# SPECIALIST REPORT

# SURFACE WATER

## UNIVERSAL COAL (PTY) LTD,

## KANGALA COAL MINE

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Environmental Solutions Provider

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# TABLE OF CONTENTS

# LIST OF TABLES



# LIST OF PLANS

# 1 TERMS OF REFERENCE

Digby Wells and Associates (Pty) Ltd (DWA) has been contracted by Universal Coal Development 1 (Pty) Ltd (Universal Coal) to complete a Surface Water Assessment for the proposed Kangala Coal Mining Project.

A mining right application was submitted to the Department of Mining in May 2009, who then requested that an Environmental Impact Assessment (EIA) be undertaken.

The surface water component of the EIA was initiated early in the year, in order to ensure that information from the high flow season can be incorporated in the assessment. The results are then incorporated into this Surface Water Report, which forms part of the EIA.

# 2 INTRODUCTION

A surface water assessment involves catchment hydrology which focuses on specific water resources and their representative catchment areas. The quantitative contribution of these catchments towards the larger system is evaluated. This is necessary in order to determine specific effects that certain activities might have on the natural catchment area and in effect the water resource contained within the area.

Opencast coal mining is an ever growing industry in South Africa and many mining right applications are conducted within the Mpumalanga province. South Africa is a water scarce country and much care should be taken into planning and development of any kind in and around any surface water resource.

The main aim of the surface water study is to evaluate the quantitative contribution of the resource within the specific site area as well as with regards to the greater catchment area. It is also necessary to evaluate the quality of the water resource not only within the site area but also possibly around the site area towards the greater catchment area. The main objectives of this study include determining flows during a possible 1:100 year return period flood event and to test the quality of the water resource. The potential impacts of the proposed coal mine on the surface water environment will also be evaluated, along with proposed mitigation measures.

## 3 STUDY AREA

The proposed site area is located in the Mpumalanga Province and falls under the Olifants Water Management Area (WMA 04) (Plan 3). The project site occurs near the town of Delmas and comprises of portions 1 and the remaining extent of portion 2 of the farm Wolvenfontein Farm 244 IR (Plan 2).

The area is classified as rural and the main land use is agriculture. Many wetland areas surround the project site and the upstream contribution of surface water drainage towards streams on site is large. A small farm dam, wetlands and a main stream that flows from west to north east occur on the project site.

## 4 AIMS AND OBJECTIVES

The 1:100 year return period flood line was determined as well as an assessment of the quality of the surface water resources in the area. The following objectives have been formulated in order to obtain these main aims;

- Catchment delineation of possible affected areas;
- Specific catchment delineation of wetlands and streams;
- Quality hydrocenses and evaluation of surface water resources in the area;
- Flow volume calculation for a possible 1:100 year flood event;
- Flood line delineation for a possible 1:100 year flood event;
- Evaluation of the surface water demand on the catchment from current water users in area;
- Mitigation plans to manage possible impacts on environment.

## 5 METHODOLOGY

A desktop study was undertaken to collect the baseline surface water information for the project site. Information collected included quaternary catchment characteristics, water quality, and registered surface water users in the area. Information sources used included published reports of the 1990 Water Research Commission (WRC) Surface Water Resources study, and the databases of the Department of Water and Environmental Affairs (DWEA). A field visit was undertaken on the 2$^{nd}$ to the 4$^{th}$ of March 2009 to collect project-site specific surface water information. Water samples were taken from the surface water bodies found in the proposed mining area and the adjacent areas for chemical water quality analysis. Surface water sub-catchments characteristics including sub-catchments boundaries, vegetation cover, land uses, topography, and average slopes were identified and verified during the field visit. Technical assessment and analysis of the surface water baseline status of the project area was then conducted based on the information collected during the desktop study and the field work. Tools such as the Geographic Information System (GIS) and the hydrological methods were also used for the analysis and the presentation of the study findings.

This report presents the chemical water quality and quantity aspects of the surface water bodies likely to be affected by the proposed coal mining project.

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).

**Rational Method**

The rational method was developed in the mid 19$^{th}$ 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.

**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.

**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.

**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).

# 6 KNOWLEDGE GAPS

Surveyed cross sectional data would improve the quality of the flood line delineation.

# 7 FINDINGS

Surface water quantity and quality results will be described in the sections to follow.

## 7.1 Surface Water Quantity

Included in the surface water quantity section below are findings on specific sub-catchment areas, flood volume flows and flood line locations. Mean annual run-off and average dry flow values are also presented.

### *7.1.1. Catchment Boundaries*

The proposed mine project falls within quarternary catchment B20A and lies on one of the upper tributaries of the Bronkhorsspruit. The sub-catchment within which the proposed mining area falls is 151 $km^2$. The area of interest was sub-divided into 15 sub-catchments for the purpose of the calculation of 1:100 year flood peaks, and delineation of flood lines for streams in the proposed mining area (Plan 4).

For the purpose of calculating the 1:100 year flood peaks and delineating the corresponding floodplains and lines as required by the national water legislation, the sub-catchments were grouped as follows from East to West (Plan 4):-

i. Stream running through the south-eastern corner of the project site (Catchment: C13). This stream has a relatively big catchment area upstream of the south-eastern part of the project site. The stream has three upstream tributaries and a number of sub-tributaries. Catchments for the tributaries are C6, C9, and C12. Catchments for the sub-tributaries are C8, C7, C10, and C11 (Plan 4);

ii. A stream that drains the southern part of the project site with two upstream tributaries (Catchment: C4). Catchments for the tributaries are C1 and C2 (Plan 4);

iii. A stream that drains the central part of the project site with a relatively significant runoff contribution from an area upstream of this part of the project site (Catchment: C3 – Plan 4);

iv. A stream that drains some of the north-western part of the project site. The stream flows past the project site on the north-west, but has a small area of the project site draining into it ( Catchment: C5 – Plan 4).

Table 1 is a summary of the sub-catchments and their relative areas.

**Table 1: Sub-catchments and their areas**

| Catchment | Area (ha) | Area ($km^2$) |
|---|---|---|
| C1 | 1134 | 11.3 |
| C2 | 1004 | 10.0 |
| C3 | 1971 | 19.7 |
| C4 | 1029 | 10.3 |
| C5 | 1075 | 10.8 |
| C6 | 420 | 4.20 |
| C7 | 629 | 6.29 |
| C8 | 618 | 6.18 |
| C9 | 1049 | 10.5 |
| C10 | 755 | 7.55 |

| Catchment | Area (ha) | Area ($km^2$) |
|---|---|---|
| C11 | 847 | 8.47 |
| C12 | 1527 | 15.3 |
| C13 | 1283 | 12.8 |
| C14 | 1113 | 11.1 |
| C15 | 620 | 6.20 |

### *7.1.2. Mean Annual Runoff*

The Mean Annual Runoff (MAR) of B20A is 38 mm (21.7 $Mm^3$). The Mean Annual Precipitation (MAP) for B20A is 661 mm and the ratio of the MAR to MAP is 5.7%. The Mean Annual Evaporation (MAE) is 1650 mm.

### *7.1.3. Normal Dry Weather Flow Volume*

During normal dry weather seasons, the flow volume per year of the quaternary catchment area is 10.22 x $10^6 m^3$ (DWAF, 2005).

### *7.1.4. Flood Flows*

**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 ($m^3/s$) |
|---|---|---|---|---|
| C1 | 95.7 | 99.4 | 91.3 | 101 |
| C2 | 93.6 | 96.8 | 88.9 | 93.6 |
| C3 | 144 | 153 | 151 | 147 |
| C4 | 80.4 | 83.3 | 93.2 | 92.9 |
| C5 | 75.1 | 77.9 | 86.2 | 84.0 |
| C6 | 45.2 | 46.2 | 43.0 | 45.4 |

| Sub-Catchment | Rational ($m^3/s$) | Alternative Rational ($m^3/s$) | SDF ($m^3/s$) | SCS ($m^3/s$) |
|---|---|---|---|---|
| C7 | 79.4 | 81.9 | 72.6 | 72.9 |
| C8 | 73.7 | 75.9 | 67.0 | 74.3 |
| C9 | 75.8 | 78.6 | 75.8 | 80.3 |
| C10 | 74.4 | 76.6 | 67.8 | 69.0 |
| C11 | 92.2 | 95.2 | 83.6 | 85.4 |
| C12 | 121 | 128 | 131 | 130 |
| C13 | 81.9 | 85.5 | 93.3 | 92.5 |
| C14 | 111 | 115 | 110 | 105 |
| C15 | 55.4 | 57.1 | 55.2 | 57.6 |

The flood peaks (1: 100 year return period) results (Table 2) obtained by using all four methods for all the sub-catchments were found to be quite close to one another. The SCS method has an added advantage over the other three methods as it allows for soil properties to be included in the flood quantities (1:100 year) estimation. Thus its (SCS method) results were selected for the determination of the water surface profiles and the floodlines (Table 2).

### *7.1.5. Flood Lines*

The floodlines, the 100 m buffer zone around the streams, and the exclusion zone for mining or mine infrastructure placement were delineated using the Geographic Information System (GIS) Software known as ArcGIS 9 (Plan 7). No mining is to take place within the buffer zone.

## 7.2 Surface Water Quality

The surface water field survey that was undertaken on the 2nd to the 4th of March 2009 on the project site covered the following farm portions (Plan 5):

- Portion 6 of Weilaagte Farm, 271 IR
- Portion 3 of Stompiesfontein Farm, 273 IR
- Portion 33 of Strydpan Farm, 243 IR
- Portion 20 of Strydpan Farm, 243 IR
- Portion 1 of Wolvenfontein Farm, 244 IR
- Portion 6 of Wolvenfontein Farm, 244 IR
- Portion R of Wolvenfontein Farm, 244 IR
- Portion 3 of Wolvenfontein Farm, 244 IR
- Portion R of Witklip Farm, 229 IR

The location of all the points from which surface water resources (rivers, streams and pans) were sampled were recorded with a hand-held Global Positioning System (GPS) for the purpose of spatial orientation and are indicated in Plan 5. The collected samples were submitted to an accredited water quality analysis laboratory for the analysis of the chemical constituents.

### *7.2.1. Field Investigation*

**Hydrocensus Nomenclature**

The following nomenclature was utilised for the identification of the water quality sampling points:

- The first two Letters in the ID number stands for the previous name of the Project i.e. “INJ” for Injula project assessment, which has now been replaced by “Kangala project assessment”;
- The number following the project name abbreviation stands for the sample number e.g. “2” indicating this was the 2nd surface water source investigated.

A total of 10 surface water resources (river, streams and pans) points were sampled in the area (Plan 5). Table 3 provides a summary of the locations, and the descriptive information of the points that were sampled.

**Table 3: Location and description of surface water samples taken in March 2009**

| Site ID | X- coord | Y- coord |
|---|---|---|
| INJ1 | S26°13'30.9" | E28°40'40.9" |
| INJ2 | S26°11'51.6" | E28°40'43.6" |
| INJ3 | S26°11'29.6" | E28°39'57.6" |
| INJ4 | S26°11'53.4" | E28°39'18.4" |
| INJ5 | S26°12'33.3" | E28°39'08.8" |
| INJ6 | S26°13'57.1" | E28°42'15.0" |
| INJ7 | S26°14'17.2" | E28°40'36.9" |
| INJ8 | S26°14'20.9" | E28°39'43.9" |
| INJ9 | S26°11'45.38" | E28°41'53.56" |
| INJ10 | S26°10'39.5" | E28°42'05.45" |

### *7.2.2. Laboratory Chemical Analysis*

A number of chemical constituents in the surface water hydrocensus samples were analysed at Regen Waters laboratory, in Witbank, Mpumalanga. The results were then benchmarked against the SANS 241 (2005) drinking water quality standards as presented in Table 4.

**Table 4: Chemical results from the surface water samples taken in March 2009.**

| Sample ID | | Total Dissolved Solids | Nitrate $NO_3$ as N | Chlorides as Cl | Total Alkalinity as $CaCO_3$ | Sulphate as $SO_4$ | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class 0 | (Ideal) | <450 | <6.0 | <100 | N/S | <200 | <80 | <30 | <100 | <25 | <0.01 | <0.05 | <70 | 6.0-9.0 | <0.15 | N/S |
| Class I | (Acceptable) | 450-1000 | 6.0-10.0 | 100-200 | N/S | 200-400 | 80-150 | 30-70 | 100-200 | 25-50 | 0.01-0.2 | 0.05-0.1 | 70-150 | 5-6 or 9.0-9.5 | 0.15-0.3 | N/S |
| Class II | (Max. Allowable) | 1000-2400 | >10-20 | >200-600 | N/S | >400-600 | >150-300 | >70-100 | 200-400 | 50-100 | >0.2-2 | >0.1-1 | >150-370 | 4-5 or 9.5-10 | >0.3-0.58 | N/S |
| Class III | (Exceeding) | >2400 | >20 | >600 | N/S | >600 | >300 | >100 | >400 | >100 | >2 | >1 | >370 | <4 or >10 | >0.58 | N/S |
| INJ1 | II | 162 | <0.10 | 13.0 | 109 | 15.6 | 12.1 | 9.93 | 22.4 | 6.75 | 0.16 | 0.20 | 24.7 | 7.29 | 0.26 | 0.78 |
| INJ2 | I | 170 | <0.10 | 30.0 | 71.0 | 23.9 | 13.7 | 8.68 | 22.2 | 8.65 | 0.02 | 0.07 | 27.4 | 6.95 | 0.12 | 0.39 |
| INJ3 | I | 62.0 | <0.10 | 3.00 | 38.0 | 8.80 | 6.55 | 3.91 | 2.59 | 5.89 | <0.01 | 0.06 | 9.27 | 6.60 | 0.13 | 0.48 |
| INJ4 | II | 54.0 | <0.10 | 3.00 | 32.0 | 6.10 | 7.53 | 1.95 | 2.69 | 5.81 | 0.38 | 0.05 | 7.65 | 6.62 | 0.12 | 0.55 |
| INJ5 | I | 250 | <0.10 | 25.0 | 171 | 7.40 | 25.3 | 15.2 | 20.8 | 19.0 | 0.14 | 0.06 | 39.5 | 7.00 | 0.12 | 0.86 |
| INJ6 | 0 | 162 | <0.10 | 11.0 | 117 | 9.00 | 15.9 | 11.4 | 18.8 | 8.24 | <0.01 | 0.04 | 26.9 | 7.10 | 0.13 | 0.75 |
| INJ7 | II | 330 | <0.10 | 14.0 | 153 | 14.8 | 18.0 | 14.7 | 29.1 | 5.58 | 1.21 | 0.04 | 34.0 | 7.23 | 0.12 | <0.20 |
| INJ8 | 0 | 190 | <0.10 | 11.0 | 146 | 13.8 | 18.6 | 15.6 | 20.1 | 3.87 | <0.01 | 0.02 | 30.6 | 7.66 | 0.12 | <0.20 |
| INJ9 | 0 | 250 | <0.10 | 12.0 | 192 | 10.0 | 24.3 | 19.0 | 26.0 | 6.52 | <0.01 | 0.03 | 39.3 | 7.85 | 0.12 | <0.20 |
| INJ10 | 0 | 202 | <0.10 | 13.0 | 157 | 8.60 | 20.5 | 14.7 | 22.3 | 7.16 | <0.01 | 0.04 | 32.6 | 7.28 | 0.13 | 0.89 |

The results were colour coded according to the colour of the SANS 241 Class in which they fall (Table 4), more especially in the cases where the Class 0 (ideal) guidelines were exceeded. The following was deduced from the results for each point that was sampled:

i. **INJ1:** Most of the chemical constituents measured at this sampling point were found to be within the ideal limit (Class 0). Fe and Al concentration levels were found to be within the acceptable limit (Class I) while Mn concentration fell within the maximum allowable limit (Class II). Considering that the highest limit or class under which one of the constituents fell was Class II, the overall water quality of this sampling point is therefore considered to be of a Class II SANS 241 drinking water quality standard.

ii. **INJ2**: Most of the chemical constituents measured at this sampling point were found to be within the ideal limit (Class 0). Fe and Mn concentration levels were found to be within the acceptable limit (Class I). In view of the fact two of the constituents fell within Class I, the overall water quality of this sampling point is therefore considered to be of a Class I SANS 241 drinking water quality standard and thus suitable for human consumption;

iii. **INJ3**: Most of the chemical constituents measured at this sampling point were found to be within the ideal limit (Class 0). The highest concentration level measured was that of Mn, which fell within the acceptable limit (Class I). Thus the overall water quality at this point is characterised as Class I and is suitable for human consumption.

iv. **INJ4:** Most of the chemical constituents measured at this sampling point were found to be within the ideal limit (Class 0). Mn and Fe concentration levels were found to be within the acceptable limit (Class I), and the maximum allowable limits (Class II), respectively. The overall water quality of this sampling point is therefore considered to be of a Class II SANS 241 drinking water quality standard and was at the time of sampling suitable for human consumption.

v. **INJ5**: Most of the chemical constituents measured at this sampling point were found to be within the ideal limit (Class 0). The concentration levels of Mn and Fe were found to be within the acceptable limit (Class I). The overall water quality of this sampling point is therefore considered to be of a Class I SANS 241 drinking water quality standard;

vi. **INJ6**: All of the chemical constituents measured at this sampling point were found to be within the ideal limit (Class 0). The overall water quality of this sampling point is therefore considered to be of a very good quality i.e. Class 0 SANS 241 drinking water quality standard;

vii. **INJ7**: All of the chemical constituents measured at this sampling point except Fe were found to be within the ideal limit (Class 0. Fe concentration level was found to be within the maximum allowable limit (Class II). The overall water quality of this sampling point is therefore considered to be of a Class II SANS 241 drinking water quality standard;

viii. **INJ8**: All of the chemical constituents measured at this sampling point were found to be within the ideal limit (Class 0). The overall water quality of this sampling point is therefore considered to be of a very good quality i.e. Class 0 SANS 241 drinking water quality standard;

ix. **INJ9**: All of the chemical constituents measured at this sampling point were found to be within the ideal limit (Class 0). The overall water quality of this sampling point is therefore considered to be of a very good quality i.e. Class 0 SANS 241 drinking water quality standard; and

x. **INJ10**: All of the chemical constituents measured at this sampling point were found to be within the ideal limit (Class 0). The overall water quality of this sampling point is therefore considered to be of a very good quality i.e. Class 0 SANS 241 drinking water quality standard;

In general, the chemical water quality in the area was at the time of sampling of quality that was suitable for human consumption ranking within Class 1 and 2 of SANS 241 standards. However, the metal concentration levels (Fe, Mn and Al) had a generally higher concentration level at a number of points that were sampled. This was attributed to the fact that most of the water samples were collected from water that seemed stagnant as the area is characterised by a high number of pans and small streams with very slow flows. Furthermore, the evaporation of water from the pan sites can contribute to the higher metal concentrations and more total dissolved solids. Although the national standards (SANS 241) for drinking water quality are the acceptable standard for water quality analysis, there are DWAF guidelines which govern other water users such as aquatic life and agricultural use.

In this case, it is important to note that the main use of water in the quaternary catchment of the proposed project area is agriculture (WARMS, 2008). Based on the DWAF guidelines for such use, the water quality of the sampled sites was within the ideal/acceptable limits. In this light, it is crucial to ensure that the mining operation will not negatively impact on the surface water resources so as to deteriorate the quality at the sampled points. Proper management measures will ensure that the downstream water users continue to receive the same quality of water during and post mining to that received pre-mining.

### 7.3 Surface Water Use

The main use of surface water in B20A is irrigated agriculture and livestock watering (Plan 6). Total number of registered surface water users in B20A is 78. Most of the users abstract water from the Koffiespruit and Bronkhorstspruit rivers and their tributaries. The annual water volumes abstracted by the users as per the DWAF database range from 365 to 640 000 $m^3/a$. Three of these users are close to the proposed mining area. One user is located on the south-eastern corner of the farm to be affected by the proposed mining project. Another user is located 1.5 kilometers south-east of the first one while the third user is 3.5 kilometres downstream of the affected farm (Plan 6).

### 7.4 Water Authority

The Department of Water Affairs and Forestry (DWAF) has the overall mandate for the management of the Olifants WMA.

## 8 DESCRIPTION OF POTENTIAL IMPACTS

### 8.1 Project Evaluated

The proposed project consists of the following:

- The mining of the coal deposit by opencast mining methods on the 2 an 4 seam;
- The establishment of topsoil, overburden and run of mine stockpiles;

- The operation of a wash plant operating at a capacity of 110 kt month;
- The replacement of discard into the mine workings, or if not feasible the establishment of a discard dump at the operation;
- The placement of slurry within the mine workings, or if not feasible the management of slurry within slurry ponds or as part of the discard dump facility.

## 8.2 Construction Phase

Risks identified for the construction phase with respect to surface water are the increase of the siltation due to earth moving activities and the risk of surface water contamination due to a major hydrocarbon spill.

The impact due to siltation is judged to be negative, to be of medium severity, local extent (as the dam immediately adjacent to the pit will accumulate the silt; this will however result in a loss of storage capacity) and medium term duration (the life of the project). The impacts will definitely occur if mitigation is not taken, mitigation is recommended.

The impact due to a major hydrocarbon spill on site is judged to be negative and of high significance. The impact will be regional (in the high flow season) and the impacts of medium term consequence (reputational damage may be permanent). The probability of occurrence is however very low.

## 8.3 Operational Phase

The operational phase will see a continuance of the impacts identified in the construction phase.

The National water act requires mines to operate in accordance with Regulation 704 in terms of water management at mines, it is assumed that the provisions of regulation 704 will be fully implemented.

The proponent considers applying for exemption of Regulation704 in terms of disposal of discard and slurry back into the mining pit. The replacement of discard into the void and the disposal of slurry will not have any direct impact on surface water resources during the operational phase, but post closure there could be impacts that will be discussed under that particular section.

Should permission not be granted a discard dump will be constructed on the property. The discard dump will allow for the formal management of the discard and slurry and should the provisions of regulation 704 be complied with no impacts on the surface water is expected.

The removal of the mining dirty catchment from the catchment area of the downstram dam will reduce the runoff into the dam. The current water use from the dam is probably irrigation. This impact is judged to be negative, site specific and of moderate significance and medium term duration. Stormwater planning must take into account the loss of yield and the current utilisation from the dam.

### 8.4 Decommissioning Phase

The impacts from the construction phase will continue during the decommissioning phase.

Additional impacts are not expected during this phase, however the failure during this phase to adequately undertake closure of the discard dump will have impacts post closure. This impact is therefore identified here and discussed to ensure that it is not overlooked. Failure to allow for sustainable management of seepage from the discard dump will lead to long term contamination of the downstream surface water as management measures utilised during the operational phase will not be adequate for the closure requirements in terms of capacity and durability under low maintenance. The impact is judged to be negative and of regional extent as the pollution will migrate downstream. The significance is moderately high and the duration permanent. The impact could probably occur.

### 8.5 Post Closure Impacts

Post closure impacts on surface water is associated with the decant of groundwater to surface and seepage from the discard dump. The severity of the impact will be dependant on the post closure water quality. The DWAF Best Practice Guidelines require substantial geochemical characterisation during the life of the mine. The results thereof will allow for a more accurate assessment of the impacts.

The impacts on surface water is expected to be negative and very significant as the current water quality has a very low TDS. The impact will be of regional extent as the contamination migrates downstream. The impact will be of permanent duration and the overall significance will be very high.

### 8.6 Cumulative Impacts

Two existing collieries operate within the Bronkhorstpruit catchment, they are Leeuwpan Colliery and Stuart Coal Colliery.

Monitoring conducted by DWAF at the Bronkhorstspruit dam indicates that TDS and sulphate levels have remained consistent sine 2000 when regular sampling commenced with the $90^{th}$ percentile over the total data set being 259 mg/l and 21.94 mg/l respectively. This does not appear to indicate an adverse effect of mining currently at this monitoring point. No upstream monitoring points closer to the mines are regularly sampled.

The most significant impacts that were identified were for the post closure phase. The closure of all three these collieries therefore need to be properly managed to prevent adverse effects post closure.

## 9 DESCRIBED MITIGATION MEASURES

### 9.1 Construction Phase

Mitigation is required.

Proper management of ground clearing and the early establishment of berms to ensure that clean and dirty water are separated, with water from disturbed areas being collected within the dirty water system.

An emergency spill response plan needs to be developed to cater for a major spill. It should be part of the contractual obligations of the hydrocarbon supplier. Kangala needs to have their own response plan in place till such time that the supplier can mobilise to site. This should focus on containment and safety, the supplier spill response plan on containment, safety and cleanup.

### 9.2 Operational Phase

Regulation 704 is a legal obligation, breach of regulation 704 can lead to a fine or a maximum jail sentence of 5 years on the first offence, 10 on the second conviction.

All personel should be adequately trained in the content and responsibilities of Regulation 704.

Substantial geochemical characterisation of the discard material and slurry is required before an application for exception from regulation 704 can be motivated for.

The owner of the dam downstream of the operation needs to be engaged and requirements for water use established. A contractual agreement needs to be entered into should the loss of yield affect the water user.

### 9.3 Decommissioning Phase

The redesign and construction of water management for post closure needs to occur. This will require substantial predictive work with regards to closure and mine water quality post closure. The hierarchy of mine water management and the DWAF best practice guidelines need to be adhered to.

### 9.4 Post Closure Impacts

The water quality needs to be monitored post closure and management measures need to be maintained to ensure effective management of mine water post closure.

## 10 RECOMMENDATIONS

The following recommendations are made based on the findings of this study:

- Opencast mining be done outside the exclusion zones of the surface water bodies found in the project site (Plan 7);
- Mitigation measures be made to ensure that the mining operation will not negatively impact on the current good quality of surface water found at the sampled points in the area; and
- Proper management measures be put in place to ensure that the downstream water users continue to receive the same quality of water during and post mining to that received pre-mining.

## 11 REFERENCES

Water Research Commission, 1994. Surface Water Resources of South Africa 1990, WRC Report No. 298/1.1/94.

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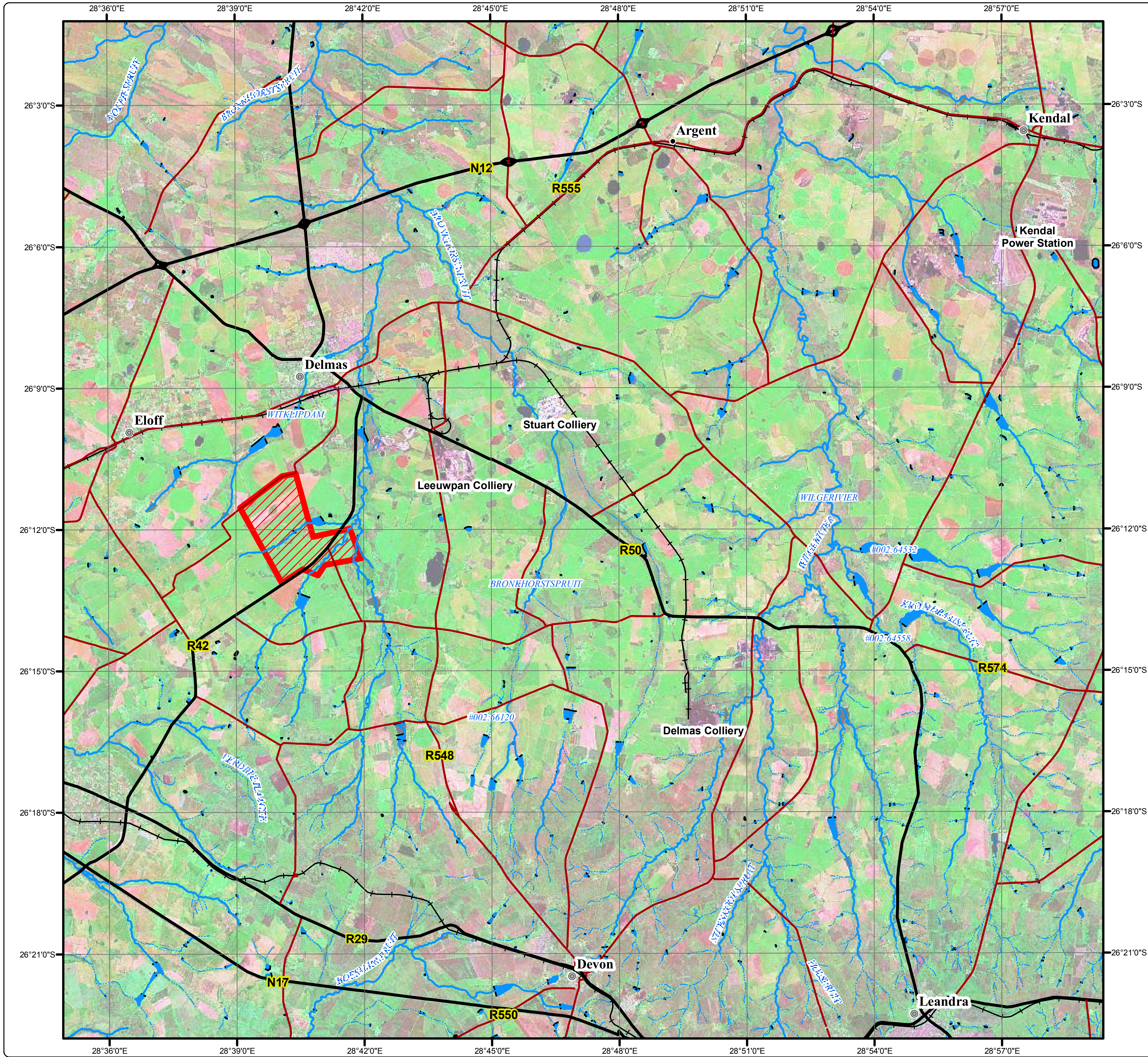
# PLANS




Plan 1

# Universal Coal Kangala Coal Mine

## Regional Setting

### Legend

- Project Area
- Capital City
- Major Town
- Other Town
- Secondary Town
- Settlement
- Arterial / National Route
- Main Road
- Railway Line
- Non-Perennial Stream
- Perennial Stream
- Dam Wall
- Dam / Lake

Universal Coal Development 1 (Pty) Ltd

DWA

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Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 29°E

Ref #: scc.UNI605.200910.014
Revision Number: 2
Date: 21/10/2009

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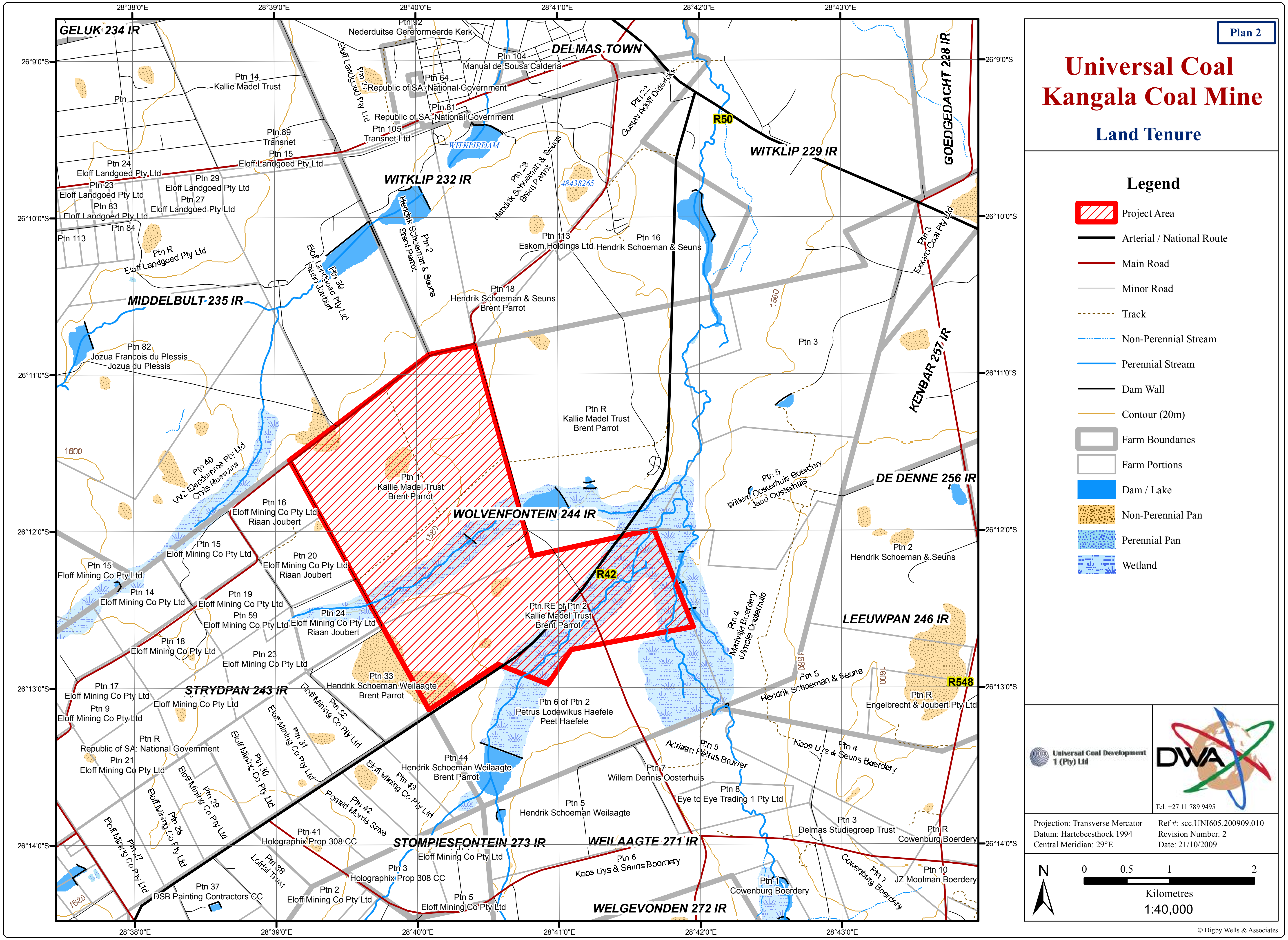

Plan 2
Universal Coal
Kangala Coal Mine
Land Tenure
Legend
Project Area
Arterial / National Route
Main Road
Minor Road
Track
Non-Perennial Stream
Perennial Stream
Dam Wall
Contour (20m)
Farm Boundaries
Farm Portions
Dam / Lake
Non-Perennial Pan
Perennial Pan
Wetland
Universal Coal Development 1 (Pty) Ltd
DWA
Tel: +27 11 789 9495
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 29°E
Ref #: scc.UNI605.200909.010
Revision Number: 2
Date: 21/10/2009
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DE DENNE 256 IR
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LEEUWPAN 246 IR
STRYDPAN 243 IR
STOMPIESFONTEIN 273 IR
WEILAAGTE 271 IR
WELGEVONDEN 272 IR
R50
R42
R548
WITKLIPDAM
Ptn 92
Nederduitse Gereformeerde Kerk
Ptn 104
Manual de Sousa Calderia
Ptn 64
Republic of SA: National Government
Ptn 81
Republic of SA: National Government
Ptn 105
Transnet Ltd
Ptn 89
Transnet
Ptn 15
Eloff Landgoed Pty Ltd
Ptn 14
Kallie Madel Trust
Ptn 24
Eloff Landgoed Pty Ltd
Ptn 23
Eloff Landgoed Pty Ltd
Ptn 29
Eloff Landgoed Pty Ltd
Ptn 27
Eloff Landgoed Pty Ltd
Ptn 83
Eloff Landgoed Pty Ltd
Ptn 84
Ptn 113
Ptn R
Eloff Landgoed Pty Ltd
Ptn 113
Eskom Holdings Ltd
Ptn 16
Hendrik Schoeman & Seuns
Ptn 18
Hendrik Schoeman & Seuns
Brent Parrot
Ptn 82
Jozua Francois du Plessis
Jozua du Plessis
Ptn 3
Ptn R
Kallie Madel Trust
Brent Parrot
Ptn 1
Kallie Madel Trust
Brent Parrot
Ptn 16
Eloff Mining Co Pty Ltd
Riaan Joubert
Ptn 15
Eloff Mining Co Pty Ltd
Ptn 20
Eloff Mining Co Pty Ltd
Riaan Joubert
Ptn 15
Eloff Mining Co Pty Ltd
Ptn 14
Eloff Mining Co Pty Ltd
Ptn 19
Eloff Mining Co Pty Ltd
Ptn 59
Eloff Mining Co Pty Ltd
Ptn 24
Eloff Mining Co Pty Ltd
Riaan Joubert
Ptn RE of Ptn 2
Kallie Madel Trust
Brent Parrot
Ptn 18
Eloff Mining Co Pty Ltd
Ptn 23
Eloff Mining Co Pty Ltd
Ptn 33
Hendrik Schoeman Weilaagte
Brent Parrot
Ptn 17
Eloff Mining Co Pty Ltd
Ptn 9
Eloff Mining Co Pty Ltd
Eloff Mining Co Pty Ltd
Ptn R
Republic of SA: National Government
Ptn 21
Eloff Mining Co Pty Ltd
Ptn 6 of Ptn 2
Petrus Lodewikus Haefele
Peet Haefele
Ptn 44
Hendrik Schoeman Weilaagte
Brent Parrot
Ptn 5
Hendrik Schoeman Weilaagte
Ptn 7
Willem Dennis Oosterhuis
Ptn 8
Eye to Eye Trading 1 Pty Ltd
Ptn 2
Hendrik Schoeman & Seuns
Ptn R
Engelbrecht & Joubert Pty Ltd
Ptn 3
Delmas Studiegroep Trust
Ptn R
Cowenburg Boerdery
Ptn 10
JZ Moolman Boerdery
Ptn 1
Cowenburg Boerdery
Ptn 41
Holographix Prop 308 CC
Ptn 3
Holographix Prop 308 CC
Ptn 37
DSB Painting Contractors CC
Ptn 2
Eloff Mining Co Pty Ltd
Ptn 5
Eloff Mining Co Pty Ltd
Eloff Mining Co Pty Ltd
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1580
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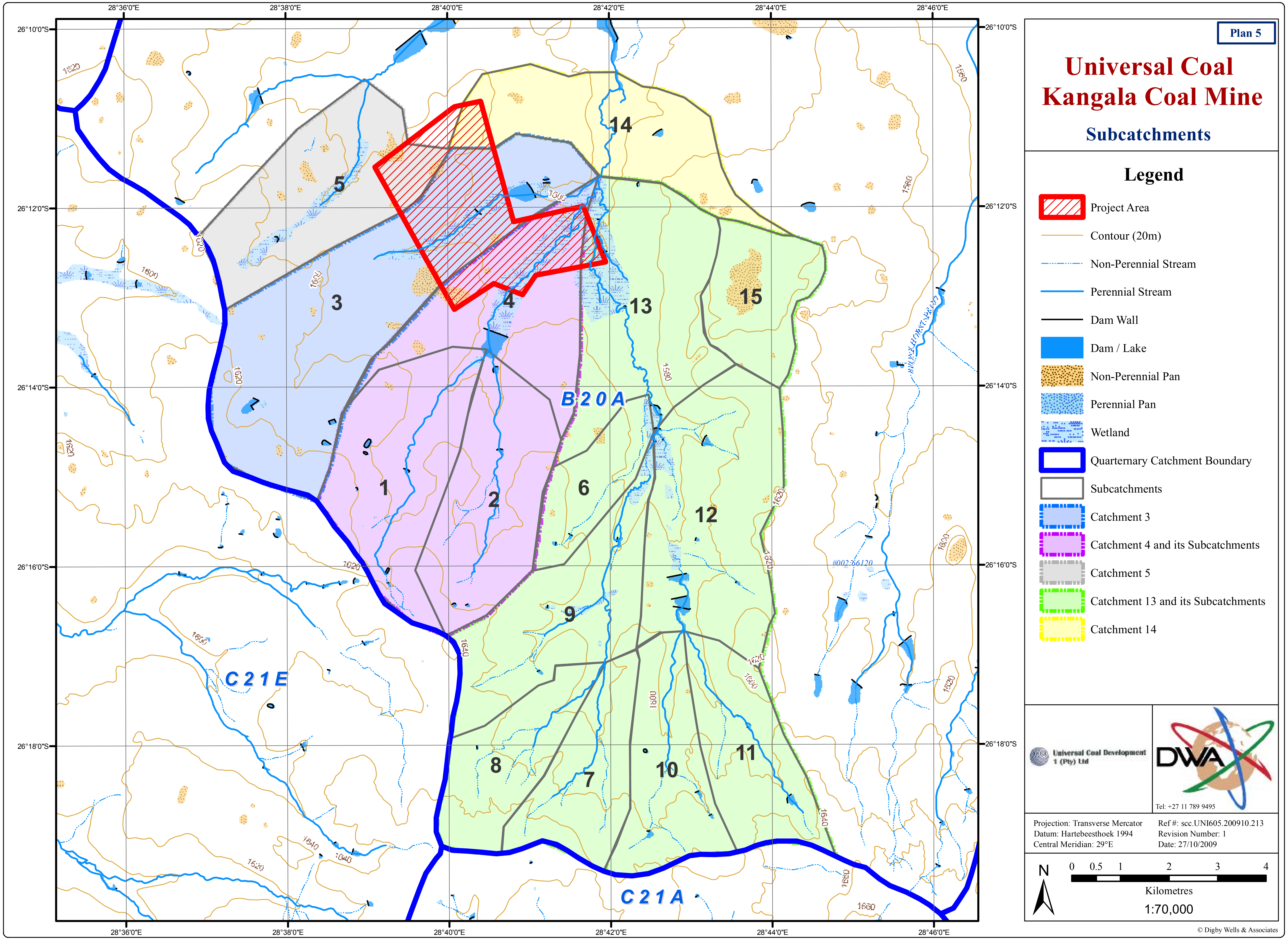
Plan 5
Universal Coal
Kangala Coal Mine
Subcatchments
Legend
Project Area
Contour (20m)
Non-Perennial Stream
Perennial Stream
Dam Wall
Dam / Lake
Non-Perennial Pan
Perennial Pan
Wetland
Quarternary Catchment Boundary
Subcatchments
Catchment 3
Catchment 4 and its Subcatchments
Catchment 5
Catchment 13 and its Subcatchments
Catchment 14
Universal Coal Development 1 (Pty) Ltd
DWA
Tel: +27 11 789 9495
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 29°E
Ref #: scc.UNI605.200910.213
Revision Number: 1
Date: 27/10/2009
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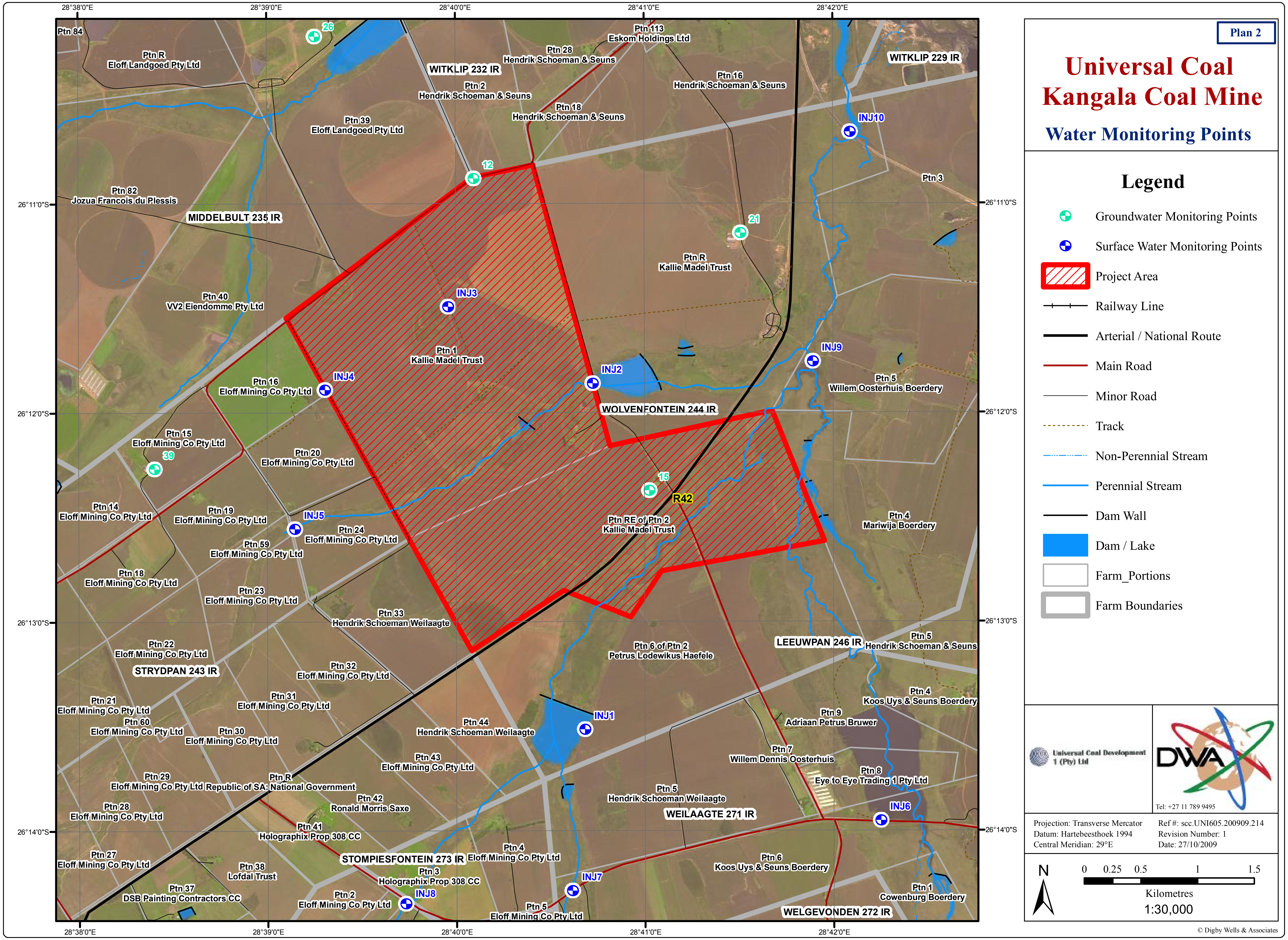

Plan 2
Universal Coal
Kangala Coal Mine
Water Monitoring Points
Legend
Groundwater Monitoring Points
Surface Water Monitoring Points
Project Area
Railway Line
Arterial / National Route
Main Road
Minor Road
Track
Non-Perennial Stream
Perennial Stream
Dam Wall
Dam / Lake
Farm_Portions
Farm Boundaries
Universal Coal Development 1 (Pty) Ltd
DWA
Tel: +27 11 789 9495
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 29°E
Ref #: scc.UNI605.200909.214
Revision Number: 1
Date: 27/10/2009
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© Digby Wells & Associates
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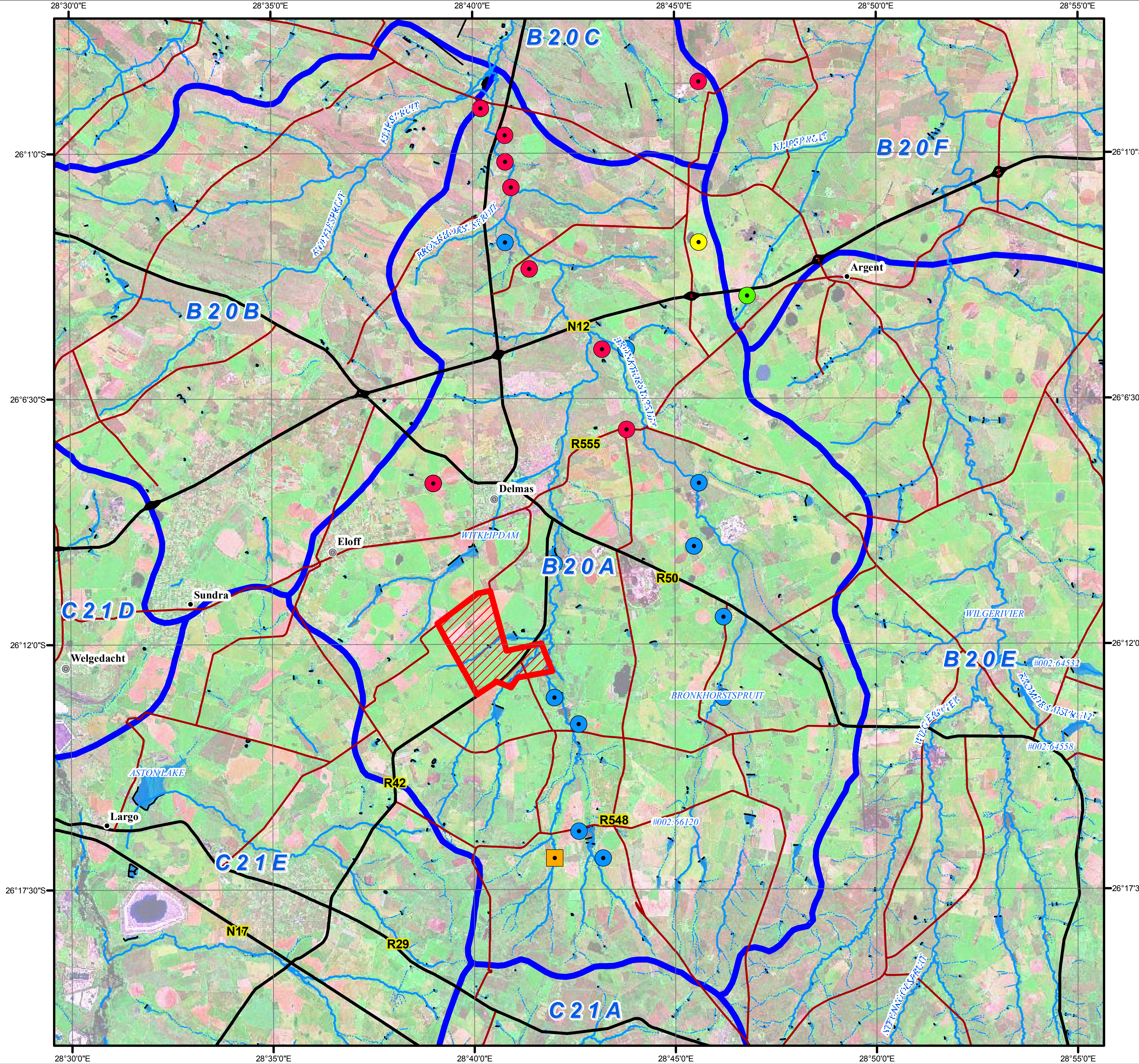
WITKLIP 229 IR
MIDDELBULT 235 IR
WOLVENFONTEIN 244 IR
LEEUWPAN 246 IR
STRYDPAN 243 IR
STOMPIESFONTEIN 273 IR
WEILAAGTE 271 IR
WELGEVONDEN 272 IR
R42
INJ1
INJ2
INJ3
INJ4
INJ5
INJ6
INJ7
INJ8
INJ9
INJ10
12
15
21
26
39
Ptn 84
Ptn R
Eloff Landgoed Pty Ltd
Ptn 113
Eskom Holdings Ltd
Ptn 28
Hendrik Schoeman & Seuns
Ptn 2
Hendrik Schoeman & Seuns
Ptn 16
Hendrik Schoeman & Seuns
Ptn 18
Hendrik Schoeman & Seuns
Ptn 39
Eloff Landgoed Pty Ltd
Ptn 3
Ptn 82
Jozua Francois du Plessis
Ptn R
Kallie Madel Trust
Ptn 40
VV2 Eiendomme Pty Ltd
Ptn 1
Kallie Madel Trust
Ptn 16
Eloff Mining Co Pty Ltd
Ptn 5
Willem Oosterhuis Boerdery
Ptn 15
Eloff Mining Co Pty Ltd
Ptn 20
Eloff Mining Co Pty Ltd
Ptn 14
Eloff Mining Co Pty Ltd
Ptn 19
Eloff Mining Co Pty Ltd
Ptn 24
Eloff Mining Co Pty Ltd
Ptn RE of Ptn 2
Kallie Madel Trust
Ptn 4
Mariwija Boerdery
Ptn 59
Eloff Mining Co Pty Ltd
Ptn 18
Eloff Mining Co Pty Ltd
Ptn 23
Eloff Mining Co Pty Ltd
Ptn 33
Hendrik Schoeman Weilaagte
Ptn 22
Eloff Mining Co Pty Ltd
Ptn 6 of Ptn 2
Petrus Lodewikus Haefele
Ptn 5
Hendrik Schoeman & Seuns
Ptn 32
Eloff Mining Co Pty Ltd
Ptn 4
Koos Uys & Seuns Boerdery
Ptn 21
Eloff Mining Co Pty Ltd
Ptn 31
Eloff Mining Co Pty Ltd
Ptn 9
Adriaan Petrus Bruwer
Ptn 60
Eloff Mining Co Pty Ltd
Ptn 30
Eloff Mining Co Pty Ltd
Ptn 44
Hendrik Schoeman Weilaagte
Ptn 7
Willem Dennis Oosterhuis
Ptn 43
Eloff Mining Co Pty Ltd
Ptn 8
Eye to Eye Trading 1 Pty Ltd
Ptn 29
Eloff Mining Co Pty Ltd
Ptn R
Republic of SA: National Government
Ptn 5
Hendrik Schoeman Weilaagte
Ptn 28
Eloff Mining Co Pty Ltd
Ptn 42
Ronald Morris Saxe
Ptn 41
Holographix Prop 308 CC
Ptn 4
Eloff Mining Co Pty Ltd
Ptn 6
Koos Uys & Seuns Boerdery
Ptn 27
Eloff Mining Co Pty Ltd
Ptn 38
Lofdal Trust
Ptn 3
Holographix Prop 308 CC
Ptn 37
DSB Painting Contractors CC
Ptn 2
Eloff Mining Co Pty Ltd
Ptn 5
Eloff Mining Co Pty Ltd
Ptn 1
Cowenburg Boerdery

Plan 5

# Universal Coal Kangala Coal Mine

## Water Use Licence Holders




### Legend

- Project Area

**Water Users**

**By Sector and Resource**

- Agriculture: Irrigation (Dam)
- Agriculture: Irrigation (Lake)
- Agriculture: Irrigation (River/Stream)
- Agriculture: Irrigation (Spring/Eye)
- Agriculture: Watering Livestock (Dam)
- Capital City
- Major Town
- Other Town
- Secondary Town
- Settlement
- Arterial / National Route
- Main Road
- Non-Perennial Stream
- Perennial Stream
- Dam Wall
- Dam / Lake
- Quarternary Catchment Boundary

Universal Coal Development 1 (Pty) Ltd

Tel: +27 11 789 9495

Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
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Revision Number: 1
Date: 27/10/2009

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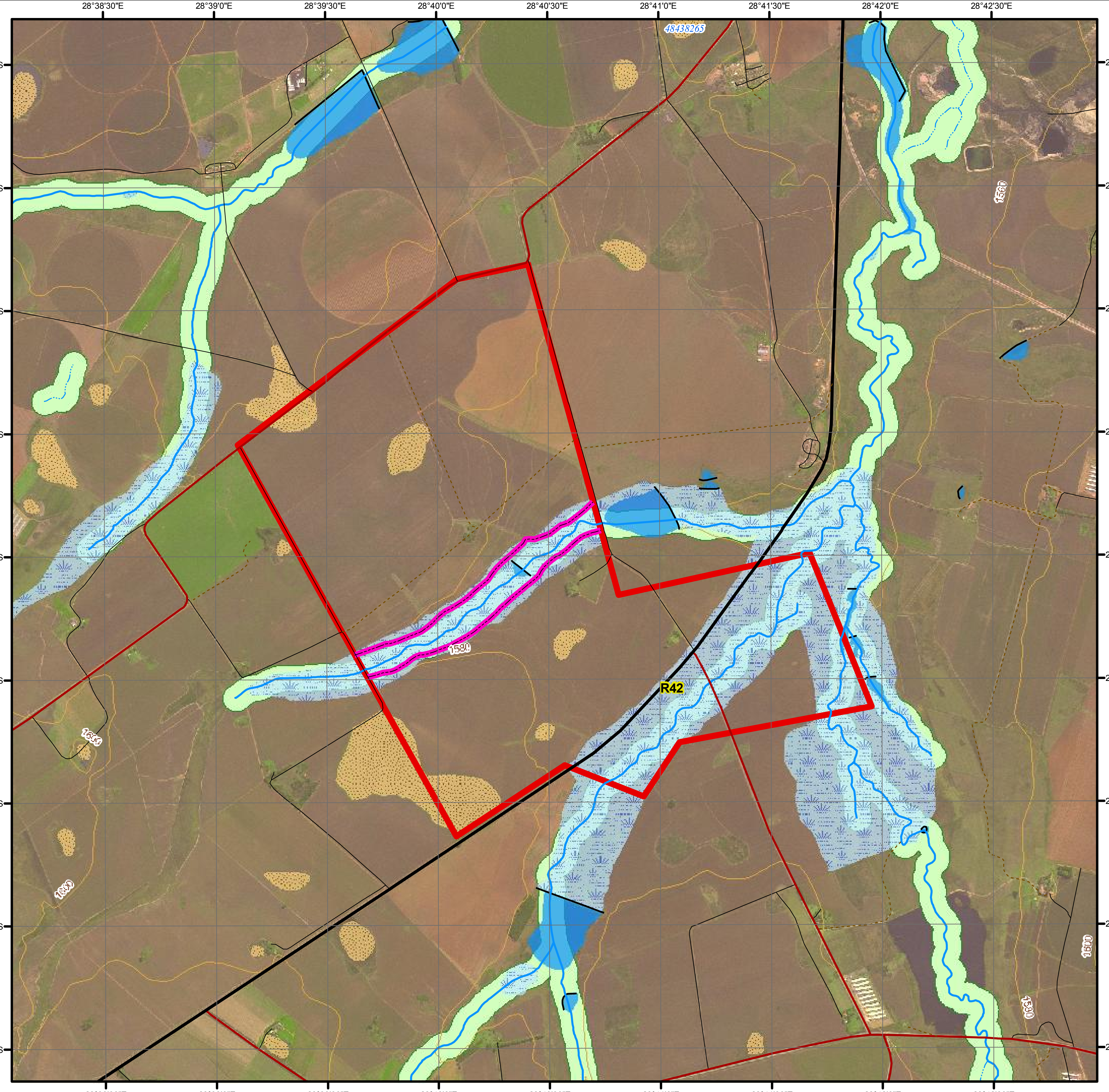


Plan 3

# Universal Coal Kangala Coal Mine

## Floodlines

### Legend

- Project Area
- Approximate 1:100 Year Floodline
- 100m Buffer of River
- Arterial / National Route
- Main Road
- Minor Road
- Track
- Contour (20m)
- Non-Perennial Stream
- Perennial Stream
- Dam Wall
- Dam / Lake
- Non-Perennial Pan
- Perennial Pan
- Wetland

Universal Coal Development 1 (Pty) Ltd

DWA

Tel: +27 11 789 9495

Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 29°E

Ref #: scc.UNI605.200909.215
Revision Number: 1
Date: 27/10/2009

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