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Environmental screening study for a proposed LNG terminal at Saldanha and associated pipeline infrastructures to Atlantis and Cape Town, Western Cape, South Africa.

Chapter 6: Identification and evaluation of key issues and potential fatal flaws

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CHAPTER 6. IDENTIFICATION AND EVALUATION OF KEY ISSUES AND POTENTIAL FATAL FLAWS

6.1. INTRODUCTION

This section presents a detailed description of the environmental sensitivity of the proposed LNG receiving terminal locations and proposed route for the gas transmission and distribution pipeline to Atlantis, Cape Town, Stellenbosch, Paarl and Wellington, highlighting the major risks for each section of the route and recommending mitigation, where appropriate. Should the project go to the Environmental Impact Assessment stage, the alignment presented in this report would undergo detailed impact studies which would result in the detailed planning and refinement of the pipeline routing. This planning would take into consideration additional environmental considerations such as the occurrence of populations of specific threatened species, ecologically important terrestrial and aquatic features and route deviations recommended within the corridor to minimise impacts on highly sensitive features.

In this screening evaluation study various factors have been used to characterise the constraints and key issues associated with the proposed pipeline (Chapter 3, Section 3.2.3). The conservation planning data were used in conjunction with the remnant vegetation (natural land cover class), threatened ecosystems and horticulture/viticulture layers to identify environmental "no-go areas" (i.e. potential fatal flaws) and to assess the sensitivity of the areas that would be affected by the proposed LNG terminal and pipeline. Furthermore, protected areas and stewardship sites have been included as forming an integral part of the conservation assessments and focus for planning. The finer-scale maps indicate the level of conservation planning which has been done for the various local authorities.

The identification and evaluation of issues and potential fatal flaws for the LNG import facility at Saldanha and the proposed transmission and distribution pipeline routes is presented under the following sections:

- Coastal and marine environment
- Terrestrial and aquatic ecology
- Heritage resources
- Visual
- Air quality
- Planning
- Risk and safety.

6.2. COASTAL AND MARINE ENVIRONMENT

6.2.1. Introduction

Robben Island to Dassen Island

The main environmental impacts of an FSRU operation located between Robben Island and Dassen Island will occur during construction rather than during routine operation of the facility.

The coastal and sub-bottom geology needs to be mapped in order to ensure that the pipeline from the FSRU mooring to the shore is not subject to stresses that raise the risk of fracturing. Sidescan and sub-bottom profiling of candidate areas will have to be undertaken. Such surveys use low-energy sources and will have a temporary, minimal impact on marine life unlike the large high-energy sources (airguns) used in offshore seismic surveys for the oil and gas industry. Should the best location for the FSRU be close (but outside the 5 km radius safety zone) to the Koeberg nuclear power station the pipeline route will have to be assessed for seismic stability.

The benthic organisms directly under or immediately adjacent to the pipeline will be destroyed or severely impacted respectively. However the width of this impact zone is unlikely to exceed 10 m along the length of the pipeline. Except for the narrow strip under the pipeline itself the area disturbed by pipe laying operations will be recolonised within a few years. Consequently construction and operation of the pipeline is not expected to have any significant impact on the overall benthic communities in the area.

From an operational perspective only whales such as the southern right whale could be an issue. These whales are present during the austral winter (June to September) when they enter inshore waters to mate and calve. They could, therefore, be present when the LNG carriers tie up to the FSRU.

Care will have to be taken to ensure that the whales do not become entangled during mooring operations. Once the LNG carrier and FSRU vessels are connected and are free to "weather vane" they will not present a hazard to whales.

Saldanha Bay

The geology of the Saldanha Bay area is of significance to the LNG jetty component of the proposed project both in terms of the construction aspect (engineering and cost) of the project and potential environmental impacts resulting from construction activities.

Saldanha Bay is underlain by Cape granite which outcrops on both the north and south sides of the entrance to the bay. The Cape granite is overlain (from bottom to top) by sandy clays, calcrete, shelly quartzose sands, calcrete, palaeosol, fossil dunes and modern sands. Should the Cape granite basement lie at a depth that requires little or no blasting, the overlying sediments may have to be dredged to provide adequate water depth for the approach channel and turning basin for the LNG carriers. Three issues arise from the dredging: (i) the suspension of fine material with its potential environmental impacts; (ii) destruction of the benthos in the dredged areas; and (iii) disposal of the dredge spoil.

If the underlying granite requires to be blasted extensively this will give rise to both a financial/technical impact and an environmental impact particularly on diving seabirds, whales and dolphins, and fishes (refer to sections 6.2.1 to 6.2.4). In particular, the potential impact on the Endangered African Penguin *Spheniscus demersus*, the most endangered of the entire world's penguin species, is of concern.

The west coast is dominated by southerly to south-westerly swells which penetrate Saldanha Bay and are responsible for the sediment transport regime in the bay. Flemming (1977) identified the shore between the root of the iron ore berth and Lynch Point as the zone most exposed to wave action. A potential location for the import jetty for the discharge of LNG is along the northernmost portion of this section of shoreline. This needs further investigation because the unprotected structure might lead to unacceptable levels of down time consequent upon excessive ship motion preventing discharge of the LNG. In addition, the dredging associated with the jetty could have an impact on longshore sediment transport and associated coastal erosion such as is currently occurring at the entrance to Langebaan Lagoon. Similarly, any attempt to protect the LNG discharge terminal with a breakwater could affect the wave regime in the bay and, consequently, the sediment dynamic processes. This could lead to erosion and/or accretion problems between the ore berth and the entrance to Langebaan Lagoon. This issue will need to be further investigated once the configuration of the LNG jetty has been confirmed.

Also, should extensive (capital) dredging be required the impact of the changed sea floor topography on wave refraction and diffraction patterns must also be investigated to ensure that the erosion conditions at the eastern side of the northern end of Langebaan Lagoon are not exacerbated. The shoreline in this area has been protected at considerable expense.

St Helena Bay

St. Helena Bay is shallow: at Bottelfontein approximately halfway between the Berg River mouth and Baboon Point the 30 m isobath lies 5 km offshore. Further south the distance to this isobath is even greater and the southern shore of the bay is generally rocky thus it is unlikely that a suitable site for an FSRU will be identified in the southern half of St Helena Bay. It is possible that, from a metocean perspective, a suitable location for the FSRU could be found inshore of the 30 m isobath along the northern half of the eastern shore of the bay which has a generally sandy shoreline. In order to accommodate an FSRU in such a location dredging will be required. This will require that the topography and sub-bottom geology of the bay be mapped using sidescan sonar and sub-bottom profiling. The impact of such a survey on marine life will be minimal both in terms of severity and duration.

The impact of laying the pipeline between the FSRU and the shore will only have an impact on the benthic organisms directly in its path. Otherwise the pipeline is not expected to have any significant impact on the benthic organisms in the area.

Similar to the Option 1 area, whales may be encountered particularly during the austral winter. Care must be taken to ensure whales do not become entangled during mooring operations.

The coastal and marine issues primarily related to Saldanha Bay are discussed in more detail below.

6.2.2. Impacts related to dredging, including blasting

6.2.2.1. African Penguin

The penguins mainly feed in the open sea and come ashore at Marcus Island where they breed. However, should a shoal of fish enter Big Bay the penguins will follow and feed on them, particularly in these times when overfishing has severely limited food availability for the penguins. The most critical time is when the penguins are feeding chicks, i.e. mainly in summer (Nov - March). Should African Penguins be in the immediate vicinity at the time of blasting (should blasting be necessary), severe (probably fatal) injuries and mortalities will occur. The entire African Penguin population is in a critical decline and any additional mortalities will exacerbate this situation. In addition, African Penguins beyond the direct blast zone may leave the area and abandon their young thereby causing secondary mortalities. This population is therefore assumed to be of ***very high sensitivity*** to underwater explosions such as blasting for dredging.

When the iron-ore berth and breakwater were constructed, experience showed that the timing of the blasting was critical. Blasting in the early morning and evening resulted in severe mortalities of African Penguins because these are the times of day when the birds go to, or return from feeding in the open sea. It is therefore recommended to blast during the middle of the day, during the non-breeding season, which would significantly reduce the mortalities. The blasting method also plays a role: a single, large, severely percussive detonation has a considerably greater impact than sequential detonation of a number of small charges ("ripple blasting"). It is also recommended to patrol the area for penguins before blasting (if they are present the blast must be cancelled/postponed until they are at least 1 000 m away from the site).

6.2.2.2. Seabirds

Severe injuries (probably fatal) and mortalities will occur if diving seabirds such as the Cape Gannet *Morus capensis* and cormorants *Phalacrocorax* spp. are present and actively feeding (i.e. diving) in the area when blasting takes place. Surface feeding seabirds may be attracted to fish killed by the blast and should a second detonation take place within a short interval mortalities will occur. The populations of almost all piscivorous South African coastal seabird species are under pressure and thus any mortalities as a result of blasting will add to the pressures on these birds. Coastal sea birds, depending on the species, will have a ***medium*** (gulls and terns) to ***very high*** (Cape Gannet and cormorants) sensitivity.

As in the case of the African Penguin, the severity of the impact could be reduced by ripple blasting and timing the blasting for the period when there is least seabird activity (mid-day).

6.2.2.3. Whales and dolphins

The great (baleen) whale populations are still recovering from the impact of whaling. If whales and dolphins are in the immediate vicinity of the detonation, severe (probably fatal) injuries and mortalities will occur. Any unnecessary mortalities will therefore have some effect on the rate at which the populations recover from the impact of whaling. In the case of the highly mobile dolphins it is difficult to assess the impact of unnecessary mortalities on their populations. The sensitivity of the baleen whales is assessed to be ***high*** and that for the dolphin is assessed to be ***medium***.

With the implementation of best practices as well as the following management actions, this impact can be significantly reduced:

- No blasting should take place while whales and dolphins are present within a minimum distance (radius) of 1 000 m.
- A helicopter overflight of the 1 000 m exclusion zone must be made immediately before any blasting takes place.
- No attempt to "herd" the whales and dolphins is permitted.
- It is illegal for a boat to deliberately approach within 300 m of whales and dolphins.

6.2.2.4. Fishes

Temporary displacement of the fishes normally using the blast zone will occur. They will return to the area once the blasting programme ends. Any fishes in the immediate of the detonation either will be killed outright or die as a result of ruptured swim bladders. Any mortality will add to both natural and fishing mortality but is unlikely to be of real significance unless a fish species is limited (endemic) to the blast zone and its environs or uses it as a spawning/nursery area.

The environmental sensitivity associated with fishes in this area is anticipated to be ***low to medium*** unless in the highly unlikely event a species is shown to be endemic to the blast zone or uses it as a significant spawning/nursery area. There are no practical mitigation measures that can be applied with respect to fishes other than avoiding blasting during spawning/nursery phases of their life cycles.

6.2.2.5. Suspended fine materials from dredging operations

The General Cargo Quay (GCQ) dredging resulted in a cloud of very fine calcarenite material being suspended near the sea floor, i.e. below the depth to which the oyster and mussel rafts extend. In time this dispersed or settled in deep water without any apparent adverse long term effect for the mariculture industry being reported although no monitoring of its long-term behaviour was done.

In all dredging operations a cloud of fine suspended material is generated in the immediate vicinity of the dredger. Generally it is aimed to operate in such a manner that background suspended particle levels are reached within 300 - 500 m from the vessel. During dredging for the GCQ located on the Small Bay side of the iron-ore terminal in Saldanha, the suspended sediment levels reached ambient values at 300 m from the vessel.

Filter-feeding organisms such as mussels, oysters and barnacles are most likely to be affected by high sediment loads. The effects include reduced digestive efficiency resulting from energy being expended in voiding the fine particles which have no food value. This effect is of particular concern to mussel and oyster farmers since the growth rate is reduced and product quality may be compromised.

Should the suspended material reach a mussel or oyster farm in sufficient density it could cause a reduction in growth rates or product quality. In extreme conditions death by smothering could occur. However the proposed location for an LNG discharge terminal in Big Bay is located at least 5 km from the mussel and oyster farms in Small Bay and thus any impact on mariculture operations from dredging operations is highly unlikely. The environmental sensitivity of the area with regards to suspended solids is anticipated to be ***low to medium***.

In the highly unlikely circumstance where the oyster and mussel farms are adversely affected by suspended material generated by dredging, the commercial viability of the operations could be compromised leading to job losses (Indirect impact).

It is recommended that the footprint of the suspended sediment cloud around the dredger does not exceed the 300 m limit used for dredging the GCQ. If it is likely to be exceeded operations must be halted until the suspended sediment has dispersed.

6.2.2.6. Destruction of benthos by dredging

Dredging inevitably results in the destruction of the habitat and benthic communities in the dredged area.

Recolonisation by organisms from the surrounding area will take place in time. The rate of recolonisation will depend to a great extent on the physical nature of the substrate prior to dredging i.e. if the conditions are similar to those prior to dredging recolonisation will occur more rapidly than in conditions where the sea floor has been altered radically. The environmental sensitivity of these organisms is anticipated to be ***low***.

The destruction of benthic communities may also lead to the loss of prey items for bottom feeding fish and invertebrates. There are no cumulative impacts anticipated unless additional dredging is done in the Port of Saldanha.

6.2.2.7. Disposal of dredge spoil

If suitable the dredge spoil can be used for land reclamation in which case it will be contained and other than the water released as it consolidates, it will have no contact with the natural environment. The return flow will have to pass through settling ponds to ensure a good quality and that no suspended material enters the sea. If there is no use for the spoil, it will have to be deposited at the Port of Saldanha's designated dredge spoil disposal site. Local disturbance of biota e.g. fishes is probable during spoil discharge due to locally generated suspension of fine materials at dredge spoil disposal site. Smothering of benthic organisms will also occur at the spoil disposal site, but not at a scale that will have a noticeable impact on the surrounding benthic communities. It is however recommended that Western Cape Government determines that the dredge spoil site has full official authorisation for this purpose.

The environmental sensitivity of these areas relating to the disposal of dredge spoil is assessed to be ***low***.

6.2.3. Wind-blown sand transport

The design of the cutting through the dune belt to route the LNG cryogenic pipeline to the onshore storage and regasification facilities is not known but could be up to 200 m in width (depending on the height of the dune belt), cleared of vegetation for fire-hazard reasons and demarcated by a security fence. The removal of the vegetation will facilitate movement of sand from the beach into the back dune area. The exact volume of sand and the conditions under which wind-blown sand transport will occur will have to be determined in order to determine the actual significance of this potential impact.

Should wind-blown sand in significant quantities reach the landward side of the dune belt it could interfere with other industrial activities in the back port area. The sensitivity of this area to impacts associated with wind-blown sand transport is anticipated to be ***medium***.

6.2.4. Destruction of benthos by trenching

In the event of trenching an LNG pipeline, the destruction of the habitat and benthic communities in the footprint of the trench will inevitably occur. Recolonisation by organisms from the surrounding area will take place in time. The rate of recolonisation will depend to a great extent on the nature of the substrate prior to trenching i.e. if the conditions are similar to those prior to trenching, recolonisation will occur more rapidly than in conditions where the sea floor has been altered radically. The environmental sensitivity of these organisms is anticipated to be ***low***.

The destruction of benthic communities may also lead to the loss of prey items for bottom feeding fish and invertebrates.

6.2.5. Re-gasification heating water discharge

The intention is to use a closed loop system in the re-gasification unit, which will avoid any water discharge at sea. However, should an open circuit re-gasification heating system be considered, studies to assess the impact of the cold water and associated biocide discharge would need to be investigated.

6.3. SHIPPING TRAFFIC

At present it is estimated that the LNG demand in the Western Cape will be met by two LNG carriers per month. These vessels will either discharge via an FSRU or be moored to a jetty.

The area between Robben and Dassen Islands (Option 1) lies north of the limits of the Port of Cape Town. Vessels departing to the north from Cape Town pass between Robben Island and the mainland and then head in a generally north-westerly direction, i.e. away from any potential FSRU location, for the high seas where international regulations for the conduct of shipping apply.

At Saldanha Bay (Option 3) the LNG carrier will be brought into port under the direction of a pilot who reports to Port Control. Present practice only permits the presence of one large vessel (ore-carrier or oil tanker) in the entrance channel at a time. Nevertheless the Port of Saldanha has sufficient capacity to handle two or more LNG carriers a month without interfering with the flow of vessels carrying other cargoes. Fishing vessels transit Small Bay en route to the factories in Saldanha town, oil drilling rigs and oil field support vessels are routed to the maintenance facilities located to the north of the ore berth. In addition, Small Bay hosts mariculture rafts and lay up areas for diamond mining vessels. For these reasons, TNPA (Mrs Abigail Links, personal communication, 19 May 2014) advised that an LNG discharge facility could not be accommodated in Small Bay.

Should the FSRU be located to the north of Salamander point, it will be away from the majority of shipping traffic in the bay (Figure 6.1).

St. Helena Bay lies outside of any formal commercial port limits but it is used by ore-carriers as an anchorage while awaiting a loading berth in the Port of Saldanha. Should an FSRU be located in St Helena Bay (Option 2) this ore-carrier anchorage may have to be formalised to prevent interference with the operation of the FSRU.

Regardless of the location selected for the LNG importation facility, whether an FSRU or a jetty, the facility with its exclusion (safety) zone will have to be marked on the appropriate South African Navy hydrographic chart and a Notice to Mariners alerting all users of the sea of the facility's presence be issued.

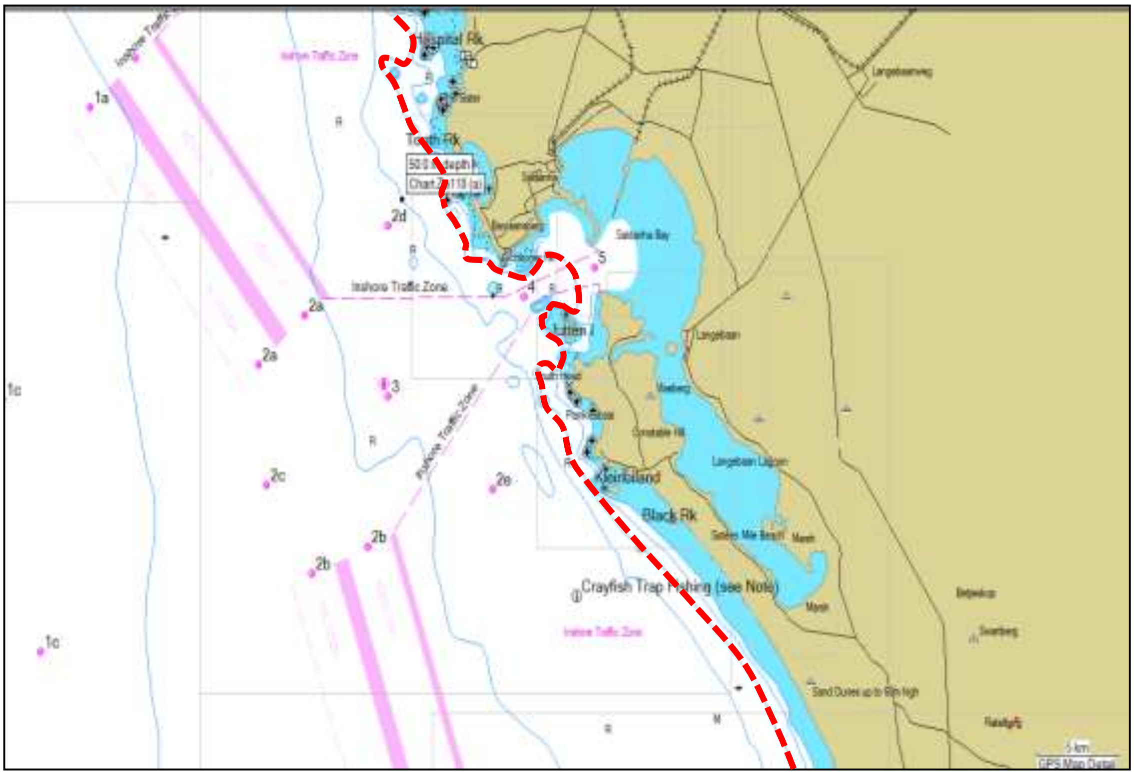


Figure 6.1 Inshore traffic zones

6.4. TERRESTRIAL AND AQUATIC ECOLOGY, LAND USE AND PROTECTED AREAS

The terrestrial and aquatic ecology issues are discussed in the following three sections:

- Generic key issues
- Land based LNG receiving terminal
- Specific issues related to the transmission and distribution gas pipeline route.

6.4.1. Generic key issues

6.4.1.1. Terrestrial Ecology, land cover and protected areas

From a terrestrial ecology perspective, the proposed pipeline will have three major impacts:

Vegetation removal during construction

Vegetation will be removed and a strip will be excavated, disturbed by machinery and then rehabilitated. Although the vegetation will be rehabilitated, the vegetation structure and composition will remain altered.

Exclusion of deeper-rooted vegetation from the pipeline route (including servitude)

The removal of deeper-rooted flora may permanently alter the structure of the plant communities and their suitability as habitat for fauna. However, the strip is anticipated to range between 20 m and 30 m in width, with the result that long-term disruption and fragmentation of the plant and animal communities should not be a significant factor. Furthermore, disturbance and changes in vegetation community structure may favour invasions by alien plant species, particularly grasses (e.g. Milton et al. 1999). Such invasions should be managed as part of ongoing pipeline corridor management. A key mitigation measure, therefore, is to ensure that the measures and conditions in the Environmental Management Plans for the construction and operation of the pipeline keep disturbance during construction to the minimum, ensure effective rehabilitation, and facilitate proper monitoring and management of the environment during the operational phase.

Threatened vegetation types

The list of threatened national vegetation types (as published in the Government Gazette (South Africa, 2011)) has important implications for this study as the pipeline routes pass through a number of threatened vegetation types. In such cases the disturbance as a result of construction, and the permanent changes in species composition caused by the exclusion of deep-rooted shrubs from vegetation cleared in a strip centred over the pipeline, will be considered important environmental impacts. These considerations also apply to areas where the gas transmission pipeline route traverses a Critical Biodiversity Area (terrestrial). This does not mean that these vegetation types/areas are "no-go" areas, but disturbance should be minimised, the remaining natural vegetation and sensitive habitats in these CBAs should be avoided wherever possible, and effects on the ability of plants and animals respectively to disperse or move through these areas should be minimised. Where the particular vegetation is considered threatened, especially in the Critically Endangered (CR) and Endangered (EN) classes, remnants in a natural or near-natural state should be avoided if at all possible. Each portion that is traversed will have to be justified and the cumulative impacts will be considered important in proposing possible alternative routes.

Where sections of the proposed pipeline crosses orchards and vineyards which cannot be replanted over the pipeline since their roots could potentially cause damage to pipeline infrastructure, the sensitivity of the affected area was assessed to be medium. The main anticipated constraint will be the negotiations with the land owner due to permanent loss of existing deep-rooted crops and the permanent exclusion of the pipeline servitude from cultivation of these crop types. Given the limited extent of the area that would be affected, the indirect social impact due to this loss is however anticipated to be low.

Conservation areas (refer to Chapter 5, section 5.3.4) include national and provincial parks as well as private conservancies and stewardship sites. The general consensus is that a proclaimed national or provincial park is regarded as a potential no-go area. It may however be acceptable to cross these areas in the event of the proposed pipeline following an existing servitude. It is also considered acceptable to traverse local authority parks, private conservancies and stewardship sites, depending on their purpose and conservation value. We however recommend avoiding all formal and informal protected areas as well as any type of conservancy/private reserve.

Generic recommended management actions

The following generic recommendations for the construction of the proposed pipeline are made:

- Limit the construction footprint and follow sound international practice for site management.
- Where applicable (i.e. pipeline route following an existing road), restrict all construction activities to between the road and the pipeline.
- Wherever possible, align the pipeline along existing servitudes and avoid, as much as possible, any remnant vegetation, in particular Critically Endangered (CR) and Endangered (EN) vegetation remnants and remnants within terrestrial CBAs.
- Vegetation rehabilitation to pre-construction state: This should be undertaken, whenever possible, before the onset of the winter rains to take maximum advantage of the growing season. Irrigation is not generally used in Fynbos restoration and is unlikely to be a viable option, except in special cases involving areas of a limited spatial extent
- Invasive alien plant control: management actions should not only focus on the woody shrub/tree invaders since sand plain fynbos, limestone fynbos and renosterveld are also very prone to invasion by introduced grasses which have a significant impact on herbaceous species and especially geophytes. Consequently management of such invasive grass species need needs special consideration. There are no set guidelines for management of herbaceous species; therefore expert input will be required when drawing up recommendations for the EIA and EMPs.

6.4.1.2. Aquatic Ecology, Wetland and Rivers

River crossings are unavoidable when considering a pipeline such as the gas pipeline proposed by the Western Cape Government. The construction of a pipeline through a wetland or river will have direct adverse effects on that specific aquatic feature as well as knock-on effect (indirect impacts) on the riparian vegetation, aquatic invertebrates, fishes etc. due to the interconnections within such a system. However, rivers rarely represent a constraint for the routing of a pipeline, unless these are associated with extensive wetlands or riverine forest belts. During the refinement of the pipeline route, the best crossing points from a technical and environmental point of view will need to be identified and assessed.

Generic key issues associated with aquatic ecology, wetlands and rivers are anticipated to include:

- Destruction of or alteration to FEPA wetlands and rivers;
- Modification of Aquatic Critical Biodiversity Areas or Ecological Support Areas;
- Movement of sediments into the river or wetland;
- Loss of soil and riparian vegetation;
- Disruption of stream flow in rivers; and
- Contamination of the wetland or river through the release of drilling fluids or other pollutants associated with construction activities.

It is assumed that where possible, crossings of smaller seasonal rivers and wetlands will be done using traditional trenching methodologies. During trenching activities, the increase in sediment levels in the river or wetland will have an impact on aquatic life and the surrounding habitat (e.g. low light levels, etc.). Stockpiling of excavated soil on the bank of the watercourse may also have an impact on the soil hydrology and riparian vegetation. Since most rivers and wetlands are dynamic and open systems, altering one section of a river of wetland may have a high impact downstream or at another section of these interconnected systems (i.e. changes to the system may not remain localised).

The use of trenchless technologies such as HDD during the routing of a pipeline through a large perennial river has less of an impact on aquatic features. The main concern related to HDD is the inadvertent release of potential toxic drilling fluids due to the loss of borehole directional control and intersecting the river or wetland bed, or the drilling through permeable soil such as gravel. The impact that the release of drilling fluid will have on the environment will depend on the nature of drilling fluid mixture being used and its biodegradability. It has been assumed that water based muds or environmentally friendly drilling muds will be used.

Several sensitive aquatic features identified as National Freshwater Ecosystems Priority Areas (FEPAs) may be affected by the proposed pipeline. The aquatic features that potentially would be affected adversely during the construction of the pipeline include FEPA Rivers, FEPA Wetlands and FEPA Phase 2 Rivers. Although various non-FEPA wetlands and rivers may also be affected adversely, the wetlands and rivers identified as FEPAs are the most sensitive from a biodiversity and ecological perspective. Major wetlands are also highly sensitive (very high) due to erosion sensitivity (preferred channelling of water) and Red Data species are often found in these systems.

Although these FEPA features are not considered to be no-go areas, where possible, the pipeline route should avoid these areas. Where FEPAs need to be crossed, stringent management actions will need to be implemented to ensure that there is limited disturbance to these areas. Crossing a large wetland or a Ramsar site would however be regarded as a fatal flaw. Large dams do represent significant constraints when routing a pipeline. The constraint here would mainly be physical i.e. a barrier similar to a mountain range.

Aquatic Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) are also present within the pipeline footprint. These are areas that require safeguarding to ensure the continued existence of biodiversity, ecological processes and ecosystem services and are therefore anticipated to have a very high environmental sensitivity in this assessment. The impact on these systems will depend on the construction techniques used and the ability of the features to return to their previous natural states following construction.

Due to the linear nature of the pipeline, the cumulative impact on the aquatic and riverine (riparian) ecosystems of the Western Cape is not anticipated to be significant since the individual wetlands are not functionally connected with each other. However, it is recommended to implement appropriate management measures to reduce the impacts at a local scale i.e. where the activity occurs, thereby significantly reducing any cumulative impacts.

Generic recommended management actions

The following generic recommendations for the construction of the proposed pipeline are made:

- Avoid FEPA river and wetland areas as far as reasonably possible.
- Implement buffer zones around the FEPA rivers and wetlands (minimum distance of 100m required). The buffer zone determination should be undertaken at the site-level.
- For Upstream Management Areas, buffer widths should be sufficiently wide to ensure that water quality issues that may arise from the proposed development do not impact downstream FEPAs and Fish Support Areas.
- Wetland FEPAs or portions thereof should not be drained or filled in and should not be disconnected from their buffers.
- Wetland clusters should not be fragmented and should be treated as a unit.
- Appointment of suitably qualified specialists to assist in the identification of the final routing of the proposed pipeline and to undertake some ground truth verification on the wetlands, rivers, aquatic CBAs and ESAs that have been identified to be on the proposed route.
- River crossings: perennial systems
  - Using non-trenching methods such as HDD when crossing large perennial rivers
  - Should trenching be the preferred method for crossing rivers this should be done in the late summer / early autumn when river flows are likely to be very low or have completely ceased.
  - Ensure that the pipeline is buried at a depth sufficient to ensure that no problems will arise, for example, during floods when scouring could occur. Sediment will be suspended during trenching which could have a local impact on the aquatic biota. We suggest that trenching should take place during low flow periods and that geotextile curtains be installed to contain the suspended sediment to the immediate vicinity of operations. Should this be done the impact will be limited/minimised and is unlikely to be discernible after the next winter flow season following installation of the pipeline.
  - Reed fringes (e.g. *Phragmites* sp.) will recover rapidly provided that the bank profile is restored and stabilized using geotextiles. Failure to do this may result in the bank being scoured by high river flows with the result that extensive sections of the reed fringe may be lost.
- River crossings: seasonal / ephemeral systems
  - Where saltmarsh has to be traversed by the pipeline it is important to confine disturbance to the very minimum area necessary for construction activities. Saltmarsh plants should be removed

carefully prior to construction and should be replanted after the pipeline has been laid. It is important to stockpile the topsoil in order to maintain the pre-construction soil profile as far as is practicable. If possible, where the pipeline has to cross saltmarsh areas, construction should be completed before autumn to take advantage of the limited winter rainfall. It must be noted that saltmarshes are not traversed by the current pipeline routing, but present within the 10 km-wide buffer around the pipeline.

- Narrow down the construction right-of-way through wetlands and rivers to minimize the area of disturbance.
- Recover surface material and install sediment barriers.
- Control the removal of indigenous plant species from a wetland FEPA or its buffer.
- Cut vegetation just aboveground level, leaving existing root systems in place, and remove it from the wetland for disposal.
- Development of a spill prevention plan for clean-up processes to be undertaken should an oil or other chemical spill occur.

6.4.2. Terrestrial ecology environmental sensitivity rating criteria

6.4.3. Land-Based LNG Receiving Terminal

The land cover in the Saldanha Bay area comprises cultivated, natural, and built-up/urban classes (refer to Chapter 5, Figure 5.15).

The proposed onshore LNG storage and regasification facility may affect five different vegetation types depending on where it is located (refer to Chapter 5, Figure 5.23 and), two of which are endangered (CR) (Table 6.1 and Figure 6.2 (locations A and B)). The vegetation in the Big Bay Coastal Belt may include small localised patches of Limestone Shrubland (part of the Spreeuwal Duneveld), which is considered to be environmentally very sensitive. The CBAs in the Saldanha Bay area are mainly associated with the larger, intact remnants of vulnerable Saldanha Flats Strandveld and endangered Saldanha Granite Strandveld (Figure 6.2).

Two formal protected areas are present in the Saldanha Bay area namely, the West Coast National Park (also a Marine Protected Area) (Figure 6.2) and the SAS Saldanha Contractual Nature Reserve (Location A, Figure 6.2)

Table 6.1: Information on vegetation types found in the Saldanha Bay area.

Name	Biome	Bioregion	Remaining extent	Protection status	Threatened status
Saldanha Flats Strandveld	Fynbos Biome	West Strandveld Bioregion	48%	Poorly protected	EN
Saldanha Limestone Strandveld			59%	Not protected	
Saldanha Granite Strandveld			37%	Poorly protected	EN
Langebaan Dune Strandveld			65%	Well protected	
Cape Seashore Vegetation	Azonal Vegetation	Seashore Vegetation	98%	Well protected	

Table 6.2 Description of terrestrial ecology and significance rating of impacts associated with the proposed onshore storage and regasification facility at three potential locations, Saldanha Bay.

Location	Description of original vegetation types	Current environmental sensitivity of original vegetation type	Current landscape status	Rating of environmental sensitivity of proposed onshore infrastructure (current landscape)
A	Saldanha Granite Strandveld (EN)	High	Mostly remnant natural, SAS Saldanha Contractual Nature Reserve	*Very High / Fatal flaw*
B	Saldanha Flats Strandveld (EN)	High	Remnant EN; CBA	*High to Very high*
C	Langebaan Dune Strandveld (Least Threatened)	Low	Least threatened vegetation unit	*Low*

Natural and artificial wetland clusters are present to the west of Saldanha town. These wetland clusters are classified as FEPA wetland clusters. A few wetlands are also present to the north of the Port of Saldanha, outside the port boundaries. The Bok River runs to the north of Saldanha and is classified as a threatened ecosystem (Critically Endangered) and parts of it are classified as aquatic CBAs. The entire area to the west and northwest of Saldanha Bay also falls within a Phase2 FEPA.

Although the environmental sensitivity of the area is ***medium***, these aquatic features (presented in Figure 6.3 below) will unlikely be affected by an onshore storage and regasification station and pipeline construction and operation. The most sensitive is Langebaan Lagoon, a Ramsar site, which is regarded as a no-go (potential ***fatal flaw***) aquatic feature.

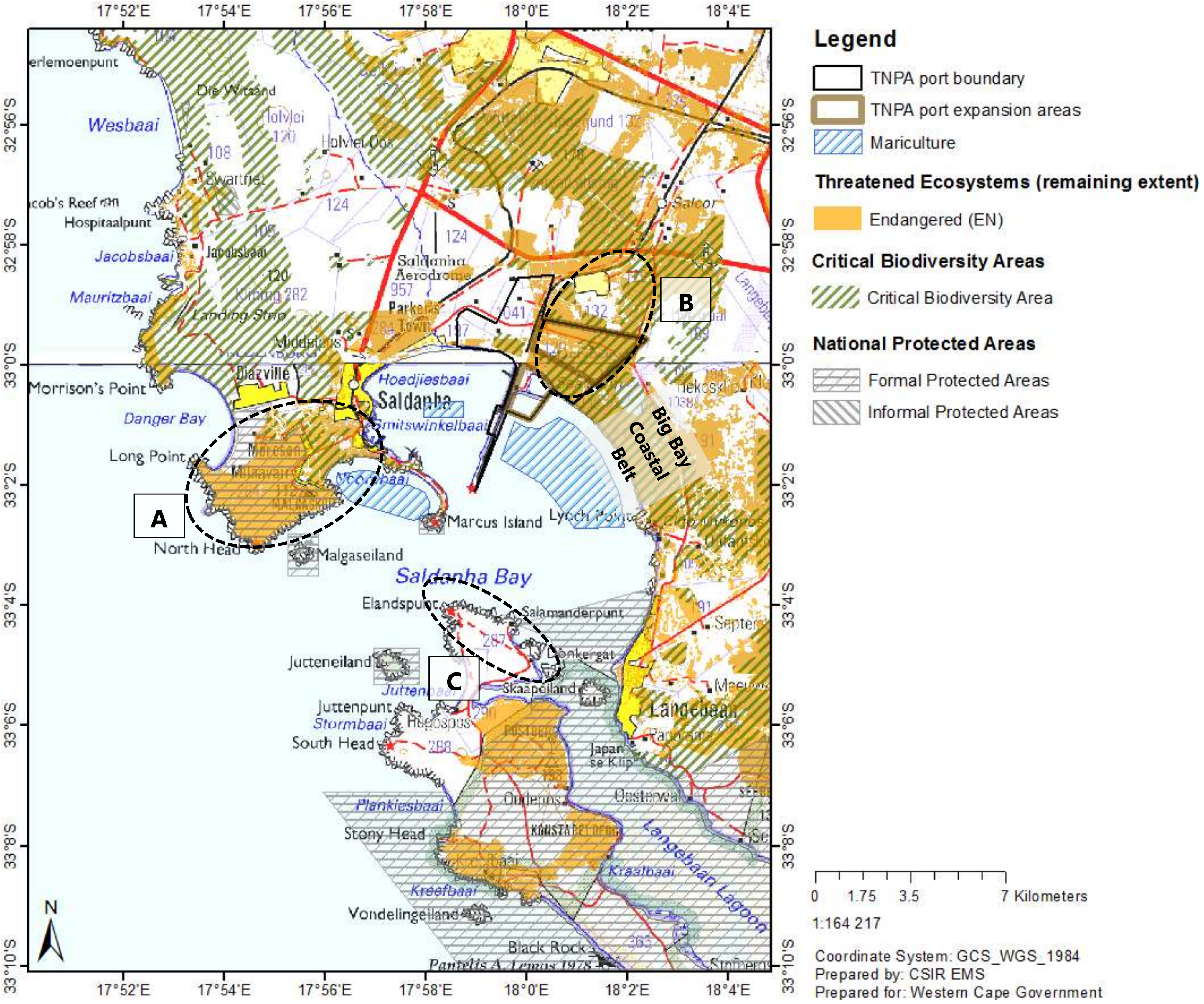


Figure 6.2: Terrestrial ecology for the environment that may be affected by the proposed onshore storage and regasification facility at Saldanha Bay.

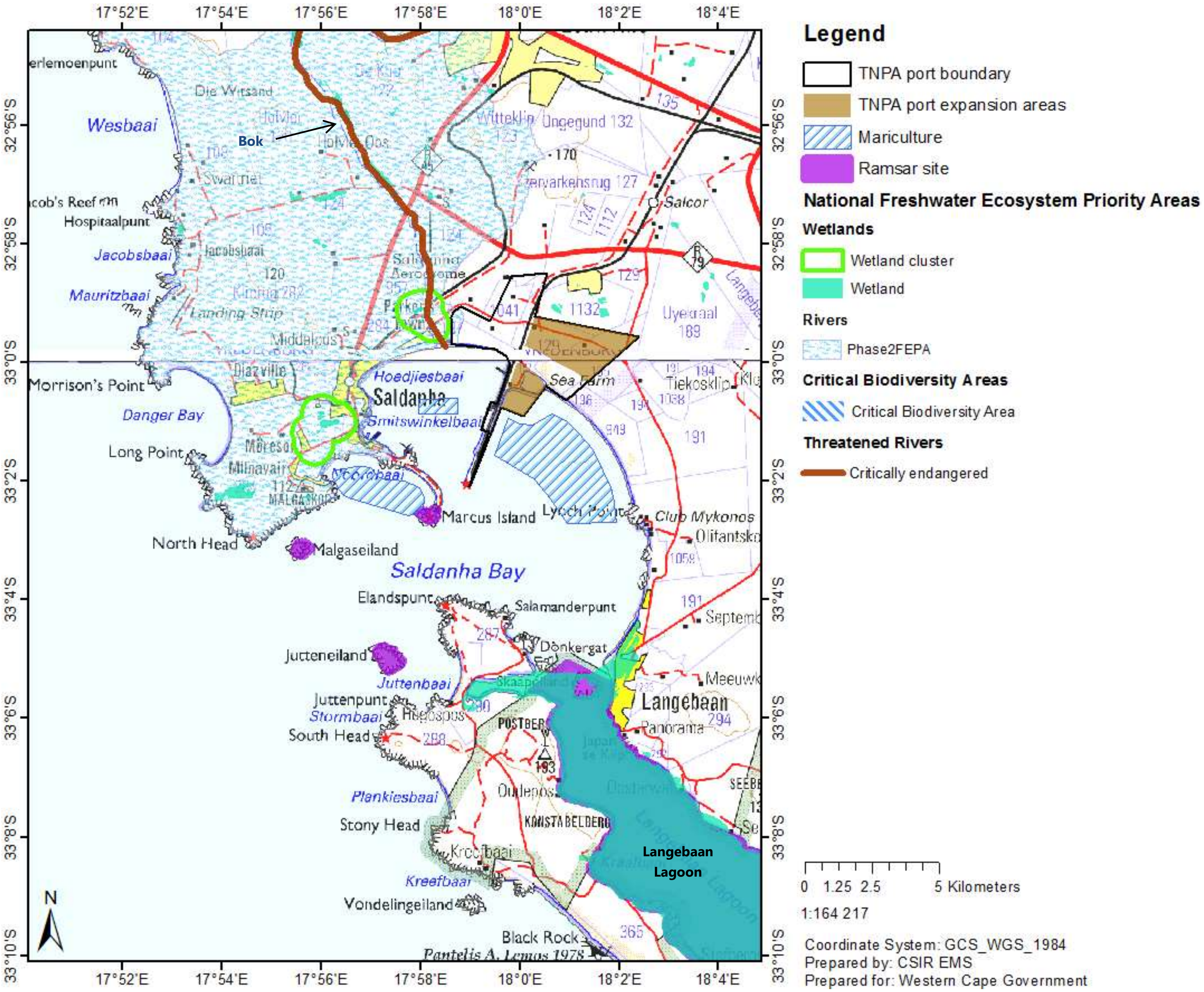


Figure 6.3: Terrestrial ecology for the proposed onshore LNG terminal site and LNG cryogenic pipeline (from the Jetty to the proposed terminal).

6.4.4. Specific key issues for the proposed pipeline route

This section describes the potential key issues on terrestrial and aquatic ecology associated with the construction of the proposed gas transmission pipeline (i.e. areas that will be directly affected by the current proposed pipeline route).

The gas transmission pipeline has been divided into sections and each has a separate table (Tables 6.3 to 6.6) and maps (Figures 6.4 to 6.9). The tables and maps should be considered in conjunction when interpreting the terrestrial and aquatic ecology of the study area.

6.4.4.1. Section 1: Saldanha Bay to Cape Town via Atlantis

The land cover between Saldanha Bay and Cape Town consists mainly of the "natural" class, with some areas of cultivated agricultural land (refer to Chapter 5, Figure 5.22).

Depending on the selected route, the proposed gas pipeline could potentially affect eleven different vegetation types (refer to Chapter 5, Figure 5.23) – three of which are listed as being critically endangered (CR), three are endangered (EN) and one is vulnerable (VU). Natural remnants of these vegetation types, especially the critically endangered ecosystems, should be avoided as far as possible as to not cause further loss and fragmentation the vegetation patches. The landscape consists of a mosaic of the vegetation types provided in Table 6.3.

All construction activities should be confined to the area between existing servitudes and the proposed gas pipeline route. No horticulture or viticultural land uses are crossed by the proposed gas pipeline.

Table 6.3: Information on vegetation types which may be affected by the proposed gas transmission pipeline between Saldanha Bay and Cape Town.

Name	Biome	Bioregion	Remaining extent	Protection status	Threatened status
Cape Lowland Freshwater Wetlands	Azonal Vegetation	Freshwater Wetlands	84%	Poorly protected	
Atlantis Sand Fynbos	Fynbos Biome	Southwest Fynbos	51%	Poorly protected	CR
Cape Flats Dune Strandveld			43%	Hardly protected	EN
Cape Flats Sand Fynbos			16%	Hardly protected	CR
Hopefield Sand Fynbos			49%	Hardly protected	VU
Swartland Shale Renosterveld		West Coast Renosterveld	8%	Hardly protected	CR
Swartland Silcrete Renosterveld			10%	Hardly protected	CR
Cape Flats Dune Strandveld		West Strandveld	61%	Poorly protected	

Name	Biome	Bioregion	Remaining extent	Protection status	Threatened status
Langebaan Dune Strandveld			65%	Well protected	
Saldanha Flats Strandveld			45%	Poorly protected	EN
Saldanha Granite Strandveld			37%	Poorly protected	EN

There are CBAs associated with larger intact fragments of vulnerable Saldanha Flats Strandveld (Section A, Figure 6.4). Furthermore, the area west and south of Atlantis (Section E, Figure 6.4) is part of the City of Cape Town Biodiversity Network in which various classes of CBAs and ESAs are defined, mainly to protect large remnants of Atlantis Sand Fynbos (CR), Cape Flats Sand Fynbos (CR) and Cape Flats Dune Strandveld (EN). Construction activities should be confined to the area between existing servitudes and the proposed gas pipeline route.

The proposed gas pipeline route passes through the West Coast National Park (formal protected area – Section B, Figure 6.4), and along the borders of the Jakkalsfontein Private Nature Reserve (Section C, Figure 6.4), and the Rondeberg-, and Grotto Bay Private Nature Reserves (Section D, Figure 6.4) (informal protected areas). The gas pipeline route diverges from the R27 road in Section B (Figure 6.4). If the pipeline does not follow an existing servitude, we propose that the pipeline should follow the R27 servitude to Saldanha Bay instead of crossing the West Coast National Park where there is an area of Saldanha Flats Strandveld (EN).

Table 6.4: Description of terrestrial ecology and significance rating of impacts associated with the proposed gas transmission pipeline between Saldanha Bay, Ankerlig Power Station (Atlantis) and Cape Town.

Section	Description of original vegetation types	Current environmental sensitivity of original vegetation type	Current landscape status	Rating of environmental sensitivity of proposed pipeline route (current landscape)
A	Saldanha Flats Strandveld (EN)	High	Mostly remnant natural and CBA	Very High *(if crossing natural EN remnants* *High (if an existing servitude is not followed an alternative route should be identified and assessed)*
B	Saldanha Flats Strandveld (EN)	High	West Coast National Park and CBA	*Very high/potential fatal flaw (when crossing remnants and National Park land)*

Section	Description of original vegetation types	Current environmental sensitivity of original vegetation type	Current landscape status	Rating of environmental sensitivity of proposed pipeline route (current landscape)
C	Hopefield Sand Fynbos (VU)	Medium	Mostly remnant natural vegetation; Jakkalsfontein Private Nature Reserve to south of R27 road.	*Medium (if crossing natural VU remnants)* *High (if crossing remnants and nature reserve)*
D	Atlantis Sand Fynbos (CR)	Very high	Mostly remnant natural vegetation; Rondeberg Private Nature Reserve; Grotto Bay Private Nature Reserve to north of R27 road	*Mostly low through transformed areas* *Very high (if crossing CR remnants and nature reserves)*
E	Atlantis Sand Fynbos (CR)	Very high	Mostly remnant natural vegetation; CCT BioNet CBAs (irreplaceable sites), PAs and ESAs	*Very high/Fatal flaw (when crossing CR remnants - DEA and CCT should be consulted)*
F	Cape Flats Dune Strandveld (EN)	High	Mostly remnant natural vegetation; CCT BioNet Other Natural Vegetation, PAs and ESAs	*Very high (CCT should be consulted)*
G	Swartland Shale Renosterveld (CR)	Very high	Trace remnant CR vegetation corresponding with CCT BioNet irreplaceable site CBAs	*Low (if crossing transformed land where no natural vegetation exists)* *Very high/Fatal flaw (when crossing CR remnants - DEA and CCT should be consulted)*
H	Cape Flats Sand Fynbos (CR)	Very high	Mostly remnant natural vegetation; CCT BioNet CBAs and trace irreplaceable sites	*Very high/Fatal flaw (when crossing CR remnants - DEA and CCT should be consulted)*

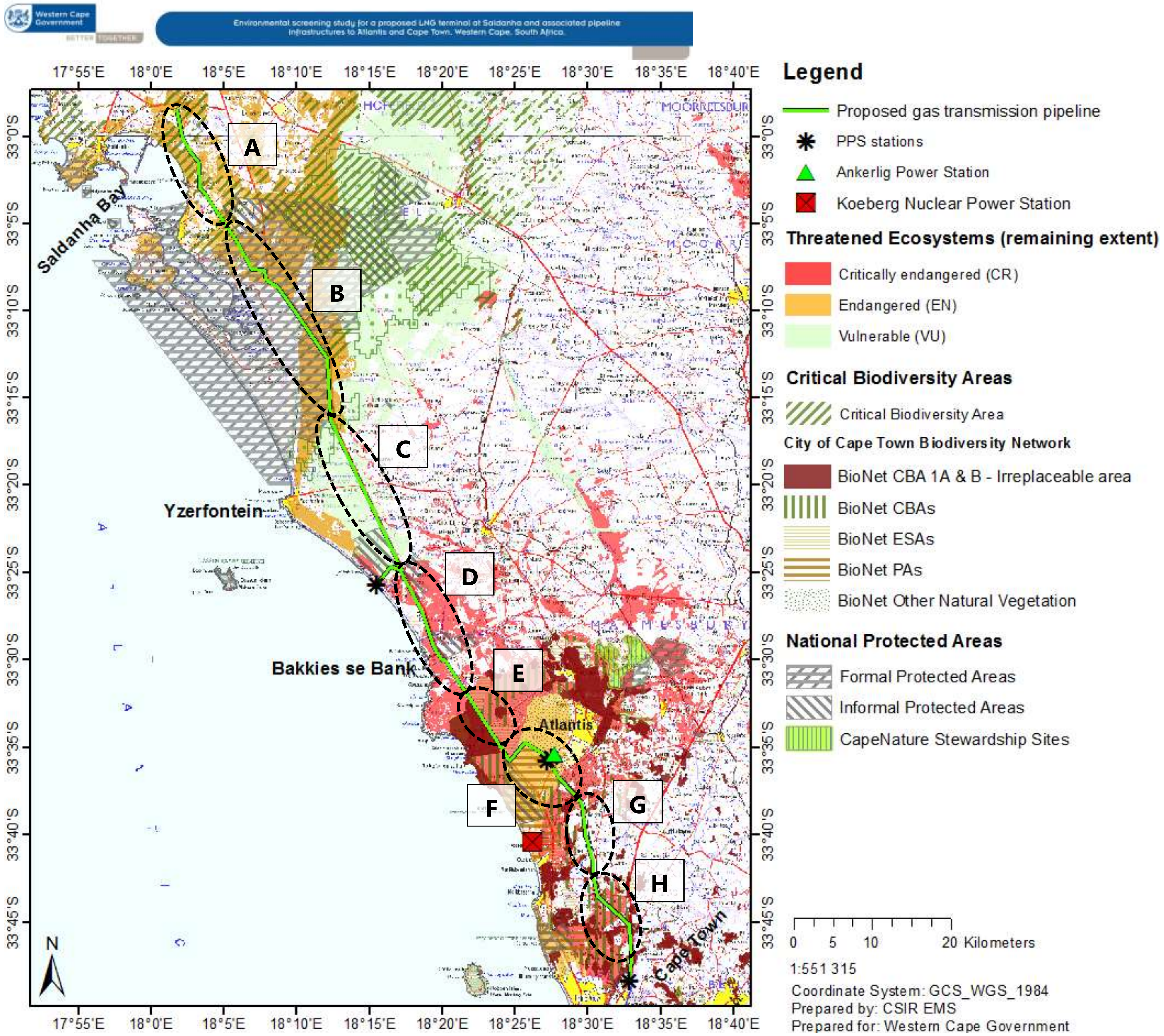


Figure 6.4: Terrestrial ecology for the environment that may be affected by the proposed gas transmission pipeline between Saldanha Bay, Ankerlig Power Station (Atlantis) and Cape Town.

Based on the very high environmental sensitivity of the area around the Atlantis it is proposed that an alternative route be assessed. Two alternative routes that diverges off from the R27 following Road 315 through Darling have been identified (Figure 6.5). Option A is to follow Road 315 towards Malmesbury following existing road servitudes via the N7 to link to Ankerlig. Option B is to follow the railway servitude between Road 315 and the N7 and then continue along the road servitude to Ankerlig. Both alternative route options may traverse Atlantis Sand Fynbos (CR) remnants with *very high* environmental sensitivity, which should ideally be avoided. Option A is preferable from a terrestrial ecology perspective, as Option B may traverse the Pela- and Riverlands Nature Reserves, as well as the Burgherspost Wine Estate and Cloof CapeNature Stewardship site (dashed circle, Figure 6.5).

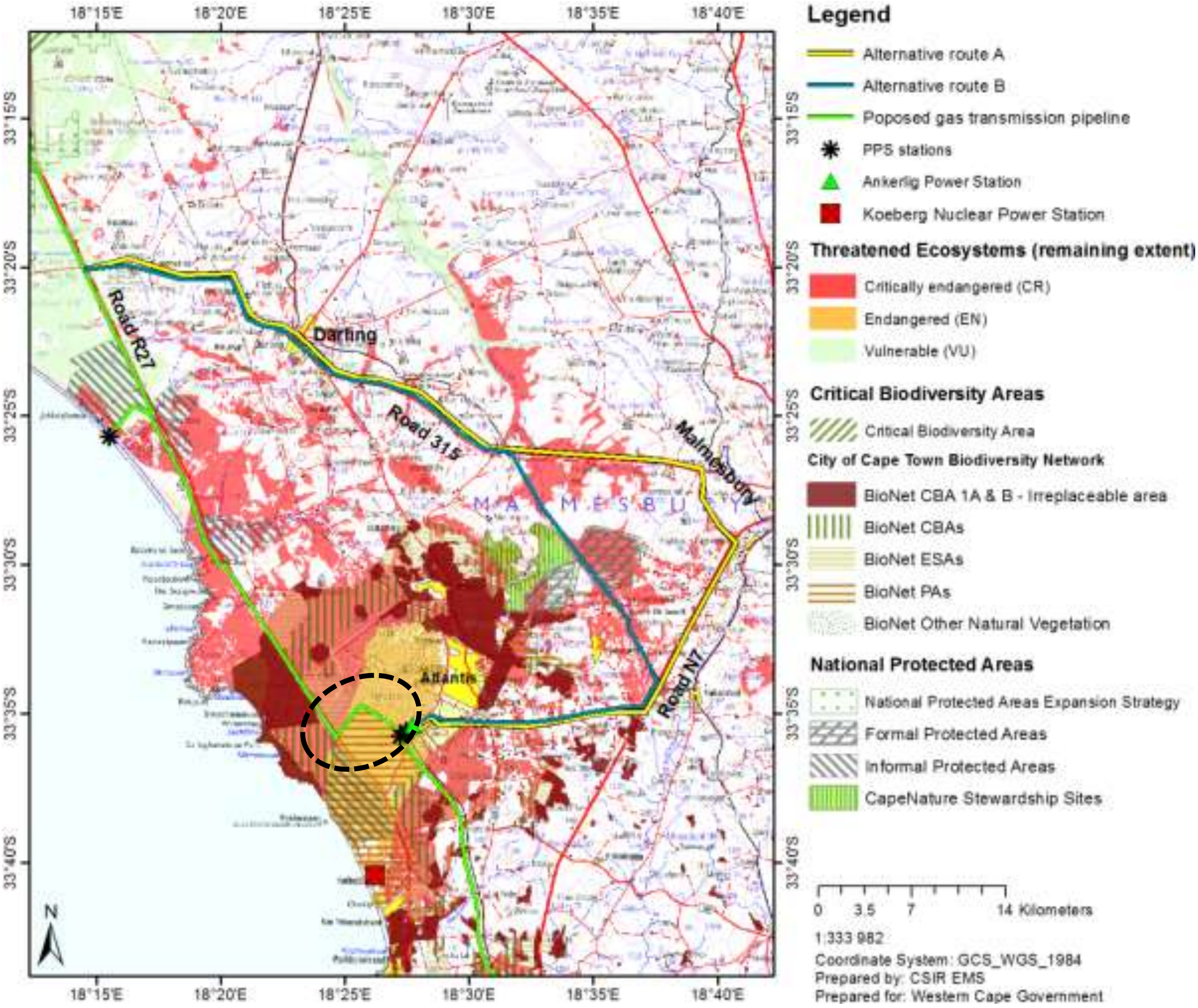


Figure 6.5: Two proposed alternative gas transmission pipeline routes to Ankerlig Power Station, Atlantis.

If the pipeline cannot be re-routed via Road 315 and the N7 to Ankerlig (as indicated in Figure 6.5 above), we propose that the pipeline follows the R27 and road 307 servitudes along the boundary of the local authority protected area of Witzand to Ankerlig, instead of cutting though the land portion indicated as "Witzand 2" on the topographic map (Figure 6.6).

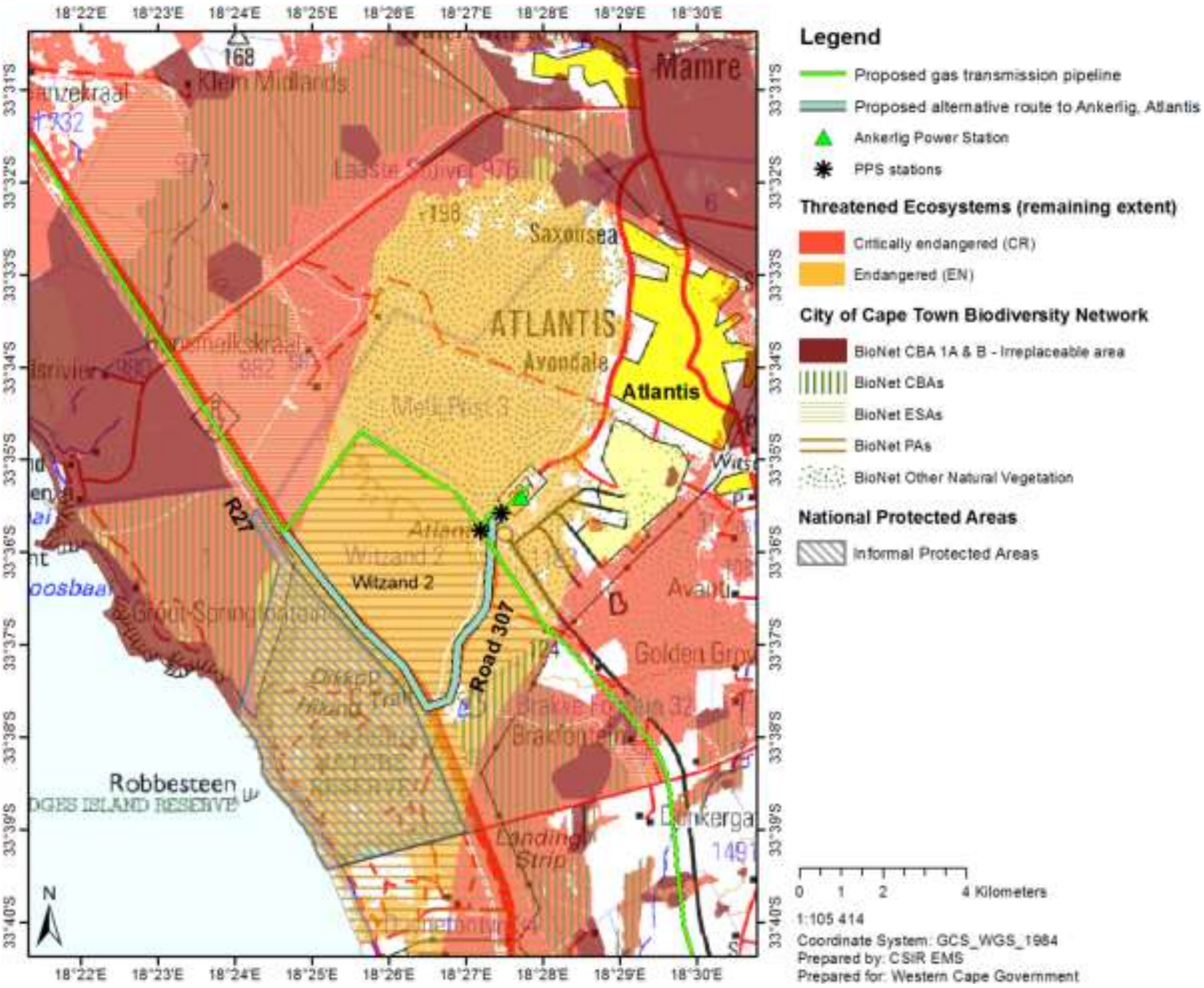


Figure 6.6: Proposed alternative gas transmission pipeline route to Ankerlig Power Station, Atlantis.

The Saldanha Bay area is characterised by several sensitive and protected aquatic features. This section of the proposed pipeline falls within the Berg Water Management Area (WMA) and the Lower Berg Sub WMA. The Langebaan Lagoon, which is a listed Ramsar site, lies to the south of the proposed pipeline.

From Saldanha to Atlantis, the pipeline crosses River FEPAs, Phase 2 FEPAs, FEPA wetlands and rivers that are classified as threatened ecosystems (Figure 6.7). The rivers that will potentially be traversed by the pipeline include the Dwars River and the Modder River which are both classified as threatened ecosystems (Critically Endangered). The area around the mouth of the Dwars River also contains several FEPA wetlands and falls within a Phase2 FEPA. Due to the threatened status of the river and the presence of FEPA wetlands, the environmental sensitivity of this area is considered to be medium to high, therefore the crossing at this section and location of the FSRU should be carefully considered so as to not impact on the wetlands present within this area.

Close to the Koeberg power station, the pipeline will traverse a FEPA river, the Sout River. The Sout River is classified as a Critically Endangered Ecosystem. The pipeline will cross a Phase2 River FEPA and FEPA wetlands within the Cape Town area.

The river crossings are all considered to be of ***medium*** environmental sensitivity, with the exception of the Dwars River, which is considered to be ***high*** because of the presence of FEPA wetlands in close proximity to the river. Should the correct design and construction of the crossing and appropriate restoration measures be implemented, the environmental impacts associated with this section of the proposed pipeline would be acceptable.

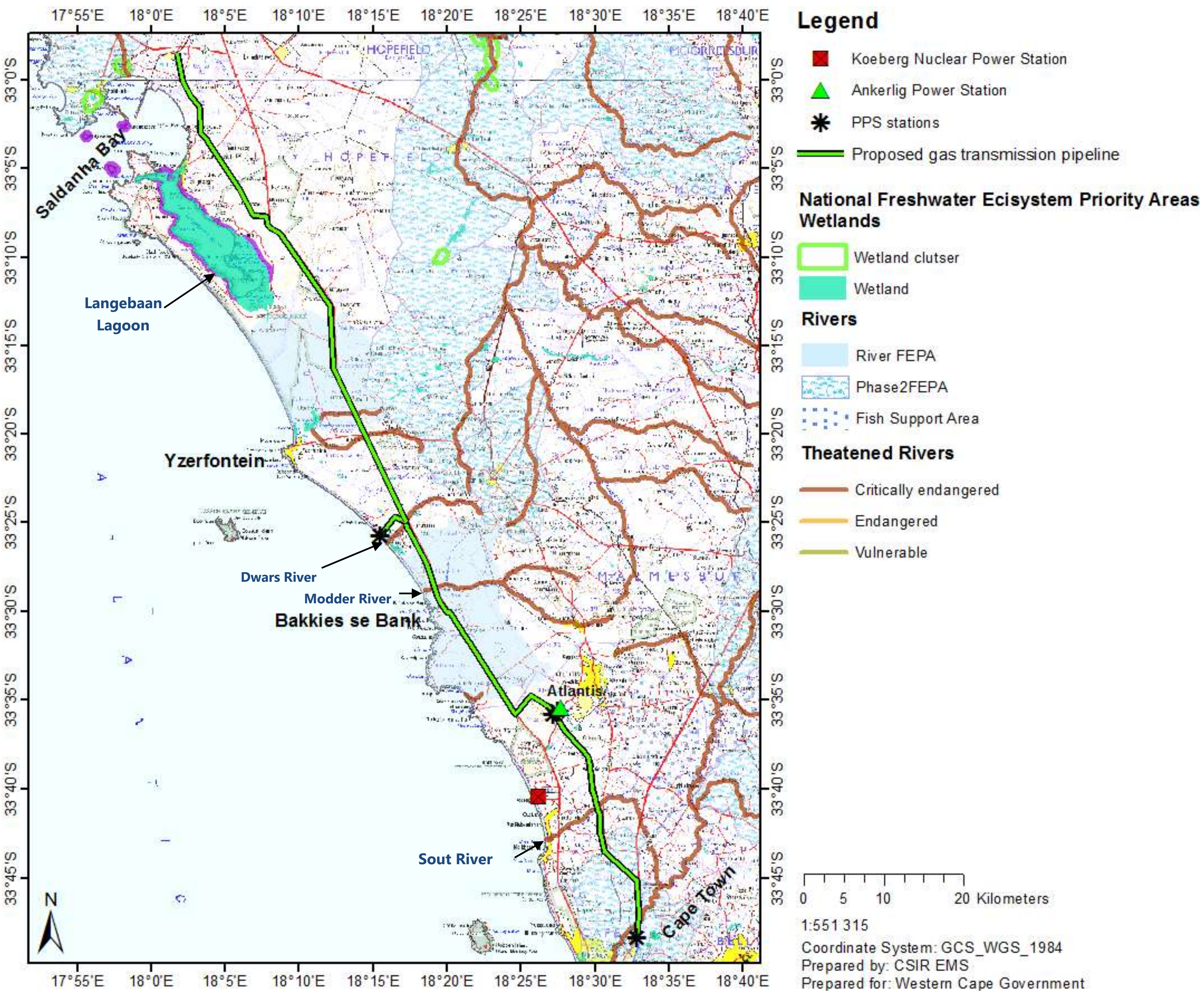


Figure 6.7. Aquatic features present between Yzerfontein Point and Bakkies se Bank

6.4.4.2. Section 2: Transmission pipeline route to Paarl/Wellington and Stellenbosch

The pipeline(s) in these areas are small, low pressure, lines and are not the same as the main line from Saldanha.

The land cover in the Bellville and Kuils River suburbs and Stellenbosch and Paarl/Wellington areas consists of mainly "urban/built-up" and "cultivation" land cover classes refer to Chapter 5, Figure 5.22). The cultivated land is primarily viticulture and horticulture, consisting of deep-rooted, perennial crops. There are some areas of degraded natural vegetation and very few natural remnants have survived.

The four vegetation types that may be affected by the transmission pipelines from Fisantekraal to Paarl/Wellington (Drakenstein Municipality) and from Kuils River to Stellenbosch are all characterised by a threatened status of Critically Endangered (CR – Table 6.5). The remaining extent and distribution of these vegetation types is very limited due to extensive landscape fragmentation and transformation, mainly caused by urbanisation and conversion to agriculture (Figure 6.8). The gas transmission pipeline routes must avoid all remaining threatened natural vegetation patches. However, it is unlikely that intact vegetation patches will be traversed by the pipelines provided that the existing servitudes are followed as closely as possible.

Table 6.5: Information on vegetation types which may be affected by the proposed gas transmission pipelines from Phesantekraal to Paarl/Wellington and from Kuils River to Stellenbosch.

Name	Biome	Bioregion	Remaining extent	Protection status	Threatened status
Cape Flats Sand Fynbos	Fynbos Biome	Southwest Fynbos Bioregion	16%	Hardly protected	CR
Swartland Alluvium Fynbos			27%	Poorly protected	CR
Swartland Granite Renosterveld		West Coast Renosterveld Bioregion	15%	Hardly protected	CR
Swartland Shale Renosterveld			8%	Hardly protected	CR

The Stellenbosch and Drakenstein Municipal areas contain some CBAs that correspond with the small remaining patches of threatened vegetation (refer to Table 6.6 and Figure 6.8). The routes proposed for the gas transmission pipelines mainly cross land transformed to horticultural/viticultural land-uses, although some remnant critically endangered vegetation patches which are also classified as CBAs (indicated by the dashed circles in Figure 6.8) may be traversed by the gas transmission pipeline between Fisantekraal and Paarl/Wellington. These areas should be avoided if a ground-truthing procedure reveals that remnants of CR vegetation occur within the road servitude.

The only protected area that may be affected is the Joostenberg Private Nature Reserve (Informal Protected Area) which is next to the N1 road between Paarl/Wellington and Fisantekraal (Figure 6.8).

Table 6.6: Description of terrestrial ecology and significance rating of impacts associated with the proposed gas transmission pipelines from Fisantekraal to Paarl/Wellington and from Kuils River to Stellenbosch.

Route	Description of original vegetation types	Current environmental sensitivity of original vegetation type	Current landscape status	Rating of environmental sensitivity of proposed pipeline route (current landscape)
Phesantekraal to Paarl/Wellington	Swartland Shale Renosterveld (CR); Swartland Granite Renosterveld (CR); Swartland Alluvium Fynbos (CR); Cape Flats Sand Fynbos (CR)	Very high	Extensively transformed and fragmented with traces of remnants (CBAs); Joostenberg Private Nature Reserve Mostly viticulture/horticulture	*Low to medium (transformed land; viticulture/horticulture)* *Very high (when crossing CR remnants)*
Kuils River to Stellenbosch	Cape Flats Sand Fynbos (CR); Swartland Shale Renosterveld (CR); Swartland Granite Renosterveld (CR)	Very high	Extensively transformed and fragmented with traces of remnants (CBAs) Mostly viticulture/horticulture	*Low to medium (transformed land; viticulture/horticulture)* *Very high (when crossing CR remnants)*

There are a number of wetlands present within this area, however the gas transmission pipeline between Cape Town and Paarl/Wellington will predominantly follow the N1 and between Cape Town and Stellenbosch the route will follow the Polkadraai/Adam Tas Road (R310) (Figure 6.9). There are no other sensitive aquatic features present within this area and the environmental sensitivity is therefore considered to be ***low***.

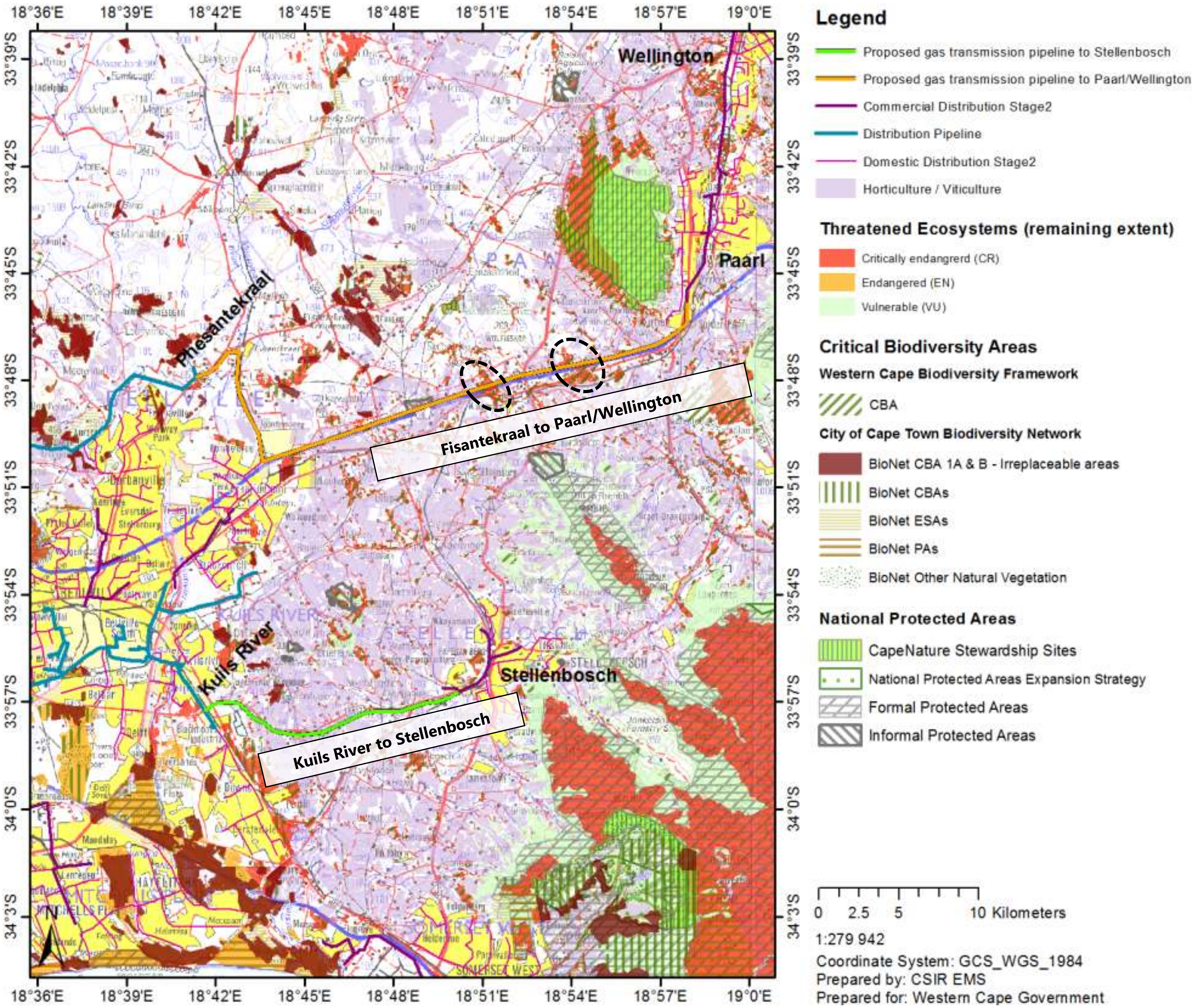


Figure 6.8: Terrestrial ecology for the environment that may be affected by the proposed gas transmission pipelines from Phesantekraal to Paarl/Wellington and from Kuils River to Stellenbosch.

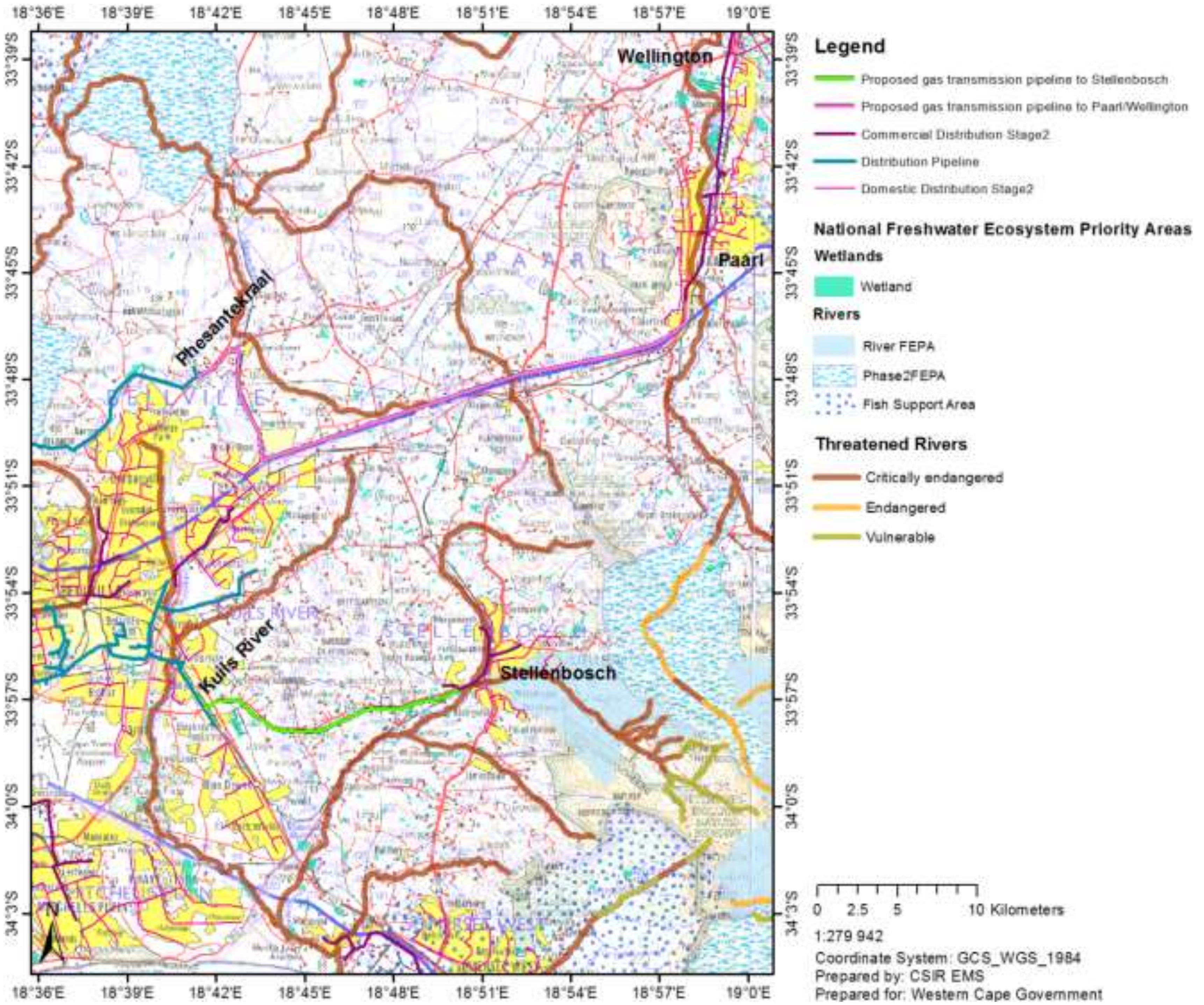


Figure 6.9: Aquatic features present in the gas transmission pipeline route to Paarl/Wellington and Stellenbosch

6.4.4.3. Distribution pipelines: Atlantis, Melkbosstrand, Cape Town, Paarl, Wellington, Stellenbosch, and Somerset West

From a terrestrial ecology perspective the domestic and commercial distribution gas pipelines – to provide Atlantis, Melkbosstrand, Cape Town, Paarl, Wellington, Stellenbosch and Somerset West – will not have adverse effects on the direct environment, as the pipelines are predominantly proposed to be constructed within urban built-up areas where no or very little natural vegetation and habitats remain (Figure 6.10). The only exception is the distribution pipeline from Atlantis to Melkbosstrand (Section A in Table 6.7, Figures 6.10 and 6.11). Here the distribution line traverses a remnant of Critically Endangered Atlantis Sand Fynbos, which is also identified by the City of Cape Town Biodiversity Network as a CBA and ESA where natural ecosystems should be maintained with the focus on sustaining ecological processes, degraded land should be restored to a more natural state and further degradation should be prevented or minimised. An alternative route, approaching Melkbosstrand from more to the south, following existing servitudes should be considered (Figure 6.11). This alternative route diverges from the main gas transmission pipeline at Melkbosstrand Road (M19) to follow the existing road into Melkbosstrand and will not fragment the large remnant of CR Atlantis Sand Fynbos. Although this proposed alternative route may avoid impinging on larger environmentally sensitive areas, it may affect some City of Cape Town BioNet irreplaceable sites (CBAs 1A and B) (Figure 6.11). Therefore, we recommend that the City of Cape Town Municipality be consulted and that the area should be ground-truthed. Furthermore, there is a portion where the distribution pipeline traverses a remnant Cape Flats Dune Strandveld (EN) which is a BioNet irreplaceable site and ESA (Section B, Table 6.7 and Figure 6.11).

Table 6.7: Description of terrestrial ecology and significance rating of impacts associated with the proposed gas distribution pipelines.

Section	Description of original vegetation types	Current environmental sensitivity of original vegetation type	Current landscape status	Rating of environmental sensitivity of proposed pipeline route (current landscape)
A	Atlantis Sand Fynbos (CR);	Very high	Mostly remnant natural vegetation; CCT BioNet CBAs (irreplaceable sites), PAs and ESAs	*Very high/Fatal flaw (when crossing CR remnants - DEA and CCT should be consulted)*
B	Cape Flats Dune Strandveld (EN)	High	Mostly remnant natural vegetation; CCT BioNet CBAs (irreplaceable sites) and ESAs	*Very high (CCT should be consulted)*

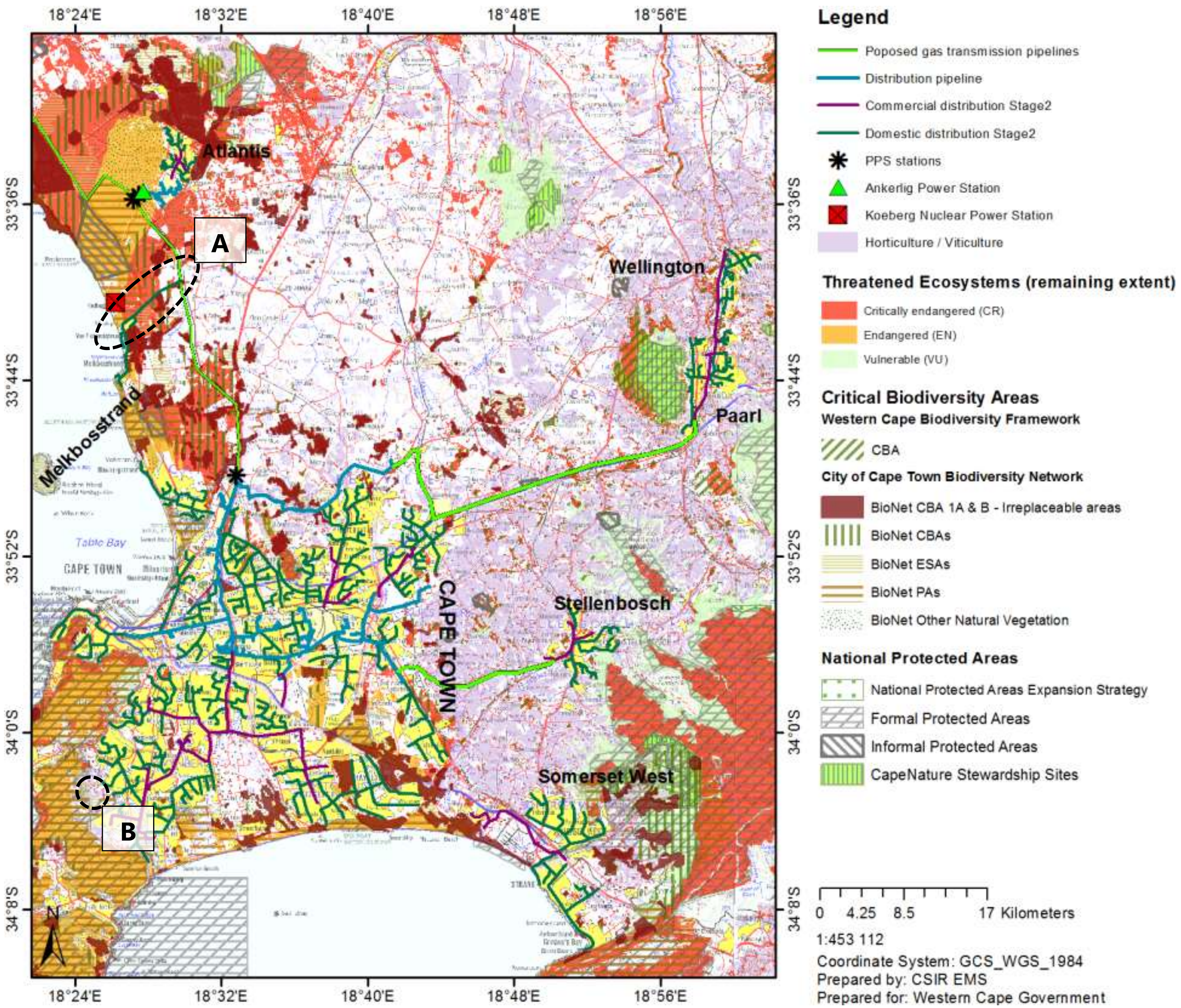


Figure 6.10: Terrestrial ecology for the environment that may be affected by the proposed domestic and commercial gas distribution lines pipelines. An alternative route to Melkbosstrand instead of the current proposed route (indicated by the dashed circle) was also assessed.

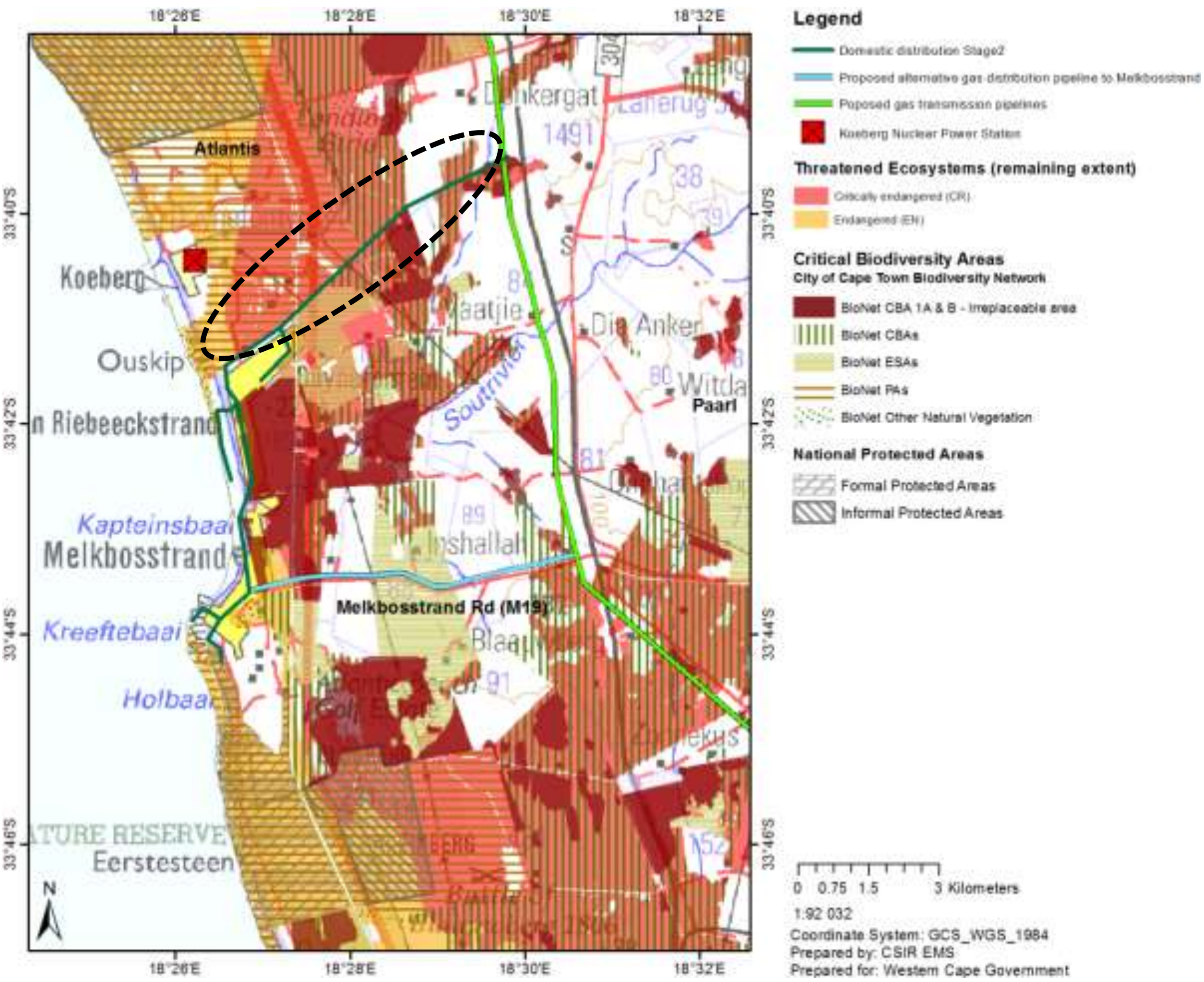


Figure 6.11: Proposed alternative gas distribution pipeline route to Melkbosstrand following Melkbosstrand Road (M19).

For the Ankerlig distribution and commercial pipelines, there are no sensitive aquatic features within the proposed pipeline routing. The proposed domestic distribution Stage 2 line at Melkbosstrand traverses the Sout River which is classified as a Critically Endangered Ecosystem and has a ***medium*** environmental sensitivity.

The Cape Town distribution pipelines (shown in the as the blue lines below in Figure 6.12) fall within the Berg WMA Greater Cape Town sub-WMA and cross a Phase 2 River FEPA and a FEPA wetland. The proposed pipeline routes cross the Elsieskraal and Kuils Rivers which are threatened rivers and classified as Critically Endangered. The construction of these sections of the line crossing the rivers and wetlands would need to be carefully considered and appropriate mitigation and management measures implemented.

The Cape Town commercial distribution lines Stage 2 (shown as the purple lines in Figure 6.12) also traverse the Vyekraal (endangered ecosystem), Elsieskraal and the Kuils Rivers. Further south to Muizenberg, these lines cross the Diep and Keysers Rivers and a FEPA wetland. Both the Diep and Keysers rivers are threatened and classified as Endangered ecosystems. The pipeline also traverses the

Greater Zandvlei Estuary Nature Reserve (shown in the red circle below) which is a 2 000 hectare wetland, river system and estuary. Zandvlei has a ***very high*** environmental sensitivity because of the protected status of the site and the biodiversity that it supports.

The Cape Town domestic distribution Stage 2 (shown as the green lines in Figure 6.12 below) pipelines cross Phase 2 FEPAs, Fish Support Area (FSA) and FEPA Rivers and Wetlands, including the Vyekraal, Diep and Keysers Rivers discussed above. The Rietvlei Wetland lies close to Milnerton, and is identified as a FEPA wetland. The Diep River (originating from The Riebeek Kasteel mountains) flows through the Rietvlei wetland and Milnerton Lagoon, which together are considered to comprise the Diep Estuary. Because of the size of the wetland and various aquatic features present in this area, the environmental sensitivity is considered to be ***very high***.

The Somerset West area is classified as a FSA, which means that the aquatic features present in the area play an important role in maintaining fish populations. Several FEPA wetlands are also present within the Somerset West area. The Somerset West distribution pipeline (shown in the as the blue lines below in Figure 6.12) fall within the FSA and traverses the Eerste River, a Critically Endangered ecosystem. The Somerset West commercial distribution lines Stage 2 (shown as the purple lines in Figure 6.12) are routed in close proximity to the Lourens River mouth. The Lourens River and Sir Lowry's River are Critically Endangered threatened ecosystems. The Sir Lowry's River is crossed by the Somerset West domestic distribution Stage 2 pipelines (shown as the green lines in Figure 6.12 below). In the Somerset West area, should the correct design and construction of the crossings and appropriate restoration measures be implemented, the impact is considered to be ***low***.

The Stellenbosch distribution and commercial pipelines fall within a River FEPA. The Blouklip, Klippies and Eerste River are all Critically Endangered ecosystems. No other sensitive aquatic features have been identified for the Stellenbosch area and the environmental sensitivity is considered to be ***high***.

The Paarl commercial and distribution pipelines (Stage 2) will cross the Critically Endangered Berg River. This section of the river is also identified as a FEPA wetland. The Hugos River is a FEPA River and the area surrounding the river is a FSA. The Wellington area is a Phase 2 FEPA, with the Krom River identified as a FEPA River and FSA. Several artificial wetlands are present in the Paarl and Wellington area, that would need to be taken into account during the routing of the pipeline. The environmental sensitivity of the Paarl and Wellington areas considered to be ***high***.

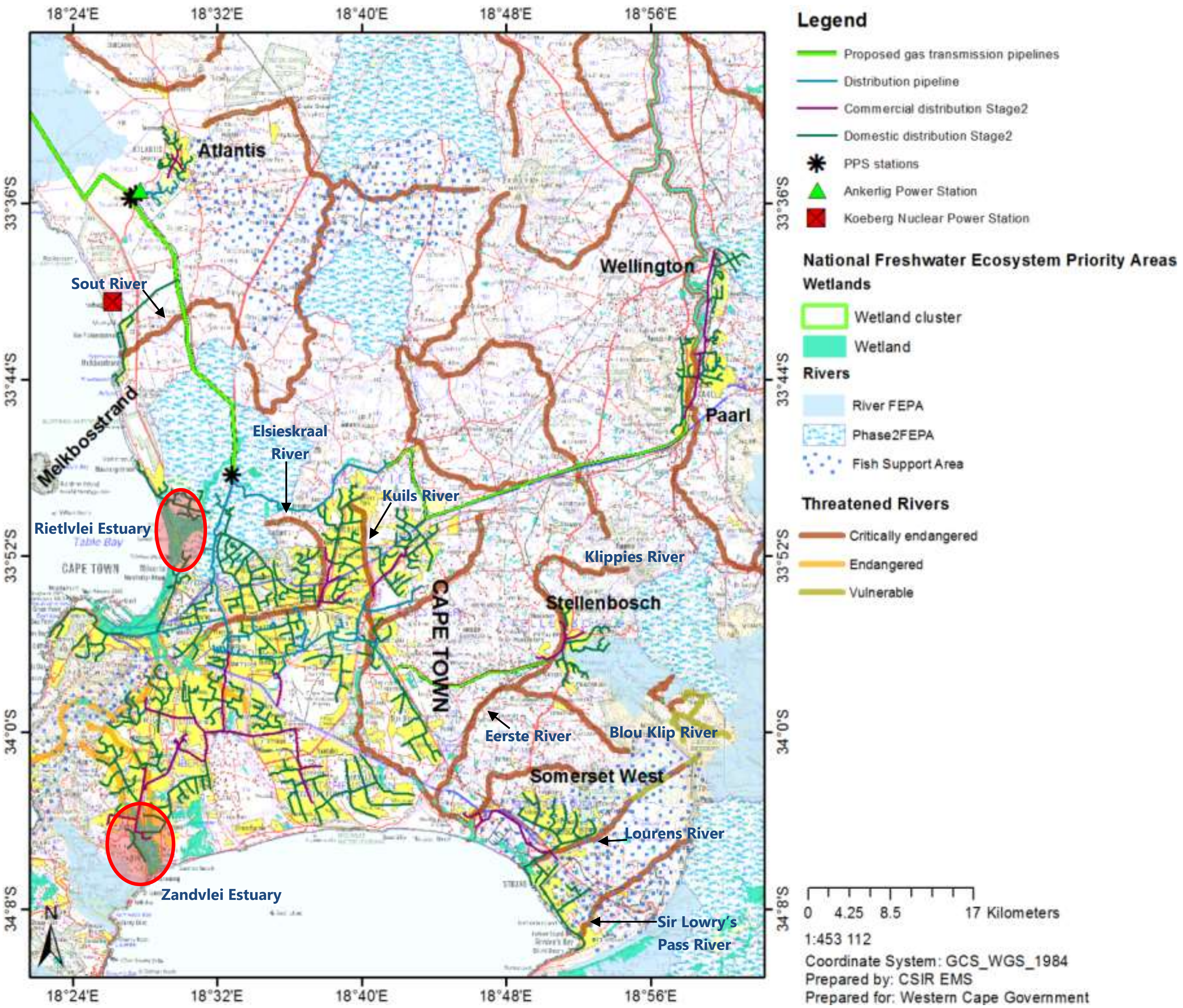


Figure 6.12: Aquatic features associated with the proposed distribution pipelines: Atlantis, Melkbosstrand, Cape Town, Paarl, Wellington, Stellenbosch, and Somerset West

6.4.4.4. St Helena Bay corridor

A 10 km wide belt with a total area of 1267 km^2 was assessed. Its northern end is located in St. Helena Bay at Baboon Point and it extends southwards past Bergriviermond to Saldanha Bay. In this area potential "no-go" areas were identified for where the gas transmission pipe comes to shore from the FSRU, as well as for an inland gas transmission pipeline route.

The land cover of this area is a mosaic of cultivated and natural land, with some urban/built-up areas towards Saldanha Bay and occasional waterbodies (Verlorenvlei in the north, Rocherpan in the middle and the Great Berg River in the south) (refer to Chapter 5, Figure 5.22).

This entire area consists primarily of vegetation types from the Fynbos Biome, with a few Azonal vegetation types along the coast and along the Great Berg River, including the estuary (Table 6.8). The Hopefield Sand Fynbos vegetation type is listed as being vulnerable (VU). There are two vegetation types in this area listed as having a threatened status of Endangered (EN): i) Leipoldtville Sand Fynbos, and ii) Saldanha Flats Strandveld (Table 6.8). Natural remnants of the above mentioned should be avoided as far as possible so as to not cause further loss and fragmentation of the vegetation patches. We recommend that, where such fragments cannot be avoided, all construction activities be confined to the area between existing servitudes and the proposed gas pipeline route. No horticulture / viticultural land uses are present in this area.

Table 6.8: Information on vegetation types found in the 10 km wide area assessed from Baboon Point to Saldanha Bay.

Name	Biome	Bioregion	Remaining extent	Conservation status	Protection status	Threatened status
Cape Estuarine Salt Marshes	Azonal Vegetation	Estuarine Vegetation	86%	Least threatened	Poorly protected	
Cape Inland Salt Pans	Azonal Vegetation	Inland Saline Vegetation	79%	Vulnerable	Poorly protected	
Cape Lowland Freshwater Wetlands	Azonal Vegetation	Freshwater Wetlands	84%	Least threatened	Poorly protected	
Cape Seashore Vegetation	Azonal Vegetation	Seashore Vegetation	98%	Least threatened	Well protected	
Graafwater Sandstone Fynbos	Fynbos Biome	Northwest Fynbos	71%	Vulnerable	Not protected	
Hopefield Sand Fynbos	Fynbos Biome	Southwest Fynbos	49%	Endangered	Hardly protected	VU
Lambert's Bay Strandveld	Fynbos Biome	West Strandveld	75%	Vulnerable	Poorly protected	
Langebaan Dune Strandveld	Fynbos Biome	Northwest Fynbos	65%	Vulnerable	Well protected	
Leipoldtville Sand Fynbos	Fynbos Biome	Northwest Fynbos	47%	Endangered	Hardly protected	EN
Saldanha Flats Strandveld	Fynbos Biome	West Strandveld	45%	Endangered	Poorly protected	EN

There are CBAs present in the 10 km wide area from Baboon Point to Saldanha Bay (Figure 6.13). The CBA areas correspond closely with the distribution of the larger fragments of VU vegetation types. These areas should be avoided as far as possible and construction activities should be confined to the area between existing servitudes and the proposed gas pipeline route.

Two NPAs and one NPAES focus area are located in the 10 km wide strip (Figure 6.13). The one to the far north is the Elandsbaai Nature Reserve (Figure 6.13, Section A), a formal Forest Act Protected Area. The second NPA is situated approximately in the middle of the study area which is the formally-protected, provincial Rocherpan Nature Reserve (Figure 6.13, Section C). A National Protected Areas Expansion Strategy focus area (NPAES) for the West Coast Leipoldtville Peninsula is situated south of Baboon Point (Figure 6.13, Section B).

Table 6.9: Description of terrestrial ecology and significance rating of impacts associated with the proposed gas transmission pipeline at St. Helena Bay between Bergriviermond and Baboon Point, with subsequent gas transmission pipeline south to Saldanha Bay.

Section	Description of original vegetation types	Current environmental sensitivity of original vegetation type	Current landscape status	Rating of environmental sensitivity of proposed pipeline route (current landscape)
A	Leipoldtville Sand Fynbos (EN)	High	Trace remnant natural (EN), CBA, Elandsbaai Nature Reserve, Vleikraal CapeNature stewardship site	*High (if crossing natural EN remnants)* *Very high (if crossing natural remnants, CBAs and stewardship site)* *Potential fatal faw (if nature reserve)*
B	Leipoldtville Sand Fynbos (EN)	High	Mostly remnant natural (EN), CBA, NPEAS focus areas	*High (if crossing natural EN remnants)* *Very high (if crossing remnant, CBA, NPEAS area)*
C	Hopefield Sand Fynbos (VU)	Medium	Trace remnant natural (VU), Rocherpan Nature Reserve	*Medium (if crossing natural VU remnants)* *Very high (if crossing remnant)* *Potential fatal faw (if crossing nature reserve)*

D	Hopefield Sand Fynbos (VU)	Medium	Mostly remnant natural (VU), CBA.	*Medium (if crossing natural VU remnants)* *Very high (if crossing remnant, CBA)*
E	Hopefield Sand Fynbos (VU); Saldanha Flats Strandveld (EN)	High	Mostly remnant natural vegetation; CBA	*Medium to High (if crossing natural VU or EN remnants)* *Very high (if crossing remnant, CBA)*
F	Hopefield Sand Fynbos (VU); Saldanha Flats Strandveld (EN)	High	Mostly remnant natural vegetation; CBA	*High (if crossing natural VU or EN remnants)* *Very high (if crossing remnant, CBA)*
G	Saldanha Flats Strandveld (EN)	High	Mostly remnant natural vegetation; CBA	*High (if crossing natural EN remnants)* *Very high (if crossing remnant, CBA)*

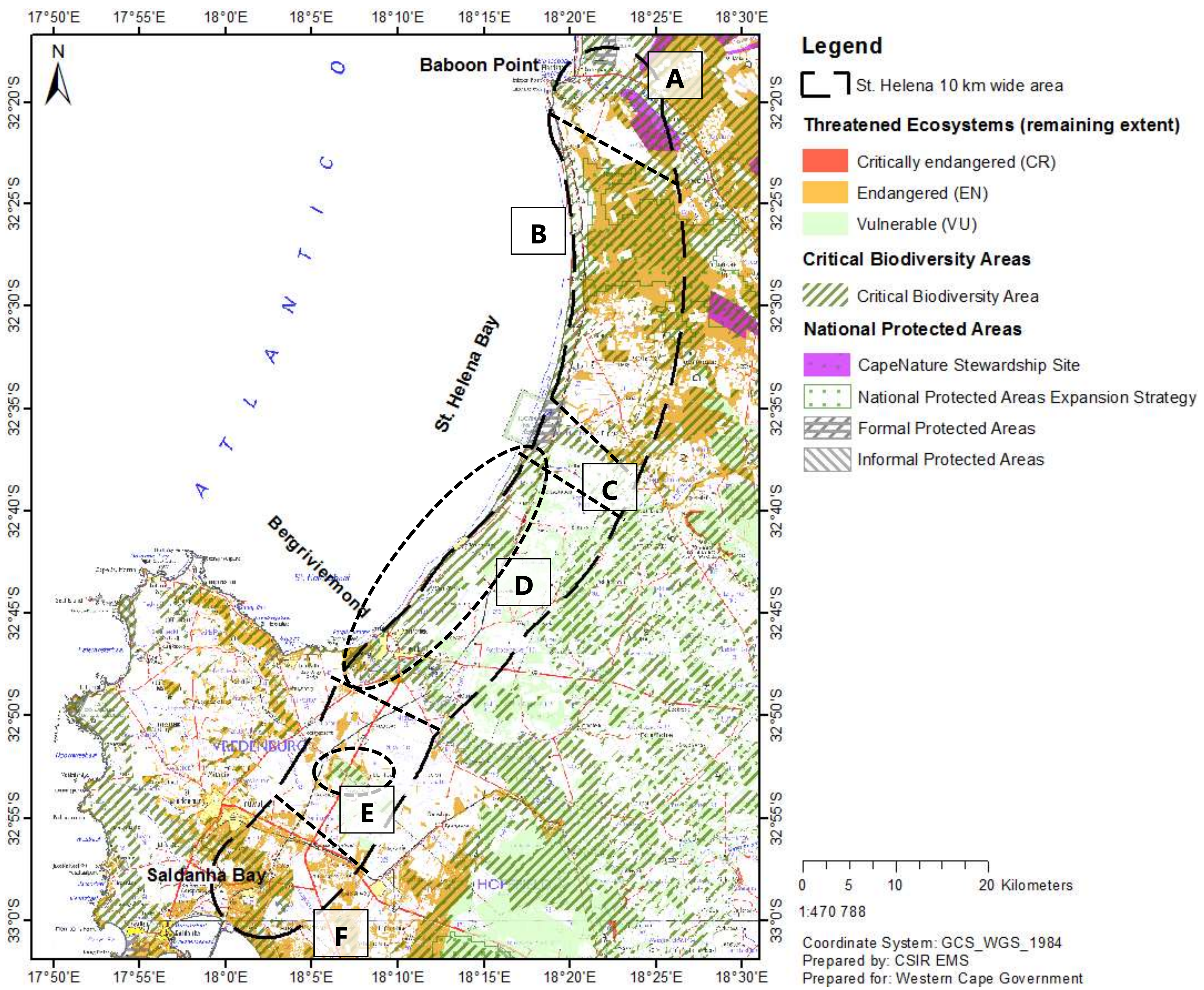


Figure 6.13: Terrestrial ecology for the environment that may be affected by the proposed gas transmission pipeline at St. Helena Bay, between Baboon Point and Bergriviermond, to Saldanha Bay.

The area in and around Baboon Point falls within the Olifants/Doorn Water Management Area (WMA) and is also a Fish Sanctuary. The pipeline route may need to cross the Verlorenvlei River, which is a Freshwater Ecosystem Priority Areas (FEPA) river and regarded as Critically Endangered (Figure 6.14). An estuary connects the river to the sea. The Verlorenvlei wetland also lies within the area and is classified as a Ramsar site. The Verlorenvlei wetland comprises an area of 1 500 hectares and is one of the largest natural wetlands along the West Coast of South Africa. Because of the high environmental sensitivity of the wetland, should the pipeline route cross this wetland, it would be regarded as a potential **fatal flaw** to the project. However, despite potential fatal flaw rating of Verlorenvlei, ground truthing may reveal locations, eg. Typha-dominated areas in the upper reaches, where a crossing may be effected with minimal impact.

Further south, the pipeline route will cross the FEPA Papkuil River (Figure 6.14). The river is a threatened ecosystem and is Critically Endangered. The pipeline may also need to traverse several smaller, natural wetlands. The pipeline routing within this section falls within the Berg WMA. Close to the Velddrif town, the pipeline will need to cross the Berg River, a FEPA river. The Berg River is a perennial river and has a catchment area of 7 688 km^2. The Berg River is classified is a threatened ecosystem (Critically Endangered) and the FEPA wetlands on the banks of the river are classified as aquatic CBAs. The FEPA wetland clusters should preferably be avoided. An estuary connects to Berg River to the sea, the mouth of river is known as the “Bergriviermond”. Because of the threatened status of the river and the presence of FEPA wetlands, classified as aquatic CBAs, the environmental sensitivity of this area is considered ***high***, therefore the crossing at this section should be carefully considered as to not impact on the wetlands and river functionality and flow regime. Smaller wetlands are present within the area between Veldrif and Saldanha.

The river crossings, with the exception of the Berg River and surrounding FEPA wetland clusters which are considered to have a ***high*** environmental sensitivity, are all considered to be of ***medium*** environmental sensitivity since they are classified as threatened ecosystems (Critically Endangered) (Figure 6.14). Should the correct design and construction of the crossing and appropriate restoration measures be implemented, the environmental sensitivity will be ***low***. It is recommended that wetlands, especially the Ramsar site, Verlorenvlei wetland, be avoided as far as possible. The overall aquatic sensitivity of this section is anticipated to be ***low*** if wetlands are avoided and mitigation and management measures be implemented when traversing the rivers/wetlands.

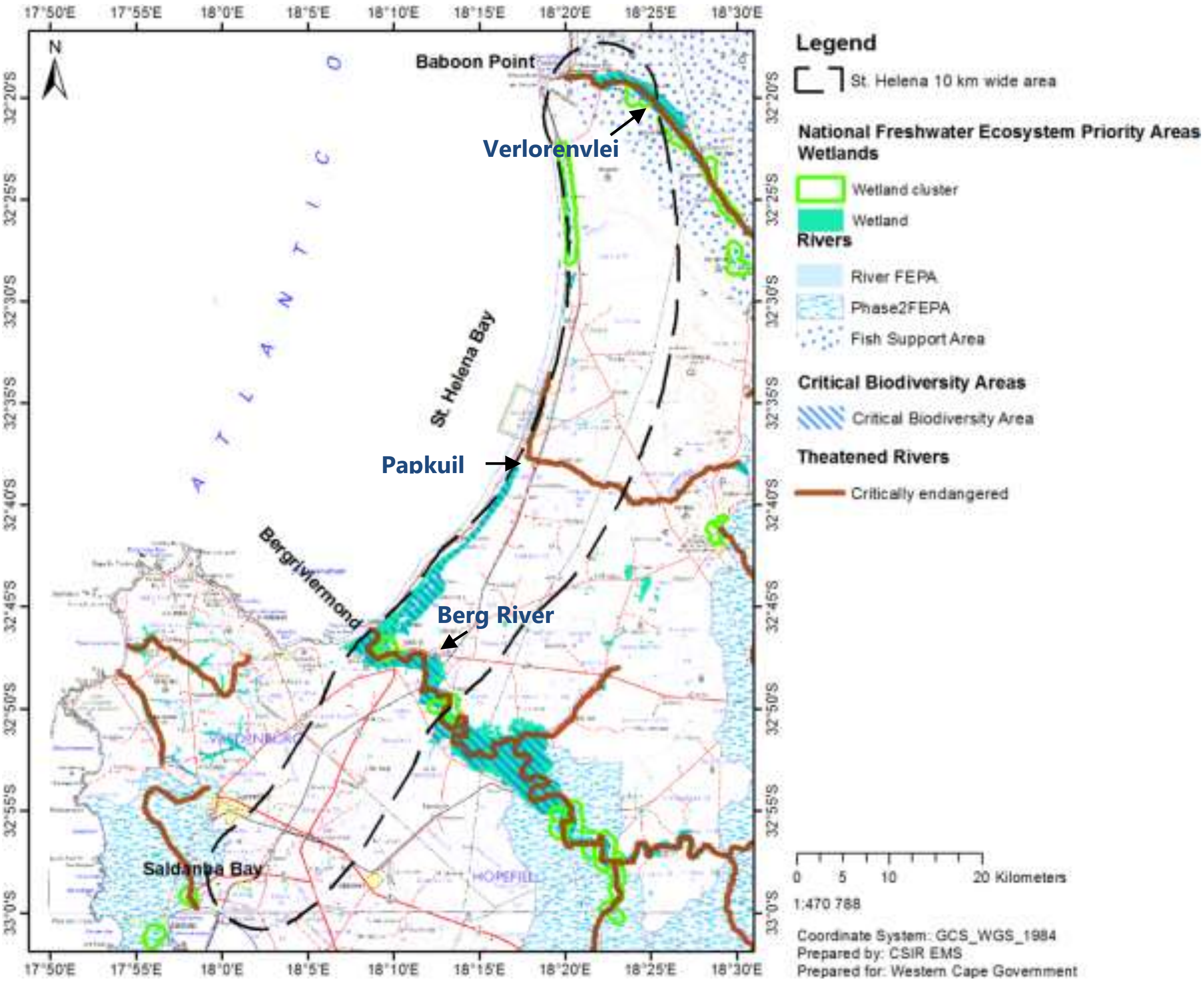


Figure 6.14: Aquatic features present between Baboon Point and Bergriviermond

6.5. HERITAGE RESOURCES

This section identifies issues and evaluates impacts for the following heritage aspects:

- Palaeontological resources (e.g. fossils)
- Terrestrial archaeological resources (e.g. shell middens, stone age tools)
- Maritime archaeological resources (e.g. shipwrecks)
- Historical resources and the built environment
- Graves and graveyards
- Scenic routes and the cultural landscape.

The overall finding is that most of the identified heritage sites have a limited extent and can be avoided when refining and finalising the route. Those that would be affected by the proposed corridor can only be adequately assessed at the route refinement stage.

6.5.1. Palaeontological resources

Palaeontological resources are scattered throughout the study area but the vicinity of Saldanha Bay (e.g. the Spreeuwal fossil site) and the Atlantis-Melkbosstrand area are the most sensitive. Palaeontological resources may be directly impacted during excavations for both the proposed transmission and distribution pipelines and the land-based LNG terminal. Fossils may be found virtually anywhere along the pipeline route, although the likelihood varies from area to area. Due to the larger excavations required at the terminal, this area will have the greatest chance of impacting on fossil heritage. However, because of the potential to expose unknown fossils, this impact can be seen as a *positive* impact if managed appropriately. These discoveries would bring the potential to gain new scientific data and fill gaps in palaeontological knowledge as a result of excavations.

Given the above, in terms of palaeontological resources the sensitivity of the proposed pipeline routes is generally ***low*** due to limited disturbance associated with the construction of a pipeline. A few sections, i.e. towards Elands Bay, to the west of the R27 from Veldrift down to the Saldanha Bay, the Atlantis dune field and the Cape flat area are rated ***medium*** to ***high*** sensitivity.

The following management/mitigation actions are recommended:

- A full desktop study will certainly be required during the EIA phase and this may need to be supported by a field survey.
- During the construction phase, fieldwork would be required to examine trenches, particularly where excavations intersect fresh, unweathered rocks, in order to document the geological sequence and any fossils occurring therein.
- Collection of fossils, under an appropriate permit (if required at the time) from HWC, might also be required during the construction phase. The collected material would then be curated in an appropriate repository.

6.5.2. Terrestrial archaeological resources

Archaeological resources may be directly impacted during excavations for both the proposed transmission and distribution pipelines and the land-based LNG terminal and, if not protected, could also be impacted by construction vehicles driving over them.

Archaeological resources are widely scattered can occur anywhere along the route, although the likelihood does vary depending on substrate and proximity to the coast, fresh water, food and stone resources. The coastal zone, particularly in the Melkbosstrand and Bloubergstrand areas, is the most sensitive. Significant Stone Age sites are generally unlikely to be encountered away from the coast, particularly along already disturbed servitudes. Historical archaeological sites are only likely to be encountered along the streets of the older built-up areas, like central Cape Town, Wellington, Paarl and Stellenbosch.

The vast majority of archaeological resources are likely to carry little scientific value, but a few more important sites, possibly requiring avoidance or mitigation, may well be found, especially in proximity to the coastline.

Impacts to archaeological resources are almost certain to occur in various parts of the study area. However, most of these areas are rated as being of ***low sensitivity*** because they are likely to contain resources that occur in poor contexts or are very ephemeral in nature. Such resources could be mitigated very easily should this even be required. The main areas of concern (***high sensitivity***) are along the coast where Later Stone Age shell middens and Middle Stone Age sites associated with calcrete occur. Such sites are more difficult and/or costly to mitigate on a large scale, but, if required, this could be done. Avoidance would be strongly preferred in such cases.

Archaeological resources are likely to be patchy and a field survey visiting those areas of the route that are considered to be most sensitive, particularly areas close to the coast and rivers, will be required during the EIA phase. Any significant archaeological sites that cannot be avoided and protected during implementation would need to be excavated/sampled by an archaeologist under an appropriate permit (if required at the time) from HWC. The collected material would then be curated in an appropriate repository.

Should the above recommended management actions be appropriately implemented, the potential archaeological impacts associated with the proposed project can be mitigated. As such, scientific data would have been captured to enable future researchers to still be able to work on the excavated material in the laboratory.

6.5.3. Maritime archaeological resources

As described in Section 5.4.4, maritime archaeological resources are not well understood in the study area and little can be predicted in this regard, i.e. the potential locations of shipwrecks in the study area are not known. The Spreeuwal fossil site already mentioned (Section 6.5.1) needs to also be borne in mind at this point, since fossil material may well be unearthed from the sea bed during construction of the proposed jetty (***high sensitivity*** area).

Maritime archaeological resources (shipwreck material) may be directly impacted by construction of the jetty or any submerged infrastructure at any of the proposed terminal location. Saldanha Bay is generally more sensitive in this regard, although certain parts of the bay have been dredged and are therefore of lower sensitivity – this would need to be established during an EIA. Unfortunately, while many wrecks are on record, their potential locations in the study area are not known and more detailed prediction of sensitivity is difficult.

The chances of encountering shipwreck material are, in reality, probably quite low. However, if any wrecks were encountered, they could be seen as anything from very low to very high sensitivity depending on the vessel, its age, the nature of its cargo (if this is even known) and whether it has been salvaged in the past. It should be noted that here again, with mitigation, impacts could be positive. This is because shipwreck material that was not known about can be salvaged and enter the archaeological record.

Recommended management/mitigation actions: a desktop study by a maritime archaeologist will certainly need to be conducted. Based on its outcome and the final terminal site chosen, a remote sensing survey eg. sidescan sonar and bottom profiling, will need to be undertaken in order to determine whether any potential shipwreck material is present. If this yields positive results then it might be necessary to dive the site in order to better understand the resource. Although the chances of a highly significant shipwreck being encountered is small, there is nevertheless the possibility that some sort of excavation or recording of the finds (if any) will need to take place prior to construction if they cannot be avoided. Less important wrecks would be ones where just some woodwork remains, while those of high significance might still contain a well-preserved cargo such as was found on the Merestein in 1971 (Turner 2009).

With the implementation of the above recommended management actions, the potential impacts of proposed submerged infrastructures on maritime archaeology can be mitigated and would likely even become positive because this resource would be protected from possible further deterioration by natural processes over time.

6.5.4. Historical resources and the built environment

Historical archaeological resources are generally located close to old houses or farm werfs. There is therefore some potential for direct impacts to historical archaeological sites to occur along the trench alignments since the distribution pipelines will pass through a number of built-up areas, some of which have many historical buildings. Although impacts to buried historical material may well occur in areas such as Cape Town, Paarl, Wellington and Stellenbosch, the nature and context of any material that might be encountered means that its sensitivity is likely to be ***low***. There is a small chance that a domestic kitchen dump or some other dense accumulation of historical artefacts might be encountered; such a find would be somewhat more important. Historical ruins (which generally fall within the realm of archaeology) can be found anywhere in the study area and would need to be identified during the EIA phase. In addition, since the pipeline would be laid underground, indirect or contextual impacts to built environment heritage resources would be temporary (during construction only) and of very little or no concern.

Discussion of the built environment is therefore not taken further in this study beyond noting that significant built environment resources do occur throughout the study area in varying densities. There is a particularly high density of significant built environment heritage resources in central Cape Town, Paarl, Wellington and Stellenbosch.

The study area is therefore assessed to be of ***low*** sensitivity with regards to historical resources and built environment. With the implementation of the following management actions, the potential impacts on these resources associated with the proposed project are anticipated to be acceptable:

- Avoid historical resources and built environment as far as possible.
- Any significant historical archaeological resources (including ruins) that cannot be avoided should be mitigated by excavation, collection or *in situ* recording as appropriate.

- Because buried historical archaeological material cannot be located from the surface, some monitoring of trench excavations through areas such as central Cape Town and Stellenbosch will be required.
- Construction time close to significant built environment resources should be kept to a minimum.

6.5.5. Graves and graveyards

It is similarly safe to assume that demarcated graveyards would be avoided during construction, although these are not always known about or marked on maps to allow for easy identification during the planning stage. Unmarked graves, generally pre-colonial graves, or farm and family graveyards can be present anywhere along the route where the substrate is suitable for manual excavation, although many more are encountered in coastal environments rather than inland. In addition graves are less likely to occur within or very close to road reserves and servitudes. However, in some cases road alignments may have been shifted or expanded such that graveyards are now in close proximity. There is therefore always the potential to encounter and therefore directly impact unmarked graves during excavations, particularly in sandy areas close to the coast.

Graveyards, particularly informal ones, can be difficult to identify without a ground survey and any in proximity to the chosen alignment would need to be identified and flagged for avoidance during the EIA phase of the project.

Graves are always regarded as highly significant heritage resources. Given that most of the study area is located along the coast, the environmental sensitivity of the area in terms of graves and graveyards is assessed to be ***high*** and careful final routing of the proposed pipeline will need to be undertaken. It is anticipated that the implementation of the following recommended actions would lead to acceptable impacts:

- Undertake a survey during the final alignment and refinement phase of the pipeline route to identify any graves that must be avoided.
- Any unmarked graves that are accidentally discovered during the construction phase would need to be immediately protected *in situ*, reported to the heritage authorities and then, if required, exhumed by an archaeologist under an appropriate permit. The remains would then be curated in an approved institution or reburied depending on their origin.

6.5.6. Scenic routes and the cultural landscape

Because of the subsurface nature of the proposed pipeline development, these aspects of heritage will not be of concern. Any visual impacts to these resources would be temporary and of little or no significance. For the proposed LNG receiving terminal, on the other hand, the degree of impact would vary depending on the location chosen. The offshore terminal options will have limited impact while the onshore options at the Port of Saldanha will have very little impact because of the established presence of industry in the area. There are many other industrial facilities in the area to the north which severely compromise the scenic environment and, for this reason, a site as far to the north as possible would be most desirable for the LNG plant so as to group the similar impacts together. It is noted that a similar facility for the importation and storage of liquid petroleum gas is currently under construction in the vicinity of the iron ore terminal to the north of the present site (De Bruyn 2013).

The north end section of the Churchhaven Peninsula is more sensitive (high sensitivity) and would result in far greater impacts because of the predominantly natural context of the receiving environment there. Also, although not actually within the boundaries of the West Coast National Park, this site is more integral with the Park than it is with the land and industrial developments on the east side of Saldanha Bay. The main area of sensitivity here is the West Coast National Park and the Langebaan Lagoon which are important tourist areas. Impacts to the various scenic routes in the region (R27 and routes through the Winelands) would be transient and thus they are considered to be of low sensitivity.

Indirect, contextual impacts to scenic routes and the landscape would be minimal and of short duration. They would constitute the temporary addition of items related to the construction activities (e.g. machinery, spoil heaps, fencing) to the environment.

The sensitivity of the scenic routes and the landscape to the addition of the proposed project is assessed to be ***low (pipeline route) to medium (LNG terminal)***. With the implementation of the following recommended management actions, the anticipated impacts would be acceptable:

- The northern tip of the Churchhaven Peninsula should be avoided, while the onshore Saldanha Bay options should be considered most suitable for the land-based receiving terminal.
- Avoid excavating very long sections of trench which need to be fenced and left open for extended periods of time.
- Try to minimise time spent working along scenic routes.

6.5.7. Sensitivity mapping

Figures 6.15 to 6.21 provide an indication of heritage sensitivity ‘on the ground’ across the study area. They have been compiled through balancing the degree of physical impact (LNG terminal is high, small distribution pipelines are low), the significance of the heritage resources and likelihood of encountering them (as described in the sections above), and the ease with which they might be mitigated (if required). This means, for example, that although building the terminal at the Port of Saldanha would have a high degree of impact (because it is a large, intrusive development), the overall heritage sensitivity for that area is given as medium because, although palaeontology is rated high, mitigation would be easy and archaeology and the cultural landscape are both rated as low to very low in this area. In this way the various parts of study area are discussed in turn.

In the far north of the study area lie Baboon Point and Mike Taylor’s Midden, two declared Provincial Heritage Sites. Those areas are highly sensitive (Figure 6.15). Moving south, the coastline within approximately 500 m is accorded moderate sensitivity for the archaeological sites that might be located there. The rest of this northern corridor is of low sensitivity except for the area close to Saldanha Bay which is given a medium sensitivity rating because of the potential to impact palaeontological resources. The West Coast Fossil Park has been marked as of high sensitivity as it has high palaeontological and tourism value.

To the south of this area lies the Langebaan Lagoon and West Coast National Park, both of which are highly visually sensitive and important tourist areas. These are highly sensitive (Figure 6.16). The area of the Park lying east of the R27 has been allocated low sensitivity, since it is not frequented by tourists and is generally not visible from the remainder of the Park. A small area between the Park and Yzerfontein is of medium sensitivity, for archaeology, while the areas close to rocky shorelines stretching to the south are highly sensitive for archaeology. Further south the rocky shore gives way to sandy shore but archaeological and palaeontological resources do occur and the coastal zone here, including at the proposed landfall site for the offshore option here, are rated as being of medium sensitivity. Moving south again, the rocky outcrops along the coast north of Koeberg are rated as highly sensitive, primarily for archaeology, while the area close to Koeberg and the Atlantis Dunes is also of high sensitivity because of the palaeontological and archaeological finds known from that area. All areas inland of those described here are accorded low sensitivity. Within Atlantis the sensitivity is low because the area will receive relatively small pipes primarily in already disturbed road reserves and servitudes.

Figure 6.15: The St Helena Bay to Saldanha Bay area. The pink outline denotes the possible corridor in the north since no routes have yet been identified. Red shaded polygons indicate areas of high heritage sensitivity, while orange indicates medium sensitivity. All other areas within the corridor or within 5 km of the proposed routes can be regarded as being of low significance.

Figure 6.16: The Saldanha Bay to Atlantis area. The yellow, green, blue, turquoise and purple lines indicate possible pipeline routings. Red shaded polygons indicate areas of high heritage sensitivity, while orange indicates medium sensitivity. All other areas within 5 km of the proposed transmission routes can be regarded as being of low significance. For the smaller (distribution) pipelines the sensitivity is only at the scale of inside and immediately alongside servitudes.

Along the shores of Table Bay the Melkbosstrand and Bloubergstrand areas are sensitive for archaeological heritage and the possibility of encountering burials. However, because this area would only receive the smaller distribution pipes and these would be laid along roads as far as possible, the coast here is rated as of medium sensitivity (Figure 6.17). Although fossil material is known from the very southern margins of the Cape Flats, the entire area has been accorded low sensitivity because of the smaller degree of impact and very low likelihood of encountering significant fossils.

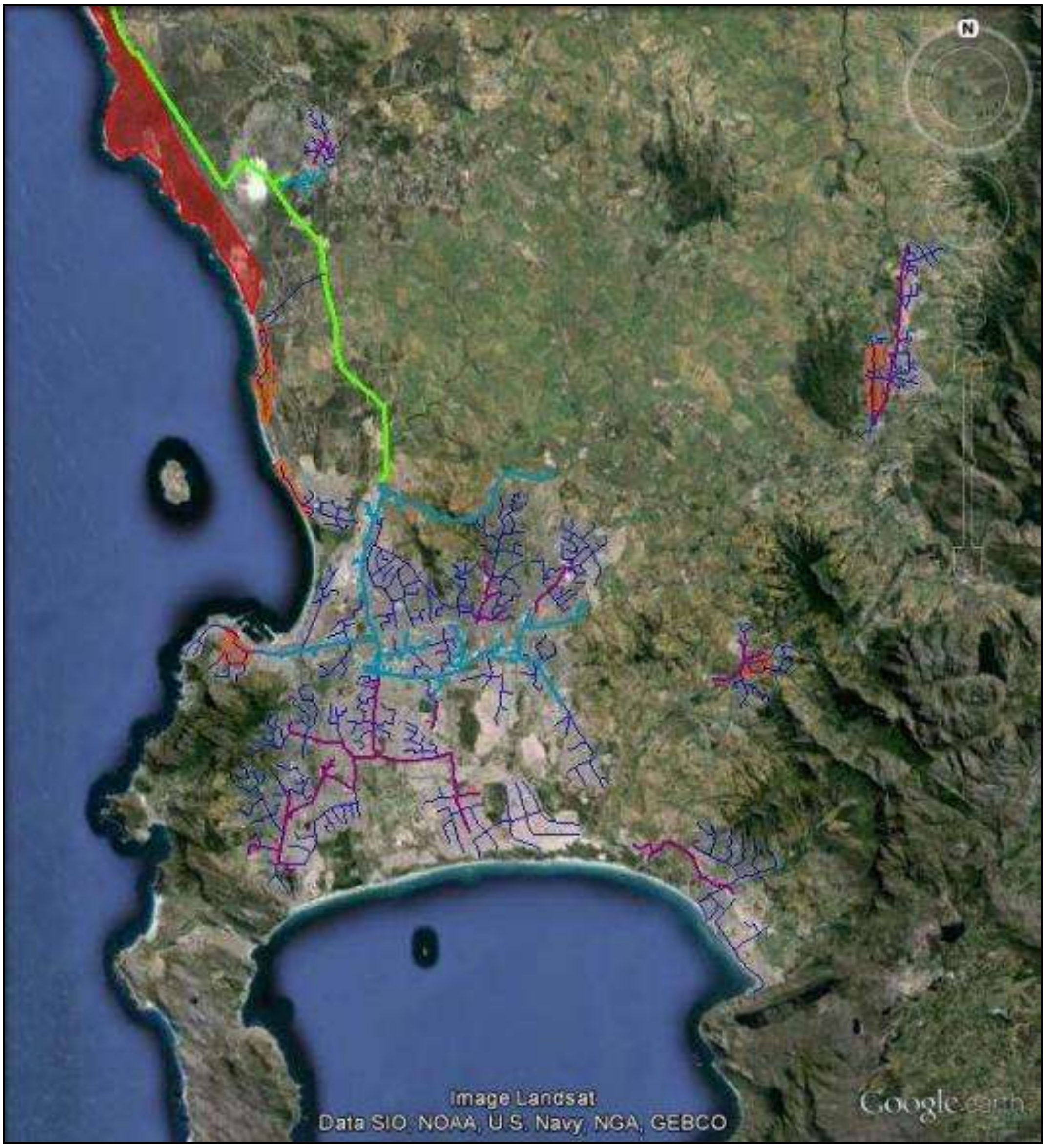


Figure 6.17: Table Bay, the Cape Flats and the winelands. The green, blue, turquoise and purple lines indicate possible pipeline routings. All other areas within 5 km of the proposed transmission routes can be regarded as being of low significance. For the smaller (distribution) pipelines the sensitivity is only at the scale of inside and immediately alongside servitudes.

Figure 6.18 shows a detail of the Cape Town city area. Because it has been under development for a long time and human remains have been encountered there from time to time, the central city is rated as of medium sensitivity. In the Greenpoint area almost every new excavation in the streets reveals human remains and this area is clearly highly sensitive.

Figure 6.18: Detail: Cape Town City Bowl area.

In Figures 6.19 to 6.21, the oldest parts of Wellington, Paarl and Stellenbosch have been demarcated as of medium sensitivity because of the potential to uncover historical material anywhere in the towns.

The offshore locations are difficult to assign sensitivity to because of the unknown and unquantified nature of the maritime archaeological resources. However, most is likely to be of low sensitivity with parts of Saldanha Bay probably of medium sensitivity. In terms of the surface development, in general, a low sensitivity can be assigned to these areas from a visual point of view.

Figure 6.19: Detail: Wellington area.

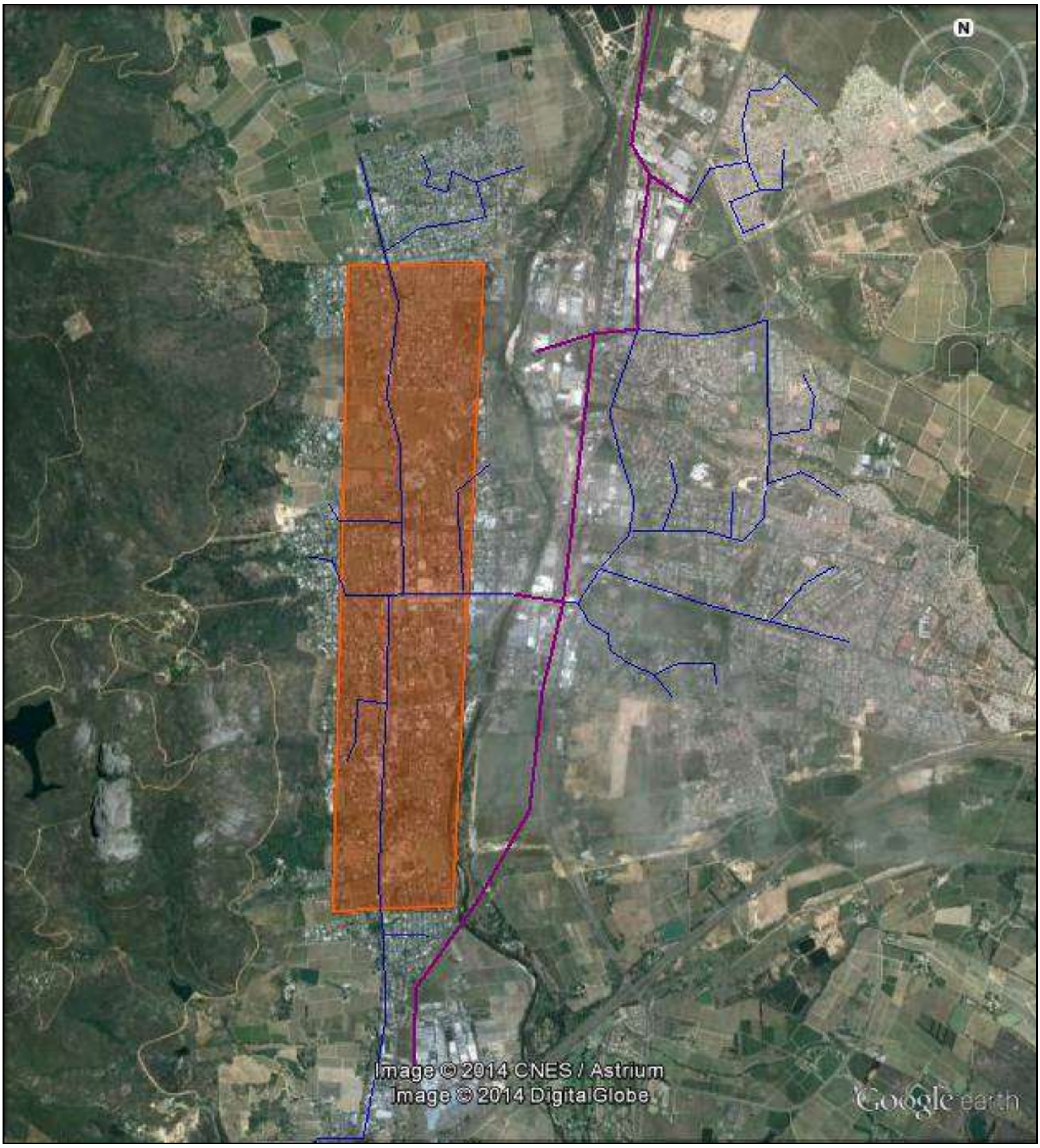


Figure 6.20: Detail: Paarl area.

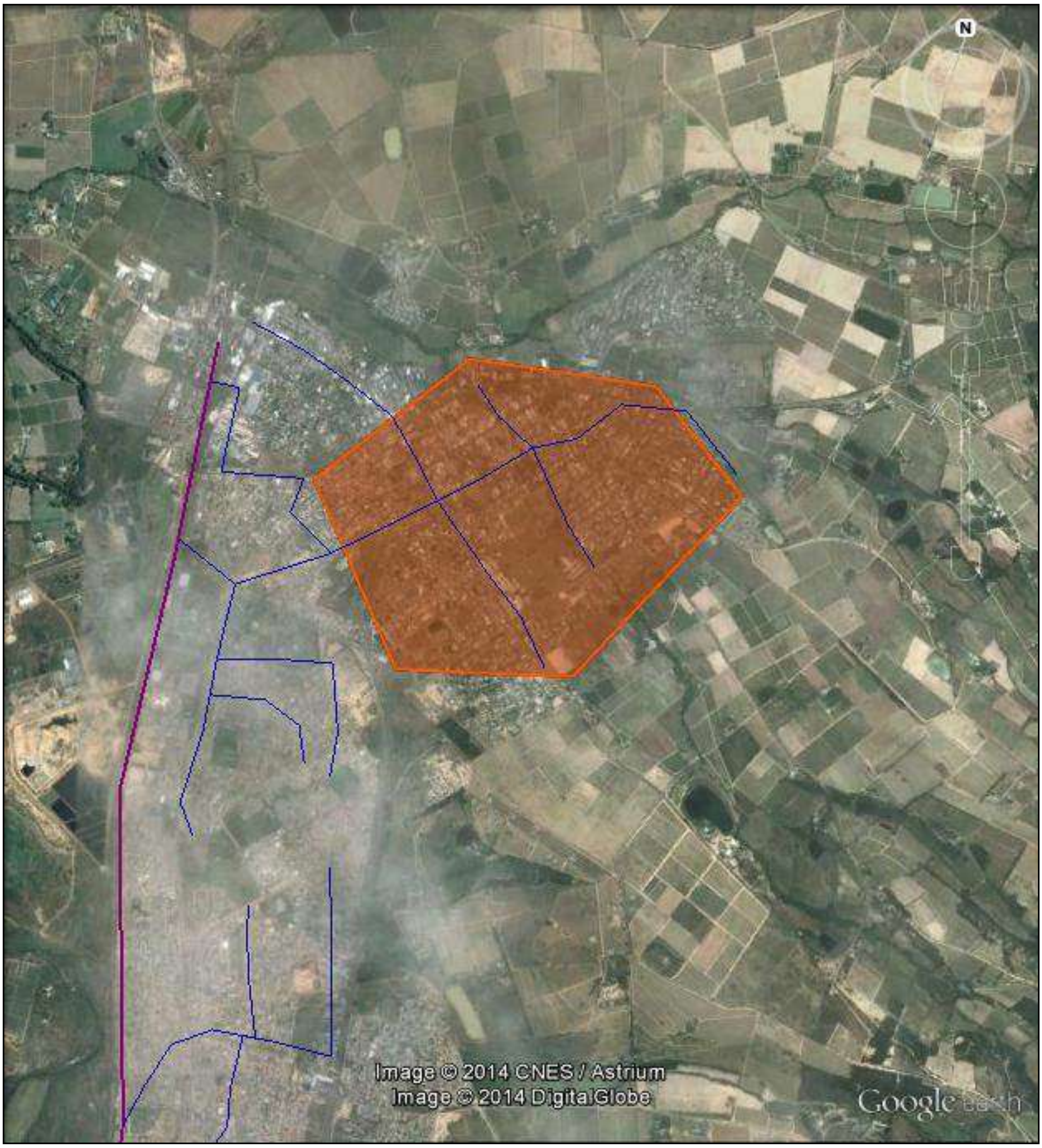


Figure 6.21: Detail: Stellenbosch area.

6.6. VISUAL IMPACT

The dune belt between the iron-ore terminal and Lynch Point serves as a natural and visual buffer between the industrial area of Saldanha and the recreational area of Club Mykonos/Langebaan, both from the seaward and the landward sides. Little can be done to mitigate the visual impact of a land-based LNG receiving terminal and pipeline cutting through the dune belt, which on the seaward side would be supplemented by the presence of the LNG tanker discharge jetty. There has always been resistance (mostly due to visual impacts and loss of sense of place) from local and nearby residents to any industrial development/expansion eastward of the Port of Saldanha. The Saldanha Bay area is therefore anticipated to be ***moderately*** to ***highly sensitive*** to visual impacts due to the disruption of the visual integrity of the dune belt and the construction of an LNG receiving terminal.

The following mitigation measures are recommended:

- The lighting design should minimise nightscape impacts such as sky glow, light spill and glare. Particular attention should be paid to lighting that may pose a risk to the local and surrounding residents, in particular in Club Mykonos/Langebaan
- A suitable specialist (e.g. landscape architect) to be consulted on planting and rehabilitation of the cut-and fill areas and other steep slopes
- Ensure that, where lighting for the facility is included in the design, the following measures are adhered to:
    - Where possible, keep bright lights downwards and use light screening features to minimise uplighting and glare
    - Lighting of the facility should not exceed, in number of lights and brightness, the minimum required for safety and security.
    - Uplighting and lights in elevated positions should be avoided
    - Include timer switches or motion detectors for areas that are not occupied continuously.
- Laydown areas and construction camps to be located in low visibility areas where possible (i.e. not unnecessarily exposed to external visual receptors).

The severe reduction, or loss, of the visual buffer between the industrial and recreational areas (a blurring of boundaries) would constitute an indirect impact.

6.7. AIR QUALITY

Under normal operational conditions, air emissions associate with an LNG terminal are anticipated to be ***negligible*** and would be limited to the emission of volatile organic compounds and carbon dioxide. It is understood that the regasification unit will be a closed loop system which is known to generate higher amounts of CO_2 than an open cycle system whereby cool water is discharged back at sea. However, when natural gas is burned for power generation, SO_2 emissions are negligible and CO_2 emissions area reduced significantly compared to other fuels such as coal and fuel oil.

Locally and in terms of contribution to South Africa's air emissions, CO_2 emissions associated with the proposed LNG terminal are anticipated to be negligible. At the same time, it is a cumulative addition to the overall CO_2 emission budget. This is not considered to be a potential significant issue.

6.8. PLANNING

The proposed project presents planning implications, which ranges from very low to very high significance. The key issues are presented below, followed by a brief discussion of each.

6.8.1. Unlocking of the Big Bay (Saldanha Bay) coastal belt for development

As mentioned in Chapter 2, Section 2.1.3.2, the offloading of LNG within the Port of Saldanha is only feasible within Big Bay. In addition, the cryogenic pipeline transferring LNG from the carrier to the land-based facility is required to be located in an open trench and should not be more than 4km in length. The proposed LNG receiving terminal will therefore need to be located on a portion of land within 3 to 4 km from the shore of Big Bay. The land uses in the study area consists of open land and industrial areas. The closest main residential area to the ore terminal is Club Mykonos located to the south east of the port of Saldanha and further south lies Langebaan.

The land located to the south of the Port of Saldanha is *not* earmarked for industrial development, as indicated in the Saldanha Bay SDF, 2011 (Figure 6.22). The Saldanha Bay Municipality plans to maintain the Big Bay coastal belt as a natural high conservation value buffer between the industrial area at the ore terminal and the recreation/residential areas south of Lynch Point (L Gaffley, Chief Town Planner Saldanha Bay Municipality, pers. comm.). The Municipality is, therefore, extremely unlikely to permit a 15 ha industrial site south of the Saldanha to Langebaan highway in this area (within the Big Bay coastal belt) to accommodate a LNG storage and regasification facility. It should also be noted that the Saldanha Steel plant site was moved inland to ensure the protection of the coastal belt for conservation of the plant communities in it.

Densification and urban infill is a stated objective of the Saldanha Bay SDF; aimed at combating sprawl within the municipal boundary. The area north of the Port of Saldanha boundaries and north east of the MR559 road is zoned for industrial development (Figure 6.22). Consequently, industrial development must be located within that area in order to fulfill the objective of densification (L Gaffley, Chief Town Planner Saldanha Bay Municipality, pers. comm.). The Big Bay coastal belt also falls outside the IDZ boundaries (refer to Chapter 5, Section 5.5.1.2).

Should development be allowed in the Big Bay coastal belt, to the east of the Port of Saldanha; it would set a precedent for future development, thereby unlocking the area for further development. The close proximity of an industrial area and the existing SFF facility would suggest that the subsequent unlocking of the coastal belt would be related to industrial development. Development in general and industrial development in particular, *will be detrimental* to the sense of place which currently characterises the coastal belt of Big Bay (outside the Port boundary).

The environmental sensitivity of the Big Bay coastal belt south of the Port of Saldanha, in terms of planning objectives set by Saldanha Bay Municipality and in terms of setting a precedent for further coastal development is assessed to lead to a potential ***fatal flaw***.

6.8.2. Development within a pristine natural area (Big Bay coastal belt)

The area south of the Port of Saldanha is currently zoned as open space. More importantly, the area contains critically endangered remnant vegetation. Plan 18 (Critical Biodiversity Areas) and Plan 15 (Vegetation (remaining extent)) of the Saldanha Bay SDF 2011 identifies this area as a pristine natural area containing remnant vegetation and requiring protection (Figures 6.23 and 6.24). The Saldanha Bay SDF 2011 states: "*When areas are earmarked for the extension of industrial areas in the vicinity of Langebaan special cognisance should be taken of environmentally sensitive areas.*" *(Saldanha Bay SDF, 2011)*. The subsequent Industrial Area Policy (Section 12.5.1; policy 47) further states that industrial development *may not* impact negatively on pristine natural environments. The Greater Saldanha Bay Area EMF (2014) designates the vast majority of the Big Bay coastal belt south of the Port of Saldanha boundaries as a Zone 1 (Keep Assets Intact) area. The management objectives of Zone 1 areas are, amongst others, to keep CBAs intact; to prevent a reduction in the overall percentage of CBAs; and to prevent negative changes to the respective conservation status of the relevant species. Subsequently, *no loss* of CBAs should be allowed and development should be avoided in this zone.

As a result, in terms of land-use zoning and planning intentions to protect pristine natural areas, the sensitivity of the vast majority of the Big Bay coastal belt is assessed to lead to a potential ***fatal flaw***.

6.8.3. Mariculture

Big Bay has been proposed as a mariculture site (refer to Chapter 5, Figure 5.43). However, to date there appear to be no plans to develop any fish farms in this area. Should a suitable site for an LNG jetty in Big Bay be identified, any conflict between LNG operations and proposed mariculture operations will have to be resolved by the appropriate authorities.

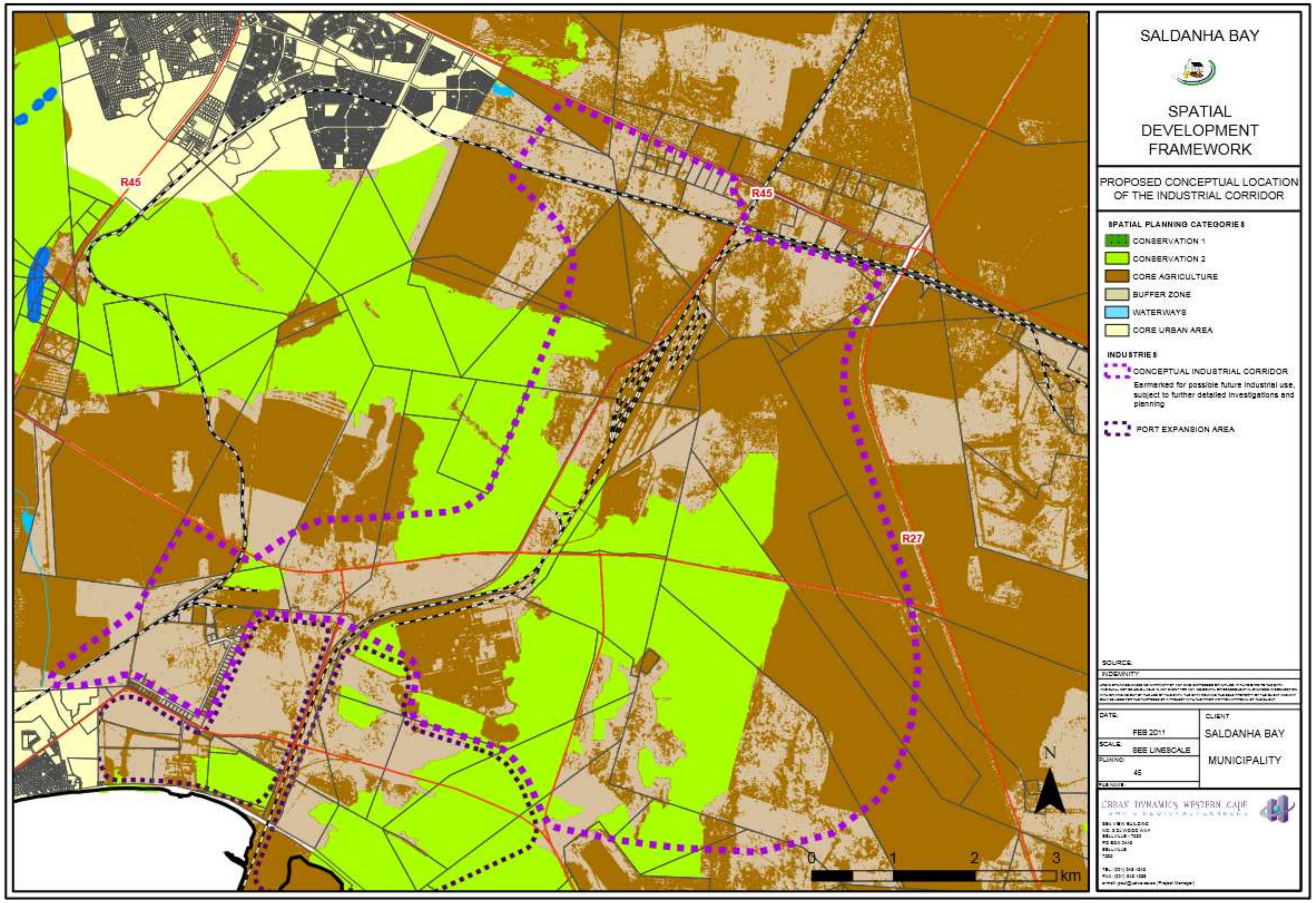


Figure 6.22: Proposed conceptual location of the industrial corridor (SDF, 2011)

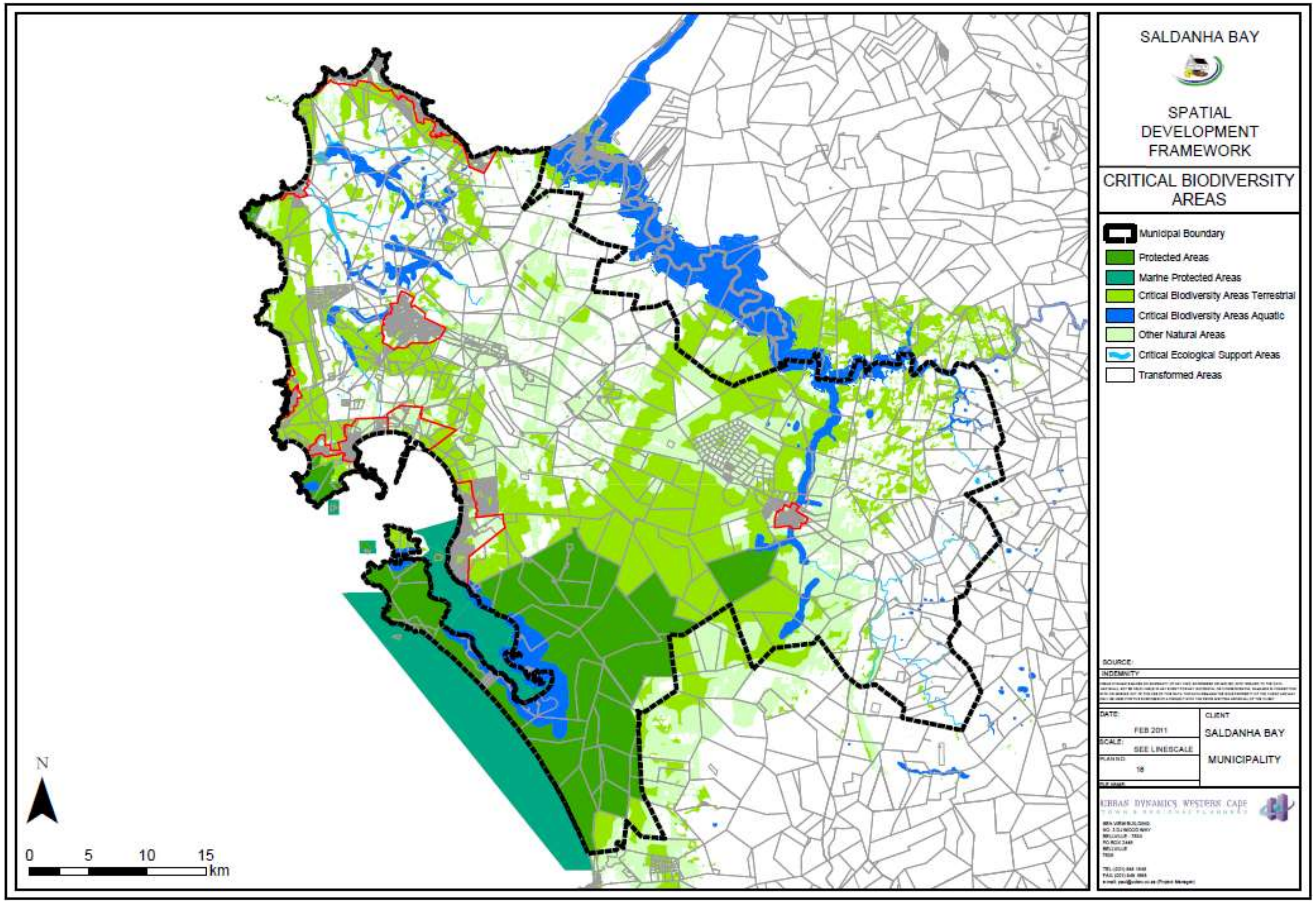


Figure 6.23: Plan 18 Critical biodiversity areas, Saldanha SDF, 2011

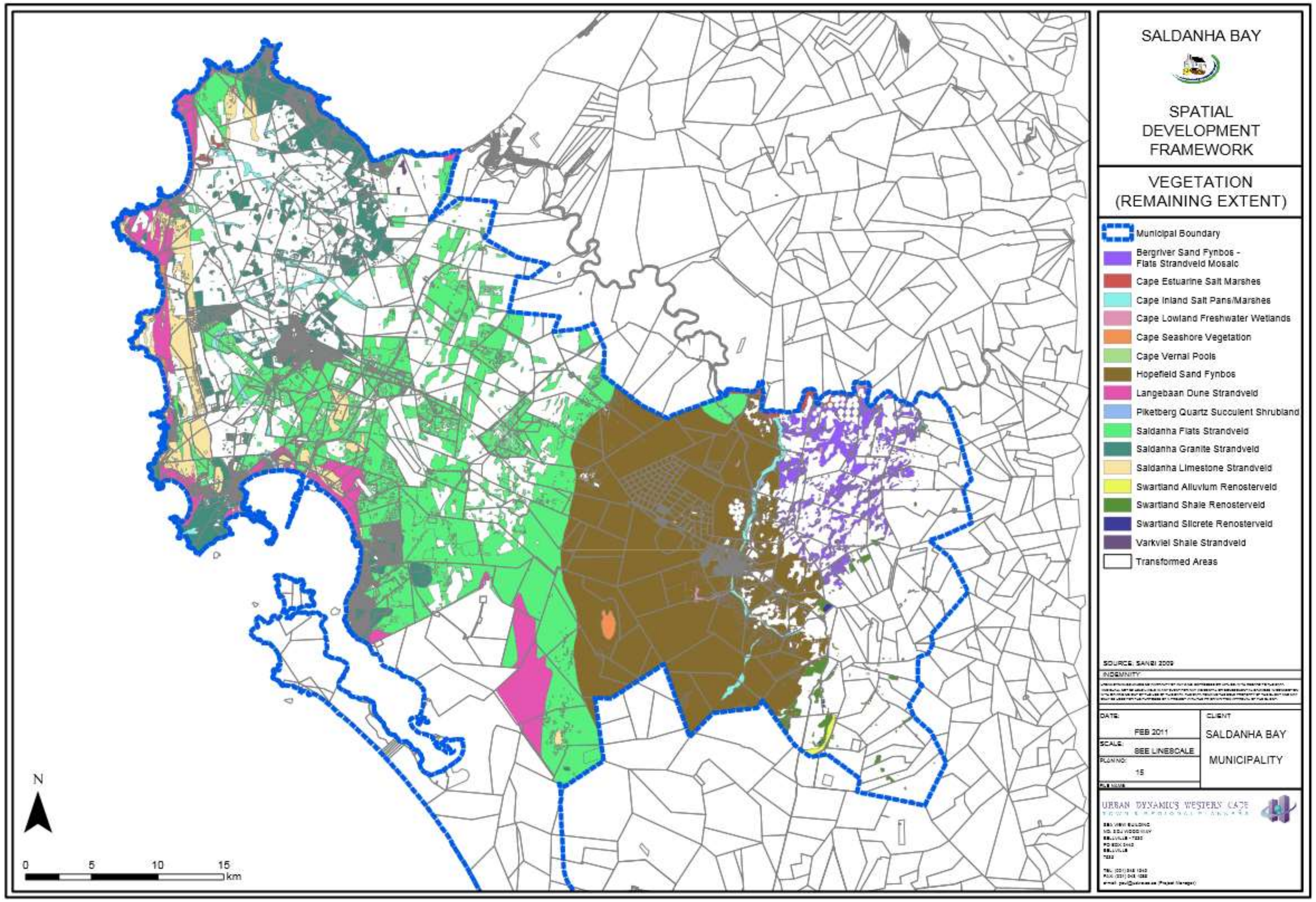


Figure 6.24: Plan 15 Vegetation (remaining extent), Saldanha SDF, 2011

6.8.4. Potential interaction with renewable energy projects in the vicinity of Saldanha Bay

It is important to ensure that the pipeline route does not interact with structures and supporting infrastructure related to renewable energy projects. It is recommended to identify the current renewable energy projects (approved and in process) and ensure that these are avoided during the refinement of the final pipeline alignment route.

6.8.5. Pipeline route through the West Coast National Park/Cape West Coast Biosphere Reserve (Saldanha Bay)

The proposed pipeline route passes through areas designated in the Cape West Coast Biosphere Reserve as Buffer Zones and Core Zones (i.e. through the West Coast National Park) (Figure 6.25). Ideally, development in buffer zones should be limited to eco-tourism-related activities (Figure 6.25), while development in Core Zones should be avoided as these represent statutory conserved areas. It is however understood that the proposed pipeline will be placed within an existing servitude currently housing a crude oil transmission pipeline connecting the Strategic Fuel Fund SFF facility with the Milnerton Caltex Refinery.

Given the limited footprint of the pipeline and the transformed nature of the areas zoned as buffer areas (through agriculture), the environmental sensitivity of these areas is rated as ***medium***.

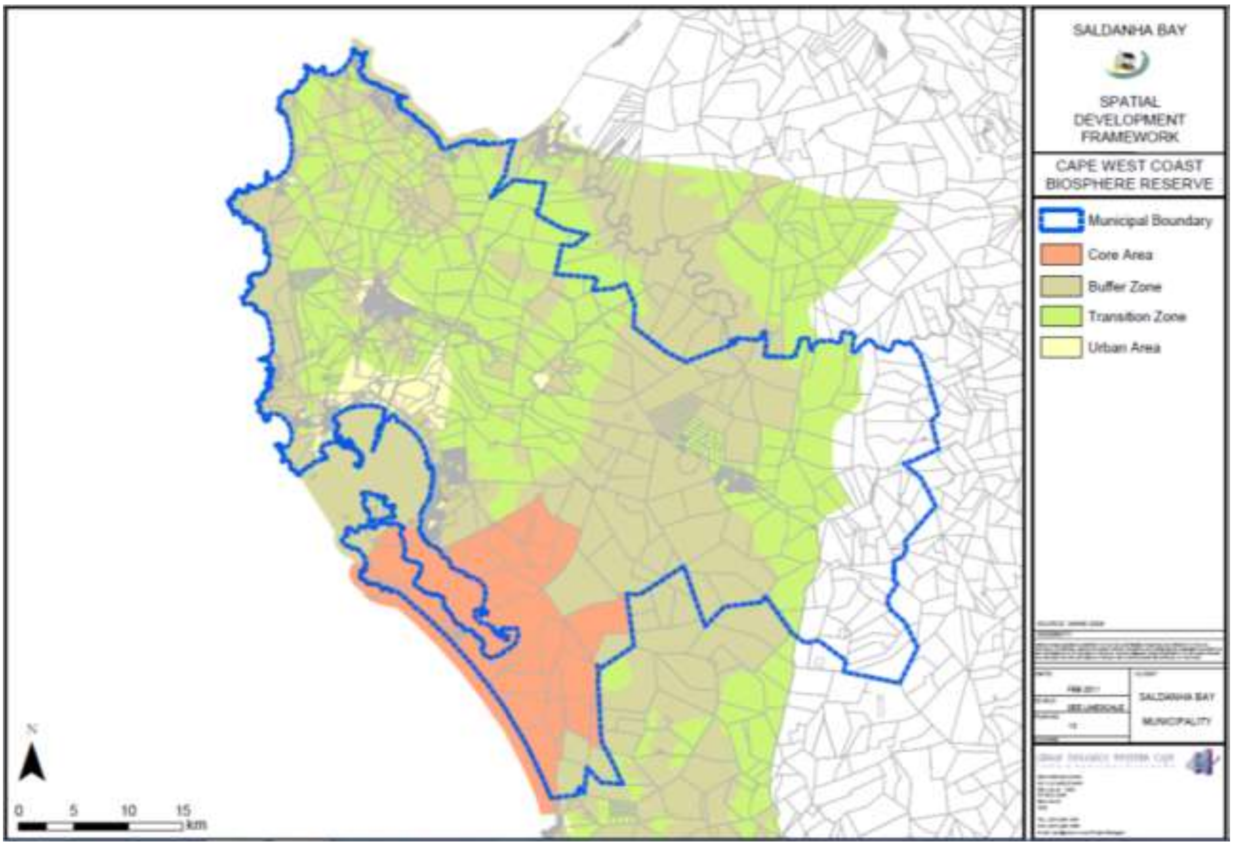


Figure 6.25 Saldanha Bay, Spatial Development Framework, Cape West Coast Biosphere Reserve, 2011

6.8.6. Addressing development needs within the Berg River Municipality

Goal 2 of the Berg River Local Municipality's IDP (2012) is: "To provide and maintain bulk and service infrastructure that will address backlogs and provide for future development". The location the proposed gas pipeline within this municipal area creates an opportunity to partially address Goal 2 of the Berg River IDP through the provision of natural gas to its major urban nodes. This will however necessitate a change in the pipeline route and would necessitate a localised distribution network.

The impact resulting from the proposed project on planning will be ***positive***. Due to the relatively low economic activity in the area, and subsequent limited available resources for infrastructure development, it is anticipated that the area would ***moderately*** benefit from this project.

6.8.7. Presence of Core 1 & 2 areas along the costal belt of the Berg River Municipality (St Helena corridor)

The Berg River SDF (2012) identifies various Core 1 and 2 areas along the costal belt of Ward 6, wherein the pipeline is proposed. Core 1 areas are not allowed to be developed, while only limited development is allowed in Core 2 areas. It is however understood that the pipeline is proposed to follow existing road reserves, which might eliminate the restrictions imposed by the SDF.

The environmental sensitivity of the area is ***medium*** to ***high*** given the proposed construction of a pipeline within Core 1 and 2 areas.

6.8.8. Potential supply of natural gas to the upgraded PPC Factory in the Swartland Municipality

The Swartland SDF (2012) indicates that the PPC Cement Factory is earmarked for upgrade within the next 5 years. This creates an opportunity to service the upgraded facility with natural gas as an alternative fuel source, but would require a spur line to the facilitiy.

The impact resulting from the proposed project will be ***positive*** and it is anticipated that PPC factory would ***moderately*** benefit from this project.

6.8.9. Addressing development needs in the Swartland Municipality

Objective 13 of the Swartland SDF (2012) calls for: "Promotion of alternative energy generation and use". The proposed gas pipeline creates the opportunity to address this development planning need through the utilisation of gas as an alternative fuel source within the municipal area. This would however require a localised distribution network.

The impact resulting from the proposed project on planning will be ***positive*** and it is anticipated that the area would ***moderately*** benefit from this project.

6.8.10. Addressing development needs in the Drakenstein Municipality

Key Performance Area 2 of the Drakenstein Municipal SDF (2012) identifies energy efficiency as a Key Focus Area applicable to development planning in the area. The proposed natural gas pipeline creates the opportunity to address this need by providing residents and industry with an alternative fuel source.

The impact resulting from the proposed project on planning will be ***positive*** and it is anticipated that the area would ***moderately*** benefit from this project.

6.8.11. Developments in the vicinity of the Koeberg nuclear power station

As stated in Section 5.5.7 (Chapter 5), the safety zones around Koeberg Nuclear Power Station are defined as:

- a 5km radius zone around the power station within which any development which may result in an increase in the population is prohibited, and
- a 16 km radius zone within which any development which may result in an increase in the population is prohibited, *unless* safety is demonstrated by means of a traffic evacuation model approved by the municipal council which must comply with the evacuation time criteria.

In addition, the sea-shore regulations (No 522, April 1977) prohibit any activity (vessels, sailing, swimming etc.) for a distance of 2 km seawards from farm Duynefontyn 34 portion (refer to Figure 5.50, Chapter 5).

The sensitivity of the area surrounding Koeberg in terms of planning is ***low*** given the proposed pipeline would not increase the population within the safety zones. It will however be required to take the Koeberg nuclear power station into consideration when undertaking a full quantitative risk assessment for the proposed project.

6.8.12. Limited space available for additional infrastructure in existing servitudes of relevant CBDs

The CBD areas of the towns of Paarl, Wellington, Stellenbosch and Cape Town are likely to have limited space available in its existing infrastructure servitudes due to the historical nature of these areas. It is reasonable to assume that these servitudes where not originally designed to accommodate gas infrastructure and would therefore not necessarily have the requisite space for the proposed pipeline. The historical nature of the relevant CBDs, and its protected heritage status, further problematizes expansion of existing servitudes. It should therefore be noted that servitude expansion could necessitate additional licensing from Heritage Western Cape.

The sensitivity of CBD areas to the construction of a proposed pipeline is rated as ***medium*** to the potential limited space available.

6.1. RISK AND SAFETY

The possibility of accidental releases can never be disregarded as such failures may pose a risk to people and the environment. It is therefore important that operators have a good understanding of the potential causes and consequences of such releases so that potential risks can be managed appropriately and to inform operational decisions. This is often done through a quantitative risk assessment.

6.1.1. Land-based LNG receiving terminal, Saldanha

It is often not the practice to set blanket 'exclusion zones' around specific types of facility. Each facility is separately examined on the basis of the risks it poses to the public (Halite, 2011). By their very nature, major accidents at terminals or storage sites have a low frequency, but are associated with potentially high consequences. It is therefore important to understand those risks and to undertake a quantitative risk assessment which is also mandatory for this proposed project in order to comply with the Occupational Health and Safety Act (Act 85 of 1993).

The level of risks (acceptable versus unacceptable) associated with the proposed installation will need to be defined by a quantitative risk assessment. It is also understood that international guidelines in terms of safety require a minimum distance of 1 km between a LPG installation and a LNG facility (Ms Abigail Links Personal communication, February 2014). This requirement will also apply to the distance between the LPG terminal, under construction, and the proposed LNG receiving facility and LNG carrier.

The health and safety risks inherent to LNG carriers and present during the offloading operations must also be considered as part of the above risk assessment. The proposed jetty will be located within Big Bay which is less protected than Small Bay and long wave energy has been problematic with bigger ships experiencing horizontal motion and in some cases, the breaking of the mooring lines. Safety concerns associated with the mooring and offloading operations can be addressed through compliance with international guidelines such as SIGTTO (Society of International Gas Tanker and Terminal Operators). Issues like fire and explosions will also be assessed during the quantitative risk assessment.

Flaring is used to safely remove the dangers of flammable material by combusting the materials at an elevated height. The potential hazards from flares include:

- Thermal radiation from continuous flaring;
- Thermal radiation from emergency flaring;
- Flammable clouds in flame-out conditions.

Consequence analysis

The LNG ship would beth at Saldanha Bay before offloading the LNG to the terminal via piplines. A loss of containment of LNG at the ship could impact up to 537 m downwind of a release from a vapour cloud explosion. A loss of containment from the LNG pipeline from the ship to the terminal could result in a distance of 370 m and 375 from the pipeline to the $1x10^{-6}$ and $3x10^{-7}$ fatalities per person per year isopleths respectively.

For pool fires in the event of a catastrophic failure of the LNG storage tank, the spilt material was assumed to spread evenly to a maximum area of 1500 m^2 (RIVM 2009). The pool would shrink as the fuel is consumed during the fire. The maximum distance to the 1% fatality represented by the 10 kW/m^2 would be 160 m under strong wind conditions.

An accidental jet fire from the compressed natural gas pipeline could have substantial reach and, depending on the orientation, on point of release and on the layout, could damage the LNG storage tanks with knock-on effects.

A loss of containment of LNG with an ignition source could form a flash fire or a vapour cloud explosion. A flash fire could extend to the LFL that under low wind speeds could reach 800 m downwind of the release. The maximum distances predicted for vapour cloud explosions was estimated at 1.2 km downwind of the release.

Risk analysis

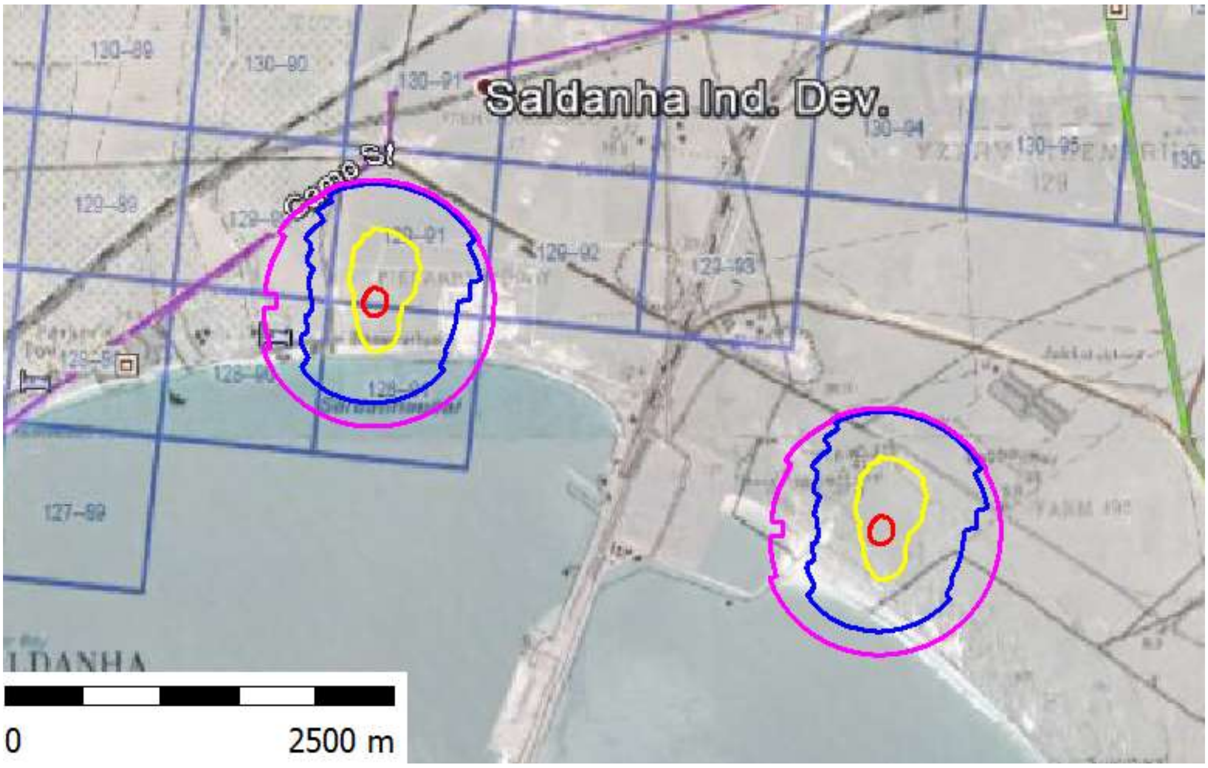
Land based LNG terminal

The maximum individual risk for the onshore facility for two of the three proposed sites is shown in Figure 6.26. In these scenarios the failure of the high pressure pumps would dominate the extent of the risk contours.

The distance of the risk isopleth of $1x10^{-4}$ fatalities per person per year was calculated to be 180 m from the point of release. This value is represents risk that is unacceptable for the public and must remain within the site boundary. The 15 ha site as proposed may be adequate providing the site is adequately designed.

The distance to the risk isopleth of $3x10^{-7}$ fatalities per person per year was calculated to be 690 m from the centre of the release. This implies that sensitive receptors (such as schools, hospitals, etc.) should be located a minimum distance of 690 m from the facility.

Appropriate land usage between the risk isopleths of $1x10^{-4}$ fatalities per person per year and $3x10^{-7}$ fatalities per person per year can be determined with use of the PADHI tables given in Appendix 2.



LEGEND **RISK (fatalities per person per year)**

red	$1x10^{-4}$
yellow	$1x10^{-5}$
blue	$1x10^{-6}$
magenta	$3x10^{-7}$

Figure 6.26: Combined risks for the proposed onshore LNG terminal at two of the three proposed positions.

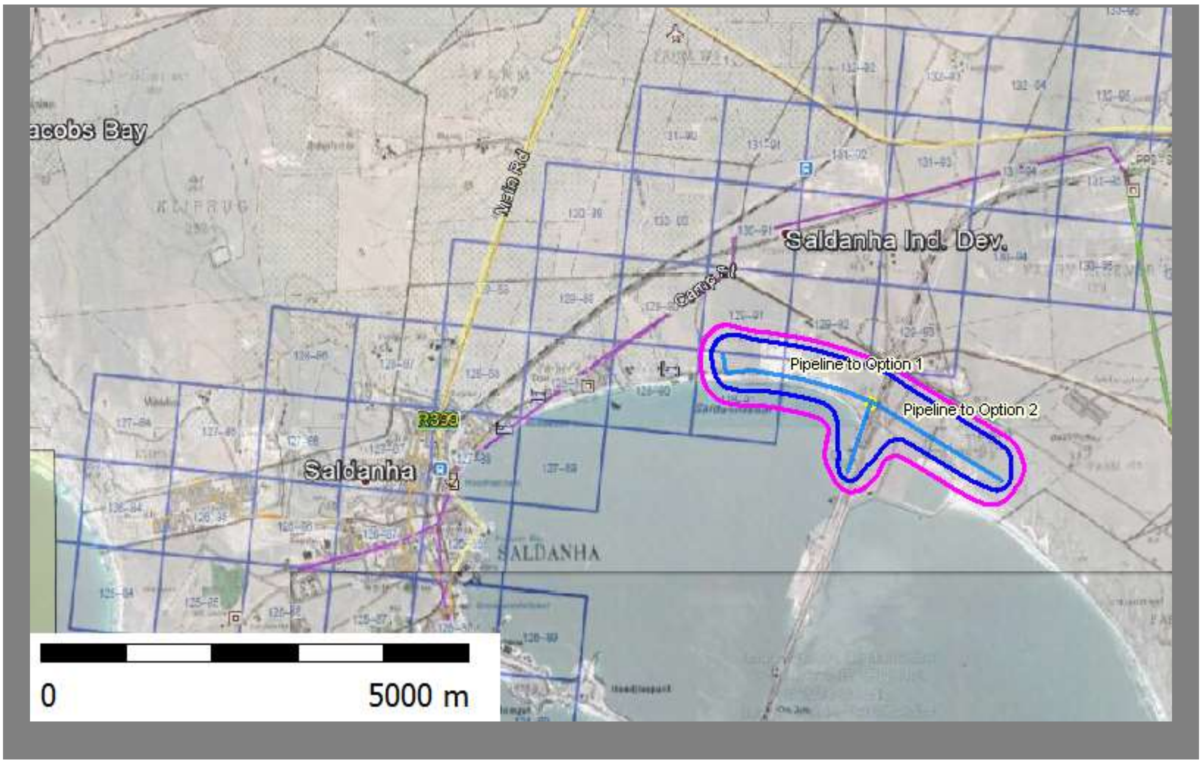
Cryogenic LNG pipeline

The LNG would be transported via a pipeline from the LNG ship to the receiving and storage terminal. The exact position of the onshore terminal and the LNG pipeline is not known, thus the risk isopleths shown in

LEGEND	RISK (fatalities per person per year)
	$1x10^{-5}$
	$1x10^{-6}$
	$3x10^{-7}$

Figure are along an assumed routing.

The proposed pipeline would have risks of $1x10^{-6}$ fatalities per person per year extending approximately 370 m from the pipeline center and while the $3x10^{-7}$ fatalities per person per yeae would extend 475 m from the pipeline.



LEGEND	RISK (fatalities per person per year)
(yellow)	$1x10^{-5}$
(blue)	$1x10^{-6}$
(magenta)	$3x10^{-7}$

Figure 6.27: Combined risks for the proposed onshore LNG terminal at two of the three proposed positions

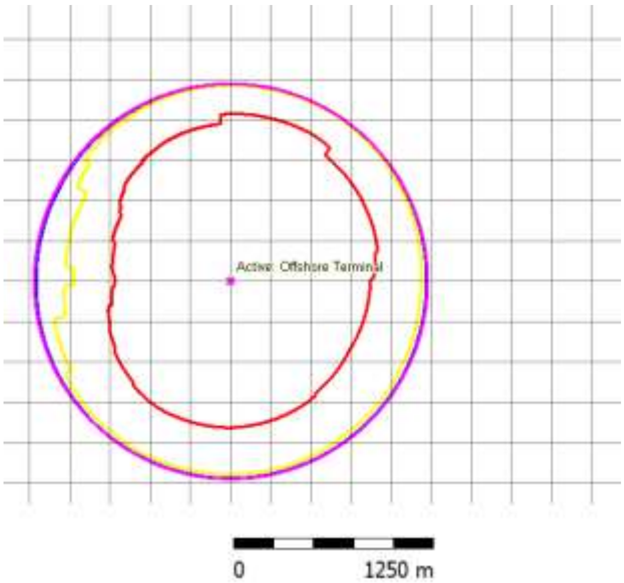
Health and safey and land use within the Ports authority are the responsibility of Transnet and does not require local authority approvals for any town planning usage. Should the $1x10^{-6}$ fatalities per person per year extend beyond the Ports Authority area, the pipeline would be classified as a Major Hazard Installation.

6.1.2. Offshore FSRU

There are no scenarios for the intrinsic failure of a ship. Loading scenarios are dominant compared to intrinsic failure (RIVM 2009).

The only scenarios that are relevant in addition to LNG loading are external damage as a result of ship collisions. These are very much determined by the local situation. In the case that a ship is located in a (small) port outside the transport routes, the probability of a collision that leads to an outflow is so small that it does not need to be taken into consideration. In other cases the basic failure frequency for accidents has to be determined based upon the specific route section. This is best obtained from a marine risk assessment. To this end, a marine risk assessment would be required on request of the Harbour Master or in the event that the FSRU would be stationed within 1.5 km of the shore, shipping lane or any other shipping or port activity.

In the case where the FSRU would be stationed outside of the Port of Saldanha Bay, risk analysis would be completed using a general basic failure frequency for accidents. The risks from collisions and ship-to-ship transfers, shown in Figure 6.28, extend 1 250 m from the release point. To this end the FSRU should not be located closer than 1 250 m from the shore, shipping lane or any other marine activities.



LEGEND **RISK (fatalities per person per year)**

	Risk
Red	$1x10^{-4}$
Yellow	$1x10^{-5}$
Blue	$1x10^{-6}$
Magenta	$3x10^{-7}$

Figure 6.28: Combined risks for the FSRU marine operations

The distance between the FSRU and the Koeberg Nuclear Power Plant would be determined by nuclear licensing and may be greater than the distance specified.

6.1.3. Gas transmission pipeline

One of the main concerns related to the construction of a high-pressure gas pipeline is the potential public health and safety risk associated with the routing of the pipeline near or through a densely populated area. Failure of a gas pipeline can occur due to a number of different causes such as external interference which is the most common, corrosion, fatigue, ground movement, material or construction defects/mechanical failures. Operational and natural hazards are mentioned as less frequent causes. Resultant failures that can occur are leaks (punctures) or breaks (ruptures) and are mainly dependant on the type of defect, pipe diameter, wall thickness, material properties and the operating pressure.

As mentioned above, the main cause of pipeline failure relates to the interference of third-party damaging the pipeline due to maintenance of essential services (water, sewerage, electricity) within the same or a nearby servitude. This risk is assessed to be higher in developed areas where maintenance of these services is regular. Associated consequences could be catastrophic due to elevated population densities in close proximity.

Population density is a reasonable index of the possible consequences of a fire or explosion; in densely populated downtown areas, for example, the consequences of a pipeline failure would be significantly greater than in suburban, peri-urban or rural areas. It is a requirement of the American Society of Mechanical Engineers ASME B31.8 code to increase the strength of the pipeline (related to wall thickness) in areas of high existing and projected population density. It is worth noting that the European Gas Pipeline Incident Group (EGIG) incident database reported no incidents with wall thickness of more than 15 mm.

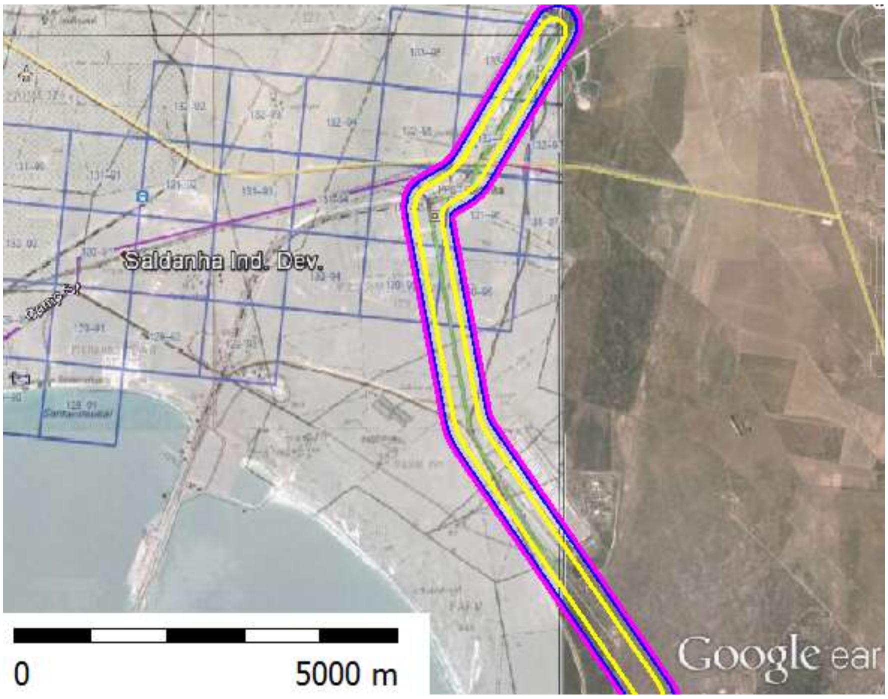
The deeper a pipeline is buried, the more protection is afforded to it, and in selecting the required depth, it is important to consider the likely types of interference from third parties. Although it is technically feasible, at considerable additional costs, to build in the appropriate safety levels for pipelines through densely populated areas (e.g. by increasing the depth at which the pipeline is laid and by encasing it in concrete or by increasing the wall thickness), international best practice has been to avoid these areas in totality. It must however be noted that even if it is possible to avoid the densely populated areas, some towns are very fast growing centres and it would only be a matter of time before developed areas encroaches on the pipeline.

The maximum predicted endpoints for the transmission pipelines are given in Table 6.10 with the 1% fatality extending up to 386 m for the 120 bar pipeline (508 mm diameter).

Table 6.10: Endpoint distances for transmission pipelines

Transmission Pipeline	Distance to Endpoint (m)			
Description	1% Fatality	Fatalities per Person per Year		
		$1x10^{-5}$	$1x10^{-6}$	$3x10^{-7}$
120 bar (508 mm) pipeline	386	165	290	327
48 bar (323 mm) pipeline	178	0	110	132

The risk isopleths for the Saldanha Bay and St Helena Bay corridor consisting of a 120 bar (508 mm) pipeline are shown in Figure 6.29, which extend approximately 290 m to the risk of $1x10^{-6}$ fatalities per person per year isopleth.



LEGEND — **RISK (fatalities per person per year)**

- (yellow) $1x10^{-5}$
- (blue) $1x10^{-6}$
- (magenta) $3x10^{-7}$

Figure 6.29: Extent of the risk isopleths for the Saldanha Bay and St Helena Bay corridor

As the risk of $1x10^{-6}$ fatalities per person per year for the transmission would extend some distance from the release, the transmission pipelines **would be classified as a Major Hazard Installation.** In accordance with Section 9 of the Major Hazard Installation regulations, land restrictions would apply as to the separation distance between the transmission pipelines and certain types of land development, particularly areas occupied by humans for part or all of the day. The applicable land use associated with the risk contours can be found in the PADHI tables given in Appendix 2.

It is common practice to place pipelines within common servitudes. ASME B31.8 Paragraph 841.143 suggests a minimum clearance of a 6" between the pipeline and any other structure. A literature search did not find any scientific relationship to the minimum distance between adjacent pipelines. Of more importance is the construction and maintenance of such pipelines, bearing in mind that third-party interference resulting in damaged pipelines with injuries and losses is the greatest cause of pipeline failures. For this reason it is suggested that placing pipelines on top of each other should be avoided and that crossover pipelines be designed and installed with caution.

For new gas transmission pipelines one should consider a separate adjacent lane with sufficient distance between the lanes for safe construction and maintenance of the pipelines. The distance would be specified by the width of the construction vehicles involved in such activities.

It is important to note that the maintenance of the pipeline is not limited to construction but also includes inspections. It would be expected that specified vehicles may traverse the length of the transmission pipelines for the observation of leaks or dangers posed to the pipeline. For this reason an adjacent vehicle lane would be required possibly situated between the gas pipeline and other fuel pipelines.

6.1.4. Distribution Pipelines

The distribution pipelines operate at a pressure range of 2–15 bar and range from 559 mm in diameter for the main pipeline to 60 mm for the low capacity end-user pipeline.

Figure 6.30 shows the maximum distance to the 1% fatality and the risk isopleths based on unmitigated pipeline designs[1], excluding mitigation such as applying the applicable design factors for lines within occupied areas. Under such circumstances, all the gas pipelines would have surface risks of 1×10^{-6} fatalities per person per year and that alone would **classify the pipeline as a Major Hazard Installation** with land use restrictions within the risk of 3×10^{-7} fatalities per person per year isopleth.

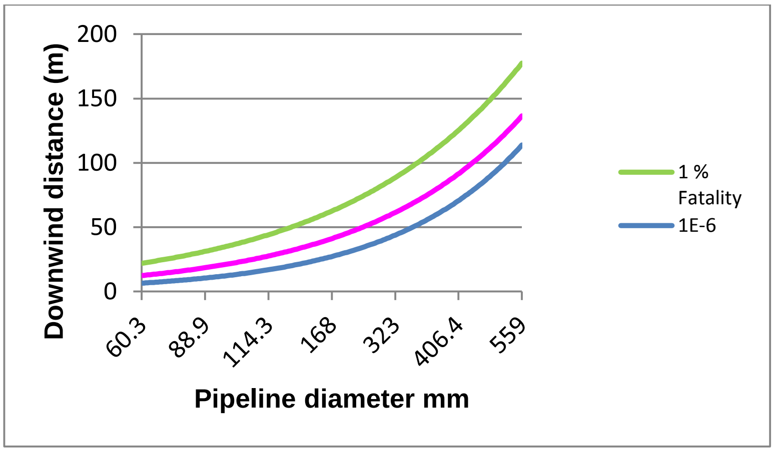


Figure 6.30: Maximum distance to the 1% fatality and risk isopleths due to a pipeline failure

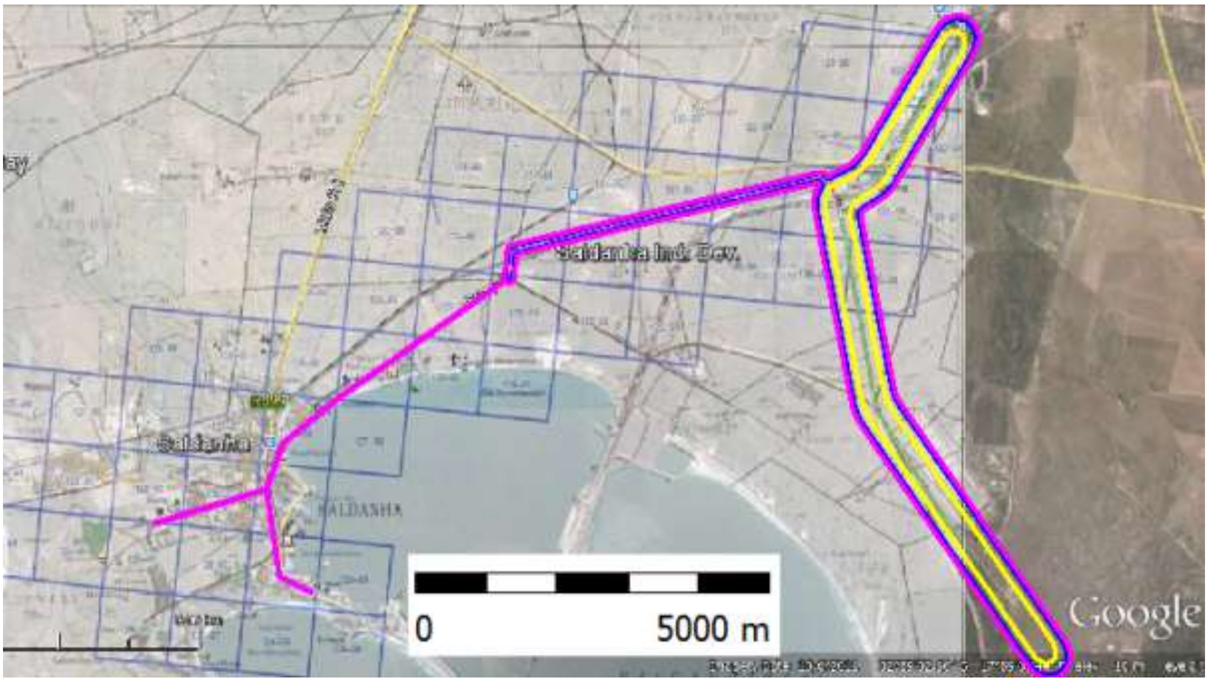
1 The unmitigated risk refers to the maximum risks for the pipeline analysis. Credit has not been given for the pipeline class or any other type of mitigation.

Distribution Pipelines (Saldanha Bay)

The proposed Saldanha Bay distribution pipelines would start at the pressure reduction station and would be routed to clients within the Saldana Bay town area at a maximum pressure of 15 bar. The diameters of the distribution pipelines were not given and pipeline diameters were assumed to be 323 mm to Camp Street and 60 mm thereafter.

The unmitigated risk[2] for the distribution pipelines is shown in Figure 6.31. The risk isopleths indicate that all the proposed pipelines would be classified **as a Major Hazard Installation with land restrictions**.

The large diameter pipelines of 323 mm would require more detailed analysis regarding the routing of the pipeline. Additional mitigation may be required for this routing to be considered acceptable.



LEGEND	RISK (fatalities per person per year)
Yellow line	1×10^{-5}
Blue line	1×10^{-6}
Magenta line	3×10^{-7}

Figure 6.31: Risk isopleths resulting from a rupture of transmission and distribution pipelines at Saldanha Bay

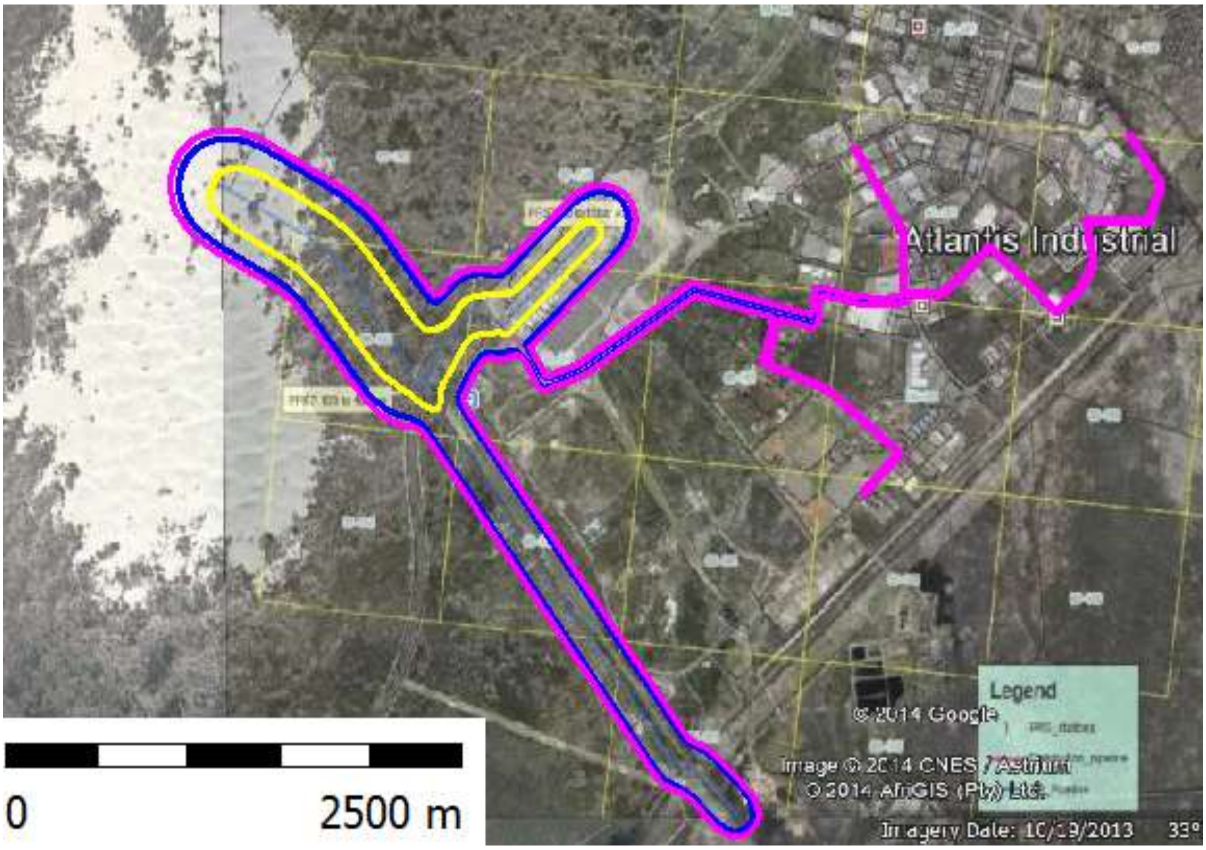
2 The unmitigated risk refers to the maximum risks for the pipeline analysis. Credit has not been given for the pipeline class or any other type of mitigation.

Distribution Pipelines (Atlantis)

The proposed Atlantis distribution pipelines would supply the Eskom Ankerlig power station at a maximum pressure of 48 bar. The pressure would be further reduced from 48 bar to 15 bar to and routed to clients within the Atlantis industrial area at a maximum pressure of 15 bar.

The unmitigated risk[3] for the distribution pipelines is shown in Figure 6.32. The risk isopleths indicate that all the proposed pipelines would be classified **as a Major Hazard Installation with land restrictions**.

With the current routing and land use within the Atlantis area no major issues were found regarding the proposed pipelines. This does not exclude further analysis for an MHI risk assessment and subsequent recommendations.



LEGEND **RISK (fatalities per person per year)**

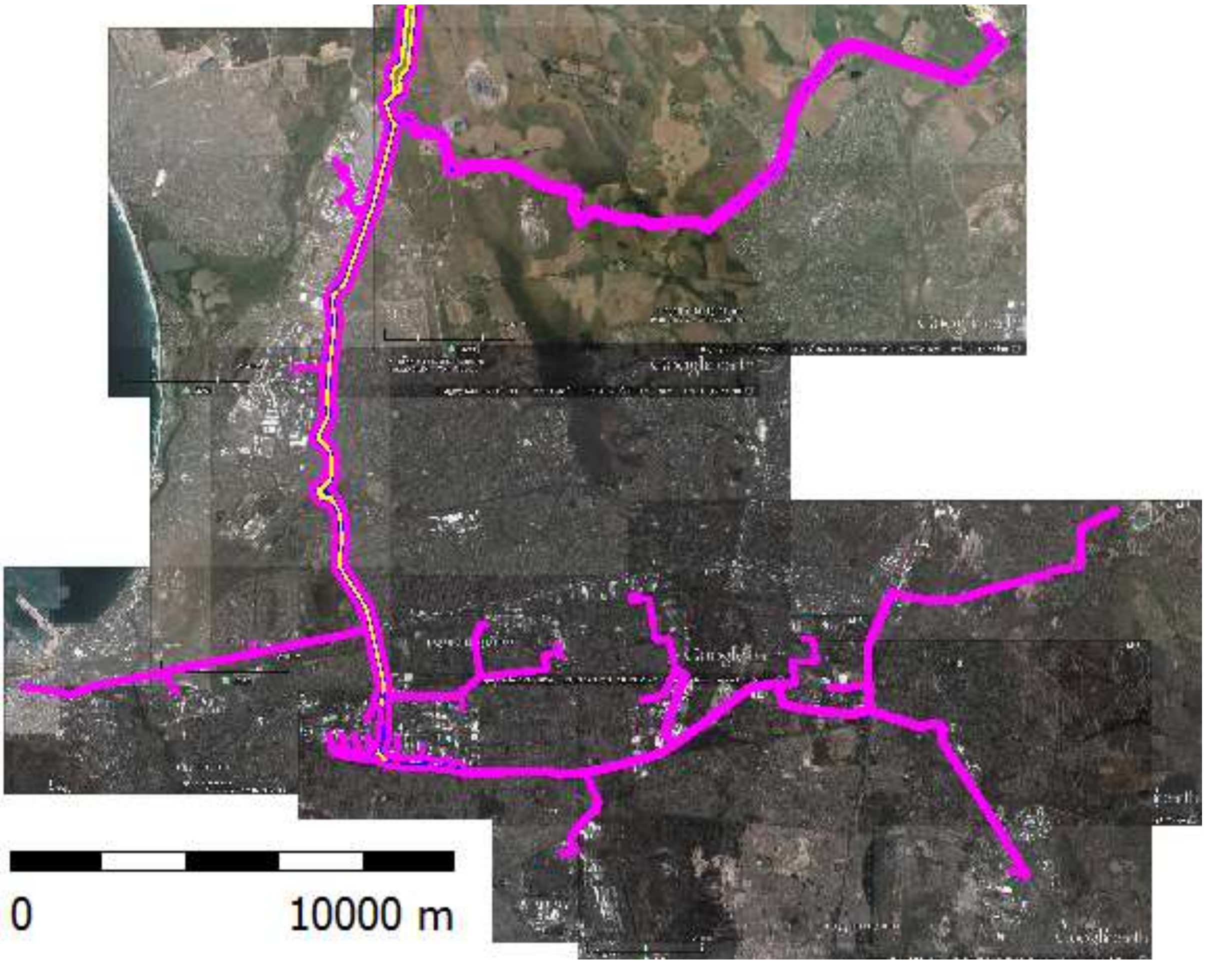
- Yellow: $1x10^{-5}$
- Blue: $1x10^{-6}$
- Magenta: $3x10^{-7}$

Figure 6.32: Risk isopleths resulting from a rupture of transmission and distribution pipelines at Atlantis

3 The unmitigated risk refers to the maximum risks for the pipeline analysis. Credit has not been given for the pipeline class or any other type of mitigation.

Distribution Pipelines (Cape Town)

The proposed Cape Town distribution pipelines would start at the pressure reduction station in the north and extend across Cape Town with a maximum pressure of 15 bar and varying pipeline diameters. The risk for the distribution pipelines is shown in Figure . The risk isopleths indicate that all the proposed pipelines would be classified **as a Major Hazard Installation with land restrictions**.



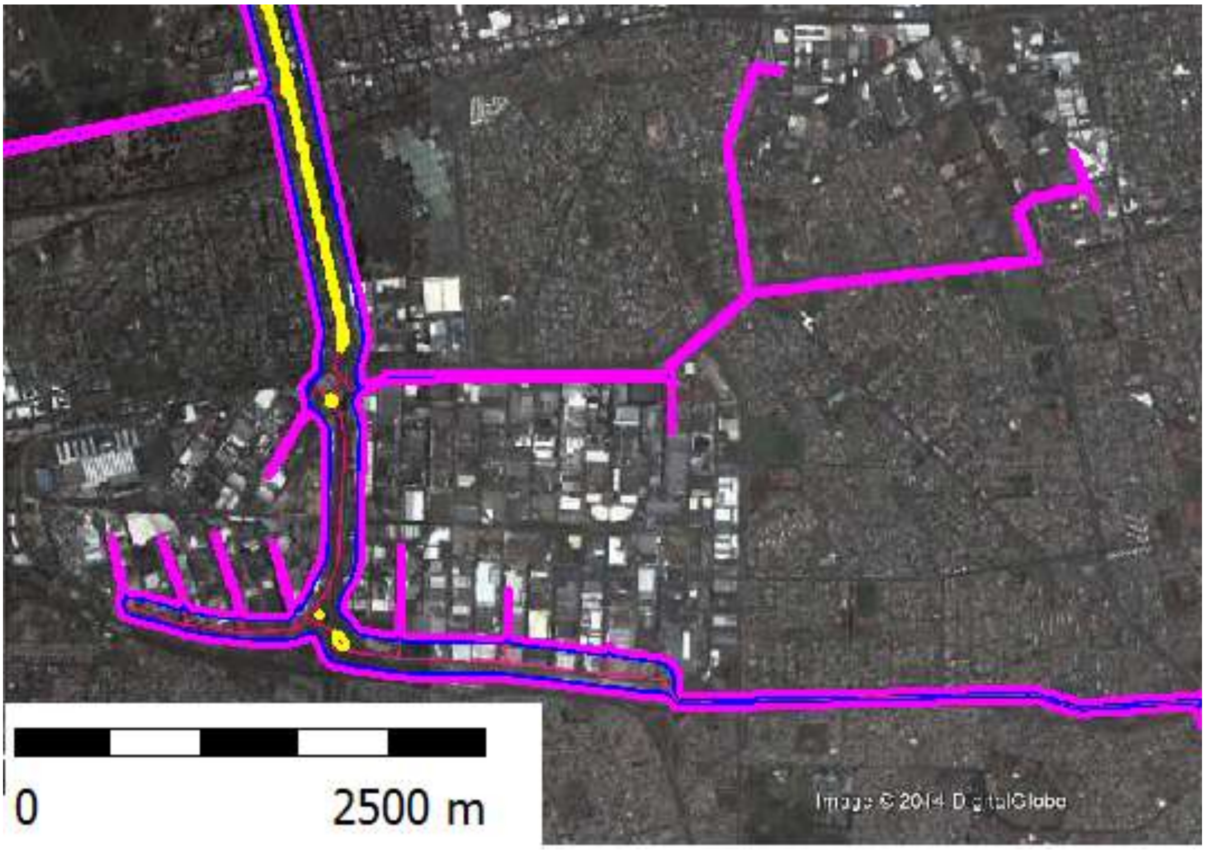
LEGEND	RISK (fatalities per person per year)
yellow line	$1x10^{-5}$
blue line	$1x10^{-6}$
magenta line	$3x10^{-7}$

Figure 6.33: Risk isopleths for the gas distribution pipelines at Cape Town

All pipelines would require detailed analysis per area to determine acceptability for surrounding developments. However, at this level of study certain areas would be considered problematic. In accordance with Section 9 of the Major Hazard Installation regulations, local authority shall not approve housing within the separation distance for some of the proposed pipelines. Areas highlighted in the following subsections would be considered problematic. Areas not included are not exempt from further study nor by default deemed safe.

The Main Distribution Pipeline and Pipelines in Epping Area

The main pipeline and pipelines in the Epping area consist of large diameter gas pipelines that have risk isopleths extending into residential and business areas as shown in Figure 6.34. The designers of the pipelines would be required to introduce further mitigation to reach a level of acceptability in this area.

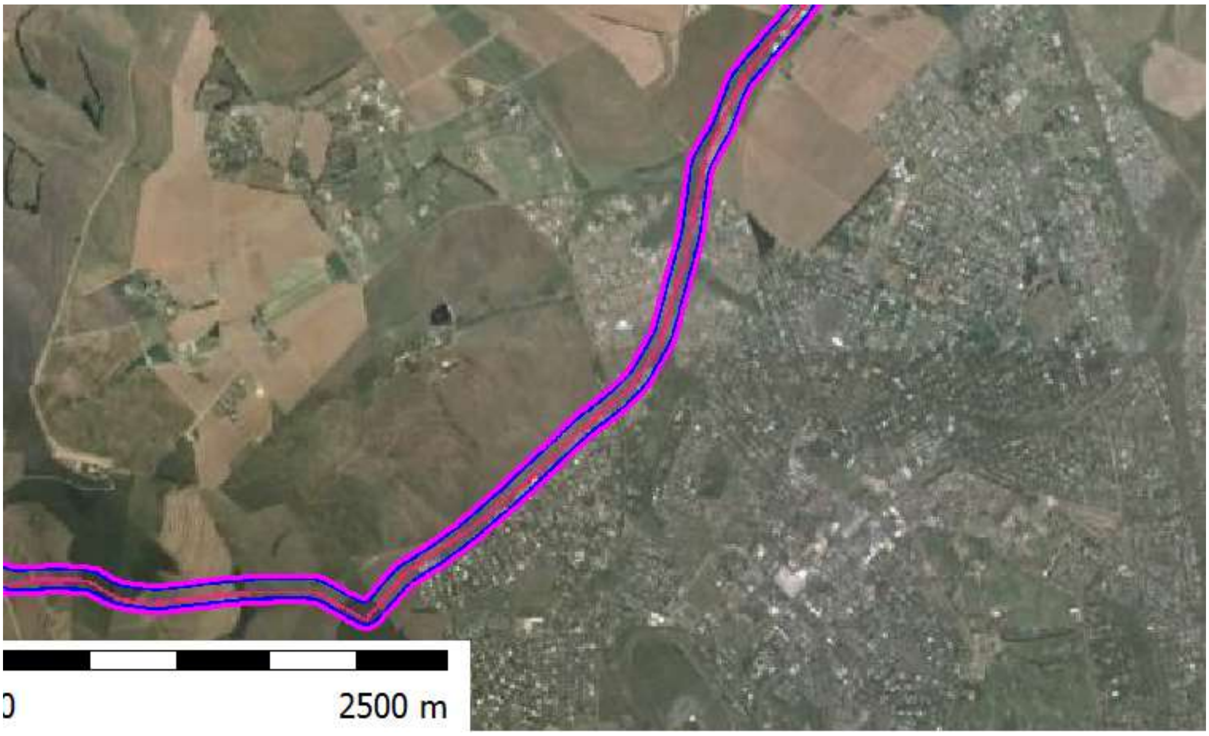


LEGEND	RISK (fatalities per person per year)
yellow	$1x10^{-5}$
blue	$1x10^{-6}$
magenta	$3x10^{-7}$

Figure 6.34: The extent of risk isopleths from the main distribution pipeline and Epping areas

Distribution Pipelines in Durbanvale Area

The proposed 323 mm pipeline would run to the north of the residential area of Altydgedach and passing through the suburb of Durbanvale, as shown in Figure 6.35. The designer must demonstrate that the risks to the public would be considered acceptable.



LEGEND	RISK (fatalities per person per year)
Yellow line	1×10^{-5}
Blue line	1×10^{-6}
Magenta line	3×10^{-7}

Figure 6.35: Risk isopleths for distribution pipelines in the Durbanvale area

6.1.5. Recommendations

The following recommendations are made:

- Undertake a full quantitative risk assessment for the proposed project to inform the final routing of the pipeline.
    - Where necessary, implement further mitigation measures (increase thickness of the pipeline, bury the pipeline deeper, etc.) to ensure that the level of risk given the surrounding land-use is acceptable.
- Precautions to reduce the chance of unintentional impacts on the buried pipeline will be taken. The owners or operators of the land under which the pipeline runs will be aware of its presence, and are regularly reminded. Where the pipeline passes under public highways there will be consultation arrangements between the pipeline operator and the local authority before any excavation work is undertaken.
- Development of an off-site emergency plan for responding to such events;
    - A means of alerting people in the surrounding area that there is an emergency (e.g. a siren); and,

    - Provision of information to members of the public in the surrounding area so that they are aware of what action to take in the event of an emergency.
- Equipment and fittings (e.g. gaskets) will be designed to appropriate standards for the pressure and process materials (gas) present in the system. System components installed during maintenance or repair operations will also meet these standards.
- Quality control procedures will be implemented throughout construction and maintenance operations. Following connection, the integrity of pipes (Hydro and pressure testing) will be checked.
- The gas will be odorised in order to aid the identification of leaks.
- Installation of pipeline marking tape above the pipelines (and umbilical) and additional marking tape is be installed at the following locations:
    - In-ground utility crossings
    - Road crossings
    - Water crossings
    - Inside aboveground installations
- Pipeline maintenance systems will be in place.
- Through an intensive publicity campaign, where appropriate, the public will be advised how to report and respond to gas leaks –
    - An off-site emergency plan will be developed for responding to such events.
    - A system alerting people in the surrounding area that there is an emergency will be developed
    - Information will be provided to members of the public in the surrounding area so that they are aware of what action to take in the event of an emergency.

Provided that the actions recommended above are implemented, the design of the onshore pipeline will generally be considered to be in accordance with best national and international industry practice and potential health and safety impacts would be considered acceptable.