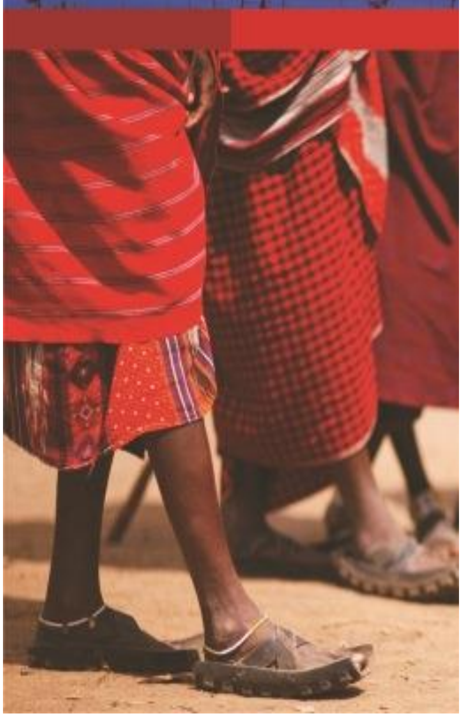

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ENVIRONMENTAL

Environmental Authorisation for the Proposed Weltevreden Mine

Surface Water

Project Number:

NOR1982

Prepared for:

Northern Coal

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EXECUTIVE SUMMARY

Northern Coal (Pty) Ltd (hereafter Northern Coal) submitted a Mining Right Application (MRA) to mine coal on portions 15 and 16 of the farm Weltevreden 381 JT within the Belfast area of the Mpumalanga Province.

Minimal mine infrastructure will be developed for the Weltevreden Project. A small scale portable crusher plant will be established on site. Electricity will be obtained from the current power supply crossing the farm with permission from Eskom. This power line will also be moved before mining operations commence and Northern Coal will construct an 11kV power line to the operation. Other infrastructure includes a portable temporary office and toilets and portable water storage tanks for domestic use.

A 46m³ above ground storage facility for hydrocarbons will be placed within a bunded area. A haul road will be constructed from the R33 to the mining area and will have a width of 8m and will be approximately 2km long. The R33 will be widened to construct a road crossing from the haul road into the R33. Temporary change houses will be placed on site. A diesel workshop will be constructed for maintenance of mine machinery. An explosive magazine will be placed on site. Water diversion berms will be built for dirty water/clean water separation. Areas will be cleared and concreted for waste management purposes (none of the waste activities are anticipated to require a waste a management license in terms of Section 21(b) of the National Environmental Management: Waste Act, Act No. 59 of 2008). There will be a topsoil stockpile for rehabilitation purposes and an overburden stockpile for the final void.

The proposed mining activity has the potential to negatively impact the surrounding surface water resources and could potentially affect the downstream water users. Northern Coal has appointed Digby Wells Environmental (hereafter Digby Wells) as an independent Environmental Assessment Practitioner (EAP) to undertake the surface water studies in support of the environmental authorisation for certain listed activities associated with the mining project.

Identified potential impacts

Construction Phase

During the construction phase the activities undertaken will impact on the surface water resources in the area in terms of their threshold limits, scale and duration.

- **Excavation**

Initial removal of topsoil will change the surface water flow patterns and might cause siltation of the surrounding surface water bodies. The impact will be of medium to low threshold, local, and medium to short term in a case of flow changes and of medium to high impact in the case of siltation of the surface water bodies.

- **Haul Road Construction**

The construction of haul roads may lead to soil erosion which may result in siltation of the surrounding surface water bodies. Haul roads need to be compacted to prevent soil erosion.

- **Construction of Offices, Workshops and Change Houses**

Construction of these infrastructures might disrupt the surface water flow patterns and that might lead to erosion due to the increased runoff velocity. This might have a site specific, moderate and short to medium siltation impact on water resources.

- **Construction Pollution Control Dam and Water Diversion Berms**

The design and construction of pollution control dams and other water management facilities poses a threat to the surface water quality in the area. If poorly designed, leakages of contaminated water might end up reporting to the surrounding water bodies. This impact is therefore rated as a localized to regional impact (should dirty water control not be well managed) that could cause significant pollution of the nearby streams.

However, a positive impact can be realized when the design, construction, operation and maintenance of pollution control dams is well executed and in line with GN 704 requirements for capacity. The dirty water use on site should be managed (re-use/recycle of even treatment) to prevent the existence of excess dirty water that could pose a negative risk to the environment.

Monitoring and implementation of mitigation measures must also be well managed.

Operational Phase

The following could be impacts on the surface water in the area in terms of their threshold limits, scale and duration.

- **Blasting**

The impact from blasting relates the release of nitrates from the explosives used. If there is no storm water management measures in place, storm water runoff from the mine may contaminate the water with nitrates.

- **Stockpiling of Soils and Overburden**

The likely impacts from stockpiles relates to soil erosion that could cause siltation of water resources and potential AMD formation from prolonged exposure of overburden to water and air. The impact associated with stockpiling of soils and overburden is therefore rated as a site specific, medium to high significance with a medium to long term duration.

- **Transportation of Coal**

Related impacts include the siltation of the water bodies from the dust created by the trucks and these impacts, although site specific could have medium significance with a duration rating from medium to long term.

Transportation of coal from the mine by the trucks using the haul roads might have impacts on the surrounding streams. Spillages of oil and diesel from the trucks may cause water pollution if storm water runoff reports to the streams. Haul roads need to be well compacted to avoid siltation from the eroded soils. This is rated as site specific, with a medium significance that has a medium to long term duration.

- **Hazardous Waste Storage and Removal**

If hazardous waste is not stored in an isolated hard bunded park area, there might be negative impacts on water bodies should any runoff from these areas reach the receiving environment. Leakages and spillages of the hazardous waste might be carried along with the storm water runoff and end up in the nearby streams. This impact might be severe, localized and of a medium to long term duration.

Decommissioning Phase

- **Surface Water Quantity**

A positive impact is expected if the rehabilitation plan is properly implemented. Water that has not been able to report to the nearby streams will be able to find their way to the rivers or dams. Surface water flow and drainage pattern will be restored.

- **Surface Water Quality**

The most significant impact will be mobilization of contaminants (include hazardous and hydrocarbon containing material) from the surface environment and these could find their way to the surface water resources.

Another possible impact may result if the water trapped in the pit and voids rise and decant onto the surface water bodies. This could result in contamination the surrounding water bodies.

Conclusions and Recommendations

Coal mining has the potential to impact on the river systems when the metals found in coal dissolves and introduced into the streams. The extent and nature of impacts can range from minimal to significant depending on a range of factors associated with ongoing mining processes as well as post mining management of the affected environment.

Therefore, certain recommendations for the proposed Weltevreden Mine have been made as mitigation measures on the identified impacts.

Proposed mitigation measures

The mining activities will have medium-low impacts on the receiving surface water environment. However, in the event of an impact occurring the following should be undertaken to prevent/minimise the stated impacts or to ultimately reverse the identified impacts:

- No mining activities should take place within the delineated 100 m buffer zone, as well as the determined floodlines;
- In the event of a major spill, for example hydrocarbon spill, all operations at that specific site should be stopped and the spill be cleaned immediately;

- Ensure that spillage control kits to contain the mobilization of the contaminants from point of spillage are available on-site throughout all activities;
- Dirty water catchments within the mine should be designated with the aim of minimizing the loss of contaminated water and ensure that all the water has been captured and stored in the pollution control dams for re-use. This can be achieved by digging trenches to divert dirty water to designated areas while allowing the free flow of clean runoff into the receiving environment;
- The overburden, fuel bays, workshops, plants and hazardous substances storage areas must be placed on hard park and be bunded. This is to prevent any runoff exposed to these areas from reaching the receiving environment and minimising the associated pollution that could result from such exposure;
- Dust suppression measures should be undertaken to prevent soil erosion which may result into siltation of the surrounding water bodies;
- The topsoil stockpiles should be vegetated to prevent dust and subsequent siltation of the water bodies;
- There must be silt and oil traps at the exit points of the hard park areas to separate any oil/diesel and silt that could negatively impact from the general dirty water system;
- The dirty water must be contained in specially designed pollution control facilities isolated from the clean catchment and general receiving environment;
- This water including any runoff that enters the pit area should be re-used on the site to prevent unnecessary wastage of water and the need for large dams that will increase the footprint of the mining operation;
- Should the contained water be more than the water use requirement, the BPGs advices that the water be recycled or as the last resort be treated to acceptable levels and discharged either to the natural environment or be supplied to other industries as a lower grade water;
- Water should be encouraged to flow off the rehabilitated surface and without causing erosion;
- During the decommissioning phase, undertake surface inspection to detect any pro-longed leaks on the surface environment;
- Where rehabilitation (grass seeding of topsoil cover) is not effective, the associated soil erosion should be mitigated by installing silt traps at areas where the surface runoff enters the surface water resources; and
- Monitoring should continue to ensure the rehabilitated mine site is not polluting the water sources.

A storm water management plan has to be developed and regularly updated in order to ensure its effectiveness during the different phases of mining. The monitoring of the water resources around the project area is of paramount importance in order to enable the implementation of mitigation measures where necessary. The abstraction of raw water from any water resources or from the water service providers must be kept to a minimum to prevent placing a burden on the catchment and surrounding water resources.

Surface water monitoring programmes

Surface water monitoring programme has to be put in place for the assessment and management of impacts on the water. This should be done with an objective of monitoring all possible impacts (pollution) emanating from the mine operations through continuous analysis of the water quality.

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1 Introduction

Northern Coal (Pty) Ltd (hereafter Northern Coal) submitted a Mining Right Application (MRA) to mine coal on portions 15 and 16 of the farm Weltevreden 381 JT within the Belfast area of the Mpumalanga Province. The MRA was then approved by the Department of Minerals (DM) on the 4th of December 2013. Through the results of feasibility studies, together with the demand for coal within the internal and international markets, Northern Coal has found it economically viable to undertake mining operations on the above mentioned portions.

Digby Wells Environmental (hereafter Digby Wells) has been appointed by Northern Coal as an independent Environmental Assessment Practitioner (EAP) to undertake the surface water studies in support of the environmental authorisation for certain listed activities associated with the mining project.

2 Project Location and Description

The Northern Coal Weltevreden Project is located within the Witbank Coalfield, approximately 10 kilometres (km) south of Belfast in the Mpumalanga Province. The precise location of the project area can be seen on Plan 1 – Regional map (Appendix A). The project area falls within the Emakhazeni (Highlands) Local Municipality and the Nkangala District Municipality. Portions 15 and 16 of the farm Weltevreden is accessible from the R33 towards Belfast which links to the N4.

Minimal mine infrastructure will be developed for the Weltevreden Project. A small scale portable crusher plant will be established on site. Electricity will be obtained from the current power supply crossing the farm with permission from Eskom. The site infrastructure will also include:

- Portable temporary offices and toilets and portable water storage tanks for domestic use.
- Temporary change houses will be placed on site.
- A diesel workshop for maintenance of mine machinery.
- A 46 m³ above ground storage facility for hydrocarbons which will be placed within a bunded area.
- A haul road will be constructed from the R33 to the mining area and will have a width of 8 m and will be approximately 2 km long. The R33 will be widened to construct a road crossing from the haul road into the R33.
- An explosive magazine.
- Water diversion berms will be built for dirty water/clean water separation.
- Areas will be cleared and concreted for waste management purposes (none of the waste activities are anticipated to require a waste a management license in terms of

Section 21(b) of the National Environmental Management: Waste Act, Act No. 59 of 2008).

- There will be a topsoil stockpile for rehabilitation purposes and an overburden stockpile for the final void.

3 Description of Affected Environment

3.1 Surface Water Quantity

3.1.1 Catchment boundaries

The site is located in the Inkomati Water Management Area (WMA 05), inside the boundaries of quaternary catchment X11D which falls in the primary catchment X. There is a defined major ridge that can be seen on Plan 2 (Appendix A) which forms part of the primary catchment area boundary (watershed) of the greater Komati River. The proposed site is approximately 2.5 km from this watershed and occurs near the fringe of the catchment area at an elevation of 1886 meters above mean sea level (m.a.m.s.l) which is also at the source of the streams that run through the area (Plan 3 - sub-catchment boundaries, Appendix A).

This locality is important in terms of surface water risks and impacts, with specific regard to pollution as any polluted surface water on the site has the potential to pollute the downstream Komati River. On site the altitude varies between 1880 m.a.m.s.l. at the highest point and 1795 m.a.m.s.l. at the lowest point; a difference in height of 85 m. This information can be further translated into a percentage of average catchment gradients on the site of 4%. Since the sub catchments comprise of very small surface areas, this gradient will in turn also contribute to large quantities of water flow along the streams.

The farm Weltevreden is located on a watershed area draining in a southerly direction away from the town of Belfast. The intermittent stream that falls in the project area, as well as the intermittent streams in the surrounding area, drains into a main tributary of the Komati River which later drains into the Nooitgedacht Dam.

3.1.2 Catchment characterization

The catchment area is characterised as a rural setting which includes a few small farm dams with no urban surroundings contained within the entire catchment area. The land cover is characterised by cultivated fields or grasslands with the contained veld in a fairly good condition; causative to a moderate storm flow potential.

3.1.3 Catchment delineation

All surface water on the proposed site drains into a farm dam located south-east of the site. The water quantity and quality of this resource could be affected by the proposed mining activity. Sub-catchments were delineated according to the effect that the mine could have on streams feeding this water resource. The total catchment area that feeds this specific dam is 18 km^2 (Plan 3, Appendix A). Two sub-catchments feeding into the dam and a third sub-catchment situated to the south-west of the proposed mining site were delineated. The third sub-catchment (it does not fall within the site boundaries) was included in the delineation as the affected catchment also falls within the site boundary. Thus mining on the proposed site could have an impact on sub-catchment three and the stream that it feeds. Table 1 represents a summary of the sub-catchments and their associated areas. The sub-catchments were delineated using ArcView 9.3.

Table 1: Sub-catchments and their relative areas

Catchment	Area (ha)	Area (km^2)
1 (Total)	1790	17.90
2 (sub1)	337	3.37
3 (sub2)	333	3.33
4 (sub3)	531	5.31

3.1.4 Mean Annual Runoff

The surface water attributes of the affected catchments namely MAR, MAP and MAR were obtained from the Water Research Commission of South Africa (WRC, 2005) and are summarised below.

The Mean Annual Runoff (MAR) of quaternary catchment X11D is 88 mm, which is representative of a net MAR of 51.8 Mm^3. The Mean Annual Precipitation (MAP) of the catchment is 744 mm. These values represent a MAR: MAP ratio of 11.8% for the X11D quaternary catchment area. The Mean Annual Evaporation (MAE) is 1450mm for the specific quaternary catchment (WRC, 2005).

3.1.5 Normal Dry Weather Flow

During normal dry weather seasons, the volume of flow of the X11D quaternary catchment area is normally 31.41 Mm^3/a.

3.1.6 Flood volumes

The peak flows for the various sub-catchments delineated were assessed utilising a combination of the following Rainfall-Runoff methods (Table 2):

- Rational;
- Alternative Rational;
- Standard Design Flood (SDF); and
- Soil Conservation Services (SCS).

3.1.6.1 Rational Method

The Rational Method was developed in the mid-19th century and is one of the best known and most widely used methods for the calculation of peak flows for small catchments. The formula indicates that Q = CiA, where the product of the rainfall intensity (i) and Runoff area (A) is equal to the inflow rate for the system (iA) and C is the runoff coefficient.

3.1.6.2 Alternative Rational Method

The Alternative Rational Method is based on the Rational Method with the point precipitation being adjusted to take into account local South African conditions.

3.1.6.3 Standard Design Flood

The Standard Design Flood method (SDF) was developed by Alexander (2002) specifically to address the uncertainty in flood prediction under South African conditions. The runoff coefficient (C) is replaced by a calibrated value based on the sub division of the country into 26 regions or WMAs. The method is generally a more conservative estimate than the other methods e.g. Rational Method or Unit Hydrograph methods.

3.1.6.4 Soil Conservation Services Method

The United States' Department of Agriculture's soil based technique (SCS) for the estimation of design flood volume and peak discharge from small catchments (i.e. < 30 km²) were originally adapted for use in Southern Africa by Schulze and Arnold in 1979. Based on extensive research and extended databases an updated version of this method was developed further for Southern Africa by Schmidt, Schulze and Dent (1987). The flows or flood peaks (m^3/s) calculated for the delineated sub-catchments are summarised in Table 2 (for the 1:100 year).

Table 2: Flood Peaks - 1:100 year return period

Sub-Catchment	Rational (m^3/s)	Alternative Rational (m^3/s)	SDF (m^3/s)	SCS (m^3/s)
2 (sub1)	89.03	85.75	70.02	31.50
3 (sub2)	74.17	70.26	59.21	26.50
4 (sub3)	102.96	97.06	80.10	45.20

The results from Table 2 indicate that the solutions for all four methods i.e. Rational, Alternative Rational, Standard Design Flood and SCS methods are relatively close to one another for all the sub-catchments except for the SCS method. The reason for this is that the SCS method has an added advantage over the other three methods because it also takes into consideration soil and moisture conditions of a catchment prior to a design flood. It was however decided that the most conservative values should be considered and hence the

1:100 year flood results from the Rational Method were used for the determination of the water surface profiles and the flood lines.

There are no major streams in the project area, thus a 100 m buffer zone around the non-perennial streams, as well as the exclusion zone for mining or mine infrastructure placement were delineated using ArcView 9.3 which is a Geographic Information System (GIS) software program (Appendix A - Plan 4).

It was concluded that the two sub-catchments contribute 40% of the total surface water drainage that drains into a farm dam located south-east of the site. Mining the proposed area could ultimately have a negative impact on both water quantity and quality of the dam. Less water could potentially drain into the dam when mining commences due to abstraction and dirty water might make its way to the dam in the event of a spill.

3.2 Surface Water Quality

A site visit was conducted in June 2014 and surface water samples were taken to update the water quality baseline from the previous sampling period which was done in 2008. Samples were collected in pans and dams found within and surrounding the project area. The samples were taken to an accredited laboratory to be analysed for physical and chemical water quality parameters. The water quality results are presented in Appendix B.

The results from the sample analysis were benchmarked against the SANS 241: 2011 drinking water guidelines, as summarized in Table 3. The data include results from the previous monitoring which was done in 2008.

Table 3: Surface water quality data (October 2008 and June 2014) benchmarked against the SANS 241:2011 Drinking water standards. This represents the closest DWA water quality monitoring stations outside the sub-catchment and municipal boundary

Sample ID		Total Dissolved Solids	Nitrate NO3 as N	Chlorides as Cl	Total Alkalinity as CaCO3	Sulphate as SO4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Iron as Fe	Manganese as Mn	Conductivity at 25° C in mS/m	pH-Value at 25° C	Aluminium as Al	Free and Saline Ammonia as N	Fluoride as F	Total Hardness
	(Aesthetic quality Recommended)	<1200	<10	<300	N/S	<250	<150	<70	<200	<50	<0.3	<0.1	<170	5-9.5	<0.3	<1.5	<1	200
	(Drinking water quality Max. Allowable)	2400	11	600	N/S	500	300	100	400	100	2	0.5	370	4-5 or 9.5-10	0.5	2	1.5	300
	Exposure Duration (years)	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs
WNSW 01		40	-1.00	10.0	-1	14.2	2.1	1.2	7.5	1.78	-0.10	-0.20	6.7	5.67	-1.00	0.03	-1.00	0
WNSW 02		54	-1.00	11.0	-1	5.4	5.7	2.4	6.7	2.78	-0.10	-0.20	8.9	5.65	-1.00	0.01	-1.00	0
WNSW 03		76	-1.00	14.0	-1	17.1	5.4	1.1	10.9	3.74	-0.10	-0.20	10.1	5.85	-1.00	0.52	-1.00	0
WNSW 04		60	-1.00	11.0	-1	7.0	6.9	3.8	7.4	0.63	-0.10	-0.20	9.9	7.55	-1.00	-0.01	-1.00	0
WNSW 08		50	-0.10	12.0	-1	11.7	3.7	1.6	7.7	2.34	0.26	-0.01	7.8	6.41	0.01	0.76	-0.20	0
WN2		116	0.46	27.0	-1	21.7	9.4	5.6	11.8	8.76	0.02	-0.01	17.8	7.34	0.01	0.67	-0.20	0
SW01		83	0.29	24.9	0	8.0	7.4	5.4	11.7	7.60	0.23	0.00	15.4	7.22	0.00	0.08	-0.06	40
SW02		63	0.30	14.5	0	5.0	9.0	5.8	6.9	0.45	0.00	0.00	12.5	9.72	0.00	0.03	-0.06	46
SW03		48	0.31	12.2	0	5.7	3.1	2.9	8.8	3.26	0.00	0.00	9.6	6.76	0.00	0.07	-0.06	20
SW04		34	0.30	6.8	0	4.1	1.6	1.3	5.9	5.04	0.29	0.00	6.8	6.37	0.00	0.11	0.07	9

Samples WNSW01, WNSW02, WNSW03, WNSWO4, WNSW08 and WN2 represent the results for 2008, while samples SW01, SW02, SW03 and SW04 represent 2014 analysis results. All the water quality parameters which were analysed were found to be within the SANS drinking water quality limits. The current status of water quality did not indicate any impact or any level of contamination compared to the SANS 241: 2011 drinking water quality standards.

3.3 Water Uses

Total number of registered water users in X11D catchment (WARMS, 2013) is 68 (Table 4), with the majority of the water users registered for irrigation (48), followed by livestock watering (09), mining (09), industry (1) and a schedule 1 user (1). The annual water volumes abstracted by the 68 users, as per the WARMS database range from 10 m^3/day (1,525,389 m^3/a), with mining being the one utilizing the most.

Table 4: Summary of water uses (adapted from WARMS, 2013)

Number of registered water users						
Description	**Irrigation**	**Livestock watering**	**Industry**	**Mining**	**Schedule 1**	**Total**
Number of users	48	9	1	9	1	68
Boreholes	3	6	1	5	1	16
Dams	11	1	0	4	0	16
Rivers/streams	32	2	0	0	0	34
Spring/Eye	1	0	0	0	0	1
Wetlands	1	1	0	0	0	2

The majority of abstractions by the registered water users were from rivers and streams (34) followed by boreholes (16), dams (16), wetland (2) and a spring (1). This is depicted in Plan 6, Appendix A.

3.4 Water Authority

The Department of Water Affairs (DWA) has the overall mandate for the management of the WMA.

3.5 Legislative Requirements

Regulation 704 of the National Water Act (NWA Act 36 of 1998) further governs the restrictions to positioning infrastructure in mining projects. This states that no person in control of a mine or activity may:

- Locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline 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;
- 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;
- Place or dispose of any residue or substance which causes or is likely to cause pollution of a water resource, in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation; or
- Use any area or locate any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50 year flood-line of any watercourse or estuary.

Should any infrastructure or mining need to occur within the restricted areas, an exemption from this provision of Regulation 704 must be applied for and granted by the Minister of Water Affairs prior to the commencement of the mining activity.

The DWA has developed and adopted a clear, logical and defensible water management hierarchy as part of the best practice that should guide water use in the mining industry namely:

- Pollution prevention;
- Water re-use/ recycle;
- Water treatment; and
- Discharge.

The proposed Weltevreden Project will exclude the 100 m buffer zone. In terms of storm water management, the GN 704 regulation that governs the use of water in mining related projects will be implemented. These include the diversion of clean storm water away from the dirty areas such as opencast and related infrastructure. The management of dirty water within the dirty area will be according to the GN 704 requirements for pollution prevention where the dirty water will be channelled to an isolated pollution control facility. On site, the separation of hydrocarbon and silt contaminated water will be managed by installing oil and silt traps to prevent further contamination of the already dirty water. The operation of the pollution control facility will be in line with the GN 704 requirements for capacity where an operational level maintained must enable the facility to contain a 1:50 year 24 hr storm event, as well as to have a 0.8 m free board at operational level.

There are no river diversions envisaged for this project. However, if necessitated the NWA requirements of water use in mining projects will be followed and a WULA will be submitted to the DWA. Furthermore, all water use activities on site will be included in the WULA prior to commencement of operation.

4 Environmental Impact assessment

4.1 The Impact Assessment Methodology

The impacts of the construction, operation and rehabilitation of the proposed project on the receiving surface water resources were assessed at different stages according to the methodology indicated in Table 5.

A clearly defined rating scale is used to assess each impact in terms of severity, spatial extent and duration (which determines the consequence) and in terms of the frequency of the activity and the frequency of the related impact (which determines the likelihood of occurrence). The overall impact significance, is then determined via a significance rating matrix (Table 6) utilising the scores obtained for consequence and likelihood of occurrence, in order to assign a final impact rating. Table 7,

Table 8 and Table 9 present the final scoring of the identified potential impacts on the construction, operational and decommission phases. The distinctive water quality and quantity impacts are explained below based on the different activities on the mine.

Table 5: Impact Assessment methodology

Rating	Severity	Spatial scale	Duration	Probability

Rating	Severity	Spatial scale	Duration	Probability
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or eco system. Persistent severe damage.	International The effect will occur across international borders	Permanent: No Mitigation No mitigation measures of natural process will reduce the impact after implementation.	Certain/ Definite. The impact will occur regardless of the implementation of any preventative or corrective actions.
6	Significant impact on highly valued species, habitat or ecosystem.	National Will affect the entire country	Permanent: Mitigation Mitigation measures of natural process will reduce the impact.	Almost certain/Highly probable It is most likely that the impact will occur.
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate	Province/ Region Will affect the entire province or region	Project Life The impact will cease after the operational life span of the project.	Likely The impact may occur.
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year	Municipal Area Will affect the whole municipal area	Long term 6-15 years	Probable Has occurred here or elsewhere and could therefore occur.
3	Moderate, short-term effects but not affecting ecosystem functions. Rehabilitation requires intervention of external specialists and can be done in less than a month.	Local Local extending only as far as the development site area	Medium term 1-5 years	Unlikely Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur.

Rating	Severity	Spatial scale	Duration	Probability
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants.	Limited Limited to the site and its immediate surroundings	Short term Less than 1 year	Rare/ improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures
1	Limited damage to minimal area of low significance, (e.g. ad hoc spills within plant area). Will have no impact on the environment.	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month	Highly unlikely/None Expected never to happen.

Table 6: Significance categories

Significance										
		Consequence (severity + scale + duration)								
		1	3	5	7	9	11	15	18	21
Probability / Likelihood	1	1	3	5	7	9	11	15	18	21
	2	2	6	10	14	18	22	30	36	42
	3	3	9	15	21	27	33	45	54	63
	4	4	12	20	28	36	44	60	72	84
	5	5	15	25	35	45	55	75	90	105
	6	6	18	30	42	54	66	90	108	126
	7	7	21	35	49	63	77	105	126	147

Significance		
High	108- 147	
Medium-High	73 - 107	

Medium-Low	36 - 72	
Low	0 - 35	

4.2 Overall Water Quantity

Continuous removal of topsoil, overburden and coal from opencast areas have an impact on the quantity of water that normally reports to the nearby watercourses, this also affect the downstream aquatic life, as well as water users as they will be getting less water downstream.

4.3 Overall Water Quality

Acid Mine Drainage (AMD) and migration is likely to occur as a result of chemical reactions within disturbed material and coal from opencast areas, and also within run of mine coal stockpiles. If seepage from the opencast spoils decants on the surface, it will impact on the water quality, potentially in terms of dissolved salts and silt. Thus, the water must be contained and kept within a closed circuit in order to minimise the impact. All water used on site is considered to be polluted and must be contained and be re-used within the mine. If there is excess water that requires to be discharged, it should be treated before discharge to avoid contamination of water bodies/streams. Coal spillages from trucks and conveyor belts have the potential to negatively impact on the water quality of the surrounding areas when the runoff water dissolves the minerals found in coal. Roads and spoil heaps must be kept vegetated and stabilised to ensure the potential for erosion and siltation is minimised.

Improper management of pollution control dams could cause serious pollution of the surrounding water bodies as a result of leakages, overflow and seepage of the contaminated water. Improper handling of industrial and hazardous wastes, hydrocarbon storage facilities, could also impact on the surface water when chemicals from these wastes report into the streams or any water bodies.

5 Potential identified impacts per activities in different phases

5.1 Construction Phase

5.1.1 Excavation

Initial removal of topsoil will change the surface water flow patterns whereby the amount of water reporting to the surrounding water resources will be reduced. Excavation also exposes the soil and that might cause siltation of the surrounding surface water bodies.

5.1.2 Haul Road Construction

The construction of haul roads removes vegetation cover and poses a risk of soil erosion which may result in siltation of the surrounding surface water bodies. This may cause a low significance impact on the surface water bodies.

5.1.3 Construction of Offices, Workshops and Change Houses

Infrastructure development might disrupt the surface water flow patterns that could cause erosion due to the increased runoff velocity. This might have a site specific, moderate and short to medium siltation impact on water resources.

5.1.4 Construction of Pollution Control Dam and Water Diversion Berms

The design and construction of pollution control dams and other water management facilities poses a threat to the surface water quality in the area. Poor design and leakage of contaminated water might end up reporting to the surrounding water bodies. This impact is therefore highly rated as a localized to regional impact (should dirty water control not be well managed) that could cause significant pollution of the nearby streams.

However, a positive impact can be realized when the design, construction, operation and maintenance of pollution control dams is well executed and in line with GN 704 requirements for capacity. This could result from the prevention of dirty water from negatively impacting on the receiving environment. The dirty water use on site should be managed (re-use/recycle of even treatment) to prevent the existence of excess dirty water that could pose a negative risk to the environment.

Monitoring and implementation of mitigation measures must also be well managed.

5.2 Operational Phase

This section discusses the proposed activities during the operational phase that will have impacts on the surface water in the area in terms of their threshold limits, scale and duration.

5.2.1 Blasting

The impact from blasting relates to the release of ammonium nitrates from the explosives used. If there is no storm water management measures in place, storm water runoff from the mine may contaminate the water with nitrates.

5.2.2 Stockpiling of Soils and Overburden

The likely impacts from stockpiles relates to soil erosion that could cause siltation of water resources and potential AMD formation from prolonged exposure of overburden to water and oxygen. The impact associated with stockpiling of soils and overburden is therefore rated as a site specific, medium to high significance with a medium to long term duration.

5.2.3 Transportation of Coal

Related impacts include the siltation of the water bodies from the dust created by the trucks and these impacts, although site specific could have medium significance with a duration rating from medium to long term.

Transportation of coal from the mine by the trucks using the haul roads might have impacts on the surrounding streams, and spillages of oil and diesel from the trucks may cause water pollution if storm water runoff reports to the streams. Haul roads need to be well compacted to avoid siltation from the eroded soils. This is rated as site specific, with a medium significance that has a medium to long term duration.

5.2.4 Hazardous Waste Storage and Removal

If hazardous waste is not stored in an isolated hard bunded park area, there might be negative impacts on water bodies should any runoff from these areas reach the receiving environment. Leakages and spillages of the hazardous waste might be carried along with the storm water runoff and end up in the nearby streams.

5.3 Decommissioning Phase

5.3.1 Surface Water Quantity

A positive impact is expected if the rehabilitation plan is implemented. Water that has not been able to report to the nearby streams during operation will be able to find their way to the rivers or dams. Surface water flow and drainage pattern will be restored.

5.3.2 Surface Water Quality

The most significant impact will be the mobilization of contaminants (include hazardous and hydrocarbon containing material) from the surface environment and these could find its way to the surface water resources.

Another possible impact may result if the water trapped in the pit and voids rise and decant onto surface. This could result in contamination the surrounding water bodies.

6 Cumulative impacts

There are few streams surrounding the project area that drains into a main tributary of the Komati River which later drains into the Nooitgedacht Dam.

There are 68 registered water users abstracting water from local water resources. The annual water abstraction volumes, as per WARMS database range from 10 m^3/day (1,525,389 m^3/a). It is therefore imperative that the impacts associated with the proposed project be managed to prevent negatively affecting the dams used for abstraction.

The water quality data was benchmarked against the SANS 241:2011, drinking water standards and indicate that all water quality parameters were within the SANS water quality limits, meaning that the water currently has no contamination. Where catchment flows are affected by mining, principles of water use and demand management must be implemented.

The dirty water must be re-used/ recycled or even treated so as to not place a burden on the water demand in the area.

The area is considered to be water scarce and farmers rely heavily on seasonal rains. With coal mining being a growing industry in the area, all coal mines and associated infrastructure will require water which may pose a threat to the quantity and the quality of the natural water resources in the area. It is thus essential that effective mitigation measures are in place at all mines to reduce the impact on surface water quality and quantity in the region. Therefore, more effort needs to be undertaken to minimise any negative impacts on the nearby water bodies.

Table 7: Construction Phase

Activity, Phase and Impact		Impact rating (before mitigation)						
Impacted Environment	**Phase impact occurs (C, O, D, PC)**	**Nature of Impact (positive / Negative**	**Spatial Scale (7)**	**Duration (7)**	**Severity (7)**	**Consequence**	**Probability (7)**	**Significance (147)**
Surface Water Impacts								
Excavation	C	N	2.0	2.0	2.0	6.0	5.0	30
Haul Road Construction		N	1.0	2.0	2.0	3.0	4.0	12
Construction of Offices, workshops and Change Houses		N	2.0	2.0	1.0	5.0	4.0	20
Construction of Water Related		N	3.0	2.0	3.0	7.0	5.0	35

Activity, Phase and Impact		Impact rating (before mitigation)						
Impacted Environment	Phase impact occurs (C, O, D, PC)	Nature of Impact (positive / Negative	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance (147)
Surface Water Impacts								
Facilities								

Table 8: Operational Phase

Activity, Phase and Impact		Impact rating (before mitigation)						
Impacted Environment	**Phase impact occurs (C, O, D, PC)**	**Nature of Impact (positive / Negative**	**Spatial Scale (7)**	**Duration (7)**	**Severity (7)**	**Consequence**	**Probability (7)**	**Significance**
Surface Water Impacts								
Blasting	O	N	5.0	5.0	5.0	6.0	7.0	42
Stockpiling of Soils and Overburden		N	3.0	4.0	4.0	5.0	6.0	30
Transportation of Coal		N	3.0	2.0	3.0	8.0	4.0	32
Hazardous Waste Storage and Removal		N	3.0	2.0	3.0	8.0	3.0	24

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Table 9: Decommissioning Phase

Activity, Phase and Impact		Impact rating (before mitigation)						
Impacted Environment	Phase impact occurs (C, O, D, PC)	Nature of Impact (positive / Negative	Spatial Scale (7)	Duration (7)	Severity (7)	Consequence	Probability (7)	Significance
Surface Water Impacts								
Surface Water Quality	D	N	2.0	2.0	3.0	7.0	4.0	28
Surface Water Quantity		N	2.0	2.0	3.0	7.0	4.0	28

7 Conclusions and Recommendations

7.1 Conclusions

The extraction of coal creates a variety of impacts on the environment before, during and after the mining operations. Coal contain of pyrites which oxidises on contact with the air producing a very acidic leachate which is able to dissolve metals from the coal thereby contaminating the water. The extent and nature of impacts can range from minimal to significant depending on a range of factors associated with ongoing mining processes as well as post mining management of the affected environment. Therefore, certain recommendations for the proposed Weltevreden Mine have been made as mitigation measures on the identified impacts.

7.2 Recommendations

7.2.1 Proposed mitigation measures

The mining activities will have medium to low impacts on the receiving environment. However, in the event of an impact occurring, the following should be undertaken to prevent/minimise the stated impacts or to ultimately reverse the negative impacts:

- No mining activities should take place within the delineated 100 m buffer zone, as well as the determined floodlines;
- In the event of a major spill (for example hydrocarbon spill) all activities at that specific area should be stopped and the spill be contained and cleaned;
- Ensure that spillage control kits to contain the mobilization of the contaminants from point of spillage are available on-site throughout all areas;
- Dirty water areas within the mine should be designed with the aim of minimizing the loss of contaminated water and ensure that all the water has been captured and stored in the pollution control dams for re-use. This can be achieved by digging trenches to divert dirty water to designated areas while allowing the free flow of clean runoff into the receiving environment;
- The overburden, fuel bays, workshops, plants and hazardous substance storage areas must be placed on hard park and be bunded. This is to prevent any runoff exposed to these areas from reaching the receiving environment and minimising the associated pollution that could result from such exposure;
- Dust suppression measures should be undertaken to prevent soil erosion which may result in siltation of the surrounding water bodies;
- The topsoil stockpiles should be vegetated as soon as possible to prevent dust and siltation of the water bodies;

- There must be silt and oil traps at the exit points of the hard park areas to separate any oil/diesel and silt that could negatively impact the general dirty water system;
- The dirty water must be contained in specially designed pollution control facilities isolated from the clean water areas and general receiving environment;
- This water including any runoff that enters the pit area should be re-used on the site to prevent unnecessary wastage of water and the need for large dams that will increase the footprint of the mining operation; and
- Should the contained water be more than the water use requirement, the BPGs advices that the water be recycled or as the last resort be treated to acceptable levels and discharged either to the natural environment or be supplied to other industries as a lower grade of water;
- Water should be allowed to flow off the rehabilitated surface as surface flow without causing erosion;
- During the decommissioning phase, undertake surface inspection to detect any prolonged leaks on the surface environment;
- Where rehabilitation (grass seeding of topsoil cover) is not effective, the associated soil erosion should be mitigated by installing silt traps at areas where the surface runoff enters the surface water resources; and
- Monitoring needs to continue to ensure the rehabilitated mine site is not polluting the water sources.

A storm water management plan has to be developed and regularly updated in order to ensure its effectiveness during the different phases of mining. The monitoring of the water resources around the project area is of paramount importance in order to enable the implementation of mitigation measures where necessary. The abstraction of raw water from any water resources or from the water service providers must be kept to a minimum to prevent placing a burden on the catchment and surrounding water resources.

7.2.2 Surface water monitoring programmes

Surface water monitoring programme has to be put in place for the assessment and management of impacts on the water. This should be done with an objective of monitoring all possible impacts (pollution) emanating from the mine operations through continuous analysis of the water quality.

7.2.2.1 Monitoring Locations

Surface water monitoring will be done at strategic locations as follows:

- The surface water points sampled during this study (Plan 5, Appendix A) should continuously be monitored to establish if there are impacts from the mine.

7.2.2.2 Frequency

- Sampling will be conducted on a monthly basis during the first year to establish seasonal trends and immediate changes on the status of water quality;
- After the first year of mining, sampling should be conducted on a quarterly basis to keep track of any negative impacts on the quality of water;
- Fluctuations in water quality will assist in identifying and informing reviews of management plans and mitigation measures. Samples should be submitted to an accredited laboratory for water quality analysis. A full analysis report on the quality of the water should be submitted to mine management, as well as the authorities on a quarterly basis.

8 References

Water Research Commission (WRC), 2005. Water Resources of South Africa.

Department of Water Affairs (DWA), 2006. Best Practice Guideline series.

NWA amendment of Regulation, 1999. Government Notice of Regulation 704 for the use of water in mining.

South African Bureau of Standards (SABS). 2011. South African National Standard: 241 Drinking Water.

Appendix A: Plans

Plan 1: Regional Setting

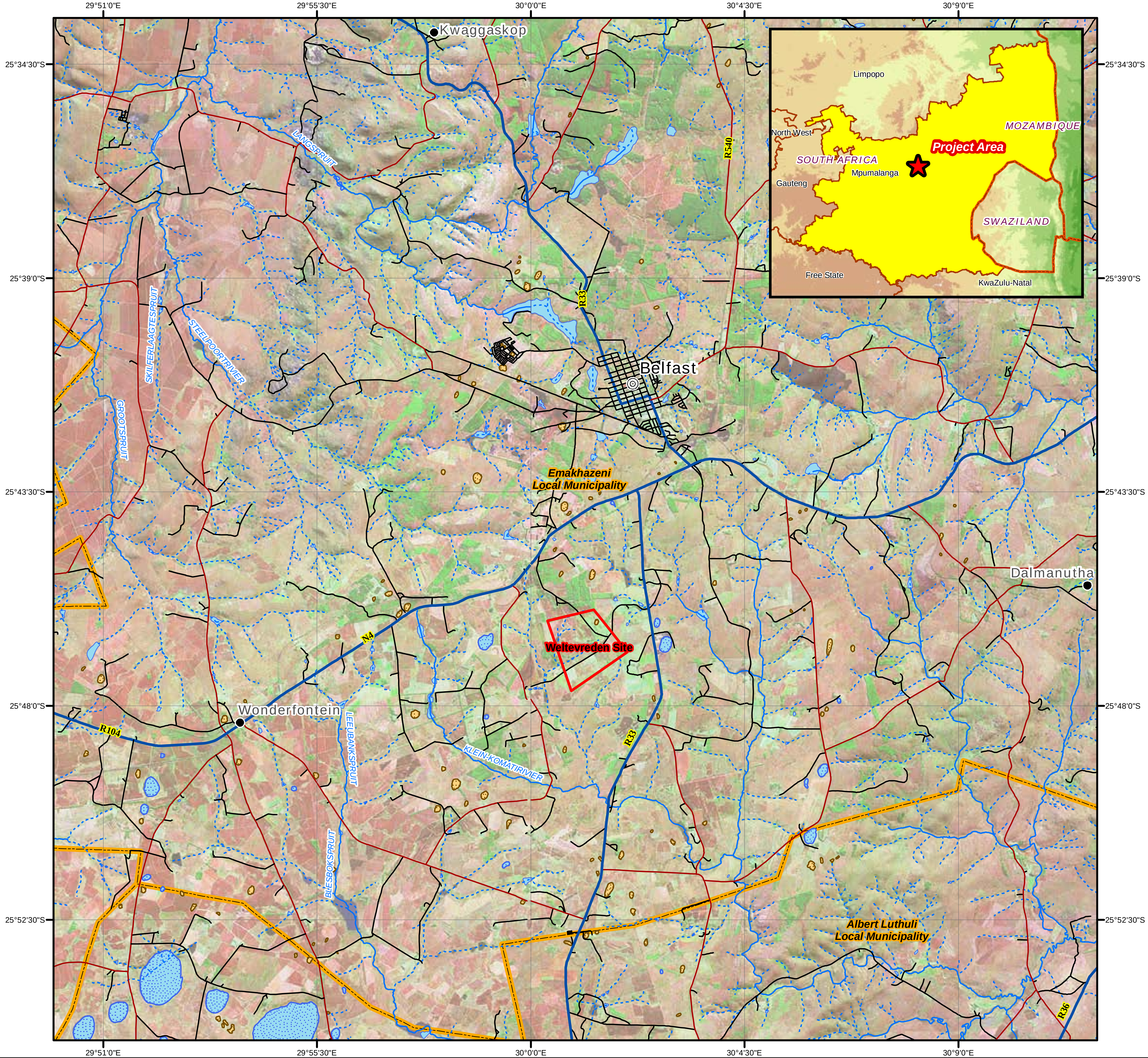
Plan 2: Quaternary Catchment

Plan 3: Sub-Catchment

Plan 4: 100m Stream Buffers

Plan 5: Surface Water Sampling Points

Plan 6: Registered Water Users



Plan 1

Northern Coal Weltevreden Project

Regional Setting

Legend

- Weltevreden Site
- Secondary Town
- Settlement
- Arterial / National Route
- Main Road
- Minor Road
- Perennial River
- Non-Perennial River
- Dam / Lake
- Perennial Pan
- Non-Perennial Pan
- Local Municipal Boundary

DIGBY WELLS ENVIRONMENTAL

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Projection: Geographic
Datum: WGS84

Ref #: idp.NOR1982.201407.139
Revision Number: 1
Date: 23/07/2014

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Kilometres
1:150 000

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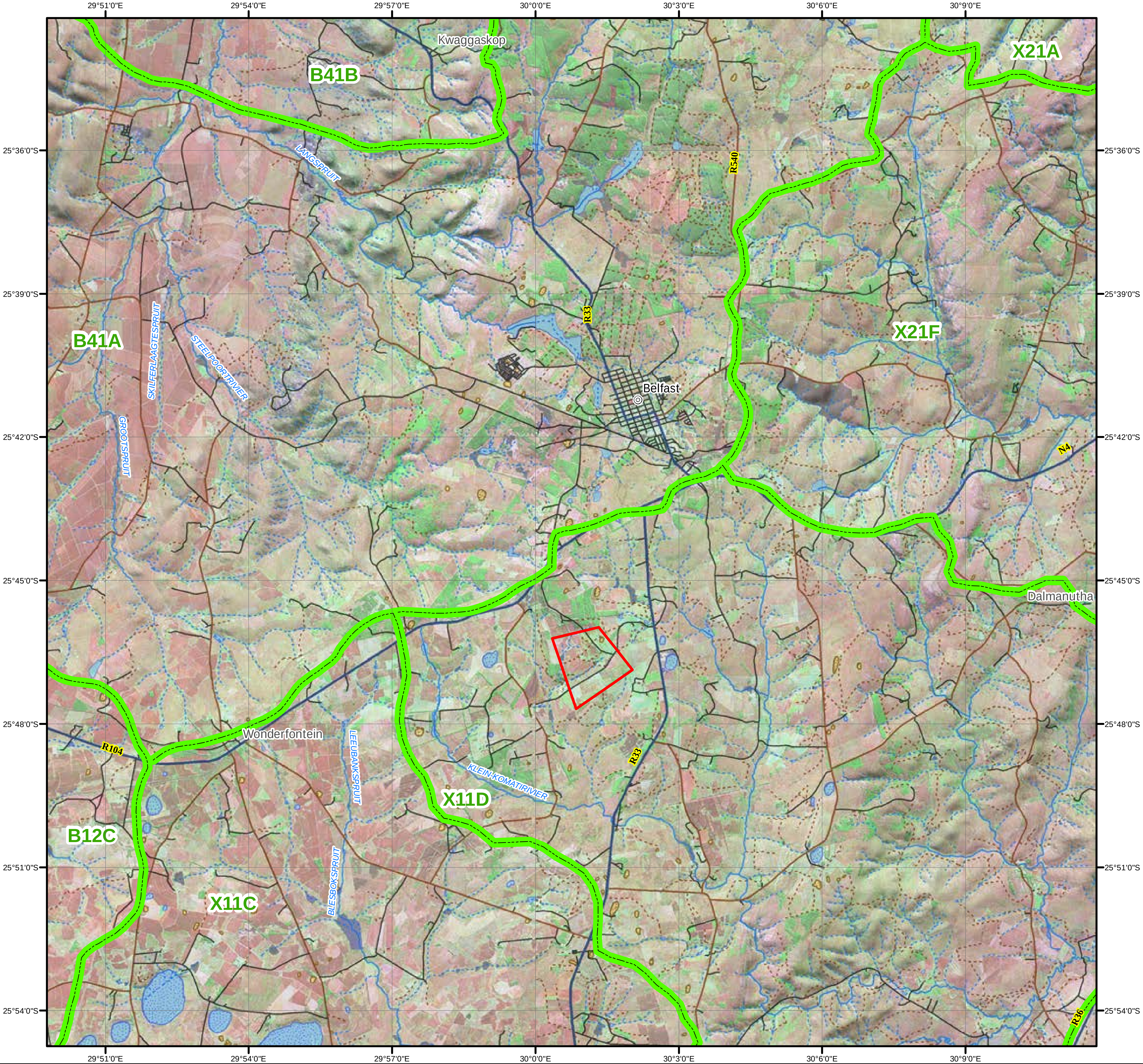

Plan 2

Northern Coal
Weltevreden Project
Quaternary Catchment

Legend

- Weltevreden Site
- Secondary Town
- Arterial / National Route
- Main Road
- Minor Road
- Tracks
- Perennial River
- Non-Perennial River
- Dam / Lake
- Perennial Pan
- Non-Perennial Pan

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Datum: WGS84

Ref #: idp.NOR1982.201407.140
Revision Number: 1
Date: 01/02/2013

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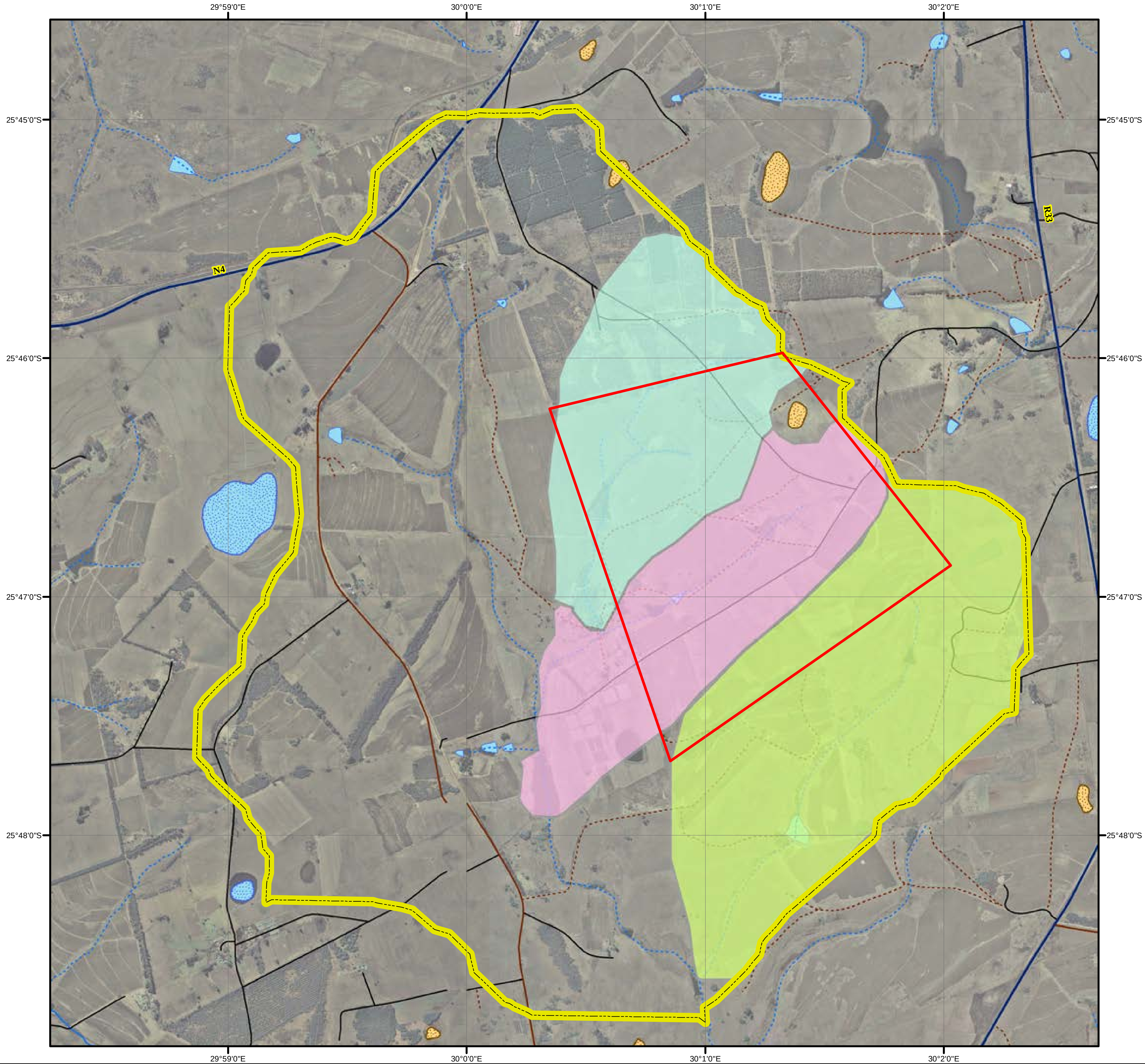

Plan 3

Northern Coal Weltevreden Project

Surface Water Sampling Locations

Legend

- Secondary Town
- Weltevreden Site
- Arterial / National Route
- Main Road
- Minor Road
- Tracks
- Perennial River
- Non-Perennial River
- Dam / Lake
- Perennial Pan
- Non-Perennial Pan
- Main Subcatchment
- Sub-catchment 1 (P3)
- Sub-catchment 2 (P4)
- Sub-catchment 3 (P5)

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Projection: Transverse Mercator	Ref #: idp.NOR1982.201407.141
Datum: WGS84	Revision Number: 1
Central Meridian: 31°E	Date: 23/07/2014

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Kilometres
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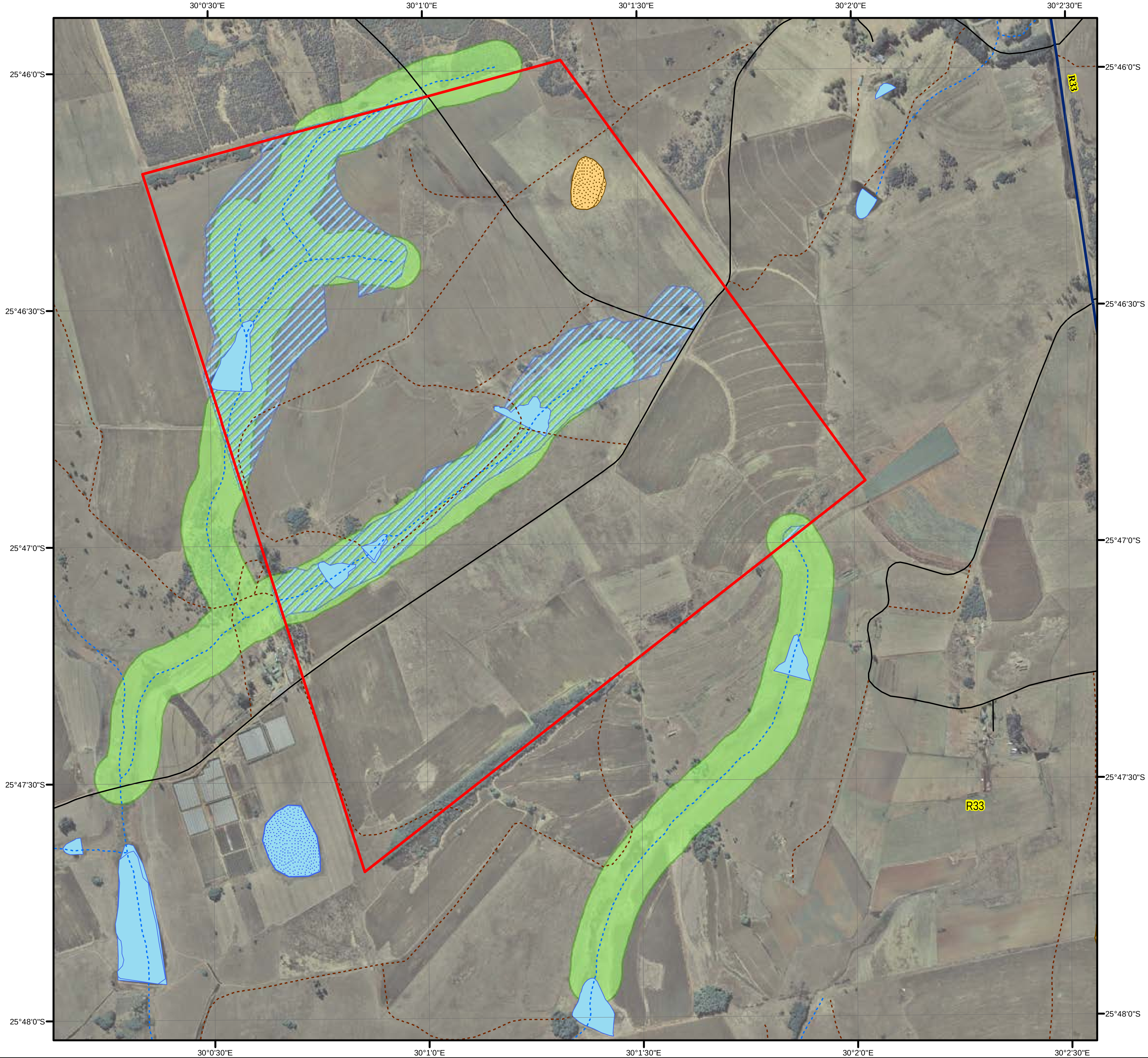

Plan 4

Northern Coal Weltevreden NEMA Floodlines

Legend

- Weltevreden Site
- Arterial / National Route
- Main Road
- Minor Road
- Tracks
- Non-Perennial River
- Dam / Lake
- Perennial Pan
- Non-Perennial Pan
- Approximate Floodplain
- 100m Buffer around Streams

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Projection: Transverse Mercator	Ref #: idp.NOR1982.201407.142
Datum: WGS84	Revision Number: 2
Central Meridian: 31°E	Date: 23/07/2014

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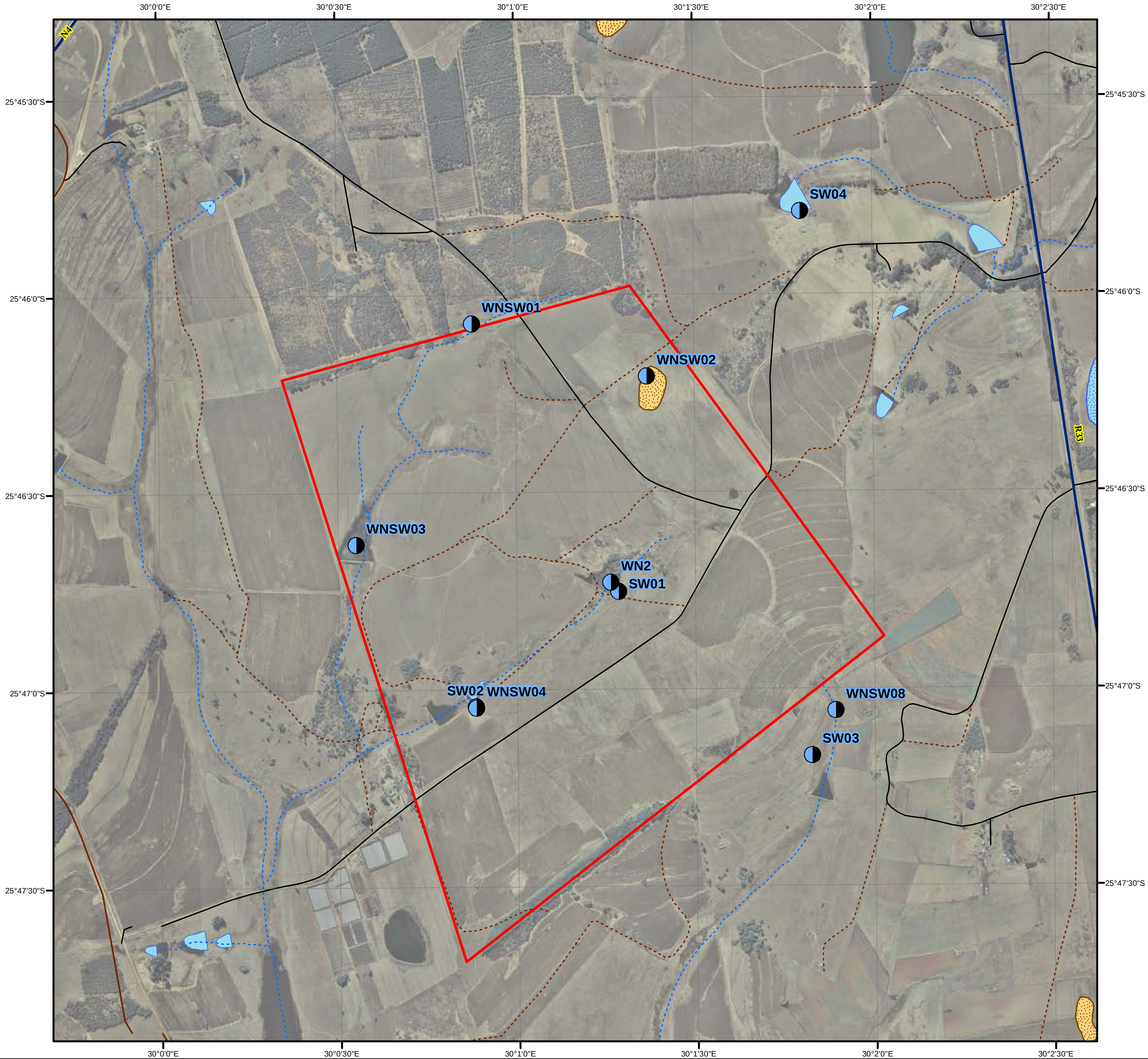
Metres

1:15 000

Plan 5

Northern Coal Weltevreden Project

Surface Water Sampling Locations



Legend

- Weltevreden Site
- Surface Water Sampling Points
- Secondary Town
- Arterial / National Route
- Main Road
- Minor Road
- Tracks
- Perennial River
- Non-Perennial River
- Dam / Lake
- Perennial Pan
- Non-Perennial Pan

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Projection: Transverse Mercator
Datum: WGS84
Central Meridian: 31°E

Ref #:idp.NOR1982.201407.144
Revision Number: 1
Date: 23/07/2014

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Kilometres
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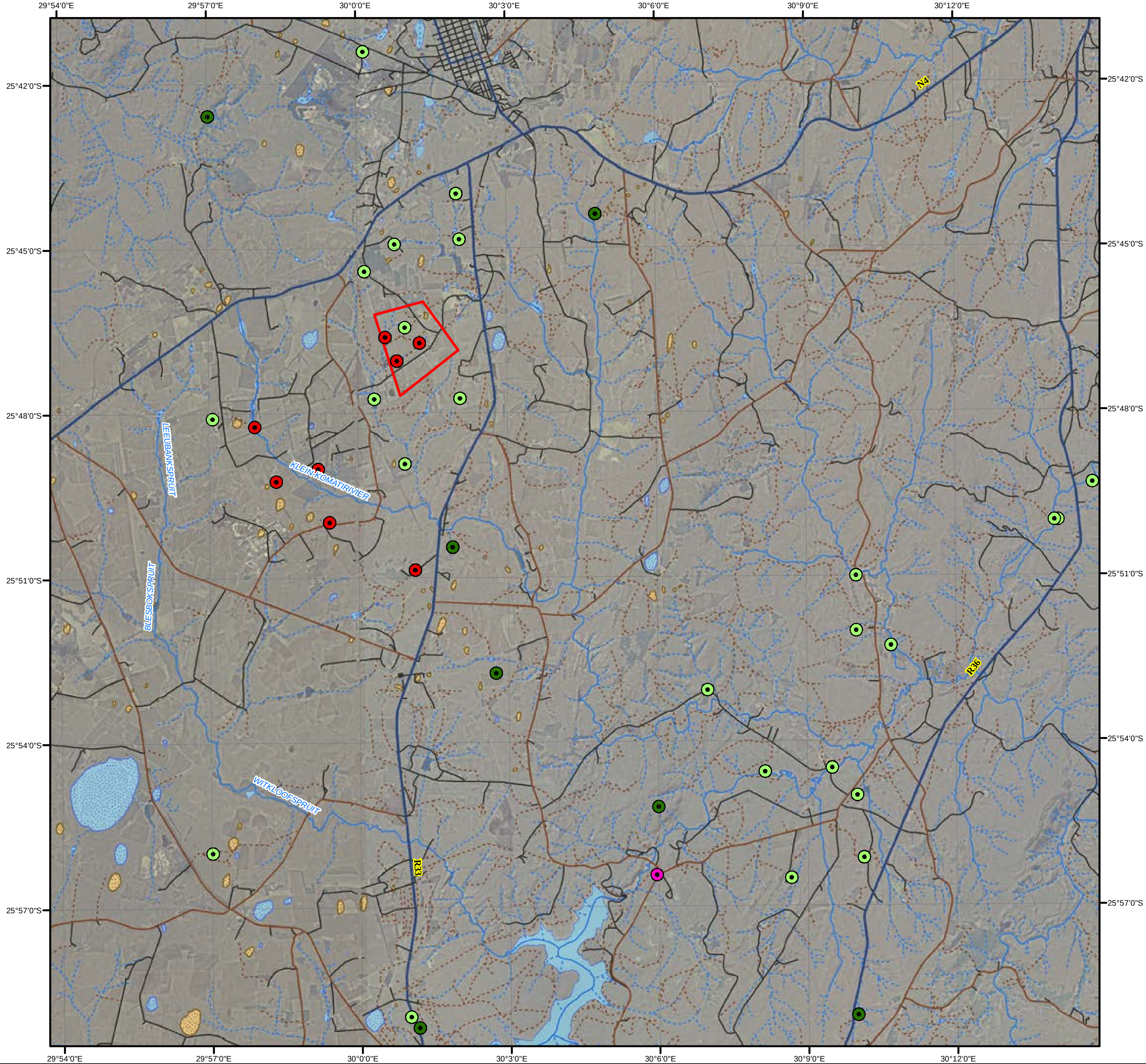
Plan 6

Northern Coal Weltevreden Project

Water Users



Legend

- Weltevreden Site
- Arterial / National Route
- Main Road
- Minor Road
- Tracks
- Perennial River
- Non-Perennial River
- Dam / Lake
- Perennial Pan
- Non-Perennial Pan

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Projection: Transverse Mercator
Datum: WGS84
Central Meridian: 31°E

Ref #:idp.NOR1982.201407.145
Revision Number: 1
Date: 23/07/2014

N

0 1 2 4 6
Kilometres
1:130 000

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Appendix B: Water Quality Data

DIGBY WELLS AND ASSOCIATES

Private Bag X 10046
RANDBURG
2125

CHEMICAL ANALYSIS : WATER SAMPLES | **Our Ref: DIG/ 269 - 283 / B /09/08**

Date received: 16 September 2008
Date completed: 17 October 2008 ***Project Name: WELTEVREDE - NOR 335***
Quantity Analyzed: 15

Lab No:	B269	B270	B271
Analysis Results mg/l	WN 1	WN 2	WN 3
Total Dissolved Solids	128	116	44
Suspended Solids	28.4	8.8	1.2
Nitrate NO_3 as N	0.9	0.46	0.51
Chlorides as Cl	22	27	4.0
Total Alkalinity as $CaCO_3$	65	32	28
Fluoride as F	<0.20	<0.20	<0.20
Sulphate as SO_4	8.5	21.7	1.8
Total Hardness as $CaCO_3$	70	46	25
Calcium Hardness as $CaCO_3$	36	24	14
Magnesium Hardness as $CaCO_3$	34	23	11
Calcium as Ca	14.3	9.44	5.45
Magnesium as Mg	8.31	5.56	2.65
Sodium as Na	10.2	11.8	4.25
Potassium as K	2.30	8.76	1.73
Iron as Fe	0.63	0.02	<0.01
Manganese as Mn	0.02	<0.01	<0.01
Conductivity in mS/m	19.61	17.75	7.25
pH-Value at 25 ° C	7.42	7.34	6.87
pHs at 21°C	8.12	8.60	8.72
Langelier Saturation Index	-0.70	-1.26	-1.85
Ortho-Phosphate $P0_4$ as P	0.26	0.21	0.17
Total Chromium as Cr	<0.01	<0.01	<0.01
Bicarbonate HCO3 as $CaC0_3$	65	32	28
Aluminium as Al	<0.01	0.01	<0.01
Chemical Oxygen Demand	43.7	47.6	<4.0
Copper as Cu	<0.01	<0.01	<0.01
Cobalts as Co	<0.01	<0.01	<0.01
Free & Saline Ammonia NH_3 as N	1.8	0.67	0.54

All heavy metal analyses have been performed on filtered samples.
Tests marked with an asterisk * are not SANAS accredited
These results are related only to the items tested

QUALITY CONTROL CHECKS			
Cation Balance	2.03	1.71	0.76
Anion Balance	2.10	1.85	0.71
% Difference	-1.6	-3.9	3.2
Measured TDS	128	116	44
Calculated TDS	108	105	38
Limits > 1.0 - <1.2	1.2	1.1	1.2
Calcul TDS / E.C. (0.55 - 0.70)	0.5	0.6	0.5

DIGBY WELLS AND ASSOCIATES

Private Bag X 10046
RANDBURG
2125

CHEMICAL ANALYSIS : WATER SAMPLES	Our Ref: DIG/ 269 - 283 / B /09/08

Date received: 16 September 2008
Date completed: 17 October 2008 ***Project Name: WELTEVREDE - NOR 335***
Quantity Analyzed: 15

Lab No:	*B272*	*B273*	*B274*
Analysis Results mg/l	**WN 4**	**WN 5**	**WN 6 (dam)**
Total Dissolved Solids	**62**	**84**	**106**
Suspended Solids	**10.8**	**1.6**	**4.8**
Nitrate NO_3 as N	**2.1**	**0.3**	**0.3**
Chlorides as Cl	**17**	**22**	**23**
Total Alkalinity as $CaCO_3$	**19**	**15**	**55**
Fluoride as F	**<0.20**	**<0.20**	**<0.20**
Sulphate as SO_4	**6.4**	**20**	**7.4**
Total Hardness as $CaCO_3$	**14**	**35**	**58**
Calcium Hardness as $CaCO_3$	**8**	**15**	**24**
Magnesium Hardness as $CaCO_3$	**6**	**19**	**34**
Calcium as Ca	**3.02**	**6.20**	**9.6**
Magnesium as Mg	**1.45**	**4.66**	**8.32**
Sodium as Na	**13.6**	**8.05**	**11.0**
Potassium as K	**3.67**	**6.99**	**2.58**
Iron as Fe	**<0.01**	**<0.01**	**<0.01**
Manganese as Mn	**0.12**	**<0.01**	**<0.01**
Conductivity in mS/m	**10.28**	**13.77**	**17.34**
pH-Value at 25 ° C	**5.76**	**6.84**	**7.20**
pHs at 21°C	**9.30**	**9.12**	**8.36**
Langelier Saturation Index	**-3.54**	**-2.28**	**-1.16**
Ortho-Phosphate $P0_4$ as P	**0.17**	**0.17**	**0.16**
Total Chromium as Cr	**<0.01**	**<0.01**	**<0.01**
Bicarbonate HCO3 as $CaC0_3$	**19**	**15**	**0.55**
Aluminium as Al	**<0.01**	**<0.01**	**<0.01**
Chemical Oxygen Demand	**11.9**	**43.7**	**31.7**
Copper as Cu	**<0.01**	**<0.01**	**<0.01**
Cobalts as Co	**<0.01**	**<0.01**	**<0.01**
Free & Saline Ammonia NH_3 as N	**0.8**	**0.44**	**0.47**

All heavy metal analyses have been performed on filtered samples.
Tests marked with an asterisk * are not SANAS accredited
These results are related only to the items tested

QUALITY CONTROL CHECKS			
Cation Balance	**1.02**	**1.25**	**1.74**
Anion Balance	**0.99**	**1.35**	**1.90**
% Difference	**1.1**	**-3.5**	**-4.4**
Measured TDS	**62**	**84**	**106**
Calculated TDS	**58**	**78**	**96**
Limits > 1.0 - <1.2	**1.1**	**1.1**	**1.1**
Calcul TDS / E.C. (0.55 - 0.70)	**0.6**	**0.6**	**0.6**

Test Report

Client: Digby Wells & Associates
Address: 359 Pretoria Ave, Fern Isle, Section 5, Ferndale, Randburg
Report no: 19140
Project: Digby Wells & Associates

Date of certificate: 03 July 2014
Date accepted: 30 June 2014
Date completed: 03 July 2014
Revision: 0

Lab no:				175955	175956	175957	175958
Date sampled:				26-Jun-14	26-Jun-14	26-Jun-14	26-Jun-14
Sample type:				Water	Water	Water	Water
Locality description:				SW1	SW2	SW3	SW4
	Analyses	**Unit**	**Method**				
A	pH	pH	ALM 20	7.22	9.72	6.76	6.37
A	Electrical conductivity (EC)	mS/m	ALM 20	15.4	12.5	9.60	6.78
A	Total dissolved solids (TDS)	mg/l	ALM 26	83	63	48	34
A	Total alkalinity	mg $CaCO_3$/l	ALM 01	28.1	33.1	17.4	12.2
A	Chloride (Cl)	mg/l	ALM 02	24.9	14.5	12.2	6.76
A	Sulphate (SO_4)	mg/l	ALM 03	7.95	4.98	5.68	4.08
A	Nitrate (NO_3) as N	mg/l	ALM 06	0.291	0.296	0.309	0.300
A	Ammonium (NH_4) as N	mg/l	ALM 05	0.080	0.031	0.070	0.112
A	Orthophosphate (PO_4) asP	mg/l	ALM 04	<0.008	<0.008	<0.008	<0.008
A	Fluoride (F)	mg/l	ALM 08	<0.055	<0.055	<0.055	0.065
A	Calcium (Ca)	mg/l	ALM 30	7.39	9.02	3.12	1.55
A	Magnesium (Mg)	mg/l	ALM 30	5.35	5.81	2.85	1.32
A	Sodium (Na)	mg/l	ALM 30	11.7	6.89	8.77	5.86
A	Potassium (K)	mg/l	ALM 30	7.60	0.451	3.26	5.04
A	Aluminium (Al)	mg/l	ALM 31	<0.003	<0.003	<0.003	<0.003
A	Iron (Fe)	mg/l	ALM 31	0.227	<0.003	<0.003	0.290
A	Manganese (Mn)	mg/l	ALM 31	<0.001	<0.001	<0.001	<0.001
A	Total chromium (Cr)	mg/l	ALM 31	<0.001	<0.001	<0.001	<0.001
A	Copper (Cu)	mg/l	ALM 31	<0.001	<0.001	<0.001	<0.001
A	Nickel (Ni)	mg/l	ALM 31	<0.001	<0.001	<0.001	<0.001
A	Zinc (Zn)	mg/l	ALM 31	<0.002	<0.002	<0.002	<0.002
A	Cobalt (Co)	mg/l	ALM 31	<0.001	<0.001	<0.001	<0.001
A	Cadmium (Cd)	mg/l	ALM 31	<0.001	<0.001	<0.001	<0.001
A	Lead (Pb)	mg/l	ALM 31	<0.004	<0.004	<0.004	<0.004
A	Total hardness	mg $CaCO_3$/l	ALM 26	40	46	20	9
A	Chemical oxygen demand (COD)	mg/l	ALM 10	48.5	10.7	20.1	92.4

A = Accredited N = Non accredited O = Outsourced S = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine
The results relates only to the test item tested.
Results reported against the limit of detection.
Results marked 'Not SANAS Accredited' in this report are not included in the SANAS Schedule of Accreditation for this laboratory.
Uncertainty of measurement available on request for all methods included in the SANAS Schedule of Accreditation.