ENVIRONMENTAL IMPACT ASSESSMENT

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

SECOND DRAFT EIA REPORT

CHAPTER 8: AQUATIC ECOLOGY

GLOSSARY

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

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 powerlines) 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;
- A number of hillslope seep wetlands (PES Category D to Category E) and channelled valley bottom wetlands (PES Category D) - these would all be crossed by, or occur within close proximity to, the proposed potable water pipeline. Of these, two valley bottom wetlands and two hillslope seeps 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 by the proposed powerline.
- The Lake Victoria wetland, near Mount Moreland would be crossed by the proposed Initial powerline route, but not by any other routes. This wetland is listed as a Global Important Bird and Biodiversity Area: this large reedbed wetland is important in its own right in terms of its large size, but also because of the fauna it supports.

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 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. An offset plan was compiled and is presented in this report, outlining measures that would need to be included in such an offset, and which would need to be a condition of any authorisation. Purchase of specific areas of land for the required offsets would be required if this measure was to be implemented, as well as the rehabilitation and ongoing management of offset wetland sites. If such offsets were available, or could not be adequately implemented, it is the understanding of this specialist that project implementation could not proceed.

- 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 required crossing of the Mdloti River estuary by the proposed powerline (Alternative 2) and pipeline (Alternative 1) – although the physical impacts of crossing of this estuary with its wide floodplain wetlands and inflowing valley bottom / seep wetlands are considered essentially mitigable to a high degree, the area itself forms part of an offset receiving area, and as such ought in theory not to be further impacted by any such developments. The proposed alignments do however fall close to the N2, thus consolidating infrastructure impacts, and mitigation measures further require additional rehabilitation of two 30m consolidated corridors along these alignments.

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 powerlines 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.

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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. The study was updated in 2017, following revisions of both proposed powerline and pipeline routes on the basis of comments received from eThekwini Municipality and Department of Water and Sanitation (DWS) regarding previous draft alignment proposals.

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.

Following input from the DWS and eThekwini Municipality on the EIA report, the aquatic specialist's scope of work was extended to allow for the following additional inputs:

- To assess sections of the proposed pipeline and powerline routes that have been amended on the basis of comments on the first Final EIA submission;
- To assess and delineate aquatic ecosystems within a 500m corridor on either side of both the proposed pipeline and powerline routes, in order to meet DWS concerns that water uses within 500m of a wetland required delineation of the wetlands in question.

With regard to the above extension of Scope, it must however be noted that, since the DWS provided input into the need for wetland delineation within a 1000m total corridor around the proposed powerline and pipeline alignments, there has been a significant change in legislation with regard to the need for water use licensing. Previously, while certain activities, and in particular [1]Section 21c and i water uses, as defined in the National Water Act (Act 36 of 1998) that were carried out within 500m of a wetland were subject to authorisation only through a full water use licence application (WULA). In 2016, a new General Authorisation (GA) was however introduced, through GN509 (August 2009). This GA allows for "impeding or diverting the flow of water in a watercourse (section 21(c)), and/or altering the bed, banks, course or characteristics of a watercourse (section 21(i)) of the NWA provided that the risk to the watercourse is assessed as LOW, using the Risk Assessment Matrix developed by DWS for this purpose. The GA does not exclude wetlands, and can thus be applied to all watercourses. The Risk Assessment Matrix is a tool, the results of which intended to provide DWS officials with a relatively quick guide as to the degree to which a particular activity would, in its mitigated state, constitute a Risk to the water resource. Activities that constitute a Low Risk, if carried out with full mitigation measures as recommended by a SACNASP-registered aquatic ecosystem specialist, are considered Generally Authorised in terms of the NWA, and thus require registration of use with DWS, but would not be subject to a full Water Use Licence Application (WULA). Activities likely to be associated with a Risk of Medium or High would require consideration for authorisation through a comprehensive WULA.

The approach to wetland assessment and delineation outlined in this study took cognisance of the above issues, noting however that the impacts associated with the proposed desalination plant itself would be high, and thus automatically require a WULA for the project as a whole. Nevertheless, the Risk Assessment process is a useful basis on which to gauge the extent of impact of some aspects of the development on adjacent wetlands – and where no risk is anticipated for wetlands, there can be no argument that there is any water "use" as envisaged in Section 21c and i of the NWA. The assumptions inherent in this approach are expanded on in Section 8.1.2.

A final stage of input into this assessment comprised input into the need for, and specifications of, a wetland offset, in the event that this application is approved, earlier drafts of this report recommended that wetland offsets would be required, given the high level of significance of residual wetland loss, even after mitigation. This report thus includes an assessment of wetland offset requirements, including rehabilitation, maintenance and management requirements, which would need to be implicit in any authorisarton of the proposed development.

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;

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1 Section 21 of the NWA lists the following water "uses", namely:

a. Taking water from a water resource;
b. Storing water;
c. Impeding or diverting the flow of water in a watercourse;
d. Engaging in a stream flow reduction activity contemplated in section 36;
e. Engaging in a controlled activity as outlined in Section 36;
f. Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g. Disposing of waste in a manner which may detrimentally impact on a water resource;
h. Disposing in any manner of water which contains waste or which has been heated in any industrial or power generation process;
i. altering the bed, banks, course or characteristics of a watercourse.

- The alignments of the proposed potable water pipelines – these were considered in detail within a roughly 50m corridor;
- The alignment of the proposed electricity powerlines, also considered in a roughly 50m wide corridor;
- Identification, desktop assessment and desktop delineation of watercourses within a 500m area on either side of the proposed centre-line of the proposed powerline and pipeline corridors.

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:

- Inputs into the first (June 2016) draft report included:
  - 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 B;
    - 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 powerline 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 including);
    - Compilation of the draft specialist EIA report (June 2016);
- Inputs into the second (December 2017) draft report:
    - Powerline alignment:
        - The proposed crossing of the Mount Moreland wetland (Lake Victoria) associated with the Initial alignment for the proposed powerline that was assessed as part of the First specialist report (June 2016) was considered an outright no-go proposition, and no offset mitigation would compensate for its authorization. Based on the above, the proposed Initial alignment for the powerline was considered fatally flawed. A proposed amendment to the alignment was identified, which avoids the Lake Victoria wetlands and roughly follows the road alignment. In its letter dated September 2016, however, the DEA, requested a re-alignment of the proposed amended powerline to avoid King Shaka Conservation Area. For completeness purposes, Appendix A of this report recaptures the description of the aquatic features crossed by the Initial alignment proposed for the powerline; **however, this alignment has not been assessed further in this report;**
        - In addition, following the scoping phase, an alternative alignment of the first section of the powerline was suggested (Alternative 1 route) to minimise the visual impacts associated with the Initial route. This Alternative was assessed in the first draft report and the findings have also been recaptured in Appendix A of this report;
        - An amended powerline route (Alternative 2) has been assessed in this second Draft EIA report;
    - Potable water pipeline:
        - In August 2016, Umgeni was made aware that the location of the proposed potable rising main and servitude traverse Erf 36/776 which is an area that is supposedly approved for the development of upmarket housing due to be constructed in 2017. This section of the potable water pipeline was therefore re-routed to avoid the proposed housing development;
        - As such an amended potable water pipeline (Alternative 1) route has been assessed in this 2nd Draft EIA report;
    - Attendance of a project team meeting on 14 March 2017, during which time clarity regarding the new pipeline and powerline alignments was obtained and specialists were able to state additional information needs and concerns around any of the proposed amendments;
    - Collation of existing spatial data for watercourses in the study area, in order to identify wetlands within the 1000m wide corridors required by DWS. The following additional data sources, all produced since the previous specialist report was submitted, were also considered in this version of the study:
        - Updated Biodiversity and Spatial Planning outputs of Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) (Ezemvelo KZN Wildlife 2016);
        - The King Shaka International Airport (KSIA) Conservation Zone;
        - The offset and conservation areas included in the Northern Spatial Development Plan for the Mdloti area (Macfarlane 2015);

- A site visit in May 2017, during which time:
  - the new proposed pipeline (Alternative 1) and powerline (Alternative 2) alignments were assessed, within the 1000m corridor required. This was done by driving the route where possible, finding viewpoints to show the wider corridor, and visually assessing wetlands identified in the desktop study – PES determinations were mad e/ ground-truthed on this basis. Particular attention was paid to proposed point of crossing of the Mdloti River – this area was walked between the river and outer (northern) floodplain;
- Liaison with the project engineers from Aurecon (Mr Graham English, Mr John-Bert Calitz and Mr P. Seebran) regarding potential construction details and mitigation measures;
- Email and telephonic discussions with Mr Greg Mullins (Environmentalist: Biodiversity Impact Assessment, eThekwini Municipality) regarding the proposed infrastructure crossing at the Mdloti Estuary and the implications of the Northern spatial Development plan biodiversity offsets and conservation areas for the proposed alignments;
- Compilation of a DWS Risk Assessment, to inform the applicability of GN509 to infrastructure such as the pipelines and powerlines – note that this Risk Assessment was applied only in an illustrative manner, to highlight watercourses that would NOT be affected by the proposed development activities. It was clear at an early stage of this study that the Risk associated with parts of the development such as the desalination plant itself would be High, even with implementation of mitigation measures. This means that a WULA would in any case be applicable to the project, and there was thus no merit in preparing Risk Assessments;
- Updating of the specialist report to reflect the latest proposed alignments.

- Inputs into the May 2018 draft report included:
  - Refinement of the wetland offset requirements and rationale;
  - Detailed consideration of the proposed offset receptor sites, from the perspective of:
    - Current condition;
    - Potential for rehabilitation;
    - Rehabilitation objectives;
    - Equivalent wetland hectares afforded by the site;
  - Compilation of a conceptual wetland rehabilitation plan;
  - Input into a wetland offset management plan;
  - Provision of criteria to be included in a legal wetland offset agreement with Umgeni Water.

  These inputs were based on the findings of all of activities already listed, as well as on the outcomes of a meeting on 26th April 2018 with Mr Greg Mullins (Environmentalist: Biodiversity Impact Assessment, eThekwini Municipality) and DWS officials (Ms Krishnee Naidoo and Mr Ayanda Mthalane) regarding the proposed wetland offset, and telephonic discussions with Ms Dinesree Thambu (kZN Wildlife).

  Input from a local botanical specialist (Mr Ryan Edwards of Eco-Pulse) was also obtained, via an on-site meeting and subsequent written submissions, regarding the plant species to include in the proposed wetland offset site. Mr Edwards also provided useful input into setting of offset site rehabilitation objectives.

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 King Shaka International Airport (KSIA) Conservation Zone;
  - Updated KZN Biodiversity Spatial Planning Terms and Processes outputs (Ezemvelo KZN Wildlife 2016)
  - 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 / powerline 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 – given the highly localised likely effect of the proposed infrastructure outside of the desalination plant itself, this approach is considered defendable as it is highly unlikely that the pipelines or electric powerlines would exert an influence on wetlands at a distance that is greater than their influence on wetlands in their immediate vicinity. Clearly however such potential influences would still be borne in mind in the assessment, and where circumstances suggest that more significant effects are likely, then there would be motivation to apply more rigorous assessment approaches;.
- 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 lower lying 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 powerline 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 Mdloti River itself was accessible only some distance upstream and immediately 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 first site visit – the river was accessed at the proposed crossing point during the 2017 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;
- 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 importance 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 following individuals into this project is gratefully acknowledged, namely:

- Dr Mike Shand and Mr Graham English (Aurecon) for input during and after the February 2015 site visit, as well as from Mr John-Bert Calitz and Mr P. Seebran (also Aurecon)) during the 2017 revisions;.
- Mr M.Theunissen assisted in the field (2015) and with GIS mapping;
- Mr Donovan Kotze reviewed 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;
- Dr Justine Ewart-Smith (FCG) assisted with the 2017 field and desktop wetland assessments;
- Mr Greg Mullins (eThekwini Municipality) provided time and energy in discussing offset concerns and conservation issues around the Mdloti estuary area.
- Mr Greg Mullins (eThekwini Municipality) , Ms Krishnee Naidoo (DWS) and Mr Ayanda Mthalane (DWS) and Ms Dinesree Thambu (kZN Wildlife) regarding offset approaches to address wetland loss on the desalination plant site.

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 high water 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 8.1);

- 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 follow existing cadastral lines as far as possible (notes from J.B. Calitz, Aurecon, at March 2017 workshop) and run as depicted on Figure 8.2. The proposed 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
    - north through cane fields to tie in with the "Bifurcation section" of the existing bulkwater system near the Tongaat Toll Plaza;
    - south, south-east, 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 tunneling machine. The earth and groundwater pressure at the cutting face would be balanced by the pressure of the drilling mud at the cutting face of the machine. The tunnel would be water-tight during and after construction, thus there would be no groundwater inflow that would need to be pumped out and disposed of. Waste generated from drilling would comprise waste water, which would be 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 some 532 m 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 powerline that would extend from the site, and run roughly in a north westerly direction, towards the N2. The proposed Alternative routes (Figure 8.2) would cross the N2 some 170 meters downstream of the N2 road bridge (avoiding the KSIA Conservation area), and follow the N2, crossing this highway some 860m north of the M27 intersection, then passing through canefields before crossing the M27 and joining up with the Umdloti Beach substation. It 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, trees within the servitudes would need to be cleared;
    - Strain structures with a height of 23.4 – 29.4 m above ground would be used at the Mdloti River crossing, with the final height to be decided on during detailed design phase, depending on the terrain and ability to achieve required clearances over the river (email from P. Seebran, Aurecon, of 25/8/2017).

Note that for completeness, both the Initial alignment for the potable water pipeline and powerline as well as the proposed Alternative alignments assessed as part of this second draft report are depicted in Figure 8.2.

Figure 8-1: 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).

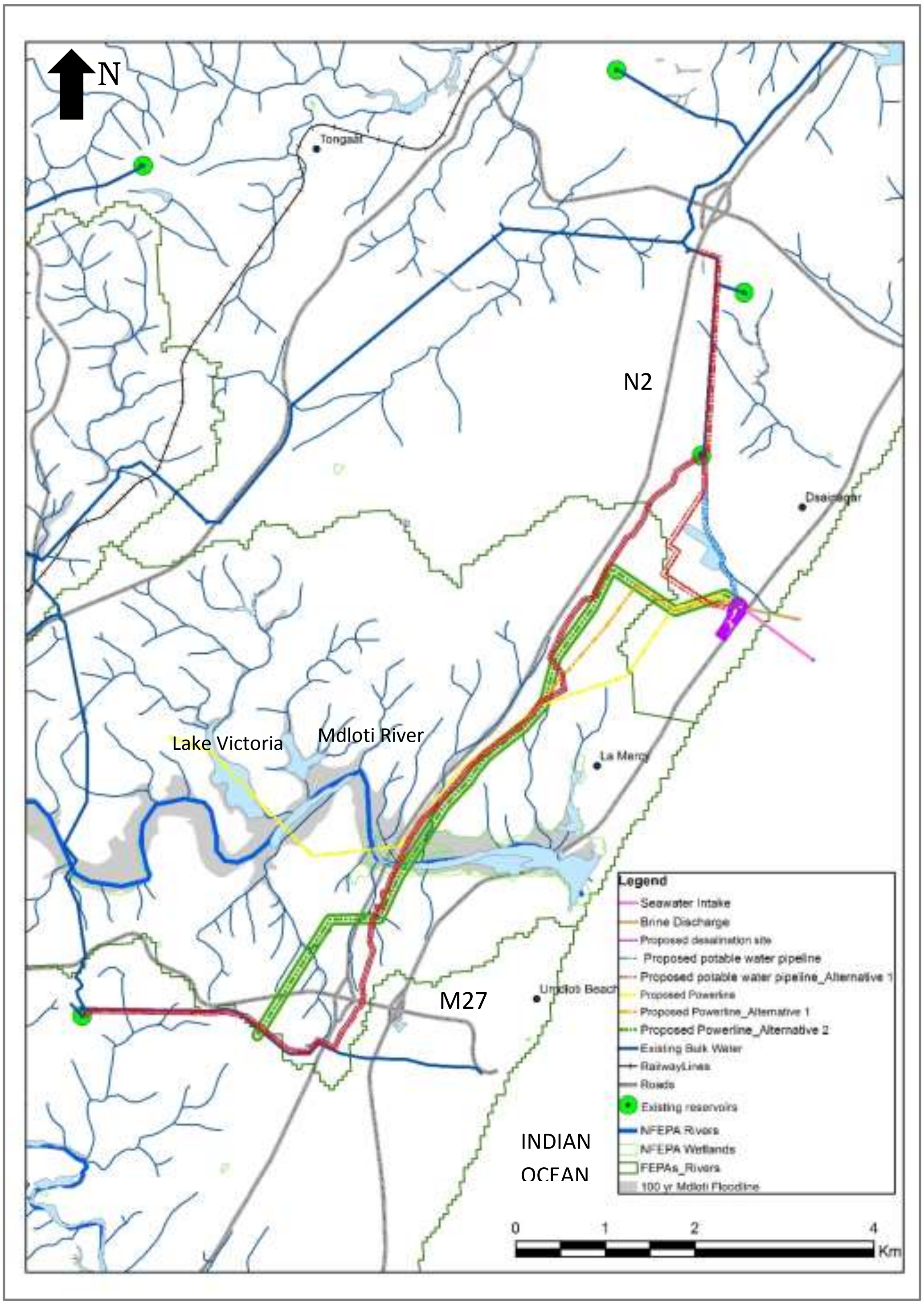


Figure 8-2a: Map of the proposed Desalination facility at Tongaat and associated infrastructure, showing river and wetland crossings based on NFEPA and SANBI wetland and river data.

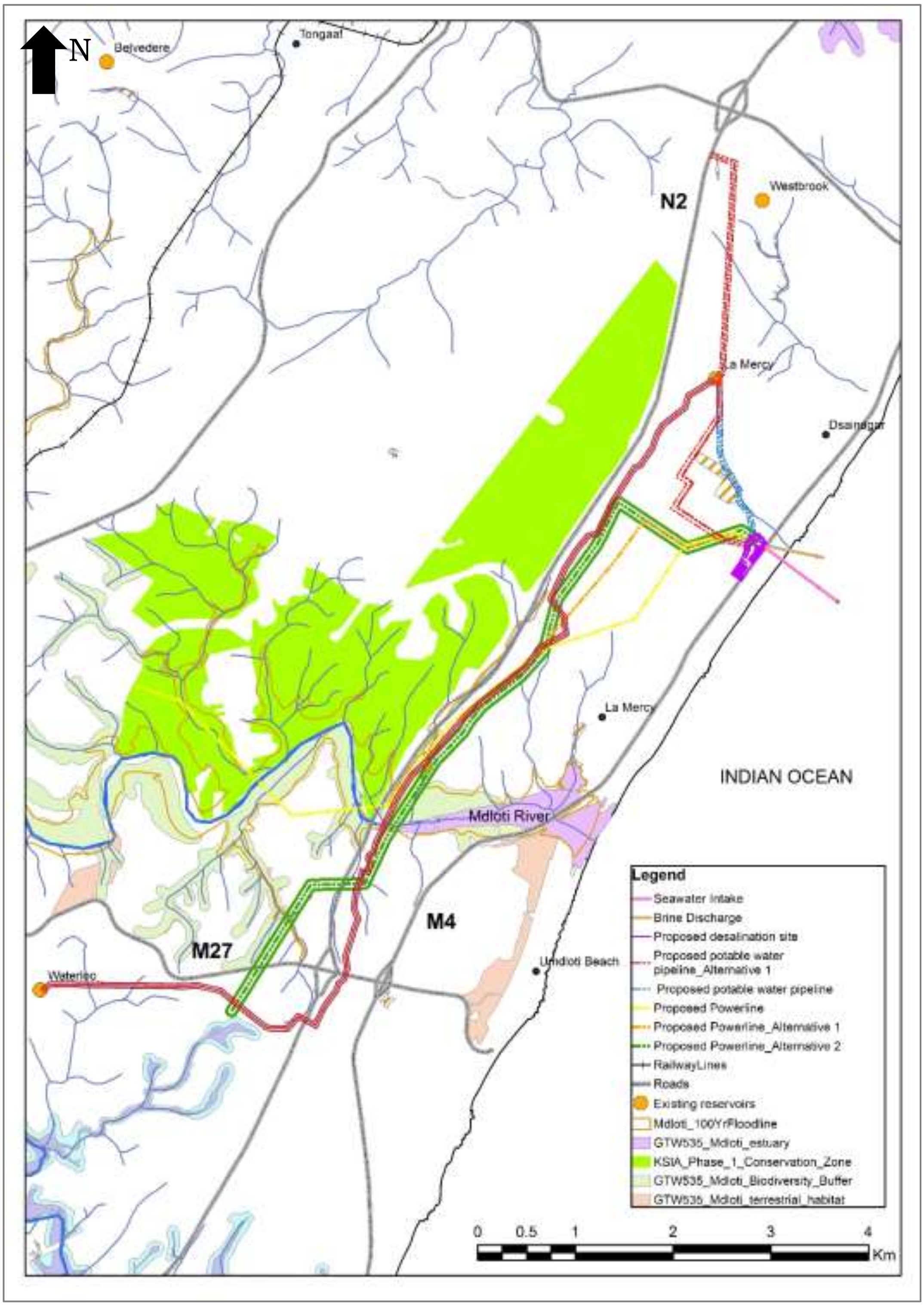


Figure 8-2b: Map of the proposed Desalination facility at Tongaat and associated infrastructure, showing river and wetland crossings. Mdloti biodiversity buffer, estuary and terrestrial habitat layers sourced as outlined in Section 8.1.3.

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 and Sanitation's (DWS) Pongola to Mtamvuna Water Management Area (WMA 4). While the proposed desalination plant itself would be located in the Tongati River catchment (DWS quaternary U30D), most of the proposed powerline infrastructure and the outgoing potable water pipeline would be located in the adjacent Mdloti River catchment (DWS quaternary U30B). The mouth of the Mdloti estuary is in fact 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 would extend 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[2], 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).

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 10 (Eastern Coastal Belt ecoregion). 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 900 mamsl;
- Usually in areas where mean annual precipitation is relatively high (MAP = 400-1000 mm) and mean annual temperature is moderate (16-20°C);
- Rainfall mainly early to very late summer; all year in places;
- Typically associated with Eastern Thorn Bushveld and Valley Thicket as well as a variety of Grassland, Bushveld and forest types.

8.3.3 Context in the National Biodiversity Assessment

The entire study area lies in the area identified in the National Freshwater Ecosystem Priority Assessment (NFEPA) dataset (Driver et al 2011) as comprising the "Indian Ocean Coastal Belt Group 2" Vegetation Group. All wetland hydrogeomorphological units in this vegetation category have been identified by the National Biodiversity Assessment (NBA) report of Nel and Driver (2012) as Critically Endangered, with the protection status of "Poorly Preserved" to "Not Preserved".

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

8.3.4 Freshwater aquatic ecosystems associated with the study area

8.3.4.1 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

General site and aquatic ecosystem 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 Critically Endangered terrestrial vegetation type. Wetland vegetation in this area has been classified as belonging to the Indian Ocean Coastal Belt (Group 2) category (see Section 8.3.3).

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.

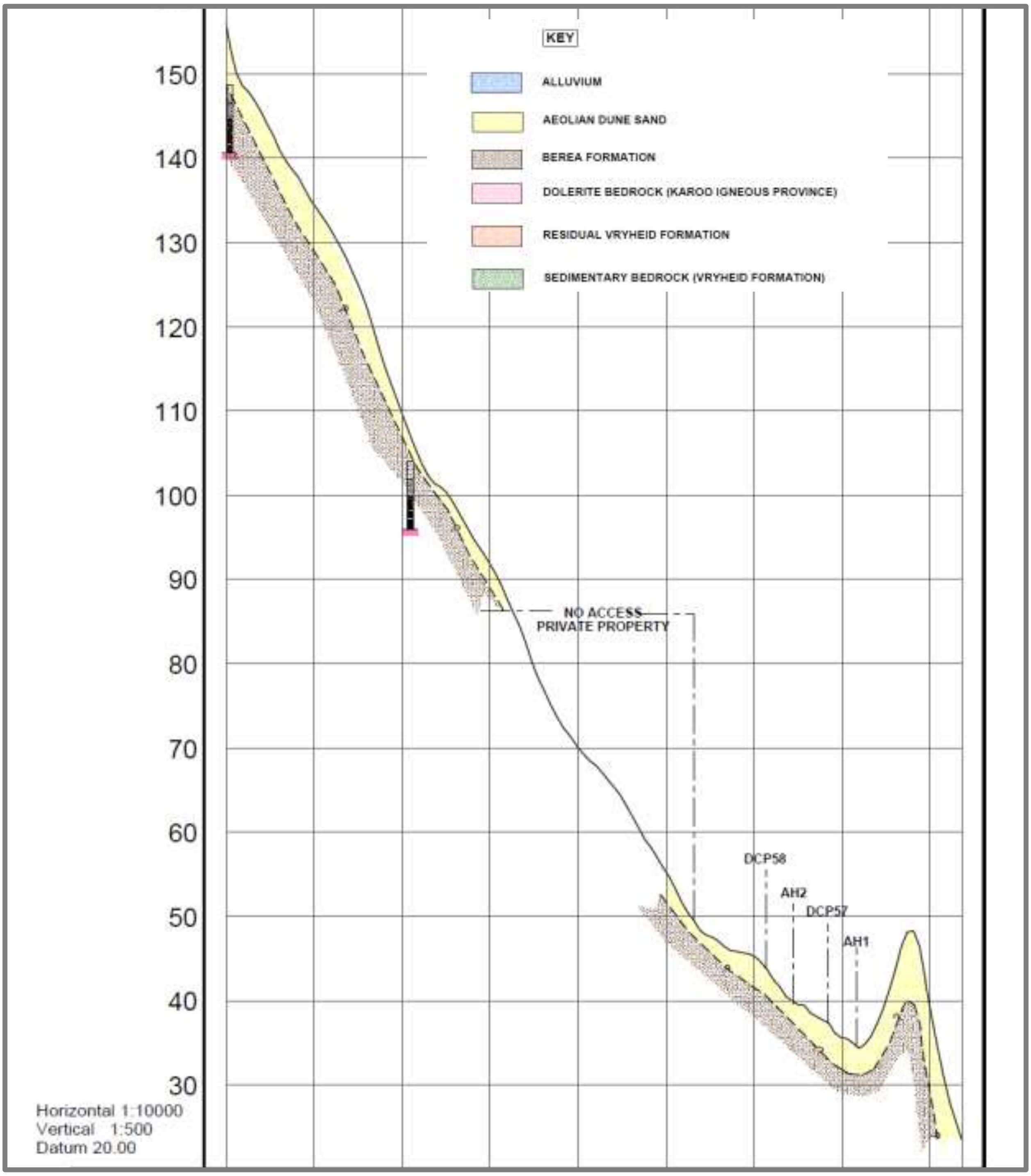


Figure 8.3: Long-section through site, from La Mercy Reservoir to Tongaat Beach, with AH1 lying towards the downslope end of the proposed Desalination Plant, followed by the low partially vegetated dune on the beach. Figure extracted directly from Appendix B, Aurecon 2015

Figure 8-4A: 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 Napier fodder (*Pennisetum purpureum*). 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 day lighting 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 surf zone. 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 Napier fodder (*Pennisetum purpureum*), as well as stands of water-tolerant bananas and various weedy species.

Water from these transformed areas, believed to have comprised mosaic areas of wetland seeps 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 low-lying 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, [3]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 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

3 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.

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 8-2 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.

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

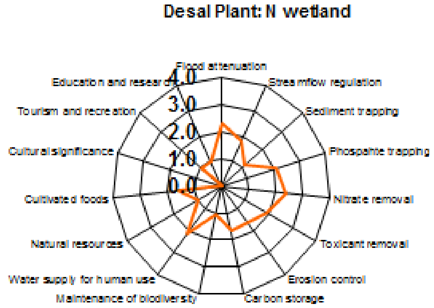
Photo I
Looking south across proposed desalination site, to high-lying land between two basins, showing terrestrial, irrigated slopes

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 and wetland classification	[4]SIZE	PRESENT ECOLOGICAL STATE (PES) / CONDITION	ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)	CONSERVATION IMPORTANCE	ECOSYSTEM SERVICES
Tongaat Desalination plant North: Seep with channelled outflow	31 382 m^2	Category E	Low/ marginal	Low – because of extent of degradation	
Tongaat Desalination Plant South: Seep with channelled outflow	11 460m^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: Seep with channelled outflow	Extent of pipeline abuts degraded wetland	Category E	Low/ marginal	Low	As per Tongaat Desalination Plant North

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

THE POTABLE WATER PIPELINE

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 8-8 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 8.3.3.7, which describe aquatic ecosystems in the close vicinity of the pipeline (that is, within the 50m corridor assessed in detail for this study). Section 8.3.4 describes aquatic ecosystems within a 1000m corridor around the proposed alignment – as required for consideration by DWS.

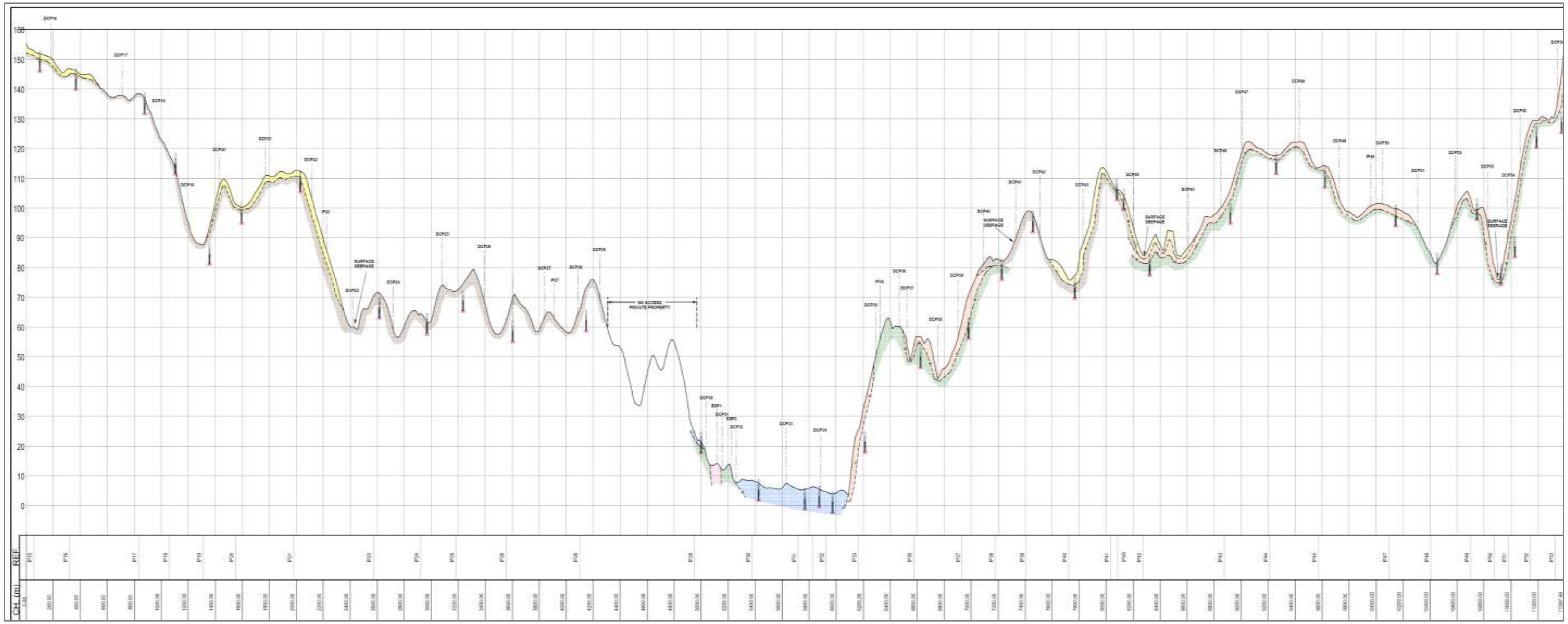


Figure 8.5: Long-section through site, from La Mercy Reservoir to Waterloo Reservoir, showing the Mdloti River and seepage areas referred to in the text of the present document. Figure extracted directly from Appendix B, Aurecon 2015.

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

The Initial pipeline route proposed along this segment would pass through a vegetated valley bottom, running parallel to Valley Road, and then cutting across cane fields towards the existing La Mercy Reservoir (Figure 8.6). 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, however ground-truthing showed no wetland features. In August 2016, it was brought to the attention of the EAP that this pipeline alignment is located in an area that is supposedly approved for the development of upmarket housing. The Initial alignment was therefore discarded and an alternative alignment (Potable water pipeline Alternative 1) was identified (Figure 8.7) and assessed further in this specialist report.

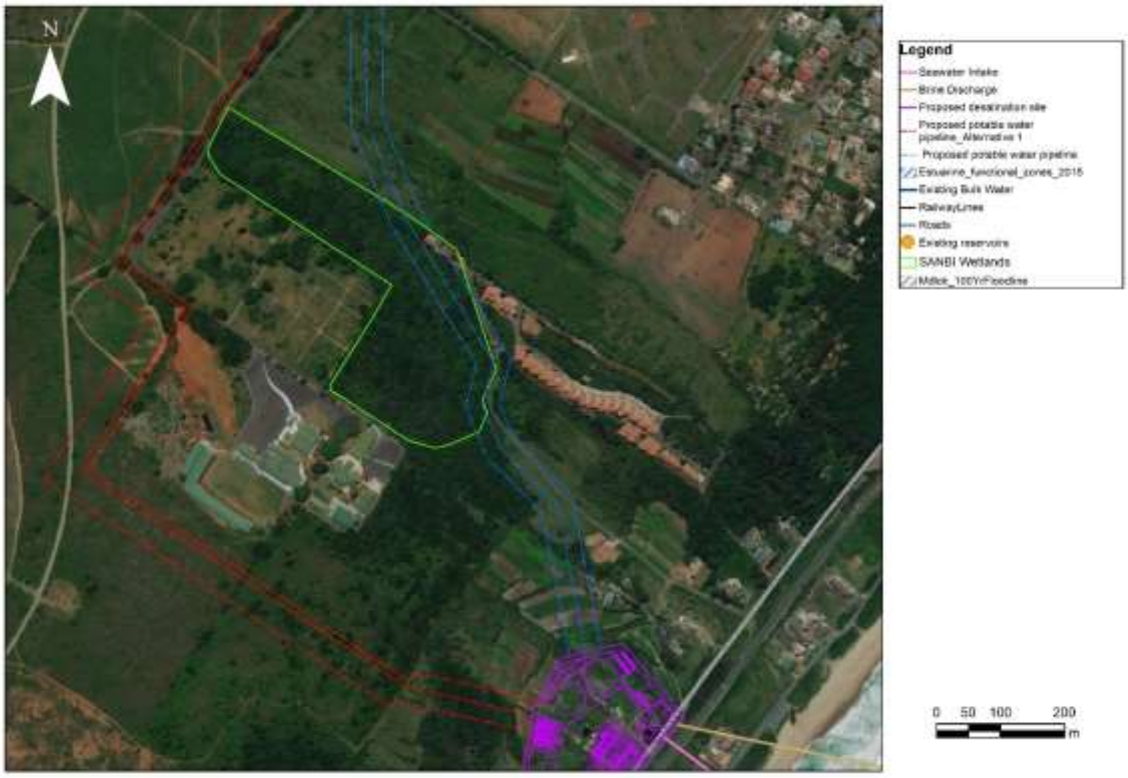


Figure 8-6: GOOGLE images of the proposed initial pipeline route (red line) – from the desalination plant to La Mercy Reservoir.

Figure 8-7 illustrates that the proposed pipeline route (Alternative 1) along this segment would pass out of the desalination site on its eastern boundary on the steep dune, and be routed initially through coastal forest but then quite quickly emerging into disturbed previously cultivated lands, and turning roughly north to follow cadastral boundaries along the edge of Sivananda Avenue – thus avoiding the mapped FEPA wetland shown in Figure 8-7. This area is referenced in SANBI finescale data as a subtropical coastal alluvial wetland. During the site visit, it was accessible only from Sivanandra Avenue and although dense coastal forest was apparent in this area, no drainage line with any visible wetland or riparian features, at least in the upper reaches near to the road, was apparent.

North east of the proposed pipeline alignment (Alternative 1), Figure 8-7 also shows a steep valley, draining towards the coast, and passing just south of Valley Road. This valley is partially included in the FEPA polygon described above. 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 north east of 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.

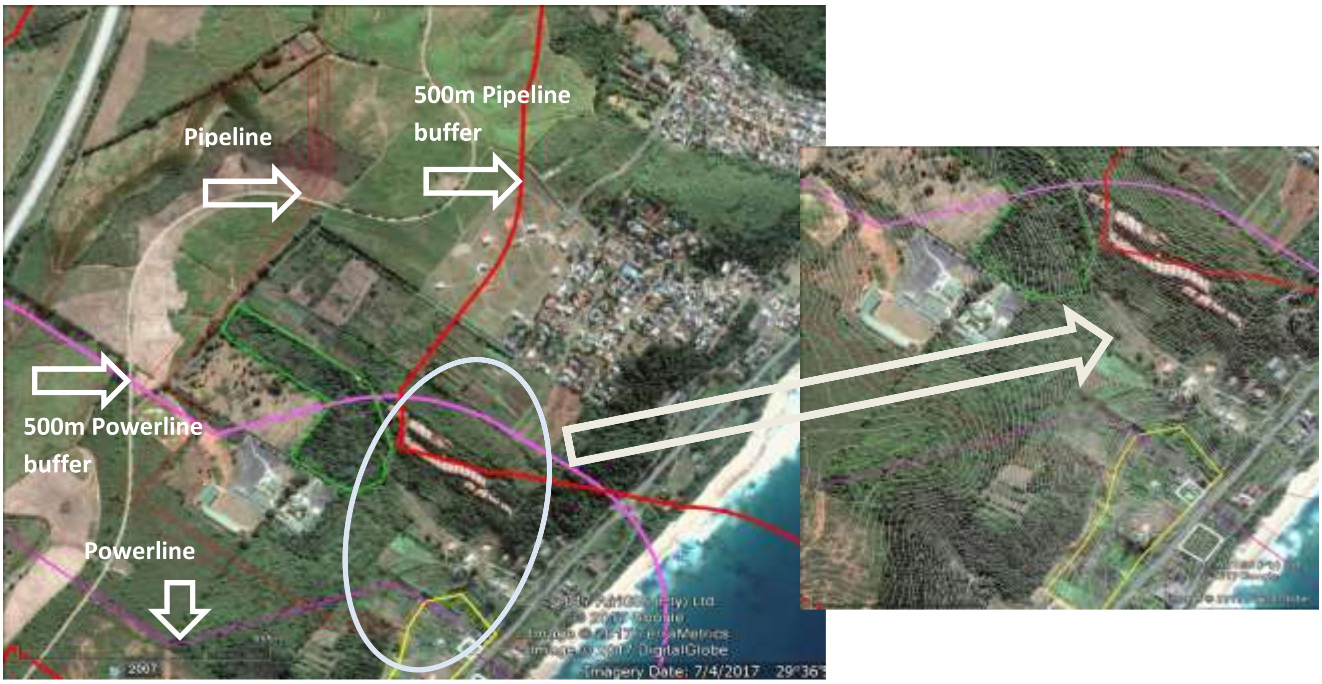


Figure 8-7: GOOGLE images of the proposed Alternative 1 pipeline route (50m corridor shown as three red lines; 1000m corridor shown as thick red line) – from the desalination plant to La Mercy Reservoir. Note inset showing 2m contours to illustrate drainage line along Valley Road. Green polygon indicates mapped FEPA wetland, also shown in SANBI fine scale map as an Alluvial Wetland with Subtropical Alluvial Vegetation – ground-truthing showed no wetland features.

8.3.4.3 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.

Figure 8-8: Proposed La Mercy to Waterloo pipeline route (red line) – La Mercy Reservoir - Bifurcation line. Green polygons indicate mapped SANBI fine scale map data for Mdloti River wetlands and tributary.

8.3.4.4 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, comprising almost wholly 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 (**Seepage B1**) was encountered within the cane fields. This seep, marked by Aurecon (2015) as exhibiting "surface seepage" (see Figure 8-9) 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.

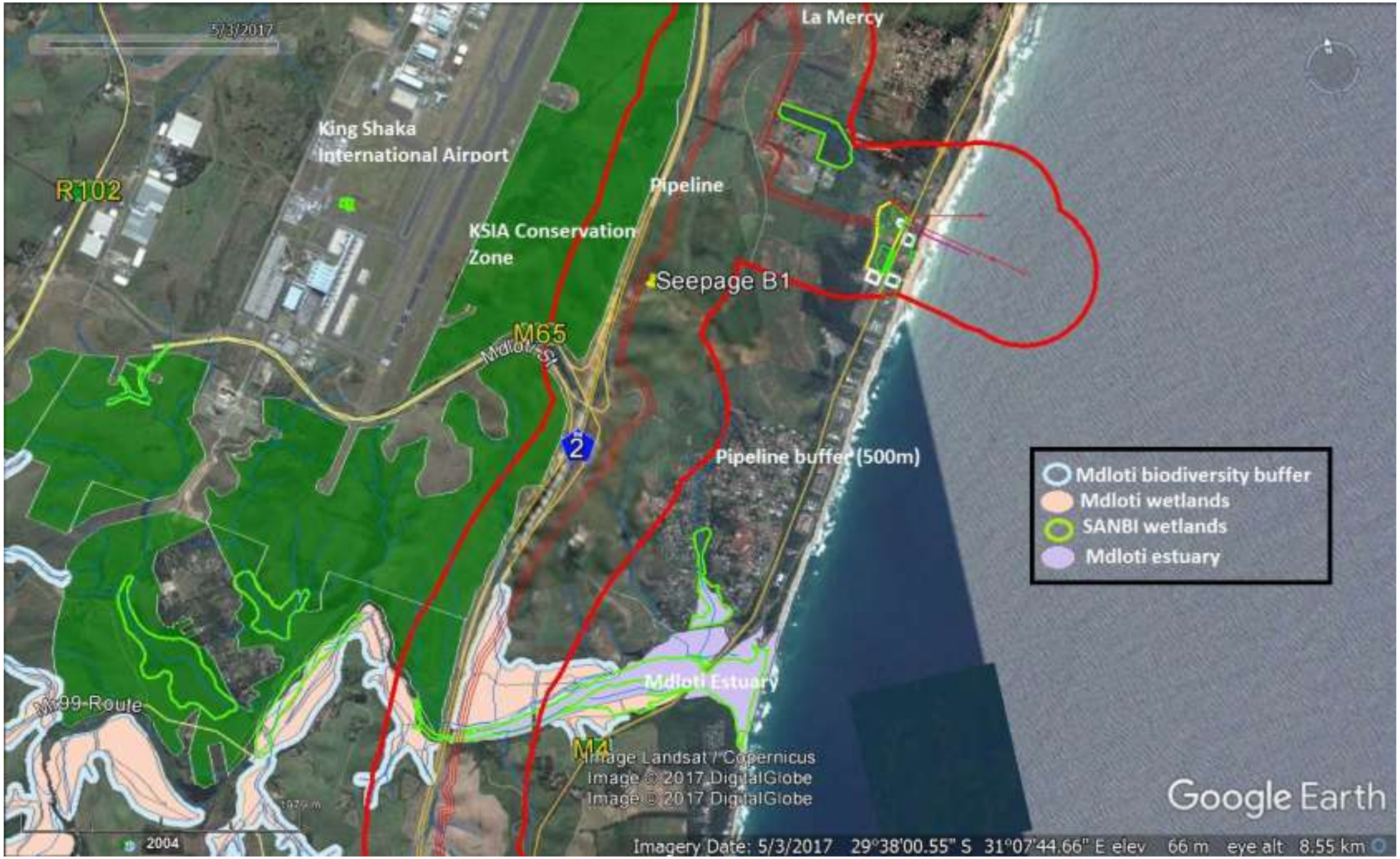


Figure 8-9: GOOGLE images of the proposed pipeline route (50m corridor shown as three red lines; 1000m corridor shown as thick red line) –La Mercy Reservoir to Waterloo Reservoir route. La Mercy Reservoir to Mdloti River section.

8.3.4.5 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 ecosystems in these reaches comprise 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.) that result in shading of the bank and the maintenance of a relatively sterile understorey as a result.

Downstream of the bridge, where the pipeline alignment would run (see Figure 8.10), the downstream side of the estuary (right hand bank, looking downstream) slopes up steeply, while the opposite bank is flatter and lower – see Photos O and P.

Figure 8.10 shows five distinct wetland zones that have been distinguished on the left hand bank, almost entirely within the 1:100 year floodline of the Mdloti River. These wetlands, broadly delineated in the eThekwini Mdloti wetland layer are described in this report as follows:

- Wetland zone A – this extends from the low flow channel up the gently sloping banks and northwards. The zone is dominated by wide *Phragmites australis* reedbeds, interspersed in places by occasional alien saplings (e.g. *Sesbania punicea* and *Eucalyptus* sp.). This zone is essentially the marginal wetland fringes of the active channel of the estuary;;
- Wetland zone B – this zone is dominated by gum trees (*Eucalyptus* sp.) – it is classified in the eThekwini Mdloti wetland layer as part of the floodplain terrace, and would be classified in terms of the National Classification System for Wetlands of Ollis et al (2013) as a floodplain wetland;
- Wetland zone C – this zone was planted with cane at the time of the 2017 site assessment. It is also classified as part of the floodplain terrace, and would similarly be classified in terms of Ollis et al (2013) as a floodplain wetland;
- Wetland zone D – this zone had been previously ploughed and planted, but at the time of the 2017 site assessment comprised a patchy mosaic of indigenous wetland plants and more disturbed weedy areas. It was separated from Zone E to the north by a drainage / diversion channel and from Zone C by a dirt road. The eThekwini Mdloti wetland layer includes this as part of the floodplain terrace and it would again be classified in terms of Ollis et al (2013) as a floodplain wetland;
- Wetland zone E – this zone was much less impacted than zones B, C and D, and comprised a mosaic of temporary, seasonal and permanently saturated wetland, vegetated with a mix of indigenous as well as weedy vegetation, with higher-lying non-wetland patches. The area is drained with a network of channels that convey water ultimately to the river channel, further downstream (Photos T to V). The mapped wetland polygon represented by this zone has been classified in the Mdloti wetland layer as an unchannelled valley bottom wetland. While a drainage line, now diverted, channelized and presumably significantly altered from its natural form does pass into and through this zone, on the basis of wetland ground-truthing it is suggested that this zone under natural conditions probably included both inflowing unchannelled and channelled valley bottom wetlands and seeps.

Figure 8.10: Near-view of proposed pipeline (Alternative 1) and powerline (Alternative 2) crossing of the Mdloti River estuary

The above wetland zones all fall within the Mdloti biodiversity buffer zone – a ±50m buffer around wetlands along the Mdloti River.

Furthermore, the Mdloti River wetlands described above have also been identified in McFarlane et al (2016) as off-site wetland offset receptor sites that are required (see Macfarlane 2015) to offset impacts to wetlands associated with development in the areas indicated in Figure 8.11. The wetlands included in Zones A –D in Figure 8.10 have been identified as biodiversity offset receptor areas, and the offset strategy outlined in McFarlane et al (2016) suggests that the following activities would need to be implemented in these areas, to address wetland functional and biodiversity loss in the development areas already earmarked:

- Re-instating wetland hydrology
- Promoting re-vegetation of targeted wetland and riparian areas through a combination of active planting and natural succession
- Establishment of buffer zones to improve connectivity between wetland systems and to buffer them from diffuse source pollutants.

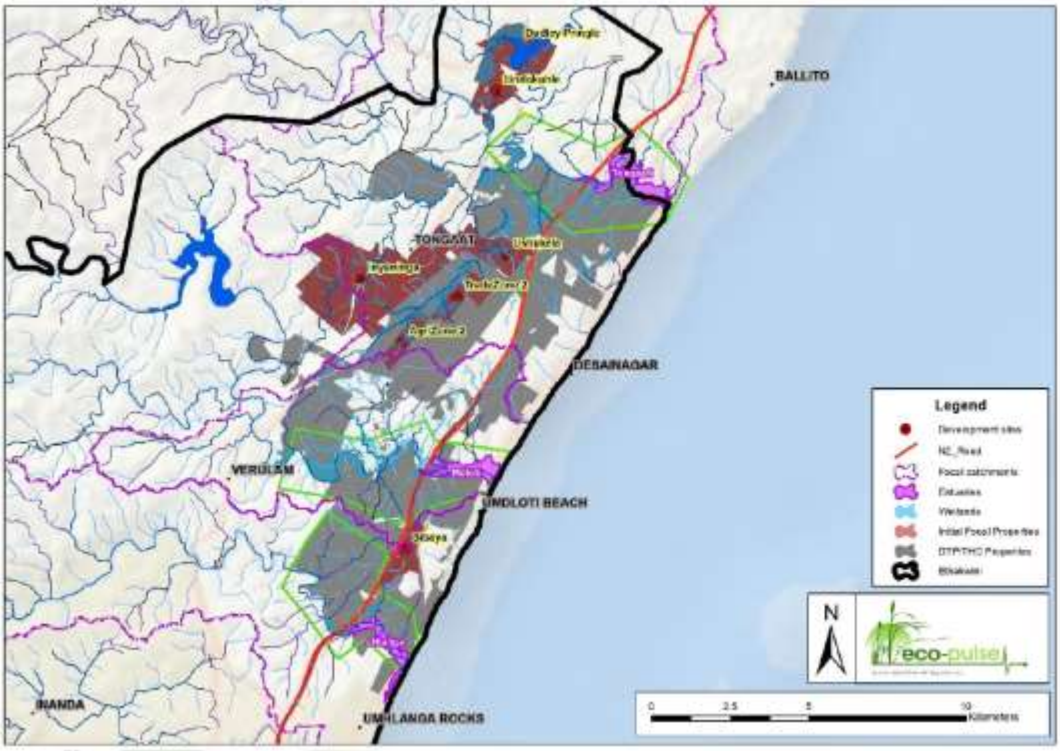


Figure 8.11: Priority development sites and preliminary focal areas identified to meet wetland offset requirements. Figure after McFarlane et al (2016). Umdloti river and estuary clearly included in offset areas.

The offset strategy proposes that offset implementation should commence around the earmarked estuarine areas, which are regarded as key priorities for conservation. Of the estuaries considered in the strategy, the Mdloti estuary is ranked second in order of priority, with the oHlanga estuary being ranked first (McFarlane et al 2017). Discussions with Mr Greg Mullins (eThekwini Municipality) during the course of this project also highlighted the importance of the linear corridor along the Mdloti River and estuary within the offset receiving area, as well as its proximity to important birding areas upstream (see Box 8.1). Included in the design of offset areas is however an acknowledgement (Mr G. Mullins, eThekwini Municipality, pers. comm.) of the need for some routing of infrastructure through the offset areas – these so-called "infrastructure corridors" had not been formally identified at the time of compilation of this report, but the existing N2 highway would certainly form one such corridor.

Photo O
Mdloti channel – N2 road bridge upstream, on RHS of photo

Photo P
Left hand bank of Mdloti – looking downstream

Photo Q
Mdloti Zone A – *Phragmites* reedbed with river on RHS of photo

Photo R
Mdloti Zone A (RHS) to Zone B (gums) (LHS); river on right hand side

Photo S
Mdloti Zone C (cane) (foreground) to Zone B (gums) (background) – photo looking towards river

Photo T
Mdloti Zone D

Photo U
Excavated channel through wetland between Zones D and E

Photo V
Mdloti Zone D into E

The Mdloti Estuary as a whole 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.

8.3.4.6 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.

Photo W
Artificially channelized seepage B3 at the M27 crossing

Along this route, shown in Figure 8-12, the pipeline would intersect at least five watercourses, labelled in the figure as Seepages B2 and B3 and Watercourses B1 and B2. The watercourses were also identified as “surface seepage” areas in the Geotechnical Report (Appendix B of Aurecon 2015), as reproduced in Figure 8-12 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.

Photo X
View from Waterloo Reservoir down across proposed pipeline alignment – watercourse B1 arrowed

On the basis of 2m contour lines, Seepage B3 appears to be a natural watercourse through canefields, but which has been channelized and diverted into a culvert at the M27 crossing (see Photo W), which it enters as an artificially deepened urban drain that receives drainage and runoff from the adjacent major roads.

The third watercourse (watercourse B1) lies in the vicinity of the Waterloo Reservoir, at the base of the steep hill on which the reservoir is situated (Photo X). 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. The proposed pipeline would also cross Watercourse B2 – a minor channelized watercourse through canefields (Photo Y).

Photo Y
Watercourse B2 – disturbed area shown on LHS is the pipeline corridor, shared with another pipeline under construction at the time of the 2017 site assessment

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. These are all similar to watercourse B2.

Table 8-3 presents data on the condition and other attributes of all of these minor watercourses.

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
Mdloti estuary	Estuary	Category D (Estuary health)	n/a	Moderately High
Mdloti River estuary wetlands – Zone A				
Mdloti River estuary wetlands – Zone B	Estuary Floodplain wetland	Category E	Low	High –existing offset value
Mdloti River estuary wetlands – Zone C				
Mdloti River estuary wetlands – Zone D				
Mdloti River wetlands – Zone E	Channelled valley bottom wetland	Category D	Moderate	High –existing offset value
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	Channelised hillslope seep	Category E	Low/ marginal	Low
Watercourse B1	Channelled Valley bottom wetland	Category D	Low	Moderate – corridor value
Watercourse B2	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

Figure 8-12 : GOOGLE images of the proposed La Mercy to Waterloo pipeline route (50m corridor shown as three red lines; 1000m corridor shown as thick red line) – Waterloo Reservoir to the Mdloti River crossing section, with 500m buffer around proposed pipeline route.

THE POWERLINE

8.3.4.7 Freshwater aquatic ecosystems along the as-yet unplanned 132kV transmission line from the proposed desalination site to the 132 kV supply point proposed by eThekwini municipality

Figure 8-13 shows the area that would need to be crossed by the section of the Initial powerline route (yellow route) that links the proposed plant to the proposed 132 kV point of supply from La Mercy. Following the scoping phase, an alternative alignment was suggested (Alternative 1 route) to minimise the visual impacts associated with the Initial route. On the basis of 2m contours, it was clear that both alignments would pass over a number of drainage lines, with Alternative 1 crossing over fewer than the Initial route. The 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.

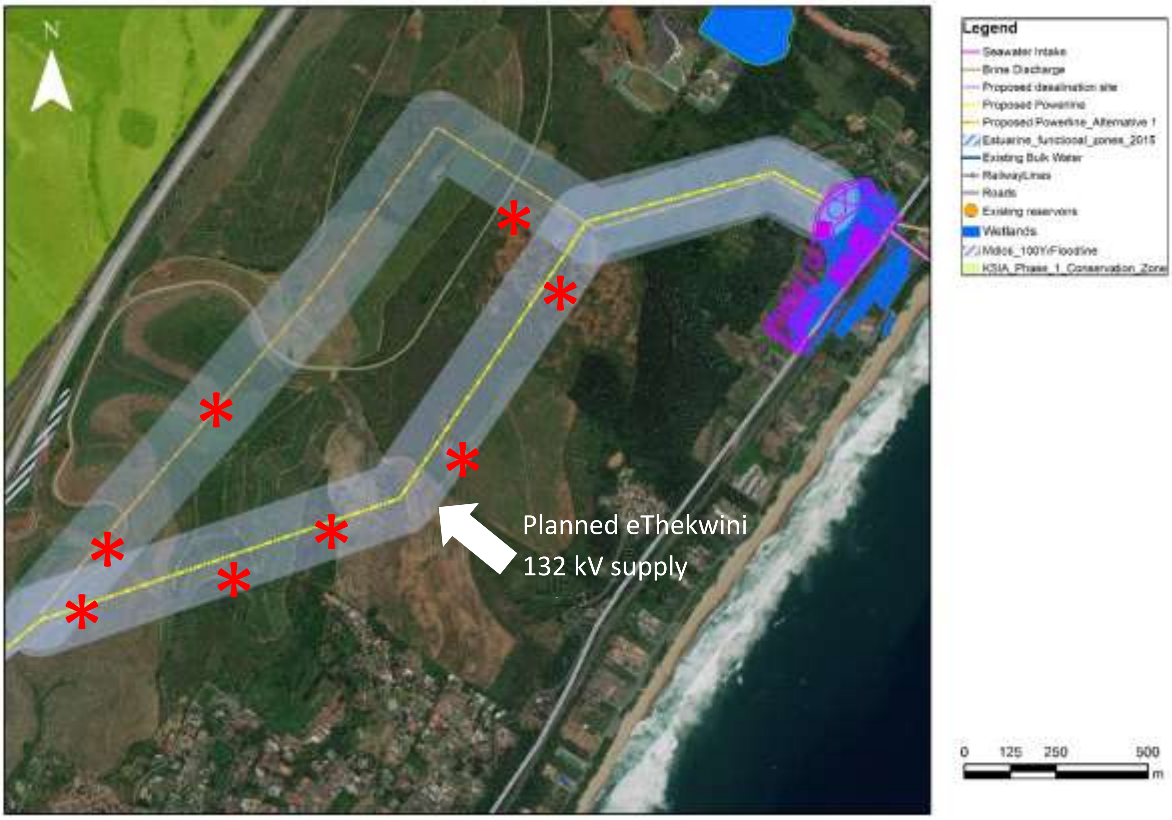


Figure 8.13: Distance to be crossed by the transmission line (Initial route (Yellow) and Alternative 1 route (Orange)) from the proposed desalination plant at Desainagar to the planned eThekwini transmission line (Drainage lines asterisked. Contours shown at 2m intervals.)

8.3.4.8 Freshwater aquatic ecosystems along the 132kV powerline from the proposed desalination site to the Mdloti Beach substation: Alternative 2 powerline

Figure 8-14 shows the area that would need to be crossed by the Alternative 2 powerline route to link to the proposed 132 kV line from the site to the Mdloti Beach substation. The powerline would pass out of the top of the site, and head west across disturbed previously cultivated lands, before swinging north west towards the N2. The powerline would run from here roughly parallel to, and south of the N2, thus avoiding the King Shaka International Airport Conservation Area, shown in Figure 8.14. The proposed powerline itself has been spaced between 160 and 200m from the N2, and would cross the Mdloti River downstream (south) of the proposed pipeline alignment already discussed and as shown in Figure 8.10.

Just north of the M27 intersection, the powerline would cross the N2, and would be routed through cultivated canefields, crossing a tributary of the Mdloti River and a number of minor associated water courses, before crossing south over the M27 and tying into the Mdloti Beach substation, within an area of canefields.

It is assumed that the positions of the pylon support structures would generally be placed on high ground, rather than at the low points which often comprise watercourses. However, a number of watercourses would be crossed by the powerlines, as annotated in Figure 8.15. These watercourses mainly comprise trenches / minor channels through agricultural areas, assessed as similar to, but often considerably smaller than that shown in Photo AB. They tended to be weed- and alien-plant infested, although some included patches of indigenous wetland plants. Invasion by cane into many of the smaller trenches has also occurred.

Photo AB
Minor tributary of the Mdloti River, which it enters upstream of the N2, and just south of the Lake Victoria wetlands (see Box 8.1 and

Of the watercourses likely to be crossed by the proposed powerlines, two do stand out as particularly significant, namely the Mdloti River itself and a small tributary that enters the Mdloti River about 1.3km north of the proposed powerline crossing. The latter is marked in Figure 8.15 as the most southerly of the identified watercourse crossings, and shown in Photo AB. Of these two systems, the Mdloti River Estuary has already been described at the point of crossing in Section 8.3.3.5 and Table 8.3. The Mdloti River tributary shown on Photo AB is a relatively small system that flows in a steep-sided incised channel, through a narrow riparian corridor. The river was very turbid at the time of the site assessment, suggesting runoff from disturbed, largely agricultural areas in its catchment, which comprised steep hillslopes planted with cane and drained by trenches.

The condition, EIS and conservation importance of the watercourses likely to be crossed by the powerlines have been summarised in Table 8.4 on a generic basis for all minor systems, except for the more significant tributary described above, which was rated separately. The Mdloti River wetlands have already been presented in Table 8.3.

Table 8-4: Summary of condition and importance of watercourses / aquatic ecosystems that would be crossed by the proposed powerline. Generic rating provided for watercourses indicated in Figure 8.15, excluding the Mdloti River channel itself.

Watercourse name	**Watercourse Type**	**PRESENT ECOLOGICAL STATE (PES) / CONDITION**	**ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)**	**CONSERVATION IMPORTANCE**
Southern tributary of the Mdloti River	Lower foothill stream	Category D	Moderate to low	Moderate – significant corridor value
Generic minor drainage lines	Channelised hillslope seeps	Category E	Low/ marginal	Moderate – corridor value

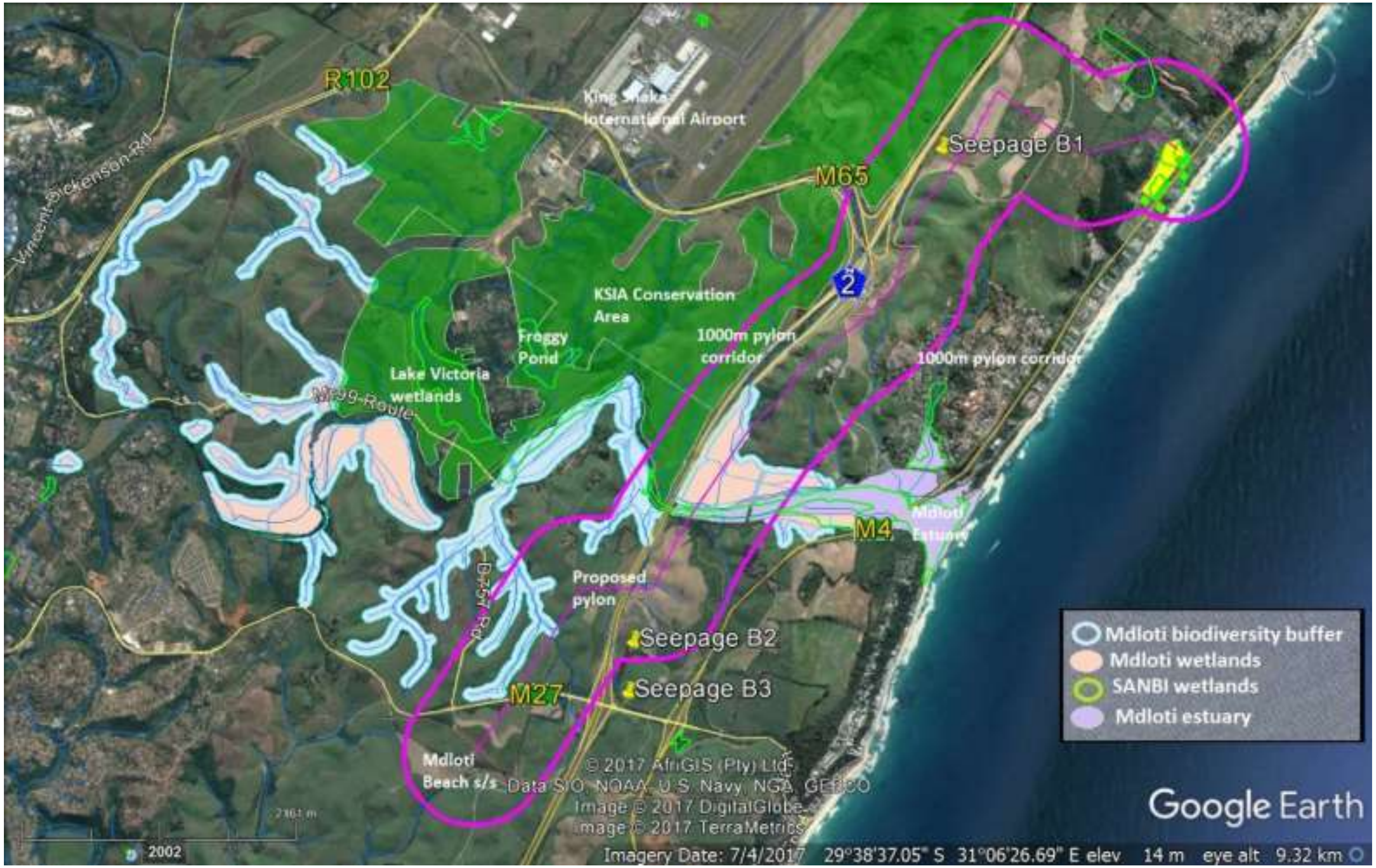


Figure 8.14: Distance to be crossed by the powerline (Alternative 2) from the proposed desalination plant at Desainagar to the Mdloti Beach substation (s/s). Powerlines shown as thin purple line; 1000m corridor shown as thick purple line. Note unbuffered minor watercourses within the 1000m corridor have been digitised as part of this study.

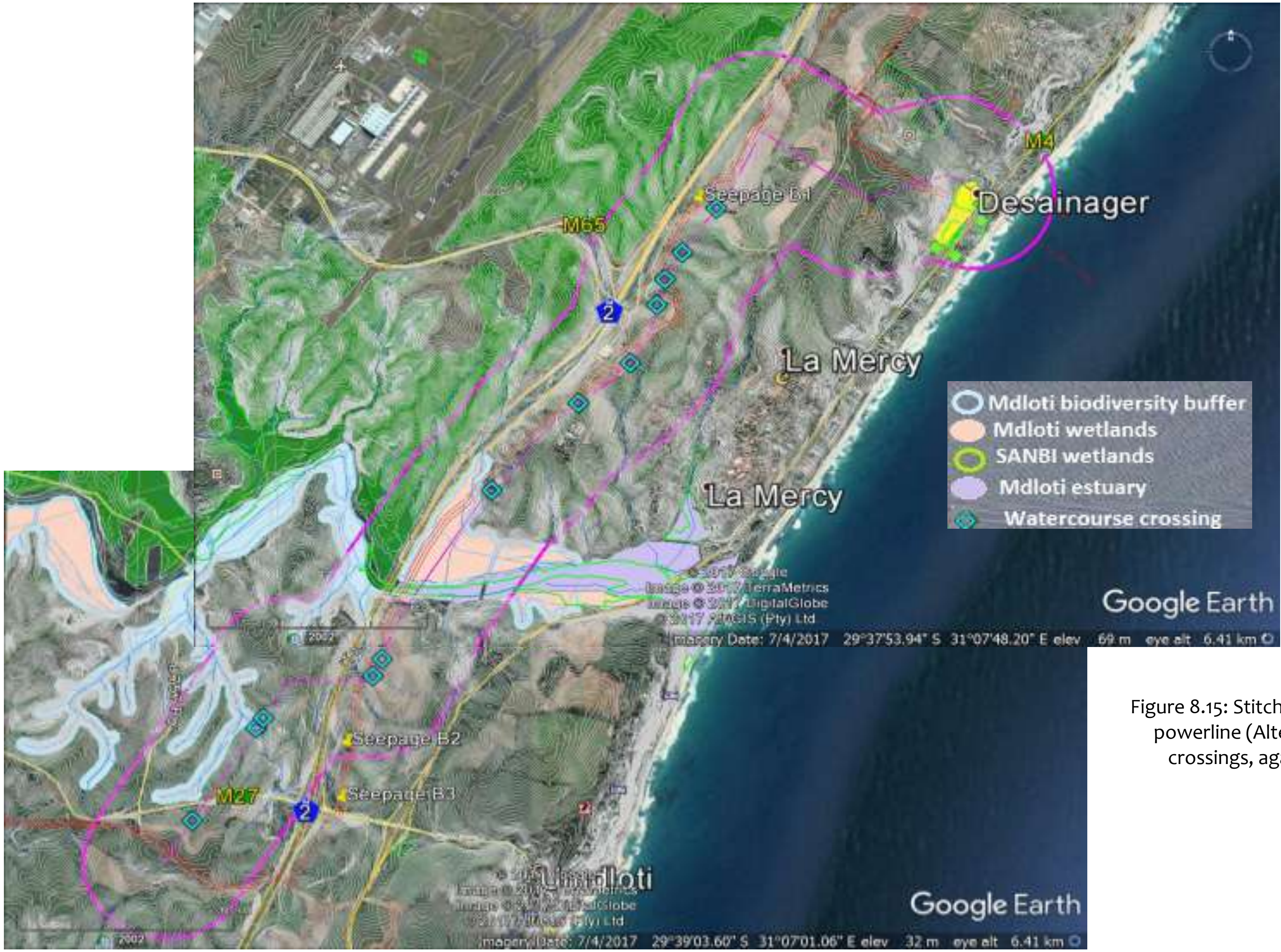


Figure 8.15: Stitched Google image showing powerline (Alternative 2) watercourse crossings, against 2m contour lines

8.3.5 Aquatic ecosystems within a 1000m corridor around the proposed (developer and ecologist's) preferred alignments

8.3.5.1 General

Section 8.3.3 described aquatic ecosystems that occur within reasonable proximity (i.e. a 50m wide corridor) of the proposed pipeline (Alternative 1) and powerline (Alternative 2) alignments required for the desalination plant, as well as the aquatic ecosystems that occur up- and down-slope of the proposed desalination plant. Of these different development components, it is possible that the desalination plant itself, with the anticipated levels of excavation, subsurface drainage and cutting into the dune slopes to create a construction platform, might affect aquatic ecosystems in a greater area than that of its actual development footprint. This is because the above activities could affect surface and subsurface flows into downstream aquatic ecosystems, and for this reason, aquatic ecosystems between the proposed desalination plant and the beach have been delineated and described in detail in this report.

With regard to the pipeline and powerline alignments, which could well impact significantly on aquatic ecosystems within their direct footprints or in their close proximity, it is however argued that it is extremely unlikely to impossible that these kinds of infrastructure would exert any influence in a broader area. The 50m corridor assessed in detail for each of the pipeline and powerlines is considered ample to identify impacts likely to accrue to adjacent aquatic ecosystems, and the desktop (rather than detailed) identification and assessment of aquatic ecosystems further afield (that is, within the 1000m corridor) is thus arguably quite adequate to meet the concerns of the DWS regarding whether Section 21c and i water uses associated with the pipeline and powerlines could affect more extensive aquatic ecosystems. The argument that the powerlines and pipeline would be unlikely to exert impacts further afield than the 50m corridors identified are based on the following considerations:

- The powerline support structures would have a very small footprint (limited to a few square metres) and these would not affect surface or subsurface flows into distant aquatic ecosystems;
- The powerlines themselves would be aligned in an area where there are existing powerlines, and would run parallel to the N2 for a large part of their route – the N2 is already raised, making the additional height of the support towers and powerlines less intrusive across a broader (1000m) corridor;
- The pipeline is a small system and although its construction could have significant local impacts, these impacts would not affect systems at a distance, as the pipeline would not interfere with surface or subsurface flows at that scale;
- The 1000 m corridors include far more substantial existing infrastructure that is likely to exert major influences on hydrological and ecological connectivity than the proposed pipeline and powerlines (e.g. the N2 highway, powerlines, human settlement and other major roads).

Given the above, but taking cognisance of the need to address DWS concerns and information requirements, desktop assessments of all aquatic ecosystems within the 1000m wide corridors around the proposed pipeline and powerline alignments were carried out.

Figure 8.16 shows the locations of all watercourses as identified in the 1000m corridors for the proposed amended routes (Alternative 1 pipeline route and Alternative 2 powerline route) that would need to be constructed as part of the present project.

8.3.5.2 Risk Assessment

In order to inform the validity of statements made in this section regarding the assumed negligible level of impact that would be likely to accrue to aquatic ecosystems outside of the 50m detailed assessment corridors, a Risk Assessment was carried out for both the proposed pipeline and powerlines, using the Risk Assessment Matrix, as developed by the DWS. Note that this Risk Assessment applies only to aquatic ecosystems outside of the 50m corridor – it is recognised that the risks to aquatic ecosystems within these corridors could potentially be significant, but this aspect is dealt with in the formal impact assessments outlined in Section 8.6.

The Risk Assessment (presented in Table 8.5) showed that there would be no risk associated with the proposed design, construction or operational phases for any aquatic ecosystem further than the 50m assessment corridor. That is, these activities would have no impact on the water quality, hydrology, sediment transport / geomorphology or biota of these watercourses. The EXCLUSION to this is the Mdloti River wetlands and estuary – it is likely that these systems would indeed be more extensively affected than within the 50m assessment corridor. These systems are in any case considered in the EIA section of this report, as they would be directly crossed by the powerlines and pipeline.

Figure 8-16: GOOGLE images of the proposed La Mercy to Waterloo pipeline route (Alternative 1) and powerline route (Alternative 2) within the 1000m desktop assessment corridors (thick red and purple lines respectively) showing watercourses (wetlands and rivers) as mapped in existing datasets, supplemented along the actual alignments with additional ground-truthed polygons and demarcated powerline crossing points.

Table 8.5: aspects and impact register/risk assessment for watercourses in the Mdloti, Ohlanga and Tongati river catchments in excess of 50m from the proposed pipeline and powerlines

Impacts without any mitigation measures applied

Risk Matrix completed by Liz Day - SACNASP Reg no. 400270/08

Note that zero scores have been derived for watercourses that would not be affected by the propsed activities

					Severity															
Impact Nr	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Vegetation)	Biota	Severity	Spatial scale	Duration	Conseq.	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Signif.	Risk Rating	Watercourse Type
1	Layout	Alignment of the pipeline and powerlines	Remote effects on flow, water quality, surface/groundwater interactions, sediment transport	None	0	0	0	0	0	0	0	0	1	0	5	1	7	0	L	Channeled and unchanneled valley bottom wetlands and seeps - as mapped in a 1000m corridor, excluding an inner 50m wide corridor for each of the actual infrastructure alignments
1	Construction	Installation of pipeline and power lines	Remote effects on flow, water quality, surface/groundwater interactions, sediment transport	None	0	0	0	0	0	0	0	0	1	0	5	1	7	0	L	
2	Operation	Maintenance of pipeline and power lines	Remote effects on flow, water quality, surface/groundwater interactions, sediment transport	None	0	0	0	0	0	0	0	0	1	0	5	1	7	0	L	

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.
- Powerline alignments
    - No alignments for the powerlines 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 power-line associated impacts that would also need to be considered would be the width of the powerline
    - 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 powerlines 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 (Alternative 1)
  - Impact 6: Disturbance to channelled valley bottom wetlands;
  - Impact 7: Disturbance to (excavation, removal of vegetation, sedimentation, compaction), and potential loss of hillslope seep 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;
- Powerline alignments (Alternatives 1 and 2)
  - Impact 9: Possible disturbance to the identified drainage line in Figures 8-13 and 8.18 as a result of the passage of powerline structures across various watercourses, requiring clearing of vegetation to facilitate line stringing, and the installation of powerline towers;
  - Impact 10: Disturbance to the Mdloti Estuary, just downstream of the N2 road bridge, across which the powerline would cross, necessitating clearing of mature gums and other vegetation to facilitate pylon erosion and line stringing;

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;
- Powerline alignments
  - Ongoing clearing of tall vegetation (e.g. trees) beneath powerlines 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 powerlines 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 "[5]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*). These species all occur, however, in watercourses outside of the 1000m assessment corridors considered in this study, and are associated with the Lake Victoria and Froggy Pond wetlands.

- 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.

Excluding "permissible" water uses, as outlined in the Act (e.g. water use for domestic purposes) authorisation for any of the above water uses would need to be obtained from the Department of Water and Sanitation (DWS) through a Water Use Licence Application (WULA), and such uses would also require Registration with the DWS following authorisation.

In the case of Section 21c and i uses, however, some activities may be considered Generally Authorised through GN509 (August 2009). This General Authorisation (GA) allows for "impeding or diverting the flow of water in a watercourse (section 21(c)), and/or altering the bed, banks, course or characteristics of a watercourse (section 21(i)) of the NWA provided that the risk to the watercourse is assessed as LOW, using the Risk Assessment Matrix developed by DWS for this purpose. The GA does not exclude wetlands, and can thus be applied to all watercourses.

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

Activities that would definitely trigger WULA and/ or GA registration or requirements would include:

- Construction of the proposed desalination plant in a wetland;
- Excavation of pipelines through watercourses;
- Construction of powerlines across watercourses (wetlands or rivers);
- Passage of pipelines across wetlands or rivers;
- Construction of other activities in the vicinity of any watercourses where these are likely to impact on the beds, banks, course or characteristics (e.g. water quality, geomorphology, biota, hydrology) of the watercourse;

The Risk Assessment Matrix is a tool, the results of which are intended to provide DWS officials with a relatively quick guide as to the degree to which a particular activity would, in its mitigated state, constitute a Risk to the water resource. Activities that constitute a Low Risk, if carried out with full mitigation measures as recommended by a SACNASP-registered aquatic ecosystem specialist, are considered Generally Authorised in terms of the NWA, and thus require registration of use with DWS, but would not be subject to a full Water Use Licence Application (WULA). Activities likely to be associated with a Risk of Medium or High would require consideration for authorisation through a comprehensive WULA. In the present project, it was clear at an early stage that the Risk associated with parts of the development such as the desalination plant itself would be High, even with implementation of mitigation measures. This means that a WULA would in any case be applicable to the project, and there was thus no merit in preparing Risk Assessments

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 Layout and 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). However, the wetland seep that would be lost as a result of development is much larger than most others occurring in this area, and has been accorded additional biodiversity importance in this report as a result. It is also, albeit impacted, a representative of a wetland type that is considered Critically Endangered in the National Biodiversity Assessment (Nel and Driver 2012).
The impact of wetland loss is considered irreversible, definite and of **high** significance.

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

i. 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;

ii. 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, **two alternative approaches** were developed to offset the impacts described above. In addition, mitigation measures were included to mitigate against the functional loss of wetlands on the site, through management of runoff from the site.

- *Essential mitigation measures:*

The following mitigation measures are considered essential and must be included in the design of the desalination plant:

i. Subsurface and surface drainage from the north eastern and south western portions of the desalination plant site must be dissipated into the wetlands downstream of South Dune Road and/or the M4 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;
ii. 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.

Implementation of the above mitigation measures would reduce the functional impacts associated with this project. The impacts would however still result in significant wetland loss. Application of the impact rating system used in this study (see Table 8.6) 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 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 restriction of downstream impacts afforded by management of stormwater outflows, as well as by the fact that the downstream wetlands are degraded, fragmented, and not connect with important estuarine or other coastal systems.

Given that the residual impacts of loss of wetland remain significant, offset approaches are recommended, in the event that this project is approved. As noted in Macfarlane et al (2016), wetland offsets are not part of the assessment process to inform an assessment as to the best practicable environmental option and do not influence any decision as to whether the project should proceed. The following two alternative approaches to offsets are outlined below, and should be included as development conditions, if the project is authorised. Section 8.8 provides separate, specific offset details to inform the developer's decision as to the costs and feasibility of pursuing a development with an Offset requirement.

- *Offset Alternative 1*

This would entail the following specific activities:

i. The wetlands downstream of the desalination plant as far as the beach (see Figure 8.17) must be rehabilitated and managed as near-natural wetland systems (as opposed to agricultural lands) – this means that the land itself must be under the control (and thus ownership) of Umgeni Water;
ii. The offset measures outlined in Section 8.8 must be implemented in full;

Figure 8-17: Wetlands in the vicinity of the site that could be considered 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. Note that the areas shown here are conceptual only – see Section 8.8 for a full discussion of offset options.

- *Offset Alternative 2*

This measure has been included to provide scope during the detailed design and planning phases of this project for alternative offset mitigation to be carried out, in consultation with DWS and eThekwini Municipality officials engaged in biodiversity offset planning. During the extended Scoping and EIA phases of this project, eThekwini Municipality produced both a strategic framework for improved wetland management in the municipality's Northern Spatial Development Area (Macfarlane 2015) and a Strategic offset assessment and conceptual plan for specified major landholdings in the same area (Macfarlane et al 2016). Of these, the former provided guidelines for strategic selection of offset areas, so as to maximise ecological and biodiversity gains. These guidelines recommended *inter alia* consolidation of offset receiving sites, rather than the often less-effective single site / piece-meal offsets, and provided the following criteria for prioritising offset receiving area site selection, which should:

- Safeguard key wetland priority areas, identified as:
    - Wetland and river priority areas as identified in the NFEPA project (that is, river and wetland FEPAs)
    - Wetlands in a good condition – in the study area, most wetlands are either transformed or degraded, but the Mount Moreland wetlands (i.e. Lake Victoria and Froggy Pond wetlands) and wetlands along the oHlanga and main Mdloti Rivers are considered degraded and rehabilitable rather than transformed;
- Enhance connectivity to improve resilience – the KSIA conservation area for example has been expanded to include various adjacent wetlands and corridors including the Mount Moreland wetlands;
- Support enhanced estuarine functioning;
- Target key functional features in the landscape – water quality enhancement was noted as particularly important.

Drawing on the above criteria, Macfarlane et al (2016) then allocated potential strategic offset receiving areas in response to known proposed developments in key landholdings in the northern spatial development plan area, namely development by the Dube TradePort Corporation (DTPC) and Tongaat Hulett Developments (THD). These receiving areas included the Mdloti estuary and associated wetlands south of the N2, as well as various other watercourses. The implications of this approach for additional developments in the study area that might be required to achieve off-site offsets is that offset receiving areas cannot potentially include the Mdloti or other identified offset sites / systems.

Given the above, implementation of this mitigation / offset approach would need to include the following:

i. The selection of appropriate off-site mitigation areas and activities in terms of this alternative must be carried out in collaboration with eThekwini Municipality officials engaged in implementation of the offset strategy;
ii. Ideally, offsets should target areas that allow consolidation of offset outcomes;
iii. Consideration could be given to sites not included in Macfarlane et al's (2016) prioritised areas (e.g. valley bottom wetlands north east of the proposed desalination plant site – see Figure 8.18);
iv. Offset activities (e.g. area and extent of rehabilitation) must be agreed with eThekwini municipal officials and must be such that the required offset measures, as calculated in Section 8.8, are met.

Figure 8-18: Possible offset receiving areas north east of the site, for consideration

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

i. 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;
ii. 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

i. 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;
ii. 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

i. 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.
ii. The efficacy of proposed mitigation designs would need to be interrogated (and approved) by a wetland specialist prior to incorporation into detailed design.
iii. 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 (Alternative 1)

Potential Impact 6: Disturbance of channelled valley bottom wetlands: specifically, "Watercourse B1" and "Watercourse B2", across which the proposed water pipeline alignment (Alternative 1) would cross (Figure 8.12). 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

i. Avoidance mitigation is not considered practical for any of these watercourses;
ii. General construction impact control measures should include:
    a. The disturbance zone in these areas should be kept to a minimum – ideally, no greater than 15m including stockpile areas;
    b. 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;
    c. The pipeline once covered should not result in the protrusion above the natural ground or channel level;
    d. Where the channel being crossed 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;
    e. Disturbed channel banks should be reshaped, with side slopes no steeper than 1:4, and tying in with the banks on either side;
    f. 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**.

Potential Impact 7: Disturbance to (excavation, removal of vegetation, sedimentation, compaction), and potential loss of hillslope seep wetlands. Specifically, wetlands "Seepage B1", "Seepage B2" and channelized wetlands "Seepage B3" and "Seepage B4" through which the proposed potable water pipeline (Alternative 1 route) would pass (Figures 8.9 and 8.12), 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

i. 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.
ii. Where crossing through seeps or depressional wetlands in this section of the pipeline route is unavoidable, mitigation should allow for the following:
    a. 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;
    b. Topsoil should be replaced after construction, taking note of the above requirement;
    c. 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;
    d. The disturbance zone in these areas should be kept to a minimum – ideally, no greater than 15m including stockpile areas;
iii. General construction impact control measures to include in all construction along the pipeline routes must include the following:
    a. 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;
    b. 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;
    c. 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;
iv. 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 8: Disturbance to the Mdloti Estuary and its associated floodplain and valley bottom wetlands (zones A – E in Figure 8.10), as a result of construction-associated disturbance and pollution during horizontal drilling of the pipeline.

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 – these would affect wetland zones A to D in particular, with the most sensitive of these to such impacts being the least-impacted zones A and E;
- 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, disturbance to floodplain channels / trenches, 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;
- Fragmentation effects – the pipeline would cross through the wetlands, potentially interfering with through-flows in the wetlands. This is impact is not however considered likely to have any effect other than within a few metres on either side of the pipeline, assuming that the pipeline is not overlain with mounds of excess spoil;
- 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.

Given that the pipeline alignment in this area would be through an area already earmarked as a biodiversity offset area (Macfarlane et al 2016), the significance ratings of the above impacts are magnified, since they arguably also represent an opportunity cost in terms of limiting (at a local but nonetheless measurable level) the extent of active rehabilitation of the wetland, as required as an offset.

The proposed alignment of the pipeline near to the N2 is however recognised as at least consolidating zones of fragmentation by infrastructure.

Key Mitigation Measures

The following measures are considered essential:

i. A detailed topographical survey of the full route of the pipeline from the outer edge of Zone E to a distance at least 400m beyond the southern (right hand bank) crossing, to ensure that the proposed approach will be technically feasible, given the steep gradient on the right hand bank;
ii. 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;
iii. The pipeline must be aligned as close as technically possible to the N2, without compromising the channelled valley bottom wetland that runs alongside the N2;
iv. 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;
v. All site preparation, laydown and drilling operations should take place outside of the wet season;
vi. The extent of areas subject to construction phase disturbance must be minimised – laydown areas should utilise existing roads or otherwise disturbed areas (e.g. the recently excavated pipeline route itself, on either side of the crossing);
vii. 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;
viii. Horizontal drilling must be used to reduce trampling / damage to wetlands on the left hand (northern) bank of the estuary, as well as to facilitate crossing beneath the estuary channel. Thus horizontal drilling must take place through Zones E, D and A. Trenching could take place in Zones B and C, if technically desirable – this measure was agreed on in discussion with Mr G.

Mullins, eThekwini Municipality) and 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;

ix. 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 wetland / riparian margins. Such measures must include:
    a. Requirements to recycle bentonite and minimise its passage to waste;
    b. 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 ;
    c. 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;

x. 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 – rehabilitation measures should include ripping of compacted soils and replanting with locally indigenous wetland and/or estuarine species as recommended by a botanical specialist;

xi. A 30 m wide swathe along the length of the pipeline must be rehabilitated as natural wetland, by appropriate shaping and planting with indigenous vegetation – this swathe may be shifted to merge with the similar swathe required as mitigation for the powerline, to create a more effective consolidated zone; the landscaping and planting of this zone should be overseen by a wetland ecologist, and cover of 60% appropriate indigenous vegetation must be achieved by the end of the construction process;

xii. Furthermore, the CEMP for this activity should specify measures to ensure that stockpiles and construction material are not located such that they will contaminate the river or any watercourse through uncontrolled runoff or wind erosion. The edge of the road between zones D and C (Figure 8.10) should be used for such purposes.

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

8.6.1.3 Powerline alignments

Impact 9: Possible disturbance to drainage lines, in particular those identified and shown in Figures 8.-13 and 8.15, as a result of the passage of powerline structures across them. Note that it is assumed that power 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 proposed powerline alignments (Alternative 1 and 2) themselves would thus centre on:

- Disturbance of drainage lines as a result of passage of vehicles across them to access installation points;
- Clearing of (alien and indigenous) vegetation to facilitate line stringing, and the installation of powerline towers.

These impacts would be sustained into the operational phase of the development, as they would be an essential part of line maintenance, with vegetation required to be kept beneath the level of the powerlines. Although most of the existing vegetation along the powerline 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).

Key Mitigation measures

i. Construction sites must be accessed via existing roads only, and watercourses must be crossed at existing crossings only;
ii. Cleared areas within 30m on either side of a minor watercourse must be maintained free of alien vegetation.
iii. 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** for both powerline alignments. Alternative 2 in this section is however an alignment that avoids all aquatic ecosystems and appears to be associated with less disturbance of coastal forest and for this reason would be preferred from a biodiversity perspective – neither alternative in this section constitutes an unmitigable and fatal flaw, and the choice of alternative should not be driven by aquatic ecosystem concerns.

Impact 10: Disturbance to the Mdloti Estuary and its associated floodplain and valley bottom / seep wetlands as a result of installation of the powerline (Alternative 2). Just over 700m of floodplain wetland and estuary channel would need to be crossed by the powerlines, and it is assumed therefore that at least two sets of support structures would need to be erected in this area. The affected area includes an area of dense gums (Zone B in Figure 8.10) along (mainly) the [6]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).

Other impacts associated with the powerline support structures could include:

- Disturbance to (infilling of the floodplain) – this would not be a major impact, given the relatively small size of the powerline structures);
- Possible disturbance to the flight paths of wetland birds moving between the estuary and important Mount Moreland wetlands to the north - this impact is assessed in the specialist faunal report for this project, but is raised here as a possible concern from a wetland biodiversity perspective. Its risk of impact is however considered to be low in this area, as the powerline structures would run relatively close and parallel with the N2 highway, which itself is raised and associated with other infrastructure along its route.
- As in the case of the proposed pipeline, the proposed alignment of powerlines through an area already earmarked as a biodiversity offset area (Macfarlane et al 2016) would magnify the significance ratings of the above impacts, since they arguably also represent an opportunity cost in terms of limiting (at a local but nonetheless measurable level) the extent of active rehabilitation of the wetland, as required as an offset.
  However, again, the alignment of the powerlines and the pipeline near to the N2 is recognised as at least consolidating zones of fragmentation by infrastructure.

The impacts described above are overall considered of low to 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.

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

Key Mitigation measures

i. Support structures should be located only in Zones C and B, and on the hillslope on the southern side of the estuary channel. This means that the lines would have to span from the outside edge of the Mdloti buffer area (50m beyond Zone E) to the outer edge of Zone C. Figure 8.19 shows that if the current position of the powerline alignment in this area was shifted south by about 30m, then the powerlines could extend from beyond the buffer to Zone C without difficulty – clearing of gums in Zone B would be required;
ii. 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 – this includes clearing of gums in Zone B;
iii. Woody vegetation that is felled for the installation of the powerlines and as part of the above recommendations must be removed from within the 1:100 year floodline of the river;
iv. 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;
v. Construction within the floodplain should take place outside of the main wet season;
vi. The estuary channel and associated wetlands must be demarcated as no-go areas during construction;
vii. 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;
viii. A 30 m wide swathe along the length of the powerline must be rehabilitated as natural wetland, by appropriate shaping and planting with indigenous vegetation – this swathe may be shifted to merge with the similar swathe required as mitigation for the pipeline, to create a more effective consolidated zone; the landscaping and planting of this zone should be overseen by a wetland ecologist, and cover of 60% appropriate indigenous vegetation must be achieved by the end of the construction process;
ix. All construction-associated material and waste / litter should be removed from the floodplain following construction;
x. No construction site camps / stockpiles / vehicle storage areas should be allowed within Zones A, B, D or E, and if located in B they should be on bunded soil such that any leaks or spills can be completely removed and the area rehabilitated;

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

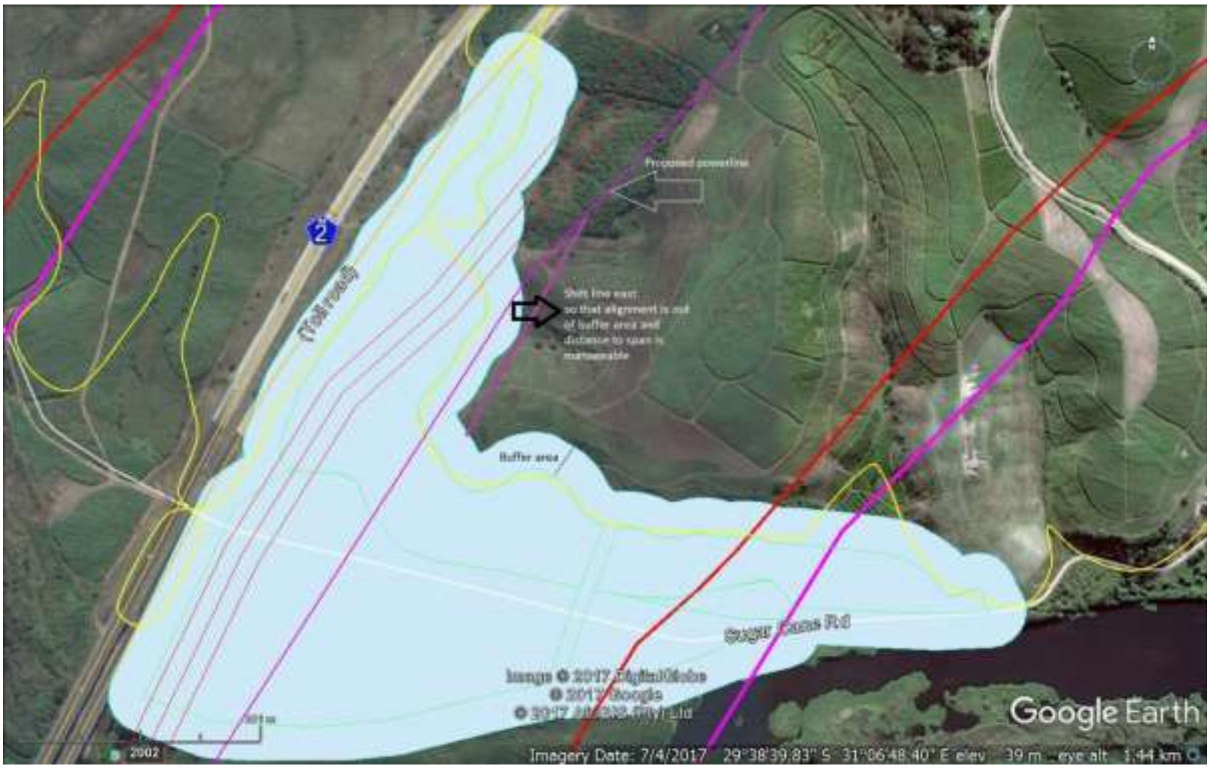


Figure 8-19: Suggested re-alignment of section of powerline so that support poles can avoid sensitive areas by spanning from outside of the buffer area to more disturbed zone C

8.6.2 Operational Phase

8.6.2.1 <u>Desalination plant impacts</u>

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

i. 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:

1. 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, as well as damage (compaction/ trampling) as a result of machine access to effect repairs. This would be of greatest significance in the wetlands of the Mdloti River floodplain. 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 (with the exception of the Mdloti River estuary crossing), affecting degraded systems with low irreplaceability, albeit potentially high sensitivity to the possible impact.

Key Mitigation Measures:

i. Repair of such leaks should take place with immediate effect;
ii. Access to the pipeline must be via existing watercourse crossings – no new *ad hoc* crossings may be created;
iii. 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;
iv. Any areas of the Mdloti River estuarine channel, its banks or the associated wetlands that are damaged / compacted during maintenance activities 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.

8.6.2.4 Powerline alignments

Impact 4: Again, negligible operational phase impacts are anticipated, except in case of damage / breakdown, likely to result in accessing the line or tower structures, which might cause damage (compaction/ trampling) as a result of machine access to effect repairs. Again, this would be of greatest significance in the wetlands of the Mdloti River floodplain.

Key Mitigation Measures:
These are as for the pipeline impacts described above and include:

i. Access to the powerline corridor must be via existing watercourse crossings – no new *ad hoc* crossings may be created;
ii. Disturbed areas of the (previously) rehabilitated wetlands must be returned to their design condition;
iii. Any areas of the Mdloti River estuary 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.

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

8.6.3 Decommissioning Phase

It is reiterated that this assessment assumes that decommissioning would entail removal of buildings but that powerlines 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:

i. Disturbed areas of the (previously) rehabilitated wetlands must be returned to their design condition;
ii. 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;
iii. 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:
The above measures are not mitigable.

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 (see Section 8.8).

8.7 IMPACT ASSESSMENT SUMMARY

Table 8-6 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 8-6: 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)**	Management of stormwater and dewatering flows into downstream wetland areas to maintain wetland functionality downstream and inclusion of a 20m wetland corridor along the side of the site. Refer to Impact 1 (Section 8.6.1.1) for details.	**Medium to High (9.5)** (note: manually adjusted rating)	Medium
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
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

IMPACT DESCRIPTION	STATUS	EXTENT	DURATION	REVERS.	POTENTIAL INTENSITY	PROBABILITY	SIGNIFICANCE (WITHOUT MITIGATION)	MITIGATION	SIGNIFICANCE (WITH MITIGATION)	CONFIDENCE LEVEL
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 Additional mitigation: 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 (Alternative 1 route)										
Potential Impact 6: Disturbance of channelled valley bottom wetland	Negative	Site specific (1)	Long Term (4)	Moderate	Medium (4)	Probable (0.5)	**Medium (4.5)**	General construction impact control measures to be included for affected watercourses (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 7: 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 – no greater than 15m; General construction impact control measures - see Section 8.6.1.2 for details	**Low**	Medium

IMPACT DESCRIPTION	STATUS	EXTENT	DURATION	REVERS.	POTENTIAL INTENSITY	PROBABILITY	SIGNIFICANCE (WITHOUT MITIGATION)	MITIGATION	SIGNIFICANCE (WITH MITIGATION)	CONFIDENCE LEVEL
Potential Impact 8: Disturbance to the Mdloti Estuary and its associated floodplain and valley bottom wetlands (zones A – E) , as a result of construction-associated disturbance and pollution, during horizontal drilling of the pipeline	Negative	Local (2)	Short Term (2)	Moderate reversibility	High (8)	Probable (0.5)	**Medium (6)**	i. A detailed topographical survey of the full route of the pipeline from the outer edge of Zone E to a distance at least 400m beyond the southern (right hand bank) crossing, to ensure that the proposed approach will be technically feasible, given the steep gradient on the right hand bank; ii. 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; iii. The pipeline must be aligned as close as technically possible to the N2, without compromising the channelled valley bottom wetland that runs alongside the N2; iv. 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; v. All site preparation, laydown and drilling operations should take place outside of the wet season; vi. The extent of areas subject to construction phase disturbance must be minimised – laydown areas should utilise existing roads or otherwise disturbed areas (e.g. the recently excavated pipeline route itself, on either side of the crossing); vii. 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	**Low**	Medium

IMPACT DESCRIPTION	STATUS	EXTENT	DURATION	REVERS.	POTENTIAL INTENSITY	PROBABILITY	SIGNIFICANCE (WITHOUT MITIGATION)	MITIGATION	SIGNIFICANCE (WITH MITIGATION)	CONFIDENCE LEVEL
								express supervision of the Environmental Control Officer (or similar designation) and in order to execute rehabilitation measures; viii. Horizontal drilling must be used to reduce trampling / damage to wetlands on the left hand (northern) bank of the estuary, as well as to facilitate crossing beneath the estuary channel. Thus horizontal drilling must take place through Zones E, D and A. Trenching could take place in Zones B and C, if technically desirable – this measure was agreed on in discussion with Mr G. Mullins, eThekwini Municipality) and 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; ix. 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 wetland / riparian margins. Such measures must include: a. Requirements to recycle bentonite and minimise its passage to waste; b. 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 ; c. Requirements to dispose of any waste that has no beneficial use outside of the 1:100 year		

IMPACT DESCRIPTION	STATUS	EXTENT	DURATION	REVERS.	POTENTIAL INTENSITY	PROBABILITY	SIGNIFICANCE (WITHOUT MITIGATION)	MITIGATION	SIGNIFICANCE (WITH MITIGATION)	CONFIDENCE LEVEL
								floodline to the sewers or other recognised official waste disposal site; x. 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 – rehabilitation measures should include ripping of compacted soils and replanting with locally indigenous wetland and/or estuarine species as recommended by a botanical specialist; xi. A 30 m wide swathe along the length of the pipeline must be rehabilitated as natural wetland, by appropriate shaping and planting with indigenous vegetation – this swathe may be shifted to merge with the similar swathe required as mitigation for the powerline, to create a more effective consolidated zone; the landscaping and planting of this zone should be overseen by a wetland ecologist, and cover of 60% appropriate indigenous vegetation must be achieved by the end of the construction process; xii. Furthermore, the CEMP for this activity should specify measures to ensure that stockpiles and construction material are not located such that they will contaminate the river or any watercourse through uncontrolled runoff or wind erosion. The edge of the road between zones D and C (Figure 8.9) should be used for such purposes.		
POWERLINE ALIGNMENTS										

IMPACT DESCRIPTION	STATUS	EXTENT	DURATION	REVERS.	POTENTIAL INTENSITY	PROBABILITY	SIGNIFICANCE (WITHOUT MITIGATION)	MITIGATION	SIGNIFICANCE (WITH MITIGATION)	CONFIDENCE LEVEL
Impact 9: Disturbance to watercourses/drainage lines as a result of installation of support towers and line stringing, including tree clearing (Alternative 1 and Alternative 2)	Negative	Local (2)	Permanent (5)	Low reversibility	Medium (4)	Probable (0.5)	**Medium (5.5)**	i. Construction sites must be accessed via existing roads only, and watercourses must be crossed at existing crossings only; ii. Cleared areas within 30m on either side of a minor watercourse must be maintained free of alien vegetation. iii. Maintenance clearing of indigenous vegetation within 30m of a watercourse should ideally not take place, and the lines should pass above such vegetation.	**Low**	Low
Impact 10: Disturbance to the Mdloti Estuary and its associated floodplain and valley bottom / seep wetlands as a result of installation of the powerline. Disturbance effects could include localised infilling of the floodplain, possible disturbance to the flight paths of wetland birds. (Alternative 2)	Negative	Local (2)	Long Term (4)	Moderate	Medium to high (5)	Highly probable (0.75)	**Medium (7.5)**	i. Support structures should be located only in Zones C and B, and on the hillslope on the southern side of the estuary channel. This means that the lines would have to span from the outside edge of the Mdloti buffer area (50m beyond Zone E) to the outer edge of Zone C. Figure 8.16 shows that if the current position of the powerline alignment in this area was shifted south by about 30m, then the powerlines could extend from beyond the buffer to Zone C without difficulty; ii. 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; iii. Woody vegetation that is felled for the installation of the powerlines and as part of the above recommendations must be removed from within the 1:100 year floodline of the river; iv. 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; v. Construction within the floodplain should take place outside of the main wet season;	**Low**	Medium

IMPACT DESCRIPTION	STATUS	EXTENT	DURATION	REVERS.	POTENTIAL INTENSITY	PROBABILITY	SIGNIFICANCE (WITHOUT MITIGATION)	MITIGATION	SIGNIFICANCE (WITH MITIGATION)	CONFIDENCE LEVEL
								vi. The estuary channel and associated wetlands must be demarcated as no-go areas during construction; vii. 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; viii. A 30 m wide swathe along the length of the powerline must be rehabilitated as natural wetland, by appropriate shaping and planting with indigenous vegetation – this swathe may be shifted to merge with the similar swathe required as mitigation for the pipeline, to create a more effective consolidated zone; the landscaping and planting of this zone should be overseen by a wetland ecologist, and cover of 60% appropriate indigenous vegetation must be achieved by the end of the construction; ix. All construction-associated material and waste / litter should be removed from the floodplain following construction; x. No construction site camps / stockpiles / vehicle storage areas should be allowed within Zones A, B, D or E, and if located in B they should be on bunded soil such that any leaks or spills can be completely removed and the area rehabilitated		

Table 8-7: Impact assessment summary table for the **Operational** Phase

NB: Refer also to Construction Phase Impacts 3 and 4 (Table 8-6) 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 (Alternative 1 route)										
Impact 3: Abnormal operational phase damage / breakdown, when it is possible that concentrated freshwater flows into wetlands might occur, triggering erosion and further degradation and disturbance associated with access for repairs would occur	Negative	Local (2)	Permanent (5)	Highly reversible	Medium-Low (2)	Low Probability (0.25)	**Low (2.25)**	i. Repair of such leaks should take place with immediate effect; i. Access to the pipeline must be via existing watercourse crossings – no new *ad hoc* crossings may be created; i. If erosion of drainage lines has been triggered, repair of	**Low**	Medium

IMPACT DESCRIPTION	STATUS	EXTENT	DURATION	REVERSIBILITY	POTENTIAL INTENSITY	PROBABILITY	SIGNIFICANCE (WITHOUT MITIGATION)	MITIGATION	SIGNIFICANCE (WITH MITIGATION)	CONFIDENCE
								knick points should be undertaken, as appropriate and if necessary in consultation with a wetland specialist; v. Any areas of the Mdloti River estuarine channel, its banks or the associated wetlands that are damaged / compacted during maintenance activities 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.		
POWERLINE IMPACTS (Alternative 1 and Alternative 2)										
Impact 4: Disturbance as a result of access for tree clearing and/or repairs of lines and support towers	Negative	Local (2)	Permanent (5)	Highly reversible	Medium-Low (2)	Low Probability (0.25)	**Low (2.25)**	i. Access to the powerline corridor must be via existing watercourse crossings – no new *ad hoc* crossings may be created; ii. Disturbed areas of the (previously) rehabilitated wetlands must be returned to their design condition; iii. Any areas of the Mdloti River estuary channel, its banks or the associated wetlands that are damaged during construction should be reinstated to their pre-	**Low**	Medium

IMPACT DESCRIPTION	STATUS	EXTENT	DURATION	REVERSIBILITY	POTENTIAL INTENSITY	PROBABILITY	SIGNIFICANCE (WITHOUT MITIGATION)	MITIGATION	SIGNIFICANCE (WITH MITIGATION)	CONFIDENCE
								construction condition or better – allowance should be made for ripping of compacted areas, reshaping and potentially replanting to address disturbance impacts if they occur;		

Table 8-8: 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 8.9 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)**	None	**High**	Low

8.8 Development of a Wetland Offset Plan for the proposed Tongaat Desalination plant

8.8.1 Background

In the event that the proposed desalination plant considered in this study is approved, then a wetland offset would be required. This requirement stemmed initially from recommendations contained in the specialist aquatic ecosystems assessment of impacts associated with the project (see Section 8.7), but has subsequently been supported in principle by eThekwini Municipality, KwaZulu Natal Wildlife and the Department of Water and Sanitation (see Section 8.8.2).

Requirements for the implementation of wetland offsets are based on the following rationale, which takes cognisance of the mitigation hierarchy that must be applied in consideration of any potential environmental impact, namely to first try to avoid, then minimise, then rehabilitate or remediate affected areas. In the current project, and with reference only to the desalination plant itself, and not to its associated off-site infrastructure:

- **Impact avoidance** through selection of an alternative site or activity is not possible – the current site is the only one that has been presented for consideration for this activity;
- Initial approaches to this project sought both to **minimise** wetland impacts and to **mitigate** against them 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 would be least affected, and 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. This issue is discussed further in Section 8.6.1.1. However. More detailed consideration of these measures by the design engineers showed that these measures could not in fact be accommodated along with the desalination plant, without seriously compromising the objectives of both. **Mitigation** against the effects of loss of upstream wetland function on downstream wetlands would however be enabled through the recommended passage of stormwater and dewatering discharges into a series of infiltration trenches downstream of the site, as specified in Section 8.6.1.1 – Impact 1 Essential Mitigation;

Given the high to medium significance of residual impacts to wetlands after implementation of the limited mitigation approaches that are available, there is an argument for securing of wetland offsets if the project is authorised as proposed.

This section of the specialist report has been prepared to provide specifications for such an offset, on the understanding that these specifications would form conditions of authorisation for the development.

8.8.2 Terms of reference for this input

The terms of reference for this input, drawn from a separate Request for Tenders by the CSIR, awarded to FCG on 23 April 2018, required that the Offset determination include the following, namely:

- Aerial quantification of proposed downstream wetland offsets, considering both the wetland area to be lost and the proposed area and planned future condition of the recipient area for offset mitigation – this task to include completion of the wetland offset calculator for both the affected wetland and the recipient offset area;

- Specifications for both the **required** and the **recommended** rehabilitation of the downstream wetland offset areas, to a level that will inform the compilation of tender documentation. These specifications will include:
  - The proposed future condition of the offset wetlands, in terms of Present Ecological State, with descriptions of proposed PES components (e.g. vegetation, hydrology, water quality);
  - Management requirements for the offset wetlands;
  - Monitoring requirements for the offset wetlands;
- Completion of the DWS Risk Assessment Matrix for the proposed project, assuming implementation of both required and recommended offset measures.

8.8.3 Approach to development of the wetland offset plan

Input into this component of the report drew heavily on this specialist's past engagement in the project and familiarity with the site, its wetlands and wetlands in the vicinity of the site. It should however be noted that in the compilation of this section, and through engagement with key stakeholders in the area, as well as discussions with other aquatic specialists also engaged in the development and/or application of wetland offset tools, some of the details regarding required offset equivalent areas and how to achieve these differ from conceptual inputs provided in previous iterations of this assessment. The recommendations and calculated offset requirements outlined in this document should be regarded as superseding all previous inputs.

The following activities / interactions specifically informed this input:

- Consideration of the impact assessment outcomes and proposed mitigation measures outlined in Section 8.7;
- A review of comments made by key institutional stakeholders regarding the need for offsets – comments from the Department of Environmental Affairs (DEA) and the eThekwini Municipality's Environmental Planning and Climate Protection Department were forwarded to FCG for consideration;
- A site visit on 26 April 2018, to undertake more detailed assessments of the proposed recipient offset areas;
- A meeting on the 26th April 2018 at the eThekwini Municipality offices with the following officials:
  - Mr Greg Mullins (eThekwini Municipality - Environmental Planning and Climate Protection Department);
  - Mr Ayanda Mthalane (Department of Water and Sanitation – Durban – Water Use Section);
  - Ms Krishnee Naidoo (Department of Water and Sanitation – Durban – Water Use Section).

  The purpose of the meeting was to agree on the proposed offset approach and discuss specific concerns / information requirements;
- Telephonic discussions with Ms Dinesree Thambu (Ezemvelo KZN Wildlife - Biodiversity Planning) on 7 May 2018, to discuss the concerns and approaches of her organisation with regard to offset planning – Ms Thambu was on sick leave at the time of the meeting on the 26th April and could thus not provide earlier input;
- Email discussions with the project engineer (Mr Graham English, Aurecon) regarding the engineering feasibility and detailed planning requirements implicit in the rehabilitation plan for the receiving offset wetland;
- Compilation of a set of guidelines for the design / management of runoff from the site into downstream wetland areas, based on the discussions with Mr English;

- Appointment of a kwaZulu Natal-based botanical / wetland specialist (Mr Ryan Edwards, Eco-Pulse) to provide additional local input into offset design objectives and to compile and appropriate plant species list to include in wetland rehabilitation plan;
- Completion of Level 1 Wet Health assessments (as per MacFarlane et al. 2008) for both the impacted and the receiving offset wetlands, for inclusion in Offset Calculations.

8.8.4 Assumptions and limitations of this section of the document

The offset plan and its associated recommendations / conditions were compiled subject to the following assumptions and/or limitations, namely:

- It is assumed that Umgeni Water would purchase and subsequently manage or appoint a suitable second party to manage the wetland offsets in the long term;
- It is assumed that the wetlands identified in this assessment would be available for purchase for off-setting purposes – at the time of the 26th May 2018 site visit, a portion of the identified properties was sign-posted as for sale, both indicating availability for purchase but also red-flagging possible loss of offset opportunity in the event that a new landowner is reluctant to sell;
- It is also assumed that, in the event that the wetlands identified in this document are not obtainable by Umgeni (due to unaffordability or unavailability) that alternative offset sites would need to be found, and would themselves require detailed rehabilitation plans. This report provides broad recommendations for identifying such sites, but does not include detailed rehabilitation recommendations or other input into alternative offset sites;
- Although this report outlines specific measures and rehabilitation objectives for the offset wetland, it does not include detailed engineering specifications for the infiltration trenches, the berm or the outflows from the receiving offset site under South Beach Road. This is because these designs would need to be informed by a detailed hydrological study that identified stormwater and dewatering volumes and flood flows, which would then need to inform detailed engineering design of various required stormwater management structures;
- Finally, this report does not include costing of the land purchase, rehabilitation measures, consultant fees or other financial costs associated with the proposed offset.

8.8.5 Context of the present project with regard to existing conceptual offset plans

During the extended Scoping and EIA phases of this project, eThekwini Municipality produced both a strategic framework for improved wetland management in the municipality's Northern Spatial Development Area (Macfarlane 2015) and a Strategic offset assessment and conceptual plan for specified major landholdings in the same area (Macfarlane et al 2016). Of these, the former provided guidelines for strategic selection of offset areas, so as to maximise ecological and biodiversity gains. These guidelines recommended *inter alia* consolidation of offset receiving sites, rather than the often less-effective single site / piece-meal offsets, and provided the following criteria for prioritising offset receiving area site selection, which should:

- Safeguard key wetland priority areas, identified as:
  - Wetland and river priority areas as identified in the NFEPA project (that is, river and wetland FEPAs)
  - Wetlands in a good condition – in the study area, most wetlands are either transformed or degraded, but the Mount Moreland wetlands (i.e. Lake Victoria and Froggy Pond wetlands) and wetlands along the oHlanga and main Mdloti Rivers are considered degraded and rehabilitable rather than transformed;

- Enhance connectivity to improve resilience – the KSIA conservation area for example has been expanded to include various adjacent wetlands and corridors including the Mount Moreland wetlands;
- Support enhanced estuarine functioning;
- Target key functional features in the landscape – water quality enhancement was noted as particularly important.

Drawing on the above criteria, Macfarlane et al (2016) then allocated potential strategic offset receiving areas in response to known proposed developments in key landholdings in the northern spatial development plan area, namely development by the Dube TradePort Corporation (DTPC) and Tongaat Hulett Developments (THD). These receiving areas included the Mdloti estuary and associated wetlands south of the N2, as well as various other watercourses. <u>The implications of this approach for additional developments in the study area that might be required to achieve off-site offsets is that offset receiving areas cannot potentially include the Mdloti or other identified offset sites / systems.</u>

8.8.6 Outcomes of engagement with key institutional stakeholders

8.8.6.1 <u>Outcomes of meeting with DWS and eThekwini officials on 26th April 2018 at the eThekwini Municipality offices</u>

The meeting resulted in the following key agreements and recommendations:

- The need for wetland offsets was agreed on;
- It was agreed that the National Guidelines for wetland offsets (MacFarlane et al 2016) would be used, rather than the more stringent guidelines outlined for the eThekwini Northern Spatial Development Area (MacFarlane et al 2015), which include consideration of opportunity costs of not being able to rehabilitate lost degraded wetlands in the future – this decision was based on the relatively small size of the wetland that would be affected in the current proposal (developments considered in the eThekwini Northern Spatial Development Area proposals include extensive areas and numerous wetlands) and the level of degradation as a result of long-term small-scale agricultural landuse;
- It was agreed that FCG would look carefully at the details of the offset calculators and include specific motivations around selection of different multiplier levels in the calculator;
- Both authorities at the meeting noted that they would require proof of signed "Options to purchase" the receiving offset sites from the relevant landowners to be included at the stage of final EIA documentation submission – it was noted that there was insufficient time at present for such arrangements to be entered into before Draft submission of the EIA report, in early May;
- Also to be included in the final EIA submissions should be a Memorandum of Agreement between the developer (Umgeni Water) and eThekwini Municipality and DWS, regarding the specific conditions of the offset, including agreement around maintenance and management responsibilities, which would fall on the developer at least until the Decommissioning Phase of the development, and ideally in perpetuity – DWS noted that without such a document, they would not be able to approve any proposed offset arrangements;
- The need to specify rehabilitation activities that require authorisation in terms of Section 21c and Section 21i of the NWA, as well as in terms of the NEMA, in the development applications for authorisation in terms of this legislation was discussed – the proposed rehabilitation activities would indeed trigger requirements for authorisation in terms of the above legislation;
- The suitability of the agricultural wetlands downstream of the development site was discussed, and it was agreed that:
  - Their location in the micro-catchment of the site was suitable;

- There is a need to secure offset sites as a matter of urgency, as if they are developed / further destroyed they would no longer be suitable offset recipients and the process would need to re-commence;
- In the event that the downstream offset sites were not adequate or not available, alternative sites would need to be sought for offsets;
- Such alternative sites would need to:
    - Lie outside of estuarine areas (as these represent a significantly different wetland type and moreover lie outside of areas considered in terms of the NWA);
    - Include similar wetland types;
    - Exclude areas already included as offset areas in the Macfarlane et al (2016) northern spatial development plan area, which have been earmarked for offsetting of development by the Dube TradePort Corporation (DTPC) and Tongaat Hulett Developments (THD). These receiving areas included the Mdloti estuary and associated wetlands south of the N2, as well as various other watercourses.

8.8.6.2 Outcomes of telephonic discussions with Ms Dinesree Thambu (Ezemvelo KZN Wildlife - Biodiversity Planning) on 7 May 2018

Ms Thambu was not available at the time of the meeting with eThekwini Municipality and DWS (see above) and instead a telephonic discussion was held between her and this author on 7 May 2018. This had the following outcomes:

- It was noted that Ezemvelo KZN Wildlife have a strict principle that the eThekwini offset approach of MacFarlane et al (2015), which includes consideration of the opportunity cost of future rehabilitation of wetlands entailed in the development / loss of wetlands must be considered in all offsets – that is, that the affected wetland must be evaluated in the Offset Calculations as a realistically rehabilitated system, rather than in its current degraded state, since a net gain in wetland function values is espoused in this approach (see MacFarlane et al 2015);
- The above principle was debated, and it was agreed that FCG should provide motivation as to why this approach should not be included in the present project. One of the reasons is that the main losses associated with the development of the wetland on the site are not functional, so much as associated with inherent biodiversity loss, including loss of a so-called "special" (if degraded) ecosystem. The main functional values of the wetland can be mitigated through effective management of stormwater and dewatering water into downstream sites. The *status quo* of wetlands on the site is wholly developed, and there is no reasonable alternative approach to the current agricultural landuse on the site that would have allowed for the wetland areas to be undeveloped – they occupy large areas of the site and are fed by water diverted from the wetlands. Such activities have also led to expansion of (degraded) wetland areas on the site, making calculations of actual natural wetland area very difficult (see Section 8.3.4). Realistic rehabilitation of the wetlands on site to a measurably better condition than at present would be unlikely, and even if required by an authority would be unlikely to elevate these wetlands from their current Category F PES to anything better than Category D and more realistically, Category E, unless the current landuse was curtailed and a rehabilitation scenario pursued as an alternative landuse;
- Ezemvelo KZN Wildlife will consider the offset plan in the draft EIA report, given that the time frames of this input are too tight to allow for consideration of the proposed approaches prior to submission.

8.8.7 Calculation of offset requirements

8.8.7.1 Approach to offset calculation

The offset calculations presented in this document are based entirely on the approach recommended by Macfarlane et al (2016), with the actual calculations being made using the spreadsheet-based "Wetland offset calculator" of the same study. The offset calculator includes 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 wetland function, ecosystem conservation and species conservation. In the present case, mitigation measures outlined in Section 8.6.1 (Impact A) largely address loss of wetland function as a result of site development, through artificial management of runoff and subsurface flows out of the site. The offset calculation presented here thus focuses on the Ecosystem Conservation component of the Offset Calculator – this is because although the wetland type is highly degraded, it nevertheless represents a critically endangered wetland type, and is considered a "special" habitat in its own right, as an example of a particularly large coastal seep in this area. While Wetland Functional Loss is not considered of high enough significance to warrant offsets in its own right, this component has been used in the Offset Calculator as well, both for completeness and also because, if Ecosystem Targets are met in the same micro-catchment as is proposed here, it is likely that Wetland Functional losses would also be offset through rehabilitation of natural wetland function in the receiving offset wetland, in addition to, and supported by, the mitigatory engineering works that are required.

If the approach of MacFarlane (2015) is used, as recommended by Ezemvelo KZN Wildlife (see Section 8.8.5), the current condition of the affected wetland is "upgraded" to a realistically achievable improved wetland condition. This has the effect of magnifying the offset requirement, in order to achieve "a net wetland gain" as opposed to a "no net wetland loss" outcome.

The offset calculations presented in this section consider the outcomes of both approaches.

8.8.7.2 Data used in offset calculations

- *WET-Health assessment of impacted wetlands*

The Vegetation Module of the Level 1 WET-Health assessment of MacFarlane et al (2008) was applied to the wetlands already mapped and described in Section 8.3.4, and illustrated again in Photo AB in this section, for ease of reference. Application of this module requires initial mapping of so-called "disturbance units" within each wetland, with disturbance units being broadly homogenous areas, differentiated on the basis of current and historic disturbances (MacFarlane et al 2008).

Photo AB
View upstream into proposed desalination plant showing extensive landscape transformation

Figure 8.20 shows the mapped disturbance units on the proposed desalination plant site. The actual areas mapped have been listed in Table 8.8, which shows the proportion of the two wetlands comprising these disturbance units.

Figure 8-20: Wetlands (yellow polygons) on the desalination plant site (red polygon) showing mapped disturbance units as per MacFarlane et al (2008). Disturbance units defined in Table 8.8.

Table 8-8: Size and categorisation of disturbance units mapped in Figure 8-20

Wetland	Type	Disturbance units included	Type	Area (ha)	Total Area per landuse (ha)
Impact Wetland A (South)	Seep	Total		1.2	
		D7	Dam	0.05	0.05
		Remainder	Cultivation	1.15	1.15
Impact Wetland B (North)	Seep	Total		3.2	
		D1	Dam	0.06	0.39
		D2		0.05	
		D3		0.04	
		D4		0.14	
		D8		0.05	
		D5		0.02	
		D6		0.03	
		C1	Channeled flow	0.05	0.08
		C2		0.03	
		B1	Buildings and parking	0.17	0.184
		B2		0.004	
		B3		0.01	
		Remainder	Cultivation	2.546	2.546

Table 8.9 presents the outcomes of the WET-Health assessments for the wetlands on the potentially impacted site. The disturbance units have been merged for these wetlands – this is because both wetlands would be lost in their entirety if the development were to be authorised and the wetlands are considered similar in terms of both impact and wetland type. Table 8.10 presents the data for merged wetland sites, calculated from Table 8.8.

Table 8-9: Results of WET-Health assessment of Impacted Wetlands A and B (see Figure 8-20). Data for combined sites from Table 8.10

Disturbance Class	Extent (%)	Table references	Intensity [1] (0 - 10)	Magnitude[2]
Infrastructure	4.2	Table 5.22 (Descriptions) & Table 5.23 (Typical intensity Scores)	10	0.4
Deep flooding by dams	0		10	0.0
Shallow flooding by dams	10		6	0.6
Crop lands [incl. channelled flow through crops]	85.8		9	7.7
Commercial plantations			9	0.0
Annual pastures			9	0.0
Perennial pastures			8	0.0
Dense Alien vegetation patches.			7	0.0
Sports fields			9	0.0
Gardens			8	0.0
Areas of sediment deposition/ infilling & excavation			8	0.0
Eroded areas			7	0.0
Old / abandoned lands (Recent)			7	0.0
Old / abandoned lands (Old)			5	0.0

Seepage below dams			3	0.0
Untransformed areas	0		1	0.0
			Overall weighted impact score [3]	**8.7**

1 Default scores are provided which should be adjusted based on field investigations or local knowledge
2 Magnitude of impact score is calculated as extent / 100 x intensity of impact.

Table 8-10: Data used in WET-Health assessment of merged Impacted Wetlands A and B as calculated from Table 8.8

WETLAND	DISTURBANCE TYPE	AREA (ha)	% Area
Impact site wetlands A and B	Total (A and B)	**4.40**	100.0
	Dam	0.44	10.0
	Cultivation	3.70	84.0
	Channelled flow	0.08	1.8
	Buildings and parking	0.18	4.2
	Natural wetland habitat	-	0.0

Table 8.11, after MacFarlane et al (2008) shows the interpretation of WET-Health impact scores in terms of Present Ecological State Categories. Table 8.10 presents the data for merged wetland sites, calculated from Table 8.8. The data show that the current state of the wetlands, with regard to vegetation, is Category F, indicative of wetlands that have reached a critical level of modification. This data is used in the calculation of wetland offsets outlined below, for which the WET-Health for vegetation was considered the most useful measure of present wetland condition from the perspective of Ecosystem Function. PES categories as derived from the DWAF (1999) Desktop Assessment was considered a more useful measure of Wetland Function.

Table 8-11: Present Ecological State categories used to define health of wetlands – table after Macfarlane et al (2008)

Description	Combined impact score	PES Category
Unmodified, natural.	0-0.9	A
Largely natural with few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2-3.9	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 - 10	F

Table 8.12 Summary of wetland condition and other attributes
WET Health (Level 1 for Vegetation calculated for this assessment)

Name	Description	Area (ha)	Wetland CBA status	Endangered status (Nel & Driver 2012)	Current condition					Future condition				
					PES	EIS	Wet Health	Ecosystem services: Ecosystem service type	Ecosystem services: Ecosystem service Category	PES	EIS	Wet Health	Ecosystem services: Ecosystem service type	Ecosystem services: Ecosystem service Category
Tongaat Desalination plant North (Impact Wetland B)	Cultivated wetland seep	3.2	Not defined: CESA	Critically endangered vegetation type Poorly protected	E	Low/ marginal	F	Stream flow regulation Flood attenuation Water supply: Toxicant removal Erosion control Carbon storage Provision of foods Biodiversity Cultural Tourism/ Rec	Intermediate Intermediate Intermediate Mod -low Mod -low Mod -low Mod -low Low None Low	n/a	n/a	n/a	Flood attenuation Water supply Toxicant removal Erosion control Carbon storage Provision of foods Biodiversity Cultural Tourism/ Rec	Intermediate (artificial)I Intermediate (downstream) None None None None None to very low (corridor) None None
Tongaat Desalination Plant South (Impact Wetland A)	Cultivated wetland seep	1.2	Not defined: CESA		E	Low/ marginal	F	Stream flow regulation Flood attenuation Water supply Toxicant removal Erosion control Carbon storage Provision of foods Biodiversity Cultural Tourism/ Rec	Intermediate Intermediate Intermediate Intermediate Mod -low Mod -low Mod -low Low – but special system None Low	n/a	n/a	n/a		

Table 8.12 summarises the data already presented in earlier sections of this report, along with WET-Health data for the impacted wetlands on the site. These data are used as the basis for the calculated Offset Requirements to address loss of wetlands on the development site. It is however noted, as stressed already in this report, that 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 8.13 presents PES categories as a percentage of naturalness. These percentage scores are used in Table 8.14 to define level of change in terms of wetland function and ecosystem condition. In the case of WET-Health scores, the Category F score of 8.7 lies towards the mid to upper end of Category F and a score of 15 was assigned for this level of function.

Where the more conservative approach of MacFarlane (2015) is used for setting wetland offsets as recommended by Ezemvelo KZN Wildlife (see Section 8.8.5.1), and the current condition of the affected wetland is considered “upgraded” to a realistically achievable improved wetland condition, then the lower level Category D (42%) has been assigned to wetland function, with ecosystem condition remaining at 15%. These categories have been selected on the basis that wetland ecosystem function on the site could conceivably be improved through better landuse practice that allowed for vegetation of channels to improve water quality runoff and reduce the rate of flow of water out of the site under wet conditions. Improvement in vegetation condition is however unlikely, without a major change in current landuse, as agriculture currently extends throughout the mapped wetlands, which comprise most of the site that lends itself to agricultural use.

Table 8.13 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 8.14 Estimated wetland function change, based on PES data and estimated wetland ecosystem change, based on WET Health data (Vegtetation Module).

Name	Wetland Function (%) (based on PES)		Wetland Ecosystem Condition (%) (based on WET Health)	
	Pre devel	**Post devel**	**Pre devel**	**Post devel**
Tongaat Desalination plant North (Impact Wetland B)	35	30	15	0
Tongaat Desalination Plant South (Impact Wetland A)	35	30	15	0
Assumed improved condition (i.e. rehabilitation opportunity) – both wetlands	42	30	15	0

8.8.7.3 RESULTS OF DETERMINATION OF OFFSET TARGETS

Table 8.15 presents the results of application of the data and approaches outlined in Section 8.8.7.2, to the wetland calculator as developed by Macfarlane et al (2016).

Determination of Wetland Functionality Offset Targets
As expected, given the low levels of current wetland function and position of the wetland in a small catchment with no significant downstream dependent areas, as well as the relatively high levels of wetland function that would be simulated by engineering design required as essential mitigation, Functional Offset Targets for the wetland would be low – 0.2 functional hectare equivalents (PES Category E) would be required to be met in an offset wetland.

If the more stringent measures required by Ezemvelo KZN Wildlife are addressed (as per the approach of MacFarlane 2015) and the current functional value of the wetland is set to 42% (see Table 8.13), then the Functional Offset Target increases to 0.5 functional hectare equivalents (PES Category D).

Determination of Ecosystem Conservation Offset Targets
Table 8.15 shows that Ecosystem Conservation Targets would be significantly higher than functionality targets – 4.4 habitat hectare equivalents (WET Health Category F).

This finding takes cognisance of the fact that the wetlands are of a critically endangered vegetation and wetland type, and have poor protection status. The wetland itself is also considered of special status, as an example of a much larger, albeit degraded, coastal seep.

Table 8.15 Results of application of wetland offset calculator (MacFarlane et al 2016)

Calculation to determine wetland offset targets

Wetland Functionality Targets

Impact Assessment	Prior to development	Wetland size (ha)	4.4
		Functional value (%)	35
	Post development	Functional value (%)	30
		Change in functional value (%)	5
	Key Regulating and Supporting Services Identified		Streamflow regulation, flood attenuation, water supply, provision of arable areas for food production
	Development Impact (Functional hectare equivalents)		0.2
Offset calculation	Offset Ratios	Triggers for potential adjustment in exceptional circumstances	None
		Functional Importance Ratio - note that lower ratio is used here, given the position of the wetland in the catchment, with no important downstream systems and no estuarine connection	1.0
	Functional Offset Target (Functional hectare equivalents)		0.2
Further considerations	Have other key Provisioning or Cultural Services been identified that require compensation?		No
	Additional compensatory mechanisms proposed	Essential mitigation measures include management of stormwater as well as dewatered water (that is, essentially all seepage flows from the site) via an infiltration trench, that will dissipate flows into the downstream wetlands thus addressing streamflow regulation and flood attenuation, as well as providing improved capacity for water quality amelioration, while at the same time presenting reduced pollution opportunities through changed landuse	

Ecosystem Conservation Targets

Impact Assessment	Prior to development	Wetland size (ha)	4.4	
		Habitat intactness (%)	15	
	Post development	Habitat intactness (%)	0	
		Change in habitat intactness (%)	15	
	Development Impact (Habitat hectare equivalents)		0.66	
Determining offset ratios	Ecosystem Status	Wetland Vegetation Group (or type based on local classification)		
		Threat status of wetland	Threat status	CR
			Threat status Score	15
		Protection level of wetland	Protection level	Not Protected
			Protection level Score	2
			Ecosystem Status Multiplier	30
	Regional and National Conservation context	Priority of wetland as defined in Regional and National Conservation Plans: [wetlands not identified but should be CESA]	Not specifically identified as important	0.5
			Regional & National Context Multiplier	0.5
	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	Low connectivity	0.5
			Local Context Multiplier	0.4
			Ecosystem Conservation Ratio	6.60
Offset Calculation	Development Impact (Habitat hectare equivalents)		0.7	
	Ecosystem Conservation Ratio		6.6	
	Ecosystem Conservation Target (Habitat hectare equivalents)		4.4	

8.8.8 Identification of the receiving offset area

8.8.8.1 Selection of receiving offset areas

Degraded wetlands downstream of the proposed desalination plant site have been selected as the most practicable approach to addressing (mainly) wetland ecosystem loss as a result of the proposed development. This recommendation, which was agreed on in discussion with eThekweni Municipality, DWS and Ezemvelo KZN Wildlife representatives (see Section 8.8.6), took cognisance of the following positive aspects associated with their selection:

- Their location in the same micro-catchment as the impacted wetlands;
- Their location downstream of the impacted wetlands, and such that outflows from the site, already addressed as part of design phase mitigation for site development, could be passed into these wetlands, which would benefit from improved infiltration and reduced concentrated runoff;
- The wetlands are highly degraded and realistically unlikely to be rehabilitated – but could be rehabilitated with effort so as to play a significantly more important role from a wetland ecosystem perspective;
- The wetlands do not form part of any larger offset agreement for other land owners;
- The wetlands lie in the range of habitat in which at least two red data frog species would have occurred under natural conditions. The range of these species is now threatened by *inter alia* habitat loss from agriculture (du Preez and Carruthers 2009). As such, the wetlands may provide opportunities to re-instate habitat suitable for these and other locally indigenous wetland species. The species comprise the Critically Endangered Pickergill's Reed Frog (*Hyperolius pickersgillli)*, and the Vulnerable Natal Leaf-Folding Frog (*Afrixalus spinifrons*), both of which currently occur in watercourses associated with the Lake Victoria and Froggy Pond wetlands some 5.2 km south west of the site.

The proposed wetlands do however have a number of disadvantages that detract somewhat from their suitability as offset sites, namely:

- The wetlands are highly degraded and determination of reference conditions is difficult;
- The wetlands are invaded by plants such as Napier Fodder which are difficult to remove in their entirety and which may add to management burdens or threaten longterm wetland sustainability – that said, this species is common in many wetlands in this area and is likely to affect most offset sites;
- The wetlands are fragmented across multiple properties, which might make land acquisition complex and / or expensive;
- Existing residential development in their vicinity means that extensive buffering of the wetlands is unlikely to be possible;
- It is uncertain whether habitat rehabilitation / remediation will result in the natural return of target frog and other species to the site – future re-introduction of target species could however be a possibility;
- The wetlands are intersected on their up- and downstream sides by roads, making fauna within them potentially vulnerable to mortalities as a result of movement onto road areas.

Despite the above issues, it was decided to pursue the proposed local wetlands as the most useful wetland offset sites that had been identified at the time of this assessment.

8.8.8.2 Description of receiving offset wetlands

Figure 8.21 shows the location and mapped extent of wetlands in the area identified for wetland offsets, noting again that accurate delineation of these highly disturbed wetlands is not possible, and that the sites have been flattened, excavated and dug through for many years.

Figure 8-21: Wetlands identified as potential offset receptor sites, south of the M4 and the proposed desalination plant site. Proposed receptor wetlands on the desalination plant site showing mapped disturbance units as per MacFarlane et al (2008). Disturbance units on receptor sites prefixed RD and RC. Disturbance units defined in Table 8.16.

Photos AC to AF provide photographic illustrations of the current condition of these sites.

	
Photo AC Current condition of proposed offset receiving wetlands showing impoundment and extensive agriculture	Photo AD Trenches convey water through the wetlands in the proposed receiving offset wetlands


Photo AE Concentration of upstream inflows through the proposed receiving offset wetlands	Photo AF Extensive *Phragmites australis* wetlands in places in the proposed receiving wetlands upstream of South Beach Road. Note site is for sale.

The wetlands mapped in Figure 8.21 have already been described in section 8.3.4, the main points of which can be summarised as follows:

- Augering of least-disturbed low-lying parts of these wetlands 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;
- The wetlands would naturally have been fed by seepage from the dune slopes on and abutting the proposed desalination plant site – these flows today reach the wetlands as a combination of seepage water, as well as channelled flows from upstream, which pass into the wetlands via culverts under South Dune Road and the M4;
- Immediately south of the M4 the dune slopes steeply down towards the seas, with water from the culverts being alternatively impounded in small unlined dams and channelled downslope via a system of channels and trenches that both supply water to lower lying impoundments and drain adjacent wetlands. Excavation in places into the steep upper slopes force premature day-lighting of seeped groundwater and near-surface water, and channel it into storage ponds and trenches;
- *Phragmites australis* reedgrowth characterises the lower and (in places) mid hillslopes, indicating a high water table;
- The wetlands on the toe and lower slopes of the dune have been almost wholly cultivated, with isolated stands of (indigenous, obligate wetland) *Phragmites australis* in under-utilised areas, where it grows along with abundant (alien) Napier fodder (*Pennisetum purpureum*), which has invaded into most areas not subject to active tillage or other management. Other alien plants found in the wetlands and their margins include bugweed (*Solanum mauritianum*), cannas (*Canna indica*), elephant ear (*Xanthosoma sagittifolium*) and terrestrial alien species such as Lantana (*Lantana camara);*
- The small irrigation storage ponds are mostly linked to pumps, which irrigate the fields, while a network of trenches prevents over - saturation of irrigated areas;
- Water passes out of the wetlands via deeply inset pipe culverts, which convey flows beneath Beach Road and out onto the beach, through mostly terrestrial coastal bush – where culverts do not connect directly with wetlands, water appears to pool against higher lying ground just upslope of South Beach Road, and flow along this area to reach the main culverts;
- Outflows from the wetlands pass over or under a network of sewage pipes, which connect to a pump station near the outlet of RA2 (Figure 8.20). Periodic blockages / overflows from these pipes and their manholes results in periodic contamination of outlets onto the beach. The

sewer runs along the edge of South Beach Road however, and it is unlikely that sewage contamination of the proposed offset wetlands would occur.

8.8.8.3 Assessment of offset receptor sites

Data already presented for this these wetlands in Section 8.3.4 indicate that the wetlands have been assessed as follows:

- PES Category E (as per DWAF 1999)
- Low / Marginal EIS
- Included in the "Indian Ocean Coastal Belt Group 2" Vegetation Group identified in Nel and Driver (2012) as both Critically Endangered and Poorly Conserved;
- Currently performing ecosystem services for a very localised area (extending only as far as the outlets onto the beach) as follows:
  - intermediate levels of stream flow regulation, flood attenuation and water supply;
  - moderate to low levels of toxicant removal, erosion control, carbon storage and provision of arable land for foods – noting that these services are intimately tied to the current landuse.

8.8.8.4 WET-Health assessments:

Disturbance units were mapped within the three identified receptor wetlands, for application of the WET-Health module.

The actual areas mapped have been listed in Table 8.16, which shows the proportion of the three wetlands comprising these disturbance units, with the "remainder" of the wetlands in each case comprising agricultural land. Table 8.17 presents the data as actually used in the WET-Health assessment, which looks at combined wetland health, given similarity of impacts across the three wetlands, while Table 8.18 presents the outcomes of application of the WET-Health Level 1 Vegetation Module, which when interpreted using Table 8.11 shows the wetlands to be in a **Category F** with regard to wetland vegetation.

Table 8-16 Size and categorisation of the disturbance units mapped in Figure 8-20

Wetland	Type	Disturbance units included	Type	Area (ha)	Total Area per landuse (ha)
Receiving Offset Area RA1	Basin Seep			1.5	
		RD1	Dam	0.04	0.05
		RD4	Dam	0.01	
		Remainder	Cultivation	1.45	1.45
Receiving Offset Area RA2	Basin Seep			0.7	
		RD2	Dam	0.005	0.005
		RC1	Channeled flow	0.02	0.02
		Remainder	Cultivation	0.675	0.675
Receiving Offset Area RA3	Basin Seep	Remainder	Cultivation	0.32	0.32

Table 8-17: Data used in WET-Health assessments of merged Receiving Offset Wetlands RA1, RA2 and RA3, as calculated from Table 8.16

WET HEALTH	TYPE	AREA	%
Receiving site wetlands (before rehabilitation)	Total (RA, RB and RC)	2.20	100.0
	Dam	0.06	2.5
	Cultivation	2.13	96.6
	Channelled flow	0.02	0.9
	Buildings and parking	0.00	0.0
	Natural wetland habitat	0	

Table 8-18: Results of WET-Health assessment of proposed offset receptor wetlands RA1, RA2 and RA3 (see Figure 8-20). Data for combined sites from Table 8.17

Disturbance Class	Extent (%)	Intensity [1] (0 - 10)	Magnitude [2]
Infrastructure	0	10	0.0
Deep flooding by dams	0	10	0.0
Shallow flooding by dams	2.5	6	0.2
Crop lands [incl. channelled flow through crops]	97.5	9	8.8
Commercial plantations		9	0.0
Annual pastures		9	0.0
Perennial pastures		8	0.0
Dense Alien vegetation patches.		7	0.0
Sports fields		9	0.0
Gardens		8	0.0
Areas of sediment deposition/ infilling & excavation		8	0.0
Eroded areas		7	0.0
Old / abandoned lands (Recent)		7	0.0
Old / abandoned lands (Old)		5	0.0
Seepage below dams		3	0.0
Untransformed areas	0	1	0.0
Overall weighted impact score [3]			8.9
1 Default scores are provided which should be adjusted based on field investigations or local knowledge			
2 Magnitude of impact score is calculated as extent / 100 x intensity of impact.			

8.8.9 Identification of a reasonable and achievable desired ecological state for the receiving offset area

The proposed offset receptor wetlands are highly degraded and their position at the downstream extent of a small catchment without an estuarine outlet means that the usefulness of large expenditure to increase wetland functionality is questionable. However, it is possible that the habitat diversity and quality of the wetlands could be improved, so as to promote greater species diversity, reflective of small coastal wetlands in this area, under less impacted conditions. While the extent of excavation and site disturbance makes re-instatement of seep areas with a substantially improved condition unlikely, it would be possible to create coastal depressional wetlands, such as would be likely to have occurred at the downstream end of seeps, and to establish these as functional, high quality wetland habitats that could support fauna and flora typical of the Critically Endangered Indian Ocean Coastal Belt Group 2 wetland vegetation.

Since offsetting functionality is less important than offsetting ecosystem conservation, it is arguably acceptable to beneficial to establish a wetland habitat type that has the same level of threat (Critically Endangered) in the National Biodiversity Assessment (NBA) report (Nel and Driver 2012) as seep wetlands of the same vegetation group, but that has higher biodiversity potential.

This argument is supported by the fact that actual reference conditions for both the impacted and the offset receptor wetlands is poorly known, although it seems reasonable that it would have comprised a mosaic of terrestrial dune and wetland habitat, with the latter comprising seep wetland on slopes and possibly depressional wetlands comprising shallow pools on flatter low-lying areas.

Based on the above discussion, the offset plan presented in this report proposes rehabilitation of the offset receptor wetlands to a mosaic of depressional, shallowly to deeply inundated wetland, that would support Indian Ocean Coastal Belt Group 2 wetland vegetation, with terrestrial buffers where possible, supporting vegetation typical of that occurring naturally in East Coast Dune Forest areas.

It is suggested that, if the Rehabilitation Plan outlined in Section 8.8.11 is implemented in full across the wetlands, and abutting terrestrial areas remaining or instated during rehabilitation within the targeted offset erven is rehabilitated as indigenous buffer areas, then a realistic PES category of at least Category C (moderately modified from natural) would be achievable.

Calculation of the equivalent hectares provided by the proposed offset wetlands is based on this assumption.

8.8.10 Evaluation of the likelihood of proposed rehabilitation of receptor wetlands to meeting offset requirements

8.8.10.1 Assumptions and calculations of post-rehabilitation wetland condition, function and extent

- Wetland extent: It is assumed that wetland area would remain unchanged, or could expand slightly, following rehabilitation, while noting that the proposed rehabilitation plan (see Section 8.8.11) would require significant earthworks on the site to create a diverse network mosaic. Given that mapped original wetland extent was rendered uncertain by the degree of disturbance as well as the unnatural increase in wetland extent as a result of daylighting of groundwater high up on the slopes, the degree of uncertainty around exact future wetland extent is not considered problematic, provided that the rehabilitation plan is implemented as proposed and that the final wetland area is not less than that mapped pre-rehabilitation;
- Wetland condition:
    - It is assumed that wetland condition would be improved to a Category C, and a PES score in the median range of this Category (i.e. 72) is considered reasonable;
    - Note that while WET-Health has been included as a measure of pre-rehabilitation wetland condition in the calculation of ecosystem conservation targets, PES Category has rather been used in the calculation of post rehabilitation condition. This is because the Level 1 Vegetation Module over-scores theoretical wetland condition in a context where the whole site is assumed to be vegetated with natural vegetation. It is assumed that although this would be the rehabilitation intention, the actual post-rehabilitation score for condition would be lower than the Category A that is derived by the

application of the WET Health tool in this scenario, and the desktop PES determination provides a broader theoretical assessment tool in this circumstance.

8.8.10.2 Summary of assessment data for present and proposed (rehabilitated) wetland condition

Table 8.19 provides a summary of the data relating to present and proposed (rehabilitated) wetland condition, ecosystem services, function and other criteria used in the Wetland Offset Calculator for receptor wetlands.

Table 8.20 provides a coarse comparison of changes in wetland PES and Health before and after rehabilitation. As in the case of the assessment of Offset Requirements (Section 8.8.7), consideration was also given to the more conservative approach of MacFarlane (2015) in assessing wetland offsets, as recommended by Ezemvelo KZN Wildlife (see Section 8.8.5.1). Again, the current condition of the receptor wetlands have been "upgraded" to a realistically achievable improved wetland condition, against which offset rehabilitation measures are assessed.

Thus, and with the same rationale around the challenges in actually improving Ecosystem condition while maintaining agricultural activities on sites that are predominantly wetland in nature, as outlined for the determination of wetland offset targets, the lower level of Category D (42%) PES has been assigned to wetland function, prior to rehabilitation, with ecosystem condition remaining at 22%.

Table 8.19: Summary of wetland condition and other attributes used in the Offset Calculator to evaluate the propsoed Offset Receptor Wetlands before and after proposed rehabilitation measures

Name	Description	Area (ha)	Wetland CBA status	Endangered status (Nel & Driver 2012)	Current condition					Future condition assuming rehabilitation				
					PES	EIS	Wet Health	Ecosystem services: Ecosystem service type	Ecosystem services: Ecosystem service Category	PES	EIS	Wet Health	Ecosystem services: Ecosystem service type	Ecosystem services: Ecosystem service Category
Wetland Receptor Sites RA1, RA2 and RA3	Cultivated wetland seeps	2.2	Not defined: CESA	Critically endangered wetland type Critically endangered terrestrial vegetation type Poorly protected	E	Low/ marginal	F	Stream flow regulation Flood attenuation Water supply: Toxicant removal Erosion control Carbon storage Provision of foods Biodiversity Cultural Tourism/ Rec	Intermediate Intermediate Intermediate Mod -low Mod -low Mod -low Mod -low Low None Low	C	At least Mod	N/A (see text)	Flood attenuation Water supply Toxicant removal Erosion control Carbon storage Provision of foods Biodiversity Cultural Tourism/ Rec	Intermediate No Intermediate Intermediate Intermediate None Moderately high None None

Table 8.20: Estimated wetland function change, with and without rehabilitation of the proposed receptor wetlands, based on PES data and estimated wetland ecosystem change

	Wetland Function (%) (based on PES)		**Wetland Ecosystem Condition (%) (based on WET Health)**	
Name	**Pre devel**	**Post rehabilitation**	**Pre devel**	**Post rehabilitation**
Wetland Receptor Sites RA1, RA2 and RA3	35	72	22	N/A – over-estimates Health because of 100% natural vegetation cover
Assumed improved condition of receptor sites without offset rehabilitation (i.e. rehabilitation opportunity)	42	72	22	22

8.8.10.3 Availability of space for wetland buffering

Figure 8.22 indicates the extent of area outside of the mapped wetlands that would be available to serve as wetland buffers. A total area of 1.56ha has been calculated from the mapped polygons, with buffer extent limited by erven over which the offset wetlands RA1, RA2 and RA3 extend, and no additional vacant / cultivated erven being included as buffers, in order to limit land purchase requirements. It is noted that, given the degree of fragmentation of the wetlands, the buffer area available is limited, and in places, there are no buffers between adjacent roads or developed erven.

Figure 8-22: Available non wetland area on erven overlapped by wetlands, that would be rehabilitated to function as buffers for the proposed offset receptor wetlands. Wetlands mapped as yellow polygons. Erf boundaries indicated (only affected erven numbered) and buffer areas shown as purple polygons.

In addition to the direct buffer areas mapped, the development site ecological corridor, stipulated as a 20m wide corridor, extending some 160 m north into the high dune has been included in the buffer area, as this zone would actively improve connectivity.

8.8.10.4 Results of determination of offset targets

Table 8.21 presents the results of application of the data provided above to the wetland calculator as developed by Macfarlane et al (2016).

Contribution towards Wetland Functionality Targets

The proposed rehabilitated wetlands would contribute 0.5 functional hectare equivalents. This is in excess of the 0.2 functional hectare target if the national offset guidelines of MacFarlane et al (2016) are used, and equivalent to the 0.5 equivalent hectares required if rehabilitation opportunity costs are considered, and the more stringent measures required by Ezemvelo KZN Wildlife are addressed (as per the approach of MacFarlane 2015).

Contribution towards Wetland Ecosystem Conservation Targets

The rehabilitated wetlands have been calculated as contributing 4.2 equivalent hectares towards Ecosystem Conservation Targets. This is just under the 4.4 equivalent hectares required in terms of meeting Ecosystem Conservation Targets.

Although the receiving offset wetlands fall 0.2 equivalent hectares short of the required offset area, set against this should be the fact that the proposed rehabilitation plan would provide habitat for at least two red data frog species, and significantly improve wetland habitat quality in an area in which there is no other driving force for rehabilitation, and where coastal development pressures are high.

Although it would be possible to provide additional wetland rehabilitation areas further away from the development site between South Beach Road and the M4, the problem with this approach is that the real wetland ecosystem benefits decrease substantially with distance from the site, mainly because they would not benefit from measures to spread upslope flows from dewatering areas on the development site, and would moreover be increasingly fragmented from other wetland sites.

Piecemeal addition of more wetland receptor sites is thus not recommended. In this specialist's opinion, rehabilitation of the wetland receptor sites as outlined in Section 8.8.11 would provide adequate offset of lost but degraded and dysfunctional wetlands on the site, particularly if medium term efforts to re-introduce appropriate red data frog species into the rehabilitated habitats were included in offset requirements, in the (likely) event that such species did not access the sites naturally.

Table 8-21 Results of application of the wetland offset calculator (MacFarlane et al 2016)
Calculations to determine potential gains made by proposed offset receiving areas

Offset Receiving Areas: Assessing potential gains

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

Contribution Towards Wetland Functionality Targets

Wetland attributes	Wetland Reference			
Alignment with site selection guidelines	**Criterion**	**Relevance**	**Site attributes**	**Acceptability Guidelines**
	Wetland type	Targeted wetlands should typically be of the same type to ensure that similar services to those impacted are improved through offset activities.	Wetland is of the same type as the impacted wetland.	Ideal
	Key services targeted	Targeted wetlands should be prioritised and selected based on their ability to compensate for key regulating and supporting services impacted by the proposed development.	Selected wetland is poorly placed to improve key regulating and supporting services identified.	Generally unacceptable
	Offset site location relative to impacted wetland	Targeted wetlands should ideally be located as close to the impacted site as possible.	Selected wetland is located within the same local catchment as the impacted wetland.	Ideal
	Overall comment on alignment with site selection guidelines	Although the wetlands are rated as "poorly placed to improve key regulating and supporting services", it is noted that the impacted wetlands are similarly poorly placed, being in a small catchment that does not support major downstream systems		
Preliminary Offset Calculation	**Prior to offset activities**	Wetland size (ha)	2.2	
		Functional value (%)	35	
	Following sucessful offset implimentation	Functional value (%)	72	
		Change in functional value (%)	37	
	Preliminary Offset Contribution (Functional hectare equivalents)		**0.8**	
Final Offset Calculation	**Criterion**	**Relevance**	**Offset activity**	**Adjustment factor**
	Types of offset activities proposed	The risk of offset failure is linked to the type of offset activity planned with wetland establishment considered less preferable and more risky than rehabilitation or averted loss activities.	Rehabilitation & Protection	0.66
	Final Offset Contribution (Functional hectare equivalents)		**0.5**	

Contribution Towards Ecosystem Conservation Targets

Wetland attributes	Wetland Reference		Wetland Receptor Sites RA1, RA2 and RA3 to be rehabilitated to depressional, herbaceous wetlands	
	Wetland Vegetation Group (or type based on local clasification)			
	Threat status of wetland		Threat status	CR
Alignment with site selection guidelines	**Criterion**	**Relevance**	**Site attributes**	**Acceptability Guidelines**
	Like for Like	Targeted wetlands should be aligned with "like-for-like" criteria to ensure that gains associated with wetland protection are commensurate with losses.	Wetland is of an alternative wetland type of the same or higher threat status as the impacted wetland, within the same wetland vegetation group	Acceptable
	Landscape planning	To what degree is wetland selection aligned with Regional and National Conservation Plans	Wetlands have not been specifically identified as important in landscape planning	May be acceptable
	Wetland condition	The habitat condition of the wetland should ideally be as good / better that that of the impacted site prior to development (or at least B PES Category in the case of largely un-impacted wetlands)	Final habitat condition is likely to be better than that of the impacted wetland.	Ideal
	Local biodiversity value	Wetlands that are unique or that are recognised as having a high local biodiversity value should be prioritised for wetland protection.	The wetland is charachterised by habitat and / species of high biodiversity value.	Ideal
	Viability of maintaining conservation values	Connectivity and consolidation with other intact ecosystems together with the potential for linkage between existing protected areas is preferable.	The wetland is poorly connected with other intact ecosystems.	Not ideal
	Overall comment on alignment with site selection guidelines	The wetland has poor connectivity with other wetlands but, with implementation of the required 20m ecological corridor along the edge of the impacted wetland site, there would be some connectivity between the coastal dune of the impacted site, the rehabilitated offset wetlands and the beach, albeit connected only via culverts under the roads		
Preliminary Offset Calculation	Wetland areas to be secured	Wetland size (ha)	**2.2**	
		Habitat intactness (%)	**75**	
		Wetland habitat contribution (hectare equivalents)	**1.7**	
	Buffer zones to be secured	Area of wetland buffer zone included in the wetland offset site	**1.9**	
		Integrity of buffer zone	**0.9**	
		Buffer zone hectare equivalents	**0.4**	
		Buffer zone contribution (hectare equivalents)	**0.4**	
Final Offset Calculation	**Criterion**	**Relevance**	**Site attributes**	**Adjustment factor**
	Security of tenure	Offset activities that formally secure offset sites for longer than the minimum requirement are more likely to be maintained in the long-term and are therefore preferred.	Highest possible level of protection permanently secured	2
	Offset Contributions	Wetland habitat contribution (hectare equivalents)	3.3	
		Buffer zone contribution (hectare equivalents)	0.9	
		Ecosystem Offset Contribution (hectare equivalents)	**4.2**	

8.8.11 Rehabilitation plan for the offset receptor wetlands

8.8.11.1 Vision

The rehabilitated wetlands assumed in the assessment of potential wetland gains (and particularly in terms of Ecosystem Offset Contributions) (see Section 8.8.10) would need to comprise a mosaic of permanently saturated to shallowly inundated herbaceous wetland, dominated by locally indigenous emergent wetland plant species. The permanent wetland would need to be edged by a fringe of seasonal wetland, which would both increase habitat diversity in the wetland area and provide stabilising functions at the outlet of the upslope seep wetland into the depressional wetlands created as part of the offset. These margins would give way to rehabilitated terrestrial East Coast Forest habitat, which would need to provide a buffer function for wetland areas. The steep slopes between the M4 and the permanent wetland marshes would probably be vegetated, at least on their lower reaches, by *Phragmites australis reedbed,* which is already present on the sites.

The depressional wetlands and their seasonal wetland margins would need to be created such that they provided habitat suitable for colonisation by flagship wetland species in this area, such as Critically Endangered Pickersgill's Reed Frogs (*Hyperolius pickersgilli*) and the (Vulnerable) Natal Leaf-Folding Frog (*Afrixalus spinifrons*). These frog species occur in densely vegetated marshy areas in coastal bushveld and grassland (du Preez and Carruthers 2009).

Key to the establishment of the required wetland habitat would be the design and installation of the infiltration trenches at the top of the slope, to ensure a spread of flows into these sites, the removal of alien vegetation (e.g. Napier Fodder), the design and installation of drop-structures at outlets from the offset wetlands, leading under South Beach Road and the design and construction of a low berm along the boundary of the wetland sites and South Beach Road, to reduce accessibility to the road by wetland fauna and, potentially, to address flood risks to the road as a result of upstream pooling of water on the site.

Photo AG illustrates the core herbaceous wetland that would need to be established and maintained in the offset areas.

Photo AG

Wetland habitat at Froggy Pond indicating the planned habitat template for the provision of herbaceous shallowly inundated and marginal wetland habitat, suitable for colonisation by a range of wetland fauna, including Critically Endangered Pickergill's Reed Frog (*Hyperolius pickersgillli)* and Vulnerable Natal Leaf-Folding Frog (*Afrixalus spinifrons.*

Photo courtesy R. Edwards, Eco-Pulse

8.8.11.2 Planning

The following information would be required at the outset of detailed offset planning, to inform detailed design and implementation of the offset wetland rehabilitation activities, namely:

i. Land acquisition – the erven indicated in Figure 8.22 must be acquired and their future use for conservation purposes only must be secured by the permanent declaration of the wetlands sites as Nature Reserves or areas of similar effective conservation status;
ii. Topographical survey – the affected sites must be surveyed, to inform detailed planning and costing of earthworks and allocations of cut-and-fill within the site;
iii. Assessment of upstream hydrology and geohydrology – a detailed hydrogeological study must be undertaken to establish the likely volume of flows that would be dewatered from the desalination plant site upslope, and other flows likely to pass into the offset wetland sites (e.g. road runoff and stormwater flows from the development site, particularly once site hardening has taken place); in addition, surface/groundwater interactions and depth to groundwater on the offset site must be considered to guide site earthworks and landscaping;
iv. Detailed design of the system of infiltration trenches – these must be designed taking into account the information generated in tasks (i) and (ii), and with the specific intention of ensuring adequate water supply into the three offset wetland areas identified. The infiltration trench(es) should be designed to be installed as close to the M4 as is technically feasible and should consider the need for access for maintenance in their design and placement;
v. The routing, depth and design of the offtake pipelines from the sea, leading to the desalination site must be determined, and ideally these pipes should be installed after initial earthworks on the rehabilitation site, but before fine landscaping and planting, and taking cognisance of the required topographical profile / need to create shallow depressions on the offset sites;
vi. A flood study must be undertaken (possibly as part of the stormwater management plan for the development site) which assesses offset site hydrology and informs the detailed design of downstream outlet structures and risk of flooding of adjacent developments and/or South Beach Road as a result of wetland rehabilitation activities;
vii. Detailed engineering design of the outlet structures must take place, taking into account the above information, and should aim to facilitate, possibly through the construction of upstream drop-inlet structures, the shallow permanent pooling of water (300 -500mm deep) across a wide, relatively flat (but gently shaped to create vertical habitat structure through plant zonation) wetland marsh, up to the toe of the slope – the position of this toe may be reworked during site earthworks (see below);
viii. Engineering design should consider the need for a berm along the upslope edge of South Beach Road to prevent flooding as a result of increased ponding of water upstream, and such information should be considered in berm design, which would also need to consider availability of material on the site created by excavation – such material (excluding plant material) should be used on the site for the construction of the berm as well as for shaping into the steep hillslopes leading to the planned depressional wetlands;
ix. Establishment of a nursery for the propagation of large numbers of the required indigenous wetland and buffer plant species during the above planning activities would improve rehabilitation efficiency and probably reduce costs.

8.8.11.3 Site preparation

Initial site preparation should entail:

i. Removal of existing infrastructure (pumps, pump houses etc)
ii. Alien removal –
    a. All alien vegetation on the site must be removed, with the most pervasive probably being Napier Fodder and lantana;

b. Alien removal must take place before major earthworks, reshaping and planting;
c. The use of machinery to remove alien plants should however be considered, particularly in the case of Napier Fodder;
d. A local alien removal specialist should provide detailed recommendations in this regard and oversee alien clearing activities;
e. Cleared alien plant material to be disposed of legally such that it will not spread propagules;
f. A follow-up alien seedling removal programme must be developed and initiated once initial clearing has been completed;
g. An accessible portion of the terrestrial / buffer section of the offset area must be selected for temporary stockpiling of spoil, plants, vehicles and for the location of temporary worker camps and refuelling areas – this area must be:
    i. Outside of any wetland area;
    ii. Readily accessible from the road;
    iii. Managed in terms of standard Best Practice in construction activities, with attention paid to bunding of refuelling areas, provision of temporary washing and ablution areas that will not contaminate wetlands or other natural areas;
    iv. Rehabilitable after initial rehabilitation implementation;
h. An Environmental Control Officer or similar designation must be appointed to oversee the rehabilitation works from an environmental perspective – this officer must consult a wetland ecologist and/or botanical specialist in the event of any uncertainty regarding rehabilitation implementation, and on a regular basis to ensure that rehabilitation outcomes are in accordance with the required offsets;

8.8.11.4 Major earthworks and shaping

i. Re-shaping of the rehabilitated wetland must be guided by the topographical survey and, it is recommended, by the excavation of at least one test pit to 3m depth on the flat lower basin section of each wetland;
ii. While the extent of excavation can be mapped roughly prior to the start of works, it should also be overseen on site by a wetland ecologist, so that the required heterogeneous topography can be obtained to mirror the required wetland template;
iii. Earthworks should aim to:
    a. Fill in / reshape all trenches and surface channels through the site, including down the dune slopes;
    b. Remove any waste / undesirable sludges in existing irrigation ponds;
    c. Extend the extent of shallow inundation of the depression across the basin – creation of excess fill can be avoided by the inclusion of raised drop-inlet structure at the outlets of the wetlands;
    d. Excess soil to be used in the construction of the berm and shaped into the wetland margins to create a transition between the wetland and abutting terrestrial areas;
    e. The permanent wetland habitat must give way to shallowly seasonally inundated to saturated margins, suitable for vegetation by *Phragmites australis* and other dense emergent wetland plants – care must be taken to allow at least a 5m band of such seasonal vegetation between the edge of the permanent marsh and the toe of the dune, to prevent slumping;
iv. Construction of the infiltration trenches, outlet structures and berms should be to engineering specifications – the first two of these activities should ideally precede the major earthworks and reshaping.

8.8.11.5 Planting

Planting of the rehabilitated wetlands must be at a scale that will create at least 80% cover of desirable vegetation (see Table 8.22) across the sites by the end of the third year after the start of rehabilitation works.

The plant species listed in the table below, at the recommendation of a botanical specialist (Appendix C) must be used as the basis for plant selection. Additional locally indigenous species suitable to the required vegetation type may be included, provided a local botanical specialist approves of their inclusion beforehand.

Planting must aim to mirror natural wetland conditions, rather than to create a landscaped park, and placement of plants must be done with this in mind.

Note that the plant species listed in the table below include species suitable for establishment in buffer areas – the calculation of the potential wetland gains entailed in the wetland rehabilitation assume that the buffer areas will have a high level of function, and they would thus need to be landscaped and planted with care to emulate natural areas.

Table 8-21: Recommended plants for inclusion in the rehabilitation of the receiving wetland offsets and their buffers Species as recommended by Eco-Pulse (see Appendix C)

Rehabilitation Wetness Zone	Recommended Plant Species & Abundances
Permanent Wetland	Re-vegetation using sods / plugs of *Phragmites australis* (Common Reed), *Cyclosorus interruptus* (Marsh Fern), *Cyperus prolifer* (Dwarf papyrus), *Leersia hexandra* (Wild Rice) and *Persicaria attenuata*. Relative abundances should be as follows: • *P. australis* - High • *C. interruptus* - High • *C. prolifer* - Low • *L. hexandra* - Low • *P. attenuata* - Low
Seasonal Wetland	Re-vegetation using sods / plugs of *Cyperus dives* (Giant Sedge), *Cyperus latifolius*, Cyperus *sphaerospermus*. *Ischaemum fasciculatum* (Hippo Grass) and *Paspalum scrobiculatum* (Veld Paspalum). Relative abundances should be as follows: • *C. dives* - High • *C. latifolius* - High • *Cyperus sphaerospermus* - Moderate • *Ischaemum fasciculatum* – Moderate • *P. scrobiculatum* – Moderate
Temporary Wetland (Herbaceous)	Re-vegetation by using plugs of *Cynodon dactylon* (Couch Grass), *Imperata cylindrica* (Cottonwool grass) and *Setaria sphacelata var. sericea* (Golden Bristle Grass). Relative abundances should be as follows: • *C. dactylon* – Moderate • *I. cylindrical* – Moderate • *S. sphacelata* - Moderate
Buffer Zones (Grassland)	Re-vegetation by using plugs of *Cynodon dactylon* (Couch Grass).
Buffer Zones (Scrubland and Bushland)	Re-vegetation by using plugs of *Chrysanthemoides monilifera* (Bush Tick-berry) and *Brachylaena discolor* (Coastal Silver-oak). Relative abundances should be as follows:

	• *C. monilifera* – High • *B. discolor* – Moderate Once the scrubland / bushland has been established, planting of desirable tree species should commence to contribute to increased species and habitat diversity. Such species include *Mimusops caffra* (Coastal Red Milkwood). *Allophylus natalensis* (Dune False-currant) and *Clerodendrum glabrum* (Tinderwood). These species should be panted in low to moderate abundances.

8.8.11.6 Signage and information

In order to improve public awareness, and thus the likelihood of long-term accrual of a sense of the ecological importance of the offset wetlands, appropriate signage should be erected following construction, to outline the objectives, background and status of the wetlands.

8.8.11.7 Wetland and buffer area maintenance

Compilation and implementation of a long-term maintenance and management plan for the offset wetlands and their buffer areas is an essential component of ensuring the successful outcomes of the offset plan. Such a plan would be best compiled once the details of the rehabilitated sites are known (i.e. during or after implementation) but financial and institutional allowance must be made for the following maintenance activities, the frequency and exact nature of which would be included in the plan itself:

i. Assignment of responsibility for maintenance costs and actual activities;
ii. Alien clearing activities;
iii. Removal of litter and dumped waste;
iv. Removal of sediment from outlet and inlet structures;
v. Maintenance of the infiltration systems;
vi. Addressing erosion on the site;
vii. Repairs to the berm, when necessary;
viii. Periodic excavation / removal of sediment from depressional wetlands;
ix. Periodic removal of senescent or dead plant material when required;
x. Replanting when necessary;
xi. Minor adjustments to weir or berm height to improve wetland function if necessary.

8.8.11.8 Establishment and vegetation of the ecological corridor along the north eastern development site boundary

The buffer areas calculated as contributing to the final condition of the receiving wetland offsets include the establishment of "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 … outside of the fence line of the development". This corridor is required as essential development mitigation. This corridor should be landscaped and planted in accordance with the plant species and landscape approaches outlined for the offset buffers, noting that the timing of such interventions may differ, as they would be dependent on construction activities on the development site.

8.8.11.9 Rehabilitation assessments / monitoring

The rehabilitated wetland should be assessed by a wetland ecologist at the following intervals following completion of rehabilitation activities:

- On completion;
- After 1 year;
- After 5 years;
- After 10 years;
- Thereafter at 5-10 yearly intervals.

These assessments should include collection and comparison of fixed-point photographs, identification of problem alien invasions or other issues negatively affecting wetland function, and appropriate, comparable assessments of wetland condition and function should be carried out (e.g. WET-Health, WET-Ecosystem Services or other assessment tools as they become available).

It is recommended that a frog specialist should assess the wetlands five years after implementation, and identify their use by any frog species. Recommendations around the suitability and desirability of re-introduction of the target red data frog species should be made by this specialist, and implemented as appropriate.

8.8.12 Offset Conditions

This section outlines the conditions that would need to be agreed on in a written Memorandum of Agreement by the developer, in the event that development was authorised conditional to the wetland offsets outlined here. Details regarding the following issues at least would need to be included:

- Signed documents (Umgeni Water and landowners) indicating Intention to Purchase the required erven in which the offset wetlands and their buffers would be located
- Rehabilitation time frames:
    - A maximum period of three years including planning is considered adequate to allow for the initial rehabilitation activities – this time line would need to commence prior to the start of construction activities on the site, with design and construction of the infiltration trenches being required as part of development planning and construction;
    - The wetland offsets and their buffers must demonstrably reach their required condition (RES Category C or better) within a time frame of 7 years after completion of construction;
    - The wetland offsets must be maintained in their required condition throughout the operational phase of the development - in the (likely) event that decommissioning of the plant does not result in the rehabilitation of wetlands on the site to a PES Category C, then the burden of offset management should be ceded to the next developer of the erf;
- The offset wetlands must be secured into the future through their permanent declaration as Nature Reserves or areas of similar effective conservation status;
- Details of financial arrangements to allow for the initial purchase, rehabilitation and long-term management of the site must be provided;
- Details of arrangements for ensuring the independent monitoring / auditing of the outcomes of the offset plan must be outlined;
- The applicant must indicate a clear understanding that the implications of failure to achieve the required level of offset (i.e. the gains in ecosystem conservation targets) would require additional offset activities to be pursued in the future.

8.8.13 Identifying Risks to meeting offset requirements

The fact that the offset proposes rehabilitation of extant rather than creation of new wetlands means that the risk of offset failure is reduced (Macfarlane et al 2016). Nevertheless, a number of risks to achieving the required level of offset have been identified, and should be considered:

- Failure to secure all of the relevant erven required for the offsets – several of the cultivated plots along South Beach Road were for sale in May 2018, and if they are purchased and developed, notwithstanding the presence of wetlands on these erven, they would no longer be available as viable offset sites;
- The wetlands are already fragmented and highly degraded – the scale and costs of the required interventions should not be underestimated;
- Invasion by alien vegetation will be an ongoing issue that will require ongoing interventions – if management does not address this issue, the wetlands will not reach their required condition;
- Financial failure of the development could jeopardise the long-term sustainability of the wetland offsets – a funding stream must be ring-fenced to ensure that wetland losses that are incurred at the outset of development are adequately and permanently offset from the time they are lost.

8.8.14 Approaches in the event that the identified offset site cannot be secured

In the event that the required wetland erven cannot be purchased to achieve the required wetland offset, consideration of other receiving offset sites would need to be made, and a new Offset Plan developed that met the offset targets specified in this report.

8.8.15 Risk assessment for offset implementation

Inherent in the rehabilitation plan for the proposed offset are activities that, despite their intended positive outcomes, constitute water uses in terms of Section 21c and I of the NWA. In order to guide DWS officials as to the degree to which different Section 21c and i water uses constitute significant negative threats to the water resource, the DWS has developed a Risk Assessment Matrix, for compilation by a SACNASP registered aquatic specialist. Section 21c and i water uses that are assessed as being of a Low Risk, using the Assessment Matrix, are considered Generally Authorised in terms of GN509, and require only Registration of Use, prior to implementation, rather than consideration through a full water use licence.

A Risk Assessment Matrix was compiled for the Section 21c and i water uses associated with the proposed rehabilitation of the receiving offset wetlands, where these uses are defined in the NWA as (21c) "impeding or diverting the flow of water in a watercourse" and (21i) "altering the bed, banks, course or characteristics of a watercourse".

Table 8.22 presents the outcomes of this assessment. Implicit in the assessment is that the rehabilitation activities would be carried out in accordance with the specifications outlined in Section 8.8.11 and under the further control of a construction phase management programme, developed to reduce construction-associated risk.

The table shows that both the Construction Phase Risks and the Operational Phase Risks would be LOW – this said, it is also noted that the DWS Risk Assessment Matrix is poorly developed for application to positive changes in key wetland drivers, and thus the assessment is inevitably skewed towards a more negative outcome in a rehabilitation scenario than is probably the case.

Table 8-22: DWS Risk Assessment of Section 21i activities potentially affecting the receiving offset wetlands as a result of planned rehabilitation activities, to meet offset targets
Impacts assume implementation of rehabilitation plan outlined in Section 8.8.11.

Risk Matrix completed by Liz Day -SACNASP Reg no. 400270/08

Impact #	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph +Vegetation)	Biota	Severity	Spatial scale	Duration	Conseq.	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Signif.	Risk Rating	Control Measures	Watercourse Type
1	Design and Construction	Installation of infiltration trenches upstream of the rehabilitation site	Spreading of flows (i.e. diversion) into the receiving rehabilitating wetland	Improved wetland function asnd expansion of wetland habitat, as well as reduced concentration of flows from the wetland	1	1	1	1	1	2	2	5	2	1	5	2	10	50	L	Compilation and implementation of a construction phase environmental management programme as outlined in Section 8.8.11, overseen by an experienced ECO (or similar designation) , with allowance for at least weekly site inspecctions, and full implementation of the rehabilitation requirements outlined in Section 8.8.11; and 8.8.12	Offset receiving wetlands RA1, RA2 and RA3 as well as identified buffer areas
2		Installation of drop structures or similar at the outlet of the wetlands upstream of South Beach	Upstream impoundment	Improved wetland condition - provision of habitat for endangered wetland fauna	1	1	1	1	1	2	2	5	2	1	5	2	10	50	L		
3		Construction of berms at the downstream end of the offset wetlands	Containment of flood flows and reduced access to downstream areas	Support of required depressional wetland and seasonal wetland areas	1	1	1	1	1	2	2	5	2	1	5	2	10	50	L		
4		Earthworks on wetland areas to rehabilitate wetland ecosystem type - depressional wetlands	Largescale disturbance of wetland areas	Compaction, sedimentation and disturbance of wetland areas	1	2	2	2	1.75	1	2	4.75	2	2	5	2	11	52.25	L		
5		Use of machinery on site, as well as proximity of worker camps, stockpile areas etc	Potential for contamination of soils or runof as a result of the passage of oils, fuel, sediment or other waste into the offset wetlands or their buffer areas	Negative - affecting fitness of areas for rehabilitation	1	2	2	2	1.75	1	2	4.75	2	2	5	2	11	52.25	L		
6	Operational	Maintenance of wetland habitat	Periodic dredging of accumulated sediment / other waste and vegetation from wetland areas as well as culverts and infiltration structures	Positive - maintenance of required permanent and seasonal wetland habitat and buffer areas with short-term disturbance	1	2	1	1	1.25	2	1	4.25	2	2	5	2	11	46.75	L		

8.9 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 powerlines 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, and in addition represent wetland types identified as Critically Endangered (despite their high level of modification) in the national biodiversity assessment (Nel and Diver 2012), as well as being "special habitats" on the current site, which includes much larger wetland seeps than in most other similar albeit impacted other sites. The loss of these wetlands to the proposed development would thus 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. The conceptual details of this rehabilitation have been calculated as a formal offset that allow for their rehabilitation to a PES Category C or better. Alternatively, engagement with eThekwini Municipality officials involved in the offset process could highlight feasible or strategically preferable alternatives that are in line with the municipality's strategy to consolidate offset areas (Macfarlane 2015). Both this process and its successful resolution would however 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 of this specialist that project implementation could not proceed.
- 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 (Lake Victoria) associated with the Initial alignment is considered an outright no-go proposition, and no offset mitigation would compensate for its authorization. In addition this alignment would also traverse the approve KSIA biodiversity offset. Based on the above, the Initial alignment for the proposed powerline is considered **fatally flawed**.

- The required crossing of the Mdloti River estuary by the proposed powerline (Alternative 2) and pipeline (Alternative 1): although the physical impacts of crossing of this estuary with its wide floodplain wetlands and inflowing valley bottom / seep wetlands are considered essentially mitigable to a high degree, the area itself forms part of an offset receiving area, and as such ought in theory not to be further impacted by any such developments. The proposed alignments do however fall close to the N2, thus consolidating infrastructure impacts, and mitigation measures further require additional rehabilitation of two 30m consolidated corridors along these alignments.

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 powerlines 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 offsets have been strongly recommended by this specialist, given the limited options for mitigation against the loss of wetlands on the proposed desalination plant site, and the resultant significant (medium to high) residual impacts that would be associated with the proposed development of the site.

8.10 REFERENCES

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8.11 APPENDIX A

This section presents, for continuity, the assessments of pipeline and powerline alternatives as presented in the previous Final specialist EIR, which have since been excluded as a result of identified "fatal flaws".

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 (Initial powerline alignment)

At the time of this report, the Initial alignment of the proposed transmission line from La Mercy substation was conceptual only. Nevertheless, the route as plotted in Figure 8-A1 shows that it would pass across 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, in the reaches beset with tall eucalypts.

Figure 8-A1: 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 proposed crossing point of the Initial powerline 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. 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.

Photo Z

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

At the time of the (first) site visit, the river in these reaches comprised a broad channel, choked with dense *Phragmites australis* reeds (see Photo Z), 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.

Lake Victoria and associated wetlands

The Initial powerline route would cut across the Lake Victoria wetland resulting in the installation of transmission line support structures within the wetland (given that the crossing length exceeds the maximum distance of 600m between support structures) to allow a total crossing length of some 730m of wetland. 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.

This wetland feeds into the Mdloti River in the vicinity of the Mount Moreland access road bridge (see Figure 8-A2 and Photo Z) and 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) notes that the outlet of the wetland is choked by balloon vine, cannas, lantana and Triffid weed.

Figure 8-A2: Proposed 132 kV powerline alignment 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 Appendix B, 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.

Given the importance of the Lake Victoria wetland habitat, and the high sensitivity of its fauna (particularly red data frog species) to physical impacts affecting an extensive zone of wetland, the proposed crossing of the Mount Moreland wetland by the Initial 132 kV transmission line has been assessed as an outright no-go proposition, and no offset mitigation would compensate for its authorization. Passage of the Initial transmission line across the wetland was therefore considered **a fatally flawed impact**.

A proposed amendment to the Initial alignment was identified and is indicated conceptually in Figure 8-A3, which avoids the Lake Victoria wetlands and roughly follows the road alignment. In September 2016 however, DEA rejected the proposed amended alignment as it traverses the new offset Conservation Area for the King Shaka Airport and therefore also constitutes a **fatal flaw** (Figure 8.A3).

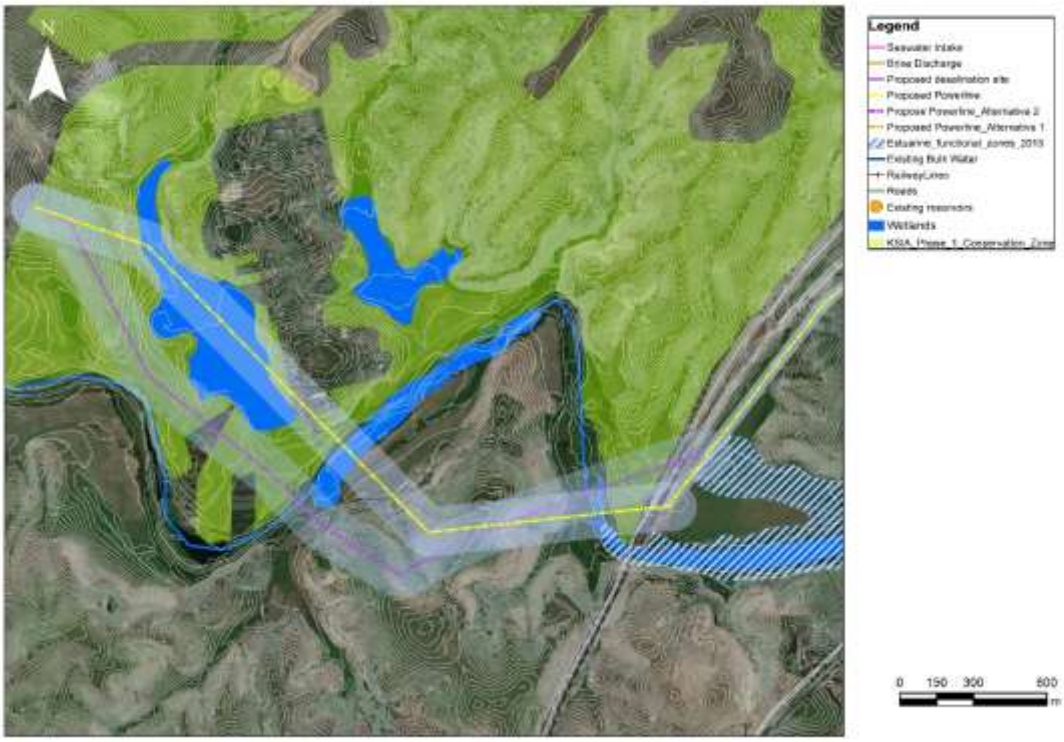

Figure 8-A3: Proposed Alternative 1 powerline route (purple line) avoiding Lake Victoria wetlands and crossing Mdloti River further upstream. Route to be ground-truthed.

An alternative route (**<u>Alternative 2</u>**) was thus proposed, that would avoid the important Mount Moreland wetland areas as well as the KSIA biodiversity offset. Hence, the Initial alignment for the proposed powerline (see Figure 8.A3) has not been assessed further in this report.

8.12 APPENDIX B

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

IMPORTANCE CLASS (ONE OR MORE ATTRIBUTES MAY APPLY)	RANGE OF MEDIAN	WETLAND IMPORTANCE CLASS
Low/marginal Representative of wetlands that: • contain large areas of coarse (reeds) wetland vegetation with minimal floral and faunal diversity; • have a high urban watershed:wetland area ratio; • are important for active and passive recreation; • provide moderate to high levels of hydraulic buffering; • may be eutrophic and generally insensitive to further nutrient loading; • are generally insensitive to changes in hydrology, patterns of inundation, discharge rates and/or human disturbance; • have regulated water; and • 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.

8.13 APPENDIX C

Botanical Input into plant selection at the proposed offset receptor wetland sites discussed in Section 8.8

08 May 2018

eco-pulse
environmental consulting services
26 Mallory Road, Hilton
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ATTENTION: Ms Liz Day
Freshwater Consulting cc

Email: liz@freshwaterconsulting.co.za

Dear Liz

SPECIALIST WETLAND REHABILITATION PLANTING ADVICE FOR THE WETLAND OFFSET FOR THE PROPOSED TONGAAT DESALINATION PLANT IN THE ETHEKWINI MUNICIPALITY, KWAZULU-NATAL

1. Project Locality & Background

The applicant intends to establish a desalination plant within a depressional valley head landform on the frontal dune at Desainager Beach in the suburb of Desainager in the eThekwini Municipality. The depressional landform within which the facility will be established hosts an extensive seep wetland that will be destroyed as part of the project. The proposed loss of the wetland is considered a significant residual impact that requires offsetting. The location of the proposed project is shown as the yellow polygon in Figure 1 below.

The Freshwater Consulting Group (FCG) have been appointed by the applicant to prepare the wetland offset plan for the proposed project. Ms. Liz Day of FCG in consultation with the eThekwini Environmental Planning & Climate Protection Department (EPCPD) have identified a number of small seep wetlands within the vicinity of the project site on the frontal dune that could be rehabilitated and secured as part of the wetland offset, as shown as the light blue polygons in Figure 1 below.

Figure 1. Locality of the proposed desalination plant and potential offset wetland sites.

As part of FCG's appointment, Eco-Pulse have been appointed to provide advice on the wetland plant species to be used in the active re-vegetation of the wetland offset site. This short letter provides such advice.

2. Recommended Plant Species Composition and Abundance

As discussed with Ms Liz Day onsite, it was decided that the desired ecosystem / habitat type of the offset wetlands to be rehabilitated and secured is permanent herbaceous wetland dominated by local emergent wetland plant species, and which could provide suitable habitat for a population of Pickersgill's Reed Frogs (*Hyperolius pickersgilli*). It is also desirable that the core of the wetland be fringed by a narrow seasonal zone to contribute to increased habitat diversity. To promote the re-establishment of permanent wetland, engineered rehabilitation control structures will need to be established to set the longitudinal gradient of the wetland(s). Basin widening and reshaping would also likely be required to maximise permanent wetland area. Furthermore, hydrological modelling would also be required to confirm whether permanent wetland conditions could be established i.e. whether there is enough water to sustain permanently saturated soil conditions from the catchment. In light of these assumptions, the recommended planting species composition and qualitative abundances for each wetness zone is provided in Table 1 below.

Table 1. Preliminary wetland planting palette.

Rehabilitation Wetness Zone	Recommended Plant Species & Abundances
Permanent Wetland	Re-vegetation using sods / plugs of *Phragmites australis* (Common Reed), *Cyclosorus interruptus* (Marsh Fern), *Cyperus prolifer* (Dwarf papyrus), *Leersia hexandra* (Wild Rice) and *Persicaria attenuata*. Relative abundances should be as follows: • *P. australis* - High • *C. interruptus* - High • *C. prolifer* - Low • *L. hexandra* - Low • *P. attenuata* - Low
Seasonal Wetland	Re-vegetation using sods / plugs of *Cyperus dives* (Giant Sedge), *Cyperus latifolius*, Cyperus *sphaerospermus*. *Ischaemum fasciculatum* (Hippo Grass) and *Paspalum scrobiculatum* (Veld Paspalum). Relative abundances should be as follows: • *C. dives* - High • *C. latifolius* - High • *Cyperus sphaerospermus* - Moderate • *Ischaemum fasciculatum* – Moderate • *P. scrobiculatum* – Moderate
Temporary Wetland (Herbaceous)	Re-vegetation by using plugs of *Cynodon dactylon* (Couch Grass), *Imperata cylindrica* (Cottonwool grass) and *Setaria sphacelata var. sericea* (Golden Bristle Grass). Relative abundances should be as follows: • *C. dactylon* – Moderate • *I. cylindrical* – Moderate • *S. sphacelata* - Moderate
Buffer Zones (Grassland)	Re-vegetation by using plugs of *Cynodon dactylon* (Couch Grass).
Buffer Zones (Scrubland and Bushland)	Re-vegetation by using plugs of *Chrysanthemoides monilifera* (Bush Tick-berry) and *Brachylaena discolor* (Coastal Silver-oak). Relative abundances should be as follows: • *C. monilifera* – High • *B. discolor* – Moderate

	Once the scrubland / bushland has been established, planting of desirable tree species should commence to contribute to increased species and habitat diversity. Such species include *Mimusops caffra* (Coastal Red Milkwood). *Allophylus natalensis* (Dune False-currant) and *Clerodendrum glabrum* (Tinderwood). These species should be panted in low to moderate abundances.

With regards to the above planting palette, the following assumptions have been made and will need to be clarified:

1. The planting methods and densities still need to be confirmed, which could have an influence on the recommended composition and abundances.
2. The use of plugs and sods is economically feasible for the project.
3. All recommended species and the required quantities can be propagated by local nurseries.
4. That the species sourced will be from the coastal zone only.
5. The selected nurseries will be able to propagate and grow the required species within mediums that are similar that present onsite.
6. At this stage it is unclear whether it is more desirable to establish scrubland and bushland or grassland as the buffer zone. This will depend on what is feasible from a management perspective and what the alien plant invasion risks are. For this reason a functional and practical planting palette has been recommended. In this regard, it is recommended that a coastal zone re-vegetation specialist provide comment on the most desirable planting palette for the buffer zone.

3. Conclusion

I thank you for the opportunity of submitting this wetland re-vegetation planting advice. Please do not hesitate to contact me if you require any additional information.

Yours faithfully,

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