Supervisory staff will be equipped with the necessary knowledge and information to guide their employees on environmental and social aspects applicable to performing a specific task.

5.4.3.3 Competency Training

The Environmental Coordinator will be responsible for the environmental and social competency and awareness training of Middle Management and supervisors. This training will be performed both on a one-on-one basis and through workshops and presentations.

Competence and the effectiveness of training and development initiatives will be determined through the following methods:

- Trend analysis of incidents reported; and
- Analysis of work areas during visits and audits.

The process to declare competency of personnel is documented in the ISO9001:2000 procedure.

This plan will be amended periodically in light of operational changes, learning experienced during its implementation and other activities that can affect the risk profiles.

5.4.3.4 Training Records

Training can be done either in a written or verbal format but will be in an appropriate format for the receiving audience. Persons having received training must indicate in writing that they have indeed attended a training session and have been notified in detail of the contents and requirements of the ESMP. The attendance registers must be kept on file.

5.4.4 Internal Communication

Internal communication of environmental and social issues to ensure environmental awareness will be achieved by the following means:

- Meetings;
- Memos;
- Notice boards;
- Briefs;
- Reports;
- Monthly themes;
- Daily operational bulletins;
- Newsletters;
- E-mail;
- Telephone; and
- Induction training.

5.4.5 External Communication

An environmental and social forum will be developed and bi-annual meetings hosted to keep stakeholders informed of significant environmental and social aspects associated with the proposed mining project. This forum will provide stakeholders with the opportunity to raise environmental and social issues and concerns. Records will be kept of all issues raised.

5.4.6 Awareness raising

RMC will provide appropriate resources to facilitate social and environmental awareness training during the construction, operational and decommissioning and closure phases of the proposed mining project.

The following methodology will be used to implement and ensure environmental and social awareness:

- Internal Communication;
- Standard Meetings;
- Environmental and Social Talk Topics;
- External Communication;
- Complaints; and
- Training.

5.5 Monitoring and Control

5.5.1 Surface Water Monitoring Plan

A conceptual surface water monitoring plan has been developed and potential monitoring points identified (**Figure 5-4**). The surface water monitoring system consist of the following components:

- Surface water quality monitoring system;
- Surface water flow monitoring system; and
- Data and information management system.

5.5.1.1 Parameters to be measured and frequency of measurements

There are two sets of monitoring parameters. A comprehensive analysis must be conducted on surface water points within or close to the mine and a screening analysis must be conducted on surface water points further away. In addition samples must be tested for trace elements once mining commences. The parameters that must be sampled for are listed in **Table 5-3**. The frequency and type of sampling is summarised in **Table 5-4**.

Table 5-3: Surface Water Sampling Parameters

A (Standard set of parameters)	B (Screening parameters)	C (Trace elements)
pH	pH	Ba
EC	EC	As
Ca		Co
Mg		Cr
Na		Ni
K		Pb
Total Alk		Se
F		Sr
Cl		V
NO_2(N)		Zn
NH_4 (N)		Nb
NO_3(N)		Mn

A (Standard set of parameters)	B (Screening parameters)	C (Trace elements)
PO_4		Cu
SO_4		Ga
Al		Ge
Fe		Rb
Mn		Y
		Zr
		Sn
		W
		Bi
		Th
		U
		Hg

Table 5-4: Frequency and type of sampling

Sampling point	Parameter list	Type of sampling	Type of measure-ment/	Frequency
Surface water points within mine boundaries	A, C*	Grab	Flow	A = Every 4 months C = Once per annum
Surface water points outside mine boundaries	B**	Grab	Flow	Once every 6 months

* If any parameters exceed SANS241-1: 2011 guidelines (or WHO guidelines if no SANS guideline available) then that parameter must become part of list A.

**If any parameters * If any parameters exceed SANS241-1: 2011 guidelines (or WHO guidelines if no SANS guideline available) then that borehole must be sampled according to the A, C list.

5.5.2 Water Balance Management

The water unit circuits considered in the preliminary water balance are based mostly on available information. Most of the inputs to water balance are simulated from groundwater and surface water flow models which have are associated with different sources of uncertainties (homogenisation, downscaling, etc...). It is very important to ensure that the water balance is regularly updated with the latest data according to a defined monitoring programme. To ensure that this happens, the focus areas for data collection are put forward in **Table 5-5**.

Table 5-5: Focus Areas for Data Collection for Water Balance Management

Focus area	Action
Open Pit	Dewatering rate (of in pit water and/or groundwater) should be monitored on daily basis together with water level drop.
Crushing/Washing plant	Inflow and Outflow should be monitored on a daily basis
Water Storage (Clean and dirty)	Inflow and Outflow should be monitored on a daily basis
Rock Dumps	Water content should be monitored
ROM	Water content should be monitored

Focus area	Action
Products	Water content should be monitored
Discard	Water content should be monitored
Rainfall	Local rainfall measurement station should be installed and rainfall recorded
Evaporation	Evaporation rate should be investigated and recorded

5.5.3 Groundwater Monitoring Programme

A comprehensive analysis will be conducted on groundwater samples from boreholes and dams within or close to the mine (**Figure 5-3**). The proposed initial monitoring boreholes consist essentially of existing boreholes (on and off site). In addition samples must be tested for trace elements once a year. The parameters that must be sampled for are listed in **Table 5-6**.

Table 5-6: Groundwater Sampling parameters

A (Standard set of parameters)	B (Trace Elements)
pH	Ba
EC	As
Ca	Co
Mg	Cr
Na	Ni
K	Pb
Total Alk	Se
F	Sr
Cl	V
NO2(N)	Zn
NH4 (N)	Nb
NO3(N)	Mn
PO4	Cu
SO4	Ga
Al	Ge
Fe	Rb
Mn	Y
	Zr
	Sn

Boreholes and surface water points should be sampled every 3 months for the standard list of parameters. Water levels should also be measured. In addition these boreholes must be sampled for trace elements once a year.

Every six months the farmer's boreholes within a 2km radius of the mine should be sampled for the standard list of parameters along with the groundwater levels.

A borehole must be drilled into backfilled opencast pit to monitor the rise in water level within the pit and the groundwater quality.

5.5.4 Biomonitoring

Ongoing biomonitoring of the aquatic resources in the vicinity of the mine must take place. Biomonitoring should take place at points located upstream and downstream of the mining activities on the Selons Rivers as long as there is sufficient habitat to do so. Biomonitoring should take place on a quarterly basis. Biomonitoring should take place using the SASS5 and IHAS indices. Biomonitoring should take place throughout the life of the mine, including the closure and aftercare phases. The results of the biomonitoring program should be compared to the results of this study to allow any temporal trends to be observed. Should any problems be indicated measures to minimise or prevent the impact should be implemented.

Toxicity testing of the proposed mines underground and open pit discharge should take place concurrently with the biomonitoring program in order to monitor the toxicological risk of the process water system to the receiving environment. Tests should include the following test organisms as a minimum:

- Vibrio fischeri
- Daphnia pulex
- Algal Growth Potential

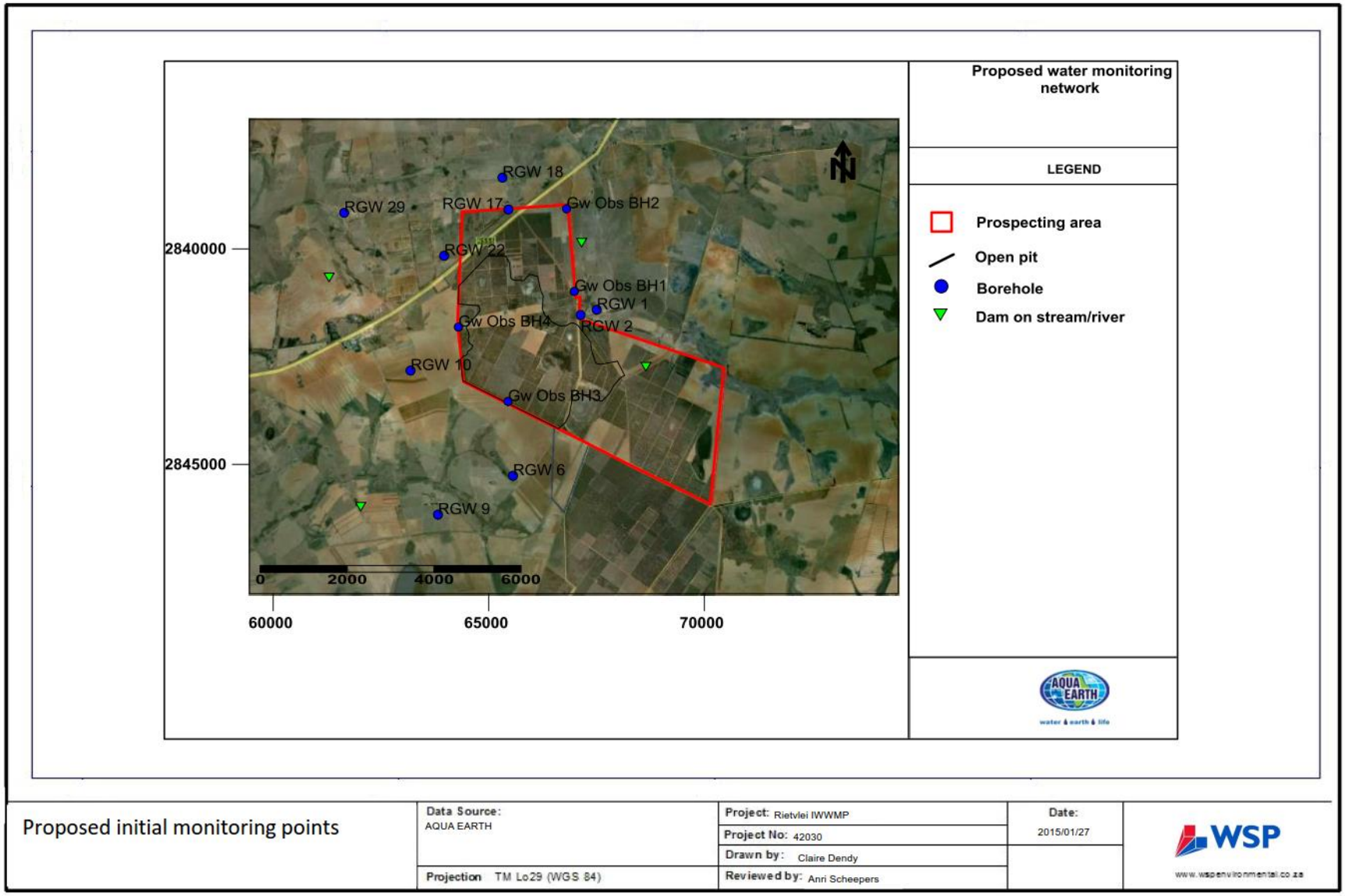


Figure 5-3: Proposed initial groundwater monitoring points (Aqua Earth, 2014)

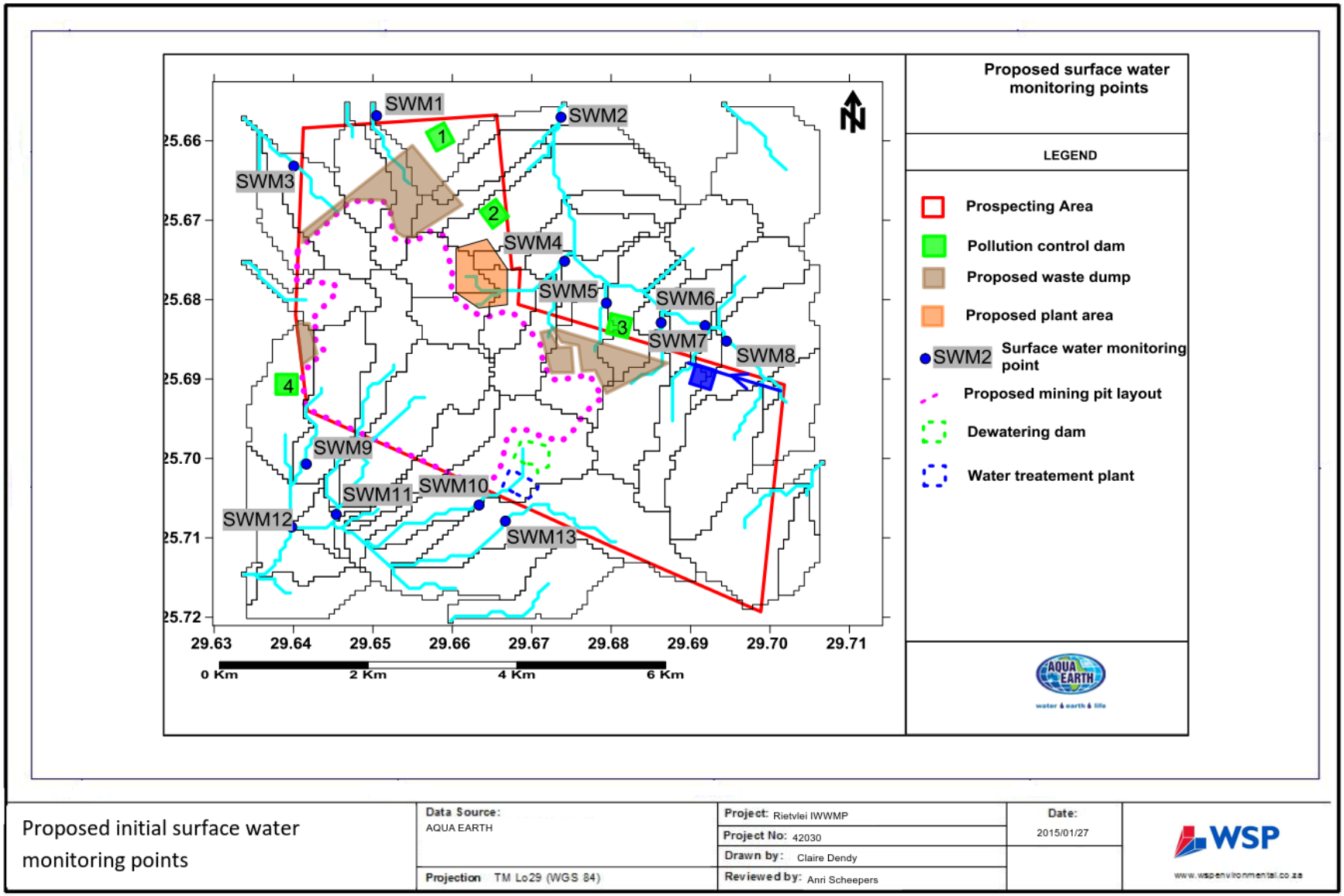


Figure 5-4: Proposed initial surface water monitoring points

On the completion of every sampling run a monitoring report must be written. Included in the report must be time series trends, Piper and Durov diagrams. These will be used to determine if there are any changes in the system. These changes must be flagged and explained in the report.

5.5.5 Waste Monitoring

Waste monitoring will be conducted as required.

Waste streams will be classified and volumes generated and disposed will be recorded.

5.6 Risk Assessment /Best Practice Assessment

The purpose of the risk asessment is to identify the potential environmental, impacts related with the water uses associated with the operations of the opencast operation\s at the proposed Rietvlei Mine. This provides a basis to identify the key risk drivers and make informed decisions on the way forward in order to ensure that these risks do not result in unacceptable social, environmental or reputational risk.

5.6.1 Risk Assessment Methodology

For each of the water uses associated with the project, the potential environmental impacts have been evaluated using recognised semi-quantitative risk assessment methodology. This methodology has been developed to ensure all procedures for the investigation, assessment and communication of the potential consequences or impacts of activities on the environment as set out in NEMA 24(4b) are met. In order to assess the significance as objectively as possible, the following criteria have been used:

- The nature, a description of what causes the effect, what will be affected and how it will be affected
- The physical extent, wherein it is indicated whether:
  - 1 - the impact will be limited to the site;
  - 2 - the impact will be limited to the local area;
  - 3 - the impact will be limited to the region;
  - 4 - the impact will be national; or
  - 5 - the impact will be international.
- The duration, wherein it is indicated whether the lifetime of the impact will be:
  - 1 - of a very short duration (0–1 years);
  - 2 - of a short duration (2-5 years);
  - 3 - medium-term (5–15 years);
  - 4 - long term (> 15 years); or
  - 5 – permanent.
- The magnitude of impact on ecological processes, quantified on a scale from 0-10, where a score is assigned:
  - 0 - small and will have no effect on the environment;
  - 2 - minor and will not result in an impact on processes;
  - 4 - low and will cause a slight impact on processes;
  - 6 - moderate and will result in processes continuing but in a modified way;
  - 8 - high (processes are altered to the extent that they temporarily cease); or

- 10 - very high and results in complete destruction of patterns and permanent cessation of processes.

- The probability of occurrence, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale where:
  - 1 - very improbable (probably will not happen);
  - 2 - improbable (some possibility, but low likelihood);
  - 3 - probable (distinct possibility);
  - 4 - highly probable (most likely); or
  - 5 - definite (impact will occur regardless of any prevention measures).
- The significance, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high;
- The status, which is described as either positive, negative or neutral;
- The degree to which the impact can be reversed;
- The degree to which the impact may cause irreplaceable loss of resources; and
- The degree to which the impact can be mitigated.

The significance is determined by combining the criteria in the following formula:

$$S = (E+D+M)*P$$

Where: **S** = Significance weighting **M** = Magnitude **P** = Probability
E = Extent **D** = Duration

The significance weightings for each potential impact are outlined in **Table 5-7**.

Table 5-7: Significance Weightings

Points	Significance Weighting	Description
< 30 points	**Low**	Where this impact would not have a direct influence on the decision to develop in the area
31-60 points	**Medium**	Where the impact could influence the decision to develop in the area unless it is effectively mitigated
> 60 points	**High**	Where the impact must have an influence on the decision process to develop in the area

5.7 Phases of Development during the Life of Mine

Potential impacts have been identified and assessed according to the phases of mine development. For purposes of this report, these phases have been generically defined below.

- **Construction Phase:**

  The construction phase includes the preparatory works/activities typically associated the creation of surface infrastructure, the pit footprint, access ramps and haul roads, the development of waste, residue

and product stockpiles, handling areas, water reticulation and electrical power. The activities most relevant to this phase include:

- Topsoil stripping and stockpiling;
- Haul road construction;
- Upgrading of the D1433;
- Construction of the surface infrastructure including the coal processing plant, buildings and offices, perimeter fence and sewage plant;
- Establishment of the coal discard facility;
- Installation of water and power supply infrastructure including storm water control infrastructure; and
- Construction of the clean and dirty water system, including 2 pollution control dams.

- **Operation Phase:**

  The operational phase includes the daily activities associated with the extraction of coal from the open cast pit. The activities most relevant to this phase include:

  - Excavation and blasting, as well as overburden stockpiling;
  - Coal removal, transport and processing;
  - Coal storage;
  - Utilisation of vehicles, equipment and machinery; and
  - Concurrent rehabilitation including, initial backfilling, levelling and placement of topsoil, fertiliser, vegetation and maintenance.

- **Decommissioning and Closure:**

  The decommissioning and closure phase includes the activities associated with the removal/dismantling of machinery/equipment/infrastructure no long necessary to the operation. This phase also includes the implementation and completion of rehabilitation goals as well as the implementation of agreed monitoring and maintenance prescribed for the cessation of operations. The activities most relevant to this phase include:

  - Dismantling surface infrastructure;
  - Rehabilitation of haul and access roads;
  - Rehabilitation of final void(s);
  - Monitoring and maintenance of ground and surface water; and
  - Monitoring and maintenance of rehabilitation areas, specifically in terms of land use and capability.

5.8 Surface Water

A Surface Water Assessment was conducted by Aqua Earth in July 2014, which is included in **Appendix 2** for further information.

5.8.1 Assumptions, Uncertainties and Gaps in Knowledge

The following assumptions, uncertainties and gaps in knowledge are applicable to this section:

- Due to a lack in data available for the mines water reticulation system at the time of compilation, it is clear that the current objectives should be reviewed and assessed on a regular basis as additional data becomes available; and

- The water balance is not to be considered as a once off investigation, but rather an iterative process to be updated as the mine's activities commence. The balances should be updated regularly to reflect the dynamic process of change at the mine.

5.8.2Nature of the Impact

5.8.2.1 Construction Phase

The mine is situated in the headwater of the catchments and no major build-up of flows is expected.

The clearing of topsoil for footprint areas associated with construction activities can increase siltation to the surface water resource during soil turning activities. Drainage lines flowing into the mining area will however have to be diverted to prevent clean water from entering the mining area and increase the risk of flooding. Slopes associated with berms, and rerouting of the storm water runoff may enhance erosion and siltation, and flood risk at the receiving stream (river).

The construction activities are likely to be associated with accidental spills of hydrocarbons (oils, diesel etc.) from the construction vehicles and other potentially hazardous chemicals. Such spills together with the construction waste constitute potential source of surface water contamination if not properly handled.

The following impacts have been considered and quantified during the construction phase:

- Siltation due to soil disturbance;
- Erosion due to rerouting of storm water runoff;
- Water quality deterioration due to Spill and /or leaking of hydrocarbon product from construction vehicles, equipment and storage; and
- Water quality deterioration due to seepage from construction waste to the surface water resource.

5.8.2.2 Operational Phase

During operational phase, surface water runoff may enter the operating open pit, coal processing plant, stockpiles and waste disposal area if not properly managed. This would result on the contamination of clean surface water runoff. Water (groundwater and rainfall) will need to be pumped from the pit for mine safety. Water from the operating areas, is considered dirty, and when not handled adequately constitutes a potential source of surface water pollution. Exposed water may increase evaporation rate on site.

Mine activities that may impact on surface water are:

- Overburden dumping: the exposure of rock dumps, result in dirty water that may contaminate surface water, if not properly managed;
- Stockpiling and transport: the exposure of stockpiling and transporting of coal, to water and oxygen, together with hydrocarbon spills from storage (organic contaminants) may also result in contamination of surface water;
- Coal processing: coal will be exposed at the washing plant area to water (with chemical) and oxygen, resulting in dirty water, and spills/slurry from the site can contaminate surface water;
- Tailing disposal: residual from coal processing will be disposed of onsite at designated are or in pit. Such disposal when not handled correctly, constitute a potential source of water contamination; and
- Septic tank: spillage from septic may constitute source of bacteriological contamination to surface water. If not properly managed.

Dirty water from any of these activities should be drained, or pumped (where required) to pollution control dams. Pollution control dams, and contaminated water drains constitute potential sources of surface water contamination as result of leakage trough improper barrier system (absent, or leaking).

Handling and transport of waste material have some potential of contaminating surface water, including domestic waste, sewage water, hydrocarbons (storage).

The following impacts have been considered and quantified during the operation phase:

- Deterioration of clean storm water runoff quality;
- Increasing of water removal activities due to in pit dewatering;
- Ponding due to storm water falling onto operating (mining pit, crushing and screening, stockpiling) areas;
- Erosion due to surface water runoff rerouting;
- Siltation due to surface water runoff rerouting;
- Water quality deterioration due spill and/or leaking of hydrocarbon;
- Water quality deterioration due to septic tank;
- Water quality deterioration due to seepage from waste disposal facility to the surface water resource;
- Water quality deterioration due to spillage, seepage and/or leak from waste disposal, storage, handling facility to surface water; and
- Water quality deterioration due to Spillage of dirty water from dirty water control system (Dams, trenches, berms etc.).

5.8.2.3 Decommissioning Phase

The closing of mining activities and rehabilitation will be undertaken concurrently. All disused infrastructure will be demolished, and waste from demolition has to be removed from site and disposed at designated site.

Surface water contaminants from the mine (including backfilled opencast pits and return water dams) can be enhanced.

Activities such as covering of the spillages with sand and collection and possibly treatment etc. are likely to be associated with accidental spills of hydrocarbons (oils, diesel etc.).

Dewatering would be stopped at that stage, and open pit flooding will occur, as recovering of groundwater levels, and subsequent decant to the surface is expected at the lowest mining area. The closure phase is usually too short to see the any evidence of decant. Decommissioning/closure is only complete once the proponent demonstrates no significant impacts. The following impacts have been considered and quantified during the closure phase:

- Erosion due to increase runoff speed and velocity (compaction, shaping);
- Siltation due to increase runoff speed and velocity (compaction, shaping);
- Deterioration of surface water quality due to:
    - Spillage, leaking of hydrocarbon product;
    - waste, and spills related to closure activities;

At post closure phase, the main potential surface water impacts to be considered and quantify are:

- Deterioration of surface water quality by decanting water;
- Flooding due to decanting water; and
- Erosion associated with runoff of decanting water.

Without any mitigation measures the impacts significance from closure of the proposed Rietvlei Mine are rated from Very Low to Very High.

5.8.2.4 Cumulative Impacts

No significant pollution source has been identified on site or surrounding, that may cumulatively with the project impact on background water quality. However the background water quality, as established from two sampling points (Selons River, Dam), is assumed to be related to surrounding activities (agricultural). As no historical observation is available locally, the background flow variation is not known, but it is assumed that flow may be reducing as regional trend. The following impacts have been considered as cumulative impacts:

- Cumulating of reduction of water flow as result of water management (storage, diversion); and
- Cumulating of water quality deterioration from mine activities with existing contaminants.

5.8.3 Significance Rating

Table 5-8, Table 5-9, Table 5-10 and **Table 5-11** outline the significance ratings for relevant surface water impacts both with and without mitigation measures.

Table 5-8: Significance Ratings for the Construction Phase Surface Water Impacts

Construction Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Siltation due to soil disturbance	Without Mitigation	1	2	2	5	**25**	**Low**	-
	With Mitigation	1	1	2	3	**12**	**Low**	-
Erosion due to rerouting of storm water runoff	Without Mitigation	1	2	2	3	**15**	**Low**	-
	With Mitigation	1	1	2	2	**8**	**Low**	-
Water quality deterioration due to Spill and /or leaking of hydrocarbon product from construction vehicles, equipment's, and storage	Without Mitigation	3	1	6	4	**40**	**Medium**	-
	With Mitigation	1	1	2	2	**8**	**Low**	-
Water quality deterioration due to seepage from construction waste site to the surface water resource	Without Mitigation	2	3	6	4	**44**	**Medium**	-
	With Mitigation	1	1	2	3	**12**	**Low**	-

Table 5-9: Significance Ratings for the Operational Phase Surface Water Impacts

Operational Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Deterioration of clean storm water runoff quality	Without Mitigation	3	4	6	5	**65**	**High**	-
	With Mitigation	1	2	2	3	**15**	**Low**	-
Increasing of water removal activities due to in pit dewatering	Without Mitigation	2	2	2	4	**24**	**Low**	-
	With Mitigation	1	1	2	3	**12**	**Low**	-
Ponding due to storm water falling onto operating (mining pit, crushing and screening, stockpiling) areas	Without Mitigation	2	2	2	4	**24**	**Low**	-
	With Mitigation	1	1	2	2	**8**	**Low**	-
Erosion due to surface water runoff rerouting	Without Mitigation	1	2	2	4	**20**	**Low**	-
	With Mitigation	1	1	2	2	**8**	**Low**	-
Siltation due to surface water runoff rerouting	Without Mitigation	1	2	2	4	**20**	**Low**	-
	With Mitigation	1	1	2	2	**8**	**Low**	-
Water quality deterioration due spill and/or leaking of hydrocarbon	Without Mitigation	2	3	6	4	**44**	**Medium**	-
	With Mitigation	1	1	2	3	**12**	**Low**	
Water quality deterioration due to septic tank	Without Mitigation	2	3	6	4	**44**	**Medium**	-
	With Mitigation	1	2	2	3	**15**	**Low**	-
Water quality deterioration due to seepage from waste disposal facility to the surface water resource	Without Mitigation	2	3	6	5	**55**	**Medium**	-
	With Mitigation	2	2	2	3	**18**	**Low**	-

Operational Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Water quality deterioration due to spillage, seepage and/or leak from waste disposal, storage, handling facility to surface water	Without Mitigation	2	3	6	4	**44**	**Medium**	-
	With Mitigation	2	1	2	3	**15**	**Low**	-
Water quality deterioration due to Spillage of dirty water from dirty water control system (Dams, trenches, berms etc)	Without Mitigation	2	3	6	5	**55**	**Medium**	-
	With Mitigation	2	1	2	3	**15**	**Low**	-

Table 5-10: Significance Ratings for the Decommissioning Phase Surface Water Impacts

Decommissioning Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Erosion due to increase of runoff speed and velocity	Without Mitigation	1	2	2	4	**20**	**Low**	-
	With Mitigation	1	1	2	2	**8**	**Low**	-
Siltation related to erosion	Without Mitigation	1	2	2	4	**20**	**Low**	-
	With Mitigation	1	1	2	2	**8**	**Low**	-
Deterioration of water quality due to spill and/or leaking from hydrocarbon storage area	Without Mitigation	3	3	6	5	**60**	**Medium**	-
	With Mitigation	1	2	2	3	**15**	**Low**	-
Deterioration of water quality due to seepage and/or spillage from waste site facility	Without Mitigation	3	3	6	5	**60**	**Medium**	-
	With Mitigation	1	2	2	3	**15**	**Low**	-

Decommissioning Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Deterioration of the surface water quality due decanting water	Without Mitigation	4	4	8	5	**80**	**High**	-
	With Mitigation	3	2	4	4	**36**	**Medium**	-
Flood risk due decant to surface	Without Mitigation	3	4	6	4	**52**	**Medium**	-
	With Mitigation	1	1	4	3	**18**	**Low**	-
Erosion due decant water runoff	Without Mitigation	1	2	2	4	**20**	**Low**	-
	With Mitigation	1	1	2	2	**8**	**Low**	-

Table 5-11: Significance Ratings for the Cumulative Surface Water Impacts

Cumulative Impacts								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Reduction of water flow as result of water management (storage, diversion)	Without Mitigation	3	3	2	4	**32**	**Medium**	-
	With Mitigation	2	2	2	3	**18**	**Low**	-
surface water quality deterioration from mine activities with existing contaminants	Without Mitigation	3	3	2	5	**40**	**Medium**	-
	With Mitigation	2	2	2	3	**18**	**Low**	-

5.8.4 Mitigation and Management Measures

The development of proposed Rietvlei Mine poses risks to surface water as assessed. The proper design, construction, operation, and maintenance of the appropriate draining and storing facilities, as well as the rehabilitation of the open mine, are part of the key focus areas to mitigate surface water impacts. The following precautions have to be taken into consideration to reduce possible surface water risks posed by the development of proposed Rietvlei Mine:

- **Construction Phase**
  - During design phase, the waste and water management infrastructures at proposed Rietvlei Mine (included dams, drains, waste area) must be designed with the appropriate water barrier system if required, and comply with the DWA minimum requirements (1998/2012/2013), with special focus on the R634, R635, R636 of the NEMWA 2008;
  - Design of the mine facilities to be conducted by an accredited or recognised professional designer;

- All dirty surface water control facilities (dam, drain) must be designed to have a minimum freeboard above full supply level, at such manner that they can always handle 1:50 year flood-event on top of its mean operational level;
- Water management infrastructure (separate clean and dirty water systems) should be in place before the commencement of construction activities.
- Storage area for hydrocarbons or any toxic construction material should be bounded according to DWA minimum requirement;
- Compaction of the area should take place during base preparation. t on top of its mean operation level;
- Sloping of the area as to allow for free runoff, towards designated pollution control structures;
- Management of speed versus velocity aspects if and when required as to prevent erosion gullies from forming.
- Surface water management strategic plan must be implemented to prevent risk of water pollution;
- Surface water monitoring network should be installed before the starting of any construction activities on site and monitoring network can be updated according to the DWA minimum requirements, if required;
- Waste classification is required in order to influence design parameters and make recommendations with regards to design and monitoring requirements. These must be adhered to in order to prevent or minimise seepage from waste disposal areas;
- Any waste and spills (especially during construction, operation and closure) need to be cleaned up immediately according to the DWA minimum requirements;
- Authorities need to be notified in the event of a spill or leachate during construction, operation and closure;
- Clean and dirty water is to be separated;
- Regular maintenance of vehicles must be implemented;
- Trucks need to be capped to minimise spillage of coal or wastes, on roads;
- The reusing dirty water from mine activities must be assessed and implemented as much as possible;
- All hazardous substances must be handle according to the requirements of relevant legislation relating to the transport, storage and use of the substance; and
- The area to be used for storage of any hazardous waste and items which contains hazardous substance must be lined with bounded walls to prevent pollution of surface water should a leakage/spillage occur.

Operational Phase

- Contaminated water drain (within the waste site) and dam must be properly operated and maintained;
- All surface dirty water control facilities (dam, drain) must be operated to have a minimum freeboard above full supply level, at such manner that they can always handle 1:50 year flood-event on top of its mean operation level;
- Keep contamination to a minimum by keeping the pit as dry as possible (dewatering) to reduce contact time of water and oxygen with exposed strata;
- Reduce the amount of water to be removed from the pit area by keeping the operating pit area as small as possible, and by continuously rehabilitating the closed pit area;
- Equip trenches and gullies with energy dissipater, and conduct frequent inspections and maintenances;

- Suspended solids should filter out (silt trap) before dirty water enters pollution control dams, and regular inspections and maintenances should follow;
- Routing of sewage to the municipality sewage works; and
- Water and mass balance should be determined and updated regularly.

- **Decommissioning and Closure Phase**
  - Implement closure of open pit progressively;
  - Effectiveness of existing surface water monitoring network should be re-evaluated;
  - Rubble from waste or contaminated areas should be dismantled and disposed of accordingly;
  - Backfill material to be fully compacted and covered, and the entire foot print of waste to be shaped for free-draining;
  - Rehabilitation to follow backfilling compaction;
  - Rehabilitation should consist of re-vegetating the site using appropriately chosen indigenous grasses. Control of vegetation cover over the rehabilitated area;
  - A rehabilitation plan must be implemented and the plan should be done in the line with the contents of NWA (Act No 36 of 1998), to avoid subsequent negative environmental impacts that may occur;
  - Continue monitoring until it can be demonstrated that vegetation is self-sustaining and no erosion channels exist;
  - Clean water system and dirty water system should be maintained on site; and
  - Inspection and maintenance should be implemented after removal of materials associated with mining on site.

5.9 Groundwater

A Groundwater Assessment was conducted by Aqua Earth in July 2014, which is included in **Appendix 3** for further information

5.9.1 Assumptions, Uncertainties and Gaps in Knowledge

A numerical model solves both complex and simple problems, and serves as basis for the simulation of various scenarios. However, it should be reiterated that, a numerical groundwater model is a simplified representation (approximation) of the real system, and the level of accuracy is sensitive to the quality of the data that is available. Errors due to uncertainty in the data and the capability of numerical methods to describe natural physical processes are always associated with groundwater numerical models. The building of a numerical model requires some assumptions to make an easier representation of the real aquifer systems. Such assumptions involve mainly:

- Geological and hydrogeological features;
- Boundary conditions of the study area (based on the geology and hydrogeology);
- Initial water levels of the study area;
- The processes governing groundwater flow; and
- The selection of the most appropriate numerical code.

Based on the available field data, the following assumptions have been made behind the conceptual model:

- The top of the aquifer is represented by the generated groundwater heads;
- Averages of the distribution of the determined parameters have been used as input of the model, and a homogenous and continuous aquifer system has been assumed;

- Where specific aquifer parameters have not been determined for some reason, text book values have been used where applicable, with reasonable estimates of similar geo-hydrological environments;
- The system is initially in equilibrium and therefore in steady state, even though natural conditions have been disturbed;
- The boundary conditions assigned to the model are considered correct; and
- The impacts of other activities (agriculture, etc...) have not been taken into account.

The complexities associated with flow and transport in aquifer systems have not been taken into account. Any interpretation and decision from the model results should be based on these assumptions

5.9.2 Nature of the Impact

5.9.2.1 Groundwater Modelling

- **Scenario 1: Mine dewatering (operation)**

  In the first scenario the opencast pit is dewatered. The cone of depression extends up to 3km away from site when pit floor will reaches lower seem bottom (50mgl). The expected inflow is in the vicinity of 300m^3/d. It should be noted that no concurrent rehabilitation has been included in this scenario and therefore it can be seen as the 'worst-case' scenario. The wetlands are groundwater dependent and will be affected by the dewatering cone, but the current model did not account for such effect. The simulated cone of depression at 20 years is shown in **Figure 5-5**. The effect of dewatering on selected boreholes surrounding proposed Rietvlei Mine, are illustrated in **Figure 5-6**. **Figure 5-7** shows the simulated groundwater elevations and drainage at 20 years of operation. All identified boreholes on site will be impacted together with few offsite boreholes (RGW10, RGW23, RGW22, RGW1, and RGW2).

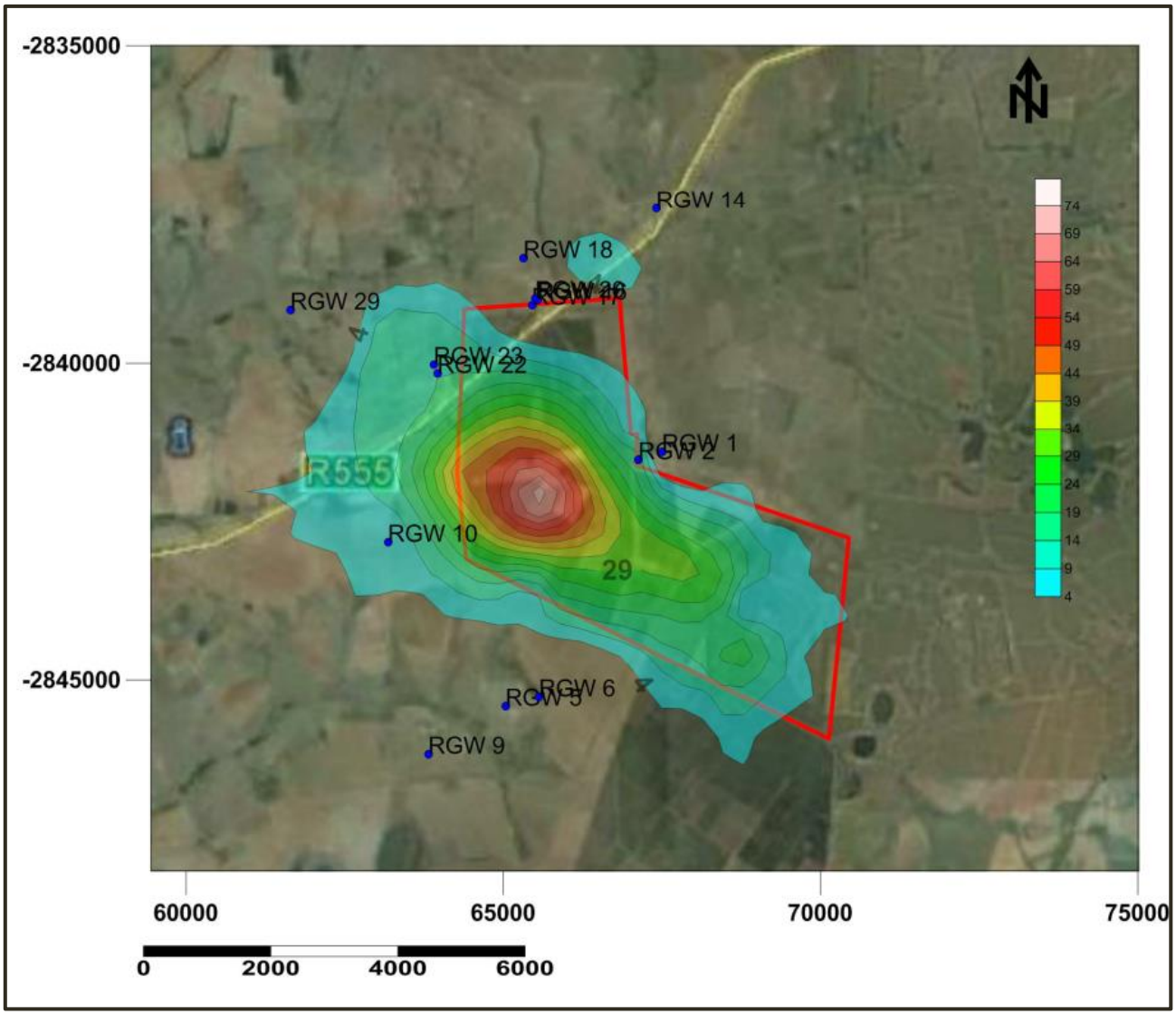


Figure 5-5: Simulated Drawdown due to Dewatering at 20 years

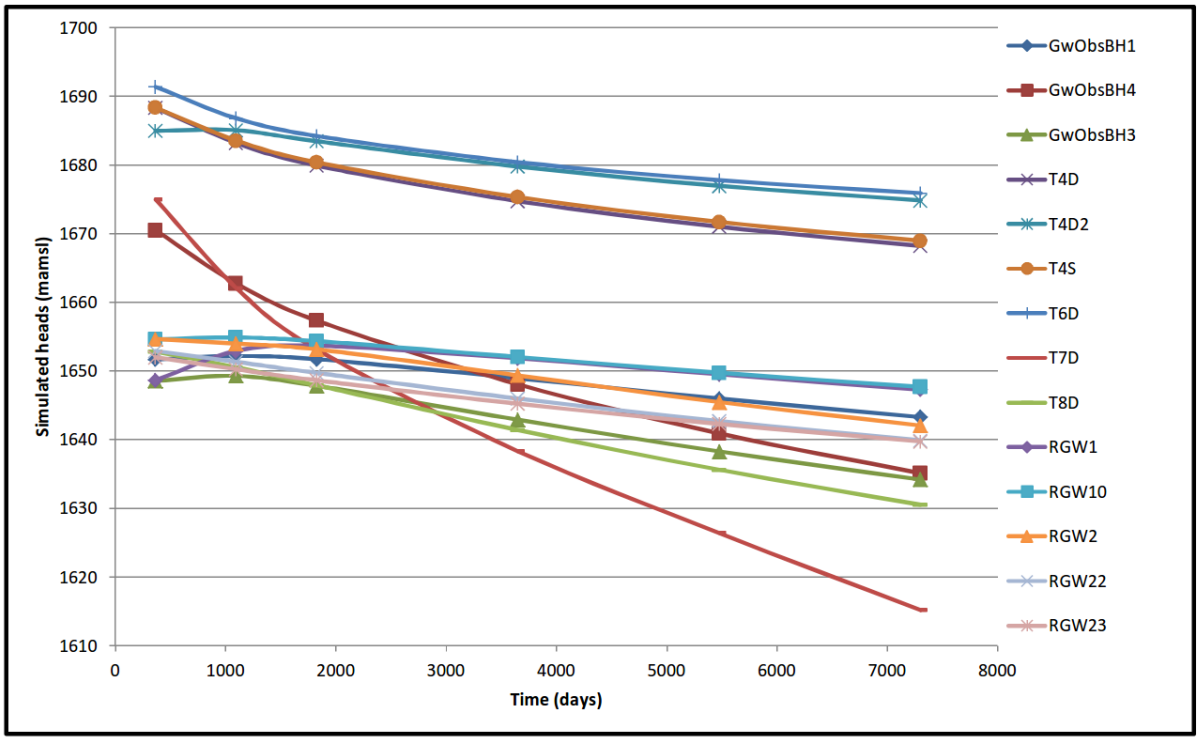


Figure 5-6: Simulated Drawdown of selected boreholes over time

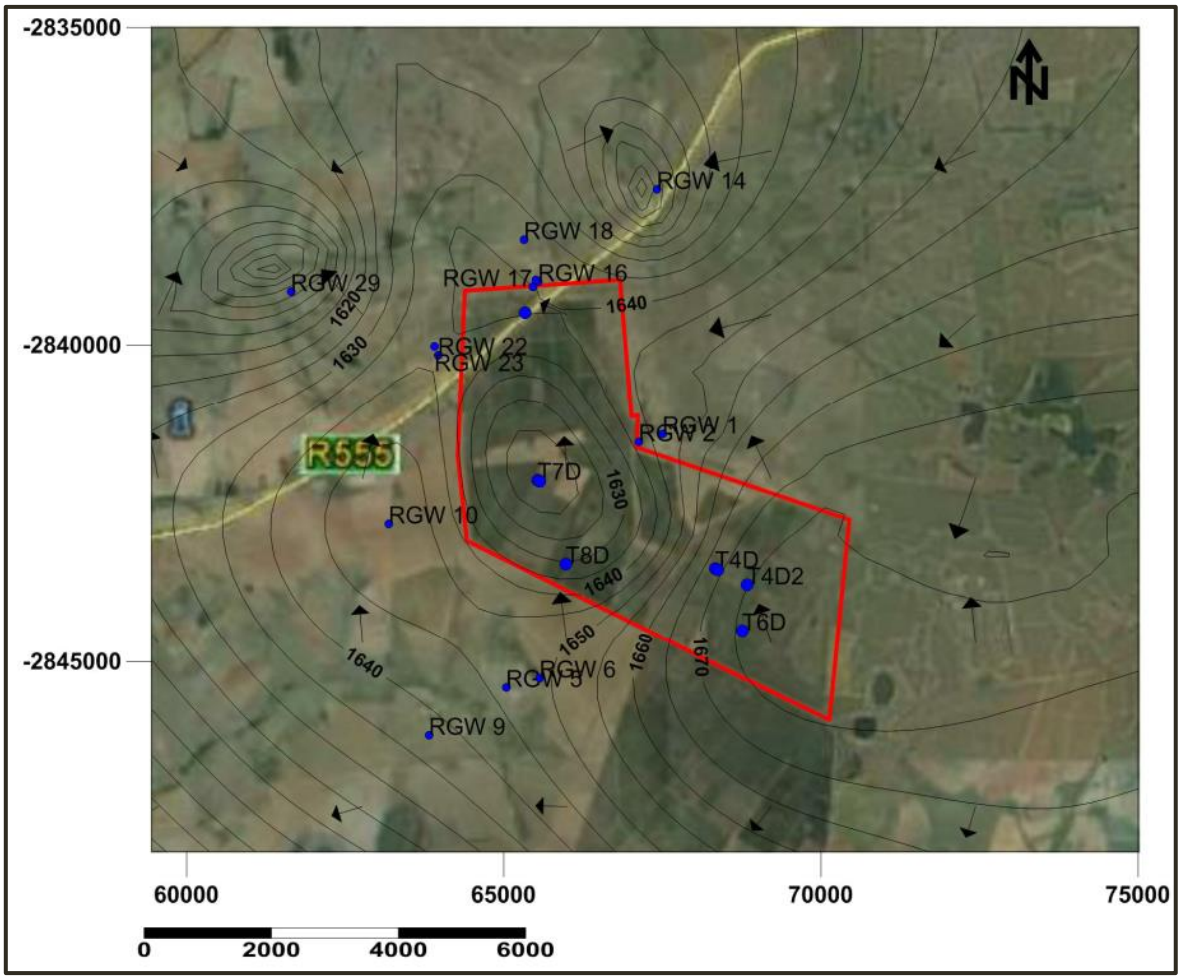


Figure 5-7: Simulated groundwater elevations drainage after 20 years of pit dewatering

- **Scenario 2: Pollution plume (operation)**

  Groundwater flow during active mining will be towards the open pit. Any pollution plumes emanating from mining activities (dumps, processing plant, water and tailing dams, drains, etc...) will move towards the open pit. The open pit area will be kept dry for mine safety and polluted water seeping through the backfill should be pumped to dirty water dams. Pollution during active mining is expected to be restricted to the mine property. Neighbouring boreholes will not be affected during active mining.

- **Scenario 3: Backfilled pit flooding (closure)**

  Dewatering would be stopped when mining will reach its full capacity, and open pit flooding will occur, as recovering of groundwater levels. Groundwater flow directions will return to pre-mining conditions. The flooding of the mine is dependent on a number of factors including preferential flow zones such as geological lineaments. Not all preferential influx zones are known at this point, so the volumes might increase, as more information becomes available. It will take 40 years for the pit to flood, thereafter decanting will commence. The position of the expected decant point is shown in **Figure 5-8**. The decant volume is estimated at 1420 m^3/d, where as it was estimated (1200 m^3/d) from the initial numerical model.

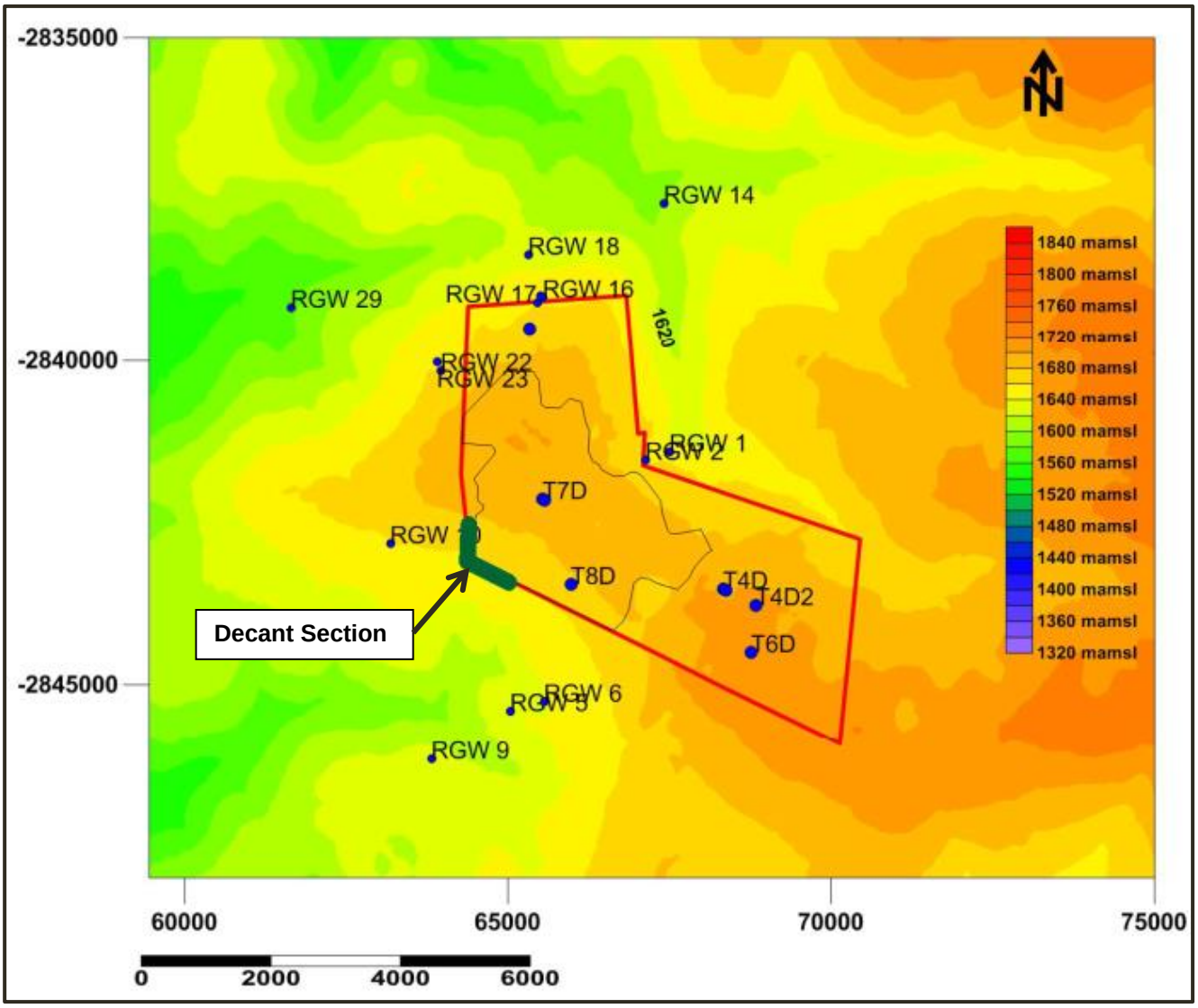


Figure 5-8: Decant Zone

- **Scenario 4: Pollution plume (post-closure)**

At this point in time it is calculated that it is likely for the mine to decant. It is expected that poorer quality groundwater will be present in the backfilled pit when total flooding is completed, as result of chemical reaction between backfill material and oxygenated water. The polluted waters in the opencast pit will start to move into the groundwater system if no water management measures are implemented. The pollution plume at 10 and 20 years after flooding is shown respectively in **Figure 5-9** and **Figure 5-10**. The boreholes affected by pollution include: RGW4 and RGW11. Slight impacts could be seen in RGW2 and RGW22.

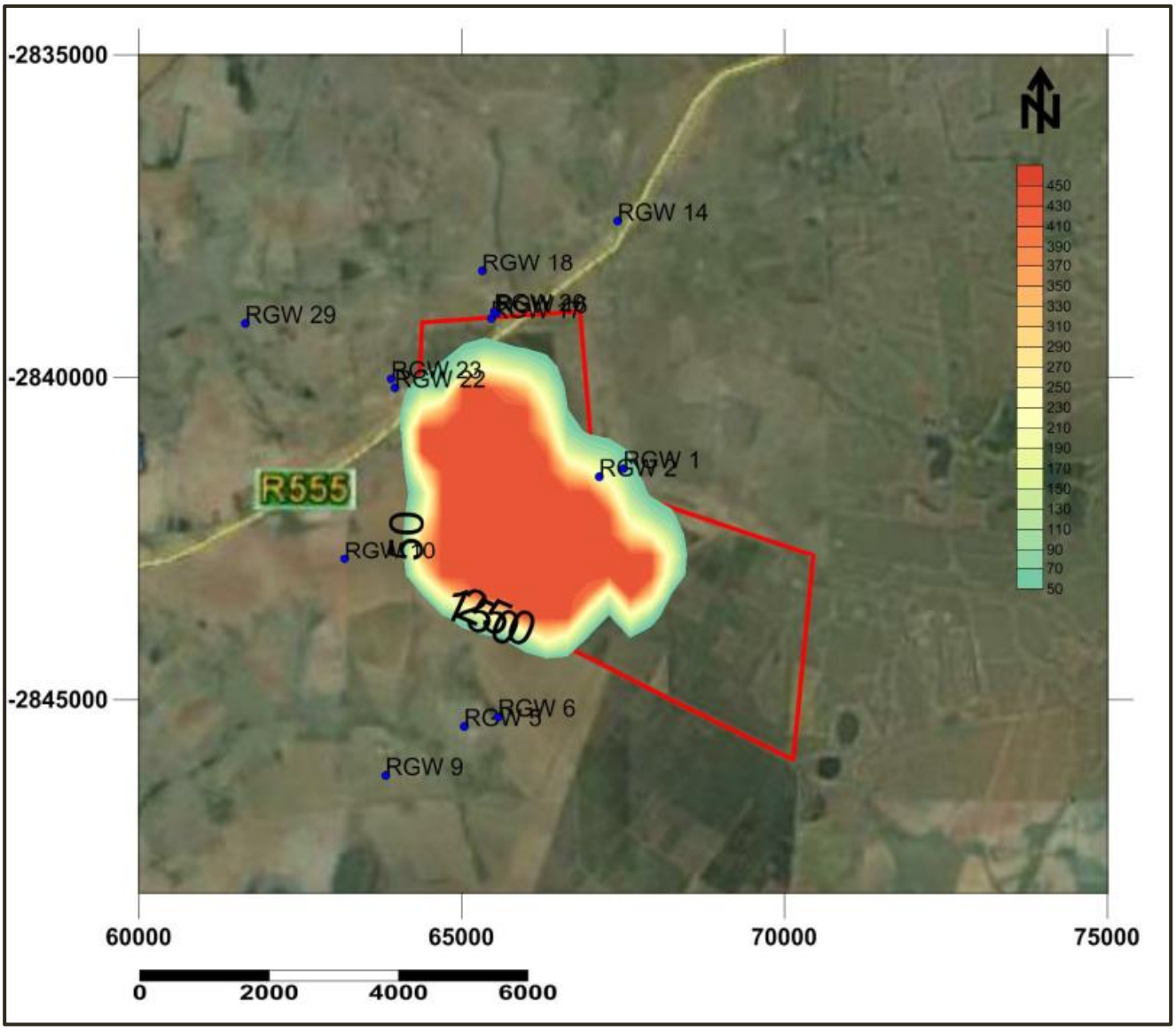


Figure 5-9: Pollution plume from backfilled pit 10 years after flooding

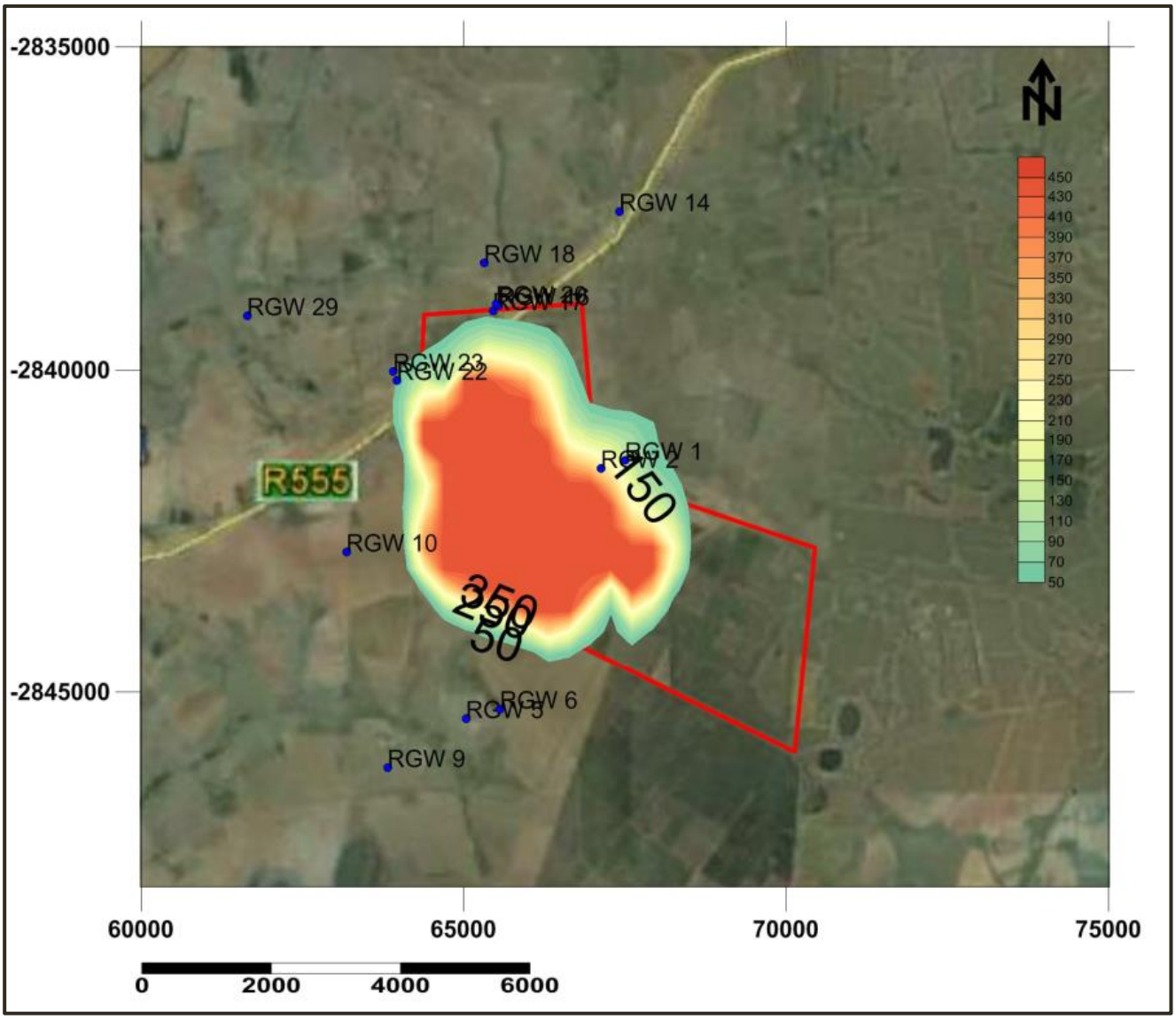


Figure 5-10: Pollution plume from backfilled pit 20 years after flooding

5.9.2.2 Construction Phase

The clearing of topsoil for footprint areas associated with the waste site construction can increase infiltration rates of water to the groundwater system and decrease buffering capacity of soils to absorb contaminants from possible spills on surface. Groundwater recharge from surface may increase, especially in the potential recharge area.

During construction phase, it would be necessary to construct the berms to prevent storm water runoff to enter working area within the prospecting area. The cut and fill activities associated with the construction of infrastructures (waste site, water control infrastructures) may intercept shallow groundwater as static levels are found shallow as 1.7mbgl. In cases where the construction will intercept groundwater, lowering of the groundwater level by dewatering may be needed during construction. This will cause localise cones of groundwater depressions around the waste site area.

Contamination of groundwater can occur as a result of groundwater seeps standing in the footprint area. The construction activities are likely to be associated with accidental spills of hydrocarbons (oils, diesel etc) from the construction vehicles, and other potentially hazardous chemicals during the construction phase. Such spills

together with the construction waste can infiltrate and cause contamination of the groundwater system if not properly handled.

The design of the waste disposal sites (rock dumps, tailings) will take into account the specification stipulated in GN 36784. Thus construction will result in:

- The reduction of the recharge potential at proposed site, and
- The disturbance of Sub-catchment storm water runoff.

The following impacts have been considered and quantified during the construction phase:

- Decreasing of the soils buffering capacity and increasing of infiltration rates;
- Deterioration of water quality due to construction waste (Chemical in construction material);
- Deterioration of groundwater quality due to hydrocarbon spills from storage (organic contaminants);
- Altered flow systems due to probable dewatering (if required); and
- Groundwater contamination due to groundwater seeps standing in the construction's footprint area.

Without any mitigation measures the impacts significance from construction of the proposed Rietvlei Mine are rated from very low to low.

5.9.2.3 Operational Phase

Opencast mining of coal will result in groundwater inflows into the pits, which needs to be pumped out for mine safety. The dewatering of the groundwater system in the immediate vicinity of the pits will become more important and results in wider cone of depression as depth to pit floor will increase. According to the importance of cone of depression surrounding users' boreholes can be impacted.

Exposure of geological strata to rainfall in the opencast areas will result in deterioration in quality of groundwater flowing into the opencast areas. Groundwater will initially be of good quality but will with time deteriorate, due to oxidation of pyrite and/or other chemical processes that can occur as a result of mining activities. This can take place for years, until the neutralizing potential is depleted. Such dirty water in opencast pit, together with groundwater ingress, if not properly handle may infiltrate and contaminate deeper aquifer system. Others mine activities that may impact on groundwater quality are:

- Overburden dumping: the exposure of rock dumps, to water and oxygen, may result in dirty water that may contaminate groundwater systems, if not properly managed;
- Stockpiling and transport: the exposure of stockpiling and transporting of coal, to water and oxygen, together with hydrocarbon spills from storage (organic contaminants) may also result in contamination of the groundwater systems;
- Coal processing: coal will be exposed at the washing plant area to water and oxygen, resulting in dirty water, and spills/slurry from the site can contaminate groundwater; and
- Tailing disposal: residual from coal processing will be disposed of onsite as tailings dam. Tailings constitute a potential source of groundwater contamination.

Dirty water from any of these activities should be drained, or pumped (where required) to pollution control dams. Pollution control dams, and contaminated water drains constitute potential sources of groundwater contamination as result of infiltration trough improper barrier system (absent, or leaking). Unlined dams will contribute highly to contamination of the groundwater system, while lined dams might still contaminate but to a lesser degree.

Handling and transport of waste material have some potential of contaminating groundwater, including domestic waste, sewage water, hydrocarbons (storage).

The following impacts have been considered and quantified during the operation phase:

- Deterioration of groundwater quality due to rock dumps;
- Deterioration of groundwater quality due to open pit mining;

- Deterioration of groundwater quality due to coal processing;
- Deterioration of groundwater quality due to tailings disposal;
- Deterioration of groundwater quality due to leaks/spillages from dirty water quality dams and drain; and
- Deterioration of groundwater quality due to handling and transport of waste material.

Without any mitigation measures the impacts significance from operation of the proposed Rietvlei Mine are rated from Low Medium to High. The High impacts significance, are associated with the potential impacts of groundwater dewatering and deterioration of groundwater quality due to tailing dams.

5.9.2.4 Decommissioning Phase

The closing of mining activities and rehabilitation will be concurrently undertaken. All disused infrastructure will be demolished, and waste from demolition has to be removed from site and disposed at designated site.

Contaminants from the mine (including backfilled opencast pits and return water dams) can seep through the unsaturated zone into the groundwater system. Lateral groundwater movement will allow the spread of the contamination within the groundwater system. If this groundwater feeds surface water bodies such as wetlands and streams, these can also be polluted. However dilution will take place therefore the impacts thereof are considered to be moderate.

Activities such as covering of the spillages with sand and collection and possibly treatment etc are likely to be associated with accidental spills of hydrocarbons (oils, diesel etc).

Dewatering would be stopped at that stage, and open pit flooding will occur, as recovering of groundwater levels. At this point in time it is calculated that it is likely for the mine to decant. It is expected that poorer quality groundwater will be present on the mine horizon when total flooding is completed.

Water management activities associated with closure activities will be conducted as appropriate. Generally decommissioning/closure phase is too short to see significant impacts on the groundwater, but in the present context where closure would be progressive, significant reduction of impacts could occur. The risk of such impacts will be reduced over time. With strong management options, the risk is expected to reduce even further. Decommissioning/closure is only complete once the proponent demonstrates no significant impacts

The following impacts have been considered and quantified during the closure phase:

- Flooding and decanting of open pit; and
- Deterioration of groundwater quality due to waste, and spills related to closure activities.

Without any mitigation measures the impacts significance from closure of the proposed Rietvlei Mine are rated from Very Low to High. The High impact is mainly associated with the potential impacts of flooding and decanting of the backfilled pit.

At post closure phase, the main potential groundwater impacts to be considered and quantify is:

- Flooding and decanting of open pit.

Without any mitigation measures the impacts significance from post-closure of the proposed Rietvlei Mine are rated as Very High.

5.9.2.5 Cumulative Impacts

No significant pollution source has been identified on site or surrounding, that may cumulatively with the project impact on background water quality. However the background high concentration of NO3-N noticed from two sampling points may be associated with surrounding agricultural activities (fertilizer, pumping). Slight cone of depressions are already developing at local points surrounding proposed Rietvlei Mine.

The following impacts have been considered as cumulative impacts:

- Cumulating of impacts due mine dewatering with existing local cone of depressions; and
- Cumulating of contaminants from mine activities with existing contaminants.

5.9.3 Significance Rating

Table 5-12, Table 5-13, and **Table 5-14** outline the significance ratings for relevant groundwater impacts both with and without mitigation measures.

Table 5-12: Significance Ratings for the Construction Phase Groundwater Impacts

Construction Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Decreasing of the soils buffering capacity and increasing of infiltration rates	Without Mitigation	1	2	2	5	**25**	**Low**	-
	With Mitigation	1	2	2	5	**25**	**Low**	-
Altered Flow systems due to probable dewatering (if required)	Without Mitigation	2	2	4	5	**40**	**Medium**	-
	With Mitigation	2	2	4	5	**40**	**Medium**	-
Deterioration of water quality due to construction waste (Chemical in construction material)	Without Mitigation	2	1	6	5	**45**	**Medium**	-
	With Mitigation	1	1	2	2	**8**	**Low**	-
Deterioration of water quality due to hydrocarbon spills from storage (organic contaminants)	Without Mitigation	2	3	6	5	**55**	**Medium**	-
	With Mitigation	1	2	2	3	**15**	**Low**	-
Groundwater contamination due to groundwater seeps standing in the construction's footprint area.	Without Mitigation	1	3	6	5	**50**	**Medium**	-
	With Mitigation	1	1	2	2	**8**	**Low**	-

Table 5-13: Significance Ratings for the Operational Phase Groundwater Impacts

Operational Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Drop of groundwater levels due to open pit	Without Mitigation	3	4	8	5	**75**	**High**	-
	With	3	4	8	5	**75**	**High**	-

Operational Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
dewatering	Mitigation							
Deterioration of groundwater quality due to rock dumps.	Without Mitigation	3	4	4	4	**44**	**Medium**	-
	With Mitigation	1	1	2	3	**12**	**Low**	-
Deterioration of groundwater quality due to open pit mining.	Without Mitigation	3	4	6	5	**65**	**High**	-
	With Mitigation	2	3	6	4	**44**	**Medium**	-
Deterioration of groundwater quality due to coal processing	Without Mitigation	3	4	8	5	**75**	**High**	-
	With Mitigation	2	1	4	2	**14**	**Low**	-
Deterioration of groundwater quality due to tailings disposal	Without Mitigation	3	4	8	5	**75**	**High**	-
	With Mitigation	3	1	2	4	**24**	**Low**	-
Deterioration of groundwater quality due to leaks/spillages from dirty water quality dams and drain	Without Mitigation	3	4	8	4	**60**	**Medium**	-
	With Mitigation	1	1	2	3	**12**	**Low**	-
Deterioration of groundwater quality due to handling and transport of waste material.	Without Mitigation	3	4	6	3	**39**	**Medium**	-
	With Mitigation	1	2	2	3	**15**	**Low**	-

Table 5-14: Significance Ratings for the Decommissioning Phase Groundwater Impacts

Decommissioning Phase							
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**	**Status**

Decommissioning Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
During decommissioning handling of waste and transport of building material can cause various types of spills (domestic waste, sewage water, hydrocarbons) which can infiltrate and cause contamination of the groundwater system.	Without Mitigation	3	3	6	4	**48**	**Medium**	-
	With Mitigation	2	3	4	4	**36**	**Medium**	-
Flooding and decanting of open pit	Without Mitigation	3	5	8	5	**80**	**High**	-
	With Mitigation	2	3	6	4	**44**	**Medium**	-

5.9.4 Mitigation and Management Measures

The development of proposed Rietvlei Mine poses risks to groundwater as assessed. The proper design, construction and operation, and maintenance of the appropriate respective liner system below dirty water dams, tailing dams should be implemented as well as the rehabilitation of the open mine, are part of the key focus areas to mitigate groundwater impacts. The following precautions have to be taken into consideration to reduce possible groundwater risks posed by the development of proposed Rietvlei Mine:

- **Construction Phase**

  - During design phase, the waste and water management infrastructures at proposed Rietvlei Mine (included dams, drains, waste area) must be designed with the appropriate water barrier system if required, and comply with the DWA minimum requirements (1998/2012/2013), with special focus on the R634, R635, R636 of the NEMWA 2008;
  - Design of the mine facilities to be conducted by an accredited or recognised professional designer;
  - The design of the dirty water drains, dams, as well as the waste storage areas should ensure their long term integrity;
  - All dirty surface water control facilities (dam, drain) must be designed to have a minimum freeboard above full supply level, at such manner that they can always handle 1:50 year flood-event on top of its mean operation level;
  - A proper construction phase should be carried out under the supervision of an accredited or recognised professional civil engineer, as approved by the designer;
  - Storage area for hydrocarbons or any toxic construction material should be bunded according to DWA minimum requirement;
  - Groundwater management strategies must be implemented to prevent risk of water pollution;
  - Groundwater monitoring network should be installed before the starting of any construction activities on site;

- The monitoring network can be updated according to the DWA minimum requirements, if required;
- Monitoring of groundwater must be done once per Quarter;
- Any waste and spills (especially during construction, operation and closure) need to be cleaned up immediately according to the DWA minimum requirements;
- Authorities need to be notified in the event of a spill or leachate during construction, operation and closure;
- Clean and dirty water is to be separated, and any containment of dirty water should be lined;
- Vehicle storage and maintenance areas to be hard-surfaced;
- Regular maintenance of vehicles must be implemented;
- Trucks need to be capped to minimise spillage of coal or wastes, on roads;
- Separate clean water from the stockpiling area to minimise water infiltrating from the site;
- The reusing dirty water from mine activities must be assessed and implemented as much as possible;
- All hazardous substances must be handle according to the requirements of relevant legislation relating to the transport, storage and use of the substance;
- The area to be used for storage of any hazardous waste and items which contains hazardous substance must be lined with bunded walls to prevent pollution of surface or groundwater should a leakage/spillage occur;
- Application for WULA amendment as per DWA requirements must be made for proposed new abstraction boreholes if any required; and
- The migration of leachate into the groundwater regime around any potential pollution sources as identified must be prevented at all times.

Operational Phase

- Contaminated water drain (within the waste site) and dam must be properly operated and maintained;
- All surface dirty water control facilities (dam, drain) must be operated to have a minimum freeboard above full supply level, at such manner that they can always handle 1:50 year flood-event on top of its mean operation level;
- Effectiveness of existing monitoring borehole position should be re-evaluated;
- The monitoring network can be updated according to the DWA minimum requirements, if required to incorporate the unsaturated zones around proposed Rietvlei Mine;
- Keep contamination to a minimum by keeping the pit as dry as possible (dewatering) to reduce contact time of water and oxygen with exposed strata; and
- Spills from the coal processing (crushing, screening and washing) in the plant area needs to be cleaned up immediately according to the DWA minimum requirements and rehabilitation should follow.

Decommissioning and Closure Phase

- Implement closure of open pit progressively;
- Effectiveness of existing monitoring borehole position should be re-evaluated;
- Rubble from waste or contaminated areas should be dismantled and disposed of accordingly;
- Backfill material to be fully compacted and covered, and the entire foot print of waste to be shaped for free-draining. This will minimise infiltration of oxygen rich water, and reduce geochemical reactions that should occur;
- Rehabilitation to follow backfilling compaction;

- Rehabilitation should consist of re-vegetating the site using appropriately chosen indigenous grasses;
- A rehabilitation plan must be implemented and the plan should be done in the line with the contents of NWA (Act No 36 of 1998), to avoid subsequent negative environmental impacts that may occur;
- Continue monitoring until it can be demonstrated that vegetation is self-sustaining and no erosion channels exist; and
- Effectiveness of existing monitoring borehole position should be re-evaluated.

5.10 Wetlands

A Wetland Assessment was conducted by Scientific Aquatic Services in April 2014, which is included in **Appendix 1** for further information.

5.10.1 Nature of the Impact

5.10.1.1 Construction Phase

The following construction phase impacts were identified with regards to wetlands:

- **Loss of wetland habitat and ecological structure**

  Site clearing and the removal of vegetation may result in loss of wetland biodiversity due to vegetation clearance. There may be direct impacts on wetland habitat due to erosion, sedimentation and increased runoff. Contamination of wetland soils and surface water may impact foraging and breeding habitats for wetland/riverine species. Contamination of water within wetlands could result from topsoil stockpiling adjacent to wetlands and runoff from stockpiles. Dumping of hazardous and non-hazardous waste into the wetland areas may result in a loss of wetland habitat and ecological structure. Earthworks in the vicinity of wetland areas may lead to increased runoff and erosion and altered runoff patterns. Compaction and loss of wetland soils may occur.

- **Changes to wetland ecological and sociocultural service provision**

  The Impacts on wetland ecology and sociocultural service is as a result of site clearing and the removal of vegetation which can lead in the loss of ecological and social cultural services depend on abundance of vegetation present and surface roughness. The construction of infrastructure can lead in the changes to instream habitat that would reduce assimilation capacity. It can also result in changes to riparian and instream characteristics that are important in terms of flood attenuation, stream flow regulation and sediment trapping. Any changes to the wetland ecology and sociocultural would result in the loss of phosphate, nitrate and toxicant removal abilities, loss of carbon storage capabilities, inability to support biodiversity and loss of water supply to the local community.

- **Impact on wetland hydrological function**

  The Impacts on the disruption of the hydrological functioning of the wetland habitats is as a result of site clearing, disturbance of soil and the removal of vegetation leading to increased runoff and erosion. Earthworks in the vicinity of wetland areas can lead to increased runoff and erosion and altered runoff patterns. Construction of stream crossings can alter stream and base flow patterns and water velocities. Topsoil stockpiling deposited adjacent to wetlands can result in runoff from stockpiles leading to sedimentation of the system. The movement of construction vehicles within wetlands can have an impact on the hydrological functioning of the wetlands.-Increased runoff volumes due to increased paved and other impervious surfaces can have an effect on the hydrology of wetlands. A change in flood peak flows, concentration and canalisation of flow, incision of wetland areas and erosion of wetland habitat and sediment deposition can result in a change in the hydrological functioning of the wetlands.

5.10.1.2 Operational Phase

The following operational phase impacts were identified with regards to wetlands:

- **Loss of wetland habitat and ecological structure**

  There may be ongoing disturbance of soils due to general operational activities. Spillages and seepage of hazardous waste material into the groundwater may occur. There is a risk of discharge from the mining infrastructure. Potential contamination from mining infrastructure, general dirty water areas as well as spillages of hydrocarbons, has the potential to contaminate the groundwater environment which in turn can affect water quality in surface water sources in the area. Runoff, seepage and potential discharge from mining infrastructure such as pipelines is anticipated. Dumping of hazardous and non-hazardous waste into the wetland areas may occur. Erosion and sedimentation of wetlands may occur. There may be inadequate separation of clean and dirty water areas. A loss of instream flow due to abstraction for water for production and the formation of a cone of dewatering from open pits may occur. Topsoil stockpiling adjacent to wetlands and runoff from stockpiles may contaminate wetland features. These activities may lead to direct impacts on the wetland, loss of wetland biodiversity, contamination of wetland soils, contamination of water within wetlands, compaction and loss of wetland soils, changes to the wetland community due to alien invasive vegetation leading to altered habitat conditions, dewatering of wetlands and loss of habitat.

- **Changes to wetland ecological and sociocultural service provision**

  The Impacts on wetland habitat as a result of ongoing disturbance of soils with general operational activities include spillages and seepage of hazardous waste material into the groundwater. There is a high risk of discharge from the mining infrastructure. This can lead to potential contamination from mining infrastructure general dirty water areas as well as spillages of hydrocarbon, has the potential to contaminate the groundwater environment which in turn can affect water quality in surface water sources in the area. Runoff, seepage and potential discharge from mining infrastructure such as pipelines can change wetland ecology. Dumping of hazardous and non-hazardous waste into the wetland areas can also lead to contamination and degradation of the wetland habitats. Erosion and sedimentation of wetlands, inadequate separation of clean and dirty water areas and loss of instream flow due to abstraction for water for production and the formation on a cone of dewatering from open pits can all contribute to the change in wetland ecological and sociocultural provision. Wetlands ecology and biodiversity may change as a result alien floral encroachment, Contamination of wetland soils, Contamination of water within wetlands, Compaction and loss of wetland soils, Sedimentation and incision leading to altered habitats, Changes to the wetland community due to alien invasion vegetation leading to altered habitat conditions, Dewatering of wetlands and loss of habitat. Topsoil stockpiling adjacent to wetlands and runoff from stockpiles may contaminate the wetlands.

- **Impact on wetland hydrological function**

  The Impacts as a result of a change in hydrological functioning of the wetland habitats is as a result of ongoing disturbance of soils with general operational activities. Earthworks in the vicinity of wetland areas can lead to increased runoff and erosion and altered runoff patterns. Topsoil stockpiling adjacent to wetlands can result in runoff from stockpiles leading to sedimentation of system. The movement of construction vehicles within wetlands, altered hydrology due to Storm water channels and dams, increased runoff volumes due to increased paved and other impervious surfaces, dewatering of wetlands and loss of habitat, change in flood peak flows, concentration and canalisation of flow, incision of wetland areas and erosion of wetland habitat and sediment deposition.

5.10.1.3 Decommissioning Phase

The following decommissioning phase impacts were identified with regards to wetlands:

- **Loss of wetland habitat and ecological structure**

  Disturbance of soils as part of demolition activities, ongoing seepage and runoff from mining infrastructure to the groundwater regime as well as the ongoing risk of discharge from mining infrastructure beyond closure may occur. Other activities that may result in negative impacts include; potential contamination from the decommissioning of mining infrastructure, vehicular use and ineffective rehabilitation. These activities may result in direct impacts on wetland, loss of wetland biodiversity due to alien floral encroachment and

mismanagement of wetland rehabilitation habitat during decommissioning, ongoing contamination of wetland soils, ongoing contamination of water within wetlands, compaction and loss of wetland soils during decommissioning, sedimentation incision leading to altered habitats, changes to the wetland community due to alien invasion vegetation leading to altered habitat conditions and continued dewatering of wetlands and loss of habitat.

- **Changes to wetland ecological and sociocultural service provision**

  The Impacts on wetland ecology and sociocultural service is as a result of closure related activities within wetland and riparian features presently considered important in terms of biodiversity, tourism and recreation. Site clearing and the removal of vegetation can lead to the loss in ecological and sociocultural services dependent on abundance of vegetation present and surface roughness. Seepage from any latent discard dumps and dirty water areas can lead to a loss in ecological and sociocultural services. The decommissioning and closure related activities can result in changes to riparian and instream characteristics that are important in terms of flood attenuation, streamflow regulation and sediment trapping. The loss of phosphate, nitrate and toxicant removal abilities, loss of carbon storage capabilities, inability to support biodiversity and loss of water supply to the local community can lead to a change in wetland ecology and sociocultural service provision.

- **Impact on wetland hydrological function**

  The Impacts on the disruption of the hydrological functioning of the wetland habitats is as a result of disturbance of soils as part of demolition activities, earthworks in the vicinity of wetland areas leading to increased runoff and erosion and altered runoff patterns, movement of construction vehicles within wetlands, altered hydrology due to in channel Storm water dams, movement of construction vehicles within wetlands, incision of wetland areas and erosion of wetland habitat and sediment deposition.

5.10.1.4 Cumulative Impacts

Due to extensive mining and beneficiation in the Middelburg and surrounding areas, along with extensive agriculture, the regional cumulative impacts as a result of loss of wetlands is considered to be highly significant. It is also critically important to consider the general impact from mining activities in the greater Olifants catchment, which includes coal mining as well as platinum group metals and the severe impact from the urban areas of Mpumalanga. In particular, specific mention is made of the impact of urban runoff and the release of treated and raw sewage effluent into the riverine systems in the area. Seepage from mining facilities such as waste dumps, TSF and general dirty water areas, agricultural activities, as well as spillages of hydrocarbons, has the potential to contaminate the groundwater environment which in turn can affect water quality in surface water sources in the area.

Within the Olifants catchment there has been significant impact on wetlands due to erosion, incision, and sedimentation into the wetlands. These impacts have led to the loss of wetlands and the loss of the wetland's ability to function naturally.

Cumulative impacts associated with the mine include:

- The loss of wetland habitat, functioning and ecoservice provision as a result of mining activities within the Middelburg region, which may in turn impact on water resources and vegetation structure.
- Loss of wetland connectivity and dewatering of wetlands due to mining activities will have a detrimental impact on faunal species utilising riparian zones as migratory corridors and the overall biodiversity in the area.

The impact on the wetland resources in the vicinity of the Middelburg operations could lead to an overall reduction of the assimilative capacity of wetlands in the Olifants catchment and lead to a general loss of ecological and socio-cultural services within this important water resource.

5.10.2 Significance Rating

Table 5-15, Table 5-16, and **Table 5-17** outline the significance ratings for relevant wetland impacts both with and without mitigation measures.

Table 5-15: Significance Ratings for the Construction Phase Wetland Impacts

Construction Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Loss of wetland habitat and ecological structure	Without Mitigation	3	5	8	4	**64**	**High**	-
	With Mitigation	2	4	6	4	**48**	**Medium**	-
Changes to wetland ecological and sociocultural service provision	Without Mitigation	3	5	8	4	**64**	**High**	-
	With Mitigation	3	3	6	3	**36**	**Medium**	-
Impact on wetland hydrological function	Without Mitigation	3	5	6	3	**42**	**Medium**	-
	With Mitigation	2	4	4	2	**20**	**Low**	-

Table 5-16: Significance Ratings for the Operational Phase Wetland Impacts

Operational Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Loss of wetland habitat and ecological structure	Without Mitigation	3	5	8	4	**64**	**High**	-
	With Mitigation	2	4	6	4	**48**	**Medium**	-
Changes to wetland ecological and sociocultural service provision	Without Mitigation	3	5	8	4	**64**	**High**	-
	With Mitigation	3	3	6	3	**36**	**Medium**	-
Impact on wetland hydrological function	Without Mitigation	3	5	6	3	**42**	**Medium**	-
	With Mitigation	2	4	4	2	**20**	**Low**	-

Table 5-17: Significance Ratings for the Decommissioning Phase Wetland Impacts

Decommissioning Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Loss of wetland habitat and ecological	Without Mitigation	3	5	8	4	**64**	**High**	-
	With	2	4	6	4	**48**	**Medium**	-

Decommissioning Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
structure	Mitigation							
Changes to wetland ecological and sociocultural service provision	Without Mitigation	3	5	8	4	**64**	**High**	-
	With Mitigation	3	3	6	3	**36**	**Medium**	-
Impact on wetland hydrological function	Without Mitigation	3	5	6	3	**42**	**Medium**	-
	With Mitigation	2	4	4	2	**20**	**Low**	-

5.10.3 Mitigation and Management Measures

The following mitigation and management measures should be considered for the construction, operation and decommissioning phases of the project with regards to wetland impacts:

- **Loss of wetland habitat and ecological structure**
  - A sensitivity map has been developed for the site, indicating the various wetland features, which are considered to be of increased ecological importance. It is recommended that this sensitivity map be considered during the planning/ pre-construction and construction phases of the proposed development activities to aid in the conservation of ecology within the site;
  - It must be ensured that planning of mining infrastructure includes consideration of adjacent wetland / pan areas to ensure that these areas are avoided as far as possible;
  - Development / mining impacts on the affected wetland features should be managed to minimise impacts on adjacent wetland features;
  - Edge effects of activities including erosion and alien / weed control need to be strictly managed in these areas;
  - Access into adjacent wetland / pan areas, particularly by vehicles, is to be strictly controlled;
  - All vehicles should remain on designated roads with no indiscriminate driving through adjacent wetland / pan areas;
  - Ensure that all stockpiles are well managed and have measures such as berms and hessian curtains implemented to prevent erosion and sedimentation;
  - Run-off from dirty water areas entering wetland habitats must be prevented and clear separation of clean and dirty water in the vicinity of the proposed infrastructure must take place. Oil must be prevented from entering the clean water system;
  - Pollution control dams should be off stream structures and not within the natural drainage system of the area, thereby minimising impacts loss of instream flow and downstream recharge;
  - Ensure that seepage from dirty water systems is prevented as far as possible;
  - It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil;
  - All spills should be immediately cleaned up and treated accordingly;

- Appropriate sanitary facilities must be provided for the life of the mine and all waste removed to an appropriate waste facility;
- Effective waste management must be implemented in order to prevent construction related waste from entering the wetland environment;
- All adjacent wetland systems must be monitored for erosion and incision;
- Erosion berms may be installed in any areas where soil disturbances within the vicinity of the wetland features have occurred to prevent gully formation and siltation of the aquatic resources. The following points should serve to guide the placement of erosion berms:
  - Where the track has slope of less than 2%, berms every 50m should be installed;
  - Where the track slopes between 2% and 10%, berms every 25m should be installed;
  - Where the track slopes between 10% and 15%, berms every 20m should be installed; and
  - Where the track has slope greater than 15%, berms every 10m should be installed.
- Restrict construction to the drier winter months if possible to avoid sedimentation of wetland features in the vicinity of the proposed mine development areas; and
- Desilt all adjacent wetland areas affected by mining and runoff from dirty water areas.

Changes to wetland ecological and sociocultural service provision

- It must be ensured that planning of mining infrastructure includes consideration of adjacent wetland areas to ensure that these areas are avoided as far as possible;
- All demarcated sensitive zones outside of the construction area must be kept off limits during any development and closure phases of the mine;
- The development footprint area must be limited to what is absolutely essential in order to minimise environmental damage;
- Run-off from dirty water areas entering adjacent wetland habitats must be prevented and clear separation of clean and dirty water in the vicinity of the proposed shaft must take place;
- Oil must be prevented from entering the clean water system;
- It must be ensured that seepage from dirty water systems is prevented as far as possible;
- It must be ensured that the mine process water system is managed in such a way as to prevent discharge to the receiving environment;
- Edge effects of activities including erosion and alien / weed control need to be strictly managed in wetland areas;
- As much vegetation growth as possible should be promoted within the proposed mine development area in order to protect soils. In this regard, special mention is made of the need to use indigenous vegetation species where hydroseeding, wetland and rehabilitation planting (where applicable) are to be implemented;
- Implement effective waste management in order to prevent construction related waste from entering the wetland environment; and
- All wetland areas must be rehabilitated upon decommissioning to ensure that wetland functions are reinstated during decommissioning and all disturbed wetland areas adjacent to the mining development must be re-vegetated with indigenous wetland species.

Impact on wetland hydrological function

- It must be ensured that planning of mining infrastructure includes consideration of adjacent wetland areas to ensure that these areas are avoided as far as possible;
- Keep all demarcated sensitive zones outside of the construction area off limits during development phases;

- Prevent run-off from dirty water areas entering wetland habitats;
- Ensure that seepage from dirty water systems is prevented as far as possible;
- Ensure that the mine process water system is managed in such a way as to prevent discharge to the receiving environment;
- Implement effective waste management in order to prevent construction related waste from entering the wetland environment;
- All wetland areas must be rehabilitated upon decommissioning to ensure that wetland functions are re-instated during decommissioning and all disturbed wetland areas adjacent to the mining development must be re-vegetated with indigenous wetland species;
- It must be ensured that all activities potentially impacting on geohydrological resources are managed according to the relevant DWA Licensing regulations and groundwater monitoring requirements;
- Post closure groundwater management will need to be very carefully managed to ensure that no impact on the wetland areas takes place after mine closure has taken place; and
- Future mine planning should ensure that mining activities does not lead to a reduction of stream flow or dewatering of any wetland areas.

5.11 Aquatic Ecology

An Aquatic Ecological Assessment was conducted by Scientific Aquatic Services in April 2014, which is included in **Appendix 1** for further information.

5.11.1 Assumptions, Uncertainties and Gaps in Knowledge

The following assumptions, uncertainties and gaps in knowledge are applicable to this section

- *Reference conditions are unknown:* The composition of aquatic biota in the aquatic resources associated with the subject property, prior to major disturbance, is unknown. For this reason, reference conditions are hypothetical, and are based on professional judgement and/or inferred from limited data available;
- *Temporal variability:* The data presented in this report are based on two site visits, undertaken in early spring (5th October 2011) and mid-summer (21st January 2014). The effects of natural seasonal and long term variation in the ecological conditions and aquatic biota found in the streams are, therefore, unknown; and
- *Ecological assessment timing:* Aquatic and terrestrial ecosystems are dynamic and complex. It is likely that aspects, some of which may be important, could have been overlooked. A more reliable assessment of the biota would require seasonal sampling, with sampling being undertaken under both low flow and high flow conditions.

5.11.2 Nature of the Impact

5.11.2.1 Construction Phase

The following construction phase impacts were identified with regards to aquatic ecology:

- **Impacts on water quality**

  Clean and dirty water systems not being constructed to the required specifications to prevent contamination of clean water areas may impact on water quality. Major earthworks and construction activities may lead to impacts on water quality. Poor housekeeping and management may lead to impacts on water quality. Spills and other unplanned events may also impact on water quality. Impaired water quality may impact on

riparian vegetation structures. Build-up of contaminants in sediments may lead to the creation of a sediment sink and a chronic source of potential water contamination.

- **Impacts on loss of aquatic habitat**

  Site clearing and the removal of vegetation leading to increased runoff and erosion may alter the aquatic habitat. Site clearing and road construction and the disturbance of soils leading to increased erosion may alter the aquatic habitat. Earthworks in the vicinity of drainage systems leading to increased runoff and erosion and altered runoff patterns may alter the aquatic habitat. Construction of bridge crossings altering streamflow patterns and water velocities may alter the aquatic habitat. Alien vegetation encroachment will impact on and alter the aquatic habitat. Aspects of the instream habitat affected include: erosion and incision of the riparian zone, altered wetting patterns leading to impacts on riparian zone continuity, loss of low flow refugia, altered substrate conditions from sandy conditions from to more muddy conditions, altered depth and flow regimes in the major drainage systems and alien vegetation proliferation.

- **Impacts on loss of aquatic biodiversity and sensitive taxa**

  Site clearing and the removal of vegetation may lead to a loss in aquatic biodiversity. Site clearing and road construction may lead to a loss in aquatic biodiversity. Earthworks and other mining construction activities in the vicinity of wetland and riparian areas may lead to a loss in aquatic biodiversity. Placement of infrastructure within non-perennial drainage lines with special mention of the overburden stockpile areas, open pits as well as road crossings and bridges may lead to a loss in aquatic biodiversity. Inadequate separation of clean and dirty water areas may lead to a loss in aquatic biodiversity. Aspects of aquatic biodiversity that may be affected include: sedimentation and loss of natural substrates, altered stream channel forms, increased turbidity of water, loss of refugia, deterioration in water quality, loss of flow sensitive macro-invertebrates and fish, loss of water quality sensitive macro-invertebrates and fish and loss of riparian vegetation species.

- **Impacts on loss of instream flow**

  Construction of possible small stream diversions may impact on the instream flow of the receiving systems. Construction of clean and dirty water separation structures for pollution control purposes may lead to altered flow levels. Clearing of areas for the initiation of the production pits may lead to reduced instream flow. Use of surface water runoff and groundwater as a water supply during construction mining project may alter the flow in the receiving systems. Aspects of instream flow that may be affected include: loss of instream surface and base flow, loss of streamflow regulation and stream recharge, loss of aquatic habitats for aquatic macro- invertebrates and fish and increased moisture stress on riparian vegetation.

5.11.2.2 Operational Phase

The following operational phase impacts were identified with regards to aquatic ecology:

- **Impacts on water quality**

  Mining activities and the establishment of mining waste may impact on water quality and thus needs to be managed to prevent pollution. Clean and dirty water systems not being maintained and operated to the required specifications to prevent contamination of clean water areas may impact on water quality. Poor housekeeping and management during the operational phase may lead to impacts on water quality. Spills and other unplanned events during the operational phase may impact on water quality. There may be impacts on riparian vegetation due to impaired water quality. Build-up of contaminants in sediments may lead to the creation of a sediment sink and chronic source of potential water contamination. Impacts on groundwater quality could manifest in surface water sources.

- **Impacts on loss of aquatic habitat**

  Ongoing disturbance of soils during general operational activities may alter the aquatic habitat. Inadequate separation of clean and dirty water areas may alter the aquatic habitat during the operational phase. Mining related activities leading to increased disturbance of soils and drainage lines may alter the aquatic habitat. Any activities which lead to the reduction of flow in the system with special mention of the open pits and the use of face and groundwater sources for production water may alter the aquatic habitat. Alien vegetation encroachment will impact on and alter the aquatic habitat. Aspects of instream habitat that may be affected include: erosion and incision of riparian zone, altered wetting patterns leading to impacts on riparian zone

continuity, loss of low flow refugia, altered substrate conditions from sandy conditions from to more muddy conditions, altered depth and flow regimes in the major drainage systems and alien vegetation proliferation.

- **Impacts on loss of aquatic biodiversity and sensitive taxa**

  Ongoing disturbance of soils with general operational activities may lead to a loss in aquatic biodiversity. Inadequate separation of clean and dirty water areas may lead to a loss in aquatic biodiversity. Loss of instream flow due to abstraction for water for production and the formation of a cone of dewatering from open pits may lead to a loss in aquatic biodiversity. Seepage from the discard dumps and overburden stockpiles may lead to a loss in aquatic biodiversity. Discharge from the mine process water system with special mention of Return Water Dams and any Pollution Control Dams may lead to a loss in aquatic biodiversity. Sewage discharge from mine offices and camps may lead to a loss in aquatic biodiversity. Nitrates from blasting leading to eutrophication of the receiving environment and may lead to a loss in aquatic biodiversity. Aspects of aquatic biodiversity that may be affected include: sedimentation and loss of natural substrates, altered stream channel forms, increased turbidity of water, loss of refugia, deterioration in water quality with special mention of impacts from cyanide, heavy metals and AMD, eutrophication of the aquatic ecosystems, loss of flow sensitive macro-invertebrates and fish, loss of water quality sensitive macro-invertebrates and fish and loss of riparian vegetation species.

- **Impacts on loss of instream flow**

  Loss of water through clean and dirty water separation may alter instream flow on the receiving systems. The formation of a cone of dewatering created by open pits may lead to loss of stream flow. Use of surface water runoff and groundwater as a water supply during the operational phase of the mine may lead to reduced instream flow. Impact on natural streamflow regulation and stream recharge due to altered hydrology in the area may lead to altered instream flow. Aspects of instream flow that may be affected include: loss of instream surface and base flow, loss of streamflow regulation and stream recharge, loss of aquatic habitats for aquatic macro- invertebrates and fish and increased moisture stress on riparian vegetation.

5.11.2.3 Decommissioning Phase

The following decommissioning phase impacts were identified with regards to aquatic ecology:

- **Impacts on water quality**

  Inadequate closure and rehabilitation leading to ongoing pollution from contaminating sources such as discard dumps may impact on water quality. Clean and dirty water systems not being maintained or decommissioned properly to the required specifications to prevent contamination of clean water areas may impact on water quality. Poor housekeeping and management during decommissioning phase may lead to impacts on water quality. Spills and other unplanned events during decommissioning phase may impact on water quality. impacts from riparian vegetation structure may result due to impaired water quality. Latent release of contaminants in sediments may lead to the formation of an ongoing source of potential water contamination. Impacts on groundwater quality could manifest in surface water sources.

- **Impacts on loss of aquatic habitat**

  Disturbance of soils as part of demolition activities may alter the aquatic habitat. Inadequate separation of clean and dirty water areas may alter the aquatic habitat during the decommissioning phase. Ongoing pollution from inappropriately decommissioned structures may alter the aquatic habitat. Alien vegetation encroachment will impact on and alter the aquatic habitat. Aspects of instream habitat that may be affected include: erosion and incision of riparian zone, altered wetting patterns leading to impacts on riparian zone continuity, loss of low flow refugia, altered substrate conditions from sandy conditions from to more muddy conditions and alien vegetation proliferation.

- **Impacts on loss of aquatic biodiversity and sensitive taxa**

  Disturbance of soils as part of demolition activities, inadequate separation of clean and dirty water areas, seepage from any latent discard dumps and dirty water areas, inadequate closure leading to post closure impacts and ongoing erosion of disturbed areas that have not been adequately rehabilitated may lead to a loss in aquatic biodiversity. Aspects of aquatic biodiversity that may be affected include: sedimentation and loss of natural substrates, altered stream channel forms, increased turbidity of water, loss of refugia,

deterioration in water quality with special mention of impacts from cyanide, heavy metals and salinisation, eutrophication of the aquatic ecosystems, loss of flow sensitive macro-invertebrates and fish and loss of riparian vegetation species.

- **Impacts on loss of instream flow**

  Loss of water to inadequately rehabilitated areas such as discard dumps and open pits may still have an impact on the flow post operational phase. The formation of a cone of dewatering created by final voids may impact on the flow in the post operational phase. Use of surface water runoff and groundwater as a water supply during the closure phase of the mine may impact on the flow. Impact on natural streamflow regulation and stream recharge due to altered hydrology in the area may impact on the flow post operational phase. Aspects of instream flow that may be affected include: loss of instream surface and base flow, loss of streamflow regulation and stream recharge, loss of aquatic habitats for aquatic macro-invertebrates and fish and increased moisture stress on riparian vegetation.

5.11.3 Significance Rating

Table 5-18, Table 5-19, and **Table 5-20** outline the significance ratings for relevant aquatic ecology impacts both with and without mitigation measures.

Table 5-18: Significance Ratings for the Construction Phase Aquatic Ecology Impacts

Construction Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Impacts on water quality	Without Mitigation	4	4	8	4	**64**	**High**	-
	With Mitigation	3	4	6	4	**52**	**Medium**	-
Impacts on loss of aquatic habitat	Without Mitigation	3	4	8	4	**60**	**Medium**	-
	With Mitigation	3	4	6	4	**52**	**Medium**	-
Impacts on loss of aquatic habitat	Without Mitigation	3	4	8	4	**60**	**Medium**	-
	With Mitigation	3	4	6	4	**52**	**Medium**	-
Impacts on loss of instream flow	Without Mitigation	4	5	8	4	**68**	**High**	-
	With Mitigation	3	4	6	4	**52**	**Medium**	-

Table 5-19: Significance Ratings for the Operational Phase Aquatic Ecology Impacts

Operational Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Impacts on water quality	Without Mitigation	4	4	8	4	**64**	**High**	-
	With Mitigation	3	4	6	4	**52**	**Medium**	-

Operational Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Impacts on loss of aquatic habitat	Without Mitigation	3	4	8	4	**60**	**Medium**	-
	With Mitigation	3	4	6	4	**52**	**Medium**	-
Impacts on loss of aquatic habitat	Without Mitigation	3	4	8	4	**60**	**Medium**	-
	With Mitigation	3	4	6	4	**52**	**Medium**	-
Impacts on loss of instream flow	Without Mitigation	4	5	8	4	**68**	**High**	-
	With Mitigation	3	4	6	4	**52**	**Medium**	-

Table 5-20: Significance Ratings for the Decommissioning Phase Aquatic Ecology Impacts

Decommissioning Phase								
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status**
Impacts on water quality	Without Mitigation	4	4	8	4	**64**	**High**	-
	With Mitigation	3	4	6	4	**52**	**Medium**	-
Impacts on loss of aquatic habitat	Without Mitigation	3	4	8	4	**60**	**Medium**	-
	With Mitigation	3	4	6	4	**52**	**Medium**	-
Impacts on loss of aquatic habitat	Without Mitigation	3	4	8	4	**60**	**Medium**	-
	With Mitigation	3	4	6	4	**52**	**Medium**	-
Impacts on loss of instream flow	Without Mitigation	4	5	8	4	**68**	**High**	-
	With Mitigation	3	4	6	4	**52**	**Medium**	-

5.11.4 Mitigation and Management Measures

The following mitigation and management measures should be considered for the construction, operation and decommissioning phases of the project with regards to aquatic ecology impacts:

- **Impacts on water quality**
  - Ensure that as far as possible all infrastructures are placed outside of wetland, riparian, drainage and stream areas. In particular mention is made of the need to not encroach on the riparian systems on the Selons River within the proposed mine area and a minimum buffer of 100m around all wetland and riparian systems should be maintained in line with the requirements of regulation GN704 of the National Water Act;

- Very clear and well managed clean and dirty water separation must take place in line with the requirements of regulation GN704 of the National Water Act;
- Pollution control dams must be adequately designed to contain a 1:50 24 hour storm water event;
- All pollution control facilities must be managed in such a way as to ensure that storage and surge capacity is available if a rainfall event occurs;
- Limit the footprint area of the construction activity to what is absolutely essential in order to minimise the loss of clean water runoff areas and the concomitant recharge of streams in the area;
- Permit only essential construction personnel within 32m of all riparian systems;
- Keep all demarcated sensitive zones outside of the construction area off limits during the construction phase of the development;
- All hazardous chemicals must be stored on specified surfaces;
- Ensure that all spills are immediately cleaned up;
- Monitor all pollution control facilities using toxicological screening methods and implement the calculation of discharge dilution factors by means of the Direct Estimation of Ecological Effect Potential (DEEEP) protocol;
- Ongoing aquatic ecological monitoring must take place on a 6 monthly basis by an SA RHP Accredited assessor;
- The extent of all operations which may impact the Selons River must be kept to an absolute minimum; and
- No infrastructure or open pits should encroach into any major drainage lines.

Impacts on loss of aquatic habitat

- Ensure that as far as possible all infrastructures are placed outside of wetland, riparian, drainage and stream areas. In particular mention is made of the need to not encroach on the riparian systems on the Selons River within the proposed mine area and a minimum buffer of 100m around all wetland and riparian systems should be maintained in line with the requirements of regulation GN704 of the national Water Act;
- Limit the footprint area of the construction activity to what is absolutely essential in order to minimise the loss of aquatic habitat in the area;
- Ensure that all stockpiles are well managed and have measures such as berms and hessian sheets implemented to prevent erosion and sedimentation which may ultimately lead to transformation of aquatic habitat areas;
- Pollution control dams should be off stream structures and not within the natural drainage system of the area, thereby minimising impacts loss or transformation of aquatic habitat;
- Permit only essential construction personnel within 100m of all riparian systems;
- Keep all demarcated sensitive zones outside of the construction area off limits during the construction phase of the development as well as during operational phase of the mine;
- Implement alien vegetation control program within wetland and riverine areas with special mention of water loving tree species;
- Ongoing aquatic ecological monitoring must take place on a 6 monthly basis by an SA RHP Accredited assessor;
- The extent of all operations which may impact aquatic habitat must be kept to an absolute minimum;
- No infrastructure or open pits should encroach into any major drainage lines; and
- Re-vegetate all disturbed areas with indigenous tree species and make use of indigenous species with an affinity for riparian zones.

- **Impacts on loss of aquatic biodiversity and sensitive taxa**
  - Ensure that as far as possible all infrastructure is placed outside of sensitive wetland areas, streams and rivers;
  - Pollution control dams should be off stream structures and not within the natural drainage system of the area, thereby minimising impacts form inundation and siltation;
  - Permit only essential construction personnel within 100m of the wetland habitat;
  - Keep all demarcated sensitive zones outside of the construction area off limits during the construction phase of the development;
  - Use of water must be minimised as far as possible in order to minimise the loss of recharge of the Selons River system;
  - Limit the footprint area of the construction activity to what is absolutely essential in order to disturbance of soils leading to runoff, erosion and sedimentation and loss of instream flow and stream recharge;
  - Prevent run-off from dirty water areas entering stream and river systems through ensuring clear separation of clean and dirty water areas;
  - Ensure that the mine process water system is managed in such a way as to prevent discharge to the receiving environment and to prevent discharge of dirty water;
  - Implement measures to contain seepage as far as possible to prevent contamination of the groundwater regime;
  - Implement alien vegetation control program within wetland and riparian areas;
  - Monitor all systems for erosion and incision;
  - Any areas where active erosion is observed must be rehabilitated and berms utilised to slow movement of water;
  - Ongoing aquatic biomonitoring should take place in order to identify any emerging issues in the receiving environment;
  - Toxicological monitoring of the receiving and process water systems on a quarterly basis;
  - The extent of all operations which may impact aquatic habitat must be kept to an absolute minimum;
  - No infrastructure or open pits should encroach into any major drainage lines; and
  - Monitoring of sediment heavy metal concentrations.
- **Impacts on loss of instream flow**
  - Ensure that as far as possible all infrastructures are placed outside of drainage and river areas. In particular mention is made of the need to not encroach on the riparian systems near the Selons River with a minimum buffer of 100m around all wetland and riparian systems should be maintained in line with the requirements of regulation GN704 of the National Water Act;
  - Limit the footprint area of the construction activity to what is absolutely essential in order to minimise the loss of clean water runoff areas;
  - No use of clean surface water or any groundwater which potentially recharges the watercourses in the area should take place. In this regard specific mention is made of any water use which will affect the instream flow in the Selons River;
  - Very strict control of water consumption must take place and detailed monitoring must take place and where all water usage must continuously be optimised;
  - Upstream dewatering boreholes should be utilised to minimise the creation of dirty water and this clean water should be used to recharge the natural systems downstream of the mining rights areas;

- Pollution control dams should be off stream and tributary structures and not within the natural drainage system of the area, thereby minimising impacts loss of instream flow and downstream recharge;
- Permit only essential construction personnel within 32m of all riparian systems;
- Keep all demarcated sensitive zones outside of the construction area off limits during the construction phase of the development;
- Implement alien vegetation control program within wetland areas with special mention of water loving tree species;
- Monitor all affected riparian systems for moisture stress;
- Monitor all potentially affected riparian zones for changes in riparian vegetation structure;
- Ongoing aquatic ecological monitoring must take place on a 6 monthly basis by an SA RHP (South African River Health Program) Accredited assessor;
- The extent of the operations in the mining rights area must be kept to an absolute minimum; and
- No infrastructure or open pits should encroach into any major drainage lines.

5.12 Issues and Responses from Public Consultation Process

5.12.1 Stakeholder Identification

During the scoping phase a number of stakeholder were identified and informed of the Proposed Project. Presently all stakeholders identified to date have been registered on the project stakeholder database. The EAP endeavoured to ensure that individuals/organisations from referrals and networking were notified of the Proposed Project. Refer to **Appendix 8** for a list of stakeholders captured in the project database.

5.12.2 Authority Notification

WSP consulted with the Department of Mineral Resources on 4 May 2015 and 18 August 2015. The minutes of this workshop are included in **Appendix 9**.

WSP notified a number of other national, provisional and local authorities of the Proposed Project via a notification letter at the start of the scoping public participation process. No comments have been received from these authorities to date however communication lines will remain in place for the duration of the Proposed Project should the authorities wish to comment on the Proposed Project and the EA processes undertaken.

5.12.3 Stakeholder Notification

5.12.3.1 Newspaper Advertisements

In accordance with the requirements of GNR 982, the Proposed Project was advertised in local newspapers during the scoping phase. The purpose of the advertisement was to notify the public of the Proposed Project and to invite them to register as stakeholders (see **Appendix 10**). The relevant advertisement dates are listed in **Table 5-21**.

Table 5-21: Date on which the Adverts were published

Newspaper	Publication Date	Language
Witbank News	7 February 2014	English
Middelburg Observer	7 February 2014	Afrikaans

5.12.3.2 Site Notices

Site notices and general project notices were placed in and around the project area. Copies of the site notices are included in **Appendix 11**.

5.12.4 One-on-one stakeholder meetings

One-on-one stakeholder meetings were held, in order to present the Proposed Project and WUL to key stakeholders and to gather concerns or queries (**Table 5-22**). WSP facilitated the meetings and was accompanied by the Proponent where applicable. The minutes to these meetings are included in **Appendix 12**.

Table 5-22: One-on-one Meetings

Stakeholder	Date	Venue
Mr Gideon Anderson	27 March 2014	Zonnebloem Farm
Mr Jan Roux	24 April 2014	Driefontein Farm

5.12.5 Public Meetings

Table 5-23 outlines the meetings that were held. The meetings outlined the details of the Proposed Project and provided opportunities for stakeholders to raise issues, concerns and queries. The meetings also established lines of communication between stakeholders and the project team. The meetings were facilitated by WSP and were attended by RMC representatives. Invitations to the meetings were sent out in the form of faxes, telephone calls, emails and site notices. The minutes to the meetings are included in **Appendix 13**.

Table 5-23: Public Meetings

Date	Time	Venue	Attendance
Thursday, 27 March 2014	10:00 – 12:00 (Authorities Meeting)	Middelburg Chamber of Commerce	Attended by a number of local and district authorities.
	13:00 – 15:00 (Community Meeting)	On site	Postponed on request of the Land-owner.
	17:30 to 19:00 (Public Open Day)	Middelburg Chamber of Commerce	No attendance.
	19:00 to 20:30 (Public Meeting)		No attendance.
Thursday, 24 April 2014	10:00 to 11:30 (Community Meeting)	On site	Postponed on request of the com-munity representatives. Meeting to be re-scheduled after consultation with the Landowner and community representatives.
Wednesday 28 May 2014	10:00 to 12:30 (Community Meeting)	On site	Attended by 19 members of the local community as well as WSP and RMC representatives.

5.12.6 Comment and Response Report

All concerns, comments, viewpoints and questions (collectively referred to as 'issues') have been documented and responded to adequately in a CRR (**Appendix 14**). The CRR records the following:

- List of all issues raised;
- Record of who raised the issues;
- Record of where the issues were raised;
- Record of the date on which the issue was raised; and

- Response to the issues.

5.13 Matters Requiring Attention / Problem Statement

- Hydrological modelling factoring in hydrogeological impacts to the surface water environment.
- Wetland rehabilitation plan;
- Waste Management Plan; and
- Water supply assessment:
  - Rainfall harvesting potential;
  - Groundwater yield capacity for abstraction – dry vs rainy season

5.14 Assessment of Level and Confidence of Information

The assessment to date is limited to the information currently available and as presented in the earlier reports, by various third parties, alongside independent works undertaken by WSP. In this regards, and notwithstanding any potential outcomes and/or additional requirements of the DEA and DWA, it is considered that confidence in the information is generally high

6 Water and Waste Management

6.1 Water and Waste Management Philosophy

RMC is an environmentally conscience and responsible company. The proposed mine is committed to careful managing and continuously improving its operation to ensure pollution prevention, elimination of waste and conservation of natural resources. This philosophy extends to:

- Optimising the use of resources in order to eliminate waste in whatever form;
- Preventing potential pollution, reducing and minimising the risk of injuries, occupational illness, disease, process losses, property damage or fire. The proposed mine will focus on assessing all environmental impacts, aspects and environmental hazards;
- Ensure compliance to all relevant legislation, regulations and any other environmental requirements to which the proposed mine will subscribe;
- Including environmental performance when measuring managerial performance; and
- Providing appropriate training to all employees and contractors whose activities have an impact on the environment.

6.2 Strategies

RMC will be developing various strategies regarding the water use and protection of water resources. As the mine has yet to commence construction or operation, these strategies will be developed and summarised in future revisions of this IWWMP.

6.3 Performance Objectives

The general performance objectives of RMC will be included in their Environmental Policy Measures to Achieve and Sustain Performance Objectives, which has yet to be developed as the proposed mine has not commenced construction or operation.

6.4 Measures to Achieve and Sustain Performance Objectives

RMC will ensure continual measures to undertake the necessary environmental assessments whereby information will be used to identify and prioritise the significance of environmental risks and ensure that appropriate environmental management programmes are implemented. Key initiatives to achieve sustainable water utilisation and protection associated with the proposed project will be developed during the construction phase of the mine.

6.5 IWWMP Action Plan

An action plan has been developed to ensure environmental and compliance related risks associated with water and waste management at the Rietvlei Coal Mine (**Table 6-1**). The plan includes objectives and issues that will need to be revised following the construction phase.

Table 6-1: IWWMP Action Plans

STRATEGY		OBJECTIVES				
Aspect	**Detail**	**Confirm to responsible practices and environmental legislation**	**Protection of surface water resources**	**Protection of subsurface environment (i.e. groundwater and soils)**	**Reduce water consumption**	**Reduce solid waste generated**
Water Resource Protection (Quantity/ Quality/Ecology)	Implement proposed storm water management plan to mitigate dirty water discharge to the environment and reduce surface water ponding and associated subsurface contamination.					
	Develop a groundwater management plan to assess subsurface impacts associated with the proposed Mine.					
	Conduct regular maintenance and inspection of storm water management and effluent management systems.					
	Manage all materials, wastes and spillages according to legal requirements, proposed procedures and best practice.					
	Implement good housekeeping measures.					
Monitoring and Compliance	Report any incident that may result in water pollution to the relevant authority.					
	Monitoring resource quality in surface water bodies and monitoring wells up gradient and down gradient of all potential point and diffuse sources of potential pollution.					
	Assess waste residues that have the potential to impact groundwater via contamination seepage.					
	Maintain an updated water and salt balance to allow for appropriate water/ effluent management and pollution control.					
	Conduct audits against the IWWMP and other relevant legal water management requirements.					
Rehabilitation and Remediation	Undertake environmental risk assessment of the discard dump and PCDs to establish any impacts to the receiving water environment.					

6.6 Control and Monitoring

6.6.1 Monitoring of Change in Baseline

Groundwater, surface water, wetlands and bio-monitoring specialist studies have been undertaken during which the baseline conditions were established. The specialist studies provided recommendations and proposed monitoring that should be undertaken. Monitoring programmes have been provided in **Section 5.5**.

6.6.2 Audit and Report on Performance Measures and Relevance of Action Plan

RMC will also ensure that annual internal audits of the conditions within the IWWMP are conducted. Audit procedures will be established, implemented and maintained that address the responsibilities and requirements for planning and conducting audits, reporting results and retaining associated reports. The procedure(s) will also address the determination of the audit criteria, scope, frequency and methods. Internal auditors will ensure objectivity of the audit process.

The specific procedures and standard operating procedures will be compiled and finalised once the mine is operational.

It is thus envisaged that the following schedule be adhered to with regard to compliance monitoring and performance assessment:

- Internal monitoring of compliance with the IWWMP
  - Monthly
- Revision of the action plan
  - Annually
- Monitoring and performance assessment of the IWWMP
  - Annually

7 Section 27 Evaluation in terms of the NWA (1998)

In terms of Section 27 of the NWA, “in issuing a general authorisation or licence the responsible authority must take into account all relevant factors, including the following”:

7.1 Existing Lawful Water Uses

No existing lawful water uses have been applied or obtained by the RMC.

7.2 The Need to Redress the Results of Past Racial and Gender Discrimination

The RMC firmly believes that the competence of its human capital is of utmost importance to the future success of the proposed project and its organisation. It furthermore recognises that in order to address the skills deficit faced by the workforce, considerable effort and investment should be directed towards the education, training and skill development of its employees. This initiative will be accomplished via the implementation of a Human Resource Development (HRD) Programme. This programme intends to facilitate the achievement of four key outcomes:

- To provide skills training opportunities to mine workers during their employment in order to improve their income earning capacity after mine closure;
- To promote employment and skills development in the local communities and major labour sending areas;
- To ensure substantially higher levels of inclusiveness and advancement of Historically Disadvantaged South Africans (HDSAs), including women, in the mining industry; and
- To contribute to the development of a pool of skilled South African workers in support of National Economic and Skills Development strategies.

With meticulous planning and implementation of the HRD Programme, the desired outcomes are inevitable. A crucial point to note is that no facet of the programme will be initiated in isolation. All manpower planning and skills development initiatives will be aligned to the company's strategic business plan as well as to the level of skill of staff employed once the mine is in operation. The mine's operational requirements, stemming from the mine works programme, will form the basis for establishing the organisations' skill development priorities. These priorities will include the following plans for implementation:

- Adult Basic Education and Training (ABET);
- Learnerships;
- Core Skills Training (relevant to the core business functions);
- Portable Skills Training (promoting employment beyond mine closure);
- Internships and Bursaries; and
- Career Progression and Mentorship Programmes.

The theme of *Employment Equity* will be interwoven through each of the above-mentioned initiatives, expanding the skills base and opportunities of HDSA employees (including women).

The RMC is committed to promoting and ensuring equity in the workplace. In line with the South African Mining Charter's attempt to redress the imbalance from the past, The RMC embraces the challenge to include women in non-traditional roles that are directly linked to the business of mining. However, there are restrictions on employment of women in opencast mines. In a concerted effort to successfully integrate women into a predominantly male-dominated environment, The RMC will place focus on the strategies detailed in **Table 7-1.**

Table 7-1: Past Racial and Gender Discrimination Strategy

Strategy	Detail
Recruitment	The RMC will strive to: ■ Adopt active recruiting strategies to attract women. ■ Recruit women from the communities surrounding the mine. ■ Recruit women for opencast mining positions traditionally occupied by men. ■ Conduct physical capability testing as part of the selection process. All positions will be made available to women, provided they meet the necessary criteria of the test. ■ Show preferential consideration to capable women when filling vacant posts.
Risk Assessment	The RMC will carry out a comprehensive risk assessment exercise to determine the risks for women on the mine. This will be documented, distributed and communicated to all relevant stakeholders.
Policies and Procedures	The RMC will: ■ Not discriminate against women in terms of pay. ■ Not discriminate against women in terms of conditions of employment. ■ Ensure that a sexual harassment policy is in place and is accessible to all employees. This will be incorporated in terms and condition of employment letter.

Strategy	Detail
	▪ Sexual harassment officers will be trained to educate, inform and address issues of sexual harassment that may arise in the workplace. ▪ Implement procedures for women working in hazardous areas, based on the risk assessment conducted.
Conducive Environment	The RMC will invest in: ▪ Appropriately furnished change house facilities for women. ▪ Suitable ablution facilities with sanitary bins – including toilets in sufficient proximity to the workplace.
Induction	The RMC will: ▪ Provide thorough induction to prepare women for working in a mining environment. ▪ Ensure that a module relating to sexual harassment forms part of the induction programme, both for new employees and those returning from annual leave. ▪ Include a cultural diversity training module as part of induction, with gender issues forming an integral component of the content. This will introduce the idea of women in the workplace and the potential challenges that could be experienced. All new employees and those returning from annual leave will be exposed to this training.
Learner ships	In line with the Social and Labour Plan, women will be appropriately represented at each annual learner ship intake.
Career Progression	Advice will be provided on the development initiatives required to pursue chosen career paths.
Mentorship	As part of The RMC's mentorship programme, special focus will be placed on mentoring all levels of women within the organisation. This will aid in the future succession planning, empowerment and leadership opportunities for women in mining.
Talent Pool	A "women in mining" talent pool will be established. ▪ Women within the workforce will be identified with the aim of fast tracking them in support of career progression and future appointments.
Meetings with Management	The RMC management will initiate *ad hoc* meetings and workshops in order to: ▪ Ascertain female employees' views, concerns and recommendations regarding working conditions at the mine. ▪ Gain a greater understanding of the successes and challenges faced by women in the organisation. ▪ Provide networking opportunities to female employees, allowing them to be exposed to management and other women in various areas of work within the mine.
Fair Representation	It is the intention of The RMC to ensure a reasonable representation of women in all occupational categories and levels of employment at the mine. Women will be well represented on the following forums: ▪ Skills development; ▪ Employment equity; ▪ Employee wellbeing; and ▪ Health and safety.

7.3 Efficient and Beneficial Use of Water in the Public Interest

It is anticipated that waste water and water containing contaminants may be generated. Therefore, a water treatment plant will be required for the mine. After closure the water treatment plant may be contracted to a third party and constructed with capacity to supply surrounding communities with potable water. It is anticipated that the water treatment plant may be required to be operational following mine closure.

Additionally, the mine may be required to construct and operate a sewage treatment plant in order to manage the sewage generated as a result of the onsite employees. The sewage treatment plant may be managed by a third party(i.e. municipality) and may be constructed with additional capacity to treat surrounding communities' sewage (please note that this will need to be assessed within the first three years of mine operation).

7.4 The Socio-Economic Impact of (i) the water use(s) if authorised; or, (ii) the failure to authorise the water use(s)

7.4.1 Of the water use or uses, if authorised

107 069 people are economically active (employed or unemployed but looking for work) and of these, 19.7% are unemployed. The majority of the 53 630 economically active youth (15 – 34 years) are employed, with only 27.1% being unemployed (**Figure 4-29**). 12.8% of the population have no household income, while the biggest income bracket (17%) has a household income of R38 201 – R76 400.

The mine will aid in the creation in jobs for both skilled and unskilled labour. The level of unemployment is low in this area however; it is proposed that the mine will decrease this already low unemployment rate. It is predicted that the mine will generate approximately 150 permanent jobs over the 20-24 year LOM. Of this total ~80 will be employed by the mining contractor, ~40 by the plant contractor and ~23 by RMC. The figures will vary with production requirements. These employees are anticipated to be sourced from the surrounding local communities. In addition, a number of contractors benefit by the operation, specifically transport and raw material suppliers. In addition, a number of contractors will benefit from the proposed mining operation, with specific reference to transport, mining supplies, catering and security. The operation will have a continued need for suppliers and services, which will be procured both locally and regionally. This together with the spending power of the employees has a significant beneficial impact on the local economy. Due to the low unemployment levels of the area, the proposed mine will have a positive impact on the local population.

7.4.1.1 Construction Phase

The construction phase is anticipated to result in the following impacts on the social environment:

- **Increased Health and Safety Risk**

  The proposed construction phase is likely to result in a number of possible health and safety risks to the surrounding communities, as outlined below.

  - **Noise** – Construction phase noise resulting from construction vehicles and equipment is likely to be limited to the immediate study area. Noise emissions are likely to be of low significance during the construction phase.
  - **Air Emissions** – A number of construction-related activities may generate particulate matter. This will affect the sensitive receptors immediately adjacent to the construction area and the (unpaved) access road to the site. Particulate matter is unlikely to have significant impacts on these receptors, due to the temporary nature of the construction phase. Despite this a number of mitigation and management measures have been recommended for implementation during the construction phase.
  - **Traffic** - The presence of construction vehicles could also pose a safety risk to farmers and surrounding communities as individuals use the main access road (D1344). An increase in traffic (specifically construction vehicles) could potentially result in an increased number of accidents resulting in injury or even mortality.

- **Communicable Diseases** - The potential influx of labour and job-seekers into the area could result in health concerns around communicable diseases, such as HIV/ AIDS and Tuberculosis (TB). There is currently a low rate of HIV/AIDs and related diseases within the Steve Tshwete Local Municipality, which could increase with the presence of additional external labour. Education and awareness campaigns are vital to managing and mitigating this risk to the local communities, as it has been indicated that labour is likely to be housed within the existing communities and Middleburg.
- **Crime** - There is the potential for crime events to increase within the local area, with additional, non-residents being present in the local environment. This is likely, however, to be restricted during the construction phase, as the number of people and access to the site will be limited. It is recommended that education and awareness campaigns are developed and implemented prior to the construction phase, and security is maintained within the mining area as a preventative measure.

- **Social Tensions and Disruptions due to Construction Activities and Labour Force**

  The presence of non-residents, perceived "outsiders" and contractors within the local environment could cause localised social tension and a change in nature of the area during construction which could result in the disruption of the construction activities.

- **Creation of Employment Opportunities**

  It is anticipated that approximately 80 employment opportunities will be generated through the construction phase. Due to the fact that specialist skills will be required during the construction phase experienced contractors are likely to be sourced from outside the local area to undertake and manage the construction activities. However, these contractors will be required to source both skilled and unskilled labour from the surrounding areas.

- **Growth of Skills and Business Development**

  The proposed mine is unlikely to provide significant skills development opportunities during the construction phase of the project. The limited number of employees required during this phase, and the specialist requirements, may result in experienced contractors being sourced from outside the local area to undertake and manage the construction activities.

  The degree to which downstream economic impacts provide local stimulus to the economy is based on the degree to which value added services can be locally sourced. There may be an opportunity for business and entrepreneurial development within the local area.

- **Informal Settlement Relocation**

  A small in informal settlement is located on the south eastern edge of the mining right area. This settlement will not be immediately affected by the mining activities; however it is proposed that RMC will relocate the settlement to a more suitable location during the construction phase.

7.4.1.2 Operational Phase

The operational phase is anticipated to result in the following impacts on the social environment:

- **Employment Opportunities**

  It is proposed that all the work undertaken on the mine during the operational phase will be undertaken by suitable mining contractors. The RMC itself will employ limited staff on the mine. In accordance with the MRPDA, the RMC has developed and submitted a social and labour plan (SLP) as part of the application for mining rights. It is anticipated that the mining contractors will be sourced from the local area (i.e. Middelburg) as far as possible. All labour will be sourced from the local population so as to avoid the need to provide housing.

- **Skill Development**

  A Workplace Skills Plan will be submitted to the DMR within 3 months of commencement of mining operations. The Workplace Skills Plan will address the operational requirements of the mine and meet the future employment and career aspirations of employees. This plan will also set targets which will be based on the education and skills levels of the employees. Underpinning the Skills Plan is the overarching objective of equipping historically disadvantaged South Africans (HDSAs) with the necessary skills to

enable them to apply for increasingly senior level and ultimately management positions within RMC. In this regard the key components of the skills development plan are:

- Assessment of current skills levels and identification of an HDSA talent pool;
- Creation of opportunities for women and promoting their participation in the day-to-day activities of RMC;
- Establishment of mentorship programmes aimed at supporting HDSAs to achieve their goals and career paths, and;
- Providing funding for HDSAs in the form of bursaries.

- **Local Economic Development**

  The prioritisation of local procurement for the provision of services such as the provision of materials, transport, catering and cleaning will contribute towards the development of local services and business development in the local area.

  The presence of the mine could also result in secondary investment in the local area, through the development of infrastructure, and tertiary sector services (e.g. retail, banking, etc.). It is however, imperative that the local community, organisations, leadership and government are involved in the development and procurement, in order to maximise local benefits from the mine for the local communities.

- **Increased Health and Safety Risk**

  There is the potential for the proposed mining operations to result in an increased health and safety risk at a local level. This is likely to be a result of a number of factors, including the following:

  - **Traffic** – There is likely to be a distinct increase in traffic (predominantly large trucks transporting coal) along the mine access road along the D1344, R555 and through Middleburg. The presence of these trucks, as well as other mining vehicles, could result in an increase in potential vehicular accidents as well as pedestrian injuries and fatalities in the Middelburg area.
  - **Blasting/vibration** – Blasting and resultant vibration could result in damage to homesteads in the surrounding areas.
  - **Noise and dust** – There is the potential for the operational phase to result in noise and particulate matter emissions from blasting, material removal, coal removal, crushing and screening activities, stockpiles, loading activities and vehicle movement. The impact of these emissions are predicted to be medium to high and localised to the area immediately adjacent to the operational area and access road. These emissions could result not only in a nuisance factor for local residents, but also health impacts from inhalation and exposure over long periods of time.
  - **Influx of labour** – The potential influx of labour and job-seekers into the area could result in health concerns around communicable diseases, such as HIV/AIDS and TB. There is currently a low rate of HIV/AIDs and related diseases within the Steve Tshwete Local Municipality, which could increase with the presence of additional external labour. This is likely to be limited during operation, with limited labour needed on site. Education and awareness campaigns are vital to managing and mitigating this risk to the local communities, as it has been indicated that labour is likely to be housed within the existing communities and Middleburg.
  - **Crime** – There is the potential for crime events to increase within the local area, with additional, non-residents being present in the local environment. This is likely, however, to be restricted during the operational phase, as access to the site will be strictly controlled. It is recommended that education and awareness campaigns are developed and implemented prior to the operational phase, and security is maintained within the mining area as a preventative measure.

- **Increase in Social Conflict**

  The potential for the influx of labour and job seekers into the area could result in social changes such as conflict for resources, conflict of cultures, and a change in nature of the area resulting in social change and the potential for disputes.

In addition, labour conflict with the mining company, regarding aspects such as wages and resources, could result in local social unrest. This could potentially adversely impact the local population should this not be managed correctly. Conflict management by RMC and the mining contractors (i.e. managing labour demands, issues and communications) is therefore a key aspect to preventing long-term social unrest.

7.4.1.3 Decommissioning and Closure Phase

The decommissioning and closure phase is anticipated to result in the following impacts on the social environment:

- **Reduction in Employment Opportunities and Associated Decline in Economic Activities**

  The mine is proposed to have a lifespan of approximately 20 years. The closure of the mine will result in the loss of direct employment as well as associated indirect employment through contractors and service providers for the mine. In addition, locally sourced employees may not be able to move to other areas for mining employment. The loss of employment could, therefore, impact the socio-economic environment through the loss of income and livelihoods, and the affect this may have on the local economic and quality of life for local populations.

- **Health and Safety Risks**

  The coal discard facility for the mine is likely to remain on site in the long-term (excess of 20 years), and will need to be managed to ensure acid mine drainage does not contaminate water and soil resources. This could be seen as a long-term health and safety risk if not managed correctly.

  Following the closure of the mine, it is anticipated that noise and dust emissions will cease, resulting in a minor improvement of health and quality of life.

7.4.2 Of the failure to authorise the water use or uses

The authorisation of the water uses is an intrinsic part of the proposed Rietvlei coal mine authorisation process. Should the water uses not be authorised, the proposed mine will not be implemented. Should this occur, the above list of potential impacts will no longer be applicable and the socio-economic status quo of the region will remain unchanged. Local communities will remain disadvantaged and unemployed, however the potential negative impacts arising from construction, operation and closure of the mine will not occur.

7.5 Catchment Management Strategy Applicable to the Relevant Water Resource

The current status quo of the water catchment area is that it is largely in balance when considered as a whole. Large amounts of water are drawn from this catchment by Eskom for the cooling of coal-powered power stations. As a result of the large volumes of water extracted from this catchment, an international agreement has been made with Swaziland that water use will not be increased in this catchment as South Africa is already drawing more than its allocation. The relevant water uses required by RMC will be discussed and considered by DWS.

7.6 The Likely Effect of the Water Use to be authorised on the Water Resource and on Other Water Users

New technologies, as well as best practise guidelines will be used to ensure water use is minimal and where possible water is reused and recycled. A plan and engineering designs will be developed to ensure that cut-off trenches/ open drains and berms separate the 1:100 “clean” water runoff, from the 1:50 “dirty” water, to divert clean runoff around the identified operational areas that may pollute water resources. The PCD’s will be sized to collect the average dirty runoff.

The RMC has acknowledged that, should the water quality of the water catchment be compromised, this may have negative knock-on effects; thus necessitating the need for proactive management plans to be developed to prevent this eventuality.

7.7 The Class and the Resource Quality Objectives of the Water Resource

The water quality in the Olifants WMA upper is determined by the current activities that occur on the catchment, land use and geology. The current water quality is considered to pose no problem for urban, industrial and irrigation use; however, there is a risk of coal mining activities which are the main contributors to the current in-stream quality. These activities have the potential to contaminate the resource and this risk must be carefully managed through the formulation of pro-active catchment management plans (DWAF 2011).

7.8 Investments Already Made and to be Made by the Water User in Respect of the Water Use in Question

Table 7-2 includes initial capital expenditure required for the construction of the mine infrastructure, the ongoing capital expenditure (relating to replacement of equipment and or sub-assemblies during the Life of Mine) as well as additional operational costs.

Table 7-2: Capital Expenditure Required for the Proposed Project

Year	Initial Capital Expenditure	Ongoing Capital Expenditure	Total
Year 1	R 124,926,881	-	R 124,926,881
Year 2	R 283,309,700	R 4,666,018	R 287,975,718
Year 3	R 64,684,732	R 8,243,633	R 72,928,365
Year 4	-	R 8,249,903	R 8,249,903
Year 5	-	R 9,932,903	R 9,932,903
Year 6	-	R 8,249,903	R 8,249,903
Year 7	-	R 38,196,287	R 38,196,287
Year 8	-	R 8,249,903	R 8,249,903
Year 9	-	R 8,249,903	R 8,249,903
Year 10	-	R 9,932,903	R 9,932,903
Year 11-20		R 112,191,315	R 112,191,315
TOTAL	**R 472,921,313**	**R 216,162,672**	**R 689,083,985**

7.9 The Strategic Importance of the Water Use to be authorised

Coal is considered one of the most valued minerals in the world and is the largest source of energy, providing 27% of the global primary energy needs and generating 41% of the world's electricity (World Coal Association, 2011). South Africa possesses Africa's only significant coal reserves; over 70% of Africa's coal reserves are found in South Africa (Snyman and Botha, 1993), with coal reserves of 30,408 million tonnes at the end of 2009, which represents 3.68% of the world's total coal production. Coal production in South Africa was valued at approximately ZAR 59.9 billion in 2009 (BP Statistical Energy Survey, 2010).

South Africa is a significant coal consuming country, with a coal consumption of 99.43 million tonnes in 2009, representing 3.3% of the world's total (Mbeni Information Services, 2011). In 2008, South Africa used coal for 93% of its electricity generation needs, and was the most dependent coal to electricity country in the world

(World Coal Association, 2011). Apart from its domestic needs, South Africa is still the world's fifth largest coal exporting country, resulting in an excess of 60 million tonnes of coal exported during 2009 (World Coal Association, 2011).

Coal plays a crucial role in the South African energy-economy and fuels local industry. The consumption of coal in South African coal-fired power stations is anticipated to continue into the future. Increased demand in Eastern countries (driven by rapid economic growth rates) will continue to result in a demand for South African coal exports, and exports are expected to increase to 105 million tonnes per annum by the year 2020. Until alternative sources of energy are successfully implemented, coal will remain the primary source in South Africa and in developing countries across the world.

Both local and international markets are highly dependent on South Africa being a main provider of coal. The identification and exploitation of new coal reserves in South Africa is therefore a prerequisite in meeting this demand. According to the Statistics SA (2007), the mining sector provides over 20% of the GDP and approximately 6% employment in the province.

Although it is noted that activities such as mining are important to enhance Mpumalanga's local economic development, the local municipalities in which the proposed Rietvlei Coal Mine is located recognise the challenges associated with balancing the needs of environmental protection with the economic and development needs of the region.

Coal will have a major role in meeting the future energy needs. Demand for coal and its vital role in the world's energy system is set to continue. Over the next 30 years, it is estimated that global energy demand will increase by almost 60%. Two thirds of the increase will come from third world countries, and by 2030 they would account for almost half of the total energy demand (www.bp.com).

The changes in the global market are placing Eskom under increasing risk in terms of securing future supplies from the local market, in which the production capacity has not kept pace with increases in both local and international demand. It is critical that local production be facilitated to ensure long-term security of supply for electricity production. Additional power stations and major power lines are being built to meet rising electricity demand in South Africa (Eskom Annual Report, 2008). Until alternative sources of energy are successfully implemented, coal will remain the primary source in South Africa.

The proposed Rietvlei Coal Mine has a gross *in situ* resource of approximately 2.5 mega tonne per annum (Mtpa) that will be exported or transported to supply Eskom power stations.

The planned life of mine (LOM) is 20 to 24 years, although this may be extended with the potential identification of additional feasible reserves within the prospecting right boundary. Additional prospecting drilling is required to adequately quantify this potential resource.

Should the water uses not be authorised, the project will be in jeopardy of commencing construction and operational activities. This will result in the RMC being non-compliant with the NWA and receiving fines. An overview of the implications of the project not going ahead is provided below. It is understood that a mineable coal resource exists within the target area, however there is concern pertaining to the sensitivities of the site and potential cumulative impacts that may result with the implementation of the project. The continuation of agriculture will not provide the level of short-term economic growth to the area that mining may offer, such as increased employment of residents in the area, greater economic input allowing development of the towns and surrounding areas, and greater socio-economic stability in the area. It is understood that the short term employment opportunities (initially 15 years) will benefit previously disadvantaged communities, however, may impact on the surrounding environment that could leave lasting environmental degradation for years to come.

7.9.1 Skills and Employment Opportunity Loss

If the project were not to precede, the additional economic activity, skills development and job opportunities would not be created and the coal reserves remain unutilised. Additional services and infrastructure such as municipal water (potentially), electricity and sanitation (potentially) will not be developed. The proposed mine could potentially result in the provision of jobs for around 150 permanent jobs. This does not include ancillary business that may result from the development of the mine (i.e. indirect business opportunities). It has been projected that these employment opportunities will be sourced primarily from the surrounding communities. The Steve Tshwete Local Municipality is a rural, largely unemployed Black African community, who rely on mining

and agriculture-based employment for household income. Therefore the provision of jobs could potentially be significant in the town, provided local residents are employed.

7.9.2 Loss of Potential Economic Growth

It is estimated that the production will result in an expected ROM of 2.5 Mtpa. The initial life of mine has been calculated to be 20 years, with possibilities for extensions based on existing resources in the remainder area within the prospecting boundary. If the RMC was not to proceed with the proposed operation, mining of these coal reserves will not be precluded or avoided, as another application in terms of the MPRDA may be made by another company.

By not mining the coal reserves available in the proposed mining development area, this will prevent the availability and use of a valuable coal reserve for the generation of electricity at a time when there is a shortage of electricity that is hampering economic growth in the country.

Furthermore, the socio-economic growth injection resulting from the proposed mining investment by the RMC will not occur. This economic boost may not continue following the closure of the proposed Rietvlei Coal Mine, however, investment from the RMC into the local economic development projects defined in the SLP, if managed adequately, will continue into the future thereby benefitting future generations.

In terms of Capex on the project from project initiation by the RMC includes money spent on authority liaison, legal, administration, money paid to previous lease owner, technical expertise, exploration and compensation for farm lands, road upgrade and engineering and procurement construction management (EPCM) (R **689,083,985** spent).

7.9.3 Precedent

According to the MTPA, there are currently a large number of applications for mining within the greater southern Mpumalanga region. If the proposed Rietvlei Opencast Coal Mine had to be authorised, this may set a precedent in the region which may result in the granting of additional mining rights within a 100 km radius of the site. Due to the documented sensitivities onsite, and should a precedent be set to mine within the area, the combined impacts of mining, afforestation and agriculture could have a deleterious impact on the biodiversity at a provincial and national level (NSS, 2013).

7.9.4 Bi-lateral and Free Trade Agreements associated with the BRICS

BRICS is the acronym for an association of five major emerging national economies: Brazil, Russia, India, China and South Africa. With the possible exception of Russia, the BRICS members are all developing or newly industrialised countries, but they are distinguished by their large, fast-growing economies and significant influence on regional and global affairs. As of 2013, the five BRICS countries represent almost 3 billion people, with a combined nominal GDP of US$14.8 trillion, and an estimated US$4 trillion in combined foreign reserves (World Economic Outlook, 2013).

The South African Government has entered into a number of bi-lateral and Free Trade Agreements with India, as a co-member of the BRICS grouping in critical identified areas of investment, which areas include mining, energy, healthcare and agriculture. The South African and Indian government's objective for foreign direct investment agreements are linked to a socio-economic growth model based on equity and justice, addressing poverty and underdevelopment, especially in rural areas of South Africa.

Through the Free Trade Agreement, South Africa and other bi-lateral agreements, invited Indian companies to participate and invest in six specific areas; mining and beneficiation, infrastructure development, agriculture, green economy initiatives and tourism. The mutual understanding and underlying principle of the investment invitation is that such investment will provide incentive to the business communities of the two countries to explore mutually beneficial commercial opportunities and contribute to the growth of bi-lateral trade, whilst directly also contributing towards socio-economic uplifting through job creation, rural development, skills and technology transfer, enterprise development and the development of small, medium and micro enterprises.

It is understood that should the project not be authorised, the commercial opportunities associated with socio-economic uplifting through job creation, rural development, skills and technology transfer, enterprise development and the development of small, medium and micro enterprises will not occur.

7.9.5 Loss of Income Tax and Royalties

Should the project not go ahead, there will be a direct loss of tax income from the proposed Rietvlei Coal Mine, income that will continue to be spent in South Africa from the ongoing maintenance of conveyor systems, mining fleets, diesel that will be purchased (which has supplements *viz.* road tax). Royalties will also not be generated which must be paid to the South African Government. Furthermore, income tax generated from employees, contractors and companies servicing the proposed Rietvlei Coal Mine will not be generated.

7.9.6 Sense of Place

The mining will be above ground over the entire mining footprint. The disturbance on the surface has been calculated to be 2 225.30ha; of this approximately 800ha will be mined. It has been noted that the project may impact the sense of place within the area, and should the project not go ahead, the current natural state of the environment will not be disturbed. This will have a positive effect for the biodiversity and ecosystems in the area thereby having a positive impact on the ecotourism of the region and a direct influence on the sense of place.

7.10 The Quality of Water in the Water Resource which may be required for the Reserve and for Meeting International Obligations

The water uses associated with the proposed project may pose a threat to the reserve and catchment, should the appropriate mitigation measures not be put in place and adhered to.

7.11 The Probable Duration of any Undertaking for Which a Water Use is to be authorised

Currently, it is anticipated that the target area has sufficient reserves to mine approximately 2.5 Mtpa resulting in a LoM of approximately 20 to 24 years based on current technology. It has been noted that additional reserves can extend the proposed Rietvlei Coal Mine LoM.

Therefore future water use and waste management are not considered to alter significantly off the current base, however any changes in water and waste management practices at the proposed Rietvlei Coal Mine will be incorporated within future revisions of the IWWMP which should be recognised as a live and dynamic document for amendment as necessary during the LoM and related water use activities.

8 Conclusion

8.1 Regulatory Status of Activity

The RMC is required to apply for relevant water uses as outlined in this IWWMP. It is understood that no activities associated with the proposed Rietvlei Coal Mine will commence prior to receipt of the WULA from the DWA.

8.2 Statement on Water Use

Given the current IWWMP, the following water uses will require authorisation in terms of the NWA:

- Impact on the wetlands and water resource in terms of Section 21(c) and Section 21(i);
- Disposing and storage of water containing waste into the co-disposal discard dump and PCDs in terms of Section 21(g); and
- Abstraction of groundwater in order to ensure safe working conditions for opencast miners in terms of Section 21(j).

Appendix 1: Faunal, Floral, Wetland and Aquatic Assessment as Part of the Environmental Assessment and Authorisation Process for the Proposed Rietvlei Colliery, Middelburg, dated April 2014, undertaken by Scientific Aquatic Services

FAUNAL, FLORAL, WETLAND AND AQUATIC ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED RIETVLEI COLLIERY OUTSIDE MIDDELBURG, MPUMALANGA PROVINCE

Prepared for

WSP Group

April 2014

Prepared by:	**Scientific Aquatic Services**
Report author	**N. Cloete**
	M. Hanekom
Report reviewers	**S. van Staden (Pri. Sci. Nat)**
Report Reference:	**SAS 213295**
Date:	**April 2014**

Scientific Aquatic Services CC
CC Reg No 2003/078943/23
Vat Reg. No. 4020235273
91 Geldenhuis Road
Malvern East Ext 1
2007
Tel: 011 616 7893
Fax: 086 724 3132
E-mail: admin@sasenvironmental.co.za

Declaration

This report has been prepared according to the requirements of Section 32 (3b) of the Environmental Impact Assessments EIA Regulations, 2010 (GNR 543). We (the undersigned) declare the findings of this report free from influence or prejudice.

Project Manager:

Stephen van Staden *Pr Sci Nat* (Ecological Sciences) 400134/05
BSc. Hons (Aquatic Health) (RAU);
M.Sc. Environmental Management (RAU).

Field of expertise:
Wetland, aquatic and terrestrial ecology.

Stephen van Staden

Date: 15/04/2014

EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a floral, faunal, wetland and aquatic ecological assessment as part of the Environmental Assessment (EIA) and authorisation process for the proposed Rietvlei Colliery, hereafter referred to as the "subject property". The subject property is situated south-east of the R555, outside Middelburg, Mpumalanga Province (25°40'18.59"S 29°39'16.47"E). The total area of the proposed opencast footprint extends over approximately 747.16ha.

1. Floral assessment

Specific outcomes of this report include the following:

- To conduct a Red Data Listed (RDL) species assessment, including the potential for species to occur on the subject property;
- To provide floral inventories of species as encountered on site;
- To determine and describe habitats, communities and the ecological state of the subject property;
- To describe the spatial significance of the subject property with regards to the surrounding natural areas;
- To identify and consider all sensitive landscapes such as wetlands and/or any other special features; and
- To determine the environmental impacts of the proposed mining activities on the terrestrial ecology within the subject property.

The following general conclusions were drawn upon completion of the floral assessment:

- The subject property is located within a district utilised for cultivation of maize with gravel roads and farm infrastructure encountered throughout. Large sections of the subject property are currently used for forestry purposes and areas of edible crop lands are also located within the subject property.
- The subject property can be divided into three dominant habitat units namely transformed grassland habitat; transformed habitat (consisting of plantation areas, bare soil / gravel roads, and agricultural lands) and wetland habitat.
    - Transformed grassland habitat: This habitat unit is located between the plantations on the subject property. Very few natural grassland areas remain on the subject property due to the surrounding agricultural and plantation activities that are dominant within the subject property.
    - Transformed habitat: Areas which are not characterised as wetlands or transformed grassland areas have been transformed by either crop cultivation or used for forestry purposes. This has led to the alteration of the floral community structure to the extent that it is completely irreversible in some areas.
    - Wetland habitat: Several wetland and pan features were identified within the subject property. The pan features were characterised as endorheic depression systems and the wetland features as a flat seepage according to the National Freshwater Ecosystem Priority Areas (NFEPA) water management database. Further to this the wetland features within the subject property was divided into two broad categories namely wetland features with permanent zones of saturation and wetland features with no permanent zones of saturation.
- An assessment considering the presence of any floral species of concern, as well as suitable habitat to support any such species, was undertaken. The complete PRECIS (Pretoria Computer Information Systems) floral list for the grid references (2529DA) was enquired from the South African National Biodiversity Institute (SANBI). The threatened status of all the species listed within the Quarter Degree Square (QDS) 2529DA was categorised as either least concern (LC) or not evaluated (NE). No RDL floral species were listed within the QDS. In addition no RDL floral species were recorded within the subject property during the site assessment.

- The information gathered during the assessment of the subject property was used to determine the Vegetation Index Score (VIS).

Habitat unit	Score	Class	Motivation
Transformed habitat	5	**Class E – extensive loss of natural habitat**	This habitat unit is associated primarily with the plantations, alien proliferation as well as agricultural activities. The ecological functionality and habitat integrity of the transformed habitat Unit is regarded as being extremely limited.
Transformed grassland habitat	6	**Class D – largely modified**	This habitat unit has undergone vegetation transformation due to the surrounding alien encroachment and tree plantations
Wetland habitat	16	**Class C – moderately modified**	This habitat unit has undergone some transformation due to the surrounding tree plantations but still provides suitable habitat for numerous wetland floral species and foraging habitat for avifaunal species.

- The largest extent of the subject property was impacted by stands of alien and invasive vegetation, which include the woody species *Eucalyptus camaldulensis, Pinus patula* and *Acacia mearnsii*. Invader species also encroached into the grassland habitat unit due to the edge effects from agricultural activities and plantations.
- None of the medicinal species found within the subject property (*Eucalyptus grandis, Helichrysum nudifolium* and *Tagetes minuta)* are listed as protected or of conservational concern. No important medicinal floral communities will be lost or impacted upon by the proposed mining activities.

Floral Impact Assessment

Based on the above assessment it is evident that there are three possible impacts on the floral ecology within the subject property. The table below summarises the findings indicating the significance of the impact before management takes place and the likely impact if management and mitigation takes place. In the consideration of mitigation it is assumed that a high level of mitigation takes place but which does not lead to prohibitive costs.

From the table it is evident that prior to management measures being put in place, two of the impacts are medium-high level impacts and one impact is a low level impact. If effective management takes place, all impacts could be reduced to a lower level impact.

A summary of the results obtained from the assessment of floral ecological impacts.

Impact	Unmanaged	Managed
1: Impact on habitat for floral species	Medium-High	Medium-Low
2: Impact on floral diversity	Medium-High	Medium-Low
3: Impact on floral species of conservational concern	Low	Low

Cumulative floral impacts

Cumulative impacts include:

- The loss of the Rand Highveld Grassland, which is considered to be an endangered vegetation type with a small fraction currently statutorily conserved.
- The spread of alien plant species within this vegetation type is considered to be significant and disturbance of natural vegetation as a result of forestry and loss of vegetation structure in the region may contribute towards lowering of the overall sensitivity of plant communities within this vegetation type.
- The cumulative impact from alien plant species proliferation in the region is considered to be high as these species replace indigenous vegetation and contribute to an overall loss of biodiversity.

Effective rehabilitation and well executed closure of the mining operation during the closure and decommissioning phase is essential in order to minimise cumulative impacts resulting from the mining activities.

2. Faunal assessment

Specific outcomes of this report include the following:

- A detailed desktop study on all faunal species recorded in the past, a description of their red data and protected status according to International Union for Conservation of Nature and Natural Resources (IUCN) red data list and the Provincial protected / red data lists;
- A record of all faunal life observed within the study area, as well as their red data and protected status according to the regional Mpumalanga State of the Environment (MP SoER, 2003) report, refer to Appendix section for all taxa, and the international IUCN (2014) red data list indicated;
- A calculation of Red Data Sensitivity Index Score (RDSIS) of all potential species that could possibly be present within the subject property; and
- Impact assessment, identification of mitigation requirements as well as recommendations for the proposed Rietvlei Colliery Mine.

The following general conclusions were drawn upon completion of the faunal assessment:

- The faunal results included all faunal observations for April, October 2011 and January 2014 site visits.
- The wetland habitat unit areas provided the most significant faunal habitat within the subject property.
- All common faunal species observed within the subject property are not regionally threatened species (MP SoER, 2003) and are considered Least Concerned by the IUCN, 2014
- No Red Data List (RDL) mammals were observed during the site survey. In terms of conservation, the likelihood that any threatened RDL mammal species should be encountered within the study area is deemed low, due to the abundance of transformed habitat within the subject property.
- No RDL birds were identified during the site survey. However, there is a probability that *Sagittarius serpentarius* (Secretarybird), *Circus ranivorus* (African Marsh Harrier), *Falco peregrinus minor* (Peregrine Falcon), *Tyto capensis* (African Grass Owl) and the *Geronticus calvus* (Bald Ibis) may be present within the subject property specifically for foraging purposes specifically within the wetland habitat associated with the subject property.
- No RDL listed reptiles species were identified during the site assessment. Low reptile species diversity is expected due to the high levels of transformation and limited suitable habitat, such as rocky out crops, availability within the subject property.
- No RDL amphibian species were encountered during the site visit. The distribution range of *Pyxicephalus adspersus* (Giant Bullfrog*)* does not extend to the subject property.
- No RDL invertebrate species were encountered on the study area. No *Metisella meninx* (Marsh sylph) were identified during the assessment and no stands of *Leersia hexandra* were observed. This species which plays a vital role in the reproductive cycle of the marsh sylph species was identified within the wetland areas of the subject property.
- No evidence was encountered of the RDL spiders and RDL scorpions within the study area. It is also highly unlikely that threatened spiders and scorpions will be encountered in the subject property due to the limited rocky habitat available and due to the predominantly transformed nature of the majority of the subject property.
- There are six (6) RDL species that have a Probability of Occurrence (POC) greater than 60%, namely; *Sagittarius serpentarius* (Secretarybird), *Circus ranivorus* (African Marsh Harrier), *Falco peregrinus minor* (Peregrine Falcon), *Tyto capensis* (African Grass Owl), the *Geronticus calvus* (Bald Ibis) and *Pyxicephalus adspersus* (Giant Bullfrog).
- The greater than 60% POC likelihood of these RDL faunal species is largely due to them entering onto the subject property for foraging purposes.
- The RDSIS assessment of the property provided a moderate score of 40%, indicating a moderate importance in terms of RDL faunal species conservation within the subject property. In terms of the proposed development project, should the wetlands and associated buffer zones be preserved, habitat requirements for the above RDL species will be maintained to a large degree and will significantly limit the impact of the proposed mining development on the faunal assemblages.

Faunal Impact assessment:

The table below serves to summarise the significance of perceived impacts on the faunal biodiversity of the area. Based on the impact assessment it is evident that there are three possible impacts on the faunal ecology within the subject property. From the table it is evident that prior to management measures being put in place, two of the impacts are medium-high level impacts and one impact is a medium-low level impact. If effective management takes place, all impacts could be reduced to a lower level impact.

A summary of the results obtained from the assessment of faunal ecological impacts.

Impact	Unmanaged	Managed
1: Impact on faunal habitat and ecological structure	Medium-high	Medium-low
2: Impact on faunal diversity and ecological integrity	Medium-high	Medium-low
3: Impact on potential RDL faunal species	Medium-low	Low

Cumulative faunal impacts

- The loss of habitat through future mining activities and other activities associated to mining activities, may contribute towards lowering of the overall sensitivity of faunal communities within the region. The cumulative impact from further habitat loss in the subject property may be considered to be high as the loss of habitat will contribute to an overall loss of faunal biodiversity.

No RDL faunal species were observed during the site survey. There are six (6) RDL species that have a Probability of Occurrence (POC) greater than 60%, namely; *Sagittarius serpentarius* (Secretarybird), *Circus ranivorus* (African Marsh Harrier), *Falco peregrinus minor* (Peregrine Falcon), *Tyto capensis* (African Grass Owl), the *Geronticus calvus* (Bald Ibis) and *Pyxicephalus adspersus* (Giant Bullfrog). Cumulative transformation and loss of habitat within the region may result in these species, as well as a number of common species known to occur within the Middelburg region, relocating and leading to the disappearance of these species in the region.

Effective rehabilitation and effective closure of the mining operation during the closure and decommissioning phase is essential in order to minimise cumulative impacts resulting from the mining activities on the faunal assemblage of this area.

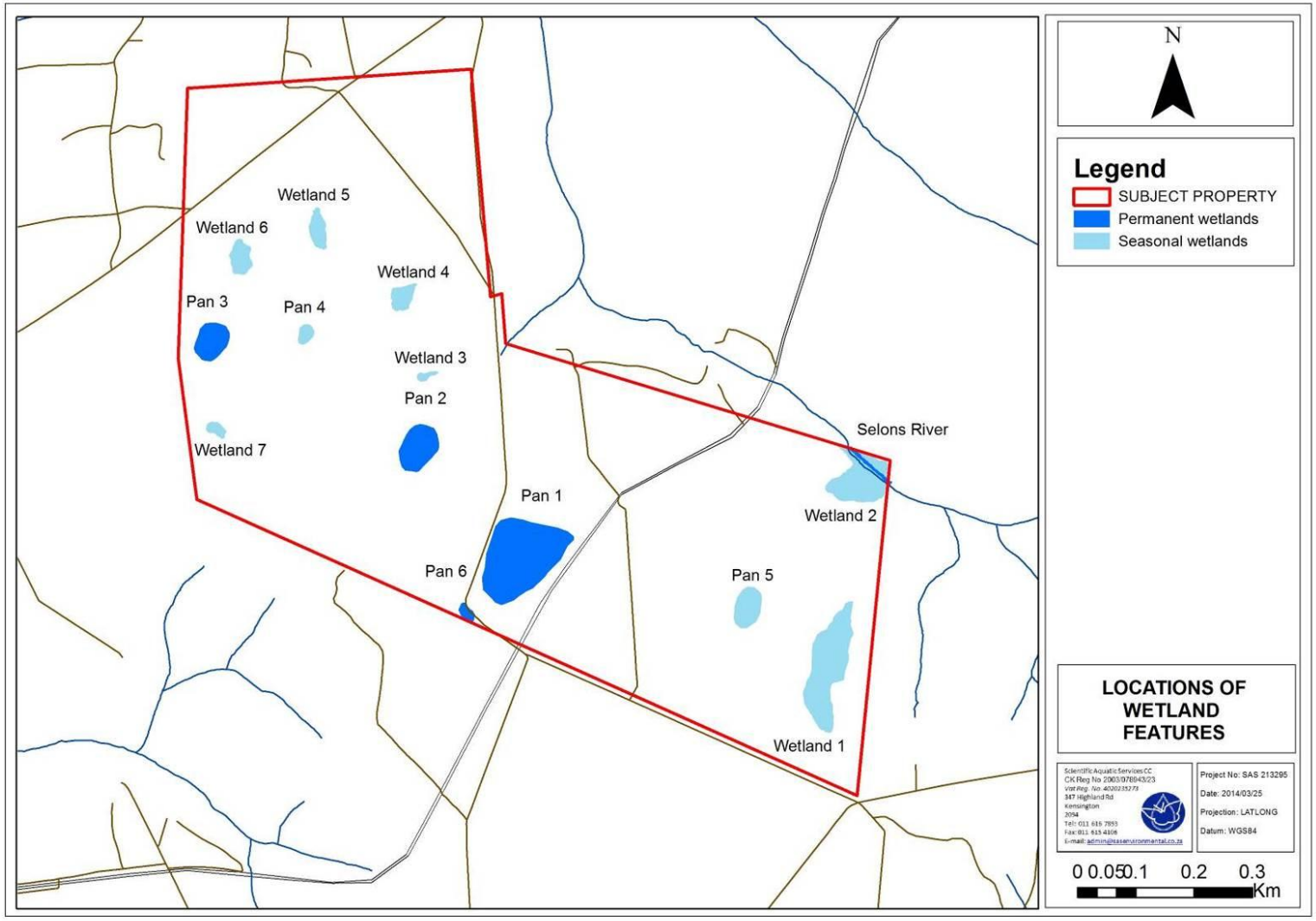
3. Wetland assessment

Several wetland and pan features were identified within the subject property. The wetland and pan features identified during the assessment of the subject property were categorised according to the method provided by Ollis *et al*., (2013).

The table below identifies the two broad wetland feature types, based on the levels of inundation observed in the systems.

The two broad wetland feature types identified within the subject property.

Wetland features with permanent zones of saturation (Permanent wetland)	Wetland features with no permanent zones of saturation (Seasonal Wetland)
Pan 1	Pan 4
Pan 2	Pan 5
Pan 3	Wetland 1
Pan 6	Wetland 2
Selons River	Wetland 3
	Wetland 4
	Wetland 5
	Wetland 6
	Wetland 7



Location of the permanent and seasonal wetland features within the subject property.

➢ The wetland function and service provision were assessed.

- **Wetland features with permanent zones of saturation**

From the results of the assessment of the permanent features, it is evident that Pan 1 and the Selons River have an intermediate level of ecological function and service provision and Pan 2, 3 and 6 has a moderately low level of ecological function and service provision.

The Pan features 1-3 and 6 are the most important in terms of carbon storage. These results obtained were mainly due to the fact that these pan features have higher peat content and little soil disturbances, thus increasing the wetlands contribution to trapping carbon. The Selons River was most important in terms of streamflow regulation and nutrient assimilation.

Thus from the overall scores obtained from the wetland ecoservices calculation it was found that Pan feature 1 and the Selons River was the most important in terms of services and function, therefore obtaining a higher service value than the Pans 2, 3 and 6.

➢ **Wetland features with no permanent zone of saturation**

From the results of the assessment, it is evident that all of the seasonal wetland features on the subject property have a moderately low level of ecological function and service provision. These wetland features and pans are the most important in terms of nitrate assimilation. The results obtained were mainly due to the fact that all of the wetland features with no permanent zone of saturation display diffuse flow characteristics causing a seepage area to occur. Agricultural practises surround some parts of these wetlands, causing water and possibly some fertilisers to wash off into the wetland sections. This increases the nutrient levels within the wetlands, thus lowering the water quality.

➢ A Level 1 WET-Health assessment was applied to the features within the subject property. The table below summarises the scores received for the three modules assessed; namely hydrology, geomorphology and vegetation.

Summarised results of the WET-Health results for the wetland features.

Wetland feature	Hydrology		Geomorphology		Vegetation		Overall score
	Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	
Pan 1	C	↓↓	A	↓↓	C	↓	C
Pan 2	D	→	A	→	D	↓	C
Pan 3	C	→	A	→	C	↓↓	B
Pan 6	C	→	A	↓	D	↓↓	C
Selons River and Wetland 2	B	→	A	→	C	↓	B
Pan 4	C	→	B	↓	E	↓	C
Pan 5	D	→	B	↓	E	↓↓	D
Wetland 1, 3-7	D	→	B	↓	E	↓↓	D

➢ The overall score for the wetland systems that aggregates the scores for the three modules, namely hydrology, geomorphology and vegetation, was calculated using the formula[1] as provided by the Wet-Health methodology. The overall score calculated for each wetland feature was determined (Table above). Due to the forestry and agricultural activities, deterioration from this categories are expected. It can be concluded from the WET-Health assessment that Pan feature 1, 3; the Selons River and Wetland feature 2 have a higher function in terms of the three modules.

➢ The results of the wetland function assessment and WET-Health assessment were used to obtain the EIS assessment, for which the results are presented below.

➢ **Wetland features with permanent zones**

[1] [(Hydrology score) x 3 + (geomorphology score) x2 + (vegetation score) x 2)]/ 7 = PES

The scores of 2.0 to 2.89 calculated during the assessment indicate that the permanent wetland features fall into the "high" EIS category (category 'B'). It should be noted that the high EIS score was obtained primarily as a result of habitat diversity and ecological function and status of the wetland features.

- **Wetland features with no permanent zones**

The scores of 1.33 to 1.56 calculated during the assessment indicate that the seasonal wetland features fall into the "moderate" EIS category (category 'C'). It should be noted that the lower EIS score was obtained primarily as a result of historical agricultural practices such as crop cultivation and grazing may have contributed to the present condition of these pans through water attenuation, increased siltation and clearing of natural vegetation.

- The results of the wetland function assessment and WET-Health assessment, together with the results of the EIS assessment, were used to form the REC. It is thus recommended that the REC for the wetland and pan features not to be mined is improved where possible and no further degradation occurs as a result of the mining activities. Strict mitigation measures needs to be implemented to ensure that the wetland function is restored. This could ensure that the impact on the wetland features and pans that may result in a decrease of the PES can be mitigated as far as possible.

Wetland Impact Assessment

Based on the above assessment it is evident that there are three possible impacts on the wetland ecology within the subject property. The table below summarises the findings indicating the significance of the impact before management takes place and the likely impact if management and mitigation takes place. In the consideration of mitigation it is assumed that a high level of mitigation takes place but which does not lead to prohibitive costs.

From the table it is evident that prior to management measures being put in place, all of the impacts are medium-high to medium-low level impacts. If effective management takes place, all impacts could be reduced to a lower level impact with impacts on the loss of wetland habitat and loss of wetland ecoservices being moderately low and impacts on impacted hydrology of the systems being regarded as a low level impact.

A summary of the results obtained from the assessment of the wetland ecological impacts.

Impact	Unmanaged	Managed
1: Loss of wetland habitat and ecological structure	Medium-High	Medium-Low
2: Change to wetland ecological and sociocultural service provision	Medium-High	Medium-Low
3: Impact on wetland hydrological function	Medium-Low	Low

Cumulative wetland impacts

Due to extensive mining and beneficiation in the Middelburg and surrounding areas, along with extensive agriculture, the regional cumulative impacts as a result of loss of wetlands is considered to be highly significant. It is also critically important to consider the general impact from mining activities in the greater Olifants catchment, which includes coal mining as well as platinum group metals and the severe impact from the urban areas of Mpumalanga. In particular, specific mention is made of the impact of urban runoff and the release of treated and raw sewage effluent into the riverine systems in the area. Seepage from mining facilities such as waste dumps, TSF and general dirty water areas, agricultural activities, as well as spillages of hydrocarbons, has the potential to contaminate the groundwater environment which in turn can affect water quality in surface water sources in the area.

Within the Olifants catchment there has been significant impact on wetlands due to erosion, incision, and sedimentation into the wetlands. These impacts have led to the loss of wetlands and the loss of the wetland's ability to function naturally.

Cumulative impacts associated with the mine include:

- The loss of wetland habitat, functioning and ecoservice provision as a result of mining activities within the Middelburg region, which may in turn impact on water resources and vegetation structure.

- Loss of wetland connectivity and dewatering of wetlands due to mining activities will have a detrimental impact on faunal species utilising riparian zones as migratory corridors and the overall biodiversity in the area.

The impact on the wetland resources in the vicinity of the Middelburg operations could lead to an overall reduction of the assimilative capacity of wetlands in the Olifants catchment and lead to a general loss of ecological and socio-cultural services within this important water resource.

4. Aquatic assessment

Physico-Chemical Water Quality

- General water quality can be considered fair although it is evident that dissolved salts are generally elevated in the region and there is some variability in salt concentrations between the two points along the Selons River system.
- Spatially during the spring of 2011, the Electrical Conductivity (EC) data indicates that the RV1 site on the upstream section of the Selons River is 22% higher than the downstream value at RV2 along the Selons River. The summer 2014 EC indicated a 6% difference between the upstream and downstream sites.
- Some additional impact from upstream activities, upstream of site RV1, on this system is deemed likely. The observed values are within the Olifants River Environmental Water Quality Assessment (OREWA, 2001) guidelines for this reach of the Olifants River system.
- It is evident that the EC between the two assessment points on the Selons River during 2011 and 2014 indicate that salinisation of the upper catchment is likely to be occurring, most likely as a result of agricultural activities in the area. The data however indicates that currently there is no addition of dissolved salts between the two assessment points for both 2011 and 2014 surveys.
- In terms of OREWA (2001) guidelines the dissolved salt concentrations in the systems are within the guideline value, supporting the findings, during 2011 and 2014, that there is no osmotic stress on the aquatic communities that may occur within the Selons River system.
- The pH may be considered natural and no impact on the aquatic ecology of the system is deemed likely at the current time and for the 2011 site survey period.
- No Dissolved Oxygen (DO) was conducted during the 2011 monitoring period.
- Along the Selons River the dissolved oxygen at both upstream RV1 (84%) site and the downstream site RV2 (83%) were within the desired 80% to 120% range for aquatic ecosystems (DWAF, 1996);
- The dissolved oxygen concentration is acceptable and can be regarded as suitable for supporting a diverse and sensitive aquatic community.
- Temperatures can be regarded as normal for the time of year and time of day when assessment took place.

General water quality parameters

- The general water quality parameters within the Selons River and pans P3 and P4 are within the acceptable parameters in accordance to TWQR guidelines (DWAF, 1996). The water quality in pan P1 indicates that salts accumulate in this system which may limit the diversity and sensitivity of the aquatic community in this system to some degree.

VEGRAI assessment

The results of this assessment indicate that both the upstream RV1 and downstream RV2 Selons River sites fall within an Ecological Category Class C (Kleynhans et al, 2007) for year 2011 and 2014, indicating a loss and change of natural habitat having occurred, but the basic ecosystem functions are still predominately unchanged (Kleynhans et al, 2007). The primary modifier to this system is likely to be the water quality and flow modification, due to the proximity to historical and current agricultural activities, that include livestock farming, which may contribute to the moderately modified vegetation in the system.

Invertebrate Habitat Integrity Assessment (IHIA)

2011 IHIA summary

The RV1 site achieved an IHIA score of 49% while the RV2 site 54%. Based on the classification system of Kemper 1999 both sites have habitat conditions that can be described as largely

modified (Class D), where a loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.

2014 IHIA summary

During the 2014 site survey, the two Selons River sites achieved an IHIA rating of 70% (RV1) and 72% (RV2), where an increase from class D to a class C has been observed since 2011 early spring late winter survey. Currently in 2014 the habitat is deemed moderately modified indicating a loss and change of natural habitat and biota, but the basic ecosystem functions are still predominantly unchanged (Kemper, 1999).

Invertebrate Habitat Assessment System (IHAS)

During the October 2011 survey, the RV1 site and RV2 site achieved an IHAS score of 46 and 44 respectively. This indicated that during 2011, habitat diversity and structure was considered inadequate for supporting a diverse aquatic macro-invertebrate community under the 2011 flow conditions.

During the 2014 assessment, an IHAS score of 71 and 67 was achieved and the RV1 site and RV2 site. Habitat diversity and structure at this time was adequate for supporting a diverse aquatic macro-invertebrate community at both points (McMillian, 1998) therefore a diverse aquatic macro-invertebrate community can be expected in the Selons River during the 2014 site survey period which is indicative of high flow conditions.

Aquatic Macro-Invertebrates (SASS5)

2011

- During the early spring 2011 assessment, the two assessment sites can be considered as Class D (largely impaired) sites according to the Dickens and Graham (2001). With mostly tolerant taxa present.
- According to Dallas (2007) classification systems the upstream RV1 site and the downstream RV2 sire are classed a Class E/F (severely/critically impaired). This is due to the naturally limited habitat that is available and the lack of flow in the river at the time of assessment (early spring 2011).
- Based on the available habitat conditions with special mention of the lack of flow and the lack of bankside vegetation cover, the poor aquatic macro-invertebrate community score in the system is most likely due to the limited availability of natural habitat at the RV1 and RV2 sites.

2014

- During the early 2014 assessment, the two assessment sites can be considered as Class D (largely impaired) sites according to the Dickens and Graham (2001).
- According to Dallas (2007) classification systems both upstream RV1 site and downstream RV2 sites are classed a Class E/F (severely/critically impaired). Even with an increase in flow these classifications have remained the same since the 2011 site survey at both sites.
- Based on the available habitat conditions the poor aquatic macro-invertebrate community score in the system is most likely due to the limited availability of natural habitat at the RV1 and RV2 sites.

- The primary impact which may affect macro-invertebrates within the Selons River at the current time which is expressed from farming activities as well as possible mining operations is water quality changes. The significance of this and other impacts can however be reduced with management actions to avoid significant degradation which may lead to additional loss of aquatic communities

Aquatic Macro-invertebrates (MIRAI)

The MIRAI results in terms of (Ecological Category classification) follow similar trends as that obtained using the SASS class classifications. The PES obtained from the application of MIRAI (Thirion, 2007) were as follows; for 2011 RV1 was a class D (41%) and RV2 class D (43%). During the 2014 site survey, RV1 was a class D (45%) and RV2 a class D (47%). The overall general deterioration in terms of macro-invertebrate community integrity is clearly evident throughout the two assessment sites along the Selons River at both low flow as well as the high flow periods. The MIRAI results confirm the SASS results for these sites.

Fish community integrity

Habitat Cover Rating (HCR) results for the two sites on the Selons River (RV1 and RV2) are provided for the 2011 early spring survey as well as the 2014 site survey period. Habitat conditions during the 2011 period were suited for slow flowing shallow and deep water species. For the 2014 HCR it is clear that shallow-fast conditions predominate in the Selons River system followed by deep-fast conditions.

Electro-shocking for fish was conducted within the Selons River within a 100m radius upstream and downstream from the sites over a 20 to 30 minute period. Fish species that were caught were photographed and then released during the survey done within the Selons River sites

No fish were caught during the 2011 site survey. During the 2014 site survey the fish expected in the area will be limited to fish with high intolerance values for slow flowing water habitats and to a lesser degree species with a high intolerance value for shallow slow water habitats and water column cover.

- Along the upstream site RV1, *Clarias gariepinus* (Sharptooth Catfish) and *Barbus anoplus* (Chubbyhead barb) species were captured while at the downstream site RV2 *B. anoplus* and *Barbus neefi* (Sidespot barb) were identified in the catch.

Impacts on fish species

- Instream modifications such as sedimentation, bed modification and flow are considered to significantly impact on the fish community in the system and interfering with fish migrations along rivers.
- Water quality changes within the Selons Rivers are one of the chief impacts which may further affect the fish community if contaminated runoff or effluent reaches the receiving environment from the proposed mining development

It is clear that the EC calculated for the FRAI (Kleynhans, 2007), along the Selons River sites, for 2011 RV1 (19%) and RV2 (20.9%) as well as for 2014 RV1 (26%) and RV2 (23%), largely corresponds to that obtained for the MIRAI which would be expected since the drivers affecting the two assemblages are largely similar.

Drivers of ecological change within the ecoregions are overgrazing throughout the ecoregions, including in the riparian zone which leads to erosion, and causes high silt levels in the rivers. Increased siltation of in-stream habitats and fish gills results may lead to the loss and fish species. Siltation also increases the risk of flooding. Runoff from mines and other activities lowers the water quality in this ecoregion, and conditions are not likely to improve in the short term

Aquatic Impact assessment

The aquatic resources in the vicinity of the subject property occur in the vicinity of open farm lands and have been slightly affected by farming activities in the area resulting in inundation and some erosion. These impacts have, however, been limited. Many of the impacts which occur as a result of the proposed colliery development will affect the local area for a long duration and are likely to increase the existing impacts on the receiving environment. If mitigation measures are implemented, the likelihood of further impacts occurring and the consequence of the impacts are significantly reduced to significantly lower levels and the duration of impacts becomes significantly reduced.

The construction footprint should as far as possible be limited, and mitigation measures (with emphasis on effective rehabilitation) should be implemented to minimise the construction impacts associated with the proposed Rietvlei Colliery. The majority of the negative impacts associated with the facility will be experienced during the lifetime of the mine, most of which are predicted to have a Medium - High significance. It is envisaged that impacts can be well mitigated leading to a Medium - Low significance for each of the impacts.

Cumulative impacts

According to the State of the Rivers Report for the Olifants River Systems, the upper parts of the Olifants River catchment, mining-related disturbances are the main causes of impairment of river health (DWAF and RHP, 2014). The Olifants River catchment experiences extreme demand for natural resources, and associated land modification and pollution. Thus river ecosystems in this

area are generally in a fair to poor condition (DWAF and RHP, 2014). There is also an extensive invasion by alien vegetation, and to a lesser extent alien fauna. The biodiversity of the Olifants River is under threat as a result of the cumulative impacts throughout the catchment and within the Olifants River tributaries such as the Selons River. These impacts are apparent in water pollution, siltation and reduced stream flows as a result of agriculture, mining, industry and power generation. Ecologically insensitive releases of water and sediment from storage dams are another major cause of environmental degradation downstream, which is particularly relevant in the middle and lower parts of the Olifants River catchment.

Priority actions for the Olifants River catchment include as per (DWAF and RHP, 2014) recommendations:

- Wetland protection and rehabilitation in the areas of the headwaters of these rivers;
- Control of alien plants especially in riparian zones, in all catchments;
- Control of effluent and mining related seepage in the upper reaches of the Olifants Catchment; and
- Release from storage dams should be based on ecological flow requirements, especially in the Olifants River catchment.

5. Sensitivity

Despite the fact that the wetland feature shows severe transformation due to alien floral encroachment and soil alterations, these features could provide habitat for avifaunal and wetland floral species. The following guidelines for buffers around the wetlands are suggested by the Department of Water Affairs (2000):

No person in control of a mine or activity may:

(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked;

The 1:100 year flood-line restriction is the internationally accepted norm for the placement of anything that may be in danger of failing or have a potential safety hazard. This norm is also reflected in section 144 of the National Water Act in respect of the locality of townships. Although certain of the regulations refer to the 1:50 year flood-line requirement (see sub regulations 4(b) below), the aspects referred to in this sub regulation is considered to potentially have a big impact on the water resources, therefore the more conservative minimum requirement is set.

This sub regulation should be interpreted similarly to sub regulation 4(b) below, which stipulates *whichever is the greatest*. This implies that the mine or activity should comply with both requirements stipulated in this sub regulation, namely the 1:100 year flood-line and the horizontal distance of 100m.

The 1:100 year flood-line should be determined by a suitably qualified person, e.g. hydrologist, civil engineer, agricultural engineer, etc., who can professionally be held liable for his/her calculations in the case of a disaster (loss of human life, extreme water pollution, etc.).

(b) except in relation to a matter contemplated in regulation 10, carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, whichever is the greatest.

The figure below illustrates the sensitivity of the subject property. High and medium sensitivity areas included pan feature 1 and 3 and 6 and the Selons River with associated 100m buffers. Low sensitivity was allocated to the seasonal wetland sections. The remainder of the site is considered very low due to the complete vegetation transformation of agricultural and plantation activities. The mining activities and structures must also ensure no de-watering of the sensitive wetland areas occur during the mining process as a result of open pit mining methods.

It can be concluded that the mining footprint and activities will have a significant effect on the permanent wetland features (Pan 1-3, 6 and the Selons River) specifically referring to the highly sensitive features should mitigation measures not be implemented. Thus planning of the mining footprint should consider higher sensitivity areas as “no-go” areas. Based on the observations of

the study, mining infrastructure should, as far as possible, be limited to the previously disturbed areas, such as the crop fields and plantation areas. Should mining activity occur within any of the wetland features, relevant authorisation should be deemed according to the National Environmental Management Act (NEMA) 107 of 1998 and Sections 21 c and i of the National Water Act 36 of 1998.

Clean and dirty water systems need to be clearly separated in line with the requirements of Regulation GN704 of the National Water Act (Act 36 of 1998) in order to minimise the impact on the wetland resources on the subject property and on adjacent farms. Specific attention must be paid to preventing decant during both the operational phase of the mine and beyond closure. Specific attention must be given to preventing runoff from dirty water areas or discharge of effluent from reaching the pan features to be retained as well as the Selons River.

6. Recommendations

After conclusion of this ecological assessment, it is the opinion of the ecologists that the proposed activity be considered favourably provided that the following essential mitigation measures as listed below are adhered to:

Aquatic features

- Measures to contain and reuse as much water as possible within the mine process water system and water from underground dewatering activities should be sought.
- A return water structure should be developed where mine process water is stored in a lined dam in order to prevent impacts on the receiving aquatic environment.
- As far as possible all mining infrastructures should remain out of the riparian zone and associated buffer in line with the requirements of Regulation GN704 of the National water Act.
- No dirty water runoff must be permitted to reach the wetland and riverine resources during the entire life of mine, and clean and dirty water management systems must be put in place to prevent the contaminated runoff (suspended solids and salts and water with low pH) from entering the receiving aquatic environment. All dirty water containment structures should be designed to contain a minimum storm event of a 24 hour 1 in 50 year flood event.
- Any dirty water runoff containment facilities must remain outside of the defined wetland areas and their buffers as a measure to minimise the footprint areas of mining within sensitive wetland areas.
- Adequate stormwater management must be incorporated into the design of the proposed development in order to prevent erosion and the associated sedimentation of the riparian and instream areas, as these systems have aquatic communities which rely on stream substrates clear of sediment and on clear, fast flowing water. In this regard special mention is made of:
- Sheet runoff from cleared areas, paved surfaces and access roads needs to be curtailed.
- Runoff from paved surfaces should be slowed down by the strategic placement of berms.
- During any construction phase or exploration drilling activities no vehicles should be allowed to indiscriminately drive through the wetland areas and vehicles must remain on designated roadways.
- All areas of increased ecological sensitivity near to mining operations should be clearly marked as “out of bounds” areas for all mining staff.
- During the construction and operational phases of the proposed mining development erosion berms should be installed to prevent gully formation and siltation of the wetland resources. The following points should serve to guide the placement of erosion berms:
- Where the track has slope of less than 2%, berms every 50m should be installed.
- Where the track slopes between 2% and 10%, berms every 25m should be installed.
- Where the track slopes between 10%-15%, berms every 20m should be installed.
- Where the track has slope greater than 15%, berms every 10m should be installed.
- No dumping of waste should take place within the riparian zone. If any spills occur, they should be immediately cleaned up.
- Upon closure it is deemed essential that all MRD’s be rehabilitated and stabilised using a suitable grass mix to prevent sedimentation of the aquatic resources in the area.
- Throughout the life of mine measures to control alien vegetation must be implemented and specific attention to riverine features should be paid.

- Upon closure all haul and access roads as well as all unnecessary mining infrastructures should be removed in order to minimise the impacts on the aquatic resources of the area beyond the life of mine.
- Close monitoring of water quality must take place. Monitoring of water quality should take place at a minimum frequency of once a month during which time major salts and basic metals, are monitored along with basic parameters such as pH, TSS and TDS, dissolved oxygen and EC.
- Ongoing biomonitoring of the aquatic resources in the vicinity of the mine must take place. Biomonitoring should take place at points located upstream and downstream of the mining activities on the Selons Rivers as long as there is sufficient habitat to do so. Biomonitoring should take place on 6 monthly basis as a minimum in the summer and winter of each year. Biomonitoring should take place using the SASS5 and IHAS indices. Biomonitoring should take place throughout the life of the mine, including the closure and aftercare phases. The results of the biomonitoring program should be compared to the results of this study to allow any temporal trends to be observed. Should any problems be indicated measures to minimise or prevent the impact should be implemented.
- Toxicity testing of the proposed mines underground and open pit discharge should take place concurrently with the biomonitoring program in order to monitor the toxicological risk of the process water system to the receiving environment. Tests should include the following test organisms as a minimum:
    - Vibrio fischeri
    - Daphnia pulex
    - Algal Growth Potential
- Definitive toxicological testing according to the DEEEP protocol should take place should it become evident that process water discharge or decant of underground water will occur.

Mining footprint

- A sensitivity map has been developed for the subject property, indicating the various wetland features, which are considered to be of increased ecological importance. It is recommended that this sensitivity map be considered during the planning/ pre-construction and construction phases of the proposed development activities to aid in the conservation of ecology within the subject property.
- All demarcated sensitive zones outside of the construction area must be kept off limits during any development and closure phases of the mine.
- It must be ensured that planning of mining infrastructure includes consideration of adjacent wetland areas to ensure that these areas are avoided as far as possible.
- Edge effects of activities including erosion and alien / weed control need to be strictly managed in these areas.
- Planning of temporary roads and access routes should take the site sensitivity plan into consideration. Such roads should be constructed a distance from the more sensitive wetland areas and not directly adjacent thereto
- Ensure that seepage from dirty water systems is prevented as far as possible.
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.
- All spills should be immediately cleaned up and treated accordingly.
- Appropriate sanitary facilities must be provided for the life of the mine and all waste removed to an appropriate waste facility.
- Effective waste management must be implemented in order to prevent construction related waste from entering the wetland environment.
- Restrict construction to the drier winter months if possible to avoid sedimentation of wetland features in the vicinity of the proposed mine development areas.

Vegetation

- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the development footprint areas.
- Species specific and area specific eradication recommendations:

- Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used.
- Footprint areas should be kept as small as possible when removing alien plant species.
- No vehicles should be allowed to drive through designated sensitive wetland areas during the eradication of alien and weed species.

- Informal fires in the vicinity of development area should be prohibited during all development phases.
- Should any other RDL or protected plant species be encountered within the proposed development footprint areas, the following should be ensured:
    - If any threatened species, or nationally or provincially protected floral will be disturbed, ensure that permit application are obtained where necessary from the relevant authorities.

All rescue and relocation plans should be overseen by a suitably qualified specialist

Wetland features

- Development / mining impacts on the affected wetland features should be managed to minimise impacts on adjacent wetland features.
- Run-off from dirty water areas entering wetland habitats must be prevented and clear separation of clean and dirty water in the vicinity of the proposed infrastructure must take place. Oil must be prevented from entering the clean water system.
- Pollution control dams should be off stream structures and not within the natural drainage system of the area, thereby minimising impacts loss of instream flow and downstream recharge.
- All adjacent wetland systems must be monitored for erosion and incision.
- Desilt all adjacent wetland areas affected by mining and runoff from dirty water areas
- It must be ensured that all activities potentially impacting on geohydrological resources are managed according to the relevant DWA Licensing regulations and groundwater monitoring requirements.
- Post closure groundwater management will need to be very carefully managed to ensure that no impact on the wetland areas takes place after mine closure has taken place.
- Future mine planning should ensure that mining activities does not lead to a reduction of stream flow or dewatering of any wetland areas.

Vehicle access

- Access into adjacent wetland / pan areas, particularly by vehicles, is to be strictly controlled.
- All vehicles should remain on designated roads with no indiscriminate driving through adjacent wetland / pan areas.
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss.
- It must be ensured that all roads and construction areas are regularly sprayed with water in order to curb dust generation. This is particularly necessary during the dry season when increased levels of dust generation can be expected. These areas should not be over-sprayed causing water run-off and subsequent sediment loss in the vicinity of the subject property.

Soils

- Ensure that all stockpiles are well managed and have measures such as berms and hessian curtains implemented to prevent erosion and sedimentation.
- It must be ensured that the mine process water system is managed in such a way as to prevent discharge to the receiving environment.
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss.
- To prevent the erosion of topsoil, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas susceptible to erosion.
- All soils compacted as a result of construction activities falling outside of development footprint areas should be ripped and profiled. Special attention should be paid to alien and

invasive control within these areas. Alien and invasive vegetation control should take place throughout all development phases to prevent loss of floral habitat in surrounding areas

- Erosion berms may be installed in any areas where soil disturbances within the vicinity of the wetland features have occurred to prevent gully formation and siltation of the aquatic resources. The following points should serve to guide the placement of erosion berms:
    - Where the track has slope of less than 2%, berms every 50m should be installed.
    - Where the track slopes between 2% and 10%, berms every 25m should be installed.
    - Where the track slopes between 10% and 15%, berms every 20m should be installed.
    - Where the track has slope greater than 15%, berms every 10m should be installed

Rehabilitation

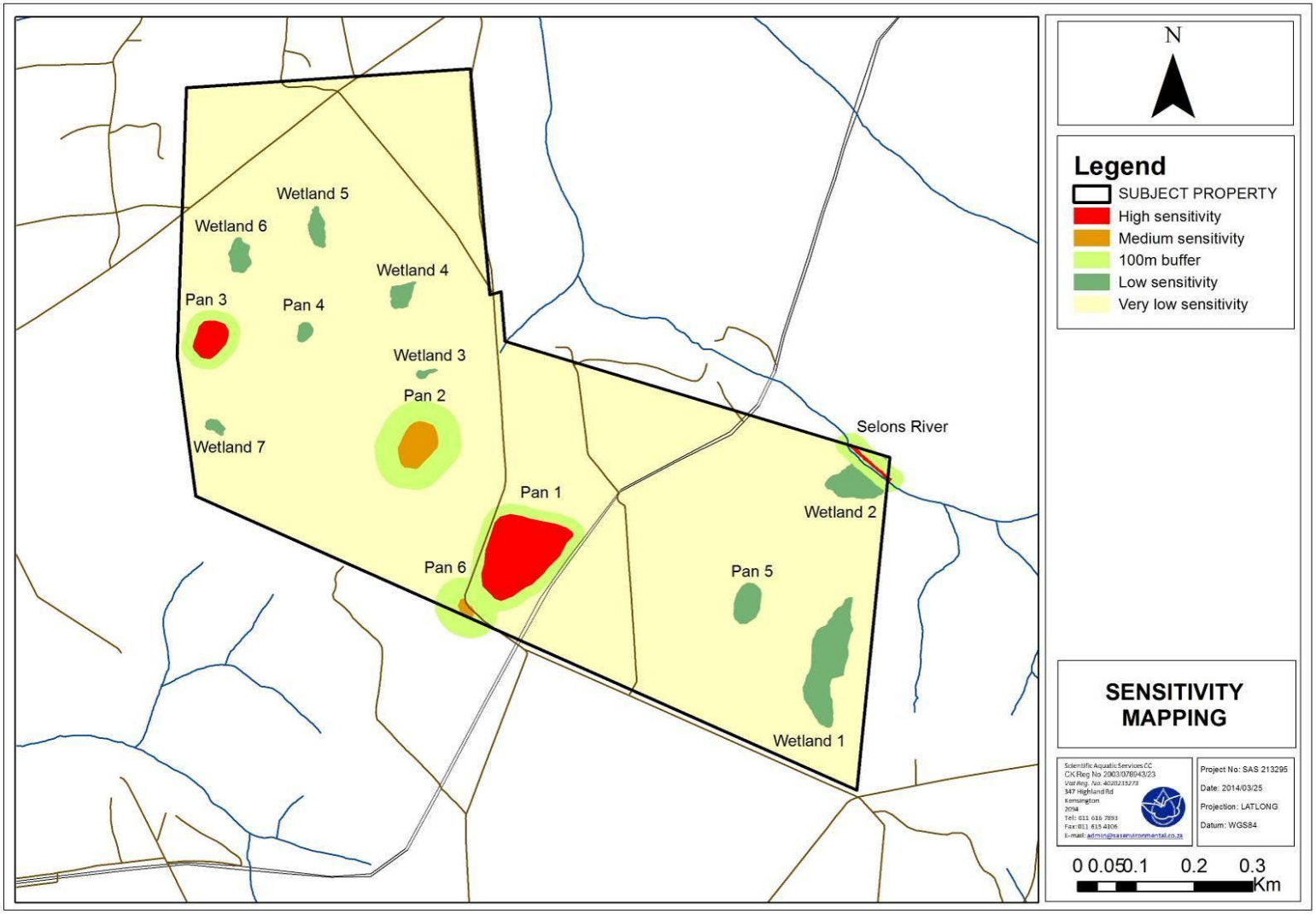
- As much vegetation growth as possible should be promoted within the proposed mine development area in order to protect soils. In this regard, special mention is made of the need to use indigenous vegetation species where hydro-seeding, wetland and rehabilitation planting (where applicable) are to be implemented.
- All wetland areas must be rehabilitated upon decommissioning to ensure that wetland functions are re-instated during decommissioning and all disturbed wetland areas adjacent to the mining development must be re-vegetated with indigenous wetland species.

RDL and Protected floral species

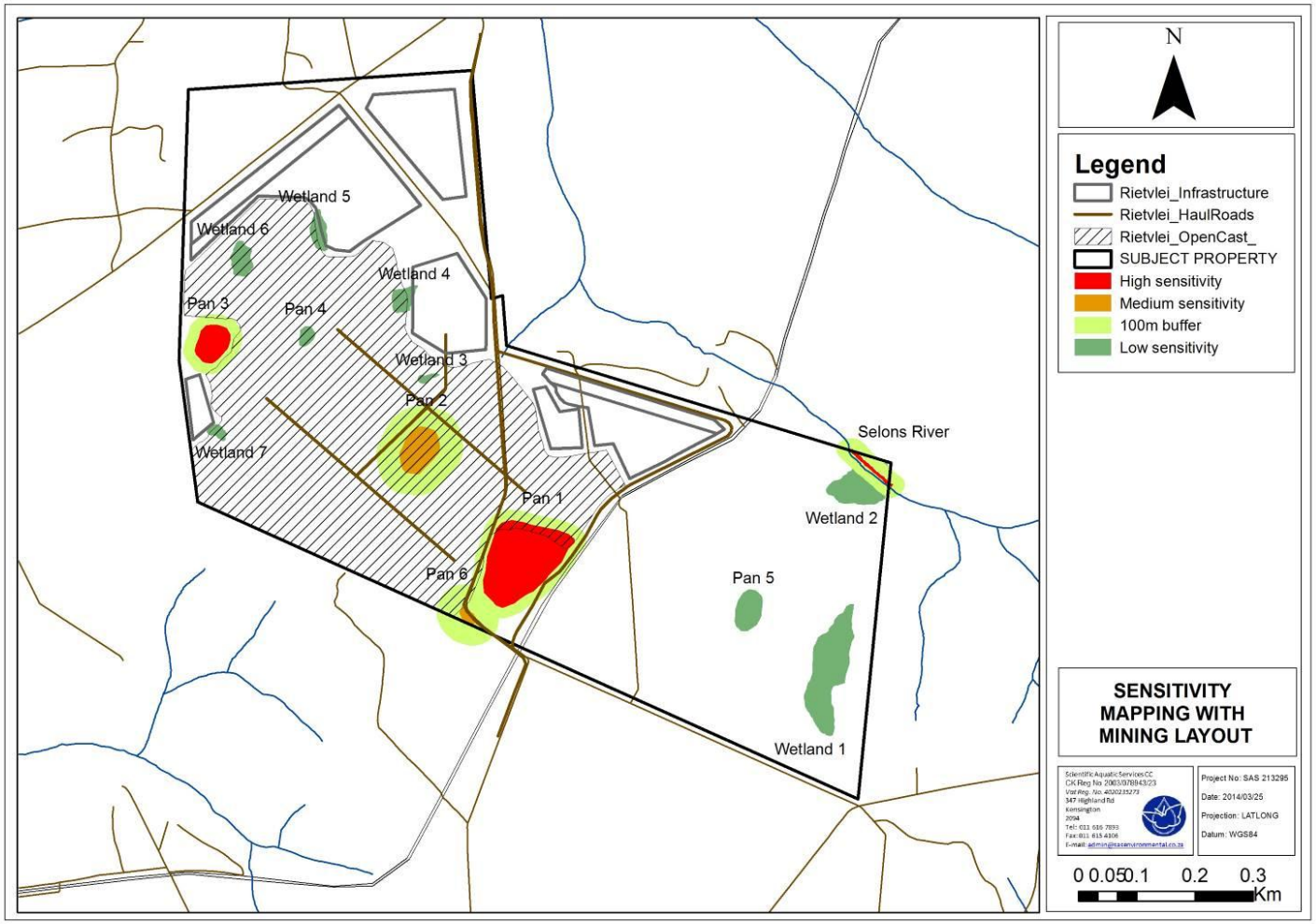
- Sensitive floral species, if discovered, are to be handled with care and the relocation of sensitive plant species is to be overseen by a botanist.
- Should any RDL or protected plant species be encountered within the proposed development footprint areas, the following should be ensured:
    - If any threatened species, or nationally or provincially protected floral will be disturbed, ensure permit applications are required from the relevant authorities before construction activities commence.
- All rescue and relocation plans should be overseen by a suitably qualified specialist.

RDL and protected faunal species

- It is recommended that a speed limit of 40km/h is implemented on all roads running through the subject property area in order to minimise risk to RDL and other fauna from vehicles.
- Educate construction and personnel about the importance of the natural faunal species and biodiversity of the natural surroundings.
- Education and awareness campaign on identification for any RDL faunal species that may be found within the subject property.
- Signs must be erected along all roads on the property cautioning people driving through the property that fauna are present, thereby creating a heightened awareness regarding faunal conservation.
- All informal fires on the subject property should be prohibited. Where a burning regime is implemented, it should be overseen by a qualified and experienced professional.
- No trapping or hunting of fauna is to take place. Access control must be implemented to ensure that no illegal trapping or poaching takes place.



Sensitivity Map for the subject property.



Sensitivity Map with the proposed mining layout for the subject property.

FAUNAL, FLORAL, WETLAND AND AQUATIC ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED RIETVLEI COLLIERY OUTSIDE MIDDELBURG, MPUMALANGA PROVINCE

Prepared for

WSP Group

April 2014

SECTION A – Background Information and Methods of Assessment

Prepared by:	**Scientific Aquatic Services**
Report author	**N. Cloete**
Report reviewers	**S. van Staden (Pri. Sci. Nat)**
Report Reference:	**SAS 213295**
Date:	**April 2014**

Scientific Aquatic Services CC
CC Reg No 2003/078943/23
Vat Reg. No. 4020235273
91 Geldenhuis Road
Marlvern East Ext 1
2007
Tel: 011 616 7893
Fax: 086 724 3132
E-mail: admin@sasenvironmental.co.za

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

GLOSSARY OF TERMS

Biome	A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate.
Bioregion	Biomes are further divided into bioregions, which are spatial terrestrial units possessing similar biotic and physical features, and processes at a regional scale.
Endangered	Organisms in danger of extinction if causal factors continue to operate.
RDL (Red Data listed) species	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status.

ACRONYMS

BGIS	Biodiversity Geographic Information System
°C	Celsius
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
GIS	Geographic Information System
GPS	Global Positioning System
MAMSL	Metres above sea level
MAP	Mean Annual Precipitation
MAPE	Mean Annual Potential for Evaporation
MASMS	Mean Annual Soil Moisture Stress
MAT	Mean Annual Temperature
MBCP	Mpumalanga Biodiversity Conservation Plan
Mm	Millimetre
NBA	National Biodiversity Act
NEMA	National Environmental Management Act
NEMBA	National Environmental Management Biodiversity Act
NFEPA	National Freshwater Ecosystem Priority Areas
NPAES	National Protected Area Expansion Strategy
PES	Present Ecological State
PRECIS	Pretoria Computer Information Systems
RDL	Red Data Listed
RDSIS	Red Data Sensitivity Index Score
REC	Recommended Ecological Category
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
Sub-WMA	Sub - Water Management Area
TDS	Total Dissolved Solids

TSP	Threatened Species Programme
WMA	Water Management Area

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a floral, faunal, wetland and aquatic ecological assessment as part of the Environmental Assessment (EIA) and authorisation process for the proposed Rietvlei Colliery (Figure 1 and 2), hereafter referred to as the “subject property”. The subject property is situated south-east of the R555, outside Middelburg, Mpumalanga Province (25°40’18.59”S 29°39’16.47”E). The total area of the proposed opencast footprint extends over approximately 747,16ha.

The subject property is surrounded by properties on which agricultural activities dominate. The ecological assessment was done with special focus on areas earmarked for mining footprint as well as areas of considered of higher ecological importance and sensitivity. The surrounding area was however considered as part of the desktop assessment of the area. The land is currently used for forestry purposes with areas of edible crop lands also located on the subject property.

This report, after consideration and the description of the ecological integrity of the subject property, must guide the Environmental Assessment Practitioner (EAP), regulatory authorities and developing proponent, by means of the presentation of results and recommendations, as to the ecological viability of the proposed development activities.

Figure 1: Digital satellite image depicting the location of the subject property in relation to the surrounding area.

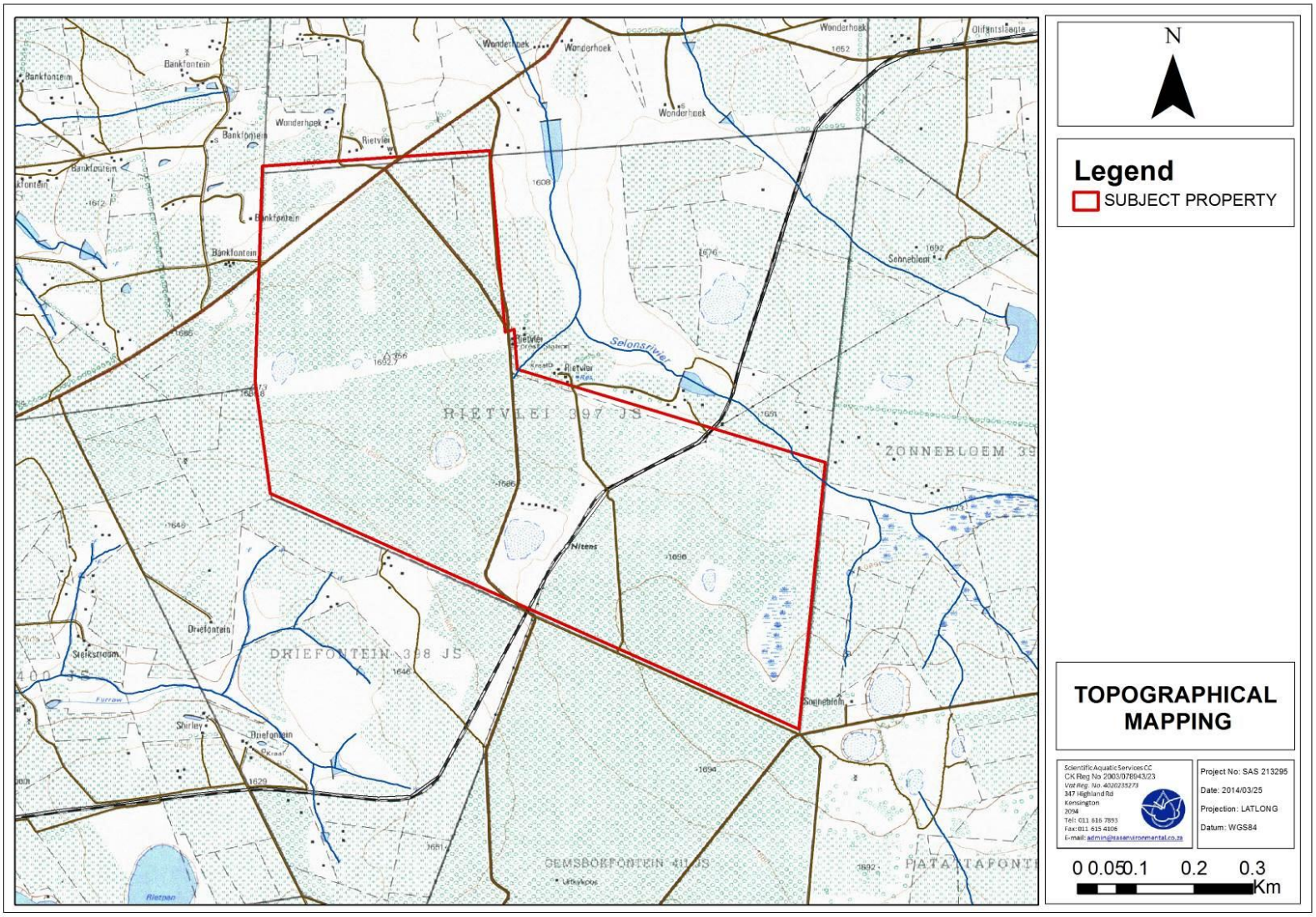


Figure 2: Subject property depicted on a 1:50 000 topographical map in relation to its surrounding area.

1.2 Project Scope

Specific outcomes in terms of this report are outlined below.

Ecological Assessment:

- To conduct a Red Data Listed (RDL) species assessment, including potential for species to occur on the subject property and the implementation of a Red Data Sensitivity Index Score (RDSIS) for the subject property;
- To provide faunal and floral inventories of species as encountered on site;
- To determine and describe habitats, communities and ecological state of the subject property;
- To describe the spatial significance of the subject property with regards to surrounding natural areas;
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and/or any other special features;
- To determine the environmental impacts of the proposed development activities on the terrestrial ecology within the subject property; and
- To present management and mitigation measures which should be included in the Environmental Management Programme (EMPr) of the development to assist in minimising the impact on the receiving environment.

Wetland Assessment:

- To define the Present Ecological State (PES) of each wetland system within the subject property;
- To determine the functioning of each system and the environmental and socio-cultural services that the system provide;
- To determine the wetland Health according to the resource directed measures guideline as advocated by Macfarlane et al., (2009);
- To determine the Ecological Importance and Sensitivity (EIS) will be determined according to the method as adapted from DWA (1999);
- To advocate a Recommended Ecological Category (REC) for each wetland feature;
- To delineate all wetlands or riparian zones occurring within the assessment site; and
- To determine the environmental impacts of the proposed development activity on the wetland areas within the subject property.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to all the report sections:

- The ecological assessment is confined to the subject property and does not include the neighbouring and adjacent properties; these were however considered as part of the desktop assessment;
- Due to the nature and habits of most faunal taxa it is unlikely that all species would have been observed during a site assessment of limited duration. Therefore, site observations are compared with literature studies where necessary;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most faunal and floral communities have been accurately assessed and considered;
- Sampling by its nature, means that not all individuals are assessed and identified. Some species and taxa on the subject property may have been missed during the assessment;
- Due to the potential impact on the Selons River, aquatic ecological assessment of the Selons River also took place even though it occurs adjacent to the subject property for most of its length;
- The wetland delineation as presented in this report is regarded as a best estimate of the wetland boundary based on the site condition present at the time of the assessment and limitations in the accuracy of the delineation due to disturbances created by grazing, existing development and anthropogenic disturbances are deemed possible; and
- Wetland and terrestrial areas form transitional areas where an ecotone is formed as vegetation species change from terrestrial species to facultative and obligate wetland species. Within the transition zone some variation of opinion on the wetland boundary may occur, however if the Department of Water Affairs (DWA), 2005 method is followed, all assessors should get largely similar results.

1.4 Project team

The project teams' role and qualifications are outlined in the table below.

Table 1: Project team.

Name	Role	Qualifications
S van Staden	Project Manager / reviewer	• MSc Environmental Management, Rand Afrikaans University • BSc (Hons) Aquatic Health, Rand Afrikaans University

		• BSc Zoology, Geography and Environmental Management, Rand Afrikaans University • Member of the Gauteng Wetland Forum and South African Soil Surveyors Association (SASSO) • Registered by the SA RHP as an accredited aquatic bio-monitoring specialist • Registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions
N Cloete	Specialist	• MSc Environmental Management, University of Johannesburg • MSc Botany and Plant Biotechnology, University of Johannesburg • BSc (Hons) Botany, University of Johannesburg • BSc Botany and Zoology, Rand Afrikaans University • Professional Member of the Grassland Society of Southern Africa • Registered at the South African Association of Botanists (SAAB) • Registered as a Candidate Professional Natural Scientist with the South African Council for Natural Scientific Professions • Member of the International Affiliation for Impact Assessments (IAIAsa) group
M Hanekom	Specialist	• MSc Zoology, University of Stellenbosch • BSc (Hons) Aquatic Health, Rand Afrikaans University • BSc Botany and Zoology, Rand Afrikaans University • Registered at the Sothern's Beekeepers Association (SBA) • Registered at the South African Bee Industry Organisation (SABIO) Zoological Society of Southern Africa (ZSSA) • Registered at the Entomological Society of Southern Africa (ESSA) • Has obtained the African snakebite institute certificate on snake awareness and venomous snake handling • An accredited river health practitioner by the South African River Health Program

2 ASSESSMENT APPROACH

2.1 General approach

In order to accurately determine the PES of the subject property and capture comprehensive data with respect to faunal and floral taxa and wetland and aquatic data, the following methodology was used:

- Maps, aerial photographs and digital satellite images were consulted prior to the field assessment in order to determine broad habitats, vegetation types and

potentially sensitive sites. A visual on-site assessment of the subject property was made in order to confirm the assumptions made during consultation of the maps.

- Literature review with respect to habitats, vegetation types and species distribution was conducted.
- Relevant data bases considered during the assessment of the subject property included the South African National Biodiversity Institute (SANBI) Threatened species programme (TSP), Pretoria Computer Information Systems (PRECIS), the Mpumalanga Biodiversity Conservation Plan (MBCP), Mpumalanga Biobase, National Threatened Ecosystems and the National Freshwater Ecosystem Priority Areas (NFEPA) database.
- Site visits were undertaken during April and October 2011 and January 2014 to determine the ecological status within the subject property. A reconnaissance 'drive around' followed by thorough 'walk through' on foot was undertaken.
- Specific methodologies for the assessment, in terms of field work and data analysis of faunal, floral, wetland and aquatic ecological assemblages will be presented in the relevant sections.

2.2 Ecological Impact Assessment Methodology

In order for the EAP to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of the risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.

- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[2]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (Table 2). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary (Table 3).

[2] The definition has been aligned with that used in the ISO 14001 Standard.

[3] Some risks/impacts that have low significance will however still require mitigation

The assessment of significance is undertaken twice. Initial significance is based on only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1998) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes (Table 4). In certain instances where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

Table 2: Criteria for assessing significance of impacts.

LIKELIHOOD DESCRIPTORS

Probability of impact	**RATING**
Highly unlikely	1
Possible	2
Likely	3
Highly likely	4
Definite	5
Sensitivity of receiving environment	**RATING**
Ecology not sensitive/important	1
Ecology with limited sensitivity/importance	2
Ecology moderately sensitive/ /important	3
Ecology highly sensitive /important	4
Ecology critically sensitive /important	5

CONSEQUENCE DESCRIPTORS

Severity of impact	**RATING**
Insignificant / ecosystem structure and function unchanged	1
Small / ecosystem structure and function largely unchanged	2
Significant / ecosystem structure and function moderately altered	3
Great / harmful/ ecosystem structure and function Largely altered	4
Disastrous / ecosystem structure and function seriously to critically altered	5
Spatial scope of impact	**RATING**
Activity specific/ < 5 ha impacted / Linear features affected < 100m	1
Development specific/ within the site boundary / < 100ha impacted / Linear features affected < 100m	2
Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	3
Regional within 5 km of the site boundary / < 2000ha impacted / Linear features affected <	4

Entire habitat unit / Entire system/ > 2000ha impacted / Linear features affected > 3000m	5
Duration of impact	**RATING**
One day to one month	1
One month to one year	2
One year to five years	3
Life of operation or less than 20 years	4
Permanent	5

Table 3: Significance rating matrix.

	CONSEQUENCE (Severity + Spatial Scope + Duration)														
LIKELIHOOD (Frequency of activity + Frequency of impact)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Table 4: Positive/Negative Mitigation Ratings.

Significance Rating	Value	Negative Impact Management Recommendation	Positive Impact Management Recommendation
Very high	126-150	Improve current management	Maintain current management
High	101-125	Improve current management	Maintain current management
Medium-high	76-100	Improve current management	Maintain current management
Medium-low	51-75	Maintain current management	Improve current management
Low	26-50	Maintain current management	Improve current management
Very low	1-25	Maintain current management	Improve current management

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develops or controls;
  - Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and

- Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.

- Risks/Impacts were assessed for all stages of the project cycle including:
  - Pre-construction;
  - Construction; and
  - Operational.
- If applicable, transboundary or global effects were assessed;
- Individuals or groups who may be differentially or disproportionately affected by the project because of their *disadvantaged* or *vulnerable* status were assessed; and
- Particular attention was paid to describing any residual impacts that will occur after rehabilitation.

Mitigation measure development

The following points present the key concepts considered in the development of mitigation measures for the proposed construction.

- *Mitigation* and *performance improvement measures* and actions that address the risks and impacts[4] are identified and described in as much detail as possible;
- Measures and actions to address negative impacts will favour avoidance and prevention over minimization, mitigation or compensation; and
- Desired outcomes are defined, and have been developed in such a way as to be *measurable events with performance indicators, targets and acceptable criteria* that can be tracked over *defined periods*, with estimates of the *resources* (including human resource and training requirements) *and responsibilities for implementation.*

2.3 Sensitivity Mapping

All the ecological features of the subject property were considered and sensitive areas were delineated with the use of a Global Positioning System (GPS). In addition identified locations of protected species (where applicable) were also marked by means of GPS. The sensitivity map should guide the design and layout of the proposed development.

[4] Mitigation measures should address both positive and negative impacts

2.4 Recommendations

Recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures which apply to the proposed development as a whole. Mitigation measures have been developed to address issues in all phases throughout the life of the operation from planning, through construction, operation and closure through to after care and maintenance.

3 LAND USE AND CONSERVATION CHARACTERISTICS OF THE SUBJECT PROPERTY

The following sections (Sections 3.1 – 3.7) present data accessed as part of the desktop assessment. It is important to note, that although all data sources used provide useful and often verifiable, high quality data, the various databases used not always provide an entirely accurate indication of the subject property's actual site characteristics. This information is however considered to be useful as background information to the study. Thus, this data was used as a guideline to inform the assessment and special attention was afforded to areas indicated to be of higher conservation importance.

3.1 National List of Threatened Terrestrial Ecosystems for South Africa (2011)

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing of threatened or protected ecosystems, in one of four categories: critically endangered, endangered, vulnerable or protected. Threatened ecosystems are listed in order to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function and composition of threatened ecosystems. The purpose of listing protected ecosystems is primarily to conserve sites of exceptionally high conservation value (SANBI, BGIS).

According to the National List of Threatened Terrestrial Ecosystems (2011) sections of the subject property falls into a vulnerable ecosystem, namely the Rand Highveld Grassland vegetation type (Figure 3).

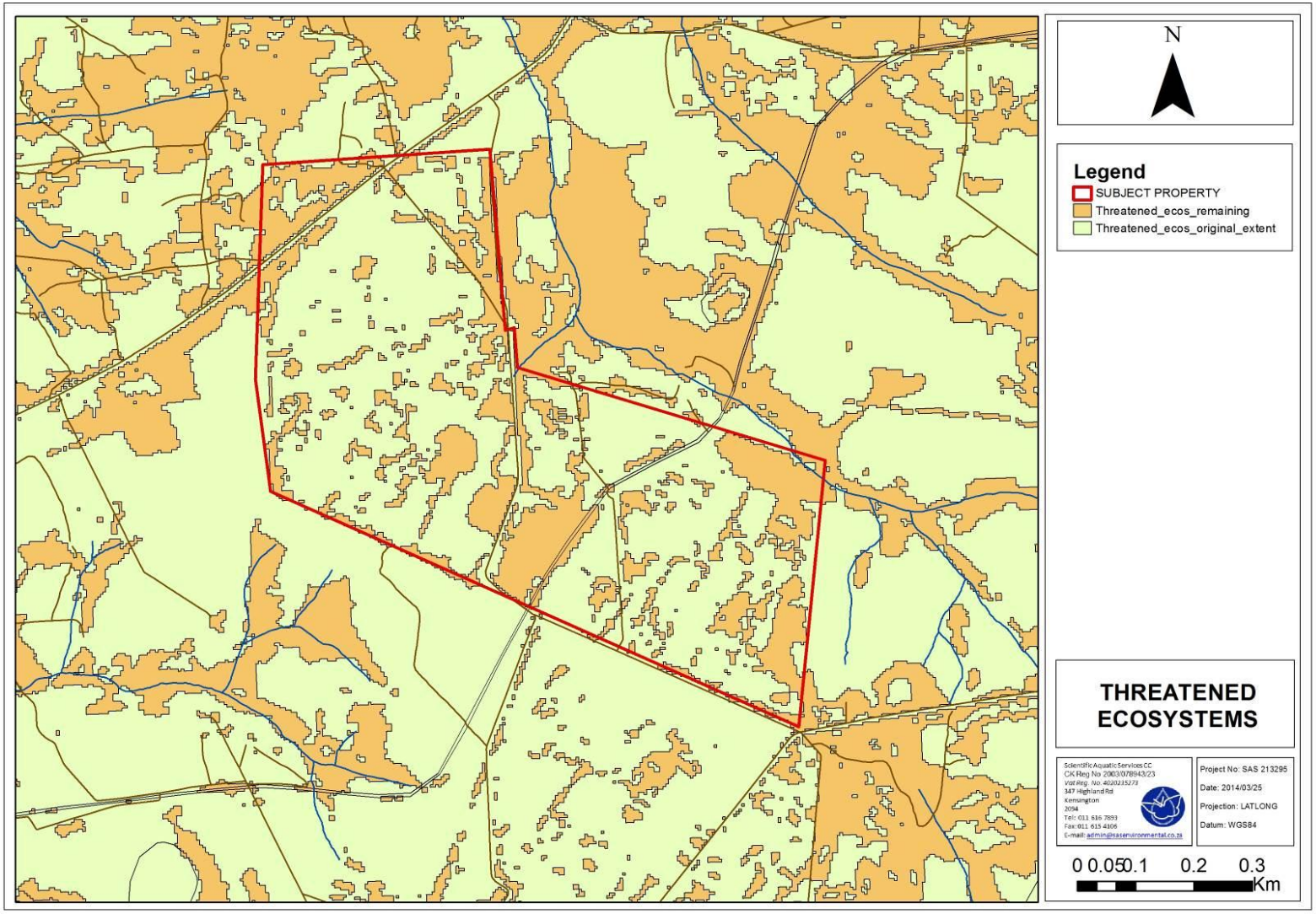


Figure 3: Original extent of threatened ecosystems surrounding the subject property (National List of Threatened Terrestrial Ecosystems, 2011).

3.2 National Protected Area Expansion Strategy (NPAES, 2010)

The goal of NPAES is to achieve cost effective protected area expansion for ecological sustainability and adaptation to climate change. The NPAES sets targets for protected area expansion, provides maps of the most important areas for protected area expansion, and makes recommendations on mechanisms for protected area expansion. It deals with land-based and marine protected areas across all of South Africa's territory (SANBI BGIS).

According to the NPAES database, the subject property does not form part of areas earmarked as part of the NPAES.

3.3 National Biodiversity Assessment (NBA, 2011)

The recently completed NBA provides an assessment of South Africa's biodiversity and ecosystems, including headline indicators and national maps for the terrestrial, freshwater, estuarine and marine environments. The NBA was led by the SANBI in partnership with a range of organisations. It follows on from the National Spatial Biodiversity Assessment 2004, broadening the scope of the assessment to include key thematic issues as well as a spatial assessment. The NBA includes a summary of spatial biodiversity priority areas that have been identified through systematic biodiversity plans at national, provincial and local levels (SANBI BGIS).

According to the NBA, the subject property is not located within a formally or informally protected area.

3.4 Importance According to the Mpumalanga Biobase

The Biobase Project identified areas of high biodiversity, in that these areas are rich in the occurrence of important vegetation communities and species. Table 5 summarises the scoring allocated for faunal importance by the Mpumalanga Biobase as well as percentage area significant in regards to the taxa and subject property. The subject property is considered most significant with regards to bird, amphibian and reptile habitat; with areas allocated of low bird, amphibian and reptile importance located close to wetland features within the subject property. Little or no importance is indicated for invertebrates, fish and mammals.

Table 5: Faunal importance scoring of the subject property according to the Mpumalanga Biobase.

FAUNA	Area %			
	High	Medium	Low	No importance indicated
Amphibian importance	0	0	100	0
Bird importance	0	0	100	0
Fish importance	0	0	0	100
Invertebrate importance	0	0	0	100
Mammal importance	0	0	8	92
Reptile importance	0	0	100	0

Table 6 summarizes the scoring allocated to vegetation and landscape characteristics by the Mpumalanga Biobase. The entire subject property is considered of no important with regards to vegetation communities, important species and wetland and pan features within the entire subject property. The subject property has seen some vegetation transformation mainly as a result of ongoing agriculture; therefore the only relatively intact habitat was encountered along wetland and pan areas.

Table 6: Vegetation and Landscape characteristic values pertaining to the subject property.

CHARACTERISTIC	Area %					
	High	Medium High	Medium	Medium Low	Low	No importance indicated
Cave areas	0	0	0	0	0	100
Floodplain and seepage	0	0	0	0	10	90
Wetlands and pans	0	0	0	0	15	85
Important forests	0	0	0	0	0	100
Important lands	0	0	0	0	0	100
Important species	0	0	0	0	20	80
Muthi plant importance	0	0	0	0	0	100
Threatened plants	0	0	0	0	0	100
Vegetation communities	100	0	0	0	0	0

3.5 Mpumalanga Biodiversity Conservational Plan (MBCP, 2007)

The subject property falls within the Quarter Degree Square (QDS) 2529DA located in the Mpumalanga Province. The MBCP was consulted with regards to the terrestrial biodiversity of this QDS and all relevant subjects are listed below.

- According to the MBCP the subject property and surrounding areas does not fall into any protected or conservation areas;
- The Aquatic Biodiversity is classified as important and necessary in the ecosystems in the north western section (Figure 4). According to the water management system of SANBI BGIS the Selons River is classified as class D (largely modified);
- The Terrestrial Biodiversity assessment of the MBCP indicates that habitat can range from "important and necessary" to "least concern and no natural habitat". Such is the case of the *Eucalyptus sp.* plantation and agricultural areas which contains no natural habitat. The centre pan feature is considered to have an important / necessary function in terms of the biodiversity of the area (Figure 5); and
- The National Wetlands Inventory indicates non-perennial wetlands and pans on the subject property.

The table below lists the mining guidelines according to the MBCP. Each category is listed with a definition as well as the mining activities that may take place within the area and / or the restrictions thereof.

Table 7: Category definitions as supplied by the MBCP (2007) (http://bgis.sanbi.org).

Category	Definition	Mining guidelines
Highly significant	Highly significant areas are those where biodiversity has been heavily compromised and very few options remain to meet biodiversity targets. Natural vegetation cover in these areas should be maintained or restored. Any significant habitat loss may cause these areas to become irreplaceable. Approved developments or changes in land use must be compatible with conservation objectives, e.g. well managed livestock grazing. If development is unavoidable, such land uses must be made sufficiently dispersed and/or small scale, to be biodiversity friendly. Decisions on land use changes will require a biodiversity specialist study as part of the EIA.	• Mining Restricted • Surface mining not permitted, actively discouraged

Important & Necessary	Biodiversity in this category is relatively intact. It represents the areas which most efficiently contribute to meeting biodiversity targets and minimise land use conflict. If biodiversity is lost from these areas, larger areas will be required elsewhere for targets to be met. This category allows some flexibility and there are options for development. However, approved developments or changes in land use must still be compatible with conservation objectives. Decisions on land-use changes will require a biodiversity specialist study as part of the EIA. Developments most antagonistic to biodiversity should be discouraged.	• Underground mining Restricted • Surface mining not permitted, actively discouraged.
Least Concern	These areas have biodiversity value in the form of natural vegetation cover. Although they are not currently required in order to meet biodiversity targets, they do contribute significantly to functioning ecosystems, including ecological connectivity. A greater variety of development choices exists in these areas. However they are still subject to National EIA legislation, where at least a scoping report is required for all listed activities.	• Underground mining permitted and actively encouraged • Surface mining restricted, by site specific conditions and controls when unavoidable, not usually permitted
No natural habitat remaining	This category covers the rest of the Province in which natural vegetation has been lost. It includes all land transformed by urban / industrial development and cultivation. Biodiversity is irreversibly changed, reduced to levels that are virtually dysfunctional. These landscapes have only residual or negative effects on the functioning of natural ecosystems.	• Underground mining permitted and actively encouraged • Surface mining restricted, by site specific conditions and controls when unavoidable, not usually permitted

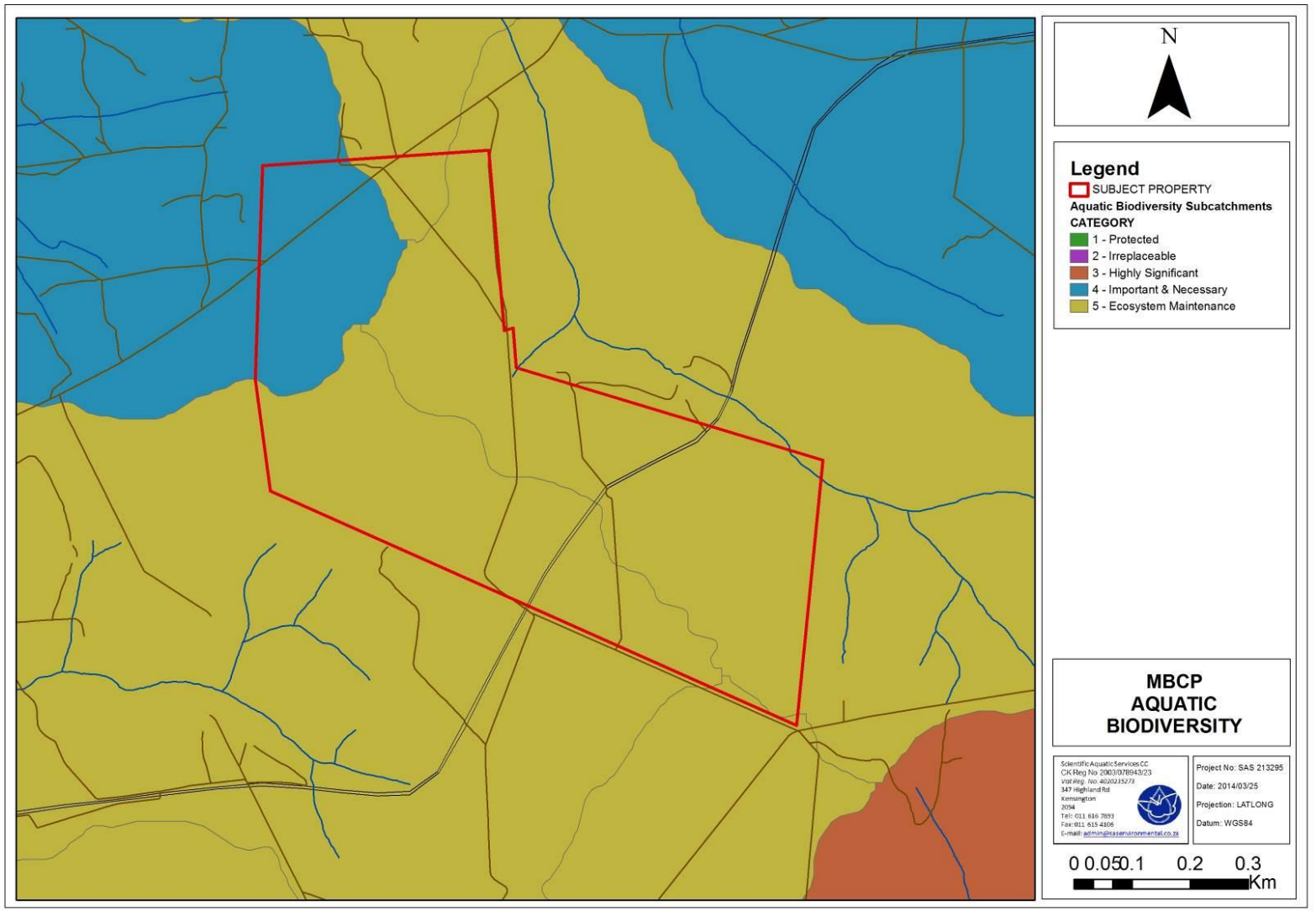


Figure 4: MBCP Aquatic Biodiversity Assessment

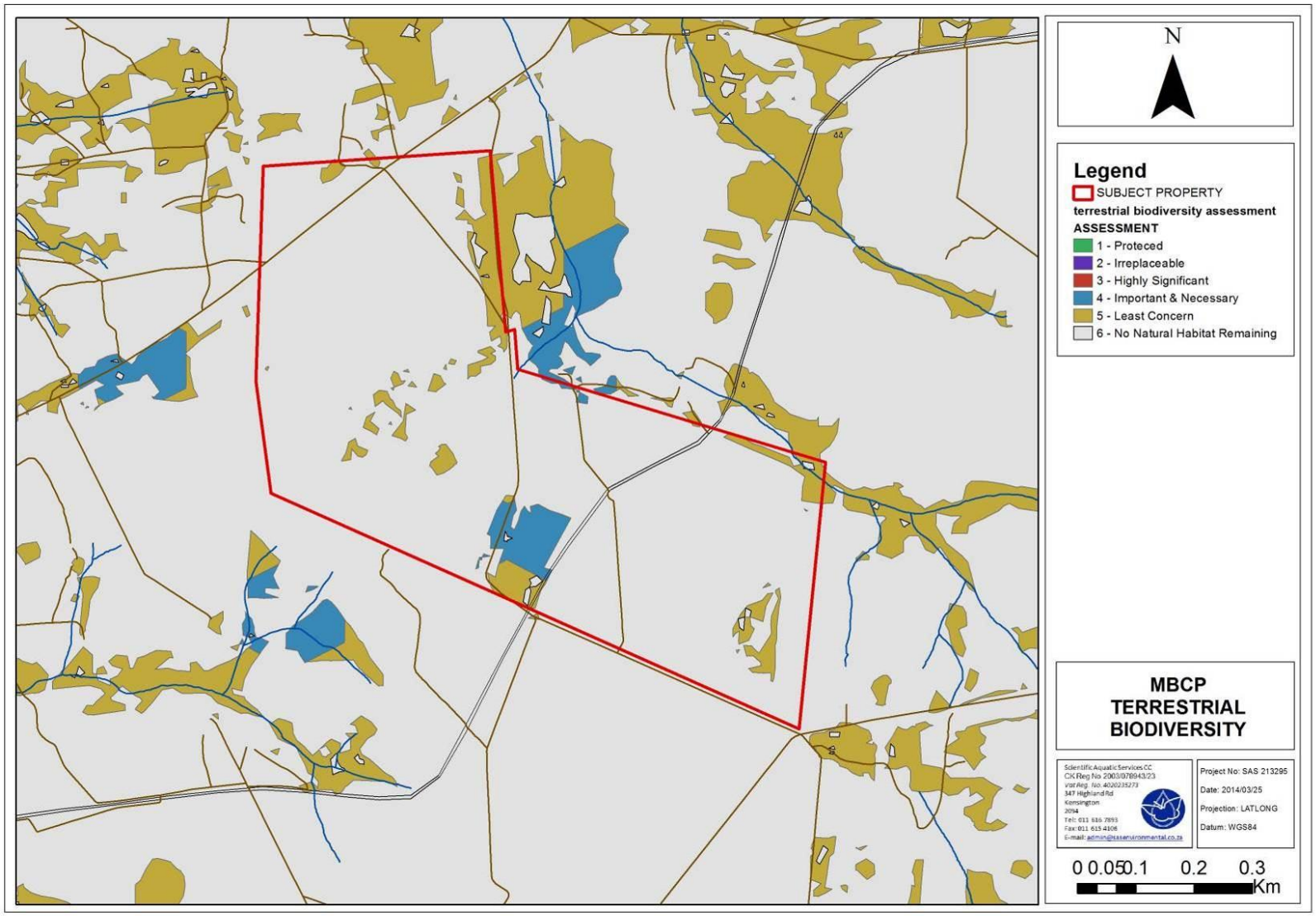


Figure 5: MBCP Terrestrial Biodiversity Assessment.

3.6 General importance of the subject property with regards to watercourse conservation

3.6.1 Ecoregions

When assessing the ecology of any area (aquatic or terrestrial), it is important to know which ecoregion the subject property is located within. This knowledge allows for improved interpretation of data to be made, since reference information and representative species lists are often available on this level of assessment, which aids in guiding the assessment.

The subject property falls within the Highveld Aquatic Ecoregion which is located within the Gauteng and Mpumalanga Province and is located within the quaternary catchments B12D, B12E and B32B and a very small section of the subject property is located within the B12C quaternary catchment (Figure 6). This high lying region is characterised by plains with a moderate to low relief, as well as various grassland vegetation types (with moist types presented towards the east and drier types towards the west and south of the eco-region).

The main attributes of the Highveld Ecoregion, and the quaternary catchments, are presented in Table 8 and Table 9 below.

Table 8: Main attributes of the Highveld Ecoregion.

MAIN ATTRIBUTES	HIGHVELD
Terrain Morphology: Broad division (dominant types in bold) (Primary)	**Plains: Low relief;** **Plains: Moderate relief;** Lowlands, Hills and Mountains; Moderate and High Relief; Open Hills; Lowlands; Mountains; Moderate to High Relief; and Closed Hills; Mountains; Moderate and High Relief.
Vegetation types (dominant types in bold) (Primary)	Mixed Bushveld (Limited); Rocky Highveld Grassland; Dry Sandy Highveld Grassland; Dry Clay Highveld Grassland; Moist Cool Highveld Grassland; Moist Cold Highveld Grassland; North Eastern Mountain; Grassland; Moist Sandy Highveld Grassland; Wet Cold Highveld; Grassland (limited); Moist Clay Highveld Grassland; and Patches Afromontane Forest (very limited).
Altitude (m a.m.s.l) (modifying)	1100-2100; 2100-2300 (very limited)
MAP (mm) (Secondary)	400 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 35
Rainfall concentration index	45 to 65

Rainfall seasonality	Early to late summer
Mean annual Temp. (°C)	12 to 20
Mean daily max. Temp. (°C): February	20 to 32
Mean daily max. Temp. (°C): July	14 to 22
Mean daily min. Temp. (°C): February	10 to 18
Mean daily min Temp. (°C): July	-2 to 4
Median annual simulated runoff (mm) for quaternary catchment	10 to >250

Table 9: Quaternary Catchment information

Catchment	Resource	EIS	PESC	DEMC
B12D	Klein Olifants	MODERATE	CLASS C	C: Moderately sensitive systems
B12E	Klein Olifants	MODERATE	CLASS B	C: Moderately sensitive systems
B32B	Selons	MODERATE	CLASS B	C: Moderately sensitive systems
B12C	Klein Olifants	MODERATE	CLASS B	C: Moderately sensitive systems

B12C

According to the ecological importance classification for the quaternary catchment, the system can be classified as a *Moderately Sensitive* system which, in its present state, can be considered a Class B (Largely natural) stream

The points below summarise the impacts on the aquatic resources in the quaternary catchment B12C (Kleynhans 1999):

- The aquatic resources within this quaternary catchment have been moderately affected by bed modification.
- Moderate flow modifications occur within the quaternary catchment.
- High impacts have occurred as a result of introduced aquatic biota such as *Labeo umbratus*.
- Impact due to inundation, is high.
- Riparian zones and stream bank conditions are considered to be moderately impacted due to erosion and some exotics.
- An impact on the aquatic community, due to altered water quality (high Total Dissolved Solids (TDS) and sulphates), is deemed to affect the catchment to a moderate degree.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a moderately low diversity of habitat types, limiting the ecological sensitivity and importance of the resources in the area.
- The quaternary catchment has a no importance in terms of conservation.
- The quaternary catchment has a moderate sensitivity to flow and flow related water quality with special mention of the fish species *Amphilius uranoscopus*, *Chiloglanis pretoriae* and invertebrates.
- The quaternary catchment is regarded as having no importance for rare and endangered species conservation.
- The quaternary catchment is considered of a low importance in terms of provision of migration routes in the instream and riparian environments.
- The quaternary catchment has a marginal importance in terms of providing refugia for aquatic community members.
- The quaternary catchment can be considered to have a moderate sensitivity to changes in water quality and flow due to many riffles.
- The quaternary catchment is of moderate importance in terms of species richness.
- The quaternary catchment is of no importance in terms of endemic and isolated species.

B12D

According to the ecological importance classification for the quaternary catchment, the system can be classified as a *Moderately Sensitive* system which, in its present state, can be considered a Class C (Moderately modified) stream.

The points below summarise the impacts on the aquatic resources in the quaternary catchment B20D (Kleynhans 1999):

- The aquatic resources within this quaternary catchment have been affected by bed modification (town influence).
- Moderate flow modifications occur within the quaternary catchment due to the influence of the Middelburg and Pienaars dam.
- Significant impacts have occurred as a result of introduced aquatic biota such as *Labeo umbratus*, *Micropterus salmoides*, *Micropterus dolomieu*, and *Cyprinus carpio*.
- Impact due to inundation is moderate.
- Riparian zones and stream bank conditions are considered to be moderately low impacted due to populations of *Acacia mearnsii*.
- An impact on the aquatic community, due to altered water quality from farming, towns and other industries, is deemed to affect the catchment to a moderately low degree.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a moderately low diversity of habitat types, limiting the ecological sensitivity and importance of the resources in the area.
- The quaternary catchment has a low importance in terms of conservation.
- The quaternary catchment has a moderate flow and flow related water quality and would be suitable for *Amphilius uranoscopus* and *Chiloglanis pretoriae* species below the town area.
- The quaternary catchment is regarded as having no importance for rare and endangered species conservation.
- The quaternary catchment is considered of very low importance in terms of provision of migration routes in the instream and riparian environments.
- The quaternary catchment has a low importance in terms of providing refugia for aquatic community members.
- The quaternary catchment can be considered to have a moderately low sensitivity to changes in water quality and flow.
- The quaternary catchment is of low importance in terms of species richness.
- The quaternary catchment is of no importance in terms of endemic and isolated species.

B12E

According to the ecological importance classification for the quaternary catchment, the system can be classified as a *Moderately Sensitive* system which, in its present state, can be considered a Class B (Largely natural) stream

The points below summarise the impacts on the aquatic resources in the quaternary catchment B12E (Kleynhans 1999):

- The aquatic resources within this quaternary catchment have been highly affected by bed modification.
- Moderate flow modifications occur within the quaternary catchment.
- Medium to high impacts have occurred as a result of introduced aquatic biota such as *Labeo umbratus* and *Micropterus dolomieu*.
- Impact due to inundation, is high.
- Riparian zones and stream bank conditions are considered to be moderately impacted due to erosion and some *Acacia mearnsii*.

- An impact on the aquatic community, due to altered water quality, is deemed to affect the catchment to a moderate degree.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a moderately high diversity of habitat types,
- The quaternary catchment has a low importance in terms of conservation.
- The quaternary catchment has a moderate flow and flow related water quality for *Amphilius uranoscopus*, *Chiloglanis pretoriae*.
- The quaternary catchment is regarded as having no importance for rare and endangered species conservation.
- The quaternary catchment is considered of a moderately high importance in terms of provision of migratory routes in the instream and riparian environments.
- The quaternary catchment has a marginal importance in terms of providing refugia for aquatic community members.
- The quaternary catchment can be considered to have a moderate sensitivity to changes in water quality and flow.
- The quaternary catchment is of moderate importance in terms of species richness.
- The quaternary catchment is of no importance in terms of endemic and isolated species.

B32B

According to the ecological importance classification for the quaternary catchment, the system can be classified as a *Moderately Sensitive* system which, in its present state, can be considered a Class B (Largely natural) stream

The points below summarise the impacts on the aquatic resources in the quaternary catchment B32B (Kleynhans 1999):

- The aquatic resources within this quaternary catchment have been moderately affected by bed modification due to sedimentation.
- Moderately low flow modifications occur within the quaternary catchment due to irrigation.
- High levels of impact have occurred as a result of introduced aquatic biota such as *Cyprinus carpio* and *Micropterus salmoides*.
- Impact due to inundation, is moderately high due to weirs.

- Riparian zones and stream bank conditions are considered to be moderately impacted due to cultivated lands and exotic encroachment such as *Acacia mearnsii*, and *Melia azedarach*.
- An impact on the aquatic community, due to altered water quality, is deemed to affect the catchment to a medium degree.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a moderately low diversity of habitat types, limiting the ecological sensitivity and importance of the resources in the area.
- The quaternary catchment has a low importance in terms of conservation.
- The aquatic biota in the quaternary catchment has a high flow and flow related water quality with special mention of *Chiloglanis pretoriae*.
- The quaternary catchment is regarded as having no importance for rare and endangered species conservation.
- The quaternary catchment is considered of a moderate importance in terms of provision of migration routes in the instream and riparian environments.
- The quaternary catchment has a marginal importance in terms of providing refugia for aquatic community members.
- The quaternary catchment can be considered to have a high sensitivity to changes in water quality and flow.
- The quaternary catchment is of moderate importance in terms of species richness.
- The quaternary catchment is of no importance in terms of endemic and isolated species.

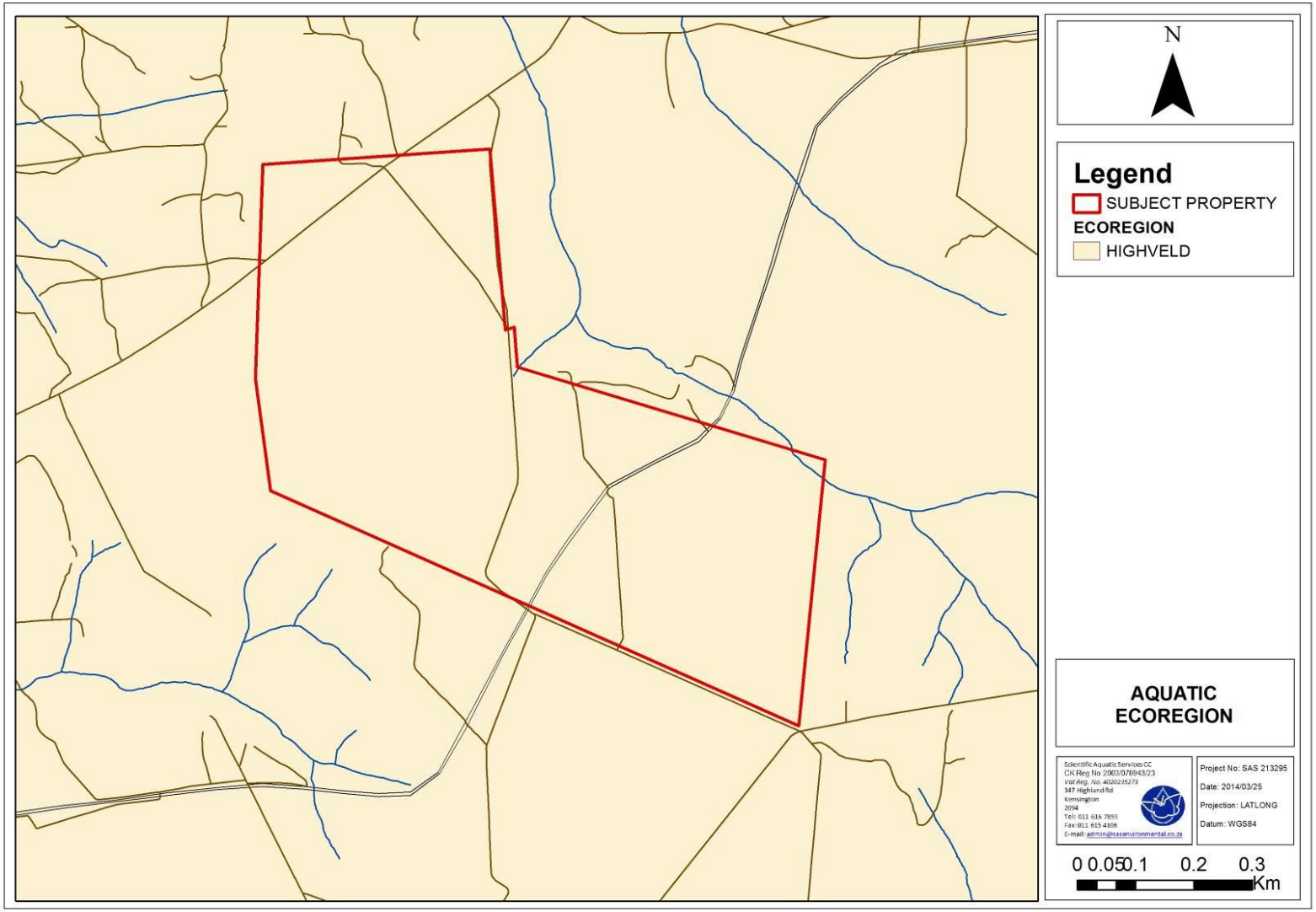


Figure 6: **The Ecoregion and Quaternary Catchment applicable to the subject property within the larger area and the two monitoring points.**

3.6.2 Importance according to the National Freshwater Ecosystems Priority Areas database (NFEPA 2011)

The SANBI Wetland Inventory (2006) and NFEPA (2011), databases was consulted to define the aquatic ecology of the wetland or river systems close to or within the subject property that may be of ecological importance. Aspects applicable to the subject property and surroundings are discussed below:

- The subject property falls within the Olifants Management Area (WMA). Each Water Management Area is divided into several sub-Water Management Areas (sub-WMA), where catchment or watershed is defined as a topographically defined area which is drained by a stream or river network. The Sub-Water management unit indicated for the subject property is the Upper Olifants sub-WMA.
- The sub-WMA is not regarded important in terms of fish sanctuaries, rehabilitation or corridors.
- The sub-WMA is not considered important in terms of translocation and relocation zones for fish.
- The sub-WMA is not listed as a fish FEPA.
- The Selons River is situated north to north-east of the subject property. The Selons River is listed as a NFEPA River system and classified as a class D – largely modified system.
- Two wetland types were classified namely a depressions and a flat, located within the subject property. A channelled valley bottom wetland feature is located on the northern to north-eastern boundary of the subject property, the Selons River.
- Conditions of the two wetland types are depicted in the figure below and are classified as:
    - Category C – depressions and flat (Percentage natural land cover 25-75%)
    - Z2 - Selons River (Majority of wetland unit is classified as “artificial” in the wetlands delineation GIS layer)
    - Z3 – Selons River (Percentage natural land cover < 25%)
- All wetlands traversing and in close proximity to the project footprint were ranked according to general importance depicted in Figure 9 below.
    - Rank 5 – Wetlands with a sub-quaternary catchment identified by experts at the regional review workshop as containing impacted working for wetlands sites; and
    - Rank 6 – Any other wetland

- Wetlands or riparian features traversed by the proposed linear development are not shown to have sighting or breeding areas for cranes;
- No RAMSAR wetlands are traversed by the proposed linear development;
- No wetlands traversed by the proposed linear development are indicated to fall within 500m of an IUCN threatened frog point locality.
- The wetland features identified within the subject property are considered natural. Two impoundments within the Selons River are considered artificial.

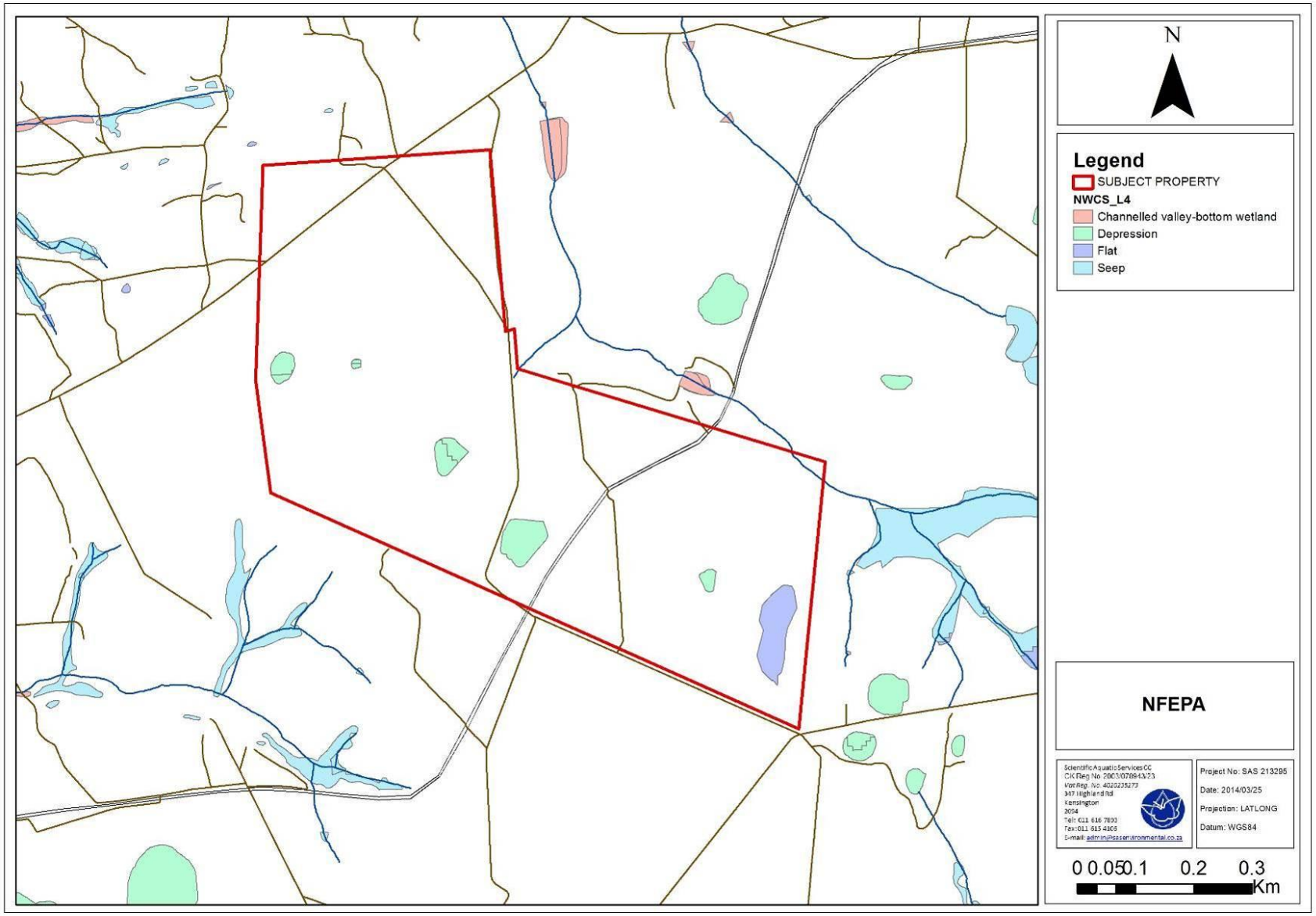


Figure 7: NFEPA wetland types within the proposed linear development.

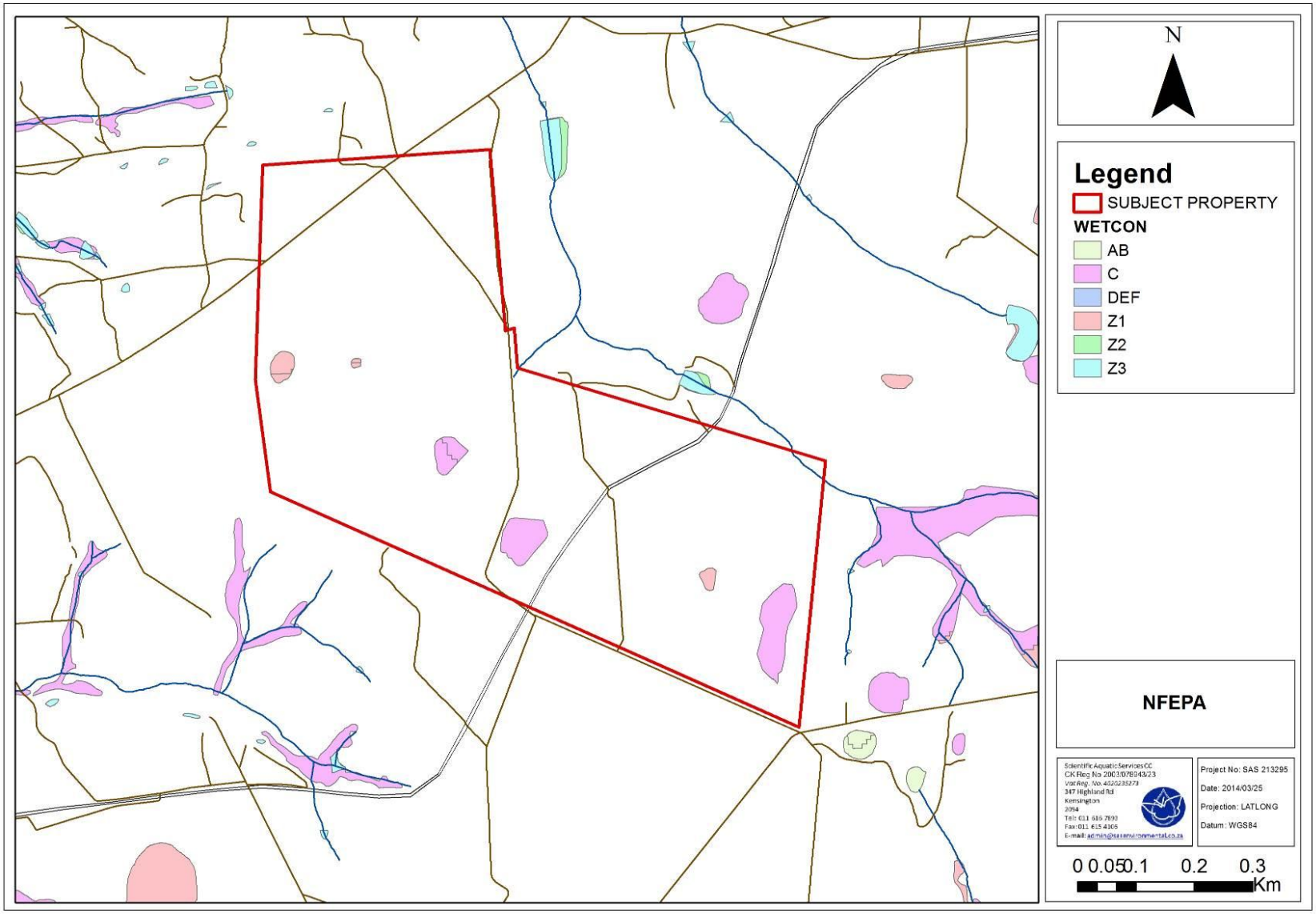


Figure 8: Wetland conditions as defined by the NFEPA wetland map.

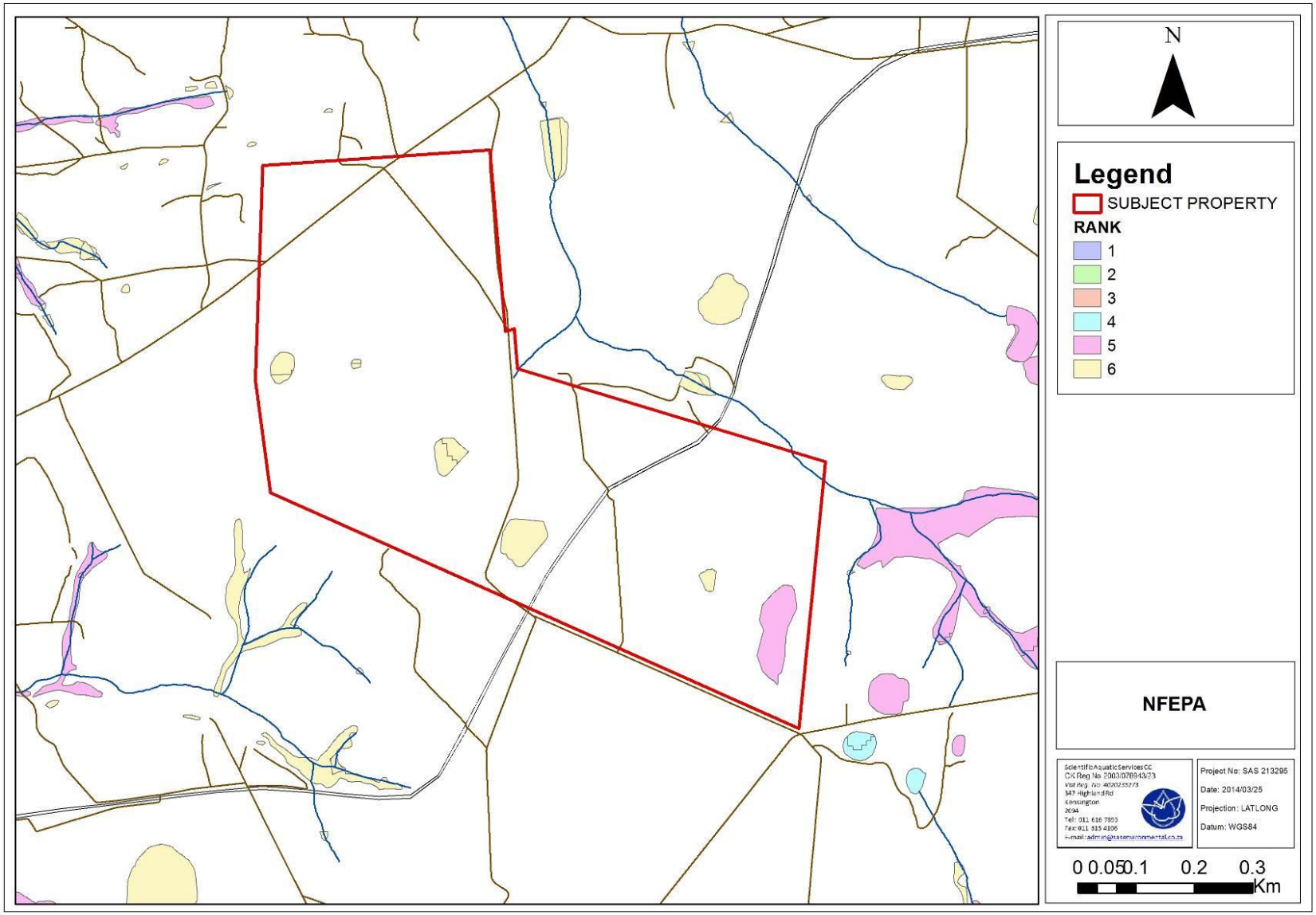


Figure 9: Ranks according to general importance.

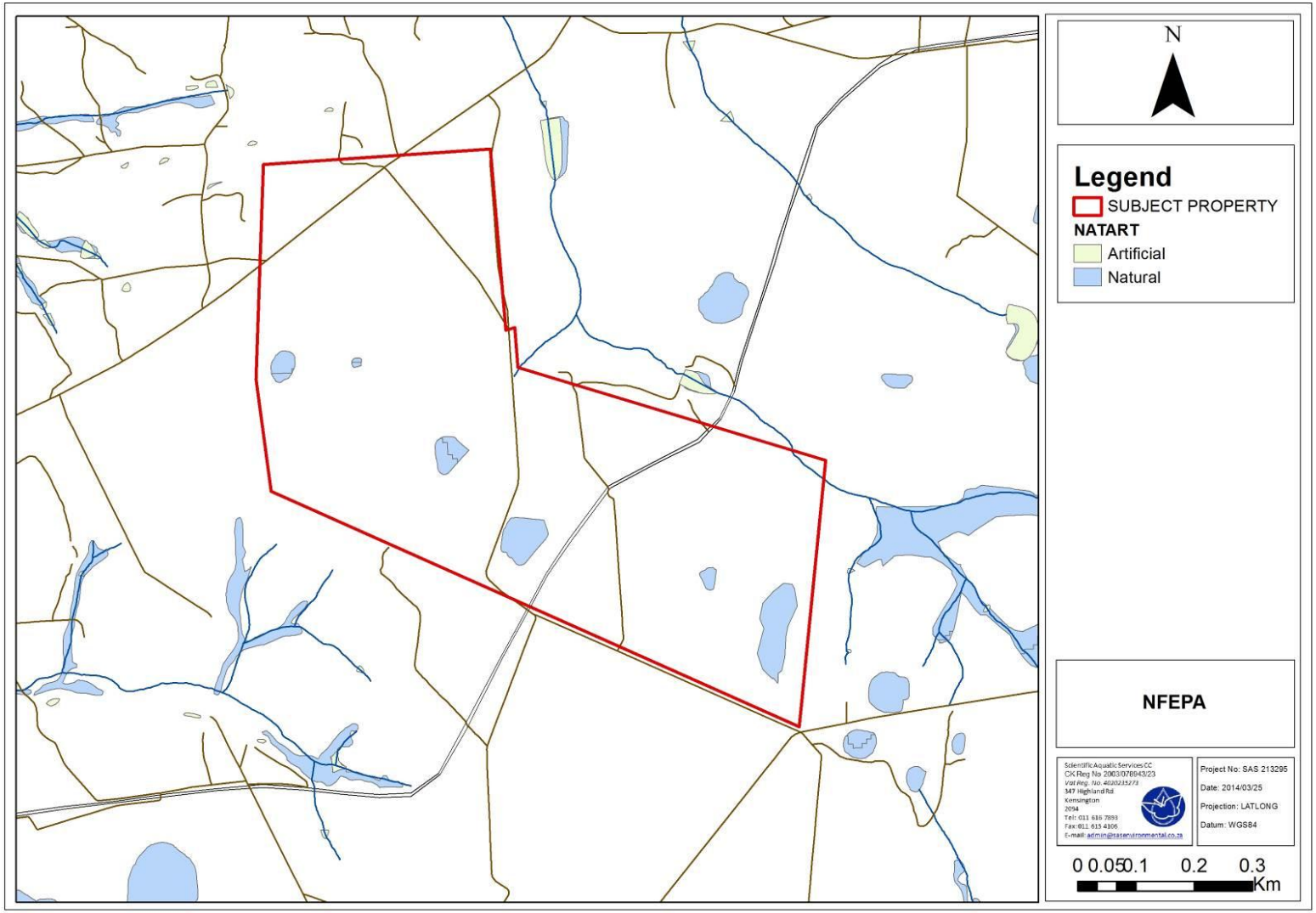


Figure 10: Wetlands indicated to be artificial or natural systems.

4 FLORAL DESCRIPTION

4.1 Biome and bioregion

Biomes are broad ecological units that represent major life zones extending over large natural areas (Rutherford, 1997). The subject property falls within the Grassland biome (Rutherford and Westfall, 1994) (Figure 11). Biomes are further divided into bioregions, which are spatial terrestrial units possessing similar biotic and physical features, and processes at a regional scale. The subject property is situated within the Mesic Highveld Grassland Bioregion (Mucina and Rutherford, 2006) (Figure 12).

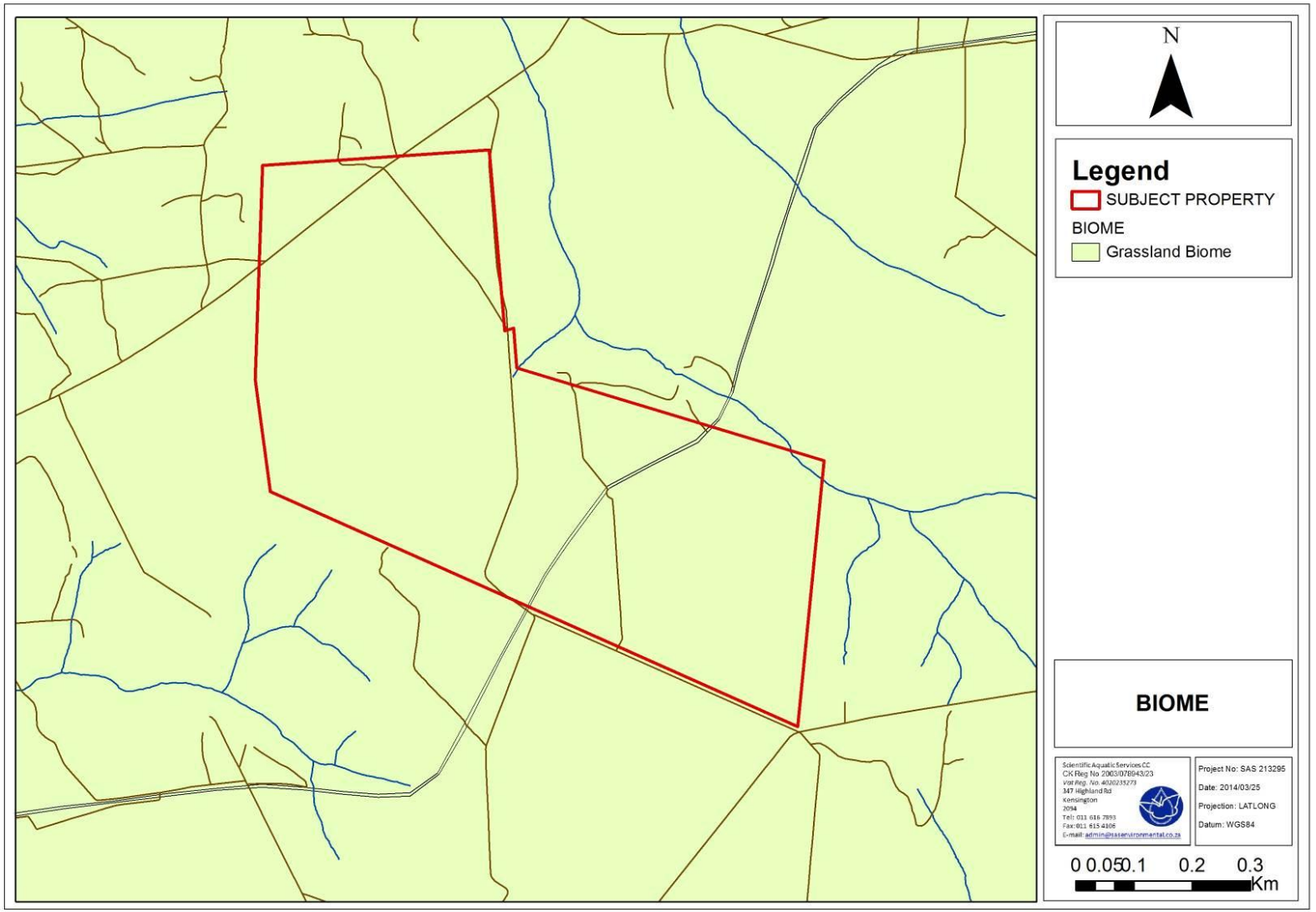


Figure 11: The biome associated with the subject property (Mucina and Rutherford, 2006).

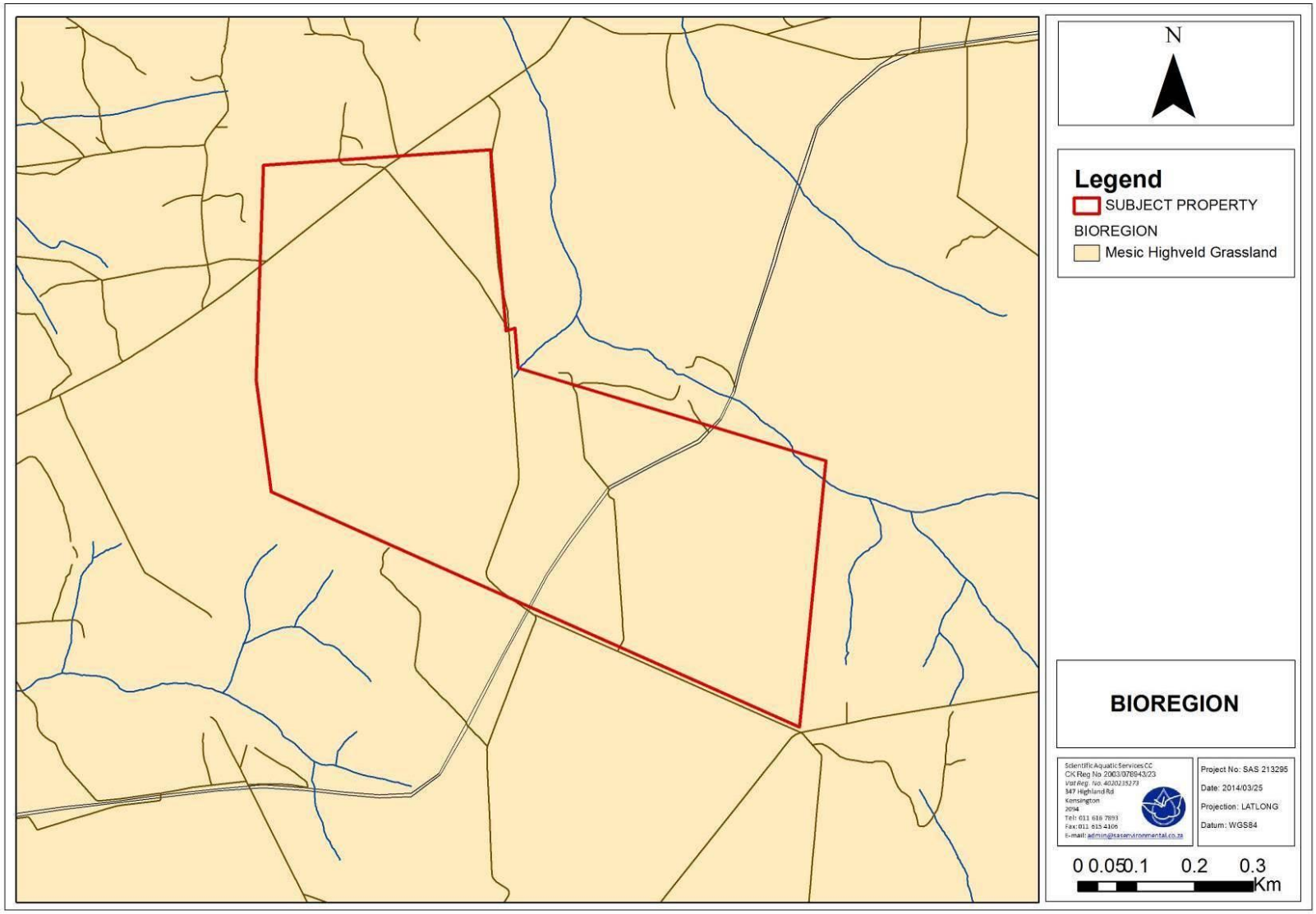


Figure 12: The bioregion associated with the subject property (Mucina and Rutherford, 2006).

4.2 Vegetation Type and Landscape Characteristics

While biomes and bioregions are valuable as they describe broad ecological patterns, they provide limited information on the actual species that are expected to be found in an area. Knowing which vegetation type an area belongs to provides an indication of the floral composition that would be found if the assessment site was in a pristine condition, which can then be compared to the observed floral list and so give an accurate and timely description of the ecological integrity of the assessment site. When the boundary of the assessment site is superimposed on the vegetation types of the surrounding area (Figure 13), it is evident that the subject property falls within one vegetation type namely the Rand Highveld Grassland vegetation type (Mucina and Rutherford, 2006). The characteristic of this vegetation type is discussed in the sections below.

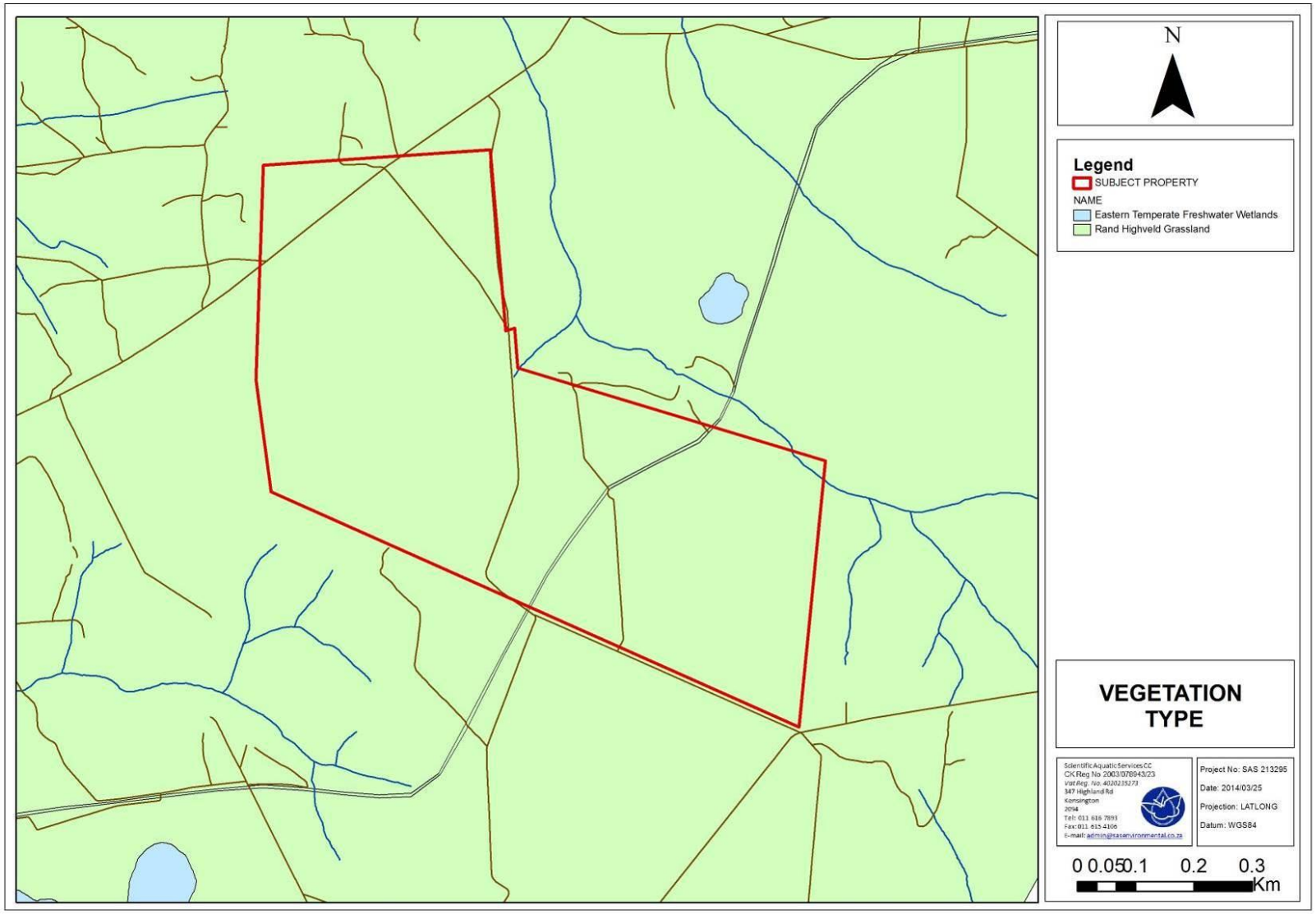


Figure 13: The vegetation type associated with the subject property (Mucina and Rutherford, 2006).

4.3 Rand Highveld Grassland Distribution

Rand Highveld Grassland occurs in the Gauteng, North-West, Free State and Mpumalanga Provinces. It occurs in areas between rocky ridges from Pretoria to Witbank, extending onto ridges in the Stoffberg and Roossenekal regions as well as west of Krugersdorp centred in the vicinity of Derby and Potchefstroom, extending southwards and northwards from there. The altitude ranges between 1300 – 1635m but reaches 1760m in places (Mucina & Rutherford, 2006).

4.3.2 Climate

Rand Highveld Grassland is characterised by strongly seasonal summer rainfall, warm-temperate region, with very dry winters. The Mean Annual Precipitation (MAP) ranges from 570 - 730mm (overall average: 654mm). The MAP is considered relatively uniform across most of this unit, but increases significantly in the west. The coefficient of variation in MAP is 28% in the west and 26% - 27% in the east, and varies only slightly from 25% to 29% across the unit. Incidences of frost are higher in the west (30-40 days) than in the east (10 – 35 days) (Mucina & Rutherford, 2006).

The Mean Annual Soil Moisture Stress (MASMS) value for the region is 76%. These values, when compared to the Mean Annual Temperature (MAT) and Mean Annual Potential for Evaporation (MAPE) averages of 15.8°C and 2,184mm, respectively, show the region to be a relatively water-stressed area. Conservation of surface (and ground) water resources is therefore imperative to biodiversity conservation within the region.

Table 10: General climatic information for the Rand Highveld Grassland (Mucina & Rutherford, 2006).

Bioregion	Vegetation types	Altitude (m)	MAP* (mm)	MAT* (°C)	MAPE* (mm)	MASMS* (%)
Mesic Highveld Grassland	Rand Highveld Grassland	1520 - 1780	654	15.8	2184	76

**MAP – Mean annual precipitation; MAT – Mean annual temperature; MAPE – Mean annual potential evaporation; MASMS – Mean annual soil moisture stress (% of days when evaporative demand was more than double the soil moisture supply)..*

4.3.3 Geology and soils

The area is characterised by quartzite ridges of the Witwatersrand supergroup and the Pretoria group as well as the Selons river formation of the Rooiberg group, supporting soils of various quality of the Rand Highveld Grassland (Mucina & Rutherford, 2006).

4.3.4 Conservation

Rand Highveld Grassland is considered endangered. Only a very small fraction is conserved in statutory reserves (Kwaggavoetpad, Van Riebeeck Park, Bronkhorstspruit, Boskop Dam nature reserve) and in private reserves (Doornkop, Zemvelo, Rhenosterpoort and Mpopomeni). Almost 50% is transformed primarily by cultivation, plantations, urbanisation and by building of dams. Cultivation may also have had an impact on an additional portion of the surface area of the unit where old lands are currently classified as grassland in land-cover classifications and poor land management has led to degradation of significant portions of the remainder of this unit. Scattered aliens (most prominently *Acacia mearnsii*) occur in about 7% of this unit. Only about 7% has been subjected to moderate to high erosion levels (Mucina & Rutherford, 2006).

4.3.5 Taxa of the Rand Highveld Grassland

In terms of recent vegetation classifications, the assessed area occurs within the Rand Highveld Grassland vegetation type (Mucina & Rutherford, 2006). This vegetation occurs in highly variable landscape with extensive sloping plains and a series of ridges slightly elevated over undulating surrounding plains. The vegetation is species-rich, wiry, sour grassland alternating with low sour shrubland on rocky outcrops and steeper slopes. The most common grasses on the plains belong to the genera *Themeda, Eragrostis, Heteropogon* and *Elionurus*. A high diversity of herbs, many of which belong to the Asteraceae, is also a typical feature. Rocky hills and ridges carry sparse woodlands with *Protea caffra* subsp. *caffra, P. Welwitschii, Acacia caffra* and *Celtis africana*, accompanied by rich suit of shrubs among which the genus *Searsia* is most prominent (Mucina and Rutherford, 2006).

Key indicator species of this vegetation type include:

- Succulent herbs: *Aloe greatheadii* var. *davyana*
- Low Shrub: *Anthospermum rigidium* subsp*. pumilum, Indigofera comosa, Rhus magalismontana, Stoebe plumose*
- Succulent shrub: *Lopholaena coriifolia*
- Geoxylic suffrutex: *Elephantorrhiza elephantine*
- Geophytic herbs: *Boophane disticha, Cheilanthes hirta*, *Haemanthus humilis* subsp. *humilis, Hypoxis rigidula* var. *pilosissima, Ledebouria ovatifolia, Oxalis corniculata*
- Grass: *Ctenium concinnum* (d), *Cynodon dactylon, Digitaria monodactyla, Diheteropogon amplectens, Eragrostis chloromelas, Heteropogon contortus,*

Loudetia simplex, Monocymbium ceresiiforme, Panicum natalense, Schizachyrium sangiuneum (d), Setaria sphacelata, Themeda triandra, Trachypogon spicatus, Tristachya biseriata (d), T. rehmannii, Andropogon schirensis, Aristida aequiglumis, Aristida congesta, A. Junciformis subsp. galpinii, Bewsia biflora, Bachiaria nigropedata, B. Serrata, Bulbostylis burchellii, Cymbopogon caesius, Digitaria tricholaenoides, Elionurus muticus, Eragrostis capensis, Eragostis curvula, Eragrostis gummiflua, Eragrostis plana, Eragrostis racemosa, Hyparrhenia hirta, Melinis nerviglumis, Melinis repens subsp. repens, Microchloa caffra, Setaria nigrirostris, Sporobolus pectinatus, Trichoneura grandiglumis, Urelytrum agropyroides

- Herbs: *Acanthospermum austral (d), Justicia anagalloides (d), Pollichia campestris (d), Acalypha angustata, Chamaecrista mimosiodes, Dicoma anaomala, Helichrysum caespititium, H. Nudifolium var nudifolium, H. rugulosum, Ipomoea crassipes, Kohautia amatymbica, Lactuca inermis, Macledium zeyherri* subsp*. argyrophylum, Nidorella hottentotica, Oldenlandia herbacea, Rotheca hirsute, Selago densiflora, Senecio coronatus, Sonchus dregeanus, Vernonia oligocephala, Xerophyta retinervis*

5 SURROUNDING PROPERTIES/LAND USES

The subject property is surrounded by properties on which agricultural activities dominate. The ecological assessment was done with special focus on areas earmarked for mining footprint as well as areas of considered of higher ecological importance and sensitivity. The surrounding area was however considered as part of the desktop assessment of the area. The land is currently used as a *Eucalyptus sp.* plantation industry with areas of edible crop lands also located on the subject property. This report aims to ensure that aspects are adequately considered during the decision making process for the proposed development in question.

6 STRUCTURE OF THE REPORT

Section A of this report served to provide an introduction to the subject property, the general approach to the study as well as the method of impact assessment. Section A also presents the results of general desktop information reviewed as part of the study including the information generated by the relevant authorities as well as the context of the site in relation to the surrounding anthropogenic activities and ecological character.

Section B addresses all the issues pertaining to the assessment of the floral ecology of the subject property.

Section C addresses all the issues pertaining to the assessment of the faunal ecology of the subject property.

Section D addresses all the issues pertaining to the assessment of the wetland ecology of the subject property.

Section E addresses all the issues pertaining to the assessment of the aquatic ecology of the subject property

7 REFERENCES

Mucina, L. and Rutherford, M.C. (Eds). 2006. *The Vegetation of South Africa, Lesotho and Swaziland.* Strelitzia 19. South African National Biodiversity Institute, Pretoria, RSA

National Environmental Management Act (NEMA) 107 of 1998

National Water Act 36 of 1998

Rutherford, M.C. 1997. Categorization of biomes. In: Cowling RM, Richardson DM, Pierce SM (eds.) Vegetation of Southern Africa. Cambridge University Press, Cambridge, pp. 91-98 ISBN 0-521-57142-1

Rutherford, M.C. and Westfall, R. H. 1994. *Biomes of Southern Africa: An objective categorization.* National Botanical Institute, Pretoria, RSA

The South African National Biodiversity Institute - Biodiversity GIS (BGIS) *[online].* URL: http://bgis.sanbi.org as retrieved on 24/03/2014

The South African National Biodiversity Institute is thanked for the use of data from the National Herbarium, Pretoria (PRE) Computerised Information System (PRECIS)

FAUNAL, FLORAL, WETLAND AND AQUATIC ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED RIETVLEI COLLIERY OUTSIDE MIDDELBURG, MPUMALANGA PROVINCE

Prepared for

WSP Group

April 2014

SECTION B – Floral Assessment

Prepared by:	**Scientific Aquatic Services**
Report author	**N. Cloete**
Report reviewers	**S. van Staden (Pri. Sci. Nat)**
Report Reference:	**SAS 213295**
Date:	**April 2014**

Scientific Aquatic Services CC
CK Reg No 2003/078943/23
Vat Reg. No. 4020235273
91 Geldenhuis Road
Malvern East Ext 1
2007
Tel: 011 616 7893
Fax: 086 724 3132
E-mail: admin@sasenvironmental.co.za

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

EIA	Environmental Impact Assessment
EAP	Environmental Assessment Practitioner
EVC	Extent of vegetation cover
HU	Habitat Unit
IUCN	International Union for Conservation of Nature
NEMA	National Environmental Management Act
PES	Present Ecological State
POC	Probability of Occurrence
PRECIS	Pretoria Computer Information Systems
PVC	Percentage cover of indigenous species
QDS	Quarter Degree Square
RDL	Red Data Listed
RIS	Recruitment of indigenous species
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
SI	Structural intactness
VIS	Vegetation Index Score

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a faunal, floral, wetland and aquatic assessment as part of the Environmental Assessment (EIA) and authorisation process for the proposed Rietvlei Colliery, hereafter referred to as the "subject property". The subject property is situated south-east of the R555, outside Middelburg, Mpumalanga Province (25°40'18.59"S 29°39'16.47"E). The total area of the subject property extends over approximately 747.16ha.

The subject property is surrounded by properties on which agricultural activities dominate and the subject property itself is currently used for forestry purposes as well as areas used for crop cultivation. The ecological assessment was done with special focus on areas earmarked for mining as well as areas considered of higher ecological importance and sensitivity. The surrounding area was however considered as part of the desktop assessment.

The purpose of the report is to present the floral inventories of species encountered on site, to determine and describe the habitat, communities and ecological state of the subject property. Furthermore, a Red Data Listed (RDL) floral species survey was conducted and sensitive landscape areas were identified. Through this, it will allow informed decision making by the authorities, proponent and Environmental Assessment Practitioner (EAP) consultants.

1.2 Assumptions and limitations

The following assumptions and limitations are applicable to this section of the report:

- The ecological assessment is confined to the subject property and does not include the neighbouring and adjacent properties; these were however considered as part of the desktop assessment; and
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most floral communities have been accurately assessed and considered as per the season of the assessment.

2 GENERAL SITE SURVEY

Field assessments were undertaken during April and October 2011 and January 2014, in order to determine the ecological status of the subject property. A reconnaissance 'walkabout' was initially undertaken to determine the general habitat types found throughout the subject property and, following this, specific study sites were selected that were considered to be representative of the habitats found within the area, with special emphasis being placed on areas that may potentially support RDL species. Sites were investigated on foot in order identify the occurrence of the dominant plant species and habitat diversities.

3 FLORAL METHOD OF ASSESSMENT

3.1 Vegetation Index Score (VIS)

The VIS was designed to determine the ecological state of each habitat unit defined within an assessment site. This enables an accurate and consistent description of the Present Ecological State (PES) concerning the subject property in question. The information gathered during the assessment also contributes towards the sensitivity mapping, leading to a more truthful representation of ecological value and sensitive habitats.

Each defined habitat unit is assessed using separate data sheets (Appendix B) and all the information gathered then contributes to the final VIS score. The VIS is derived using the following formulas:

VIS = [(EVC) + (SI x PVC) + (RIS)]

Where:

1. **EVC** is extent of vegetation cover;
2. **SI** is structural intactness;
3. **PVC** is percentage cover of indigenous species and
4. **RIS** is recruitment of indigenous species.

Each of these contributing factors is individually calculated as discussed below. All scores and tables indicated in blue are used in the final score calculation for each contributing factor.

1. ***EVC=[(EVC1+EVC2)/2]***

EVC 1 - Percentage natural vegetation cover:

Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**

Site score						
EVC 1 score	0	1	2	3	4	5
EVC2 - Total site disturbance score:						
Disturbance score	**0**	**Very Low**	**Low**	**Moderately**	**High**	**Very High**
Site score						
EVC 2 score	5	4	3	2	1	0

2. ***SI=(SI1+SI2+SI3+SI4)/4)***

	Trees (SI1)		**Shrubs (SI2)**		**Forbs (SI3)**		**Grasses (SI4)**	
Score:	***Present State**	***Perceived Reference State**	**Present State**	**Perceived Reference State**	**Present State**	**Perceived Reference State**	**Present State**	**Perceived Reference State**
Continuous								
Clumped								
Scattered								
Sparse								

*Present State (P/S) = currently applicable for each habitat unit

*Perceived Reference State (PRS) = if in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived Reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. ***PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]***

Percentage vegetation cover (exotic):						
Vegetation cover %	0%	1-5%	6-25%	26-50%	51-75%	76-100%
PVC Score	0	1	2	3	4	5
Percentage vegetation cover (bare ground):						
Vegetation cover %	0%	1-5%	6-25%	26-50%	51-75%	76-100%
PVC Score	0	1	2	3	4	5

4. ***RIS***

Extent of indigenous species recruitment	**0**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**

RIS	0	1	2	3	4	5

The final VIS scores for each habitat unit are then categorised as follows:

Table 1: The VIS score sheet for each assessment class.

Vegetation Index Score	Assessment Class	Description
22 to 25	A	Unmodified, natural
18 to 22	B	Largely natural with few modifications
14 to 18	C	Moderately modified
10 to 14	D	Largely modified
5 to 10	E	The loss of natural habitat extensive
<5	F	Modified completely

3.2 Red Data Species Assessment

Prior to the field visit, a record of RDL floral species and their habitat requirements was acquired from the South African National Biodiversity Institute (SANBI) for the Quarter Degree Square (QDS) 2529DA. Throughout the floral assessment, special attention was paid to the identification of any of these RDL species as well as identification of suitable habitat that could potentially sustain these species.

The Probability of Occurrence (POC) for each floral species of concern (within the QDS 2529DA) was determined using the following calculations wherein the habitat requirements and habitat disturbance were considered. The accuracy of the calculation is based on the available knowledge about the species in question, with many of the species lacking in-depth habitat research. Therefore, it is important that the literature available is also considered during the calculation.

Each factor contributes an equal value to the calculation.

Literature availability

	No Literature available					Literature available
Site score						
Score	0	1	2	3	4	5

Habitat availability

	No Habitat available					Habitat available
Site score						
Score	0	1	2	3	4	5

Habitat disturbance

	0	Very Low	Low	Moderately	High	Very High
Site score						
Score	5	4	3	2	1	0

[Literature availability + Habitat availability + Habitat disturbance] / 15 x 100 = POC%

4 RESULTS OF FLORAL INVESTIGATION

The subject property is located within a district utilised for cultivation of maize with gravel roads and farm infrastructure encountered throughout. Large sections of the subject property are currently used for forestry purposes and areas of edible crop lands are also located within the subject property. Therefore the majority of the subject property is considered transformed. However, some natural grassland and wetland features, were found within the subject property that can be considered less transformed.

As a result the subject property can be divided into three dominant habitat units namely transformed grassland habitat; transformed habitat (consisting of plantation areas, bare soil / gravel roads, and agricultural lands) and wetland habitat, discussed in detail below. Each of these habitat units identified was individually assessed to determine the PES of the subject property as a whole.

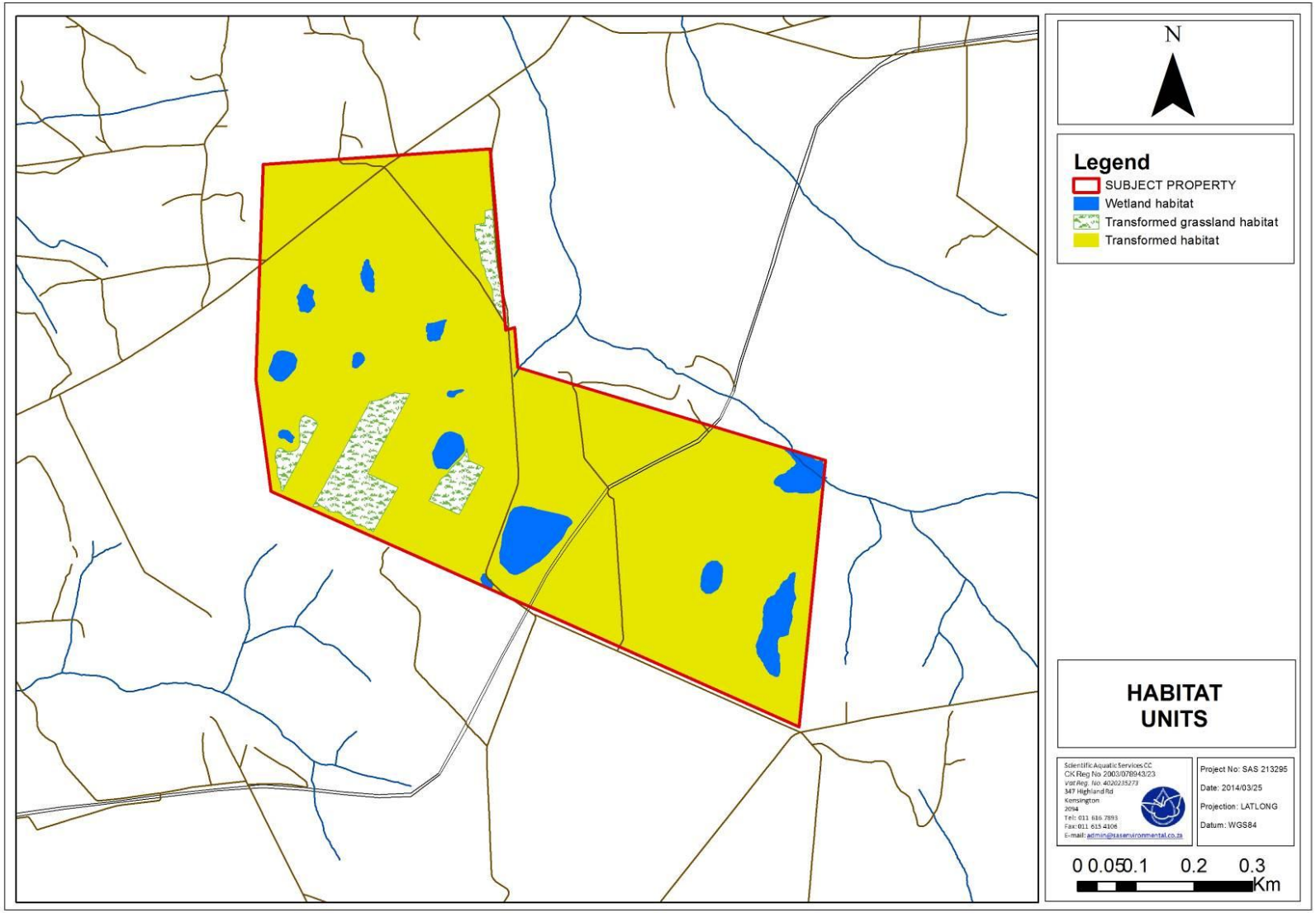


Figure 1: Habitat units identified within the subject property.

4.1 Habitat unit 1: Transformed Grassland habitat

This habitat unit is located between the plantations on the subject property. Very few natural grassland areas remain on the subject property due to the surrounding agricultural and plantation activities that are dominant within the subject property. Floral species found within this habitat unit included *Eucalyptus species*, *Themeda triandra,* various *Eragrostis sp.* species*, Aristida junciforme; Hyparrhenia hirta, Helichrysum setosum, Helichrysum kraussii and Hypoxis rigidula.*

The transformed grassland habitat unit is considered to be of low ecological importance due to historic and on-going activities and disturbance such as agricultural and plantation activities. The transformed grassland unit is affected by alien vegetation encroachment such as *Eucalyptus* sp. and *Tagetes minuta* growing between these transformed grassland sections.

Due to the high level of vegetation transformation mining activities within this habitat unit will have no significant impact on the local ecological conservation of floral species. Table 2 lists the floral species identified during the assessment.

Figure 2: The transformed grassland areas among the plantations.

Table 2: Floral species identified during the assessment of the subject property.

Trees	Grass	Shrub/forb
Acacia mearnsii	*Andropogon eucomus*	*Albuca setosa*
Acacia podalyriifolia	*Aristida congesta*	*Berkheya radula*
Eucalyptus camaldulensis	*Aristida junciforme*	*Calliepis leptophylla*
Eucalyptus cinerea	*Cynodon dactylon*	*Cephalaria zeyheri*
Eucalyptus grandis	*Cyperus esculentis*	*Euphorbia striata*
	Cyperus longus	*Denekia capensisi*
	Cyperus marginatus	*Felicia muricata*
	Cyperus rupestris	*Gazania krebsiana*
	Digitaria eriantha	*Helichrysum krassii*
	Eragrostis curvula	*Helichrysum setosum*

Trees	Grass	Shrub/forb
	Eragrostis chloromelas	*Helichrysum pilosellum*
	Eragrostis plana	*Hypoxis radula*
	Eragrostis rigida	*Ledebouria ovatifolia*
	Heteropogon contortus	*Lopholaena coriifolia*
	Hemarthria altissima	*Mariscus congesta*
	Hyparrhenia hirta	*Monopsis decipiens*
	Imperata cylindrica	*Nemesia fruticans*
	Melinis repens	*Pelargonium pseudofumariodes*
	Pogonathria squarrosa	*Rhynchosia totta*
	Sporobolus centrifugus	*Senecio affinis*
	Themeda triandra	*Senecio inaequidens*
	Typha capensis	*Senecio gregatus*
		Seriphium plumosum
		Tagetes minuta
		Taraxacum officinale
		Verbena bonariensis
		Wahlenbergia eucomus

4.2 Habitat Unit 2: Transformed habitat

Areas which are not characterised as wetlands or transformed grassland areas have been transformed by either crop cultivation or used for forestry purposes. This has led to the alteration of the floral community structure to the extent that it is completely irreversible in some areas.

Ecological functioning was found to be very low in most areas. Alien species consisted of mainly weeds or invaders such as *Eucalyptus sp*. *Datura stramonium, Cirsium vulgare, Bidens pilosa, B. formosa* and *Tagetes minuta.* As the floral community structure and habitat characteristics have been altered, the likelihood of RDL floral species occurring here is very low. Thus this habitat unit is not regarded as sensitive and does not provide an ecologically important function. Any mining activity within this habitat unit is not regarded a threat to the overall floral biodiversity within the region.

Figure 3: Transformed areas associated with agricultural related farming activities

Figure 4: *Eucalyptus sp.* plantations dominated most areas of the subject property (left). *Pinus patula* were also located within the transformed habitat unit and alongside wetland features (right).

4.3 Habitat Unit: Wetland habitat

Several wetland and pan features were identified within the subject property. The pan features were characterised as endorheic depression systems and the wetland features as a flat seepage according to the National Freshwater Ecosystem Priority Areas (NFEPA) water management database.

Further to this the wetland features within the subject property was divided into two broad categories namely wetland features with permanent zones of saturation and wetland features with no permanent zones of saturation (Table 3 and Figure 5). For detail on the function attributes of the wetland and pan features, refer to section D (Wetland Assessment) of the reports.

Table 3: The two broad wetland feature types identified within the subject property.

Wetland features with permanent zones of saturation (Permanent wetland)	Wetland features with no permanent zones of saturation (Seasonal Wetland)
Pan 1	Pan 4
Pan 2	Pan 5
Pan 3	Wetland 1
Pan 6	Wetland 2
Selons River	Wetland 3
	Wetland 4
	Wetland 5
	Wetland 6
	Wetland 7

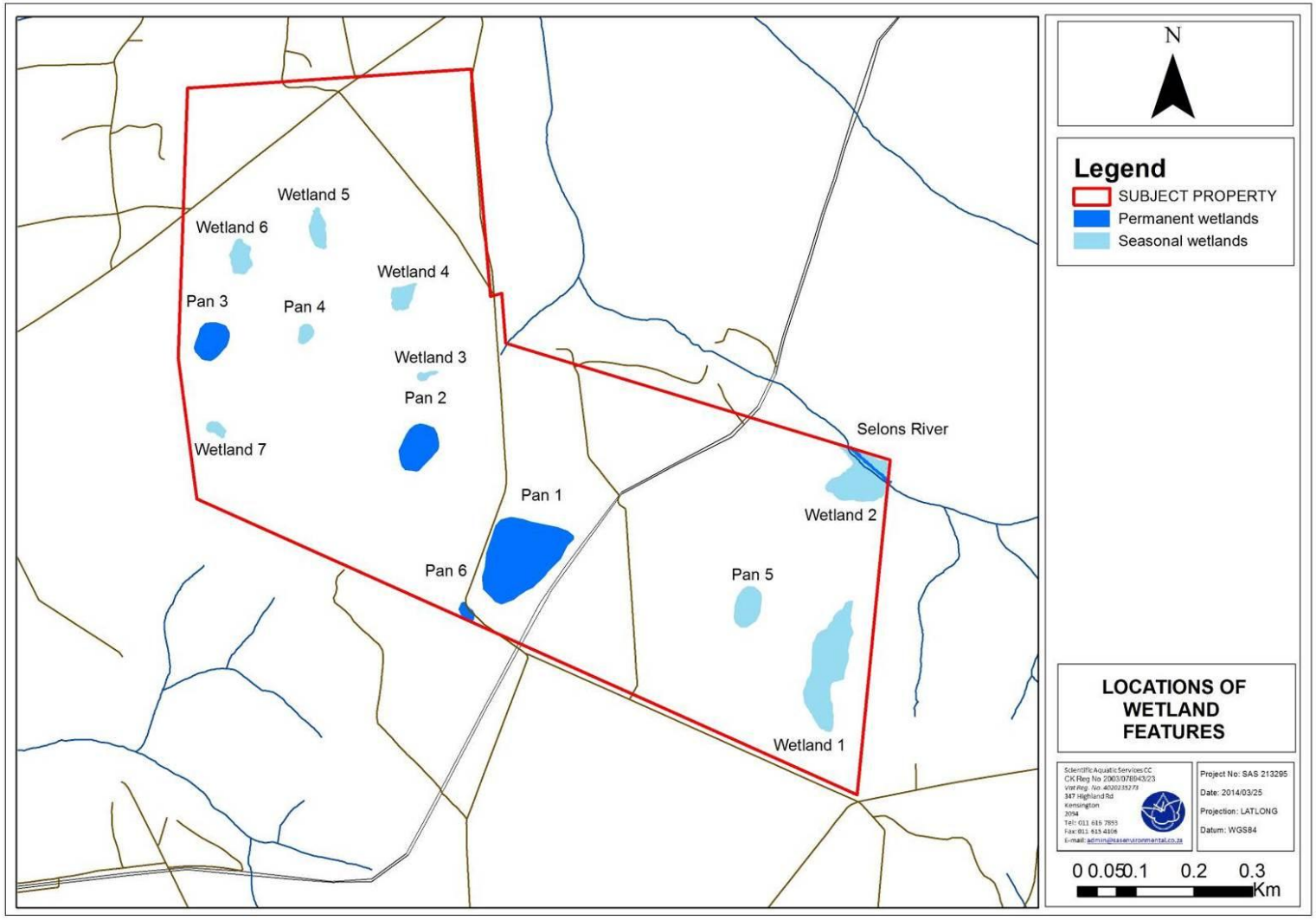


Figure 5: Location of the permanent and non-permanent wetland features within the subject property.

Upon the assessment of the subject property, the various wetland vegetation components were assessed. Dominant species were characterised as either wetland or terrestrial species. The wetland species were then further categorised as temporary, seasonal and permanent zone species. This characterisation is presented in the tables below, including the terrestrial species identified on the subject property.

Table 4: Dominant floral species identified during the wetland delineation of the wetland features with permanent zones (Pan 1-3, 6 and the Selons River) within the subject property.

Terrestrial species	Temporary species	Seasonal species	Permanent species
Acacia mearnsii	*Brachiaria serrata*	*Andropogon eucomus*	*Cyperus esculentis*
Eragrostis chloromelas	*Cyperus esculentis*	*Brachiaria serrata*	*Cyperus rotundus*
Eragrostis rigida	*Cyperus longus*	*Eragrostis heteromera*	*Imperata cylindrica*
Eragrostis gummiflua	*Cyperus marginatus*	*Eragrostis gummiflua*	*Kylinga alba*
Eucalyptus grandis	*Cyperus rupestris*	*Helichrysum pilosellum*	*Mariscus congesta*
Denekia capensis	*Eragrostis curvula*	*Homeria pallida*	*Miscanthus junceus*
Gazania krebsiana	*Eragrostis rigida*	*Hypoxis rigida*	*Phragmites australis*
Hyparrhenia hirta	*Kylinga alba*	*Monopsis decipiens*	*Typha capensis*
Ipoemoea purpurea	*Mariscus congesta*	*Kylinga alba*	*Verbena bonariensis*
Lopholaena coriifolia	*Senecio gregatus*	*Pelargonium luridum*	
Seriphium plumosum	*Taraxicum officinalis*	*Paspalum dilatatum*	
Taraxicum officinalis	*Verbena bonariensis*	*Senecio inaequidens*	
		Sporobulus pyramidalis	
		Wahlenbergia caledonica	

Pan features 1 to 3 and 6 have mostly natural vegetation occurring, with very little alien encroachment except close to the main road and cultivated lands. These pan features could provide very good habitat for avifaunal species.

The Selons River was located on the north-eastern corner of the subject property. This river system is classified as a FEPA river, providing suitable habitat for avifaunal and aquatic species. However, some transformation has occurred within the river system due to grazing of livestock and vegetation clearance resulting in erosion of the river banks. Refer to the sensitivity mapping in Section D (Wetland Assessment Report).

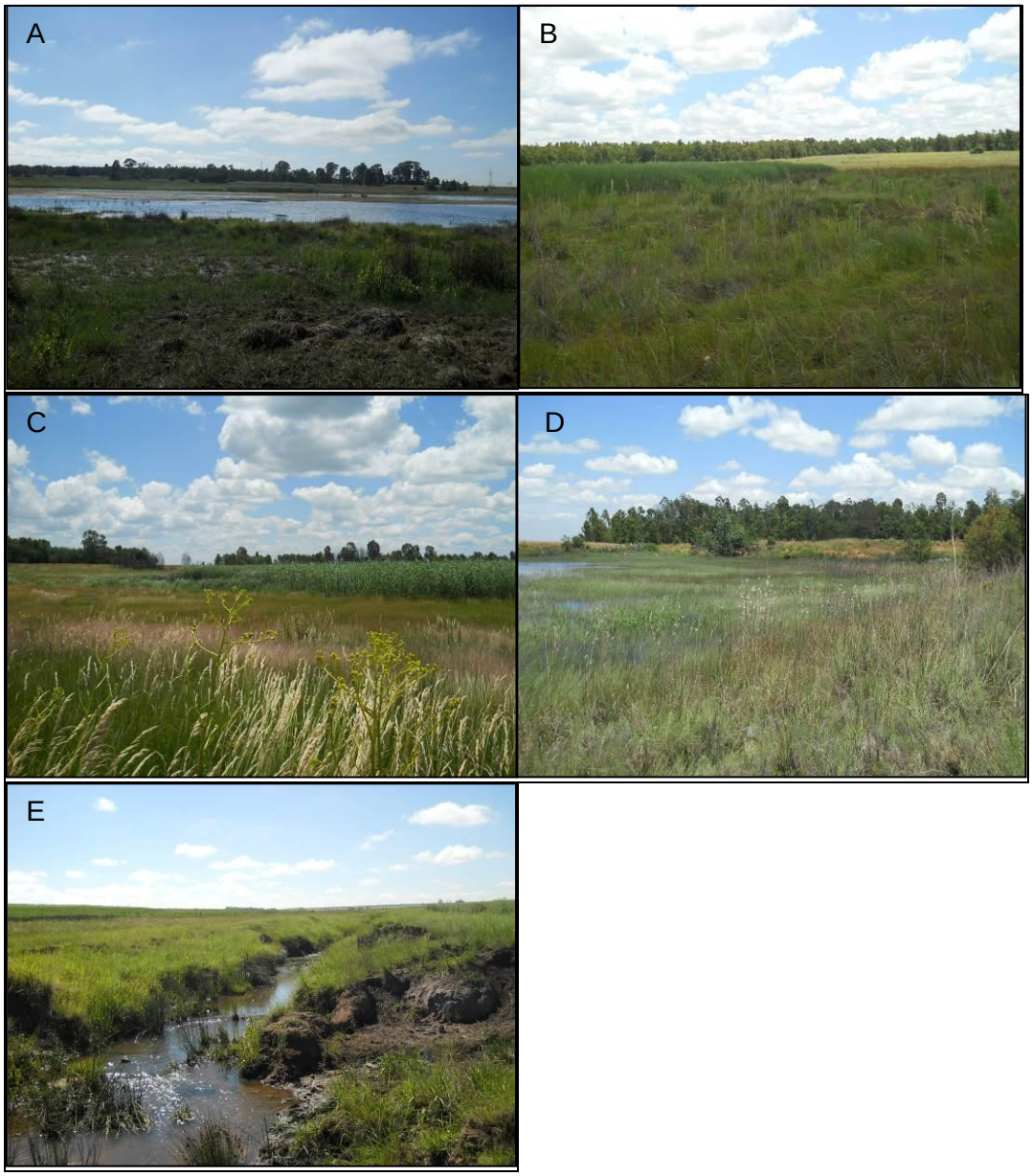


Figure 6: The wetland features with permanent zones identified within the subject property: a) Pan 1, b) Pan 2, c) Pan 3 d) Pan 6 and e) Selons River.

Table 5: Main floral species identified during the wetland delineation of the wetland features with no permanent zones (Pan 4-5, Wetland 1-7) within the subject property.

Terrestrial species	Temporary species	Seasonal species
**Acacia mearnsii*	*Cyperus esculentis*	*Andropogon eucomus*
Eragrostis chloromelas	*Cyperus longus*	*Cyperus marginatus*
Eragrostis rigida	*Cyperus marginatus*	*Cyperus rupestris*
Eragrostis curvula	*Cyperus rupestris*	*Eragrostis heteromera*
Eragrostis gummiflua	*Eragrostis rigida*	*Helichrysum pilosellum*
**Eucalyptus grandis*	*Imperata cylindrica*	*Homeria pallida*

Terrestrial species	Temporary species	Seasonal species
Denekia capensis	*Kylinga alba*	*Hypoxis rigida*
Gazania krebsiana	*Mariscus congesta*	*Monopsis decipiens*
Hyparrhenia hirta	*Senecio gregatus*	*Paspalum dilatatum*
**Ipomoea purpurea*	**Verbena bonariensis*	*Pelargonium luridum*
Lopholaena coriifolia		*Senecio inaequidens*
**Seriphium plumosum*		*Sporobulus pyramidalis*
Themeda triandra		*Wahlenbergia caledonica*

Exotic and invader vegetation species were mainly encountered within the wetland features with no permanent zones of saturation (seasonal wetland features). Although some alien encroachment occurred due to the adjacent plantation and agricultural activities, pockets of well vegetated habitat still occur within these features and will provide foraging and breeding habitat for flora and fauna species.

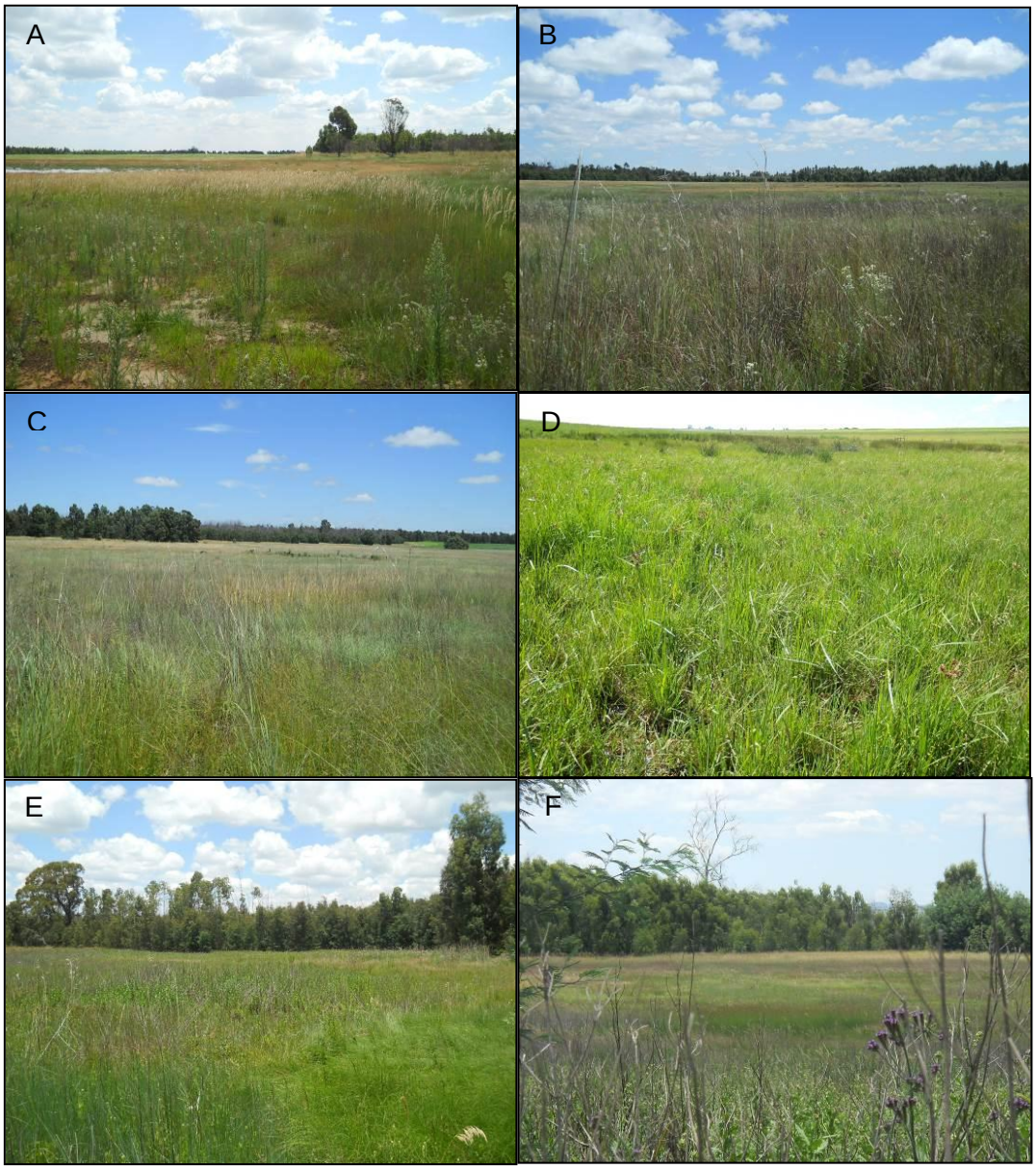


Figure 7: The seasonal wetland features identified within the subject property: a) Pan 4, b) Pan 5, c) Wetland 1, d) Wetland 2, e) Wetland 3 and f) Wetland 4.

Figure 8: The seasonal wetland features identified within the subject property: g) Wetland 5, h) Wetland 6 and i) Wetland 7.

4.4 Floral Community Assessment

Grass communities can provide information regarding the ecological status of specific areas within a subject property. If the species composition is quantitatively determined and characteristics of all components of the grass communities are taken into consideration, it is possible to determine the PES of the portion of land represented by the assessment point. Any given grass species is specifically adapted to specific growth conditions. This sensitivity to specific conditions make grasses good indicators of veld conditions.

The sections below summarise the dominant grass species identified within the transects with their associated habitats and optimal growth conditions with reference to the table and figure below. It should be noted that transect locations were chosen within all areas moderately representative of vegetation in a good condition, therefore areas with complete vegetation transformation such as the transformed habitat unit which have been disturbed due to alien and invader vegetation, were not assessed using this method. These transformed areas were however assessed using the VIS (see section below).

Table 6: Grouping of gasses (Van Oudtshoorn, 2006).

Pioneer	Hardened, annual plants that can grow in very unfavourable conditions. In time improves growth conditions for perennial grasses.
Subclimax	Weak perennials denser than pioneer grasses. Protects soils leading to more moisture, which leads to a denser stand, which deposits more organic material on the surface. As growth conditions improve climax grasses are replaced by subclimax grasses.
Climax	Strong perennial plants adapted to optimal growth conditions.
Decreaser	Grasses abundant in good veld.
Increaser I	Grasses abundant in underutilized veld.
Increaser II	Grasses abundant in overgrazed veld.
Increaser III	Grasses commonly found in overgrazed veld.

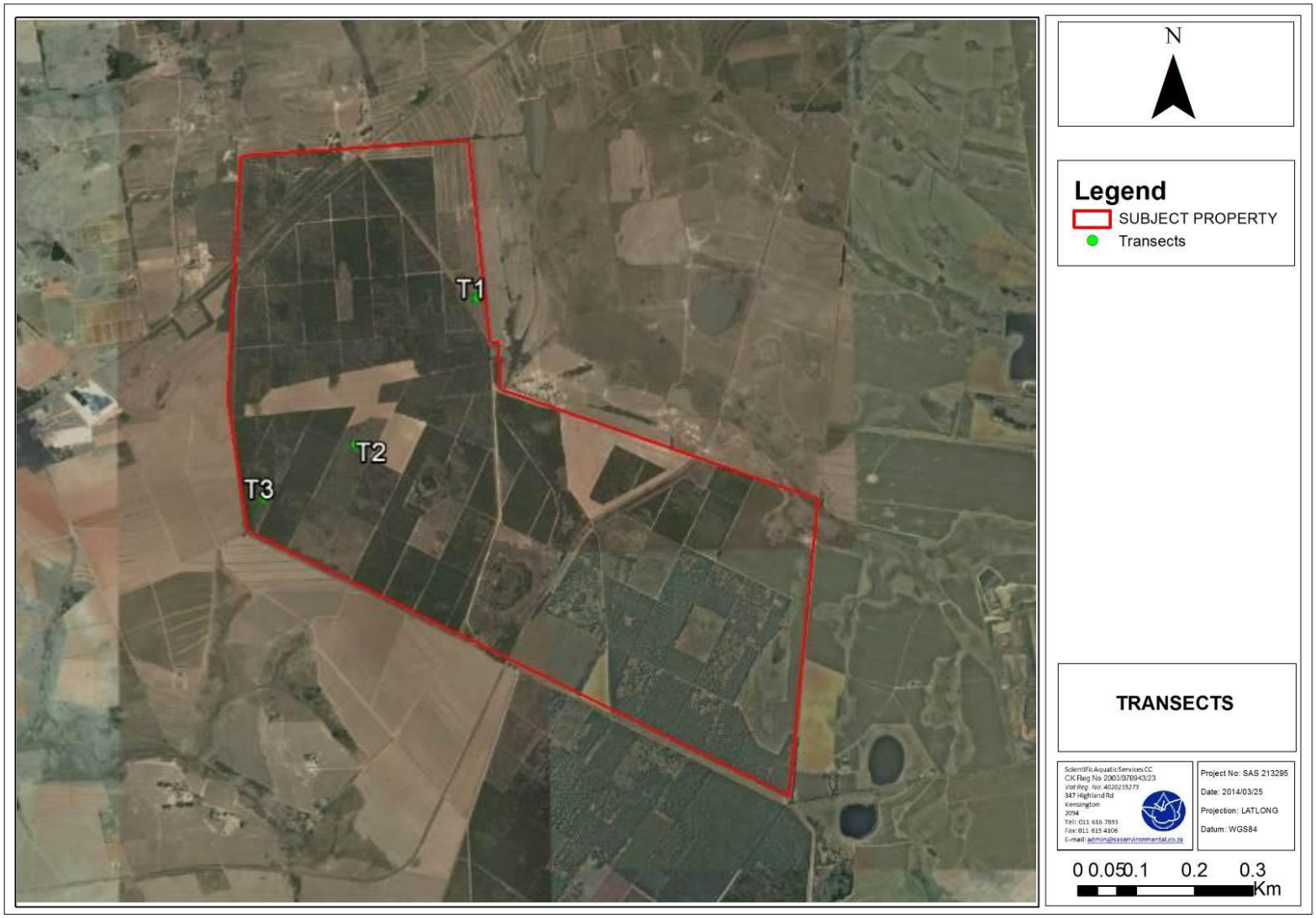
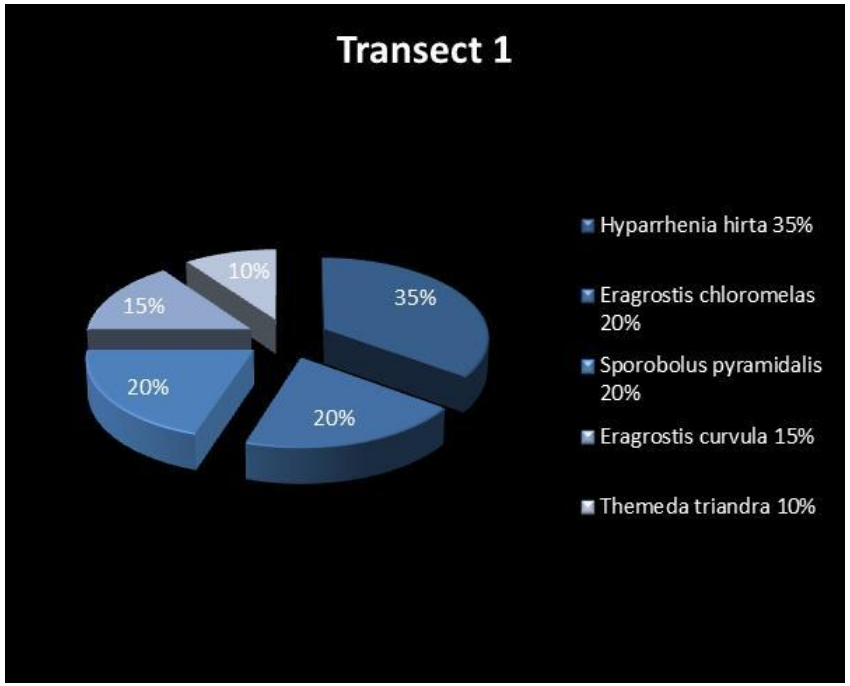


Figure 9: Digital satellite image depicting location of the transects.

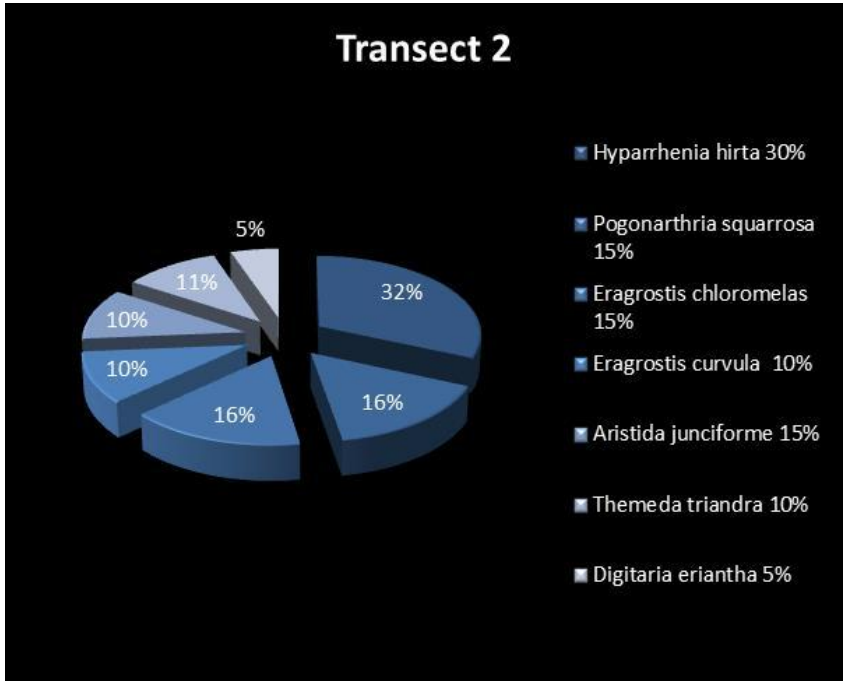


Transect 1 – Close to seasonal wetland feature 2

- *Hyparrhenia hirta* (Common thatching grass) [Increaser I, Climax grass]. Grows well in drained soil, especially gravelly soil, in open grassland, as well as in bushveld. It is often found in disturbed places such as old cultivated lands and road reserves. It is also sometimes found along riversides on heavier soil.
- *Themeda triandra* (Red grass) [Decreaser, climax grass]. Red grass is abundant in undisturbed open grassland and bushveld in parts with an average to high rainfall.
- *Eragrostis curvula* (Weeping love grass) [Increaser II, subclimax, climax grass]. Usually grows in disturbed places such as old cultivated land and along roadsides, mostly in well-drained fertile soil. It is associated with regions with a high rainfall with overgrazed and trampled veld.
- *Eragrostis chloromelas* (Narrow curly leaf) [Increases II, subclimax and climax grass]. Curly leaf grows on stony slopes in sandy and loam soil. It is more common in open grassland than in the bushveld.
- *Sporobolus pyramidalis* (Cats tail dropseed) [Increaser II, subclimax grass]. Catstail dropseed grows in disturbed places such as trampled veld and old cultivated lands in areas with high rainfall or in damp places. It is often found near kraals or other places where animals pass by. It grows in all soil types, especially in fertile soils.

Conclusion: Majority of identified species are floral species with high affinity for moist soils and transformed grassland with special mention of *Sporobolus pyramidalis* and *Hyparrhenia hirta* dominating the area

Figure 10: Transect 1



Transect 2 – Transformed grassland habitat

- *Hyparrhenia hirta* (Common thatching grass) [Increaser I, Climax grass]. Grows well in drained soil, especially gravelly soil, in open grassland, as well as in bushveld. It is often found in disturbed places such as old cultivated lands and road reserves. It is also sometimes found along riversides on heavier soil.
- *Eragrostis curvula* (Weeping love grass) [Increaser II, subclimax, climax grass]. Usually grows in disturbed places such as old cultivated land and along roadsides, mostly in well-drained fertile soil. It is associated with regions with a high rainfall with overgrazed and trampled veld.
- *Eragrostis chloromelas* (Narrow curly leaf) [Increases II, subclimax and climax grass]. Curly leaf grows on stony slopes in sandy and loam soil. It is more common in open grassland than in the bushveld.
- *Themeda triandra* (Red grass) [Decreaser, climax grass]. Red grass is abundant in undisturbed open grassland and bushveld in parts with an average to high rainfall. It grows in any type of soil, but mostly in clay soil.
- *Digitaria eriantha* (Common finger grass) [Decreaser, climax grass]. Common finger grass grows in sandy and gravel soil in parts that are more arid and in damp soils such as vleis in areas with high rainfall. It utilises a wide range of other habitat types. It mainly grows in undisturbed veld.
- *Pogonarthria squarrosa* (Herringbone grass) [Increaser II, subclimax grass]. Herringbone grass grows in disturbed places such as roadsides but is also sparsely distributed in undisturbed veld
- *Aristida junciforme* (Gongoni Tree-awn) [Climax grass, Increaser II]. It grows in most types of soil, but mostly in poor, gravelly soil on slopes and in clay soil in vleis and other wet places.

Conclusion: Majority of identified species are grass species with high affinity for moist soils and transformed grassland with special mention of *Eragrostis chloromelas, Eragrostis curvula* and H*yparrhenia hirta* dominating the area. Other species occurring in undisturbed areas includes *Themeda triandra* and *Digitaria eriantha*.

Figure 11: Transect 2.

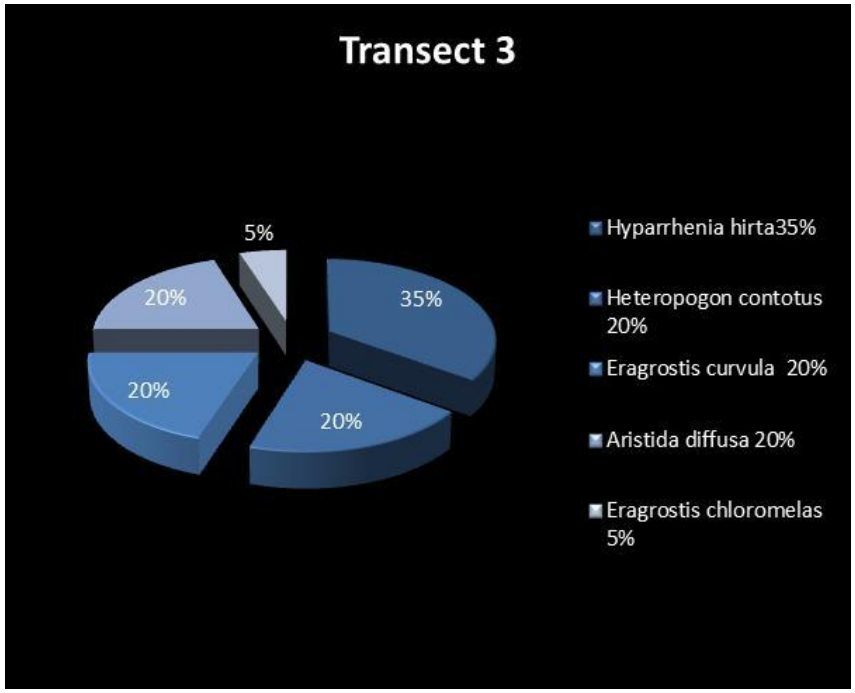


Figure 12: Transect 3.

Transect 3 – South eastern portion of subject property (Pan 1)

- *Hyparrhenia hirta* (Common thatching grass) [Increaser I, Climax grass]. Grows well in drained soil, especially gravelly soil, in open grassland, as well as in bushveld. It is often found in disturbed places such as old cultivated lands and road reserves. It is also sometimes found along riversides on heavier soil.
- *Eragrostis curvula* (Weeping love grass) [Increaser II, subclimax, climax grass]. Usually grows in disturbed places such as old cultivated land and along roadsides, mostly in well-drained fertile soil. It is associated with regions with a high rainfall with overgrazed and trampled veld.
- *Eragrostis chloromelas* (Narrow curly leaf) [Increases II, subclimax and climax grass]. Curly leaf grows on stony slopes in sandy and loam soil. It is more common in open grassland than in the bushveld.
- *Aristida diffusa* (Iron grass) [Increaser III, subclimax and climax grass]. Common finger grass grows in sandy and gravel soil in more arid Iron grass grows in a variety of soil types but mostly on slopes in gravelly soils. It is particularly associated with shallow soils in overgrazed veld.
- *Heteropogon contortus* (Spear grass) [Increases, subclimax grass]. Spear grass grows especially in gravelly and other well-drained soil. It often grows on slopes and in disturbed places such as road reserves where it can form dense stands.

Conclusion: Majority of identified species are grass species, which are indicative of transformed grassland with special mention of H*yparrhenia hirta*, which dominates the area.

The grass species diversity within the transformed grassland habitat unit, assessed, was relatively low due to the degree of vegetation transformation in some habitat units. *Eragrostis* species dominated the grassland area. The vegetation community within the transformed areas were dominated by grass species associated with disturbance. The dominant species associated with disturbance within the areas where the transects were undertaken included *Eragrostis curvula, Hyparrhenia hirta,* and *Eragrostis chloromelas*. The grass community is in a sub-climax condition, no primary grasslands occur on the subject property and the proposed mining activitty does not pose a threat to grassland conservation.

4.5 RDL Floral Assessments

An assessment considering the presence of any floral species of concern, as well as suitable habitat to support any such species, was undertaken. The complete PRECIS (Pretoria Computer Information Systems) floral list for the grid references (2529DA) was enquired from SANBI - see tables below.

Table 7: IUCN RDL Categories – Version 3.1 as supplied by SANBI

Category	Definition
EX	Extinct
EW	Extinct in the wild
CR	Critically endangered
EN	Endangered
VU	Vulnerable
NT	Near threatened
LC	Least concern
DD	Data deficient
NE	Not evaluated

The threatened status of all species listed within the QDS 2529DA was categorised as either least concern or not evaluated. No RDL floral species were listed within the QDS. In addition no RDL floral species were recorded within the subject property during the site assessment.

4.6 VIS

The information gathered during the assessment of the subject property was used to determine the VIS - see Appendix B for calculations. The tables below list the scoring system as well as the results.

Table 8: Scoring for the VIS.

Vegetation Index Score	Assessment Class	Description
22 to 25	A	Unmodified, natural
18 to 22	B	Largely natural with few modifications.
14 to 18	C	Moderately modified
10 to 14	D	Largely modified
5 to 10	E	The loss of natural habitat extensive
<5	F	Modified completely

Table 9: VIS calculated for each habitat unit.

Habitat unit	Score	Class	Motivation
Transformed habitat	5	**Class E – extensive loss of natural habitat**	This habitat unit is associated primarily with the plantations, alien proliferation as well as agricultural activities. The ecological functionality and habitat integrity of the transformed habitat Unit is regarded as being extremely limited.
Transformed grassland habitat	6	**Class D – largely modified**	This habitat unit has undergone vegetation transformation due to the surrounding alien encroachment and tree plantations
Wetland habitat	16	**Class C – moderately modified**	This habitat unit has undergone some transformation due to the surrounding tree plantations but still provides suitable habitat for numerous wetland floral species and foraging habitat for avifaunal species.

4.7 Alien and Invasive Floral Species

Alien invaders are plants that are of exotic origin and are invading previously pristine areas or ecological niches (Bromilow, 2001). Not all weeds are exotic in origin but, as these exotic plant species have very limited natural “check” mechanisms within the natural environment, they are often the most opportunistic and aggressively growing species within the ecosystem. Therefore, they are often the most dominant and noticeable within an area. Disturbances of the ground through trampling, excavations or landscaping often leads to the dominance of exotic pioneer species that rapidly dominate the area. Under natural conditions, these pioneer species are overtaken by sub-climax and climax species

through natural veld succession. This process however takes many years to occur, with the natural vegetation never reaching the balanced, pristine species composition prior to the disturbance. There are many species of indigenous pioneer plants, but very few indigenous species can out-compete their more aggressively growing exotic counterparts.

Alien vegetation invasion causes degradation of the ecological integrity of an area, causing (Bromilow, 2001):

- A decline in species diversity;
- Local extinction of indigenous species;
- Ecological imbalance;
- Decreased productivity of grazing pastures and
- Increased agricultural input costs.

The table below indicated the alien and invader species identified during the site assessment.

Table 10: Exotic or invasive species within the subject property.

Species	English name	Type or Origin	Category*
Acacia mearnsii	Black wattle	Eurasia	2
Acacia podalyriifolia	Pearl acacia	Australia	3
Cynodon dactylon	Couch grass	Tropical Africa / Asia	N/A
Cyperus esculentis	Yellow nutsedge	Unknown	N/A
Eucalyptus grandis	Saligna gum	Australia and nearby Asia	2
Eucalyptus camaldulensis	Red river gum	Australia and nearby Asia	2
Eucalyptus cinerea	Florist's gum	Australia and nearby Asia	2
Imperata cylindrica	Cotton wool grass	Indigenous invader	N/A
Siriphium plumosum	Bankrupt bush	Indigenous invader	N/A
Taraxacum officinale	Common dandelion	Europe	
Tagetes minuta	Tall khakiweed	Native to S America	NA
Verbena bonariensis	Wild Verbena	Native to S America	1

The largest extent of the subject property was impacted by stands of alien and invasive vegetation, which include the woody species *Eucalyptus camaldulensis, Pinus patula* and *Acacia mearnsii*. Invader species also encroached into the grassland habitat unit due to the edge effects from agricultural activities and plantations.

Removal and control of invasive floral species should take place throughout the pre-construction, construction, operational and decommissioning and closure phase of the mine.

4.8 Medicinal Floral Species

Medicinal floral species are not necessarily indigenous species, with many of them regarded as alien invasive weeds. The majority of the medicinal species identified within the subject property are commonly occurring species.

The table below presents a list of floral species with traditional medicinal value, floral parts traditionally used and their main applications, which were identified during the field assessment.

Table 11: Traditional medicinal floral identified during the field assessment. Medicinal applications and application methods are also presented (van Wyk, et al., 1997; van Wyk and Gericke, 2000; van Wyk and Wink, 2004; van Wyk, Oudtshoorn, Gericke, 2009).

Species	Name	Plant parts used	Medicinal uses
Eucalyptus grandis	Saligna gum	Leaves	Oils are used in medicinal preparations (inhalants and ointments), soaps, detergents, food, dentistry and veterinary products.
Helichrysum nudifolium	Everlasting	Leaves, twigs and sometimes the roots	Many ailments are treated, including coughs, colds, fever, infections, headache and menstrual pains. It is a popular ingredient in wound dressing.
Tagetes minuta	Tall khakiweed	Leaves	The essential oils are used in perfumery and as a flavourant in food, beverages and tobacco. Some gardeners use warm water extracts of the fresh plant to keep roses and other plants free from insects and fungal diseases

Of these medicinal species listed above, none is listed as protected or conservational concern species. No important medicinal floral communities will be lost or impacted upon by the proposed development activities.

5 SENSITIVITY MAPPING

The subject property has been transformed due to numerous current and historic anthropogenic activities such as tree plantations resulting in alien encroachment and a decrease in the natural floral asseblage. As a result, vegetation transformation has occurred throughout the subject property and can be considered irreversible in some portions.

The figure below illustrates the sensitivity of the subject property. High and medium sensitivity areas included pan feature 1 and 3 and 6 and the Selons River with associated 100m buffers. Low sensitivity was allocated to the seasonal wetland sections. The

remainder of the site is considered very low due to the complete vegetation transformation of agricultural and plantation activities.

It can be concluded that the mining footprint and activities will have a significant effect on the wetland features with permanent zones (Pan 1-3, 6 and the Selons River) specifically referring to the highly sensitive features should mitigation measures not be implemented. Thus, layout planning of the mine footprint should consider higher sensitivity areas as “no-go” areas. Based on the observations of the study, mining infrastructure should, as far as possible, be limited to the previously disturbed areas, such as the crop fields and plantation areas. Should mining activity occur within any of the wetland features, relevant authorisation should be acquired according to the National Environmental Management Act (NEMA) 107 of 1998 and Sections 21 c and i of the National Water Act 36 of 1998.

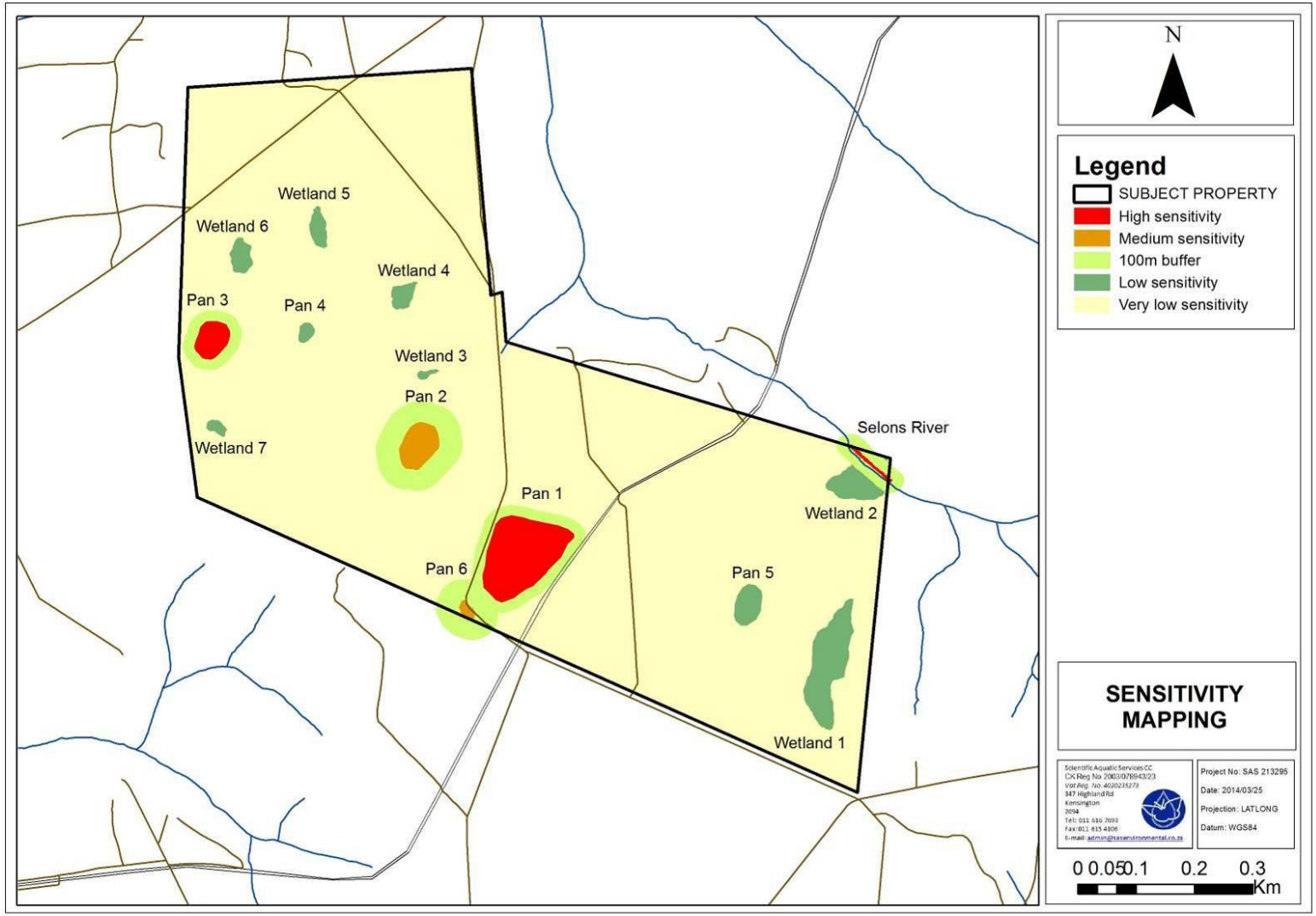


Figure 13: The overall sensitivity map of the subject property.

6 IMPACT ASSESSMENT

The tables below serve to summarise the significance of potential impacts on the floral communities occurring on or directly adjacent to the subject property. A summary of all potential pre-construction, construction, operational and decommissioning and closure phase impacts is provided. The sections below present the impact assessment according to the method described in Section A. In addition, it also indicates the required mitigatory and management measures needed to minimise potential ecological impacts and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures, assuming that they are fully implemented.

6.1 Impact Discussion

All proposed development activities that may result in an impact on the floral communities of the subject property are discussed below.

6.1.1 IMPACT 1: Impacts on habitat for floral species

Activities leading to impact

Pre-Construction	Construction	Operational	Decommissioning & Closure
Planning of mine infrastructure placement and design leading to overall loss of floral habitat within areas of increased ecological sensitivity	Site clearing and the removal of vegetation	Ongoing disturbance of soils with general operational activities leading to altered floral habitat	Ineffective rehabilitation of exposed and impacted areas and failure to implement an alien floral control plan may lead to ongoing loss of floral habitat
Inadequate design of infrastructure leading to pollution of soils and ground water	Encroachment of construction activities into more sensitive areas within the subject property could lead to loss of indigenous floral habitat	Discharge and contamination from operational facilities may pollute receiving environment	Disturbance of soils as part of demolition activities may alter floral habitat
Inadequate design of infrastructure leading changes in floral habitat	Site clearing and the disturbance of soils	Seepage affecting soils and the groundwater regime	Ongoing seepage and runoff may affect the groundwater regime beyond closure
	Movement of construction vehicles and access road construction impacting on floral habitat	Runoff and seepage from operational facilities may lead to habitat loss	Ongoing risk of discharge from mining facilities beyond closure

	Dumping of construction material leading to loss of floral habitat	Ongoing disturbance may lead to erosion and sedimentation of wetland features	Ineffective rehabilitation of exposed and impacted areas and failure to control alien floral species may lead to ongoing loss of floral habitat
	Compaction of soils due to construction activities affecting floral habitat	Ineffective monitoring during operational activities due to poor management	Insufficient aftercare and maintenance leading to post closure impacts on floral habitat due to poor management
			Insufficient aftercare and maintenance leading to unchecked erosion and sedimentation
			Ineffective monitoring of rehabilitation due to poor management

Aspects of floral ecology affected

Construction	Operational	Decommissioning & Closure
Impact on floral wetland habitat	Impact on floral wetland habitat	Direct impact on floral habitat during decommissioning
Loss of floral biodiversity	Loss of floral biodiversity	Loss of floral biodiversity
Contamination of soils	Contamination of soils	Ongoing contamination of soils
Contamination of ground and surface water	Contamination of ground and surface water	Ongoing contamination of ground and surface water after decommissioning
Compaction and loss of soils	Compaction and loss of soils	Compaction and loss of soils during decommissioning
Sedimentation and erosion	Sedimentation and erosion	Sedimentation and erosion
		Changes to the floral communities due to alien invasive vegetation leading to altered habitat conditions

Without Management	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
	4	3	3	3	5	7	11	77 (Medium-High)

Essential mitigation measures:

- A sensitivity map has been developed for the subject property, indicating the Wetland habitat units, which are considered to be of increased ecological importance. It is recommended that this sensitivity map be considered during all development phases to aid in the conservation of floral habitat within the subject property.
- No activities are to infringe upon these sensitive areas or associated buffer zones.
- The boundaries of the development footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas.
- Edge effects of all construction and operational activities, such as erosion and alien plant species proliferation, which may affect floral habitat, need to be strictly managed in all areas of increased ecological sensitivity.
- All areas of increased ecological sensitivity should be designated as No-Go areas and be off limits to all unauthorised vehicles and personnel. Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.
- Planning of temporary roads and access routes should take the site sensitivity plan into consideration. If possible, such roads should be constructed a distance from the more sensitive wetland areas and not directly adjacent thereto.
- It must be ensured that mining related waste or spillage and effluent do not affect the sensitive habitat boundaries and associated buffer zones.
- It must be ensured that the mine process water system is managed in such a way as to prevent discharge to the receiving environment.
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss.
- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the mine expansion and development footprint areas. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled.
- All soils compacted as a result of construction activities falling outside of development footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas. Alien and invasive vegetation control should take place throughout all development including

decommissioning phases to prevent loss of floral habitat.

- To prevent the erosion of top soils, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas susceptible to erosion. It must be ensured that topsoil stockpiles are located outside of any drainage lines and areas susceptible to erosion. Stockpiles should be placed away from areas known to contain hazardous substances such as fuel and if any soils are contaminated, it should be stripped and disposed of at a registered hazardous waste dumping site.
- All disturbed habitat areas must be rehabilitated and planted with indigenous floral species as soon as possible to ensure that floral ecology is re-instated.

Recommended mitigation measures

- During the construction and operational phases of the proposed mining expansion, erosion berms may be installed to prevent gully formation and siltation of the wetland resources. The following points should serve to guide the placement of erosion berms:
    - Where the track has a slope of less than 2%, berms every 50m should be installed.
    - Where the track slopes between 2% and 10%, berms every 25m should be installed.
    - Where the track slopes between 10% and 15%, berms every 20m should be installed.
    - Where the track has a slope greater than 15%, berms every 10m should be installed.

With Management	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
	3	3	3	4	4	6	11	66 (Medium-Low)

Probable latent impacts:

- Loss of floral habitat may lead to altered floral biodiversity.
- Ineffective rehabilitation may lead to permanent transformation of floral habitat.

6.1.2 IMPACT 2: Impacts on floral diversity

Activities leading to impact

Pre-Construction	Construction	Operational	Decommissioning & Closure
Poor planning of mine infrastructure placement and design	Site clearance and removal of vegetation	An increase in alien plant species leading to altered plant community structure and composition within wetland features	

Inadequate design of infrastructure leading to pollution of soils and ground water	Construction of infrastructure and access roads through more sensitive wetland areas	Erosion and sedimentation as a result of operational activities	Ineffective rehabilitation of exposed and impacted areas and failure to implement alien floral control
	Proliferation of alien species may alter plant community structure within wetland features.	Increased fire frequency and intensity, as well as uncontrolled fires during mining operations due to increased human activity	Erosion and sedimentation as a result of closure and decommissioning activities
	Soil compaction as a result of construction activities	Potential blasting and drilling during the construction phase will lead to an increase in dust	Failure to monitor rehabilitation efforts and implement an alien floral control plan
	Heavy vehicle movement		Increased fire frequency and intensity, as well as uncontrolled fires during closure and decommissioning
	Increased fire frequency and intensity, as well as uncontrolled fires due to increased human activity		
	Potential blasting and drilling during the construction phase will lead to an increase in dust		

Aspects of floral ecology affected

Construction	Operational	Decommissioning & Closure
Loss of floral biodiversity	Loss of floral biodiversity	Loss of floral biodiversity
Contamination of ground and surface water on which wetland floral species are reliant	Contamination of soils due to a lack of infrastructure maintenance	Alteration of floral community structure due to alien invasion vegetation leading to loss of floral biodiversity
Compaction and loss of soils leading to loss of floral biodiversity	Contamination of ground and surface water	
	Alteration of floral community structure due to alien invasion vegetation leading to loss of floral biodiversity	

Without Management	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
	4	3	4	3	5	7	12	84 (Medium-High)

Essential mitigation measures:

- A sensitivity map has been developed for the subject property, indicating wetland areas which are considered to be of increased ecological importance. It is recommended that this sensitivity map be considered during all development phases to aid in the conservation of floral habitat within the subject property.
- All development footprint areas and areas affected by the proposed mine development should remain as small as possible and should not encroach onto surrounding more sensitive wetland areas and the associated buffer zones. It must be ensured that these areas are off-limits to construction vehicles and personnel.
- Removal of the alien and weed species encountered during the operational and decommissioning and closure phase must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act, 1998). Species specific and area specific eradication recommendations:
    - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used.
    - Footprint areas should be kept as small as possible when removing alien plant species.
    - No vehicles should be allowed to drive through designated sensitive wetland areas during the eradication of alien and weed species.
- Informal fires in the vicinity of mining areas should be prohibited during all development phases.

Recommended mitigation measures

- It must be ensured that all roads and construction areas are regularly sprayed with water in order to curb dust generation. This is particularly necessary during the dry season when increased levels of dust generation can be expected. These areas should not be over-sprayed causing water run-off and subsequent sediment loss into waterways and drainage lines in the vicinity of the subject property.
- The local communities residing within and in the vicinity of the subject property, as well as mining and construction personnel, should be informed about fire control and prevention measures to reduce the frequency of uncontrolled veld fires in areas surrounding and within the subject property.

With Management	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
	3	3	3	3	3	6	9	54 (Medium-Low)

Probable latent impacts

- Loss of floral habitat may lead to altered floral biodiversity.
- Ineffective rehabilitation may lead to permanent loss of floral biodiversity.

6.1.3 IMPACT 3: Impact on floral species of conservational concern

Activities leading to impact

Pre-Construction	Construction	Operational	Decommissioning & Closure
Inadequate design of infrastructure leading to pollution of soils and ground water	Site clearance and removal of vegetation	An increase in alien plant species leading to loss of medicinal, protected and potential RDL floral species by outcompeting these species	Ineffective rehabilitation of exposed and impacted areas and failure to implement a comprehensive alien floral control plan
	Construction of infrastructure and access roads through wetlands, areas	Erosion and sedimentation as a result of operational activities leading	Continued erosion and sedimentation during closure and decommissioning
	Poor control of vehicular movement and management of edge effects		

Aspects of floral ecology affected

Construction	Operational	Decommissioning & Closure
Sedimentation and erosion leading to loss of important plant species	Sedimentation and erosion leading to loss of important plant species	Sedimentation and erosion leading to loss of important plant species
Alteration of floral community structure	Alteration of floral community structure due to alien invasion vegetation leading to loss of important plant species	Alteration of floral community structure due to alien invasion vegetation leading to loss of important plant species

Without Management	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
	3	2	3	1	5	5	9	45 (Low)

Essential mitigation measures:

- A sensitivity map has been developed for the subject property, indicating wetland areas which are considered to be of increased ecological importance. It is recommended that this sensitivity map be considered during all development phases to aid in the conservation of floral habitat within the subject property.

- All development footprint areas and areas affected by the proposed mine development should remain as small as possible and should not encroach onto surrounding more sensitive wetland areas and the associated buffer zones. It must be ensured that these areas are off-limits to construction vehicles and personnel.
- Sensitive floral species, if discovered, are to be handled with care and the relocation of sensitive plant species is to be overseen by a botanist.
- Should any RDL or protected plant species be encountered within the proposed development footprint areas, the following should be ensured:
    - If any threatened species, or nationally or provincially protected floral will be disturbed, ensure permit applications are required from the relevant authorities before construction activities commence.
    - All rescue and relocation plans should be overseen by a suitably qualified specialist.

With Management	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
	2	2	2	2	4	4	8	32 (Low)

6.2 Impact Assessment Conclusion

Based on the above assessment it is evident that there are three possible impacts on the floral ecology within the subject property. The table below summarises the findings indicating the significance of the impact before management takes place and the likely impact if management and mitigation takes place. In the consideration of mitigation it is assumed that a high level of mitigation takes place but which does not lead to prohibitive costs.

From the table it is evident that prior to management measures being put in place, two of the impacts are medium-high level impacts and one impact is a low level impact. If effective management takes place, all impacts could be reduced to a lower level impact.

Table 12: A summary of the results obtained from the assessment of floral ecological impacts.

Impact	Unmanaged	Managed
1: Impact on habitat for floral species	Medium-High	Medium-Low
2: Impact on floral diversity	Medium-High	Medium-Low
3: Impact on floral species of conservational concern	Low	Low

6.3 Cumulative impacts

Due to extensive mining and beneficiation of minerals occurring in Middelburg and surrounding areas, along with extensive agriculture, the regional cumulative impacts as a result of loss of natural vegetation and plant life is considered to be highly significant.

Cumulative impacts include:

- The loss of the Rand Highveld Grassland, which is considered to be an endangered vegetation type with a small fraction currently statutorily conserved.
- The spread of alien plant species within this vegetation type is considered to be significant and disturbance of natural vegetation as a result of forestry and loss of vegetation structure in the region may contribute towards lowering of the overall sensitivity of plant communities within this vegetation type.
- The cumulative impact from alien plant species proliferation in the region is considered to be high as these species replace indigenous vegetation and contribute to an overall loss of biodiversity.

Effective rehabilitation and well executed closure of the mining operation during the closure and decommissioning phase is essential in order to minimise cumulative impacts resulting from the mining activities.

7 RECOMMENDATIONS

After conclusion of this ecological assessment, it is the opinion of the ecologists that the proposed activity be considered favourably provided that the following essential mitigation measures as listed below are adhered to:

Development and footprint

- A sensitivity map has been developed for the subject property, indicating the Wetland habitat units, which are considered to be of increased ecological importance. It is recommended that this sensitivity map be considered during all development phases to aid in the conservation of floral habitat within the subject property.
- The boundaries of the development footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas.
- Edge effects of all construction and operational activities, such as erosion and alien plant species proliferation, which may affect floral habitat, need to be strictly managed.
- Planning of temporary roads and access routes should take the site sensitivity plan into consideration. Such roads should be constructed a distance from the more sensitive wetland areas and not directly adjacent thereto.
- It must be ensured that mining related waste or spillage and effluent do not affect the sensitive habitat boundaries and associated buffer zones.

Vegetation

- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the development footprint areas.
- Species specific and area specific eradication recommendations:
    - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used.
    - Footprint areas should be kept as small as possible when removing alien plant species.
    - No vehicles should be allowed to drive through designated sensitive wetland areas during the eradication of alien and weed species.

- Informal fires in the vicinity of development area should be prohibited during all development phases.
- Should any other RDL or protected plant species be encountered within the proposed development footprint areas, the following should be ensured:
    - If any threatened species, or nationally or provincially protected floral will be disturbed, ensure that permit application are obtained where necessary from the relevant authorities.
- All rescue and relocation plans should be overseen by a suitably qualified specialist.

Vehicle access

- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss.
- It must be ensured that all roads and construction areas are regularly sprayed with water in order to curb dust generation. This is particularly necessary during the dry season when increased levels of dust generation can be expected. These areas should not be over-sprayed causing water run-off and subsequent sediment loss in the vicinity of the subject property.

Soils

- It must be ensured that the mine process water system is managed in such a way as to prevent discharge to the receiving environment.
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss.
- To prevent the erosion of topsoil, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas susceptible to erosion.
- All soils compacted as a result of construction activities falling outside of development footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas. Alien and invasive

vegetation control should take place throughout all development phases to prevent loss of floral habitat in surrounding areas.

- During the construction and operational phases of the proposed mining expansion erosion berms may be installed to prevent gully formation and siltation of the wetland resources. The following points should serve to guide the placement of erosion berms:
    - Where the track has a slope of less than 2%, berms every 50m should be installed.
    - Where the track slopes between 2% and 10%, berms every 25m should be installed.
    - Where the track slopes between 10% and 15%, berms every 20m should be installed.
    - Where the track has a slope greater than 15%, berms every 10m should be installed.

Rehabilitation

- All disturbed habitat areas must be rehabilitated as soon as possible to ensure that floral ecology is re-instated.
- Reseeding with indigenous grasses should be implemented in all affected areas and strategic planting of bushveld tree species should take place to re-establish microclimates and niche habitats.

RDL and Protected floral species

- Sensitive floral species, if discovered, are to be handled with care and the relocation of sensitive plant species is to be overseen by a botanist.
- Should any RDL or protected plant species be encountered within the proposed development footprint areas, the following should be ensured:
    - If any threatened species, or nationally or provincially protected floral will be disturbed, ensure permit applications are required from the relevant authorities before construction activities commence.
    - All rescue and relocation plans should be overseen by a suitably qualified specialist.

8 REFERENCES

Bromilow, C. (2001) **Problem Plants of South Africa.** Briza Publications, Pretoria.

Henderson, L. (2001) **Alien Weeds and Invasive plants – A Complete Guide to Declared Weeds and Invaders in South Africa.** Plant Protection Research Institute, Agricultural Research Council Handbook No 12. Pretoria.

Low, A.B. and Rebelo, A.G. (eds) (1998) **Vegetation of South Africa, Lesotho and Swaziland.** Department of Environmental Affairs & Tourism, Pretoria

Raimondo, D., von Staden, L., Foden, W., Victor, J.E, Helme, NA., Turner, R.C, Kamundi, DA., Manyama, PA. (eds) (2009). **Red List of South African Plants** Strelitzia 25. South African National Biodiversity Institute, Pretoria.

SANBI (2007) The South African National Biodiversity Institute is thanked for the use of data from the National Herbarium, Pretoria (PRE) Computerised Information System (PRECIS).

Tainton, N. (Editor) (1999) **Veld Management in South Africa.** University of Natal Press, Pietermaritzburg.

Threatened Species Programme (2005) Red **Data List of South African Plant Species.** Available online: http://www.redlist.org.

Van Oudtshoorn, F. (1999) **Guide to Grasses of Southern Africa.** Briza Publications, Pretoria.

Van Wyk, B. and Malan, S. (1998) **Field Guide to the Wild Flowers of the Highveld.** Struik Publishers, Cape Town.

Van Wyk, B., van Oudtshoorn, B. and Gericke, N. (1997) **Medicinal Plants of South Africa.** Briza Publications, Pretoria.

Van Wyk, B. van Wyk, P. and van Wyk, B. (2000) **Photographic Guide to Trees of Southern Africa.** Briza Publications, Pretoria.

Appendix A

Expected floral species list for 2529DA

(Available on request)

Appendix B

Vegetation Index Score

Vegetation Index Score – Transformed grassland Habitat Unit

1. EVC=[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover:

Vegetation cover %	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Site score			X			
EVC 1 score	0	1	2	3	4	5

EVC2 - Total site disturbance score:

Disturbance score	0	Very Low	Low	Moderately	High	Very High
Site score					X	
EVC 2 score	5	4	3	2	1	0

2. SI=[(SI1+SI2+SI3+SI4)/4]

	Trees (SI1)		Shrubs (SI2)		Forbs (SI3)		Grasses (SI4)	
Score:	Present State	Perceived Reference State	Present State	Perceived Reference State	Present State	Perceived Reference State	Present State	Perceived Reference State
Continuous	X							
Clumped		X			X	X	X	X
Scattered				X				
Sparse			X					

Present State (P/S) = Currently applicable for each habitat unit

Perceived Reference State (PRS) = If in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived Reference state (PRS)	Continuous	Clumped	Scattered	Sparse
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]

Percentage vegetation cover (exotic):

	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Vegetation cover %			X			
PVC Score	0	1	2	3	4	5

Percentage vegetation cover (bare ground):

	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Vegetation cover %			X			
PVC Score	0	1	2	3	4	5

4. RIS

Extent of indigenous species recruitment	**0**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
				X		
RIS	**0**	**1**	**2**	**3**	**4**	**5**

VIS = [(EVC)+(SI x PVC)+(RIS)] = 6

The final VIS scores for each habitat unit are then categorised as follows:

Vegetation Index Score	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications.
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely

Vegetation Index Score – Wetland Habitat Unit

1. EVC=[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover:

Vegetation cover %	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Site score					X	X
EVC 1 score	0	1	2	3	4	5

EVC2 - Total site disturbance score:

Disturbance score	0	Very Low	Low	Moderately	High	Very High
Site score				X		
EVC 2 score	5	4	3	2	1	0

2. SI=[(SI1+SI2+SI3+SI4)/4]

	Trees (SI1)		Shrubs (SI2)		Forbs (SI3)		Grasses (SI4)	
Score:	Present State	Perceived Reference State	Present State	Perceived Reference State	Present State	Perceived Reference State	Present State	Perceived Reference State
Continuous	X	X						
Clumped			X	X	X	X	X	X
Scattered								
Sparse								

Present State (P/S) = Currently applicable for each habitat unit

Perceived Reference State (PRS) = If in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived Reference state (PRS)	Continuous	Clumped	Scattered	Sparse
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]

Percentage vegetation cover (exotic):

	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Vegetation cover %		X				
PVC Score	0	1	2	3	4	5

Percentage vegetation cover (bare ground):

	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Vegetation cover %		X				
PVC Score	0	1	2	3	4	5

4. RIS

Extent of indigenous species recruitment	**0**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
				X		
RIS	**0**	**1**	**2**	**3**	**4**	**5**

VIS = [(EVC)+(SI x PVC)+(RIS)] = 16

The final VIS scores for each habitat unit are then categorised as follows:

Vegetation Index Score	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications.
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely

Vegetation Index Score – Transformed Habitat Unit

1. EVC=[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover:

Vegetation cover %	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Site score				X		
EVC 1 score	0	1	2	3	4	5

EVC2 - Total site disturbance score:

Disturbance score	0	Very Low	Low	Moderately	High	Very High
Site score						X
EVC 2 score	5	4	3	2	1	0

2. SI=[(SI1+SI2+SI3+SI4)/4]

	Trees (SI1)		Shrubs (SI2)		Forbs (SI3)		Grasses (SI4)	
Score:	Present State	Perceived Reference State	Present State	Perceived Reference State	Present State	Perceived Reference State	Present State	Perceived Reference State
Continuous								X
Clumped		X		X	X			
Scattered	X		X			X	X	
Sparse								

Present State (P/S) = Currently applicable for each habitat unit

Perceived Reference State (PRS) = If in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived Reference state (PRS)	Continuous	Clumped	Scattered	Sparse
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]

Percentage vegetation cover (exotic):

	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Vegetation cover %				X		
PVC Score	0	1	2	3	4	5

Percentage vegetation cover (bare ground):

	0%	1-5%	6-25%	26-50%	51-75%	76-100%
Vegetation cover %			X			
PVC Score	0	1	2	3	4	5

4. RIS

Extent of indigenous species recruitment	**0**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
	X					
RIS	**0**	**1**	**2**	**3**	**4**	**5**

VIS = [(EVC)+(Si x PVC)+(RIS)] = 5

The final VIS scores for each habitat unit are then categorised as follows:

Vegetation Index Score	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications.
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely

FAUNAL, FLORAL, WETLAND AND AQUATIC ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED RIETVLEI COLLIERY OUTSIDE MIDDELBURG, MPUMALANGA PROVINCE

Prepared for

WSP Group

April 2014

SECTION C– Faunal Assessment

Prepared by:	**Scientific Aquatic Services**
Report author	**M Hanekom**
Report reviewer	**S. van Staden (Pr. Sci. Nat)**
Report Reference:	**SAS 213295**
Date:	**April 2014**

Scientific Aquatic Services CC
CC Reg No 2003/078943/23
Vat Reg. No. 4020235273
91 Geldenhuis Rd
Malvern East, Ext 1
2007
Tel: 011 616 7893
Fax: 086 724 3132
E-mail: admin@sasenvironmental.co.za

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

EIA	Environmental Impact Assessment
EAP	Environmental Assessment Practitioner
IUCN	International Union for Conservation of Nature
LC	Least Concern
MP SoER	Mpumalanga Province State of the Environment Report
NYBA	Not yet been assessed
POC	Probability of Occurrence
QDS	Quarter Degree Square
RDL	Red Data Listed
RDSIS	Red Data Listed Species
SAS	Scientific Aquatic Services
TSS	Total Species Score
TT	Threatened Taxa
VU	Vulnerable

1. INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a faunal, floral, wetland and aquatic assessment as part of the Environmental Assessment (EIA) and authorisation process for the proposed Rietvlei Colliery, hereafter referred to as the "subject property". The subject property is situated south-east of the R555, outside Middelburg, Mpumalanga Province (25°40'18.59"S 29°39'16.47"E). The total area of the subject property extends over approximately 747.16ha.

The subject property is surrounded by properties on which agricultural activities dominate. The ecological assessment was done with special focus on areas earmarked for mining footprint as well as areas of considered of higher ecological importance and sensitivity. The surrounding area was however considered as part of the desktop assessment of the area. The land is currently used for forestry purposes with areas of edible crop lands also located on the subject property.

The purpose of the report is to present the faunal inventories of species encountered on site, to determine and describe the habitat, communities and ecological state of the subject property. Red Data Sensitivity Index Score (RDSIS) were implemented o provide an indication of the potential red data faunal species that could reside in the area. Through this, it will allow informed decision making by the authorities, proponent and Environmental Assessment Practitioner (EAP) consultants.

1.2 Assumptions and Limitations

The following assumptions and limitations are applicable to this report section:

- Due to the nature and habits of most faunal taxa it is unlikely that all species would have been observed during a site assessment of limited duration. Therefore, site observations are compared with literature studies where necessary; and
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most faunal communities have been accurately assessed and considered.

2. FAUNAL METHOD OF ASSESSMENT

2.1 Desktop Study

Initially a desktop study was undertaken to gather background information regarding the site and its surrounding areas. All relevant authorities were consulted regarding conservational species lists, as well as all the latest available literature utilised to gain a thorough understanding of the area and its surrounding habitats. This information and further literature reviews were then used to determine the potential biodiversity lists for the proposed development site and surrounding areas. This information incorporated (amongst others) data on vegetation types, habitat suitability and biodiversity potential coupled to this information.

2.2 General site survey

Three visits were undertaken during two full days in April, October 2011 and January 2014 to determine the ecological status of the proposed development sites and the surrounding area (see Section A for site maps). A reconnaissance 'drive around' followed then by a thorough 'walk through' was undertaken to determine the general habitat types found throughout the subject property and, following this, specific study sites or habitat regions were chosen that were representative of the habitats found within the area. Special emphasis was placed on potential areas that may support Red Data Listed (RDL) species. Sites were investigated on foot to identify the occurrence of the *dominant* communities, species and habitat diversities. The presence of any faunal inhabitants of the subject property was also assessed through direct visual observation or identifying them through calls, tracks, scats and burrows, with emphasis being placed on determining if any RDL species occur within the subject property.

2.3 Fauna

Faunal habitat units were identified and faunal species were recorded during the subject property assessment. It is important to note that due to the nature and habits of fauna it is unlikely that all species will have been recorded during the site assessment. In addition the levels of anthropogenic, farming and other activities in the subject property and surrounding area may determine whether species will be observed. The faunal categories covered are; Mammals; Avifauna; Reptiles; Amphibians; Invertebrates and Araneae in the results section and includes a definition for the general faunal habitat within the subject property.

Mammals

Small mammals are unlikely to be directly observed in the field because of their nocturnal/crepuscular and cryptic nature. A simple and effective solution to this problem is to use Sherman traps. A Sherman trap is a small aluminium box with a spring-loaded door. Once the animal is inside the trap, it steps on a small plate that causes the door to snap shut, thereby capturing the individual. Trapping took place within relatively undisturbed small mammal habitat identified throughout the subject property. In the event of capturing a small mammal during the night, the animal would be photographed and then set free unharmed early the following morning. Traps were baited with a universal mixture of oats, peanut butter, and fish paste.

Larger faunal species were recorded during the assessment with the use of visual identification, spoor, call and dung. Observed mammals will be verified in Smither's (2000) Mammals of Southern Africa, A Field guide.

Figure 1: Sherman trap and bait used to capture small mammal species.

Avifauna

The complete list of bird species expected for the Quarter Degree Square (QDS) 2529DA (Roberts Multimedia Birds of Southern Africa) is included in Appendix 2a. The Southern African Bird Atlas Project 2 species list for the quarter degree square 2529DA is listed on the website (http://sabap2.adu.org.za) and was also compared with the recent field survey database of birds identified on the subject property during the April, October 2011 and January 2014 surveys. Field surveys were undertaken utilising a pair of binoculars and

birdcall identification techniques were also utilised during the assessment in order to accurately identify avifaunal species. Avifaunal species are referenced using Birds of Southern Africa (Sinclair *et al*, 2002).

Reptiles

Reptiles were physically identified during the field survey. Areas where reptiles were likely to reside, specifically wetland areas which were associated with rocky outcrop areas, were also investigated. Throughout the subject property there were limited suitable rocky out crop areas which reptile species favour. Nonetheless, the data gathered during the assessment along with the habitat analysis provided an accurate indication of which reptile species are likely to occur on the subject property. Reptiles identified will be verified in Reptile species in Southern Africa by Alexander and Marais (2008).

Amphibians

All amphibian species encountered within the subject property were recorded during the field assessment with the use of direct visual identification along with other identification aids such as call identification. Amphibian species flourish in and around wetland and riparian areas. It is in these areas that specific attention was given to searching for amphibian species. However, it is unlikely that all amphibian species will have been recorded during the site assessment, due to their cryptic nature and habits, varied stages of life cycles, seasonal and temporal fluctuations within the environment. However, the data gathered during the assessment along with a habitat analysis provided an accurate indication of which amphibian species are likely to occur on the subject property. Frog species are referenced in du Preez and Carruthers (2009).

Invertebrates

A list of visually identified and observed invertebrate species was compiled during the field surveys. However, due to their cryptic nature and habits, varied stages of life cycles, seasonal and temporal fluctuations within the environment, it is unlikely that all invertebrate species will have been recorded during the site assessment periods. Nevertheless, the data gathered during the assessment along with a habitat analysis provided an accurate indication of which invertebrate species are likely to occur on the subject property. Invertebrate species will be referenced in Picker *et al* (2004).

Spiders and Scorpions

Within the subject property there were limited suitable habitats, such as rocky outcrop areas and undisturbed natural land, where spiders and scorpions are likely to reside. The subject property comprised primarily of transformed habitat for agriculture purposes. The wetland and riparian habitat holds limited habitat for a diverse spider and scorpion score, due to high levels of disturbance. Thus there is limited suitable habitat for RDL Mygalomorphae arachnids (Trapdoor and Baboon spiders) as well as RDL scorpions within the subject property. Observed spiders and scorpions will be referenced in Leroy and Leroy (2003).

2.4 Red Data Species Assessment

Fauna and the RDSIS

Given the restrictions of field assessments to identify all the faunal species that possibly occur on a particular property, the RDSIS has been developed to provide an indication of the potential red data faunal species that could reside in the area, while simultaneously providing a quantitative measure of the subject property's' value in terms of conserving faunal diversity. The RDSIS is based on the principles that when the knowledge of the species' historical distribution is combined with a field assessment that identifies the degree to which the property supports a certain species' habitat and food requirements, inferences can be made about the chances of that particular species residing on the property. Repeating this procedure for all the potential red data faunal species of the area and collating this information then provides a sensitivity measure of the property that has been investigated. The detailed methodology to determine the RDSIS of the property is presented below:

Probability of Occurrence (POC): Known distribution range (D), habitat suitability of the site (H) and availability of food sources (F) on site were determined for each of the species. Each of these variables is expressed a percentage (where 100% is a perfect score). The average of these scores provided a Probability of Occurrence (POC) score for each species. The POC value was categorised as follows:

- **0-20% = Low;**
- **21-40% = Low to Medium;**
- **41-60% = Medium;**
- **61-80% = Medium to High and**
- **81-100% = High**

POC = (D+H+F)/3

Total Species Score (TSS): Species with POC of more than 60% (High-medium) were considered when applying the RDSIS. A weighting factor was assigned to the different to International Union for Conservation of Nature and Natural Resources (IUCN) categories providing species with a higher conservation status, a higher score. This weighting factor was then multiplied with the POC to calculate the total species score (TSS) for each species. The weighting as assigned to the various categories is as follows:

- **Data Deficient = 0.2;**
- **Rare = 0.5;**
- **Near Threatened = 0.7;**
- **Vulnerable = 1.2;**
- **Endangered = 1.7 and**
- **Critically Endangered = 2.0**.

TSS = (IUCN weighting*POC) where POC > 60%

Average Total Species (Ave TSS) and Threatened Taxa Score (Ave TT): The average of all TSS potentially occurring on the site is calculated. The average of all the Threatened taxa (TT) (*Near threatened*, *Vulnerable*, *Endangered* and *Critically Endangered)* TSS scores are also calculated. The average of these two scores (Ave TSS and Ave TT) was then calculated in order to add more weight to threatened taxa with POC higher than 60%.

Ave = Ave TSS [TSS/No of Spp] + Ave TT [TT TSS/No of Spp]/2

Red Data Sensitivity Index Score (RDSIS): The average score obtained above and the sum of the percentage of species with a POC of 60% or higher of the total number of Red Data Listed species listed for the area was then calculated. The average of these two scores, expressed as a percentage, gives the RDSIS for the area investigated.

RDSIS = Ave + [Spp with POC>60%/Total no Of Spp*100]/2

RDSIS interpretation:

Table 1: RDSIS value interpretation with regards to RDL mammal importance on the subject property.

RDSIS Score	RDL mammal importance
0-20%	**Low**
21-40%	**Low-Medium**
41-60%	**Medium**
60-80%	**High-Medium**
81-100%	**High**

3. RESULTS

The subject property comprises of transformed habitat, which includes grassland, plantation and agricultural lands, and wetland habitat which comprises of pans and sections of the Selons River (refer to maps in Section A). Transformed habitat comprises of pockets of grassland between plantations and agricultural lands. Due to plantations, agricultural land use and alien encroachment there is little diversity in faunal habitat. The transformed grassland may provide habitat for many common avifaunal and small mammal species, whilst the wetland habitat may provide suitable habitat for additional faunal species. The subject property location as well as current and prior land uses will have a marked impact on the faunal diversity found within the subject property. Refer to Section B (Floral report) for habitat description and photos. The faunal results included all faunal observations for April, October 2011 and January 2014 site visits.

3.1 Mammals

Visual and field signs of *Canis mesomelas* (Black Backed Jackal), *Cynictis penicillata* (Yellow Mongoose) and *Lepus saxatilis* (Scrub hare) were noted within the subject area. *Sylvicapra gimmia* (Common Duiker) field signs were also observed. The majority of the subject property has been significantly transformed, however, the wetland areas especially at the pans present on the subject property still provide sufficiently intact habitat for many mammals. The wetland areas are also the habitat unit where nearly all of the mammal species were encountered. Baited Sherman traps were utilised to capture small mammals which may inhabit the subject property. Traps were placed in areas where suitable small mammal habitat was observed. No small mammals were successfully trapped during the exercise. However, the presence of raptor birds (Black-Shouldered Kite) indicates that a significant small mammal population is likely to be present on the subject property.

Some other common mammal species that may occur within the subject property are the *Suricata suricatta* (Meerkat), *Cryptomys hottentotus* (Common Mole rat), *Leptailurus serval* (Serval), *Hystrix africaeaustralis* (South African Porcupine), *Crocidura mariquensis* (Swamp musk shrew) and the *Otomys angoniensis* (Angoni vlei rat) to name a few. The above mentioned mammal species are not regionally threatened species (Mpumalanga State of the Environment Report; MP SoER, 2003) and are considered Least Concern by the IUCN (2014).

A list of the recorded mammal species during the surveys is listed in the table below.

Figure 2: Spoor of the *Canis mesomelas* (Black Backed Jackal) and *Sylvicapra gimmia* (Common Duiker)

Figure 3: Pan 1 where Sherman traps were set out and most sightings occurred

Table 2: Mammal special recorded during the site survey.

Species	Common name	MP SoER 2003 RDL	IUCN 2014 RDL
Cynictis penicillata	Yellow Mongoose	LC	LC
Canis mesomelas	Black Backed Jackal	LC	LC
Lepus saxatilis	Scrub hare	LC	LC
Sylvicapra gimmia	Common Duiker	LC	LC

LC = Least Concern

In terms of conservation, no RDL or threatened mammal species were encountered during the field assessments. Furthermore, the likelihood of any threatened mammal species as listed in Appendix 1 being encountered within the subject property is considered to be low due to the transformed nature of the majority of the subject property. Thus it is unlikely that RDL or sensitive mammal species will utilise the site for habitation or foraging purposes. RDL mammal species from the MP SoER, 2003 and the IUCN RDL

are listed in Appendix 1. This list was compiled by Cohen and Camacho (2002a) for the MP SoER report (2003).

3.2 Avifauna

All bird species seen or heard during this time of the assessment were recorded. Surveys were conducted across the entire subject property and in the immediate surroundings.

Due to the subject property consisting of predominantly *Eucalyptus sp.* plantations, agricultural lands and transformed grasslands, there is very little grassland habitat and there was thus a low diversity of grassland avifaunal species recorded. The likelihood of grassland bird species flying onto the subject property to forage is however good. The list below indicates avifaunal species that were observed during the April, October 2011 and January 2014 site visits. Species encountered were concentrated near the pans and Selons River. The avifaunal species found in the subject property are common species found within the region. These avifaunal species are all categorised as species of Least Concern by the IUCN (2014). See the table below for all identified bird species observed along with their regional (MP SoER, 2003) and global (2014, IUCN) status.

Table 3: Bird species recorded during the bird survey.

Scientific Name	Common Name	MP SoER 2003 RDL	IUCN 2014 RDL
Numida meleagris	Helmeted Guineafowl	LC	LC
Streptopelia senegalensis	Laughing Dove	LC	LC
Streptopelia capicola	Cape Turtle Dove	LC	LC
Columba livia	Rock Dove	LC	LC
Fulica cristata	Red Knobbed Coot	LC	LC
Alopochen aegyptiaca	Egyptian Goose	LC	LC
Plectropterus gambensis	Spur-Winged Goose	LC	LC
Vanellus armatus	Blacksmith Plover	LC	LC
Lanius collaris	Common Fiscal Shrike	LC	LC
Elanus caeruleus	Black Shouldered Kite	LC	LC
Anhinga rufa	African Darter	LC	LC
Euplectes progne	Long tailed Widowbird	LC	LC
Cisticola juncidis	Zitting cisticola	LC	LC
Bubulcus ibis	Cattle Egret	LC	LC
Bostrychia hagedash	Hadeda ibis	LC	LC
Phalacrocorax africanus	Reed Cormorant	LC	LC
Ardea cinerea	Grey Heron	LC	LC
Ardea purpurea	Purple Heron	LC	LC
Egretta intermedia	Yellow-Billed Egret	LC	LC
Plegadis falcinellus	Glossy Ibis	LC	LC
Anas undulata	Yellow-Billed Duck	LC	LC

Scientific Name	Common Name	MP SoER 2003 RDL	IUCN 2014 RDL
Anas hottentota	Hottentot Teal	LC	LC
Gallinula chloropus	Common Moorhen	LC	LC
Actophilornis africanus	African Jacana	LC	LC
Amaurornis flavirostris	Black Crake	LC	LC
Ploceus velatus	Southern Masked Weaver	LC	LC

LC = Least Concern

No global or regional RDL avifaunal species as listed in the table below or in Appendix 2 were identified during the site survey. Mention must be made that faunal species, especially avifaunal species, are mobile and are capable of moving primarily in search for new foraging resources. Thus, there is a significant probability that the *Sagittarius serpentarius* (Secretarybird), *Circus ranivorus* (African Marsh Harrier), *Falco peregrinus minor* (Peregrine Falcon), *Tyto capensis* (African Grass Owl) and the *Geronticus calvus* (Bald Ibis) may be present within the subject property specifically for foraging purposes specifically near the wetland habitat units. No sightings of these above mentioned RDL bird species were recorded during the site survey.

Table 4: RDL avifaunal species with a POC of more than 60%

Scientific Name	Common Name	MP SoER 2003 RDL	IUCN 2014 RDL	POC
Tyto capensis	African Grass Owl	VU	LC	66
Falco peregrinus minor	Peregrine Falcon	VU	NYBA	64
Geronticus calvus	Southern Bald Ibis	VU	VU	62
Circus ranivorus	African Marsh Harrier	VU	LC	66
Sagittarius serpentarius	Secretary bird	-	VU	68

VU = Vulnerable, LC = Least Concern

The impact of associated mining activates on possible RDL threatened avifaunal species should be minimal provided the mining activities and associated infrastructure are not allowed to encroach on the sensitive wetland habitat areas (refer to sensitivity maps in the Floral report). All sensitive buffer zones should also be kept strictly off limits to mining personnel, to limit the increase in anthropogenic activities and thus lower impacts from a conservation point of view.

3.3 Reptiles

No suitable rocky ridge outcrops were identified within the subject property. Only one reptile species was identified during the assessment and this was near the Selons River namely, *Lycodonomorphus rufulus* (Common Brown Water Snake). It is anticipated that commonly occurring reptile species might inhabit the wetland areas on the subject property. However, reptiles are notoriously difficult to detect, are well camouflaged, may occur subterranean and have good senses to hide from predators, thus making identification of reptiles difficult. The above mentioned reptile specie is not a RDL threatened species (Appendix 3, MP SoER, 2003) and is classified as Least Concerned by the IUCN (2014).

The table below presents the reptile species encountered during the assessment.

Table 5: Reptile species recorded during the survey.

Species	Common name	MP SoER 2003 RDL	IUCN 2014 RDL
Lycodonomorphus rufulus	Common Brown Water Snake	LC	LC

LC = Least Concern

No reptile RDL species were encountered and none are expected to occur due to the levels of habitat transformation and the limited suitable reptile habitat available. The proposed mining development will thus not pose a significant threat to RDL reptile species conservation provided that the sensitive zones in the sensitivity map and mitigation activities are adhered to (refer to Section A for sensitivity maps).

3.4 Amphibians

One amphibian species was noted during the field assessment, namely the *Xenopus laevis* (Common platanna).This low diversity was potentially due to the largely nocturnal habits of amphibians and the limited habitat units available to support amphibians within the subject property. Amphibian species will favour the wetland habitat areas within the subject property.

Common species which may occur in the surrounding region include the *Ptychadena anchietae* (Plain Grass Frog), *Afrana angolensis* (Common River frog), *Cacosternum boettgeri* (Common Caco), *Kassina senegalensis* (Bubbling kassina), *Amietophrynus gutturalis* (Guttural toad), *Tomopterna natalensis* (Natal sand frog) and the *Ptychadena mossambica* (Striped grass frog) all of which are considered not threatened (MP SoER, 2003 and the IUCN, 2014).

Table 6: Amphibian species identified during the assessment of the subject property

Scientific names	Common name	MP SoER 2003 RDL	IUCN 2014 RDL
Xenopus laevis	Common platanna	LC	LC

LC = Least Concern

RDL amphibian species are listed in Appendix 4. The only amphibian species listed as being of conservational concern in relation to the subject property is the *Pyxicephalus adspersus* (Giant Bullfrog) (MP SoER, 2003). *P. adspersus* breed in shallow waters and can occupy temporary floodplains and rapidly drying pool areas and are also known to travel vast distances and may utilise wetlands as migratory corridors in favourable conditions. *P. adspersus* species RDSIS scores high for distribution and food potential but low for breeding habitat since the lack of extensive areas with shallow seasonal pans / wetlands will limit the ability for this species to successfully breed on the site. *P. adspersus* thus scores 63% POC on the subject property.

Table 7: RDL amphibian species with a POC of more than 60%

Amphibian species	Common name	MP SoER 2003 RDL	IUCN 2014 RDL	POC
Pyxicephalus adspersus	Giant African bullfrog	VU	LC	63

VU = Vulnerable, LC = Least Concern

Never the less, the proposed development is likely to pose a low threat to amphibian species provided that the sensitivity map (refer to section A) is adhered to as amphibian species will most likely to be restricted to the wetland habitat areas which are situated within wetland sensitive areas throughout the subject property (refer to section A, sensitivity maps).

3.5 Invertebrates

The invertebrate assessment conducted was a general assessment with the purpose of identifying common species and taxa in the subject property. As such, the invertebrate assessment will not be an indication of the complete invertebrate diversity potential of the proposed development site and surrounding area. No evidence was encountered of the Mygalomorphae arachnids (Trapdoor and Baboon spiders) in the subject property, although it should be noted that these species are notoriously difficult to detect. A representation of commonly encountered families in the Insecta class that were observed during the assessment is listed in the table below.

Table 8: General results from invertebrate collecting during the assessment of the subject property

Insects	Comments
Order: Lepidoptera (Butterflies & Moths) Family: Nymphalidae Subfamily: Danainae *Danaus chrysippus aegyptius* (African monarch)	Visual observations: These are all commonly occurring species typical of the locality and habitat.
Order: Orthoptera (Grasshoppers, Crickets & Locusts) Family: Acrididae Family: Gryllidae	Visual observations and sweep netting.
Order: Hymenoptera & Isoptera (Ants, Bees, Termites & Wasps) Family: Apidae *Apis mellifera scutellata (African honey bee)* Family: Formicidae Family: Termitidae Family: Vespidae	Visual observations.
Order: Hemiptera (Bugs) Family: Buprestidae	Visual observations showed this taxon to be commonly represented throughout the subject property.

Metisella meninx or commonly known as the Marsh Sylph (Butterfly) is an invertebrate noted as vulnerable by MP SoER 2003. The subject property falls within the distribution range noted for *M. Meninx*. No *M. meninx* was identified during the assessment but its preferred habitat comprises of wetlands where *Leersia hexandra* (marsh grass) is dominant. No *L. hexandra* grass was observed during the survey and the presence of *M meninx* will thus have a low possibility of occurrence within the subject property.

The proposed development will not pose a threat to invertebrate conservation in the region and no other RDL invertebrate species are likely to occur within the range of influence of the proposed project. However, by conserving the wetland areas and implementing a suitable buffer zone (see Section A), the habitat for several invertebrate species will be conserved.

3.6 Spider and scorpions

Trapdoor and Baboon spiders are listed as threatened throughout South Africa (Dippenaar-Schoeman, 2002). All baboon spider species from the genus; *Ceratgyrus, Harpactira* and *Pterinochilus* are protected under NEMBA status for South Africa. All scorpion species from the genus; *Hadogenes, Opisthacanthus* and *Opistophthalmus* are also protected under NEMBA status for South Africa.

There is no threatened spider or scorpion species lists of conservational interest provided by the Mpumalanga Province (MP SoER, 2003). Therefore, a record of threatened spiders and scorpions was acquired from the most resent RDL spider and scorpion data available for South Africa using the SANBI threatened species database (http://www.speciesstatus.sanbi.org).

No RDL spiders or RDL scorpions were encountered within the subject property, although it should be noted that these species are notoriously difficult to detect. Within the subject property specific attention was paid with the identification of suitable habitat for spiders and scorpions. Specific attention was paid to near the rocky outcrop habitat area in the east of the subject property.

The only spider species found was *Adriana* sp (tube web spider) which was found within the wetland/pan habitat area. This species is considered common and not threatened.

Thus the proposed development will not pose a threat to spider and scorpion conservation in the subject property, provided that the sensitive habitat areas are conserved (refer to sensitivity map in Section A).

4. FAUNAL RED DATA SPECIES ASSESSMENT

Regional Mpumalanga RDL species taken into consideration for calculation of the RDSIS are indicated in the Appendix section for all taxa as indicated throughout the report. Six (6) RDL threatened species found to have a 60% or greater probability of being associated with the subject property are presented in the table below. These species RDSIS score high due to distribution and foraging criteria and low for favourable habitat. These species are likely to occur during foraging times.

Table 9: Threatened faunal species with a 60% or greater Probability of Occurrence (POC) on the subject property

Scientific Name	Common Name	MP SoER 2003 RDL	IUCN 2014 RDL	POC
Tyto capensis	African Grass Owl	VU	LC	66
Falco peregrinus minor	Peregrine Falcon	VU	NYBA	64
Geronticus calvus	Southern Bald Ibis	VU	VU	62
Circus ranivorus	African Marsh Harrier	VU	LC	66
Sagittarius serpentarius	Secretary bird	-	VU	68
Pyxicephalus adspersus	Giant African bullfrog	VU	LC	63

VU = Vulnerable, LC = Least Concern

The species presented in the table above were then used to calculate the RDSIS for the site, the results of which are presented in the following table.

Table 10: Red Data Sensitivity Index Score calculated for the subject property.

Red Data Sensitivity Index Score	
Average Total Species Score	**66**
Average Threatened Taxa Score	**78**
Average (Ave TSS + Ave TT/2)	**72**
% Species greater than 60% POC	**9%**
RDSIS of Site	**40%**

The RDSIS assessment of the property provided a moderate score of 40%, indicating a moderate importance in terms of RDL faunal species conservation within the subject property. In terms of the proposed development project, should the wetlands and associated buffer zones be preserved, habitat requirements for the above RDL species will be maintained to a large degree and will significantly limit the impact of the proposed mining development on the faunal assemblages.

The proposed activities are thus deemed not to pose a threat to faunal conservation in the region and no RDL faunal species are likely to occur within the range of influence of the proposed activities with the exception of possible RDL bird species mentioned above.