human life • Prevent intensification of development in low risk zone, but allow exercising of existing rights. 	
Primary Use	With special consent	Not supported
As per base land use controls	<ul style="list-style-type: none"> • Where buildings lie partly in two coastal risk overlay zones, the higher risk zone will apply • In-fill sub-divisions • Public resorts 	WWTW
Zone Additional Controls		
<ul style="list-style-type: none"> • Structures must preferably be elevated on pilings, posts, piers-and-joists, column or similar foundations – with the lowest floor of the structure to be above a pre-determined risk level. • Lower floors of structures/buildings must be permeable – i.e. have openings to allow for the entry and exist of flood waters – to allow effective interior and exterior hydrostatic pressure equalisation during and post inundation. • Consideration during conceptual building design must be given to issues of privacy, overshadowing and visual impact and the apportionment and positioning of higher risk site areas for parking, open space and recreational areas. • Building design must demonstrate reasonable risk reduction measures and should include innovative solutions (adaptable buildings, re-locatable buildings, flood-proofed buildings, flood resistant and resilient construction etc.) without increasing and transferring risks to adjacent properties. • Key mechanical and electrical services/structures (e.g. substations, transformers, generators, geysers and DB boards) must be located above a pre-determined risk level. • After construction, any exposed ground area must be stabilised by the use of ground covering plants or mulches to minimise the risk of erosion. • On request from the municipality, a storm water management plan might be required to be submitted along with building plans. • Hardened surfaces to be minimised and suitable permeable alternative utilised to maximise natural infiltration and reduce overland flow and associated velocities with concomitant risk of erosion and damage. • Only fully enclosed / self-contained effluent storage and treatment systems will be permitted if links to sewer mains are not possible. These must be located either on the landward side of structures or either side of structures, and recommended by Registered Engineer to ensure suitable sealing and safety. 		
Issues Proposed To Be Included In By-Laws		
<ul style="list-style-type: none"> • Municipal engineering infrastructure (e.g. WWTW, Substation, Pumps and Reservoirs) to be located outside overlay zone, unless related to public amenity (e.g. playground). 		

Table 4: Suggested development management parameters for General Risk Rural areas

GENERAL RISK COASTAL OVERLAY ZONE (RURAL AREAS)		
ZONE	ZONE INTENTION	MAP REFERENCE
General Risk (rural areas)	<ul style="list-style-type: none"> • Maintain coastal quality • Prevent development, but allow exercising of existing rights in respect to single residential dwelling on agricultural land 	
Primary Use	With special consent	Not supported
As per base land use controls.	<ul style="list-style-type: none"> • Intensification of development within development islands • Agricultural support functions • Public resorts 	General residential (urbanisation), Commercial, Industry, school
Zone Additional Controls		
<ul style="list-style-type: none"> • Structures must preferably be elevated on pilings, posts, piers-and-joists, column or similar foundations – with the lowest floor of the structure to be above a pre-determined risk level. • Lower floors of structures/buildings must be permeable – i.e. have openings to allow for the entry and exist of flood waters – to allow effective interior and exterior hydrostatic pressure equalisation during and post inundation. • Building design must demonstrate reasonable risk reduction measures and should include innovative solutions (adaptable buildings, re-locatable buildings, flood-proofed buildings, flood resistant and resilient construction etc.) without increasing and transferring risks to adjacent properties. • Key mechanical and electrical services/structures (e.g. substations, transformers, generators, geysers and DB boards) must be located above a pre-determined risk level. • After construction, any exposed ground area must be stabilised by the use of ground covering plants or mulches to minimise the risk of erosion. • On request from the municipality, a storm water management plan might be required to be submitted along with building plans. • Hardened surfaces to be minimised and suitable permeable alternative utilised to maximise natural infiltration and reduce overland flow and associated velocities with concomitant risk of erosion and damage. • Only fully enclosed / self-contained effluent storage and treatment systems will be permitted if links to sewer mains are not possible. These must be located either on the landward side of structures or either side of structures, and recommended by Registered Engineer to ensure suitable sealing and safety. • Development should be sited to minimise the removal of trees and endemic vegetation. • Existing coastal processes, including dune migration and littoral drift should not be impeded and indigenous vegetation must be maintained. • Exotic species of vegetation should be limited to feature trees or shrubs within an indigenous setting. • Fencing or other barriers must be permeable to accommodate storm events and limit structural damage and associated negative impacts on the environment. 		
Issues Proposed To Be Included In By-Laws		
<ul style="list-style-type: none"> • Consolidated access points / paths to the beach preferably on raised wooden / recyclable plastic boardwalks to reduce negative impact on dunes and associated vegetation. 		

- Limit and preferably avoid expansion of existing footpaths and volumes of existing structures and buildings within the risk zone.

Table 5: Suggested development management parameters for General Risk Estuarine areas

GENERAL RISK ESTUARINE OVERLAY ZONE		
ZONE	ZONE INTENTION	MAP REFERENCE
General Estuarine Risk	<ul style="list-style-type: none"> • Maintain coastal quality • Reduce public liability • Reduce risk to human life • Prevent intensification of development in general risk zone, but allow exercising of existing rights • Prevent encroachment that will impact on the integrity of the shoreline ecology • Enable safe evacuation in an emergency 	
Primary Use	With special consent	Not supported
As per base land use controls.	<ul style="list-style-type: none"> • In-fill sub-divisions 	Industry, school, WWTW
Zone Additional Controls		
<ul style="list-style-type: none"> • All structures on properties larger than 400m² in the general estuarine risk zone require approval from a professionally registered engineer. Structures on smaller properties may obtain similar design approval based on predetermined standard conditions. • Structures must preferably be elevated on pilings, posts, piers-and-joists, column or similar foundations in a manner that does not impede the lateral flow of water and that does not increase the opportunity for the accumulation of flood related debris – with the lowest floor of the structure to be above a pre-determined risk level. • Lower floors of structures/buildings must be permeable – i.e. have openings to allow for the entry and exist of flood waters – to allow effective interior and exterior hydrostatic pressure equalisation during and post inundation. • Building design must demonstrate reasonable risk reduction measures and should include innovative solutions (adaptable buildings, re-locatable buildings, flood-proofed buildings, flood resistant and resilient construction etc.) without increasing and transferring risks to adjacent properties. • Any new development must be designed and positioned within reason to limit potential flood damage and risk to human life, including but not limited to positioning buildings in suitably acceptable elevated portions of properties. • Any new development must be set as far back from the estuarine functional zone as possible. Either rear space or building line, which ever furthest away from the estuary, will be relaxed (up to the maximum allowed in the applicable scheme). • Key mechanical and electrical services/structures (e.g. substations, transformers, generators, geysers and DB boards) must be located above a pre-determined risk level. • After construction, any exposed ground area must be stabilised by the use of ground covering plants or mulches to minimise the risk of erosion. • On request from the municipality, a storm water management plan might be required to be submitted along with building plans. • Hardened surfaces to be minimised and suitable permeable alternative utilised to maximise natural infiltration and reduce overland flow and associated velocities with 		

concomitant risk of erosion and damage.

- Only fully enclosed / self-contained effluent storage and treatment systems will be permitted if links to sewer mains are not possible. These must be located either on the landward side of structures or either side of structures, and recommended by Registered Engineer to ensure suitable sealing and safety.
- Development should be sited to minimise the removal of trees and endemic vegetation.
- Exotic species of vegetation should be limited to feature trees or shrubs within an indigenous setting.
- Fencing or other barriers must be permeable to accommodate storm events and limit structural damage and associated negative impacts on the environment.
- Existing coastal processes and indigenous vegetation within the estuarine functional zone must be maintained.

Issues Proposed To Be Included In By-Laws

- Consolidated access points / paths to the beach preferably on raised wooden / recyclable plastic boardwalks to reduce negative impact on dunes and associated vegetation.
- Limit and preferably avoid expansion of existing footpaths and volumes of existing structures and buildings within the risk zone.
- Municipal engineering infrastructure (e.g. WWTW, Substation, Pumps and Reservoirs) to be located outside overlay zone, unless related to public amenity (e.g. playground).
- Collective/integrated response by adjacent properties or developments to optimise resources and prevent spill over effect

6 STAKEHOLDER ENGAGEMENT

Public engagement was an on-going process throughout the project. The engagement was conducted for several reasons, the most pertinent of which was to ensure that instead of coastal management/set-back lines and the associated management zones being presented to the public as a *fait accompli*, public engagement was being undertaken to facilitate a participatory determination of coastal management/set-back lines and associated guidelines.

Three rounds of public engagement and a series of public meetings were held during this project:

Table 6: Stakeholder engagement process

Phase	Description
Phase 1: Project Inception	<ul style="list-style-type: none">• Public Notification;• Authority Notification;• Compilation and maintenance of a stakeholder database.
Phase 2: CML	<ul style="list-style-type: none">• Public Notification;• Authority Notification;• Public review of Draft CML;• Availability of Draft CML Reports;• 4 Public Meetings (2nd - 5th March 2015);• Authorities Consultation;• Compilation and maintenance of an Issues & Response table.
Phase 3: Project Finalisation	<ul style="list-style-type: none">• Public Notification;• Authority Notification;• Public review of Final Report

The main objectives of the first stakeholder engagement process were to notify and inform the public about the development and refinement of the CML for the Overberg District and update as well as maintain an existing stakeholder database.

The second stakeholder engagement process focussed on the proposed CML and associated risk zones. A draft report was made available to the public for comment, as well as the draft CML and risk zones for viewing on the Google Earth™ platform. All stakeholders on the database were e-mailed a notification of the date, time and venue of the four stakeholder engagement meetings and where to find information on the project.

All relevant authorities, including all three spheres of government, were notified via e-mail on 20 February 2015. Consultation with and the buy-in of the three affected Local

Municipalities was deemed critical to the success of the project and was therefore actively sought. Other key stakeholders were informed of the process, and specifically invited to comment or engage with the project team.

All comments were collated into an issues trail table, discussed with the PSC and the outcomes integrated into the project approach and project reports.

The third and final stakeholder engagement process provides the I&AP's with a final opportunity to check if their comments have been addressed. The final comments are submitted to the Western Cape Government Coastal Management Unit as an accompaniment to the final report.

7 WAY FORWARD

7.1 Promulgation and implementation

While the ICM Act requires Municipalities to give effect to the coastal management (set-back) line(s) in their local spatial planning and mapping, the Western Cape Government methodology is yet to be confirmed.

Initial thinking proposes the adoption of the coastal overlay zones and their respective controls to the local Town Planning Schemes. This could possibly be supplemented by, or refined as so-called Coastal Planning Schemes, as provided for in Section 56 of the ICM Act. Coastal planning schemes may be developed at national, provincial and/or municipal spheres. Section 57 further stipulates that a municipal coastal planning scheme may form and be enforced as part of a municipal land use scheme. It further stipulates that a municipality may not adopt a land use scheme that is inconsistent with a national or provincial coastal planning scheme that has been adopted in terms of the ICM Act.

Prior to implementation, however, the WCG will need to formally adopt the CML and CPZ in accordance with the prescriptions of the ICM Act. In terms of Section 25(1) of the ICM Act, the MEC can declare coastal management (set-back) line(s) after consultation with Municipalities and interested and affected parties, through publishing it as regulations in the Government Gazette. Once determined, the lines and risk zones must be delineated on the map or maps that form part of the municipal zoning scheme. This is done so that the public may determine the position of the coastal management (set-back) line and risk overlay zones in relation to existing cadastral boundaries.

The process for adoption and future adjustment of the CPZ is, however, not a simple process and the Act requires authorities to consider the concerns and representations of interested and affected parties as well as the interests of any local community affected by the boundary or amendment to a boundary. The applicable authority needs to consider any coastal specific planning (applicable coastal management programme) prior to amending boundaries and such amendments then need to be reflected on municipal zoning schemes. Thereafter the relevant Registrar of Deeds needs to be notified in writing and provided with a description of the land involved. The notification must be accompanied by a diagram signed by a surveyor who is approved in terms of the Land Survey Act. The relevant Registrar of Deeds is then required to make note of such determination, adjustment or demarcation.

Authorities can also consider the option of incorporating some of the areas identified as high risk areas into protected areas. Formal proclamation as protected areas under the National Environmental Management: Protected Areas Act, Act 57 of 2003, would increase awareness of the eminent risks, and make it harder to place new infrastructure in harm's way.

7.2 Further studies and refinements

The scale at which this project was undertaken means that some data gaps or uncertainties remain unresolved. Although measures are put in place to minimise the effect that such uncertainties have on the overall project, a need remains for further refinement as well as groundtruthing over time.

Improved accuracy is also possible should higher resolution studies be done for specific locations. The resolution of this study does take coastal form and topography into consideration, but cannot compensate for local dynamics such as stormwater runoff from the shore, human intervention in sediment transport, or geological resistance to erosion. It is therefore conceivable that studies on particular properties could point out detail like submerged or sand-covered rock layers that are not evident from aerial photography but which would substantially alter the rates of erosion. Similarly, in some locations, concentration of human activity could lead to destabilisation of dune vegetation, accelerating the rate of erosion.

Some specific areas or situations that warrant more in-depth investigation and resolution on a local scale are:

- Areas where issues related to wind-blown sand bear witness to the remobilisation of littoral active zones, or interference with natural balances. These areas, such as are found along Nerine Crescent in Betty's Bay, need to be investigated in order to fully understand the dynamics driving the destabilisation. The findings can then inform an amendment to the risk projections and resultant risk zones to better reflect both current and projected future risks. An immediate recommendation is to consider the full extent of the affected littoral active zone as part of the High Risk zone, negating the need to project the risk emanating from the mobilised sand into the future.
- Although fine scale biodiversity planning was used to inform the delineation of the CML, the extent of inclusion of CBA's and ESA's was sometimes restricted to the area seaward of prominent roads. Examples include the rural areas between Rooi-Els, Pringle Bay and Betty's Bay, as well as the area east of Pearly Beach. Local scale investigations in these areas should inform further refinement of the CML (and CPZ) to determine an appropriate consideration of coastal ecological sensitivities.
- Although it is found that there is general agreement between the 5m amsl contour height and 1:50 or 1:100 yr floodlines around estuaries, a more refined approach should ideally be followed. Where at all possible, estuary management plans, delineation of floodlines and accurate demarcation of the functional estuarine zone should be used as informants for the delineation of the CML and demarcation of the CPZ.

7.3 Coastal development management parameters

Although the introduction of risk-aware development management parameters through Land Use Management Schemes (or similar) is a generally acceptable form of 'passive retreat' in the face of increasing coastal risks, the general scale of implementation will result in unintended consequences. One of these consequences will be an increase in the

costs of development due to the requirements for specialised investigations, designs and construction methods. This will make development for and by impoverished communities increasingly unaffordable. Special arrangements or pre-emptive solutions need to be found in order to accommodate the need for, for example, in-situ upgrades of informal settlements or the provision of social services facilities in disadvantaged communities. This could potentially be in the form of authority-determined design standards that would make individual investigations unnecessary.

7.4 Stakeholder engagement

As this project entailed the refinement of coastal management risk and coastal management (set-back) lines previously determined, a reduced stakeholder engagement process was possible.

It is, however, critical that future engagement processes for similar projects revert to the extensive process undertaken for the West Coast District. Additional stakeholder engagement sessions in potentially high conflict / well developed areas, should be considered.

7.5 Time Allocation

As this project entailed the refinement of coastal management risk and coastal management (set-back) lines previously determined, a reduced timeline for project completion was possible.

The significantly reduced time allocation can cause unforeseen errors to occur and a more realistic time schedule should be afforded to future projects.

8 CONCLUSION

Application and implementation of the CML, in conjunction with the risk-based overlay zones, is envisaged as part of an overall coastal management scheme that will satisfy the principles of the ICM Act, as shown below in Table 7. It also forms part of the WCG's programme of adaptation and mitigation to climate change impacts.

In order for the proposed CML and risk-based overlay zones to function effectively as part of the overall integrated coastal management on the Overberg, an alignment of resources and intent needs to be achieved. Responsibility is shared between the Provincial and Local Authorities, with the municipality playing a pivotal role as the ultimate implementers and enforcers of the proposed spatial and developmental controls. However, as the authority ultimately responsible for the coordination of coastal management in the Western Cape, the WCG shares the responsibility albeit in the form of oversight and in a strategic coordination and advisory capacity.

All planning and decision-making related to coastal management (set-back) lines and risk zonations must ultimately recognise the need to limit and fairly allocate the liabilities related to development in the coastal zone. Municipalities are responsible for decision-making and they need to take into account the best information that is currently available. However, risk is a shared responsibility and the private sector along with Municipality and other government departments need to ensure that information available translates into sustainable development. Consequently, in order to reduce conflicts over responsibilities and appropriation of blame, it is of utmost importance that the information and knowledge generated by this and similar studies be applied with the necessary level of consistency and alignment.

Table 7: ICM Act principles and the coastal management (set-back) lines project

Principle	Application
National asset	Undeveloped and sensitive areas will be protected as part of a national coastal resource.
Economic development	Opportunities for development of coastal resources will be protected from risk, and informed decisions can be made in terms of long term sustainability.
Social equity	Stakeholder engagement is used to inform planning of the management schemes, and inter-generational (long term) impacts are considered.
Ecological integrity	Sensitive, vulnerable and dynamic coastal ecological systems are highlighted and protected.
Holism	Interrelationships between global changes, coastal dynamics, ecological processes and human presence are considered and responded to.
Risk aversion and precaution	Risk projections allow for a precautionary approach to new coastal development.
Accountability and	Informed decision-making and fair allocation of risk liability can be

Principle	Application
responsibility	based on the knowledge generated.
Duty of care	Coastal authorities and the public stakeholders are jointly informed by, and made responsible for the incorporation of risk projections into development planning.
Integration and participation	Cooperation and engagement between parties form a key part of the demarcation of the coastal management (set-back) lines and associated management schemes.
Co-operative governance	All three tiers of government and various Provincial stakeholders are involved in the project, and jointly work towards a final implementation scheme that will be to the benefit of all parties.

9 REFERENCES

DEADP (2010). *Development of a Methodology for Defining and Adopting Coastal Development Setback Lines*, Volume 1: Main Report, 31 May 2010. Western Cape Government Environmental Affairs and Development Planning.

Mather, A. A., Stretch, D. D., & Garland, G. (2010). *A simple empirical model for extreme wave run-up on natural beaches*. International conference on Coastal Engineering, Shanghai. China.

Van der Stoep, H (2013). *A Framework for Environmental Zoning: Overstrand Municipality Case Study*. Mini-dissertation submitted in partial fulfilment of the requirements for the degree of Masters in Environmental Management, University of the Free State.

WCG (2012). *The Establishment of Coastal Set-back Lines for the Overberg District*, March 2012. Western Cape Government Environmental Affairs and Development Planning.

WCG (2014). *Coastal Management / Set-back Lines for the West Coast District*, Final Project Report, July 2014. Western Cape Government Environmental Affairs and Development Planning.

APPENDIX A: COASTAL PROCESSES AND RISK MODELLING