Century Property Development

Wetland Delineation

OLIFANTSFONTEIN FILLING STATION,
GAUTENG, SOUTH AFRICA

By
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1 INTRODUCTION

The Biodiversity Company was commissioned to identify, delineate and assess selected wetland areas associated with the proposed Olifantsfontein filling station project area, adjacent to Midrand at the intersection of Olifantsfontein Road and the N1 in Gauteng.

Wetland delineation focussed on the surface extent of the study site, which is approximately 6ha, with the surrounding areas being delineated and discussed at a desktop level. A general wetland desktop assessment was conducted, whereby a 500m buffer of the project area was considered for the identification of any potential wetland areas.

The wetland delineation was conducted in accordance with document titled, “A practical field procedure for identification and delineation of wetlands and riparian areas (DWAF, 2005)”, The assessment was carried out to delineate and assess any wetland areas within the study site, demarcating the presence and extent (boundary) of any wetland areas.

Taking into consideration that the area is extensively cultivated, the implementation of the four wetland indicators was inhibited, with Soil Wetness and Soil Form both primary considerations for the study.

1.1 TERMS OF REFERENCE

The biodiversity assessment requirements by the Gauteng Department of Agriculture and Rural Development (GDARD) (2014), were considered for the study. The specific requirements that were considered for this study include the following:

- The wetland delineation procedure must identify the outer edge of the temporary zone of the wetland, which marks the boundary between the wetland and adjacent terrestrial areas and is that part of the wetland that remains flooded or saturated close to the soil surface for only a few weeks in the year, but long enough to develop anaerobic conditions and determine the nature of the plants growing in the soil;
- Delineation must be undertaken according to “DWAF, 2005: A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones”;
- Locating the outer edge of the temporary zone must make use of four specific indicators including the terrain unit indicator, the soil form indicator, the soil wetness indicator and the vegetative indicator;
- The wetland and a protective buffer zone, beginning from the outer edge of the wetland temporary zone, must be designated as sensitive in a sensitivity map;
- The present ecological state of the wetland; and
- The impacts which are likely to occur due to the proposed development, and recommendations to avoid or minimize such impacts.

1.2 LIMITATIONS

The following limitations are noted for the study:

- The area has been disturbed by varying activities, some of which include dumping, excavation, roads and development which may impede the application of the four wetland indicators, this may inhibit the accuracy of the
delineated areas. A Google Earth image depicting the level of disturbance is presented in Figure 1;

- The survey was conducted during the dry season, with portions of the project area being burnt, as a result of this the implementation of vegetation to aid the delineation of wetland areas was inhibited to some extent;
- The stormwater systems associated with the Olifantsfontein Road and N1 intersection have diverted stormwater to the project area, which has created signs of wetness, but these areas were assessed with caution to identify and assess natural wetland systems;
- Only a high-level site development plan was made available at the time of compiling this report, with no details pertaining to expected project activities, and as a result of this, a general risk assessment has been completed for this study; and
- Wetland systems identified at desktop level within 500 m of the project area were considered for the identification and desktop delineation, with wetland areas within the project area being the focus for ground truthing.

![Figure 1: A Google Earth image (09/13/2011) depicting the level of disturbance associated with the project area](image.png)

2 KEY LEGISLATIVE REQUIREMENTS

2.1 NATIONAL WATER ACT (NWA, 1998)

The DWS is the custodian of South Africa’s water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (NWA) (Act No. 36 of 1998) allows for the protection of water resources, which includes:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an
ecologically sustainable way;
- The prevention of the degradation of the water resource; and
- The rehabilitation of the water resource.

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; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The NWA recognises that the entire ecosystem, and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS. Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i).

However, according to General Notice 1199 as published in the Government Gazette No. 32805 of 2009, it must be noted that as defined by the Replacement General Authorisation in terms of Section 39 of the National Water Act, on account of the extremely sensitive nature of wetlands and estuaries, the section 21(c) and (i) water use General Authorisation does not apply to:
- Any wetland or any water resource within a distance of 500 m upstream or downstream from the boundary of any wetland; and
- Any estuary or any water resource within a distance of 500 m upstream from the salt mixing zone of any estuary.

For the purposes of this project, a wetland area is defined according to the NWA (Act No. 36 of 1998): “Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”.

It must be noted that the NWA definition is not concerned with marine systems and clearly distinguishes wetlands from estuaries, classifying the latter as a water course (SANBI, 2009). Wetlands therefore have one or more of the following attributes to meet the NWA wetland definition (DWAF, 2005):
- A high water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil;
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils; and
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).
2.2 NATIONAL ENVIRONMENTAL MANAGEMENT ACT (NEMA, 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Environmental Impact Assessment (EIA) Regulations (No R. 982, 983, 984 and 985) as amended in December 2014, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This project will follow the Environmental Impact Assessment (EIA) process.

In accordance with the NEMA and the abovementioned regulations (No R 982), this specialist report attempted to contain all the information set out in Appendix 6 to these regulations.

3 METHODS

The National Wetland Classification System (NWCS, 2010) developed by the South African National Biodiversity Institute (SANBI) was considered for this study. This system comprises of a hierarchical classification process, defining a wetland based on the principles of the hydro geomorphic (HGM) approach at higher levels, and further includes structural features at the lower levels of classification (SANBI, 2009).

3.1 WETLAND DELINEATION

The wetland areas are delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 2. The outer edges of the wetland areas are identified by considering the following four specific indicators:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation;
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

Vegetation is used as the primary wetland indicator, which must be present under normal circumstances. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.
Figure 2: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (DWAF, 2005)

3.2 WET-HEALTH

WET-Health is a tool designed to assess the health or integrity of a wetland. Wetland health is defined as a measure of the deviation of wetland structure and function from the wetland’s natural reference condition. This technique attempts to assess hydrological, geomorphological and vegetation health in three separate modules. The ecological status categories and descriptions are provided in Table 1.

Table 1: The PES categories and descriptions for WET-Health (Macfarlane et al, 2008)

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Unmodified, natural</td>
<td>0-0.9</td>
</tr>
<tr>
<td>B</td>
<td>Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.</td>
<td>1-1.9</td>
</tr>
<tr>
<td>C</td>
<td>Moderately modified. A moderate change in ecosystem process and loss of natural habitats has taken place but the natural habitat remains predominantly intact.</td>
<td>2-3.9</td>
</tr>
<tr>
<td>D</td>
<td>Largely Modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.</td>
<td>4-5.9</td>
</tr>
</tbody>
</table>
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.

Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.

### 3.3 RISK ASSESSMENT

The risk assessment was conducted in accordance with the DWS risk-based water use authorisation approach and delegation guidelines.

The matrix assesses impacts in terms of consequence and likelihood. Consequence is calculated based on the following formula:

\[
\text{Consequence} = \text{Severity} + \text{Spatial Scale} + \text{Duration}
\]

Whereas likelihood is calculated as:

\[
\text{Likelihood} = \text{Frequency of Activity} + \text{Frequency of Incident} + \text{Legal Issues} + \text{Detection}
\]

Significance is calculated as:

\[
\text{Significance} \times \text{Risk} = \text{Consequence} \times \text{Likelihood}
\]

The significance of the impact is calculated according to Table 2.

**Table 2: Significance ratings matrix**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Class</th>
<th>Management Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 55</td>
<td>(L) Low Risk</td>
<td>Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.</td>
</tr>
<tr>
<td>56 – 169</td>
<td>M) Moderate Risk</td>
<td>Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.</td>
</tr>
<tr>
<td>170 – 300</td>
<td>(H) High Risk</td>
<td>Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.</td>
</tr>
</tbody>
</table>
3.4 FIELD SURVEY AND SEASONALITY

A field survey was performed on 6 June 2016 by a wetland practitioner to identify any potential wetland areas. The timing of the study is considered to be within the dry season.

During the field survey, the proposed development site was covered on foot and augured to obtain samples. The first 50cm of the soil profile was assessed for signs of wetness, but auguring generally went beyond this, or until an impermeable layer was encountered.

3.5 DESKTOP SURVEY

3.5.1 Datasets

The desktop assessment consisted of relevant information as presented by the South African National Biodiversity Institutes (SANBI’s) Biodiversity Geographic Information Systems (BGIS) website (http://bgis.sanbi.org). Wetland specific information resources taken into consideration during the desktop assessment of the study area included:

- Aerial imagery (Google Earth).
- The National Freshwater Ecosystem Priority Areas (NFEPAs).
- The Gauteng Conservation Plan (C-Plan) version 3.3.
- Contour data.

The NFEPAs project was a partnership and collaborative process with research institutes, government departments and experts. The NFEPAs project maps strategic spatial priorities for conserving South Africa’s freshwater ecosystems and supporting sustainable use of water resources (Net et al., 2011). For the wetland NFEPAs, only the actual mapped wetland zone is indicated, not the associated sub-quaternary catchment.

4 RESULTS

4.1 WETLAND DELINEATION

The desktop delineation attempted to identify the location of wetland areas associated with the project area. No FEPA type wetlands were identified either within 500m or in close proximity to the project area. A channelled valley bottom FEPA wetland is associated with the Rietspruit system, this is presented in Figure 3. Contour data and Google Earth imagery were also considered to identify any other potential wetland areas.

The Gauteng C-Plan indicates that the project area is primarily classified as a Critical Biodiversity Area, with smaller portions of Ecological Support Areas delineated by the GDARD in close proximity to the project area. The GDARD information does not provide any information that could be considered for the delineation of wetland areas, other than suggesting that wetlands may be in the general vicinity. The location of the study area in relation to the Gauteng C-Plan is presented in Figure 4.
Critical Biodiversity Areas (CBAs): CBAs include natural or near-natural terrestrial and aquatic features that were selected based on an area’s biodiversity characteristics, spatial configuration and requirement for meeting both biodiversity pattern and ecological process targets. Some CBAs are degraded or irreversibly modified but are still required for achieving specific targets, such as cultivated lands for threatened species. These areas may include such as high priority wetlands and catchments, pan clusters and pans within priority catchments.

Ecological Support Areas (ESAs): Natural, near-natural, degraded or heavily modified areas required to be maintained in an ecologically functional state to support Critical Biodiversity Areas and/or Protected Areas. ESAs maintain the ecological processes on which Critical Biodiversity Areas and Protected Areas depend. These areas may include remaining floodplains, corridors, catchments and wetlands.

Figure 3: The FEPA wetlands that were considered to aid the desktop wetland delineation
The desktop findings were ground truthed and the DWAF (2005) wetland guidelines implemented. Wetland boundaries were ground truthed based on soil forms, soil wetness and vegetation. Photographs of wetland indicators identified for the study are presented in Figure 5. Additionally, for the purpose of the ground truthing exercise, the extent of the wetland areas also considered the following:

- The ability of the systems to receive run-off flow following precipitation events under natural conditions, with limited base flow present for the project area;
- The presence of wetland indicators consistent with the definition of a natural (non-artificial) wetland; and
- Supporting drainage areas (channels) are not consistent with the definition of a channel-associated watercourse due to the absence of a natural channel or channel features that may contain regular or intermittent flow (NWA, 1998, Act No. 36 of 1998).
- Are associated with a watercourse;
- Contain distinctively different plant species than adjacent areas; and contain species similar to adjacent areas but exhibiting more vigorous or robust growth forms; and
May have alluvial soils.

Figure 5: A – Phragmites sp. & Typha capensis. B – Imperata cylindrical. C - Populus sp. D – Soil mottling

All wetland and watercourse features identified within the study area were classified as Inland Systems. Table 3 describes some of the characteristics that form the basis for the classification of the HGM type for the project. The delineated wetland area is presented in Figure 6.
Table 3: Wetland hydro-geomorphic type typically supporting inland wetlands in South Africa and also present within the study area (adapted from Kotze et al. 2007)

<table>
<thead>
<tr>
<th>Hydrogeomorphic types</th>
<th>Description</th>
<th>Source of water maintaining the wetland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valley bottom with a channel</td>
<td>Valley bottom areas with a well defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.</td>
<td>***</td>
</tr>
</tbody>
</table>

Precipitation is an important water source and evapotranspiration an important output in all of the above settings.

Water source:
- *** Contribution usually large
- **/* Contribution may be small or important depending on the local circumstances

Channelled valley bottom wetlands resemble floodplains, however, they are characterized by less active deposition of sediment and also the absence of oxbows and other floodplain features such as natural levees and meander scrolls (Kotze et al., 2007). These systems are generally narrower and have a steeper gradient, with the contribution from lateral groundwater input relative to the main stream channel being generally greater. These systems contribute less towards flood attenuation and sediment trapping. Some nitrate and toxicant removal potential would be expected, particularly from the water being delivered from the adjacent hillslopes.
Figure 6: The delineated wetland area associated with the project area

Figure 7 presents the location of selected soil sample locations which were considered for the delineation of wetland areas. Sample site 22 displayed signs of wetness due to the presence of *Cyperus sp* (vegetation), considered to be a wetland indicator. The site was investigated and the soil profile does not suggest the area to be associated with a wetland. On closer inspection, it appears that a pipeline was broken (or ruptured) during the construction activities on site which may be the source of water for the site. It is the opinion of the specialist that this area is not a wetland system.
Figure 7: The delineated wetland area associated with the project area

A desktop (Level 1) assessment requires that the wetlands are screened to establish whether they are likely to be providing any of the listed hydrological benefits. The hydrological benefits likely to be provided by valley bottom and hillslope seepage wetlands are presented in Table 4.
Table 4: Preliminary rating of the hydrological benefits likely to be provided by the hillslope seepage wetlands

<table>
<thead>
<tr>
<th>HGM Unit</th>
<th>Regulatory benefits provided</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flood attenuation</td>
<td>Stream flow reg.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Early wet</td>
<td>Late wet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valley bottom wetland</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Rating:  
0 Benefit unlikely to be provided to any significant extent  
+ Benefit likely to be present at least to some degree  
++ Benefit very likely to be present (and often supplied to a high level)

4.2 WETLAND HEALTH ASSESSMENT

Three modules, namely hydrology, geomorphology and vegetation, were assessed to ascertain the health of the wetland systems. The health assessment was conducted at desktop level (Level 1), with a site investigation supplementing the study (Level 2). The health assessment was conducted for the delineated wetland area. The current status of the systems was observed, and some notable impacts to the respective systems were identified. Photographs of some of the identified impacts are presented in Figure 8. A brief overview of some of the local impacts to the systems are as follows:

- The development of the area which includes housing developments and road infrastructure have altered the catchment area considerably, resulting in increased run-off velocities and loss of infiltration, and furthermore water diversion for stormwater management.
- The altered hydro-dynamics of the catchment have resulted in the narrowing of wetland areas, and the incision of valley bottom areas.
- The management of stormwater for the catchment has altered the surface hydrology of the associated Rietspruit system.
- The development of the area has also resulted in vegetation areas being cleared, decreasing surface roughness for the area.
Figure 8: Photographs of some identified impacts. A – Channelisation. B - Solid waste disposal. C – Broken services. D – Stormwater inputs

In addition to the desktop assessment, the abovementioned impacts (amongst others) have been taken into account to discuss the health of these systems. The results of this assessment are summarised in Table 5.

Table 5: Summary of the scores for the wetland PES

<table>
<thead>
<tr>
<th>Wetland</th>
<th>Hydrology</th>
<th>Geomorphology</th>
<th>Vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rating</td>
<td>Description</td>
<td>Rating</td>
</tr>
<tr>
<td>Unchannelled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>valley bottom</td>
<td>C</td>
<td>Moderately Modified</td>
<td>C</td>
</tr>
<tr>
<td>Overall PES Class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C: Moderately Modified
The delineated wetland system is in a moderately modified (Category C) state, suggesting a moderate change in ecosystem processes and loss of natural habitats has taken place, however the natural habitat remains predominantly intact. A summary for the status of the three modules is as follows:

- Hydrology: A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.
- Geomorphology: A moderate change in geomorphic processes has taken place but the system remains predominantly intact.
- Vegetation: Composition has been moderately altered but introduced, alien and/or increased ruderal species are still clearly less abundant than characteristic indigenous wetland species.

4.3 BUFFER ZONES

Buffer zones have been used in land-use planning to protect natural resources and limit the impact of one land-use on another. A buffer zone has been prescribed for this project to serve as a “barrier” between the proposed development and the wetland systems that will be traversed by the pipeline.

In the Province of Gauteng, the GDARD requires buffers of 32 m and 100 m to be established for rivers/streams in urban and non-urban settings respectively. Additionally, a buffer zone of 30 m and 50 m (GDARD, 2014) must be allocated to wetland areas inside and outside urban areas respectively.

A method developed by Macfarlane et al. (2014) to define an appropriate buffer width for the proposed project was applied for the study. The proposed buffer zone for the project is presented in Table 6 and Figure 8.

Table 6: The determined buffer zone for the wetland

<table>
<thead>
<tr>
<th>Project Component</th>
<th>Buffer Width (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valley bottom wetland</td>
<td>15</td>
</tr>
</tbody>
</table>

According to the implemented buffer determination method (Macfarlane et al., 2014), the largest threat to the system is increased sediment inputs during the construction phase of the project, with a high risk. Numerous low and very low risk aspects were also identified for the study, these include contaminant inputs during the construction phase, and altered flow regimes and flow patterns. These potential impacts should be specifically considered for mitigation measures. The process has assumed that efforts will be made to mitigate these potential impacts and as a result a buffer width of 15 m is recommended for the wetland area. This recommended buffer area has taken into account the nature of the proposed development and the current ecological status and environmental characteristics associated with the study area.
5 RISK ASSESSMENT

A risk assessment has been conducted for the proposed filling station. No details pertaining to the proposed activities in particular were available, and as a result of this a high-level (or general) assessment has been conducted for the expected risks. The extent and location of the proposed filling station in relation to the delineated wetland area is presented in Figure 9. In addition to this, Figure 9 also presents the extent and location of the planned (New) PWV5 Road Reserve. This road reserve has not been considered for the risk assessment, but should be considered for the WULA process for potential future disturbances to the wetland system. The following summary items are important to consider for the risk assessment:

- The delineated wetlands are in a modified state, numerous disturbances are reason for this. These disturbances include dumping, access routes, stormwater inputs, construction activities and diversion channels.
- Stormwater contributions from the adjacent developments and road networks may have contributed to the increase in extent of the wetland areas.
- The proposed filling station will not impact directly on the wetland system, but the footprint area does encroach into the 15 m buffer zone. As a result of this, no direct losses of wetlands are expected for the project.

The development of the filling station may incur indirect impacts to the wetland systems which are adjacent to the site. In addition to the area already being disturbed, the project area is also likely to be further developed in the future, with the notable inclusion of the PWV5 Road Reserve. The potential impacts expected during the construction phase of the project are expected to be relatively short term, particularly of the wetland area is not demarcated as a no-go area. During the operational phase, there is the potential for ongoing disturbances to the adjacent wetland area due to the fact that the proposed filling station will require the management of stormwater. Findings from the DWS aspect and impact register / risk assessment are provided in Table 7 and Table 8.
Figure 9: The proposed filling station (and new PWV5 Road Reserve) in relation to the wetland system and buffer zone (15m)
### Table 7: The risk identified for the project activities and aspects

<table>
<thead>
<tr>
<th>Activity</th>
<th>Aspect</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction &amp; operation of a filling station</td>
<td>Clearing of areas for infrastructure and laydown yards</td>
<td>Sedimentation of wetlands</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Obstructed / altered hydrology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Impeding interflow</td>
</tr>
<tr>
<td></td>
<td>On-site vehicle and machinery activities</td>
<td>Damage to wetlands (or loss)</td>
</tr>
<tr>
<td></td>
<td>Excavation for foundations and tanks</td>
<td>Contaminated soil profile</td>
</tr>
<tr>
<td></td>
<td>Removal and stockpiling of soils</td>
<td>Impaired water quality</td>
</tr>
<tr>
<td></td>
<td>Compaction of soil profile</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ablutions and waste handling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increased vehicle traffic</td>
<td></td>
</tr>
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</table>
Table 8: The risk assessment conducted for the study.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Flow Regime</th>
<th>Water Quality</th>
<th>Habitat</th>
<th>Biota</th>
<th>Severity</th>
<th>Spatial scale</th>
<th>Duration</th>
<th>Consequence</th>
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<tr>
<td>Clearing of areas for infrastructure and laydown yards</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2.5</td>
<td>3</td>
<td>2</td>
<td>7.5</td>
</tr>
<tr>
<td>On-site vehicle and machinery activities</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Excavation for foundations and tanks</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2.5</td>
<td>3</td>
<td>2</td>
<td>7.5</td>
</tr>
<tr>
<td>Removal and stockpiling of soils</td>
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<td>2</td>
<td>2</td>
<td>1.75</td>
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<tr>
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<td>1</td>
<td>1.25</td>
<td>1</td>
<td>3</td>
<td>5.25</td>
</tr>
<tr>
<td>Ablutions and waste handling</td>
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<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Increased vehicle traffic</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1.5</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Frequency of activity</th>
<th>Frequency of impact</th>
<th>Legal Issues</th>
<th>Detection</th>
<th>Likelihood</th>
<th>Sig.</th>
<th>Risk Rating</th>
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<tr>
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<td>1</td>
<td>5</td>
<td>1</td>
<td>8</td>
<td>60</td>
<td>Moderate</td>
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<tr>
<td>On-site vehicle and machinery activities</td>
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<td>1</td>
<td>5</td>
<td>1</td>
<td>8</td>
<td>48</td>
<td>Low</td>
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<td>1</td>
<td>5</td>
<td>1</td>
<td>8</td>
<td>60</td>
<td>Moderate</td>
</tr>
<tr>
<td>Removal and stockpiling of soils</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>8</td>
<td>46</td>
<td>Low</td>
</tr>
<tr>
<td>Compaction of soil profile</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td>52.5</td>
<td>Low</td>
</tr>
<tr>
<td>Ablutions and waste handling</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>9</td>
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<td>Low</td>
</tr>
<tr>
<td>Increased vehicle traffic</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td>90</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
5.1 MITIGATION MEASURES

The most significant impacts are expected during the construction phase of the project, and these risks are predominantly associated with increased sediment inputs into the wetland system. Mitigation measures include the following.

- The minimum buffer zone 15 m for the wetland area must be adhered too. This buffer zone should be marked to avoid unauthorised encroachment within the buffer area;
- The delineated wetland area and associated buffer must be avoided. The wetland areas should be classified as no-go areas;
- Laydown yards, camps and storage areas must be beyond the wetland and buffer areas. Where possible, existing access routes and walking paths must be made use of, and new routes limited;
- The avoidance and protection of the wetland area must be included into a site induction. Contractors and employees must all undergo the induction and made aware of the wetland areas to be avoided;
- A suitable stormwater management plan must for formulated for the project. The plan must ensure that clean and dirty water are separated, that only clean water is diverted into the wetland system;
- Vegetation should be cleared in a phased approach, minimising the extent of exposed areas. It is recommended that sparsely vegetated areas be cleared first, with the densely vegetated areas being cleared last. Only indigenous vegetation should be used for re-vegetation purposes. Alternatively, it is recommended that vegetation first be cleared on the upper slopes of the catchment, before progressing downslope towards the valley bottom wetland;
- The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
- It is preferable that construction takes place during the dry season (if possible) to reduce the erosion potential of the exposed surfaces;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel;
- Prevent uncontrolled access of vehicles through wetlands that can cause a significant adverse impact on the hydrology and soil structure of these areas through rutting (which can act as flow conduits) and through the compaction of soils;
- During construction, the preparation of the site and the clearing of areas for infrastructure (e.g. camps, laydown yards etc) will expose topsoil that could be transported to the wetland areas by wind or stormwater, resulting in sedimentation of these systems. These footprint areas should be kept to a minimum and clearly marked for construction;
- Construction activities and vehicles could cause spillages of lubricants, fuels and construction material which could then be transported to the wetland areas, impacting on the water quality and potentially the functioning of the systems. All vehicles and equipment must be maintained, and all re-fuelling and servicing of equipment is to take place in demarcated areas outside of the wetland / riparian and buffer areas; and
- No equipment may be washed within the watercourse, nor may dumping of construction material into the systems take place.
6 CONCLUSION

A channelled valley bottom wetland was identified and delineated for the study. The western section of the project area is traversed by the wetland system, which is associated with the Rietspruit system. The integrity (health) of the delineated wetland system was determined to be moderately modified, and taking into account the assessed wetland system and the proposed activity, a 15 m buffer area was assigned to the wetland area.

The general area has been disturbed considerably, these disturbances include housing developments, road networks and access routes, illegal dumping, construction activities and stormwater management. These have all impacted on and altered the extent and status of the wetland system. In addition to this, a new PWV5 Road Reserve is also planned for the project area which is likely to incur further impacts to the local wetland systems.

A risk assessment was conducted for the project, specifically for the proposed filling station. The filling station will not directly impact on the wetland system, but indirect impacts are expected to result from the project. The significance of risks to the wetland system resulting from the proposed filling station vary from low to moderate. Mitigation measures have been provided to further reduce the significance of the expected risks.
7 REFERENCES

Department of Water Affairs and Forestry (DWAF) 2005. Final draft: A practical field procedure for identification and delineation of wetlands and Riparian areas.


8 APPENDIX

Appendix 1: Specialist Proof of Qualification

Andrew Husted

[Image of SACNASP certificate]
Personal Details
Date of Birth: 19 April 1979
Place of Birth: Johannesburg, South Africa
Nationality: South African
ID No.: 7904195054081
Gender: Male
Race: Caucasian/White
Language Proficiency: English/Afrikaans (basic working proficiency)
Email: andrew@thebiodiversitycompany.com
Website: www.thebiodiversitycompany.com

OVERVIEW
An overview of the specialist technical expertise include the following:

- Aquatic ecological state assessments of rivers and dams.
- Instream Flow Requirement or Ecological Water Requirement studies for river systems.
- Ecological wetland assessment studies, including the integrity (health) and functioning of the wetland systems.
- Wetland offset strategy designs.
- Wetland rehabilitation plans.
- Monitoring plans for rivers and other wetland systems.
- Toxicity and metal analysis of water, sediment and biota.
- Fish telemetry assessment that included the translocation of fish as well as the monitoring of fish in order to determine the suitability of the hosting system.
- Faunal surveys which includes mammals, birds, amphibians and reptiles.
- The design, compilation and implementation of Biodiversity and Land Management Plans and strategies.

TRAINING
Some of the more pertinent training undergone include the following:

- Wetland and Riparian Delineation Course for Consultants (Certificate of Competence) – DWAF 2008
- The threats and impacts posed on wetlands by infrastructure and development: Mitigation and rehabilitation thereof – Gauteng Wetland Forum 2010
- Ecological State Assessment of Lentic Systems using Fish Population Dynamics – University of Johannesburg/Rivers of Life 2010
- Soil Classification and Wetland Delineation – Terra Soil Science 2010
- Wetland Rehabilitation Methods and Techniques - Gauteng Wetland Forum 2011
- Application of the Fish Response Assessment Index (FRAI) and Macroinvertebrate Response Assessment Index (MIRAI) for the River Health Programme 2011
- Tools for a Wetland Assessment (Certificate of Competence) – Rhodes University 2011

PROJECTS

The following project list provides the details of selected studies that I have completed, highlighting the extent of my experience. Providing insight into the various projects, roles and locations I have worked in.

<table>
<thead>
<tr>
<th>Project</th>
<th>Role</th>
<th>Activities</th>
<th>Resource</th>
<th>Client</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kibali Gold Mine, Hydropower Project</td>
<td>Technical specialist</td>
<td>Instream Flow Requirements</td>
<td>Hydropower</td>
<td>Randgold Resources</td>
<td>DRC</td>
</tr>
<tr>
<td>Selebi-Phikwe Economic Diversification Project</td>
<td>Technical specialist</td>
<td>Ecological State Assessment of the Letsibogo Dam</td>
<td>Water (Dam)</td>
<td>European Commission</td>
<td>Botswana</td>
</tr>
<tr>
<td>Biodiversity Management Plans (for five operations)</td>
<td>Project Manager</td>
<td>Technical input &amp; project management</td>
<td>Gold</td>
<td>Randgold Resources</td>
<td>DR Congo, Mali and Ivory Coast</td>
</tr>
<tr>
<td>Biodiversity Management Plans (for six operations)</td>
<td>Project Manager</td>
<td>Technical input &amp; project management</td>
<td>Coal</td>
<td>Anglo American</td>
<td>South Africa (Mpumalanga &amp; Free State)</td>
</tr>
<tr>
<td>Biodiversity Management Plans (for Xstrata Group)</td>
<td>Project Manager</td>
<td>Technical input &amp; project management</td>
<td>Coal</td>
<td>Xstrata Coal South Africa</td>
<td>South Africa (Mpumalanga &amp; KwaZulu-Natal)</td>
</tr>
<tr>
<td>Boikarabelo Biodiversity Management Plan</td>
<td>Project Manager</td>
<td>Technical input &amp; project management</td>
<td>Coal</td>
<td>Ledjadja Coal</td>
<td>South Africa (Limpopo)</td>
</tr>
<tr>
<td>Putu Iron Ore Mine</td>
<td>Project Manager</td>
<td>Project manager</td>
<td>Iron ore</td>
<td>Putu Iron Ore Mine</td>
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</tr>
<tr>
<td>Arnot Colliery Wetland Offset Strategy</td>
<td>Technical specialist</td>
<td>Wetland specialist</td>
<td>Coal</td>
<td>Exxaro</td>
<td>South Africa (Mpumalanga)</td>
</tr>
</tbody>
</table>
EMPILOYEMET EXPERIENCE

CURRENT EMPLOYMENT: The Biodiversity Company (December 2014 – Present)

I founded The Biodiversity Company in 2014 that consist of experienced ecologists who provide technical expertise and policy advice to numerous sectors, such as mining, agriculture, construction and natural resources. The team at The Biodiversity Company have conducted stand-alone specialist studies, and provided overall guidance of studies with a pragmatic approach for the management of biodiversity that takes into account all the relevant stakeholders, most importantly the environment that is potentially affected. We manage risks to the environment to reduce impacts with practical, relevant and measurable methods.

EMPLOYMENT: Digby Wells Environmental (October 2013 – December 2014)

Digby Wells assigned me to the role of Country Manager for the United Kingdom. This was a new endeavour for the company as the company’s global footprint continues to increase. The primary responsibilities for the role included the following:

- **Clint liaison** to be able to interact more efficiently and personally with current mining clients, mining industry service providers, legal firms and banking institutions in order to introduce Digby Wells as a services provider with the aim of securing work.

- **Project management** for international projects which may require a presence in the United Kingdom, this was dependent on the location and needs of the client. These projects would mostly be based on the Equator Principles (EP) and International Finance Corporation (IFC) Performance Standards.

- **Technical input** to provide specialist technical expertise for projects, this included fauna, aquatic ecology, wetlands and rehabilitation. Continued with the design and implementation of Biodiversity and Land Management Plans to
assist clients with managing the natural resources. Responsibilities also included the mentorship and management (including reviewing and guiding) other expertise such as flora, fauna and pedology.

EMPLOYMENT: Digby Wells Environmental (March 2012 – September 2013)
Manager of a multi-disciplinary department of scientists providing specialist services in support of national and international requirements as well as best practice guidelines, primarily focusing on the mining sector. In addition to managing the department, I was also expected to contribute specialist services, most notably focusing on water resources. Further responsibilities also included the management of numerous projects on a national or international scale. A general overview of the required responsibilities are as follows:

- **Project management** for single as well as multi-disciplinary studies on a national and international scale. This included legislation and commitments for the respective country being operated in, as well as included the World Bank (WB), EP and IFC requirements.
- **Individual and/or team management** in order to provide mentoring and supportive structures for development and growth in support of the company’s strategic objectives.
- **Scientific report writing** to ensure that the relevant standards and requirements have been attained, namely local country legislation, as well as WB, EP and IFC requirements.
- **Report reviewing** in order to ensure compliance and consideration of relevant legislation and guidelines and also quality control.
- **Specialist management** to facilitate the collaboration and integration of specialist skills for the respective projects. This also included the development of Biodiversity and Land Management Plan for clients.
- **Client Resource Manager** for numerous clients in order to establish as well as maintain working relationships.

An overview of the tenure working with the company is provided below:

- **October 2013 – December 2014: London Operations Manager** – Deployed to establish a presence for the company (remote office) in the United Kingdom by means of generating project work to support the employment of staff and operation of a business structure.
- **March 2012 – September 2013: Biophysical Department Manager** – Responsible for the development and growth of the department to consist of four specialist units. This included the development of a new specialist unit, namely Rehabilitation.
- **January 2011 - February 2012: Ecological Unit Manager** – In addition to implementing aquatic and wetland specialist services, the role required the overall management of additional specialist services which included fauna & flora.
- **June 2010 - December 2010: Aquatic Services Manager** – This required the marketing and implementation of specialist programmes for the client base such as biomonitoring and wetland off-set strategies. In addition to this, this also included expanding on the existing skill set to include services such as toxicity, bioaccumulation and ecological flow assessments.
- **August 2008: Aquatic ecologist** – Employed as a specialist to establish the aquatic services within the company. In addition to this, wetland specialist services were added to the existing portfolio.
PREVIOUS EMPLOYMENT: Econ@UJ (University of Johannesburg)

- June 2007 – July 2008: Junior aquatic ecologist
  - Researcher
  - Technical assistant for fieldwork
  - Reporting writing
  - Project management

GENERAL SKILLS

**Literacy**
Read, write and speak English fluently. Read, write and speak Afrikaans. Basic German.

**Generic**
Advanced user of Microsoft Office applications.

**Mapping**
Introductory skill level for ArcGIS and Quantum GIS.

ADDITIONAL EXPERIENCE

**Compliance audits**
Conducting site investigations in order to determine the level of compliance attained, ensuring that the client maintains an appropriate measure of compliance with environmental regulations by means of a legislative approach.

**Control officer**
Acting as an independent Environmental Control Officer (ECO), acting as a quality controller and monitoring agent regarding all environmental concerns and associated environmental impacts.

**Screening studies**
Project investigations in order to determine the level of complexity for the environmental and social studies required for a project. This is a form of risk assessment to guide the advancement of the project.

**Public consultation**
The provision of specialist input in order to communicate project findings as well as assist with providing feedback if and when required.

**Water use licenses**
Consultation with the relevant authorities in order to establish the project requirements, as well as provide specialist (aquatics/wetland) input for the application in order to achieve authorisation.

**Closure**
Primarily the review of closure projects, with emphasis on the closure cost calculations. Support was also provided by assisting with the measurements of structures during fieldwork.
The review of visual studies as well as the collation of field data to be considered for the visual interpretation for the project.

ACADEMIC QUALIFICATIONS

University of Johannesburg, Johannesburg, South Africa (2009): MAGISTER SCIENTIAE (MSc) - Aquatic Health:

Title: Aspects of the biology of the Bushveld Smallscale Yellowfish (Labeobarbus polylepis): Feeding biology and metal bioaccumulation in five populations.

Rand Afrikaans University (RAU), Johannesburg, South Africa (2004): BACCALAUREUS SCIENTIAE CUM HONORIBUS (Hons) – Zoology


PUBLICATIONS


Tate RB and Husted A. 2013. Bioaccumulation of metals in *Tilapia zillii* (Gervai, 1848) from an impoundment on the Badeni River, Cote D'Iviore. African Journal of Aquatic Science.

