SAMANCOR CHROME FERROMETALS

APPENDIX G: BASIC ASSESSMENT REPORT (BAR) & DRAFT EMP

DRAFT FOR I&AP REVIEW (40 Days)

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Decommissioning of 3 Slimes Dam Footprints
DEA Ref: 12/9/11/L144116/6
DEDET Ref: 17/2/3N-386
DWS Ref: 16/2/7/C231/B18/Y1/1

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Sustainable Environmental Solutions
through
Integrated Science and Engineering

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INTRODUCTION & EXECUTIVE SUMMARY

Ferrometals, a business unit of Samancor Chrome Limited, located within the Emalahleni Local Municipality and which is part of the Nkangala District Municipality of the Mpumalanga Province, produces ferrochrome at its furnaces.

In the smelting process, off-gasses are captured at the bag house plants and the dust is separated into two size fractions. Coarse dust is fed to the pelletizing plant and finer dust is treated, settled with water and the resulting slurry is pumped to the slimes dams.

The slimes classify as hazardous waste and are currently disposed of on the Ferrometals North Slimes Dam.

Prior to disposal of the slimes on the North Slimes Dam, Ferrometals operated three other slimes dams. These Historic Slimes Dams were taken out of operation in the period between 1999 and 2005, and were informally decommissioned and rehabilitated.

After detailed investigations, confirming the hazardous nature of the slimes, Ferrometals now intends to formally decommission these facilities in terms of the provisions of both the National Environmental Management Act, as well as the National Environmental Management Waste Act. The proposed project activities are detailed in a Civil Engineering Design Report.

The provisions of the listed legislation requires that a formal authorization be obtained prior to decommissioning, and that the application for decommissioning must be supported with a Basic Assessment Process, as defined in the NEMA.

JMA Consulting (Pty) Ltd (JMA) was appointed as the Environmental Assessment Practitioner (EAP) by Ferrometals to obtain the necessary environmental authorizations for the decommissioning of the three Historic Slimes Dams. These facilities are included in the Water Use License (04/B11K/709) issued to Ferrometals on the 02 April 2011.

The first step to enter this formal Basic Assessment Process was taken on the 12 of August 2014 when a Waste License Application was lodged with the Department of Environmental Affairs (DEA). The Application was accepted on 17 September 2014 - Reference Number 12/9/11/L44116/6.

An Application for Environmental Authorisation (Basic Assessment) was also lodged with the Department of Economic Development, Environment and Tourism (DEDET). The Application was accepted on 28 August 2014 - Reference Number 17/2/3N-386.

In addition, a pre-Application/ Consultation meeting was conducted with the Department of Water and Sanitation (DWS) on 13 November 2014 where the decommissioning and rehabilitation design approach and methodology for the three Historic Slimes Dams were discussed. The proposed design was accepted by DWS on 24 November 2014 - Reference Number 16/2/7/C231/B18/Y1/1.

The Waste License Application submitted to decommission these Historic Waste Disposal Facilities, together with the Basic Assessment Process, is based on, and supported by, the outcomes of *inter alia* an environmental impact assessment, a detailed waste classification assessment and a civil engineering design study.

The engineering study includes the assessment of feasible and reasonable alternatives, as well as preliminary civil engineering designs compiled to give compliance with regulatory requirements and best practice guidelines for the decommissioning and closure of Hazardous Waste Management Facilities.

This report represents the Basic Assessment Report (BAR) and Draft Environmental Management Plan (EMP) compiled in terms of the EIA Regulations of 2010, for submission to the Mpumalanga Department of Economic Development, Environment and Tourism.

The Basic Assessment Report was compiled in strict adherence to the Departmental Requirements as listed in SECTION D of the BAR Template provided by the Department.

Respectfully submitted

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Jasper L Muller (Pr.Sci.Nat.)

1. EXISTING ENVIRONMENT/POTENTIAL IMPACTS

Section D1 of the Basic Assessment Report Template requires a description of the environment that may be affected by the proposed activity and the manner in which the geographical, physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity.

1.1 THE CURRENT ENVIRONMENTAL SETTING

The proposed project comprises the decommissioning and closure of three Historic Slimes Disposal Facilities on the currently active Ferrometals site, located in the industrial area of Ferrobank, due west from the Town of Emalahleni in Mpumalanga.

In view of the fact that the Ferrobank industrial area has been in existence for at least 60 years, it is obvious that the current environment can be only described as brown fields.

Ferrometals can be classified as a heavy industry and the infrastructure and processes developed and which are currently in operation on the site itself, as well as in the surrounding industrial area, has changed the original geographical, physical, biological, social, economic and cultural aspects of the site in an irreversible fashion.

The site is also surrounded by now defunct shallow underground coal mining activities which effectively destroyed the ground water resources in the shallow weathered zone aquifers in the area.

Against this background, a synoptic description of the environment that may be affected and the manner in which the decommissioning and closure of the three Historic Slimes Dams may impact the environment will now be given.

1.2 THE EXISTING ENVIRONMENTAL BASE LINE

The map depicted in Figure 1.2(a) shows the Ferrometals site and its surroundings. The three Historic Slimes Dams to be decommissioned are highlighted.

The brown fields nature of the Ferrometals site, fully surrounded by industrial and defunct mining operations, is clearly evident.

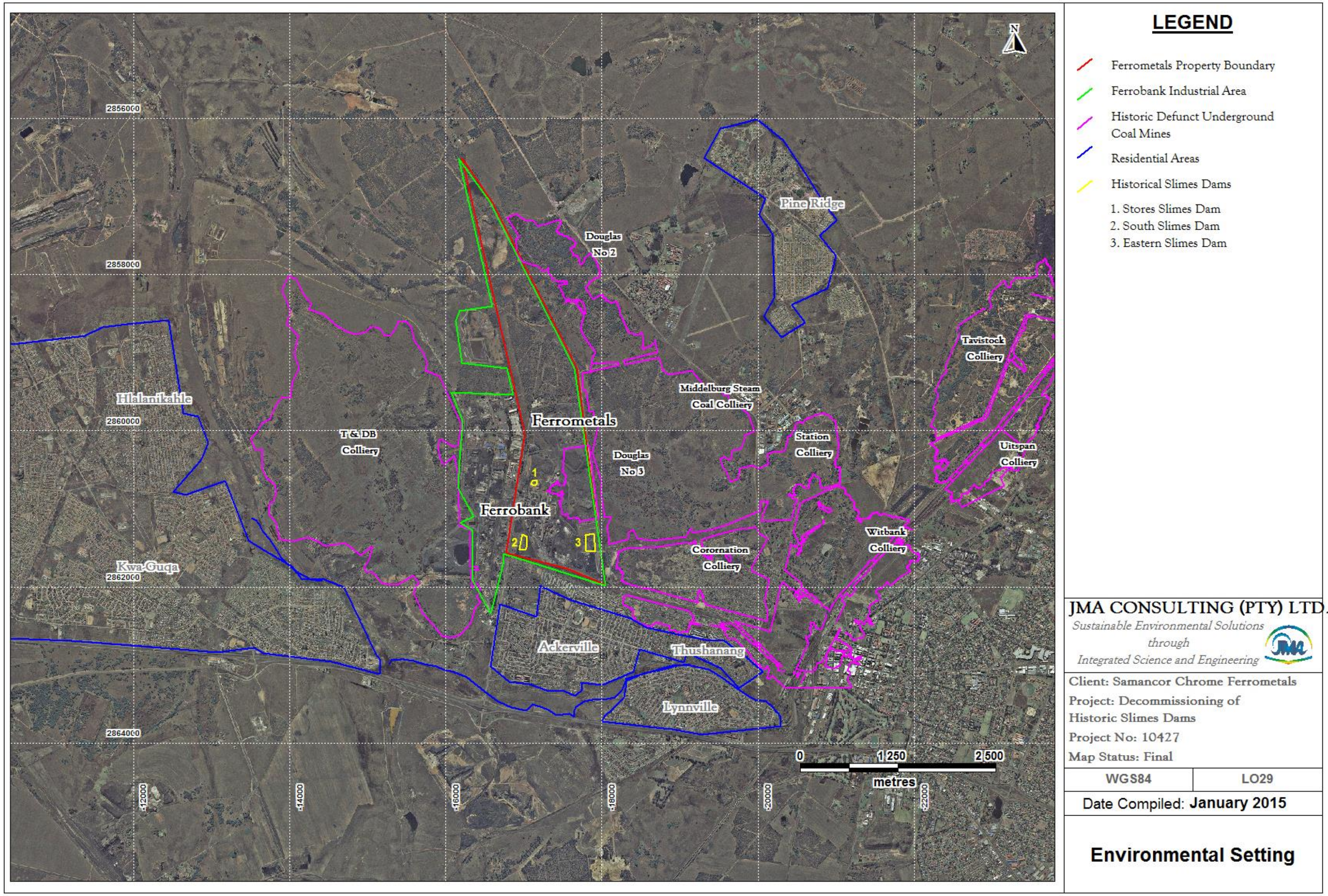

Figure 1.2(a): Environmental Setting of the Ferrometals Site

1.2.1 Socio-Cultural Environment

The three historic sites to be rehabilitated and closed are located within the site perimeter fence of the Ferrometals site located in Ferrobank, an area developed and zoned for heavy industrial activities.

The Ferrobank industrial area is bounded to the south by the west-east N4 highway, which connects Pretoria and Emalahleni, and which continues to Nelspruit and beyond towards Mozambique.

The Ferrobank industrial area is surrounded by formal and informal residential settlements, defunct underground coal mining activities and very restricted agricultural activities to the far north.

The current socio-cultural situation in the area is typical of that found in proximity to mining and industrial development. The current socio-cultural situation is deemed to be in harmony with the Ferrobank industrial area and actually developed to a large degree as a result of the existence of the Ferrobank industrial area, the proximity of Emalahleni, as well as the existence of the general mining and industrial activities of the region.

1.2.2 Socio-Economic Environment

Similar to the socio-cultural situation, the socio-economic environment in which the Ferrometals Site is located is typical of that found in highly developed mining and industrial zones. From a socio-economic perspective, Emalahleni and its surrounding areas are primarily dependent on mining and its associated industries. Although agriculture does play a part in the greater Emalahleni area, Ferrobank and the people living in the area, are as such, totally dependent on mining and industrial activities for a livelihood.

1.2.3 Heritage and Paleontological Resources

From a cultural heritage perspective, Ferrobank and the areas surrounding it, also represents an impacted environment due to the extensive mining and industrial activities. A detailed site survey conducted by a specialist Archaeologist on the Ferrometals site itself, confirmed that no heritage resources are present in the study area.

A paleontological desktop assessment of the site by a specialist palaeontologist concluded that although fossils may be present in the Karoo rocks underlying the site, the decommissioning of the three historic slimes facilities is unlikely to significantly impact paleontological resources.

These assessments conducted for the purposes of an EIA Assessment at Ferrometals, have been submitted to SAHRA for consideration and their response and recommendations are attached in **APPENDIX 1.2.3**. The SAHRA response confirms that based on the information generated, it is unlikely that the closure of the three historic slimes facilities will impact on any heritage/paleontological resources. The recommendations will be included in the EMP.

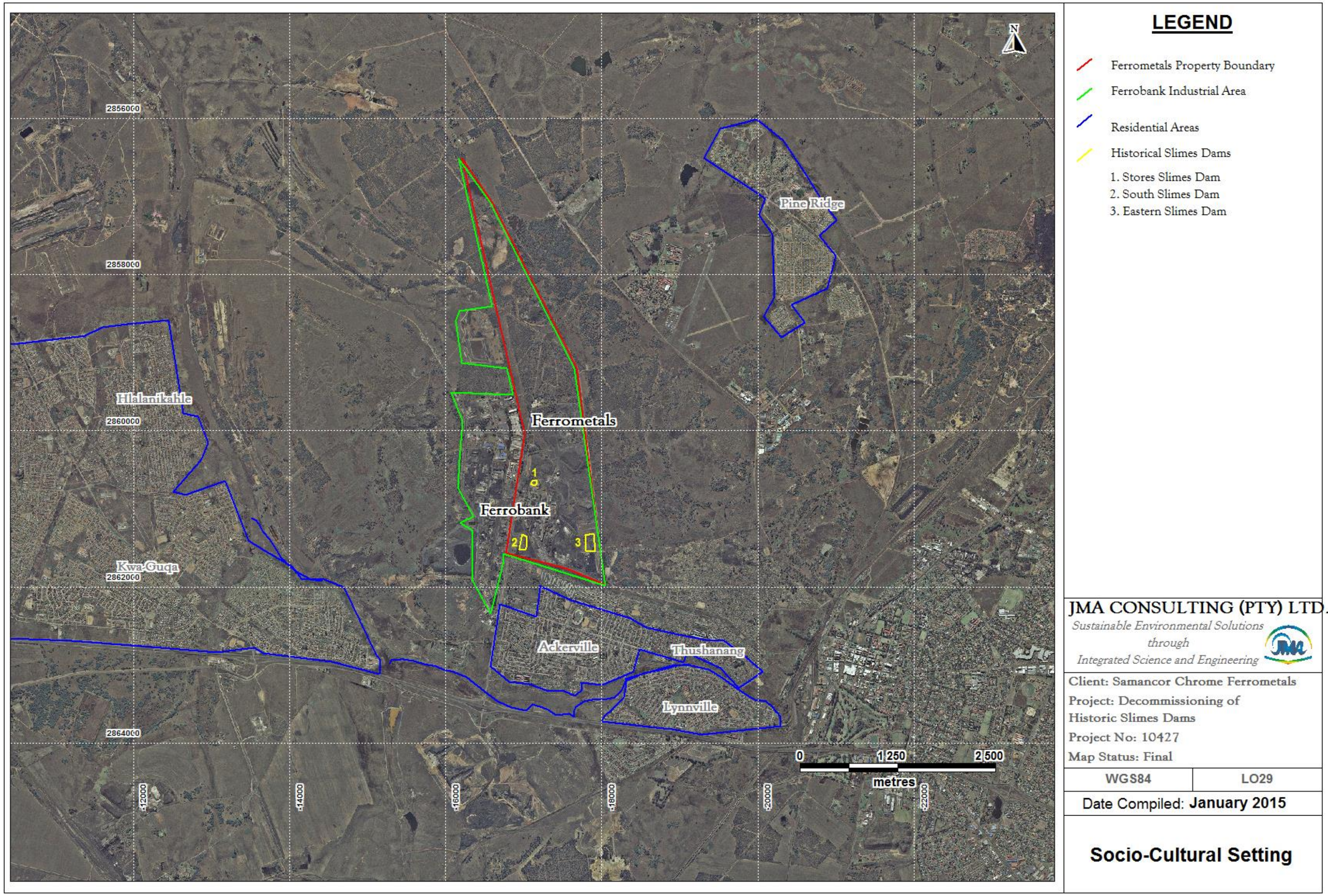

Figure 1.2.1(a): Socio-Cultural Setting of the Ferrometals Site

1.2.4 Climate

Regional Climate

The Emalahleni area is located on the Highveld plateau characterised by an undulating landscape without significant hills or ridges. The area has a typical Highveld climate with warm summers and cold winters and frost is experienced on average approximately 30 days per year. The average daily summer temperatures are moderate (average 24.5°C) due to the elevation above sea level, which also results in low average winter daytime temperatures (19.2°C).

Ferrometals is located within the B11K quaternary catchment, which has a Mean Annual Precipitation (MAP) of 684 mm/annum and a Mean Annual Evaporation (MAE) of 1700 mm/annum resulting in the site having a negative climatic balance. Although there is also a distinct seasonal variation the monthly evaporation is much more evenly spread during the year as opposed to the monthly rainfall distribution.

The dominant wind directions are: northerly, westerly, east- and east-south-easterly. Wind speeds that are 210 m/s or more are mainly from the east and east-south-east. Calm conditions (wind speeds <1 m/s) occur approximately 7.4% of the time. The strongest winds are recorded during autumn and winter. During the summer months, the primary wind direction is from the north or east, during autumn winds mostly occur from the east, while during winter the primary wind direction is from the south. There are a high percentage of wind calm periods, mostly during dry months. Wind direction is very important when the location of industrial areas or waste water works is considered, in this regard the Ferrobank industrial area is very suitably located.

Rainfall

The study area falls within a summer rainfall region, with over 70% of the annual rainfall occurring during the October to February. The mean annual precipitation (MAP) at Ferrometals is taken as 740 mm/annum, which is slightly higher than the average MAP for the B11K quaternary catchment.

The monitoring station situated at 'Witbank Municipality' (0515412) has data from recorded for longest period of time (January 1913 to July 2000) compared to the other stations located in the study area. The data recorded at this monitoring station is therefore used as the primary source of rainfall data. The statistical analysis of the 24 hour rainfall events as recorded for the study area is depicted in the Table below.

Statistics	24 Hour Rainfall (mm)
50th Percentile	0
75th Percentile	0
95th Percentile	13.6
99th Percentile	33.8
Maximum	126

The recorded rainfall data indicates that the site is not prone to high rainfall intensities. Over the 87 years of daily rainfall analysed, the 50 year recurrence interval 24 hour storm event rainfall depth of 115 mm (Adamson, 1981) was exceeded on only three occasions.

The 100-year recurrence interval, 24 hour storm event rainfall of 131 mm (Adamson, 1981) has never been exceeded within the recorded period which points towards the absence of abnormal storm events.

Evaporation

The mean annual evaporation (MAE) at Ferrometals is taken as 1650 mm/annum, which is slightly lower than the average MAP for the B11K quaternary catchment.

Based on the MAP (740 mm/annum) and MAE (1 650 mm/annum) assigned to the Ferrometals site it is evident that the site has a **negative climatic water balance**.

1.2.5 Topography

The 5 m interval topographical contours for the greater study area are shown in Figure 1.2.5(a). The Ferrometals site is located immediately west of the surface topographical divide between the Klipspruit to the west and the Blesbokspruit to the east.

The topography in the area of interest slopes from east to west at a surface gradient of approximately 1:55 which equates to some 1.8%.

Natural storm water run-off from the site will also run in a westerly direction towards the Klipspruit. However, the Ferrometals site being located in a formally developed industrial area, storm water leaving the premises will most probably be intercepted by the municipal storm water drainage system.

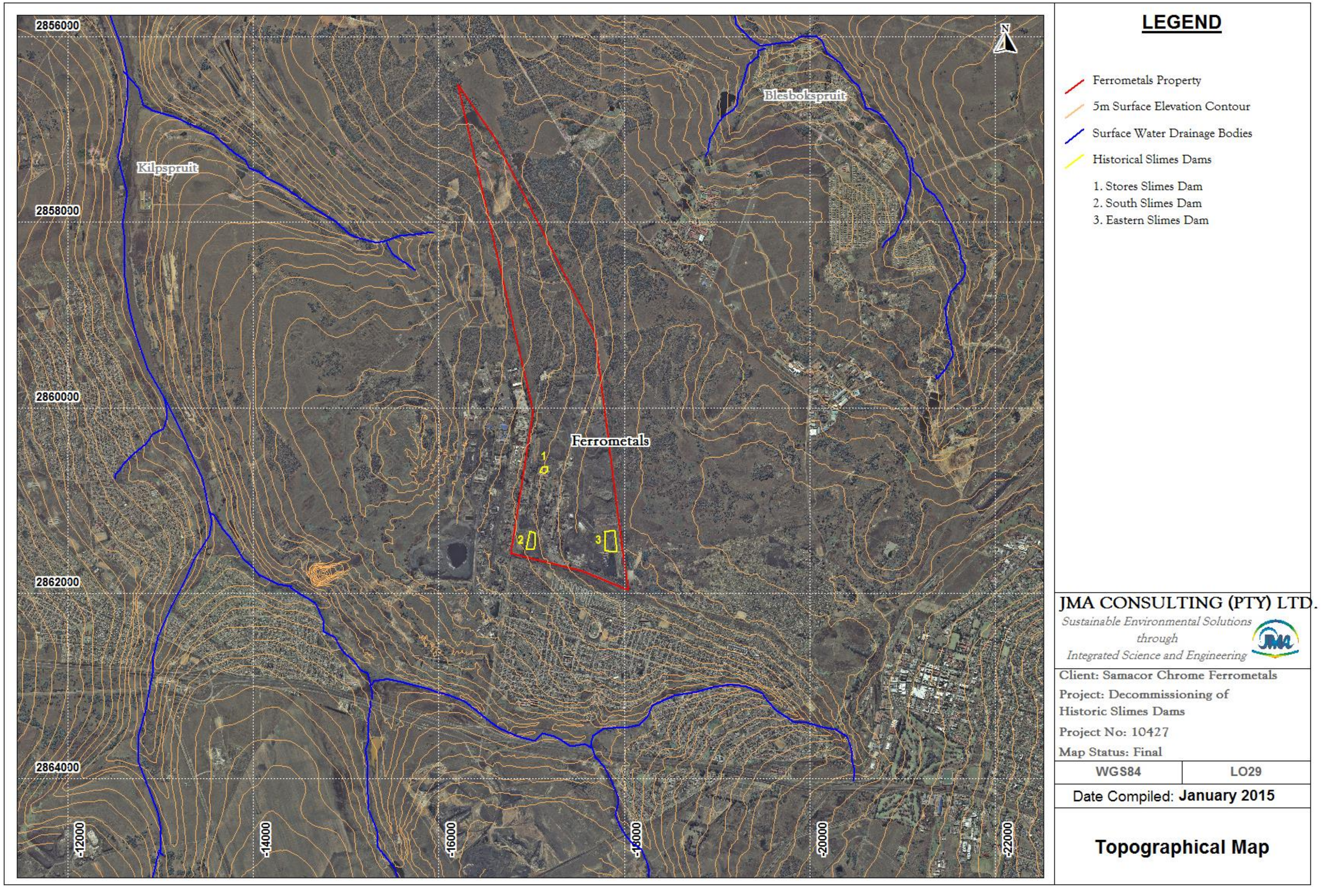

Figure 1.2.5(a): Topographical Setting of the Ferrometals Site

1.2.6 Soils

The natural soils present at Ferrometals are derived from the in situ decomposition of shale and subordinate sandstone and coal measures of the Vryheid Formation, Ecca Group, Karoo Sequence. Percussion drilled monitor boreholes on the site provide the deep sedimentary section beyond that observed during the test pitting phase (< 3m) and the DPSH penetration tests conducted during a geotechnical survey for the development of the new slimes dam.

The borehole data also provided the underlying geology which provided the basis for DPSH refusal – which was accepted to be hard sedimentary bedrock of either Vryheid shale or sandstone. The average soil and bedrock profile as estimated from the test pitting, penetration tests and monitor borehole data is given in the Table 1.2.6(a) below.

Table 1.2.6(a): Average Soil and Bedrock Profile.

Soil/Bedrock Profile	Origin	Ave. Thickness (m)	Depth Range from – to (m)
Loose to very loose brown-maroon recent soil	Silty/clayey sand of Various Origins	4	Surface to 4
Stiff brown-maroon clayey residuum grading into hard light beige-ivory sandy residuum	Derived from in situ decomposed shale	6	4 - 10
Beige shale intercalated with ivory coloured medium to course sandstone	Sediments of the Vryheid Formation	5	10 - 15
No. 2 Coal Seam,	Coal measures of the Witbank Coal Field	5	15 - 20
Beige to brown medium grained sandstone with grey shale lenses	Vryheid Formation sediments	5	20 - 25
No. 1 Coal Seam	Coal measures of the Witbank Coal Field	1	25 - 26
Beige – ivory sandstone	Vryheid Formation	4	26 - 30

1.2.7 Land Capability

The land capability for the Ferrometals site has been irreversibly altered to that of man-made soils, thus compromising the natural land capability of the original soil profile.

1.2.8 Land Use

The surrounding land use is predominantly mining, industrial and residential. eMalahleni is a coal mining area with 22 Collieries in an area no more than 40 km in any direction. There are also a number of power stations, a steel mill (Highveld Steel) and Vanadium Corporation nearby. The KwaQuqa residential areas are situated to the south and west of Ferrometals (approximately 6 km away). The village of Clewer is approximately 10 km to the south west of Ferrometals.

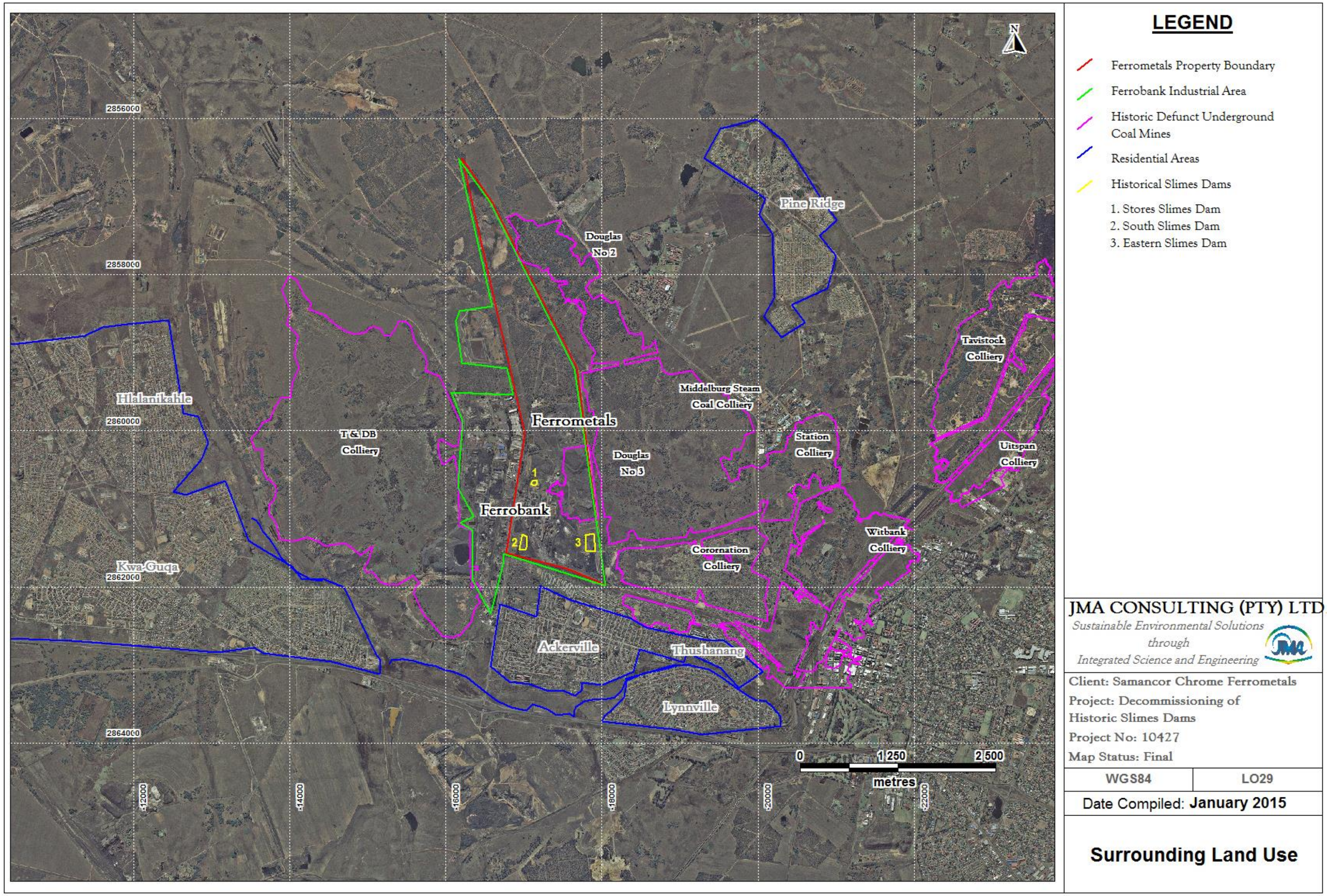

Figure 1.2.8(a): Land Use for the Ferrometals Site and its Immediate Surrounds

1.2.9 Geology

The geology underlying the Ferrometals site comprises of sediments of the Ecca Group (denoted as “Pe”) which forms part of the Karoo Supergroup (Figure 1.2.9(a)).

The sedimentary rocks of the Karroo Supergroup are underlain by the glacial tillites of the Dwyka Formation, sediments (sandstones and conglomerate) of the Waterberg Group as well igneous rocks of the Bushveld Igneous Complex. The geology underlying the site forms part of a slight north-west striking anticlinal structure with dips at around 2° towards the west below the western part of the site and at even lower dip angles to the east below the eastern part of the site.

Dolerite intrusions such as dykes are not common in this part of the Witbank Coalfield and no known faults cross the Ferrometals site. Near the surface, the Ecca sedimentary rocks have been weathered to soil and clay, ranging between 0 m and 16 m in depth with and average thickness about 5 m. Thick clay layers, with depths of up to 15 m below surface have been reported, especially in the south-western regions of the site. The weathering depth varies between 0 m and 28 m with an average weathering depth of about 13 m.

The site is located within the Springs-Witbank Coalfield and numerous mining operations have been undertaken adjacent to and in some places below the Ferrometals site. The so-called “No 1” and “No 2” coal seams occur throughout the study area. The sediments of the coal bearing Ecca group of the Karoo sequence were deposited on an undulating pre-Karoo floor. This had a significant influence on the nature, distribution and thickness of many of the sedimentary formations, including the coal seams.

A map delineating the extent of the mining operations is depicted as Figure 1.2.9(b). It is important to note that portions of the Ferrometals site have been undermined as well (Figure 1.2.9(b)). The mining operations are defunct and surface subsidence as a result of the mining operations is visible at the surface predominantly to the east of Ferrometals.

Mining activities on the No.1 and No.2 coal seams in the Blesbokspruit and Brugspruit catchments, started some 100 years ago. Ferrometals is flanked to the west by the old Transvaal and Delegoa Bay Mine (T. & DB Colliery), is further partially underlain by the old Douglas No.3 Colliery and flanked to the east by the old Douglas No.1, and 2, Middelbult Steam, Coke and Coronation Collieries (Figure 1.2.9(b)).

Although underground mining ceased in the late 1940's and early 1950's, some mining activities of fringe coal took place between the mid-1970's and mid-1990's. Some mining activities are also currently taking place. The No.2 coal seam floor elevations for the greater Ferrometals area slopes from a northwest-southeast orientated ridge (1534 -1552 mamsl) along the central Middelbult Steam & Coke and Coronation Collieries, westwards in the direction of the old Transvaal and Delgoa Bay Mine (T. & D.B.), towards elevations ranging between 1467 and 1487 mamsl along the western bounds of this mine before eventually outcropping along the downslope to the Blesbokspruit.

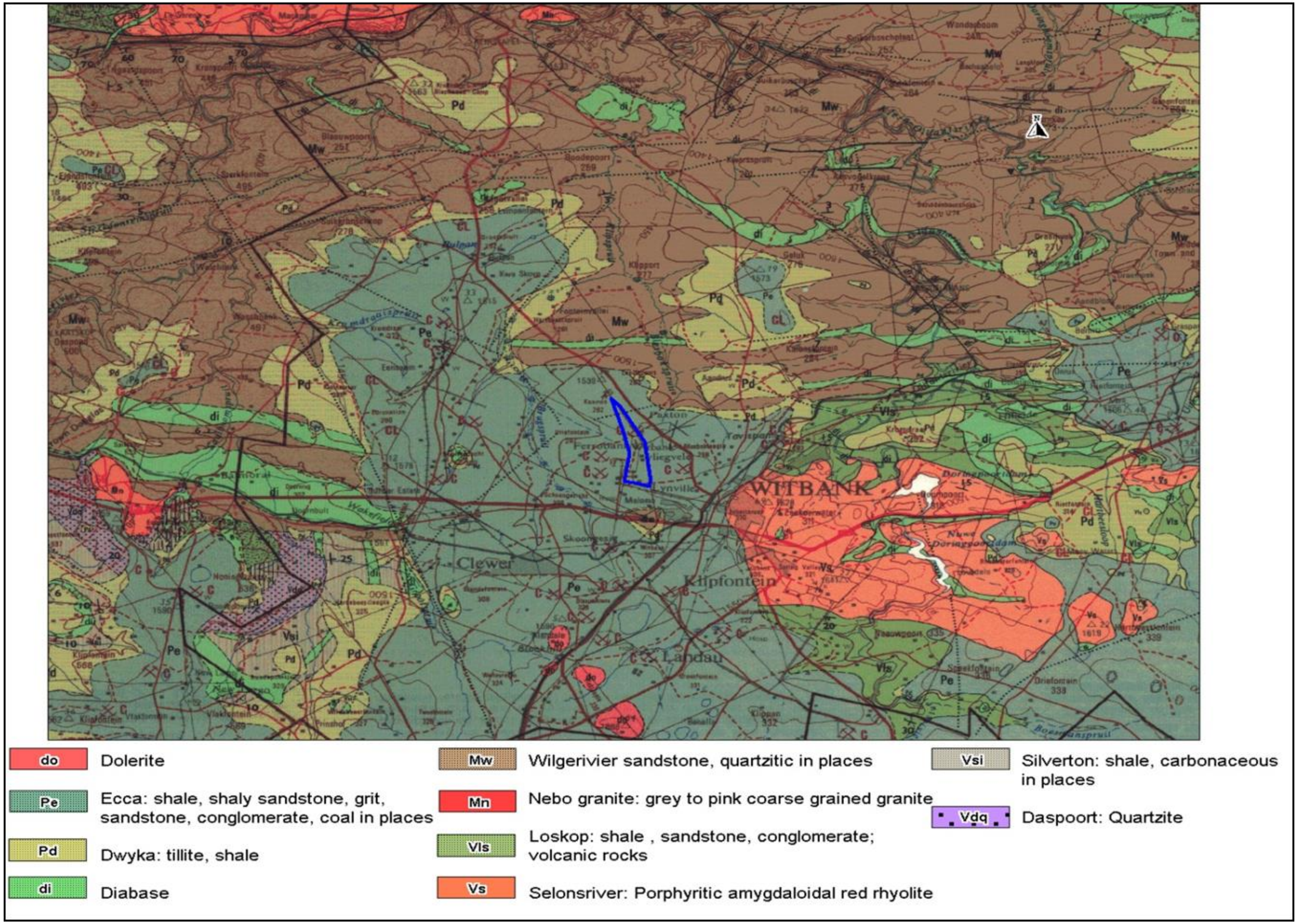

Figure 1.2.9(a): Regional Geological Map (1:250 000 Geological Map – Sheet 2528 Pretoria)

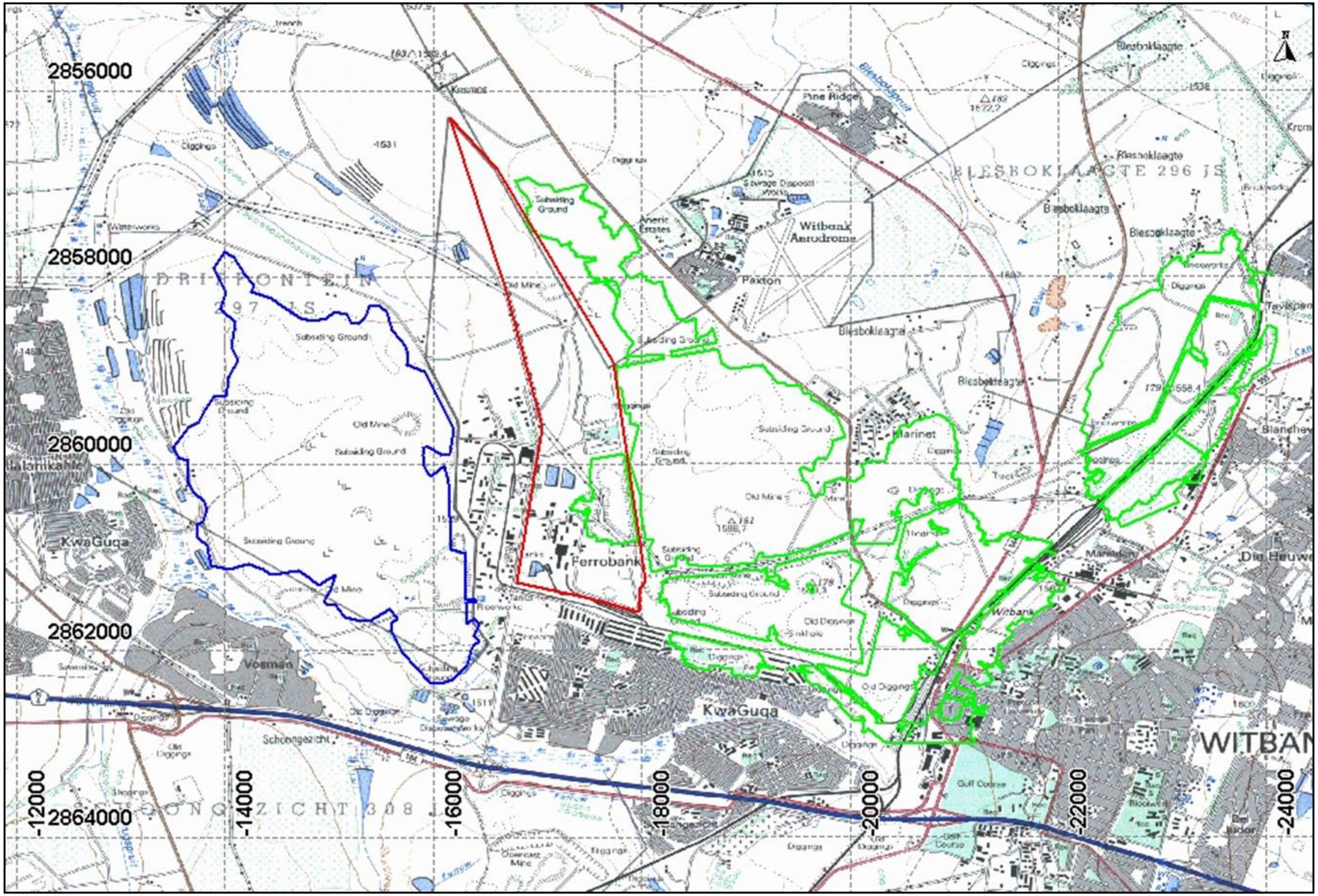

Figure 1.2.9(b): Defunct Underground Coal Mines Layout Map – See encroachment onto Ferrometals Site

1.2.10 Ground Water

A detailed quantitative geohydrological study was conducted during 2013 in order to support the waste license application for the proposed new Slimes Dam at Ferrometals.

Physical Aquifer Description

The regional aquifer host rock comprises primarily of sediments of the coal bearing Ecca Group. Based on the setting two types of aquifers are expected to exist at Ferrometals, namely:

- Shallow perched aquifer(s).
- Shallow weathered zone aquifers.

The geohydrological conditions at Ferrometals were quantitatively determined during the drilling of 37 geohydrological information and groundwater monitoring boreholes. The boreholes were drilled to investigate the occurrence of, as well as the conditions of and within the perched aquifers as well as the weathered zone aquifers, if present. 17 boreholes were drilled to specifically assess the perched aquifer conditions, 18 boreholes were drilled to assess the weathered zone aquifers and 2 boreholes were drilled into the underground mining operations underlying the site.

The localities of the 17 Perched Aquifer (FSS) Boreholes, 18 Weathered Zone Aquifer (FSD) Boreholes and the 2 boreholes (FSM) drilled into the underground mining operations are indicated on Figures 1.2.10(a), 1.2.10(b) and 1.2.10(c) respectively.

In addition to the information obtained from the 37 boreholes drilled at Ferrometals, the information obtained from 91 boreholes, drilled to varying depths (10.3 m – 42 m) adjacent to Ferrometals was used as well. The information recorded at these boreholes includes borehole depths, water strike depths and yields, lithologies penetrated as well as the aquifer permeability.

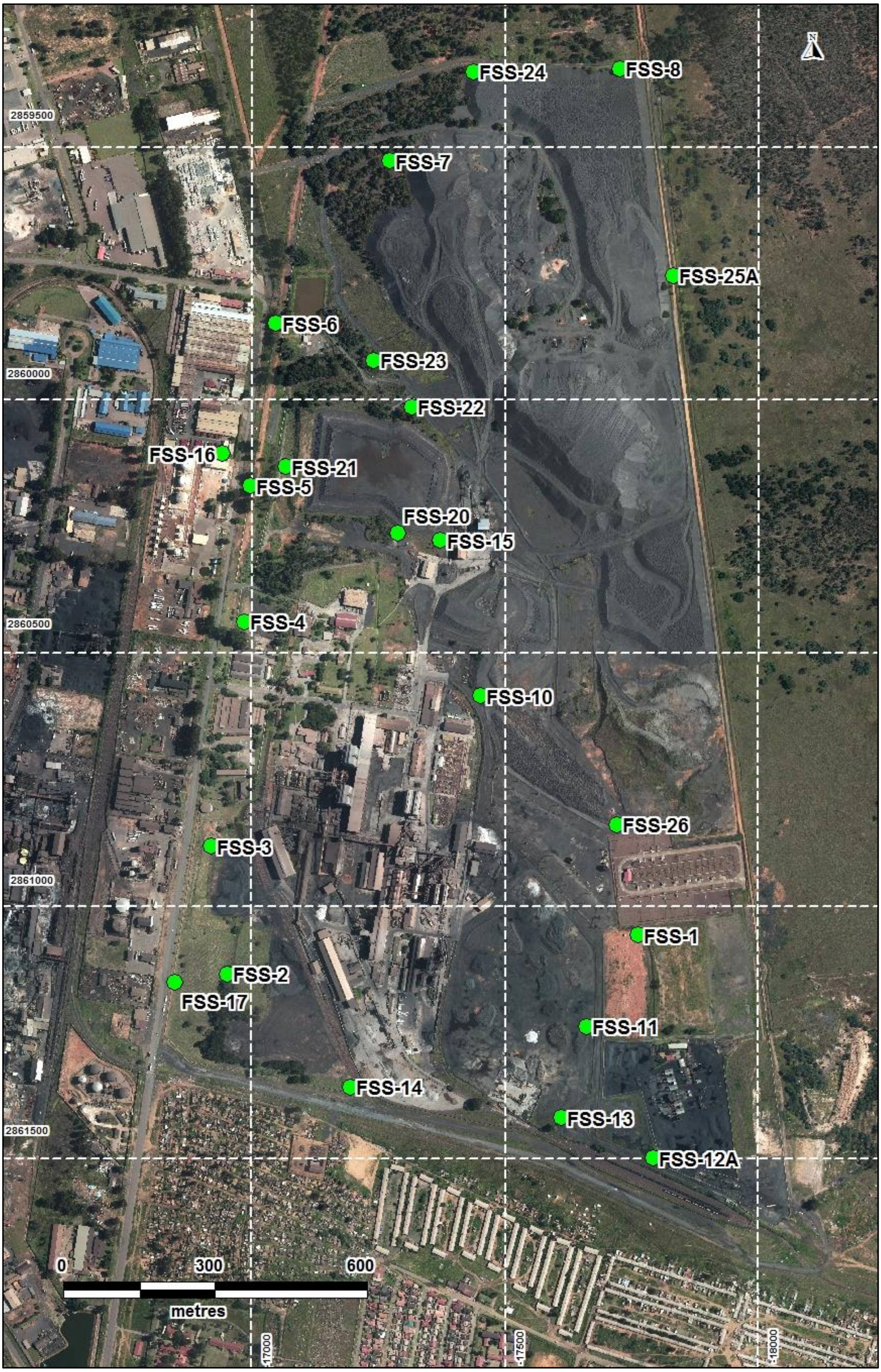

Figure 1.2.10(a): Shallow Perched Aquifer (FSS) Borehole Localities

Figure 1.2.10(b): Shallow Weathered Zone Aquifer (FSD) Borehole Localities

Figure 1.2.10(c): Localities of the Boreholes drilled into the Underground Workings

The purpose of the FSS and FSD boreholes was to generate geohydrological data, pertaining not only to the determination of local aquifer characteristics, but also to investigate/confirm the presence of any possible preferential flow zones as well as any sources that could have an impact on the groundwater. The onsite disposal and storage facilities were used as guidance for the selection of borehole localities.

The FSS and FSD boreholes were drilled in close proximity to one another, to serve as borehole pairs. This was done in order to optimally distinguish between perched aquifer and weathered zone aquifer conditions.

The FSS boreholes were drilled to depths of up to 5 m below the surface and did not penetrate through the underlying clay layer(s). The FSD boreholes were drilled to depths of 30 m below the surface and were isolated from any potential perched aquifers.

Based on the information obtained during the drilling operations, the following has relevance with regards to the perched and weathered zone aquifers at Ferrometals:

- The perched aquifer(s) present exist within the soft overburden zone and can therefore be described using the soil profiles observed during the drilling of the Perched Aquifer(s) monitoring boreholes (FSS-) and the deeper weathered zone aquifer monitoring boreholes (FSD-).

  The soil profile underlying the Ferrometals site ranges between 0.5 m - 15 m and has an average thickness of approximately 5.16 m and comprises of isolated thick clay layers with depths up to 15 m as well.

  These clay layers have very low permeabilities and when they occur at the base of the soft overburden this horizon represents the perched aquifer zone. These perched aquifers are isolated and do not occur across the entire footprint of the site.

- The weathered zone aquifers present in the study area, comprise of overburden, soil and clay at depths of between 0.5 m and 15 m, followed by layers of weathered sandstone, shale and in some places coal, which become less weathered and fractured with depth. The average weathering thickness observed in boreholes in the area is calculated as **12.45 m**. The bottom of the weathered zone aquifer is located at the interface between the fractured and fresh host rock lithologies.

These aquifers are hydraulically highly heterogeneous, as the varying degree of weathering of the different lithological units, result in a large variety of physical and hydraulic end products e.g. sand, clay and fractured shale etc. The old mine workings area also adds to the heterogeneity of flow in the aquifer. These aquifers are however laterally very extensive and occur below the entire footprint area of the site.

Hydraulic Aquifer Description

Based on the information recorded during the drilling of the boreholes and subsequent hydrogeological conditions of the boreholes, two hydraulic aquifer conditions occur, namely:

- Unconfined Aquifers, comprising of the Perched Aquifer(s).
- Semi-Unconfined Aquifers comprising of the Weathered Zone Aquifers.

Aquifer Permeability and Transmissivity

The permeability of the weathered zone aquifers were determined by means of slug tests performed at the various FSD monitoring boreholes. A summary of the calculated aquifer permeabilities are indicated in Table 1.2.10(a).

Table 1.2.10(a): Aquifer Permeability Summary

	Aquifer Permeability (m/day)
Minimum	0,001
Maximum	3,340
Mean	0,534
Variance	1,093
Harmonic Mean	0,007
Geometric Mean	0,056

It is generally accepted to assume that the permeability of shallow weathered zone aquifers will be a value bounded by the calculated harmonic mean and the geometric mean. A permeability value of **0.03 m/day** is therefore considered to be representative of the weathered zone aquifer at Ferrometals.

The transitional zone between the shallow weathered zone aquifer and the fresh host rock underneath is generally characterized by fractures with high permeabilities, separated by zones of low permeability. High permeability values of 3.0 m/day, encountered for two boreholes, have been included in this analysis. These value variations are typical of fractured Karoo aquifers.

Aquifer Porosity

The porosity of the aquifer host rock, together with the permeability and the groundwater gradient, governs the actual ground water seepage velocity. Regionally the porosity is anticipated to be highly variable. The inherent variability is a function of the following:

- The composition of the host rock/formation.
- The weathering/fracturing status of the host rock.

The porosity of the aquifers at Ferrometals was not quantified (core drilling is required to do so) during the field investigations. Literature values for porosity for the geological formations forming the aquifer host rock of the shallow weathered zone aquifers in the study area, puts porosity in a range varying between 1% and 10%.

The porosity of fresh shale will probably be in the region of 1%, while it will increase, with increasing weathering, to about 10%. The porosity value for fresh sandstone is in the region of 5-30%, 25-50% for weathered sandstone.

A porosity value of **3%** is realistic as an average for the study area. Where mining has disturbed the geology, the porosity may be as high as up to 30%.

Aquifer Storativity

The aquifer storativity is measure of how much water can be abstracted from a ground water system over the long term. This aquifer parameter is of great significance during the assessment of long-term aquifer potential. It also influences the aquifer classification, which of course reflects on the strategic value of the aquifers in the study area. Furthermore, it becomes important during pollution remediation feasibility assessments.

No tests were conducted to quantify the storativity of the aquifer zone at Ferrometals. Theoretical storativity values for the aquifer types as which occur at Ferrometals range between **0.001** and **0.005** and can be expected at Ferrometals.

Aquifer Yields

The aquifer yields were recorded during the drilling of the each of boreholes at as well as adjacent to Ferrometals.

Twenty six out of sixty three boreholes on the Vantra industrial site and Blesbokspruit mining area adjacent to Ferrometals yielded water ranging between 0.01 l/s and 25.5 l/s, the average yield being **2.14 l/s**. The water strike intersection depths at these boreholes ranged between 2.5 m and 23 m, the average depth being **12.91 m**.

Nine of the thirty-seven boreholes drilled at Ferrometals yielded water ranging between 0.13 l/s and 5.0 l/s, with an average yield calculated as **1.35 l/s**. The water strike intersection depths at these boreholes ranged between 6 m and 27 m, the average depth being **13.5 m**.

The higher yields observed and recorded in boreholes FSD-6 and FSM-2, can mostly be associated with the pond being situated next to borehole FSD-6, and in the case of FSM-2, with the borehole being situated in the abandoned mine workings area, which is mostly filled up with water.

Recharge

The volume of rainfall that can potentially recharge to the underlying aquifers is mainly a function of the following: Topographic Gradient; Rainfall Distribution and Intensity; Soil/Surface Characteristics; Vegetation Cover as well as the Aquifer Type.

The following parameters further play an important role in determining the site specific recharge figures:

- Geology, with specific reference to dolerite dykes and mined out subsidence areas.
- Depth of weathering.

Based on the geological environment, depths to the water table, rainfall conditions, climate, topographical slopes and aquifer permeabilities, recharge to the underlying aquifers at Ferrometals is expected to vary between 3% and 5% of the MAP.

Working with an average MAP of 740 mm/annum, this equates to an annual recharge to groundwater resource of between **22 mm/annum** and **37 mm/annum**.

Lateral Aquifer Boundaries

Two types of lateral aquifer boundaries are anticipated to exist within the Ferrometals site's zone of influence, namely:

- Physical Aquifer Boundaries - These include impermeable dolerite/diabase dykes and sills, or other geological discontinuities, for example where layers pinch out or outcrop.
- Hydraulic Aquifer Boundaries – These include surface infiltration sources which usually represent constant head influx boundaries, streams which act as either groundwater discharge boundaries (normal and low flow conditions) or as groundwater infiltration boundaries (high flow and flood conditions), and groundwater divides which act as no-flow boundaries.

Subject to information mentioned above, the following observations pertaining to the delineation of lateral aquifer boundaries for the Ferrometals zone of influence are important:

- All surface water dams/ponds will most probably act as constant infiltration boundaries with groundwater flow away from them within both the perched and shallow weathered zone aquifers. These boundaries are superimposed onto the regional groundwater flow directions.
- Ferrometals lies west of a watershed, where recharge from rainfall occurs in-between the Plant and this boundary. Although this watershed would normally be a no-flow boundary, this watershed does however not form a no-flow boundary as the undermined area causes flow past the watershed towards the east in certain areas.
- The maximum lateral extent of the hydraulic influence radius associated with the Ferrometals site and surrounding potential pollution sources, via their interaction with the perched and weathered zone aquifers, is delineated by the lateral aquifer boundaries (Figure 1.2.10(d)).

The lateral aquifer boundaries for the Ferrometals site are delineated by the following:

- The western boundary is a discharge aquifer boundary delineated by the Brugspruit.
- The southern boundary is a discharge aquifer boundary delineated by the unnamed tributary that flows into the Brugspruit.
- The south-eastern boundary is delineated as a no-flow boundary taken perpendicular to the surface contours and is deemed to be parallel with the natural groundwater flow directions.
- The eastern boundary is a discharge aquifer boundary delineated by the Blesbokspruit.
- The northern boundary is a combination of discharge aquifer boundary and a no-flow aquifer boundary. The discharge boundaries are delineated by the unnamed tributaries of the Brugspruit (west) and Blesbokspruit (east). The no-flow boundary is located across the central extent of the northern aquifer boundary is taken perpendicular to the surface contours and is deemed to be parallel with the natural groundwater flow directions.

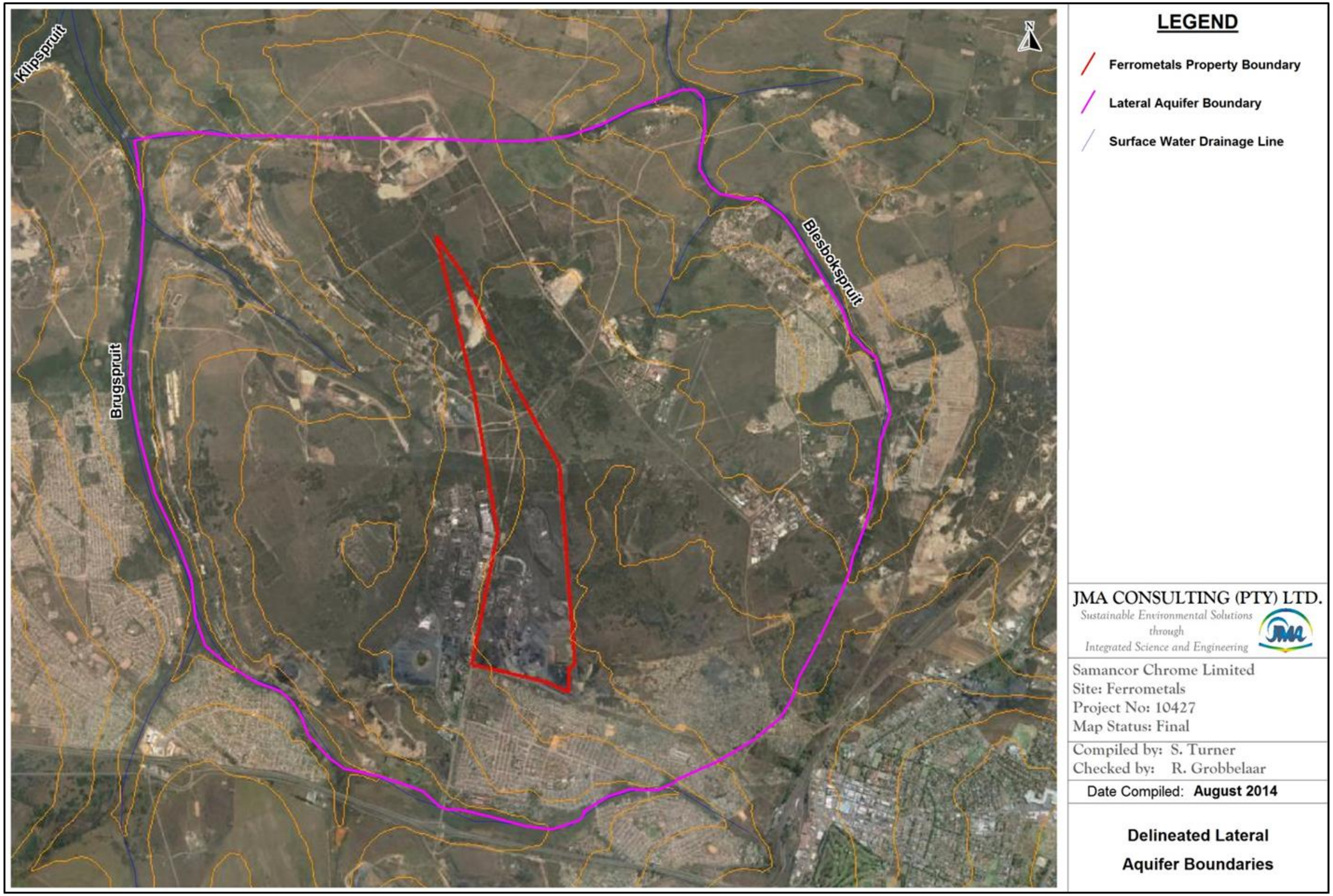

Figure 1.2.10(d): Delineated Lateral Aquifer Boundaries

Groundwater Levels

The groundwater levels are recorded separately for the two aquifer types at Ferrometals, namely the perched aquifers and the weathered zone aquifers. The groundwater levels in the perched aquifers are recorded using the FSS boreholes, whilst the groundwater levels in the weathered zone aquifers are recorded using the FSD boreholes.

Perched Aquifers

The depth to the water table in the perched aquifer(s) zone, as recorded in the FSS boreholes and omitting the boreholes that were dry (no water in the borehole) during the 2013 groundwater monitoring programme, ranged between 1.43 m and 5.45 m with an average water level of 3.30 m.

Weathered Zone Aquifers

The top of the unsaturated zone is defined by the original ground surface, while the bottom is defined by the water table, which represents a non-fixed boundary. The depth to the water table in the weathered zone aquifers, as recorded in the FSD- boreholes and omitting the boreholes that were dry (no water in the borehole) during the 2013 groundwater monitoring programme, ranged between 0.88 m and 10.56 m with an average water level of 5.36 m.

Groundwater Flow

The flow of groundwater in the semi-confined to unconfined weathered zone aquifers is determined by the groundwater elevation within the weathered zone. The groundwater will flow from areas of higher elevations towards lower elevations. The velocity at which the groundwater flows is further a function of the aquifer permeability, porosity and groundwater gradients.

The groundwater levels recorded in the FSD monitoring boreholes at Ferrometals during November 2012 were used to determine the groundwater elevations. The groundwater flow directions were compiled through the application of a steady state ground water flow model. The simulated steady state groundwater elevations and flow directions are depicted on Figure 1.2.10(e) (Geostratum, 2013). It is evident from Figure 1.2.10(e) that the groundwater flow directions are predominantly to the west and north-west across the extent of the Ferrometals site. There is a good correlation (91%) between the simulated groundwater elevations and recorded groundwater elevations.

Based on the calculated groundwater elevations an average hydraulic gradient of **0.02** is assigned to weathered zone aquifer below the Ferrometals site, towards the west and north-west. Using this gradient as well as the permeability (0.03 m/day) and porosity (3%) assigned to the weathered zone aquifer, the following calculation is made, regarding the groundwater seepage velocity (v_s):

v_s = (permeability * ground water gradient) / porosity

Interestingly permeability is of the same magnitude as porosity resulting in ground water seepage velocity (v_s) being equal to the ground water gradient. As a consequence the ground water flow histogram is also representative of the ground water seepage velocity.

It is therefore important to note that the ground water gradient varies across the site and hence the ground water seepage velocities will vary across the site as well. The groundwater seepage velocity for the bulk of the aquifer varies between 0.02 m/day and 0.03 m/day, which calculates to between **7.3 m/year** and **10.95 m/year** towards the **west** and in some places towards the north-west.

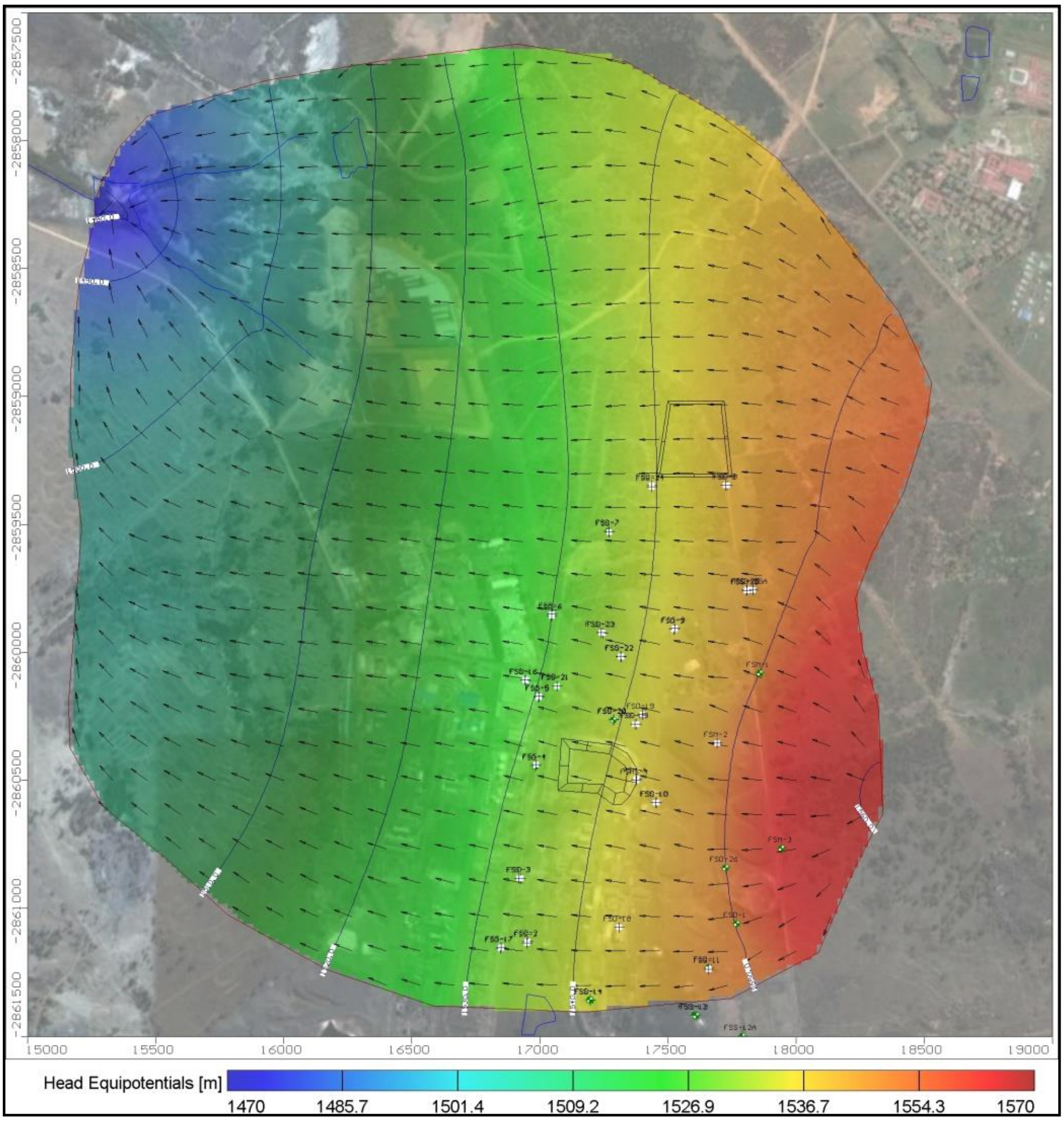

Figure 1.2.10(e): Simulated Steady State Groundwater Elevations and Flow Directions

Aquifer Classification

The aquifer(s) pertaining to the regional study area can be classified in accordance with "A South African Aquifer System Management Classification, December 1995". Furthermore with reference to the "Aquifer Classification Map of South Africa" and "Definitions of Aquifer System Management Classes" the aquifers pertaining to the regional study area are classified as **minor aquifer systems** with a Groundwater Quality Management **(GQM) Index** score of **4**.

The definition of a minor aquifer system is as follows: "*These can be fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are important for local supplies and in supplying base flow for rivers*."

The **vulnerability**, or the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer, is classified as **moderate**.

The **aquifer susceptibility**, a qualitative measure of the relative ease with which a groundwater body can be potentially contaminated by anthropogenic activities, which includes both aquifer vulnerability and the relative importance of the aquifer in terms of its classification, is classified as **medium**.

Groundwater Quality

The groundwater quality at Ferrometals is monitored on a quarterly basis and has been monitored since 2002. The groundwater was initially monitored on a six-monthly basis. Ferrometals however received its Water Use Licence on 2 April 2011, which required that that the groundwater be monitored on a quarterly basis. The groundwater samples collected are analysed for the following variables: pH, EC, TDS, Ca, Mg, Na, K, T-Alk, Cl, SO_4, NO_3, F, NH_4, Si, Fe, Mn, Cr, Cr^{6+} , COD, Suspended Solids, PO_4, Boron, Al and V.

During 2013 four ground water sampling runs were conducted. The ground water monitoring currently relates to formal compliance monitoring based on the formal authorization requiring ground and surface water monitoring.

The groundwater quality in both the perched and weathered zone aquifers are required to be monitored. The FSS boreholes are used to sample the groundwater in the perched aquifers, whilst the FSD boreholes are used to sample the groundwater in the weathered zone aquifers.

No water quality objectives have been specified for the groundwater in the Water Use License issued to Ferrometals, and so the water quality criteria against which the groundwater quality is evaluated is namely the SANS 241:2011 Drinking Water Standard, which depicts the "fitness for long-term use" of the water. The "standard limit" used for the assessment is "*based on the consumption of 2 l of water per day by a person with a mass of 60 kg over a period of 70 years*".

Note: The assessment using the SANS 241:2011 Drinking Water Standard is therefore extremely stringent, and is only used for a visual assessment of the data. It has no correlation to any sort of compliance criteria assigned to Ferrometals.

Using the criteria as specified by the SANS 241:2011 Drinking Water Standard, the following has relevance with regards to the visual assessment of the water qualities:

- Groundwater concentrations that exceed the standard limits (chronic and / or aesthetic) stipulated in the SANS 241:2011 Drinking Water Standard are depicted in **red**.
- Groundwater concentrations that fall below the standard limit for chronic health limits, but exceed the standard limit for aesthetic limits as stipulated in the SANS 241:2011 Drinking Water Standard are depicted in **orange**.
- Groundwater concentrations that fall below the standard limits (chronic and / or aesthetic) stipulated in the SANS 241:2011 Drinking Water Standard are depicted in **green**.

The variables Ca, Mg and K do not have limits in SANS 241:2011 Drinking Water Standard and these variables are thus assessed with regards to the limits specified in the SANS 241:2006 Drinking Water Standard.

The purpose of applying evaluation protocols to data gathered during sampling runs is to assess the current status of the observed or identified ground water impacts introduced by Ferrometals' activities with the following aims:

- Monitor the current situation.
- Identify any significant changes since the baseline assessment.
- Evaluate the significance of any potential impacts.
- Establishing long term water quality trends.

Perched Aquifers

The quality of the groundwater sampled in the perched aquifers during the February 2013, May 2013, August 2013 and November 2013 sampling runs are indicated in Tables 1.2.10(a). 1.2.10(b), 1.2.10(c) and 1.2.10(d) respectively.

Table 1.2.10(a): Perched Aquifer Groundwater Qualities (February 2013)

Sample Nr	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cℓ mg/l	SO_4 mg/l	NO_3 mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	NH_4 mg/l	$Cr^{(total)}$ mg/l	Cr^{6+} mg/l	V mg/l
SANS 241:2011 limit	>5 - <9	≤ 170	≤1200	150-300	70-100	<200	50-100	≤ 300	≤250 250-500	≤ 11	≤ 1.5	≤ 0.3	≤ 0.3 0.3-2	≤ 0.1 0.1-0.5	≤ 1.5	≤ 0.05	≤ 0.05	≤ 0.2
FSS-2	6.35	175	1125	47.7	62.1	197	90.6	115	502	0.664	0.366	<0.01	<0.01	<0.01	3.31	<0.01	<0.01	<0.01
FSS-4	7.96	154	1009	37.3	95.2	119	66.9	82.2	520	<0.01	0.023	<0.01	<0.01	0.431	0.031	<0.01	<0.01	<0.01
FSS-5	7.03	410	2979	66.4	24.2	626	330	372	1432	<0.01	0.037	<0.01	<0.01	0.155	0.122	<0.01	<0.01	<0.01
FSS-6	9.02	212	1255	12.8	61.3	238	153	191	372	<0.01	0.139	<0.01	<0.01	<0.01	6.81	<0.01	<0.01	<0.01
FSS-10	7.44	99.5	587	23.3	68.8	103	19.8	36.1	120	2.19	0.247	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
FSS-12A	7.17	84.2	505	73.2	54.0	19.1	8.33	9.43	161	<0.01	0.024	<0.01	<0.01	0.339	2.50	<0.01	<0.01	<0.01
FSS-14	8.11	84.1	475	18.1	41.3	99.9	9.59	73.1	59.9	<0.01	0.120	<0.01	<0.01	<0.01	0.107	<0.01	<0.01	<0.01
FSS-15	7.95	292	2203	14.9	28.5	602	163	197	977	<0.01	0.102	<0.01	<0.01	0.024	0.125	<0.01	<0.01	<0.01
FSS-16	8.23	150	853	8.86	3.45	271	42.2	366	95.3	<0.01	0.181	<0.01	<0.01	<0.01	0.073	<0.01	<0.01	<0.01
FSS-17	7.01	35.3	194	15.3	7.79	28.6	16.4	23.4	70.3	0.487	0.456	<0.01	<0.01	<0.01	0.188	<0.01	<0.01	0.072
FSS-20	7.23	307	2096	73.9	78.7	323	265	150	1086	12.9	0.783	<0.01	<0.01	<0.01	<0.01	0.175	<0.01	<0.01
FSS-21	8.24	386	2814	20.6	29.0	630	308	232	1336	0.213	1.34	<0.01	<0.01	0.534	10.1	<0.01	<0.01	<0.01
FSS-22	7.31	346	2726	251	170	324	175	235	1320	2.97	1.04	<0.01	<0.01	<0.01	0.023	0.086	<0.01	<0.01
FSS-23	5.98	181	1179	74.3	67.6	159	55.7	140	626	<0.01	0.022	<0.01	<0.01	21.9	5.95	<0.01	<0.01	<0.01

Table 1.2.10(b): Perched Aquifer Groundwater Qualities (May 2013)

Sample Nr	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cℓ mg/l	SO_4 mg/l	NO_3 mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	NH_4 mg/l	$Cr^{(total)}$ mg/l	Cr^{6+} mg/l	V mg/l
SANS 241:2011 limit	>5 - <9	≤ 170	≤1200	150-300	70-100	<200	50-100	≤ 300	≤250 250-500	≤ 11	≤ 1.5	≤ 0.3	≤ 0.3 0.3-2	≤ 0.1 0.1-0.5	≤ 1.5	≤ 0.05	≤ 0.05	≤ 0.2
FSS-2	7.03	110	669	28.9	28.6	108	63.2	50.3	281	0.683	0.393	3.55	3.74	0.035	1.56	0.016	<0.01	0.064
FSS-4	7.56	157	1057	28.1	92.2	144	86.0	67.2	538	0.499	0.055	0.112	0.251	0.341	0.112	<0.01	<0.01	<0.01
FSS-5	6.79	387	2643	18.2	13.0	665	358	330	1139	0.554	0.121	0.021	0.028	0.083	0.793	<0.01	<0.01	<0.01
FSS-6	8.78	175	1129	12.7	66.3	198	120	187	401	0.476	0.163	0.058	0.097	<0.01	3.71	<0.01	<0.01	<0.01
FSS-8	8.94	140	906	40.7	49.7	168	17.0	93.4	251	49.3	0.049	<0.01	0.057	2.52	2.18	<0.01	<0.01	<0.01
FSS-10	6.92	105	605	27.5	94.5	56.6	17.8	16.1	159	1.79	0.227	0.074	0.083	<0.01	0.096	0.288	0.243	<0.01
FSS-12	6.97	88.8	551	106	44.4	8.85	8.39	3.53	139	0.428	0.035	<0.01	0.490	0.448	8.23	<0.01	<0.01	<0.01
FSS-14	7.91	87.6	497	20.3	63.9	76.7	10.9	41.9	65.0	0.481	0.142	<0.01	0.057	0.012	0.243	<0.01	<0.01	<0.01
FSS-15	8.05	342	2362	142	28.4	504	170	293	1134	0.418	<0.01	<0.01	0.039	0.590	8.34	<0.01	<0.01	<0.01
FSS-16	7.70	137	775	2.58	1.31	248	42.0	301	100	0.454	0.078	0.032	<0.01	<0.01	0.127	<0.01	<0.01	<0.01
FSS-17	7.20	34.7	190	12.3	10.1	25.4	14.7	12.7	80.1	0.524	0.557	<0.01	0.011	<0.01	0.263	<0.01	<0.01	<0.01
FSS-20	7.79	320	2153	106	46.9	394	234	155	1109	6.63	0.504	0.075	0.322	0.022	3.60	0.034	<0.01	<0.01
FSS-21	8.16	411	2647	22.2	20.5	633	339	270	1094	0.694	1.02	0.011	0.041	0.132	12.3	<0.01	<0.01	<0.01
FSS-22	7.98	550	4023	268	185	636	288	343	2090	1.84	0.494	0.018	0.041	0.424	0.811	<0.01	<0.01	<0.01
FSS-23	6.44	197	1407	86.6	71.3	170	60.5	167	761	0.512	0.058	<0.01	3.71	19.6	10.8	<0.01	<0.01	<0.01

Table 1.2.10(c): Perched Aquifer Groundwater Qualities (August 2013)

Sample Nr	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cℓ mg/l	SO_4 mg/l	NO_3 mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	NH_4 mg/l	$Cr^{(total)}$ mg/l	Cr^{6+} mg/l	V mg/l
SANS 241:2011 limit	>5 - <9	≤ 170	≤1200	150-300	70-100	<200	50-100	≤ 300	≤250 250-500	≤ 11	≤ 1.5	≤ 0.3	≤ 0.3 0.3-2	≤ 0.1 0.1-0.5	≤ 1.5	≤ 0.05	≤ 0.05	≤ 0.2
FSS-2	7.36	90.0	494	21.5	22.2	91.7	53.4	90.2	77.6	0.010	0.620	5.34	4.48	0.060	0.960	<0.01	<0.01	<0.01
FSS-5	6.77	365	2428	79.8	25.0	592	244	390	1019	0.010	0.380	0.400	2.12	0.441	1.25	<0.01	<0.01	<0.01
FSS-6	8.87	157	917	11.2	45.9	167	108	164	298	0.010	0.220	0.160	0.480	0.070	3.69	<0.01	<0.01	<0.01
FSS-8	8.89	163	843	48.7	41.3	140	7.90	121	213	41.0	0.100	0.010	0.620	2.68	2.17	<0.01	<0.01	<0.01
FSS-10	6.81	96.6	557	36.6	84.3	38.6	15.1	42.6	117	1.54	0.480	0.403	0.324	<0.01	1.12	0.051	<0.01	<0.01
FSS-14	8.18	71.8	349	17.6	38.6	54.8	6.68	87.7	31.1	0.010	0.130	0.010	0.315	0.029	0.470	<0.01	<0.01	<0.01
FSS-16	7.70	124	650	5.96	3.50	202	34.7	267	66.1	0.010	0.130	0.080	0.230	0.030	0.450	<0.01	<0.01	<0.01
FSS-17	8.05	44.4	232	15.4	11.4	36.7	12.5	47.9	63.5	0.242	0.610	<0.01	0.355	<0.01	0.630	<0.01	<0.01	<0.01
FSS-20	6.93	391	2494	127	33.1	512	176	253	1239	9.40	0.200	0.010	0.670	0.740	5.58	0.048	0.010	<0.01
FSS-21	8.22	347	2243	26.2	22.2	482	237	250	992	0.021	1.29	3.11	3.40	0.330	16.7	<0.01	<0.01	<0.01
FSS-22	7.26	610	5039	244	184	868	284	480	2887	0.187	1.69	3.36	5.14	1.60	0.185	0.501	0.010	<0.01
FSS-23	6.03	208	1352	93.4	78.2	153	50.1	189	724	<0.01	0.010	0.140	3.33	11.1	12.1	<0.01	<0.01	<0.01

Table 1.2.10(d): Perched Aquifer Groundwater Qualities (November 2013)

Sample Nr	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cℓ mg/l	SO_4 mg/l	NO_3 mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	NH_4 mg/l	$Cr^{(total)}$ mg/l	Cr^{6+} mg/l	V mg/l
SANS 241:2011 limit	>5 - <9	≤ 170	≤1200	150-300	70-100	<200	50-100	≤ 300	≤250 250-500	≤ 11	≤ 1.5	≤ 0.3	≤ 0.3 0.3-2	≤ 0.1 0.1-0.5	≤ 1.5	≤ 0.05	≤ 0.05	≤ 0.2
FSS-2	7.78	231	1397	64.2	73.2	219	109	128	598	7.27	0.24	0.67	0.67	0.12	2.140	0.010	0.010	0.010
FSS-4	7.29	221	1591	136.0	117	141	83.3	103	938	0.01	0.01	0.09	0.38	4.78	0.520	0.010	0.010	0.010
FSS-5	7.42	445	3017	47.7	18.4	716	291	337	1418	0.01	0.01	0.01	35.90	0.90	3.970	0.010	0.010	0.010
FSS-6	8.46	209	1212	16.3	72.7	206	121	166	404	0.84	0.01	0.01	0.01	0.03	4.070	0.010	0.010	0.010
FSS-8	7.31	128	785	36.0	44.5	145	8.9	117	179	37.30	0.03	0.01	0.03	2.47	1.750	0.010	0.010	0.010
FSS-12A	7.50	134	813	121.0	93.2	20	10.7	9	281	1.73	0.17	0.01	0.01	0.20	0.070	0.010	0.010	0.010
FSS-14	7.74	87	452	15.7	49.4	88	8.5	104	52	0.01	0.10	0.01	0.16	0.14	0.420	0.010	0.010	0.010
FSS-15	8.10	271	1766	38.0	26.1	445	136	269	719	0.01	0.01	0.01	0.01	0.13	1.180	0.010	0.010	0.010
FSS-16	8.00	138	781	15.3	9.9	217	41.7	320	130	0.01	0.01	0.01	0.22	0.71	0.091	0.010	0.010	0.010
FSS-17	8.15	44	228	15.8	13.6	26	16.1	13	103	1.16	0.53	0.01	0.01	0.01	0.111	0.010	0.010	0.010
FSS-20	8.07	390	2819	110.0	49.6	563	243	298	1405	10.40	0.72	0.16	0.83	0.01	10.300	0.135	0.010	0.010
FSS-21	8.41	439	2947	16.3	19.6	708	286	369	1144	0.18	1.65	0.01	0.01	0.95	47.100	0.010	0.010	0.010
FSS-22	8.18	658	5058	338.0	219	858	321	540	2364	30.60	0.89	0.01	0.23	0.53	0.071	0.563	0.548	0.010
FSS-23	6.89	334	2264	102.0	120	315	97.5	359	1196	0.03	0.01	0.01	16.50	16.50	9.620	0.010	0.010	0.010

Based on the quality of the groundwater sampled from the perched aquifers adjacent to the slag dump, slimes dam and plant area since 2005, it is observed that although the water qualities are erratic between sampling runs, a long-term sideways trend is dominant. This indicates that over the time of monitoring although variability is observed for individual parameters the chemistry observed range within the certain limits and the quality of the groundwater within the perched aquifers has remained consistent.

Weathered Zone Aquifers

The quality of the groundwater sampled in the weathered zone aquifers during the February 2013, May 2013, August 2013 and November 2013 sampling runs are indicated in Tables 1.2.10(e). 1.2.10(f), 1.2.10(g) and 1.2.10(h) respectively.

The water quality variables EC and SO_4 are deemed to be conservative variables in that they are chemically stable in the aquatic environment. Any increase in the concentration of one of these indicates a surface induced impact on the underlying groundwater resource.

Based on the quality of the groundwater sampled from the weathered zone aquifers adjacent to the slag dump, slimes dam and plant area since 2005, it is observed that although the water qualities are erratic between sampling runs, a long-term sideways trend is dominant in most boreholes. This indicates that over the time of monitoring although variability is observed for individual parameters the chemistry observed range within the certain limits and the quality of the groundwater within the perched aquifers has remained consistent.

The quality of the groundwater sampled at borehole FSD-21 is indicated as having an improving trend, whilst the quality of the groundwater sampled at boreholes FSD-6 and FSD-16 are classified as having deteriorating trends. All three of these boreholes are located down-gradient of the current northern slimes dam.

Table 1.2.10(e): Weathered Zone Aquifer Groundwater Qualities (February 2013)

Sample Nr	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cℓ mg/l	SO_4 mg/l	NO_3 mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	NH_4 mg/l	$Cr^{(total)}$ mg/l	Cr^{6+} mg/l	V mg/l
SANS 241:2011 limit	>5 - <9	≤ 170	≤1200	150-300	70-100	<200	50-100	≤ 300	≤250 250-500	≤ 11	≤ 1.5	≤ 0.3	≤ 0.3 0.3-2	≤ 0.1 0.1-0.5	≤ 1.5	≤ 0.05	≤ 0.05	≤ 0.2
FSD-1	7.77	11.1	56.5	7.42	5.56	3.64	3.39	4.20	5.21	<0.01	0.060	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
FSD-2	8.87	46.6	266	16.1	12.3	52.3	12.7	50.2	98.0	<0.01	0.091	<0.01	<0.01	<0.01	0.448	<0.01	<0.01	<0.01
FSD-3	5.03	58.8	279	30.1	24.3	2.26	9.63	175	2.01	<0.01	<0.01	<0.01	28.3	1.18	0.581	<0.01	<0.01	<0.01
FSD-5	9.35	91.7	504	5.28	5.21	184	8.29	224	4.59	<0.01	0.327	<0.01	<0.01	<0.01	0.500	<0.01	<0.01	<0.01
FSD-6	7.61	138	797	18.0	23.4	185	22.4	221	249	<0.01	<0.01	<0.01	0.556	9.02	9.19	<0.01	<0.01	<0.01
FSD-7	6.47	39.0	204	7.25	8.81	58.5	2.62	52.4	4.95	<0.01	0.139	<0.01	<0.01	0.596	0.154	<0.01	<0.01	<0.01
FSD-8	9.17	66.4	354	3.77	6.87	119	8.88	102	26.9	0.168	2.68	<0.01	<0.01	<0.01	2.25	<0.01	<0.01	<0.01
FSD-10	7.95	61.0	347	25.1	14.9	78.8	12.9	134	55.3	<0.01	0.087	<0.01	<0.01	<0.01	0.033	<0.01	<0.01	<0.01
FSD-11	6.71	20.1	111	7.80	7.47	19.6	5.93	42.1	6.71	<0.01	0.052	<0.01	<0.01	<0.01	0.148	<0.01	<0.01	<0.01
FSD-12A	9.19	22.1	119	15.3	7.76	10.5	4.98	6.28	48.0	<0.01	0.223	<0.01	<0.01	<0.01	0.727	<0.01	<0.01	<0.01
FSD-13	9.38	33.3	170	13.5	9.92	32.3	6.40	40.4	15.6	<0.01	0.078	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
FSD-14	9.35	42.1	210	5.44	6.88	59.6	8.81	44.0	15.5	<0.01	0.099	<0.01	0.653	<0.01	1.03	<0.01	<0.01	<0.01
FSD-15	7.92	21.0	104	9.21	7.73	15.1	6.04	32.2	6.20	<0.01	0.100	<0.01	<0.01	0.054	<0.01	<0.01	<0.01	<0.01
FSD-16	9.07	171	971	7.44	4.07	344	6.00	343	174	<0.01	0.405	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
FSD-17	7.04	52.2	276	17.0	8.03	68.2	9.03	92.1	13.8	<0.01	0.074	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
FSD-18	5.87	47.7	253	16.2	9.26	52.6	4.62	63.2	21.0	12.5	0.556	<0.01	0.837	0.659	0.266	<0.01	<0.01	<0.01
FSD-19	6.93	112	657	43.2	33.3	112	21.3	122	292	<0.01	0.067	<0.01	<0.01	0.122	2.98	<0.01	<0.01	<0.01
FSD-20	9.13	80.0	432	4.86	5.08	142	29.6	146	15.7	0.270	0.786	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
FSD-21	9.88	191	1130	4.30	3.35	345	94.5	204	350	<0.01	1.39	<0.01	<0.01	<0.01	4.63	<0.01	<0.01	<0.01
FSD-22	6.83	42.6	210	25.0	9.63	28.8	12.3	118	0.580	<0.01	0.143	<0.01	<0.01	<0.01	0.377	<0.01	<0.01	<0.01
FSD-23	8.92	25.8	134	3.54	1.03	41.3	5.74	45.8	5.20	<0.01	0.995	<0.01	<0.01	<0.01	0.141	<0.01	<0.01	<0.01
FSD-24	8.12	28.2	151	19.9	9.11	13.6	7.62	12.0	7.39	<0.01	0.184	<0.01	<0.01	<0.01	4.13	<0.01	<0.01	<0.01
FSD-25A	7.04	12.3	71.8	2.33	0.960	21.6	4.24	19.3	6.55	0.367	0.047	<0.01	<0.01	0.023	0.091	<0.01	<0.01	<0.01
FSD-26	7.77	33.9	205	18.1	28.0	16.6	6.13	20.2	28.0	<0.01	0.058	<0.01	<0.01	0.251	0.326	<0.01	<0.01	<0.01

Table 1.2.10(f): Weathered Zone Aquifer Groundwater Qualities (May 2013)

Sample Nr	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cℓ mg/l	SO_4 mg/l	NO_3 mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	NH_4 mg/l	$Cr^{(total)}$ mg/l	Cr^{6+} mg/l	V mg/l
SANS 241:2011 limit	>5 - <9	≤ 170	≤1200	150-300	70-100	<200	50-100	≤ 300	≤250 250-500	≤ 11	≤ 1.5	≤ 0.3	≤ 0.3 0.3-2	≤ 0.1 0.1-0.5	≤ 1.5	≤ 0.05	≤ 0.05	≤ 0.2
FSD-1	7.10	12.9	66.1	9.94	5.05	4.19	3.29	4.61	5.59	0.409	0.058	0.022	0.118	<0.01	0.166	<0.01	<0.01	<0.01
FSD-2	8.42	58.9	311	29.5	14.5	45.1	11.2	43.4	147	0.319	0.060	0.013	0.103	<0.01	1.15	<0.01	<0.01	<0.01
FSD-3	5.51	61.4	321	37.2	15.6	5.84	7.72	196	4.65	0.388	0.097	0.064	38.1	1.41	1.19	<0.01	<0.01	<0.01
FSD-5	9.09	92.9	502	6.86	5.56	170	10.2	232	4.46	0.298	0.283	0.010	0.024	<0.01	<0.01	<0.01	<0.01	<0.01
FSD-6	7.26	100	540	8.78	8.39	143	7.56	255	41.8	0.361	0.303	<0.01	15.4	4.57	5.22	<0.01	<0.01	<0.01
FSD-8	8.54	72.9	387	8.66	6.52	102	7.82	83.1	89.1	3.64	1.45	0.027	3.13	4.03	3.62	<0.01	<0.01	<0.01
FSD-10	7.72	59.9	299	10.6	10.3	76.6	12.7	135	20.0	0.347	0.090	<0.01	0.139	<0.01	<0.01	<0.01	<0.01	<0.01
FSD-11	6.86	20.0	103	7.05	6.56	17.8	5.84	33.0	0.520	0.330	0.074	0.029	0.030	<0.01	0.386	<0.01	<0.01	<0.01
FSD-12A	8.02	21.8	129	20.1	8.32	5.52	4.12	4.11	52.6	0.913	0.091	0.025	0.096	<0.01	0.185	<0.01	<0.01	<0.01
FSD-13	9.13	33.6	153	7.19	11.9	30.5	6.72	37.5	13.4	0.362	0.161	0.423	0.344	<0.01	0.207	<0.01	<0.01	<0.01
FSD-14	9.57	41.4	199	3.23	6.63	60.7	7.44	46.9	10.3	0.299	0.108	0.091	0.131	<0.01	1.74	<0.01	<0.01	<0.01
FSD-15	8.22	22.9	109	12.8	9.87	9.83	5.88	37.3	2.54	0.331	0.109	<0.01	0.098	0.168	0.187	<0.01	<0.01	<0.01
FSD-16	8.89	171	957	4.35	5.31	326	6.39	339	183	0.297	0.101	<0.01	0.369	<0.01	0.132	<0.01	<0.01	<0.01
FSD-17	6.79	55.8	256	17.5	12.2	58.7	8.27	82.0	7.31	0.290	0.238	<0.01	1.26	0.236	0.406	<0.01	<0.01	<0.01
FSD-18	6.65	44.7	256	12.0	7.45	56.9	4.59	49.8	17.9	14.7	0.076	0.191	0.488	0.671	1.62	<0.01	<0.01	<0.01
FSD-19	7.89	86.6	479	24.3	8.96	106	23.4	96.0	188	2.13	0.110	0.091	0.244	<0.01	0.627	0.023	<0.01	<0.01
FSD-20	10.2	81.4	434	2.63	7.77	129	29.9	167	8.94	0.330	0.776	0.015	0.121	<0.01	0.132	<0.01	<0.01	<0.01
FSD-21	10.05	185	1083	3.25	2.98	311	84.5	251	309	0.268	0.779	<0.01	0.064	<0.01	6.54	<0.01	<0.01	<0.01
FSD-22	7.45	75.4	436	61.8	32.3	22.4	12.5	120	167	0.292	0.094	<0.01	0.090	0.294	0.486	<0.01	<0.01	<0.01
FSD-23	8.45	22.7	101	4.18	1.11	28.2	5.29	34.7	0.080	0.285	0.959	0.131	0.059	<0.01	0.403	<0.01	<0.01	<0.01
FSD-25	7.21	12.6	57.0	1.96	1.51	11.5	3.31	14.2	4.69	0.638	0.066	0.086	1.35	0.108	0.713	<0.01	<0.01	<0.01
FSD-26	7.14	33.6	173	11.5	25.2	14.8	5.91	16.8	11.4	0.331	0.098	<0.01	0.677	0.389	0.901	<0.01	<0.01	<0.01

Table 1.2.10(g): Weathered Zone Aquifer Groundwater Qualities (August 2013)

Sample Nr	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cℓ mg/l	SO_4 mg/l	NO_3 mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	NH_4 mg/l	$Cr^{(total)}$ mg/l	Cr^{6+} mg/l	V mg/l
SANS 241:2011 limit	>5 - <9	≤ 170	≤1200	150-300	70-100	<200	50-100	≤ 300	≤250 250-500	≤ 11	≤ 1.5	≤ 0.3	≤ 0.3 0.3-2	≤ 0.1 0.1-0.5	≤ 1.5	≤ 0.05	≤ 0.05	≤ 0.2
FSD-1	8.95	12.2	67.4	11.3	3.62	4.23	3.71	6.78	8.19	0.020	0.090	0.508	0.733	0.040	0.530	0.093	0.010	<0.01
FSD-2	8.47	61.1	323	35.4	13.4	35.9	10.1	38.3	164	0.010	0.170	0.880	0.860	0.030	1.46	<0.01	0.010	<0.01
FSD-3	6.31	66.9	345	47.3	19.8	6.03	9.69	218	2.10	0.010	0.390	<0.01	35.9	0.870	1.13	<0.01	0.010	<0.01
FSD-5	8.76	92.6	482	8.86	6.01	159	9.65	215	6.30	0.010	0.010	<0.01	0.460	0.030	1.40	<0.01	<0.01	<0.01
FSD-6	6.90	165	965	29.3	29.1	190	45.4	229	365	0.810	0.010	0.420	1.15	8.78	9.66	<0.01	0.010	<0.01
FSD-7	6.25	43.5	189	15.5	8.29	34.2	6.05	46.8	16.1	1.03	0.010	<0.01	0.040	1.06	1.73	<0.01	0.010	<0.01
FSD-10	7.94	63.4	307	14.8	12.6	67.1	12.7	137	37.0	0.010	0.090	<0.01	0.360	0.040	0.510	<0.01	<0.01	<0.01
FSD-11	7.24	20.0	92.5	8.35	4.62	13.9	4.59	38.7	0.100	0.010	0.040	0.790	0.520	0.060	0.650	<0.01	<0.01	<0.01
FSD-12A	8.76	50.4	331	51.7	17.1	13.2	5.08	12.7	212	0.010	0.260	<0.01	0.140	0.060	2.88	<0.01	<0.01	<0.01
FSD-13	7.97	34.8	163	6.89	14.0	26.0	7.00	40.4	35.5	0.010	0.070	0.210	0.220	0.020	0.360	<0.01	<0.01	<0.01
FSD-14	7.93	83.2	485	32.9	28.6	65.5	9.23	63.4	207	0.010	0.140	<0.01	0.360	0.830	8.74	<0.01	<0.01	<0.01
FSD-15	7.91	22.5	104	11.9	7.04	11.9	5.09	39.8	0.100	0.010	0.110	<0.01	0.400	0.140	0.170	<0.01	<0.01	<0.01
FSD-16	8.82	184	1088	7.17	7.00	368	5.42	332	252	0.010	1.83	0.310	3.12	0.100	0.300	<0.01	<0.01	<0.01
FSD-17	6.94	62.2	325	27.5	18.4	58.2	12.1	92.1	40.0	0.010	0.110	<0.01	0.510	0.410	0.690	<0.01	<0.01	0.035
FSD-18	6.82	36.8	182	12.9	7.52	31.1	5.73	51.0	11.3	0.010	0.110	<0.01	1.64	0.250	4.57	<0.01	<0.01	0.010
FSD-19	6.94	138	810	86.8	32.5	99.4	19.3	141	387	0.010	0.160	<0.01	0.320	0.420	4.49	<0.01	<0.01	<0.01
FSD-20	8.47	85.2	437	8.90	10.6	114	30.5	161	33.3	0.010	0.830	0.060	0.750	0.040	1.56	<0.01	<0.01	<0.01
FSD-21	9.60	177	1071	2.86	3.12	307	81.5	243	308	0.010	1.78	<0.01	0.490	0.020	7.29	<0.01	<0.01	<0.01
FSD-22	7.43	104	573	85.8	37.6	28.5	12.5	116	267	0.020	0.010	0.710	<0.01	2.21	0.600	<0.01	<0.01	<0.01
FSD-23	8.30	23.5	109	4.82	1.83	25.4	7.25	40.0	0.100	0.010	1.03	1.58	0.750	0.030	0.480	<0.01	<0.01	<0.01
FSD-25	6.81	12.2	53.9	1.96	1.52	10.9	3.71	16.1	2.61	0.320	0.130	0.040	0.930	0.080	0.930	<0.01	<0.01	<0.01
FSD-26	6.71	45.1	197	16.8	27.1	14.3	5.78	18.2	18.5	0.290	0.100	<0.01	2.52	0.270	1.70	<0.01	<0.01	<0.01

Table 1.2.10(h): Weathered Zone Aquifer Groundwater Qualities (November 2013)

Sample Nr	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cℓ mg/l	SO_4 mg/l	NO_3 mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	NH_4 mg/l	$Cr^{(total)}$ mg/l	Cr^{6+} mg/l	V mg/l
SANS 241:2011 limit	>5 - <9	≤ 170	≤1200	150-300	70-100	<200	50-100	≤ 300	≤250 250-500	≤ 11	≤ 1.5	≤ 0.3	≤ 0.3 0.3-2	≤ 0.1 0.1-0.5	≤ 1.5	≤ 0.05	≤ 0.05	≤ 0.2
FSD-1	8.24	12	58	7.7	4.4	5.9	3.8	7	0.3	0.14	0.05	0.01	0.01	0.01	0.350	0.010	0.010	0.010
FSD-2	8.66	59	371	27.7	19.8	54	12.3	54	180	0.24	0.01	0.01	0.01	0.01	1.380	0.010	0.010	0.010
FSD-3	6.45	63	364	37.3	20.3	7.4	8.8	229	15	0.01	0.01	0.01	39.20	1.13	1.230	0.010	0.010	0.010
FSD-5	9.02	94	483	9.7	6.7	160	9.8	218	3	0.01	0.33	0.01	0.25	0.01	0.890	0.010	0.010	0.010
FSD-6	7.57	157	956	28.5	36.3	176	39.2	218	381	0.92	0.01	0.01	1.34	10.40	10.800	0.010	0.010	0.010
FSD-7	7.07	41	195	16.7	9.8	34	6.1	56	10	0.17	0.10	0.01	0.30	0.84	1.190	0.010	0.010	0.010
FSD-10	8.43	59	295	6.3	10.0	79	10.7	133	28	0.02	0.03	0.01	0.01	0.01	0.230	0.010	0.010	0.010
FSD-11	7.15	19	87	7.3	5.5	13	4.7	37	0.3	0.01	0.04	0.01	0.01	0.02	0.450	0.010	0.010	0.010
FSD-12A	9.00	42	268	45.1	18.6	11	4.8	10	157	0.29	0.14	0.01	0.01	0.01	0.610	0.010	0.010	0.010
FSD-13	7.77	34	158	7.5	11.9	29	7.8	43	21	0.01	0.03	0.01	0.01	0.01	0.110	0.010	0.010	0.010
FSD-14	8.62	54	301	7.6	13.8	70	7.6	62	71	0.01	0.03	0.01	0.33	0.01	3.720	0.010	0.010	0.010
FSD-15	8.10	23	112	12.2	8.8	12	5.9	45	1.2	0.01	0.14	0.01	0.01	0.15	0.020	0.010	0.010	0.010
FSD-16	9.07	193	1090	7.4	8.8	354	6.0	328	272	0.01	0.07	0.01	6.36	0.01	0.010	0.010	0.010	0.010
FSD-17	7.46	61	321	25.8	16.5	59	8.7	96	36	0.01	0.10	0.01	1.23	0.45	0.450	0.010	0.010	0.018
FSD-18	7.01	31	153	9.3	6.8	28	5.8	42	6	0.48	0.16	0.01	0.44	0.31	4.890	0.010	0.010	0.010
FSD-19	7.55	147	858	95.8	35.9	121	21.6	162	383	0.09	0.01	0.01	0.11	0.48	4.210	0.010	0.010	0.010
FSD-20	8.63	85	432	8.0	10.9	118	28.9	157	24	0.01	0.72	0.01	0.26	0.01	0.820	0.010	0.010	0.010
FSD-21	9.20	171	909	3.3	3.6	259	76.6	243	206	0.01	1.40	0.01	0.01	0.01	6.030	0.010	0.010	0.010
FSD-22	8.37	46	217	27.4	12.7	23	10.5	116	11	0.01	0.21	0.01	0.01	0.19	0.420	0.010	0.010	0.010
FSD-23	8.39	24	110	4.8	1.9	27	8.7	36	2	0.01	0.97	0.17	0.01	0.01	0.350	0.010	0.010	0.010
FSD-24	6.24	46	242	31.0	15.3	11	8.7	1	7	0.01	0.01	0.01	10.10	0.09	10.300	0.010	0.010	0.010
FSD-25A	7.05	17	82	2.8	2.0	20	4.4	23	12	0.02	0.18	0.01	1.13	0.06	0.530	0.010	0.010	0.010
FSD-26	7.67	43	212	14.2	31.1	16	6.3	17	23	0.08	0.12	0.01	0.44	0.14	0.860	0.010	0.010	0.010

Hydro-census

A groundwater hydrocensus was conducted within a 2 km radius of the Ferrometals site in 2004. During the groundwater hydrocensus, 5 boreholes and 1 fountain were identified. The coordinates of the boreholes (GWE-1 to GWE-5) and fountain (GWE-F1) are provided in Table 1.2.10(i). The localities of the boreholes and fountain are depicted on Figure 1.2.10(f).

Table 1.2.10(i): Boreholes and Fountain identified during the Hydrocensus

Site Number	Latitude	Longitude	In Use (Y/N)	Application
GWE-1	25° 48' 44.4" S	29° 09' 37.4" E	Yes	Domestic: All purposes
GWE-2	25° 49' 07.9" S	29° 10' 17.5" E	No	Observation borehole
GWE-3	25° 50' 47.2" S	29° 09' 44.7" E	Yes	Domestic: Garden only
GWE-4	25° 50' 06.7" S	29° 09' 12.6" E	No	None
GWE-5	25° 50' 36.6" S	29° 09' 36.6" E	No	None
GWE-F1	25° 51' 48.5" S	29° 09' 23.7" E	No	None

It was identified during the groundwater hydrocensus that only two boreholes within a 2 km radius from the Ferrometals site were in use. The one borehole was used for all types of domestic purposes, whilst the other was only used for watering the garden.

Ferrometals is located in the Ferrobank industrial area to the east of Emalahleni and the area is supplied with municipal water. The demand for the use of groundwater as water source is therefore extremely low and isolated.

It is identified that the boreholes and fountain identified to the west of the Ferrometals site are also down-gradient from the industrial and mining operations located adjacent to the Ferrometals operations. The quality of the groundwater resource adjacent to Ferrometals could potentially be impacted on by the adjacent mining and industrial activities as well.

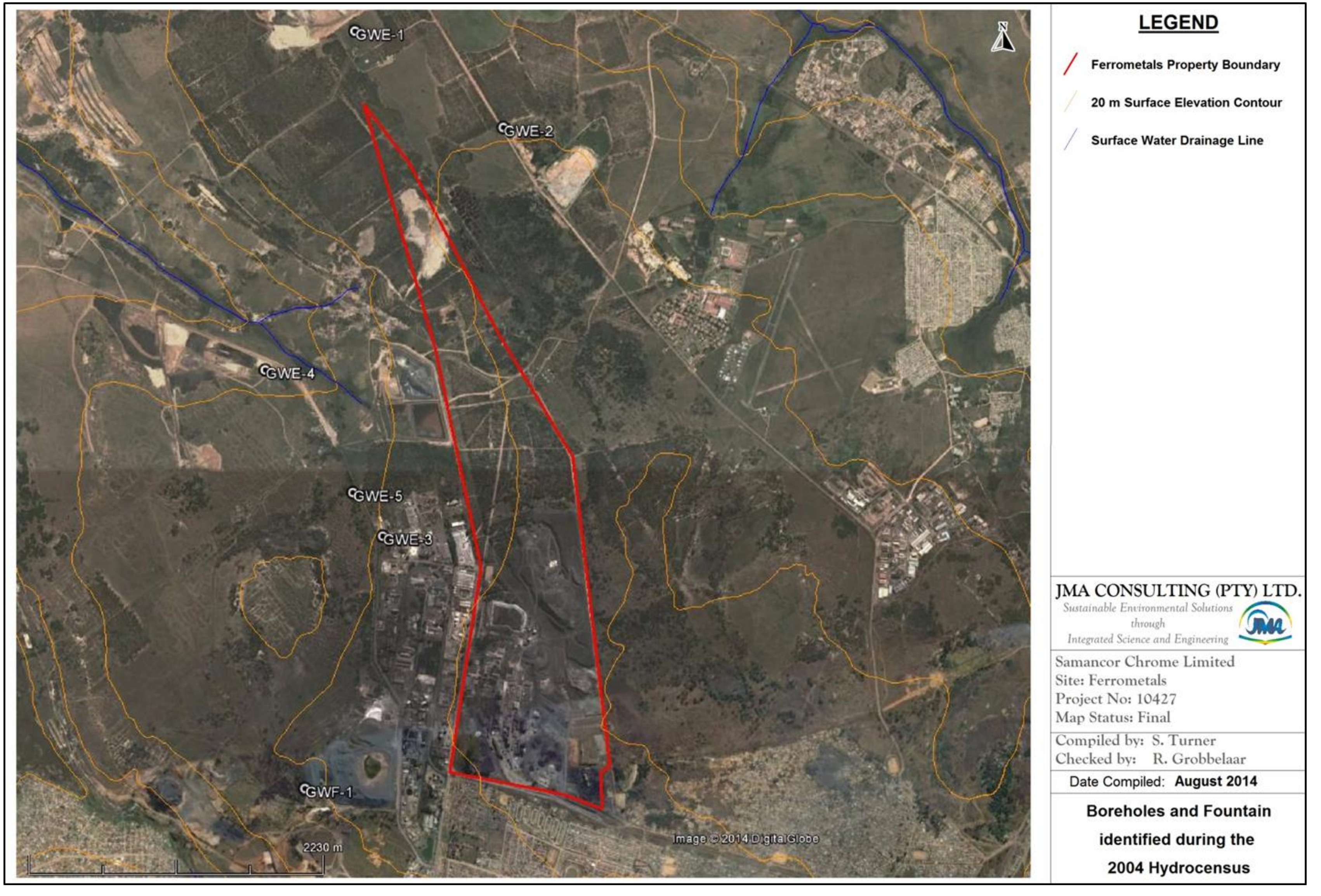

Figure 1.2.10(f): Boreholes (GWE) and Fountain (GWF) identified during the Groundwater Hydrocensus

1.2.11 Surface Water

Water Management Area

Ferrometals is located within the B11K quaternary catchment within the Olifants River (B) Primary Catchment and Olifants Water Management Area (Figures 1.2.11(a) and 1.2.11(b)).

Surface Water Hydrology

A local watershed between the Brugspruit (West of Ferrometals) and the Blesbokspruit (East of Ferrometals) is located just to the east of the Ferrometals eastern boundary (Figure 1.2.11(c)).

Ferrometals is located within the Brugspruit sub-catchment area and surface water on site naturally drains in north-westerly direction towards a tributary of the Brugspruit. The site is however buffered from the Brugspruit by the defunct Transvaal and Delegoa Bay Colliery located to the north-west of Ferrometals.

It should be noted here that there are no delineated surface water resources within the delineated Ferrometals site boundary.

The Brugspruit mainly originates to the south of Ferrobank within the Highveld Steel, Clever agricultural holdings and Landau Colliery areas. One branch of the Brugspruit also originates from the KwaGuqa area, a suburb of Witbank just south of Ferrobank, next to the N4 highway.

The Brugspruit flows northwards until its confluence with the Klipspruit. The Klipspruit flows in a north-easterly direction until its confluence with the Blesbokspruit. The Klipspruit then further discharges into the Olifants River, upstream of Loskop Dam.

Mean Annual Runoff (MAR)

All surface water on site drains in a general north-westerly direction and is captured and channelled by a series of berms and canals in order to separate clean and dirty surface water runoff on site. Clean surface water runoff enters the defunct Transvaal and Delegoa Bay Colliery site at various points along its eastern boundary.

The site is located in a moderate rainfall region with the Mean Annual Runoff (MAR) of around 8% of the MAP, which calculates to 60 mm/annum for the study area. The surface at Ferrometals is relatively flat (average gradient of 0.2 towards the north-west) and water is drained off the site via the implemented Surface Water Management Infrastructure, as indicated in Section 5.

The drainage regions upstream of the Loskop Dam comprise of three major systems, namely the Olifants River, Klipspruit and the Wilge River. The Olifants River comprises of three separate catchment areas.

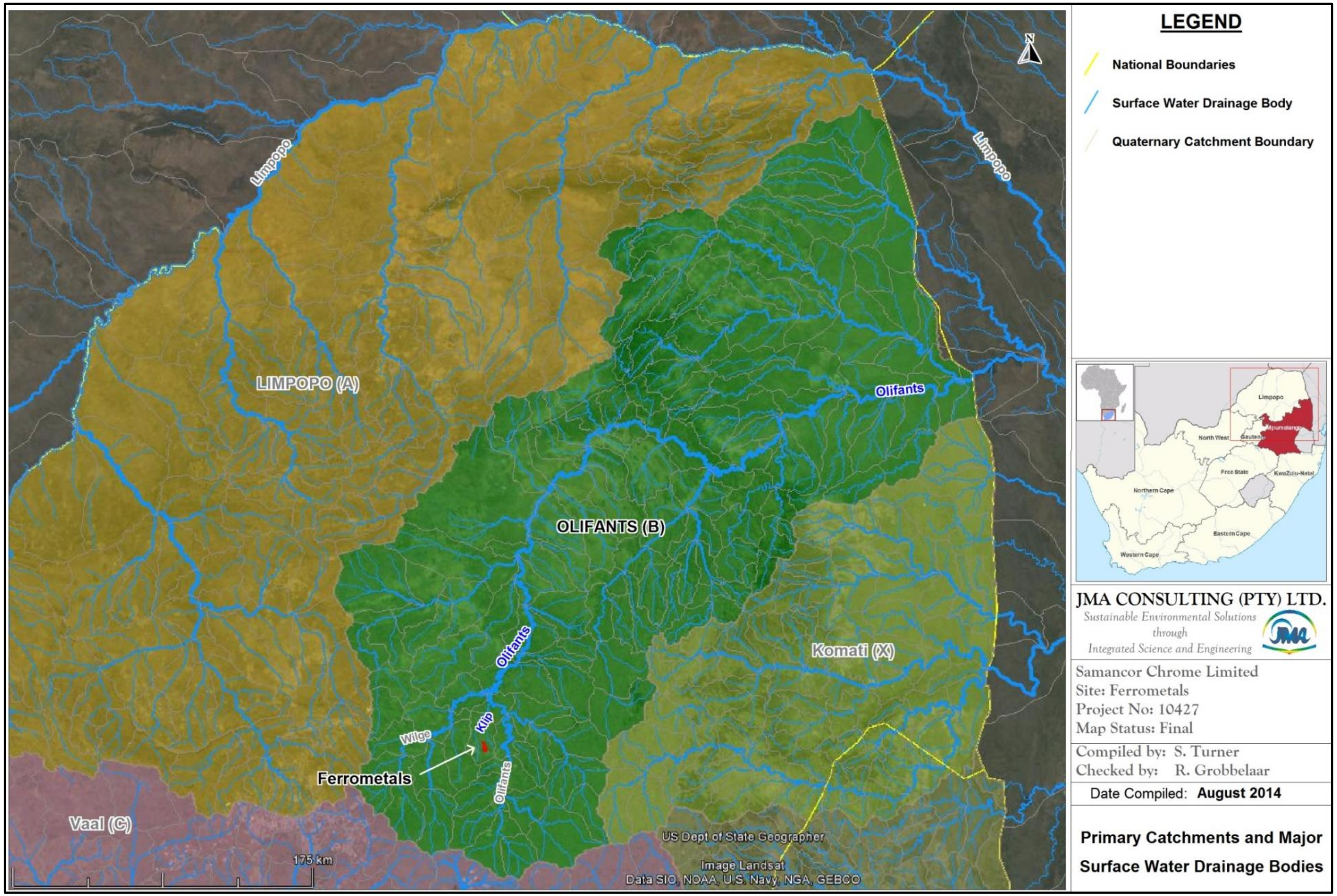

Figure 1.2.11(a): Primary Catchments and Major Surface Water Drainage Bodies

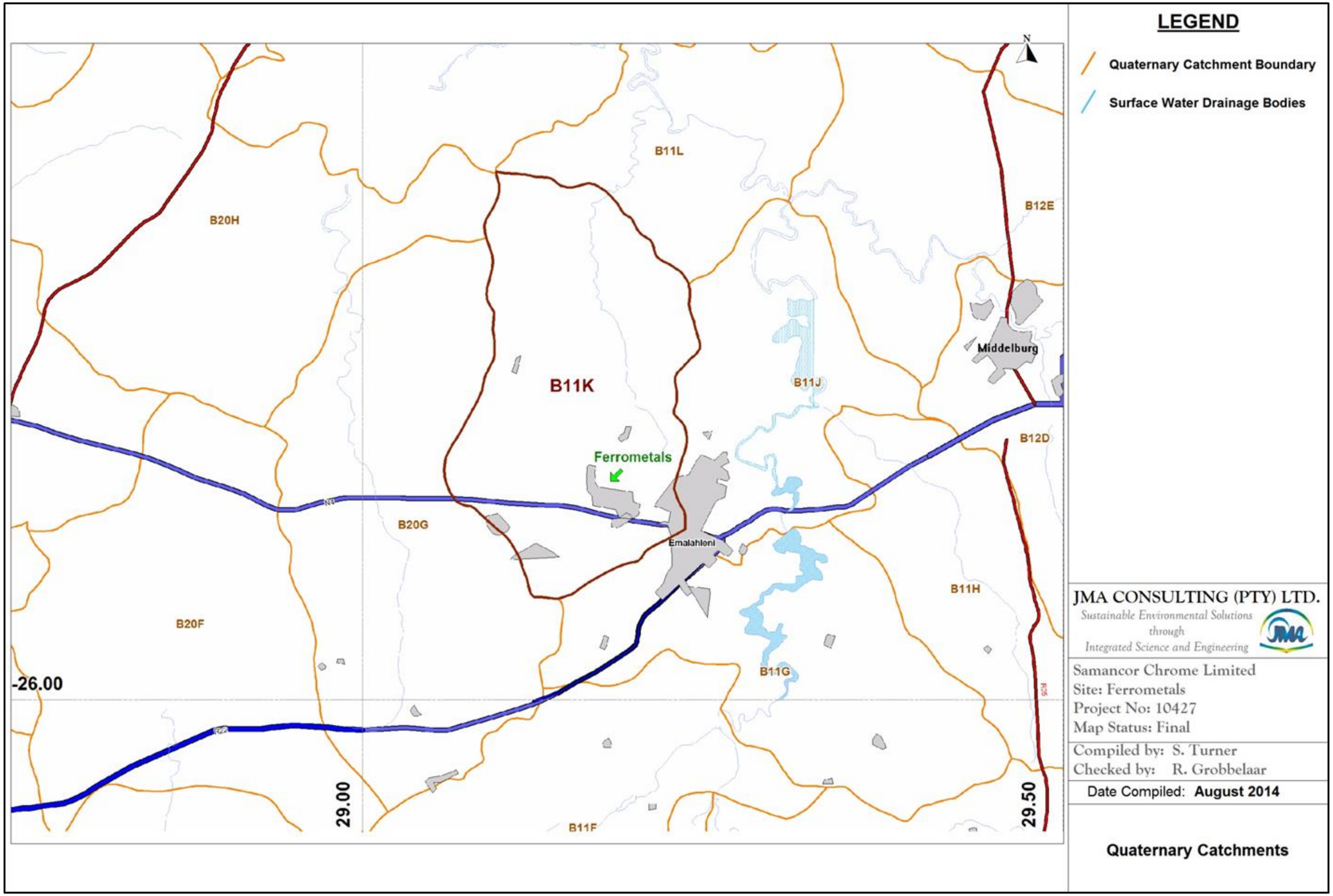

Figure 1.2.11(b): Delineated Quaternary Catchments

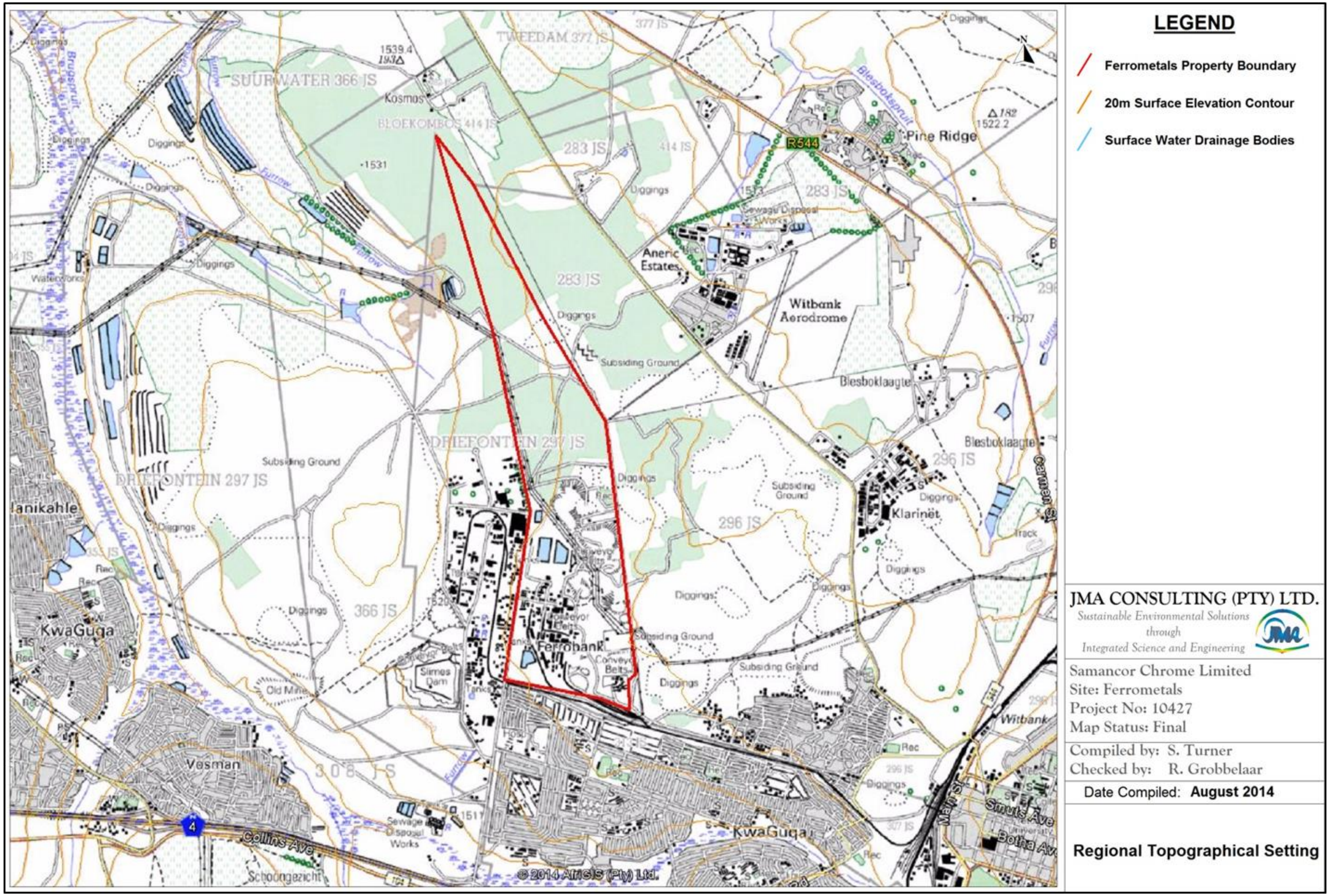

Figure 1.2.11(c): Local Watershed between the Brugspruit (West of Ferrometals) and the Blesbokspruit

A summary of the 6 catchment areas and surface water runoff from the drainage basins upstream of the Loskop Dam is indicated in Table 1.2.11(a). Ferrometals is located within the Klipspruit catchment area, which is by far the smallest of the catchment areas.

Table 1.2.11(a): Catchment Areas and Runoff from Drainage Basins Upstream of the Loskop Dam

Drainage Basin	Catchment Area (km^2)	Naturalised Mean Annual Runoff (million m^3/annum)
Olifants River (upstream of Witbank Dam)	3 256	125.1
Olifants River (downstream of Witbank Dam and Middelburg Dam)	2 905	180.4
Klein Olifants River (upstream of Middelburg Dam)	1 401	43.8
Klipspruit	**376**	**11.2**
Wilge River	4 347	130.4
TOTAL	**12 285**	**490.9**

The DWS operates a permanent water flow and quality monitoring station at Zaaihoek (B1H004) within the Klipspruit. The monitoring point is downstream of the Ferrobank industrial area and at the discharge point of the B11K quaternary catchment. This monitoring point therefore measures the flow as well as the cumulative surface water runoff from the B11K quaternary catchment.

The coordinates of the monitoring station are 25°40'25.10"S; 29°10'23.60"E and the locality of the monitoring station in relation to the Ferrometals site is depicted as Figure 1.2.11(d).

Access to the information recorded at this monitoring station can be obtained from the following link:

http://www.dwa.gov.za/hydrology/HyDataSets.aspx?Station=B1H004,

which opens the relevant page on the Department of Water & Sanitation’s website.

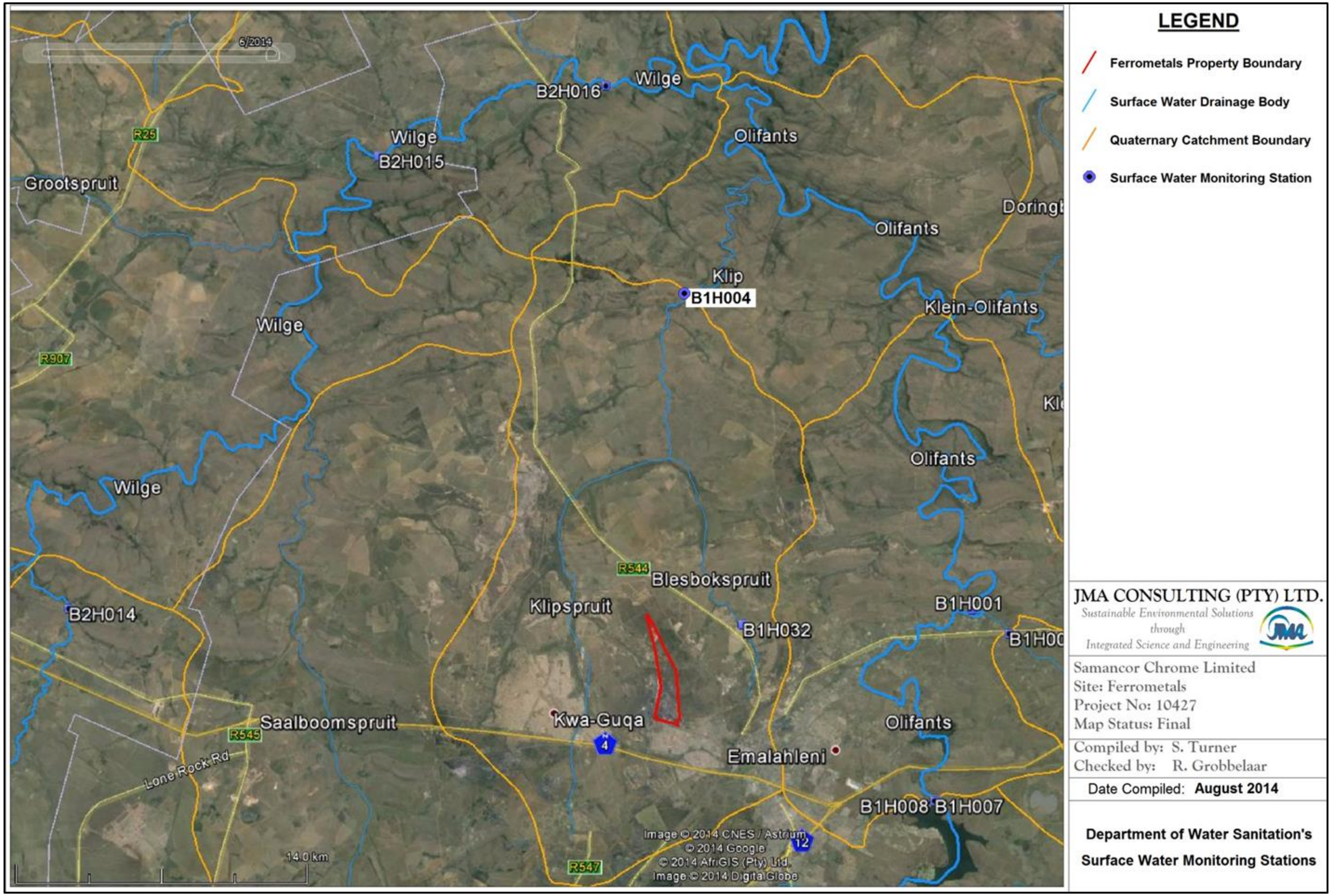

Figure 1.2.11(d): Locality of the DWS Zaaihoek Surface Water Monitoring Station (B1H004)

A picture of the monitoring station as obtained from the website is depicted as Figure 1.2.11(e).

Figure 1.2.11(e): Image of the DWS Zaaihoek Monitoring Station (B1H004)

The volume of water that flows over the weir at the Zaaihoek Monitoring Station has been recorded on a monthly basis since March 1959. The monthly flow volumes recorded at the weir since March 1959 is depicted as Figure 1.2.11(f).

<u>Surface Water User Survey</u>

Surface water users for the area surrounding Ferrometals consist predominantly of mining activities as well as urban activities.

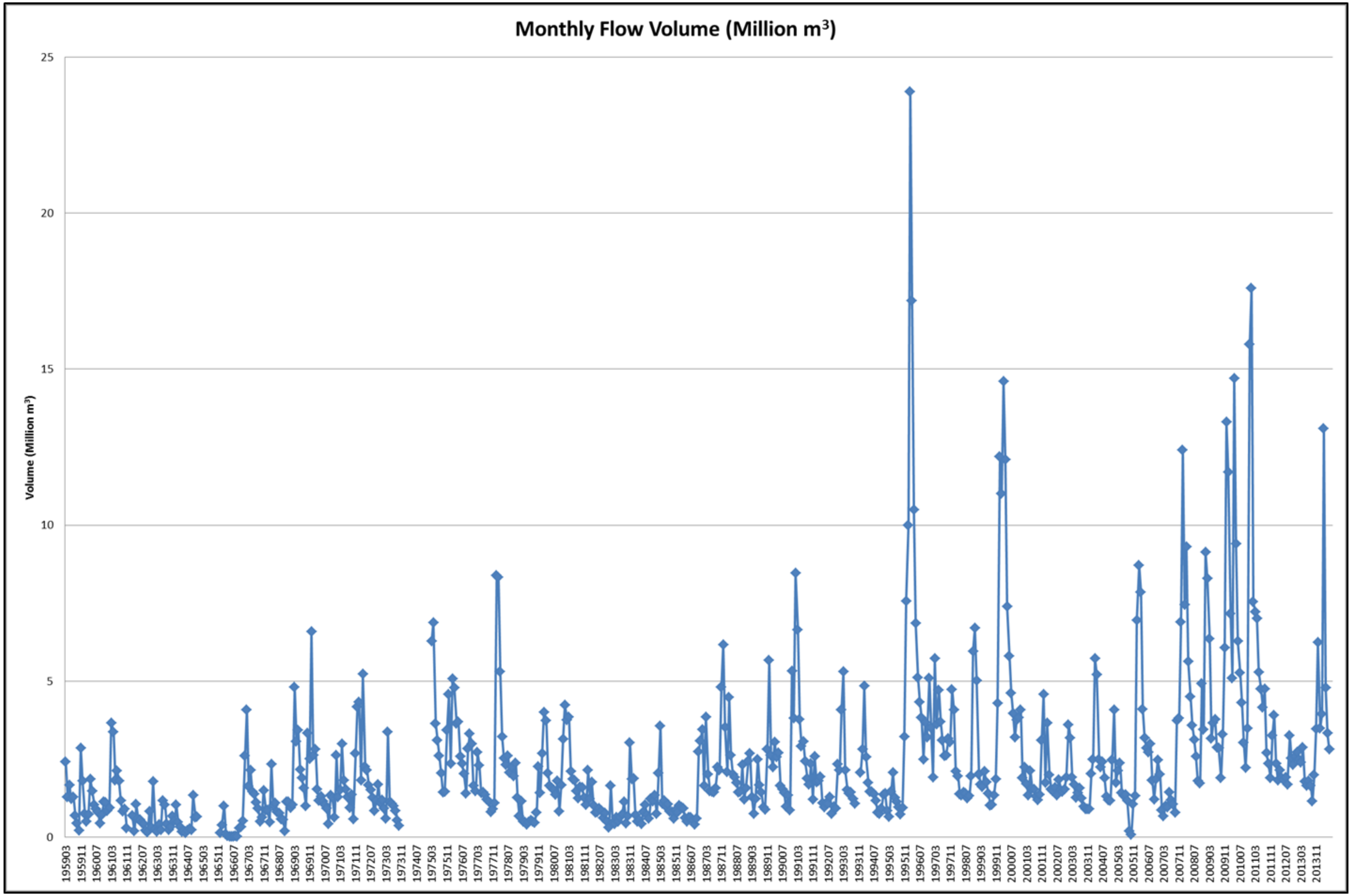

Figure 1.2.11(f): Monthly Flow Volumes Recorded at the Zaaihoek Monitoring Station (B1H004) Weir

Surface Water Quality

Water quality in the Klipspruit sub-catchment has already been impacted on by several sources of contamination, which include:

- Urban-related activities.
- Extensive coal mining.
- Power stations, and associated ash deposits.
- Historical, non-reclaimed, abandoned mining operations.

The main water quality variables of concern in the Klipspruit sub-catchment are salinity-related, including electrical conductivity (EC), total dissolved solids (TDS) and sulphate, as well as urban related variables such as ammonium, phosphate and nitrate. There is also a persistent acidity problem, which results in metals like aluminium, iron and manganese being mobilised into the streams.

The quality of the water that flows over the weir at the Zaaihoek Monitoring Station (Klipspruit River) has been recorded on a monthly basis since 1976 for the following variables: pH, EC, TDS, Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Sodium (Na^{+}), Potassium (K^{+}), Chloride (Cl^{-}), Sulphate (SO_4^{2-}), Total Alkalinity (T.Alk), Fluoride (F^{-}), Phosphate (PO_4^{3-}) as P, Total Phosphate (P_{Tot}) as P, Nitrate (NO_3^{-}) and Nitrite (NO_2^{-}) as N as well as Ammonium (NH_4^{+}) as N. The recorded water qualities are depicted as Figure 1.2.11(f). This information can be obtained from the DWS website using the link:

http://www.dwa.gov.za/iwqs/wms/data/B11/B11_90408.png.

The surface water quality information depicted on Figure 1.2.11(g) clearly indicates that there is a significant variation in the surface water quality from year to year as well from season to season. A summary of the surface water quality data recorded at the Zaaihoek Monitoring Station (B1H004) within the Klipspruit since 1967 is indicated in Table 1.2.11(b).

Table 1.2.11(b): Surface Water Quality recorded at the Zaaihoek Station

Constituent	Min	Max	Standard Deviation	Average	Median
pH	2.18	8.35	1.44	4.75	4.05
EC	14.80	186.00	30.35	103.81	101.20
TDS	92.00	1307	204.0	649.72	629.00
Ca^{2+}	0.50	168.60	20.72	62.04	59.60
Mg^{2+}	2.70	72.79	7.29	24.10	23.80
Na^{+}	7.10	249.10	37.09	96.60	91.33
K^{+}	0.45	25.27	3.25	8.03	7.40
Cl^{-}	1.50	355.00	23.41	45.07	42.06
SO_4^{2-}	6.20	793.00	138.06	386.96	378.10
T.Alk	2.00	152.03	15.85	9.76	4.00
NO_3^{-}_NO_2^{-}	0.02	12.74	2.27	1.91	1.28
F^{-}	0.03	1.73	0.33	0.47	0.42
NH_4^{+}	0.02	45.00	2.88	1.49	0.09
PO_4^{2-}	0.00	0.25	0.02	0.02	0.01

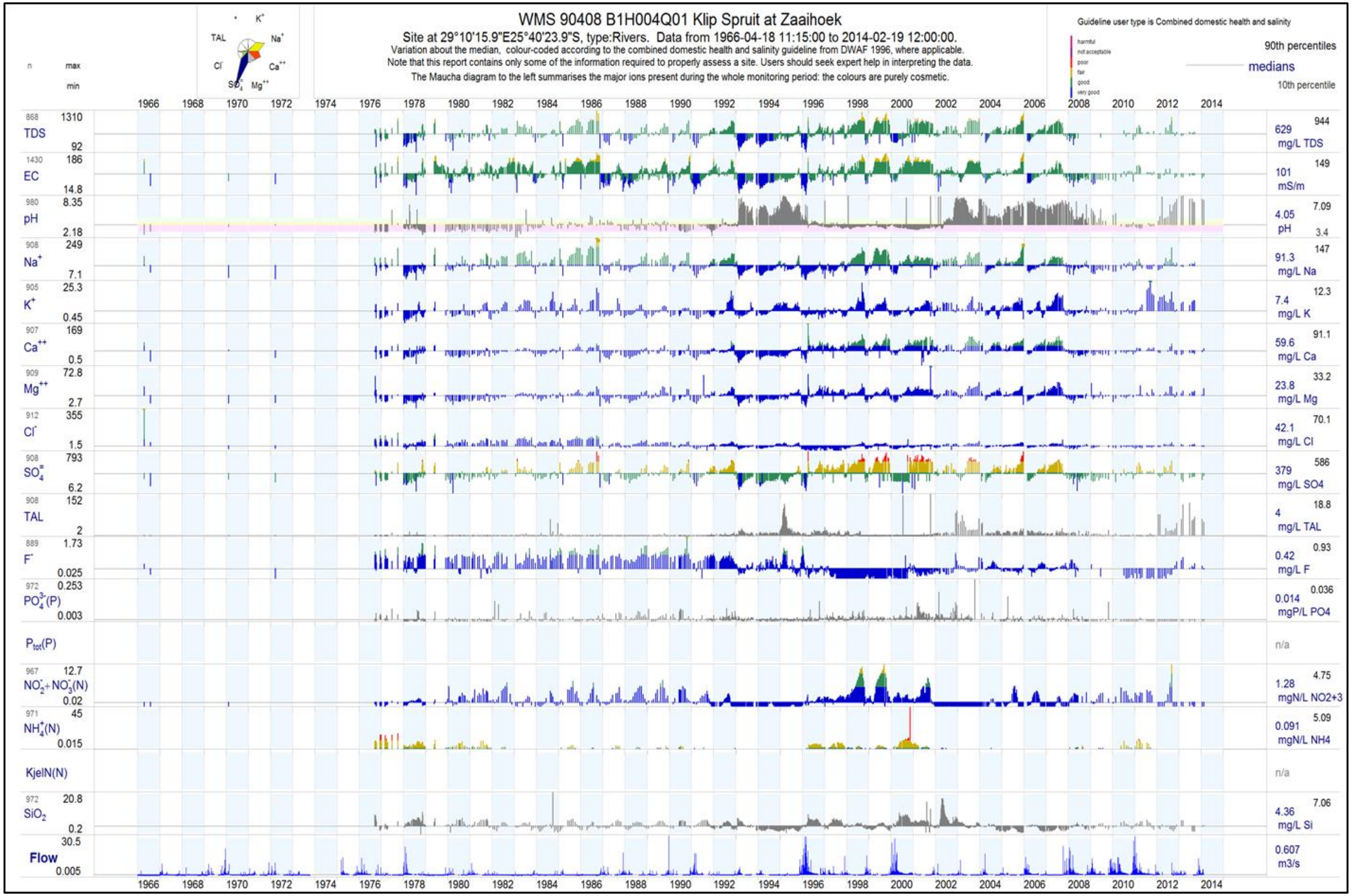

Figure 1.2.11(g): Water Qualities Recorded at the DWS Zaaihoek Surface Water Monitoring Station (B1H004)

Water Quality Objectives

Ferrometals has been issued with a Water Use Licence (Licence No. 04/B11K/709) (WUL) which stipulates certain water quality objectives, which relate to the quality of waste water which may be disposed as well as surface water qualities which may not be exceeded.

Condition 5.1 of the WUL states that the impact of the Ferrometals activities on the Brugspruit and Blesbokspruit shall not exceed the in-stream water quality objectives (or resource water quality objectives) for the area, as stipulated in Table 1.2.11(c).

Table 1.2.11(c): Receiving Surface Water Resource Quality Objectives

Parameter	Resource Quality Objectives
pH	6-9.5
Electrical Conductivity (EC) in mS/m	98.40
Sodium (Na) in mg/l	32.01
Magnesium (Mg) in mg/l	78.76
Calcium (Ca) in mg/l	41.46
Chloride (mg/l)	47.94
Sulphate (mg/l)	32.10
Nitrate (mg/l)	7.17
Fluoride (mg/l)	0.14

Condition 3.1 of the WUL states that the quality of storm water (clean or dirty) disposed of into the storm water channel at Ferrometals shall not exceed the limits of the general standards indicated in Table 1.2.11(d).

Table 1.2.11(d): Quality Limits of Waste Water permitted to be disposed at Ferrometals

Variables and Substances	General Effluent Standard
Chemical Oxygen Demand	65 mg/l
Color, odour or taste	No substance capable of producing the variables listed
Cyanide (as Cn)	0.03 mg/l
Dissolved oxygen concentration	At least 75% saturation
Fluoride (as F)	1,0 mg/l
Increase in electrical conductivity	Not by more than 75 mili-Siemens/m above that of the receiving water
Increase in sodium (as Na) concentration	Not by more than 90 mg/l above the receiving water
Ionized and unionized ammonia (free and saline ammonia)	3,0 mg/l
Nitrate (as N)	15 mg/l
Oil or grease	0 mg/l
pH	Between 5,5 and 9,5

Variables and Substances	General Effluent Standard
Phenol index	0,1 mg/l
Residual chlorine (as Cl)	0,1 mg/l
Soap or detergents	0 mg/l
Soluble ortho phosphate (as P)	1,0 mg/l
Sulphides (as S)	1,0 mg/l
Suspended solids	18 mg/l
Temperature	Not more than 25°C
Total aluminum	0,05 mg/l
Total arsenic (as As)	0,06 mg/l
Total boron (as B)	0,5 mg/l
Total cadmium (as Cd)	0,008 mg/l
Total chromium III (as Cr_{III})	0,11 mg/l
Total chromium VI (as Cr_{VI})	0,02 mg/l
Total copper (as Cu)	0,006 mg/l
Total iron (as Fe)	0,3 mg/l
Total lead (as Pb)	0,01 mg/l
Total manganese (as Mn)	0,4 mg/l
Total mercury (as Hg)	0,002 mg/l
Total selenium (as Se)	0,05 mg/l
Total zinc (as Zn)	0,05 mg/l
Typical faecal coli per 100 ml	0

1.2.12 Terrestrial Ecology (Plant Life & Animal Life)

An ecological scan was performed by Scientific Aquatic Services at Ferrometals. The report focussed on identifying whether sensitive habitats such as wetlands or habitat that may support the presence of Red Data Listed (RDL) species or flora and fauna are present. Based on the report, the following has relevance:

- The study area comprises of the vulnerable (VU) (Figure 1.2.12(a)) Eastern Highveld Grassland vegetation type (Figure 1.2.12(b)), as indicated in the National List of Threatened Terrestrial Ecosystems (2011). The vegetation within the study area however has undergone irreversible loss of natural habitat, thus lowering the overall sensitivity of vegetation found within the study area. According to the National Protected Area Expansion Strategy (NPAES), the study area is not located within a formal or informal NPAES protected area or within a NPAES Focus Area.

- The Terrestrial Biodiversity assessment of the Mpumalanga Biodiversity Conservation Plan (MBCP) indicates that habitat is “least concern” and “no natural habitat” as is expected within areas dominated by alien tree stands (Figure 1.2.12(c)). The majority of the study area is classified as “no natural habitat remaining”. These areas have been largely transformed due to alien vegetation encroachment, where biodiversity has been irreversibly changed and virtually dysfunctional.

- The ecological assessment found that the study area is characterised by high levels of alien floral invasion as a result of historic and on-going disturbances and edge effects from surrounding areas. This has resulted in significant transformation of the natural floral community composition and structure. No sensitive habitat types that warrant conservation are present within the study area.

Due to the highly transformed level of the vegetation, the study area is not considered sensitive and does not contain any sensitive habitat or RDL flora or fauna.

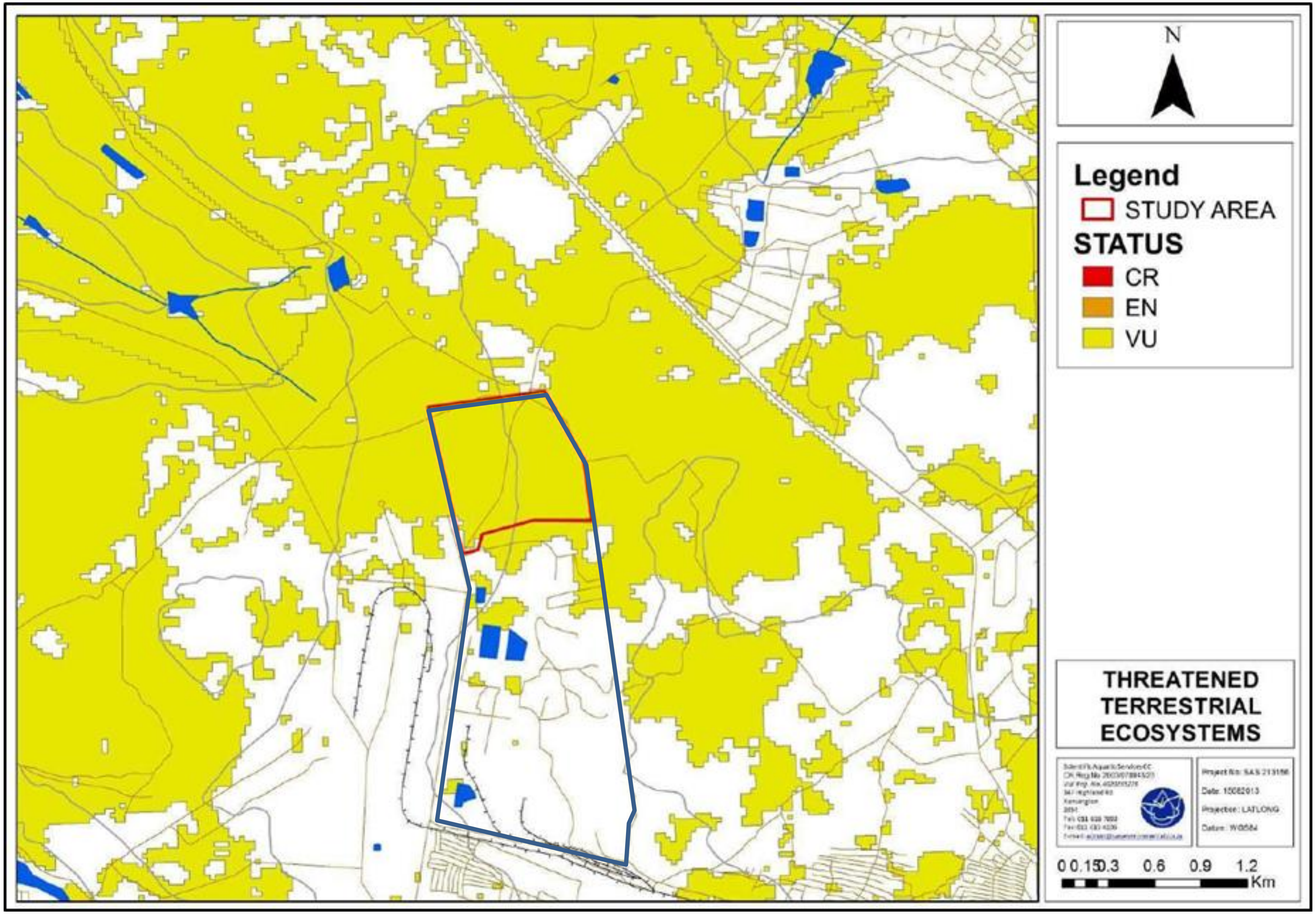

Figure 1.2.12(a): Threatened Terrestrial Ecosystems

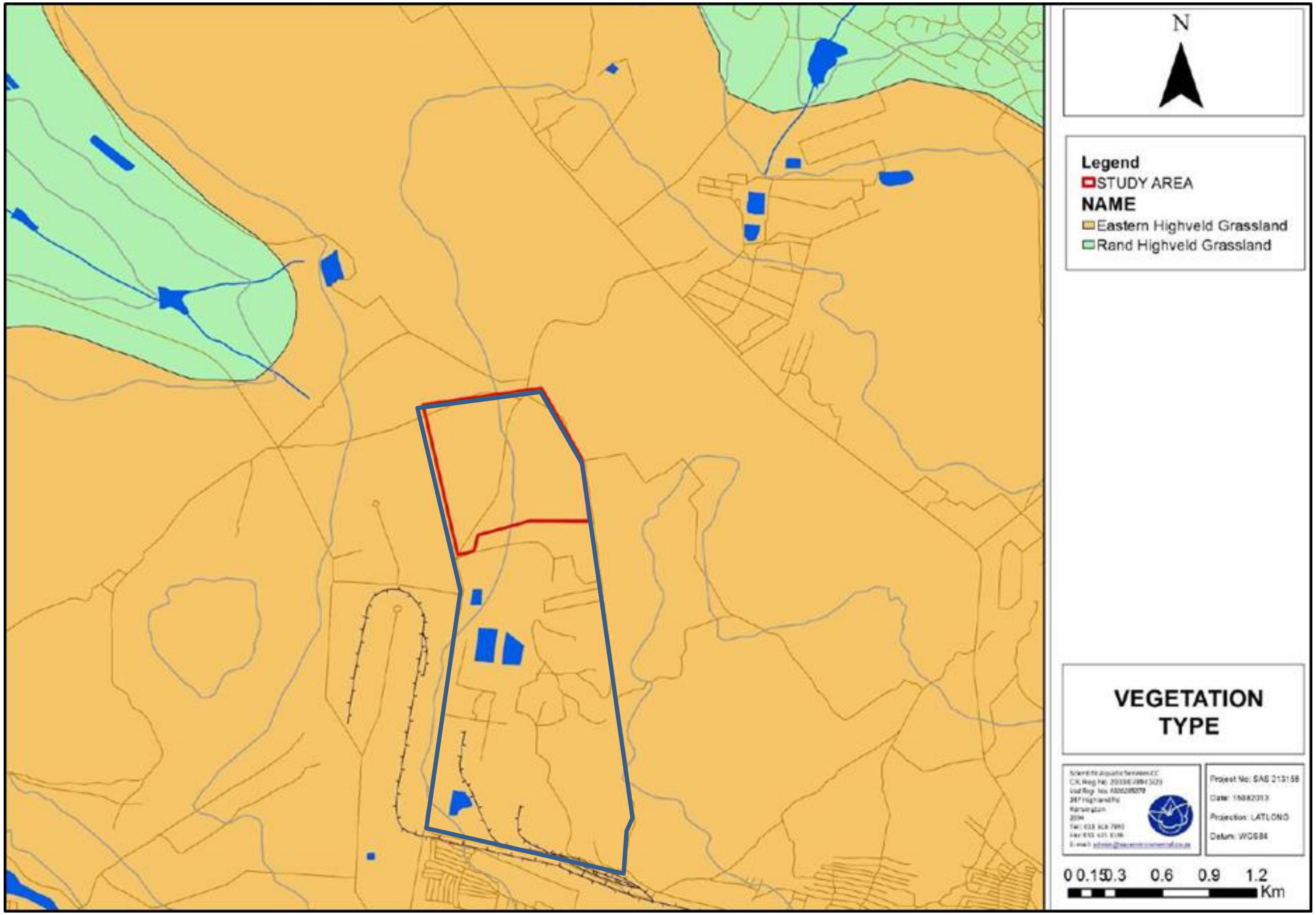

Figure 1.2.12(b): Vegetation Type (Mucina & Rutherford, 2006)

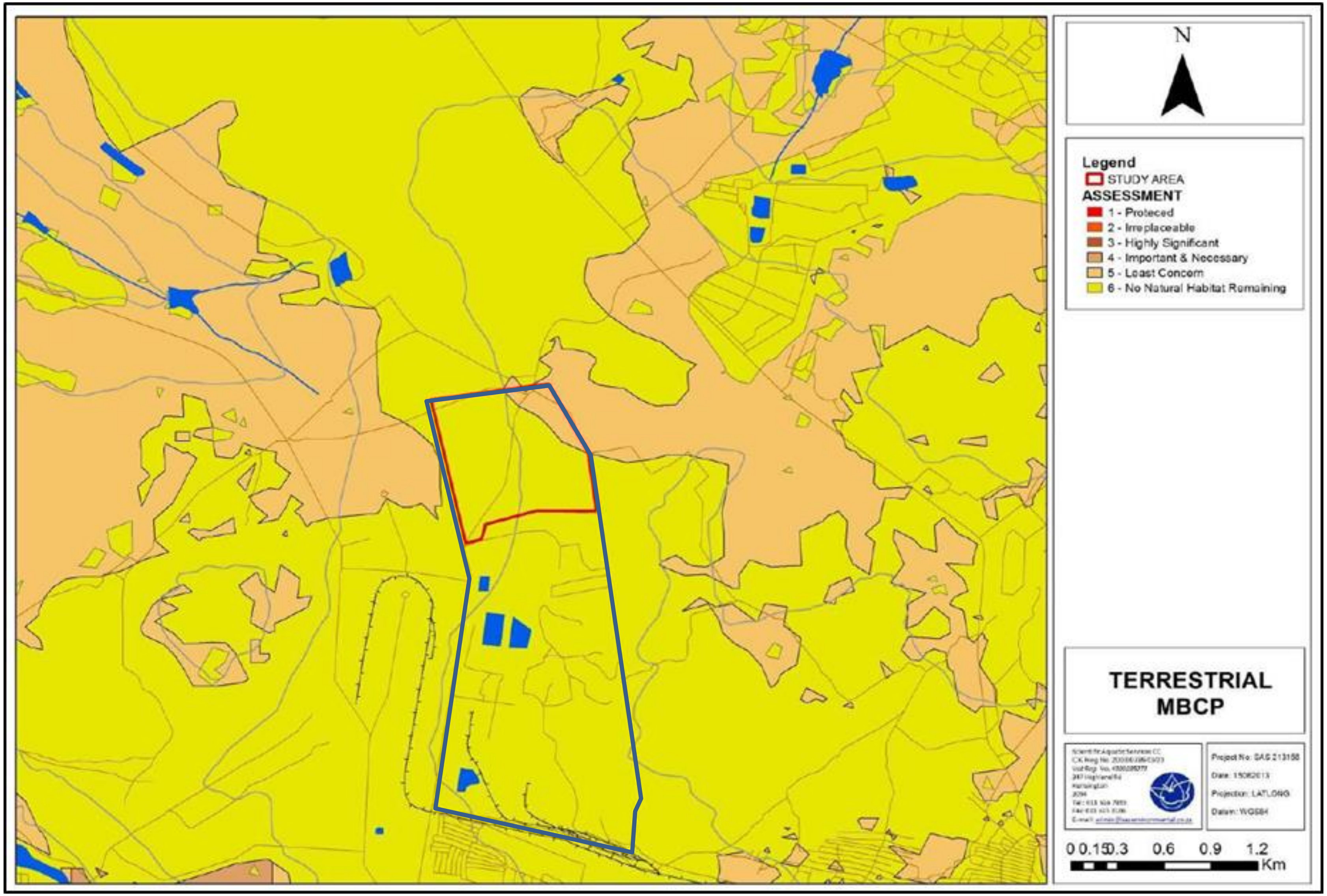

Figure 1.2.12(c): MBCP Terrestrial Biodiversity Assessment

1.2.13 Wetlands and Aquatic Ecology

The Freshwater Ecosystem Priority Area (FEPA) database was consulted to define the ecology of wetland or river systems close to or within the study area that may be of ecological importance. No wetland or river systems were indicated by the FEPA database for the study area (Figure 1.2.13(a)). Two wetland types were located within the 500m radius of the subject property, namely a channelled valley bottom wetland feature and flat wetland features. The flat wetland features can be further classified as artificial wetlands.

The overall ecological assessment found that the study area is characterised by high levels of alien floral invasion as a result of historic and on-going disturbances and edge effects from surrounding areas. This has resulted in significant transformation of the natural floral community composition and structure. No wetlands or any other sensitive habitat types that warrant conservation are present within the study area.

Due to the highly transformed level of the vegetation, the study area is not considered sensitive and does not contain any sensitive habitat or RDL flora or fauna. No sensitive areas or delineated wetlands have been identified at the Ferrometals industrial site either.

Resource Class and River Health

The Resource class essentially describes the desired condition of the resource, along with the degree to which it can be utilised. These classes range from minimally used to heavily used. The Management class facilitates the balance between protection and use of the water resource and defined by taking into consideration the social, economic and ecological landscape.

According to preliminary class determination by the Department, the Klipspruit is currently below a **Class D Ecological Category** which is unacceptable. This area is mostly impacted by urban runoff and mining. This implies that this area falls within a **Class III (heavily used) Management class**. Monitoring is therefore essential for this area to upgrade the Klipspruit to a Class II management class.

It should be noted that there are no surface water resources within the delineated property boundary at Ferrometals and no Present Ecological Status (PES) / Ecological Importance and Sensitivity (EIS) determinations have therefore been carried out at Ferrometals.

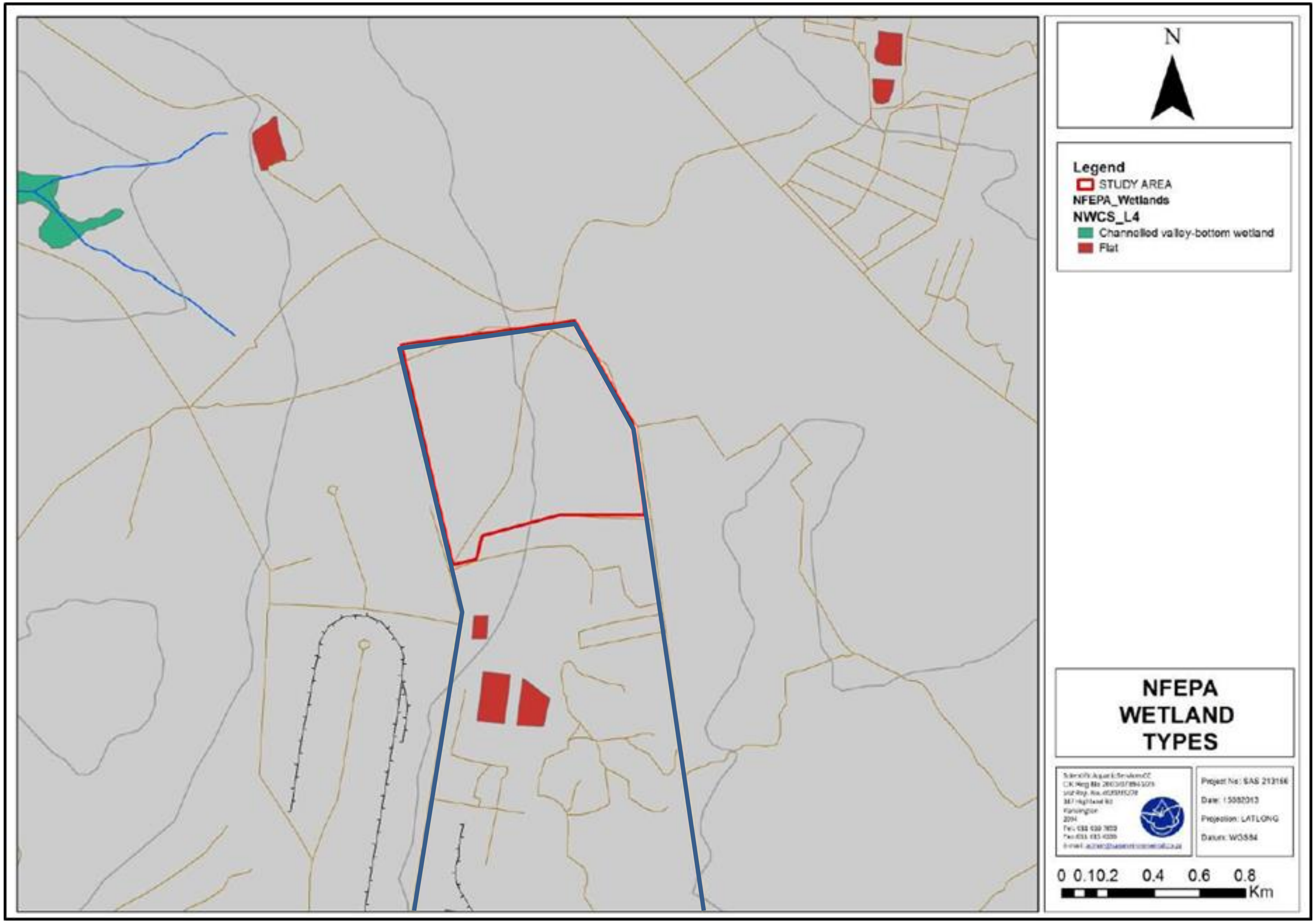

Figure 1.2.13(a): Wetland Types as Indicated by the NFEPA Database (2011)

1.2.14 Air Quality

Airshed Planning Professionals (Pty) Ltd was appointed by Samancor Chrome to undertake a baseline air quality impact assessment for Ferrometals (FMT) in Witbank, Mpumalanga.

<u>Site Description</u>

FMT is situated in eMalahleni (formerly called Witbank), Mpumalanga (Figure 1.2.14(a). eMalahleni is in the coal mining area with 22 collieries in an area no more than 40 km in any direction. There are a number of power stations (such as the Duvha Power Station), as well as a steel mill, Highveld Steel and Vanadium Corporation, nearby.

The FMT site is surrounded by potential sensitive receptor areas. These areas include the KwaQuqa residential areas situated directly south and to the west of FMT, Witbank (~ 6 km to the east of FMT) and Clewer (~ 10 km to the south west of FMT).

The topography of the area surrounding the site is presented in Figure 1.2.14(b). The landscape consists largely of gently rolling hills with scattered trees and grassland.

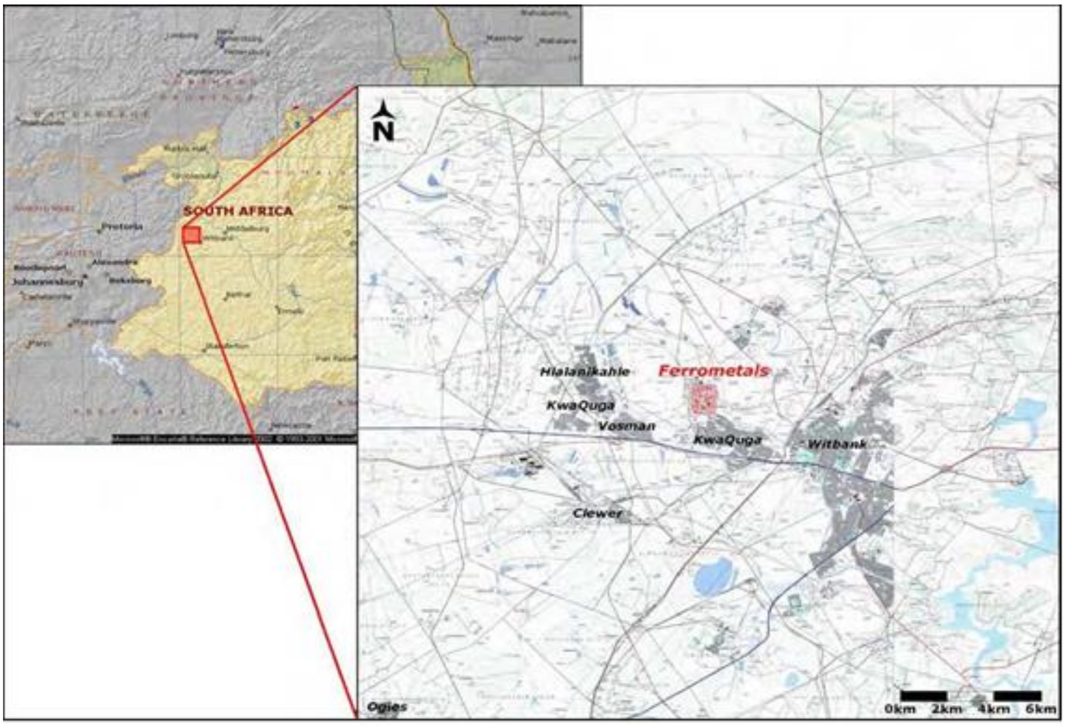

Figure 1.2.14(a): Location of Ferrometals in Witbank

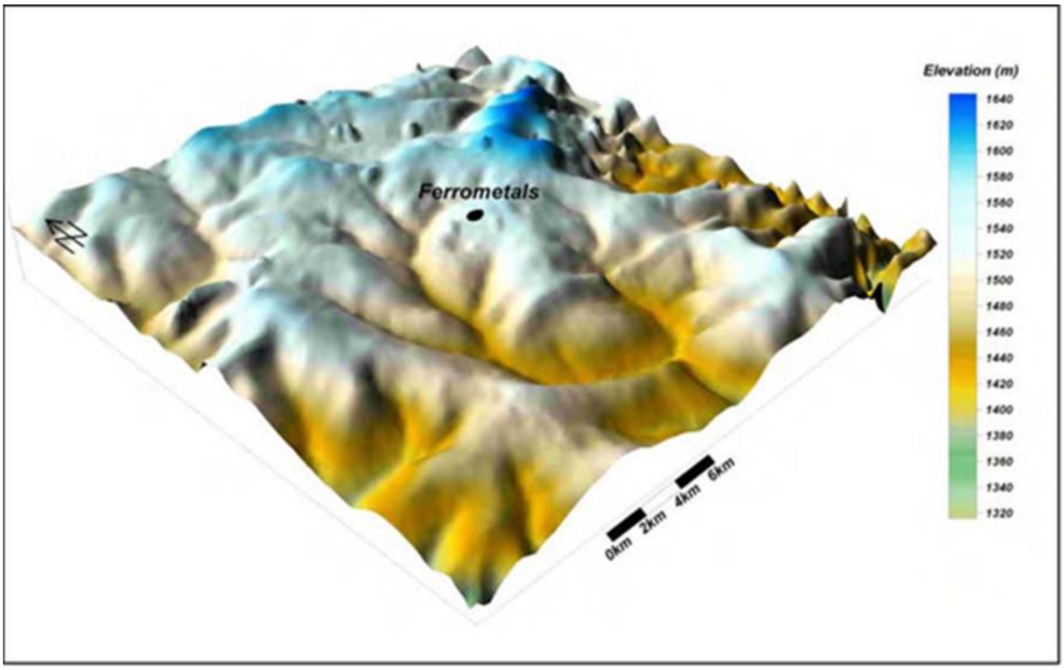

Figure 1.2.14(b): Topography of the Witbank Area

Ambient PM 10 and Dustfall Monitoring

The monitoring localities for the ambient PM 10 and Dustfall Monitoring are shown in Figure 1.2.14(c).

Figure 1.2.14(c): PM 10 and Dustfall Monitoring Locations at Ferrometals

PM10 Monitoring

Ambient PM10 monitoring was done at two locations viz. at the HT Yard and the SHER Office (Figure 1.2.14(c)). Results for the short term PM10 monitoring campaign are shown in Figure 1.12.14(d).

Thirteen exceedances of the current South African daily average PM10 standard of 180 µg/m³ was recorded during the 17 day monitoring period at the "HT Yard". The proposed daily average PM10 standard of 75 µg/m³ was exceeded a total of 16 days. The average and maximum daily average PM10 concentrations recorded over the period was 332 µg/m³ and 822 µg/m³ respectively.

At the "SHER Office", 12 exceedances of the current South African daily average PM10 standard of 180 µg/m³ was recorded during the 13 day monitoring period. The proposed daily average PM10 standard of 75 µg/m³ was exceeded a total of 13 days. The average and maximum daily average PM10 concentrations recorded at the weigh bridge was 480 µg/m³ and 1410 µg/m³ respectively.

Dustfall Monitoring

Dustfall monitoring was done for one month at ten locations around the FMT plant (Figure 1.2.14(c)). Results for the short term dustfall monitoring campaign are shown in Figure 1.2.14(e) and summarized in Table 1.2.14(a).

Table 1.2.14(a): Dustfall Monitoring Results.

Site	mg/m²/day	DEAT Dustfall Category (a)	SANS Dustfall Band (b)
Railway	1434	Very Heavy	
ACP	3486	Very Heavy	
Eskom	753	Heavy	
Sand Hills	351	Moderate	
Asphalt	128	Slight	
Car Park	884	Heavy	
Sand 2	465	Moderate	
Fuel Depot	2880	Very Heavy	
Fuel 2	2694	Very Heavy	
KwaQuqa	2456	Very Heavy	
HT Yard	2260	Very Heavy	
SHER Office	1471	Very Heavy	

Notes:

(a) SLIGHT (<250 mg/m²/day); MODERATE (250 -500 mg/m²/day); HEAVY(500 - 1200 mg/m²/day); VERY HEAVY(> 1200 mg/m²/day)

(b) RESIDENTIAL (<600 mg/m²/day); INDUSTRIAL (600-1200 mg/m²/day); ACTION (1200 - 2400 mg/m²/day); ALERT (>2400 mg/m²/day)

The average dustfall recorded over all the sites during the month was 1605 mg/m2/day.

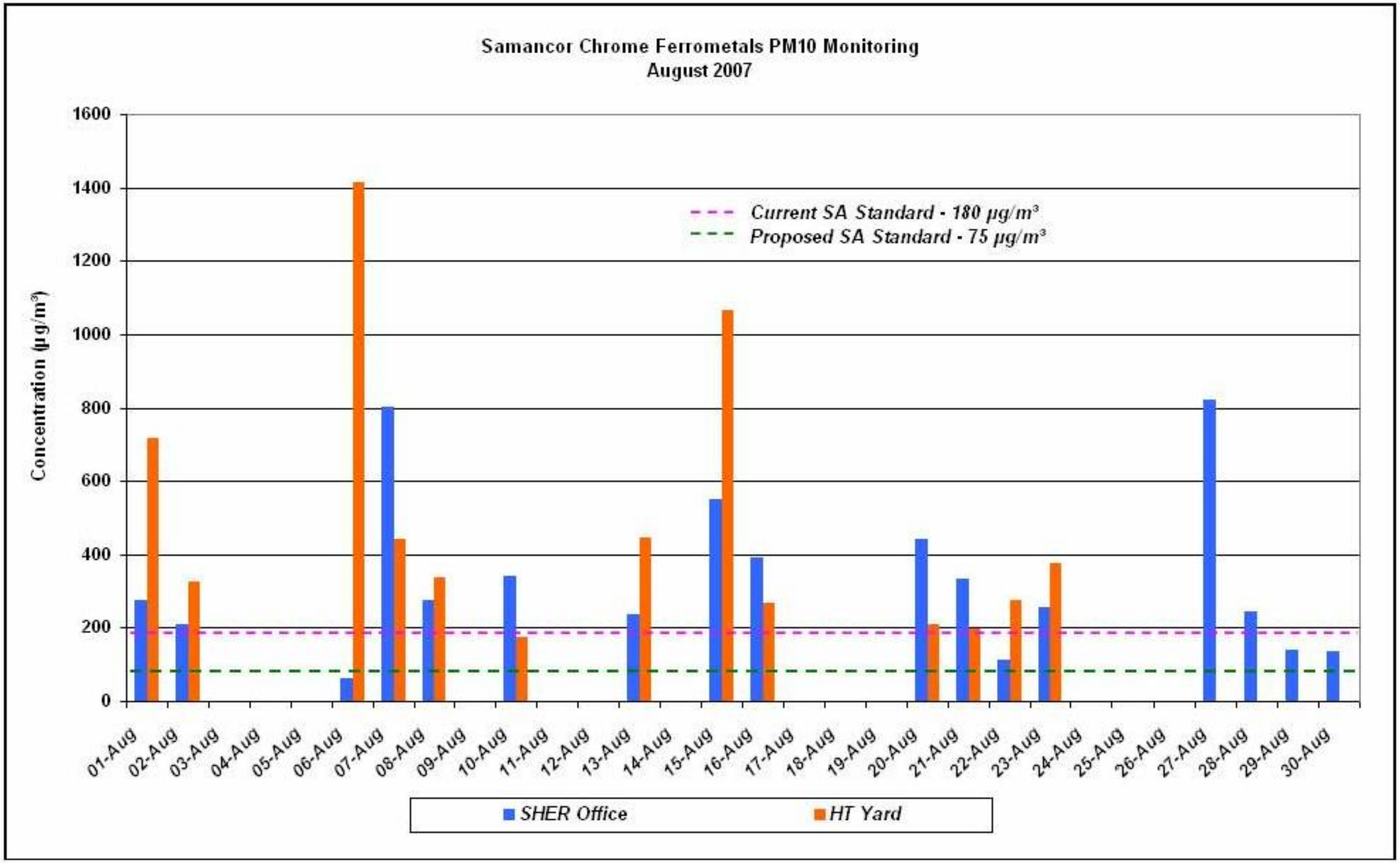

Figure 1.2.14(d): Ambient PM10 Monitoring at Ferrometals

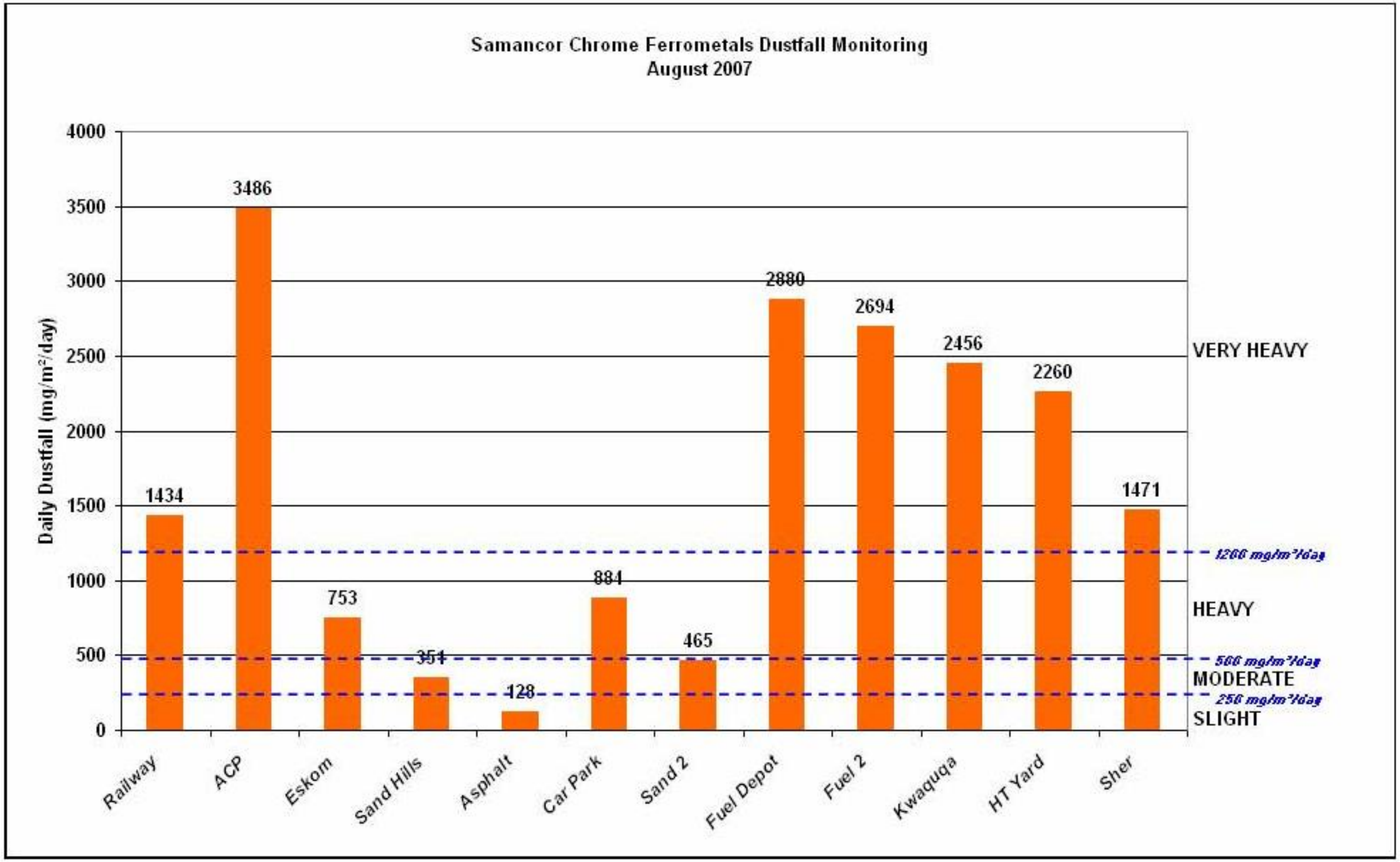

Figure 1.2.14(e): Dustfall Monitoring at Ferrometals

1.3 POTENTIAL ENVIRONMENTAL IMPACTS

In order to identify the potential environmental impact which could be associated with the proposed activities at Ferrometals, it is necessary to understand the project and its associated activities, and then to identify all aspects related to the project which could impact on the environment.

1.3.1 The Proposed Project Activities

The proposed activities which triggers this BA, relates to the decommissioning of three Historical Slimes Dams Facilities at the Ferrometals Site, a Business Unit of Samancor Chrome Limited, which is located near the town of Emalahleni (formerly Witbank) in the Emalahleni Local Municipality within the Nkangala District Municipality. A Civil Engineering Design Report was compiled which gives full details on the proposed project activities – the report is attached as **APPENDIX 1.3.1**.

The Historical Slimes Dams Facilities are no longer in operation. The Historical Slimes Dams Facilities consist of three small slimes tailings dams referred to as the South Slimes Dam, East Slimes Dam and the Stores Slimes Dam.

Historical Slimes Dam	Footprint (ha)	Max Height (m)	Estimated Dam Volume (m^3)
South Slimes Dam	1,48	6,84	45000
East Slimes Dam	2,57	3,60	65700
Stores Slimes Dam	0,23	1,50	5800

The South- and East Slimes Dams if properly rehabilitated will not extend the already effected footprints and from an economical perspective and stability perspective *in situ* rehabilitation seems to be the most viable option. It's recommended that the material at the small Stores Slimes Dam should be removed and deposited at the South Slimes Dam.

The Slimes Dams will be treated as Hazardous Waste facilities. Schedule No. R.636 published under the National Environmental Management: Waste Act of 2008, Act No. 59 of 2008, section 7(1)(c) requires hazardous waste to be contained in a Class A Landfill. Therefore the requirement for any new slimes tailings facility to stockpile Ferrometals slimes would require a Class A Landfill.

At closure the Class A Landfill or tailings facility should be capped with a specified capping configuration as detailed in the Minimum Requirements. It requires a double composite liner system with leakage detection system.

When no bottom containment barrier is present, which is the case at the historical slimes dams, the final cover detail must be extended by providing a flexible membrane below the cover soil with the clayey layers to be 4 x 150mm thick. It is accepted by DWS that the clayey soil layers may be replaced with a Geosynthetic Clay Layer (GCL) which is +-10mm thick unhydrated.

None of the Historical Slimes Dams Facilities have a base barrier and the minimum requirements implies that in such case that the capping must ensure that the ingress of precipitation into the waste body to generate leachate must be prevented. Therefore in the absence of a required base barrier the proposed capping detail consists from top to bottom of:

- 450mm topsoil layer;
- 2mm Flexible membrane (FML);
- Geosynthetic Clay Layer (GCL) and
- 150mm capillary break and drainage layer.

Finally, the capped and shaped landfill site will be re-vegetated and monitored.

1.3.2 Aspects Causing Environmental Impacts

The project will have two life cycle phases namely:

- Decommissioning and Closure
- Post Closure

Aspects which could cause Environmental Impacts as they relate to the two project life cycle phases are:

Decommissioning and Closure:

- Remove Slimes Material and Contaminated Soil from Stores Slimes Dam footprint and deposit on the South Slimes Dam.
- Shape the three sites to make them free draining.
- Cap the East and South Slimes Dams with an appropriate liner system to prevent infiltration of rain water and install appropriate storm water management measures such as drains, channels and shutes to tie up with overall Ferrometals Storm Water Management System.
- Re-vegetate all three Slimes Dam sites.

Post Closure:

- Failure of the Vegetative Cover.
- Failure of the Capping System.
- Failure of the Storm Water Management System.

1.3.3 Potential Environmental Impacts

The potential Environmental Impacts that could associated with the above listed aspects for the two project life cycle phases, are given in the two Tables below. The impact assessments will be dealt with in more detail in the section dealing with the Environmental Impact Assessment itself – section 6. of this BAR.

Table 1.3.3(a): Potential Environmental Impacts – Decommissioning and Closure Phase

Decommissioning and Closure Phase		
Activity	Aspect	Potential Environmental Impact/Issue
Decommissioning and Closure of the three Historic Slimes Dams	Remove Slimes Material and Contaminated Soil from Stores Slimes Dam footprint and deposit on the South Slimes Dam.	Surface Water: Contamination of the surface water resource due to erosion caused by storm water runoff and surface water discharge with high suspended solids load.
		Air Quality (Gaseous Emissions): Deterioration in ambient air quality due to gaseous emissions generated from construction machinery and vehicles
		Air Quality (Dust Fallout): Deterioration in ambient air quality due to dust generated from decommissioning activities.
		Noise: Impact on ambient sound level due to decommissioning activities.
		Noise: Generation of noise due to reverse hooters/alarms from construction machinery and vehicles.
	Shape the three sites to make them free draining.	Surface Water: Contamination of the surface water resource due to erosion caused by storm water runoff and surface water discharge with high suspended solids load.
		Air Quality (Gaseous Emissions): Deterioration in ambient air quality due to gaseous emissions generated from construction machinery and vehicles
		Air Quality (Dust Fallout): Deterioration in ambient air quality due to dust generated from capping activities.
		Noise: Impact on ambient sound level due to decommissioning activities.
		Noise: Generation of noise due to reverse hooters/alarms from construction machinery and vehicles
	Cap the East and South Slimes Dams with an appropriate liner system to prevent infiltration of rain water and install appropriate storm water management measures such as drains, channels and shutes to tie up with overall Ferrometals Storm Water Management System.	Surface Water: Contamination of the surface water resource due to erosion caused by storm water runoff and surface water discharge with high suspended solids load.
		Air Quality (Gaseous Emissions): Deterioration in ambient air quality due to gaseous emissions generated from construction machinery and vehicles
		Air Quality (Dust Fallout): Deterioration in ambient air quality due to dust generated from capping activities.
		Noise: Impact on ambient sound level due to decommissioning activities.
		Noise: Generation of noise due to reverse hooters/alarms from construction machinery and vehicles
	Re-vegetate the Capped Slimes Dams	Plant Life: Restoration of Habitat due to re-vegetation of the footprint.
		Plant Life: Restoration of Biodiversity due to the repair of natural vegetation/habitat.

Table 1.3.3(b): Potential Environmental Impacts – Post Closure Phase

Post Closure Phase		
Activity	Aspect	Potential Environmental Impact/Issue
Decommissioning and Closure of the three Historic Slimes Dams	Failure of the Vegetation Cover	Soils: Loss of soil horizon due to erosion and surface water run-off.
		Surface Water: Contamination of the surface water resource due to erosion caused by storm water runoff and surface water discharge with high suspended solids load.
		Plant Life: Loss of habitat due to vegetation cover not returning to natural state.
		Plant Life: Loss of biodiversity due to a loss of habitat.
		Animal Life: Loss of habitat due to vegetation cover not returning to natural state.
		Animal Life: Loss of biodiversity due to a loss of habitat.
		Air Quality (Dust Fallout): Deterioration in ambient air quality due to windblown dust generated from denuded surfaces.
	Failure of the Capping System	Groundwater: Contamination of the groundwater resource due to infiltration of rainwater through the capping and the subsequent infiltration of contaminated water through the footprint of the Slimes Dam into the sub-surface.
	Failure of the Storm Water Management System	Soils: Loss of soil horizon due to erosion.
		Soils: Contamination of soil due to toe seepages and storm water run-off.
		Surface Water: Contamination of the surface water resource due to uncontrolled run-off of contaminated storm water from the Slimes Dam.

2. LEGISLATION AND GUIDELINES CONSIDERED

2.1 LISTING OF ACTS, REGULATIONS AND GUIDELINES

A review of the project components has indicated the following Environmental Acts, Regulations and Guidelines, listed in Table 2.1(a), to be applicable to the project.

Legislation Considered for Application	
1.	Constitution Act 108 0f 1996
2.	National Environmental Management Act 107 of 1998 (NEMA)
3.	Environment Conservation Act 73 of 1989 (ECA)
4.	National Water Act 36 of 1998 (NWA)
5.	National Heritage Resources Act 25 of 1999 (NHRA)
6.	National Environmental Management Air Quality Act 39 of 2004 (NEMAQA)
7.	Atmospheric Pollution Prevention Act 45 of 1965 (APPA)
8.	National Environmental Management Biodiversity Act 10 of 2004 (NEMBA)
9.	National Environmental Management Waste Act 59 of 2008 (NEMWA)
10.	National Forests Act 84 of 1998 (NFA)
11.	Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA)
12.	National Environmental Management Integrated Coastal Management Act 24 of 2008 (NEMICMA)
13.	National Building Regulations and Building Standards Act 103 0fof 1997 (NBRBSA)
14.	Conservation of Agricultural Resources Act 43 of 1983 (CARA)

Considered Regulations	
NEMA	
1.	GNR 543 of 18 June 2010 – EIA Regulations
2.	GNR 544 of 18 June 2010 – Basic Assessment Listed Activities
3.	GNR 545 of 18 June 2010 – Scoping and EIA Listed Activities
4.	GNR 546 of 18 June 2010 – Basic Assessment Listed Activities- Specified Geographical Areas
NWA	
1.	GNR 2274 of 23 October 1981 – Regulations promulgated in terms of section 30(2) of the Water Act 54 of 1956 in respect of subterranean water control areas
2.	GNR 704 of 4 June 1999 – Regulations on use of water for mining and related activities aimed at the protection of water resources
3.	GNR 1160 of 1 October 1999 – Establishment of Water Management Areas
4.	GNR 1352 of 12 November 1999 – Regulations requiring that a water use be registered
5.	GNR 212 of 10 March 2000 – Request to register a water use
6.	GN 398 of 26 March 2004 – General authorizations in terms of Section 39 of the National Water Act
7.	GN 470 of 12 May 2000 – Request to register a water use
8.	GNR 399 of 26 March 2006 – General authorizations in terms of Section 39 of the National Water Act
ECA	
1.	GNR 154 of January 1992 – Noise Control Regulations
NEMAQA	
1.	GNR 248 of 31 March 2010 – List of Emission Activities
NEMWA	
1.	GNR 718 of 3 July 2009 – List of Waste Management Activities

Considered Technical Guidelines	
DEA and DEDET	
1.	Integrated Environmental Management, Information Series 0, Overview of Integrated Environmental Management
2.	Integrated Environmental Management, Information Series 1, Screening
3.	Integrated Environmental Management, Information Series 2, Scoping
4.	Integrated Environmental Management, Information Series 3, Stakeholder Engagement
5.	Integrated Environmental Management, Information Series 4, Specialist Studies
6.	Integrated Environmental Management, Information Series 5, Impact Significance
7.	Integrated Environmental Management, Information Series 6, Ecological Risk Assessment
8.	Integrated Environmental Management, Information Series 7, Environmental Resource Economics
9.	Integrated Environmental Management, Information Series 8, Cost Benefit Analyses
10.	Integrated Environmental Management, Information Series 9, Project Alternatives in EIA
11.	Integrated Environmental Management, Information Series 10, Environmental Impact Reporting
12.	Integrated Environmental Management, Information Series 11, Review in EIA
13.	Integrated Environmental Management, Information Series 12, Environmental Management Plans
14.	Integrated Environmental Management, Information Series 13, Environmental Auditing
15.	Integrated Environmental Management, Information Series 14, Life Cycle Assessment
16.	Integrated Environmental Management, Information Series 15, Strategic Environmental Assessment
17.	Integrated Environmental Management, Information Series 16, Cumulative Effects Assessment
18.	Integrated Environmental Management, Information Series 17, Environmental Reporting
19.	Integrated Environmental Management, Information Series 18, Environmental Assessment of Trade Related Agreements and Policies in South Africa
20.	Integrated Environmental Management, Information Series 19, Environmental Assessment of International Agreements
21.	Integrated Environmental Management, Information Series 20, Linking EIA and EMS
22.	Integrated Environmental Management, Information Series 21, Environmental Monitoring Committees
23.	Integrated Environmental Management, Information Series 22, Socio-Economic Impact Assessment
24.	Integrated Environmental Management, Information Series 23, Risk Management
25.	Guideline 3: General Guide to the Environmental Impact Assessment Regulations
26.	Guideline 4: Public Participation
27.	Guideline 5: Assessment of Alternatives and Impacts
28.	Guideline 6: Environmental Management Frameworks
29.	Guideline 7: Detailed Guide to Implementation of the EIA Regulations
30.	DWAF, Second Edition, 1998. Waste Management Series. Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste.
31.	DWAF, Second Edition, 1998. Waste Management Series. Minimum Requirements for Waste Disposal by Landfill.
32.	DWAF, Second Edition, 1998. Waste Management Series. Minimum Requirements for Water Monitoring at Waste Management Facilities.
33.	Draft Guideline: Companion Document on the Environmental Impact assessment Regulations 2010.
34.	Draft Guideline: Public Participation in the EIA Process, 2010.
35.	Draft Guideline: Environmental Management Framework Guideline in support of the Environmental Management Framework Regulations, 2010.
36.	White Paper on Integrated Pollution and Waste Management for South Africa.
DWA	
1.	External Guideline: Generic Water Use Authorisation Application Process, 2007
2.	Internal Guideline: Generic Water Use Authorisation Application Process, 2007
3.	External Guideline: Section 21(c) and (i) Water Use Authorisation Application Process (impeding or diverting the flow of water in a watercourse and /or altering the bed, banks, course or characteristics of a watercourse)
4.	Internal Guideline: Section 21(c) and (i) Water Use Authorisation Application Process

	(impeding or diverting the flow of water in a watercourse and /or altering the bed, banks, course or characteristics of a watercourse)
5.	Internal Guideline: Section 21(e), (f), (g), (h) and (j) Water Use Authorisation Application Process (waste discharge related)
6.	Operational Guideline: IWWMP Technical Document, February 2010
7.	Best Practice Guideline A2 – Water Management for Mine Residue Deposits; 2006
8.	Best Practice Guideline A4 – Pollution Control Dams; 2006
9.	Best Practice Guideline A6 – Water Management for Underground Mines; 2006
10.	Best Practice Guideline G1 – Storm Water Management; 2006
11.	Best Practice Guideline G2 – Water and Salt Balances; 2006
12.	Best Practice Guideline G3 – Water Monitoring Systems; 2006
13.	Best Practice Guideline G4 – Impact Prediction; 2006
14.	Best Practice Guideline H1 – Integrated Mine Water Management; 2006
15.	Best Practice Guideline H2 – Pollution Prevention and Minimization ; 2006
16.	Best Practice Guideline H3 – Water Reuse and Reclamation; 2006
17.	Best Practice Guideline H4 – Water Treatment; 2006

2.2 EXISTING ENVIRONMENTAL AUTHORIZATIONS

All existing Environmental Authorizations for the Ferrometals Operations are listed below, whilst copies of the relevant ROD's, Permits and Licences are attached in **APPENDIX 2.2**.

Appendix Number	Existing Environmental Authorizations
2.2 (A)	ECA Section 20 Permit (12/9/11/P106) issued on 30 June 2009
2.2 (B)	Waste Management License Variation (12/9/11P106V1) issued on 09 March 2012
2.2 (C)	Waste Management License (12/9/11/L670/6) issued on 14 November 2014
2.2 (D)	Waste Management License (12/9/11/L700/6) issued on 14 November 2014
2.2 (E)	Air Emissions License (AEL) 17/04/AEL/MP312/11/03 issued on 30 September 2014
2.2 (F)	Water Use Permit (1464N) issued on 08 August 1985
2.2 (G)	Water Use License (04/B11K/709) issued on 02 April 2011
2.2 (H)	Environmental Authorization (Ref: 17/2/1/25 MP-5) issued on 06 December 2011
2.2 (I)	Environmental Authorization (Ref: 17/2/3/9(1) N-6) issued on 06 December 2011

2.3 OTHER AUTHORIZATIONS REQUIRED

In terms of NEMA, the primary activity applied for is:

National Environmental Management Act, Act No. 107 of 1998		
Section 24	**Environmental Authorisation Application**	
GNR 544		
Identification of the competent authority	The competent authority in respect of the activities listed in this part of the schedule is the environmental authority in the province in which the activity is to be undertaken unless it is an application for an activity contemplated in section 24C(2) of the Act, in which case the competent authority is the Minister or an organ of state with delegated powers in terms of section 42(1) of the Act, as amended.	
Activity 27 (iv)	"The decommissioning of existing facilities or infrastructure, for – (iv) activities, where the facility or the land on which it is located is contaminated"	**The activity applied for relates to the Decommissioning of three Historic Slimes Dam facilities at the Ferrometals site. The disposed slimes classify as hazardous waste and are therefore the facilities are deemed to be contaminated.**

In addition to the above, the following other authorization(s) will be applied for during the course of the Environmental Authorization phase of this project for the Closure of the Historic Slimes Facilities at the Ferrometals Site:

National Environmental Management Waste Act, Act No. 59 of 2008		
GNR 921 of 29 November 2013	**Waste Management Activities**	
CATEGORY A		
14	The decommissioning of a facility for a waste management activity listed in Category A or B of this Schedule.	**Decommissioning of the three Historic Slimes Dam facilities at the Ferrometals Site – South Slimes Dam, East Slimes Dam and Stores Slimes Dam. Due to the hazardous classification of the slimes waste, the historic waste management activities relate to Category B.**

3. PUBLIC PARTICIPATION PROCESS

A synoptic description of the relevant aspects of the Public Participation Process conducted for this Basic Assessment will now be given.

3.1 DESCRIPTION OF THE PUBLIC PARTICIPATION PROCESS

The Public Participation Process was conducted in strict compliance with the requirements as contained in NEMA, the MPRDA and the NEMWA, and their associated applicable Regulations, Guidelines and Compliance Systems.

3.1.1 Compile Stakeholder Data Base

At the start of any public participation process a formal I&AP data base has to be compiled and which need to be updated/expanded as the process continues. The relevant regulations define I&AP's as:

- Any person, group of persons or organisation interested in, or affected by an activity
- Any organ of state that may have jurisdiction over any aspect of the activity

In the DMR guidelines for Scoping, I&AP's are defined as:

- Host Communities
- Traditional Land Owners
- Title Deed Land Owners
- Traditional Authority
- Land Claimants
- Lawful Land Occupier
- Any other person on adjacent or even non-adjacent land whose socio-economic conditions may be directly affected by the proposed project
- The Local Municipality
- The Regional Municipality
- The Department of Rural Development and Land Reform
- The Department of Economic Development, Environment and Tourism
- The Department of Water Affairs
- The Department of Mineral Resources
- The Department of Environmental Affairs
- The relevant Government Agencies and Institutions responsible for the various aspects of the environment and for infrastructure

Having full regard for the above, a formal I&AP data base was compiled for the Ferrometals Project. This data base will be continually updated throughout the process. A copy of the current I&AP data base is attached as **APPENDIX 3.1.1**.

3.1.2 Submit Application Forms - Obtain Reference Numbers

The Basic Assessment (BA) Application forms were completed and submitted to the Department of Environmental Affairs (DEA) on 18 August 2014 and to the Department of Economic Development, Environment and Tourism (DEDET) on 12 August 2014.

Copies of Proof of receipt of the BA Application forms from DEDET and DEA are attached as **APPENDIX 3.1.2.** The relevant Project Reference Numbers are DEA:12/9/11/L144116/6 and DEDET: 17/2/3N-386.

3.1.3 Consultations with the Competent Authority

A Pre-application Consultation Meeting was held with the Department of Water and Sanitation (DWS) on 13 November 2014.

The purpose of the meeting was to discuss:

- The application
- To give background on the project
- The Historical Slimes Facilities
- Storm Water Designs

Minutes of this meeting are attached as **APPENDIX 3.1.3**.

3.1.4 Notify I&AP's of Application

Notification letters were sent out to I&AP's via e-mail, fax, sms, and posted in cases where relevant details were available. Proof of notifications is attached as **APPENDIX 3.1.4**.

3.1.5 Place Advertisements in Newspapers to notify I&AP's of Application

Advertisements were placed on 23 January 2015 in the Witbank News and Middelburg Observer. These advertisements were to notify I&AP's of the process and of the new applications lodged with the DEDET and DEA. This also gave the public the opportunity to register as Interested and Affected Parties for the project. Proof of the placement of the advertisement in the newspaper is attached as **APPENDIX 3.1.5**.

3.1.6 Put up Site Notices to notify I&AP's of Application

Site Notices were put up on 21 January 2015 at the following sites:

- Entrance of Ferrometals
- fence of the site

These site notices were to notify I&AP's of the process and of the new applications lodged with the DEDET and DEA. This also gave the public the opportunity to register as Interested and Affected Parties for the project.

Proof of the site notices at the localities where they were placed is attached as **APPENDIX 3.1.6**.

3.1.7 Prepare Draft Basic Assessment Report (BAR)

Using all available information generated, a Draft Basic Assessment Report (BAR) was compiled. This report was compiled in strict compliance with the EIA Regulations.

3.1.8 Place Advertisements in Newspapers for Public Meeting

Advertisements were placed two weeks prior to the Basic Assessment Public Meeting to appear on 6 February 2015 in the Witbank News and Middelburg Observer. The advertisements notified I&AP's of the Public Meeting to be held on 19 February 2015 at the Emalahleni Local Municipality, Committee Room. Proof of the placement of these advertisements in the newspapers is attached as **APPENDIX 3.1.8**.

3.1.9 Put up Site Notices

Site Notices were put up two weeks prior to the Public Meeting at the following sites:

- Emalahleni Public Library
- Emalahleni Local Municipality
- Venue for Public Meeting
- Entrance of Ferrometals

Proof of the site notices at the localities where they were placed is attached as **APPENDIX 3.1.9**.

3.1.10 Conduct Public Meeting

The Public Meeting to present and discuss the Draft Basic Assessment Report (BAR) was held 19 February 2015 at the Emalahleni Local Municipality, Committee Room.

JMA addressed the full agenda in the format of a slide show and explained what was proposed by Samancor Chrome - Ferrometals. Opportunity was provided to I&AP's to ask questions and to raise concerns regarding the proposed project.

The contents of the Draft Report were discussed with the I&AP's and the opportunity to comment was provided.

I&AP's were informed that the Draft Report would be available for public review as from 20 February 2015 for a time period of 40 days. The closure date for comments was agreed as 17h00 on 31 March 2015. After consultation, it was agreed by the meeting, that hard copies of the reports would be made available at the following localities:

- Emalahleni Public Library
- Samancor Chrome – Ferrometals Entrance/Reception
- Ferrometals Environmental Department

Electronic Copies will also be provided to registered I&AP's on request. The report can also be downloaded from the JMA website: www.jmaconsult.co.za.

3.1.11 Compile Minutes and Circulate

The proceedings were recorded on a voice recorder. This recording will be used to compile comprehensive Minutes of the Meeting. After completion, the minutes will be distributed via e-mail, fax and post to I&AP's in cases where relevant details were available. A copy of the Public Meeting minutes will be attached as **APPENDIX 3.1.11**.

3.1.12 Distribute Draft Basic Assessment Report for I&AP Review

During the meetings that were conducted it was ensured that I&AP's knew when and where draft documents/reports would be made available for review. Electronic copies of the reports on CD disk will be available and distributed to I&AP's on request. Notifications will be e-mailed, faxed and sent via sms to all Registered I&AP's after distribution of reports in cases where relevant details are available. Timeframes for commenting was clearly indicated to I&AP's and was set for a timeframe of 40 days as required by the NEMA regulations.

The report will be available for comment on 20 February 2015 to I&AP's for a 40 day period until 17h00, 31 March 2015.

The Draft Basic Assessment Report (BAR) will be available for I&AP review at the following public sites:

- Emalahleni Public Library
- Samancor Chrome – Ferrometals Entrance/Reception
- Ferrometals Environmental Department

I&AP's were consulted on preferred venues.

Additional copies will also be provided on request. Proof of distribution of reports is attached as **APPENDIX 3.1.12**.

3.1.13 Capture I&AP Comments and Issue Acknowledgements

I&APs will have 40 days' time to comment and give feedback to JMA Consulting regarding the Draft Basic Assessment Report (BAR).

Guidance was given to I&AP's on the review and comment process, and also where they would be able to find information relating to the different aspects of the project.

Details of the different available formats in which comments can be submitted were provided to the I&AP's along with the relevant contact information. It was clearly indicated to all I&AP's that all comments received would be recorded and dealt with in an Issues & Response Register.

The EAP also explained the function of the Issues and Response Register and what responsibility it generates for each of the affected parties.

3.1.14 Recover Reports after Review

After the available 40 days for commenting expires, the reports and comments will be collected from the relevant distribution localities on 31 March 2015.

3.1.15 Compile Issues and Response Register

All the comments and feedback gathered from the I&AP's, throughout the Public Participation Programme will be compiled into the Issues and Response Register. Each comment will be reviewed by the EAP and responded to either by the EAP, or else by the relevant specialist.

The updated Issues and Response Register will be attached as **APPENDIX 3.1.15**. in the Final Basic Assessment Report.

3.1.16 Prepare Final Basic Assessment Report (BAR) for Submission to Authorities

Using all new information and comments received from I&AP's during the allocated timeframe, a Final Basic Assessment Report (BAR) will be compiled. This report will be compiled in strict compliance with the EIA Regulations.

3.1.17 Submit Final Basic Assessment Report (BAR) to Authorities and I&AP's

I&AP's:

During the authority and public meetings that were conducted it was ensured that I&AP's knew when and where final documents/reports would be made available for review. Electronic copies of the reports on CD disk will also be available and distributed to I&AP's on request. Notifications will be e-mailed, faxed, sent via sms and posted to all Registered I&AP's after distribution of reports in cases where relevant details are available.

The Final Basic Assessment Report (BAR) will be available to Registered I&AP's and made available to Non-Registered I&AP's on request. Comments can be sent directly to DEA and DEDET.

Authorities:

- Two hard copies and one electronic copy of the Final Basic Assessment Report (BAR) will be presented for review and comment to the Department of Environmental Affairs (DEA) in Pretoria on 15 April 2015.
- Two hard copies and one electronic copy of the Final Basic Assessment Report (BAR) will be presented for review and comment to the Department of Economic Development, Environment and Tourism (DEDET) in Witbank 15 April 2015.

Proof of submission of the Final Basic Assessment Report (BAR) to the various parties will be attached as **APPENDIX 3.1.17**.

3.1.18 Authority review

The Competent Authority (CA) must acknowledge receipt of the Final Basic Assessment Report (BAR) within 14 days after the report was submitted to the CA. After the CA acknowledged the report they have 30 days to Accept or Reject the report. After the report was accepted by the CA, they have another 30 days to grand or refuse authorisation.

3.2 NOTIFICATION OF I&AP's

The existing I&AP's data base was used to send out notifications to the identified I&AP's to notify them of the activities being applied for. Newspaper adverts were placed in the Witbank News and Middelburg Observer on 23 January 2015 to notify the public of the applications lodged in terms of the Basic Assessment and to give them the opportunity to register as I&AP's for the project. They were also provided with an I&AP's registration form to register as I&AP's and to identify other I&AP's that must be included in the project. Newspaper adverts were also placed in the Witbank News and Middelburg Observer on 06 February 2015 to notify the public of the Public Meeting that took place on 19 February 2015. Proof of notifications is attached as **APPENDIX 3.1.4**. Proof of the placement of the advertisement in the newspaper is attached as **APPENDIX 3.1.5 and APPENDIX 3.1.8**.

3.3 PROOF OF ALL NOTIFICATIONS

Notification letters were sent out to I&AP's via e-mailed, faxed, sms and posted in cases where relevant details were available. Notifications were also send out 14 days in advance to I&AP's to notify them of the public meeting as well as where the Draft Basic Assessment Report (BAR) can be viewed. Site notices were put up along the fence line of the Ferrometals site and other areas identified within the community. Proof of notifications is attached as **APPENDIX 3.1.4**. Proof of the site notices at the localities where they were placed is attached as **APPENDIX 3.1.6. and APPENDIX 3.1.9.**

3.4 LIST OF REGISTERED I&AP's

A formal I&AP data base was compiled for the Ferrometals project. This data base was continually updated throughout the process and a copy of the current I&AP data base is attached as **APPENDIX 3.1.1**.

3.5 COMMENTS, ISSUES & RESPONSES BY EAP

All questions asked, issues raised, concerns expressed, and comments made by Authorities and I&AP's throughout the project, either by way of verbal statement, written comment and/or formal letters addressed to the EAP or Applicant, was captured in the Issues and Response Register and will be continually updated.

The formal responses to each of these were compiled by the EAP in collaboration with the relevant Specialists and the Applicant. The responses were fully recorded in the Issues and Response Register and will be updated after I&AP's had the opportunity to review the Draft Basic Assessment Report (BAR).

An updated Issues and Response Register is available in the Draft Basic Assessment Report (BAR) attached as **APPENDIX 3.1.15.**

4. NEED AND DESIRABILITY

Following the Guideline on Need and Desirability in terms of Environmental Impact Assessment (EIA) Regulations, 2010 (GN 891 of 20 October 2014), it is the responsibility of the government decision makers as well as the environmental assessment practitioners to consider any development within the broader societal need and public interest. They are accountable to the public and must serve their social, economic and ecological needs equitably.

Below is a concise summary of how the Ferrometals site as a whole contribute to the broader social and economic sectors of the area and how the activity (i.e. decommissioning of three Historic Slimes Dam Facilities) specifically will influence the social, economic and ecological aspects of the area.

4.1 NEED FOR THE PROJECT (TIMING)

Ferrometals is a business unit of Samancor Chrome Ltd which has been and continues to be a major role player in the production of Ferrochrome.

Samancor Chrome is one of the largest integrated ferrochrome producers in the world and has five business units, consisting of 2 mines and 3 smelter plants. The mines are namely the Eastern Chrome Mines and Western Chrome Mines, and the smelters are namely Ferrometals, Middelburg Ferrochrome, and Tubatse Ferrochrome.

Ferrometals is both the oldest and the biggest of the three plants and still has an expected operational life timeframe in excess of at least 25 years, depending on the demand for the product. The Ferrometals site is ‘brown-fields’ site which has been operational since 1959 and currently produces charge chrome in both a lumpy and granulated form as well as intermediate-carbon ferrochrome in a granulated form, each used in different areas of the stainless steel smelting process.

Ferrometals is currently operating at full capacity and utilises the Pelletizing and Sintering Plant, the six Charge Chrome Furnaces (4 open and 2 closed), the Chrome Recovery Plant and the Intermediate Carbon Ferrochrome (IC3) converter.

The three Historical Slimes Dam Facilities at the Ferrometals site to be decommissioned have reached their end of life and are no longer in operation. These footprints can no longer accommodate slimes disposal and therefore need to be decommissioned and rehabilitated according to the approved designs to ensure no residual detrimental effect on the environment.

4.2 DESIRABILITY FOR THE PROJECT (PLACING)

The Ferrometals site is ‘brown-fields’ site which has been operational since 1959. The three Historical Slimes Dam Facilities at the Ferrometals site are no longer in operation as they have reached their full capacity. Hence, the footprints of the activity (i.e. decommissioning of the three Historic Slimes Dam Facilities) are established. The activity will not have any effect on the surrounding land use or communities.

5. FEASIBLE & REASONABLE ALTERNATIVES

Alternatives considered for this project relate to the decommissioning of the three Historical Slimes Dam Facilities at the Ferrometals site.

As far as the different alternatives to be considered, reference is made to the definition for "**alternatives**" as contained in the Environmental Impact Assessment Regulations – GNR 543 of 18 June 2010.

"**alternative**", in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to –

(a) the property on which or location where it is proposed to undertake the activity;
(b) the type of activity to be undertaken;
(c) the design or layout of the activity;
(d) the technology to be used in the activity;
(e) the operational aspects of the activity;
(f) the option of not implementing the activity.

5.1 PROPERTY AND/OR LOCATION

Alternatives considered in terms of the property/location where the activity (decommissioning of the three Historical Slimes Dam Facilities) will take place are not deemed relevant, as the three Historical Slimes Dam Facilities are current facilities located within the Ferrometals property boundary (Portion's 9 & 12 of the farm Driefontein 297 JS) and which therefore represents a 'brown-fields' situation. The assessment of alternative land uses is therefore not relevant to this application as the current land use will not be compromised by the activity associated with the current application process.

5.2 TYPE OF ACTIVITY

Three alternative options were considered as far as the type of activity to be undertaken:

1. Disposal on site by moving the waste to the new Slimes Dam on the Ferrometals site.
2. Disposal of slimes at a licensed waste disposal facility for hazardous waste by appointing an external service provider that will collect the waste and transport it to the approved landfill site - due to handling and transport cost this alternative is not a feasible option.
3. *In situ* rehabilitation and closure.

The third option was considered to be the Best Practicable Environmental Option and is thus proposed as the Preferred Alternative.

5.3 ALTERNATIVE DESIGN OR LAYOUT

The proposed designs and layouts for the rehabilitation and closure of the three historic slimes dams were done in compliance with the DWS Best Practice Guidelines, as required by the competent authority. The designs were submitted to DWS for approval. The designs were approved by DWS. A copy of the approval letter is attached together with the Civil Engineering Design Report as **APPENDIX 1.3.1**.

5.4 ALTERNATIVE TECHNOLOGIES

In view of the fact that the proposed project relates to the closure of historic activities, the consideration of alternative technologies is not relevant.

5.5 ALTERNATIVE OPERATIONAL ASPECTS

No alternatives were considered in terms of the operational aspects of the activity as all three of the historic slimes dam facilities are no longer in operation.

5.6 CONSEQUENCES OF THE NO-GO OPTION

The proposed closure of the three historic slimes disposal facilities has the primary objective of removing the environmental threat which will remain if they are not properly rehabilitated and closed. If not closed, an ongoing risk to surface water quality, ground water quality, as well as air quality will remain. The consequences of the no-go option would therefore be to maintain an unacceptable threat to the environment.

5.7 COMPARATIVE ASSESSMENT (POSITIVES versus NEGATIVES)

There is no doubt that the positive environmental outcomes of the rehabilitation and closure of the three historic slimes dam footprints at Ferrometals far outweigh the potential negative outcomes. The consequences of the no-go option clearly illustrates this.

6. ENVIRONMENTAL IMPACT ASSESSMENT

Best practice for the conducting of impact assessments, is to present them in Tabular format. This not only facilitates the structured inclusion of the requirements as stated in various guidelines, but also provides the basis for the compilation of a comprehensive draft Environmental Management Programme ensuring that all identified potential impacts are managed.

6.1 THE IMPACT ASSESSMENT PROCESS

JMA Consulting has developed an Impact Assessment Process that uses a sequential development protocol. The process starts with the definition and description of the actual **activities** (section 1.3.1), followed by the definition of the relevant **aspects** (section 1.3.2), consideration of the relevant **environmental components** followed by the description of the actual **environmental impacts** as per environmental component (section 1.3.3).

Activities

For the Ferrometals project the EAP (JMA Consulting) compiled the Impact Assessment Tables (IA Tables) in a step-wise fashion. The first step was to identify the activities associated with the project. **Activities** as defined by the National Environmental Management Act 107 of 1998, means *policies, programmes, processes, plans and projects.* In terms of the Ferrometals project one Activity was identified, namely:

- Decommissioning of three Historic Slimes Dam Facilities

A more detailed description of the activity is given in section 1.3.1.

Aspects

During the second step, all the **Aspects** associated with the Activity were identified. An "Environmental Aspect" as defined in the ISO 14001 Environmental Management System (EMS) Standard is: *"Elements of an Organisations Activity, Products or Services which can interact with the Environment. A significant Environmental Aspect is an Environmental Aspect which has, or can have a Significant Environmental Impact."*

Decommissioning and Closure:

- Remove Slimes Material and Contaminated Soil from Stores Slimes Dam footprint and deposit on the South Slimes Dam.
- Shape the three sites to make them free draining.
- Cap the East and South Slimes Dams with an appropriate liner system to prevent infiltration of rain water and install appropriate storm water management measures such as drains, channels and shutes to tie up with overall Ferrometals Storm Water Management System.
- Re-vegetate all three Slimes Dam sites.

Post Closure:

- Failure of the Vegetative Cover.
- Failure of the Capping System.
- Failure of the Storm Water Management System.

Environmental Components

Subsequently, the potential impact that the identified Aspects will have on the environment was determined/assessed in terms of the following **Environmental Components**: *Socio-Cultural, Heritage, Socio-Economic, Land Use, Infrastructure, Topography, Soils, Land Capability, Geology, Ground Water, Surface Water, Plant Life, Animal Life, Wetlands, Aquatic Ecosystems, Air Quality, Noise, Traffic and Visual Aspects.*

Below are Tables listing the different Aspects identified per life-cycle phase of the Activity as well as the Environmental Components deemed to potentially be impacted upon.

Decommissioning and Closure Phase	
Aspect	Environmental Component
Remove Slimes Material and Contaminated Soil from Stores Slimes Dam footprint and deposit on the South Slimes Dam.	Surface Water, Air Quality, Noise.
Shape the three sites to make them free draining.	Surface Water, Air Quality, Noise.
Cap the East and South Slimes Dams with an appropriate liner system to prevent infiltration of rain water and install appropriate storm water management measures such as drains, channels and shutes to tie up with overall Ferrometals Storm Water Management System.	Surface Water, Air Quality, Noise.
Re-vegetate all three Slimes Dam sites.	Plant Life

Post Closure	
Aspect	Environmental Component
Failure of the Vegetative Cover.	Soils, Surface Water, Plant Life, Animal Life, Air Quality.
Failure of the Capping System.	Ground Water.
Failure of the Storm Water Management System.	Soils, Surface Water.

Environmental Impacts

The outcome of this first part of the Assessment Process is the compilation of a three column Table for each life cycle phase and which lists the Activity in Column 1, the Aspects in Column 2 and the Potential Environmental Impact in Column 3 – see section 1.3.3. These Tables forms the backbone of the Impact Assessment Methodology which will be described in section 6.2. The three columns in these Tables form the first three columns of the Impact Assessment Tables contained in section 6.3.

6.2 IMPACT SIGNIFICANCE AND RISK RATING METHODOLOGY

The Impact Significance and Risk Rating Methodology used for the Ferrometals project is based on an Impact Assessment Rating Matrix developed by JMA Consulting.

This matrix contains all the critical elements for Environmental Impact Assessment as proposed in the formal DEAT Protocol for Environmental Impact Assessment – *DEAT (2002) Impact Significance, Information Series 5, Department of Environmental Affairs and Tourism (DEAT), Pretoria.*

The protocol comprises a series of steps in order to systematically go through a process of:

1. Identifying and Quantifying the **Significance** of an impact: **Step 1**.
2. Determining the **Probability** of an impact happening: **Step 2.**
3. Determine the **Risk Level** attached to the impact: **Step 3.**

The identification process is conducted by the EAP and then the Step 1 Significance Assessment is completed based on the EAP's interpretation. The interpretation is converted into the numerical rating contained in Table 6.2(a), and an Impact Significance Total is calculated. The Significance Total is converted into a Significance S Number, for population of the overall Risk Matrix. The components considered to arrive at the Significance Rating (S Number) are as follows:

- Spatial extent of the impact
- Intensity or Severity of the impact
- Duration of the impact
- Unacceptability of the impact
- Mitigatory difficulty of the impact

The sum of the numerical ratings for the above components represents the Significance Total.

Table 6.2(a): Impact Significance Assessment Criteria

CRITERIA FOR DETERMINING SIGNIFICANCE		
Criteria	**Definition**	**Points**
Spatial Extent		
High	Widespread. Far beyond site boundary. Regional/national/international scale.	3
Medium	Beyond site boundary. Local area.	2
Low	Within site boundary.	1
Intensity or Severity		
High	Disturbance of pristine areas that have important conservation value. Destruction of rare or endangered species.	3
Medium	Disturbance of areas that have potential conservation value or are of use as a resource. Complete change in species occurrence or variety.	2
Low	Disturbance of degraded areas that have little conservation value. Minor change in species occurrence or variety.	1
Duration		
High (Long term)	Permanent. Long Term (more than 20 years). Beyond decommissioning.	3
Medium (Medium term)	Reversible over time. Lifespan of the project. Medium Term (3-20 years). Operational Phase	2
Low (Short term)	Quickly reversible. Less than the project lifespan. Short Term (0 – 3 years). Construction Phase	1
Un-Acceptability		
High (Unacceptable)	Abandon project in part or in its entirety. Redesign project to remove impact or avoid impact.	3
Medium (Manageable)	With regulatory controls. With project proponent's commitments.	2
Low (Acceptable)	No risk to public health.	1
Mitigatory Difficulty		
High	Little or no mechanism to mitigate negative impacts.	3
Medium	Potential to mitigate negative impacts. However, the implementation of mitigation measures may still not prevent some negative effects.	2
Low	High potential to mitigate negative impacts to the level of insignificant effects.	1

Once a Significance Total has been calculated for a specific impact, an Impact Significance Number is determined (S-number) as completion of **Step 1**, based on the Table below:

Table 6.2(b): Assignment of Impact Significance S-Number

Significance Total	Significance S-Number
15	S5
12 - 14	S4
9 - 11	S3
6 - 8	S2
5	S1

Table 6.2(c): Explanation for Impact Significance Rating

EXPLANATION FOR IMPACT SIGNIFICANCE RATING		
Impact Significance	**Explanation**	**Points**
Very High	Of the highest order possible within the bounds of impacts that could occur. In the case of adverse impacts, there is no possible mitigation that could counteract the impact, or mitigation is difficult, expensive, time-consuming or a combination of these. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt. In the case of beneficial impacts, the impact is of a substantial order within the bounds of impacts that could occur.	**>14**
High	Impact is high and substantial in relation to other impacts that might take effect within the bounds of those that could occur. In the case of adverse impacts, mitigation is possible but expensive. Social, cultural and economic activities of communities are changed, but can be continued (albeit in a different form). Modification of the project design or alternative action will be required. In the case of beneficial impacts, the project out performs other alternatives in terms of time, cost and effort.	**12-14**
Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. In the case of adverse impacts, mitigation is both feasible and fairly easily possible. Social, cultural and economic activities of communities are changed, but can be continued (albeit in a different form). Modification of the project design or alternative action may be required. In the case of beneficial impacts, other means of achieving this benefit are about equal in time, cost and effort.	**9-11**
Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Social, cultural and economic activities of communities can continue unchanged. In the case of beneficial impacts, alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming.	**6-8**
Insignificant	Although an impact may exist it is rated as insignificant and is not deemed to warrant any specific management measures or even monitoring.	**<6**

During **Step 2** the Probability of an impact occurring/re-occurring is assessed.

Table 6.2(d): Probability of an Impact Occurring (P-Value)

Likelihood Descriptors		Probability Intervals	Likelihood Definitions
P1	**Unlikely**	**0 - 25%**	**Less than 25% probability that a specific impact will occur.**
P2	**Possible**	**25 - 50%**	**25% - 50% probability that a specific impact will occur.**
P3	**Probable**	**50 - 75%**	**50% - 75% probability that a specific impact will occur.**
P4	**Highly Probable**	**75 - 100%**	**More than 75% probability that a specific impact will occur.**

Finally, the overall impact is quantified in a Risk Matrix, by combining the S-Number (determined in **Step 1**) with the P-Value (determined in **Step 2**) in the Risk Matrix provided below (**Step 3**). The matrices shown above make use of generic criteria in order to systematically identify, predict, evaluate and determine the significance of impacts resulting from project construction, operation and decommissioning.

Table 6.1(e): Risk Matrix

RISK MATRIX					
	Significance S1	**Significance S2**	**Significance S3**	**Significance S4**	**Significance S5**
Probability P4	**Low Risk**	**Low Risk**	**Moderate Risk**	**High Risk**	**High Risk**
Probability P3	**Very Low Risk**	**Low Risk**	**Moderate Risk**	**Moderate Risk**	**High Risk**
Probability P2	**Very Low Risk**	**Very Low Risk**	**Low Risk**	**Low Risk**	**Moderate Risk**
Probability P1	**Very Low Risk**	**Very Low Risk**	**Very Low Risk**	**Very Low Risk**	**Low Risk**

All of the above is conducted in Tabular format in the Impact Assessment Tables. A separate Table is compiled for each relevant project Life Cycle Phase.

Each Impact Assessment Table contains the following columns:

Column 1: Activity
Column 2: Aspect
Column 3: Potential Impact Description
Column 4: Spatial Extent
Column 5: Intensity/Severity
Column 6: Duration
Column 7: Unacceptability
Column 8: Mitigatory Difficulty
Column 9: Impact Significance Total
Column 10: Significance S Number
Column 11: Probability of Occurrence
Column 12: Impact Risk Level Before Management

6.3 ASSESSMENT OF IMPACT SIGNIFICANCE AND RISK

The protocol and methodology discussed above was used to determine the Impact Significance and Risk Ratings for the Ferrometals Slimes Dam Closure Project. Impact Significance and Risk Rating Tables were compiled for two life cycle phases:

- Table 6.3 (a): Decommissioning and Closure Phase
- Table 6.3 (b): Post Closure Phase

Table 6.3(a): Impact Significance and Risk Rating Table – Decommissioning and Closure Phase

Decommissioning and Closure Phase Impact Assessment												
Activity	Aspect	Potential Environmental Impact/Issue	Criteria for Determining Significance						Significance S-Number	Probability of Occurrence	Risk Level Before Management
			Spatial Extent	Intensity/ Severity	Duration	Unacceptability	Mitigatory Difficulty	Significance Total			
Decommissioning and Closure of the three Historic Slimes Dams	Remove Slimes Material and Contaminated Soil from Stores Slimes Dam footprint and deposit on the South Slimes Dam	Surface Water: Contamination of the surface water resource due to erosion caused by storm water runoff and surface water discharge with high suspended solids load.	2	1	1	2	1	7	S2	P2	**Very Low Risk**
		Air Quality (Gaseous Emissions): Deterioration in ambient air quality due to gaseous emissions generated from construction machinery and vehicles.	1	1	1	2	1	6	S2	P2	**Very Low Risk**
		Air Quality (Dust Fallout): Deterioration in ambient air quality due to dust generated from decommissioning activities.	1	1	1	2	1	6	S2	P2	**Very Low Risk**
		Noise: Generation of noise due to reverse hooters/alarms from construction machinery and vehicles.	1	1	1	1	1	5	S1	P3	**Very Low Risk**
	Shape the three sites to make them free draining	Surface Water: Contamination of the surface water resource due to erosion caused by storm water runoff and surface water discharge with high suspended solids load.	2	1	1	2	1	7	S2	P2	**Very Low Risk**
		Air Quality (Gaseous Emissions): Deterioration in ambient air quality due to gaseous emissions generated from construction machinery and vehicles.	1	1	1	2	1	6	S2	P2	**Very Low Risk**
		Air Quality (Dust Fallout): Deterioration in ambient air quality due to dust generated from capping activities.	1	1	1	2	1	6	S2	P2	**Very Low Risk**
		Noise: Generation of noise due to reverse hooters/alarms from construction machinery and vehicles	1	1	1	1	1	5	S1	P3	**Very Low Risk**

Decommissioning and Closure Phase Impact Assessment											
Activity	**Aspect**	**Potential Environmental Impact/Issue**	**Criteria for Determining Significance**						**Significance S-Number**	**Probability of Occurrence**	**Risk Level Before Management**
			Spatial Extent	**Intensity/ Severity**	**Duration**	**Unacceptability**	**Mitigatory Difficulty**	**Significance Total**			
	Cap the East and South Slimes Dams with an appropriate lines system to prevent infiltration of rain water and install appropriate storm water management measures such as drains, channels and shutes to tie up with overall Ferrometals Storm Water Management System	Surface Water: Contamination of the surface water resource due to erosion caused by storm water runoff and surface water discharge with high suspended solids load.	2	1	1	2	1	7	S2	P2	**Very Low Risk**
		Air Quality (Gaseous Emissions): Deterioration in ambient air quality due to gaseous emissions generated from construction machinery and vehicles	1	1	1	2	1	6	S2	P2	**Very Low Risk**
		Air Quality (Dust Fallout): Deterioration in ambient air quality due to dust generated from capping activities.	1	1	1	2	1	6	S2	P2	**Very Low Risk**
		Noise: Generation of noise due to reverse hooters/alarms from construction machinery and vehicles	1	1	1	1	1	5	S1	P3	**Very Low Risk**
	Re-vegetate the capped Slimes Dams	Plant Life: Restoration of Habitat due to re-vegetation of the footprint.	-	-	-	-	-	-	-	-	**Positive Impact**
		Plant Life: Restoration of Biodiversity due to the repair of natural vegetation/habitat.	-	-	-	-	-	-	-	-	**Positive Impact**

Table 6.3(b): Impact Significance and Risk Rating Table – Post Closure Phase

Post Closure Phase Impact Assessment												
Activity	**Aspect**	**Potential Environmental Impact/Issue**	**Criteria for Determining Significance**						**Significance S-Number**	**Probability of Occurrence**	**Risk Level Before Management**
			Spatial Extent	**Intensity/ Severity**	**Duration**	**Unacceptability**	**Mitigatory Difficulty**	**Significance Total**			
Decommissioning and Closure of the three Historic Slimes Dams	Failure of the Vegetation cover	Soils: Loss of soil horizon due to erosion and surface water run-off.	1	2	3	2	1	9	S3	P3	**Moderate Risk**
		Surface Water: Contamination of the surface water resource due to erosion caused by storm water runoff and surface water discharge with high suspended solids load.	2	2	3	3	1	11	S3	P3	**Moderate Risk**
		Plant Life: Loss of habitat due to vegetation cover not returning to natural state.	1	1	3	2	1	8	S2	P3	**Low Risk**
		Plant Life: Loss of biodiversity due to a loss of habitat.	1	1	3	2	1	8	S2	P3	**Low Risk**
		Animal Life: Loss of habitat due to vegetation cover not returning to natural state.	1	1	3	2	1	8	S2	P3	**Low Risk**
		Animal Life: Loss of biodiversity due to a loss of habitat.	1	1	3	2	1	8	S2	P3	**Low Risk**
		Air Quality (Dust Fallout): Deterioration in ambient air quality due to windblown dust generated from denuded surfaces.	2	1	3	2	1	9	S3	P3	**Moderate Risk**
	Failure of the Capping System	Groundwater: Contamination of the groundwater resource due to infiltration of rainwater through the capping and the subsequent infiltration of contaminated water through the footprint of the Slimes Dam into the sub-surface.	1	2	3	2	1	9	S3	P2	**Low Risk**
	Failure of the Storm Water Management System	Soils: Loss of soil horizon due to erosion.	1	2	3	2	1	9	S3	P3	**Moderate Risk**
		Soils: Contamination of soil due to toe seepages and storm water run-off.	1	2	3	2	1	9	S3	P2	**Low Risk**
		Surface Water: Contamination of the surface water resource due to uncontrolled run-off of contaminated storm water from the Slimes Dam.	2	1	3	2	1	9	S3	P2	**Low Risk**

6.4 CUMULATIVE IMPACTS

As defined by GNR 543 of 18 June 2010: Environmental Impact Assessment Regulations, a **Cumulative Impact** means the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

6.4.1 Cumulative Impacts - Decommissioning and Closure Phase

All negative impacts identified and rated for this phase came out as having a **Very Low Risk** after mitigation. This is mainly due to the **very limited aerial extent** of the proposed decommissioning activities, the relative **low intensity** of the impacts anticipated, and the **very short duration time** which they will be active (3 to 4 months).

Although impacts on surface water quality, air quality and noise all have the potential to accumulate, the fact that the activities will take place within a heavy industrial area, together with their very low impact and risk rating, suggest that the **cumulative effect of the impacts associated** with the decommissioning phase is **highly unlikely to be significant** at all – **Very Low Cumulative Impact and Risk**.

6.4.2 Cumulative Impacts – Post Closure Phase

Provided that effective after care and maintenance is conducted during the Post Closure Phase, the potential for impacts and risks to accumulate, is of a **Very Low Risk**.

7. MANAGEMENT & MITIGATION MEASURES

After compilation of the Impact Assessment and Risk Tables (detailed in sections 6.1, 6.2 and 6.3), appropriate management/mitigation measures for each of the potential impacts emanating from the activity were determined and are presented in a structured tabular format which forms the Draft Environmental Management Programme (EMP).

The full **Draft EMP is contained in section 9. of this report** – the **Management & Mitigation Measurement Tables are given in sections 9.3.1 and 9.3.2**.

These Tables were compiled for the Decommissioning and Closure Phase as well as for the Post Closure Phase.

Appropriate management and mitigation measures are developed in a structured fashion within these Tables.

The first 4 columns of the Management Measures Tables contain information taken from the Impact Assessment Tables, namely the description of the **Activity**, the identification and definition of the relevant **Aspect** which could cause the impact, the actual description of the expected **Impact**, and then in column 4 the **Impact and Risk** rating prior to mitigation.

The selection and development of the proposed management and mitigation measures commence with the statement of the **Management Objective** in column 5, followed by the **Best Practicable Management Measure** in column 6.

The **Impact and Risk Rating** is then again assessed to determine the post mitigation impact and risk (column 7), and if deemed acceptable, the proposed management and mitigation measure is confirmed (column 6).

Therefore, for the selected and proposed Management Objectives and Mitigation and Management Measures for both the Decommissioning and Closure, as well as the Post Closure phases, please refer to columns 5 and 6 of the Management Measures Tables contained in sections 9.3.1 and 9.3.2 of the Draft EMP.

8. SPECIALIST INPUTS

A wealth of environmental technical information was available for the Ferrometals site courtesy of recent work (2013 and 2014) done to support several Environmental Authorization processes, including an EIA, a Water Use License Application, as well as a Waste License Application as related to the proposed development of a new Slimes Disposal facility, as well as the Closure of the Slimes Disposal facility to be replaced with the new one. The base line information presented in this report was sourced for these earlier reports.

However, specifically for this project which comprises the closure of the three Historic Slimes Dams, Inprocon Consultants has been contracted by JMA Consulting, the EAP for the project, for the rehabilitation design of these Historic Slimes Dam facilities. Inprocon compiled a Preliminary Detail Design Report which gives engineering details including the type of capping that needs to be done in terms of the Minimum Requirements, as well as the general closure and rehabilitation requirements.

This Design Report was submitted to the DWS for consideration and approval. The report was approved by DWS.

A copy of this report, together with the DWS approval is attached as **APPENDIX 1.3.1.**

In addition to the above, a specialist Heritage Report as well as a specialist Paleontological Report compiled for the 2014 EIA for the Ferrometals site, was submitted to the head office of SAHRA in Cape Town with the request to assess its validity and applicability to this project for the closure of the three Historic Slimes Dams.

SAHRA provided written confirmation of the validity and applicability of the reports for the current project. Their written confirmation is attached as **APPENDIX 1.2.3**.

9. DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

The DEDET BAR Template requires the compilation of a Draft EMP that contains the aspects contemplated in Regulation 33 of GNR 543.

9.1 CONTENTS OF DRAFT EMP

A draft Environmental Management Programme (EMPr) must comply with section 24N of the National Environmental Management Act and include -

(a) details of-

(i) the person who prepared the environmental management programme; and
(ii) the expertise of that person to prepare an environmental management programme;

(b) information on any proposed management or mitigation measures that will be taken to address the environmental impacts that have been identified in a report contemplated by these Regulations, including environmental impacts or objectives in respect of-

(i) planning and design;
(ii) pre-construction and construction activities;
(iii) operation or undertaking of the activity;
(iv) rehabilitation of the environment; and
(v) closure, where relevant.

(c) a detailed description of the aspects of the activity that are covered by the draft environmental management programme;

(d) an identification of the persons who will be responsible for the implementation of the measures contemplated in paragraph (b);

(e) proposed mechanisms for monitoring compliance with and performance assessment against the environmental management programme and reporting thereon;

(f) as far as is reasonably practicable, measures to rehabilitate the environment affected by the undertaking of any listed activity or specified activity to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development, including, where appropriate, concurrent or progressive rehabilitation measures;

(g) a description of the manner in which it intends to-

- *(i) modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;*
- *(ii) remedy the cause of pollution or degradation and migration of pollutants;*
- *(iii) comply with any prescribed environmental management standards or practices;*
- *(iv) comply with any applicable provisions of the Act regarding closure, where applicable;*
- *(v) comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable;*

(h) time periods within which the measures contemplated in the environmental management programme must be implemented;

(i) the process for managing any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of undertaking a listed activity;

(j) an environmental awareness plan describing the manner in which-

- *(i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and*
- *(ii) risks must be dealt with in order to avoid pollution or the degradation of the environment;*

(k) where appropriate, closure plans, including closure objectives.

9.2 DETAILS OF COMPILER OF THE EMP

The duly appointed EAP for the Project is JMA Consulting (Pty) Ltd.

Table 9.2 (a): Details of Project Consultancy

Project Consultancy:	JMA Consulting (Pty) Ltd
Company Registration:	2005/039663/07
Professional Affiliations:	South African Council for Natural Scientific Professions (SACNASP)
Contact Person:	Mr Jasper Muller (Pr.Sci.Nat.)
Physical Address:	15 Vickers Street DELMAS 2210
Postal Address:	P O Box 883 DELMAS 2210
Telephone no:	+27 13 665 1788
Fax no:	+27 13 665 2364
E-mail:	jasper@jmaconsult.co.za

The principle Environmental Assessment Practitioner on this project, and also the **person responsible for the compilation of this Draft EMP**, is Mr Jasper Muller (Pr.Sci.Nat.) Jasper Muller holds a M.Sc. (cum laude) in Geohydrology from the University of the Free State and has been active as an earth scientist and environmental scientist since 1986. He has, since 1993, been involved in the compilation of more than 200 EMPR's, EIA's, IWWMP's and EMP's.

Jasper L Muller (Pr.Sci.Nat.)
(M.Sc. Geohydrology)

Jasper Muller holds a double professional registration with SACNASP as Earth Scientist and Environmental Scientist. A synoptic CV and signed Declaration of Interest are attached as **APPENDIX 9.2.**

9.3 PROPOSED MANAGEMENT & MITIGATION MEASURES

This Draft Environmental Management Programme (EMPr) was compiled to address both life cycle phases of this project to Rehabilitate and Close the three Historic Slimes Dams at Ferrometals.

- Decommissioning and Closure Phase
- Post Closure Phase

JMA Consulting has developed a Tabular format for the compilation of EMP's which gives structured compliance with all aspects as legally required to be included in an EMP.

The EMP Table contains 17 columns:

Column 1: Activity
Column 2: Aspect
Column 3: Potential Impact Description
Column 4: Impact and Risk Significance before Mitigation/Management
Column 5: Management Objective
Column 6: Proposed Management Measure
Column 7: Impact and Risk Significance after Mitigation/Management
Column 8: Person Responsible for Implementation of Management Measures
Column 9: Management Time Schedule
Column 10: Management Budget Quantum
Column 11: Management Budget Allocation/Provisioning
Column 12: Monitoring Requirement
Column 13: Monitoring Frequency
Column 14: Monitoring Budget Quantum
Column 15: Monitoring Budget Allocation/Provisioning
Column 16: Performance Assessment
Column 17: Performance Assessment Time Schedule

Using the above method, the Draft EMP was compiled for the two applicable life-cycle phases, namely the Decommissioning (Rehabilitation; refer to section 9.3.1) and Post Closure (refer to section 9.3.2) phases.

The **Management Objectives are given in Column 5** and the **Mitigation and Management Measures are given in Column 6** of the Tables in sections 9.3.1 and 9.3.2.

9.3.1 Decommissioning and Closure Phase Draft EMP

Decommissioning and Closure Phase Management Plan																
			Management Measures													
Activity	Aspect	Potential Environmental Impact/Issue	Risk Level Before Management	Management Objective	Proposed Management Measure	Risk Level after Management	Responsible Person	Management Time Schedule	Management Budget Quantum	Management Budget Allocation/ Provisioning	Monitoring Required	Monitoring Frequency	Monitoring Budget Quantum	Monitoring Budget Allocation/ Provisioning	Performance Assessment	Performance Assessment Time Schedule
Decommissioning and Closure of the three Historic Slimes Dams	Remove Slimes Material and Contaminated Soil from Stores Slimes Dam footprint and deposit on the South Slimes Dam	Surface Water: Contamination of the surface water resource due to erosion caused by storm water runoff and surface water discharge with high suspended solids load.	**Very Low Risk**	Prevent contamination of the surface water resource	Construct earth berms around Stores Slimes Dam footprint. Preferable to decommission during dry season. Settle suspended solids out and analyse for quality before any discharge into environment.	**Very Low Risk**	Ferrometals Logistics Manager	Decommissioning and Closure Phase	Decommissioning and Closure Phase Environmental Management Budget	Decommissioning and Closure Phase Environmental Management Budget	Water Quality sampling	Monthly	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Air Quality (Gaseous Emissions): Deterioration in ambient air quality due to gaseous emissions generated from construction machinery and vehicles.	**Very Low Risk**	Minimize gaseous emissions.	Service machinery and vehicles on a regular basis. Prevent unnecessary idling of motors.	**Very Low Risk**	Ferrometals Logistics Manager	Decommissioning and Closure Phase	Decommissioning and Closure Phase Environmental Management Budget	Decommissioning and Closure Phase Environmental Management Budget	Visual Inspection	Continuously	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Air Quality (Dust Fallout): Deterioration in ambient air quality due to dust generated from decommissioning activities.	**Very Low Risk**	Minimize dust generation.	Perform regular dust suppression of the decommissioning site in a scheduled fashion.	**Very Low Risk**	Ferrometals SHEQ Manager	Decommissioning and Closure Phase	Decommissioning and Closure Phase Environmental Management Budget	Decommissioning and Closure Phase Environmental Management Budget	Dust fall-out monitoring	Monthly	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Noise: Generation of noise due to reverse hooters/alarms from construction machinery and vehicles.	**Very Low Risk**	Minimize noise impact on ambient sound levels.	Restrict decommissioning activities to daylight hours.	**Very Low Risk**	Ferrometals Logistics Manager	Decommissioning and Closure Phase	Decommissioning and Closure Phase Environmental Management Budget	Decommissioning and Closure Phase Environmental Management Budget	Complaints register	Continuously	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
	Shape the three sites to make them free draining	Surface Water: Contamination of the surface water resource due to erosion caused by storm water runoff and surface water discharge with high suspended solids load.	**Very Low Risk**	Prevent contamination of the surface water resource	Construct earth berms around Stores Slimes Dam footprint. Preferable to decommission during dry season. Settle suspended solids out and analyse for quality before any discharge into environment.	**Very Low Risk**	Ferrometals Logistics Manager	Decommissioning and Closure Phase	Decommissioning and Closure Phase Environmental Management Budget	Decommissioning and Closure Phase Environmental Management Budget	Water Quality sampling	Monthly	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Air Quality (Gaseous Emissions): Deterioration in ambient air quality due to gaseous emissions generated from construction machinery and vehicles.	**Very Low Risk**	Minimize gaseous emissions.	Service machinery and vehicles on a regular basis. Prevent unnecessary idling of motors.	**Very Low Risk**	Ferrometals Logistics Manager	Decommissioning and Closure Phase	Decommissioning and Closure Phase Environmental Management Budget	Decommissioning and Closure Phase Environmental Management Budget	Visual Inspection	Continuously	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Air Quality (Dust Fallout): Deterioration in ambient air quality due to dust generated from capping activities.	**Very Low Risk**	Minimize dust generation.	Perform regular dust suppression of the decommissioning site in a scheduled fashion.	**Very Low Risk**	Ferrometals SHEQ Manager	Decommissioning and Closure Phase	Decommissioning and Closure Phase Environmental Management Budget	Decommissioning and Closure Phase Environmental Management Budget	Dust fall-out monitoring	Monthly	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually

Decommissioning and Closure Phase Management Plan																
			Management Measures													
Activity	**Aspect**	**Potential Environmental Impact/Issue**	**Risk Level Before Management**	**Management Objective**	**Proposed Management Measure**	**Risk Level after Management**	**Responsible Person**	**Management Time Schedule**	**Management Budget Quantum**	**Management Budget Allocation/ Provisioning**	**Monitoring Required**	**Monitoring Frequency**	**Monitoring Budget Quantum**	**Monitoring Budget Allocation/ Provisioning**	**Performance Assessment**	**Performance Assessment Time Schedule**
		Noise: Generation of noise due to reverse hooters/alarms from construction machinery and vehicles	**Very Low Risk**	Minimize noise impact on ambient sound levels.	Restrict decommissioning activities to daylight hours.	**Very Low Risk**	Ferrometals Logistics Manager	Decommissioning and Closure Phase	Decommissioning and Closure Phase Environmental Management Budget	Decommissioning and Closure Phase Environmental Management Budget	Complaints register	Continuously	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
	Cap the East and South Slimes Dams with an appropriate lines system to prevent infiltration of rain water and install appropriate storm water management measures such as drains, channels and shutes to tie up with overall Ferrometals Storm Water Management System	Surface Water: Contamination of the surface water resource due to erosion caused by storm water runoff and surface water discharge with high suspended solids load.	**Very Low Risk**	Prevent contamination of the surface water resource	Construct earth berms around Stores Slimes Dam footprint. Preferable to decommission during dry season. Settle suspended solids out and analyse for quality before any discharge into environment.	**Very Low Risk**	Ferrometals Logistics Manager	Decommissioning and Closure Phase	Decommissioning and Closure Phase Environmental Management Budget	Decommissioning and Closure Phase Environmental Management Budget	Water Quality sampling	Monthly	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Air Quality (Gaseous Emissions): Deterioration in ambient air quality due to gaseous emissions generated from construction machinery and vehicles	**Very Low Risk**	Minimize gaseous emissions.	Service machinery and vehicles on a regular basis. Prevent unnecessary idling of motors.	**Very Low Risk**	Ferrometals Logistics Manager	Decommissioning and Closure Phase	Decommissioning and Closure Phase Environmental Management Budget	Decommissioning and Closure Phase Environmental Management Budget	Visual Inspection	Continuously	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Air Quality (Dust Fallout): Deterioration in ambient air quality due to dust generated from capping activities.	**Very Low Risk**	Minimize dust generation.	Perform regular dust suppression of the decommissioning site in a scheduled fashion.	**Very Low Risk**	Ferrometals SHEQ Manager	Decommissioning and Closure Phase	Decommissioning and Closure Phase Environmental Management Budget	Decommissioning and Closure Phase Environmental Management Budget	Dust fall-out monitoring	Monthly	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Noise: Generation of noise due to reverse hooters/alarms from construction machinery and vehicles	**Very Low Risk**	Minimize noise impact on ambient sound levels.	Restrict decommissioning activities to daylight hours.	**Very Low Risk**	Ferrometals Logistics Manager	Decommissioning and Closure Phase	Decommissioning and Closure Phase Environmental Management Budget	Decommissioning and Closure Phase Environmental Management Budget	Complaints register	Continuously	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
	Re-vegetate the capped Slimes Dams	Plant Life: Restoration of Habitat due to re-vegetation of the footprint.	**Positive Impact**	Ensure successful re-vegetation.	Re-vegetate according to plant specialist recommendations and specifications.	**Positive Impact**	Ferrometals SHEQ Manager	Decommissioning and Closure Phase	Decommissioning and Closure Phase Environmental Management Budget	Decommissioning and Closure Phase Environmental Management Budget	Visual Inspection	Daily	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Plant Life: Restoration of Biodiversity due to the repair of natural vegetation/habitat.	**Positive Impact**	Ensure successful re-vegetation.	Re-vegetate according to plant specialist recommendations and specifications.	**Positive Impact**	Ferrometals SHEQ Manager	Decommissioning and Closure Phase	Decommissioning and Closure Phase Environmental Management Budget	Decommissioning and Closure Phase Environmental Management Budget	Visual Inspection	Daily	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually

9.3.2 Post Closure Phase Draft EMP

Post Closure Phase Management Plan																
Activity	Aspect	Potential Environmental Impact/Issue	Management Measures													
			Risk Level Before Management	Management Objective	Proposed Management Measure	Risk Level after Management	Responsible Person	Management Time Schedule	Management Budget Quantum	Management Budget Allocation/ Provisioning	Monitoring Required	Monitoring Frequency	Monitoring Budget Quantum	Monitoring Budget Allocation/ Provisioning	Performance Assessment	Performance Assessment Time Schedule
Decommissioning and Closure of the three Historic Slimes Dams	Failure of the Vegetation cover	Soils: Loss of soil horizon due to erosion and surface water run-off.	**Moderate Risk**	Maintain stable vegetation cover.	Conduct bi-annual vegetation condition assessments. Implement recommendations (fertilization, irrigation, removal of aliens, etc.) as per outcome of assessment.	**Very Low Risk**	Ferrometals SHEQ Manager	Post Closure Phase	Post Closure Phase Environmental Management Budget	Post Closure Phase Environmental Management Budget	Visual Inspection	Bi-annually	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Surface Water: Contamination of the surface water resource due to erosion caused by storm water runoff and surface water discharge with high suspended solids load.	**Moderate Risk**	Maintain zero quality impact on surface water resources.	Conduct bi-annual assessment of storm water management measures. Implement recommendations (maintain run-off shutes, vegetation, etc.) as per outcome of assessment.	**Very Low Risk**	Ferrometals SHEQ Manager	Post Closure Phase	Post Closure Phase Environmental Management Budget	Post Closure Phase Environmental Management Budget	Water Quality sampling	Bi-annually	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Plant Life: Loss of habitat due to vegetation cover not returning to natural state.	**Low Risk**	Maintain stable vegetation habitat.	Conduct bi-annual vegetation condition assessments. Implement recommendations (fertilization, irrigation, removal of aliens, etc.) as per outcome of assessment.	**Very Low Risk**	Ferrometals SHEQ Manager	Post Closure Phase	Post Closure Phase Environmental Management Budget	Post Closure Phase Environmental Management Budget	Visual Inspection	Bi-annually	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Plant Life: Loss of biodiversity due to a loss of habitat.	**Low Risk**	Maintain stable vegetation biodiversity.	Conduct bi-annual vegetation condition assessments. Implement recommendations (fertilization, irrigation, removal of aliens, etc.) as per outcome of assessment.	**Very Low Risk**	Ferrometals SHEQ Manager	Post Closure Phase	Post Closure Phase Environmental Management Budget	Post Closure Phase Environmental Management Budget	Visual Inspection	Bi-annually	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Animal Life: Loss of habitat due to vegetation cover not returning to natural state.	**Low Risk**	Maintain stable faunal habitat.	Conduct bi-annual faunal condition assessments. Implement recommendations as pertaining to vegetation cover and diversity.	**Very Low Risk**	Ferrometals SHEQ Manager	Post Closure Phase	Post Closure Phase Environmental Management Budget	Post Closure Phase Environmental Management Budget	Visual Inspection	Bi-annually	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Animal Life: Loss of biodiversity due to a loss of habitat.	**Low Risk**	Maintain stable faunal biodiversity.	Conduct bi-annual faunal condition assessments. Implement recommendations as pertaining to vegetation cover and diversity.	**Very Low Risk**	Ferrometals SHEQ Manager	Post Closure Phase	Post Closure Phase Environmental Management Budget	Post Closure Phase Environmental Management Budget	Visual Inspection	Bi-annually	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Air Quality (Dust Fallout): Deterioration in ambient air quality due to windblown dust generated from denuded surfaces.	**Moderate Risk**	Maintain zero dust fallout.	Conduct bi-annual vegetation condition assessments. Implement recommendations (fertilization, irrigation, removal of aliens, etc.) as per outcome of assessment.	**Very Low Risk**	Ferrometals SHEQ Manager	Post Closure Phase	Post Closure Phase Environmental Management Budget	Post Closure Phase Environmental Management Budget	Visual Inspection	Bi-annually	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
	Failure of the Capping System	Groundwater: Contamination of the groundwater resource due to infiltration of rainwater through the capping and the subsequent infiltration of contaminated water through the footprint of the Slimes Dam into the sub-surface.	**Low Risk**	Minimize infiltration.	Conduct bi-annual assessment of capping system. Implement recommendations (maintain run-off shutes, vegetation, etc.) as per outcome of assessment.	**Very Low Risk**	Ferrometals SHEQ Manager	Post Closure Phase	Post Closure Phase Environmental Management Budget	Post Closure Phase Environmental Management Budget	Water Quality sampling	Bi-annually	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
	Failure of the Storm Water Management System	Soils: Loss of soil horizon due to erosion.	**Moderate Risk**	Maintain stable vegetation cover.	Conduct bi-annual vegetation condition assessments. Implement recommendations (fertilization, irrigation, removal of aliens, etc.) as per outcome of assessment.	**Very Low Risk**	Ferrometals SHEQ Manager	Post Closure Phase	Post Closure Phase Environmental Management Budget	Post Closure Phase Environmental Management Budget	Visual Inspection	Bi-annually	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Soils: Contamination of soil due to toe seepages and storm water run-off.	**Low Risk**	Prevent seepages.	Conduct bi-annual assessment of seepage drains and collection system. Implement recommendations as per outcome of assessment.	**Very Low Risk**	Ferrometals SHEQ Manager	Post Closure Phase	Post Closure Phase Environmental Management Budget	Post Closure Phase Environmental Management Budget	Visual Inspection	Bi-annually	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually
		Surface Water: Contamination of the surface water resource due to uncontrolled run-off of contaminated storm water from the Slimes Dam.	**Low Risk**	Maintain zero quality impact on surface water resources.	Conduct bi-annual assessment of storm water management measures. Implement recommendations (maintain run-off shutes, vegetation, etc.) as per outcome of assessment.	**Very Low Risk**	Ferrometals SHEQ Manager	Post Closure Phase	Post Closure Phase Environmental Management Budget	Post Closure Phase Environmental Management Budget	Water Quality sampling	Bi-annually	Environmental Monitoring Budget	Environmental Monitoring Budget	EMP Audit	Annually

9.4 ASPECTS COVERED BY DRAFT EMP

An "Environmental Aspect" as defined in the ISO 14001 Environmental Management System (EMS) Standard is: *"Elements of an Organisations* ***Activity****, Products or Services which can interact with the Environment. A significant Environmental Aspect is an Environmental Aspect which has, or can have a Significant Environmental Impact."*

Activity

Activities as defined by the National Environmental Management Act 107 of 1998, means *policies, programmes, processes, plans and projects.* In terms of the Ferrometals project one Activity was identified, namely:

- Decommissioning of three Historic Slimes Dam Facilities

Aspects

The following **Aspects** identified to be associated with this Activity, are covered by the Draft EMP – see Tables 9.3.1 and 9.3.2:

Decommissioning and Closure Phase:

- Remove Slimes Material and Contaminated Soil from Stores Slimes Dam footprint and deposit on the South Slimes Dam.
- Shape the three sites to make them free draining.
- Cap the East and South Slimes Dams with an appropriate liner system to prevent infiltration of rain water and install appropriate storm water management measures such as drains, channels and shutes to tie up with overall Ferrometals Storm Water Management System.
- Re-vegetate all three Slimes Dam sites.

Post Closure Phase:

- Failure of the Vegetative Cover.
- Failure of the Capping System.
- Failure of the Storm Water Management System.

9.5 PERSON(S) RESPONSIBLE FOR IMPLEMENTATION

Two persons at Ferrometals will be responsible for the implementation of the project as well as the environmental management and control:

- Ferrometals SHEQ Manager
- Ferrometals Logistics Manager

Refer to **Column 8** of the Draft EMP Tables in sections 9.3.1 and 9.3.2 for the Decommissioning and Closure (Rehabilitation) as well as the Post Closure Phases. The person responsible for implementing the management measures have been identified per aspect assessed.

9.6 COMPLIANCE MONITORING & REPORTING MECHANISMS

A Compliance Monitoring and Reporting Mechanism has been developed and is contained in **Columns 12 through 17** of the Draft EMP as contained in sections 9.3.1 and 9.3.2.

The following components are included:

Column 12: Monitoring Requirement
Column 13: Monitoring Frequency
Column 14: Monitoring Budget Quantum
Column 15: Monitoring Budget Allocation/Provisioning
Column 16: Performance Assessment
Column 17: Performance Assessment Time Schedule

9.7 LEGAL/FORMAL COMPLIANCE FRAMEWORK

The rehabilitation and closure of the three Historic Slimes Dams at Ferrometals will be done within the formal legal framework which includes:

In terms of NEMA, the primary activity applied for is:

National Environmental Management Act, Act No. 107 of 1998		
Section 24	**Environmental Authorisation Application**	
GNR 544		
Identification of the competent authority	The competent authority in respect of the activities listed in this part of the schedule is the environmental authority in the province in which the activity is to be undertaken unless it is an application for an activity contemplated in section 24C(2) of the Act, in which case the competent authority is the Minister or an organ of state with delegated powers in terms of section 42(1) of the Act, as amended.	
Activity 27 (iv)	"The decommissioning of existing facilities or infrastructure, for – (iv) activities, where the facility or the land on which it is located is contaminated"	**The activity applied for relates to the Decommissioning of three Historic Slimes Dam facilities at the Ferrometals site. The disposed slimes classify as hazardous waste and are therefore the facilities are deemed to be contaminated.**

In terms of NEMWA, the activity applied for is:

National Environmental Management Waste Act, Act No. 59 of 2008		
GNR 921 of 29 November 2013	**Waste Management Activities**	
CATEGORY A		
14	The decommissioning of a facility for a waste management activity listed in Category A or B of this Schedule.	**Decommissioning of the three Historic Slimes Dam facilities at the Ferrometals Site – South Slimes Dam, East Slimes Dam and Stores Slimes Dam. Due to the hazardous classification of the slimes waste, the historic waste management activities relate to Category B.**

The formal authorization process is that of a Basic Assessment in support of the Waste License Application, whilst the technical compliance requirements relate to the Waste Management Regulations and DWS Best Practice Guidelines.

The Civil Engineering Design Report attached as **APPENDIX 1.3.1** discusses compliance with the technical requirements in detail.

9.8 REHABILITATION TO SUPPORT POST CLOSURE LAND USE

Indications at present are that the post closure land use for the Ferrometals site could resort back to industrial, recreational, business and even residential use. Apart from some minor modifications to the topography and despite slightly impaired agricultural potential and some impacts on ground water quality, the influence of the post closure environmental impact profile on post closure land use, is predicted to be **Very Low**.

The civil engineering design was done to cater for this post closure land use condition in that the design philosophy incorporates design elements such as shaping, stabilizing, capping, top soiling, re-vegetation, erosion control, storm water management and leachate/seepage/drainage control all to ensure that the decommissioned facilities are environmentally suited for its proposed end-use and closure land use and that it is environmentally acceptable after closure.

The rehabilitation of these three sites will therefore ensure that the final condition of these sites are environmentally acceptable and that there will be no adverse long term effects on the surrounding areas, the water regime or the population. After closure the sites must be monitored on an ongoing basis.

9.9 TIME FRAMES FOR EMP IMPLEMENTATION

The EMP covers two life cycle phases namely:

- Decommissioning and Closure
- Post Closure

The implementation of the decommissioning activities as per the civil engineering design report, will take between 4 and 6 months.

After this the new vegetative cover could take some 2 years to fully re-establish.

Only after the vegetation has established fully and sign-off can be given on the storm water management measures and stability of the site from an erosion perspective, will the site move into the Post Closure phase.

9.10 ENVIRONMENTAL AWARENESS PLAN

As specified in the Environmental Impact Assessment Regulations – GNR 543 of 2010; (33) a Draft Environmental Management Programme must include:

(j) an environmental awareness plan describing the manner in which-

(i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and
(ii) risks must be dealt with in order to avoid pollution or the degradation of the environment;

9.10.1 Employee Notification of Environmental Risks

I order to address the above mentioned requirements, the general objectives of an Environmental Awareness Plan should include the education of employees on the importance of conserving natural resources and their specific role in conserving the environment which they encounter on a daily basis.

The Applicant (Ferrometals) informs employees of any environmental risk which may result from their work by means of a General Induction, Plant Specific Induction, Training on Operating Procedures, Pre-Shift Talks on SHEQ related matters as well as weekly communication opportunities.

APPENDIX 9.10.1 contains the illustrations of the General Induction as well as an example of a Plant Specific Induction for a particular department discussed with employees. The objective of these inductions is to ensure zero harm to employees, contractors and the environment.

An example of the Applicants' Environmental Emergency Preparedness and Response procedure (document PRO144) is also provided in **APPENDIX 9.10.1**. This procedure aims to enable all personnel to understand their responsibilities during an environmental and hazardous material emergency.

In addition, an Emergency Procedure (Document PRO148) specifically relaying guidance for emergencies related to the Laboratory, Canteen, Clinic, Security and Reception is also provided as well as the Emergency Procedure for the Chrome Recovery Plant (CRP) as well as the Logistics Department.

The objective of this procedure is to minimize the impact of injuries and losses to the applicant by establishing a compact, practical procedure to instruct and guide the employees of these departments on actions to be taken following or during a serious incident or accident.

9.10.2 Risk Management Training

Risk Management Training deals with all the elements required to effectively deal with all environmental risks in order to avoid pollution or degradation of the environment.

An example of a risk assessment carried out at the Ferrometals Closed Furnaces along with a baseline risk assessment for the CRP and the Logistics department in the form of an Aspect/Impact Register is attached as **APPENDIX 9.10.2**. Hazards and risks are rated before controls are implemented and after controls are implemented.

9.10.3 Risk Awareness Training

As stated above, the Applicant (Ferrometals) informs employees of any environmental risk which may result from their work by means of a General Induction, Plant Specific Induction, Training on Operating Procedures, Pre-Shift Talks on SHEQ related matters as well as weekly communication opportunities.

A comprehensive procedural system is in place for the Environment, Health and Safety. Training on Standard Operating Procedures is conducted per department. An attendance register is signed by all those that were trained. Further verification of understanding is undertaken by the supervisor through a task observation (critical or planned task observations) and loaded onto Ferrometals Integrated Management System (IMS). Mock drills are carried out in a regular basis.

A few examples of weekly communication by Human Resources regarding SHEQ related matters are provided in **APPENDIX 9.10.3**.

9.11 CLOSURE OBJECTIVES & PLANS

The three Historic Slimes Dam facilities at Ferrometals were decommissioned some time ago. Inprocon Consultants has been contracted by JMA Consulting for the final rehabilitation and closure design of these Historic Slimes Dams.

9.11.1 Closure Objectives

The closure vision is to rehabilitate these facilities in such a way that a sustainable post-closure land use is obtained through the application of BPEO principles. The objectives of rehabilitation and closure of the facilities are to ensure that the sites are:

- In a condition consistent with the post-closure land use objectives;
- Neither a danger to public health and safety nor animal health and safety;
- Not a source of on-going pollution of the environment;
- In an ecological and geophysical stable state;
- Aesthetically acceptable;
- Rehabilitated to the legal requirements and commitments stated in the EMP and
- Sustainable in the long term, with minimum post-closure intervention in the form of monitoring and remedial works.

9.11.2 Closure Plan

The Historical Slimes Dams, after careful consideration do not merit to be merged into a single dam. This is mainly due to unavailable space at the existing active facility (North Slimes Dam) that will reach end of life within the next two years. The South and East Slimes Dams if properly rehabilitated will not extend the already affected footprints and from an economical perspective and stability perspective *in situ* rehabilitation follows to be the most viable alternative.

The construction, operation and upgrading of the historic slimes dams are already dealt with in the Ferrometals Water Use Licence, License No. 04/B11k/709, dated 02 April 2011 issued by Water Affairs.

During the rehabilitation design phase it was concluded that the small Stores Slimes Dam should be removed and stockpiled at the South Slimes Dam. The motivation for this decision is based on the following:

- The stores slimes dam is small and clearing would reduce the affected areas at Ferrometals.
- The affected footprint of the South Slimes Dam will not be enlarged by placing the stores dam slimes on top of the crest as fill is required to fill and shape the crest to be free draining.
- On the long term lessor waste sites to manage and monitor.

The following design criteria as were adopted for the closure plan design, are applicable to the rehabilitation and capping of the Historic Slimes Dams:

- The final footprint area after shaping and contouring of the dam must not impede existing buildings or infrastructure still in use – the final footprint area must thus be minimised to allow for other activities around the slimes dams to continue;
- Contouring and shaping of the slimes dam must be such that no ponding occurs;
- The capping/cover material must be able to prevent ingress of surface water and must be sufficiently erosion resistant against surface water run-off and wind;
- The side slopes of the slimes dam must have a Factor of Safety (FOS) of at least 1.3 against sliding and must not be steeper than 1V:5H;
- Storm water run-off resulting from the 1:100 year 24 hour storm duration must be accommodated through sufficient drains, canals, berms and chutes and discharged into the natural environment;
- Leachates through the foundation into the groundwater must be continuously reduced and if required, a seepage trench at the toe of the slimes dams must be provided and;
- A suitable monitoring system must be provided to check the post closure groundwater quality around the slimes dams.

The complete rehabilitation and closure design for the three Historic Slimes Dams at Ferrometals is given in the **approved** Civil Engineering Design Report attached as **APPENDIX 1.3.1**.

10. ASSUMPTIONS, UNCERTAINTIES & GAPS

In support of the waste license application for the closure of the three Historic Slimes Dams, a comprehensive waste characterization and classification assessment was conducted, followed by a detailed civil engineering design in accordance with the Best Practice Guidelines as applicable to water and waste management.

Based on the above, approval was obtained from the relevant division at DWS as far as the rehabilitation and closure design is concerned.

From an Environmental Impact and Risk Assessment perspective, the project was supported with site specific environmental base line information generated during 2013 and 2014 to support the EIA process for the authorization of a proposed new Slimes Dam at Ferrometals. This facilitated an accurate Environmental Impact and Risk Assessment.

It can therefore be stated with a high degree of certainty, that **no significant assumptions** had to be made, or that **any significant uncertainties or gaps existed** as far as the project design and the associated impact and risk assessment is concerned.

11. OPINION FOR AUTHORIZATION

11.1 REASONED RECOMMENDATION

The proposed closure of the three Historical Slimes Dams, at Ferrometals, will occur on a brown fields industrial site.

The detailed planning and design of the proposed activities took full cognizance of the potential impacts of the activities on the environment. Bearing this in mind and based on the outcome of the high integrity impact and risk assessments undertaken, is could be confirmed that the rehabilitation and closure of the three Historic Slimes Dams at Ferrometals, will not result in any environmental impacts of unacceptable magnitude and risk.

All impacts and risks identified for the two life cycle phases of the project can indeed be fully managed to acceptable levels using existing best practice methodologies. In this regard Ferrometals, through innovative planning and design, has demonstrated their full capacity and commitment towards managing the rehabilitation and decommissioning of the three Historic Slimes Dams related impacts to acceptable levels.

It is therefore recommended by the EAP that approval be granted to Ferrometals to proceed with the activities as applied for, subject of course to conditions as could be specified by the relevant regulatory authorities within their respective mandates of regulation.

11.2 CONDITIONS FOR AUTHORIZATION

Conditions for approval remain the prerogative and responsibility of the relevant regulatory authority. However, the Recommendation for Approval of the EAP is made subject to the following conditions:

- That the Environmental Management Plan as detailed in the Management Measure Tables, be implemented as proposed, or alternatively with motivated alterations.

- On-going environmental monitoring at, as well as maintenance to the decommissioned footprints, for a time period as specified by the Authorities.

- That environmental management measures be adapted, or continued, based on the outcome of the monitoring programmes.

Respectfully submitted,

Original Signed By

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Jasper L Muller (Pr.Sci.Nat.)

12. REPRESENTATIONS/COMMENTS RECEIVED

All the comments and feedback gathered from the I&AP's and Authorities, throughout the Public and Stakeholder Participation Process, were compiled into the Issues and Response Register. Each comment was reviewed by the EAP and responded to either by the EAP, or else by the relevant specialist, before finalising the Draft Basic Assessment Report and submitting the Final BA Report to the relevant competent authorities. The Issues and Response Register is attached as **APPENDIX 3.1.13 to this** Report.

THIS SECTION WILL BE FINALIZED AFTER THE RESPONSE TIME AS PROVIDED FOR IN THE PUBLIC PARTICIPATION PROCESS HAS LAPSED.

13. MINUTES OF I&AP/STAKEHOLDER MEETINGS

I&AP Public and Stakeholder Meeting have the function of providing additional opportunities for communication between the Applicant, Authorities and I&APs in order to prevent any misunderstanding and/or to address sensitive issues that may arise during the formal public participation process.

A public meeting was held I&AP's on the 19th of February 2015 to discuss the project and activities applied for as well as to give I&AP's the opportunity to ask questions and to raise concerns. I&AP's were notified well in advance about the meeting. I&AP's also had the opportunity to request a focus group meeting to resolve key issues. The Minutes of the Meetings were distributed after the meeting to all I&AP's present at the meeting and are attached as **APPENDIX 3.1.9.**

THIS SECTION WILL BE FINALIZED AFTER THE RESPONSE TIME AS PROVIDED FOR IN THE PUBLIC PARTICIPATION PROCESS HAS LAPSED.

14. RESPONSES BY EAP

All the comments and feedback gathered from the I&AP's and Authorities, throughout the Process that formed part of the Issues and Response Register were reviewed by the EAP and responded to either by the EAP, or else by the relevant specialist, before finalising the Draft Basic Assessment Report and submitting the final BA report to the relevant competent authorities. The Issues and Response Register is attached as **APPENDIX 3.1.13 to this** Report.

THIS SECTION WILL BE FINALIZED AFTER THE RESPONSE TIME AS PROVIDED FOR IN THE PUBLIC PARTICIPATION PROCESS HAS LAPSED.

15. INFORMATION REQUIRED BY CA

This is additional information that the CA request after they reviewed the Draft BAR, before the report can be finalised.

THIS SECTION WILL BE FINALIZED AFTER THE CA HAS REVIEWED THE DRAFT BAR.

16. MATTERS ITO SECTIONS 24(4)(a) or (b) of NEMA

These matters will be raised by the Competent Authority only after they have reviewed the draft BAR.

THIS SECTION WILL BE FINALIZED AFTER THE CA HAS REVIEWED THE BAR.