Rehabilitation of the Orlando Dam, Soweto
City of Johannesburg

Vegetation Assessment

Date: January 2020

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Indemnity

This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information at the time of study. Therefore, the author reserves the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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The Environmental Impact Assessment Regulations (Government Notice No. R982 of 4 December 2014), requires that certain information is included in specialist reports. The terms of reference, purpose of the report, methodologies, assumptions and limitations, impact assessment and mitigation (where relevant to the scope of work) and summaries of consultations (where applicable) are included within the main report. Other relevant information is set out below:

Expertise of author:

- Working in the field of ecology, and in specific vegetation related assessments, since 2007;
- Is registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions in the field of ecology (Reg. No. 400019/11); and
- Has been working with plants indigenous to South Africa since 1997.

Declaration of independence:

Dimela Eco Consulting in an independent consultant and hereby declare that it does not have any financial or other vested interest in the undertaking of the proposed activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998). In addition, remuneration for services provided by Dimela Eco Consulting is not subjected to or based on approval of the proposed project by the relevant authorities responsible for authorising this proposed project.

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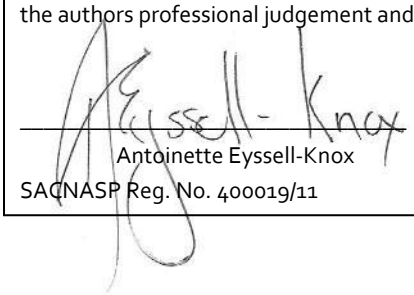
Dimela Eco Consulting undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) and will provide the competent authority with access to all information at its disposal regarding the application, whether such information is favourable to the applicant or not.

Based on information provided to Dimela Eco Consulting by the client, and in addition to information obtained during the course of this study, Dimela Eco Consulting present the results and conclusion within the associated document to the best of the authors professional judgement and in accordance with best practise.



_____ ____2020.02.25_____

Antoinette Eyssell-Knox Date

SACNASP Reg. No. 400019/11

COMPLIANCE WITH THE APPENDIX 6 OF THE AMENDED 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R326	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix E
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Preceding page and separate provincial document
c) an indication of the scope of, and the purpose for which, the report was prepared;	1. Introduction -p1
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	2 Methodology
e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	2 Methodology
f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	5 Vegetation Vulnerability / Sensitivity – p24
g) an identification of any areas to be avoided, including buffers;	5 Vegetation Vulnerability / Sensitivity – p24
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 9 Sensitivity map – p26
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	1.2 Assumptions – p2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	6. Impact assessment – p28 7. Conclusion – p41
k) any mitigation measures for inclusion in the EMPr;	6. Impact assessment – p28
l) any conditions for inclusion in the environmental authorisation;	6 Impact assessment -p28
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	6. Impact assessment – p28 7. Conclusion – p41
n) a reasoned opinion- i. as to whether the proposed activity or portions thereof should be authorised; and ii. if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	7. Conclusion – p41
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	NA
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	NA
q) any other information requested by the competent authority.	-

EXECUTIVE SUMMARY

The Orlando Power Station Dam is registered with Department of Water and Sanitation (DWS) as a Category II Dam with a "Small" size classification and a "Significant" hazard rating. The "Significant" hazard rating is due to the presence of the main road bridge immediately downstream of the dam and the housing developments further downstream and adjacent to the dam. Previous dam safety inspection reports, including the latest one from 2019 recommended that the following rehabilitation measures be implemented to ensure the continued safe functioning of the dam:

- Repair/replace and strengthen displaced, damaged and missing interlocking Armorflex blockwork on the training walls of the Auxiliary Spillway.
- Backfilling of the trench along embankment crest. This can be temporary measure until the NOC has been reconstructed to currently accepted engineering standards for embankment dams.
- Rehabilitation and/or total reconstruction of the upstream face of the embankment from a level below where benching has commenced to NOC level and protected with properly designed riprap.
- Rehabilitation and/or total reconstruction of the upper 1.8 m (at least) of the NOC of the embankment.
- Rehabilitation and/or total reconstruction of the downstream face of the embankment with a blanket chimney drain and backfill of imported embankment to reinstate the downstream face of embankment to design slope of 1.0V:2.0H.
- The right-hand training wall of the Auxiliary Spillway should be raised to NOC level and extended in a downstream direction.
- Rehabilitation of the 600 mm diameter outlet pipe and control valve.

The Works will essentially be rehabilitating of the existing structures. Reconstruction of the embankment crest might result in a nominal increase in height of the embankment. The existing spillway crest levels will remain as it is currently. The water level in the reservoir will therefore remain unchanged. The upgrades to the spillway will repair the damaged lining. The spillway capacity will unchanged.

Dimela Eco Consulting was appointed by Envirolution Consulting to determine whether any sensitive vegetation communities or threatened and protected plant species will be affected by the proposed rehabilitation of the Orlando Dam wall, as well as to recommend rehabilitation measures to ensure that the area is colonised by suitable indigenous vegetation post construction.

This vegetation investigation involved desktop studies, a site visit, review of aerial imagery and a report indicating amongst others:

- Data from existing literature and spatial layers (GIS and aerial images) with regards to the site (includes vegetation maps, threatened ecosystems, and the Gauteng Conservation Plan);
- Review of existing information, data collected on site and aerial imagery;
- Short list of any plant species of conservation concern (threatened and protected species) that have historically been recorded within the area that the dam is situated in and rate the probability of these species still occurring on the site based on the presence of suitable habitat and degree of past or current vegetation and soil disturbances;
- Map highlighting potential areas of vegetation importance, if present; and
- Assessment of potential impacts of the proposed development on sensitive vegetation – if found to be present.
- Recommendations to ensure indigenous vegetation colonise the disturbance footprint post construction.

Limitations and assumptions exist, but none are regarded as fatal flaws or lowers the confidence level of the results. The site visit took place on the 21st of January 2020, after enough summer rains. This assessment relied on a literature survey (including two historic reports for the site), a site visit and reporting.

The Orlando Dam is situated within Soweto, directly south of the defunct Orlando Power Station and the well-known Soweto Towers (City of Johannesburg). The dam falls between the residential areas of Nancefield in the south-west and in Masopha in the north. Mbambisa Road (constructed in 2011) traverses the wetland downstream of the Orlando Dam. The dam falls within the quarter degree square 2627BD.

The dam is situated within the Diepkloofspruit that enters the dam from the south. Another non-perennial river enters the dam from the east. The site is situated in the Soweto Highveld Grassland vegetation type that is classified as Endangered. According to the Gauteng Conservation Plan the Orlando Dam forms part of an Ecological Support Area (ESA) and surrounding grassland and moist fall within a Critical Biodiversity Area (CBA): Important.

Historical Google Earth aerial imagery show that the vegetation around the dam has been disturbed continuously over time. Other than the historic activities of the Orlando Power Station, the construction of Mbabisa Road, sewerage leaks, grazing and dumping modified the landscape. At the time of the site visit, cattle, goats and sheep grazed the site. The invasive lawn, *Pennisetum clandestinum* (kikuyu) invaded the moist soils north of the dam wall. Most of the vegetation north of the dam wall where the rehabitlation activities are proposed, comprised weedy exotic and invasive plant species. The soil on the dam wall was destabilised and several ditches and dumping noted downstream of the wall.

The historic reports for the site that was assessed as part of the literature survey (2004 and 2009) stated that the vegetation on the site was severely degraded and disturbed. Since the drafting of the historic reports that was assessed (2004 and 2009), the site vegetation has remained in a degraded state while numerous additional weeds have since colonised the site.

Most of the vegetation that will be impacted on by the dam rehabilitation was classified as moderately to severely modified form the reference state of Soweto Highveld Grassland, with a high frequency of alien invasive plant species. The vegetation was mapped to a 100m buffer around the project area as follows:

Broad vegetation community	Importance and vulnerability	Gauteng Conservation Plan Category	Main mitigation measures
Watercourse vegetation	**Medium**	**ESA and CBA**	• Development within these areas could proceed with limited impact to sensitive vegetation, provided that appropriate mitigation measures are taken. • High impact developments should be considered with caution, if at all. Development must be restricted in footprint and impacts managed and mitigated by an approved management plan. Edge effects to higher sensitivity classes in its proximity must be mitigated / prevented. • Remove alien invasive plant species prior to construction. • Limit soil disturbances and the use of heavy machinery • Rehabilitate using indigenous plant species and monitor the success of rehabilitation for at least three years
Moist grassland-modified	**Medium**	**ESA and CBA**	
Modified grassland	**Low-medium**	**Portions fall within an ESA**	• Developable areas that are connected to sensitive features. • Edge effects must be presented.
Built-up and gardens	**Low**	-	• Most types of development can proceed within these areas with little to no impact on conservation worthy vegetation. • Edge effects to other proximate sensitivity classes must be mitigated / prevented.

The proposed dam rehabilitation offers the opportunity to clear invasive species from the moist grassland, thereby preventing its spread downstream and re-establishing indigenous species. From a vegetation perspective, the project could have a positive impact if mitigation measures are properly implemented.

TABLE OF CONTENTS

EXECUTIVE SUMMARY ii
1. INTRODUCTION 1
1.1 Terms of reference 2
1.2 Assumptions and Limitations 2
2. Methodology 3
2.1 Literature Review 3
2.2 Field survey 3
2.3 Mapping 3
2.4 Sensitivity Analysis 4
3. BACKGROUND TO THE STUDY SITE 4
3.1 Locality 4
3.2 Hydrology and Topography 4
3.3 Overview of historic vegetation type 7
3.4 Listed Ecosystems 7
3.5 Gauteng Conservation Plan 8
3.6 Gauteng Ridges 8
3.7 Land Use and Disturbances 8
4. RESULT OF THE ASSESSMENT 16
4.1 Vegetation Survey Overview 16
4.1.1 Watercourse vegetation 16
4.1.2 Moist grassland 19
4.1.3 Modified grassland 20
4.2 Plant Species of Conservation Concern 22
4.3 Protected plants 22
4.3.1 NEMBA Threatened or Protected Plant Species (TOPS) 22
4.3.2 Provincially Protected Plants 23
4.4 Alien Invasive Plant Species 23
5. VEGETATION VULNERABILITY AND IMPORTANCE 26
5.1 Rating and Analysis of Vegetation Importance 26
5.2 Discussion 29
5.2.1 Vegetation of Medium sensitivity 29

5.2.2 Vegetation of Low medium sensitivity 29
5.2.3 Vegetation of low sensitivity 29
6. IMPACT ASSESSMENT AND MITIGATION 29
6.1 Assessment Criteria 30
6.2 Impact Assessments 31
6.2.1 Clearing / degradation of vegetation 31
6.2.2 Destruction or degradation of vegetation associated with the moist grassland 33
6.2.3 Bare soils post construction 35
6.2.4 Potential increase in invasive vegetation 38
6.2.5 Removal of alien invasive vegetation 39
6.2.6 Clearing of land for construction camps and potential pollution of the soil and water 40
6.2.7 Exposure to erosion and subsequent sedimentation or pollution of proximate watercourses 42
7. CONCLUSION 43
8. REFERENCES 44
9. GLOSSARY 46
APPENDIX A: Vegetation Sensitivity Evaluation 49
APPENDIX B: PLANTS SPECIES RECORDED 52
APPENDIX C: PLANTS OF CONSERVATION CONCERN 60
APPENDIX D: ALIEN INVASIVE PLANT GUIDELINES 62
APPENDIX E: SPECIALIST QUALIFICATIONS 78

TABLES

Table 1: Typical species occurring in the Soweto Highveld Grassland (Mucina and Rutherford, 2006) 7
Table 2: Category 1b alien invasive species recorded on and around the site 24
Table 3: Weighting scores 26
Table 4: Scoring of vegetation around the Orlando Dam 26

FIGURES

Figure 1: Locality map forOrlando Dam 5
Figure 2: Hydrology of the area within which the dam is situated 6
Figure 3: The site falls within the historic extent of the Soweto Highveld Grassland 10
Figure 4: As per the Gauteng Conservation Plan, the Orlando Dam forms part of an ESA and CBA: Important 11
Figure 5: The Orlando Dam is situated in proximity to Class 2 ridge 12
Figure 6: Google Earth aerial imagery of the dam and surrounding vegetation from 2000, 2004, 2006, 2010, 2011 and 2019 show the continuous soil disturbances around the dam over time 13
Figure 7: Vegetation groups within 100m around the dam. 17
Figure 8: Threatened species and species of conservation concern 22
Figure 9: Sensitivity of the vegetation within a 100m of the dam 28
Figure 10: Sample map 49

PHOTOGRAPHS

Photograph 1: a) Cattle grazing the vegetation north of the dam wall and b) kikuyu sods harvested from site 14
Photograph 2:a) Bare soils on the dam wall, b) eroded dam wall and c) vegetation north of the dam wall- ditches and invasive plant species were common. 15
Photograph 3: a) *P australis* in the pond underneath the dam overflow north of the dam wall, b) *P australis* in the spillway, c) around the dam and d) at the inflow of the Diepkloofspruit at Chris Hani Road. 18
Photograph 4: a) *Typha capensis* patches west of Sheffield Road and b) invasive species dominated vegetation east of the Sheffield Road 19
Photograph 5: Alien invasive species dominate the moist grassland a) west of Mbambisa Road, b) and c) along the dam wall and north-west thereof 20
Photograph 6: Modified grassland downstream of the dam wall a) west of Mbambisa Road, b) east of the road c) on top of the dam wall (dominated by *Cynodon dactylon)* and d) modified grassland just north of Chris Hani Road. 21

1. INTRODUCTION

The Orlando Power Station Dam is registered with Department of Water and Sanitation (DWS) as a Category II Dam with a "Small" size classification and a "Significant" hazard rating. The "Significant" hazard rating is due to the presence of the main road bridge immediately downstream of the dam and the housing developments further downstream and adjacent to the dam. Previous dam safety inspection reports, including the latest one from 2019 recommended that the following rehabilitation measures be implemented to ensure the continued safe functioning of the dam:

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1.1 Terms of reference

This vegetation investigation involved desktop studies, a site visit, review of aerial imagery and a report indicating amongst others:

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- Short list of any plant species of conservation concern (threatened and protected species) that have historically been recorded within the area that the dam is situated in and rate the probability of these species still occurring on the site based on the presence of suitable habitat and degree of past or current vegetation and soil disturbances;
- Map highlighting potential areas of vegetation importance, if present; and
- Assessment of potential impacts of the proposed development on sensitive vegetation – if found to be present.
- Recommendations to ensure indigenous vegetation colonise the disturbance footprint post construction.

1.2 Assumptions and Limitations

The following limitations and assumptions exist, but none are regarded as fatal flaws or lowers the confidence level of the results.

- Vegetation studies should be conducted during the growing season of all plant species that may potentially occur. Threatened species are usually also cryptic species that are easily overlooked when not in flower. This assessment relied on a site visit undertaken on 21 January 2020 after good rains fell.
- The grassland around the Orlando Dam was grazed and are regularly mowed along road verges. This hampered the positive identification of certain species.
- The potential occurrence of plant species of conservation concern was assessed based on the availability of suitable habitat.
- It is assumed that only vegetation downstream, within and directly around the dam will be impacted on and that upstream vegetation will remain intact.
- At the time of the site visit, the general area was assessed as no locality for the rehabilitation activities or construction camps were available.
- Limited information is available about *Lepedium mossi*, a plant species of conservation concern that could be present on the site or surrounds. Not enough is known about the distribution, specific habitat or current population status of this species and its current national status is classified as Data deficient-insufficient information

2. METHODOLOGY

The assessment entailed a literature review which included short listing plants of conservation concern that could potentially occur on or near the pipeline. The methodology used is shortly summarised below.

2.1 Literature Review

The description of the regional vegetation relied on literature from Mucina & Rutherford (2006). Plant names follow Germishuizen *et al* (2006) and the following reference books were used to assist with plant identification: Van Wyk & Van Wyk (1997), Van Wyk & Malan (1997), Pooley (1998), Henderson (2001), Van Oudtshoorn (2002) and Bromilow (2010). Historic reports of the area drafted by Strategic Environmental Focus was also consulted (SEF, 2004 & 2009).

Standardised definitions, as recommended by Lexicon for Biodiversity Planning in South Africa by the South African National Biodiversity Institute (SANBI) were used to describe the state of vegetation and ecological condition (SANBI, 2016).

Natural	Unmodified. No significant changes in composition, structure or function have taken place. Good ecological condition.
Near Natural	Small changes in composition and structure may have taken place, but ecosystem functions are essentially unchanged. Good ecological condition
Semi-natural	Ecological function is predominantly unchanged even though composition and structure have been compromised. Fair ecological condition
Moderately modified	An ecological condition class in which ecological function is predominantly unchanged even though composition and structure have been compromised. Equates to a fair to poor ecological condition
Severely modified	An ecological condition class in which loss of composition, structure and ecological function is extensive. The land is in a poor ecological condition.

2.2 Field survey

A site visit took place on the 21st of January 2020. The field survey data was supplemented with Google Earth aerial imagery.

2.3 Mapping

Mapping has been done by comparing georeferenced ground survey data to the visual inspection of available Google-Earth Imagery and in that way extrapolating survey reference points to the entire study area. Delineations are therefore approximate, and due to the intricate mosaics and often gradual

mergers of vegetation associations, generalisations had to be made. Mapped associations will thus show where a certain vegetation unit is predominant, but smaller inclusions of another vegetation association in this area do exist but have not been mapped separately.

2.4 Sensitivity Analysis

It has been clearly demonstrated that vegetation not only forms the basis of the trophic pyramid in an ecosystem, but also plays a crucial role in providing the physical habitat within which organisms complete their life cycles (Kent & Coker 1992). Vegetation is thus an important determination of the biodiversity of an area. The vegetation sensitivity assessment aimed to identify whether the broad vegetation associations present on the site are of ecological importance as it is amongst others:

- Situated in a listed ecosystem or threatened vegetation unit;
- Habitat or potential habitat to plant species of conservation concern, protected plants or protected trees as well as the probability of such species to survive or re-establish itself following disturbances, and alterations to their specific habitats;
- Situated within ecologically sensitive features such as wetlands, riparian areas or ridges, koppies and inselbergs,
- In good ecological condition and functional.

This implies that the sensitivity, not only aspects that currently prevail in the area should be taken into consideration, but also if there is a possibility of a full restoration of the original environment and its biota, or at least the rehabilitation of ecosystem services resembling the original state after an area has been significantly disturbed. The criteria and weighting scores used to determine the vegetation sensitivity, function and conservation importance are given in Appendix A.

3. BACKGROUND TO THE STUDY SITE

3.1 Locality

The Orlando Dam is situated within Soweto, directly south of the defunct Orlando Power Station and the well-known Soweto Towers (City of Johannesburg). The dam falls between the residential areas of Nancefield in the south-west and in Masopha in the north (Figure 1). The arterial M68 (Chris Hani) road is directly south of the dam. Mbambisa Road (constructed in 2011) traverses the wetland downstream of the Orlando Dam. The dam falls within the quarter degree square (qds) 2627BD.

3.2 Hydrology and Topography

The dam is situated within the Diepkloofspruit that enters the dam from the south (Figure 2). Another non-perennial river enters the dam from the east (Figure 2). The dam drains towards the Klip River.

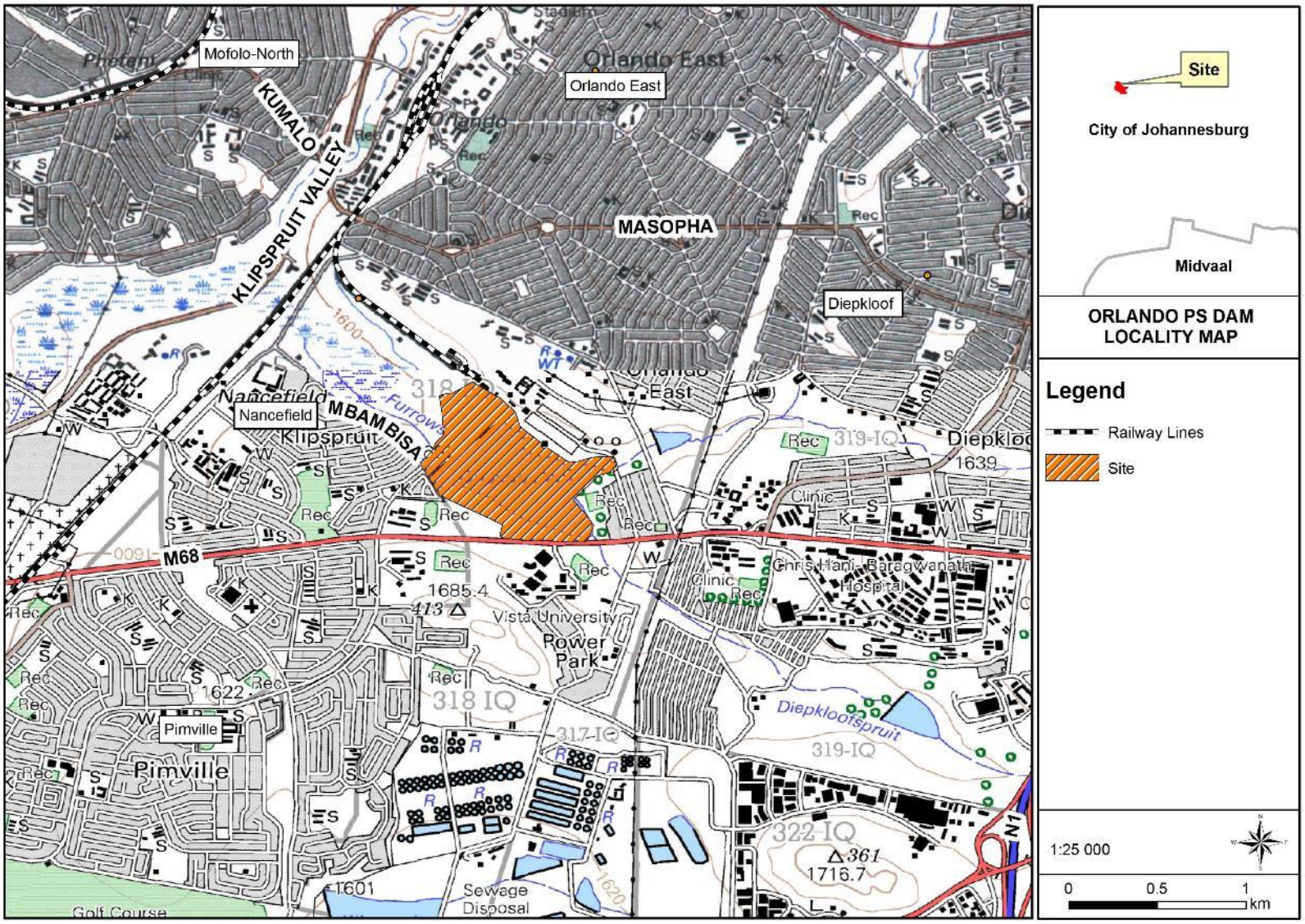


Figure 1: Locality map for Orlando Dam

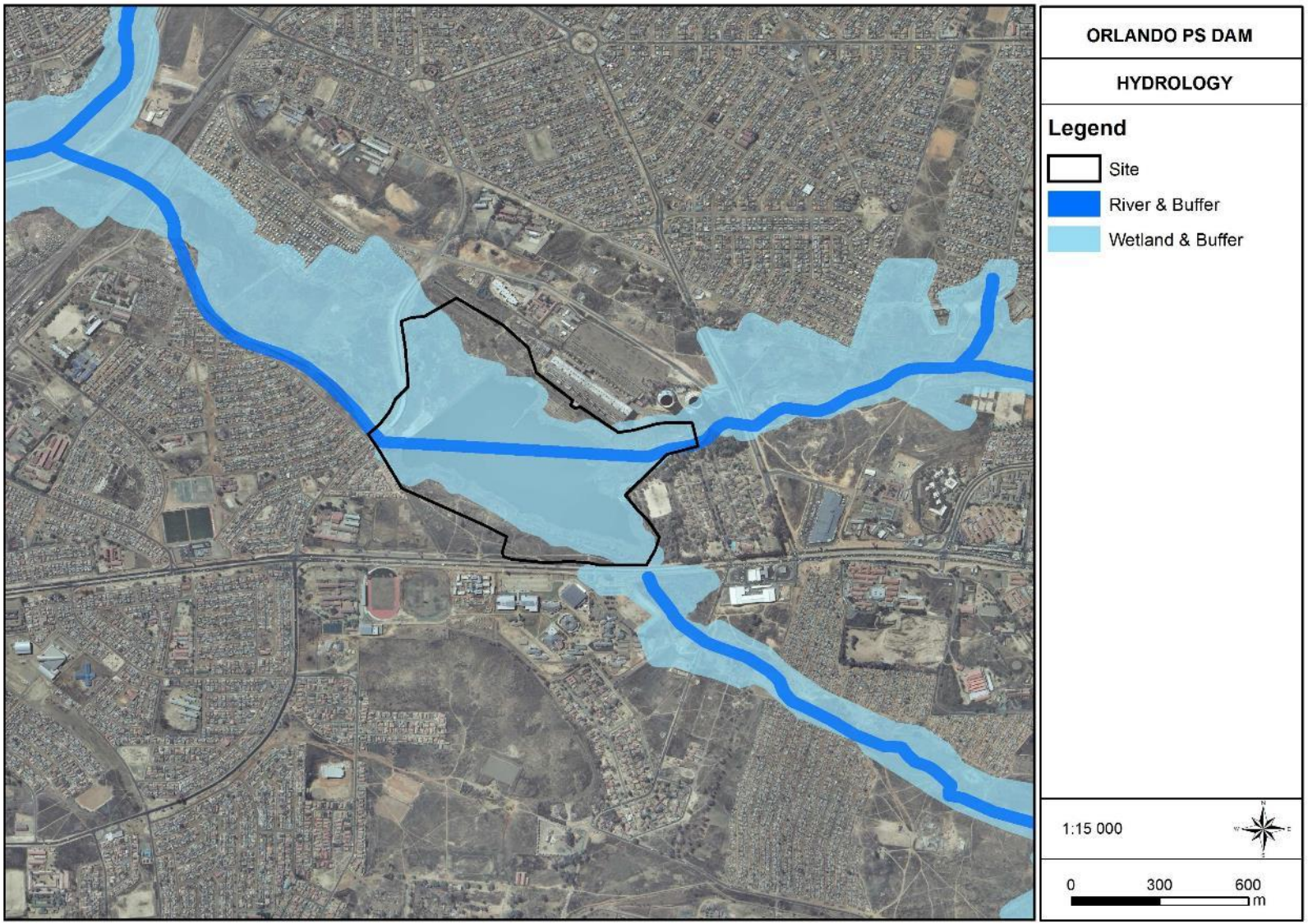


Figure 2: Hydrology of the area within which the dam is situated

3.3 Overview of historic vegetation type

The site is situated within the Grassland Biome that experiences summer rainfall and dry winters with frost (and fire), which are unfavourable to tree growth. Therefore, grasslands comprise mainly of grasses and plants with perennial underground storage organs, for example bulbs, tubers and suffrutex species. In some grassland areas, the surface topography (e.g. rocky hills and protected valleys) creates habitats that are favourable to shrublands and trees (Mucina & Rutherford, 2006). The grassland biome is under severe threat from urbanisation, industrialisation, mining and agriculture, especially in Gauteng. The site is situated in the Soweto Highveld Grassland vegetation type that is classified as Endangered as the extent conserved is less than the targeted extent that should be conserved (Mucina and Rutherford, 2006) (Figure 3).

This grassland comprises a moderately undulating landscape that supports short to medium high and dense grassland dominated mainly by the grass *Themeda triandra*. Wetlands, rocky outcrops and ridges are embedded in this grassland.

Table 1: Typical species occurring in the Soweto Highveld Grassland (Mucina and Rutherford, 2006)

Graminoids:	*Andropogon appendiculatus* (d), *Brachiaria serrata* (d), *Cymbopogon pospischilii* (d), *Cynodon dactylon* (d), *Elionurus muticus* (d), *Eragrostis capensis* (d), *E. chloromelas* (d), *E. curvula* (d), *E. plana* (d), *E. planiculmis* (d), *E. racemosa* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Setaria nigrirostris* (d), *S. sphacelata* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Andropogon schirensis*, *Aristida adscensionis*, *A. bipartita*, *A. congesta*, *A. junciformis* subsp. *galpinii*, *Cymbopogon caesius*, *Digitaria diagonalis*, *Diheteropogon amplectens*, *Eragrostis micrantha*, *E. superba*, *Harpochloa falx*, *Microchloa caffra*, *Paspalum dilatatum*.
Herbs:	*Hermannia depressa* (d), *Acalypha angustata*, *Berkheya setifera*, *Dicoma anomala*, *Euryops gilfillanii, Geigeria aspera* var. *aspera*, *Graderia subintegra*, *Haplocarpha scaposa*, *Helichrysum miconiifolium*, *H. nudifolium* var. *nudifolium*, *H. rugulosum*, *Hibiscus pusillus*, *Justicia anagalloides*, *Lippia scaberrima*, *Rhynchosia effusa*, *Schistostephium crataegifolium*, *Selago densiflora*, *Senecio coronatus*, *Hilliardiella oligocephala*, *Wahlenbergia undulata*.
Geophytic herbs	*Haemanthus humilis* subsp. *hirsutus*, *H. montanus*
Low Shrubs:	*Anthospermum hispidulum*, *A. rigidum* subsp. *pumilum*, *Berkheya annectens*, *Felicia muricata*, *Ziziphus zeyheriana*.
Herbaceous Climber	*Rhynchosia totta*

3.4 Listed Ecosystems

The National Environmental Management: Biodiversity Act (Act 10 of 2004) provides for listing threatened or protected ecosystems in one of four categories: critically endangered (CR), endangered (EN), Vulnerable (VU) or Protected (Section 52(1)(a) of the National Environmental Management: Biodiversity Act (Government Gazette 34809, Government Notice 1002, 9 December 2011)). The ecosystem status is based on the percentage of original area remaining untransformed (by croplands, mining, urban development & roads) in relation to the biodiversity target and a threshold for ecosystem functioning. The purpose of listing threatened ecosystems is primarily to reduce the rate of ecosystem and species extinction. This includes preventing further degradation and loss of structure, function and composition of threatened ecosystems.

The site is situated within the Soweto Highveld Grassland, which is listed as a Vulnerable ecosystem.

3.5 Gauteng Conservation Plan

According to the Gauteng Conservation Plan (version 3.3), the Orlando Dam forms part of an Ecological Support Area (ESA) and surrounding grassland falls within a Critical Biodiversity Area (CBA): Important (Figure 4). The Gauteng Conservation Plan (Version 3.3) (GDARD, 2011) classified areas within the province based on its contribution to reach the conservation targets within the province. These areas are grouped as Critical Biodiversity Areas (CBAs) or Ecological Support Corridors (ESAs). The CBAs comprise 'Irreplaceable' areas that must be conserved and areas classified as 'Important' to reach the conservation targets of the Province. ESA's are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. (ESAs) to ensure sustainability in the long term.

3.6 Gauteng Ridges

The Orlando Dam is situated north of a Class 2 ridge, which will not be impacted on by the proposed rehabilitation activities (Figure 5). Ridges are protected environments within Gauteng (GDACE, 2006). The term ridge refers to hills, koppies, mountains, kloofs and gorges and/or a landscape type or topographic feature that is characterized by two or more of the following features: a crest, plateau, cliff or footslope. Many threatened species of plants and animals inhabit ridges. As such, the conservation of ridges in Gauteng will contribute significantly to the future persistence of these species. Ridges are thus of conservation concern and development within such areas are restricted, depending on the classification of each ridge. The Gauteng Development Guideline for Ridges (GDACE, 2006) classified ridges into four classes based on the percentage of the ridge that has been transformed.

3.7 Land Use and Disturbances

Historical Google Earth aerial imagery show that the vegetation around the dam has been disturbed continuously over time (Figure 6). Other than the construction, operation and decommissioning of the Orlando Power Station, various other impacts can be noted.

The spillway to the west of the dam has been in use prior to the year 2000. The area north of the dam wall was inundated in 2000 and later dried up. At the time of the site visit, this area also received sewerage from a leaking system which likely also caused the inundation in 2000. By 2004 the vegetation had a low basal cover and was likely already dominated by weedy species as was noted at the time of this assessment. Construction of Mbambisa Road commenced in 2006 and was only completed by late 2010 or early 2011. This could have caused several impacts to adjacent vegetation. In addition, activities south of the dam also resulted in vegetation clearance over time, which was later colonised by grasses and weedy species.

At the time of the site visit, cattle, goats and sheep grazed the site (Photograph 1a). The invasive lawn, *Pennisetum clandestinum* (kikuyu) invaded the moist soils north of the dam wall. The community harvest sods of this species for use on gardens (Photograph 1b). Most of the vegetation north of the dam wall comprised weedy exotic and invasive plant species (Photograph 2). The soil on the dam wall was destabilised and several ditches and dumping noted downstream of the wall.

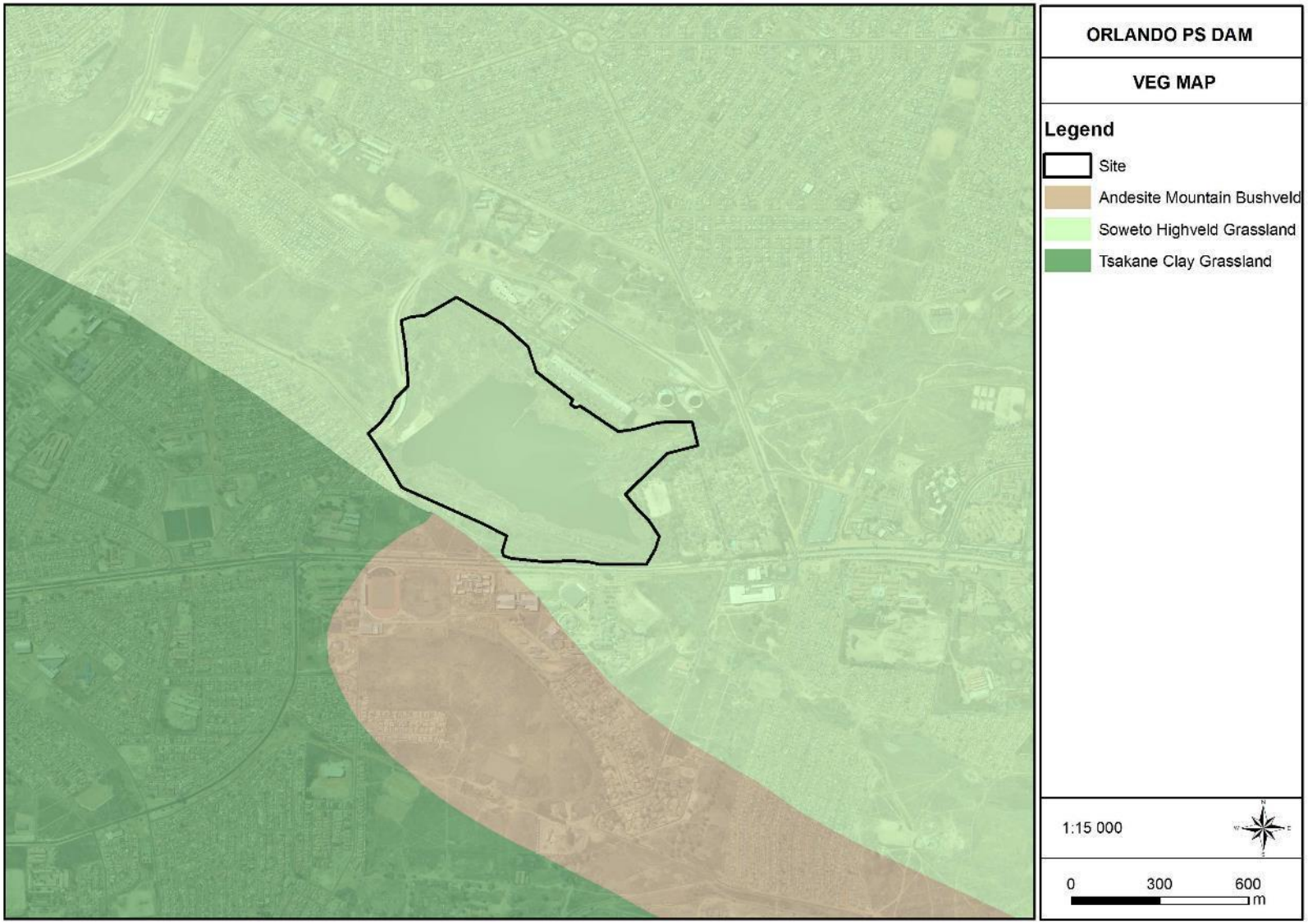


Figure 3: The site falls within the historic extent of the Soweto Highveld Grassland

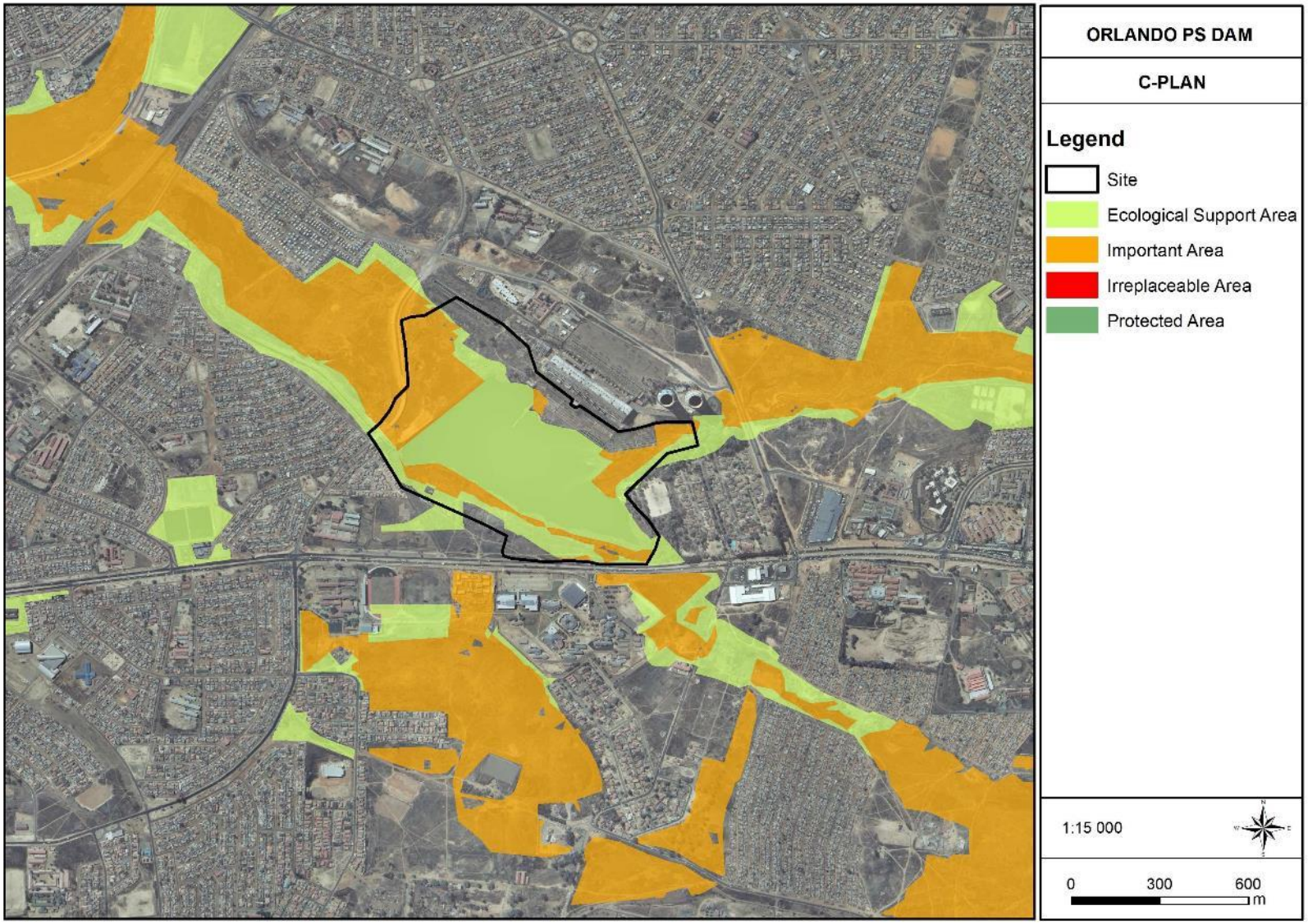


Figure 4: As per the Gauteng Conservation Plan, the Orlando Dam forms part of an ESA and CBA: Important

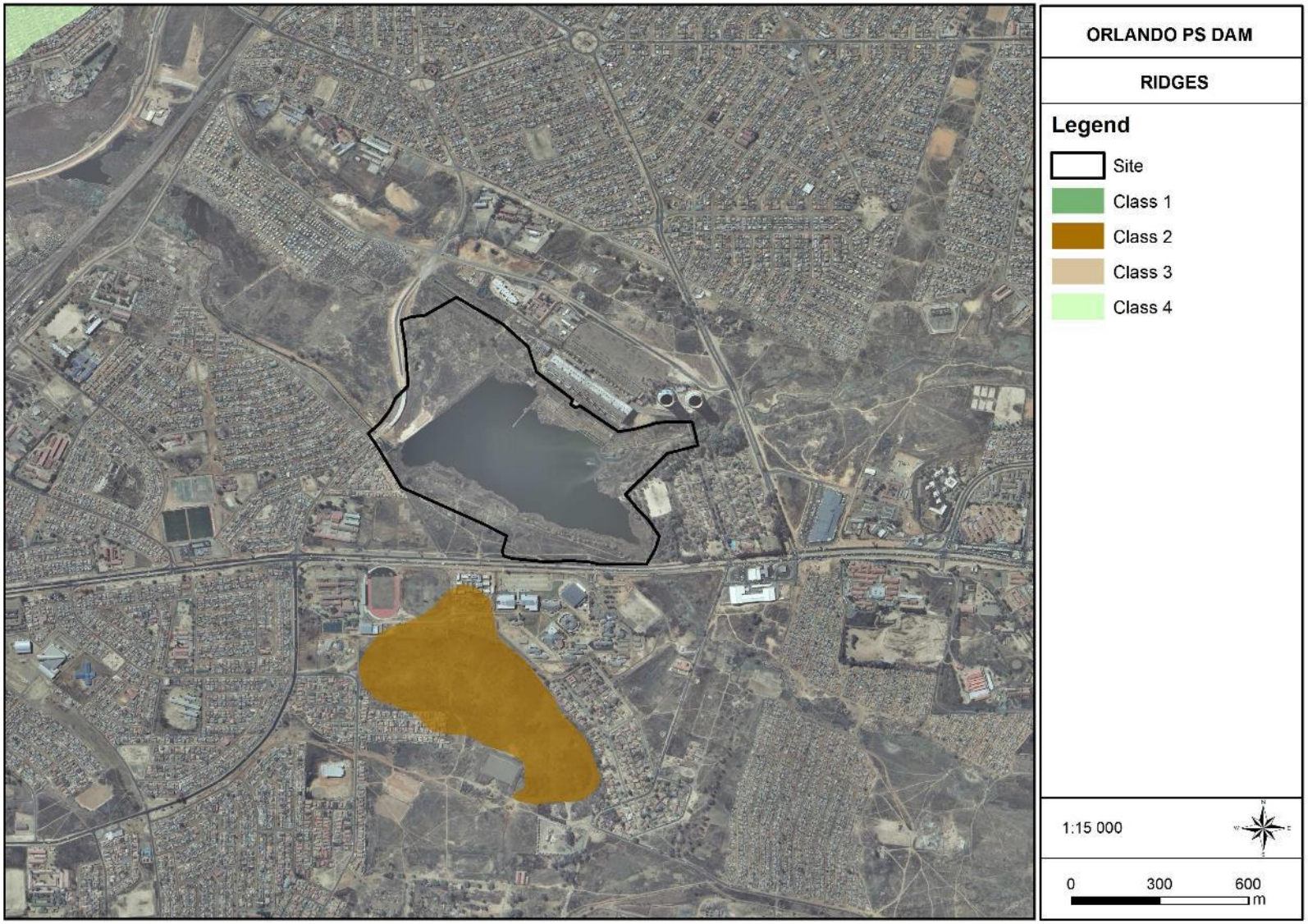
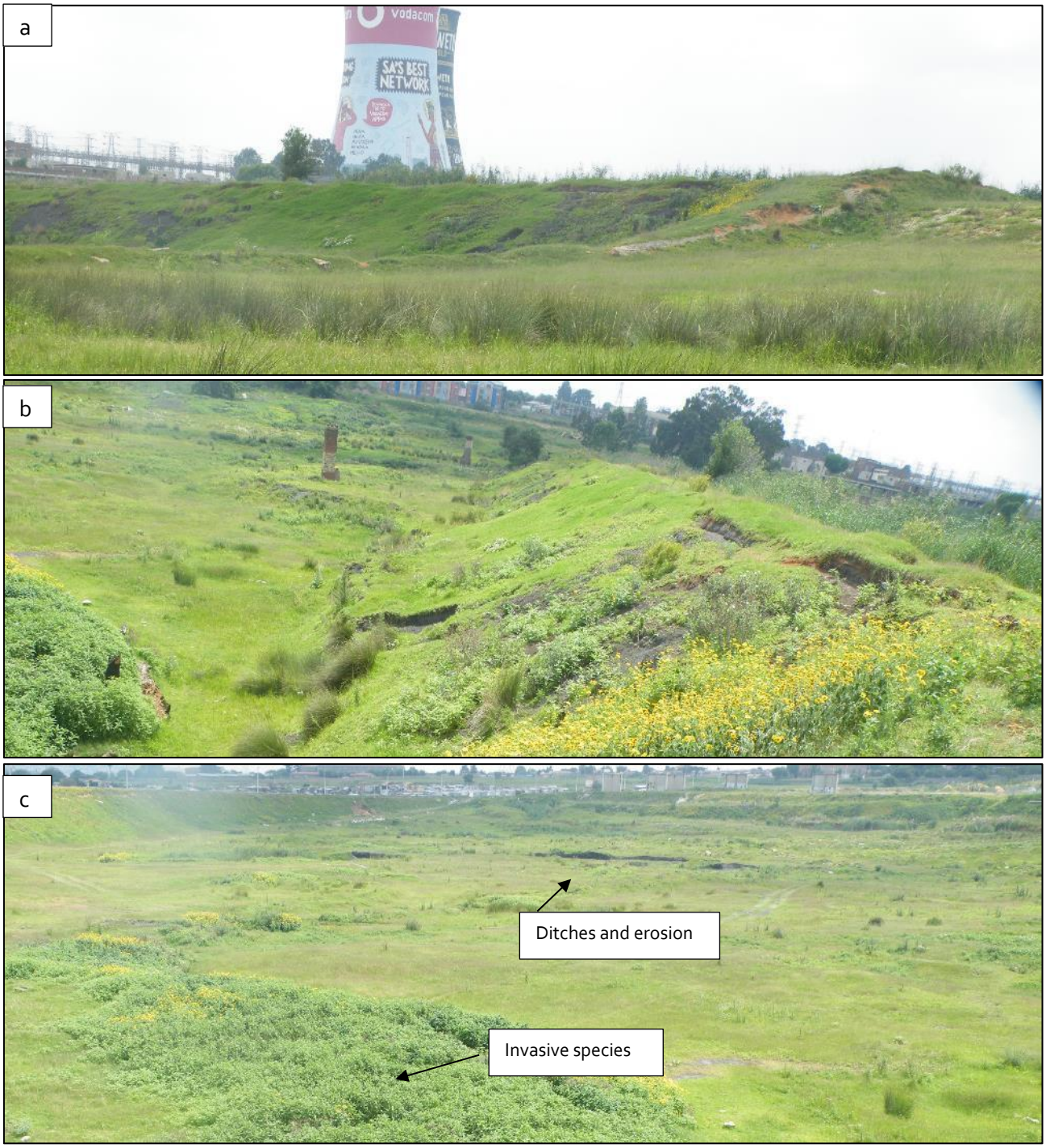


Figure 5: The Orlando Dam is situated in proximity to Class 2 ridge

Figure 6: Google Earth aerial imagery of the dam and surrounding vegetation from 2000, 2004, 2006, 2010, 2011 and 2019 show the continuous soil disturbances around the dam over time

The SEF 2004 and 2009 reports indicated that the site is degraded and dominated by invasive species. Since the drafting of these reports the site vegetation has remained in a degraded state while numerous additional weeds have since colonised the site.

Photograph 1: a) Cattle grazing the vegetation north of the dam wall and b) kikuyu sods harvested from site



Photograph 2:a) Bare soils on the dam wall, b) eroded dam wall and c) vegetation north of the dam wall- ditches and invasive plant species were common.

4. RESULT OF THE ASSESSMENT

4.1 Vegetation Survey Overview

Vegetation associations identified during this assessment are based on the overall similarity in vegetation structure, perceived species composition, and abiotic features such as moistness.

Most of the vegetation that will be impacted on by the dam rehabilitation was classified as moderately to severely modified form the reference state of Soweto Highveld Grassland. The vegetation was mapped to a 100m buffer around the project area as follows:

1. Watercourse vegetation:
   - *1.1 Phragmites asutralis vegetation*
   - *1.2 Typha capensis-Mirabilis jalapa vegetation*
2. Severely modified moist grassland
3. Modified to severely modified grassland

The vegetation is geographically represented in Figure 7 and discussed below. Built-up areas or where historic structures were demolished was mapped as no natural habitat / built-up and not discussed further. Species recorded in each vegetation group is listed in Appendix B.

4.1.1 Watercourse vegetation

According to the National Water Act (Act No.36 of 1998), a watercourse means a river or spring; a natural channel in which water flows regularly or intermittently; a wetland, lake or dam into which, or from which, water flows.

Two watercourses drain into the Orlando Dam. The permanently wet areas were grouped based on the dominant species present and discussed below. No plant species of conservation concern were recorded in the watercourse vegetation, although such species may be present.

Phragmites australis vegetation

The dominant grass around the dam, as well as the watercourses flowing into the dam from the east and south-east, was the tall growing *Phragmites australis* (common reed) (Photograph 3). Small pockets, mainly areas where water flows out of the dam or into the dam included the reed *Typha capensis* (bulrush). *Phragmites* plays an important role in wetlands, particularly disturbed or impacted wetlands as it has an extensive root system that binds soils and prevent erosion. It can withstand high levels of environmental contamination and can assimilate heavy metals, nitrogen and phosphorous (Tarr, 2006).

Other grasses included species such as *Paspalum dilataum* and the invasive *Pennisetum clandestinum* (kikuyu). Exotic trees such as *Salix babylonica* (willow) and *Ligustrum* species (privet) were recorded.

The *P. australis* vegetation is in a natural state as this species tends to form dense stands allowing little if any forb species to grow.

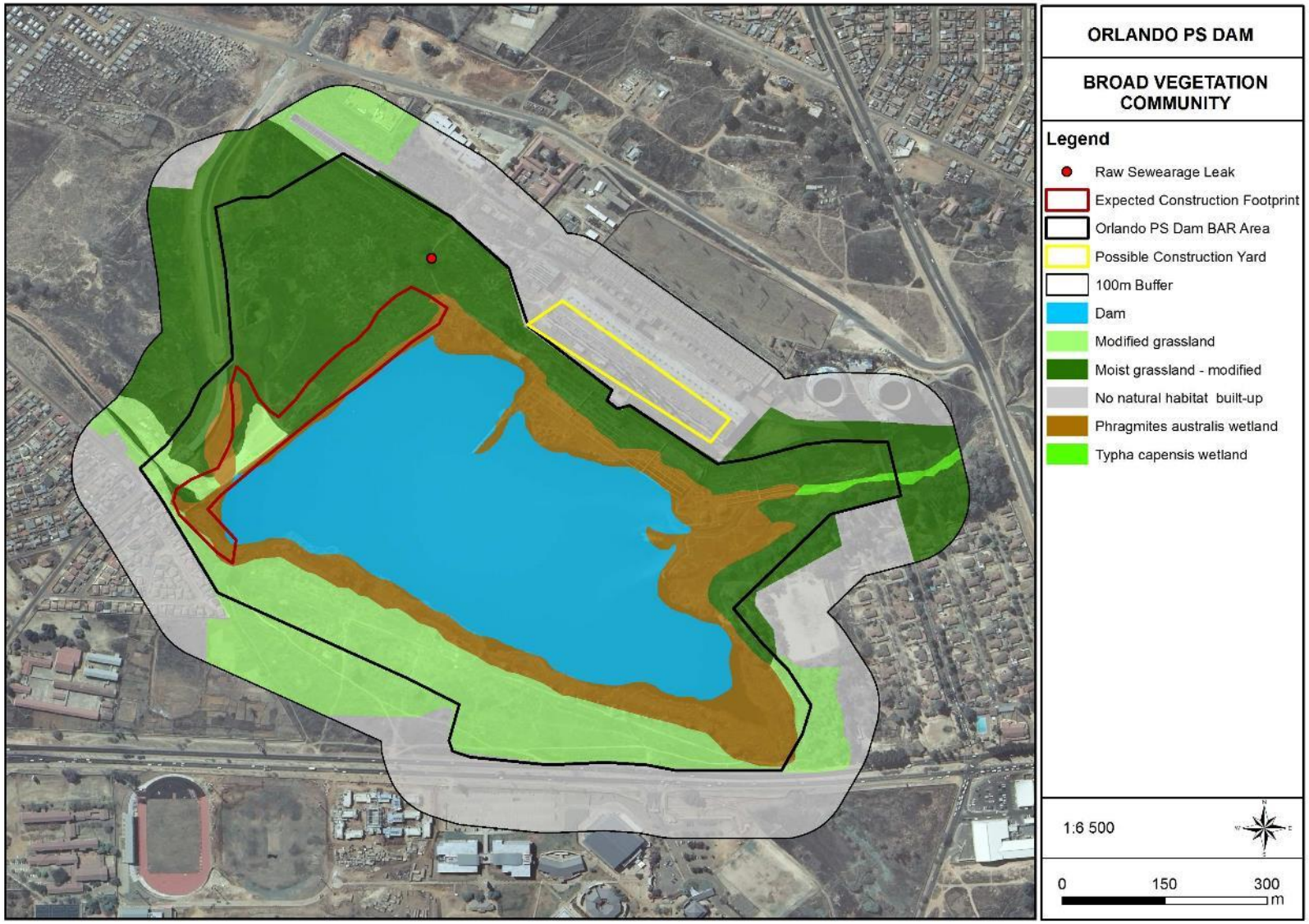


Figure 7: Vegetation groups within 100m around the dam.

Photograph 3: a) *P australis* in the pond underneath the dam overflow north of the dam wall, b) *P australis* in the spillway, c) around the edge of the dam and d) at the inflow of the Diepkloofspruit at Chris Hani Road.

Typha capensis-Mirabilis jalapa vegetation

The non-perennial river draining into the Orland Dam from the east were dominated by the indigenous reed *Typha capensis* (bulrush) in the permanently wet areas (Photograph 4a). However, the vegetation was invaded by numerous alien and invasive plant species, with the category 1b invasive shrub *Mirabilis jalapa* (four-o'clocks), being the most dominant on either side of Sheffield Road that traverses the watercourse (Photograph 4b). This invasive species was not noted during the historic vegetation assessments of the site (SEF, 2004 & 2009) and has since emerged as the dominant species in the area.

Invasive species outnumbered indigenous vegetation with limited indigenous species such as *Cynodon dactylon* (couch grass), *Hyparrhenia hirta* and the reeds *Schonoplectus corymbosus* and *Juncus effuses* present. Other than *M jalapa*, the most common invasive species were *Pennisetum clandestinum* (kikuyu), *Solanum mauritianum* (bugweed), *Amaranthus hybridus* (pigweed), *Nasturtium officinale* (watercress), *Melilotus alba* (bokhara clover) and *Ricinus communis* (castor oil) (Appendix B).

The species composition of this vegetation is modified from typical highveld wetland vegetation. However, the degraded vegetation plays a role in flood attenuation and soil stabilisation.

Photograph 4: a) *Typha capensis* patches west of Sheffield Road and b) invasive species dominated vegetation east of the Sheffield Road

4.1.2 Moist grassland

Moist grassland surrounds the dam and the watercourse. Here the soil moisture is elevated due to wetland conditions and sewerage leaks. Some plant species are adapted to temporary or permanently inundated soil conditions and grows in the moist grassland.

The moist grassland north of the dam wall is grazed and subsequently dominated by *Cynodon dactylon* (Photograph 5). Other indigenous grasses include *Hyparrhenia hirta* (common thatch grass and *Eragrostis plana* (tough love grass). Much of the vegetation was dominated by alien invasive plant species. The dominant spreading grass was the invasive *Pennisetum clandestinum* (kikuyu). Forbs were also weedy in nature e.g. *Plantago lanceolata, Centella asiatica* (marsh pennywort) and the category 1b invasive species *Cirsicum vulgare* (Scotch thistle), *Verbena bonariensis, Flavernia bidentis* (smelters bush) and a dominance of the emergent weed *Verbesina encelioides* var *encelioides* (wild sunflower).

Photograph 5: Alien invasive species dominate the moist grassland a) west of Mbambisa Road, b) and c) along the dam wall and north-west thereof

The moist grassland is modified from natural wetland vegetation in the Highveld. However, the vegetation is the typical result of increased stormwater or sewerage, soil disturbances, erosion and colonisation by invasive plant species in an urban environment. No plant species of conservation concern are expected to be present due to the historical disturbances in the area (see section 4.3). Even though parts of the moist grassland north of the dam wall is classified as a CBA: Important, it is not in a primary state.

4.1.3 Modified grassland

Modified landscapes are regarded as areas where the vegetation structure and composition have been compromised and are not representative of the reference state, in this case, Soweto Highveld Grassland (SANBI, 2016). However, ecological function continues, albeit in an altered way. These areas usually support a low species diversity. Modified land can range from moderately modified to severely or irreversibly modified. Subsequently, these areas are usually of a poor to fair ecological condition.

The drier grassland surrounding the dam and moist grassland was historically disturbed and vegetation clearance took place in various portions (Figure 6; SEF 2004 and 2009). Indigenous grass species colonised the disturbed land, along with weedy pioneer species (Photograph 6). Parts of the grassland have reached a secondary state; however, the forb and grass diversity remained low. The grassland is regularly mowed and grazed. Trampling and dumping were also noted.

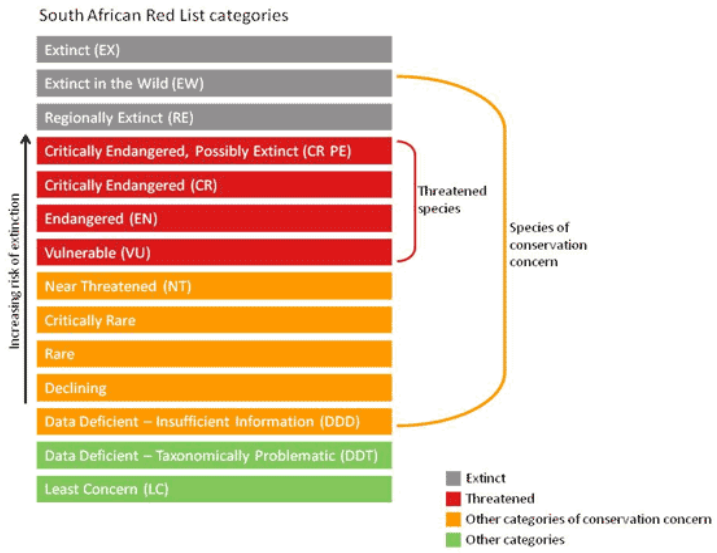
Photograph 6: Modified grassland downstream of the dam wall a) west of Mbambisa Road, b) east of the road c) on top of the dam wall (dominated by *Cynodon dactylon)* and d) modified grassland just north of Chris Hani Road.

The grass layer was dominated by the indigenous pioneer grass *Cynodon dactylon* (couch grass) and *C nlemfuensis* (star grass), which were likely planted as part of the post construction rehabilitation of Mbambisa Road. Other indigenous grasses include *Hyparrhenia hirta* (common thatch grass), *Eragrostis curvula* (love grass), *Panicum repens* and limited *Digitaria eriantha* (finger grass) and *Eragrostis plana* (tough love grass). The forb layer was dominated by the weedy *Plantago lanceolata* and patches of *Conyza podocephala.* Other species include *Cleome gynandra* (African cabbage), *Tribulus terrestris* (common devil's thorn), *Lactuca inermis* (wild lettuce), *Gomphocarpus fructicosus* (milk weed) and *Nidorella hottentottica* (Appendix B).

The species diversity was poor and altered from the reference state of Soweto Highveld Grassland (see Table 1). However, the grassland maintains its function as an ESA although it is unlikely to support plant species of conservation concern.

4.2 Plant Species of Conservation Concern

Plants of conservation concern are those plants that are important for South Africa's conservation decision making processes and include all plants that are Threatened, Extinct in the wild, Data deficient, Near-threatened, Critically rare, Rare and Declining (Figure 8). Chapter 4, Part 2 of NEMA Biodiversity Act, 2004 (Act No. 10, 2004) provides for listing of species that are threatened or in need of protection to ensure their survival in the wild, while regulating the activities, including trade, which may involve such listed threatened or protected species and activities which may have a potential impact on their long-term survival.



(Source: http://redlist.sanbi.org/redcat.php)

Figure 8: Threatened species and species of conservation concern

A list of plants of conservation concern was compiled using information from the South African National Biodiversity Institute's (SANBI) checklist (SANBI, 2009), Raimondo *et al*, (2009) and information received from the Gauteng Department of Agriculture and Rural Development (GDARD) for the quarter degree square (qds) 2627BD. Eight (8) species which were historically recorded in the qds and for which potential habitat is present in the project area, are listed in Appendix C. No suitable habitat was present for most of the species listed in Appendix C. Neither were any of the species recorded in walked transects on the site.

4.3 Protected plants

4.3.1 NEMBA Threatened or Protected Plant Species (TOPS)

Chapter 4, Part 2 of the National Environmental Management: Biodiversity Act (No. 10 of 2004), (NEMBA) provides for listing of plant and animal species as threatened or protected. If a species is listed as threatened, it must be further classified as Critically Endangered, Endangered or Vulnerable. These species are commonly referred to as TOPS listed. The Act defines these classes as follows:

- Critically endangered species: any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- Endangered species: any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.

- Vulnerable species: any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- Protected species: any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category will include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Certain activities, known as 'Restricted Activities', are regulated on listed species using permits by a special set of regulations published under the Act. Restricted activities regulated under the act are keeping, moving, having in possession, importing and exporting, and selling. The first list of threatened and protected species published under NEMBA was published in the government gazette on the 23rd of February 2007 along with the Regulations on Threatened or Protected Species.

At the time of this assessment, no TOPS listed species were recorded within the proposed development footprint or are expected to occur.

4.3.2 Provincially Protected Plants

Several provincially protected plants are listed in the Transvaal Nature Conservation Ordinance Act No. 12 of 1983. These plants are not to be removed, damaged, or destroyed without permit authorisation from Gauteng Department of Agriculture and Rural Development (GDARD

Bulbs such as *Crinum bulbipsermum* and *Eucomis autumnalis* could be present within the moist grassland, however none were noted during this assessment or historic assessments (SEF. 2004 and 2009).

4.4 Alien Invasive Plant Species

Declared weeds and invader plant species have the tendency to dominate or replace the canopy or herbaceous layer of natural ecosystems, thereby transforming the structure, composition and function of natural ecosystems. Therefore, it is important that these plants are controlled and eradicated by means of an eradication and monitoring programme. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species (Henderson, 2001).

The National Environmental Management: Biodiversity Act (NEMBA) is the most recent legislation pertaining to alien invasive plant species. On 29 July 2016 the list of Alien Invasive Species was published in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (Government Gazette No 864 of 2016). The legislation calls for the removal and / or control of alien invasive plant species (Category 1 species). In addition, unless authorised thereto in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland. Category 3 plants are also prohibited from occurring within proximity to a watercourse.

Below is a brief explanation of the three categories in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA):

> Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
> Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
> Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
> Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

The most prominent alien plant species present are listed in Appendix B. Table 2 lists the category 1b species present that should form the focus of an alien invasive plant management programme compiled in accordance with the Alien and Invasive Species Regulations in terms of the National Environmental Management: Biodiversity Act (NEM:BA) and the draft regulations published on the 16th of February 2018.

Table 2: Category 1b alien invasive species recorded on and around the site

Species	Common name	Main are of occurrence
Araujia sericifera	Moth catcher	West of dam along fences
Argemone ochroleua	Mexican Poppy (White)	Modified grasslands
Cirsium vulgare	Scotch Thistle	Modified grassland and -moist grassland, north of dam wall
Cuscuta campestris	Common Dodder	Modified grassland south of dam
Datura stramonium (M)	Thorn-apple / Olieboom	Modified grassland and -moist grassland, north of dam wall
Eucalyptus camalduensis	River buegum	Moist grassland and surrounds
Ipomoea purpurea	Morning Glory	West of dam along fences
Ligustrum japonicum	Privet	Watercourse and moist grassland within the Diepkloofspruit
Mirabilis jalapa	Four-o'clocks	Moist grassland (dominant species)
Pennisetum clandestinum	Kikuyu Grass	Moist grassland and modified grassland (a dominant species)
Solanum mauritianum	Bugweed	Moist grassland
Solanum sisymbrifolium	Wild Tomato	Modified grassland
Verbena bonariensis	Wild Verbena	Moist grassland
Verbena officionalis	Verbain	Moist grassland

Species	Common name	Main are of occurrence
Verbesina encelioides var encelioides Emerging weed proposed Category 1b	Wilde Sonneblom	Moist grassland (dominant species)

5. VEGETATION VULNERABILITY AND IMPORTANCE

It has been clearly demonstrated that vegetation not only forms the basis of the trophic pyramid in an ecosystem, but also plays a crucial role in providing the physical habitat within which organisms complete their life cycles (Kent & Coker 1992). Therefore, the vegetation of an area will largely determine the ecological sensitivity thereof.

5.1 Rating and Analysis of Vegetation Importance

In order to determine the vegetation condition and importance on the site, weighting scores as listed below (Table 3) were applied. Vegetation of conservation importance were classified based on the findings of the study and the criteria as listed in Appendix A. The sensitivity analysis results were classified as per Table 3, geographically represented in Figure 9 and discussed below.

Table 3: Weighting scores

Scoring	Sensitivity	Explanation
13-18	High	• Development within these areas is not supported. • Impacts are difficult to mitigate, if at all • Such features usually protected by legislation or guiding policies.
12	Medium-high	• Development within these areas is undesirable and impacts are difficult to mitigate, if at all. • Impacts must be avoided or managed by an ecological management plan
7-11	Medium	• Development within these areas could proceed with limited impact to sensitive vegetation, provided that appropriate mitigation measures are taken. • High impact developments should be considered with caution, if at all. Development must be restricted in footprint and impacts managed and mitigated by an approved management plan. Edge effects to higher sensitivity classes in its proximity must be mitigated / prevented.
6	Low-medium	• Developable areas that are connected to sensitive features. • Edge effects must be presented.
0-5	Low	• Most types of development can proceed within these areas with little to no impact on conservation worthy vegetation. Edge effects to other proximate sensitivity classes must be mitigated / prevented.

Table 4: Scoring of vegetation around the Orlando Dam

Broad vegetation community	Conservation Status of regional Vegetation unit	Predominant state	Protection by legislation/ policies	Plants of conservation concern	Ecological Function	Conservation Importance / unique habitat	Total Score out of max of 18	Importance and vulnerability

Watercourse vegetation	**2***	**1**	**3®#**	**1**	**2**	**2**	**11**	**Medium**
Moist grassland-modified	**2***	**0**	**2#**	**1**	**1**	**1**	**8**	**Medium**
Modified grassland	2*	0	2#	0	1	1	**6**	**Low-medium**
Built-up and gardens	0	0	0	0	1	0	**1**	**Low**

*Soweto Highveld Grassland is Endangered

#situated in an ESA/CBA

®National Water Act

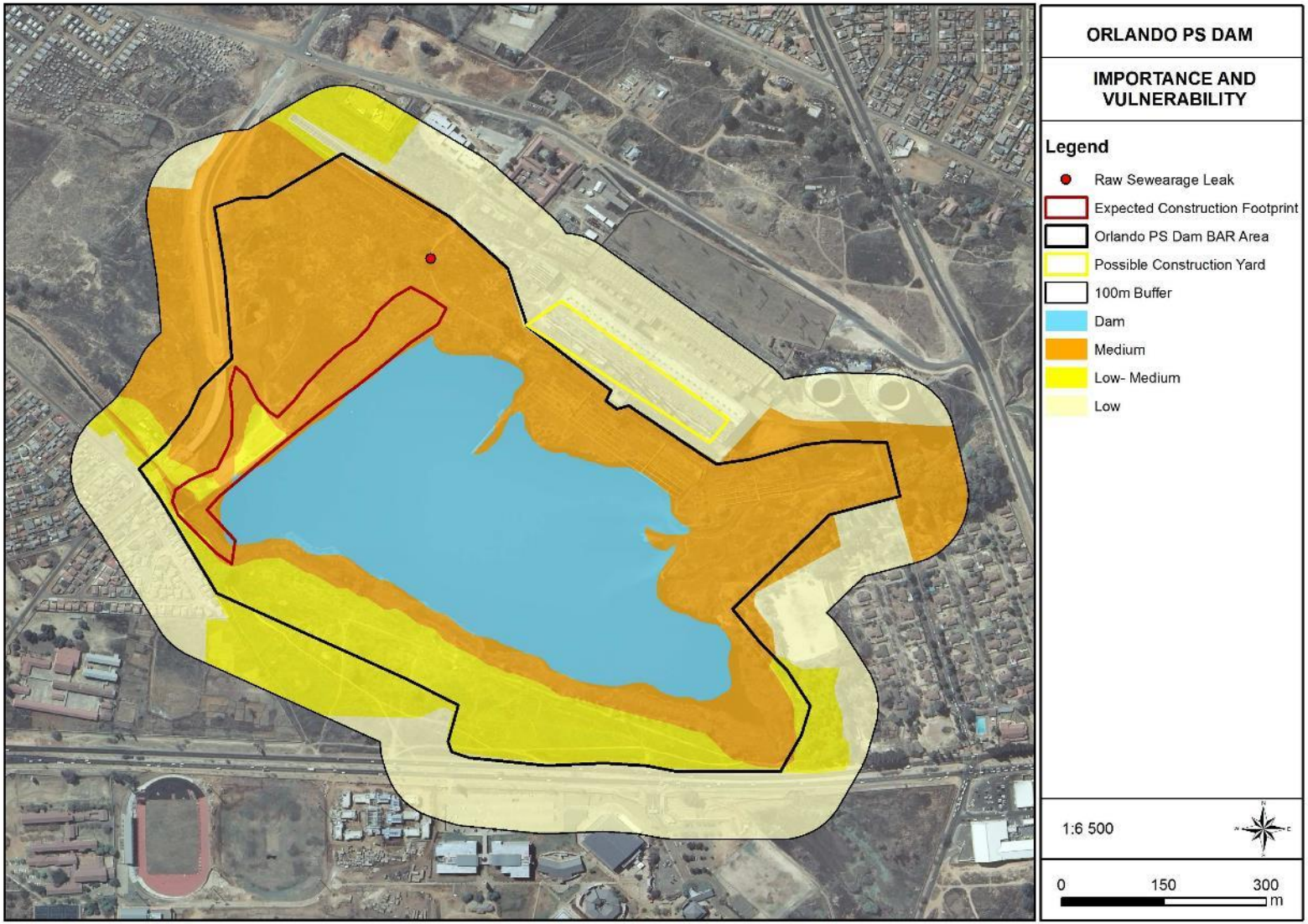


Figure 9: Sensitivity of the vegetation within a 100m of the dam

5.2 Discussion

5.2.1 Vegetation of Medium sensitivity

All watercourses are protected by legislation and impacts on these areas as well as a regulated buffer zone should be avoided. Activities within and in proximity to watercourses (Regulation 1199 of the National Water Act, 1998 (Act 36 of 1998) are subjected to strict mitigation measures and authorisation from the competent authority in order to protect and sustainably utilise South Africa's water resources. In addition, the moist grasslands and watercourse vegetation fall within a CBA as classified by the Gauteng Conservation Plan.

Moist grasslands are usually indicative of wetland conditions which are also protected by national legislation. The moist grasslands are essential to maintain ecological corridors for the movement and survival of species within a landscape fragmented by cultivation and urbanisation. In addition, the hydrological processes associated with the wetlands are closely associated with the intactness of the vegetation within and surrounding these areas. The vegetation plays an important role in flood attenuation, prevent soil erosion and sedimentation of wetlands and pans and promote the uptake of toxins from the water. The Orlando Dam vegetation is degraded; however, it plays a valuable role in soil stabilisation and flood attenuation in the absence of good condition grassland. The vegetations sensitivity rating as medium is mainly due to its functional role, as well as the statutory protection of watercourses. The proposed dam rehabilitation offers the opportunity to clear invasive species from the moist grassland, thereby preventing its spread downstream, while re-establishing indigenous species.

5.2.2 Vegetation of Low medium sensitivity

The modified grassland plays a functional role, although it is modified from the reference state of Soweto Highveld Grassland, it supports a low species diversity and several alien invasive plant species. It is unlikely that the vegetation supports any plant species of conservation concern as mowing limits the potential for such species to occur. The grassland forms part of an ESA which increases its sensitivity rating. Impact on the grassland and the function of the ESA can be minimised and mitigated.

5.2.3 Vegetation of low sensitivity

Built-up areas and gardens are irreversibly modified from the reference state of Soweto Highveld Grassland and are not considered sensitive to the proposed rehabilitation.

6. IMPACT ASSESSMENT AND MITIGATION

Mankind depends on the natural environment for many ecological services provided for by ecosystems, ecological processes and plant species in general. However, any development activities in natural systems will impact on the surrounding natural environment and usually in a negative way. In order to limit or negate these impacts, the source, extent, duration and intensity of the possible impacts needs to be identified. Once the significance of the impacts is understood, the development could both

adequately plan for and mitigate these impacts to a best practise and acceptable level. However, if the impacts are significant, especially in already threatened ecosystems and vegetation units, and no adequate mitigation measures could reduce or avert these impacts, then the development should not be allowed to proceed.

6.1 Assessment Criteria

The possible impacts, as described in the next section, were assessed based on the Significance Rating. The Significance of the impact is calculated as follows and rating significance is explained below:

Significance = Consequence *(Extent + Duration+ Magnitude)* **X Probability**

I. The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.

II. The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):

III. The **duration**, wherein it will be indicated whether
- the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
- the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
- medium-term (5–15 years) – assigned a score of 3;
- long term (> 15 years) - assigned a score of 4; or
- permanent - assigned a score of 5;

IV. The **consequences (magnitude)**, quantified on a scale from 0-10, where
- 0 is small and will have no effect on the environment,
- 2 is minor and will not result in an impact on processes,
- 4 is low and will cause a slight impact on processes,
- 6 is moderate and will result in processes continuing but in a modified way,
- 8 is high (processes are altered to the extent that they temporarily cease), and
- 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

V. The **probability** of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where
- 1 is very improbable (probably will not happen),
- 2 is improbable (some possibility, but low likelihood),
- 3 is probable (distinct possibility),
- 4 is highly probable (most likely) and
- 5 is definite (impact will occur regardless of any prevention measures).

VI. The significance, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and

VII. The **status**, which will be described as either positive, negative or neutral.

VIII. The degree to which the impact can be reversed.

IX. The degree to which the impact may cause irreplaceable loss of resources.

X. The degree to which the impact can be mitigated.

The **significance** weightings for each potential impact are as follows:

- **< 30 points:** Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- **30-60 points:** Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- **60 points:** High (i.e. where the impact must have an influence on the decision process to develop in the area).

6.2 Impact Assessments

The tables below list the activities that could impact on the vegetation because of the proposed dam rehabilitation, as well as impacts that may be associated with the operation thereof. The tables also list recommended mitigation measures to limit the impacts.

6.2.1 Clearing / degradation of vegetation

Nature: The construction and rehabilitation activities will require the removal or vegetation from the dam wall and surrounds. In addition, vegetation within the moist grassland will be destroyed or degraded and activities could degrade or destroy the surrounding grassland that serve as catchment and buffer to the watercourse downstream of the dam. If these impacts are foreseen, it can be mitigated.

The sources of this impact could include:

- Clearing of and damage to vegetation in construction footprint, access roads, construction camps, vehicle / machinery traffic and trampling by workers;
- Removal of vegetation from the dam
- Illegal disposal and dumping of construction material such as cement or oil, as well as maintenance materials during construction.

	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Definite (5)	Definite (5)
Duration	Short term (2)	Short term (2)
Extent	Site and surrounds (2)	Limited to Site (1)
Magnitude	Moderate (6)	Low (4)
Significance	**50 (medium)**	**35 (medium)**
Status (positive or negative)	Negative	Positive

OPERATIONAL PHASE		
Probability	Probable (3)	Improbable (2)
Duration	Short term (2)	Very short (1)
Extent	Limited to the site and downstream (2)	Limited to Site (1)
Magnitude	Low (4)	Low (4)
Significance	**32 (medium)**	**12 (low)**
Status (positive or negative)	Negative	Positive, replacement of non-indigenous vegetation with indigenous vegetation, stabilisation of soils and limiting erosion
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	Moderate	Low
Can impacts be mitigated?	Yes	

Mitigation:

Planning:

- No construction camps or storage of equipment must be planned within the moist grassland and particularly within proximity to the watercourse. Adhere to buffers as recommended by the wetland specialist. As indicated in Figure 9, the construction camps are planned within the built-up and degraded area of the defunct Orlando Power Station. This is ideal as the area is disturbed, however, the potential impact on the dam must be mitigated.
- Plan to use manual labour and limit the use of heavy machinery through moist grasslands north of the dam wall.
- Removal of alien invasive plant species should take place as part of the rehabilitation of the dam wall.

Construction:

- An independent Ecological Control Officer (ECO) should be appointed to oversee construction.
- A temporary fence or demarcation must be erected around the construction area to prevent access to adjacent moist grassland vegetation.
- Prohibit vehicular or pedestrian access into natural areas beyond the demarcated boundary of the construction area or any natural areas outside of the construction.
- No activities should take place during rainy events and at least 2 days afterwards.
- Removed structures should not be dumped in the surrounding vegetation.
- Where topsoil needs to be removed, store such in a separate area where such soils can be protected until they can be re-used for post-construction rehabilitation where applicable. Never mix topsoil with subsoils or other spoil materials.
- Maintain site demarcations in position until the cessation of construction / rehabilitation work.
- After construction of the intervention, the land must be cleared of rubbish, surplus materials, and equipment, and all parts of the land must be left in a condition as close as possible to that prior to construction.

Operational:

- Rehabilitate construction camps and any other vegetation that was impacted on by the construction.

Sow an indigenous grass mix containing species naturally occurring in the area such as: *Cynodon dactylon* (Kweek / couch grass), *Digitaria eriantha* (Smuts finger gras), *Chloris gayana* (Rhodes grass), and *Eragrotis curvula* (see 6.2.3) • Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular or pedestrian access. • Ensure that maintenance work does not take place haphazardly, but according to a fixed plan. • Maintenance workers may not trample natural vegetation and work should be restricted to previously disturbed footprint. In addition, mitigation measures as set out for the construction phase should be adhered to. • Address erosion donga crossings, applying soil erosion control and bank stabilisation procedures as specified by the ECO.
Cumulative impacts: None
Residual Risks: • Localised alteration of soil surface characteristics. • The colonisation of the disturbance footprint by invasive plant species

6.2.2 Destruction or degradation of vegetation associated with the moist grassland

Nature: The construction will inevitably require the removal of moist grassland or at least some edge effects onto these. Although the moist grassland is degraded, further impacts must be limited. Construction could also result in pollution of the watercourse. Desilting could result in a lower streamflow downstream and then desiccation of portion of moist grassland or death of species adapted to the elevated soil moisture.

	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Definite (5)	Probable (3)
Duration	Medium-term (3)	Medium-term (3)
Extent	Limited to site (1)	Limited to site (1)
Magnitude	Moderate (6)	Moderate (6)
Significance	**50 (medium)**	**30 (medium)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Probable (3)	Improbable (3)
Duration	Short term (3)	Very short term (1)
Extent	Limited to Local Area (2)	Limited to the Site (1)
Magnitude	Moderate (6)	Moderate (6)
Significance	**33 (medium)**	**24 (low)**
Status (positive or negative)	Negative	Positive – re-establish indigenous vegetation
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	Moderate	Low
Can impacts be mitigated?	Yes	

Planning Phase:

- No activities may proceed within or in proximity to watercourses without a Water Use License permitting the activity.

Construction Phase:

- The moist grassland areas that will not be directly impacted on by construction should be fenced during the construction phase to prevent any human activity from encroaching into these areas, other than that which is essential to the construction and removal of alien invasive plant species. Monitoring of the fences is important to ensure no infringement of the fences occurs, particularly as the area is being grazed by cattle, sheep and goats.
- Activities within moist grassland should preferably take place during the dry winter months.
- Input of sediment during construction activities should be prevented at all cost. Mitigation for this potential impact includes establishment of vegetation as soon as possible after construction.
- Pollution of the surface and groundwater. Mitigation for this potential impact includes:
    - In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water Affairs must be informed immediately;
    - Store all litter carefully so it cannot be washed or blown into the water course;
    - Construction vehicles are to be maintained in good working order to reduce the probability of leakage of fuels and lubricants;
    - Storage of potentially hazardous materials should be above any 100-year flood line or the functional wetland boundary (and its associated buffer zone). These materials include fuel, oil, cement, bitumen etc.;
    - Surface water draining off contaminated areas containing oil and petrol would need to be channelled towards a sump which will separate these chemicals and oils;
    - Concrete is to be mixed on mixing trays only, not on exposed soil;
    - Concrete shall be mixed only in areas which have been specially demarcated for this purpose;
    - After all the concrete mixing is complete all waste concrete shall be removed from the batching area and disposed of at an approved dumpsite;
    - All construction materials liable to spillage are to be stored in appropriate structures with impermeable flooring; and
    - No uncontrolled discharges from the construction crew camps to any surface water resources shall be permitted. Any discharge points need to be approved by the relevant authority.
- Ensure that the vegetation disturbed during construction is rehabilitated with indigenous grass species naturally occurring in the area (see 6.2.3).

Operational:

- After construction, the land must be cleared of rubbish, surplus materials, and equipment, and all parts of the land must be left in a condition as close as possible to that prior to construction.
- Ensure that maintenance work does not take place haphazardly, but according to a fixed plan and only within the dedicated road reserves.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular and pedestrian access until such time that rehabilitation was successful.

- Maintenance workers may not trample natural vegetation and work should be restricted to previously disturbed footprint. In addition, mitigation measures as set out for the construction phase should be adhered to.
- Address erosion donga crossings, applying soil erosion control and bank stabilisation procedures as specified by the ECO.
- Repair all erosion damage as soon as possible and in any case not later than six months before the termination of the Maintenance Period to allow for enough rehabilitation growth.
- Stormwater drains and silt traps must be maintained and regularly checked for any blockage.
- Monitor rehabilitation for at least three years after construction is complete. If monitoring observed failed rehabilitation or erosion, corrective action should be taken immediately to determine the cause and correct the problem.

Cumulative impacts: Loss of functionality of the vegetation, as well as erosion due to edge effects.

Residual Risks: Erosion, pollution of the watercourse, invasion by alien invasive plant species.

6.2.3 Bare soils post construction

Nature: Post construction of the rehabilitation measures, the soils could erode or be colonised by alien invasive plant species. The establishment of vegetation is likely the most important stage in the rehabilitation of moist grasslands and the dam wall. This will restore and enhance wetland functionality as well as provide suitable habitat to biodiversity on the site.

	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Probable (3)	Improbable (2)
Duration	Long term (4)	Short-term (2)
Extent	Limited to site and downstream (2)	Limited to site (1)
Magnitude	Moderate (6)	Low (4)
Significance	**36 (medium)**	**14 (low)**
Status (positive or negative)	Negative	Positive
OPERATIONAL PHASE		
Probability	Probable (3)	Improbable (2)
Duration	Short term (2)	Very short term (1)
Extent	Limited to Site (2)	Limited to the Site (1)
Magnitude	Moderate (6)	Low (4)
Significance	**30 (medium)**	**12(low)**
Status (positive or negative)	Negative	-
Reversibility	High	High
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation:

Planning:

- Limit the disturbance footprint and vegetation clearing, except for the clearing of alien invasive plant species.

- Other than natural occurring reeds (*Juncus* and *Schoenoplectus* species), no plant species that are on the site should be used for rehabilitation due to the infestation with alien and invasive plant species. Grass sods of *Cynodon dactylon* (couch grass) hat currently dominate the area could eb considered if the contractor can distinguish between this and the invasive *Pennisetum clandestinum* (kikuyu).

Site preparation:

The following steps must form part of site preparation and the subsequent maintenance of the re-vegetated areas:

- Remove all building rubble, equipment and material;
- Ensure that all alien invasive plant species (particularly *Pennisetum clandestinum*) have been removed.
- Maintain site demarcations, erected prior to construction, in position until the cessation of all construction and rehabilitation work.
- Engage with the community to prevent livestock from trampling and grazing the rehabilitated areas.
- Rip and / or scarify all disturbed areas
- Do not rip and / or scarify areas under wet conditions, as the soil will not break up and it could result in further compaction.
- Planting should preferably be done during the rainy season.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent any access.
- Allow for a maintenance and monitoring period of at least two years following completion.

<u>Grassland</u>

- Rehabilitate construction camps and any other vegetation that was impacted on by the construction. Due to the high degree of alien invasive plant species, re-using grass sods that was removed during construction is not recommended.
- Grasses can be sown. Grass mix containing the following could be used are listed in the table below

Species	Rate of application
Eragrotis tef (teff)	2kg/ha
Cenchrus ciliaris (buffalo grass)	5kg/ha
Cynodon dactylon (Kweek / couch grass)	4kg/ha
Digitaria eriantha (Smuts finger gras)	4kg/ha
Chloris gayana (Rhodes grass)	3kg/ha.
Eragrotis curvula	4kg/ha

- The ratio of the seed mix used for re-vegetation is usually specified by the supplier and based on site conditions, however, an average of 3kg/ha is recommended per species
- Perennial species should form the basis of the grass mix, while at least one species used must provide rapid and dense ground cover during the establishment season. This is likely to include annual, fast growing species.
- Seeds must be thoroughly mixed before applying.
- The seeds must be applied according to the required rates.
- Application rates can be increased in areas that are unfavourable or steep, but no more than double the recommendations.

- Seeds can be mixed with a spreading agent such as river sand, bran or finely sifted kraal to ensure even distribution.
- Manure or agricultural lime and granular fertiliser mix can be applied prior to reseeding.
- Once complete, the seeded area must be watered and patted down gently.
-

Moist grassland and dam:

The following herbaceous species could be considered for re-vegetation:

Position	Specie
Shallow edges of dam	Grasses: • *Leersia hexandra* (Rice Grass) • *Hermarthria altissima* (Red Swamp Grass) • *Cynodon dactylon* (Couch Grass) • *Hermarthria altissima* (Red Swamp Grass) Sedges: • *Cyperus latifolius*
Edges on deep side of the dam / permanently wet areas	Grasses: • *Hermarthria altissima (Red Swamp Grass)* • *Leersia hexandra (Rice Grass)* Sedges: • *Typha capensis (Bulrush)* • *Cyperus papyrus (Papyrus)* • *Phragmites australis (Common Reed)* • *Juncus krausii (Juncus)* • *Cyperus latifolius*
Dam wall (permanently wet areas)	• *Imperata cylindria (Cotton Wool Grass)* • *Cynodon dactylon (Couch Grass) - initial quick growing stabilisation* • *Hermarthria altissima (Red Swamp Grass)* • *Phragmites australis* Sedges: • *Cyperus latifolius*
Moist grassland	Grasses • *Eragrostis plana* • *Sporobulus africanus* in disturbed areas • *Cynodon dactylon* • *Chloris* species • *Leersia hexandra* (Rice Grass) • *Imperata cylindrica* (Cotton Wool Grass) Sedges • *Fuirena pubescens* • *Fuirena stricta*

	• *Juncus effesus* • *Shoenoplectus corymbosus* *Forbs and bulbs* • *Crinum bulbispermum or C. macowanii* (River Lilies) • *Mentha aquatic* (Indigenous mint) • *Kniphofia species (*Red Hot Pokers) • *Ranunculus multifidus* (buttercup)
Around the dam area	Tree species that could be planted to provide nesting areas include: (note that the trees should not be planted within the wetlands.) • *Combretum erythrophyllum* (river Bushwillow) • *Vachellia karroo* (Sweet thorn) • *Salix muncronata* (River willow) • *Celtis africana* (White Stinkwood)

After planting and reseeding, no soil compaction (vehicles, pedestrians and animals) should be allowed until such time that re-vegetation as successful.

Operational:

- Establishment of the vegetation should be monitored for at least two years post relocation. If die back is noted, a specialist should be consulted, and corrective action taken as soon as possible.

Cumulative impacts: If mitigation measures are adequately implemented, no cumulative impacts are expected.

Residual Risks: Failed rehabilitation, death of planted vegetation due to drought or vegetation could be washed away by a flood prior to being established.

The risk of infestation by alien invasive plant species remain high

6.2.4 Potential increase in invasive vegetation

Nature: The seed of alien invasive plant species that occur on and in the vicinity of the construction areas could spread into the disturbed and stockpiled soil. Also, the construction vehicles and equipment were likely used on various other sites and could introduce alien invasive plant seeds or indigenous plants not belonging to this vegetation unit to the construction site

	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Highly probable (4)	Probable (3)
Duration	Long-term (4)	Short-term (2)
Extent	Local Area (2)	Site bound (1)
Magnitude	High (8)	Low (4)
Significance	**56 (medium)**	**21 (low)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Probable (3)	Improbable (2)

Duration	Long term (4)	Short term (2)
Extent	Limited to Local Area (2)	Limited to the Site (1)
Magnitude	Low (4)	Minor (2)
Significance	**30 (medium)**	**10 (low)**
Status (positive or negative)	Negative	Positive –removal of such species
Reversibility	Moderate	High
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation:

Construction:

- Alien invasive category 1b species that were identified on site must be removed from the development footprint and immediate surrounds, prior to construction or soil disturbances (see images and recommended measures of removal in Appendix D). By removing these species, the spread of seeds will be prevented into disturbed soils which could thus have a positive impact on the surrounding natural vegetation.
- All alien seedlings and saplings must be removed as they become evident for the duration of construction.
- All construction vehicles and equipment, as well as construction material should be free of plant material. Therefore, all equipment and vehicles should be thoroughly cleaned prior to access on to the construction areas. This should be verified by the ECO.
- If filling material is to be used, this should be sourced from areas free of invasive species.

Operational:

- Only use indigenous species within the rehabilitation of vegetation.
- Monitor and control the grassland and remove alien invasive species as soon as they become apparent.

Cumulative impacts: Several invasive species are present within the area that the proposed development is situated in. Therefore, if mitigation measures to limit and prevent the spread of alien species are not implemented, the cumulative impact could lead to remaining natural vegetation transformed by alien plant species.

Residual Risks: Re-infestation in areas initially cleared and on rehabilitated areas

6.2.5 Removal of alien invasive vegetation

Nature: Removing of existing invasive alien vegetation within the Orlando Dam and surrounds, could have a positive effect. By removing alien vegetation, the numbers of alien species, as well as the potential for these plants to spread into disturbed soil are reduced, if rehabilitation was successful.

Follow-up control as a mitigation measure is essential or the positive impact will be negated.

	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Probable (3)	Highly probable (4)
Duration	Short-term (2)	Long-term (4)
Extent	Local Area (2)	Local Area (2)

Magnitude	Moderate (6)	High (8)
Significance	**30 (low)**	**56 (medium)**
Status (positive or negative)	**Positive**	**Positive**
OPERATIONAL PHASE		
Probability	Probable (3)	Highly probable (4)
Duration	Short-term (2)	Long-term (4)
Extent	Local Area (2)	Local Area (2)
Magnitude	Moderate (6)	High (8)
Significance	**30 (low)**	**56 (medium)**
Status (positive or negative)	**Positive**	**Positive**
Reversibility	High	High
Irreplaceable loss of resources?	Not Applicable	Not Applicable
Can impacts be mitigated?	Yes	

Mitigation:

Construction:

- Compile and implement an alien invasive monitoring plan to remove alien invasive plant species from the development areas, prior to construction. See Appendix D for guidelines
- Rehabilitate all areas cleared of invasive plants as soon as practically possible, utilising specified methods and species.
- Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge. Monitoring should continue for at least two years after construction is complete.
- Follow manufacturer's instruction when using chemical methods, especially in terms of quantities, time of application etc.
- Ensure that only properly trained people handle and make use of chemicals. Ideally manual labour should be used to reduce the risk of contamination of the watercourse and soil compaction.
- Dispose of the eradicated plant material at an approved solid waste disposal site.
- Only indigenous plant species naturally occurring in the area should be used during the rehabilitation of the areas affected by the construction activities.

Maintenance:

- Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge. Monitoring should continue for at least two years after construction is complete.

Cumulative impacts: The removal and sustained low or no infestation with alien invasive species will have a positive cumulative impact as the seed source of these species within the area will be reduced.

Residual Risks: If alien invasive species monitoring is not maintained, the cleared areas could become infested again.

6.2.6 Clearing of land for construction camps and potential pollution of the soil and water

Nature: These may be at one or several locations, area will be cleared and levelled where necessary, site offices may be temporary structures, machinery, building supplies and temporary staff facilities (excluding accommodation) will be housed here. The impacts could include:

- Removal of vegetation
- Levelling and compaction of soils
- Storage of machinery, supplies and staff facilities

This could lead to the loss of vegetation, alteration and loss of microhabitats, altered vegetation cover, increased erosion and contamination of soil and groundwater.

	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Probable (3)	Improbable (2)
Duration	Medium-term (3)	Short-term (2)
Extent	Local Area (2)	Site bound (1)
Magnitude	Moderate (6)	Low (4)
Significance	**33 (moderate)**	**14 (low)**
Status (positive or negative)	**Negative**	**Negative**
OPERATIONAL PHASE		
Probability	Probable (3)	Improbable (2)
Duration	Short-term (2)	Very short-term (1)
Extent	Local Area (2)	Site bound (1)
Magnitude	Moderate (6)	Low (4)
Significance	**30 (Moderate)**	**12 (low)**
Status (positive or negative)	**Negative**	**Negative**
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	Not Applicable	Not Applicable
Can impacts be mitigated?	Reasonably	

Mitigation:

Planning:

- Construction camps must not be located within the buffer to moist grassland vegetation. If the defunct power station is used, place activities as far from the watercourse as possible and prevent edge effects.

Construction:

- Prevent spillage of construction material and other pollutants, contain and treat any spillages immediately, strictly prohibit any pollution/littering. Ensure there is a method statement in place to remedy any accidental spillages immediately.
- No open fires may be lit for cooking or any other purposes, unless in specifically designated and secured areas
- No vehicles may be washed on site, except in suitably designed and protected areas
- No vehicles may be serviced or repaired on the property, unless it is an emergency in which case adequate spillage containment must be implemented

Operational:

• Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge. Monitoring should continue for at least two years after construction is complete.
Cumulative impacts: Pollution of the watercourses
Residual Risks: Compaction on construction camps could result in altered topsoil characteristics and vegetation composition. These areas are also prone to invasion by alien invasive plant species.

6.2.7 Exposure to erosion and subsequent sedimentation or pollution of proximate watercourses

Nature: The removal of surface vegetation will expose the soils, which in rainy events would wash down into the watercourses, causing sedimentation. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully and seeds from proximate alien invasive plant species can spread easily into these eroded soils. After construction, a lack of rehabilitation or failed rehabilitation will result in bare soils that are susceptible to erosion. Furthermore, maintenance vehicles could disturb rehabilitated areas which could lead to soil erosion, habitat modification, and trampling of vegetation. The sources of this impact include:

- Removal of vegetation in proximity to the moist grassland, without proper rehabilitation or failure of rehabilitation;
- Access roads, especially on slopes, channels rainfall and causes erosion;
- Lack of rehabilitation or failed rehabilitation;
- Maintenance vehicles disturbing rehabilitated areas;
- Spillages of construction material and harmful chemicals; and
- Failure of rehabilitation of the construction footprint.
- Grazing post rehabilitation

	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Highly Probable (4)	Probable (3)
Duration	Medium-term (3)	Short-term (2)
Extent	Limited to Local Area (2)	Limited to site (1)
Magnitude	High (8)	Low (4)
Significance	**52 (medium)**	**21 (low)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Probable (3)	Improbable (2)
Duration	Medium term (3)	Short term (2)
Extent	Limited to Local Area (2)	Limited to the Site (1)
Magnitude	Moderate (6)	Low (4)
Significance	**33 (medium)**	**14 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	Low	Low

Can impacts be mitigated?	Yes

Mitigation:

Construction:

- Do not allow erosion to develop on a large scale before acting.
- Where possible, no construction / activities should be undertaken within the riparian or moist grassland areas. The extent of wetland conditions should be verified by a wetland specialist and no activities should take place within these areas without that a Water Use License was granted by the Department of Water Affairs (DWA) for these activities.
- Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area (DWAF, 2005).
- Runoff from road must be managed to avoid erosion and pollution problems.
- Ensure that runoff from compacted or sealed surfaces is slowed down and dispersed sufficiently to prevent accelerated erosion from being initiated (erosion management plan required)
- Colonisation of the disturbed areas by plants species from the surrounding natural vegetation must be monitored to ensure that indigenous vegetation cover is enough within one growing season. Due to the high degree of invasive species in the area, active rehabilitation e.g. hydroseeding is recommended, along with an alien invasive management plan.
- Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas.
- After construction clear any temporarily impacted areas of all foreign materials, re-apply and/or loosen topsoils and landscape to surrounding level.

Operational:

- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, livestock and pedestrian access where needed.
- Monitor rehabilitation and ensure that rehabilitated areas do not erode.
- If monitoring finds that indigenous vegetation are not establishing, consult an expert

Cumulative impacts: Erosion from the dam wall can increase sedimentation in already degraded watercourses. However, this could be mitigated. Possible contamination of wetlands and/or groundwater reserves due to hydrocarbon or other spillage and an increase of modified areas (together with surrounding developments) that will affect flora population dynamics and runoff patterns

Residual Risks: None

7. CONCLUSION

The site comprised mainly of invasive and exotic vegetation, degraded from the natural state of Soweto Highveld Grassland. Built-up areas and gardens that are present within the 100m buffer mapped around the dam, are irreversibly modified from the reference state of Soweto Highveld Grassland and are not considered sensitive to the proposed development. However, edge effects into the nearby watercourses must be prevented.

The secondary grassland forms part of an ESA which increases its sensitivity rating. Impact on the grassland can be minimised and mitigated as the grassland is not considered sensitive, although impacts to the adjacent watercourses must be mitigated.

The Orlando dam vegetation is not sensitive *per se*, however, it plays a valuable role in soil stabilisation and flood attenuation. The vegetation is degraded and modified and its sensitivity rating as medium is mainly due to its functional role, as well as the statutory protection of watercourses.

The proposed dam rehabilitation offers the opportunity to clear invasive species from the moist grassland, thereby preventing its spread downstream and re-establishing indigenous species. From a vegetation perspective, the project could have a positive impact if mitigation measures are properly implemented.

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9. GLOSSARY

Alien species Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity

Conservation concern (Plants of..) Plants of conservation concern are those plants that are important for South Africa's conservation decision making processes and include all plants that are Threatened (see **Threatened**), Extinct in the wild, Data deficient, **Near threatened**, Critically rare, Rare and **Declining**. These plants are nationally protected by the National Environmental Management: Biodiversity Act. Within the context of these reports, plants that are provincially protected are also discussed under this heading.

Conservation status An indicator of the likelihood of that species remaining extant either in the present day or the near future. Many factors are taken into account when assessing the conservation status of a species: not simply the number remaining, but the overall increase or decrease in the population over time, breeding success rates, known threats, and so on.

Critically Endangered A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

Data Deficient There is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. However, "data deficient" is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.

Declining A taxon is declining when it does not meet any of the five IUCN criteria and does not qualify for the categories Threatened or Near Threatened, but there are threatening processes causing a continuous decline in the population (Raimondo *et al*, 2009).

Edge effect Inappropriate influences from surrounding activities, which physically degrade habitat, endanger resident biota and reduce the functional size of remnant fragments including, for example, the effects of invasive plant and animal species, physical damage and soil compaction caused through trampling and harvesting, abiotic habitat alterations and pollution

Endangered A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future

Exotic species Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity

Forb	A herbaceous plant other than grasses.
Indigenous	Any species of plant, shrub or tree that occurs naturally in South Africa
Invasive species	Naturalised alien plants that have the ability to reproduce, often in large numbers. Aggressive invaders can spread and invade large areas
Irreversibly modified	An ecological condition class in which the ecosystem has been modified completely, with an almost complete loss of composition and structure. All or most ecosystem function has been destroyed and the changes are irreversible. Can apply to a site or an ecosystem.
Mitigation	The implementation of practical measures to reduce adverse impacts
Moderately modified	An ecological condition class in which ecological function is predominantly unchanged even though composition and structure have been compromised. Equates to a fair ecological condition or semi-natural
Natural	Unmodified. No significant changes in composition, structure or function have taken place. Good ecological condition.
Near Natural	Small changes in composition and structure may have taken place, but ecosystem functions are essentially unchanged. Good ecological condition
Near Threatened	A Taxon is Near Threatened when available evidence indicates that that it nearly meets any of the five IUCN criteria for Vulnerable and is therefore likely to qualify for a threatened category in the near future (Raimondo *et al*, 2009).
Protected Plant	According to Provincial Nature Conservation Ordinances or Acts, no one is allowed to sell, buy, transport, or remove this plant without a permit from the responsible authority. These plants are protected by provincial legislation.
Red Data	A list of species, fauna and flora that require environmental protection - based on the IUCN definitions. *Now termed Plants of Conservation Concern*
Semi-natural	Ecological function is predominantly unchanged even though composition and structure have been compromised. Fair ecological condition
Severely modified	An ecological condition class in which loss of composition, structure and ecological function is extensive. The land is in a poor ecological condition.
Species diversity	A measure of the number and relative abundance of species
Species richness	The number of species in an area or habitat

Threatened Threatened Species are those that are facing a high risk of extinction, indicated by placing in the categories Critically Endangered (CR), Endangered (E) and Vulnerable (VU) (Raimondo *et al,* 2009)

Transformation The removal or radical disturbance of natural vegetation, for example by crop agriculture, plantation forestry, mining or urban development.
Transformation mostly results in a serious and permanent loss of biodiversity and fragmentation of ecosystems, which in turn lead to the failure of ecological processes. Remnants of biodiversity may survive in transformed landscapes

Vegetation Unit A complex of plant communities ecologically and historically (both in spatial and temporal terms) occupying habitat complexes at the landscape scale. Mucina and Rutherford (2006) state: "Our vegetation units are the obvious vegetation complexes that share some general ecological properties such as position on major ecological gradients and nutrient levels, and appear similar in vegetation structure and especially floristic composition".

Vulnerable A taxon is Vulnerable when it is not Critically Endangered or Endangered but meets any of the five IUCN criteria for Vulnerable and are therefore facing a high risk of extinction in the wild in the future (Raimondo *et al*, 2009)

APPENDIX A: VEGETATION SENSITIVITY EVALUATION

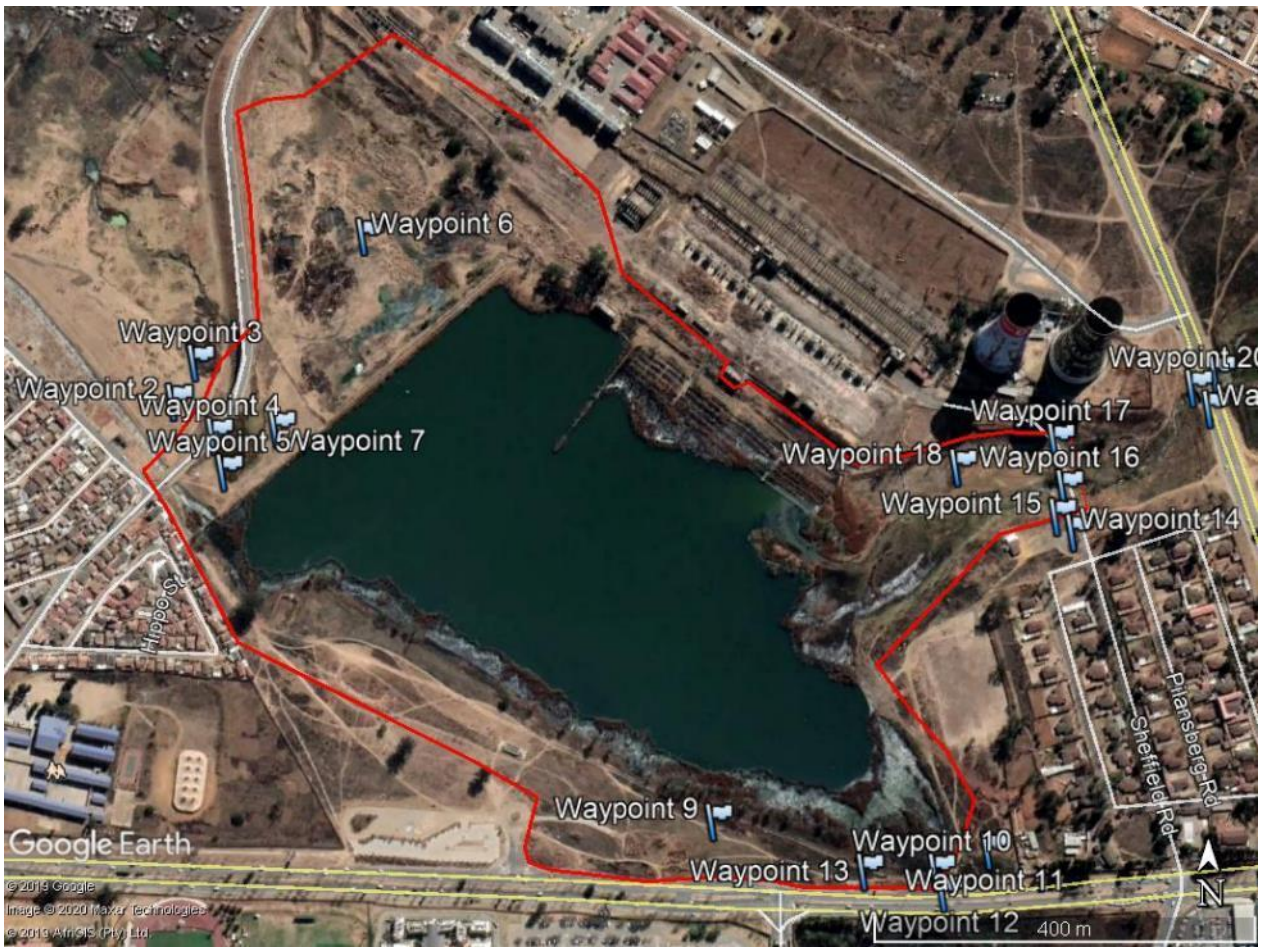


Figure 10: Sample map

The following criteria and weighting were used to determine the vegetation sensitivity, function and conservation importance:

1. The status of the regional vegetation that is expected to occur on the study site, only where natural vegetation is remaining.

Conservation status*	Scoring
Critically Endangered	3
Endangered	2
Vulnerable	1
Least threatened	0

*This scoring is not applicable (N/A) for areas devoid of natural vegetation.

2. Predominant state or condition of the vegetation

Vegetation condition	Scoring
Primary state	3
Sub-climax state	2
Secondary state	1
Pioneer or Degraded state or No natural vegetation remaining	0

3. Whether the vegetation or ecological feature is protected by legislation:

Legislation	Scoring
National legislation	3
Provincial policies and guidelines	2
Municipal or other protection	1
No legislated protection	0

4. The presence of suitable habitat for plants of conservation concern as well as the actual occurrence thereof.

Suitable habitat / presence	Scoring
Confirmed presence of red listed species (Threatened)	3
Confirmed presence of Orange listed (Near threatened, Declining), and Suitable habitat and some likelihood of occurrence of Threatened species	2
Suitable habitat but unlikely to occur	1
No suitable habitat	0

5. Ecological Function: areas important to ecological processes such as ecological corridors, hydrological processes and important topographical features such as ridges.

Ecological function	Scoring
High: Sensitive vegetation communities with low inherent resistance or resilience towards disturbance factors; vegetation that are considered important for the maintenance of ecosystem integrity. Most of these vegetation communities represent late succession ecosystems with high connectivity with other important ecological systems.	3
Medium to high: Vegetation communities that occur at disturbances of low-medium intensity and representative of secondary succession stages with a high degree of connectivity with other ecological systems OR disturbed vegetation connected to an ecological and protected system e.g. ridge, wetland or river	2
Medium: Vegetation communities that occur at disturbances of low-medium intensity and representative of secondary succession stages with some degree or limited connectivity with other ecological systems	1
Low: Degraded and highly disturbed vegetation with little ecological function	0

6. Conservation Importance: indication of the necessity to conserve areas based on factors such as the importance of the site on a national and/or provincial scale and on the ecological state of the area (degraded or pristine). This is determined by the presence of a high diversity, rare or endemic species and areas that are protected by legislation.

Ecological importance	Scoring
High: Ecosystems with high species diversity and usually provide suitable habitat for several threatened species. OR protected ecosystems e.g. wetlands, riparian vegetation etc. These areas should be protected	3
Medium to high: Ecosystems with intermediate levels of species with the possible occurrence of threatened species	2
Medium: Ecosystems with intermediate levels of species diversity without any threatened species.	1
Low: Areas with little or no conservation potential and usually species poor (most species are usually exotic).	0

Weighting scores

Scoring	Sensitivity	Explanation
13-18	High	• Development within these areas is not supported. • Impacts are difficult to mitigate, if at all • Such features usually protected by legislation or guiding policies.
12	Medium-high	• Development within these areas is undesirable and impacts are difficult to mitigate, if at all. • Impacts must be avoided or managed by an ecological management plan
7-11	Medium	• Development within these areas could proceed with limited impact to sensitive vegetation, provided that appropriate mitigation measures are taken. • High impact developments should be considered with caution, if at all. Development must be restricted in footprint and impacts managed and mitigated by an approved management plan. Edge effects to higher sensitivity classes in its proximity must be mitigated / prevented.
6	Low-medium	• Developable areas that are connected to sensitive features. • Edge effects must be presented.
0-5	Low	• Most types of development can proceed within these areas with little to no impact on conservation worthy vegetation. Edge effects to other proximate sensitivity classes must be mitigated / prevented.

APPENDIX B: PLANTS SPECIES RECORDED

1= species recorded

Species	Common name	Habitat notes	Watercourse	Moist grassland	Modified grassland
Trees					
Combretum erytrohyllum	River Bushwillow	Grassland and bushveld, usually along rivers or streams		**1**	
Total number of tree species = 1			**0**	**1**	**0**
Grasses					
Avena fatua	Common wild oats	Disturbed areas e.g. road reserves, fallow lands, dumping sites, usually in moist conditions.		1	
Cynodon dactylon	Couch grass	Most soils, usually in disturbed areas. Increaser II grass, palatable		1	1
Cynodon nlemfuensis	Star Grass	Well adapted to any soils, grows mostly on disturbed land such as road reserves and old fields. Propagate by runners		1	1
Digitaria eriantha	Finger Grass	Sandy, rocky soil in arid areas or next to rivers/vlei's in areas with higher rainfall. Planted for pasture			1
Enneapogon cenchroides	Nine-awned Grass	Distrubed veld in sandy and rocky soils. Increaser II grass			1
Eragrostis cilianensis	Stink Love Grass	Disturbed areas, usually where water accumulates		1	
Eragrostis curvula	Weeping Love Grass	Mostly occurs in disturbed areas / sown as pasture. Increaser II grass		1	1
Eragrostis inamoena	Tite Grass	Moist areas such as marshes, vlei's and drainage lines. Increaser II grass		1	
Eragrostis plana	Tough Love Grass	Disturbed areas, mostly in moist patches. Increaser II grass		1	

Species	Common name	Habitat notes	Watercourse	Moist grassland	Modified grassland
Eragrostis trichophora	Hairy Love Grass	Disturbed areas, mostly in shallow and rocky soil, but also where rainwater accumulates		1	1
Hyparrhenia hirta	Common Thatching Grass	Well drained, rocky soil in open grassland and disturbed areas. Increaser I grass		1	1
Melinis repens	Natal Red Top	Disturbed grassland. Increaser II grass.		1	1
Panicum repens	Couch Panicum	Often grows where water accumulate in the rainy season. Decreaser grass		1	
Paspalum dilatatum	Dallis Grass	Introduced grass, moist areas in vlei's and close to rivers. Sometimes planted for pasture	1	1	
*Pennisetum clandestinum**	Kikuyu	Disturbed, moist areas.		1	1
Phragmites australis	Common Reed	Grows close to water sources such as rivers and wetlands.	1		
Poa annua	Annual blue grass	Disturbed, moist and or shady areas		1	
Urochloa mosambicensis	Bushveld Signal Grass	Disturbed areas such as farmland, also in compacted soils. Good grazing grass. Increaser II		1	1
Urochloa panicoides	Garden Urochloa	Disturbed areas, farmed land and moist areas.		1	1
Total number of grass species = 19			**2**	**16**	**11**
Shrubs / Forbs					
Centella asiatica (M)	Marsh Pennywort	Marshes, vlei's.		1	
Cleome gynandra	African	Plains, roadsides			1

Species	Common name	Habitat notes	Watercourse	Moist grassland	Modified grassland
	cabbage				
Convolvulus sagittatus subsp sagitatus		Grassland, bushveld			1
Conyza podocephala		Roadsides and disturbed grasslands		1	
Delosperma herbeceum	Highveld White Vygie	Grassland, disturbed areas			1
Felicia muricata		Grassland, proliferating in overgrazed/disturbed places			1
Gomphocarpus fructicosus	milkweed	Grassland, often along roadsides and abandoned cultivated fields, disturbed areas.			1
Lactuca inermis	Wild lettuce	Grassland and disturbed areas.		1	1
Nidorella anomala		Grassland, often occurring in groups in moist areas.		1	
Nidorella hottentottica		Grassland, often along roadsides. Sometimes in moist areas		1	
Ocimum cf americanum	Wild basil	Mixed woodland, tends to spread into disturbed areas			1
Salvia disermas	Large Blue Sage	Along temporary watercouses and roadsides in the dry interioir of the country		1	1
Selago densiflora		Grassland and bushveld.			1
Senecio inaequidens	Canary weed	Grassland, often in overgrazed and disturbed places.			1
Senecio isatideus	Dan's Cabbage	Moist grassland, usually in groups in vlei's.		1	
Tribulus terrestris	Common Devil's Thorn	Spreading weed in disturbed places			1

Species	Common name	Habitat notes	Watercourse	Moist grassland	Modified grassland
	/ Dubbeltjie				
Total number of forb species = 16			**0**	**7**	**11**
Sedges					
Cyperus congestus		Depressions in grassland, damp and temporary wet areas, ditches		1	
Cyperus esculentus		Weedy exotic in marshy or ploughed areas		1	1
Cyperus rotundus subsp rotundus	Purple nut-sedge	Moist areas, weedy in culitvated areas	1	1	
Juncus effusus	Soft Rush	Wetland, swampy areas and streambeds	1		
Schoenoplectus corymbosus		Marshy grassland, forming stands. Edge of rivers		1	
*Typha capensis**	Bulrush	Grows in marshy areas and along watercourses.	1	1	
Total number of sedge species = 6			**1**	**6**	**2**
Alien / Invasive Species					
Amaranthus hybridus	Common Pigweed	Disturbed areas		1	1
Araujia sericifera	Moth catcher	Category 1b			1
Argemone ochroleua	Mexican Poppy (White)	Category 1b			1
Bidens pilosa	Blackjack	Widespread, naturalised weed.			1
Canna spp	Canna	Weed in drainage lines and riparian areas		1	
Chenopodium carinatum	Green goosefoot	Weed, particularly in vegetable crops		1	
Cirsium vulgare	Scotch Thistle	Category 1b (NEMBA) Biennial		1	

Species	Common name	Habitat notes	Watercourse	Moist grassland	Modified grassland
Cichorium intybus subsp intybus	Chicory	Perennial weed			1
Conyza albida	Tall Fleabane	Weed			1
Cuscuta suaveolens	Fringed Dodder	Category 1 (CARA), parasitic plant			1
Datura stramonium (M)	Thorn-apple / Olieboom	Category 1b			1
Eucalyptus camaldulensis	Red River Gum	Category 1b		1	
Fallopia convolvulus	Climbing Knotweed	Invader specie			1
Flaveria bidentis	Smeltersbush	Grassland, usually in moist areas. Declared Category 1b invader (NEMBA)		1	
Galinsoga parviflora	Knopkruid	Cosmopolitain weed in disturbed places		1	1
Gomphrena celosiodes	Prostrate Globe Amaranth	Cosmpolitain Weed			1
Guilleminea densa	Carrot weed	Weed along roadsides, disturbed areas			1
Hibiscus trionum	Bladderweed	Invasive weed in disturbed places.			1
Hypochaeris radicata	Hairy Wild Lettuce	Weed in gardens and waste places		1	1
Ipomoea purpurea	Morning Glory	Invader, Category 1b			1
Ligustrum japonicum	Privet	Category1 b	1		

Species	Common name	Habitat notes	Watercourse	Moist grassland	Modified grassland
Limonium sinuatum	statice	Weed along roadsides and disturbed areas			1
Melia azedarach	Syringa	Category 1b (3 in urban areas)		1	
Melilotus indica	Yellow Sweet Clover	Invades streams and in cultivated or disturbed areas		1	
Melilotus alba	Bokhara Clover	Naturalised weed in disturbed places. Grown as fodder plant		1	
Mirabilis jalapa	Four-o'clocks	Category 1b invader		1	
Morus alba	Mulberry	Invader, Category 3		1	
Nasturtium officinale (was Rorippa nasturtium-aquaticum)	Watercress	Live in water, but rooted in soilCategory 2		1	
Oenothera stricta	Yellow Evening Primrose	Weed along roadsides and disturbed areas	1	1	
Pennisetum clandestinum	Kikuyu Grass	Category 1b in wetlands and protected areas	1	1	1
Persicaria lapathifolia	Spotted Knotweed	Invasive weed	1	1	
Persicaria serrulata	Snake root	Invades moist and swampy places		1	
Pinus spp.	Pines	Invaders. Category 2, transform landscape and reduce carrying capacity			1
Plantago lanceolata	Narrow-leaved	Introduced weed, usually in disturbed places		1	1

Species	Common name	Habitat notes	Watercourse	Moist grassland	Modified grassland
	Plantain				
Prunus persica	Peach tree	Exotic species		1	
Prunus armeniaca	Apricot				1
*Pseudognaphalium luteo-album**	Cud Weed	Moist places in grassland.		1	1
Rapistrum rugosum	wild mustard	Waste places and roadsides			1
Raphanus raphanistrum	Wild Radish	Native to Europe, weed in moist places		1	
Ricinus communis vat communis	Castor Oil	Category 2 that invade moist areas, roadsides and waste lands		1	
Rumex acetosella subsp angiocarpus	Sheep sorrel	Weed in disturbed areas			1
Salix babylonica	Weeping Willow	Category 2 Invader per the CARA legislation , although this specie is not listed in the NEMBA list. The spreading root mass can reduce the depth of waterways thereby increasing the risk of flooding	1	1	
Schkuhria pinnata	Dwarf Marigold	Weedy annual herb from S America			1
Solanum mauritianum	Bugweed	Category 1b		1	
Solanum sisymbrifolium	Wild Tomato	Category 1b			1
Sonchus oleraceus	Sowthistle	Weed, widespread in cultivated areas			1
Tagetes minuta	Khaki Weed	Weed in disturbed places. Has become naturalised and due to the vast amount of seed set, difficult to control		1	1

Species	Common name	Habitat notes	Watercourse	Moist grassland	Modified grassland
Verbascum thapsus (or cultivar of)	Mullein	Herb, emerging invasive			1
Verbena aristegera (=V. tenuisecta)	Fine-leaved Verbena	Garden escape, now naturalised along roadsides and disturbed areas			1
Verbena bonariensis	Wild Verbena	Category 1b (NEMBA)		1	
Verbena officionalis	Verbain	Category 1b (NEMBA)		1	
Verbesina encelioides var encelioides	Wilde Sonneblom	Naturalised, weed from S. America		1	
Total number of alien and invasive species = 51			**5**	**29**	**29**

APPENDIX C: PLANTS OF CONSERVATION CONCERN

The species listed alphabetically below have previously been recorded in the qds and have a likelihood of occurring within the Orlando Dam area. No suitable habitat was present for most of the species listed below.

Species	Conservation status	Habitat notes ***Likelihood of occurrence***	Flowering period
Cineraria longipes	Vulnerable	This specie occurs in grassland amongst rocks and along seepage areas and exclusively on basalt koppies on south facing slopes in association with Pteridium *No suitable habitat on site*	March-May
Dioscorea sylvatica	Vulnerable	Wooded places with fair to reasonably good rainfall (e.g. moister bushveld areas, coastal bush and wooded mountain kloof) *No suitable habitat on site*	Oct-Jan
Gnaphalium nelsonii	Near threatened	Seasonally wet places in grassland and savanna, and along dry watercourses. A poorly known species. It is possibly overlooked, and its resilience to disturbance is not known. The risk of extinction of this species is very uncertain, due to a lack of supporting data, but it is preliminarily assessed as Near Threatened, pending further field studies. *Potential occurrence in moist grasslands, however it was not recorded in walked transects.*	Oct-Dec
Habenaria mossii	Endangered	Occurs in grassland on dolomite. In black or sandy soil. *No suitable habitat on site*	March-April
Hypoxis hemerocallidea	Declining in Gauteng (reclassified to LC nationally)	Occurs in a wide range of habitats,appears to be drought and fire tolerant and can tolerate some disturbance. *Suitable habitat on the site in the modified grassland, however, the ongoing disturbances, including mowing and the potential to be harvested for medicinal purposes, limits the potential of occurrence on the site.*	Sept-March
Khadia beswickii	Vulnerable	Open shallow soil over rocks in grassland. No suitable habitat on site	Jul-April
Lepdidium mossii	*Data deficient - D*	unknown - known from a locality in Nancefield and the Free State. Not enough is known about the distribution, specific habitat or current population status of this species to determine its status.	*unknown*

Species	Conservation status	Habitat notes ***Likelihood of occurrence***	Flowering period
		Potential occurrence on site and in the area, however, limited information is available about the species. This makes it difficult to determine the species potential of occurrence other than suitable habitat was historically present within the Nancefield area.	
Lithops lesliei subsp. lesliei	Near threatened	Primary habitat appears to be the arid grasslands in the interior of South Africa where it usually occurs in rocky places. *No suitable habitat on site*	March-June

APPENDIX D: ALIEN INVASIVE PLANT GUIDELINES

The table below serves to assist the contractor in identifying alien invasive plant species and to recommend some methods of removal and control. This is not a removal and relocation plan, merely a guideline of the category 1b invasive species recoded at the tome of this assessment.

Species identification	Control methods

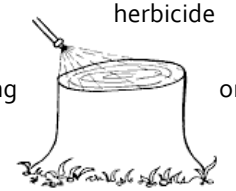
Species identification	Control methods
Araujia sericifera Moth Catcher ☠**Poisonous** • Vigorous climber with milky juice • Dark green leaves: smooth above and pale green or whitish below with short, dense hairs • Flowers are white, cream or pale pink (Nov-April) • Green, spongy fruits which turn brown and woody and split to release numerous • 	<u>Mechanical:</u> Uprooted the plants when small <u>Chemical:</u> Spray young plants (preferably still seedlings) with post-emergence herbicides (e.g. Roundup).

Species identification	Control methods
Argemone ochroleuca Mexican Poppies **☠Whole plant and seeds are poisonous** **Sap and spines are skin irritants** • An annual, spiny herb • Grey or bluish green and spiny leaves with prominent white vein • Stem exude yellow sap when cut • Flowers yellow to creamy white from Sept –Jan  	<u>Mechanical control:</u> These annual weeds can be controlled by shallow cultivation, before flowering and seed set. After rainy events, the plants can be pulled out by hand, but be sure to wear cloves and remove all seeds from the disturbed soils. <u>Chemical control:</u> Young plants can be sprayed with a post-emergence herbicide

Species identification	Control methods
Crisium vulgare Scotch Thistle ☠**Spines may cause skin irritation** • Spiny herbaceous plant; • Leaves are large, flat rosette leaves; dark green with stiff hairs above, white woolly beneath, deeply lobed – lobes ending in strong spines; • Pink-mauve flowers, surrounded by spiny bracts (September to April)   	<u>Mechanical:</u> Hand pull / use garden tools to remove young plants from wetland areas <u>Chemical:</u> Foliar spray: *Confront 360 SL (L7314), Plenum 160 ME (L7702)* <u>Manual control, prevention of further spread:</u> Manually cut and bag flower heads prior to seeding. Destroy the flowers. If already in seed, remove seed heads, bag and burn.

Species identification	Control methods
Cucuta campestris Dodder • Slender, leafless, parasitic plant with yellowish or whitish, twining stems up to 2m high and forming dense patches up to 6m across. • Loose clusters of whitish flowers 3-4mm long from November to April. It has greenish-yellow fruits  	<u>Mechanical R</u>emove small infestations by hand. Mow, prune or burn larger infestations <u>Chemical</u>: Spray herbicide to prevent seeding

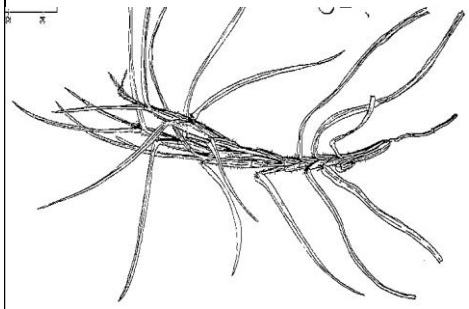
Species identification	Control methods
Datura stromonium Common Thorn-apple / Olieboom ☠**Whole plant and seeds are poisonous** • Annual up to 1.5m tall • Leaves dark green to purple, veins prominent • Flowers white, narrowly funnel-shaped  	<u>Mechanical control</u> Remove whole plant before seed opens, hand pull or use handheld hoe <u>Chemical control:</u> Foliar spray with herbicide (Banvel 480SL).
Eucalyptus camalduensis Blue gums	<u>Mechanical</u> • Removal of whole tree / sapling; or

Species identification	Control methods
• Mainly single-stemmed; • Leaves of the mature plants are lanceolate (thin and tapering) and alternate (not opposite each other) with a waxy or glossy texture and aromatic when crushed; • The bark varies with the age of the plant and can peel in strips  	• *Cut stump:* Stems should be cut as low as possible. Apply the recommended herbicide mixed in water to the cut surface of stumps. NB: Do not spray the sides of the stumps. Apply herbicide mix within 1 hour after felling the cut wound will seal, or.  or • *Frill method:* Use an axe and make angled cuts downward into the cambium layer through the bark in a ring. Cuts should be distributed around the entire stem and herbicide applied into the cuts.  <u>Chemical</u> Herbicide for stump treatment: • *Plenum 160 ME (L7702);* • *Access 240 SL (L4920);* • *Browser 240 SL (L7357)* Apply a solution of 7L herbicide to 100L water to the cambium region immediately after felling.

Species identification	Control methods
Flaveria bidentis Smeltersbush • Erect annual up to about 1m high • Yellowish stems • Leaves opposite, bases of each pair of leaves joined around the stem • Leave margins toothed • Yellow flower heads, flowering all year  	<u>Mechanical control</u> Shallow cultivation with hand-held hoe <u>Chemical control</u> Conventional herbicides such as Round-up or 200 – 250 g Merlin plus either 2,0 – 2,5 Bayer Diuron or 2,0-2,5 kg Karmex DF per hectare
Ipomoea purpurea Morning glory • Herbaceous perennial twiner with hairy stems growing to 3 m or more • Leaves are green, sparsely hairy, oval to heart-shaped • Flowers are purplish-blue, reddish, magenta or white, sometimes with contrasting stripes, funnel-shaped (November-May) • Produce small capsules 	<u>Manual:</u> manually remove the plants and monitor for any re-growth. <u>Chemical:</u> Foliar spray with Glyphosate-isopropylamine_____*(e.g. Mamba, Touchdown etc)*
Ligustrum species	<u>Mechanical is recommended: R</u>emove

Species identification	Control methods
Privet **☠ Seeds are poisonous** • Can grow up to 5m, arching branches • Leaves are elliptic-ovate to elliptic-oblong dark lustrous green above, yellowish green below • Flowers are creamy-white with an unpleasant scent • Round small seeds, black when mature 	the entire tree, being sure to collect any seeds on the ground, bag it and burn. <u>Cut stump method</u>: Cut the stump and paint with Garlon4 immediately on the cut surfaces. Collect any seeds on the ground, bag it and burn. <u>Chemical (only if dense stands of saplings are noted in future)</u>: Spray young trees with Round-up or Garlon 4 as per manufacturer's description
Mirabilis jalapa Four-o'clocks **☠ poisonous** • Perennial herb, up to 2m high with a tuberous root. • Ovate leaves • White pink and sometimes red tubular flowers (November to March). Fragrant in the afternoon. • The fruit is a small, brown, one-seeded capsule. 	<u>Mechanical is recommended: R</u>emove the entire plant, being sure to collect any seeds on the ground, bag it and burn.

Species identification	Control methods
www.durbaninvasvies.org	

Species identification	Control methods
Pennisetum clandestinum Kikuyu grass • Mat-forming perennial grass commonly used in the past for garden lawn • Grass creep by underground stems or runners; • Bright green leaves with short hairs, folded at first then expanded.   	<u>Manual removal:</u> Manually remove where possible. Runners must be dug up – be careful not to let any plant material remain as this will regrow. <u>Chemical:</u> *Focus-Ultra*, a grass specific herbicide can be sprayed. Take care when utilising any herbicide products in or near wetland and riparian areas. Spraying should only be undertaken during dry summer months, on sunny wind free days.

Species identification	Control methods
Ricinis communis Castor Oil ☠**Highly toxic seeds** • Annual, can grow up to 4m tall, shiny big leaves, palmate with 5-9 lobes (fingers), margins serrated, • Flowers: reddish (upper), cream (lower) on stalks • Fruits green, brown or reddish, 3-lobed capsule covered with soft spines  	<u>Mechanical:</u> • Cut stump / Frill method • Large plants can easily be controlled by chopping them out, sensitive to herbicides <u>Chemical:</u> • *Confront 360 SL (L7314):* 200ml / 10 Litres water and 0.5% Wetter & Dye • *Plenum 160 ME (L7702): 100ml / 10 Litres water and 0.5% Wetter & Dye* *Hatchet 100 SL (L7409: 300ml / 10 Litres Water and 0.1% Dye*

Species identification	Control methods
Solanum mauritianum Bug tree/ luisboom **☠ Poisonous** • Grow up to 8m tall • All parts of the plant are hairy except for the older stems • The oval shaped leaves are rather like tobacco leaves with 1-2 smaller leaflets (with no stalks) at the base of each leaf • Leaves emit a strong smell when bruised • Flowers are purple and produced in clusters at the ends of branches Fruits are also borne in clusters of 20-80. Each fruit may have 100-250 seed Fruits are yellow and soft when ripe • Flowers all year round. when removed mechanically, fine hair dislodged from leaves contain toxins that have been blamed for respiratory problems (Wear masks as part of safety clothing)   	Mechanical: by either cutting and painting the remains with herbicide or removing the entire plant. Chemical: Herbicides used include: *Garlon 4 EC (L3249) Confront 360 SL (L7314) Plenum 160 ME (L7702) Roundup Max 680 WG (L6790) Tumbleweed 240 SL (L4781) Mamba 360 SL (L4817)* Biocontrol: The Bugweed Lace Bug (*Gargaphia decoris*) Contact 0800 005 376 or Ivan Riggs (012)3295938 or Mike Menge (013)7551961

Species identification	Control methods
Solanum sisymbrifolium Wild Tomato ☠**Poisonous** • Much-branched, very spiny, low shrub 0.5–1.5 m high, with extensive root system • Covered with sticky, glandular hairs and bright orange-red to brown-yellow spines • Dull green, spiny, leaves that are hairy, deeply pinnately lobed and toothed • Spines mainly on midrib and veins • White, cream or bluish flowers through the year • Shiny berries, green turning bright red  	<u>Chemical:</u> Apply as a full-cover spray to the point of run-off. *Bromoxynil / terbuthylazine 150 / 330 g/ℓ SE. Mix as directed on the label.*

Species identification	Control methods
Verbena bonariense Wild verbena • Erect, growing up to 2m tall • Stems are square in cross-section and rough • Leaves are stalkless and clasping the stem at the base, strongly veined beneath and the margins are sharply toothed. • Flowers are purple, appearing in congested terminal spikes in summer   www.invasives.org.za	<u>Foliar chemical control:</u> Use herbicide BEFORE FLOWERING commences and seeds produced. *Plenum with wetting agents and dyes* If the plant is in flower, spray it first and then cut off the flowers, bag them, and burn. If the flowers have already gone to seed, the flowers should be cut, bagged and burned, and the plants should only be sprayed after the flowers have been removed.

Species identification	Control methods
Verbesina encellioides Wild sunflower • Erect annual herb up to 1 m high. • Belongs to the daisy family Asteraceae. • Leaves are silvery green-hairy above and densely white-hairy beneath, ovate to lanceolate, with coarsely toothed margins. • Yellow, sunflower like flowers in summer • Seeds are winged along the margins  	Mechanical: this is the preferred method in a watercourse. Remove the entire plant. First remove the flowerheads, bag and brunt it. This will prevent seed spreading into the disturbed soils. Pull out entire plant, do not leave parts of the taproot intact or it will regrow. Manual removal efforts must be repeated at least three times over three months to remove ensuing seedlings. Then follow-up monthly. Chemical: use a registered foliar spray but prevent drift and contamination of the watercourse.

APPENDIX E: SPECIALIST QUALIFICATIONS

Curriculum Vitae

Antoinette Eyssell-Knox

Personal Information Summary

Name:	Antoinette Eyssell-Knox
Highest qualification:	MSc Environmental Science (2010), University of Pretoria
Professional membership:	SACNASP Pr Sci Nat (400019/11) Ecological Science
Company:	Dimela Eco Consulting
Contact details:	Antoinette@dimela-eco.co.za
	Tel 083 642 6295

Professional Experience

1. Environmental Management:

I have been working in the field of environmental management as a vegetation specialist since the year 2007 (11 years). I have been self-employed since November 2011.

Nov 2011 – current:	Dimela Eco Consulting
Sep 2007 – Nov 2011:	Strategic Environmental Focus (SEF)

Main field of work and experience include:

- Vegetation assessments, overviews or scans;
- Strategic ecological assessments;
- Ecological management, rehabilitation- and biodiversity action plans (including alien vegetation management);
- Specialist input: Gauteng and North-West Outlook Reports, ecological conditional requirements for Green Star rating;
- Ground-truthing of vegetation related data;
- Review of ecological reports; and
- Mentoring.

2. Environmental Education:

2011 – current:	Writer of the ecology feature for the bimonthly Supernova Kids Magazine
Aug 2003 – Sep 2007:	Snr Environmental Education Officer, South African National Biodiversity Institute (SANBI), Pretoria National Botanical Garden

3. Horticulture

Jun – Jul 2003:	Horticultural Trainer, 7 Shaft Training Centre, Johannesburg
May 1997 – Mar 2002	Horticulturist, Pretoria National Botanical Garden (then NBI, now SANBI)

Qualifications

- M.Sc Environmental Science, University of Pretoria (2010)

Dissertation: *Land cover change and its effect on future land uses*

- B. Sc (Hons) Horticulture, University of Pretoria (1999-2000)

Dissertation: *Horticultural uses of the indigenous Barleria species*

- B. Sc (Agriculture) Horticulture, University of Pretoria (1993-1996)

Memberships and Affiliations

SACNASP: Registered as a Professional Natural Scientist in the field of ecology since 2011 (Reg no 400019/11)

Botsoc: Member of the Botanical Society of Southern Africa since 2013

Course History

2018: Asteraceae Identification Course

2015: SAGIC Invasive Species Consultant Training

2012: Tools for Wetland Assessment (Rhodes University – September 2012)

2012: Landscape Functional Assessment, introductory workshop with David Tongway and Prof Klaus Kellner (North West University)

2012: Soil Classification and Wetland Delineation (Terra Soil)

2007: ISO 14000 Advanced EMS Auditors Course (SGS & University of Pretoria)

2007: Introduction into Forestry Stewardship Council (FSC) (University of Pretoria)

2006: Permaculture training course (S.E.E.D)

2005: Project Management Course (Wildlife and Environment Society of South Africa (WESSA) Umgeni Valley)

2004: Grass and plant identification courses

Presentations

July 2007: Environmental Education in a changing world, World Environmental Education Conference (WEEC), Durban

Sept2006: Environmental Education, BGCI Conference, Oxford England

Selected Project Experience (2011 onwards)

1. <u>Provincial Environmental Outlook Reports</u>

2017-2018: Vegetation input: Gauteng Outlook Report

in process: Vegetation input: North-West Outlook Report

2. <u>Open Space Planning</u>

Nov 2015: The proposed Kaalspruit Open Space Project, Thembisa, Gauteng. Kaalspruit River Rehabilitation Biodiversity Scan: (NuLeaf Planning and Environmental)

2015-2016: City of Johannesburg Open Space Planning – vegetation input for Linbro Park, Bassonia, Kyalami and Ruimsig areas (Iggdrasil)

3. Management- and Rehabilitation Plans

April-May 2012: Vegetation base line study and input into Biodiversity Action Plan for Kumba Iron Ore (Lidwala Consulting Engineers)

Jan 2015: Environmental Management Plan for the Krugersdorp Nature Reserve – vegetation section

Jan 2016: Tharisa Mine Railway Line – Vegetation rehabilitation plan (Limosella Consulting)

Sept 2016: General vegetation rehabilitation plan for the proposed Mezo Kitchens Panel Processing Facility (Shangoni)

Nov 2016: General Ecological Rehabilitation and Monitoring Plan for the N4 additional lane between: R52 Koster offramp & D1325 Marikana Interchange; and The R512 (Brits West Interchange) & K67 (Ga-Rankuwa Interchange) North West and Gauteng Provinces

Nov 2016: Biodiversity Management Plan: Afrisam (Sa) (Pty) Ltd, Dudfield Cement – vegetation input

June 2017: Rehabilitation planning for the Klip- Lower and Upper Rietspruit Water Management Units (Pregio, via Limosella Consulting)

Dec 2017: Eskom underground cable river crossings – vegetation input into rehabilitation plants (Envirolution)

4. Linear Infrastructure

March 2012: Kranspoort road upgrade Protected tree identification (Lidwala Consulting Engineers)

Oct 2012: Eskom: Perseus to Gamma Vegetation assessment (Mokgope Consulting)

March 2013: Diepsloot Eskom line and substation, Johannesburg (Envirolution)

Nov 2013: Masa Ngwedi 750kV and 400kV lines (Limpopo & North-West Provinces) Section D & E Vegetation Input for EMP (Mandara Consulting)

2013-2014 Eskom: Northern Alignments (Perseus in the Northern Cape to Juno in the Western Cape) (Mokgope Consulting)

Feb 2014: Meteor substation, as well as the 88kV line between the Pulsar, Meteor and Sonland substations, Sebokeng, (Nsovo Environmental Consulting)

Dec2014: Upgrading of Internal Roads in Stinkwater, Hammanskraal (Gauteng) (GladAfrica)

Sept 2015: Railway Siding for GCMC Open Cast Mine, Lephalale (Limpopo)

Feb 2016: N4 - Additional lane between Brits and Rustenburg (Environamic)

Nov 2016: Aggeneis-Paulputs 400kV Powerline and Substations Upgrades

Feb 2017: Proposed Lulamisa to Diepsloot East to Blue Hills to Crowthorne 88kv Power Line / Cable and 2 Substations Gauteng (Envirolution)

May 2017: Proposed 132 kV Powerline Between Fochville Municipal Substation and an Existing Line, Gauteng Province (Envirolution)

5. Solar Developments

January 2012: Schmidsdrift, Northern Cape Vegetation Assessment for Solar Panels (Nuleaf)

Aug 2015: Proposed Construction of A 75mw Solar Energy Facility Project, Limpopo Tshikovha Environmental and Communication Consulting

6. Mining

April 2012:	Rietfontein Open Cast Vegetation assessment (Cabanga Concepts)
Jan 2013:	Vierfontein Colliery Vegetation assessment and EMP input (Cabanga Concepts)
Jan 2017:	G&W Base and Industrial Minerals Koppies Betonite Mine Vegetation Assessment & Management Input Report (Cabanga Concepts)

7. Other Development

Dec 2013:	Marekele Bush camp – vegetation & fauna assessments (NuLeaf)
May 2013:	Komati Power Station – Coal stockyard (Envirolution)
April 2014:	Blesboklaagte & Leeupoort Township development (Shangoni)
May 2014:	Goldi Farm Composting Site, Section 24G Fauna and Flora assessment and Summary document (Shangoni)
Feb 2015:	TOPIGS: Proposed Piggery,Mpumalanga(Shangoni)
May 2015:	Kwaggasrant Recycling Facility Upgrade (Shangoni)
Oct 2016:	Proposed piggery on portion 139 of the farm Honingnestkrans 269JR Vegetation and Fauna investigation (Methale Environmental Consulting)
Oct 2017:	Ongoing Clinic Development & Proposed Emergency Medical Services Facility on Prt 79 of the farm De Wagendrift 417 JR Gauteng Province. (Methale Environmental Consultants)

8. Plant relocation and monitoring

April 2014:	Relocation of *C bulbipermum,* overlooked Colliery in Mpumalanga (Cabanga Concepts)
Feb 2017:	Monitoring report for the relocated *Crinum bulbispermum* at Overlooked Colliery
May 2017:	Relocation of protected plant species: Evander Mine
Feb 2018:	Monitor populations of the Critically Endangered *Chlorophytum radula* at the Woodbush Plantation, Limpopo.

9. International:

Oct 2009:	Tatu, Nairobi: Vegetation Assessment (Kenya) (Lokisa Environmental Consulting)
Sept 2014:	Vegetation input to the Regional Environmental and Social Assessment of Coal-based Energy Projects along the South Africa- Botswana Border (World bank Project, Mott MacDonald)

10. Mentorship:

May 2017:	Technical Peer Review of the vegetation section for the Emfuleni Bulk Water Supply Pipelines: Ecological Assessment. GIBB Engineering & Architecture (Pty) Ltd
Nov 2017:	Mentorship and Technical Peer Review of the vegetation section for the Merensky-Kennedy Powerline: vegetation assessment GIBB Engineering & Architecture (Pty) Ltd