ENVIRONMENTAL IMPACT ASSESSMENT
Final Environmental Impact Assessment Report for the Proposed Construction, Operation and Decommissioning of a Seawater Reverse Osmosis Plant and Associated Infrastructure in Tongaat, Kwazulu-Natal

# FINAL EIA REPORT

# CHAPTER 8: AQUATIC ECOLOGY

# Abbreviations

| | |
|---|---|
| DEA | Department of Environmental Affairs |
| DWS | Department of Water and Sanitation |
| EC | Electrical Conductivity |
| EIA | Environmental Impact Assessment |
| EIS | Ecological Importance and Sensitivity |
| GA | General Authorisation (in terms of the NWA) |
| m amsl | metres above mean sea level |
| m bmsl | metres below mean sea level |
| NWA | National Water Act |
| PES | Present Ecological State |
| WULA | Water Use Licence Application |

# EXECUTIVE SUMMARY

This chapter focuses on the freshwater aquatic ecosystems (that is, rivers and wetlands), that are considered potentially liable to be impacted by the proposed desalination plant and its associated infrastructure (i.e. a pump station, seawater intake and brine discharge pipelines, potable water pipelines and transmission lines) that have been proposed for construction at Tongaat, near Durban, KwaZulu-Natal.

**Affected aquatic systems**

The study has identified a number of potentially affected aquatic ecosystems, namely:

- Extensive but highly transformed / degraded hillslope seep wetlands associated with the proposed pump station site, the desalination plant and the alignment of the brine discharge and seawater intake pipelines – these occur where groundwater daylights at or near the surface, forming areas of permanent to seasonal saturation. They have however all been impacted to a significant level (PES Category E) by agriculture, drainage and excavation, and their conservation importance is considered Low. However, the ecosystem services still performed, and in a future development context, still to be performed by these wetlands, are considered important wetland assets. The wetlands are moreover considered readily rehabilitable to a more sustainable condition and improved level of function;
- Four hillslope seep wetlands (PES Category D to Category E), one artificial channeled depression and a channeled valley bottom wetland (PES Category D) - these would all be crossed by, or occur within close proximity to, the proposed potable water pipeline. Of these, the valley bottom wetland and one hillslope seep were assessed as of Moderate conservation importance from an ecological corridor perspective, while the rest were considered of Low conservation importance, largely due to their existing levels of degradation, mainly as a result of extensive cultivation with canefields;
- The Mdloti River – this would be crossed near the N2 road bridge in its estuarine reaches by both the potable pipeline (this would be carried out via horizontal drilling under the estuary) and (further upstream) by the proposed transmission line, with a second planned crossing of the river in its reaches near Mount Moreland by the transmission lines;
- The Lake Victoria wetland, near Mount Moreland: this large reedbed wetland is important in its own right in terms of its large size, but also because of the fauna it supports, namely:
  - at least three indigenous frog species, including the (IUCN listed Critically Endangered) Pickergill's Reed Frog (*Hyperolius pickersgillli)*, the (Vulnerable) Natal Leaf-Folding Frog (*Afrixalus spinifrons*) and the (Vulnerable) Spotted Shovel-nosed Frog (*Hemisus guttatus*) – of these, Pickergill's Reed Frog is known to occur at only ten sites, with Mt Moreland hosting one of the biggest known populations of this species;
  - roosting areas for as many as three million migratory Barn Swallows (*Hirundo rustica*) in spring and summer, resulting in the broader Mount Moreland area, including Lake Victoria and Froggy Pond being listed by Birdlife International as a Global Important Bird and Biodiversity Area (IBA).

**Assumptions and Limitations**

The assessments of the above wetlands and the impacts of the proposed desalination plant and its associated infrastructure on these systems, as presented in this report, were subject to the following important limitations / assumptions, namely that:

- Delineation of natural wetland extent at the desalination plant was carried out with low confidence, in light of the high degree of past transformation of the site and disturbance to soils – the section of the site focused on in terms of mitigation was, however, identified with much higher levels of confidence;
- It is possible that the detailed design phase of the project may result in additional wetlands / watercourses being identified and/or potentially affected by infrastructure – the report has, however, provided generic mitigation measures against such impacts, and no systems of high ecological or conservation importance are likely to have been missed in this study, with the areas of low confidence in terms of wetland identification comprising the existing cane fields.

**Impact assessment and mitigation**

Although several minor and relatively easily mitigated impacts that could be associated with the proposed project were identified, the following were considered of particular concern, namely:

<u>The proposed desalination plant site itself:</u>

The overall site includes in its extent two large wetland areas. Although these have been degraded to a highly significant degree, they remain both functional (in some respects) and rehabilitable. Their loss to the development would be considered a **highly** significant (negative) impact, and this report recommended that key (i.e. essential) mitigation measures would need to include **off-site mitigation**, i.e. rehabilitation of a swathe of wetlands between the site and the coast and their management as near-natural wetland systems. Rehabilitation of these wetlands would need to focus on improving flood attenuation and habitat function, and would play a useful role in mitigation of other impacts associated with the project, including the management of stormwater runoff from the site. Development of the details of this rehabilitation would need to be calculated as a formal offset identification and calculation process during the detailed design phase of the development, but would need to allow for their rehabilitation to a PES Category D or better. Both this process and its successful resolution would need to be a condition of any authorisation. Purchase of the affected land would be required if this measures was to be implemented. If such offsets were not adequately identified and made available, it is the understanding that project implementation could not proceed. Please refer to Chapter 8 Appendix B for a draft discussion document: “Considerations around the use of wetland offsets to address impacts associated with the proposed Tongaat Desalination Plan”.

<u>The proposed sea water pump station:</u>

Like the proposed desalination plant, this structure would lie mainly within a wetland area, and its construction would entail both loss of (highly degraded) wetland as well as at least short-term dewatering to at least 11m bsl, potentially altering downstream hydrology, drawing down the water table of adjacent wetlands and contributing sediments and other pollutants into downstream flows.

<u>The proposed crossing of the Mount Moreland wetland:</u>

This crossing is considered an outright **no-go proposition**, and no offset mitigation would compensate for its authorization. The wetland supports three species of red data frogs, and is considered a (globally) Important Bird and Biodiversity Area, as a result of its use as a seasonal roost site by millions of Barn Swallows. Passage of the transmission lines across the wetland would be considered a fatally flawed impact, both affecting frog, swallow and other faunal and floral habitat in the short term, and potentially preventing effective maintenance activities such as fire, without which the reed-beds would become moribund. Fortunately, avoidance options for the Lake Victoria wetland area seem available, and this report has suggested an alternative route, that would avoid the important wetland areas.

Despite the importance of the Mdloti River and its estuary, the impacts to these systems that are likely to be associated with the proposed project in all of its phases are considered readily mitigatable, largely through implementation of standard best practice impact mitigation, setback of construction activities outside of the riparian area, avoidance and (in some cases) minor rehabilitation measures.

Cumulative impacts:

The assessment of Cumulative impacts highlighted this specialist's belief that, even with mitigation measures in place, including the recommended off-site rehabilitation of a swathe of wetlands between the site and the coast, construction of the proposed desalination plant would nevertheless result in a substantial net loss of wetlands, extending across a large area of the site, and moreover would be likely to result in further degradation of downstream wetlands, as a result of changes in runoff patterns and intensities. While it is acknowledged that the wetlands in question have been highly and permanently degraded by past activities, if this argument is applied to development along the Durban coastline as a whole, where few if any unimpacted examples of such wetlands are likely to occur, then the cumulative loss of wetlands of this type will be highly significant. Moreover, the wetlands on the desalination plant site, although highly degraded, are at present still considered rehabilitable to at least an improved condition (PES Category D), considered more sustainable (Kleynhans et al 2005). Their complete loss at a site level to the development (as currently proposed) would curtail any future rehabilitation options.

For this reason, additional off-site offset measures are strongly recommended to address the Cumulative Impacts described above. Off-site offset rehabilitation should ideally actively improve the condition of similar or more threatened wetland habitat, to a condition that is better than Category D – that is, Category C or better. Additional off-site mitigation measures could focus on (inter alia):

- The spread of upstream flows from the site into, and the rehabilitation of existing agricultural wetlands downstream of the southern portion of the proposed desalination plant site (between South Dune Road And South Beach Road, and South Beach Road and the beach – refer to Figure 8-13 Green polygons), in a similar manner to the recommended rehabilitation of the wetlands to the east of the north part of the site (see Red polygons as defined in Impact 1 mitigation); or
- The rehabilitation of the (degraded) FEPA valley bottom wetlands located to the north of the proposed plant, which could possibly also be rehabilitated as far as their beach outlets or other similar alternative wetlands that will meet offset requirements.

Inclusion of off-site mitigation measures as outlined above would reduce the significance of Cumulative Impacts substantially from High (negative) to **Medium** to **low**, with possibilities for positive impacts in the proposed rehabilitation of existing degraded valley bottom wetlands.

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# CHAPTER 8: AQUATIC ECOLOGY, RIVERS AND WETLANDS

This chapter presents the aquatic ecology specialist study undertaken by Dr Liz Day from The Freshwater Consulting Group as part of the Environmental Impact Assessment for the proposed 150 Ml Seawater Reverse Osmosis Plant and associated infrastructure in Tongaat, KwaZulu Natal.

## 8.1 INTRODUCTION

### 8.1.1 Scope of Work and Terms of References

Following initial input into the Scoping Report for this project in April 2014, the terms of reference for the aquatic ecology (rivers and wetlands) component of the project EIA phase required the specialist to undertake the following activities:

- Conduct a comprehensive survey of the freshwater ecology aspects of the site and, more particularly, the proposed pipeline corridors from the site, including ground-truthing of the mapped NEFEPA wetland layer;
- Use the above information to provide a description of the baseline environment, including:
  - identification and mapping of wetland / river ecosystems;
  - comments on their sensitivity and importance/conservation significance, and
  - where appropriate, rapid assessments of Present Ecological State (PES) and/or Wetland Ecosystem Services;
- Determine and assess the potential negative as well as any positive impacts on freshwater ecosystems that could result from the proposed development and include mitigation measures to reduce negative impacts, where possible.
- Report on potential impacts and recommended mitigation measures in terms of
  - Pre-construction
  - Construction
  - Operational phases
- Describe cumulative impacts, and assess their significance;
- Provide recommendations for construction and operational phase monitoring.

### 8.1.2 Study Approach

The freshwater ecosystems study focused on the following key areas:
- The footprint of the proposed desalination plant;
- The alignment of the seawater intake and brine discharge pipelines from the high water mark to the desalination plant;
- The alignments of the proposed potable water pipelines – these were considered within a roughly 50m swathe (see below);
- The alignment of the proposed electricity transmission lines, also considered in a roughly 50m wide swathe.

All reference to wetlands and water courses in this document were based on the following definitions of wetlands and water courses, as stipulated in the National Water Act (NWA) (Act 36 of 1998):

*"**watercourse**" means -*

*(a) a river or spring;*
*(b) a natural channel in which water flows regularly or intermittently;*
*(c) a wetland, lake or dam into which, or from which, water flows; and*
*(d) any collection of water which the Minister may, by notice in the Gazette, declare to be watercourse, and a reference to a watercourse includes, where relevant, its bed and banks;*

*"**wetland**" means -*

*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.*

Note that this study specifically excludes assessment of groundwater and marine aquatic ecosystems, and focuses on Inland Aquatic Ecosystems as defined by Ollis et al (2013).

The following activities were undertaken during the EIA phase of the project, with a view to meeting the Terms of Reference outlined above, namely:

- Attendance of a project team meeting and site visit on 9 March 2015, during which time clarity was obtained from the project team as a whole and the project engineer Dr Mike Shand (Aurecon) in particular regarding the proposed alignments and design of the desalination infrastructure, as well as some of the proposed pipeline alignments considered in the project feasibility stage;
- Desktop mapping and consideration of the proposed locations for the desalination plant and its associated infrastructure at Tongaat;
- A second site visit was carried out in May 2015, during which time:
  - the proposed desalination plant site as well as the the seawater intake and brine discharge pipelines from the high water mark to the plant were assessed, and wetlands on and associated with any of these areas were identified and characterized in terms of the National Wetland Classification system and their Present Ecological State (PES), Ecological Importance and Sensitivity and contribution to Wetland Ecosystem Services calculated, where appropriate, using the methodologies outlined in Appendix A;
  - the proposed alignment of the potable water pipeline from the desalination plant was visually assessed – assessment entailed a combination of driving to appropriate high points from which to assess the route, as illustrated in engineering plans and during the February site visit, and accessing portions of the proposed alignment that were either readily accessible or which appeared, on the basis of desktop mapping, likely to pass in the vicinity of water courses of concern;
  - the alignment of the proposed 132kV transmission line was also assessed, using a similar combination of visual assessment from a distance, and identification of watercourses and other freshwater ecosystems of potential concern;
- Liaison with the project engineers (Mr Graham English and Dr Mike Shand, Aurecon) regarding potential alternative alignments / mitigation measures that could be considered the detailed design phases of the project;
- Compilation of an aquatic ecosystem sensitivity map, using the results of ground truthing as well existing information sources (e.g. NFEPA and Fine Scale Planning data);
- Compilation of the current report.

### 8.1.3 Information Sources

In addition to information gleaned during site assessments and in discussion with other specialists and project team members, the findings of this report were also informed by the following data sources:

- A review of GIS covers of freshwater ecosystems in the area, including:
  - SANBI wetland data, downloaded from BGIS, and including KZN Wetland Inventory data, fine scale planning data and Ezemvelo KZN Wildlife KwaZulu-Natal Provincial Pre-Transformation Vegetation Type Map (Scott-Shaw et al 2011)
  - the National Freshwater Ecosystems Priority Areas Assessment (NFEPA) (CSIR 2010)
  - the National Wetlands Cover
  - 1:50 000 and 1: 500 000 rivers National Rivers layers
  - National Ecoregion (Level 1) GIS covers
- Conservation planning reports and associated data, including Conservation Targets and Status for Vegetation Types in KwaZulu-Natal (Jewitt 2011)
- Consideration of the findings of the specialist Geotechnical Report with regard to the Desalination site and pipeline / transmission line alignments (Aurecon 2015 – Appendices A and B).

### 8.1.4 Assumptions and Limitations

The findings of this study should be considered in light of the following assumptions and limitations:

- The approach did not allow for accurate delineation of wetland extent, given issues such as accessibility, time in the field and likely high level of land transformation – the extent of wetlands identified within the assessed corridors / sites was broadly mapped using a handheld GPS to ground-truth mapping off aerial photographs, with soil augering based on the principles of DWAF (2005) utilised to increase mapping confidence.
- At the proposed desalination plant and pump station site, disturbance to surface soils was extensive, with most areas assumed to have been natural wetland having been turned over for agriculture, excavated, channelized and either drained or saturated with diverted groundwater flows. As a result, while areas that are not wetland showed clearly, with their high chroma soils and lack of any indicators of wettedness, the accuracy of delineation of the lowerlying wetland areas is poor. This issue was addressed in part by provision of a relatively high confidence map of assumed natural perennial saturation extent, and a lower confidence polygon of wetland extent that would have included seasonal and temporary saturation components, based largely on contours.
- The proposed potable water pipeline and transmission line alignments were not accessible along all of their routes, and were assessed instead from selected vantage points, used in conjunction with aerial photography – although it is possible that small wetland areas were missed as a result, any such areas would in any case have been transformed by agriculture (sugar cane) and their treatment in the current development context would in any case be covered by the generic "Best Practice" mitigation measures included in this report.
- The potable water pipeline refers to a 50 m corridor along the proposed alignment while the transmission line includes a 50m corridor along the proposed alignment, with the exception of the section from the desalination site to the planned Ethekwini transmission line, where a 200m corridor was assessed.
- The Mdloti River itself was accessible only upstream and downstream of the proposed pipe bridge, and not at the point of crossing, as a result of extensive road works in this area at the time of the site visit.
- The study assumes that the botanical specialist will provide input with regard to the identification of red data or other important wetland plants.

- The study assumes that the faunal specialist will provide detailed assessment of the implications of the proposed project for birds – in particular, for the swallows associated with the Mount Moreland area, although this aspect has been conservatively included in the present study as well;
- No aquatic faunal assessment was allowed for, other than in the form of SASS5 biomonitoring, which was inappropriate for any of the aquatic ecosystems assessed. A desktop study was however carried out to highlight specific habitat requirements of red data fauna known to occur in some of the potentially affected river and wetland ecosystems (e.g. in wetlands in the Mount Moreland area); none of the NFEPA subcatchments in which the study area falls have been identified as of for fish taxa.
- It is assumed that mitigation measures inherent to the project design, as described in the project description, will be implemented regardless of additional mitigation measures recommended by this study (i.e. ratings for impact 'without additional mitigation' is assumed to already include mitigation measures inherent to the design).

### 8.1.5 Acknowledgements

Input from the project team and in particular from Dr Mike Shand and Mr Graham English (Aurecon) during and after the February site visit is gratefully acknowledged.

Mr Matt Theunissen (Freshwater Consulting cc) is also thanked for assistance in the field and with GIS mapping.

Mr Donovan Kotze is thanked for his review of an early draft of this report. Dr Kotze is a wetland ecologist with a long experience of wetland assessments in KwaZulu Natal, and provided most useful insights and critical review of early findings.

## 8.2 PROJECT DESCRIPTION: AQUATIC ECOSYSTEMS – RIVERS AND WETLANDS PERSPECTIVE

Information provided in this section has been presented specifically to reflect the specialist's understanding of the proposed project, and how it relates to freshwater aquatic ecosystems. The study focuses on the area upland of the highwater mark at Tongaat, the freshwater ecosystems of which are described in detail in Section 8.3.

The following main infrastructure components have been considered in this study, as potentially of relevance to freshwater aquatic ecosystems:

- The proposed pipeline (tunnel) conveying sea water from the intake to the proposed reverse osmosis desalination treatment plant: this pipeline would be aligned as shown in Figure 8.1 and would be passed beneath the dune along the high water mark of the beach, under South Beach Road, through / beneath agricultural land between South Beach Road and the M4, beneath the M4 and into the proposed site for the desalination plant (see Figure 8.2);
- A brine return-pipeline (tunnel) along a similar alignment to that shown above;
- A pump station (P1 in Figure 8-1). It is anticipated that the invert of the pump station sump at the Tongaat Site would require excavation to about 11 m below Mean Sea Level (bmsl).
- Pipelines conveying fresh (potable) water from the desalination plant to connect with the existing bulk water infrastructure – the pipelines would run as follows:

- A 1100 mm steel pipeline would run from the desalination plant in a roughly northerly direction, largely through sugar cane farming areas, as far as the La Mercy Reservoir, whereafter it would be routed in two directions, namely:
  - North through cane fields, and then north, north-west across the N2 near the Tongaat Toll Plaza, to tie in with the "Bifurcation section" of the existing bulkwater system;
  - South, south-east from La Mercy Reservoir, oriented roughly parallel to the N2, and aligned along its eastern side – this pipeline would cross the Mdloti River just downstream of the N2 road bridge. Communications from the design engineers (email from J. Calitz, Aurecon of 6/11/2015) indicate that the crossing would be achieved by horizontal drilling. The drilling fluid would comprise a starch-based compound (an edible fish food). The excavated material (spoil) would be removed in slurry form via a pipeline inside the tunnel. The spoil slurry would be separated at the surface into the excavated material (stone chips or sand), and the drilling mud would be re-cycled back into the tunnelling machine. The earth and groundwater pressure at the cutting face is balanced by the pressure of the drilling mud at the cutting face of the machine. The tunnel is water-tight during and after construction, thus there is no groundwater inflow that would need to be pumped out and disposed of. Waste generated from drilling would comprise waste water, which is discharged into a sewer, and excavated mud and rock which would be trucked to a waste disposal site or provided to farmers to spread on their fields, if so desired. During construction, a maximum working area of 0.5 ha would be required at the entry and exit points of the drilled pipeline, which would be reduced if waste bentonite was recycled.

    Further on, the pipeline would then be pipe-jacked under the N2 immediately south of the N2 - M27 Umdloti fly-off, and pass initially in a north-westerly direction, before swinging towards the west, running largely in low-lying areas, as far as the Waterloo Reservoir, in the settlement of Waterloo.

- Power supply infrastructure comprising construction of a 132kV transmission line, from the La Mercy substation to a point within 500m from the site; since no details have been provided / are yet available regarding the alignment of the transmission line from the site itself to the tee-in point of the line shown in Figure 8.1, potential impacts to freshwater ecosystems are dealt with in terms of generic impacts and best practice mitigation measures. The proposed transmission line shown in Figure 8.1 is moreover considered a conceptual one only (Mr Martin Piper, Aurecon, email of 3 June 2015 to Liz Day ), but would include the following elements of relevance to freshwater ecosystem impact assessment and recommendations for impact mitigation:
  - average spans would usually be 300 – 400 m, but can go over 600m depending on the lay of the land;
  - where new servitudes are required, the trees within the servitudes would need to be cleared;
  - the current conceptual alignment of the proposed transmission line corridor would cross the Mdloti River some 140m upstream of the N2 road bridge, and again, some 2.2 km upstream of the N2 bridge, before crossing the Lake Victoria wetland area near Mount Moreland.

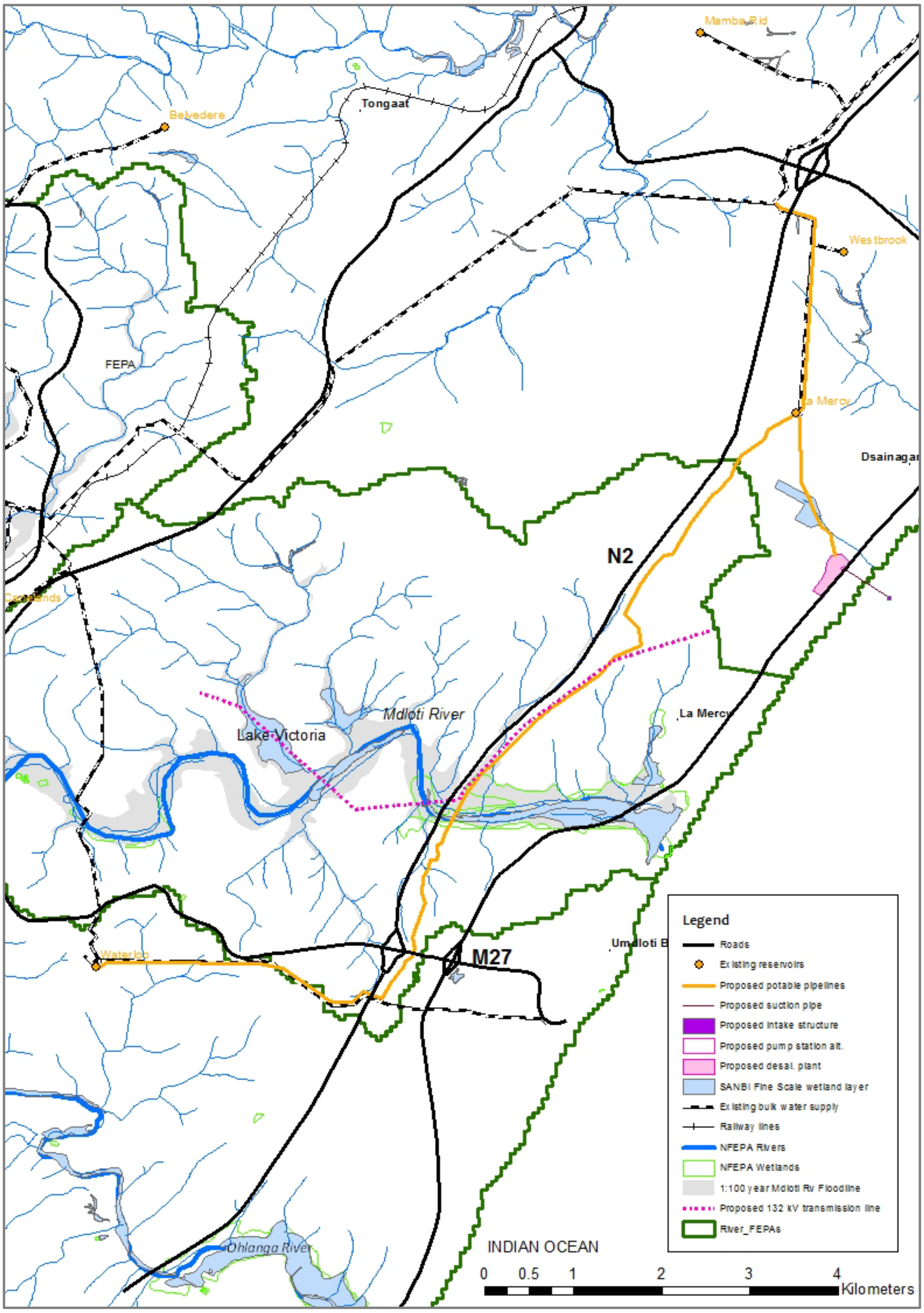



Figure 8-1: Map of the proposed Desalination facility at Tongaat and associated infrastructure, showing river and wetland crossings based on NFEPA and SANBI wetland and river data


Figure 8-2: GOOGLE 2015 view of the proposed desalination facility at Tongaat, showing locations of proposed pump station (P1), desalination plant boundary (yellow polygon) and position of proposed seawater intake pipeline (tunnel) (orange).

## 8.3 DESCRIPTION OF THE AFFECTED ENVIRONMENT: RIVERS AND WETLANDS

### 8.3.1 Catchment context

The project itself would be located in the Department of Water Affair's (DWA) Mvoti to Umzimkulu Water Management Area (WMA 14), in the Mvoti Sub WMA. While the proposed desalination plant itself would be located in the Tongati River catchment, much of the proposed outgoing potable water pipeline infrastructure would be located in the adjacent Mdloti River catchment, the mouth of the estuary of which is located some 3 km south west of the plant site, with the estuary itself extending to just upstream of the N2 road crossing over the river. A short section of the proposed potable water pipeline extends further south, into the Ohlanga River catchment (see Figure 8-1).

Of the above river systems, NFEPA River data (Nel et al 2011) show that the Tongati River has been classified as in a Present Ecological State (PES) Category C[1], indicative of rivers that have been Moderately modified from their natural condition, while both the Mdloti River and the Ohlanga River are considered more intensively modified, and representative of rivers with a PES Category D (Highly modified).

1 Present Ecological State is a measure of a river or wetland's condition, when compared to its natural and/or reference condition.

### 8.3.2 Ecoregion context

Ecoregions are groups of rivers that share similar physiography, climate, geology, soils and (under natural conditions) natural vegetation. The National Ecoregional Classification of Kleynhans (2005) classifies both of the above catchments as falling within Ecoregion 17 (North Eastern Coastal Belt). Rivers within this ecoregion are characteristically:

- Associated with a diversity of terrains, but usually occurring in closed hill and mountain terrain, at altitudes from sea level to 700 mamsl;
- Typically associated with Valley Thicket and a variety of Grassland and Bushveld types;
- Usually in areas where mean annual precipitation and temperatures are both high (MAP = 700-1000 mm and mean annual temperature =16-22°C).

### 8.3.3 Freshwater aquatic ecosystems associated with the study area

#### *8.3.3.1 Freshwater ecosystems associated with the Tongaat beach and adjacent areas along the seawater intake / brine outfall routes, including the proposed pump site and the desalination plant site itself*

General site and aquatic ecosystems descriptions

This broad area, shown in Figure 8.2, comprises steep hillslopes down to a line of low-lying vegetated dunes just above the beach, as illustrated in the vertical section shown in Figure 8.3 (after Appendix A of Aurecon 2015). The hillslopes include two concave depressions, separated by higher lying ground on which residential and farming-related buildings have been constructed. The hillslopes and depressions have been wholly transformed on the site, although alien-invaded but otherwise relatively untransformed terrestrial vegetation still occurs on the upper hillslopes, above the proposed desalination site. This closely abuts East Coast Dune Forest mapped in the SANBI BGIS dataset and is assumed to be part of the same terrestrial vegetation type.

The presence of freshwater ecosystems in this area is dictated by the site geomorphology. This has been described in detail in Appendix A of Aurecon (2015), which indicates that the steep hillslopes are underlain at depth by the weathered sedimentary bedrock of the Permian Vryheid Formation, which comprises very soft to soft rock siltstone or sandstone. Above this, Cenozoic sand dunes built up in the past, creating sediments of the Berea Formation which occur as orange to red soft to firm sandy clays and loose to medium dense clayey sands on the site. The report notes that the base of the Berea Formation does locally contain boulder beds with boulder diameters of up to 500mm embedded in a sandy matrix. More recent dune sands have built up upon this layer, forming the present Aeolian dune sands indicated in Figure 8.3. The flatter depressional areas of the slope are however underlain by several metres of estuarine/alluvial sands and peaty sands overlying either recent dune sands or the sandy clays and clayey sands of the Berea Formation, and the report interprets this paleo-morphology as indicating alluvial and estuarine conditions, with the approximate areas of the two morphological depressions alternating with dune sands deposits.

At the time of the site visits informing the present study, wetland conditions were evident along most of the lower lying depressional basins of the proposed desalination plant, with evidence for the presence of wetlands (as per DWAF 2005) including gleyed soils below a thick (about 10cm in depth) organic layer at the surface, and a raised water table, to some 30cm below the augered surface. This area has however been almost completely transformed, with a number of excavations into the water table some way up the hillslopes channelling water into storage ponds in the lower, basin part of the site, as well as along a series of trenches in which wetland crops (e.g. watercress) were being cultivated at the time of the site visit. Nutrient enrichment of stored water was suggested by the proliferation of aquatic plant growth in standing water ponds, including the floating macrophyte *Lemna gibba* and, in some shallow channels, filamentous algae. *In situ* water quality measurements taken in the channel at the downstream end of the site indicated that water passing through the site was fresh, with low concentrations of dissolved salts, as indicated by the low Electrical Conductivity (EC) value of 19.6 mS/m, with pH in the range of neutral-mildly alkaline (pH 7.8), as would be expected in coastal dune areas.

The steep, largely dry terrestrial slopes of the hillside are irrigated with water from the storage ponds, which is pumped upslope. Augering of soils on these slopes showed no signs of hydromorphic conditions, with the soils being of high chroma, and showing no signs of permanent or even seasonal saturation (e.g. mottling). Auger sites WP1, WP2, WP3 and WP4 in Figure 8-4 illustrate these conditions.

Excavation, extensive turning over the ground for agriculture, channelling, berming, trenching and the wholesale clearance of natural vegetation from the site makes it difficult to provide a clear outline of natural wetland extent on the site (see also Section 8-1-4), and consideration of historical photographs of the study area (1937 aerial photographs were accessed from the Chief Directorate: Surveys and mapping) did not add any clarity to this issue. On the basis of the general site layout, consideration of the 2m contours shown in Figure 8-4, the identification of peaty soils by the Geotechnical Study (Appendix A in Aurecon 2015) in the depressional basis and with regard to the proposed model for surface / groundwater interactions in the area, as outlined below, it is however suggested that the two lower, depressional areas of the site comprise natural wetland areas that have been highly modified by agricultural and other activities, and which are almost certainly much wetter and more extensive today than under natural conditions, prior to excavation and artificial channelling and storage of water in these areas. Figure 8.4 provides a coarse assessment of wetland extent on the proposed desalination site, noting the above limitations, with demarcated wetland extent being guided to some degree by site elevation. The figure shows two wetland areas in the north of the site – a smaller lower lying area, considered likely to denote natural permanent wetland, on the basis of the clear gleying of deeper soils (e.g. WP6), and a larger area, mapped with low confidence as to the degree to which it reflects a natural wetland boundary, but nevertheless arguably likely to comprise such conditions, given the marked flattening out of the contours just upslope of the mapped polygon, as well as the fact that an existing excavation into the water table, at the 26m contour excavated, was about 1.5m - 2m deep, and allowed groundwater to trickle out and be channelled downslope. This supports the idea, as mapped in Figure 8-4, that the water table might naturally be within the top 0.5m of the surface by the 24m contour, and this line has therefore been used as an approximate indicator of the upland level of wetland extent. A second wetland area has been mapped in the southern portion of the site. This wetland has also been highly transformed, with its northern portion comprising excavated and bermed storage ponds, and its southern extent agricultural fields and an access road. The northern wetland includes several buildings, roads and parking areas in its extent.

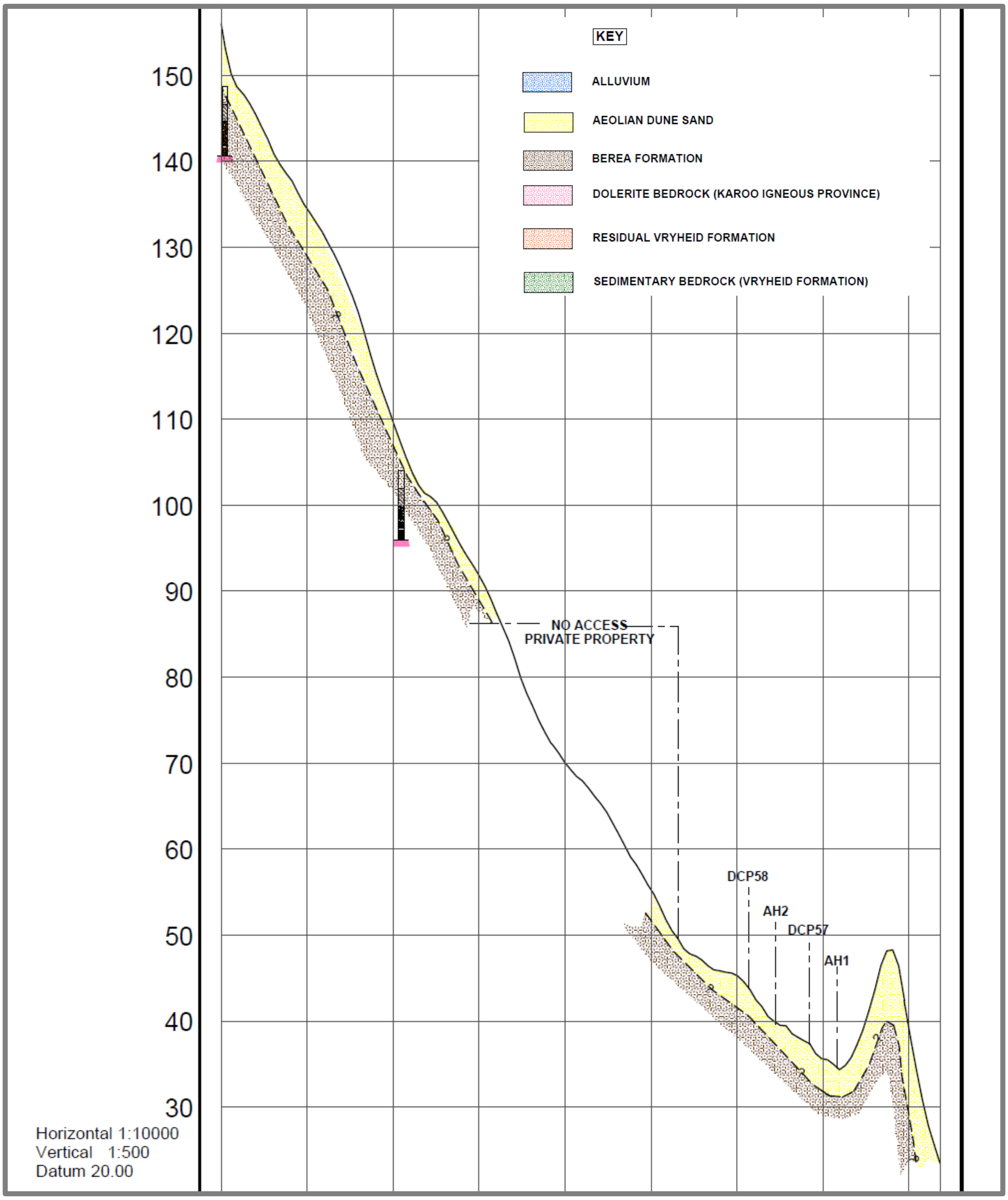



Figure 8.3: Long-section through site, from La Mercy Reservoir to Tongaat Beach, with AH1 lying towards the downslope end of the proposed Desalination Plant, followed by the low partially vegetated dune on the beach. Figure extracted directly from Appendix B, Aurecon 2015


Figure 8-4: 2015 GOOGLE Earth image of the proposed desalination site, with 2 metre interval contour data and estimated extent of wetlands (green polygons) within the two basins in the desalination plant area. Purple polygon indicates proposed pump station site; the yellow polygon indicates the proposed desalination plant site boundary. “WP” prefix indicates augered points referred to in text.

The proposed site is edged on its downslope side by South Dune Road, with water passing from deep (1.5-2 m deep) excavated trenches, flowing at the time of the site visit as strong trickle flow past pond storage areas, into a culvert and beneath the road. These flows daylight into the presently undeveloped area between South Dune Road and the M4, where they feed a broad wetland, vegetated at the time of the site visit with a combination of *Phragmites australis* reeds and, predominantly, dense stands of sugar cane escapees. The edges of the area where there is more light at ground level support patches of *Carex* spp. – obligate wetland species.

Downstream of the M4, and roughly in line with the proposed desalination site, the land between the M4 and South Beach Road comprises a mix of infilled and/or higher lying ground on which houses / small commercial developments (e.g. shops) have been constructed, as well as a number of open plots, utilised for small-scale agriculture (mainly market gardening-type activities). The latter are considered on the basis of the site assessment to be wetlands, in the sense that they are characterised by water at or near the surface for most of the year, and would clearly support wetland vegetation were it not for the fact that they are cultivated. This said, the areas are highly disturbed, and there has been clear manipulation of water flowing onto and through these sites, with excavation into the steep upper slopes of the site, to force premature daylighting of seeped groundwater and near-surface water, and channel it into storage ponds and trenches from where, as in the upstream site, it is conveyed throughout the remainder of the site, either in irrigation trenches or as sprayed irrigation from pipes.

The proposed seawater intake and brine discharge pipelines tunnelled sections would pass underneath these areas from the pump station location through the offshore surfzone.

A network of deeper trenches controls the extent of saturation of the area, and the ground surface has also clearly been levelled, terraced and probably wholly altered from its natural topography. Augering of least-disturbed low-lying parts of this area indicated that the soils were gleyed beneath an organically enriched surface layer, indicating periods of prolonged saturation near to the surface – that is, wetland conditions. Outside of formally cultivated areas, saturated soils supported *Phragmites australis* reeds, *Carex* spp and stands of water-tolerant bananas and various weedy species.

Water from these transformed areas, believed to have comprised mosaic areas of wetland and dunes prior to human development in these areas, passes via subsurface seepage beneath the road and (mainly) through culverts, into the area downslope of South Beach Road, where water daylights onto the beach in a number of open surface flows (see Figure 8.4). At the time of the May 2015 site visit, water flowing out onto the beach immediately downslope of the proposed desalination plant site was visibly contaminated with organic material, assumed on the basis of its smell and the presence of a poorly maintained sewer manhole at the road above, to have derived from leaked sewage.

<u>Surface/ groundwater linkages</u>
Although no geohydrological model has been proposed for the movement of groundwater through the site in this area, the following is suggested as a probable working hypothesis that would explain the extent of current wetland conditions on the site. This hypothesis is derived largely from the cross-section shown in Figure 8.3 and the understanding of this specialist, derived from discussions with local landowners as well as from observations on site, that the water table on the depressional basin of the proposed desalination plant site lies close to the surface (1.5 to 0.5 m below the surface), even under the present conditions of ongoing drainage by means of trenches, and that in lowlying areas downslope of the M4, it lies at the surface during much of the year.

The following conceptual model is proposed:
- The dune area extending north and west of the proposed desalination site acts as a large sponge during rainfall conditions, trapping water in its sandy surface soils;
- The dune is underlain by remnant bedrock of the Vryheid Formation, and effectively forms a perched primary aquifer, comprising the overlying clayey soils of the Berea formation and the more recent Aeolian dune sands;
- Groundwater flows downslope, towards the sea;
- In the basin area comprising the current lower reaches of the proposed desalination plant site, ground water pools, and as a result of the permanently saturated, anaerobic conditions thus created, [2]peaty soils have been produced over time at the surface;
- Artificial excavations into the dune area above the depressional basin result in premature daylighting of groundwater, and its channelling downslope as surface runoff for storage in excavated pools. This suggests that natural wetland extent on the site was probably much less than that at present, with current excavations having resulted in the artificial creation of large areas of saturated soils and shallow to deep standing water in the basin area;
- Water pooled in the interdune area of the depressional basin passes into downslope areas through the Aeolian dune ridge;
- Where boulders are included in the Berea formation, passage of groundwater downslope is likely to be rapid; where the Berea formation comprises clayey soils, it is likely to impede drainage downslope;
- It is assumed that the bedrock layer of the Vryheid Formation daylights close to the surface near the beach, forcing daylighting of subsurface flows onto the beach surface, where surface

2 Note that reference to peaty soils is taken from Aurecon (2015) and it is not clear that actual analysis of carbon content informed this classification. Nevertheless, it is clear from the report that these soils had a high organic composition, indicative of prolonged saturation of organic material.

flow seeps are visible in aerial photography (see Figure 8.4). Although these flows are referred to as "estuarine" in the Geotechnical report (Aurecon 2015), they are small, and do not display distinct tidal and salinity regimes beyond the beach area. As a result, in this report they are regarded simply as the outlets of dune hillslope seeps.

Table 8-1 provides photographic illustrations of the proposed pump station and desalination plant sites, as well as the broad area underneath which the seawater intake and brine discharge tunnelled sections would pass above the highwater mark, as described in the previous sections. Table 8-2 summarises the results of PES, EIS and conservation importance assessments, as well as the assessment of wetland ecosystem services, for wetlands within these areas. Although wetlands identified within the pump station, desalination plant site and (above) pipeline alignment have been fragmented by roads, channels and the construction of houses and infrastructure, they are essentially part of the same wetland system, extending under natural conditions across low-lying areas between the toe of the large dune to the northwest, as bar as the beach, interrupted by coastal dunes. Current land use and extensive impacts on the wetlands in the different development pockets is considered effectively the same, and Table 8-2 thus reflects the same scores / categories for the assessment methodologies, between sites. Essentially:

- The extent of degradation of wetlands as a result of fragmentation, agricultural activities, the near-complete loss of indigenous wetland vegetation and substantial changes in wetland hydrology mean that wetland conditions, as measured by PES, was assessed as Category E – illustrating a serious level of ecosystem modification;
- Ecological Importance and Sensitivity (EIS) was low-to marginal, indicative of a system that is relatively insensitive to (further) changes in water quality or hydrology, and that does not support taxa that are considered important from a biodiversity perspective;
- The extent of degradation of the site means that conservation importance of the wetlands is considered low (but not zero);
- Wetland ecosystem services assessments show that while the wetlands offer little in the way of cultural or educational services, they do, in part facilitated by sources of impacts such as ponding and pooling, provide ecosystem services such as opportunities for nutrient and toxicant trapping, which are of importance in the context of the current land use of the site as an agricultural area, which is assumed to be associated with relatively high levels of nutrient and possibly toxicant (e.g. herbicides and pesticides) inputs. The wetland itself is important as a source of water for agricultural use – this use could however be relocated elsewhere.

<u>The Potable water pipeline</u>

Figure 8-5 shows this pipeline route in Section, from La Mercy Reservoir to Waterloo Reservoir, as taken from Aurecon (2015). Figures 8-6 to 8-9 show the proposed route of the potable pipeline, from the proposed Tongaat desalination plant site described in the previous section, along the length of its route. The different segments of this pipeline are discussed in sections 8.3.3.2 to 8.3.3.6.

Table 8-1: Photographic illustrations of wetlands in the vicinity of the proposed seawater intake and brine discharge pipelines as well as downslope of, and on, the proposed pump station and desalination plant.

Photo A
Outlet of wetlands from the desalination plant onto the beach

Photo B
Organic sludge at beach outlet, assumed to result in part from leaked sewage, but showing broad freshwater wetlands daylighting onto the beach

Photo C
Extensive wetland areas between the M4 and South Beach Road, with wetland extent expanded and wetter as a result of early daylighting of groundwater

Photo D
Water passed in trenches throughout area between the M4 and South Beach Road, and used to irrigate crops

Photo E
Excavated storage pond and pumped irrigation system in area just downslope of M4

Photo F
Market gardening across highly transformed dune / wetland area downslope of the M4

Photo G
Market gardening on dune slopes and basin on the northern side of proposed desalination plant site, with excavation just downstream of banana plant on right of photo daylighting groundwater and passing it as channelled runoff into the basin below.

Photo H
Looking downslope from the upper edge of the cultivated area of the dune, onto the northern portion of the proposed desalination plant site

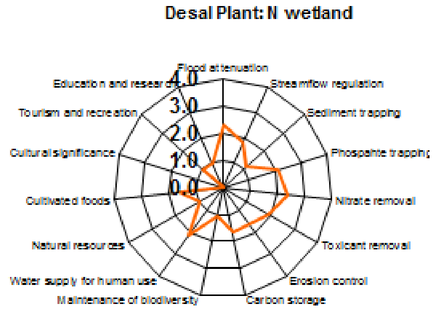
Photo I
Looking south across proposed desalination site, to high-lying land between two basins, showing terrestrial, irrigated slopes

Photo J
South view across southern portion of proposed desalination plant site

Photo K
Drainage trenches, water storage and irrigation of assumed wetland mosaic habitat on southern portion of proposed desalination plant site

Photo L
Excavated storage area in lower reaches of proposed desalination plant site, in vicinity of proposed pumpstation site P1

Table 8-2: Summary of wetland condition and importance in the areas associated with the proposed desalination site and pump station areas

| SITE NAME | [3]SIZE | PRESENT ECOLOGICAL STATE (PES) / CONDITION | ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS) | CONSERVATION IMPORTANCE | ECOSYSTEM SERVICES |
|---|---|---|---|---|---|
| Tongaat Desalination plant North | 31 382 $m^2$ | Category E | Low/ marginal | Low – because of extent of degradation |  |
| Tongaat Desalination Plant South | 11 460$m^2$ | Category E | Low/ marginal | Low – because of extent of degradation | |
| Pump station 1 | As per Tongaat Desalination plant North | | | | |
| Seawater inlet and brine discharge pipelines (tunnels) above highwater mark | Extent of pipeline abuts degraded wetland | Category E | Low/ marginal | Low | As per Tongaat Desalination Plant North |

[3] Areas based on conversions from GOOGLE earth polygons, using http://www.earthpoint.us/Shapes.aspx – should be considered as rough estimates only

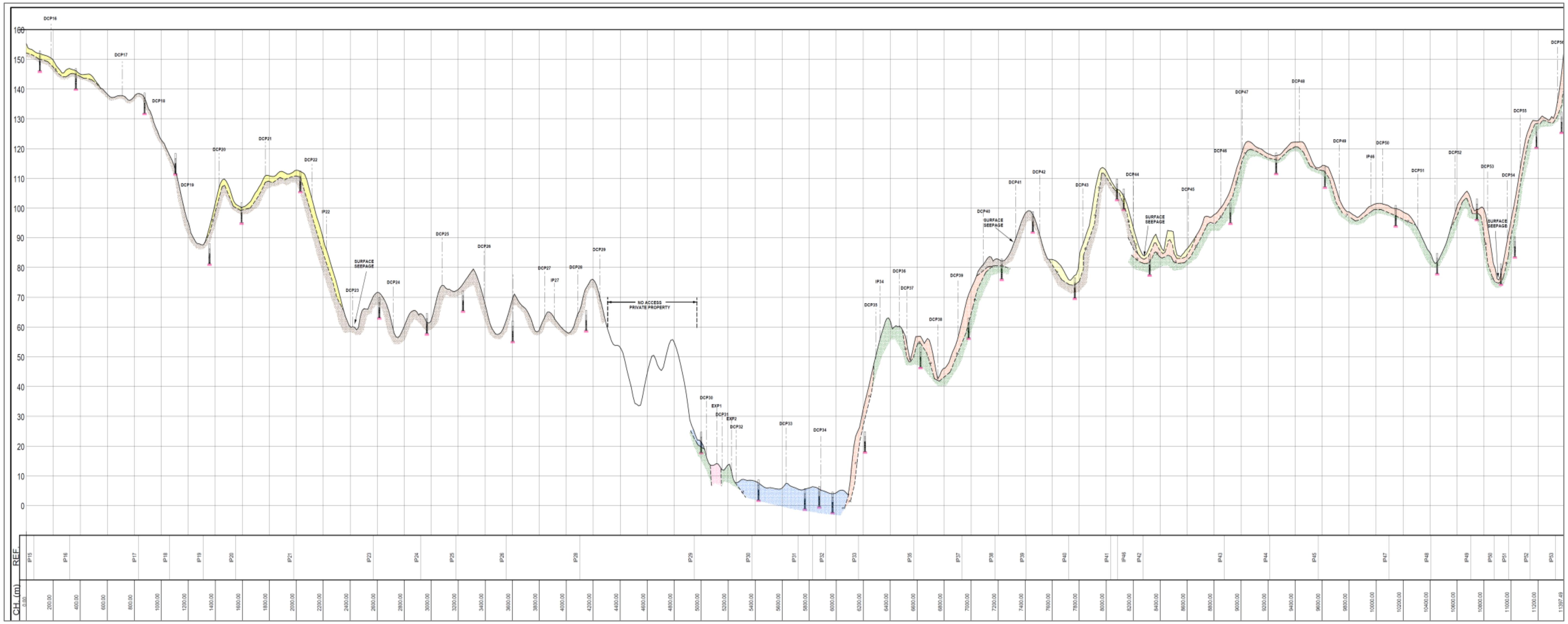


Figure 8.5: Long-section through site, from La Mercy Reservoir to Waterloo Reservoir, showing the Mdloti River and seepage areas referred to in the text of the present document. Figure extracted directly from Appendix B, Aurecon 2015 –

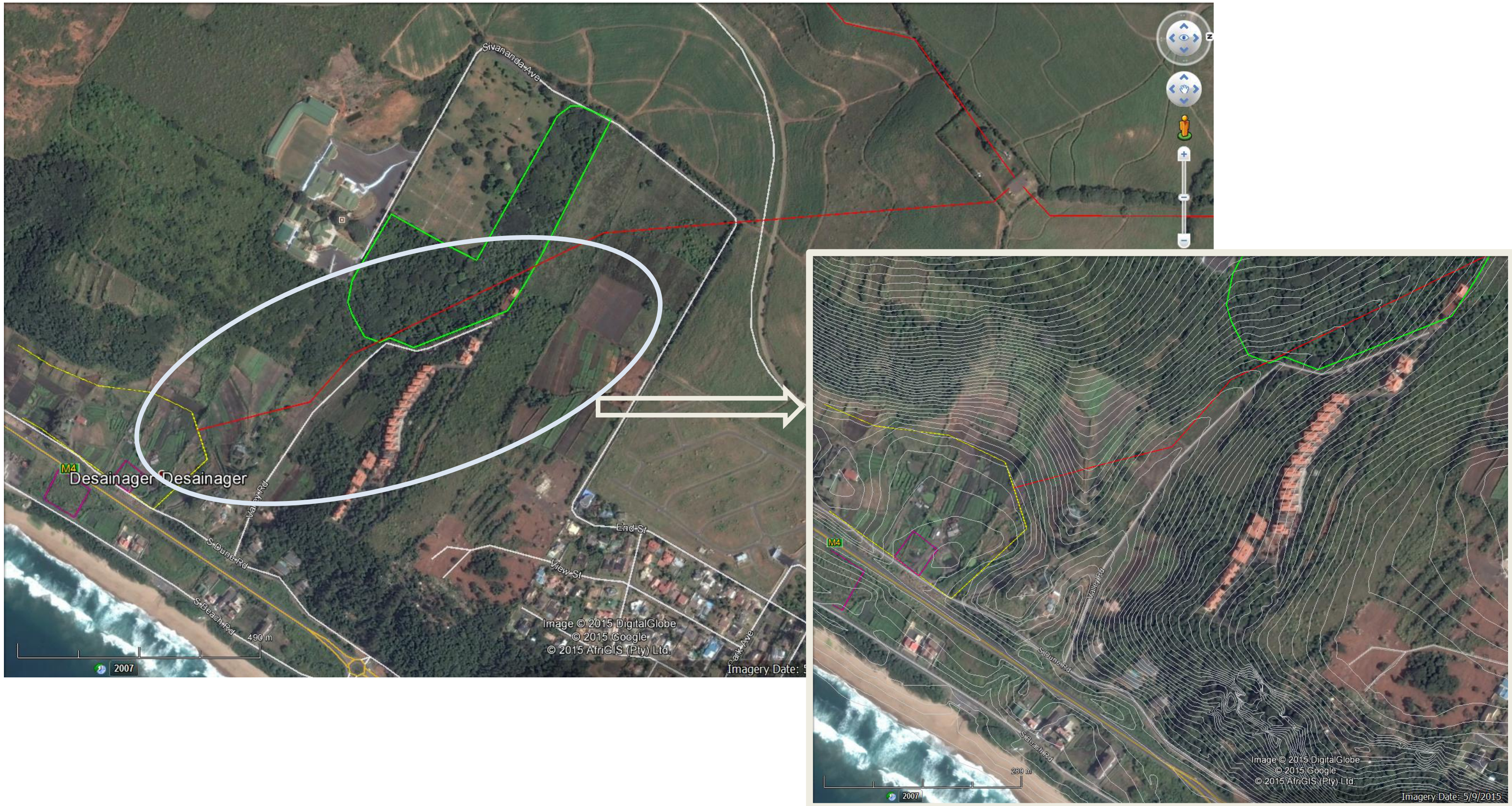



Figure 8-6: GOOGLE images of the proposed pipeline route (red line) – desalination plant to La Mercy Reservoir. Note rotated North arrow, and inset showing 2m contours to illustrate drainage line along Valley Road. Green polygon indicates mapped FEPA wetland, also shown in SANBI fine scale map as an Alluvial Wetland with Subtropical Alluvial Vegetation.


Figure 8-7: GOOGLE images of the proposed pipeline route (red line) –La Mercy Reservoir to Waterloo Reservoir route. La Mercy Reservoir to Mdloti River section. Note rotated North arrow. Blue polygons indicates mapped FEPA wetlands, also shown in SANBI fine scale maps

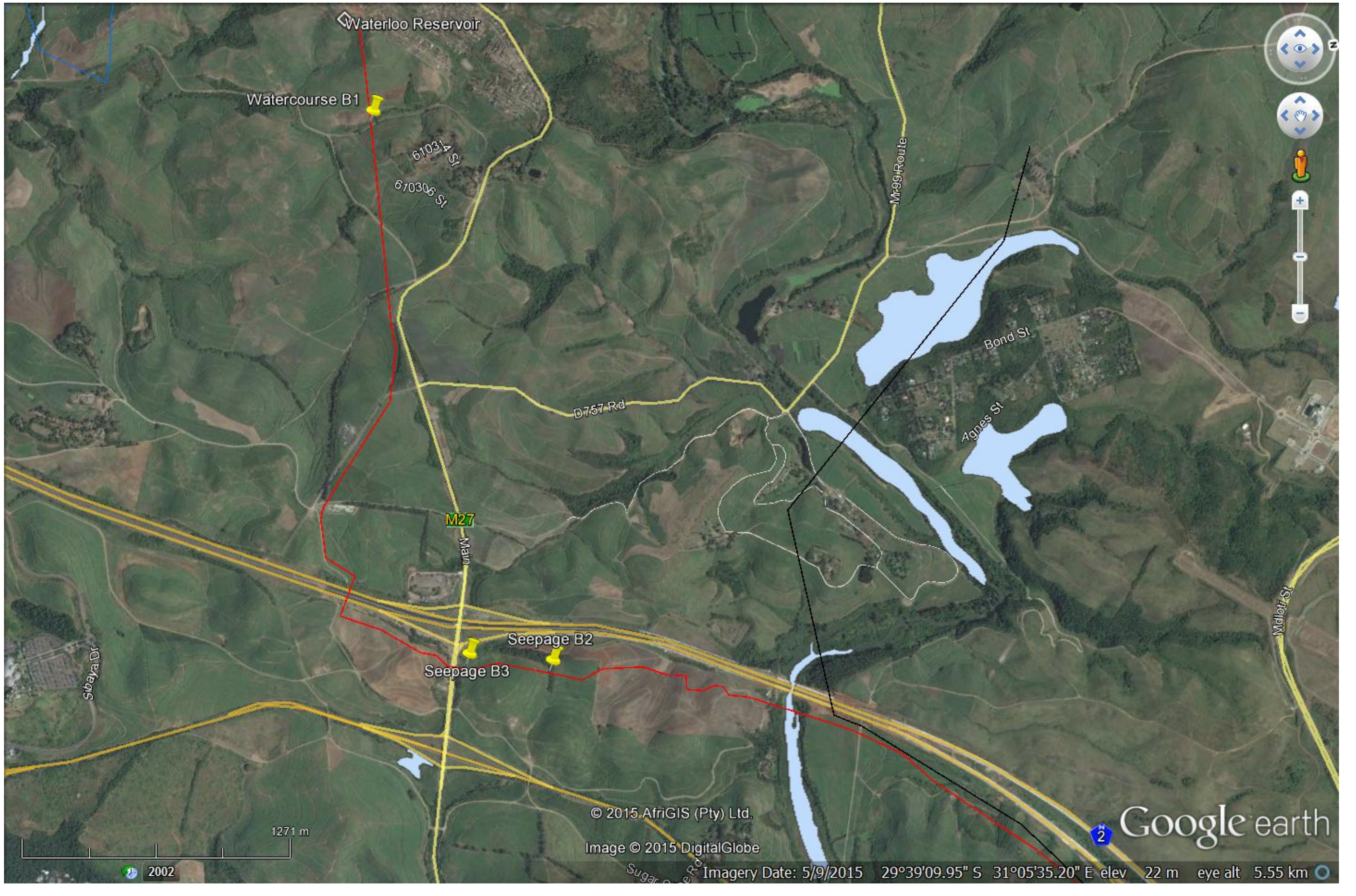



Figure 8-8 : GOOGLE images of the proposed La Mercy to Waterloo pipeline route (red line) – Waterloo Reservoir to the Mdloti River crossing section. Note rotated North arrow. Blue polygons indicate mapped SANBI fine scale map data for Mdloti River wetlands and tributary

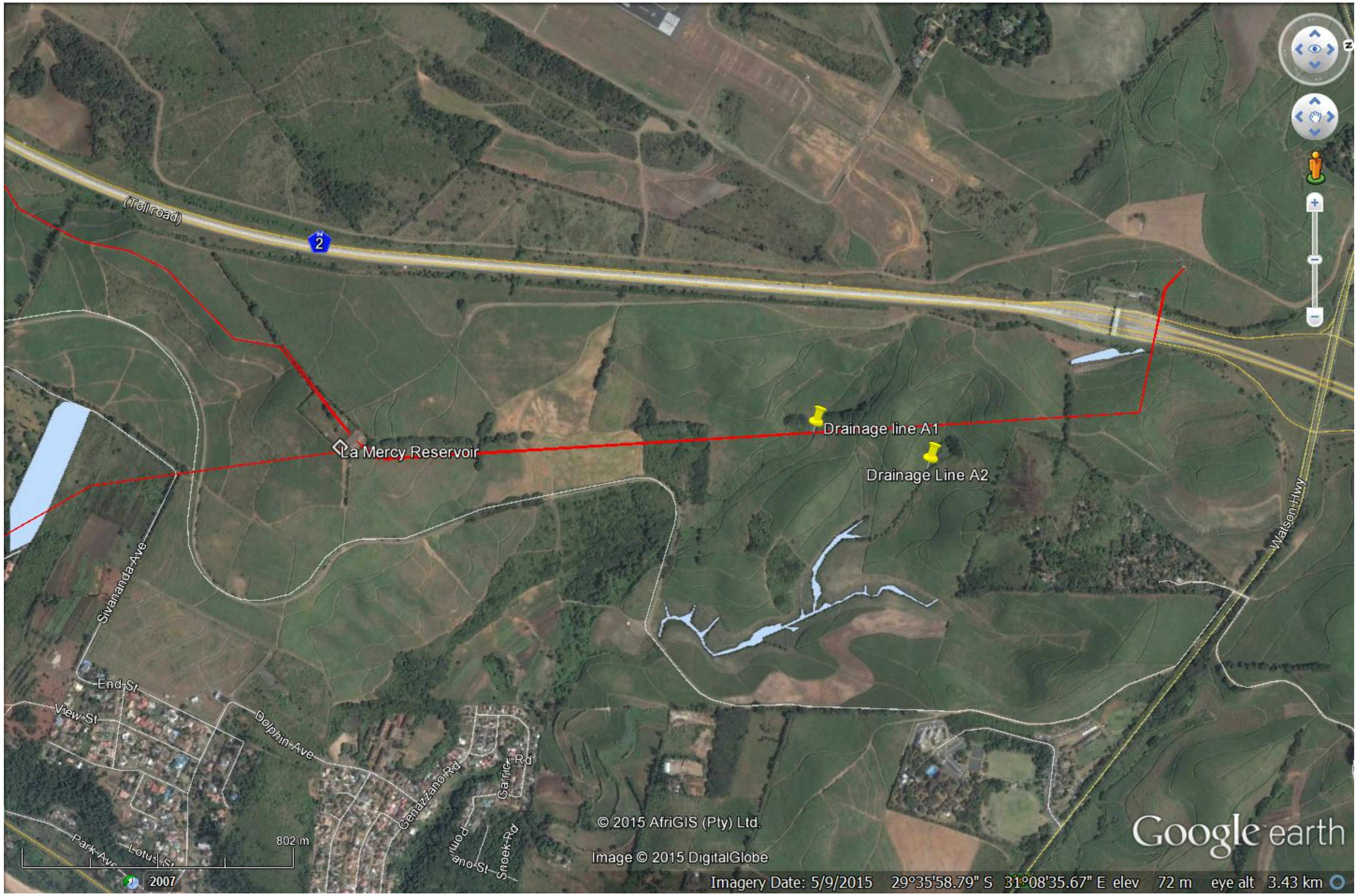



Figure 8-9: GOOGLE images of the proposed La Mercy to Waterloo pipeline route (red line) – La Mercy Reservoir - Bifurcation line. Note rotated North arrow. Blue polygons indicate mapped SANBI fine scale map data for Mdloti River wetlands and tributary.

#### *8.3.3.2 Freshwater aquatic ecosystems along the proposed potable water pipeline route: from the desalination site to La Mercy Reservoir*

Figure 8-6 illustrates that the proposed pipeline route along this segment would pass out of the desalination site, and through a vegetated valley bottom, running parallel to Valley Road, and then cutting across cane fields towards the existing La Mercy Reservoir. The pipeline would be routed along the lowest point of the valley, at least in places. A portion of the vegetated valley bottom area has been mapped as a FEPA wetland and included in SANBI finescale data as a subtropical coastal alluvial wetland.

During the site visit, the mapped FEPA wetland was accessible only from Sivanandra Avenue (Figure 8-6). This indicated dense coastal forest, but no drainage line with any visible wetland or riparian features, at least in the upper reaches near to the road.

A steep valley, draining towards the coast, and passing just south of Valley Road is indicated in the contour map shown in Figure 8-6, and is partially included in the FEPA polygon. The valley was inaccessible as a result of dense vegetation, although the first 430m of its length from the desalination site boundary were walked, until the vegetation became impenetrable. No signs of riparian vegetation or of seasonal or perennial wettedness were observed in this area, suggesting that it is unlikely that such conditions occurred higher up the drainage line either. The drainage line is relatively high lying (36m amsl at the lowest point crossed by the pipeline route), and well above the levels at which groundwater daylights in the dune to the south (a ±1.5m deep excavation to expose the water table has been made at about the 26m amsl contour on the desalination site – see Photo G). Thus although there is undoubtedly a drainage line running adjacent to the proposed pipeline route and immediately south of Valley Road, it appears that surface flows along this line are largely dissipated into the dune sands, or taken up by coastal vegetation, and that groundwater levels are well below the level of the valley floor, for most of its length. The only signs of aquatic ecosystems associated with the drainage line were in its reaches downstream of the M4, below the 12m contour, whereafter the watercourse displayed aquatic ecosystem features, before dissipating as a visible trickle onto the beach. It is likely that, in the event that largescale clearing of coastal vegetation occurred, and particularly if this was accompanied by catchment hardening (e.g. associated with development), that the upstream watercourse would become a more significant feature, with stronger flows and less dissipation into surface sands.

No aquatic ecosystems were observed within the cane fields beyond the FEPA wetland, as far as the La Mercy Reservoir, and the only aquatic issues likely to be of concern would be those regarding the treatment of runoff, with the creation of eroding drainage lines being a potential consequence of unmanaged runoff from roads through the agricultural area.

#### *8.3.3.3 Freshwater aquatic ecosystems along the proposed potable water pipeline route from La Mercy Reservoir to the Mdloti River*

From the La Mercy Reservoir, the proposed pipeline would run through an area just east of the N2 highway, almost comprising cultivated cane fields, intersected in places by internal (unpaved) and paved roads. The pipeline would generally be routed across higher lying areas, but in places, as shown in Figure 8-5, the topography drops, and the pipeline follows the topography.

Between La Mercy Reservoir and the Mdloti River crossing, the proposed alignment passes through only one area where a small hillslope seep (Seep B1) was encountered within the cane fields. This seep, marked by Aurecon (2015) as exhibiting "surface seepage" (see Figure 8-6) and shown in Photo M comprised a highly degraded wetland seep, which has lost virtually all natural vegetation associated with seepage wetlands. Based on the findings of the geotechnical study at Inspection Pits (IP) 21 and 23 on either side of the seep, along the pipeline route, the seep is likely to reflect the daylighting of a shallow, perched water table, daylighting into shallow sands / topsoils above a clay layer, described (for the nearby site IP23) as moist, reddish brown very sandy clay from the Berea Formation (Appendix B of Aurecon 2015).

Photo M
Seep through cane fields
north of Mdloti River

Its condition has however been assessed as PES Category E, given the extent of degradation. Table 8-3 presents data on the condition and other attributes of this small seep, as assessed during the site visit.

No other freshwater ecosystems have been identified along the proposed pipeline alignment as far as the Mdloti River. It is however possible that there are other seeps that are not apparent in the dense cane fields or that would arise in wetter conditions. This issue is discussed in this report in Section 8.4.

#### *8.3.3.4 The Mdloti River Estuary at the potable pipeline crossing*

**Photo N**

Mdloti River just upstream of the N2 road bridge showing dense Eucalyptus stands and reedbed river

NFEPA data show that the T2 crosses the Mdloti River in its estuarine reaches, with the upstream reaches of the estuary extending just upstream of the bridge. The aquatic ecosystem in these reaches comprises the main river channel, within broad bands of reedbed wetland, separated from the main channel by low lying levees. The channel upstream of the bridge is lined with mature stands of alien gum trees (*Eucalyptus* sp. which result in shading of the bank and the maintenance of a relatively sterile understorey as a result. At the time of the site visit, upgrading of the N2 road bridge limited access to the river bank, and was associated with disturbance (excavation by earth moving equipment) along the channel margins. The downstream side of the estuary (right hand bank, looking downstream) sloped up steeply, while the other banks were flatter and lower.

The Mdloti Estuary was rated by Turpie and Clark (2007) as having a moderately high overall importance score of 72.8, based on ratings of 80 and 90 for each of size and habitat importance, but only 10 for habitat rarity and 69 for biodiversity importance. The more recent Estuary component of the National Biodiversity Assessment (van Niekerk and Turpie 2011) categorized estuarine habitat in this system as comprising mainly open channel, with a similar areas made up of reeds and sedges, as well as sand/mud banks and swamp forest. These authors cited the estuary as having a Current Health Category of D, with a Recommended Ecological Category of C. The main impacts affecting the estuary as noted by this study included high levels of pollution and habitat loss, as well as mining. In terms of estuarine Health, the estuary was rated as in Good condition with regard to its hydrology, with an overall Fair condition rating for Habitat State, a Poor condition rating for Biological State and a Fair condition rating for Mean Estuary Health.

#### *8.3.3.5 Freshwater aquatic ecosystems along the proposed potable water pipeline route from the Mdloti River to Waterloo Reservoir*

The proposed route of the pipeline between the Mdloti River crossing and the Waterloo Reservoir would run almost entirely through cultivated cane fields, as far as the Waterloo Reservoir. The exceptions to this land use comprise short areas of road reserve, where the pipeline would be jacked under the M27 (to Mdloti) and again, under the N2, as the pipeline swings towards the Waterloo Reservoir, just east of the small settlement of Waterloo.

Along this route, shown in Figure 8-8, the pipeline would intersect at least three watercourses, labelled in the figure as Seepages B2 and B3 and Watercourse B1. The watercourses were also identified as "surface seepage" areas in the Geotechnical Report (Appendix B of Aurecon 2015), as reproduced in Figure 8-6 of the present report. Of these, Seepage B2 was not accessible during the site visit, and GOOGLE imagery in combination with the geotechnical report findings was used to describe this seep, which is considered a highly disturbed, low-lying and small seep, occurring within cane fields. The nearest Inspection Pit described in Appendix B of Aurecon (2015) is IP39, which is indicated in section as having a shallow (20cm) surface layer of fine loosed Aeolian dune sand, overlying moist brown clayey sands of the Berea Formation, which would be likely to impede surface flow and could contribute, in low-lying areas, to the formation of seep conditions.

Seepage B3 is considered a product of past excavation, drainage and runoff from the adjacent major roads, resulting in a low-lying area with wetland characteristics (e.g. surface soils saturated for extended periods), which conveys road edge and local runoff into a culvert leading under the M27.

The third watercourse lies in the vicinity of the Waterloo Reservoir, at the base of the steep hill on which the reservoir is situated. The watercourse comprises a minor drainage channel, classified (in terms of Ollis et al 2013) as a channelled Valley Bottom wetland, which drains (eventually) into the Ohlanga River – a NFEPA river, the catchment of which lies just south of the Mdloti River catchment (see Figure 8-1). At the time of the site visit it was channelized and eroded in places, supporting stands of *Eucalyptus* gums along its banks and, outside of patchy reeds and sedges, little indigenous vegetation. Its condition in the reaches potentially crossed by the pipeline has been assessed as PES Category D, which takes into account assumed changes in natural hydrology and extensive loss of indigenous vegetation. Table 8-3 presents data on the condition and other attributes of this small watercourse.

No other freshwater ecosystems were identified along this section of the proposed pipeline, although it is noted that in the area west of the N2, as far as Waterloo, there are numerous valley bottom wetlands, and slight alterations in the proposed alignment could result in additional systems being crossed.

#### *8.3.3.6 Freshwater aquatic ecosystems along the proposed potable water pipeline route from La Mercy Reservoir to the Bifurcation section*

The proposed pipeline would cross through one watercourse (Drainage line A1) and pass in close proximity to another one (Drainage line A2) along this section of the proposed pipeline alignment. Of these, the former comprises a narrow channelled hillslope seep, closely abutted by (and in places, invaded by) cane field. It drains into a small stream system that daylights onto the beach near Gezzano, some 2km north east along the beach from the proposed desalination plant. The pipeline would pass just upslope of Drainage line A2 – a minor hillslope seep that is joined by other seeps and forms a small channelled valley bottom system, classified in the SANBI fine scale wetland layer as an Alluvial Wetland (subtropical alluvial vegetation) and in the NFEPA data as a FEPA wetland, and classified in this dataset as an "Indian Ocean Coastal Belt Group 2 Channelled valley-bottom wetland". These seeps and their downstream valley bottom wetlands are considered highly sensitive to erosion, and most have been highly degraded by extensive loss of indigenous wetland vegetation and changes in hydroperiod and natural catchment characteristics, largely as a result of extensive catchment-scale cane cultivation.

In addition to the above watercourses, it is possible that there are some seeps in the area that have not been identified in the dense cane fields or that would arise in wetter conditions. These would be likely to be highly degraded and minor, and their treatment in a development context is discussed in Section 8.4 of this report. The geotechnical survey did not however highlight any areas of potential seepage either, along this alignment.

Table 8-3: Summary of condition and importance of wetland ecosystems crossed by the proposed potable water pipeline

Sites as shown in Figures 8-7 to 8-9

| **SITE NAME** | **WETLAND TYPE** | **PRESENT ECOLOGICAL STATE (PES) / CONDITION** | **ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)** | **CONSERVATION IMPORTANCE** |
|---|---|---|---|---|
| Seepage B1 | Hillslope seep | Category D/E | Low/ marginal | Low – because of extent of degradation |
| Seepage B2 | Hillslope seep | Category E | Low/ marginal | Low – because of extent of degradation |
| Seepage B3 | Channelled Depression | ARTIFICIAL | Low/ marginal | Low |
| Watercourse B1 | Channelled Valley bottom wetland | Category D | Low | Moderate – corridor value |
| Drainage Line A1 | Hillslope seep | Category D | Low/ marginal | Low |
| Drainage Line A2 | Hillslope seep | Category D | Low/ marginal | Moderate – corridor value |

### *8.3.3.7 Freshwater aquatic ecosystems along the as-yet unplanned 132kV transmission line from the proposed desalination site to the 132 kV line proposed by eThekwini municipality*

Figure 8-10 shows the area that would need to be crossed by the transmission line to link to the proposed 132 kV line from La Mercy, as assessed in the next section. At the time of this report, two alternative alignments had been suggested. On the basis of the 2m contours shown on GOOGLE imagery in the figure, it is clear that both alignments would pass over a number of drainage lines, with Alternative 2 crossing over fewer than Alternative 1. The 200m corridor alignments have been assessed at desktop level only, but the significance of these drainage lines in terms of aquatic ecosystem biodiversity is assumed to be low, as extrapolated from sections of the alignments that were ground-truthed.

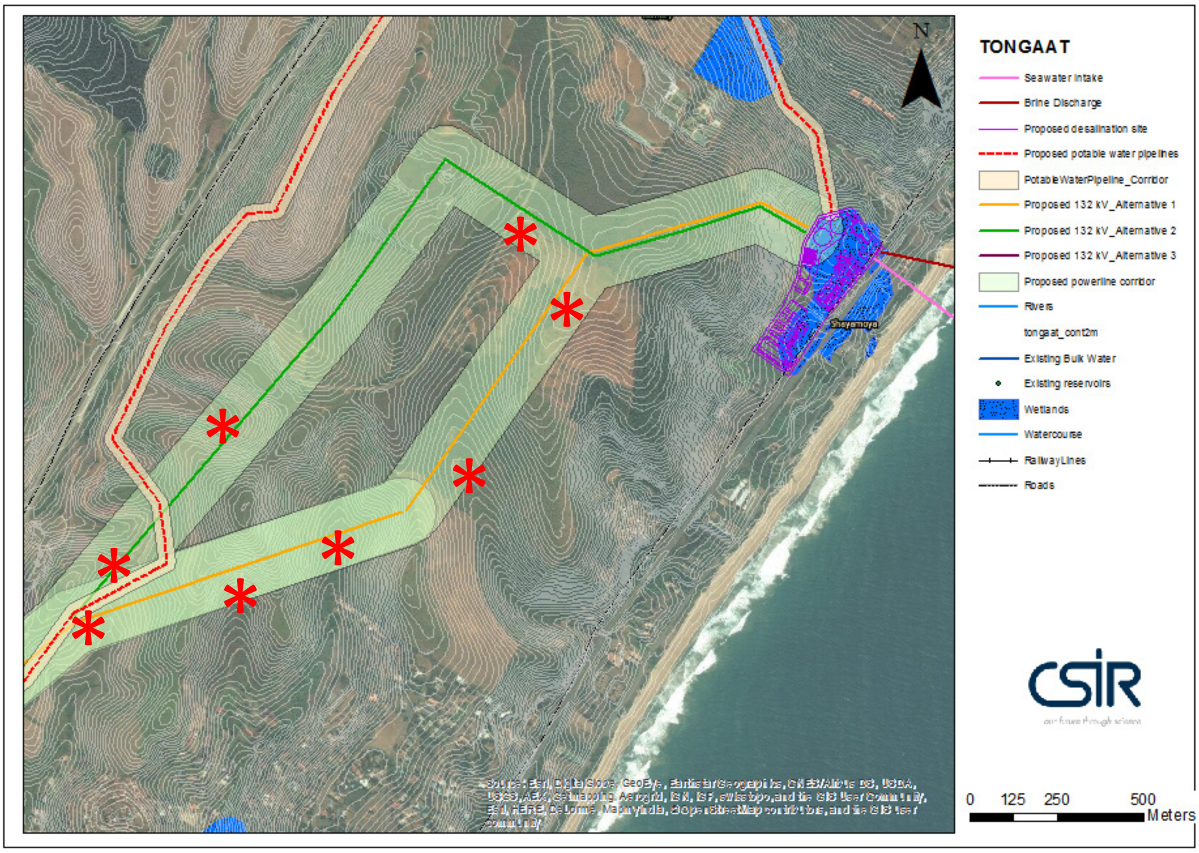



Figure 8.10: Distance to be crossed by the transmission line from the proposed desalination plant at Desainagar to the planned eThekwini transmission line (Drainage lines asterisked. Contours shown at 2m intervals. Transmission lines shown in 200m corridors)

### *8.3.3.8 Freshwater aquatic ecosystems along the 132 kV line proposed by eThekwini municipality from the La Mercy substation, across the Mdloti River, Lake Victoria and other associated wetlands*

At the time of this report, the alignment of the proposed transmission line from La Mercy substation was conceptual only. Nevertheless, the route as plotted in Figure 8-11 shows that it would pass across three minor drainage lines, would cross the Mdloti River twice and would also pass over / through the Lake Victoria wetlands, near Mount Moreland.

The most downstream crossing of the Mdloti River would be in the estuary reaches, immediately upstream of the N2 bridge. The proposed transmission line would pass over the upper reaches of the estuary (already described in Section 8.3.3.4), in the reaches beset with tall eucalypts (see Photo O).

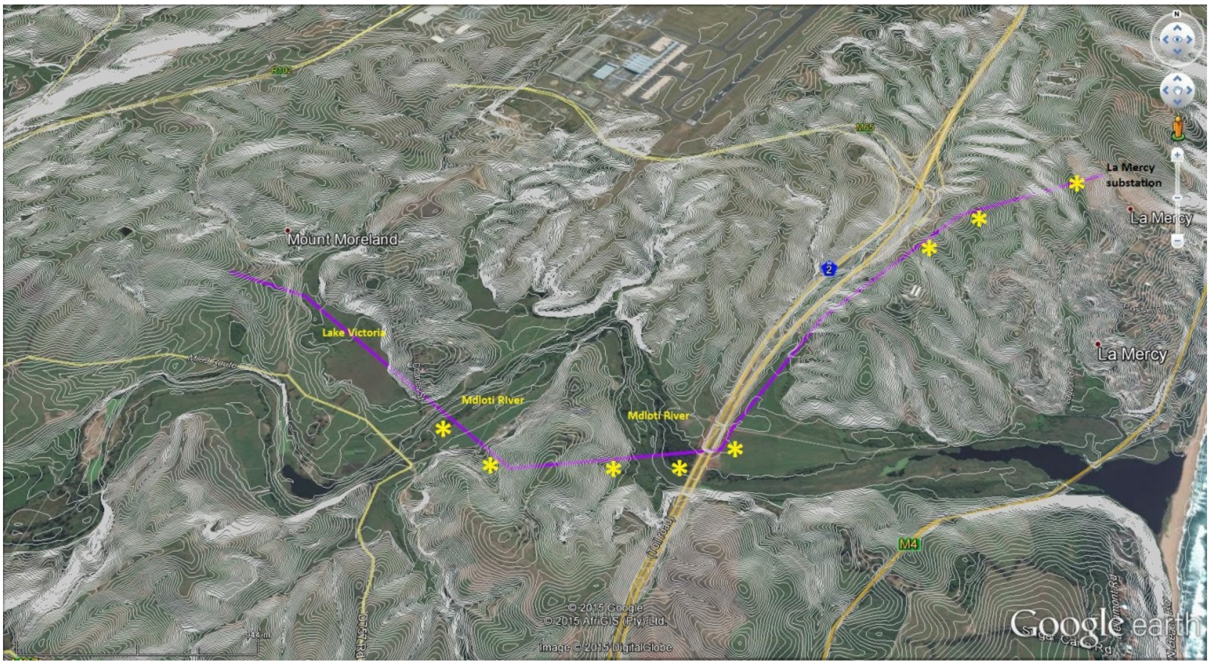



Figure 8-11: Proposed 132 kV Transmission Line alignment (purple line) from La Mercy to substation near Mount Moreland 2m contour lines shown; drainage lines of concern asterisked.

**The Mdloti River near Mount Moreland**

The point of the proposed transmission line crossing lies just downstream of the Ethekwini River Health Monitoring Point "Mdloti d/s Mt Moreland Rd Bridge" referred to in Ethekwini Municipality. (2006). This point occurs along the lower reaches of the river, just upstream of the estuary, as mapped by NFEPA (see Figure 8.1). The river in these reaches is described in the State of Ethekwini Rivers Report (Ethekwini Municipality 2006) as:

- Ecologically "stressed" by the cumulative impacts of the upstream catchment activities and discharges into the Mdloti River – the river reach in question lies downstream of the urban area of Verulam which is assumed (on the basis of river health data presented by Ethekwini Municipality (2006) to contribute poor water quality into the system;
- Characterised by nutrient enrichment from upstream activities, which encourages invasion of Limpopo Grass (*Echinochloa pyramidalis)*- this species threatens to invade into open water habitat during low flow conditions;
- Associated with an Ecostatus of "**Fair**", with the presence of alien vegetation and the removal of indigenous riparian vegetation being the main impacts to river habitat integrity, as assessed in this document.

The river in these reaches at the time of the site visit comprised a broad channel, choked with dense *Phragmites australis* reeds (see Photo P), but including various alien aquatic species, such as bugweed (*Solanum mauritianum*) and water hyacinth (*Eicchornia crassipes*), and terrestrial alien species such as Lantana (*Lantana camara)* and Brazilian Pepper trees (*Schinus terebinthifolius*). The channel is associated in places with broad expanses of reedbed wetlands, classified in the NFEPA data as valley bottom wetlands, and including those associated with small valley bottom wetlands that feed into the main stem of the river. In the Mount Moreland area, such wetlands include Lake Victoria and the so-called Froggy Pond wetland, described in the following section.

**Photo P**

Mdluli River at Mount Moreland turnoff, just upstream of proposed transmission line crossing

**Lake Victoria and associated wetlands**

The proposed transmission line route would cut across the Lake Victoria wetlands – a broad reedbed wetland that feeds into the Mdloti River in the vicinity of the Mount Moreland access road bridge (see Figure 8-12 and Photos P and Q). This wetland has been identified in the SANBI finescale planning layer as a Tall Reed floodplain wetland, with a kZN vegetation type of Subtropical Alluvial Vegetation: Lowveld Floodplain Grasslands. It comprises an extensive (±5 ha) *Phragmites australis* reedbed, invaded along its drier margins by woody alien species such as Brazilian Pepper trees and bugweed, and severely encroached on its northern, western and southern margins by sugar cane cultivation. The Mount Moreland Conservancy website ([http://www.mountmorelandconservancy.co.za](http://www.mountmorelandconservancy.co.za)) notes that the outlet of the wetland is choked by balloon vine, cannas, lantana and Triffid weed.


Figure 8-12: Proposed 132 kV Transmission Line alignment (purple line) in the Mount Moreland area, showing wetlands of concern

Lake Victoria is an important roosting area for Barn Swallows (*Hirundo rustica*), supporting the largest number of these common migratory birds in South Africa. They roost in the reedbeds of both the Lake Victoria Wetland and Froggy Pond in numbers estimated as around three million at their peak in spring and summer. As a result, the broader Mount Moreland area has been listed by Birdlife International as a Global Important Bird and Biodiversity Area (IBA) (rating criterion A4) (http://www.birdlife.org.za/component/k2/item/227-sa123-mount-moreland: accessed June 2015).

Both the Lake Victoria and Froggy Pond wetlands also support at least three indigenous frog species, including the (IUCN listed Critically Endangered) Pickergill's Reed Frog (*Hyperolius pickersgillli)*, the (Vulnerable) Natal Leaf-Folding Frog (*Afrixalus spinifrons*) and the (Vulnerable) Spotted Shovel-nosed Frog (*Hemisus guttatus*). Of these, Pickersgill's Reed Frog occurs only at 10 isolated sites along the kwaZulu-Natal coastline between St Lucia and Kingsburgh, with Mt Moreland hosting one of the biggest known populations of this species (http://www.mountmorelandconservancy.co.za). Du Preez and Caruthers (2009) describe this small frog as occurring in densely vegetated marshy area in coastal bushveld and grassland, with breeding sites concealed in dense emergent vegetation. The Spotted Shovel-nosed Frog also occurs in a limited area of KwaZulu-Natal, where its habitat comprises pans and marshy ground in coastal bush and grassland, but forages over extensive area and diverse habitats (Du Preez and Caruthers 2009). The Natal Leaf-folding Frog is described by the same authors as threatened in its restricted distribution range by farming and urban development, although occurring in a wide variety of coastal bushveld habitats.

On this basis, and using the methodologies outlined in the Appendices (Section 8-10), the Lake Victoria wetland has been accorded a (low confidence) PES of (lower) Category C, indicating moderate modifications, at the lower range of this category, an EIS of Very High (reflecting its support of key populations of rare or endangered species) and a Conservation Importance of High.

**Photo Q**

View across Lake Victoria reedbed from Mount Moreland. The proposed transmission line would cross through this wetland

## 8.4 IDENTIFICATION OF KEY ISSUES AND POTENTIAL IMPACTS

### 8.4.1 Key Issues identified during the Scoping Phase

The potential impacts to freshwater ecosystems identified during the scoping phase of this EIA process were distinguished in terms of different project components, namely the proposed desalination plant itself, and the potable water pipeline alignments.

#### *8.4.1.1 Key issues*

The Scoping Phase of this project made the following comments on possible impacts to freshwater ecosystems, namely:

- Desalination plant
    - From aerial photography, it appears that the development footprint does include natural or artificial wetlands and is in close proximity to a water course. During the EIA phase, the history of formation, characteristics and functional importance of these areas would need to be explored or determined, and the likelihood that the proposed building structure would result in loss of these areas would need to be assessed with more detailed construction / layout information.
    - In addition, issues such as the management of stormwater runoff from hardened surfaces into water courses would also need to be considered.
- Potable water pipeline and other linear infrastructure
    - Disturbance to channel banks and beds at crossing points;
    - Potential triggers of headcut erosion by altering upstream gradients at wetland crossing points;
    - Construction-related water quality impacts.
- Transmission line alignments
    - No alignments for the transmission lines had been determined at the time of the Scoping Report, but it was noted that similar impacts to those identified for the pipelines could be anticipated.
    - Other transmission-line associated impacts that would also need to be considered would be the width of the transmission line
    - corridor and the extent to which it is deemed necessary that it should include a maintenance access road – in this case, the extent of long term disturbance associated with the transmission lines would be greater, and potential impacts such as compaction and disturbance of wetland areas included in such corridors, as well as the potential to trigger donga / head cut erosion at watercourse crossings, would need to be considered.

#### ***8.4.1.2 Issues raised during Scoping Phase public participation:***

- eThekwini's Environmental Planning and Climate Protection Department commented that "Review of the Environmental Planning and Climate Protection Department (EPCPD) GIS database has identified the presence of extensive wetland habitat on the selected Sea Water Reverse Osmosis (SWRO) site. It is acknowledged that the wetland habitat is transformed, however the impact to this systems and the mitigation of potential loss of habitat and ecosystem function must be addressed in detail by the relevant specialist assessments" and "Similarly, the various pipeline and powerline routes have the potential to impact on both wetland habitat and water courses. The necessary precautions must be taken in avoiding impacts to these habitats. Of specific concern are impacts that could have negative effects on the Mdloti Estuary and various systems feeding into that habitat".

- Comment on the presence of red data frog species in the Mount Moreland wetlands was also received from the above department.
- The KZN Wetland Inventory data and data held by Ezemvelo KZN Wildlife should be used, rather than NFEPA data.

### 8.4.2 Identification of Potential Impacts

Based on the information highlighted during the Scoping Phase of this project, and in particular from information gathered during the site visits and assessments, a number of potential direct impacts to aquatic freshwater ecosystems (i.e. rivers and wetlands) have been identified as likely to be associated with different parts of the proposed project, if implemented. These are listed below, noting that "construction phase" impacts include those associated with project design and layout, which would be manifest once construction commenced.

#### *8.4.2.1 Construction Phase*

- Desalination plant and pump station impacts
  - Impact 1: Destruction of wetlands on the desalination plant site;
  - Impact 2: Water quality pollution and sedimentation of wetlands downstream of the site as a result of runoff from the construction site, including drainage of existing storage ponds;
  - Impact 3: Changes in hydrology (i.e. increased flows), sedimentation and water quality pollution of wetlands downstream of the site as a result of runoff from the construction site;
  - Impact 4: Premature daylighting of groundwater on the site and its channelled passage into downstream areas, potentially resulting in erosion of downstream wetlands and possible increased beach saturation levels;
  - Impact 5: Disturbance to the hydrology of (highly transformed) wetlands downstream of South Dune Road as far as the beach, as a result of tunnelling of the proposed brine discharge and seawater intake pipelines to the proposed pump station.
- Potable water pipeline impacts
  - Impact 6: Disturbance to (excavation, removal of vegetation, sedimentation, compaction), and potential loss of hillslope seep wetlands;
  - Impact 7: Disturbance to channelled valley bottom wetlands;
  - Impact 8: Disturbance to the Mdloti Estuary, as a result of disturbance (polluted runoff from waste water and spoil as well as physical disturbance at either end of the drilled tunnel) during horizontal drilling entailed in taking the pipeline across the channel – given the steep slopes of the embankment on the right hand channel (facing downstream), the extent of disturbance associated with tunnelling in this area is assumed to be high; .
- Transmission line alignments
  - Impact 9: Possible disturbance to the identified drainage line in Figure 8-10 as a result of the (as-yet unplanned) passage of transmission line structures across the drainage line, requiring clearing of vegetation to facilitate line stringing, and the installation of transmission line towers;

- Impact 10: Disturbance to the Mdloti Estuary, just upstream of the N2 road bridge, across which the transmission line would cross, necessitating clearing of mature gums and other vegetation to facilitate pylon erosion and line stringing;
- Impact 11: Disturbance to the lower reaches of the Mdloti River as a result of potential location of transmission towers in the vicinity of the river banks, and vegetation clearing beneath the transmission lines;
- Impact 12: Disturbance to the Lake Victoria wetland habitat and associated fauna and flora as a result of installation of pylons in the wetland to allow a total crossing length of some 730m of wetland, resulting in compaction, and water quality impacts (e.g. sedimentation).

#### *8.4.2.2 Operational Phase*

- Desalination plant impacts
  - Impact 1: Runoff of surface water from hardened surfaces, compounding construction/ design phase impacts of increased volumes of water into downstream areas as a result of groundwater drainage / dewatering;
- Pump station impacts:
  - Impact 2: Possible leakage of saline water into freshwater wetlands in the event of damage / breakdown of the pump station;
- Potable water Pipeline impacts
  - Impact 3: Potential for concentrated freshwater to flow into wetlands in case of damage / breakdown of the pipeline;
- Transmission line alignments
  - Ongoing clearing of tall vegetation (e.g. trees) beneath transmission lines would take place, resulting in (localized) alien clearing over the Mdloti estuary as well as over the mixed indigenous / alien invaded but possibly long-term sterilization of riparian areas in the lower Mdloti River. This impact is included in construction phase assessments of the same issue.

#### *8.4.2.3 Decommissioning Phase*

| |
|---|
| This assessment assumes that decommissioning would entail removal of buildings but that transmission lines and pipelines would remain *in situ*, for potential use in upgraded facilities. |

- Desalination plant impacts
  - Impact 1: Passage of sediment into downstream wetlands during removal of plant – it is unlikely that buildings would be physically removed unless part of a new project plan;
  - Impact 2: Possible long-term accumulation of water on the site and re-establishment of wetlands, in the event that drainage systems for cuts into groundwater were not maintained.

#### *8.4.2.4 Cumulative impacts*

**Impact 1:** Loss of coastal wetlands associated with runoff from dune systems.

## 8.5 PERMIT REQUIREMENTS

The following legislation has direct relevance to freshwater ecosystems, as described in this Section, noting that this is not intended to be an exhaustive review of legislation, but simply to highlight key legislation that must be considered, in addition to the National Environmental Management Act (NEMA) (Act 107 of 1998) on which the present EIA document is based:

- The **National Environmental Management**: **Biodiversity Act** (NEMBA) (Act 10 of 2004: Amendment R1187 of 2007) ensures the protection of all species and prohibits any destruction of or damage to any threatened or keystone species and ecosystems. This act also seeks to control invasive plant species that affect indigenous vegetation, and specifies the required treatment of different invasive species. **Permits** may be required in terms of Section 57(1) of this Act, for "[4]restricted activities" involving specimens of "listed, threatened or protected species in terms of Section 57 (1)". In terms of the present project, these would include the three indigenous frog species described in Section 8.3.3.8, namely the Critically Endangered Pickergill's Reed Frog (*Hyperolius pickersgillli)*, the Vulnerable Natal Leaf-Folding Frog (*Afrixalus spinifrons*) and the Vulnerable Spotted Shovel-nosed Frog (*Hemisus guttatus*).

- The **National Water Act** (NWA) (Act 36 of 1998) must be considered with regard to any activity that entails a water use, with water uses further defined in Section 21 of the Act as follows:
    - 21(a): Taking water from a water resource;
    - 21(b): Storing water;
    - 21(c): Impeding or diverting the flow of water in a watercourse;
    - 21(d): Engaging in a stream flow reduction activity;
    - 21(e): Engaging in a controlled activity;
    - 21(f): Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit;
    - 21(g): Disposing of waste in a manner which may detrimentally impact on a water Resource;
    - 21(h): Disposing in any manner of water which contains waste from, or which has been heated in any industrial or power generation process.
    - 21(i): Altering the bed, banks, course or characteristics of a watercourse.
    - 21(j): Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people.
    - 21(k): Using water for recreational purposes.

Authorisation for any of the above activities would need to be obtained from the Department of Water Affairs and Sanitation (DWS) through a Water Use Licence Application (WULA), where they are conducted within 500 m of a wetland.

- While certain uses (e.g. Section 21c and i uses) may be Generally Authorised in terms of the NWA, where they take place in rivers, rather than wetlands, and in excess of 500m from a wetland boundary, such uses would require Registration through the DWS;
- Activities that would definitely trigger either GA registration or WULA requirements would include:
    - Construction of the proposed desalination plant in a wetland;
    - Excavation of pipelines through or within 500m of a wetland – this applies to all of the wetlands described in this study including the Lake Victoria wetlands;

4 The term "Restricted activity" is defined in NEMBA, and includes activities that would damage or destroy any specimen of a listed or protected species.

- Construction of transmission lines across wetlands or rivers;
- Passage of pipelines across wetlands or rivers;
- Consultation with DWS officials should take place during the EIA phase of the project, to obtain clarity as to the process to follow in this regard, noting that in practice there is often a wide discrepancy in the requirements imposed by different regional and national DWS officials in this regard.

## 8.6 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

### 8.6.1 Construction Phase

#### *8.6.1.1 Desalination plant and pump station impacts*

**Potential Impact 1:** Destruction of wetlands on the desalination plant (which includes the proposed pump station): Specifically, both the northern and the southern wetlands shown in Figure 8-4 would be destroyed by construction of the desalination plant, if it extends across the full extent of the site. In addition to loss of (now largely artificial excavated) wetland habitat, presumably as a result of wetland infilling, this impact would destroy all ecosystem services offered by these wetlands – however, such services are specific to their current use – namely agriculture, and centre on some trapping of sediments and nutrient amelioration. In the absence of agricultural use of the site, the requirement for such services would largely fall away. Wetland services such as flood attenuation are however also provided by the wetlands on site, and the loss of such services would be likely to affect downstream wetland integrity, with the passage of increased flows downstream, and onto the seep daylighting onto the beach.

This impact would be considered negative, and associated with the permanent loss of wetlands and their functions on the site, thus also constituting an opportunity cost, in that future wetland rehabilitation would no longer be possible either. Thus despite the fact that these have already been highly and permanently modified from natural, such impacts are assessed as occurring at a high scale of intensity, associated with a notable alteration in natural patterns and processes (particularly hydrology) but not impacting wetland fauna or flora directly, given that these have been largely eliminated from the site already. The extent is considered local, given that these coastal / dune wetlands occur along the abutting coastline in several areas (albeit many of them are already impacted). The impacts are however considered irreversible, definite and of **high** significance.

*Key Mitigation:*
During early iterations of this report, on-site mitigation was proposed as follows:

- Minimising wetland loss by locating the bulk of the proposed desalination footprint further towards the southern portion of the site, so that the flow of water through the northern, wetter part of the site is least affected, and attempting to rehabilitate at least part of this wetland, so that improved levels of function, particularly with regard to flood attenuation and provision of wetland habitat might be achieved. It is possible that if substantial efforts were focused on rehabilitating wetland function, at least in the perennial wetland mapped in Figure 8-4, and in the area immediately upslope of this (i.e. north west to the site boundary) improvement in wetland condition to a PES Category D might be achievable. This would also allow for the more sustainable treatment of stormwater flows from the site, using the rehabilitated wetland as the receiving body for stormwater generated on at least parts of the site, and from cut-off drains assumed to be a necessity in the construction process. Reconfiguration of the proposed layout of the site, including possible re-siting of the proposed pump station, would be required to allow for implementation of this measure, with the final layout being determined in discussion with a wetland ecologist, but including the following elements:

- Retention and rehabilitation of an upslope swathe of width at least 30m, from the edge of the rehabilitated wetland (see below) to the site boundary;
- Allowance for re-landscaping and shaping of the area set aside for wetland rehabilitation, such that it links functionally with the upslope swathe, and does not merely comprise a deep excavated pond, but is shaped and vegetated to incorporate a range of seasonally to perennially wet to inundated habitat types. It is assumed that implicit in the rehabilitation activities would be possible removal and rehabilitation of the footprints of the existing buildings in this part of the site, likely in any case to be removed as part of the proposed new development. While there is scope for manipulation of the final extent and proposed shape of the wetland area, it should be at least 50m in width (including a devised setback area), and include logical surface – groundwater flow pathways;
- Clearing of invasive alien plant material from areas to be rehabilitated;
- Allowance for planting of the rehabilitated area with appropriate indigenous vegetation;

- The rehabilitated wetland extent, design, links with the stormwater management plan and development interface must be finalized during the detailed design phase of the project, and close collaboration between the wetland ecologist, working in collaboration with the site engineer and a botanical specialist.

Even with the above efforts to minimise impacts and allowing for on-site offset mitigation measures, loss of the southern wetland and of a substantial portion of the northern wetland would definitely still occur. During iterative interactions with the project engineers, it was also noted that the above recommendations could not be accommodated along with the desalination plant, without seriously compromising the objectives of both. As a result, **an alternative approach** was developed to offset the impacts described above. Implementation of these measures requires additional land to be purchased for these purposes, and managed as outlined below. The area in which the proposed mitigation would take place has been indicated in Figure 8.13. The following specific activities would need to be included in this regard:

- The wetlands downstream of the desalination plant must be rehabilitated and managed as near-natural wetland systems ( as opposed to agricultural lands) – this means that the land itself, identified in Figure 8-13 in red polygons, must be under the control (and thus ownership) of Umgeni Water;
- Long-term management of the offset wetland area must be allowed for, to ensure attainment and retention of its required condition;
- Subsurface and surface drainage from the north eastern portion of the desalination plant site must be dissipated into these wetlands, via a series of specifically designed dissipation trenches constructed and maintained along the upstream (i.e. road) edge of each wetland portion so as to allow the broad dissipation of flow into the wetland, and encourage wetland function in these areas;
- Existing cultivated crops would need to be replaced with locally indigenous wetland vegetation, the species composition of which should be established in consultation with a botanist with local knowledge;

- Maintenance of wetland areas would need to be ongoing, and allow for alien plant removal as well as the maintenance of infiltration trenches, prevention and management of erosion, and the maintenance of extensive plant cover;
- The rehabilitated wetland extent, design, links with the stormwater management plan and development interface must be finalized during the detailed design phase of the project, with close collaboration between the wetland ecologist, the site and/ or design engineer and a botanical specialist;
- An ecological corridor, vegetated with locally indigenous vegetation, must be established along the north eastern boundary of the site, in a band of width 20m minimum, extending to the undeveloped land on the upslope side of the property – the purpose of this would be to maintain a level of ecological connectivity between the lower wetland areas and the upland portions of the catchment, not-withstanding the acknowledged high level of fragmentation that is already associated with the impact of roads. If security fencing is used to secure the site, then this corridor should be outside of the fenced area.


Figure 8-13 Proposed (compromise) conservation of wetlands off-site in exchange for wholesale loss of wetlands on the site. Wetlands earmarked for downstream rehabilitation and management (and by implication, sale of land to Umgeni Water) shown as red polygons. Proposed 20 m ecological corridor shown as red arrow – width not to scale.

Implementation of the key mitigation measures outlined above would reduce the impact associated with this project substantially. The impacts would however result in major alteration to the environment even with the implementation on the appropriate mitigation measures. Application of the impact rating system used in this study (see Table 8.4) resulted in assignment of a significance rating of 10 for this impact, allowing for mitigation as outlined above. This falls into the threshold (10-17) of a High significance impact, correctly reflecting the scale of permanent environmental change that would still accrue, despite the clear influence of mitigation measures. The significance rating was however manually reduced to just below this threshold, to a rating of **medium to high** (9.5) with mitigation. This was done to take cognisance of the extent to which the wetland is currently degraded, and the potential improvement in PES category to the downstream wetland afforded by the rehabilitation measures, if adequately implemented.

Ideally, similar offset mitigation should take place for the wetlands lost from the south east of the site. However, these measures are not considered essential, in that the (essential) rehabilitation of natural plant communities and the management for flows from the north eastern part of the site would in fact be a significant improvement in wetland function in this area, and similar levels of offset rehabilitation for all affected wetlands on the site cannot be justified, given their current state of degradation.

**Potential Impact 2:** Water quality pollution, sedimentation and the passage of aquatic alien vegetation into wetlands downstream of the site as a result of runoff from the construction site.

The construction phase of the proposed works would result in high levels of physical disturbance of the site, and would also require, it is assumed, the emptying, infilling and compaction of existing ponds excavated into the water table. It is thus likely that downstream wetlands, including the channelled outlet to the sea, would receive additional inflows of sediment, both inorganic sediment from disturbed sands on the site, and (potentially) organically enriched sludges and water from the ponded areas. The impact of this would be greatest in the nearest wetland, comprising the impacted, cane-invaded wetland between the M4 and South Dune Road. Affected wetlands would potentially be more prone to (terrestrial) alien invasion in areas of sediment accumulation, while if ponds are drained into downstream areas, some aquatic weeds would also pass into receiving areas, with alien plants including *Azolla filiculoides* and *Myriophylluym aquaticum* potentially included amongst plants passed downstream. Note however that the impacted systems downstream are already vulnerable to occasional flushing downstream, and the systems are small, not characterized by standing water and unlikely areas in which these plants would thrive.

This negative impact would be considered of **medium to low** intensity, affecting hardy wetlands on a local basis (just downstream of the site) and would be likely to be relatively short-term and limited to the construction phase. The wetlands they would affect are degraded, and have relatively low (but not no) sensitivity to such disturbance, particularly downstream of South Beach Road. The impact would probably have high reversibility, and is considered of low probability, particularly with distance downstream, affecting impacted wetlands that are locally not rare.

*Key Mitigation*

- Measures should be set in place through a Construction Phase Environmental Management Programme (CEMP) to minimize the passage of sediments from the disturbed site into downstream areas – these measures should include sediment stilling ponds (or devices with similar functions) sized so as to contain and treat all dewatering and construction phase runoff from disturbed areas;
- Runoff from cuts into the dune should be managed so as to bypass any construction areas, without accruing additional sediments or construction-associated contaminants.

With the implementation of the proposed mitigations as described above, the impact significance would be expected to shift from low-medium (no mitigation) to **low**.

Additional measures recommended to address the treatment of organic material in existing ponds include that these ponds should be dredged prior to construction, and the spoil either included in compacted material used on the site, or disposed of elsewhere, where it will not impact on wetland or other sensitive systems;

**Potential Impact 3:** Changes in hydrology (i.e. increased flows), sedimentation and water quality pollution (e.g. cementitious water) of wetlands downstream of the site as a result of runoff from the construction site – the invert of the pump station sump would need to be at a depth of 11 m bmsl, meaning that between 36 and 38m depths of sand would need to be excavated out, to reach this depth at the proposed site. Sand extracted from this area would probably be in a loose slurry, given the locally high water table, and dewatering of excavated areas would potentially result in the discharge of sand-laden water from the site, increasing sedimentation of downstream areas.

Indirect effects such as dewatering of adjacent and/or downstream wetlands as a result of the excavation and dewatering of deep sumps such as this would also be possible.

This negative impact would be considered of medium to low intensity, affecting (albeit disturbed) wetlands on a local basis (just downstream of the site) through the construction phase, although dewatering of groundwater is assumed to be an essential part of plant design, and thus required on a long-term basis. The affected wetlands are degraded, and have relatively low (but not no) sensitivity to such disturbance, particularly downstream of South Beach Road. The impact would probably have low to moderate reversibility, and would be considered probable, although affecting wetlands that are locally not rare, albeit mostly impacted in the broader area.

*Key mitigation*

- Deep excavation would need to incorporate cut-off sleeves or other devices that separate upland groundwater inflows from the excavated area, and allow for their passage and subsequent infiltration / diffusion downstream of the site, without resulting in erosion of downstream wetlands;
- The efficacy of proposed mitigation designs would need to be interrogated (and approved) by a wetland specialist prior to incorporation into detailed design.

With mitigation as described above, the impact significance would be expected to shift from **medium** (no mitigation) to **low**.

**Potential Impact 4:** Erosion of downstream wetlands draining onto the beach and possible increased beach saturation levels, as a result of premature daylighting of groundwater on the site and its channelled passage into downstream areas. This impact would be triggered by cuts into the hillslope (e.g. to create a building platform) that exacerbated existing premature daylighting of groundwater, and its channelling through the site. In the absence of irrigation requirements on the site, it is assumed that subsurface drainage of this water and its passage into downstream wetlands would be required, resulting in increased rates and volume of surface flow from the site. Although not a freshwater ecosystem impact, increased beach saturation can affect beach quality for users. This impact would be initiated in the construction phase but would continue through the operational phase of the development, and presumably even after decommissioning, and is thus considered permanent.

This negative impact would be considered of medium to low intensity, affecting wetlands on a local basis (downstream of the site). The affected wetlands are degraded, and have relatively low (but not none) sensitivity to such disturbance, particularly downstream of South Beach Road. The impact would probably have high irreversibility (as it would be implicit to the design of the plant), and is considered of medium to high probability, although affecting wetlands that are locally not rare, albeit mostly impacted. Without mitigation, this impact is therefore anticipated to be of **medium** significance.

*Key Mitigation measures*

- The plant design should incorporate measures that allow collection of groundwater flows upstream of the built structures of the desalination plant, and their diversion and subsequent infiltration across the full width of the existing two wetland basins downstream of the built structures, such that downstream wetlands (including the agricultural areas) are impacted by neither too much concentrated runoff, nor by diversion of runoff.
- The efficacy of proposed mitigation designs would need to be interrogated (and approved) by a wetland specialist prior to incorporation into detailed design.
- Rehabilitation of a portion of the northern wetland, as outlined in Key Mitigation for Impact 1, would also mitigate against this impact;

With the implementation of key mitigations as described above, the impact significance would be expected to shift from medium (without mitigation measures in place) to **low-medium**.

**Potential Impact 5:** Disturbance to the hydrology and condition of (highly transformed) wetlands downstream of South Dune Road as far as the beach, as a result of tunnelling of the proposed brine discharge and seawater intake pipelines to the proposed pump station. This impact is considered possible, but likely to affect a very localised area of transformed wetland, probably only for a short period. Without mitigation, the impact is anticipated to be of **low** significance.

*Key Mitigation Measures*

- Given the low significance without application of mitigation measures, additional mitigation measures are not considered essential.

The following additional measures would however be considered best practice, and would further reduce risk of impact to aquatic ecosystems:

- Any disturbance to wetland areas caused by tunnelling of the pipelines (e.g. excavation requirements, soil disturbance, required dewatering, spoil deposits) should be addressed and the affected wetland returned to its pre-impact condition or better, through appropriate landscaping, shaping or other measures.

#### *8.6.1.2 Potable water pipeline impacts*

**Potential Impact 6:** Disturbance to (excavation, removal of vegetation, sedimentation, compaction), and potential loss of hillslope seep wetlands. Specifically, wetlands "Seepage B1", "Seepage B2", artificial wetland "Seepage B3", "Drainage Line A2" and "Drainage Line A1", through which the proposed pipelines would pass, as well as any as-yet unidentified wetlands along the pipeline route. These wetlands have all been assessed as impacted systems, of Category D or lower (see Table 8-3), with low conservation importance, owing to their small size and level of degradation. At a regional level, they are considered common features of this near-coastal area, although less-impacted wetlands of this type are probably rare. It is assumed that passage of the pipeline through these wetlands would disturb soil horizons, potentially altering conditions in which perching of wetlands occurs. Implicit mitigation measures assumed to be inherent in the design and applicable along the pipeline length include however the fact that excavated soils would be re-spread evenly over the pipeline, rather than creating a raised mound of disturbed conditions.

In the event that all soil excavated from the pipeline trench was replaced in the same area, natural depressions would potentially be infilled and drainage lines subtly altered by the creation of a raised area, where the pipeline is relatively shallow.

The above impacts would be negative, but probably persist only in the short to medium term, and would be of low to medium intensity, given the condition and small number of affected wetlands, which are considered of medium irreplaceability (they require specific conditions of soil and surface water to occur, and would also have low reversibility. The likelihood of these impacts occurring to some degree is considered probable.

*Key Mitigation measures*

- Mitigation against the above impacts would be most effective if it took the form of impact avoidance, by shifting the pipeline alignment so as to by-pass the wetland.
- Where crossing through seeps or depressional wetlands in this section of the pipeline route is unavoidable, mitigation should allow for the following:
    - The profile at the crossing point should be as it was prior to construction – that is, excess spoil would need to be disposed of elsewhere, so that a raised mound is not created along the pipeline;
    - Topsoil should be replaced after construction, taking note of the above requirement;
    - Where the seep or valley bottom is on a steep slope, the disturbed area should be replanted with appropriate indigenous grasses or sedges; to effect stability;
    - The disturbance zone in these areas should be kept to a minimum – ideally, no greater than 15m including stockpile areas;
- General construction impact control measures to include in all construction along the pipeline routes include the following:
    - Basic Best Practice construction measures should be included in the CEMP for the construction process, specifying measures to ensure that stockpiles and construction material are not located within 40m of any watercourse, or such that they will contaminate such areas through uncontrolled runoff or wind erosion;
    - Construction of the pipeline should take place in the dry season, when damage to wetland areas as a result of churning up of muddy areas is least likely;
    - Dewatering of water accumulating in the pipeline trenches should be designed to allow collection of sediment and control of runoff velocities, ideally promoting diffuse infiltration of dewatered liquids, rather than channelled flow into watercourses;
    - Following construction, all construction-associated waste (litter, excess pipes, etc.) should be removed from the construction area, and from any watercourse or other sensitive ecosystems.

Without and with the effective implementation of the above key mitigations, the impact significance is expected to be **low**.

**Potential Impact 7:** Disturbance of channelled valley bottom wetlands: specifically, "Watercourse B1", across which the pipeline would cross, and the drainage line shown in Figure 8-6 in the vicinity of the mapped FEPA wetland through which the pipeline would cross. The construction phase of the project would result in localized disturbance to these systems, entailing removal of vegetation (largely alien trees with some indigenous specimens, grasses and shrubs) as well as excavation through the channel banks and beds, and the passage of machinery and construction personnel through the watercourse. Without mitigation, these impacts could result in long-term changes in channel morphology (e.g. changes in gradient, leading to downstream erosion or headcut formation). Such impacts would be considered of medium intensity, and although their reversibility would be moderate, and requiring intervention to achieve, the probability of such impacts occurring is however considered relatively low.

*Key Mitigation Measures*

- Avoidance mitigation is not considered practical for any of these watercourses;
- General construction impact control measures outlined for Impact 6 should be included:
  - The disturbance zone in these areas should be kept to a minimum – ideally, no greater than 15m including stockpile areas;
  - Prior to construction, channel banks should be cleared of invasive alien vegetation in a corridor of width at least 30m across the channel, using methods appropriate to a location on a watercourse;
  - The pipeline once covered should not result in the protrusion above the natural ground or channel level;
  - Where the channel is considered significantly incised as a result of head cut erosion, consideration should be given to the inclusion of a low gabion weir structure across the channel at the point of crossing, to flatten an artificially steepened channel gradient;
  - Disturbed channel banks should be reshaped, with side slopes no steeper than 1:4, and tying in with the banks on either side;
  - All disturbed banks should be planted with appropriate locally indigenous vegetation, sufficient to ensure bank stability;

With mitigation as described above, the impact significance would be expected to shift from medium (no mitigation) to **low**.

In addition, it is also noted that crossing of the mapped watercourse between the desalination plant and La Mercy pump station within the coastal forest area could be avoided by running it along the disturbed edge of Valley Road and then on the edge of the existing development – this would minimize destruction of coastal forest vegetation.

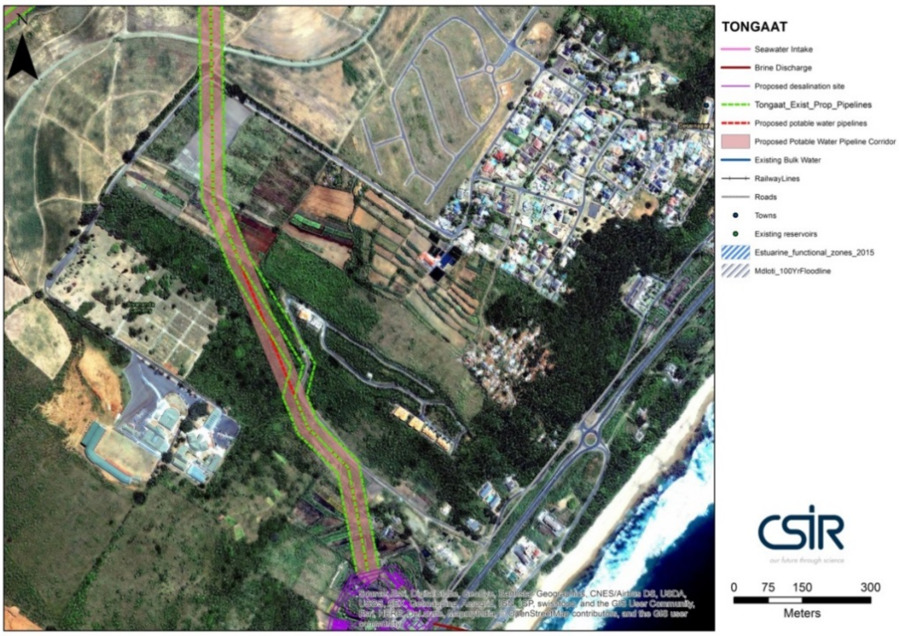



Figure 8-14: Proposed amendments to the proposed potable water pipeline (Red – Original route and Green – amended route)

**Potential Impact 8:** Disturbance to the Mdloti Estuary, as a result of construction-associated pollution, during horizontal drilling of the pipeline. Figure 8.15 indicates the proposed pipeline route at the estuary.

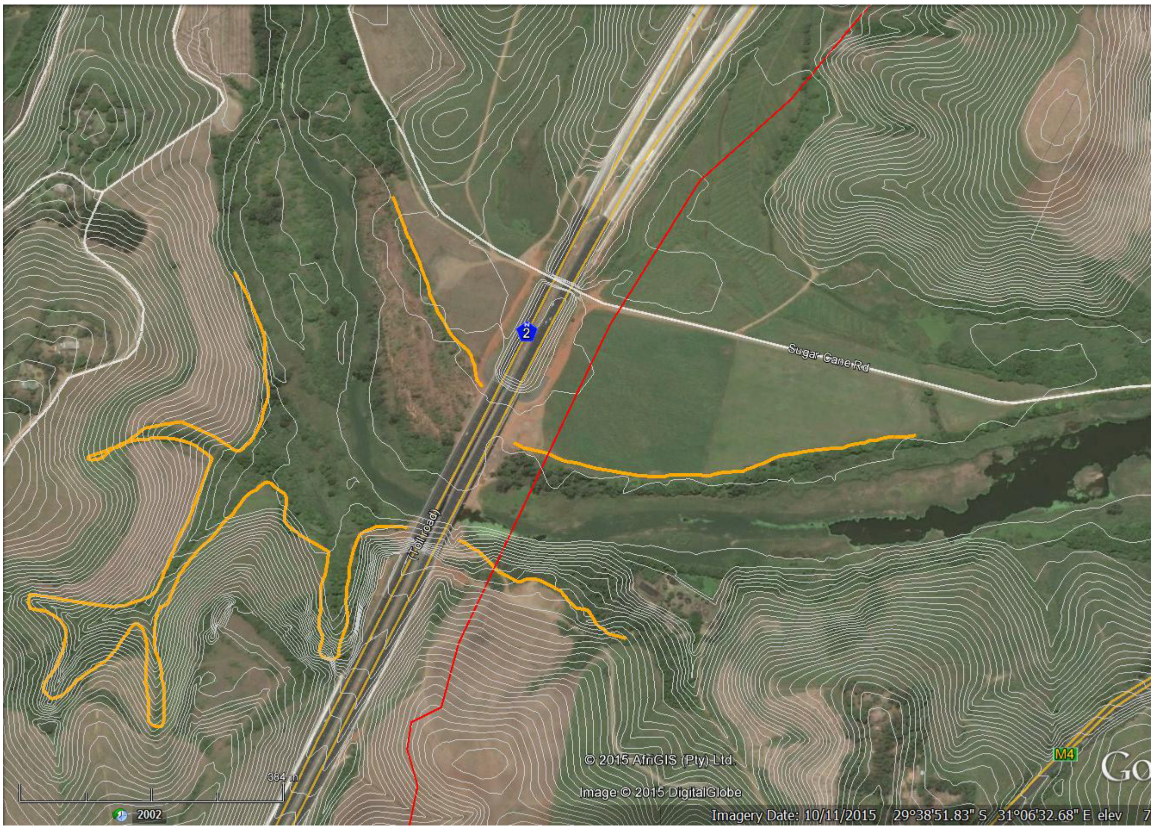



Figure 8.15: Proposed pipeline alignment (red line) beneath the Mdloti Estuary, showing 2m contours (white lines) with desktop assessment of edge of riparian fringe shown in yellow

The following impacts are likely:

- Localised disturbance (compaction, damage to vegetation, creation of pits and disturbed piles of soil material) as a result of test-hole excavation during project planning;
- Disturbance of areas on either side of the estuary, for laydown of pipelines, location of pipeline drilling equipment / heavy plant as well as control structures (assumed to comprise metal "container-type" offices) and storage of waste materials comprising waste bentonite and /or waste slurry / spoil – this kind of disturbance would result in soil compaction, damage to / removal of vegetation, possible runoff of sediment-enriched water into the estuary, increasing turbidity; possible contamination with the bentonite slurry (this is however an organic, edible (to fish) material and contamination effects are not considered likely or significant) and general ecological degradation as a result of the accumulation of waste on an (albeit already impacted) floodplain and riparian zone;
- Possible contamination of marginal estuary and floodplain areas as a result of runoff or spillage from waste storage or processing areas – such waste would include rocks, gravel, muds and possible bentonite mix;
- Location effects – the proposed location of the pipeline crossing is in an area where the hillslopes are steep, and it seems unlikely that the pipeline installation process has taken cognisance of local conditions downstream of the existing N2 road bridge;

*Key Mitigation Measures*

The following measures are considered essential:

- Pre-construction disturbance associated with exploratory drilling / test hole excavation must be addressed, so that disturbed areas are returned to their pre-test condition or better. This means that all test holes must be refilled and shaped to pre-impact levels. This rehabilitation intervention must take place prior to the start of the construction phase.
- The final proposed alignment of the river crossing should be ground-truthed with an aquatic ecologist to ensure that the proposed mitigation measures remain relevant and effective against the likely impacts associated with the intervention;
- All site preparation, laydown and drilling operations should take place outside of the wet season;
- The extent of areas subject to construction phase disturbance must be minimised – laydown areas should utilise existing roads or otherwise disturbed areas (e.g. areas disturbed during current N2 road repair or the recently excavated pipeline route itself, on either side of the crossing);
- The disturbance corridor should be clearly demarcated with temporary fencing, and areas outside of the corridor should be maintained as "no go" areas, unless under the express supervision of the Environmental Control Officer (or similar designation) and in order to execute rehabilitation measures;
- Horizontal drilling activities (including laydown, control and other associated measures) on either side of the estuary should be located outside of the existing riparian zone, and no closer than 50m from the edge of the main channel, whichever is the furthest distance – this would need to be confirmed on site by an estuary or wetland specialist, but would include the visible treed fringe (mainly alien trees) shown in the above figure (see orange lines on Figure 8.13). This means that the actual estuary margins, secondary channels, side pools and other features that would potentially be impacted by the construction process would in theory not be damaged as the pipeline would pass deep beneath them. It also means that the damage associated with runoff and contamination would be further removed from the estuary channel itself;
- Method statements must be developed prior to the start of operations to outline clear and practical measures to prevent the passage of any construction waste into the estuary or its riparian margins. Such measures must include:
    - Requirements to recycle bentonite and minimise its passage to waste;
    - Requirements to dispose of spoil outside of the 1:100 year floodline of this (or any other) watercourse and such that it will not impact negatively on any ecosystem of conservation importance ;
    - Requirements to dispose of any waste that has no beneficial use outside of the 1:100 year floodline to the sewers or other recognised official waste disposal site;
- Following construction, the disturbance corridor as well as the no go areas must be assessed and areas where compaction, waste contamination or other impacts likely to affect long-term ecological function have occurred should be identified and restored to their pre-impacted condition or better.
- Furthermore, the CEMP for this activity should specify measures to ensure that stockpiles and construction material are not located within 50m of the river or any watercourse, or such that they will contaminate such areas through uncontrolled runoff or wind erosion.

With mitigation as described above, the impact significance would be expected to shift from **Medium** (no mitigation) to **Low**.

Additional mitigation measure

- The route of the pipeline could alternatively be adjusted to cross on the upstream side of the N2 bridge, as close to the bridge as possible, and passing under the existing minor watercourse entering the estuary from the south (right hand bank looking downstream). This would prevent the pipeline having to pass (somehow) up the steep abutting slopes (and incidentally, since this would require pipe jacking the pipeline under the N2 earlier, would also avoid the small wetlands identified south of the river (Impact 6)) – the feasibility of this measure would need to be assessed by the project engineers, and it should be noted that a downstream crossing would not be considered a "no go" scenario – but new alignments resulting from the detailed design phase implementation of this project would need to be ground-truthed and approved with regard to their potential impacts on aquatic ecosystems prior to being finalised;

#### *8.6.1.3 Transmission line alignments*

**Impact 9:** Possible disturbance to the identified drainage lines shown in Figure 8-10, as a result of the passage of transmission line structures across them, as well as disturbance to minor drainage lines indicated in Figure 8-11. Note that it is assumed that transmission towers themselves would not be located within drainage lines, as the towers would need to be located on higher ground, to facilitate pylon support. Impacts associated with the transmission lines themselves would thus centre on

- clearing of (alien and indigenous) vegetation to facilitate line stringing, and the installation of transmission line towers.

This impact would be sustained into the operational phase of the development, as it would be an essential part of line maintenance, with vegetation required to be kept beneath the level of the transmission lines. Although most of the existing vegetation along the transmission line routes comprises cane fields, the identified drainage lines are in areas of mixed natural coastal forest and woody aliens (mainly gums). Where the lines actually cross the drainage lines, the maintenance of cleared areas would facilitate the establishment of weedy shrubby alien species in well-lit cleared areas (lantana and bugweed being the main invaders of such areas along watercourses).

The likelihood of the above impacts occurring is unknown, given the poor quality of information regarding the alignment of the planned connection from the site to the La Mercy substation. The intensity of the impacts would however be low, although considering that these activities would be maintained into the operational phase, it is assumed that the transmission lines would be associated with a permanent corridor of low growing mainly alien weedy vegetation, across the width of the transmission line corridor.

*Key Mitigation measures*

- Cleared areas within 30m on either side of a minor watercourse must be maintained free of alien vegetation.
- Maintenance clearing of indigenous vegetation within 30m of a watercourse should ideally not take place, and the lines should pass above such vegetation.

With mitigation as described above, the impact significance would be expected to shift from **medium** (no mitigation) to **low**.

**Impact 10:** Disturbance to the Mdloti Estuary, just upstream of the N2 road bridge, across which the transmission line would cross, necessitating clearing of mature gums and other vegetation to facilitate pylon erection and line stringing. Based on the 2m contour data illustrated in Figure 8-11, some 335m of estuary and associated wetland vegetation would be crossed by the transmission lines just upstream of the N2. This includes an area of dense gums, along (mainly) the [5]left hand river bank. Disturbance to the estuary could result from clearing of gums (particularly if these were left *in situ*, where at best they result in infilling of floodplain habitat or worse, wash downstream during large floods, causing erosion and debris dams). The maintenance of these lines, implicit in their erection, would result in the same dominance of cleared areas by weedy, mainly alien shrub and pioneer species. In the event that transmission line support structures were placed within the area between the N2 and the 8m contour on the right hand side of the river, these could result in:

- Disturbance to (infilling of the floodplain) – this would not be a major impact, given the relatively small size of the transmission line structures);
- A more complex indirect effect would however be the need to protect such a structure, once installed. In the long term, meaning that rehabilitation activities such as the clearing of gum trees from the river corridor and the resultant reactivation of sections of the floodplain might not be effected in the long term, as a result of the need to protect such infrastructure,

The impacts described above are considered of medium intensity, occurring at a local scale, but with long-term to permanent implications. These would be reversible – with removal of the structures – but would occur with a high probability.

*Key Mitigation measures*

- No transmission line support towers should be located below the 8m contour or within the 1:50 year floodline of the estuary, whichever is the greater distance from the channel – effectively, this means that the transmission lines in this area would need to span a distance of between 350 and 400m;
- The entire section of the Mdloti estuary and its associated wetlands must be maintained free of alien vegetation within a band 50m in length along the channel;
- Woody vegetation that is felled for the installation of the transmission lines and as part of the above recommendations must be removed from within the 1:100 year floodline of the river;
- All construction material associated with the implementation of the proposed project must be removed from the (1:100) year floodplain on completion of the project;
- Construction within the floodplain should take place outside of the main wet season;
- The estuary channel and associated wetlands must be demarcated as no-go areas during construction;
- Any areas of the channel, its banks or the associated wetlands as far as the 8 m contour that are damaged during construction should be reinstated to their pre-construction condition or better – allowance should be made for ripping of compacted areas, reshaping and potentially replanting to address disturbance impacts if they occur;
- All construction-associated material and waste / litter should be removed from the floodplain following construction;
- No construction site camps / stockpiles / vehicle storage areas should be allowed within 50m upslope of the 8m contour;

With mitigation as described above, the impact significance would be expected to shift from **medium** (no mitigation) to **low**.

5 By convention, left and right hand as seen when facing downstream

**Impact 11:** Disturbance to the lower reaches of the Mdloti River as a result of potential location of transmission towers in the vicinity of the river banks, and vegetation clearing beneath the transmission lines: The impacts associated with the proposed river crossing would be similar to that associated with the estuary crossing, and could include:

- Clearing of alien and indigenous woody vegetation along the river bank to allow for erection (and ongoing maintenance) of the transmission lines – associated with this would be the establishment of weedy vegetation in cleared area, exacerbating opportunities for invasion by lantana and bugweed, already present in the area;
- In the event that felled woody vegetation was left in situ, this could potentially wash into the channel during floods, causing debris dams and associated erosion and flood issues.

*Key Mitigation measures*

- No transmission line support towers should be located below the 12 m contour or within the 1:50 year floodline of the river, whichever is the greater distance from the channel – effectively, this means that the transmission lines in this area would need to span a distance of between 350 and 400m;
- The entire section of the Mdloti River and its associated wetlands must be maintained free of alien vegetation within a band 50m in length along the channel at the point of crossing;
- Woody vegetation that is felled for the installation of the transmission lines and as part of the above recommendations must be removed from within the 1:100 year floodline of the river;
- All construction material associated with the implementation of the proposed project must be removed from the (1:100) year floodplain on completion of the project;
- Construction within the floodplain should take place outside of the main wet season;
- The river channel and its associated wetlands below the 12m contour must be demarcated as no-go areas during construction;
- Any areas of the channel, its banks or the associated wetlands that are damaged during construction should be reinstated to their pre-construction condition or better – allowance should be made for ripping of compacted areas, reshaping and potentially replanting to address disturbance impacts if they occur;
- All construction-associated material and waste / litter should be removed from the floodplain following construction;
- No construction site camps / stockpiles / vehicle storage areas should be allowed within 50m upslope of the 8m contour;

With mitigation as described above, the impact significance would be expected to shift from **medium** (no mitigation) to **low**.

**Impact 12:** Disturbance to the Lake Victoria wetlands and associated fauna and flora: the crossing as shown would result in the installation of transmission line support structures within the wetland to allow a total crossing length of some 730m of wetland, resulting in compaction of wetland areas, an extensive area of disturbance across the wetland to access installation points for transmission support structure(s) within the wetland (given that the crossing length exceeds the maximum distance of 600m between support structures) and (localised along the transmission line) disturbance to important wetland habitats utilised by three red data frog species, as well as other wetland fauna. Disturbance would be in the form of compaction, increased turbidity in the vicinity of the construction corridor, possible water quality pollution if transmission support towers are founded on concrete bases, damage to reedbeds and mortalities to any fauna trapped within this corridor and unable to move away.

Given the importance of the Lake Victoria wetland habitat, and the high sensitivity of its fauna to physical impacts such as those described above, affecting an extensive zone of wetland, extending right across the habitat, this impact would be considered of Very High intensity, occurring at a regional scale, with low reversibility from a faunal perspective. The residual impacts are considered highly probable, and have been assessed as of **very High** significance – and without mitigation, **a Fatal Flaw**. While physical recovery of reedbed habitat would be relatively rapid, potential losses to faunal (particularly red data frog) species could be much longer term.

Although it is possible that transmission lines across the wetland would provide expanded perching areas for the Barn Swallows that roost in large numbers in the Lake Victoria wetlands / Mount Moreland area, this would be the case with an alternative route as well, and should not be used to argue in favour of the current proposed alignment. Moreover, the installation of transmission lines across the wetland could have a significant long term impact on wetland management options and hence sustainability as a roosting site and general reedbed wetland habitat. This is because fire is likely to be an important factor in achieving long-term sustainability of the reedbeds (Birdlife South Africa IBA information sheets (http://www.birdlife.org.za/component/k2/item/227-sa123-mount-moreland - accessed June 2015) but its active implementation would be curtailed by the presence of important transmission lines.

*Key Mitigation Measures*

- Mitigation needs to seek impact avoidance, and it is thus strongly recommended that the proposed transmission line route must be re-aligned, such that it does not cross through the important Lake Victoria wetlands. A proposed alternative alignment is indicated conceptually in Figure 8-16, which avoids the Lake Victoria wetlands and roughly follows the road alignment. Other alternative alignments that could be shown to avoid sensitive ecosystems would also be acceptable as mitigation, provided their alignments were approved (with ground truthing if necessary) by a freshwater ecologist and a botanist.

With avoidance mitigation as described above, no impact to the Lake Victoria wetlands would occur, and the impact of crossing the river would be as for Impact 11, noting that an alternative river crossing point would need to be ground-truthed.

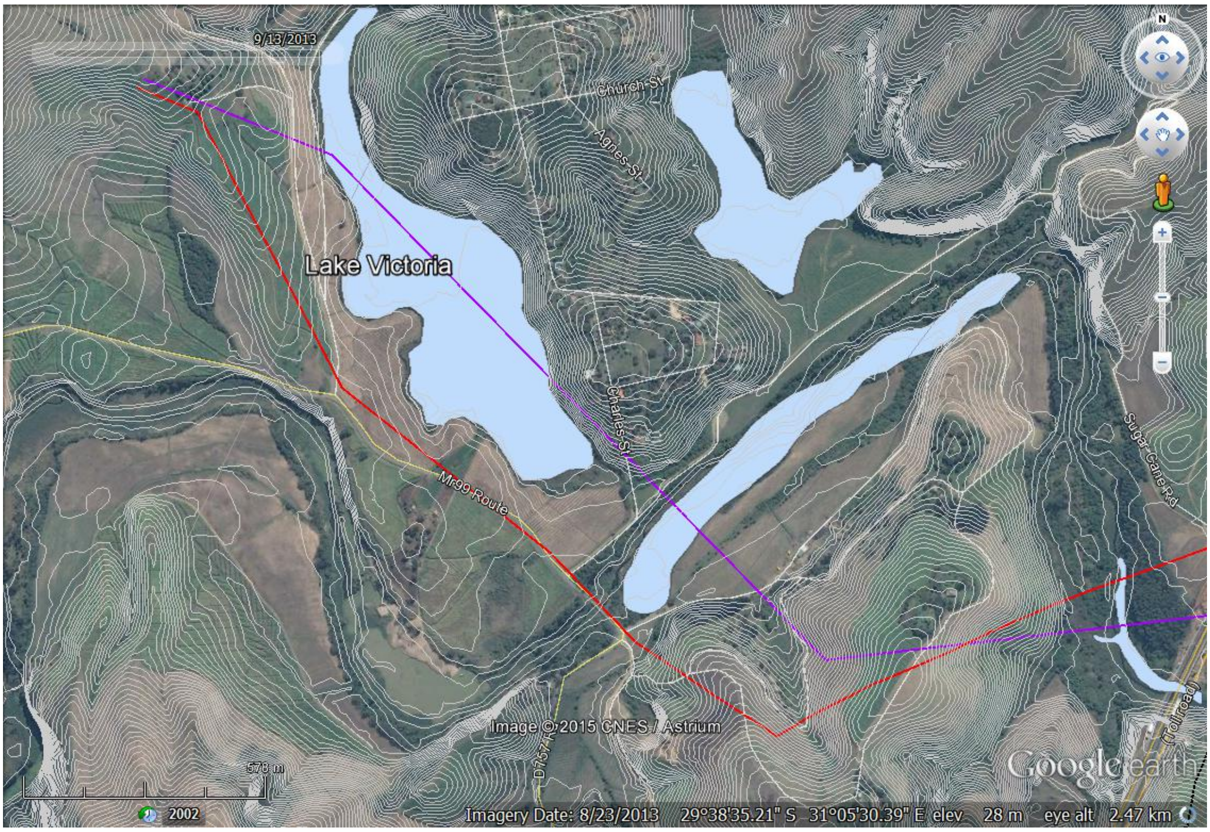



Figure 8-16: Proposed alternative transmission line route (red line), avoiding Lake Victoria wetlands and crossing Mdloti River further upstream. Route to be ground-truthed. Assessed alignment shown in purple.

### 8.6.2 Operational Phase

#### *8.6.2.1 Desalination plant impacts*

Operational phase impacts comprising ongoing drainage / dewatering of wetlands into downstream areas, resulting in potential channelization as a result of increased velocities and possible increased wettedness of the beach, have already been described and assessed in terms of the Construction phase impacts for this project (Construction Phase Impacts 3 and 4), and are therefore not re-assessed in this section.

**Impact 1:** Increased runoff of surface water from hardened surfaces, compounding construction/ design phase impacts of increased volumes of water into downstream areas as a result of groundwater dewatering: The proposed transformation of the site from a sandy, largely unsurfaced site into a built environment, with high levels of roof and paved areas would result in increased rates of runoff during rainfall events. The resultant requirement for effective stormwater management would result in concentrated flows of water from the site, channelled into downstream areas and potentially further degrading downstream wetlands. It is assumed that the bulk of this impact would be in the most degraded wetland area between the M4 and South Dune Road.

*Key Mitigation measures*

- A stormwater management plan must be designed for the site, to ensure that the site includes stormwater detention facilities and other Sustainable Urban Drainage Systems (SUDS) devices, designed to ensure that at least the velocity of runoff as a result of direct precipitation on the site does not increase compared to pre-development levels – this is important, given the fact that ongoing groundwater dewatering is likely throughout the operational phase of the development.

With mitigation as described above, the impact significance would be expected to shift from **medium** (no mitigation) to **low**.

#### *8.6.2.2 Pump station impacts:*

**Impact 2:** Negligible operational phase impacts are anticipated, except in case of damage / breakdown, when it is possible that leakage of saline water into freshwater wetlands might occur. Such impacts are considered of low probability, but would have site-specific impacts on affected wetlands, resulting in die-back of freshwater plant species, sustained over an extended time period until salt water had been flushed from the wetlands. Given the degraded state of the wetlands likely to be affected by such impacts, their intensity would however be rated as medium, and not affecting irreplaceable systems or communities.

*Key Mitigation Measures:*

- Repair of such breakdowns should take place with immediate effect.

With mitigation as described above, the impact significance would be expected to shift from **low** (no mitigation) to **very low**.

#### *8.6.2.3 Potable water pipeline impacts*

**Impact 3:** Negligible operational phase impacts are anticipated, except in case of damage / breakdown, when it is possible that concentrated freshwater flows into wetlands might occur, triggering erosion and further degradation. Given the importance of the potable water resource to end users, it is assumed that leaks large enough to promote erosion as a consequence would be noticed and attended to quickly, and the probability of this impact actually occurring is considered low. The intensity of impact would be considered medium to low, and affecting degraded systems with low irreplaceability, albeit potentially high sensitivity to the possible impact.

*Key Mitigation Measures:*

- Repair of such leaks should take place with immediate effect;
- If erosion of drainage lines has been triggered, repair of knick points should be undertaken, as appropriate and if necessary in consultation with a wetland specialist.

#### *8.6.2.4 Transmission line alignments*

The impact of ongoing clearing of tall vegetation (e.g. trees) beneath transmission lines has been included in discussions / impacts associated with the Construction Phase (Impacts 9 to 12, Section 8.6.1.4), as it is an indirect consequence of the alignments.

### 8.6.3 Decommissioning Phase

It is reiterated that this assessment assumes that decommissioning would entail removal of buildings but that transmission lines and pipelines would remain *in situ*, for potential use in upgraded facilities.

#### *8.6.3.1 Desalination plant impacts*

**Impact 1:** Physical disturbance and passage of sediment into wetlands during removal of plant and (potentially) of buildings. It is assumed that decommissioning would not however involve re-landscaping of the building platforms on the site. This impact would be considered localised, affecting largely degraded wetlands, but possibly impacting on the rehabilitated wetlands required in terms of Construction Phase Impact Mitigation (Impact 1). Its overall significance would be **medium**.

*Key Mitigation Measures:*

- Disturbed areas of the (previously) rehabilitated wetlands must be returned to their design condition;
- Measures to prevent the passage of sediment and other pollutants into adjacent wetlands on and off the site must be included in Method Statements for Decommissioning Activities, and implemented as specified;
- Decommissioning activities entailing disturbance to soils should be carried out in the dry season only.

With mitigation as described above, the impact significance would be expected to shift from **medium** (no mitigation) to **low**.

**Impact 2:** Possible long-term accumulation of water on the site and re-establishment of wetlands, in the event that drainage systems for cuts into groundwater were not maintained.

This impact would be considered positive, but of low ecological significance and unlikely to occur on a sustained basis in reality. No mitigation measures are recommended.

### 8.6.4 Cumulative Impacts

#### *8.6.4.1 Cumulative impacts*

**Impact 1:** Construction of the proposed desalination plant would result in the loss of wetlands, extending across a large area of the site, and is moreover likely to result in further degradation of downstream wetlands, as a result of changes in runoff patterns and intensities. While it is acknowledged that the wetlands in question have been highly and permanently degraded by past activities, if this argument is applied to development along the Durban coastline as a whole, where few if any unimpacted examples of such wetlands are likely to occur, then the cumulative loss of wetlands of this type will be highly significant. Moreover, the wetlands on the desalination plant site, although highly degraded, are at present still considered rehabilitable to at least an improved condition (PES Category D), and one which is considered sustainable (Kleynhans et al 2005). Their complete loss at a site level to the development as currently proposed would curtail any future rehabilitation options.

*Key mitigation measures:*

In light of the above discussion, additional off-site offset measures are recommended as essential to address the issue of Cumulative Impacts described above. Suitable offset targets would allow the rehabilitation of similar or more threatened wetland habitat, to a condition that is better than Category D – that is, Category C or better.

Additional off-site mitigation measures could focus on (inter alia):

- The spread of upstream flows from the site into, and the rehabilitation of existing agricultural wetlands downstream of the southern portion of the proposed desalination plant site (between South Dune Road And South Beach Road, and South Beach Road and the beach – refer to Figure 8-13 Green polygons), in a similar manner to the recommended rehabilitation of the wetlands to the east of the north part of the site (see Red polygons as defined in Impact 1 mitigation).
- The rehabilitation of the (degraded) FEPA valley bottom wetlands shown in Figure 8-6, which could possibly also be rehabilitated as far as their beach outlets or other similar alternative wetlands that will meet offset requirements.

Inclusion of off-site mitigation measures as outlined above would reduce the significance of Cumulative Impacts substantially from High (negative) to **Medium to low**, with possibilities for **positive impacts** in the proposed rehabilitation of existing degraded valley bottom wetlands.

## 8.7 IMPACT ASSESSMENT SUMMARY

Table 8-4 summarises the impacts of the proposed desalination plant and its associated infrastructure, from a freshwater ecosystems perspective. The assessment rating methodology is as prescribed by the CSIR to specialists engaged in this project.

Table 8-4: Impact assessment summary table for the **Construction** Phase

| IMPACT DESCRIPTION | STATUS | EXTENT | DURATION | REVERS. | POTENTIAL INTENSITY | PROBABILITY | SIGNIFICANCE (WITHOUT MITIGATION) | MITIGATION | SIGNIFICANCE (WITH MITIGATION) | CONFIDENCE LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| **DESALINATION PLANT IMPACTS** | | | | | | | | | | |
| Potential Impact 1: Destruction of wetlands on the desalination plant | Negative | Site specific (1) | Permanent (5) | Irreversible | High (8) | Definite (1) | **High (14)** | Off-site wetland rehabilitation and management of flows. Refer to Impact 1 (Section 8.6.1.1) for details. | **Medium to High (9.5)** (note: manually adjusted rating) | Medium to low |
| Potential Impact 2: Water quality pollution, sedimentation and the passage of aquatic alien vegetation into wetlands downstream of the site as a result of drainage / runoff from the site | Negative | Local (2) | Short Term (2) | Moderate | Medium (4) | Low Probability (0.25) | **Medium-Low (2)** | CEMP to outline measures to minimize the passage of sediments from the disturbed site into downstream areas, including sediment stilling ponds or similar, sized to contain and treat all dewatering and construction phase runoff, with runoff from cuts into dune bypassing any construction areas | **Low** | Medium |
| Potential Impact 3: Sedimentation and water quality pollution in downstream wetlands as well as possible wetland drawdown as a result of dewatering | Negative | Local (2) | Permanent (5) | Low | Medium (4) | Probable (0.5) | **Medium (5.5)** | Deep excavation would need to incorporate cut-off sleeves or other devices that separate upland groundwater inflows from the excavated area, and allow for their passage and subsequent infiltration / diffusion downstream of the site, without resulting in erosion of downstream wetlands; The efficacy of proposed mitigation designs would need to be interrogated (and approved) by a wetland specialist | **Low** | Medium |

| IMPACT DESCRIPTION | STATUS | EXTENT | DURATION | REVERS. | POTENTIAL INTENSITY | PROBABILITY | SIGNIFICANCE (WITHOUT MITIGATION) | MITIGATION | SIGNIFICANCE (WITH MITIGATION) | CONFIDENCE LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| Potential Impact 4: Erosion of downstream wetlands draining onto the beach, and possible increased beach saturation levels | Negative | Local (2) | Permanent (5) | Low | Medium (4) | Highly probable (0.75) | **Medium (8.25)** | The plant design should allow collection of groundwater flows upstream of the built structures of the desalination plant, and their diversion and subsequent infiltration across the full width of the existing two wetland basins - design to be approved by wetland specialist | **Medium** | Medium |
| Potential Impact 5: Disturbance to the hydrology and condition of wetlands downstream of South Dune Road as far as the beach, as a result of tunnelling of the proposed brine discharge and seawater intake pipelines to the proposed pump<br><br>Additional mitigation:<br>Any disturbance to wetland areas caused by tunnelling of the pipelines should be addressed and the affected wetland returned to its pre-impact condition or better, through appropriate landscaping, shaping or other measures. | Negative | Site specific (1) | Short Term (2) | Highly reversible | Medium-Low (2) | Low Probability (0.25) | **Low (1.25)** | No key mitigation required | **Low** | Low |
| **POTABLE WATER PIPELINE IMPACTS** | | | | | | | | | | |
| Potential Impact 6: Disturbance to and potential loss of hillslope seep wetlands, creating a raised mound of disturbed conditions | Negative | Site specific (1) | Medium Term (3) | Moderate | Medium-Low (2) | Highly probable (0.75) | **Low (4.5)** | Avoidance by shifting pipelines - as specified in Section 8.6.1.2; where crossing through seeps or depressional wetlands is unavoidable, mitigation should allow for the following: The profile at the crossing point should be as it was prior to construction; Topsoil to be replaced after construction; on steep slopes, disturbed area to be replanted to effect stability; disturbance zone to be minimised – | **Low** | Medium |

| IMPACT DESCRIPTION | STATUS | EXTENT | DURATION | REVERS. | POTENTIAL INTENSITY | PROBABILITY | SIGNIFICANCE (WITHOUT MITIGATION) | MITIGATION | SIGNIFICANCE (WITH MITIGATION) | CONFIDENCE LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | no greater than 15m; General construction impact control measures - see Section 8.6.1.2 for details | | |
| Potential Impact 7: Disturbance of channelled valley bottom wetland | Negative | Site specific (1) | Long Term (4) | Moderate | Medium (4) | Probable (0.5) | **Medium (4.5)** | Avoidance mitigation to be applied to the mapped drainage line between the desalination plant and La Mercy pump station. General construction impact control measures to be included for other watercourses (i.e. Drainage Lines A1, A2 and Watercourse B1) (see Section 8.6.1.2); disturbance zone to be minimised (< 15m); channel banks to be cleared of invasive alien vegetation in a corridor of width 30m ; Disturbed channel banks to be reshaped and planted. | **Low** | Medium |
| Potential Impact 8: Disturbance to the Mdloti Estuary, as a result of construction-associated pollution, during horizontal drilling of the pipeline | Negative | Local (2) | Short Term (2) | Moderate reversibility | High (8) | Probable (0.5) | **Medium (6)** | • Pre-construction disturbance associated with exploratory drilling / test hole excavation must be addressed, so that disturbed areas are returned to their pre-test condition or better;<br>• The final proposed alignment of the river crossing should be ground-truthed with an aquatic ecologist to ensure that the proposed mitigation measures remain relevant and effective;<br>• All site preparation, laydown and drilling operations should take place outside of the wet season;<br>• The extent of areas subject to | **Low** | Medium |

| IMPACT DESCRIPTION | STATUS | EXTENT | DURATION | REVERS. | POTENTIAL INTENSITY | PROBABILITY | SIGNIFICANCE (WITHOUT MITIGATION) | MITIGATION | SIGNIFICANCE (WITH MITIGATION) | CONFIDENCE LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | construction phase disturbance must be minimised;<br>• The disturbance corridor should be clearly demarcated with temporary fencing, and areas outside of the corridor should be maintained as "no go" areas, unless under the express supervision of the Environmental Control Officer (or similar designation);<br>• Horizontal drilling activities should be located outside of the existing riparian zone, and no closer than 50m from the edge of the main channel, whichever is the furthest distance;<br>• Method statements must be developed prior to the start of operations to outline clear and practical measures to prevent the passage of any construction waste into the estuary or its riparian margins. See Section 8.6.1 (Impact 8 mitigation measures)<br>• Following construction, the disturbance corridor as well as the no go areas must be assessed and areas where compaction, waste contamination or other impacts likely to affect long-term ecological function have occurred should be identified | | |

| IMPACT DESCRIPTION | STATUS | EXTENT | DURATION | REVERS. | POTENTIAL INTENSITY | PROBABILITY | SIGNIFICANCE (WITHOUT MITIGATION) | MITIGATION | SIGNIFICANCE (WITH MITIGATION) | CONFIDENCE LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | and restored to their pre-impacted condition or better;<br>• The CEMP should specify measures to ensure that stockpiles and construction material are not located within 50m of the river or any watercourse, or such that they will contaminate such areas through uncontrolled runoff or wind erosion. | | |
| **TRANSMISSION LINE ALIGNMENTS** | | | | | | | | | | |
| Impact 9: Possible disturbance to drainage lines as a result of plant clearing (construction phase and ongoing) | Negative | Local (2) | Permanent (5) | Low reversibility | Medium (4) | Probable (0.5) | **Medium (5.5)** | Cleared areas within 30m on either side of a minor watercourse must be maintained free of alien vegetation | **Low** | Low |
| Impact 10: Disturbance to the Mdloti Estuary as a result of alien clearing, with establishment of weedy alien vegetation expected in its place, and increased flooding/ erosion risks from felled material. | Negative | Local (2) | Long Term (4) | Moderate | Medium (4) | Highly probable (0.75) | **Medium (7.5)** | Support towers to be located above 8m contour or within the 1:50 year floodline , whichever is the greater; the Mdloti estuary and its associated wetlands must be maintained free of alien vegetation within a band 50m in length along the channel; felled woody vegetation must be removed from within the 1:100 year floodline ; All construction material to be removed from the 1:100 year floodplain on completion of the project; construction to take place outside of the main wet season; estuary channel and associated wetlands to be demarcated as no-go areas during construction; Damaged areas below the 8 m contour to be reinstated to pre-construction condition or better; no construction | **Low** | Medium |

| IMPACT DESCRIPTION | STATUS | EXTENT | DURATION | REVERS. | POTENTIAL INTENSITY | PROBABILITY | SIGNIFICANCE (WITHOUT MITIGATION) | MITIGATION | SIGNIFICANCE (WITH MITIGATION) | CONFIDENCE LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | site camps / stockpiles / vehicle storage areas allowed within 50m upslope of the 8m contour; | | |
| Impact 11: Disturbance to the Mdloti River as a result of alien clearing, with establishment of weedy alien vegetation expected in its place, and increased flooding/ erosion risks from felled material. | Negative | Local (2) | Long Term (4) | Moderate | Medium (4) | Highly probable (0.75) | **Medium (7.5)** | Support towers to be located above 12m contour or within the 1:50 year floodline , whichever is the greater; the Mdloti river and associated wetlands to be maintained free of alien vegetation within a band 50m in length along the channel; felled woody vegetation must be removed from within the 1:100 year floodline ; All construction material to be removed from the 1:100 year floodplain on completion of the project; construction to take place outside of the main wet season; river channel and associated wetlands to be demarcated as no-go areas during construction; Damaged riverine or wetland areas to be reinstated to pre-construction condition or better; no construction camps / stockpiles / vehicle storage areas allowed within 50m upslope of the 8m contour; | **Low** | Medium |
| Impact 12: Disturbance to the Lake Victoria wetlands and associated fauna and flora, and potential impacts on wetland sustainability | Negative | Regional (3) | Permanent (5) | Low | Very High/Fatal Flaw (16) | Highly probable (0.75) | **Fatally flawed (18)** | Avoidance mitigation through re-alignment out of Lake Victoria wetlands | N/A | High |

Table 8-5: Impact assessment summary table for the **Operational** Phase

**NB: Refer also to Construction Phase Impacts 3 and 4 (Table 8-4) and their mitigation: these would be expected to continue in the Operational Phase.**

| IMPACT DESCRIPTION | STATUS | EXTENT | DURATION | REVERSIBILITY | POTENTIAL INTENSITY | PROBABILITY | SIGNIFICANCE (WITHOUT MITIGATION) | MITIGATION | SIGNIFICANCE (WITH MITIGATION) | CONFIDENCE |
|---|---|---|---|---|---|---|---|---|---|---|
| **DESALINATION PLANT IMPACTS** | | | | | | | | | | |
| Impact 1: Increased runoff of surface water from hardened surfaces, compounding construction/ design phase impacts of increased volumes of water into downstream areas as a result of groundwater dewatering | Negative | Local (2) | Permanent (5) | Low reversibility | Medium-Low (2) | Highly probable (0.75) | **Medium (6.75)** | A stormwater management plan must be designed for the site, to ensure that the site includes stormwater detention facilities and other Sustainable Urban Drainage Systems (SUDS) devices, designed to ensure that at least the velocity of runoff as a result of direct precipitation on the site does not increase compared to pre-development levels – this is important, given the fact that ongoing groundwater dewatering is likely throughout the operational phase of the development | **Low** | Medium |
| Impact 2: Abnormal operational phase damage / breakdown, involving leakage of saline water into freshwater wetlands | Negative | Local (2) | Permanent (5) | Moderate reversibility | Medium-Low (2) | Low Probability (0.25) | **Low (2.25)** | Repair of such breakdowns should take place with immediate effect | **Low** | Medium |
| **POTABLE WATER PIPELINE IMPACTS** | | | | | | | | | | |
| Impact 3: Abnormal operational phase damage / breakdown, when it is possible that concentrated freshwater flows into wetlands might occur, triggering erosion and further degradation | Negative | Local (2) | Permanent (5) | Highly reversible | Medium-Low (2) | Low Probability (0.25) | **Low (2.25)** | Repair of such leaks should take place with immediate effect; if erosion of drainage lines has been triggered, repair of knick points should be undertaken, as appropriate and if necessary in consultation with a wetland specialist | **Low** | Medium |

Table 8-6: Impact assessment summary table for the **Decommissioning** Phase

| IMPACT DESCRIPTION | STATUS | EXTENT | DURATION | REVERSIBILITY | POTENTIAL INTENSITY | PROBABILITY | SIGNIFICANCE (WITHOUT MITIGATION) | MITIGATION | SIGNIFICANCE (WITH MITIGATION) | CONFIDENCE LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| **DESALINATION PLANT IMPACTS** | | | | | | | | | | |
| Impact 1: Physical disturbance and passage of sediment into wetlands during removal of plant and (potentially) of buildings | Negative | Local (2) | Temporary (1) | Highly reversible | Medium-Low (2) | Low Probability (0.25) | **Very Low (1.25)** | Decommissioning involving demolition of structures on site must include measures to trap sediments on site, and should be carried out during the dry season only | **Low** | Low |
| Impact 2: Possible long-term accumulation of water on the site and re-establishment of wetlands, in the event that drainage systems for cuts into groundwater were not maintained | Positive | Site specific (1) | Short Term (2) | Highly reversible | Medium-Low (2) | Low Probability (0.25) | **Very Low (1.25)** | None | NA | NA |

Table 8-7: Impact assessment summary table for the **Cumulative** Impacts

| IMPACT DESCRIPTION | STATUS | EXTENT | DURATION | REVERSIBILITY | POTENTIAL INTENSITY | PROBABILITY | SIGNIFICANCE (WITHOUT MITIGATION) | MITIGATION | SIGNIFICANCE (WITH MITIGATION) | CONFIDENCE LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| Impact 1: Contribution to large-scale loss of coastal wetlands as a result of wetland impacts at desalination plant and pump station sites and further degradation of downstream wetlands | Negative | Regional (3) | Permanent (5) | Irreversible | High (8) | Highly probable (0.75) | **High (12)** | Off-site rehabilitation / offsets (refer to Section 8.6.4 for details) | **Medium** | Low |

## 8.8 CONCLUSION AND RECOMMENDATIONS

The aspects of the proposed desalination project at Tongaat that have been assessed in this section as potentially affecting freshwater ecosystems comprise the desalination plant itself, the seawater inlet and brine discharge pipelines above the highwater mark, a pump station, the potable water pipeline route and the routing of transmission lines to supply power to the site.

In reading the freshwater ecosystem assessment, cognisance should however be taken of the following important factors, namely that:

- Delineation of natural wetland extent at the desalination plant was carried out with low confidence, in light of the high degree of past transformation of the site and disturbance to soils – the section of the site focused on in terms of mitigation was however identified with much higher levels of confidence;
- It is possible that the detailed design phase of the project may result in additional wetlands / watercourses being identified and/or potentially affected by infrastructure – the report has however provided generic mitigation measures against such impacts, and no systems of high ecological or conservation importance are likely to have been missed in this study, with the areas of low confidence in terms of wetland identification comprising the existing cane fields.

Although the report identified several minor and relatively easily mitigated impacts that could be associated with the proposed project, a number of impacts were considered of particular concern, namely:

- The proposed desalination plant site itself – this site includes in its extent two large wetland areas. Although these have been degraded to a highly significant degree, they remain both functional (in some respects) and rehabilitable. Their loss to the development would be considered a highly significant (negative) impact. On-site mitigation measures such as shifting the development platform southwards, to allow for the rehabilitation of a portion of the northern wetland proved incompatible with the proposed landuse. As a result, offsite mitigation is required, in the form of rehabilitation and ongoing management of a swathe of wetlands between the site and the coast. Rehabilitation of these wetlands would need to focus on improving flood attenuation and habitat function, and would play a useful role in mitigation of other impacts associated with the project, including the management of stormwater runoff from the site. Development of the details of this rehabilitation would need to be calculated as a formal offset identification and calculation process during the detailed design phase of the development, but would need to allow for their rehabilitation to a PES Category D or better. Both this process and its successful resolution would need to be a condition of any authorisation. Purchase of the affected land would be required if this measures was to be implemented. If such offsets were not adequately identified and made available, it is the understanding that project implementation could not proceed. Please refer to Chapter 8 Appendix B for a draft discussion document: "Considerations around the use of wetland offsets to address impacts associated with the proposed Tongaat Desalination Plan".

  Even with this rehabilitation, it was found that the proposed development would still be associated with residual cumulative impacts that were of high significance, and additional off-site offset mitigation in the form of rehabilitation of similar, or more important wetland ecosystem types, to a condition of PES Category C or better, has been recommended to address this impact.

- The proposed sea water pump station also largely lies in a wetland area, and its construction would entail both loss of (highly degraded) wetland as well as at least short-term dewatering to at least 11m bsl, potentially altering downstream hydrology, drawing down the water table of adjacent wetlands and contributing sediments and other pollutants into downstream flows.
- The proposed crossing of the Mount Moreland wetland – this crossing is considered an outright no-go proposition, and no offset mitigation would compensate for its authorization. The wetland supports three species of red data frogs, and is considered a (globally) Important Bird and Biodiversity Area, as a result of its use as a seasonal roost site by millions of Barn Swallows. Passage of the transmission lines across the wetland would be considered a fatally flawed impact, both affecting frog, swallow and other faunal and floral habitat in the short term, and potentially preventing effective maintenance activities such as fire, without which the reedbeds would become moribund. Fortunately, avoidance options for the Lake Victoria wetland area seem available, and this report has suggested an alternative route, that would avoid the important wetland areas.

Over and above the above issues, this report also identified a number of important aquatic ecosystems that would be crossed by the proposed transmission lines or potable water pipelines. These include the Mdloti River, in its estuarine and lowland river reaches. Despite the importance of the systems, the likely impacts are however considered readily mitigable, and mitigation measures have been described in detail in this report.

It is noted that the proposed design includes a number of measures that have already been incorporated to reduce potential environmental impacts. Those assumed to be inherent to this project include:

- Implementation of standard construction mitigation controls (e.g. siting of construction camps and stock piles outside of sensitive ecosystems; management of litter and waste on site, disposal of construction rubble and waste after construction, prevention of pollution from vehicles);
- Conceptual provision for re-alignment of the transmission lines to less damaging alignments;
- General avoidance of crossing drainage lines with pipelines, routed where feasible along high-lying areas.

In conclusion, it is noted that, from an aquatic ecosystem perspective, the project as a whole requires careful consideration as to how to mitigate effectively against the challenges posed by the development. Off-site mitigation has been strongly recommended by this specialist, and this aspect should be explored further, particularly given the high cumulative impacts that are likely to be associated with this project, with regard to its effect on coastal dune wetland systems.

## 8.9 REFERENCES

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# 8.10 APPENDIX A

## ASSESSMENT METHODOLOGIES: FRESHWATER ECOSYSTEM ASSESSMENT

### 1. Wetland Conservation Importance

In order to provide a more specific guide to the relative conservation importance of individual wetland patches on the present site, a methodology developed by Ractliffe and Ewart-Smith (2002) was utilised. This methodology assigns low, medium and high conservation importance ratings to individual wetlands, on the basis of the following criteria (note that the highest category applicable to any wetland, based on any one criteria, is the one accorded the wetland as a whole):

- **Low conservation importance:**
  - does not provide ecologically or functionally significant wetland habitat, because of extremely small size or degree of degradation, and/or
  - of extremely limited importance as a corridor between systems that are themselves of low conservation importance.
- **Moderate conservation importance:**
  - provides ecologically significant wetland habitat (e.g. locally important wetland habitat types), and/or
  - fulfils some wetland functional roles within the catchment, and/or
  - acts as a corridor for fauna and/or flora between other wetlands or ecologically important habitat types, and/or
  - supports (or is likely to support) fauna or flora that are characteristic of the region and/or provides habitat to indigenous flora and fauna, and/or
  - is a degraded but threatened habitat type (e.g. seasonal wetlands), and/or
  - is degraded but has a high potential for rehabilitation, and/or
  - functions as a buffer area between terrestrial systems and more ecologically important wetland systems, and/or
  - is upstream of systems that are of high conservation importance.
- **High conservation importance:**
  - supports a high diversity of indigenous wetland species, and/or
  - supports, or is likely to support, red data species; supports relatively undisturbed wetland communities, and/or
  - forms an integral part of the habitat mosaic within a landscape, and/or
  - is representative of a regionally threatened / restricted habitat type, and/or
  - has a high functional importance (e.g. nutrient filtration; flood attenuation) in the catchment, and/or
  - is of a significant size (and therefore provide significant wetland habitat, albeit degraded or of low diversity).

### 2. Environmental Importance and Sensitivity (EIS) protocol for wetlands

The method used to assess the EIS of wetlands is a refinement of the DWAF Resource Directed Measures for Water Resources: Wetland Ecosystems method (DWAF, 1999b). It includes an assessment of ecological (e.g. presence of rare and endangered fauna / flora), functional (e.g. groundwater storage / recharge) and socio-economic criteria (e.g. human use of the wetland).
Scoring of these criteria then places the wetland in a Wetland Importance Class (A-D) (see Table A1).

Table A1: Wetland Importance Class integrating Ecological Importance and Sensitivity, and functional and socio-cultural importance modifiers.

| IMPORTANCE CLASS (ONE OR MORE ATTRIBUTES MAY APPLY) | RANGE OF MEDIAN | WETLAND IMPORTANCE CLASS |
|---|---|---|
| **Very high**<br>Representative of wetlands that:<br>• support key populations of rare or endangered species;<br>• have a high level of habitat and species richness;<br>• have a high degree of taxonomic uniqueness and/or intolerant taxa;<br>• provide unique habitat (e.g. salt marsh or ephemeral pan; physiognomic features, spawning or nursery environments);<br>• is a crucial avifaunal migratory node (e.g. RAMSAR wetlands);<br>• may provide hydraulic buffering and sediment retention for large to major rivers that originate largely outside of urban conurbations;<br>• have groundwater recharge/discharge comprising a major component of the hydrological regime of the wetland;<br>• are highly sensitive to changes in hydrology, patterns of inundation, discharge rates, water quality and/or disturbance; and<br>• are of extreme importance for conservation, research or education. | >3 <=4 | A |
| **High**<br>Representative of wetlands that:<br>• support populations of rare or endangered species, or fragments of such populations that are present in other similar and geographically-adjacent wetlands;<br>• contain areas of habitat and species richness;<br>• contain elements of taxonomic uniqueness and/or intolerant taxa;<br>• contain habitat suitable for specific species (e.g. physiognomic features);<br>• provide unique habitat (e.g. salt marsh or ephemeral pan; spawning or nursery environments, heronries);<br>• may provide hydraulic buffering and sediment retention for rivers that originate largely outside of urban conurbations, or within residential fringes of urban areas;<br>• have groundwater recharge/discharge comprising a component of the hydrological regime of the wetland;<br>• may be sensitive to changes in hydrology, patterns of inundation, discharge rates, water quality and/or human disturbance; and<br>• are important for conservation, research, education or eco-tourism. | > 2 <= 3 | B |
| **Moderate**<br>Representative of wetlands that:<br>• contain small areas of habitat and species richness;<br>• provide limited elements of habitat that has become fragmented by development (e.g. salt marsh, ephemeral pan; roosting sites and heronries);<br>• provide hydraulic buffering for rivers that originate in urban areas;<br>• are moderately sensitive to changes in hydrology, patterns of inundation, discharge rates and/or human disturbance; | >1 <= 2 | C |

| IMPORTANCE CLASS (ONE OR MORE ATTRIBUTES MAY APPLY) | RANGE OF MEDIAN | WETLAND IMPORTANCE CLASS |
|---|---|---|
| • perform a moderate degree of water quality enhancement, but are insensitive to sustained eutrophication and/or pollution; and<br>• are of importance for active and passive recreational activities. | | |
| **Low/marginal**<br>Representative of wetlands that:<br>• contain large areas of coarse (reeds) wetland vegetation with minimal floral and faunal diversity;<br>• have a high urban watershed:wetland area ratio;<br>• are important for active and passive recreation;<br>• provide moderate to high levels of hydraulic buffering;<br>• may be eutrophic and generally insensitive to further nutrient loading;<br>• are generally insensitive to changes in hydrology, patterns of inundation, discharge rates and/or human disturbance;<br>• have regulated water; and<br>• contain large quantities of accumulated organic and inorganic sediments. | >0 <= 1 | D |

### 3. Assessment of wetland condition

Wetland condition was assessed using the desk-top Present Ecological State (PES) methodology, adapted from DWAF (1999). The methodology is based on a comparison of current attributes of the wetland, which are scored against those of a desired baseline or reference condition, resulting in the assignment of a wetland to one of six PES categories, as defined in DWAF (1999) and described in Table A2. The methodology is applicable to natural wetlands only.

Table A2: Interpretation of PES score, using the DWAF (1999) methodology.

| PES SCORE | WETLAND DESCRIPTION | PES CATEGORY | COMMENT |
|---|---|---|---|
| > 4 | Unmodified or approximates natural condition | A | Acceptable Condition |
| > 3 <=4 | Largely natural with few modifications, minor loss of habitat | B | |
| > 2 <=3 | Moderately modified with some loss of habitat | C | |
| = 2 | Largely modified with loss of habitat and wetland functions | D | |
| > 0 < 2 | Seriously modified with extensive loss of habitat and wetland function. | E | Unacceptable Condition |
| 0 | Critically modified. Losses of habitat and function are almost total, and the wetland has been modified completely. | F | |

## 4. Assessment of Wetland Ecosystem Services

An assessment of the extent and relative value of ecosystem services performed by the wetland on Remainder Erf 1960 was carried out, using the WET-Ecoservices approach (Kotze et al. 2008). The WET-EcoServices assessment method involves the rating of 15 potential ecosystem benefits, as outlined in Table A3, which include both direct and indirect benefits that can be derived from wetlands.

Table A3: List of ecosystem services assessed in WET-EcoServices [after Kotze et al. 2008]

| ECOSYSTEM SERVICES SUPPLIED BY WETLANDS[1] | | | | DESCRIPTION OF THE BENEFIT |
|---|---|---|---|---|
| INDIRECT BENEFITS | Regulating & supporting benefits | Flood attenuation | | *The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream* |
| | | Streamflow regulation | | *Sustaining streamflow during low flow periods* |
| | | Water quality enhancement benefits | Sediment trapping | *The trapping and retention in the wetland of sediment carried by runoff waters* |
| | | | Phosphate assimilation | *Removal by the wetland of phosphates carried by runoff waters, thereby enhancing water quality* |
| | | | Nitrate assimilation | *Removal by the wetland of nitrates carried by runoff waters, thereby enhancing water quality* |
| | | | Toxicant assimilation | *Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters, thereby enhancing water quality* |
| | | | Erosion control | *Controlling of erosion at the wetland site, principally through the protection provided by vegetation.* |
| | | Carbon storage | | *The trapping of carbon by the wetland, principally as soil organic matter* |
| | Biodiversity maintenance[2] | | | *Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity* |
| DIRECT BENEFITS | Provisioning benefits | Provision of water for human use | | *The provision of water extracted directly from the wetland for domestic, agriculture or other purposes* |
| | | Provision of harvestable resources | | *The provision of natural resources from the wetland, including livestock grazing, plants, fish,* |
| | | Provision of cultivated foods | | *The provision of areas in the wetland favourable for the cultivation of foods* |
| | Cultural benefits | Cultural heritage | | *Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants* |
| | | Tourism and recreation | | *Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife* |
| | | Education and research | | *Sites of value in the wetland for education or research* |

[1] The wetland benefits included in WET-EcoServices are those considered most important for South African wetlands, and which can be readily and rapidly described. It is recognised that other benefits may also be important, but most are difficult to characterise at a rapid assessment level.
[2] Biodiversity maintenance is not an ecosystem service *per se*, but encompasses attributes widely acknowledged as having potentially high value to society.

In the WET-Ecoservices method, a composite score is derived for each of the specified ecosystem benefits by calculating the median of the individual ratings assigned to various characteristics or attributes, according to guideline criteria. The scores for both individual characteristics and the overall composite score for each ecosystem benefit range from 0 to 4 (with a score of 0 indicating that a wetland is not important for a particular function and a score of 4 indicating high importance). For certain ecosystem services, separate scores are calculated for "effectiveness" and "opportunity". The *effectiveness* refers to the efficiency of a wetland in performing a certain ecological service, while the *opportunity* refers to the prospect the wetland has for providing the service. For "biodiversity maintenance", WET-EcoServices considers both the noteworthiness of a wetland with regard to biodiversity and the ecological integrity ('health') of the system.

The composite scores for each of the 15 specified ecosystem services are interpreted using the rating guidelines outlined in Table A4, below.

Table A4: Guidelines for interpreting the scores obtained in WET-EcoServices

| **Score (range = 0–4):** | **<0.5** | **0.5 – 1.2** | **1.3 – 2.0** | **2.1 – 2.8** | **>2.8** |
|---|---|---|---|---|---|
| Rating of the likely extent to which a benefit is being supplied | Low | Moderately low | Intermediate | Moderately high | High |

The overall scores determined for the provision of the various ecosystem services by each HGM unit are visually summarised using radar diagrams, to facilitate comparisons.

The final step in the WET-EcoServices assessment is to evaluate the level of potential threats to the continuation of the current level of ecosystem services being maintained by each HGM unit associated with the proposed development, against the opportunity score for increasing ecosystem benefits in a development context.

## 8.11 APPENDIX B

# Considerations around the use of wetland offsets to address impacts associated with the proposed Tongaat Desalination Plant

**Discussion Document for comment**

**Document prepared by:**

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## 1. Introduction

### 1.1. Background and Purpose of document

This document was compiled as a preliminary input into discussions around the feasibility of using wetland offsets to address the permanent, irreversible impacts to wetlands that would occur in the event that the proposed development of the Tongaat Desalination Plant, Tongaat, is authorised. This is in the context that the Final Wetland Specialist Basic Assessment Report for the above project (Day 2016) found that construction of the proposed desalination plant would result in the loss of wetlands, extending across a large area of the site, and would moreover be likely to result in further degradation of downstream wetlands, as a result of changes in runoff patterns and intensities.

At the same time, meaningful conservation of the wetlands on the site was not considered compatible with its development as a desalination plant. As a result, offset mitigation was recommended as a possible approach to allow development to proceed on the site, and an area immediately south of the site was provisionally identified, for purchase and active rehabilitation and ongoing permanent management as a rehabilitation site. The following specific activities were listed by the specialist as essential elements of such rehabilitation and management:

- The wetlands downstream of the desalination plant must be rehabilitated and managed as near-natural wetland systems ( as opposed to agricultural lands);
- The offset land must be under the control (and thus ownership) of Umgeni Water;
- Long-term management of the offset wetland area must be allowed for, to ensure attainment and retention of its required condition;
- Subsurface and surface drainage from the north eastern portion of the desalination plant site must be dissipated into these wetlands, via a series of specifically designed dissipation trenches constructed and maintained along the upstream (i.e. road) edge of each wetland portion so as to allow the broad dissipation of flow into the wetland, and encourage wetland function in these areas;
- Existing cultivated crops would need to be replaced with locally indigenous wetland vegetation, the species composition of which should be established in consultation with a botanist with local knowledge;
- Maintenance of wetland areas would need to be ongoing, and allow for alien plant removal as well as the maintenance of infiltration trenches, prevention and management of erosion, and the maintenance of extensive plant cover;
- The rehabilitated wetland extent, design, links with the stormwater management plan and development interface must be finalized during the detailed design phase of the project, with

close collaboration between the wetland ecologist, the site and/ or design engineer and a botanical specialist;

- An ecological corridor, vegetated with locally indigenous vegetation, must be established along the north eastern boundary of the site, in a band of width 20m minimum, extending to the undeveloped land on the upslope side of the property – the purpose of this would be to maintain a level of ecological connectivity between the lower wetland areas and the upland portions of the catchment, not-withstanding the acknowledged high level of fragmentation that is already associated with the impact of roads. If security fencing is used to secure the site, then this corridor should be outside of the fenced area.

In consideration of cumulative impacts associated with the development of the site as a Desalination Plant, the specialist also raised the issue of offset mitigation. While she acknowledged that the wetlands in question have been highly and permanently degraded by past activities, she noted that few if any unimpacted examples of the affected wetlands are likely to remain along the Ethekwini coastline and that if degradation was seen as acceptable grounds for their destruction, then cumulative loss of this wetland type would be highly significant. Moreover, the wetlands on the desalination plant site, although highly degraded, are at present still considered rehabilitable to at least an improved condition (PES Category D), albeit that it is highly unlikely that rehabilitation of the wetlands is a likely future outcome of these wetlands, unless driven by some external pressure.

The specialist thus recommended additional off-site offset measures as essential to address the issue of Cumulative Impacts described above. Suitable offset targets would allow the rehabilitation of similar or more threatened wetland habitat, to a condition that is better than Category D – that is, Category C or better. The following additional approaches were recommended, namely:

- The spread of upstream flows from the site into, and the rehabilitation of existing agricultural wetlands downstream of the south western portion of the proposed desalination plant site, in a similar manner to the recommended rehabilitation of the wetlands on the south eastern part of the site, and
- The rehabilitation of (degraded) FEPA valley bottom wetlands east of the site as far as their beach outlets.

The present document was compiled to feed into preliminary discussions regarding the ecological and/or economic feasibility of achieving adequate offset mitigation in this project, and provides an estimate of the extent and condition of wetland that would need to be rehabilitated and conserved in perpetuity in order to adequately offset the loss of wetlands entailed in the proposed development.

### 1.2. Approach to offset calculation

The offset calculations presented in this document are based entirely on the approach recommended by Mc Farlane et al (2014), with the actual calculations being made using the spreadsheet-based "Wetland offset calculator" of the same study. The offset calculators include consideration of wetland condition, extent, existing buffer condition, likely wetland condition in a development context, wetland importance in local, regional and bioregional conservation plans and the impacts of development on so-called wetland functionality.

Data used in the spreadsheet were taken from Day (2016). Note that some measure of inaccuracy in the derivation of actual wetland area is likely, as outlined in Day (2016).

**Tables 1 to 4** summarise the data taken from the above report – wetland extent and the sites themselves can be seen in the specialist report itself. The assumptions and limitations of these data are discussed in Day (2016), and include the fact that the mapped polygons of wetland extent comprise a mosaic of wetland depressions interspersed by higher lying terrestrial areas, all of which have been highly disturbed by a long history of agricultural and other developments.

**Table 1**
**Summary of wetland condition and other attributes**
**Data from Day (2016). WET Health (Level 1 for Vegetation calculated for this assessment)**

| Name | Description | Area (ha) | Wetland CBA status | Overall CBA status | Current condition | | | | | Future condition | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PES | EIS | Wet Health | Ecosystem services | | PES | EIS | Wet Health | Ecosystem services | |
| | | | | | | | | Ecosystem service type | Ecosystem service Category | | | | Ecosystem service type | Ecosystem service Category |
| Tongaat Desalination plant North | Cultivated wetland depression – basin | 3.1382 | Not defined: CESA | Critically endangered vegetation type | E | Low/ marginal | F | Flood attenuation<br>Water supply:<br>Toxicant removal<br>Erosion contrl<br>Carbon storage<br>Provision of foods<br>Biodiversity<br>Cultural<br>Tourism/ Rec | Intermediate<br>Intermediate<br>Mod -low<br>Mod -low<br>Mod -low<br>Mod -low<br>Low<br>None<br>Low | n/a | n/a | n/a | Flood attenuation<br>Water supply<br>Toxicant removal<br>Erosion contrl<br>Carbon storage<br>Provision of foods<br>Biodiversity<br>Cultural<br>Tourism/ Rec | Intermediate (artificial)I<br>None (natural)<br>None<br>None<br>None<br>None<br>None to very low (corridor)<br>None<br>None |
| Tongaat Desalination Plant South | Cultivated wetland depression – basin | 1.1460 | Not defined: CESA | | E | Low/ marginal | F | Flood attenuation<br>Water supply<br>Toxicant removal<br>Erosion contrl<br>Carbon storage<br>Provision of foods<br>Biodiversity<br>Cultural<br>Tourism/ Rec | Intermediate<br>Intermediate<br>Intermediate<br>Mod -low<br>Mod -low<br>Mod -low<br>Low<br>None<br>Low | n/a | n/a | n/a | | |

**Table 2**
**Relationship between Present Ecological State (PES) and showing deviation from natural conditions, as defined in DWAF (2008). (Note: subcategories of DWAF 2008 have been excluded)**

| PES Rating/ Value | Deviation from Reference Conditions | Score (% similarity to reference or natural condition) | PES Category |
|---|---|---|---|
| 0 | No change | ≥92 | A |
| 1 | Small change | >82 to 92 | B |
| 2 | Moderate change | >62 to 82 | C |
| 3 | Large change | >42 to 62 | D |
| 4 | Serious change | > 22 to 42 | E |
| 5 | Extreme change | 0 to 22 | F |



**Table 3**
**Estimated wetland function change, based on data in Tables 1 and 2**

| | Wetland Health Functionality (%) (based on PES) | |
|---|---|---|
| **Name** | **Pre devel** | **Post devel** |
| Tongaat Desalination plant North | 35 | 5 |
| Tongaat Desalination Plant South | 30 | 0 |

## 2. RESULTS OF DETERMINATION OF OFFSET TARGETS

### 2.1 Tongaat Desalination Plant North

**Determining wetland offset targets**

Note: Cells where information must be entered are highlighted in grey

**Wetland Functionality Targets**

| | | | |
|---|---|---|---|
| Impact Assessment | Prior to development | Wetland size (ha) | 3.1382 |
| | | Functional value (%) | 35 |
| | Post development | Functional value (%) | 5 |
| | | Change in functional value (%) | 30 |
| | Key Regulating and Supporting Services Identified | | |
| | Development Impact (Functional hectare equivalents) | | 0.9 |
| Offset calculation | Offset Ratios | Triggers for potential adjustment in exceptional circumstances | None |
| | | Functional Importance Ratio | 1.0 |
| | Functional Offset Target (Functional hectare equivalents) | | 0.9 |

| | | |
|---|---|---|
| Further considerations | Have other key Provisioning or Cultural Services Identified that require compensation? | |
| | Additional compensatory mechanisms proposed | |

**Ecosystem Conservation Targets**

| | | | | |
|---|---|---|---|---|
| Impact Assessment | Prior to development | Wetland size (ha) | | 3.1382 |
| | | Habitat intactness (%) | | 20 |
| | Post development | Habitat intactness (%) | | 0 |
| | | Change in habitat intactness (%) | | 20 |
| | Development Impact (Habitat hectare equivalents) | | | 0.62764 |
| Determining offset ratios | Ecosystem Status | Wetland Vegetation Group (or type based on local clasification) | | |
| | | Threat status of wetland | Threat status | CR |
| | | | Threat status Score | 15 |
| | | Protection level of wetland | Protection level | Poorly Protected |
| | | | Protection level Score | 1 |
| | | | Ecosystem Status Muliplier | 15 |
| | Regional and National Conservation context | Priority of wetland as defined in Regional and National Conservation Plans: [wetlands not identified but should be CESA] | Moderate Importance | 0.75 |
| | | | Regional & National Context Multiplier | 0.8 |
| | Local site attributes | Uniqueness and importance of biota present in the wetland | Low biodiversity value | 0.5 |
| | | Buffer zone integrity (within 500m of wetland) | Buffer compatability score | 0.2 |
| | | Local connectivity | Good connectivity | 1 |
| | | | Local Context Multiplier | 0.5 |
| | | | Ecosystem Conservation Ratio | 5.51 |
| Offset Calculation | Development Impact (Habitat hectare equivalents) | | | 0.6 |
| | Ecosystem Conservation Ratio | | | 5.5 |
| | Ecosystem Conservation Target (Habitat hectare equivalents) | | | 3.5 |

**Outcome: Ecosystem Conservation Target**: 3.5 ha of equivalent habitat

## 2.2 Tongaat Desalination Plant South

# Determining wetland offset targets

Note: Cells where information must be entered are highlighted in grey

### Wetland Functionality Targets

| | | | |
|---|---|---|---|
| Impact Assessment | Prior to development | Wetland size (ha) | 3.1382 |
| | | Functional value (%) | 35 |
| | Post development | Functional value (%) | 5 |
| | | Change in functional value (%) | 30 |
| | Key Regulating and Supporting Services Identified | | |
| | Development Impact (Functional hectare equivalents) | | 0.9 |
| Offset calculation | Offset Ratios | Triggers for potential adjustment in exceptional circumstances | None |
| | | Functional Importance Ratio | 1.0 |
| | Functional Offset Target (Functional hectare equivalents) | | 0.9 |

| | | |
|---|---|---|
| Further considerations | Have other key Provisioning or Cultural Services Identified that require compensation? | |
| | Additional compensatory mechanisms proposed | |

### Ecosystem Conservation Targets

| | | | | |
|---|---|---|---|---|
| Impact Assessment | Prior to development | Wetland size (ha) | | 1.146 |
| | | Habitat intactness (%) | | 20 |
| | Post development | Habitat intactness (%) | | 0 |
| | | Change in habitat intactness (%) | | 20 |
| | Development Impact (Habitat hectare equivalents) | | | 0.2292 |
| Determining offset ratios | Ecosystem Status | Wetland Vegetation Group (or type based on local clasification) | | |
| | | Threat status of wetland | Threat status | CR |
| | | | Threat status Score | 15 |
| | | Protection level of wetland | Protection level | Poorly Protected |
| | | | Protection level Score | 1 |
| | | | Ecosystem Status Muliplier | 15 |
| | Regional and National Conservation context | Priority of wetland as defined in Regional and National Conservation Plans: [wetlands not identified but should be CESA] | Moderate Importance | 0.75 |
| | | | Regional & National Context Multiplier | 0.8 |
| | Local site attributes | Uniqueness and importance of biota present in the wetland | Low biodiversity value | 0.5 |
| | | Buffer zone integrity (within 500m of wetland) | Buffer compatability score | 0.2 |
| | | Local connectivity | Good connectivity | 1 |
| | | | Local Context Multiplier | 0.5 |
| | | | Ecosystem Conservation Ratio | 5.51 |
| Offset Calculation | Development Impact (Habitat hectare equivalents) | | | 0.2 |
| | Ecosystem Conservation Ratio | | | 5.5 |
| | Ecosystem Conservation Target (Habitat hectare equivalents) | | | 1.3 |

**Outcome: Ecosystem Conservation Target:** 1.3 ha of equivalent habitat: PES Category D or better

## 2.3 Total Required conservation target including additional offset

4.8 hectares of basin depression wetlands of similar vegetation type and condition.

## 3. Possible offset wetlands in vicinity of site


*Figure 1 - Rough calculations of wetland extent in vicinity of site – all wetlands assumed PES Category E and WetHealth Category F*

Figure 1 shows the approximate areas of wetlands downstream of the proposed site – these have a combined area of around 2.81 ha, and are of a similar (highly degraded) quality to those on the site. Note that the area of the northern wetland considered for offset includes the full extent of wetland lost, and not just the "core" area of still functional but highly degraded wetland on which the EIA focuses.

## 4. Next steps in wetland offset process

The next steps in a wetland offset application comprise establishment of suitable potential offset sites, usually entailing the location and procurement of a site where the required conservation criteria can be met, either with a wetland/s of equal area and condition to that outlined in Table 1, or with a greater area or wetlands of a better condition. A similar process for calculation of the suitability of different sites for wetland offsets is included in the offset calculator of Mc Farlane et al (2014).

With regard to Figure 1, which indicates that downslope wetlands do not account for the required offset area, it is noted that Mc Farlane et al (2014) list a number of options in which offsets can be achieved in theory, namely:

- Protection;
- Averted loss;
- Rehabilitation;
- Establishment;

- Direct compensation (usually appropriate where loss of ecosystem services is entailed, and more problematic in terms of biodiversity).

These different approaches would need to be explored in more detail if an offset approach is considered seriously for this project. Identification of other sites to increase the offset area should be explored, as well as measures to improve wetland quality as outlined already in Day (2016).

In this context, it is noted that the better the condition of the final offset, the less area is required to meet the offset. Thus if degraded wetlands (Category E) can be rehabilitated to a realistic Category C, then less area would be required than if they were rehabilitated to a Category D. Note that management of any wetland in a condition worse than Category D is not considered sustainable and an offset would need to achieve at least a Category D.

It should be stressed moreover that an important part of offset functionality would be in its links to the water source passing through the current site. Thus rehabilitation of sites that are hydrologically connected to the proposed desalination plant site would generally be preferable to rehabilitation of (possibly larger) wetlands elsewhere.

In the event that no offset is provided, then the cumulative impact of the proposed project for wetland ecosystems would be **high**.



## 5. References cited

Day, E. (Liz). 2016. Chapter 8. Aquatic Ecology. In. CSIR 2016. Draft Environmental Impact Assessment Report for the proposed construction, operation and decommissioning of a Sea Water Reverse Osmosis Plant and associated infrastructure at Tongaat, Kwa-Zulu Natal. Report for Umgeni Water.

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