2019
Strategic Environmental Assessment for Marine and Freshwater Aquaculture Development in South Africa

APPENDIX A-4

Visual, Aesthetic and Scenic Resources Specialist Assessment







Visual, Aesthetic and Scenic Resources Specialist Assessment

Integrating Author	Bernard Oberholzer [1]
Contributing Authors	Quinton Lawson[2], Graham Young[3]

1 Bernard Oberholzer Landscape Architect (BOLA) Landscape and Environmental Planning, Stanford
2 MLB Architects, Cape Town
3 Graham A Young Landscape Architect (GYLA), University of Pretoria

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ABBREVIATIONS & ACRONYMS

CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DEM	Digital Elevation Model
ECO	Environmental Control Officer
EMPr	Environmental Management Programme
GIS	Geographic Information System
GDP	Gross domestic product
HIA	Heritage impact assessment
NEMA	National Environmental Management Act (Act No.17 of 1998)
NFEPA	National Freshwater Ecosystem Priority Areas
NHRA	National Heritage Resources Act (Act No.25 of 1999)
SA	South Africa
SANBI	South African National Biodiversity Institute
SAPAD	South African Protected Areas Database
SDF	Spatial Development Framework
SEA	Strategic Environmental Assessment
VAC	Visual Absorption Capacity
VIA	Visual Impact Assessment
WC DEA&DP	Western Cape Department of Environmental Affairs and Development Planning
ZVI	Zone of Visual Influence

GLOSSARY OF TERMS

Cultural landscapes	Human-modified landscapes, particularly those of aesthetic, historical or archaeological significance.
Cumulative impacts	The combined or incremental effects resulting from changes caused by a proposed development in conjunction with other existing or proposed activities.
Landscape types	The classification of the landscape into units, each unit having typical physiographic or scenic characteristics.
Offsets	Measures to compensate or provide restitution as a result of adverse impacts.
Protected Areas	A system of protected areas, including nature reserves, wilderness areas, world heritage sites, protected forest areas and mountain catchment areas, intended to protect, amongst others, natural landscapes and seascapes.
Sense of place	The unique or special qualities found in a particular location, including the combined natural, cultural, aesthetic, symbolic and spiritual qualities.
Receptors	Viewers who would be affected by a proposed development, the viewers usually being residents, commuters, visitors or tourists.
View corridor	A linear geographic zone, usually along movement routes such as trails, roads and railways, visible to users of the routes.
Viewshed	A geographic zone encompassing a view catchment area, usually defined by ridgelines, similar to a watershed.
View shadow	A zone within the view catchment area that is visually obscured from the proposed development by the topography, trees or structures.
Visual	'Visual' here broadly includes visual (human perception), aesthetic (the concept of beauty) and scenic resources (economic value).
Visual buffer	A geographic zone of varying distance, indicating visual sensitivity or visual constraints for proposed development or activities.
Zone of visual influence	The geographic area within which proposed development would be visible (viewshed) or have an effect on the overall sense of place.This could be at the site scale, local district scale or wider regional scale.

1 SUMMARY

Certain large scale aquaculture development, such as abalone factories, could be industrial in nature and affect scenic resources, as well as nearby sensitive receptors, such as those in residential areas or tourism destinations. As these effects could affect property values and the economy of the region, visual, aesthetic and scenic concerns need to be considered as discussed in Section 2.

The visual assessment in this chapter is a high-level desktop study at a regional scale, which did not involve fieldwork, but uses available information and knowledge of the various study areas by the authors. It is clear therefore that more detailed visual assessments would need to be carried out at the local scale, given the diversity of the identified study areas and the wide range of aquaculture type developments, as set out in Section 3.

Geology and the resulting landforms tend to constitute the main scenic features at the regional scale, and a description of these for each study area, together with the main landscape features, are briefly illustrated. The criteria for determining visual sensitivity are provided, including a list of scenic features and typical visual receptors, which are then also mapped as layers for each of the study areas, together with a synthesis map with four levels of 'visual sensitivity' in Section 4. The sensitivity maps are divided into aquaculture developments with a low to moderate visual influence, and those with a higher degree of visual influence.

A range of potential visual impacts could result from both marine and freshwater aquaculture type developments, and these, together with possible mitigation measures, are identified in Section 5. The intensity of potential visual impacts tends to be a function of the scale or footprint of the proposed development, along with the height of structures in the landscape for both water-based and land-based aquaculture facilities. Mitigation tends to involve avoidance measures at the planning phase and mitigation measures at the construction and operational phase. Finally offset measures could be considered where visual impacts cannot be avoided.

An assessment of the visual risks associated with aquaculture development is derived from a combination of visual sensitivity levels, the nature or scale of the visual impact, and the potential for mitigation. These are in turn combined with levels of consequence (from slight to extreme) and the likelihood of the impact occurring to determine the final visual risk, both before and after mitigation, as indicated in Table 16 of Section 6. Many of the risks for aquaculture are related to steep mountainous terrain or protected environments within the study areas.

Finally, best practice guidelines derived from similar activities in South Africa and elsewhere, based on both relevant literature and the experience of the authors, are presented to guide the aquaculture industry as well as the authorising agencies.

2 INTRODUCTION

2.1 Relevance of the Visual Study

Aquaculture development activities, along with related infrastructure, if developed on a large scale, could potentially have an industrial connotation, affecting important scenic resources. Pristine or protected landscapes are particularly vulnerable, while previously disturbed areas may be less sensitive.

Aquaculture development could, in addition, detract from the amenity value of recreation or resort areas, and affect property values in some cases, which together with national parks, game farms and other visitor destinations, have important economic value in the form of tourism for the country.

The siting of aquaculture developments therefore has implications for not only the scenic resource base (the receiving environment), but also for communities and the tourism industry (the receptors). The purpose of this strategic level visual assessment is to identify scenic resources at the regional scale, as well as potential sensitive receptors that could be affected, and to recommend measures to avoid, mitigate or offset possible adverse effects.

2.2 International and National Context

Fish farming is increasingly being seen as a source of food for growing populations, and at the same time taking pressure off wild stocks of fish, allowing these to recover. Historically fish and shellfish have been cultivated around the world in natural ponds, lakes and estuaries to provide a reliable source of food. According to a Mauritius report, world aquaculture is the fastest growing food industry, (Department of the Environment, 2009).

In countries like South Africa (SA), which has poverty and food security issues, aquaculture development could provide a valuable source of protein locally and a commodity for export. However, large parts of South Africa's coastline are exposed, with only a few sheltered bays or lagoons, while there are few perennial rivers or natural lakes inland. This could mean that aquaculture would compete in some cases with other land uses, such as residential, resort or tourism development, which depend on scenic landscapes, both on the coast and inland. Therefore, as the impetus for aquaculture development grows, controls need to be put in place to resolve potential visual conflicts and protect scenic resources, such as those outlined from local and international sources in Section 7 of this Chapter (See Gentry R.R. *et al*, 2017).

2.3 Links to Other Topics

The Visual chapter is closely linked to the Heritage chapter in the current study (Smuts *et al*, 2017), with regard to heritage sites and cultural landscapes, particularly those that are legally protected and therefore have increased visual significance. A link to the chapter on Socio-economics exists because of perceptions and benefits related to local communities and industry. Scenic resources are closely linked to tourism, and particularly eco-tourism, which contributes significantly to the country's gross domestic product (GDP).

3 SCOPE OF THE VISUAL ASSESSMENT

3.1 Definition of Visual Issues

The term 'visual' broadly includes visual, aesthetic, scenic, and amenity values, which contribute to an area's overall 'sense of place', and which encompass both natural and cultural landscapes. In addition, visual issues are concerned with the integrity of natural landscapes (ecological health) on the one hand and the social well-being or 'quality of life' (human health) on the other. Guidelines for assessing visual impacts have been prepared by the Provincial Government of the Western Cape (Oberholzer, 2005).

From the above it can be seen that visual assessments by their nature encompass both tangible and more abstract qualities of the landscape, resulting in a degree of subjectivity. This regional-scale strategic visual study focuses on the spatial distribution of scenic resources and sensitive receptors. The assessment is a scoping-level study, focused primarily on interpreting existing information, using a range of scenic mapping criteria, and the knowledge of the authors.

At this regional scale, landforms such as mountain ridges, escarpments, koppies, prominent rock outcrops and large water bodies, play a large role in the mapping of scenic resources. Vegetational differences and land uses tend to only become meaningful at the local scale and have therefore not been considered in the current visual sensitivity mapping.

At the local or project scale a more detailed visual impact assessment (VIA) may be required involving, amongst others, viewshed analyses and visual modeling in the form of photomontages to indicate anticipated changes to the local setting. This process requires viewpoints and view corridors to be identified, along with potential visual receptors, including both local residents and visitors (Falconer *et al*, 2013).

3.2 Visual Assessment Considerations

No standardised approach to scenic resource mapping exists for the country as a whole at present, or for rating the significance of these. Some work on this has been done for the Western Cape Province (Winter and Oberholzer, 2013). Legislation relating to the protection of scenic resources in South Africa tends to fall under the National Environmental Management Protected Areas Act and the National Heritage Resources Act (NHRA) (see Table 1 below).

Table 1: National legislation relating to the protection of scenic resources.

Instrument	Key objective
National Environmental Management: Protected Areas Act, (Act 57 of 2003).	The Act is intended to protect areas representative of South Africa's biological diversity and its natural landscapes and seascapes in a system of protected areas.
National Heritage Resources Act (Act 25 of 1999) (NHRA)	Includes protection of national and provincial heritage sites, as well as areas of environmental or cultural value, and proclaimed scenic routes.
Local authority by-laws	Local authority spatial development frameworks (SDFs) and zoning schemes can be used to protect natural and cultural heritage resources through 'Conservation Areas', 'Heritage Overlay Zones' and 'Scenic Overlay Zones' including scenic routes.

In the assessment of scenic value, aspects such as landscape complexity, topographical variety and geo-diversity of the landscape have been considered. Protected landscapes, such as those in National Parks or nature reserves, as well as heritage sites, where these are known, tend to increase visual sensitivity. Landscape integrity, or intactness, as opposed to disturbed or degraded landscapes, are another consideration at the local project scale, usually as part of a Visual Impact Assessment (VIA).

In determining 'visual sensitivity' for aquaculture development, the authors adopted a similar approach to that used in other strategic environmental assessments (Lawson and Oberholzer, 2014; Oberholzer *et al*, 2016). This allowed a common database and sensitivity analysis to be used covering similar geographical areas, providing consistency in assessing competing land uses.

3.3 Assumptions and Limitations

Being strategic in nature, the current visual aesthetic study makes use of broad baseline information, resulting in a number of assumptions and limitations listed in Table 2.

Table 2: Assumptions and limitations of this assessment.

Limitation	Included in the scope of this study	Excluded from the scope of this study	Assumption
Level of mapping detail	1: 500 000 topographical maps and 1:1 000 000 geological survey maps.	1:250 000 and 1:50 000 topographical maps.	More detailed 1:50 000 maps and aerial imagery would be used for local or project scale assessments.
Information on cultural landscapes	Included where known	Cultural and heritage sites.	Heritage information and mapping provided in the Heritage study – Chapter 06.
Protected areas and scenic routes	Protected areas included from the South African Protected Areas Database (SAPAD).	Some reserves and scenic routes at the municipal level.	Scenic routes were based on knowledge of the authors. Detailed mapping would be needed at the project scale.
Information on private reserves, game farms	Information included where facilities were known.	Detailed survey of private reserves / game farms.	Detailed information would be needed at the project scale.
Viewsheds of National Parks /nature reserves	None	Viewsheds for individual features/visual receptors	Viewshed mapping would be needed at the project scale.

3.4 Data Sources

A list of data sources on which the visual assessment was based, and from which sensitive features were mapped, is given in Table 3.

Table 3: Spatial data used in the assessment to represent sensitive features.

Data title	Source and date of publication	Data Description
1:1000000 Geological Map of SA	Council for Geoscience (2011).	Geological information.
1:500 000 topographical maps of SA	Surveys and Mapping (several sheets).	Topographical information.
South African Protected Areas Database (SAPAD)	Dept. Environmental Affairs (2017).	National Parks, Reserves and Protected Areas.
Heritage and Scenic Resources: Inventory and Policy Framework for the Western Cape	Winter and Oberholzer, (2013). For DEADP, Provincial Government of the Western Cape.	Survey and rating of heritage and scenic resources in Western Cape.
National Freshwater Ecosystem Priority Areas (NFEPA)	South African National Biodiversity Institute (SANBI BGIS) 2011-2013. (http://bgis.sanbi.org/nfepa/project.asp)	Rivers and wetlands shape files.
AfriGIS Towns and Settlements	AfriGIS 2013 provided by CSIR/SANBI	Cities, towns, settlements and municipal areas shape files.
Open Street Map (OSM)	OSM SA Roads and Railways (2017). (www.openstreetmap.org)	National, Provincial, Regional roads, tracks shape files

3.5 Description of Aquaculture Development

A summary of marine and freshwater aquaculture facilities is given in Table 4 and Table 5 below, with the focus on facilities that have visual implications. It was assumed that related buildings or sheds would be about 8 m in height. The information was provided by the CSIR (Sept. 2017), based on information collected from the aquaculture industry.

Table 4: Range of freshwater aquaculture facilities.

Aquaculture Facility	Footprint	Height	Visual implications
Instream Facilities:			
Cage culture Instream (dams)	2 - 4 ha farm (water) 1000 - 2000m² (land)	0.2 - 1.2m buildings ±8m	Cages, launch harbour, jetties, boats, offices, processing, packaging, access roads.
Land-based Facilities:			
Pond culture embankment or excavated ponds	20 ha farm (water) 160 - 600m² factory	1 - 5m buildings ±8m	Pump house, offices, processing and packaging facilities, access roads, fish tanks, canals, water reservoirs, hatcheries, and powerlines.
Tanks and ponds, using flow-through.	1 - 5 ha farm (water) 300 - 500m² factory	elevated ±1.5m buildings ±8m	Constructed concrete or earthen raceways, pump house, offices, processing and packaging facilities, nursery tanks, road dykes/bridges, and access roads.
Tanks using recirculation.	3 ha farm (land)	1 - 10m	Related infrastructure incl. hatcheries, live feed tanks, pump house, offices, processing and packaging facilities, pipelines, powerlines, parking, access roads.

Table 5: Range of marine aquaculture facilities.

Aquaculture Facility	Footprint	Height	Visual implications
Offshore Facilities:			
Cage culture (floating or submersible cages)	50 ha farm 1000 - 2000m² (land)	0.8 - 1.4m buildings ±8m	Cages, bird nets, buoys and lines, lanterns (lights), boats, Launch harbour, jetties, offices, storage, processing and packaging facilities, access roads.
Nearshore Facilities:			
Cage culture (floating cages)	10 ha farm 1000 - 2000m² (land)	0.8 - 1.4m buildings ±8m	Cages, bird nets, buoys and lines, lanterns (lights), boats, Launch harbour, jetties, offices, storage, processing and packaging facilities, access roads.
Longlines	30 ha farm 1000 - 2000m² (land)	buoys 0.5m buildings ±8m	Longlines, buoys, Launch harbour, jetties, offices, storage, processing and packaging facilities, access roads.
Floating rafts / racks	30 ha farm (rafts) 10 ha farm (racks) 1000 - 2000m² (land)	0.5m - 1.2m buildings ±8m	Rafts, baskets, launch harbour, jetties, boats, barges, offices, storage, processing and packaging facilities, access roads.
Land-based Facilities:			
Pond culture dam or embankment	50 ha farm 2 500 - 10 000m²	1 - 5m buildings ±8m	Pump house, offices, processing and packaging facilities, access roads, fish tanks, canals, water reservoirs, hatcheries, and powerlines.
Tanks and ponds, using flow-through.	3 - 10 ha farm	elevated tanks ±1.5m buildings ±8m	Related infrastructure incl. hatcheries, pump house, offices, processing and packaging facilities, pipelines, powerlines, parking, access roads.
Tanks using recirculation.	0.5 – 1 ha farm	1 - 10m	Related infrastructure incl. hatcheries, live feed tanks, pump house, offices, processing and packaging facilities, pipelines, powerlines, parking, access roads.

East London, E. Cape 2.2 ha

Romansbaai, W.Cape 12 ha

Haga Haga, E. Cape 20 ha

Mtunzini, KZN 40 ha

Figure 1: Indication of marine aquaculture development footprints (in hectares).

Table 6: Potential zone of visual influence of production systems

Production system	Water footprint	Land footprint	Existing examples with footprints	Zone of Visual Influence (ZVI)
Freshwater				
Cage culture: Water-based (Dams) Floating cages	2 - 4 ha	0.1 to 0.2 ha	Mainly small farm dams.	Low
Pond culture: Land-based Earthen ponds, Constructed ponds	-	20 ha	KZN Jozini: ±2 ha FS Springfontein: ±10 ha	Low-moderate
Flow-through: Land-based Constructed raceways	-	1 – 3 ha	Small footprints.	Low
Flow-through: Land-based Earthen raceways, Danish ponds	-	3 - 5 ha	Mainly small footprints.	Low
Flow-through: Land-based Tanks	-	3 ha	Mainly small footprints.	Low
Recirculation (RAS): Land-based Tanks	-	3 ha	GP Hekpoort: ±1.5 ha EC Grahamstown: ± 1 ha Others often smaller.	Low
Marine				
Cage culture: Water-based (Offshore & Near-shore) Floating cages	10 – 50 ha	0.1 to 0.2 ha	Water-related facilities height less than 1.5m. Land footprints small.	Low-moderate
Longlines: Water-based (Near-shore) Suspended culture, lines, racks and baskets	30 Ha	0.1 to 0.2 ha	ditto	Low-moderate
Rafts: Water-based (Near-shore) Floating rafts	30 Ha	0.1 to 0.2 ha	ditto	Low-moderate
Racks: Water-based (Near-shore) Off bottom culture	10 ha	0.1 to 0.2 ha	ditto EC Hamburg: 1.5 ha	Low-moderate
Pond culture: Land-based Earthen ponds, Constructed ponds	-	50 ha	WC Paternoster: ±18 ha KZN Mtunzini: ± 40 ha	High
Flow-through: Land-based Ponds, Tanks	-	3 - 10 Ha	EC Haga Haga: ±20 ha WC Gansbaai: ±12 ha NC Hondeklipbaai: ±1 ha	High
Recirculation (RAS): Land-based Ponds, Tanks	-	0.5 - 1 Ha	E. Cape <1 ha	Low

4 KEY ATTRIBUTES AND SENSITIVITIES OF THE STUDY AREAS

4.1 Description of Study Areas

Landscape characteristics for each of the study areas, for both freshwater and marine aquaculture, are summarised in Table 7 and Table 8 below. More detailed descriptions of landscape types and significant landscape features are recorded in Appendix A. Being a desktop study, references such as those on regional characteristics (Erasmus, 2014), and geological features (Norman and Whitfield, 2006), proved useful.

Table 7: Description of the freshwater study areas.

Freshwater Study Areas	Landscape Characteristics	Significant Visual Features
F1 Limpopo	Ancient flat plain to the north of the Soutpansberg mountain range, and grassed plains to the south, with the Stydpoort and Leola Mountains rising to the southeast.	Scenic Soutpansberg mountains. Vhembe Biosphere Reserve with Funduzi Lake and Tathe Vondo Forest. Scenic Steelpoort River Valley. Wolkberg Wilderness Area. Tzaneen Dam.
F2 Mpumalanga	Eastern escarpment and rugged northern extent of the Drakensberg range form the backdrop to the Lowveld, with the foothills and Komati River Valley to the east.	Drakensberg escarpment with ravines and waterfalls. Ancient stone walls of archaeological importance. Vygeboom Dam recreation area. Game reserves and nature reserves. Barberton Greenstone Belt of ancient volcanic rocks.
F3 Gauteng - North-west	Magaliesberg mountain range to the north, and a complex geological landscape to the south with mining and maize farming.	Scenic and recreational Magaliesberg with kloofs and waterfalls. World Biosphere Reserve. Groot Marico, Vaal and Mooi Rivers. Vredefort Dome World Heritage Site.
F4 Vaalharts	Ghaap Plateau escarpment to the west, and expansive plains with dolerite koppies and outcrops to the east. Cattle / sheep farming.	Ghaap escarpment feature. Vaal River with irrigated lands and alluvial diamonds. Dolerite outcrop features and salt pans.
F5 Free State - KZN Highlands	Mountainous Drakensberg range and foothills to the southwest, and lower lying area intruded by dolerite to the northeast.	Drakensberg mountain backdrop. Protected wilderness areas, incl. Giant's Castle Game Reserve. Sterkfontein, Woodstock and Spioenkop Dams. Numerous mountain streams.
F6 Richards Bay	Coastal plain in the east and rolling, steep-sided hills inland to the west, with sugar cane, gum and wattle plantations.	Richard's Bay Game Reserve and Mhlatuze River Lagoon. Mangroves and dune forests. Historical Zulu battle sites. Scenic Mabelbele mountains and Lake Phobane.
F7 Vanderkloof - Gariep	Generally flat Karoo landscape intruded in places by dolerite koppies. Cattle and merino sheep farming.	Orange River (Gariep River) Vanderkloof, Gariep and Bethulie Dams. Nature reserves and recreational areas around the dams.
F8 Eastern Cape	Coastal plain in the southeast rising inland with hills and mountains formed by the dolerite dykes and sills.	Numerous rivers and estuaries. Amathole range and mountain passes. Bridle Drift and Laing Dams. Large dams east of Queenstown. Numerous kraals and settlements.
F9 Western Cape	Varied landscape from coastal plain in the southwest, to the rolling wheatlands and Cape Fold Mountains, formed by Table Mountain Group sandstones.	Numerous mountain ranges incl. Langeberg and Riviersonderend ranges. Breede River Valley. Theewaterskloof and Brandvlei Dams. Historical towns, farmsteads and winelands.

Table 8: Description of the marine study areas.

Mariculture Study Areas	Landscape Characteristics	Significant Visual Features
M1 Durban - Richards Bay	Coastal plain with high dunes and river estuaries, ranging to low rolling hills inland.	Coastal forests and mangrove swamps. Mlathuze lagoon and numerous estuaries incl. Tugela, Umgeni and Mlalazi Rivers. Umlalazi Nature Reserve.
M2 East London - Kei	Narrow coastal belt and rolling landscape with numerous river estuaries.	Sandy beaches, high dunes and river mouths. Wild Coast recreation resorts. Kwelera and Henderson Nature Reserves.
M3 Port Elizabeth	Sandy coastal plain with rocky sandstone outcrops in places along the coast.	Cape Recife Nature Reserve. Recreational beaches. Swartkops and Sundays River estuaries.
M4 Gouritz - George	Sandy coastal plain with rocky peninsulas. Kaaimans River gorge near the Wilderness.	Scenic Kaaimans River gorge and estuary. Part of the Garden Route. Groot and Klein-Brak estuaries. Numerous holiday resorts.
M5 Hermanus - Arniston	Sandy coastal plain with sandstone mountains to the west at Hermanus and Kleinmond.	Walker Bay and De Mond Nature Reserves. Agulhas National Park and Southern Tip of Africa. Numerous holiday and tourism destinations.
M6 Veldrif - Saldanha	Broad coastal plain of dune sand and limestone interrupted by rocky granite headlands.	Berg River estuary in the north. Saldanha Bay and Langebaan Lagoon. Paternoster and Langebaan resorts.
M7 Strandfontein - Lamberts Bay	Broad Sandveld coastal plain with sections of rocky sandstone coastline.	Tidal Olifants River estuary in the north. Jakkals River mouth at Lamberts Bay. Holiday resorts at Stranfontein and Doringbaai.
M8 Orange - Hondeklipbaai	Arid sandy coastal plain with rocky granite and gneiss shoreline.	Orange River mouth at Alexander Bay. Buffels River mouth at Kleinzee. Old diamond mines and shipwrecks.

4.2 Visual Sensitivity Criteria

Aspects that play a role in visual assessments can be divided into scenic resources and sensitive receptors, as listed in Table 9 below and in Tables 10 and 11, (as well as the maps in Appendix B). Heritage sites have not been included here as they form part of the Chapter on Heritage resources, although they can add to visual sensitivity.

The key scenic resources and visually sensitive receptors within the study areas, have been categorised according to very high, high, moderate and low visual sensitivity, as indicated in Table 10 and Table 11 below. Visual buffers have been included for each of the scenic resources and sensitive receptors. The buffers represent nominal distances for regional scale mapping and could be amended with more detailed information, such as viewshed mapping, at the local scale. The buffers are not intended to be exclusion zones or prescriptive setbacks, but merely serve as a broad indicator. The Visual Sensitivity maps are included in Appendices C and D.

Table 9: Criteria for determining visual sensitivity.

Scenic Resource	Contributing Factors
Topographic features	At the regional scale landforms contribute to scenic and natural heritage value. These include features that provide interest or contrast in the landscape such as mountain peaks, ridgelines, escarpment rims, steep cliffs and geological features. Complex landscapes with topographical diversity and intact wilderness character tend to have higher scenic value and more sensitivity to development. Landscapes with less topographic variety or altered by human activities tend to have reduced scenic value.
Water Features	Water bodies and shorelines generally have aesthetic scenic, recreational and amenity value. These include estuaries, lagoons, lakes, rivers and vleis. Coastal promontories / peninsulas tend to be visually sensitive. Sensitivity relates to national, regional or local significance. Altered or degraded systems tend to have lower scenic value.
Cultural landscapes	Cultural landscapes include cultivated land, such as the winelands and often occur along fertile river valleys. They tend to have rural scenic value and historical or cultural significance and could include archaeological or spiritual sites relating to pre-colonial cultures. Sensitivity would relate to their national, regional or local significance. These need to be correlated with the chapter on Heritage resources.
Sensitive Receptors	**(includes residents, commuters, visitors and tourists)**
National Parks / Ramsar sites	Usually have wilderness characteristics and scenic attributes in addition to their biological conservation role, serving as important visitor / tourist destinations. Visual significance is increased by their national protection status. They tend to be sensitive to loss of wilderness quality.
Nature Reserves / Biosphere Reserves	Reserves have scenic attributes similar to those of National Parks, with conservation, recreation and tourism importance. Visual significance is increased by their legislated provincial and municipal protection status.
Private reserves / resorts	Private nature reserves, game farms, recreation resorts and tourist accommodation are important for the local economy, and tend to be sensitive to loss or degradation of scenic quality resulting from incompatible development. Some types of fish farming could be compatible, particularly if they have a recreational component.
Human settlements	Towns and villages, particularly residential and resort areas tend to be sensitive to visual intrusions, including an effect on property values and tourism, considering aquaculture may have an industrial connotation. Rural settlements and kraals may be less sensitive where fish farming forms part of food security. (Large towns and cities have been excluded from the sensitivity maps as it was not possible to distinguish between residential and industrial areas at a regional scale).
Scenic routes and arterial roads	Scenic routes, including mountain passes and poorts, tend to have historical, recreational and tourism importance within the region, and are therefore visually sensitive. National and provincial arterial routes, which serve regional users for commuting, recreation and tourism, may be visually sensitive within their view corridors.
Passenger rail lines	Rail serves both commuting and tourism functions, and as in the case of roads, they are sensitive to visual intrusions along view corridors.
Heritage sites	These form part of the heritage study, but also have visual implications. Usually subject to a Heritage Impact Assessment (HIA) or VIA at the project scale.

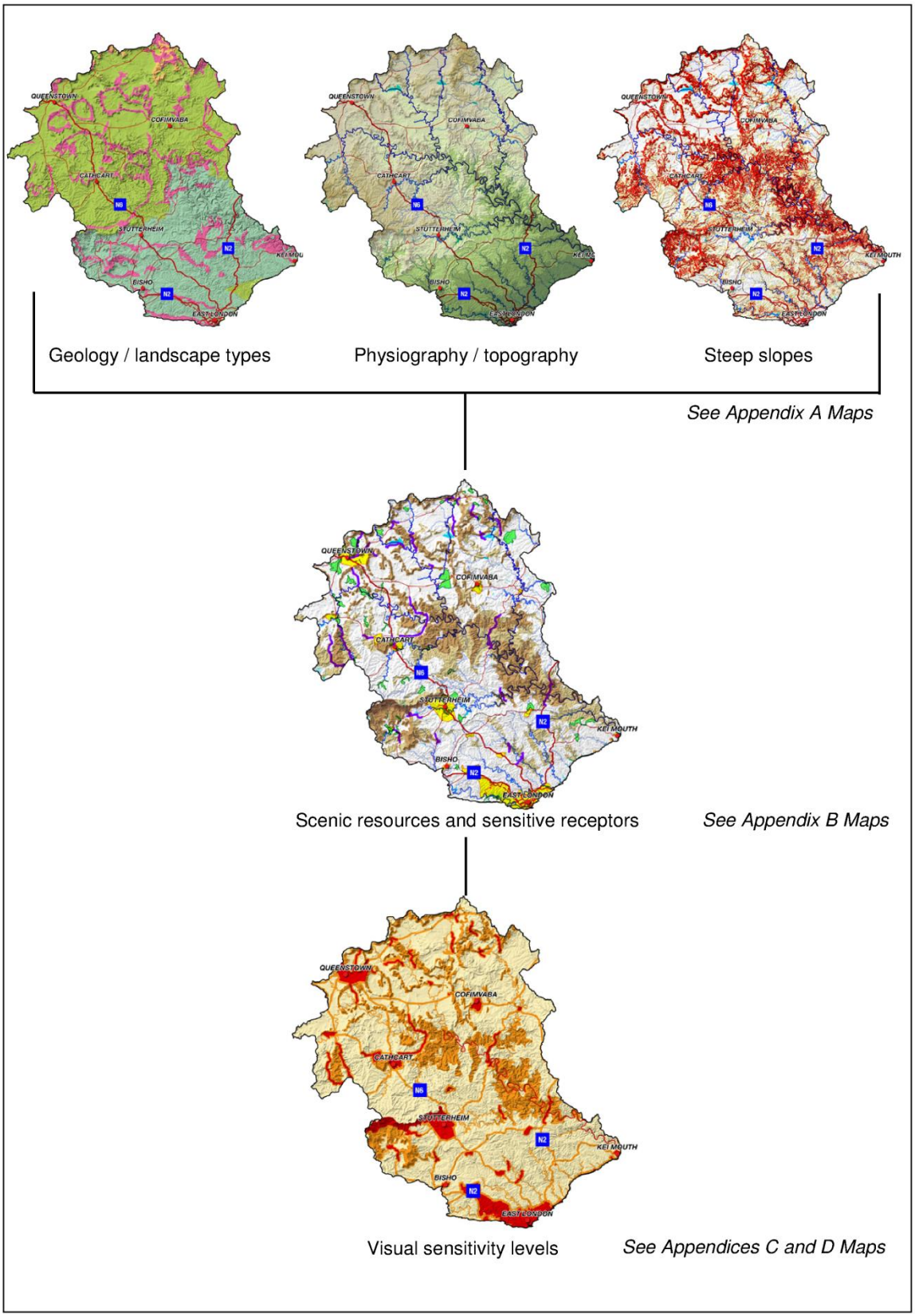

Figure 2: Visual sensitivity mapping layers.

Table 10: Visual sensitivity mapping categories for small-scale marine / freshwater aquaculture.

Scenic Resources	Very high visual sensitivity	High visual sensitivity	Moderate visual sensitivity	Low visual sensitivity
Topographic features	-	Landscapes of national scenic value	Landscapes of regional scenic value	Landscapes of local scenic value
Water features	-	Features of national scenic value	Features of regional scenic value	Features of local scenic value
Coastal zone	-	Prominent coastal features	500 m coastal zone	1 km coastal zone
Cultural landscapes	-	Cultural landscapes of national significance	Cultural landscapes of regional significance	Cultural landscapes of local significance
Protected Landscapes / Sensitive Receptors				
World Heritage Sites / National Parks / Ramsar sites	protected World Heritage Site area	protected park area	within 1.5 km	within 3 km
Nature Reserves / Biosphere Reserve	-	protected reserve area	within 1 km	within 2 km
Private reserves and game farms	-	protected private reserve area	within 500 m	within 1 km
Small settlements / rural villages	-	residential / resort settlement	within 500 m	within 1 km
Large settlements / towns	-	residential / resort settlement	within 1 km	within 2 km
Scenic routes	-	within 500 m	within 1 km	within 2 km
Arterial routes	-	-	within 500 m	within 1 km
Passenger rail	-	-	-	within 1 km

Table 11: Visual sensitivity mapping categories for larger scale marine aquaculture.

Scenic Resources	Very high visual sensitivity	High visual sensitivity	Moderate visual sensitivity	Low visual sensitivity
Topographic features	Landscapes of national scenic value	Landscapes of regional scenic value	Landscapes of local scenic value	-
Water features	Features of national scenic value	Features of regional scenic value	Features of local scenic value	-
Coastal zone	Prominent coastal features	500 m coastal zone	1 km coastal zone	-
Cultural landscapes	Cultural landscapes of national significance	Cultural landscapes of regional significance	Cultural landscapes of local significance	-
Protected Landscapes / Sensitive Receptors				
World Heritage Sites / National Parks / Ramsar sites	protected World Heritage Site or park area	within 1.5 km	within 3 km	-
Nature Reserves / Biosphere Reserve	protected reserve area	within 1 km	within 2 km	-
Private reserves and game farms	protected private reserve area	within 500 m	within 1 km	-
Small settlements / rural villages	residential / resort	within 500 m	within 1 km	-
Large settlements / towns	residential / resort	within 1 km	within 2 km	-
Scenic routes	within 500 m	within 1 km	within 2 km	-
Arterial routes	-	within 500 m	within 1 km	-
Passenger rail	-	-	within 1 km	-

5 KEY POTENTIAL VISUAL IMPACTS AND THEIR MITIGATION

5.1 Visual Impact Intensity

From a visual perspective, the physical scale, or footprint, as well as the height of buildings and infrastructure of land-based aquaculture facilities, as well as extensive water-based facilities, would tend to have the most visual influence and effect on receptors. As a consequence, it is these physical structures that have been prioritized in the visual assessment and in the formulation of mitigation measures. The coastal location of facilities, particularly in natural environments, may compete with other urban and tourism related uses, and could therefore add to potential visual impacts.

Offshore and inshore cages, longlines, rafts and racks tend to have a lower visual profile (< 1 m above the surface), and are further away from receptors, and therefore may have fewer visual implications, except in pristine or undisturbed areas close to the shoreline. Mitigation of these water-based structures tends to be less feasible, although coastal buffers could be applied.

Freshwater aquaculture and processing facilities could have significant visual effects if large in scale and/or located near prime residential or resort areas, while those located in industrial areas are more likely to be visually compatible. Small-scale aquaculture facilities in rural areas would tend to be less visually significant and be easier to mitigate through visual screening measures e.g. trees, hedges, etc.

5.2 Management of Visual Impacts

Strategies for the management of potential visual impacts should be an integral and necessary part of the planning and design of aquaculture development. Strategies can be divided into 3 possible approaches, being **avoidance, mitigation** and **offsets**. The impact mitigation hierarchy approach dictates that impacts should firstly be avoided and if unavoidable appropriate measures should be taken to minimise, reduce and remediate such impacts.

Avoidance involves minimising visual impacts at the early planning stage through the identification and protection of valuable scenic resources, including the use of visual buffers where necessary. Avoidance can be achieved through Spatial Development Frameworks (SDFs).

Mitigation involves reducing the effects of aquaculture development, and minimising visual intrusion on sensitive scenic resources or receptors at the design, construction, operational and decommissioning stages of development. This could involve changes to the design, as well as controls through an Environmental Management Programme (EMPr).

Offsets could take a number of forms, and can be used where avoidance or mitigation measures cannot achieve the desired effect. For example, a feature or amenity that will be lost through aquaculture activities could be compensated by creating a similar amenity elsewhere, or by rehabilitating a previously disturbed area.

The potential visual impacts and recommended mitigation measures listed in Table 12 and Table 13 below encompass these strategies. The measures are by necessity generic in nature and not place-specific. Detailed avoidance, mitigation and offset measures would need to be formulated on a project basis taking the nature of the proposed development and site context into account.

Table 12: Possible visual impacts and options for mitigation – freshwater aquaculture.

Activity	Possible visual impacts	Options for mitigation of impacts
Production system: Instream and land-based freshwater aquaculture (Study areas F1 to F9). **Types**: Floating cages, earthen and constructed ponds / raceways, ponds and tanks. **Physical structures:** Cages, raceways, office, processing and packaging buildings, pump houses, nursery tanks, reservoirs, water channels, access roads. **Phases**: Construction, operation, decommissioning.	**Overall effect on the character and sense of place of scenic areas**, incl. potential loss of wilderness or rural character resulting from aquaculture development.	Apply visual buffers from protected landscapes, scenic routes and human settlements, as recommended in Tables 10 and 11, and through Provincial and Municipal SDFs and zoning schemes.
	Visual intrusion of building infrastructure on prominent topographical and water features, including the siting of land-based facilities in scenic or pristine areas.	Avoid siting of building infrastructure in areas of high scenic value or intact vegetation, indicated in the visual sensitivity mapping (Appendices C and D), and prioritise previously disturbed areas for this purpose.
	Visual intrusion and fragmentation of the natural / rural landscape caused by high structures and extensive infrastructure.	Limit the height of buildings in natural / rural areas to conform and be architecturally sympathetic with that of existing rural structures. Minimise the footprint of infrastructure by creating a compact layout with clustered buildings.
	Visual impact on residential, resort and tourism facilities, as well as heritage sites, particularly where this affects property values or the tourism economy of the region.	Apply visual buffers from residential / resort areas and scenic routes / mountain passes, as recommended in Tables 10 and 11, and by selecting sites with low visibility or by means of screen planting. Prioritise use of areas earmarked / zoned for industrial development.
	Increased visual clutter created by power lines, pipelines, water reservoirs and access roads, particularly in scenic mountain areas or visually sensitive skylines.	Locate utilities underground, as far as possible. Minimise the length and width of access roads and use existing roads where possible. Screen utility structures with earth berms and tree / shrub planting to blend with the surrounding landscape.
	Disturbance of dark skies at night from operational and security lighting, as well as from buildings and vehicle headlamps.	Avoid high-mast lighting and use reflectors to shade light sources. Use shades on windows and avoid or minimise vehicle trips at night.
	Noise, dust and litter from construction sites and heavy trucks / machinery.	Avoid construction activities after work hours and include dust / litter control measures in the EMPr. Stabilise or seal construction roads to minimise dust.
	Loss of landscape views, access and amenity along rivers and dams used for conservation and recreational purposes.	Consider providing linking access routes along rivers and dams, as well as aquaculture education facilities or ecotourism opportunities. Include protected areas within the development site and rehabilitate disturbed or invaded areas to compensate for the loss of natural / rural landscape.

Table 13: Possible visual impacts and options for mitigation – marine aquaculture.

Activity	Possible visual impacts	Options for mitigation of impacts
Production system: Offshore and nearshore marine aquaculture (Study areas M1 to M8). **Types**: Floating cages, longlines, rafts / racks and baskets, plus raceways, ponds and tanks. **Physical structures:** Mainly land-based jetties, service decks, office, processing and packaging buildings, pump houses, fish tanks, reservoirs, canals, access roads. **Phases**: Construction, operation, decommissioning	**Overall effect on the character and sense of place of the local coastal landscape**, incl. potential loss of wilderness or rural character resulting from land-based harbour, building infrastructure and floating cages or longlines. **Visual intrusion of building infrastructure** on prominent coastal features and coastal vegetation, including the siting of both water and land-based facilities in scenic or pristine areas. **Visual intrusion and fragmentation of the coastal landscape** caused by high structures and extensive infrastructure. **Visual impact on residential, resort and tourism facilities, as well as scenic routes, on or near the coastline,** particularly where this affects property values or the tourism economy of the region. **Increased visual clutter created by power lines, pipelines, water reservoirs and access roads**, particularly in scenic coastal areas, seascapes or visually sensitive skylines. **Increased disturbance of dark skies at night from operational and security lighting**, as well as from buildings and vehicle headlamps. **Noise, dust and litter from construction sites and during operation**, and from heavy trucks / machinery. **Loss of coastal views, access and amenity** for conservation and recreational purposes.	Apply visual buffers from protected landscapes and human settlements as recommended in Tables 10 and 11 and through Provincial and Municipal SDFs and zoning schemes. Avoid siting of building infrastructure in areas of high scenic value or intact vegetation, indicated in the visual sensitivity mapping (Appendices C and D), and prioritise previously disturbed areas for this purpose. Limit the height of buildings in natural / rural areas to conform to that of existing rural structures and minimise the footprint of infrastructure by creating a compact layout with clustered buildings. Apply visual buffers from residential / resort areas and scenic routes, as recommended in Tables 10 and 11, and by selecting sites with low visibility or by means of screen planting. Prioritise use of areas earmarked / zoned for industrial development. Locate land-based utilities underground, as far as possible. Minimise the length and width of access roads and use existing roads where possible. Screen utility structures with earth berms and tree / shrub planting to blend with the surrounding landscape. Avoid high-mast lighting and use reflectors to shade light sources. Use shades on windows and avoid or minimise vehicle trips at night. Avoid construction activities after work hours and include dust / litter control measures in the EMPr. Stabilise or seal construction roads to minimise dust. Consider providing safe access routes along the coastline as well as aquaculture ecotourism opportunities and education facilities. Conserve areas within the development site and rehabilitate disturbed or invaded areas to compensate for the loss of natural coastal scenery.

6 RISK ASSESSMENT

A number of steps have been followed to determine risks relating to aquaculture development, as described below:

Step 1 – Determining the nature of the impact (Table 6): Relates to the type and scale (zone of visual influence) of the proposed activities, which range from 'low' to 'high'.

Step 2 – Determining visual sensitivity (see Table 10 and Table 11): Relates to scenic resources / visually sensitive receptors / in terms of very high, high, moderate and low visual sensitivity zones.

Step 3 – Determining visual mitigation measures (Table 12 and Table 13): These take the form of planning policies, design measures and environmental management controls.

Step 4 – Determining consequence levels (Table 15): A combination of impact intensity, exposure (extent and duration) and the visual sensitivity of the receiving environment.

Step 5 – Determining likelihood: Probability of the impact occurring ranging from extremely unlikely to very likely.

Step 6 – Determining risk (Table 16): both before and after mitigation, by combining probability (likelihood) of the risk occurring with the consequence level from Table 15 below.

Table 14: Significance criteria.

Hazard (nature of impact)	Exposure (extent)	Exposure (duration)	Vulnerability (sensitivity)
Low (Small scale facilities)	Site scale (site environs)	Short-term (0-5 years)	Low in scenic resources / sensitive receptors (<10% of the area)
Moderate (Medium scale facilities)	Local scale (local viewshed area)	Medium-term (5-15 years)	Moderate in scenic resources / sensitive receptors (10-50% of the area)
High (Large scale facilities)	Regional scale (beyond local area)	Long-term (15+ years)	High in scenic resources / sensitive receptors (>50% of the area)

Table 15: Consequence levels.

Slight	Moderate	Substantial	Severe	Extreme
Low intensity at the site scale over the short term in zones of low visual sensitivity.	Low / mod. intensity at the local scale over the short-med term in zones of low-mod. sensitivity.	Mod. intensity at the local scale over the medium term in zones of moderate visual sensitivity.	Mod-high intensity at the local scale over the med-long term in zones of mod-high sensitivity.	High intensity at the local / regional scale over the long term in zones of high visual sensitivity.
Visually non-intrusive, with good potential for mitigation.	Some alteration to scenic quality / sense of place with moderate potential for mitigation.	Strongly affects scenic quality / sense of place with some potential for mitigation.	Significantly affects scenic quality / sense of place, with minor potential for mitigation.	Drastically affects scenic quality / sense of place, with limited potential for mitigation.

Table 16: Risk assessment matrix.

Impact	Scenario (Table 6)	Location (Table 7& Table 8)	Without mitigation			With mitigation		
			Consequence	Likelihood	Risk	Consequence	Likelihood	Risk
Visual intrusion of aquaculture facilities altering the rural / wilderness character of the landscape and / or impacting on sensitive receptors.	High intensity development (marine study areas)	Very high sensitivity	Extreme	Very Likely	Very High	Severe	Very Likely	High
		High sensitivity	Extreme	Very Likely	Very High	Severe	Very Likely	High
		Medium sensitivity	Severe	Likely	High	Substantial	Likely	Moderate
		Low sensitivity	Substantial	Likely	Moderate	Moderate	Likely	Low
	Moderate intensity development (marine and freshwater areas)	Very high sensitivity	Severe	Very Likely	High	Substantial	Very Likely	Moderate
		High sensitivity	Severe	Very Likely	High	Substantial	Very Likely	Moderate
		Medium sensitivity	Substantial	Likely	Moderate	Moderate	Likely	Low
		Low sensitivity	Substantial	Likely	Moderate	Moderate	Likely	Low
	Low intensity development (freshwater study areas)	Very high sensitivity	Substantial	Very Likely	Moderate	Moderate	Very Likely	Low
		High sensitivity	Moderate	Very Likely	Low	Moderate	Likely	Low
		Medium sensitivity	Moderate	Likely	Low	Slight	Not Likely	Very Low
		Low sensitivity	Slight	Not Likely	Very Low	Slight	Not Likely	Very Low

6.1 Limits of Acceptable Visual Change

There are no specific or quantifiable standards that can be used to determine limits of acceptable visual change, or thresholds, for visual impacts in the South African context. Legislation, such as the NHRA, can be used to protect scenic resources, which are considered a part of the 'national estate'.

The tipping point for the limit of acceptable change would relate to the footprint of the aquaculture development and the land use planning context of the site. Indicators for limits of acceptable change could include any of the following:

- Areas of 'very high' visual sensitivity, e.g. those mapped in dark red on the maps in Appendix B;
- Development in close proximity to sensitive visual receptors, e.g. residential settlements or scenic routes;
- Development that is out of scale or visually incompatible with the receiving environment;
- Cumulative visual impacts, where the aggregation of development has a synergistic effect resulting in the loss of a scenic resource or significant alteration of the character of the landscape / townscape, e.g. loss of rural character or wilderness experience. However, clustering of development may in some cases be preferably to these being spread out.

The measurement of these limits of acceptable change can only be determined at the local scale for a specific site by means of a VIA that considers factors such as the zone of visual influence (ZVI) and the visual absorption capacity of the area (VAC), usually with the help of photomontages. Areas mapped as high visual sensitivity, or risk, are not necessarily exclusion areas, but should require a full Heritage Impact Assessment (HIA) and VIA at the project level.

Cumulative visual impacts, which often occur incrementally, and sometimes imperceptibly over time, can result in a significant change to an area's 'sense of place'. It is important therefore that valuable scenic resources, as listed in Tables 9, 10 and 11, are identified and protected through NEMA and NHRA legislation, as well as provincial and municipal spatial development frameworks (SDFs) and zoning schemes, including Conservation Areas, Heritage Overlay Zones and Scenic Overlay Zones.

7 BEST PRACTICE GUIDELINES

Best practice guidelines in Table 17 below have been generally gleaned from experience by the authors with projects of a similar nature locally, as well as from overseas best practice manuals for aquaculture, (Maine Aquaculture Association, undated, RPS Group plc. 2007, Scottish Natural Heritage 2014, and The Highland Council 2016). Consideration should be given to incorporating the guidelines in Table 17 into approval permits and EMPrs.

Table 17: Best practice visual guidelines.

Development Stage	Visual Guidelines
Planning / site selection phase	**Location**: • Take cognizance of visual sensitivity zones contained in this Visual Chapter and other regional planning documents for the various districts, including SDFs. • Avoid placement of aquaculture farms in proximity to visually sensitive receptors, such as National Parks, nature reserves, scenic and tourist routes, or areas of 'high' or 'very high' visual sensitivity indicated in the Appendix C and D Maps. • Observe recommended visual buffers between proposed aquaculture developments and sensitive landscape features or receptors, such as those provided in Tables 10 and 11. • Preferably locate aquaculture development where industrial development or disturbed sites, such as quarries, already exist, and avoid pristine or scenic landscapes. • Assess the cumulative visual effect of more than one aquaculture farm in the proposed siting of aquaculture facilities, as described in Section 6.1, to avoid industrialisation of natural or rural landscapes. • Conduct detailed site analyses at the planning stage to identify visual constraints, important scenic features and visually sensitive receptors in the area. • Commission a visual assessment, with viewshed analyses, to determine visibility and other potential effects resulting from the proposed siting of the aquaculture farm and related infrastructure in all areas except those of 'low' visual sensitivity in the Appendix C and D Maps, unless required otherwise by the relevant authority. • Avoid placement of land-based facilities and other infrastructure, such as powerlines on ridgelines, elevated landforms and steep slopes because of their visual effect on the skyline. Use the mitigating effect of low-lying areas or belts of trees. • Align access roads with the natural contours and avoid steep gradients requiring additional earthworks. Use existing district and farm roads where feasible, and minimise new roads.
Construction / operation phase	**Footprint:** • Minimise excessive fragmentation of natural or cultural landscapes as far as possible through grouping or sharing of infrastructure such as powerlines or access roads. • Create a compact layout and group buildings together to minimise the aquaculture farm footprint and consequently the visual effect on landscape character. • Avoid excessive loss of natural veld or agricultural land. Use previously disturbed areas in preference to pristine or agriculturally productive landscapes as far as possible. • Use low-profile cages and low buildings where possible to reduce their visibility from adjacent areas. Large buildings should preferably be broken down into a series of smaller structures. • Avoid unnecessary visual clutter, such as irregular cage sizes and haphazard layouts. Ensure that water-based structures are in scale with the coastline form, dam or lake, and do not visually dominate these features. • Keep access roads as narrow as feasible and minimise cut and fill earthworks. Locate pipelines adjacent to roads to minimise visual disturbance. **Visual Screening, Noise and Odour Abatement:** • Screen land-based facilities and related infrastructure by means of earth berms and/or planting. Spoil material could be used in the construction of berms. These are also effective if placed at strategic positions near public routes and viewpoints to screen foreground views. • Locate parked vehicles under shaded carports where possible, using natural colours for shade cloth or roof covering, to minimise their visibility in the landscape. Plant shade trees in open parking areas.

Development Stage	Visual Guidelines
Construction / operation phase	• Use muted colours with a matt surface for cages / baskets to merge with the surrounding seascape. Avoid reflective materials for both water-based and land-based structures. • Emulate local rural building forms in the design of sheds and other structures. • Avoid excessive noise and odours by means of baffles to minimise the effect on receptors and the overall sense of place. **Lighting and Signage:** • Minimise outdoor lighting to that required for safe operations. Generally avoid high-mast lighting, but where these are required use reflectors to avoid light spillage and 'sky-glow' effects, particularly in natural or rural surroundings. • Use low-level bollard lights and bulkhead lights with downward reflectors in place of high level lighting for parking and footpaths. Use light timers to turn off lights when not needed. • Minimise the amount and intensity of lights used on sea-based structures without affecting safety or navigational requirements. • Limit signage to only that which is absolutely necessary. Fix signage to walls or buildings to minimise visual clutter. • Prohibit billboards or self-illuminated signs because of their visual intrusion. Restrict the size of signs to a maximum of 4 square metres. **Maintenance:** • Maintain the aquaculture facilities and related infrastructure in a tidy, clean condition. • Control litter and other waste to avoid visual impacts on the surroundings. • Avoid visual scarring of the landscape caused by runoff and erosion by using stormwater management measures.
Rehabilitation and post closure phase	• Implement landscape rehabilitation measures during decommissioning. • Remove all above-ground structures, dams, ponds and reservoirs unless these are recycled for new uses. • Grade the affected area to pre-development topographic conditions, unless the area is required for new specific uses. • Scarify compacted areas and re-spread topsoil stored at the time of the initial clearing and re-seed exposed areas. Use stored rocks to simulate rock outcrops of the area. • Vegetation used for the restoration is to match that of the surrounding veld, unless new uses are planned for the site.
Monitoring requirements	Ensure that the visual guidelines listed above form part of the EMPr, and are included in on-going monitoring during the following stages: **Pre-construction monitoring:** • Create procedures for the review of project plans, including landscape rehabilitation plans as part of the EMP process to ensure that mitigation measures have been included in the design. • Appoint a suitably qualified landscape architect or restoration ecologist to prepare a phased rehabilitation plan for all stages of the project. Implement these plans by means of the mandatory EMP.

Development Stage	Visual Guidelines
Monitoring requirements	**Construction monitoring:** • Create procedures for ensuring that the specified visual management actions are carried out on site as part of the EMPr. Appoint an ECO to educate construction workers, monitor the implementation of mitigation measures and report to the EMP Team on a weekly basis. **Operational monitoring:** • Create procedures for the on-going control of aesthetic aspects of the project including signage, lighting, fencing, litter control etc. to ensure that the management actions are being applied. **Decommissioning monitoring:** • Create procedures for the removal of structures and stockpiles at the end of the lifespan of the aquaculture farm and related infrastructure, including re-use of the site and recycling of materials, as well as the rehabilitation or redevelopment of the site to a visually acceptable form. Monitoring of the rehabilitation by the Environmental Management Team is required, with signing off by the delegated authority.

8 GAPS IN KNOWLEDGE

Limitations for the visual study include the following, with recommendations provided to address gaps:

Lack of standardised scenic resource baseline information:

A scenic resource inventory of South Africa should be prepared, ideally with each resource graded according to national, regional and local significance, similar to that for heritage resources, which would allow for better accuracy and consistency in visual sensitivity mapping and VIAs generally.

Lack of cultural landscapes baseline information:

A survey of 'cultural landscapes' for the South African context, with the help of heritage specialists, as well as significance grading and more detailed mapping, would help to refine overall visual sensitivity rating and mapping.

Lack of tourism baseline information:

A more detailed and complete inventory of all private reserves, game farms, guest farms, resorts and tourist destinations would provide a better indication of visually sensitive receptors in the study area for mapping purposes.

Existing and proposed aquaculture facilities:

A GIS inventory of all existing and proposed aquaculture facilities, similar to that for wind energy farms, would provide a clearer indication of concentrations of aquaculture development and possible cumulative visual impacts.

The above information on scenic resources, cultural landscapes and tourism resources tend to be inter-linked, and a detailed study with a database should be prepared by a combined team of visual, heritage and tourism specialists. More detailed fine-scale mapping of the above information at the provincial and local scales would help to inform visual assessments for aquaculture development, as well as a spectrum of other forms of development, going forward.

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Appendix A: Description of Study Areas

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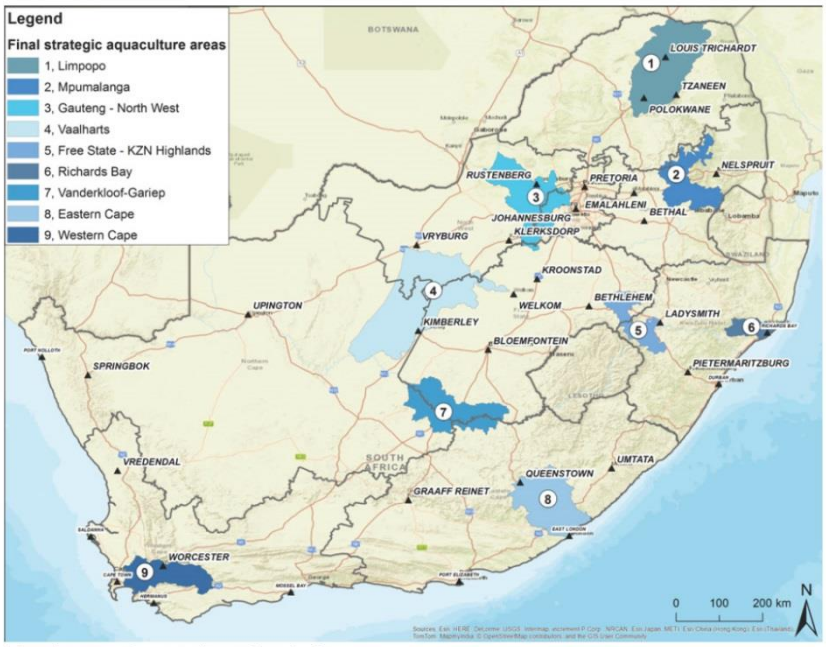
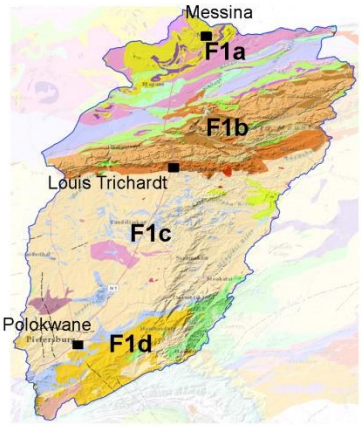


Freshwater Aquaculture Study Areas

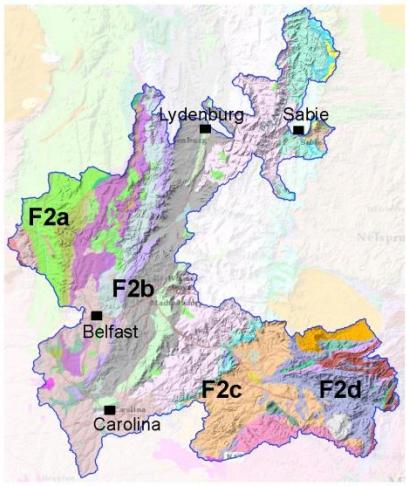
Marine Aquaculture Study Areas

F1 Limpopo



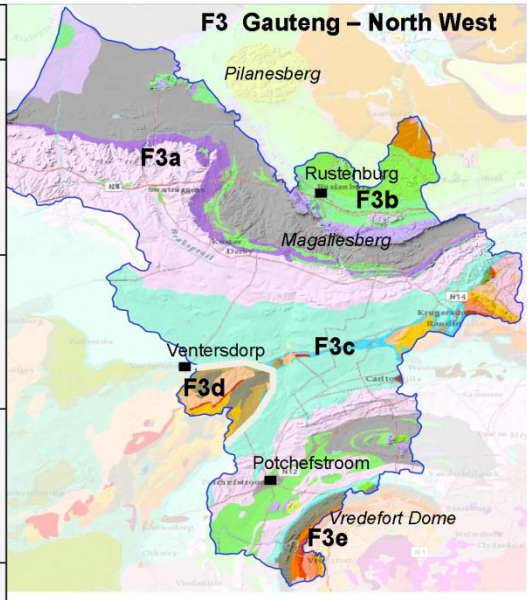
	Landscape Type	Landscape Features
F1a	Ancient flat plain with Beit Bridge Complex basement rocks dipping towards the Limpopo River, (gneiss, quartz, marble and other rocks).	The area is known for its concentration of baobab trees and the striking landscape of the Mapungubwe National Park and World Heritage Site. Agricultural land occurs near Tshipise and under irrigation along the Limpopo River.
F1b	Soutpans Group rocks of the Soutpansberg mountain range (sandstone, shale conglomerate, basalt and quartzite).	Striking cliffs waterfalls, indigenous forests and scenic passes. Important tourist / recreation area. Forms part of the Vhembe Biosphere Reserve which includes the mythically-endowed Funduzi Lake and Thathe Vondo sacred forest.
F1c	Vast grassed plain of old granite and gneiss rock types.	Granite koppies, or inselbergs, are a striking feature. The area to the east, drained by the Klein Letaba River is more rugged. Louis Trichardt is an agricultural centre in the foothills of the Soutpansberg.
F1d	Strydpoort and Leolo mountain topography consisting of resistant dolomite and quartzite type rocks.	Scenic Steelpoort River valley and mountains around Mokopane. The northern extent of the Drakensberg range forms the edge of the Great Escarpment, with striking ridges, cliffs and waterfalls, and includes the Wolkberg Wilderness Area. The Tzaneen dam, south of Modjadjiskloof, supplies water to cultivated lands producing tropical and citrus fruits.

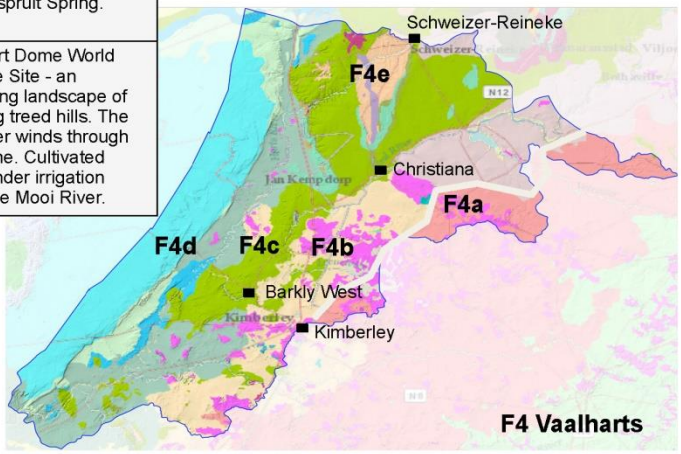
F2 Mpumalanga



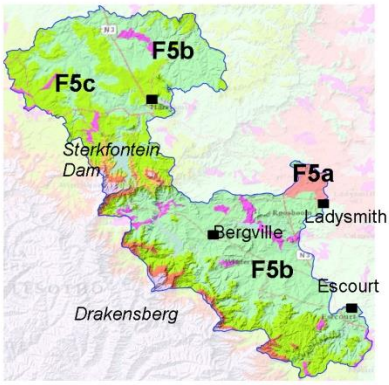
	Landscape Type	Landscape Features
F2a	Rolling grassland topography consisting of Bushveld Complex rocks including gabbro and diorite	Landscape features include scenic rolling grasslands contrasted with rocky hilly outcrops and lush riverine valleys with cold running streams.
F2b	Transvaal Complex rocks including quartzite, shale and andesite form this northern part of the Drakensberg range	The escarpment forms a dramatic backdrop to the Lowveld - an important scenic tourism destination with mountain peaks reaching over 2000 m, along with ravines and waterfalls. Ancient stone walls occur in this area. Cultivated lands under irrigation occur around the Kwena Dam.
F2c	The lower lying eroded foothills of the escarpment are formed by ancient gneiss and granite.	The Komati River valley winds through this scenic landscape into Swaziland. The Vygeboom Dam is a recreation attraction as well as supplying irrigation water. Protected landscapes include the Nkomazi Game Reserve and Nelshoogte Nature Reserve.
F2d	Barberton Supergroup volcanic rocks in this area are some of the oldest on earth, known as the Barberton Greenstone Belt.	Rugged mountainous area and forested ravines south of Barbeton, being a foothill extension of the Great Escarpment. Area includes the Songimvelo Game Reserve, known for its scenic beauty and ancient geology.

	Landscape Type	Landscape Features
F3a	Transvaal Supergroup rocks, consisting of quartz, shale and andesite of the Magaliesberg mountains.	World Biosphere Reserve. Bushveld savannah and Highveld grasslands punctuated by lone mountains and rocky outcrops. Important scenic, recreation area, with striking quartzite cliffs, kloofs and waterfalls.
F3b	Bushveld Igneous Complex rocks, including gabbro and diorite.	Highly mineralised region with platinum, chrome, tin and lead along with marble, granite and slate. Mining and quarrying have compromised the natural landscape.
F3c	Transvaal Supergroup rocks with quartzites, shales, and dolomite, plus granite and gabbro intrusions.	Landscape characterised by maize farming and mining. Cultivated lands under irrigation occur along the Groot Marico River.
F3d	Ventersdorp and Witwaters-rand Group rocks consisting of basalt, andesite, quartzites and shales.	More varied landscape and fertile agricultural maize farmlands. Numeous springs in the area including the Schoonspruit Spring.
F3e	Vredefort Dome, an asteroid impact site, consisting of basalt, granite, andesite, quartzite and lava.	Vredefort Dome World Heritage Site - an interesting landscape of radiating treed hills. The Vaal river winds through the Dome. Cultivated lands under irrigation along the Mooi River.





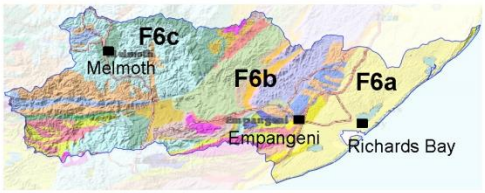
	Landscape Type	Landscape Features
F4a	Undulating plain of Dwyka and Ecca Group shales with Dolerite intrusions.	Few topographic features. Character-istic salt pans on hardpan calcrete. Cattle and sheep farming. Cultivated land along the Vaal River.
F4b	Expansive plain consisting of Aeolian sand cover with dolerite outcrops.	Grass and scrub vegetation dotted with treed hills. Diamond mining along Vaal River terraces.
F4c	Ventersdorp Supergroup including andesite lavas.	Open grassland with dense bush along Vaal River. Savannah-clad hills south of Barkly West. Cultivated lands under central pivot irrigation.
F4d	Transvaal Supergroup including quartzites and shales. Ghaap plateau escarpment.	Featureless plain with relatively dense vegetation. Prominent escarpment feature to the west.
F4e	Granite and Gneiss rock types.	Flat featureless grasslands dominated by grazing.



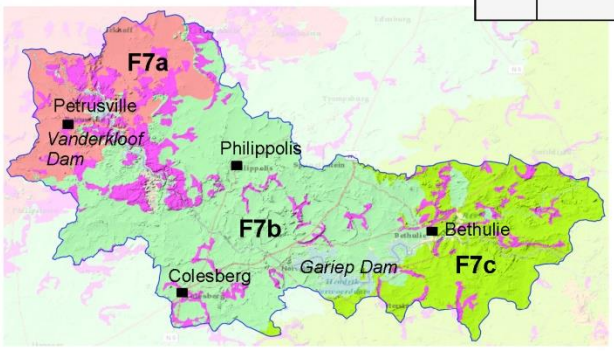
F5 Free State – KZN Highlands

	Landscape Type	Landscape Features
F5a	Ecca Group shales (Volksrust Formation) around Ladysmith	Lower lying area drained by a number of rivers, including the Tugela River.
F5b	Beaufort Group mudstones and sandstones, intruded in places by dolerites, are responsible for the more varied topography	Several large dams, including the Sterkfontein, Woodstock and Spioenkop Dams, are fed by streams from the Drakensberg to the southwest.
F5c	Beaufort Group mudstones and sandstones (Tarkstad Formation) form the foothills of the Drakensberg.	The area hosts a number of protected wilderness areas, including the Giant's Castle Game Reserve.

F6 Richards Bay

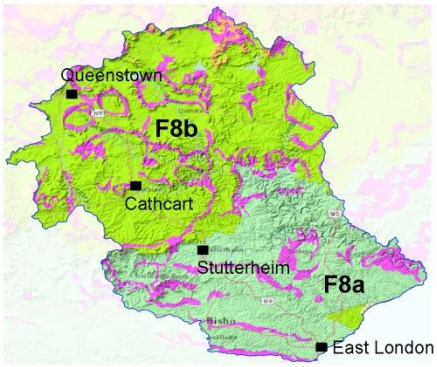


	Landscape Type	Landscape Features
F6a	Coastal plain consists of sand, alluvium and calcrete with sandy beaches, dunes and estuaries.	Features include Richard's Bay Game Reserve, Mhlatuze River lagoon, mangrove swamps and dune forests. Eucalyptus plantations occur further inland.
F6b	Rolling hills of granite, gneiss, schist and basalt.	Hills are covered with sugar cane. A region of numerous Zulu settlements and historical battle sites.
F6c	Steep-sided hills and valleys consist of quartzitic sandstone, along with granite and greenstone.	Wattle and Eucalyptus plantations have generally replaced indigenous mistbelt grasslands. Lake Phobane in the scenic Mabelbele mountain range provides for cultural tourism and water for irrigation schemes.



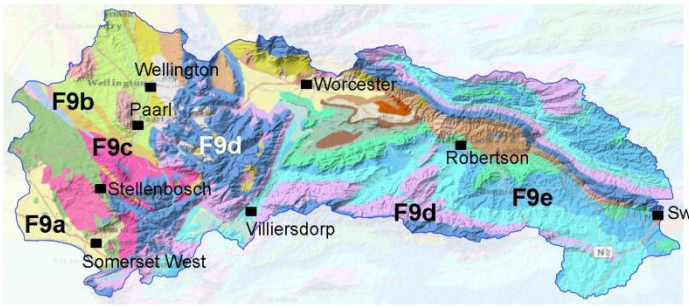
F7 Vanderkloof - Gariep

	Landscape Type	Landscape Features
F7a	Karoo landscape derived from softer Ecca Group shales (Tierberg Formation). Dolerite intrusions (shown in pink), are the only landscape features.	Vanderkloof Dam on the Orange River (Gariep R.), includes the Rolfontein Nature Reserve. Irrigated cultivation takes place along the banks of the Orange River.
F7b	Karoo landscape with dolerite koppies, formed by Beaufort Group mudstones and sandstones, (Adelaide Formation),	Gariep Dam and Nature Reserve, on the Orange River, is the main landscape feature and prime recreation area. The arid landscape is known for merino sheep farming.
F7c	More varied landscape underlain by Beaufort Group mudstones and sandstones, (Tarkastad Formation), intruded in places by dolerite.	The more resistant sandstones tend to form the ridges. Sheep and cattle farming around Bethulie. Mynhardt Nature Reserve is on the banks of the Bethulie Dam.



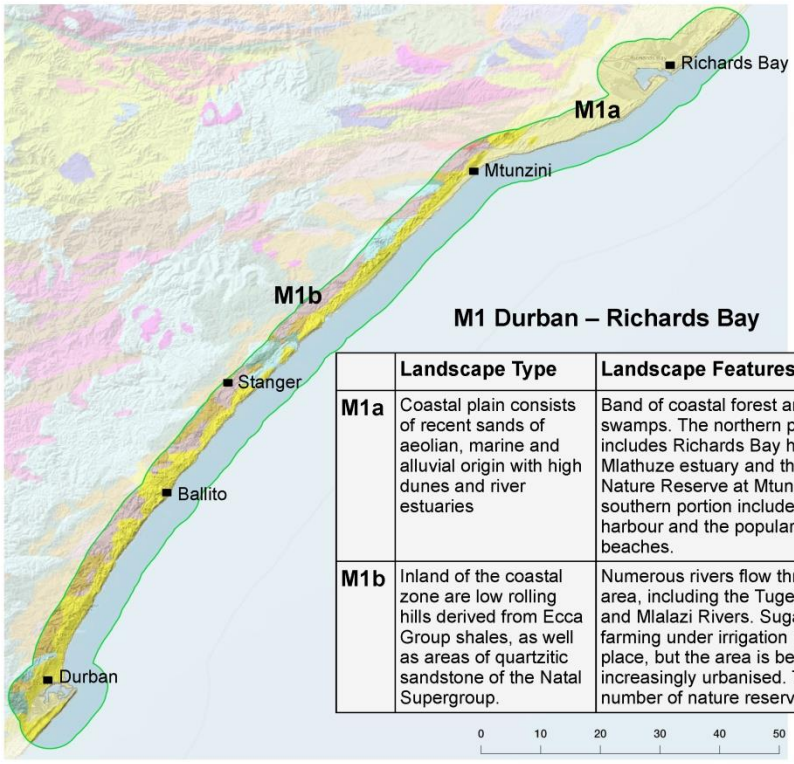
F8 Eastern Cape

	Landscape Type	Landscape Features
F8a	Alternating mudstones and sandstones of the Beaufort Group (Adelaide Formation), intruded inland by dolerite sills and dykes (pink on the map).	East London is located on a flatter coastal plain, the land rising gradually to the scenic Amathole range near Stutterheim.
F8b	Mudstones and sandstones of the Beaufort Group, (Tarkastad Formation), intruded by dolerite, the latter forming the distinctive peaks and ridges typical of the area.	The hills are dotted with numerous kraals and settlements, and several large dams have been constructed east of Queenstown.



F9 Western Cape

	Landscape Type	Landscape Features
F9a	Sandy coastal plain - forms part of the Cape Flats on False Bay	Main settlements are Strand and Gordons Bay fishing harbour at the eastern end.
F9b	Undulating landscapes consisting of weathered Malmesbury Group shale, greywacke and phyillite.	Area characterised by wheatlands. The Paarl Rock granite pluton is a prominant landscape feature. The Berg River flows through this area.
F9c	The Cape Granite Suite (shown in pink),	Famed Cape Winelands in the Stellenbosch and Franschhoek areas - important for their cultural heritage.
F9d	Resistant quartzitic sandstones of the Table Mountain Group - responsible for the scenic Cape Fold Mountains.	Important as water catchment areas with numerous streams. Protected nature reserves with mountain fynbos. Major dams are the Steenbras, Theewaterskloof and Brandvlei dams, while the Breede is the major river of the region.
F9e	Bokkeveld Group shales are responsible for the rolling topography.	Important winter-rainfall wheat-growing area.



M1 Durban – Richards Bay

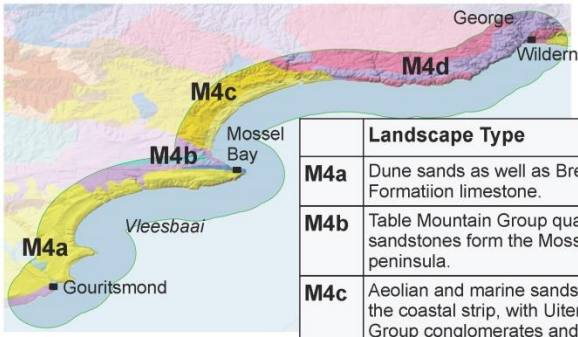
	Landscape Type	Landscape Features
M1a	Coastal plain consists of recent sands of aeolian, marine and alluvial origin with high dunes and river estuaries	Band of coastal forest and mangrove swamps. The northern portion includes Richards Bay harbour / Mlathuze estuary and the Umlalazi Nature Reserve at Mtunzini, while the southern portion includes Durban harbour and the popular North Coast beaches.
M1b	Inland of the coastal zone are low rolling hills derived from Ecca Group shales, as well as areas of quartzitic sandstone of the Natal Supergroup.	Numerous rivers flow through the area, including the Tugela, Umgeni and Mlalazi Rivers. Sugar cane farming under irrigation has taken place, but the area is becoming increasingly urbanised. There are a number of nature reserves.

M2 East London - Kei

	Landscape Type	Landscape Features
M2a	Other than the narrow coastal belt, most of the study area is composed of mudstones and sandstones of the Beaufort Group (Adelaide Formation), creating an undulating landscape. Areas near East London and the Kei Mouth are intruded by dolerite (shown in pink).	Characteristic features are the sandy beaches, high dunes and numerous river mouths along the coastal belt. East London on the Buffalo River is South Africa's only river port. The 'Wild Coast' to the north is famed for its recreation resorts. Road access to the coast is less developed towards the north.
M2b	Smaller areas of mudstones and sandstones of the Beaufort Group, (Tarkastad Formation) occur north of Gonubie and of the Kei Mouth.	These areas have a similar rolling landscape to that of the rest of the study area, incised by numerous rivers. The Kwelera and Henderson Nature Reserves are located on the coast.

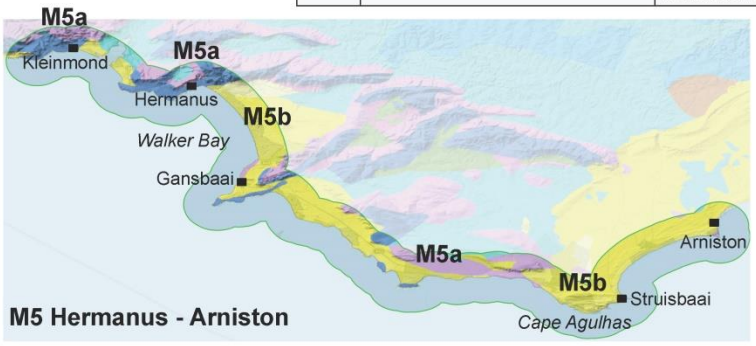
M3 Port Elizabeth

	Landscape Type	Landscape Features
M3a	Cape Recife is a sandy coastal plain covered with aeolian dune sand.	The area includes the Summerstrand residential area, Nelson Mandela University campus and numerous recreation and resort facilities.
M3b	The coastal strip consists of aeolian / marine sands, and limestone, with patches of Uitenhage Group sandstone further inland.	Industrial, residential and resort development occurs along the coast, along with an estuarine port at Coega. Landscape features include the Swartkops River mouth north of Port Elizabeth, and the Sundays River mouth near Colchester.
M3c	Eastern extent of the mountainous quartzitic sandstones of the Table Mountain Group.	A largely built-up area that includes the Port Elizabeth harbour and the tip of Cape Recife.

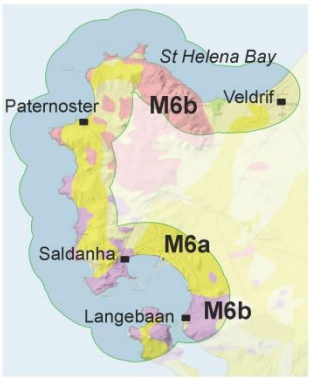


M4 Gouritz - George

	Landscape Type	Landscape Features
M4a	Dune sands as well as Bredasdorp Formatiion limestone.	Gouritsmond and Vleesbaai are mainly holiday settlements.
M4b	Table Mountain Group quartzitic sandstones form the Mossel Bay peninsula.	The area is an important holiday destination. The port at Mossel Bay has storage facilities for oil and gas.
M4c	Aeolian and marine sands along the coastal strip, with Uitenhage Group conglomerates and sandstone inland.	Residential and resort development along the coast, and the Klein- and Groot Brak River estuaries.
M4d	Cape granite rocky coastline along with Kaaimans Group quartzite.	Scenic Kaaimans River gorge. The Wilderness is an important tourist destination on the Garden Route.



	Landscape Type	Landscape Features
M5a	The mountainous landscape of the Overstrand consists of Table Mountain Group quartzitic sandstones.	Besides coastal residential development, the area is important as a holiday and tourist destination. Abalone aquaculture takes place on the rocky coastlines of Hermanus and Gansbaai.
M5b	The coastal plain is formed by dune sands and Bredasdorp Formatiion limestone.	Protected areas include Walker Bay and De Mond Nature Reserves, and Agulhas National Park, the southern tip of Africa being an important visitor destination. Whale watching in Hermanus and shark diving in Gansbaai are tourist attractions.

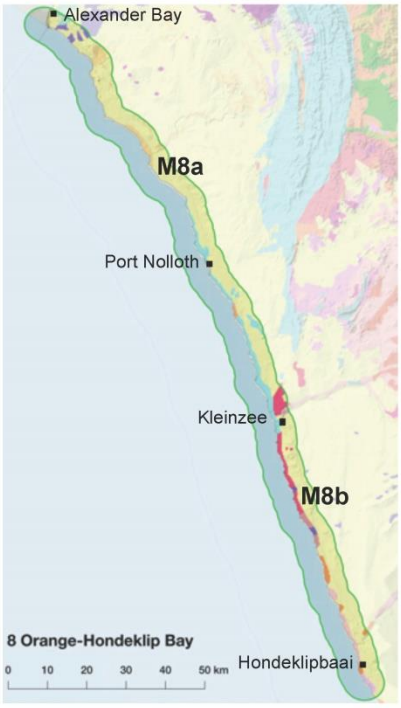


M6 Veldrif - Saldanha

	Landscape Type	Landscape Features
M6a	Dune sands and Bredasdorp Formation limestone form the flat coastal plain.	Residential, recreation and holiday settlements, include Paternoster. St Helena Bay is a hub for commercial fishing. Berg River estuary at Veldrif / Laaiplek forms an important landscape feature.
M6b	the rocky coastline and headlands consist of Cape granite creating characteristic rounded granite landforms, either as dome-like hills or outcrops.	Saldanha is a natural sheltered harbour with industrial (fish canning) and aquaculture development. Also home of the Navy's training gymnasium. The West Coast National Park lies immediately to the south. Langebaan is a popular residential and holiday destination, with Club Mykonos resort nearby.

M7 Strandfontein – Lamberts Bay

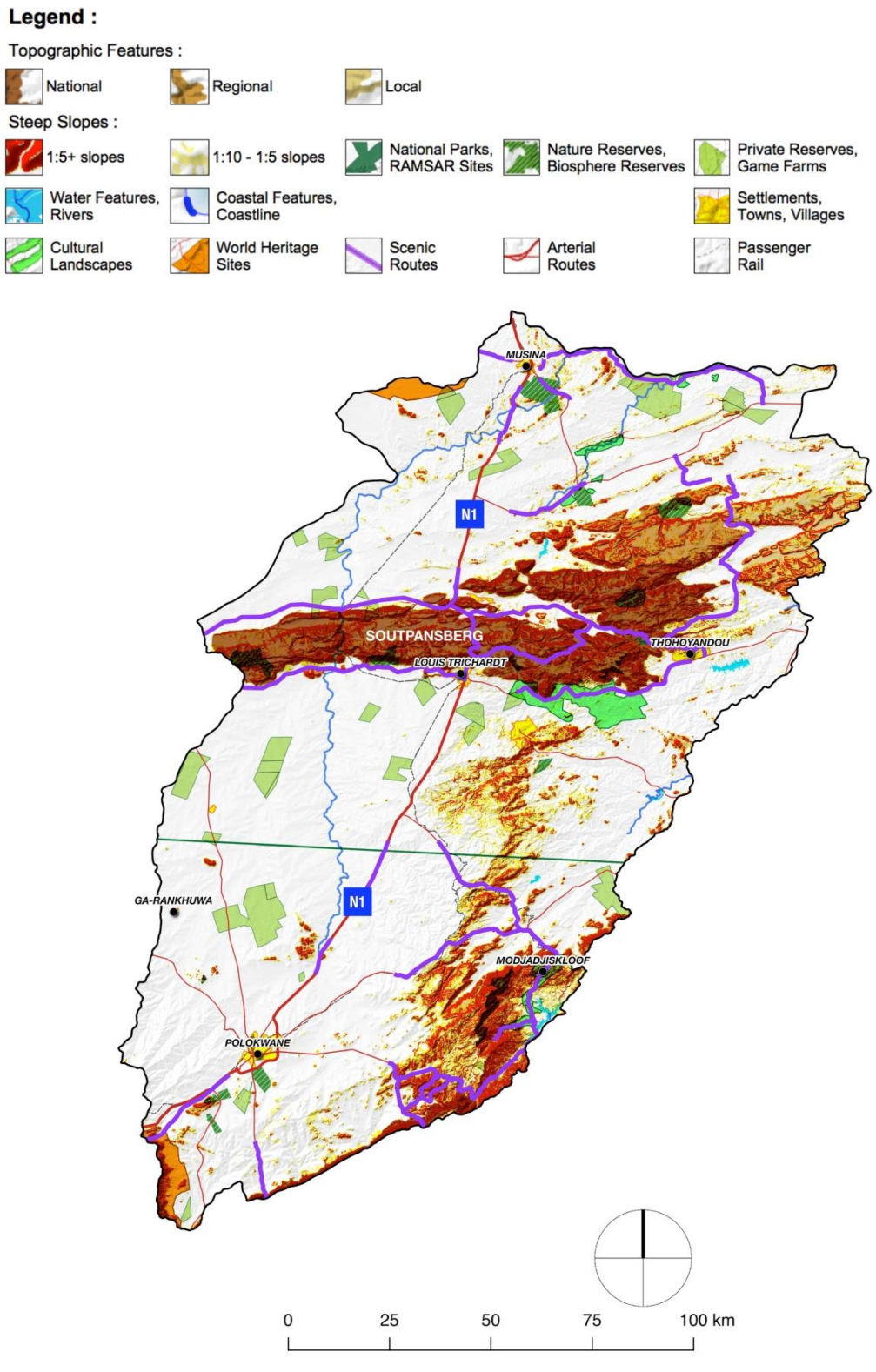
	Landscape Type	Landscape Features
M7a	The Sandveld coastal plain consists of marine and aeolian dune sand, alluvium and calcrete.	The mainly dry Jakkals River enters the sea at Lamberts Bay, which has a fishing harbour and fish processing facilities.
M7b	The rocky coastline is formed by quartzitic sandstone of the Table Mountain Group.	Doringbaai and Strandfontein mainly used for holiday purposes. The tidal Olifants River mouth at Papendorp, north of Strandfontein, is an important landscape feature.



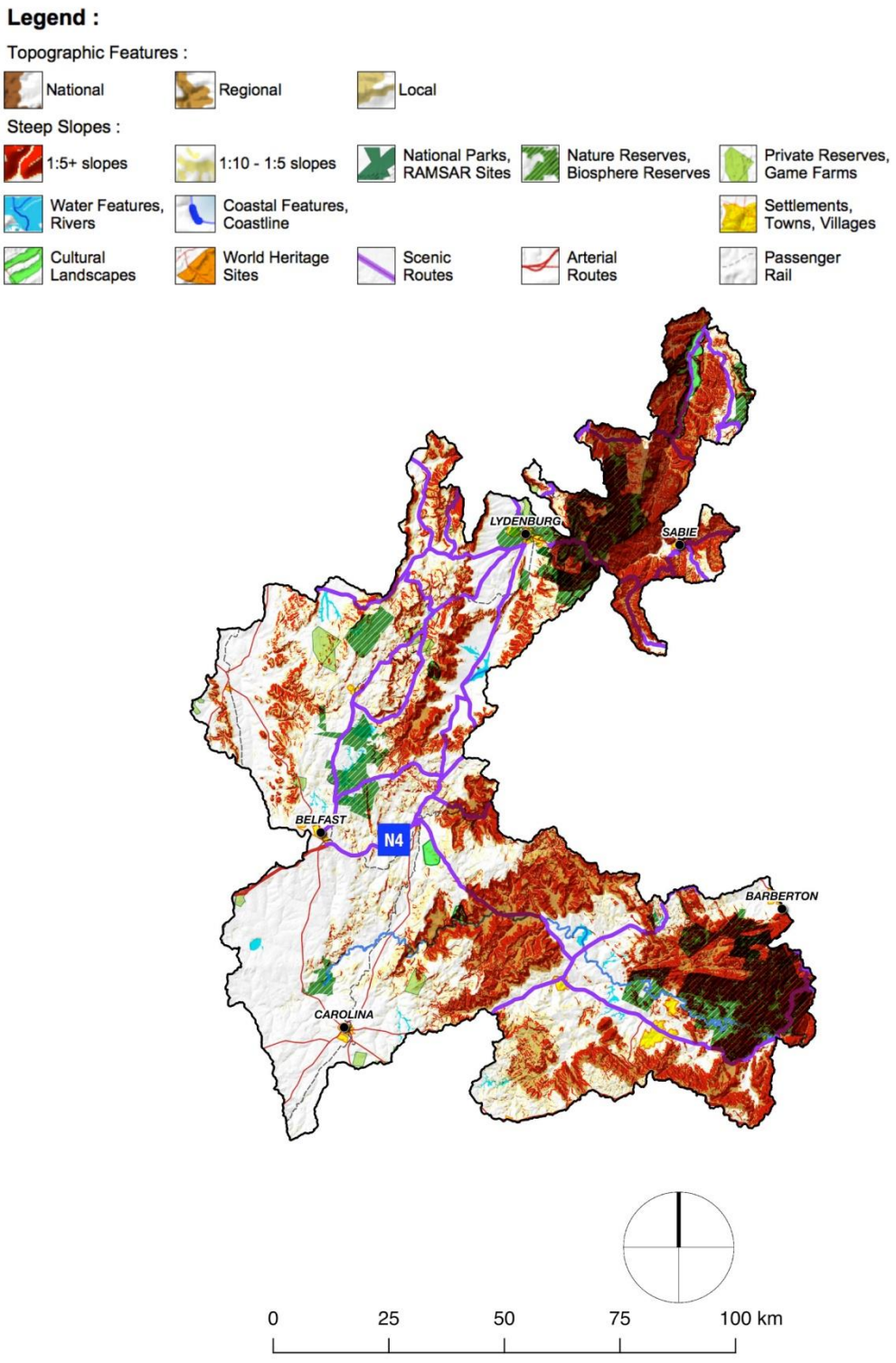
M8 Orange – Hondeklip Bay

	Landscape Type	Landscape Features
M8a	Basement rocks exposed along the coastline include Gariep Complex schist, gneiss and arenite, with surface deposits, such as sand, gravel, alluvium and calcrete.	An arid region where scarce water comes from springs and boreholes. Diamond mines occurred along the coast, many of which have closed down, although diamond dredging offshore continues.
M8b	South of Kleinzee the basement rocks exposed along the coastline consist of Namaqua granites and gneiss belonging to the Spektakel Suite and Okiep Group of rocks.	Except for the rock outcrops, the coastal landscape is largely featureless and exposed. The Buffels River mouth at Kleinzee, although largely dry, is a landscape feature.

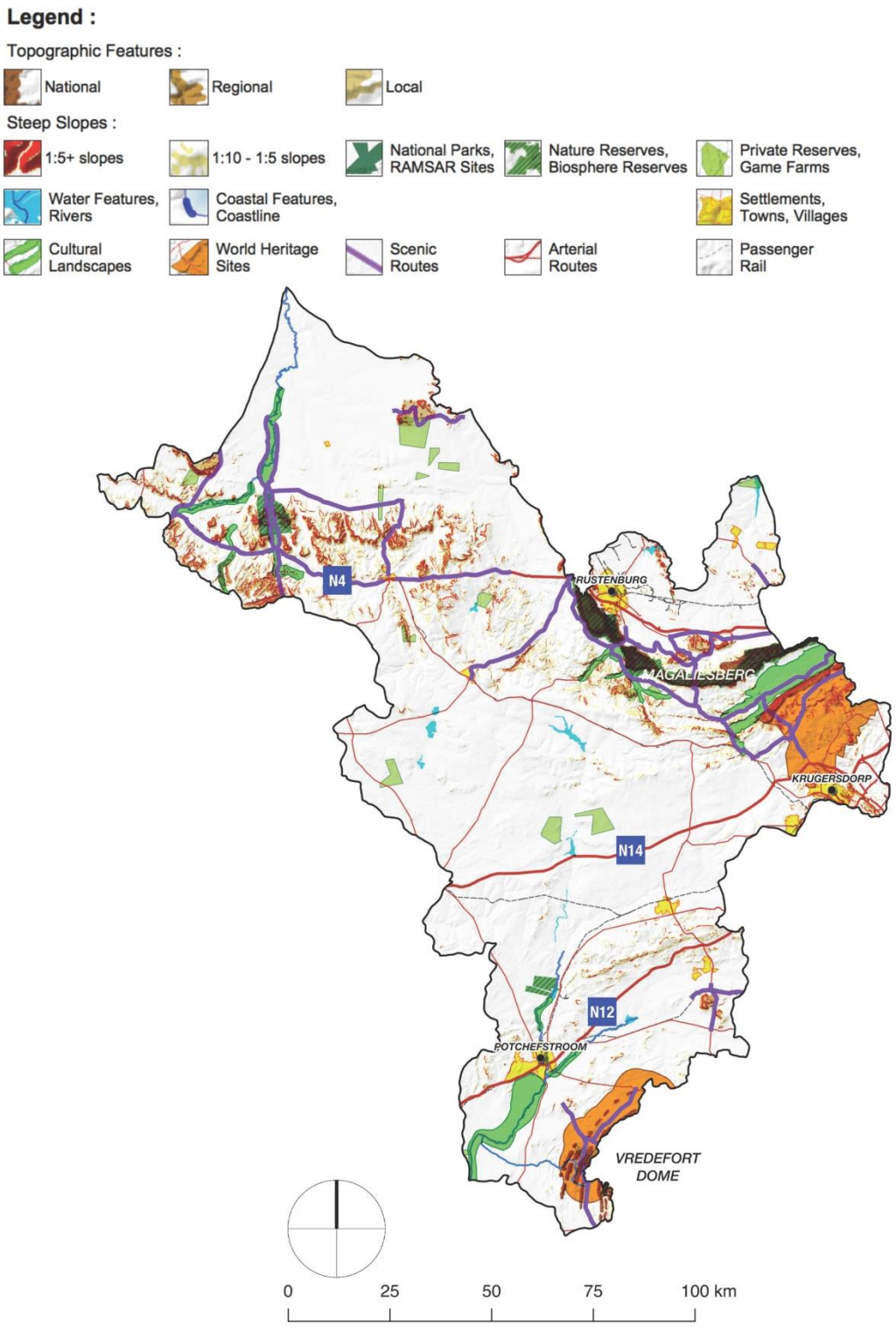
Appendix B: Scenic resources and Visual Receptors



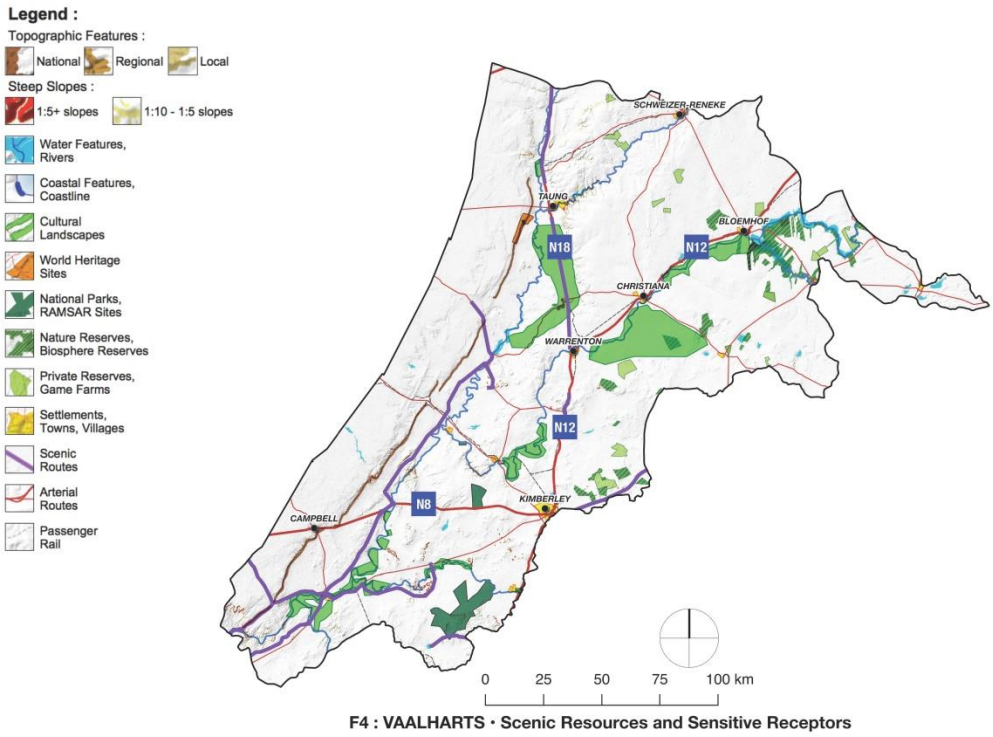
F1 : LIMPOPO · Scenic Resources and Sensitive Receptors



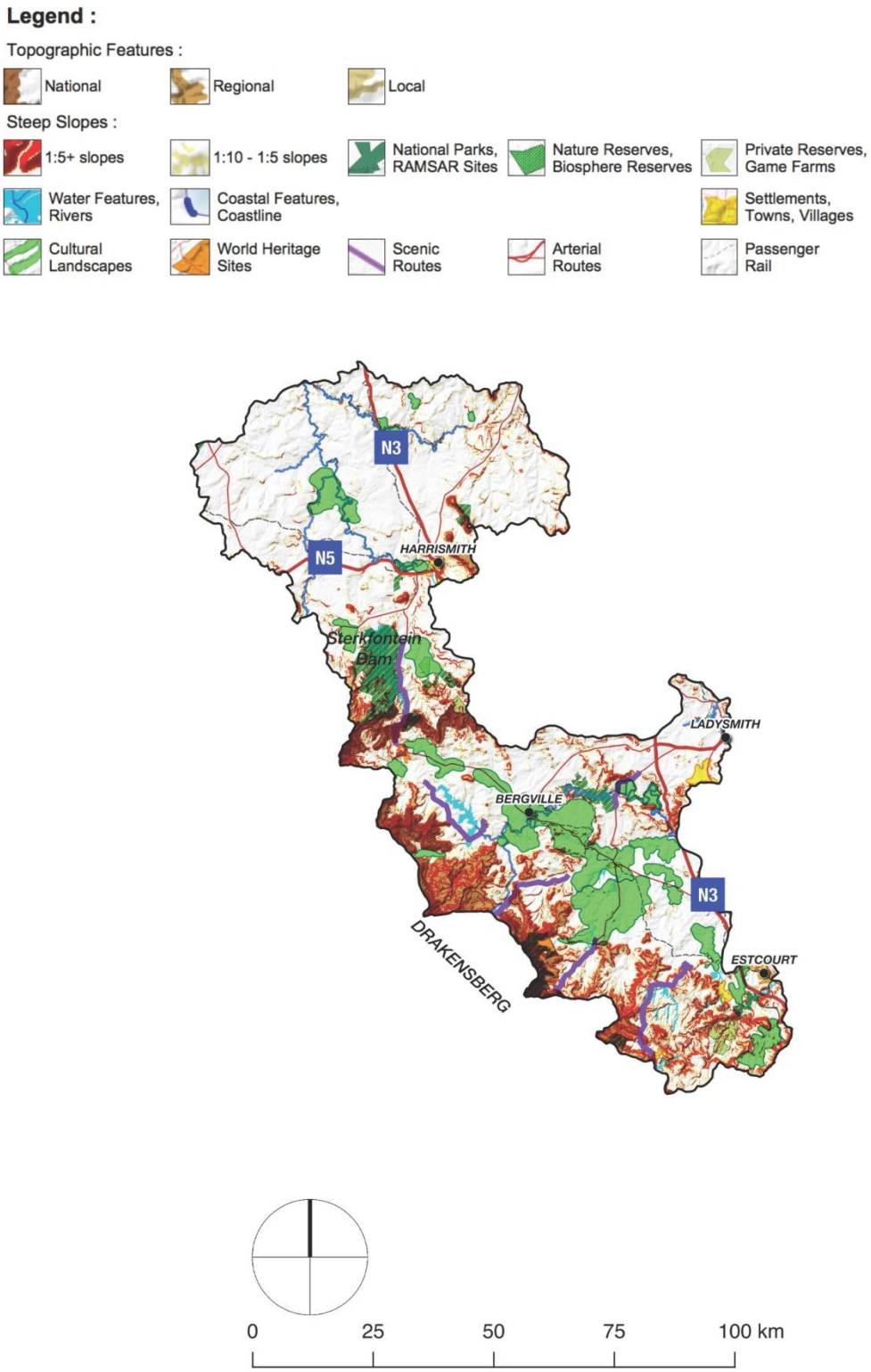
F2 : MPUMALANGA · Scenic Resources and Sensitive Receptors



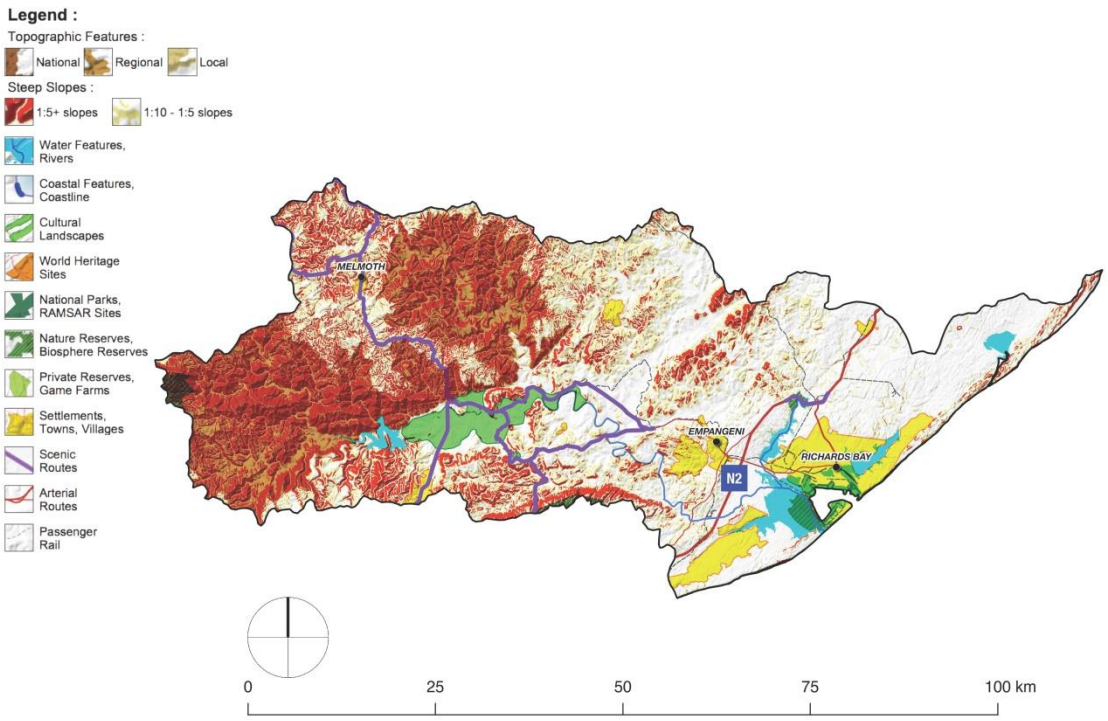
F3 : GAUTENG NORTH-WEST • Scenic Resources and Sensitive Receptors



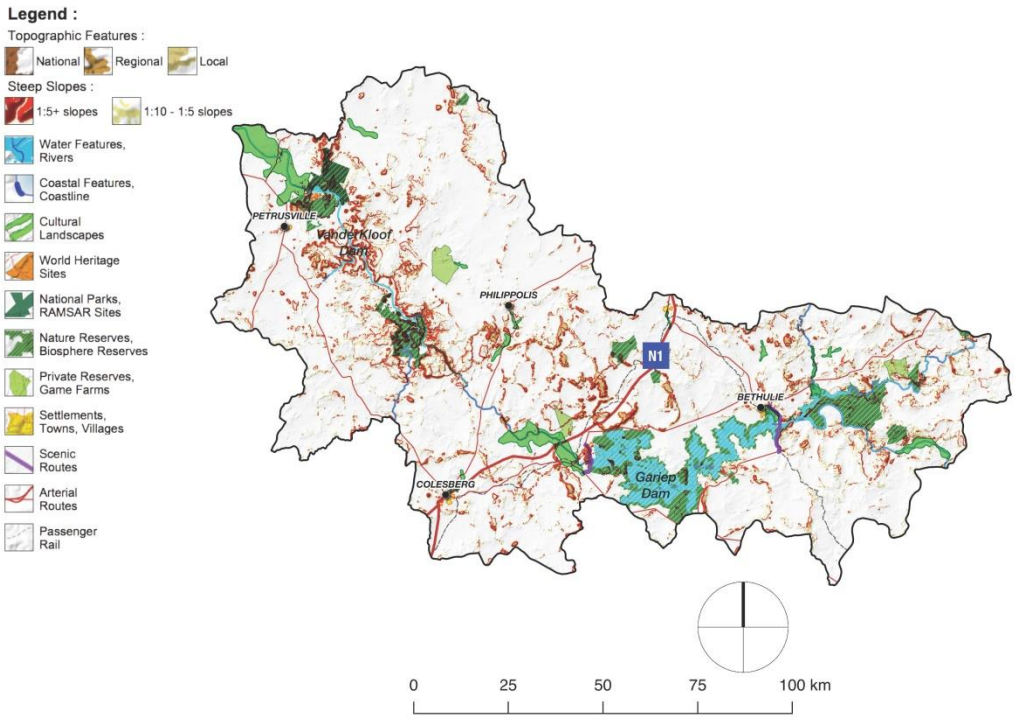
F4 : VAALHARTS · Scenic Resources and Sensitive Receptors



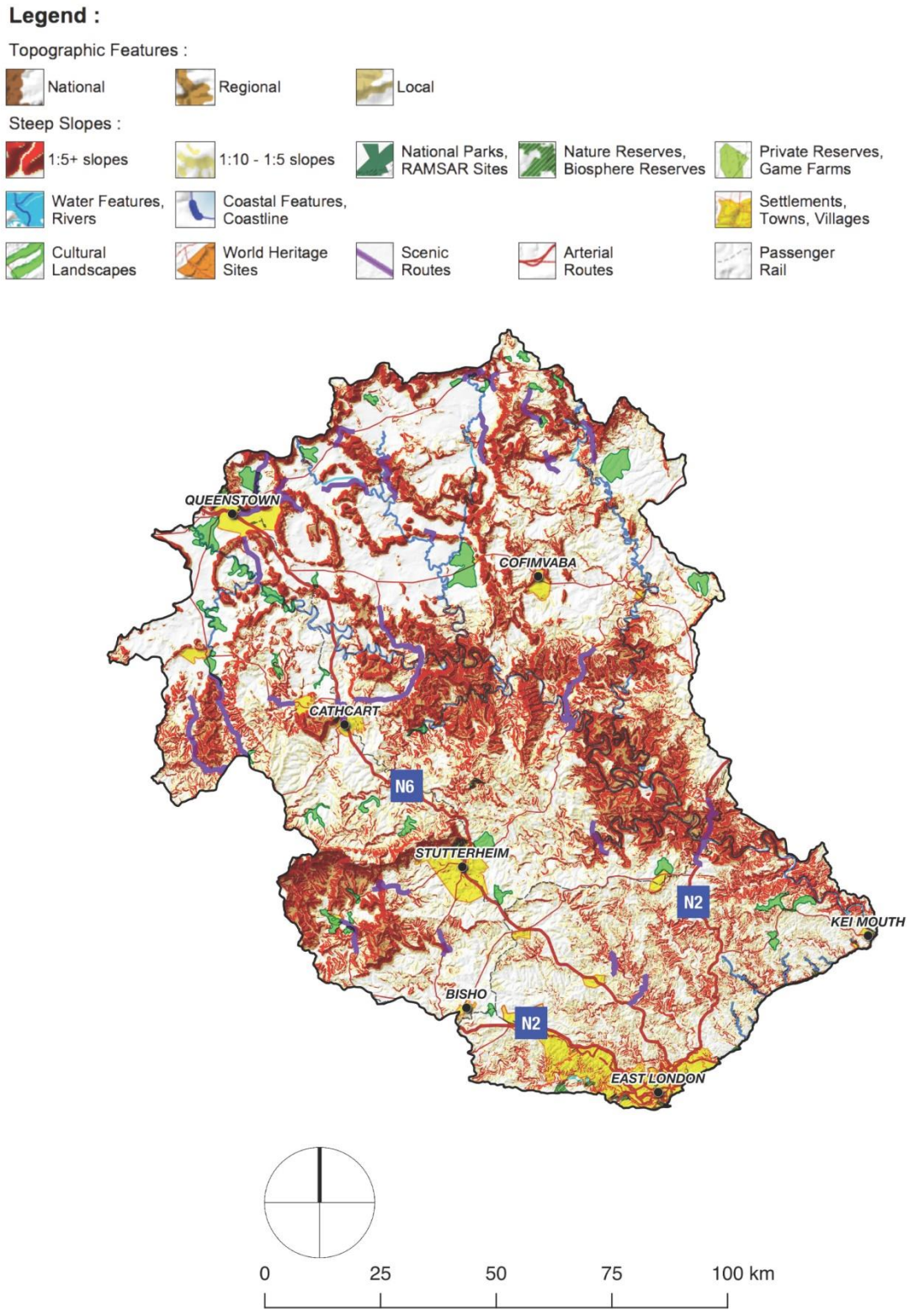
F5 : FREE STATE - KZN HIGHLANDS • Scenic Resources and Sensitive Receptors



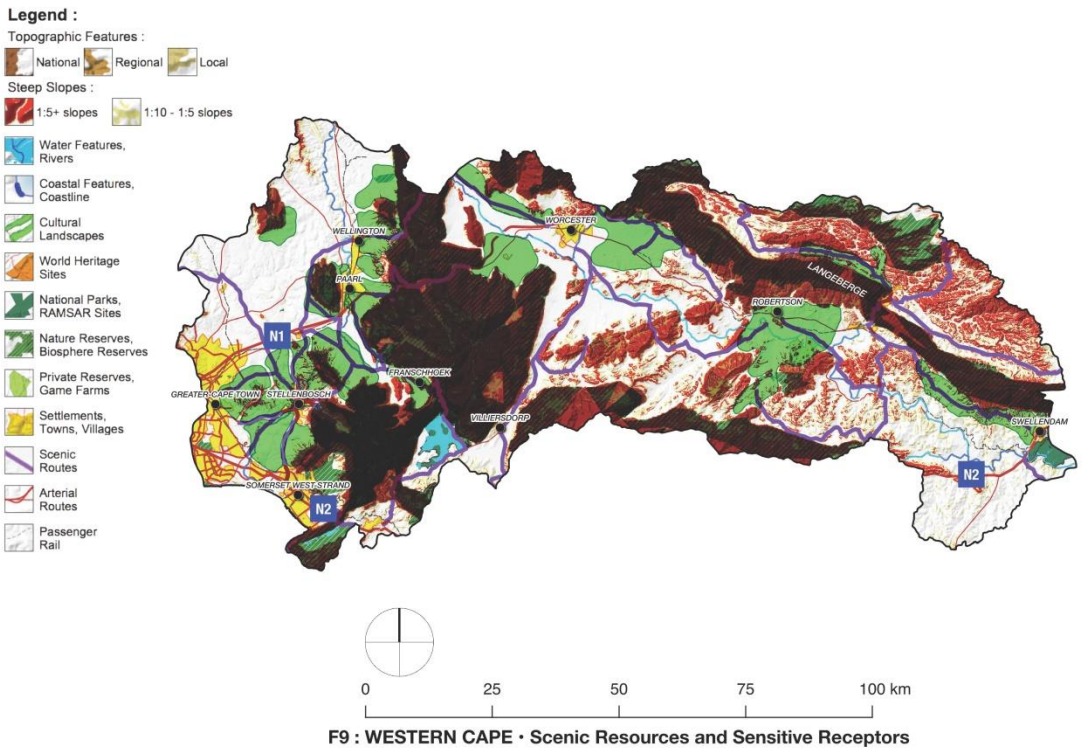
F6 : RICHARDS BAY · Scenic Resources and Sensitive Receptors



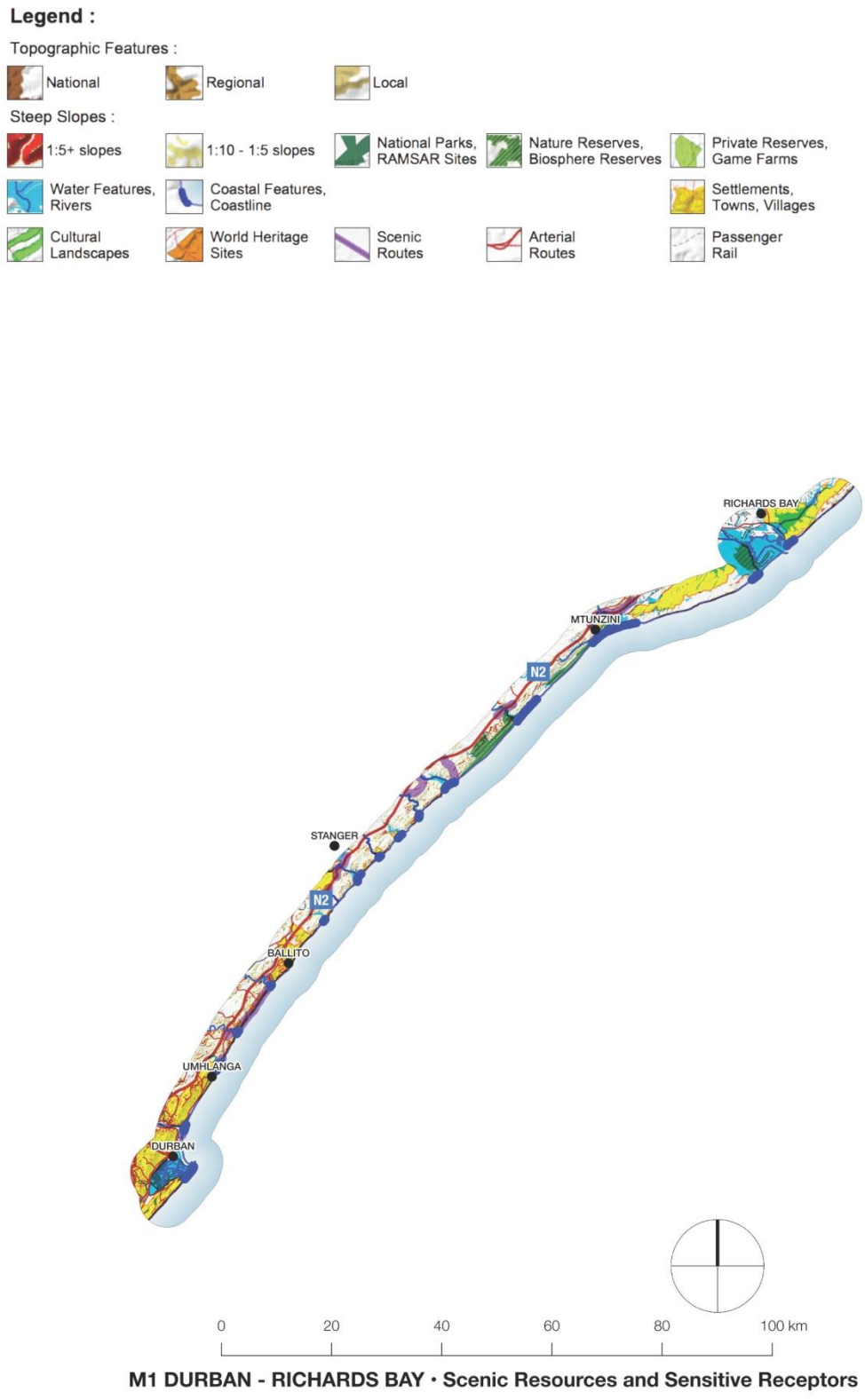
F7 : VANDERKLOOF GARIEP · Scenic Resources and Sensitive Receptors



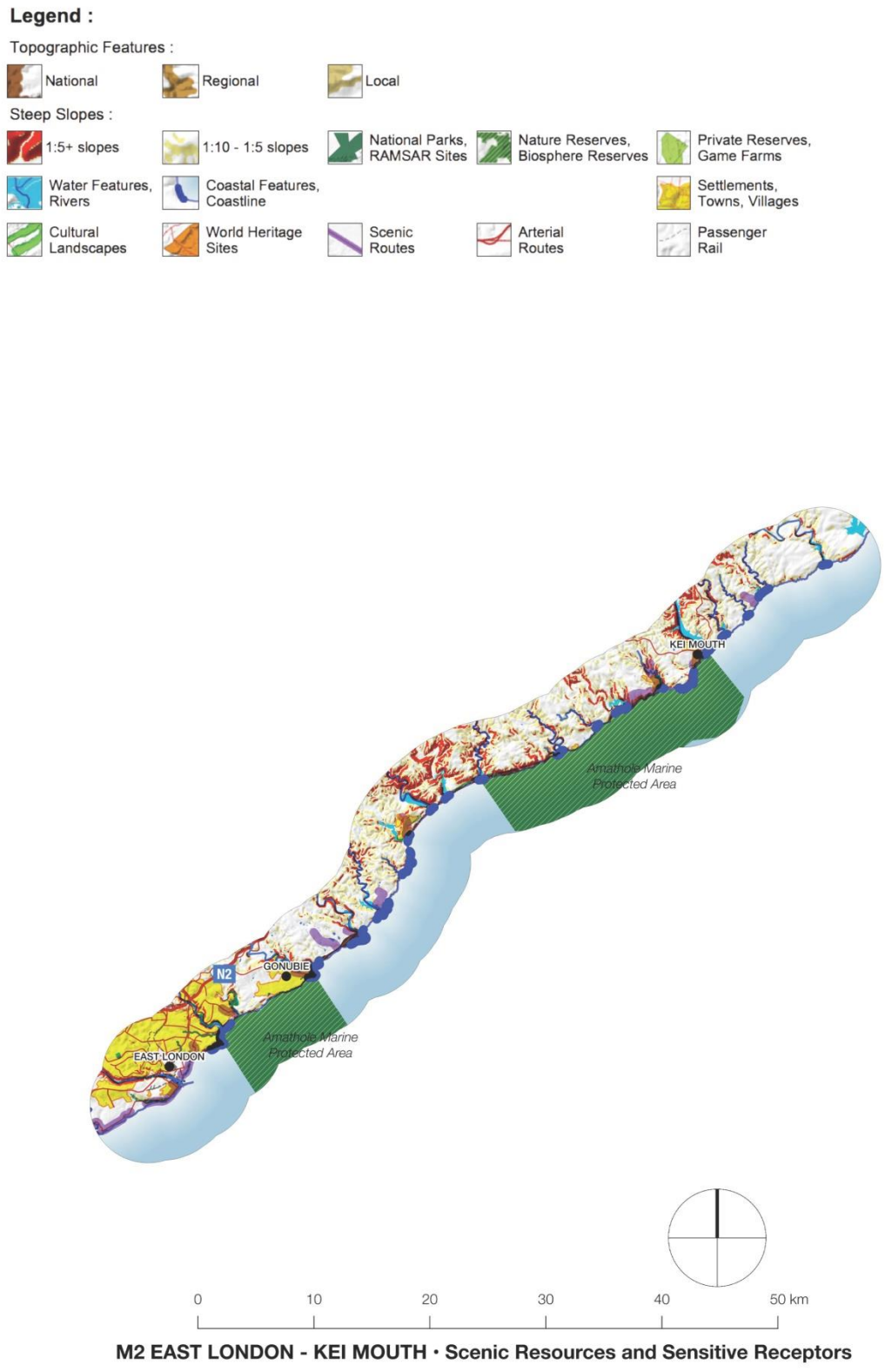
F8 : EASTERN CAPE · Scenic Resources and Sensitive Receptors



F9 : WESTERN CAPE · Scenic Resources and Sensitive Receptors

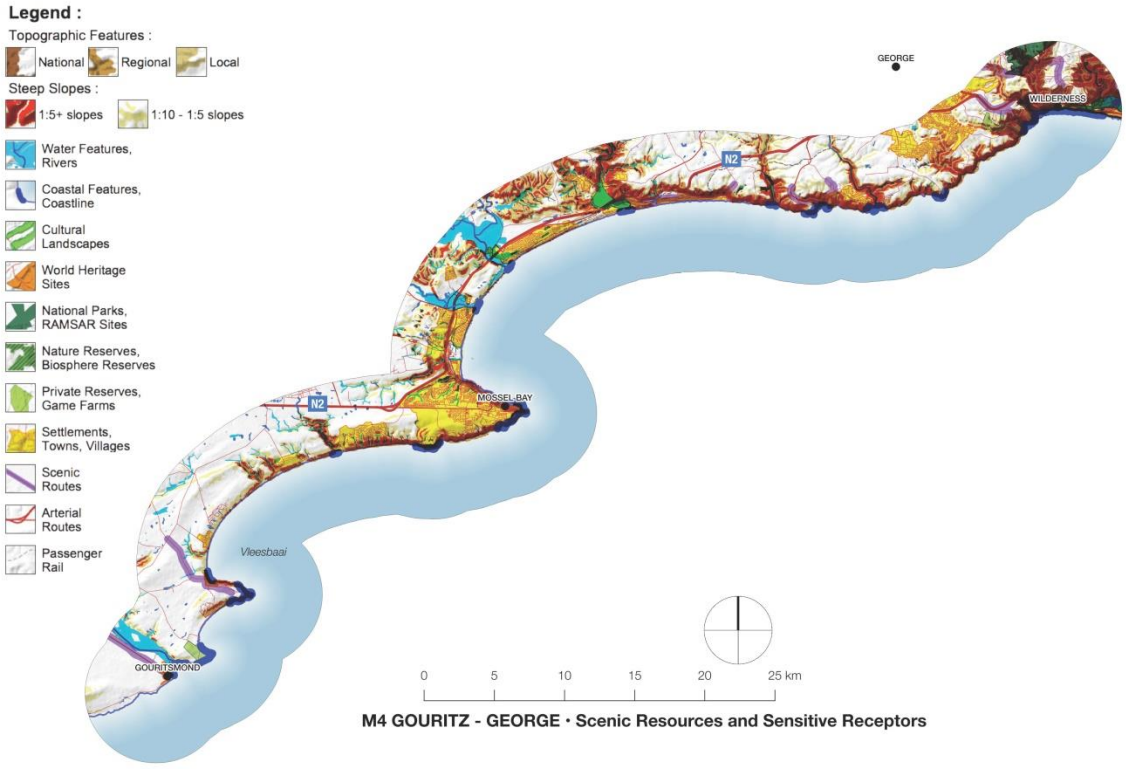


M1 DURBAN - RICHARDS BAY • Scenic Resources and Sensitive Receptors

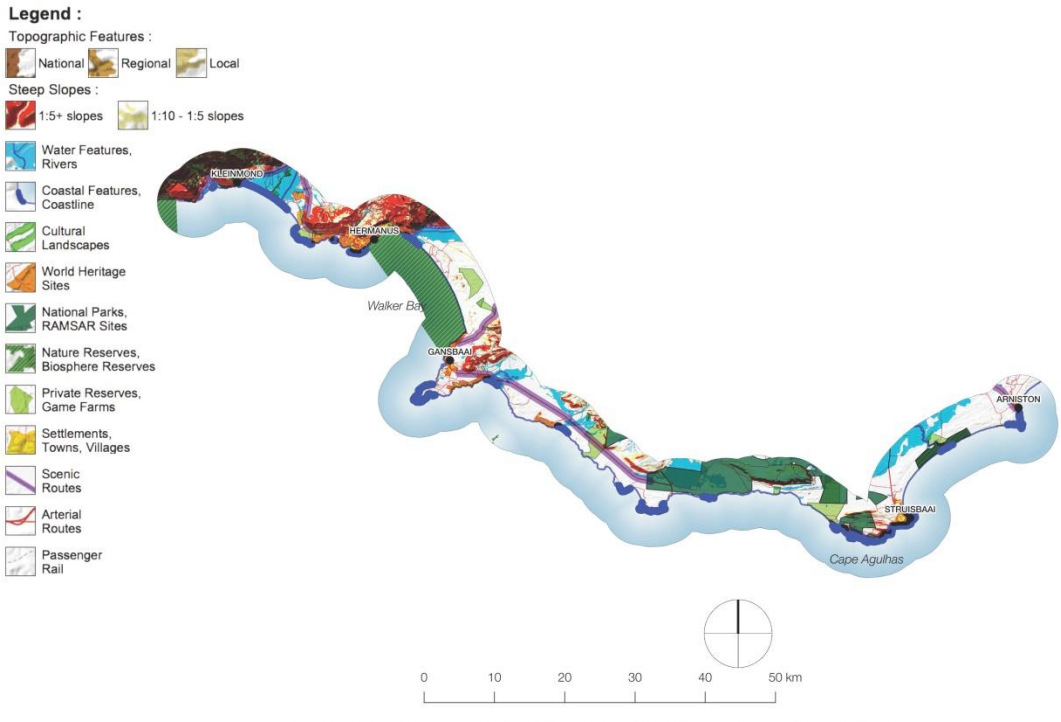


M2 EAST LONDON - KEI MOUTH · Scenic Resources and Sensitive Receptors

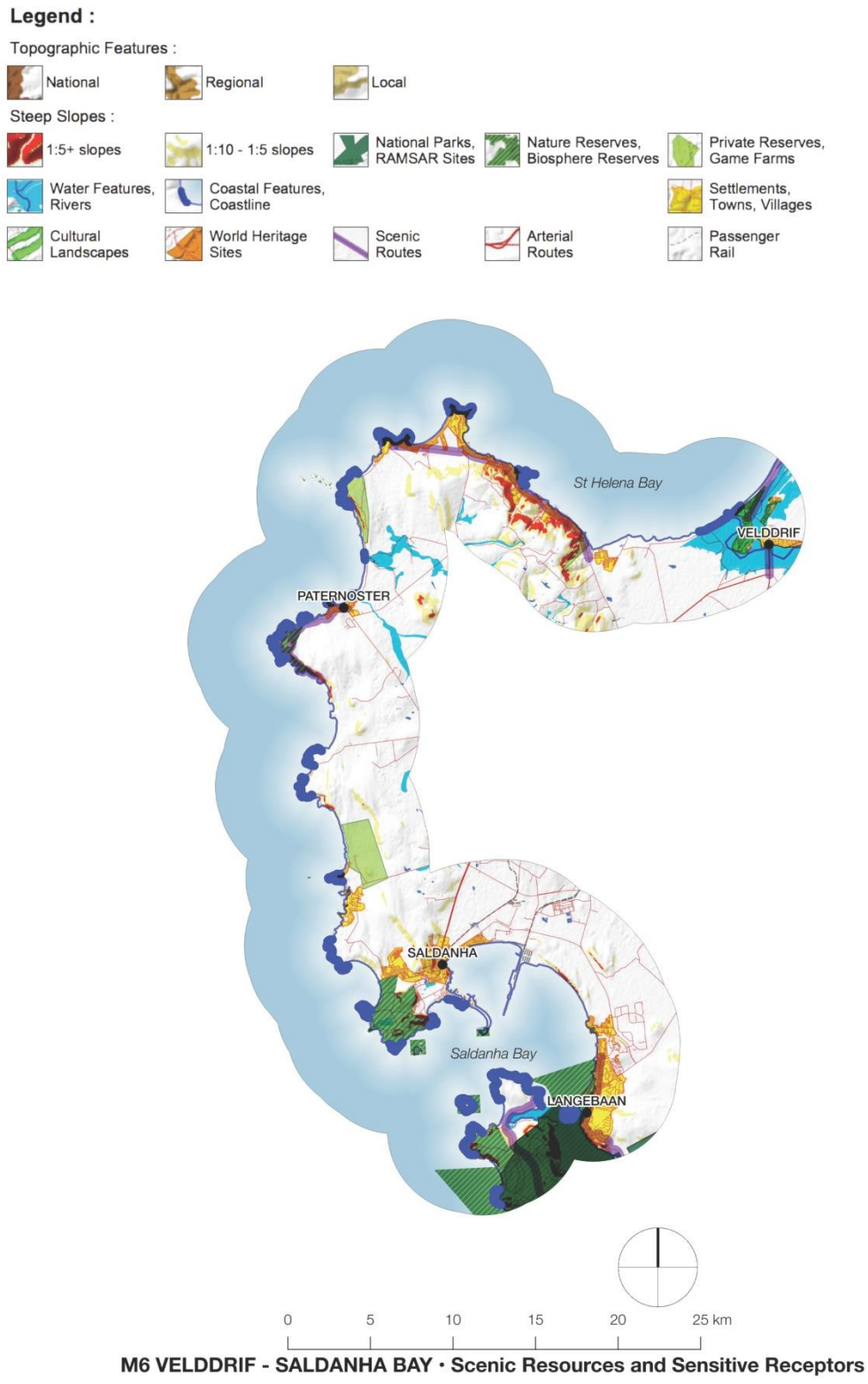
M3 PORT ELIZABETH • Scenic Resources and Sensitive Receptors



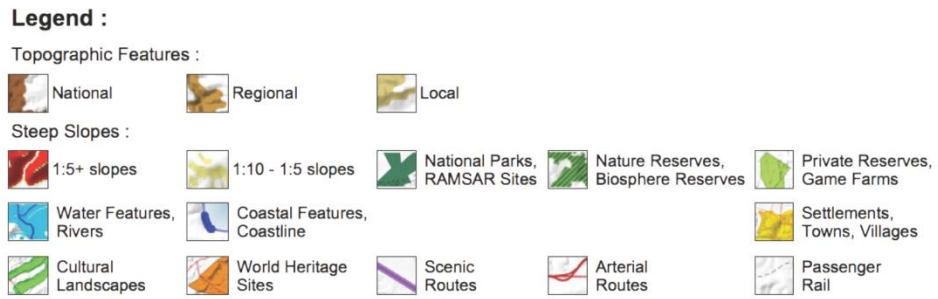
M4 GOURITZ - GEORGE · Scenic Resources and Sensitive Receptors



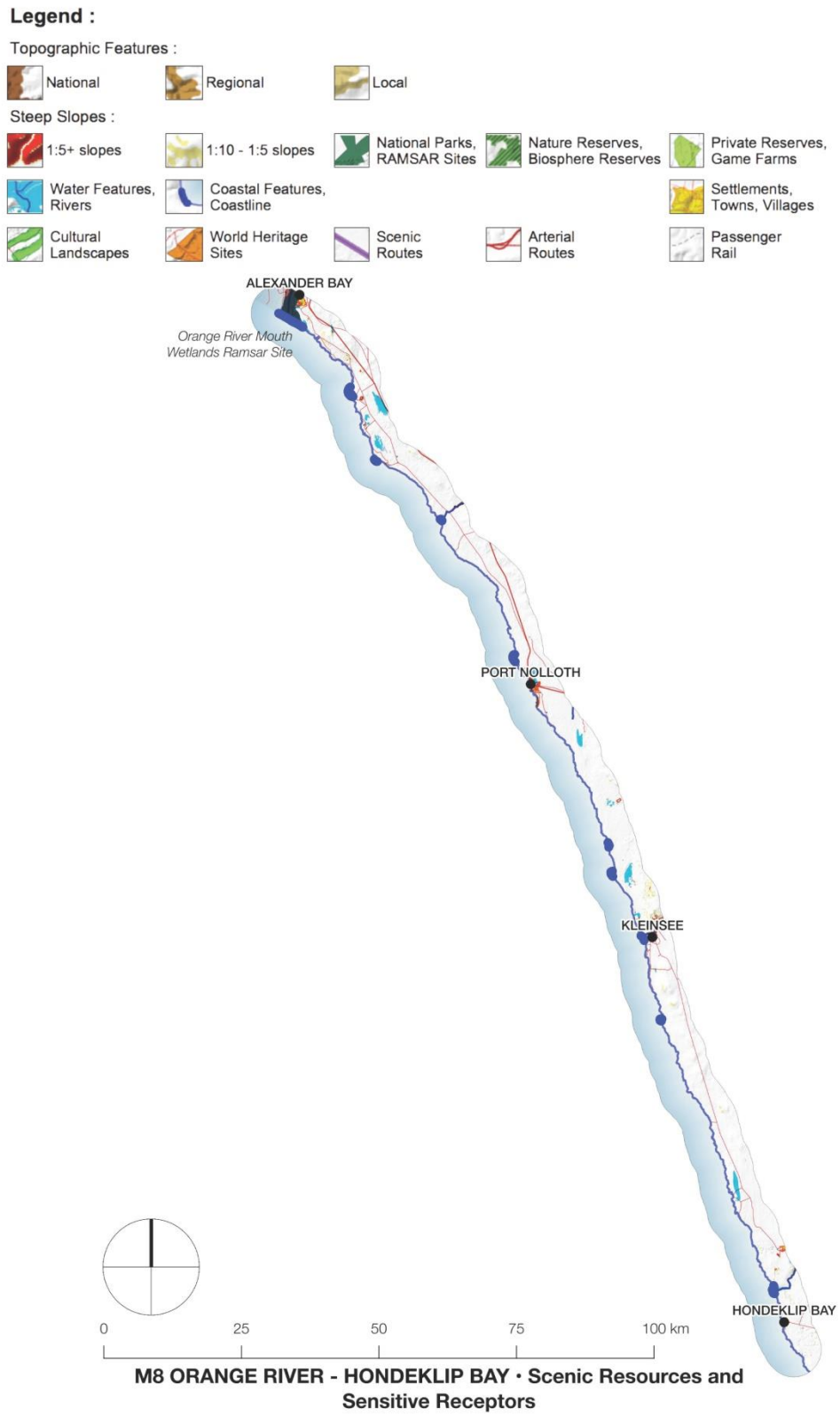
M5 HERMANUS - ARNISTON · Scenic Resources and Sensitive Receptors



M6 VELDDRIF - SALDANHA BAY • Scenic Resources and Sensitive Receptors



M7 STRANDFONTEIN - LAMBERTS BAY • Scenic Resources and Sensitive Receptors



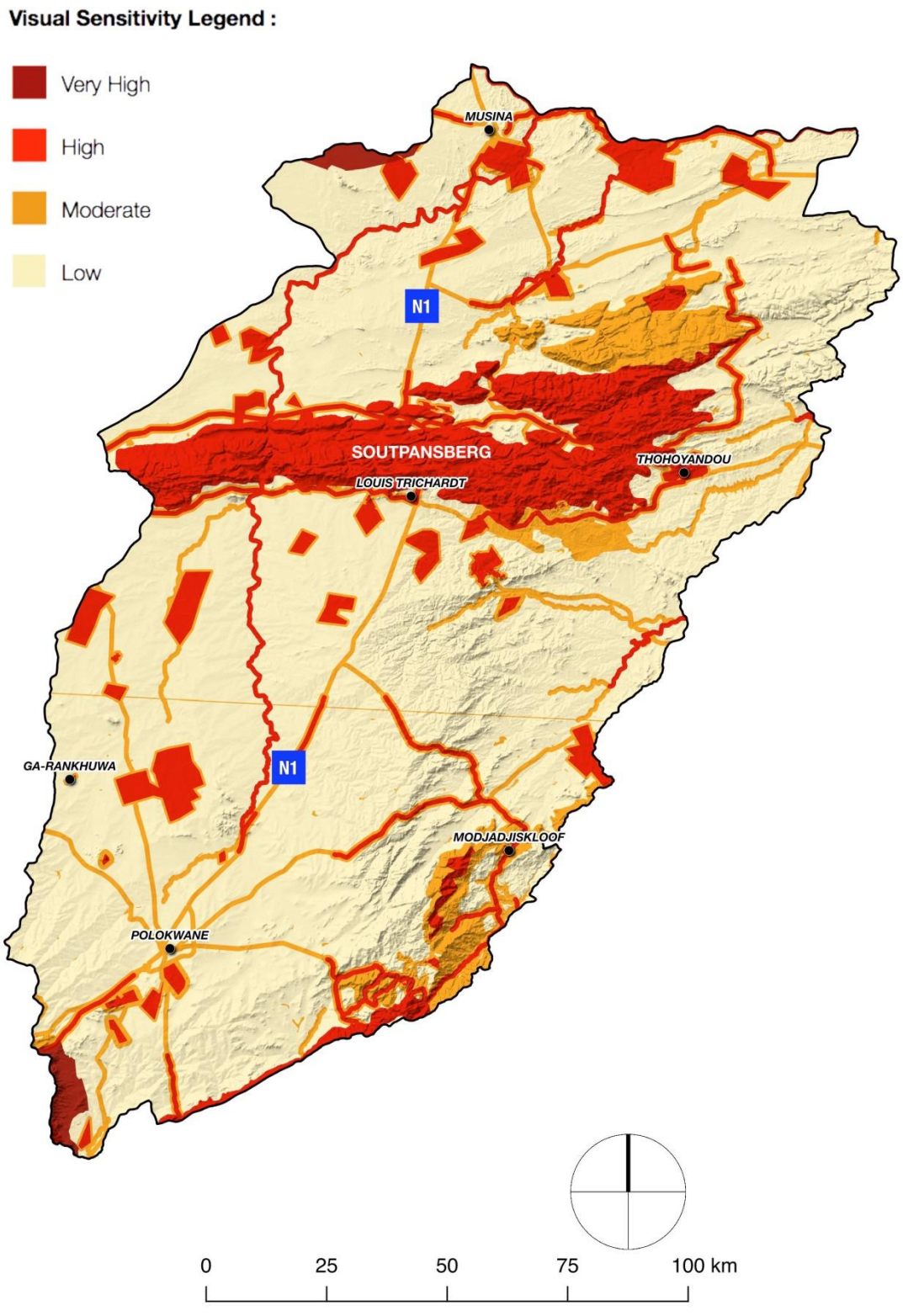
M8 ORANGE RIVER - HONDEKLIP BAY · Scenic Resources and Sensitive Receptors

Appendix C: Visual Sensitivity - Small-Moderate Scale Aquaculture

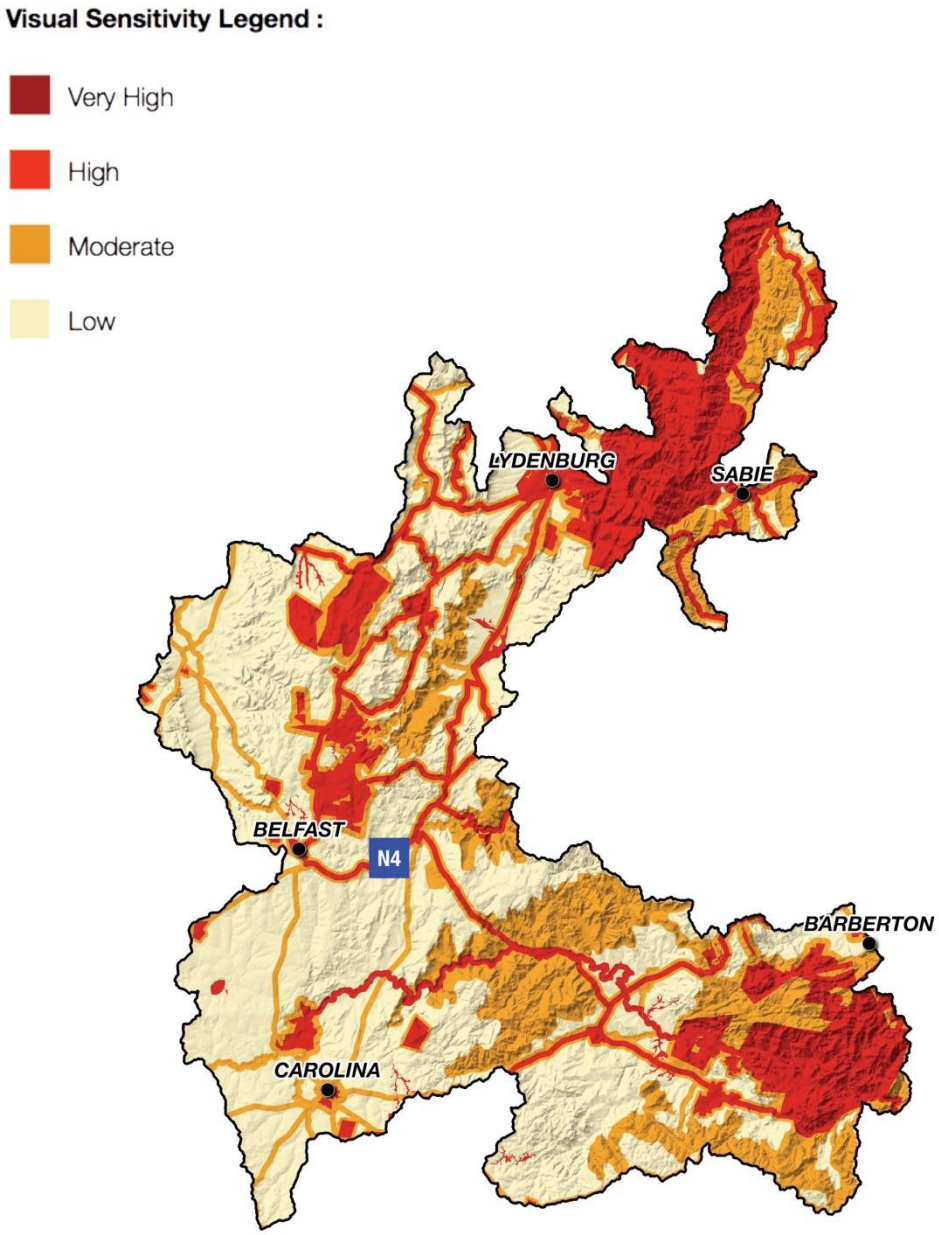
Appendix C:

Visual Sensitivity Maps

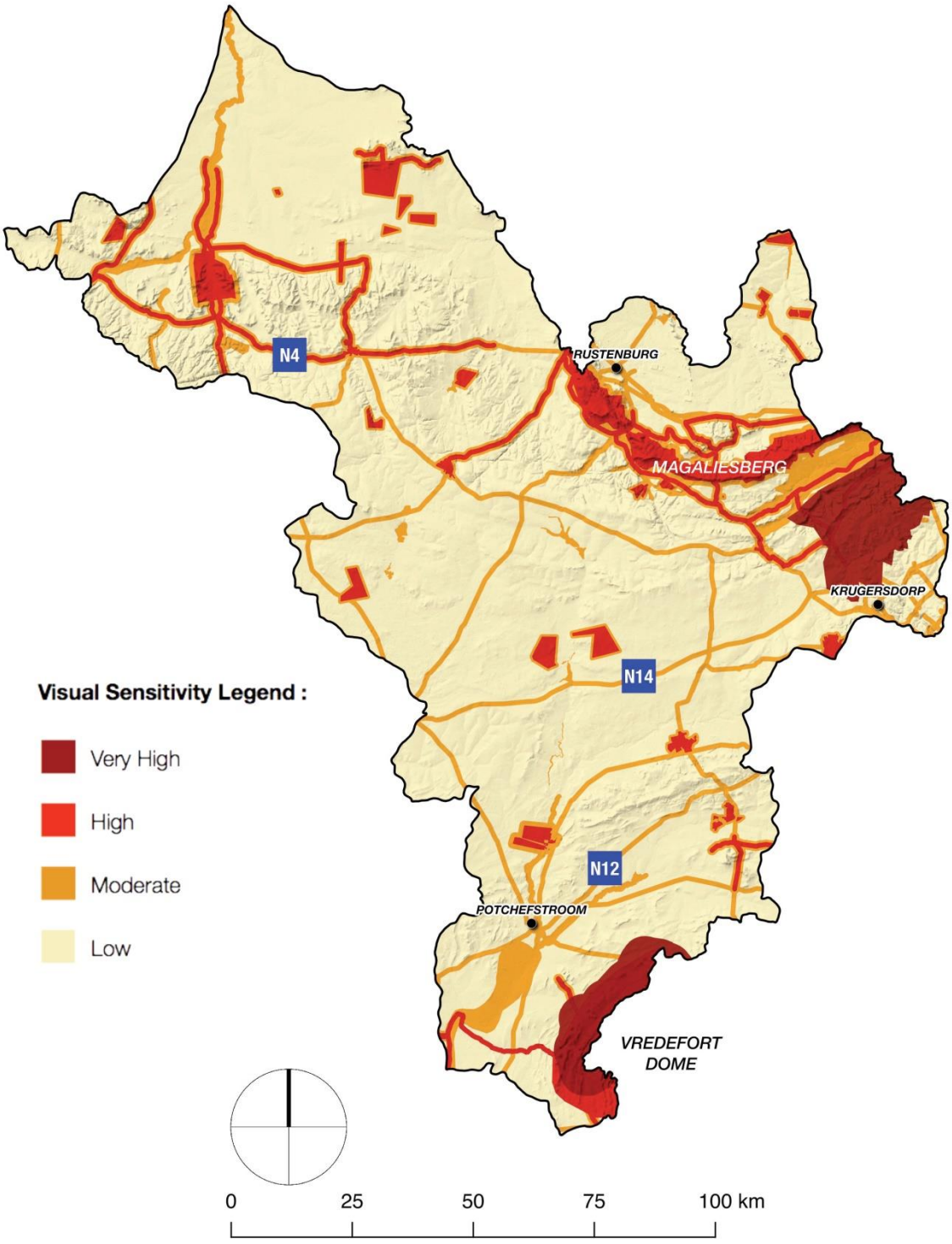
Small to Moderate Scale Aquaculture



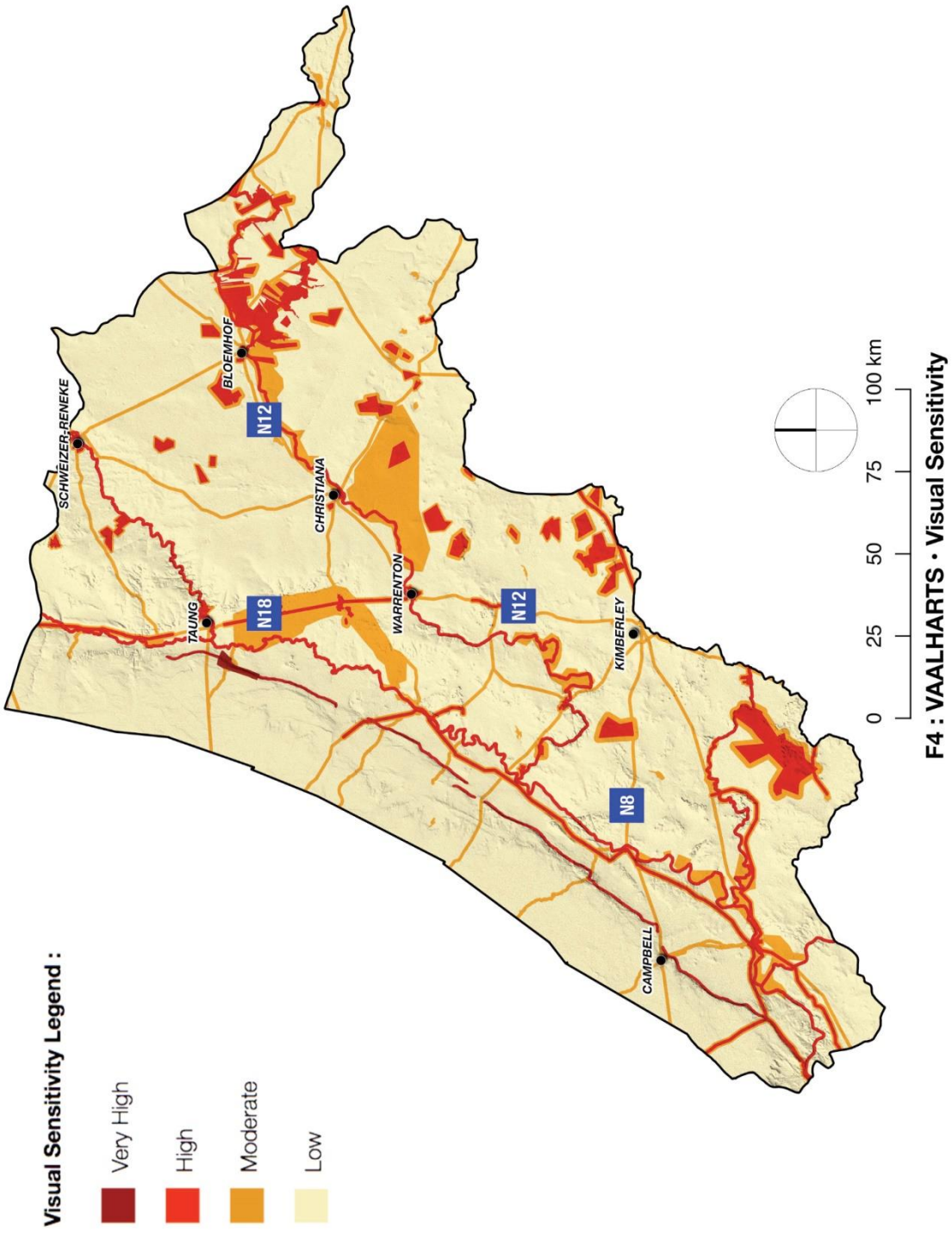
F1 : LIMPOPO · Visual Sensitivity

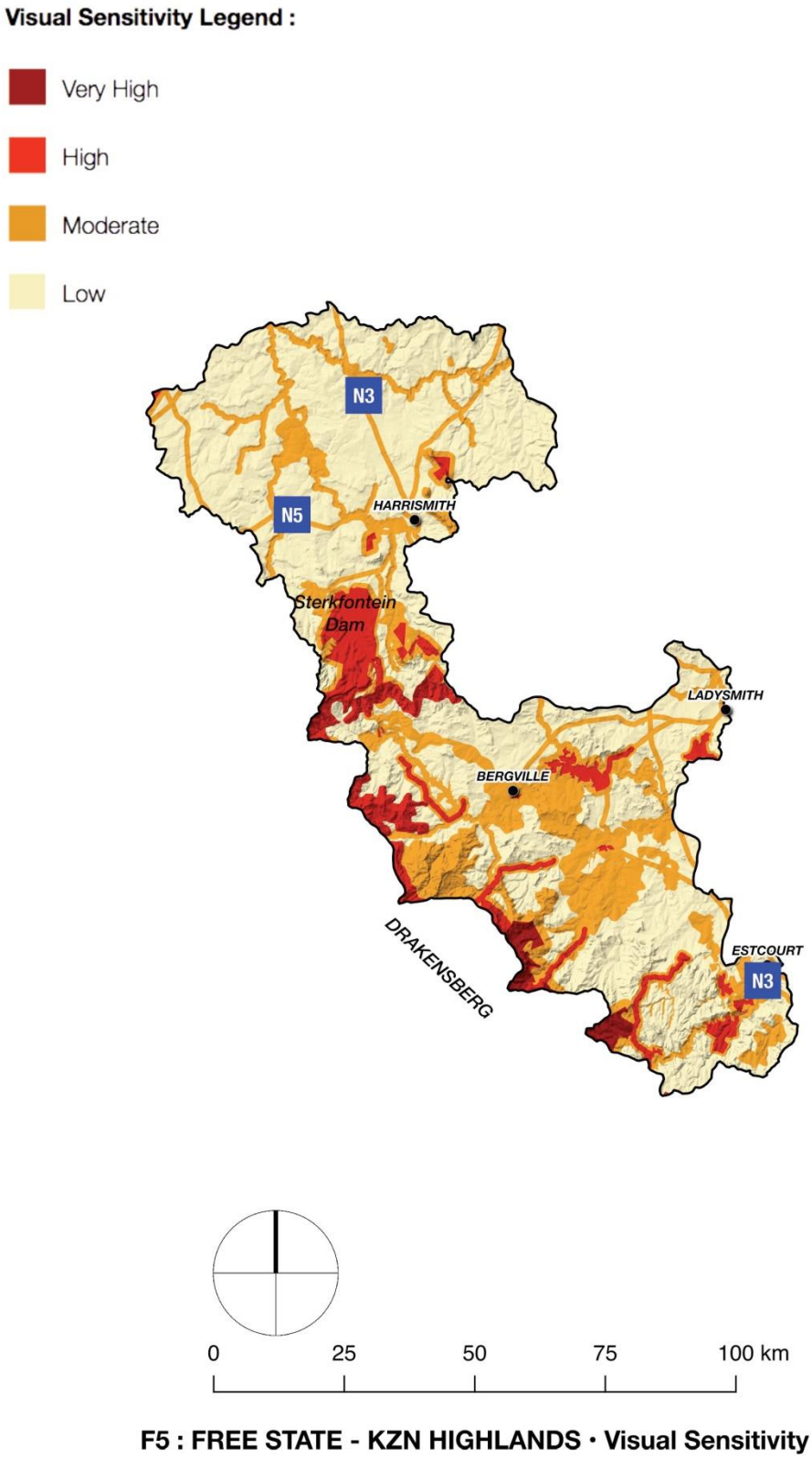


F2 : MPUMALANGA · Visual Sensitivity

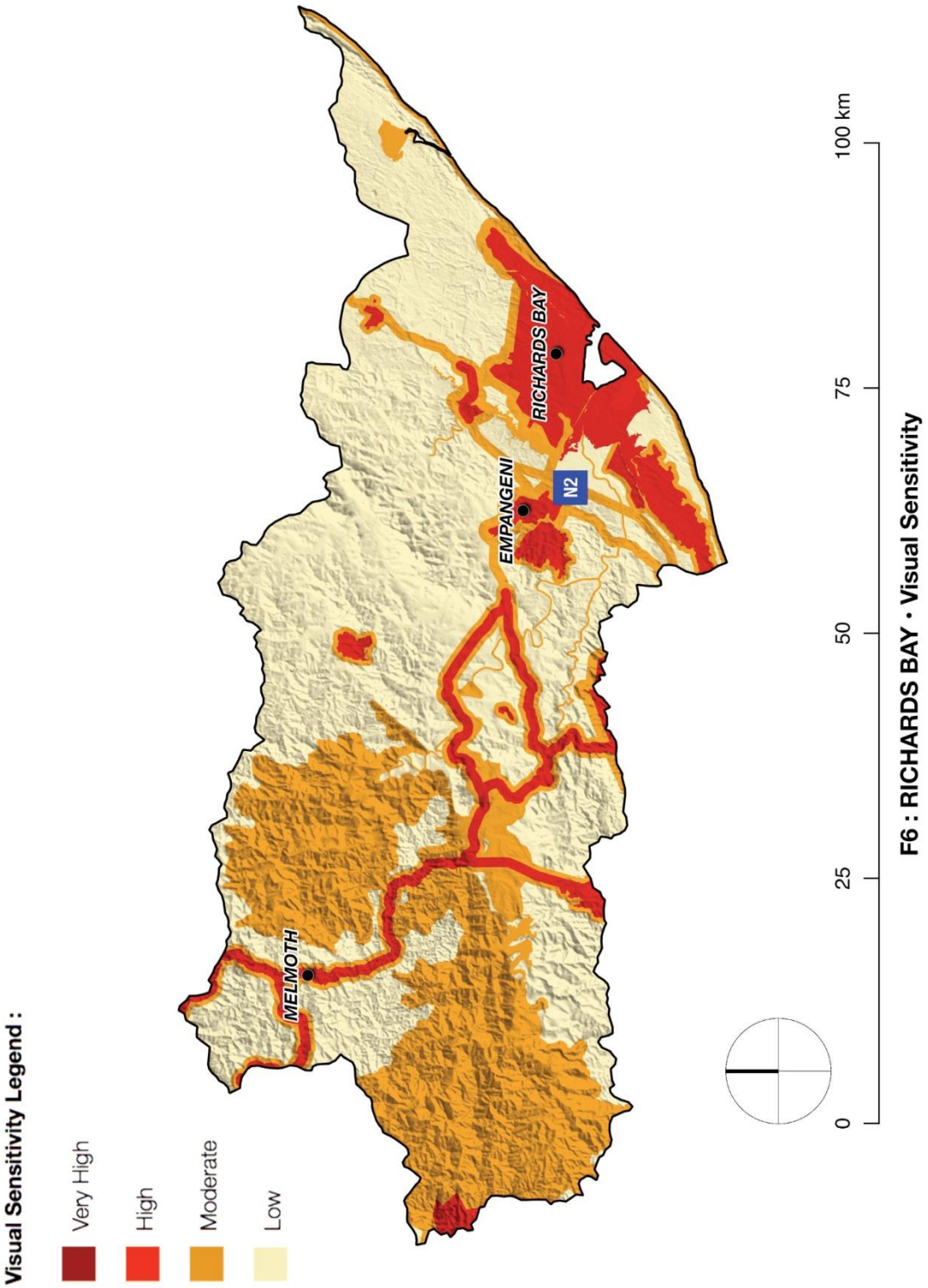


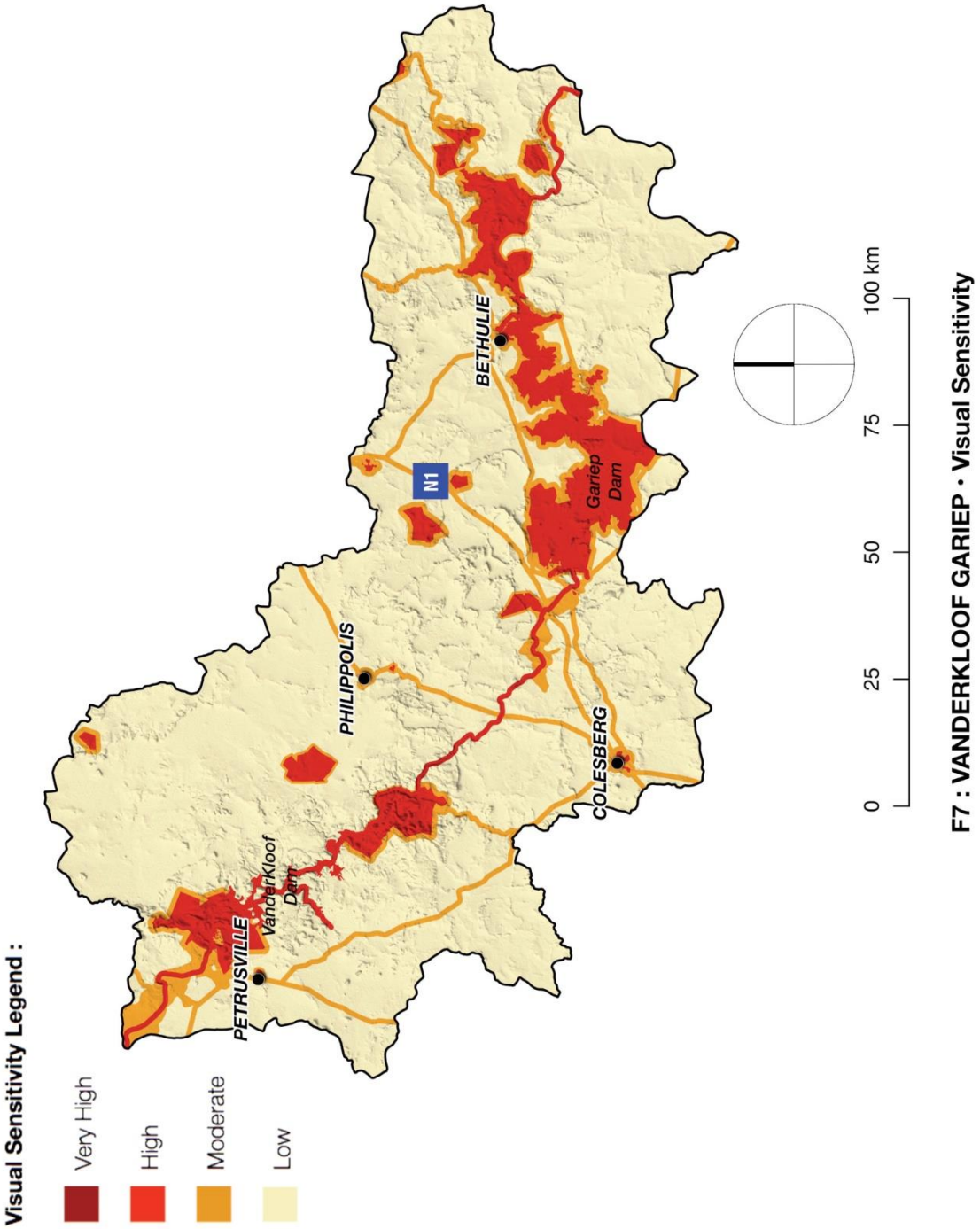
F3 : GAUTENG NORTH-WEST • Visual Sensitivity

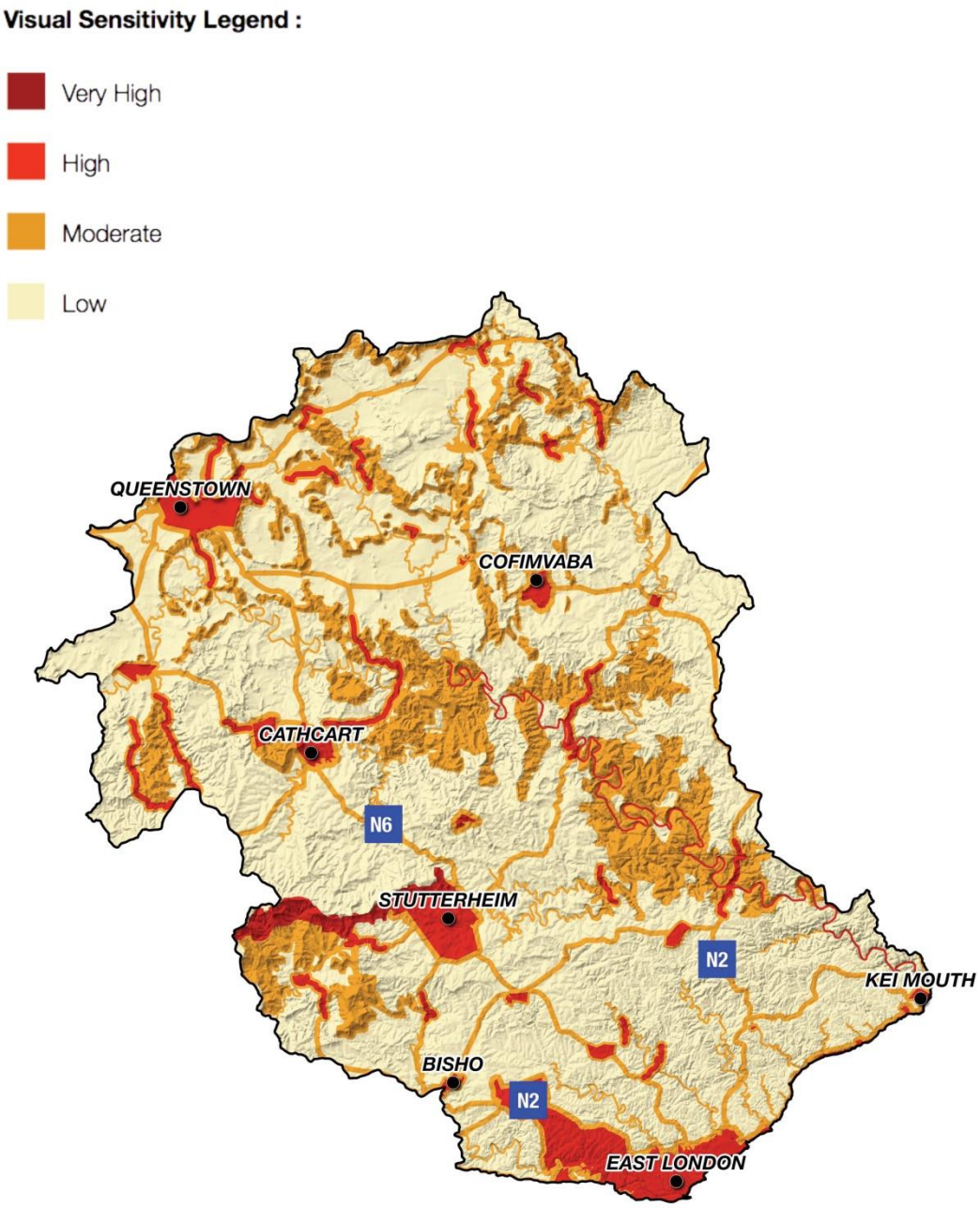

F4 : VAALHARTS • Visual Sensitivity
0
25
50
75
100 km
SCHWEIZER-RENEKE
BLOEMHOF
CHRISTIANA
WARRENTON
TAUNG
KIMBERLEY
CAMPBELL
N12
N18
N12
N8
Visual Sensitivity Legend :
Very High
High
Moderate
Low



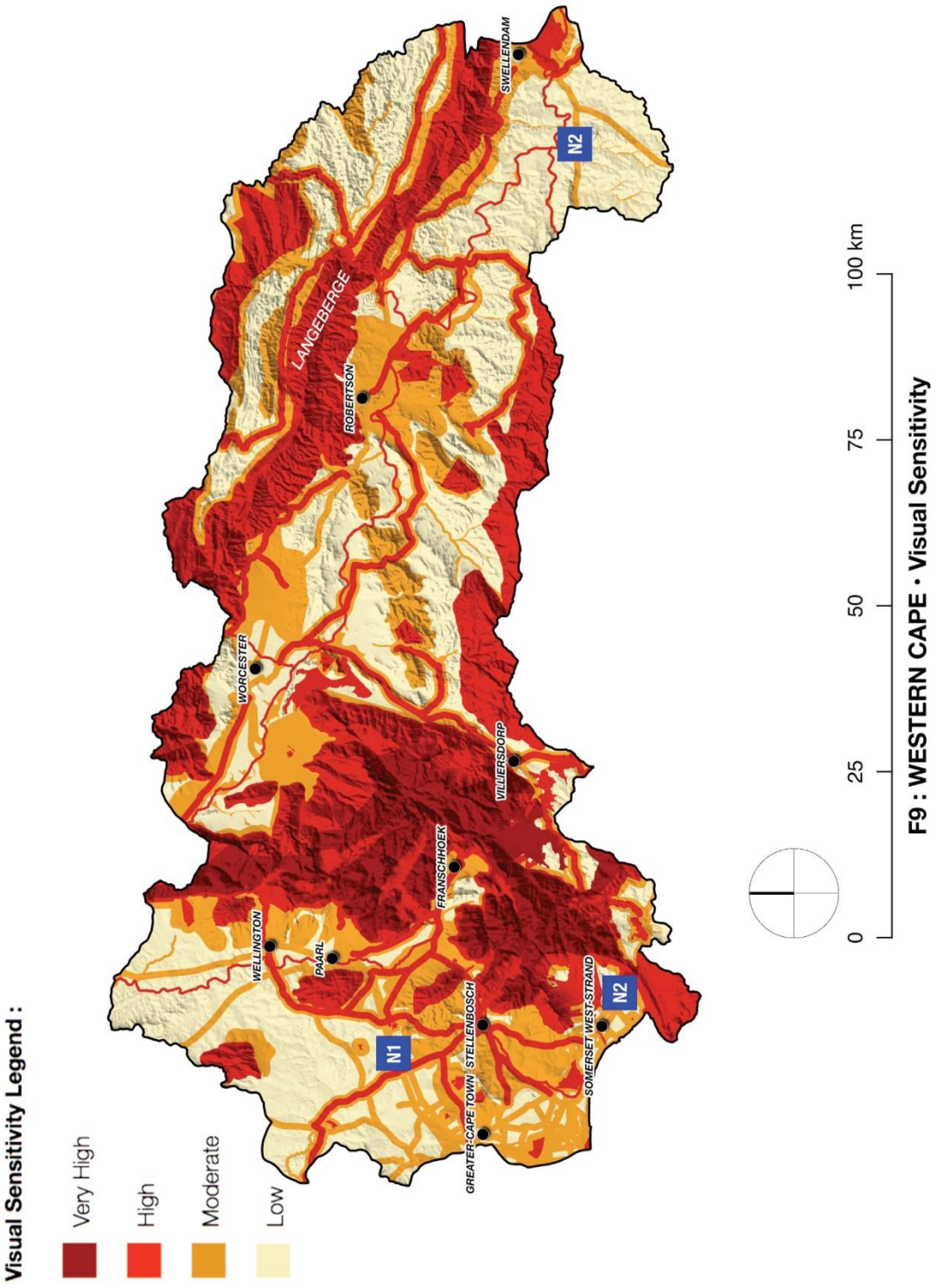
F5 : FREE STATE - KZN HIGHLANDS • Visual Sensitivity

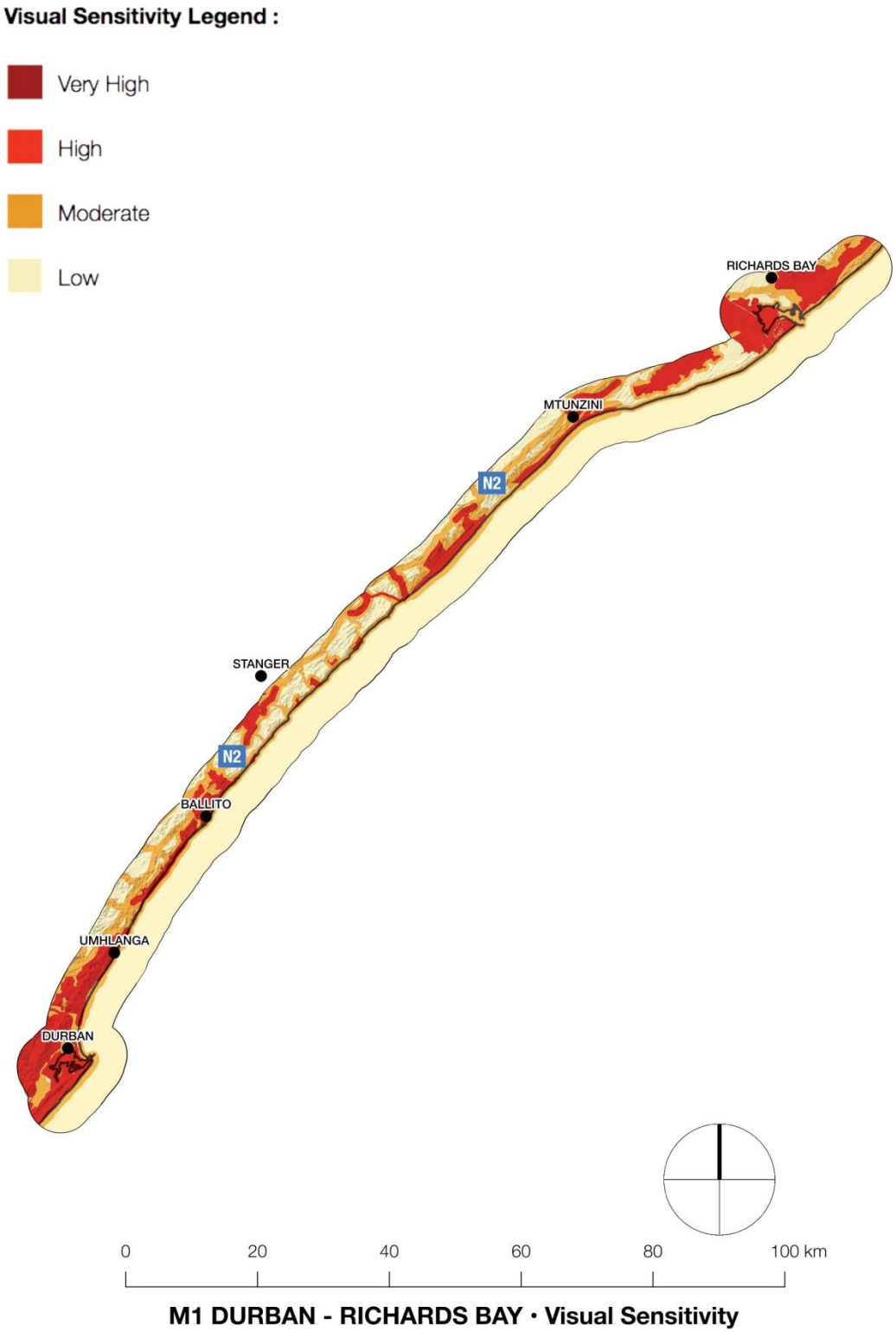

Visual Sensitivity Legend :
Very High
High
Moderate
Low
MELMOTH
EMPANGENI
RICHARDS BAY
N2
0
25
50
75
100 km
F6 : RICHARDS BAY • Visual Sensitivity


F7 : VANDERKLOOF GARIEP • Visual Sensitivity
0
25
50
75
100 km
BETHULIE
N1
Gariep Dam
PHILIPPOLIS
COLESBERG
PETRUSVILLE
VanderKloof Dam
Visual Sensitivity Legend :
Very High
High
Moderate
Low

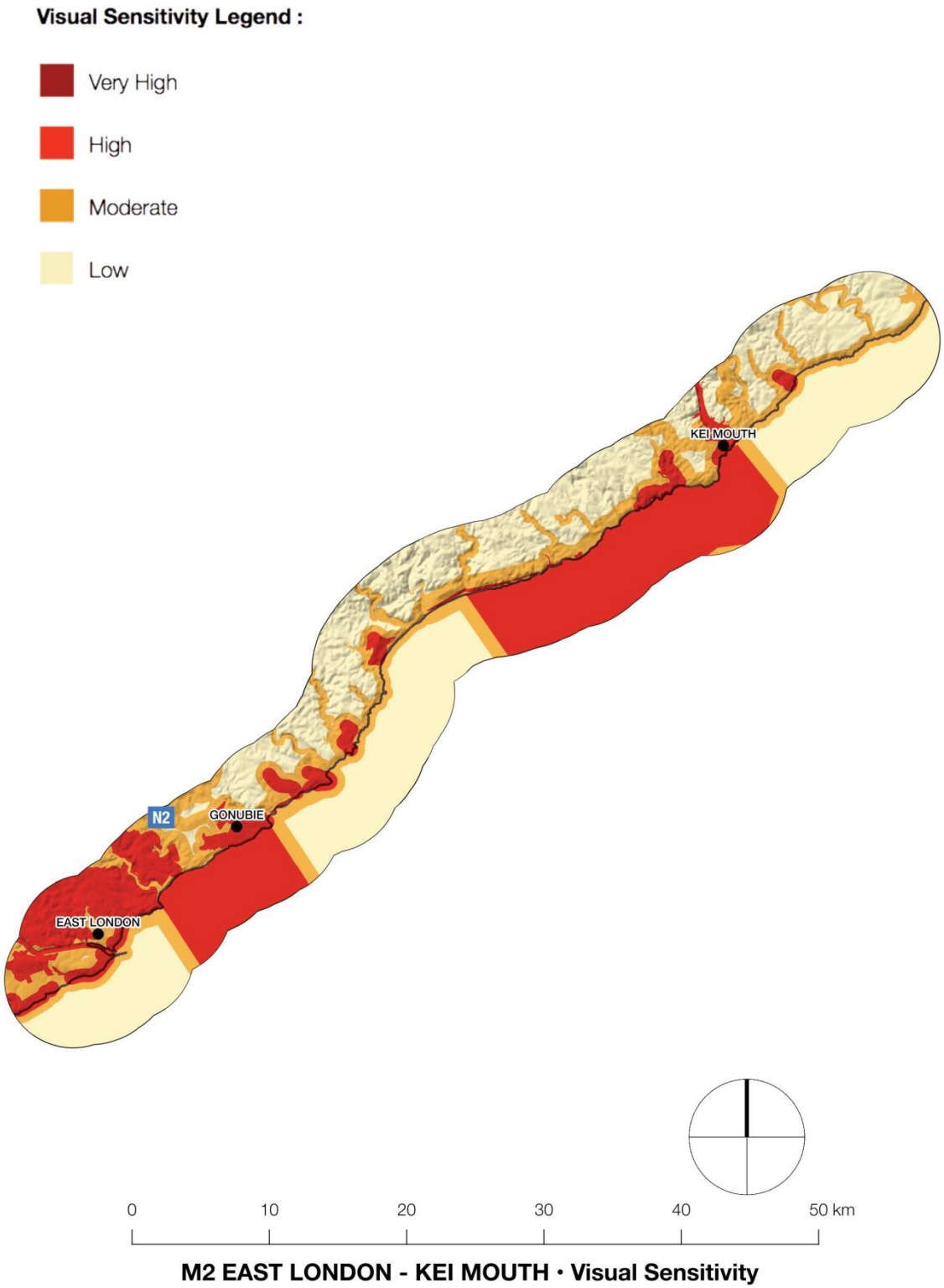


F8 : EASTERN CAPE · Visual Sensitivity

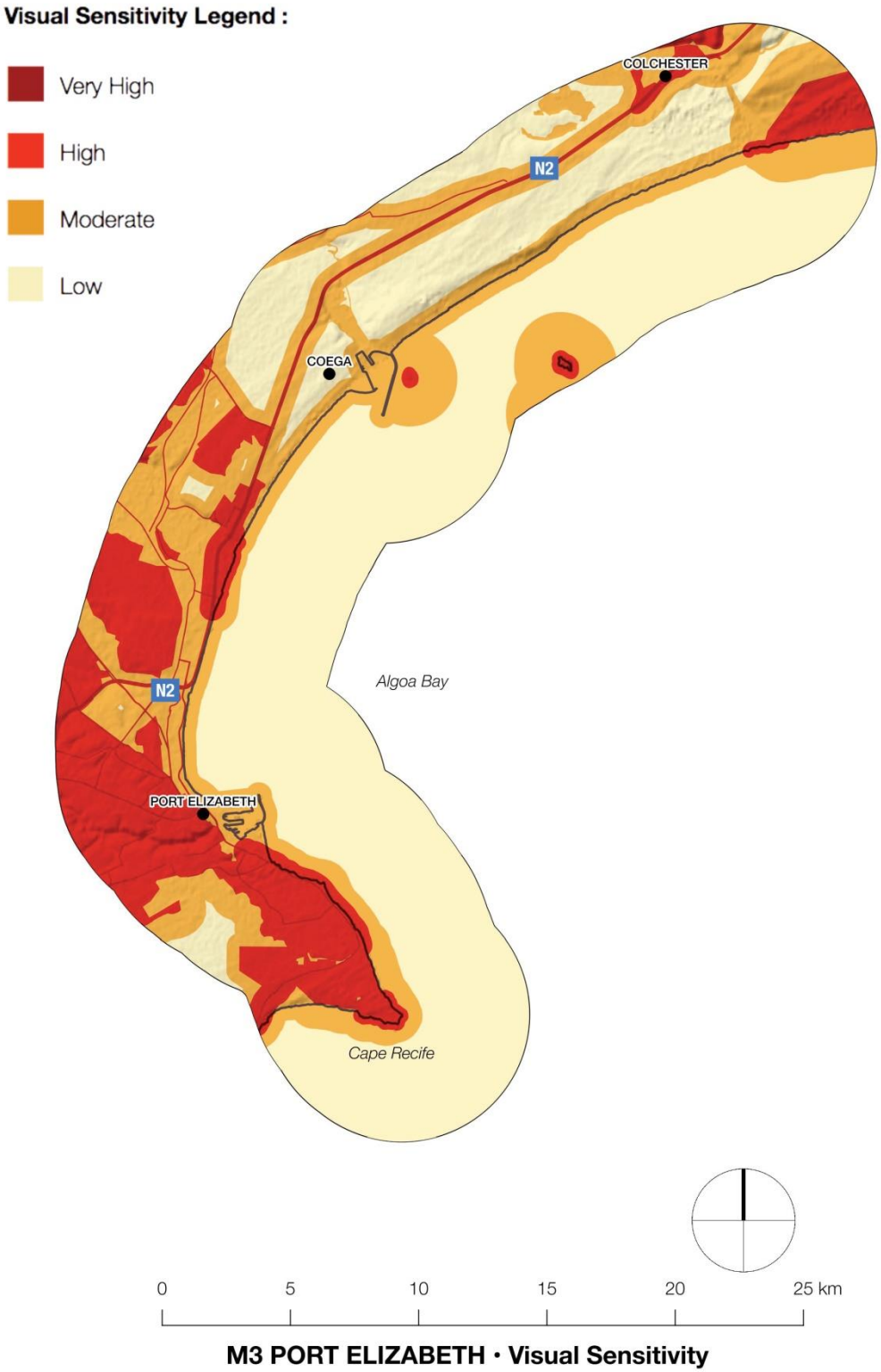

F9 : WESTERN CAPE • Visual Sensitivity
0
25
50
75
100 km
Visual Sensitivity Legend :
Very High
High
Moderate
Low
SWELLENDAM
N2
LANGEBERGE
ROBERTSON
WORCESTER
VILLIERSDORP
FRANSCHHOEK
WELLINGTON
PAARL
N1
STELLENBOSCH
GREATER CAPE TOWN
SOMERSET WEST-STRAND
N2



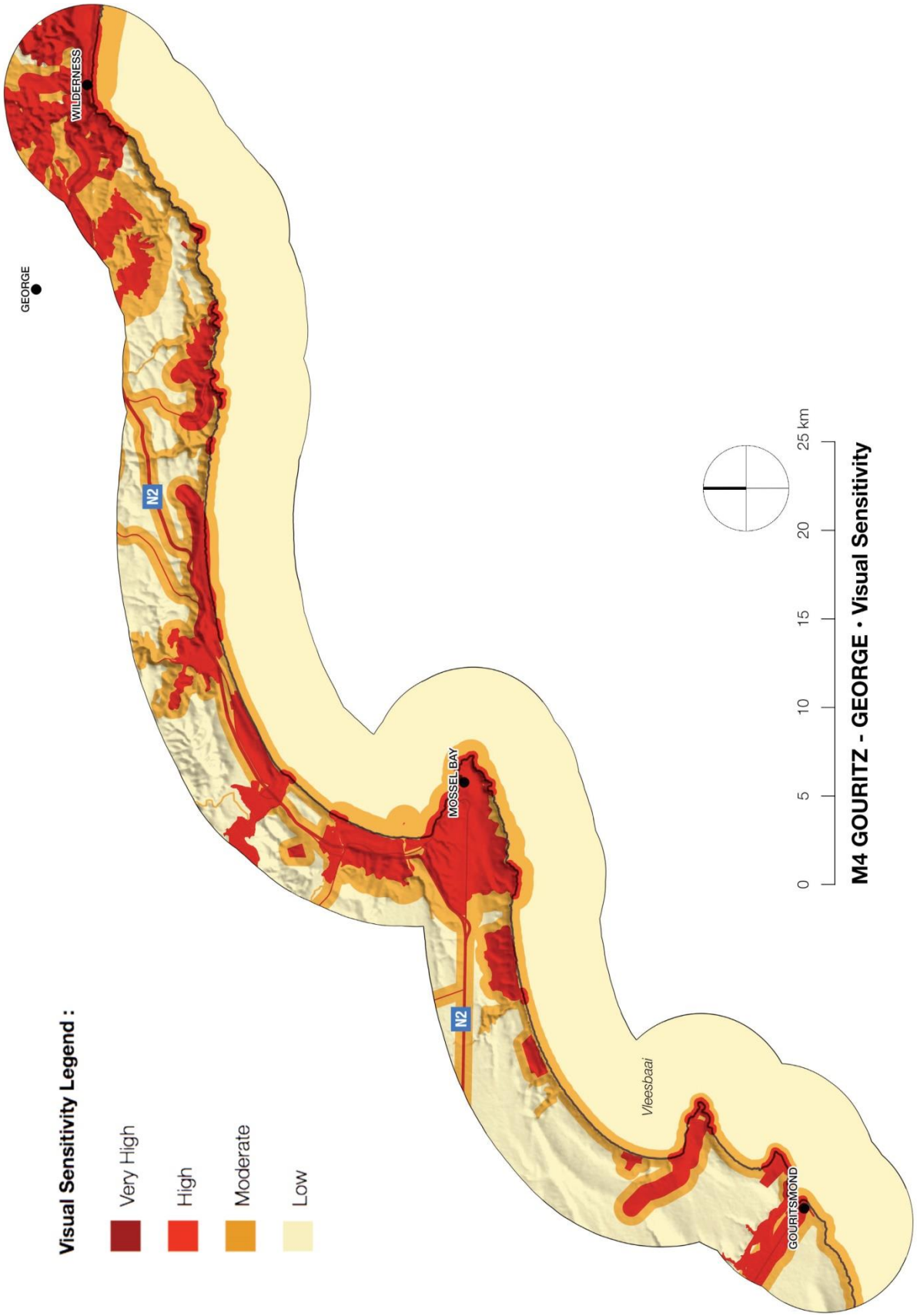
M1 DURBAN - RICHARDS BAY · Visual Sensitivity

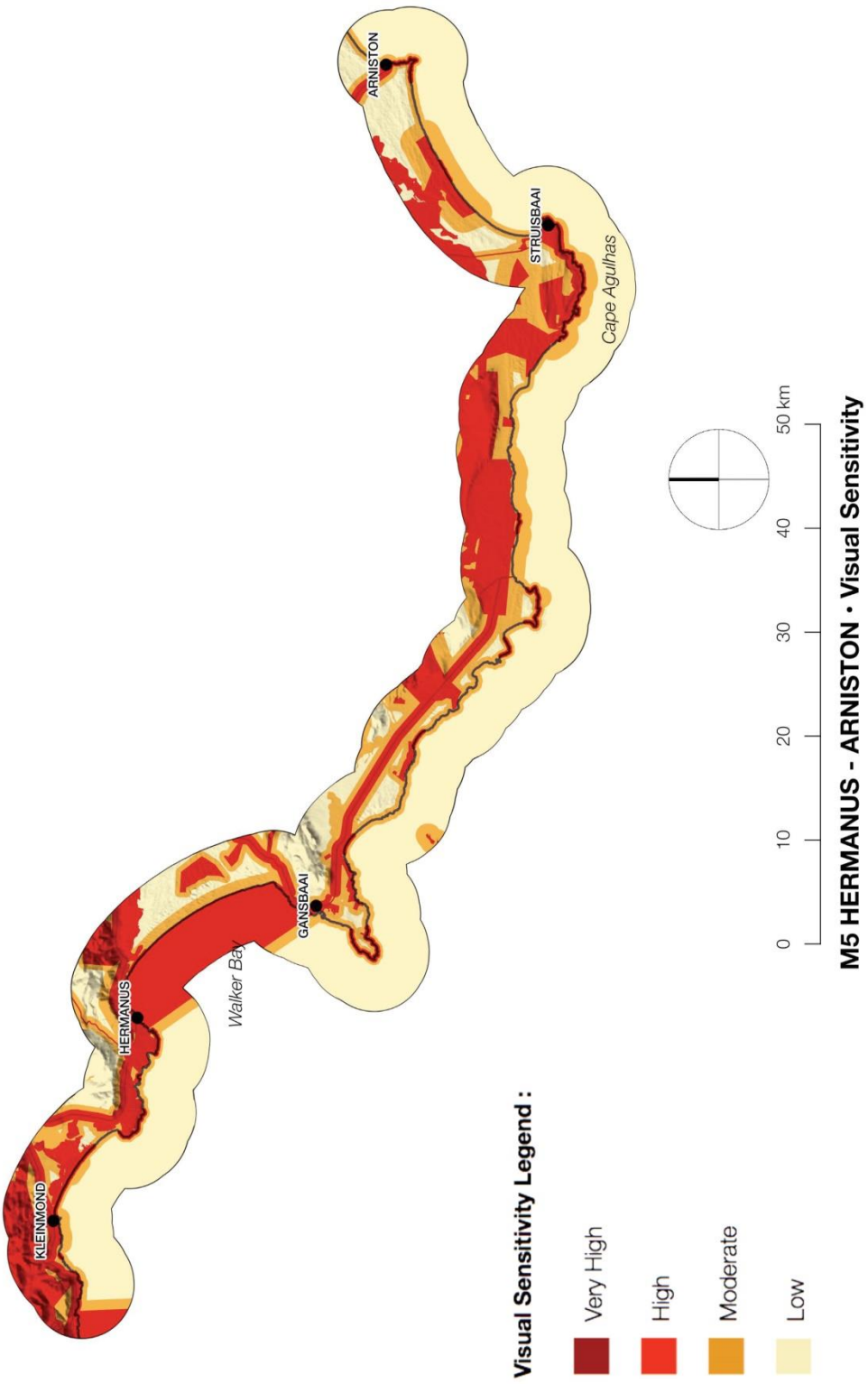


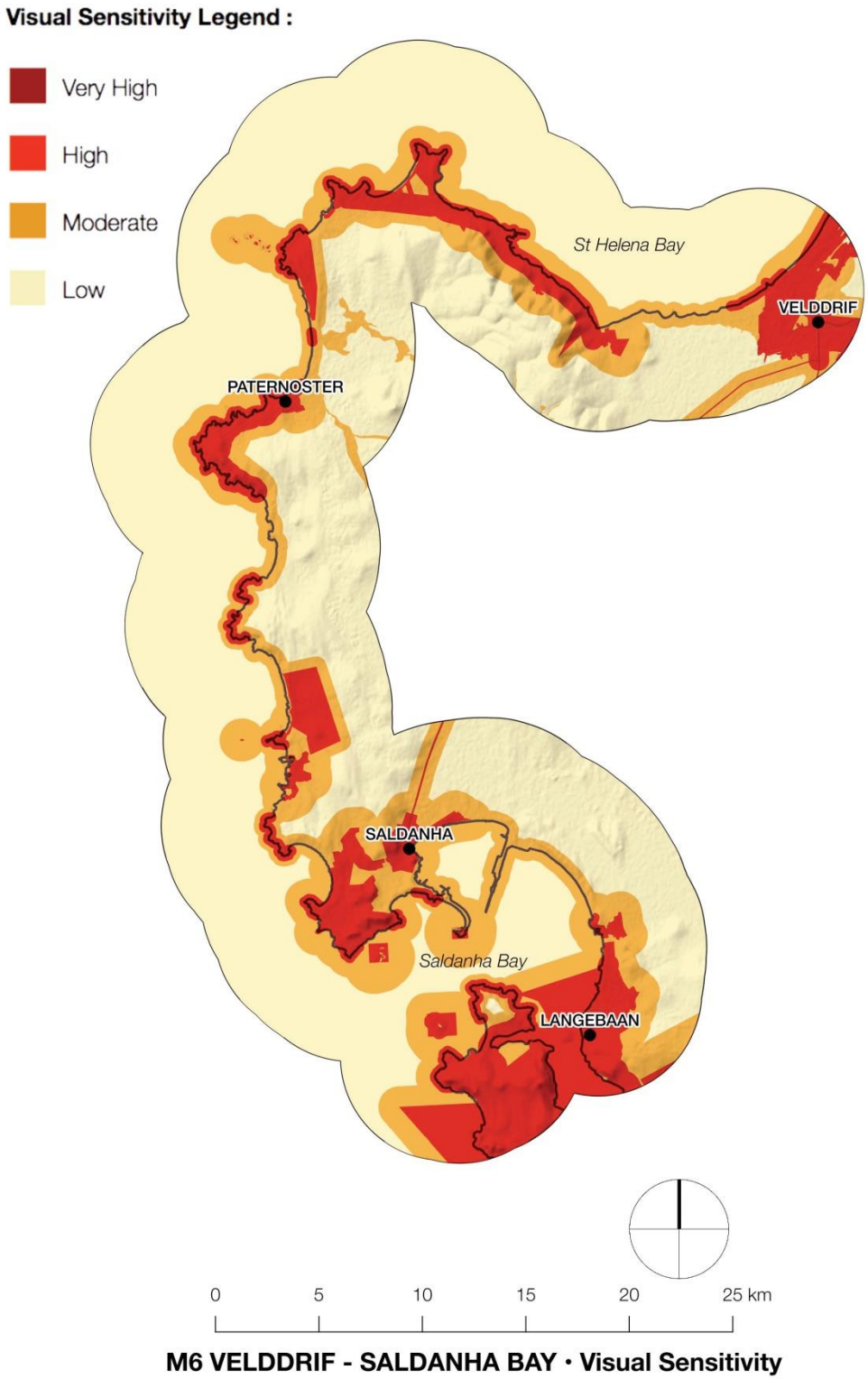
M2 EAST LONDON - KEI MOUTH · Visual Sensitivity



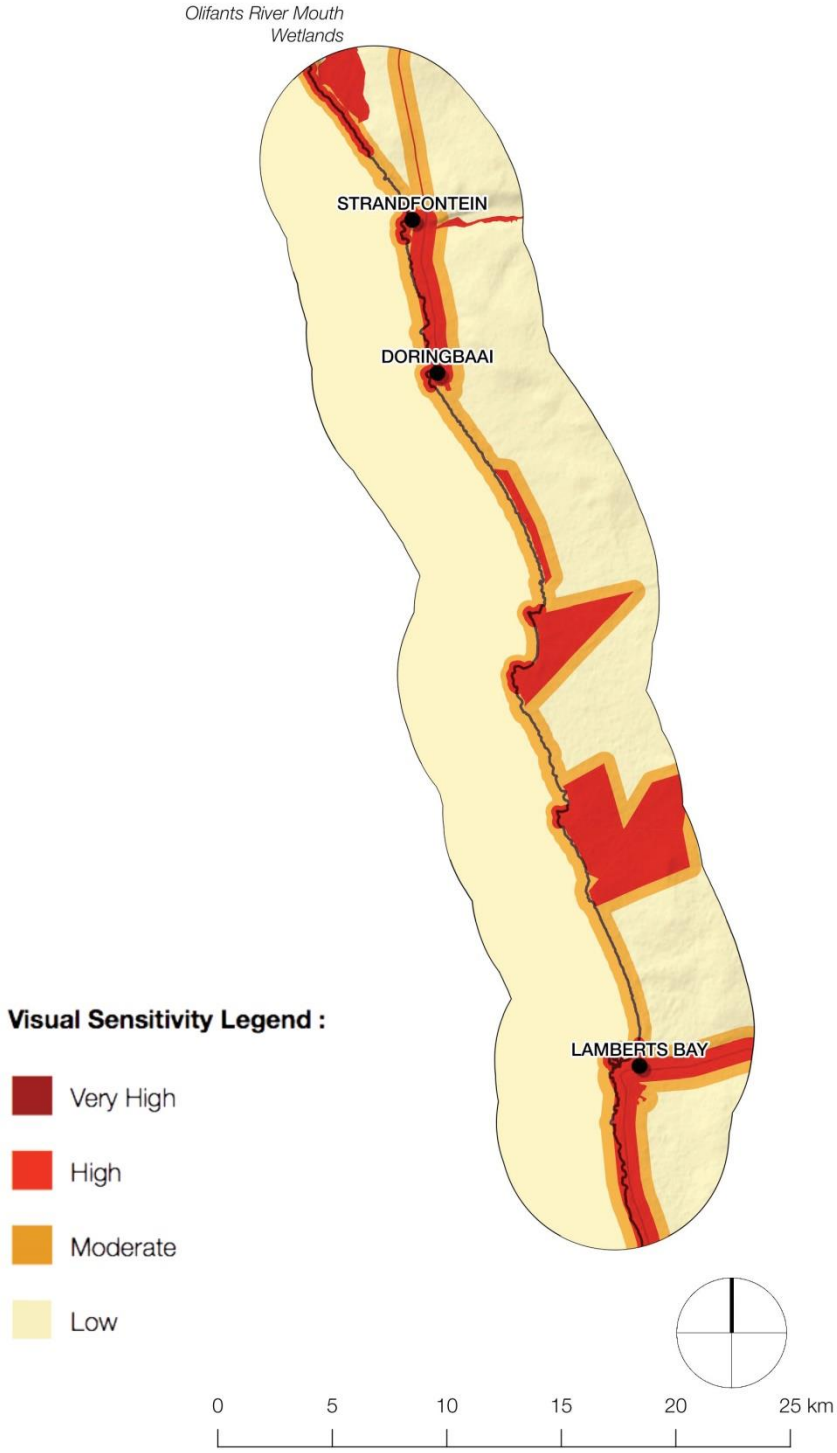
M3 PORT ELIZABETH · Visual Sensitivity


M4 GOURITZ - GEORGE • Visual Sensitivity
0
5
10
15
20
25 km
Visual Sensitivity Legend :
Very High
High
Moderate
Low
GEORGE
WILDERNESS
N2
MOSSEL BAY
N2
Vleesbaai
GOURITSMOND

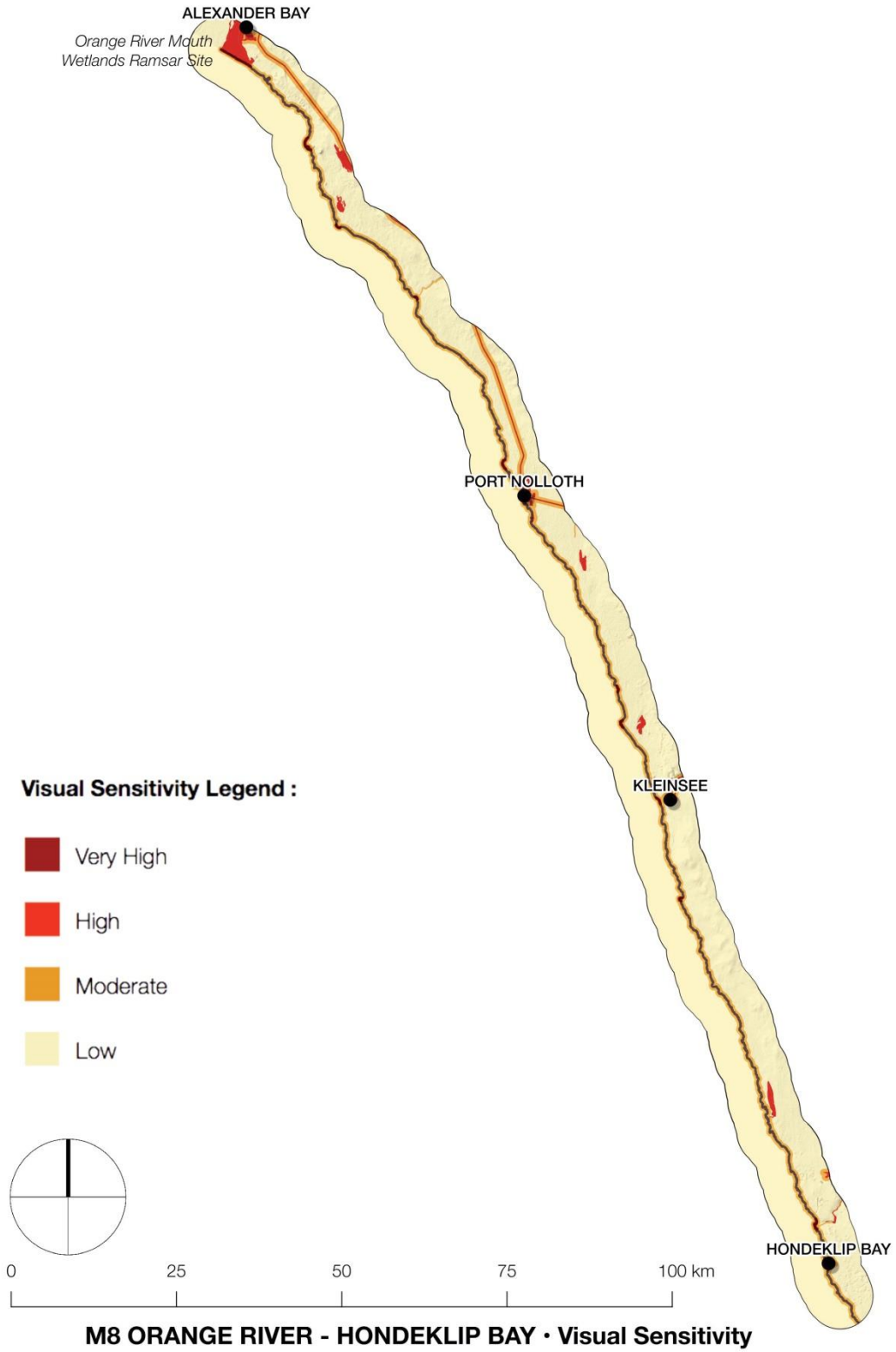

ARNISTON
STRUISBAAI
Cape Agulhas
GANSBAAI
HERMANUS
KLEINMOND
0
10
20
30
40
50 km
M5 HERMANUS - ARNISTON • Visual Sensitivity
Visual Sensitivity Legend :
Very High
High
Moderate
Low



M6 VELDDRIF - SALDANHA BAY • Visual Sensitivity



M7 STRANDFONTEIN - LAMBERTS BAY · Visual Sensitivity



M8 ORANGE RIVER - HONDEKLIP BAY • Visual Sensitivity

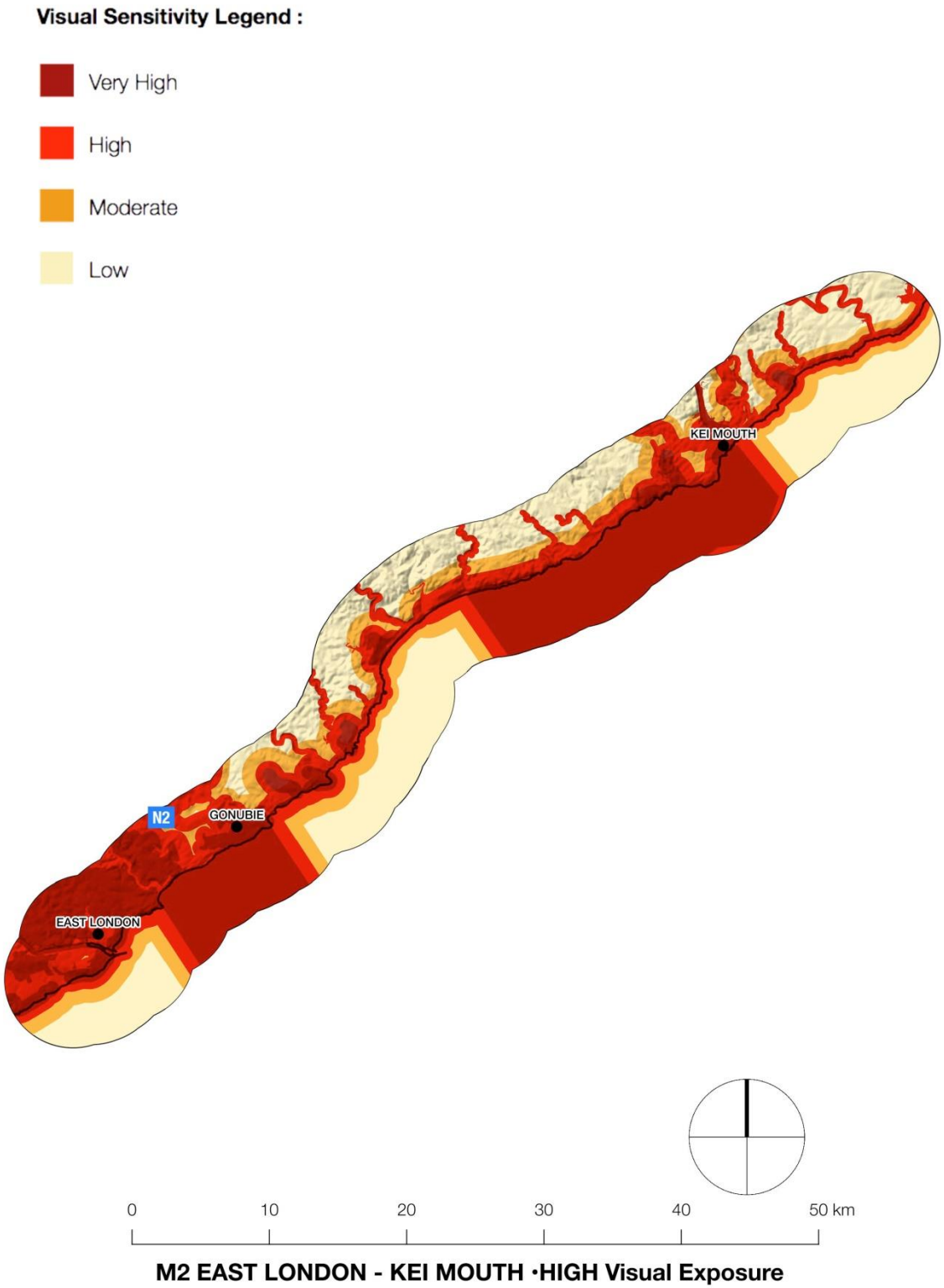
Appendix D: Visual Sensitivity - Large Scale Aquaculture

Appendix D:

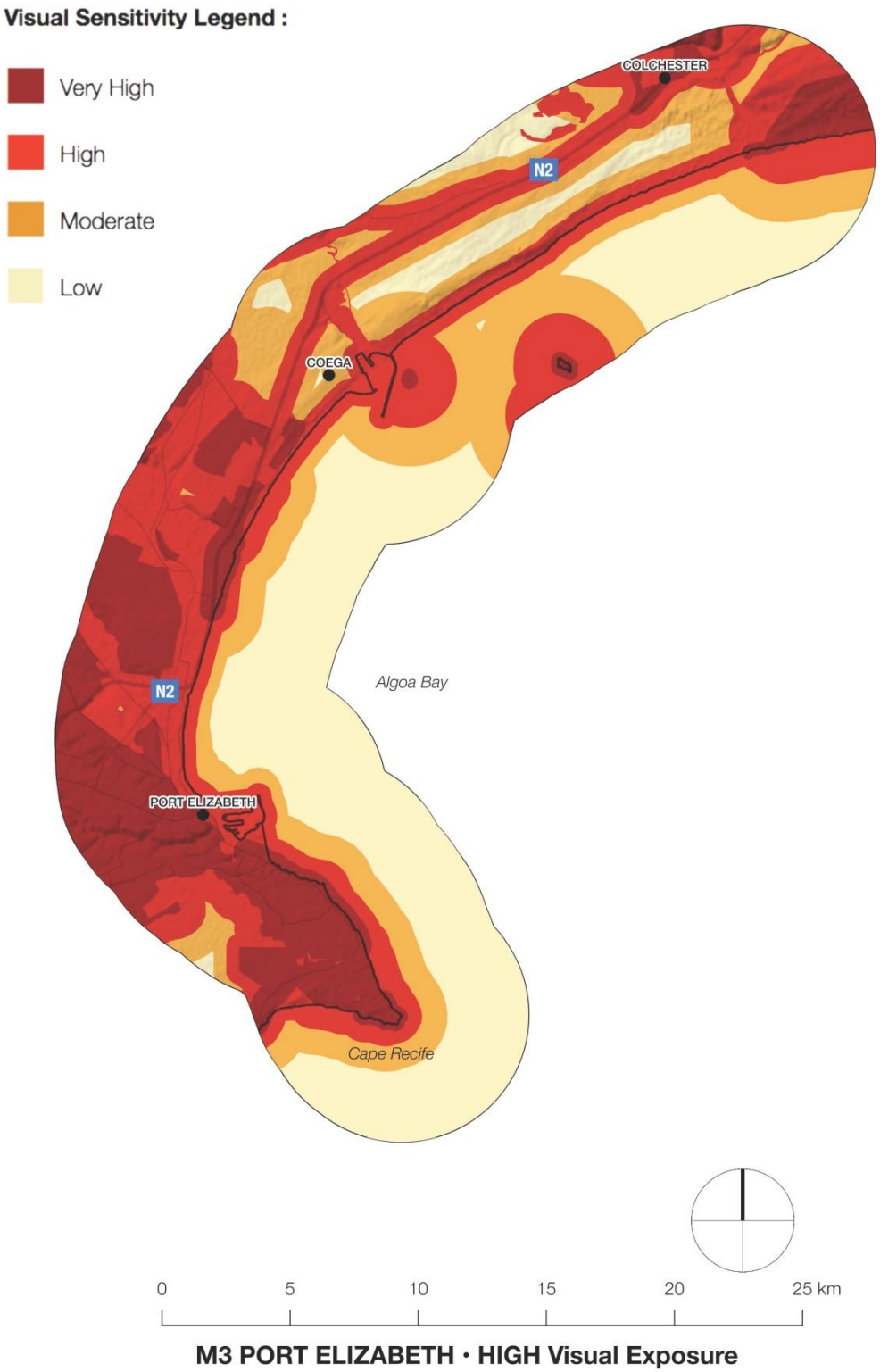
Visual Sensitivity Maps

Large Scale Aquaculture

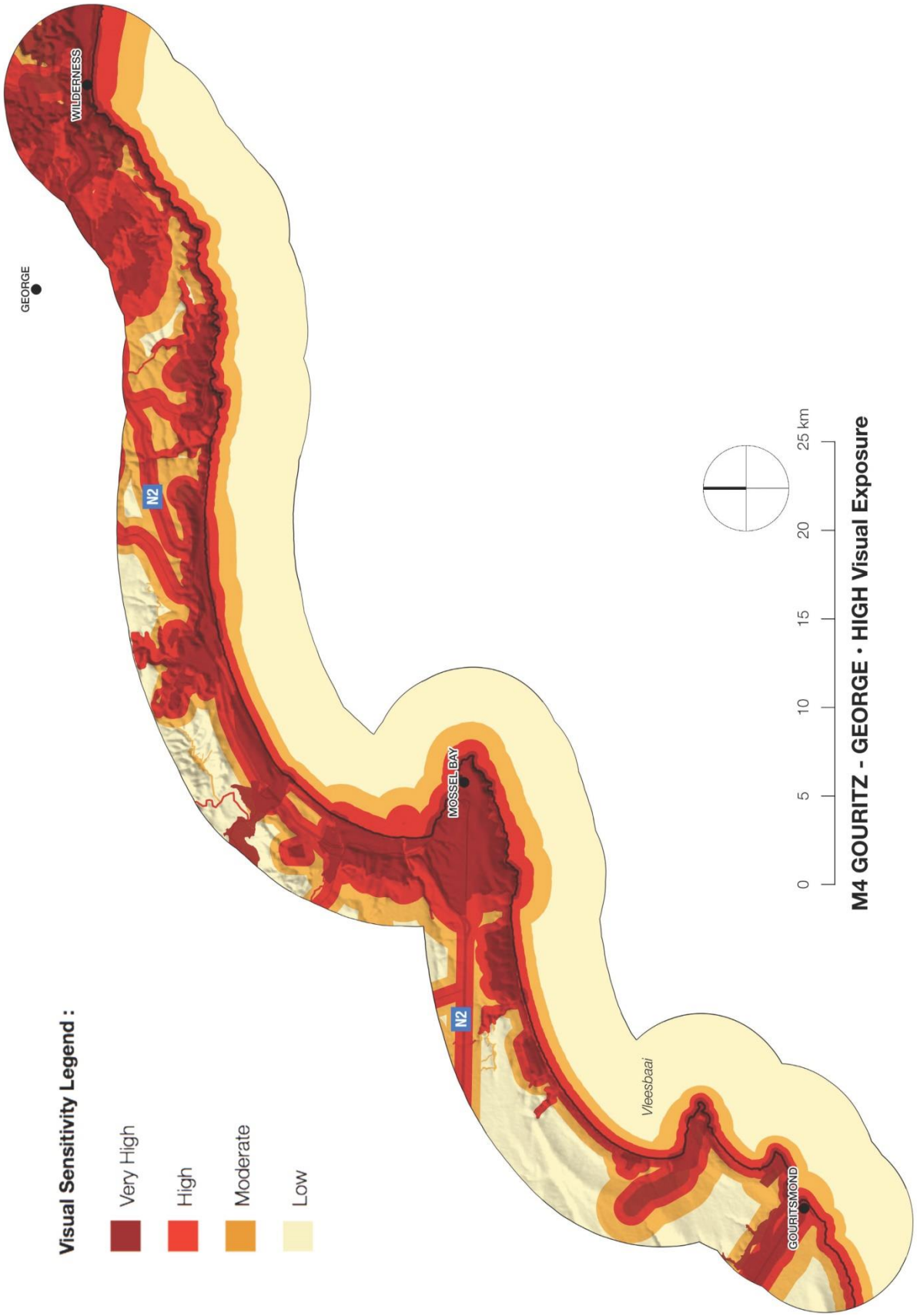
M1 DURBAN - RICHARDS BAY · HIGH Visual Exposure

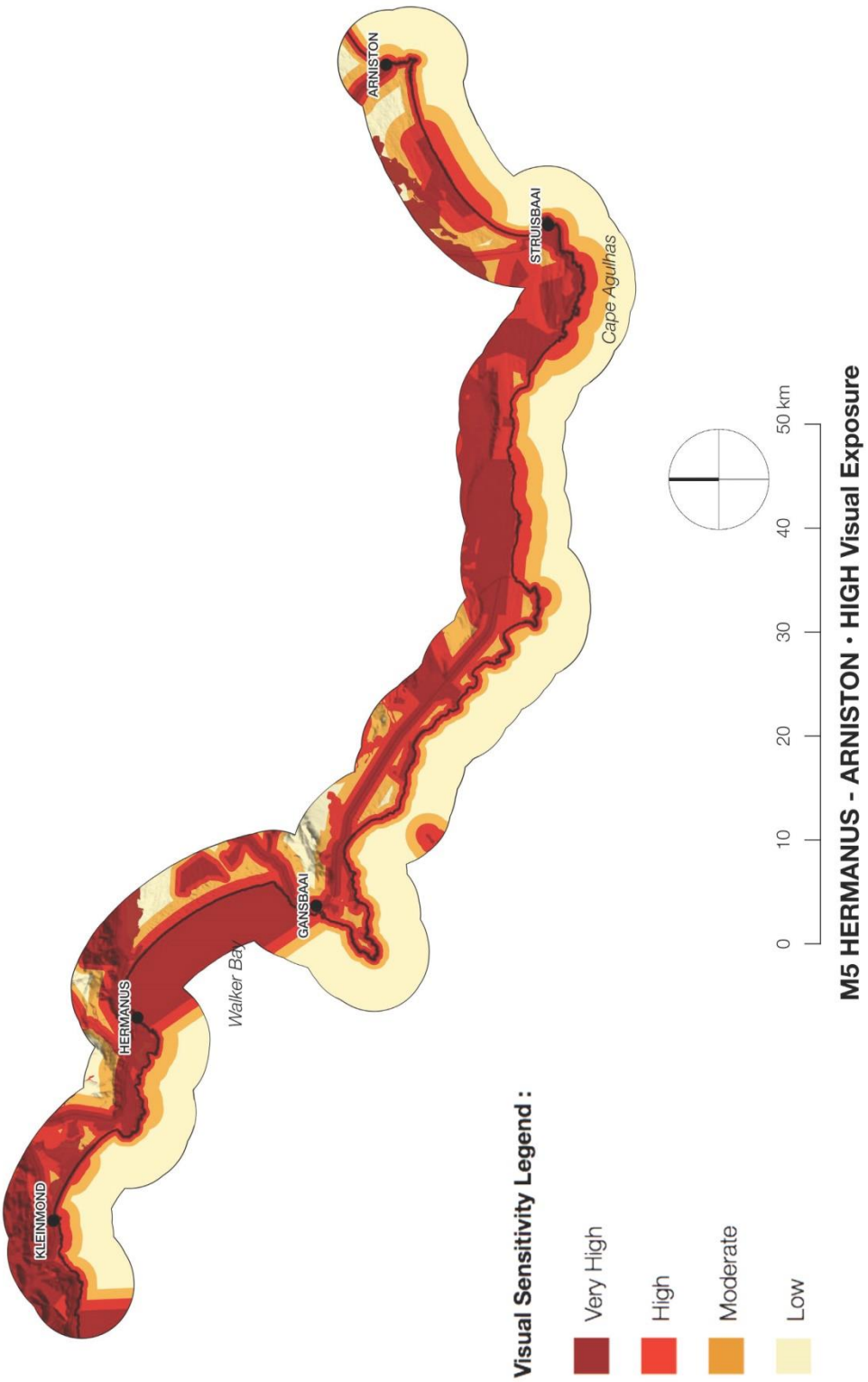


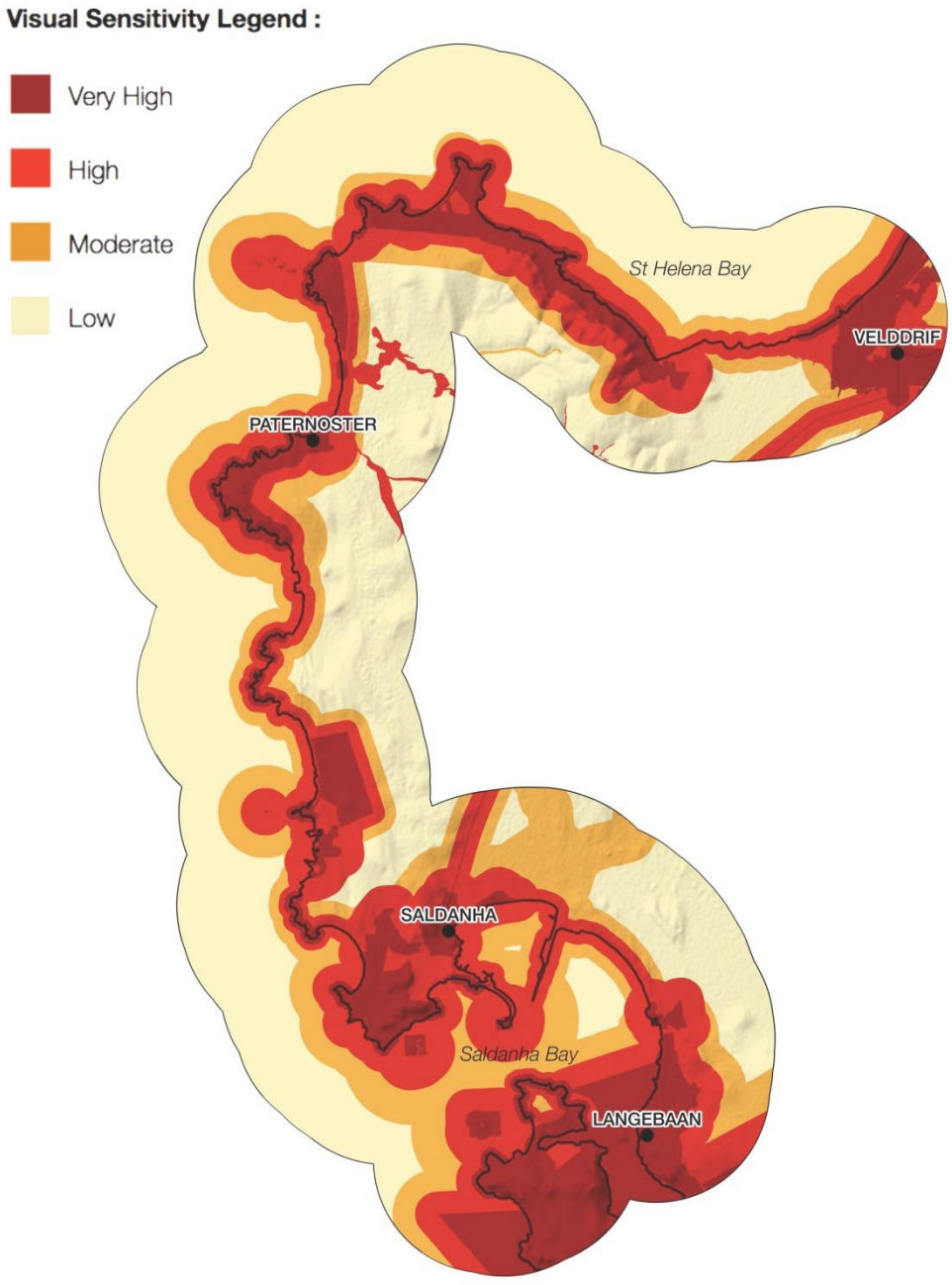
M2 EAST LONDON - KEI MOUTH ·HIGH Visual Exposure



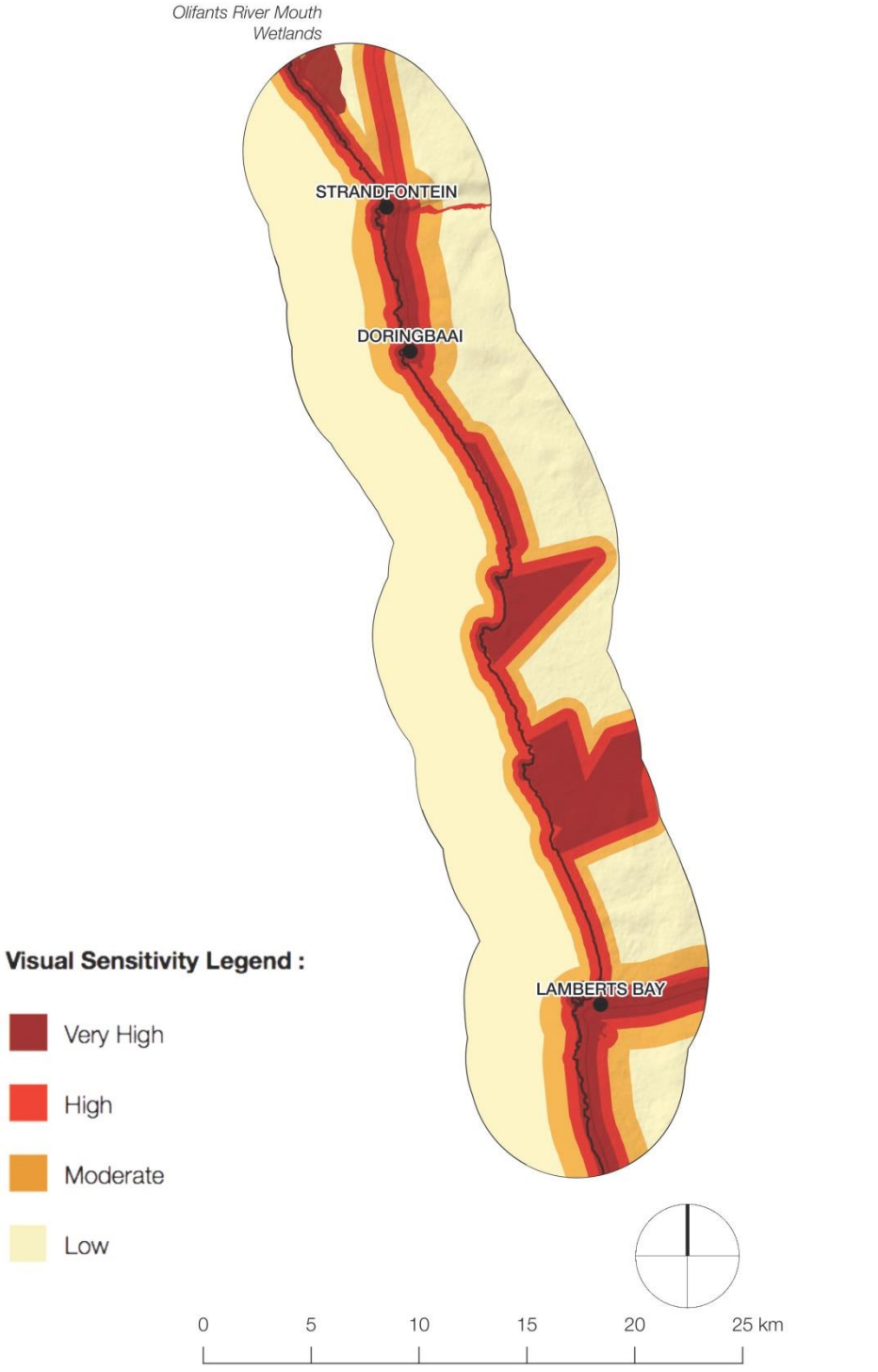
M3 PORT ELIZABETH · HIGH Visual Exposure


M4 GOURITZ - GEORGE • HIGH Visual Exposure
0
5
10
15
20
25 km
Visual Sensitivity Legend :
Very High
High
Moderate
Low
GEORGE
WILDERNESS
N2
MOSSEL BAY
N2
Vleesbaai
GOURITSMOND


ARNISTON
STRUISBAAI
Cape Agulhas
GANSBAAI
HERMANUS
KLEINMOND
0
10
20
30
40
50 km
M5 HERMANUS - ARNISTON • HIGH Visual Exposure
Visual Sensitivity Legend :
Very High
High
Moderate
Low



M6 VELDDRIF - SALDANHA BAY · HIGH Visual Exposure



M7 STRANDFONTEIN - LAMBERTS BAY • HIGH Visual Exposure

M8 ORANGE RIVER - HONDEKLIP BAY · HIGH Visual Exposure