ASSESSMENT OF KWAZULU-NATAL PROVINCE'S COAL MINING AND COAL RESOURCES

By

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EXECUTIVE SUMMARY

KwaZulu-Natal has mined coal for over one hundred years. However, since 1982, the province's production has steadily decreased from 20Mt to 2.5Mt in 2005. This was primarily due to:-

- difficult mining conditions as a result of narrow seams, large topographic differences, highly faulted ground conditions and numerous occurrences of dolerite dykes. This resulted in low extraction rates and tonnages, high mining costs and few opportunities for opencast mining;
- the abolition of the coal marketing controls took place in the early 1990's. These controls had prevented the sale of coal produced within a province from being sold outside of that particular province. This abolition resulted in the cheap coal produced in Mpumalanga being sold into the KwaZulu-Natal market. Although the Mpumalanga coals had further to travel to reach the KwaZulu-Natal market, the combined mining and transportation costs for this coal were still significantly less than the high cost coal produced within KwaZulu-Natal;
- the decrease in the demand for export anthracite from KwaZulu-Natal. Other sources of cheaper, better quality anthracite were being supplied into the global market;
- closure of part of the Newcastle steelworks which consumed significant amounts of coking coal;
- old and aging mines reaching their limits of extraction;
- a significant gas explosion in one of the collieries; and
- the Witbank and associated coalfields have been the focus of mining operations as these deposits host thick seams with few structural difficulties. These conditions enable high tonnage opencast mines, often serviced by draglines, and large underground mines. The net result is low cost mines.

Mintek was mandated by Trade and Investment KwaZulu-Natal (TIKZN) to overview the current coal industry in the province, calculate the remaining coal resources and identify high potential areas for future development. This has been achieved through the generation of a user-friendly GIS (Geographic Information System) repository of extensive publicly available information compiled in a unique manner. This information can be used by TIKZN to promote the coal industry in the province with the purpose of attempting to increase production to its previous status.

In order to provide TIKZN with a full understanding of the coal industry from formation to sales, we have included descriptions of coal formation, classification, beneficiation and the products required by the various market segments. Furthermore, by placing KwaZulu-Natal into context with the remainder of South African's coal industry it is evident that the KwaZulu-Natal coals are typically of high quality but only contribute 2% of the market.

KwaZulu-Natal coal is deposited into thin seams of anthracite, bituminous and coking coal. The coal deposits have been divided into the five coalfields, namely from west to east; Klip River, Utrecht, Vryheid, Nongoma and Somkele. The coal seams are developed in the Ecca Group in the Klip River, Utrecht and Vryheid Coalfields and Beaufort Group in the Nongoma and Somkele Coalfields. The province is riddled with dolerite dykes which result in faults cutting across the coal. The dykes, depending on their proximity to the coal, either increase the quality or burn the coal.

In comparison to the other South African coal deposits, KwaZulu-Natal coal mining is difficult due to large topographic differences, structural complexities and thin seams. However, KwaZulu-Natal is advantageously positioned with respect to the export markets due to the proximity of the ports of Durban and Richards Bay.

Publicly available information was gathered and collated from various sources including, but not limited to, the Department of Minerals and Energy (DME) and Council for Geoscience (CGS). This information was compiled into a GIS.

Base datasets in the Mintek GIS include the Province's infrastructure, rivers, topography, farm boundaries, boreholes, mines and coalfields. These data provided the information used to estimate the remaining coal resources in the province on a farm by farm basis, with coal borehole data providing the primary source of information on coal seams and their associated thicknesses. Opencast and underground potential was assessed by borehole data and used to define areas of reconnaissance resources. The resources are quoted in accordance with the South African Guide to Systematic Evaluation of Coal Resources and Coal Reserves (SANS 10320:2004). Coal tonnages were only assessed on farms on which boreholes had been drilled and on which potential for eventual economic extraction of the coal exists. These estimates cover a total of 490 farms. The resources were combined to estimate the remaining tonnages by coalfield, as summarised in the table below.

COALFIELD	GROSS TONNAGE IN SITU (GTIS) 2007 (Mt)	GEOLOGICAL LOSSES AT 40%	IN SITU RECCONNAISSANCE COAL RESOURCES (TOTAL TONNES IN SITU) (TTIS) (Mt)	TOTAL 1997 (Mt) (TTIS)	2007-1997 DIFFERENCE
Klip River	4,461	1,784	2,677	1,695	982
Nongoma	4,116	1,646	2,470	257	2,213
Somkele	6,133	2,453	3,680	467	3,213
Utrecht	2,265	906	1,359	950	409
Vryheid	2,084	834	1,250	222	1,028
GRAND TOTAL	**19,059**	**7,623**	**11,436**	**3,591**	**7,845**

These tonnages were compared to estimates made in 1997(cited in Pinheiro, 1999), with significant differences. The 1997 data is the last official record of the Provinces' resources in the public domain.

Most of the remaining coal resources are located in the Somkele Coalfield. This is mostly due to the fact that Somkele's coal occurs in zones rather than thin coal seams and to a lesser extent that no mining had taken place at the time.

In order to identify the areas of high potential a ranking scheme was developed. The ranking scheme was applied to the 490 farms bearing coal. A total of 18 farms were identified with a high potential. These 18 farms are listed in the table below and are identified for further exploration. According to the ranking scheme the high potential areas occur on the western region of KwaZulu-Natal, where 14 of the highly ranked farms are located in the Klip River Coalfield, with the remaining 4 farms located in the Utrecht Coalfield.

FARM NAME	FARM NUMBER	COALFIELD	RATING
Roy Point	2959	Klip River	37.71
Newcastle Townland	4702	Klip River	37.50
Braak Fontein	4278	Klip River	35.94
Tiger Kloof	3333	Klip River	35.50
Yarl	2962	Klip River	35.50
Avalon	14869	Klip River	32.51
Tuam	13485	Klip River	32.50
Uithoek	1335	Klip River	32.02
Lot A of Loch End	10896	Klip River	31.74
Walmsley	4266	Klip River	31.09
Klip Rand	3723	Klip River	30.54
Leicester	2970	Klip River	30.50
Vaalbank	103	Klip River	30.50
Klein Fontein	1262	Klip River	30.42
Nooitgedacht	90	Utrecht	33.66
Rendsburg	80	Utrecht	32.50
Zoetmelksrivier	86	Utrecht	30.50
Geluk	17067	Utrecht	30.50

This study has demonstrated that KwaZulu-Natal has a large remaining resource base which has potential for development. The Klip River Coalfield has the greatest percentage of high potential projects and therefore this area should be the focus of future investment. The clustering of groups of high potential farms should be used to the advantage of the operators.

In order to promote the coal industry within KwaZulu-Natal, the Province's distinct advantages must be focused upon. These include:-

- proximity to the export points through the ports at Richards Bay and Durban. With the increasing costs and unreliability of rail transport, as well as the increasing road transport costs associated with the diesel price, KwaZulu-Natal offers a cost advantage; and
- ability to produce high quality niche market coals including low phosphorous anthracite and coking coal.

The focus of the province's promotion of its coal industry must be on small-medium scale underground and opencast mining operations (e.g. 50,000tpm) to extract and beneficiate niche products.

Small-medium scale mining may also have additional economic potential if a number of separate mining operations supply ROM coal to a central processing facility. In this way the small tonnages produced by the individual mines can be amalgamated into a critical mass at the plant and then be sold into the market. This diverse number of operations would decrease the risk of coal supply to the plant and decrease the capital required for each of the mines. The plant may be owned and operated by a separate company or owned on a share basis by the surrounding mines. Alternatively, portable plants may be utilised and moved from deposit to deposit as tonnages are extracted.

This type of mining would be highly suited to Broad Based Black Economic Empowerment (BBBEE) companies.

This report and the accompanying GIS can be used by TIKZN to promote the industry through:-

- Compiling an Information Memorandum on the highest rated projects either individually or combined and presenting this to the market; and/or
- Allowing open- or fee-generating access for interested parties/companies to the GIS and target database to allow them to identify their own particular target areas; and/or
- including articles in the mining-related press describing what has been completed on the coal resources in the Province and providing details on the product which is available (i.e. the GIS and associated target database).

It should be noted that this report has been based upon economic factors prevailing at the beginning of 2007. The mining width economic cut-off of one metre was used as a mining equipment constraint. The size of individually identified coal resources is also an existing constraint that may be alleviated with respect to commercial returns if materially higher coal prices occur in the future. The merits of any of identified resources should be consistently reviewed within this context.

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1 INTRODUCTION

Mintek was mandated by (TIKZN) to assess the coal mining industry and coal resources situated in KwaZulu-Natal, South Africa. Mintek was in turn subcontracted by Mintek to complete this mandate.

In order to assess the coal resources, publicly available information was gathered from various sources and compiled into three databases. These databases are included in a Geographic Information System (GIS) for the province. The information covers the following:-

- location of the province's coalfields (Figure 1);
- sales and quality data from producing coal mines;
- sales and quality data from defunct mines;
- location of all boreholes drilled in the province and indications as to whether coal was intersected;
- coal depth and thickness measurements for boreholes which intersected coal; and
- positions of current mines and mined out areas for the defunct mines.

Interpretation of the information was undertaken on a farm by farm basis within the coalfields. The opencast and underground mining potential on these farms was assessed using borehole information. The farms with coal mining potential were then ranked according to a scheme specifically designed for this project and then the associated coal tonnages estimated.

2 PURPOSE OF THE ASSESSMENT

KwaZulu-Natal has been extracting coal for over 100 years. However, since 1982, the province has been subject to a steady decline in production with associated mine closures. The reasons for this demise are discussed in detail in Section 7.2. The purpose of this assessment is to increase the knowledge base and promote the coal mining industry in the province and to restore the industry to its former importance as a coal producer. In order to begin to promote the industry suitable areas for future development needed to be identified. This has been achieved through this study and the generation of the following:-

- a user friendly GIS repository of extensive publicly available information compiled in a unique manner;
- target areas which, with detailed exploration, have potential to become future mining operations; and
- estimates of reconnaissance coal tonnages within the province.

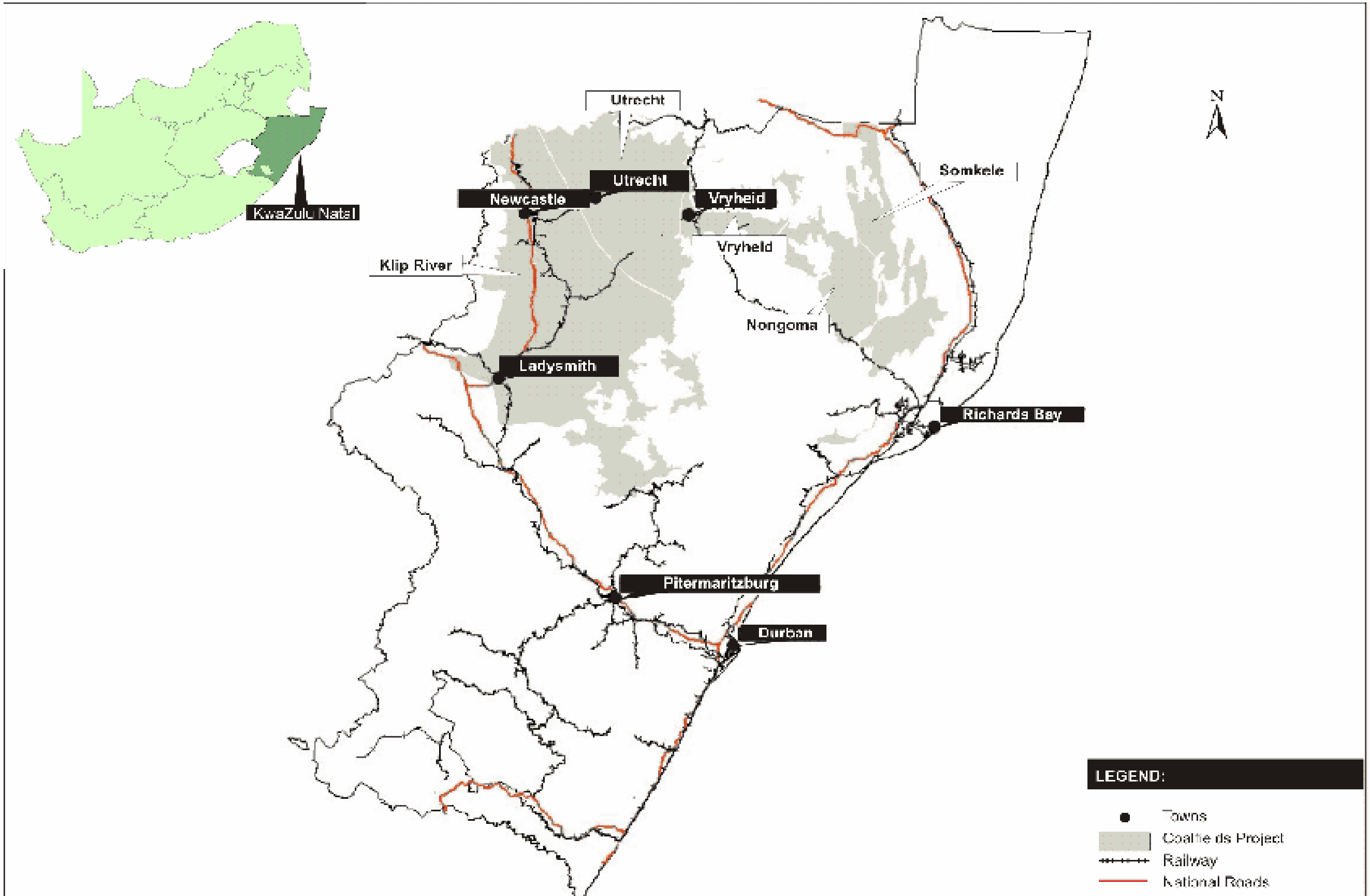
Using this assessment and the GIS the following can be undertaken to promote the industry:-

- finance raised (by TIKZN or other appropriate institutions) to carry out exploration on a select number of the targets. The purpose of the exploration would be to increase the classification and confidence in the resources in the manner prescribed in the SAMREC Code. Once this has been completed, the projects can be packaged into Information Memoranda and presented to current coal mining and exploration companies and new companies looking to enter this market, with particular focus on the BBBEE companies; and/or
- compile an Information Memorandum on the highest rated projects either individually or combined and present this to the market; and/or
- allow open- or fee-generating access for interested parties/companies to the GIS and target database to allow them to identify their own particular target areas; and/or
- include articles in the mining-related press describing what has been completed on the coal resources in the province and provide details on the product which is available (i.e. the GIS and associated target database).

KWAZULU NATAL COAL RESOURCES

KZN COALFIELDS IN RELATION TO INFRASTRUCTURE

Figure 1



Source: Mintek, CGS

3 CAPABILITY STATEMENT

The South African government established what is now Mintek in 1934 to assist with the development of the minerals and metals industries in South Africa. During Mintek's 72 years of existence, its objective has been to assist in ensuring the sustainability and growth of the minerals and metals industries. This continues to be reflected in the most recent Mintek Act, which states that Mintek's objectives are to promote mineral technology, and to foster the establishment and expansion of industries in the field of minerals and products derived there from. This is to be achieved through research, development and technology transfer.

4 REPORTING COMPLIANCE

The resources quoted in this study are reported according to the South African Code for Reporting of Mineral Resources and Mineral Reserves (SAMREC Code). This code provides the framework and standards for public reporting on the Johannesburg Stock Exchange (JSE) and is also embodied in Chapter 12 of the JSE Listing Requirements. The resources are also quoted in accordance to the South African Guide to the Systematic Evaluation of Coal Resources and Coal Reserves (SANS 10320:2004) prepared by Standards South Africa, a division of the South African Bureau of Standards (SABS).

SANS defines coal deposits as "an occurrence of coal of economic interest which forms the physical envelope that encompasses a coal resource or reserve, or both" (Figure 2). The code further divides coal deposits into those comprised of:-

- **Multiple Seam Deposits**, i.e. "characterised by a discrete number of coal seams, typically between 0.5m and 7.0m in thickness, separated by inter-burden units of thickness generally significantly exceeding the thickness of the individual coal seams" (Figure 2); and
- **Thick Interbedded Seam Deposits**, i.e. "characterised by a succession of multiple, thinly interbedded coal and non-coal layers with a total thickness of typically between 40m and 70m (Figure 2).

Both SANS and SAMREC Code define a coal resource as an "occurrence of coal of economic interest in or on the earth's crust in such form, quality and quantity that there are reasonable and realistic prospects for eventual economic extraction". Resources are subdivided into the following categories, as shown in Figure 2:-

- **Reconnaissance Coal Resource**; i.e. "coal in the full seam where the coal seam is of economic interest and the distribution of physical points of observation is such that physical continuity may be assumed at a low level of confidence, and there is limited coal quality data, such that the available coal quality data includes coal quality of economic interest". These resources require a point of intersection at a maximum distance of 2,000m for multiple seam deposits and 4,000m for thick interbedded deposits;
- **Inferred Coal Resource**; i.e. "part of a coal resource for which tonnage, densities, shape, physical characteristics and coal quality can be estimated with a low level of confidence. The resource is inferred from geological evidence and assumed, but not verified physical continuity with or without coal quality continuity". Inferred resources require a point of intersection at a maximum distance for multiple and interbedded seam deposits at 1,000m and 3,000m, respectively;
- **Indicated Coal Resource**; i.e. "part of a coal resource for which tonnage, densities, shape, physical characteristics and coal quality can be estimated with a moderate level of confidence… The locations are appropriate to confirm physical continuity, while the locations are too widely or inappropriately spaced to confirm coal quality continuity". These resources require a point of intersection at a maximum distance of 500m for multiple seam deposits and 1,000m for thick interbedded deposits;
- **Measured Coal Resource**; i.e. "part of a coal resource for which tonnage, densities, shape, physical characteristics and coal quality can be estimated with a high level of confidence. The locations are spaced closely enough to confirm physical continuity and coal quality continuity". Measured coal resources require a point of intersection at a maximum distance for multiple and interbedded seam deposits at 350m;

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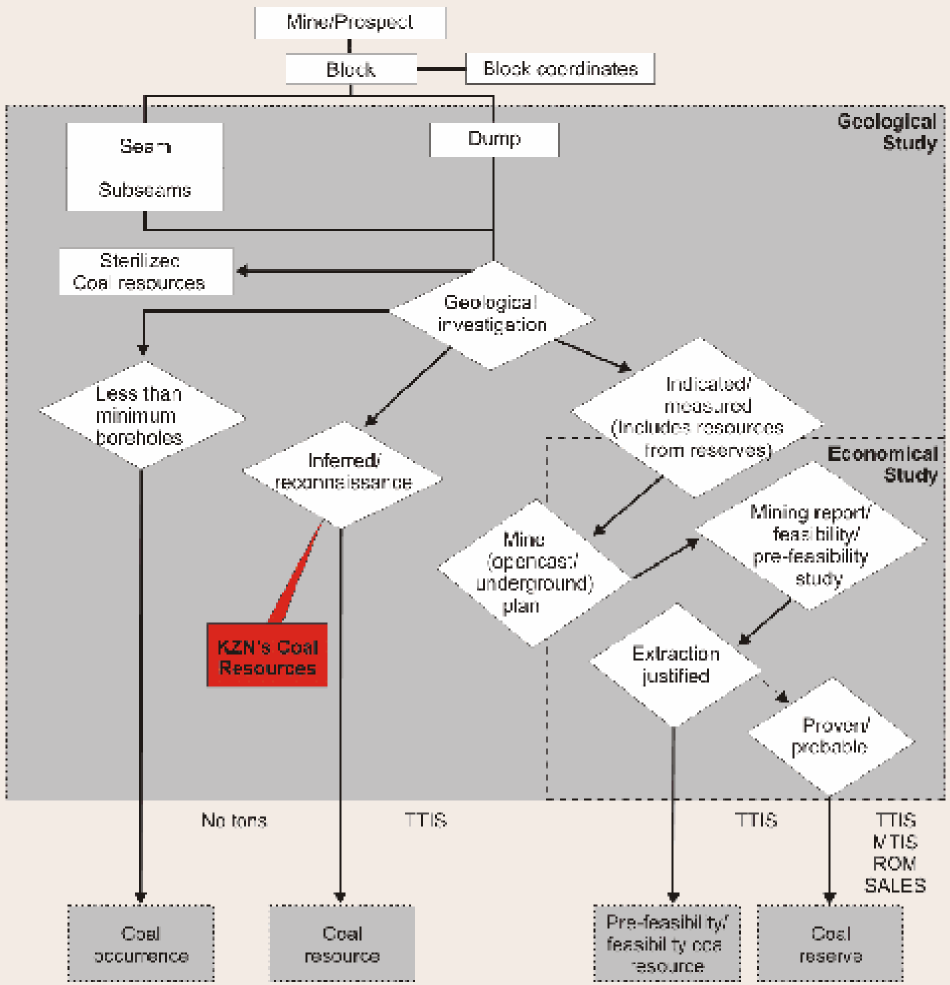
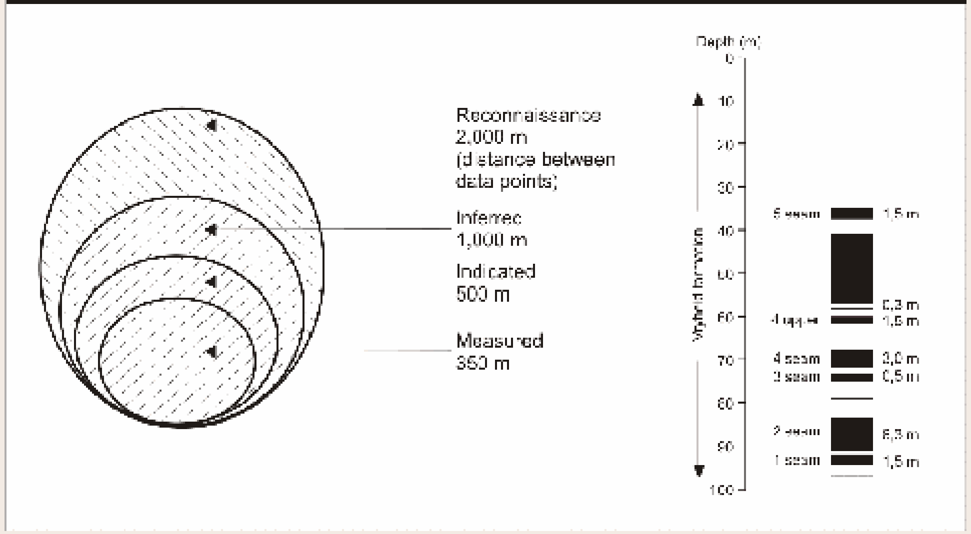
SANS GUIDE TO CLASSIFYING COAL RESOURCES AND RESERVES

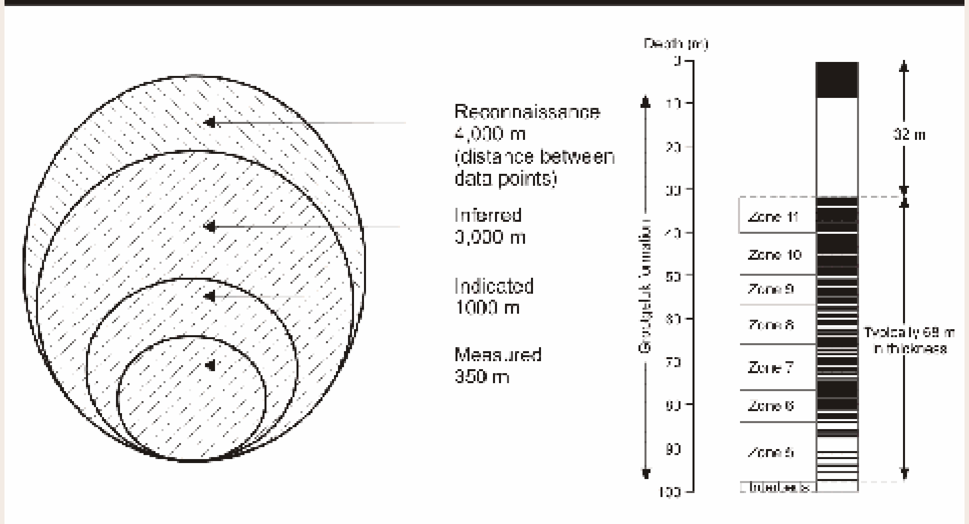
Figure 2



Multiple seam deposit type coal resources (<50% ash) and Generalised Stratigraphic Column



Thick interbedded seam deposit type coal resources (<65% ash) and Generalised Stratigraphic Column



All coal tonnages quoted in this report are defined as reconnaissance coal resources. This type of study is defined as an “initial geological evaluation typically composed of a desktop study, and including a literature review of all available data, with limited fieldwork”. The tonnages are quoted as Gross Tonnes In Situ (GTIS). However, a Total Tonnes In Situ (TTIS) is also quoted which takes into account the geological losses that might be expected within the context of geological setting of the GTIS. This is considered to be an appropriate and realistic presentation of the coal qualities that might be anticipated in the areas based upon the available information assessed during this study, albeit at the lowest of confidence levels (Figure 2).

5 COAL

The sections to follow provide background information on this mineral substance.

5.1 Formation of Coal Deposits

Coal is a fossil fuel composed of oxygen, hydrogen and approximately 70%, by volume, of carbonaceous material. It is essentially a combustible sedimentary rock that formed from prehistoric organic remains that were buried and altered through geological time.

The greatest coal-forming time in geological history was during the 354 to 290 million years ago (Ma), Carboniferous Period. In addition some large coal deposits are found in the Permian age (290 to 248Ma). During coal-forming periods most of this region of the earth was covered in swamps, with plants growing within these swamps. Coal formation is two-fold: the first stage is peat formation (humification), followed by putrefication (saprofication). When the plants die, their biomass is deposited in layers within the aquatic environment, where conditions are anaerobic. The lack of oxygen prevents the complete decay of the organic material by oxidation, and decomposition is slow. Interaction from bacteria converts the material into peat, which is then compacted by sediment loading, and squeezing the interstitial water out of the peat.

Burial of the material increases the pressure (increased overburden stress), while temperature is affected by burial depth, the presence of intrusive bodies, and geothermal influences in regions of crustal weakness. Increasingly deeper burial and heat gradually converts the organic material to coal. Generally, to form a coal seam 1m thick, between 10m and 30m of peat is required.

The factors controlling the rate and degree of degradation (coalification) include sedimentary environments and tectonic control, prevailing climatic conditions, plant communities and geochemical conditions such as water level, potential difference (Eh) and alkalinity (Ph) conditions, and salinity. The changes in maturity of coal are controlled by pressure, temperature and the passage of time. Eventually, and usually due to the initial onset of tectonic events, the coal forming environment ceases. This is often abrupt, resulting in coal seams having a sharp upper contact with the overlying strata.

A prolonged stable environment is paramount for the formation of economic coal and the waters feeding the peat swamps must remain essentially free of sediment. This requires minimal erosion in the uplands of the rivers which feed the coal swamps, and efficient trapping of the sediments.

Southern hemisphere coals formed in the Permian Period and are somewhat different from the Carboniferous coals of the northern hemisphere. Northern hemisphere swamps were set in a hot, humid, equatorial climate and coal-bearing basins were set in uncompacted deep, actively and rapidly subsiding geosynclines within the Laurasian supercontinent. Plant growth was rapid with long, continuous growing seasons. The rate of plant degradation was also rapid.

The Gondwanaland supercontinent lay in the southern hemisphere. The Permian swamps here existed in a cool temperate climate associated with the waning of a massive ice age induced by the drifting of the supercontinent away from the South Pole. Peat was deposited within relatively stable continental depressions. The flora that dominated was significantly different to that which flourished in the considerably warmer northern hemisphere. Plant growth was only moderate with short growing seasons, and degradation was slow to moderately rapid.

South African coals are all hosted within the Karoo Supergroup. The major period of coal formation commenced at about 260Ma and lasted for about 30Ma in the southern and eastern Mpumalanga and northern KwaZulu-Natal in the Middle Permian. From this central region in the main Karoo Basin, coal development radiated outwards in all directions over the ensuing period, finally ceasing during the Upper Permian. Deposits are found within two major tectonic settings, namely stable cratonic platforms and fault-bounded rift basins.

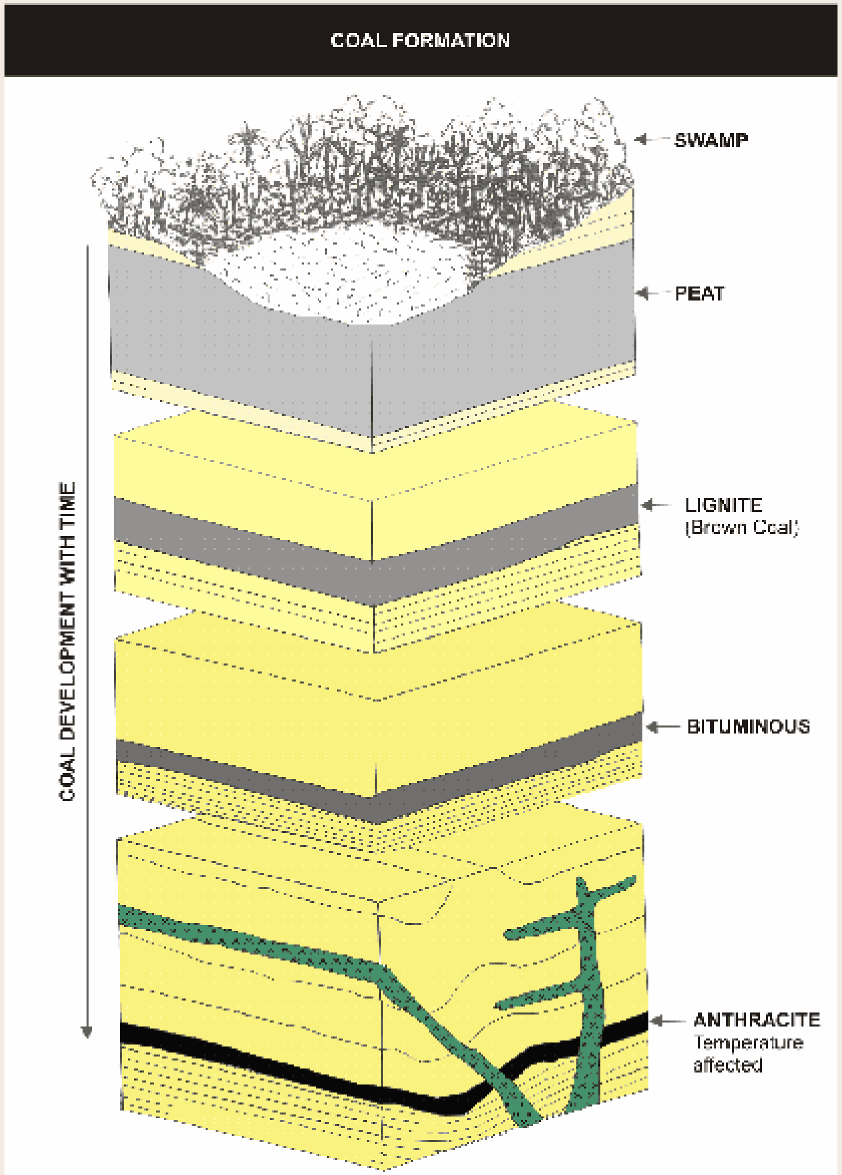
KWAZULU NATAL COAL RESOURCES

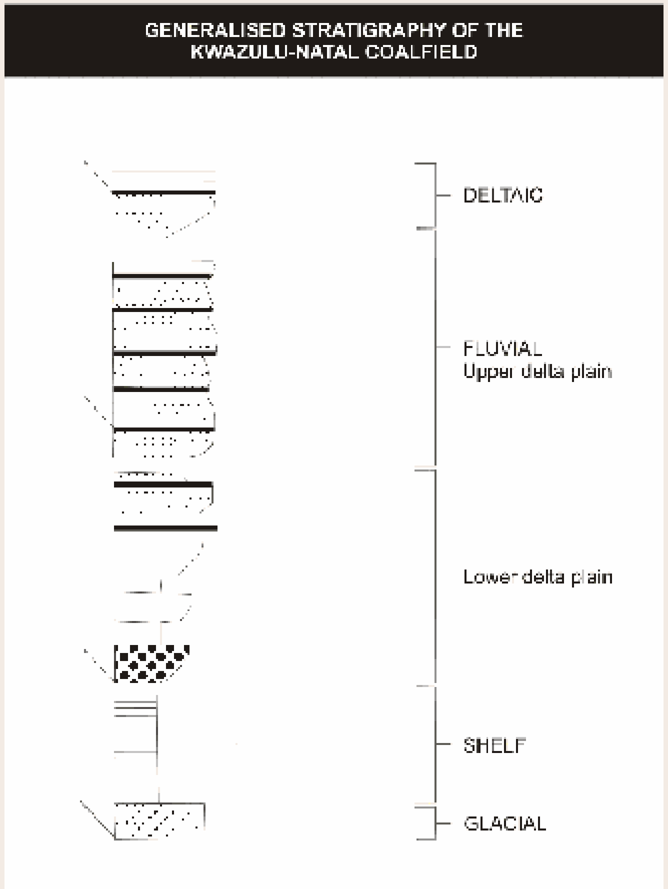
FORMATION OF COAL OF VARIOUS TYPES

Figure 3

LEGEND:

- Coal
- Dolerite
- Karoo Supergroup Sediments





Source: Geological Society of South Africa

The Karoo basin deposits correlate to the former, contiguous depositional environment, while those in the northern areas of South Africa correlate to the latter, restricted sedimentary environment. Coal rank in the main Karoo basin generally increases in an easterly direction. The coal in the northern basins varies from low to high rank.

5.2 Coal Types and Classification

Coal is a complex, heterogeneous material. Four principal lithotypes of stratified coals exist. These include:-

- vitrain (shiny layers, “bright coal”);
- clarain (similar to bright coal but with the presence of dull laminae giving rise to fine banding);
- durain (dull lustre, fracture surfaces); and
- fusain (sooty appearance).

Each lithotype is composed of inorganic mineral matter together with organic matter.
Over twenty variables can be used to characterise coals. These include:-

- carbon;
- hydrogen;
- oxygen;
- sulphur;
- nitrogen;
- volatile matter;
- moisture;
- ash contents;
- calorific value (CV) (specific heat content);
- ash coking parameters;
- ash composition; and
- several coking parameters, amongst others.

The variables are affected by the composition of the original plant material and the conditions under which they were deposited, including the range of temperature and pressure conditions that they were subjected to and the amount of time that they were exposed to these conditions. A set of three independent classification systems have been devised to classify coal. These are:-

- **Grade:** is the variation of mineral matter in the coal. It is inversely related to the percentage of organic material and is largely determined during the depositional stage of formation when clastic minerals were deposited together with the plant material. High-grade coal contains little mineral matter, whereas lower-grade coal contains more mineral matter, mainly from mud in the peat swamp;
- **Type:** is the variation in the original plant material from which the coal is formed and its subsequent alteration. In contrast to the mineral portion, this organic debris is not crystalline and is dominant. The organic units are distinct and are called macerals, each of which has a distinct set of physical and chemical properties that control the behaviour of coal and are dependant on the rank of the coal. Three basic, microscopically distinguishable groups of macerals exist, each containing separate submaceral varieties distinguished by their shape and internal structure:-
    - vitrinite - is the most abundant group and vitrinite macerals are derived from coalified woody tissue;
    - exinite (liptinite) macerals - are derived from the resinous and waxy parts of plants which are resistant to weathering and diagenesis. This group of macerals is very sensitive to advanced coalification and the liptinite macerals begin to disappear in coals of medium volatile rank and are absent in coals of low-volatile rank. When the liptinite macerals are present in a coal, they tend to retain their original plant form and thus they are usually "plant fossils" or phyterals. The phyteral nature of the liptinite macerals is the main basis on which they are classified;

- inertite - is derived from charred plant cell wall material that has been strongly degraded and biochemically altered during the peat stage of formation.

- **Rank:** is the difference in the degree of burial and subsequent coalification. The physical and chemical properties of coal are affected by the degree of change undergone as it matures. As coal is further compressed, the carbon and energy content increases while the moisture content falls. Accompanying this is an increase in rank. A higher ranking coal is usually considered to be the oldest as it has been subjected to increased burial and subsequent metamorphic conditions through time. There are four major ranks of coal recognized, reflecting the progressive response of individual deposits of coal to increasing heat and pressure. Each type is characterized by a set of properties including composition and propensity to burn. An increase in rank is proportional to an increase in hardness. Low rank coals (lignite and sub-bituminous coal) are typically soft and friable with a dull, earthy appearance. They are primarily used for the generation of electricity and are susceptible to spontaneous combustion. They are characterized by high moisture levels and low carbon, and therefore low energy, content. High rank coals (bituminous and anthracite) are generally hard and strong, with a black vitreous lustre. Higher ranks are associated with high carbon content and clean combustion. Dirtiness of the fuel increases down the ranks. In addition, as the rank increases, so does the heat (calorific value) emitted by the coal when it burns. South African coals generally increase in rank from west to east across the country.

The first type of coal to form from peat is lignite or brown coal (Figure 3). Peat has a moisture content of up to 90% (Table 1), so loss of water is of prime importance in the conversion of peat into lignite. Lignite has the lowest rank and is geologically young. It has the lowest carbon content and has very high water content. These variations in quality are summarised in Table 1 and in Figure 4.

Table 1 : Variation of Coal Parameters with Rank

COAL TYPE	MOISTURE CONTENT (%)	CARBON CONTENT (%)	CALORIFIC VALUE (MJ/kg)
Peat	90%		
Lignite	35%	25-35%	9 - 21
Sub-bituminous	10%	35-45%	19-26
Bituminous	8-10%	45-85%	23-33
Anthracite	0-5%	85-95%	32-35

A further graphical representation of coal quality versus rank is illustrated in Figure 5.

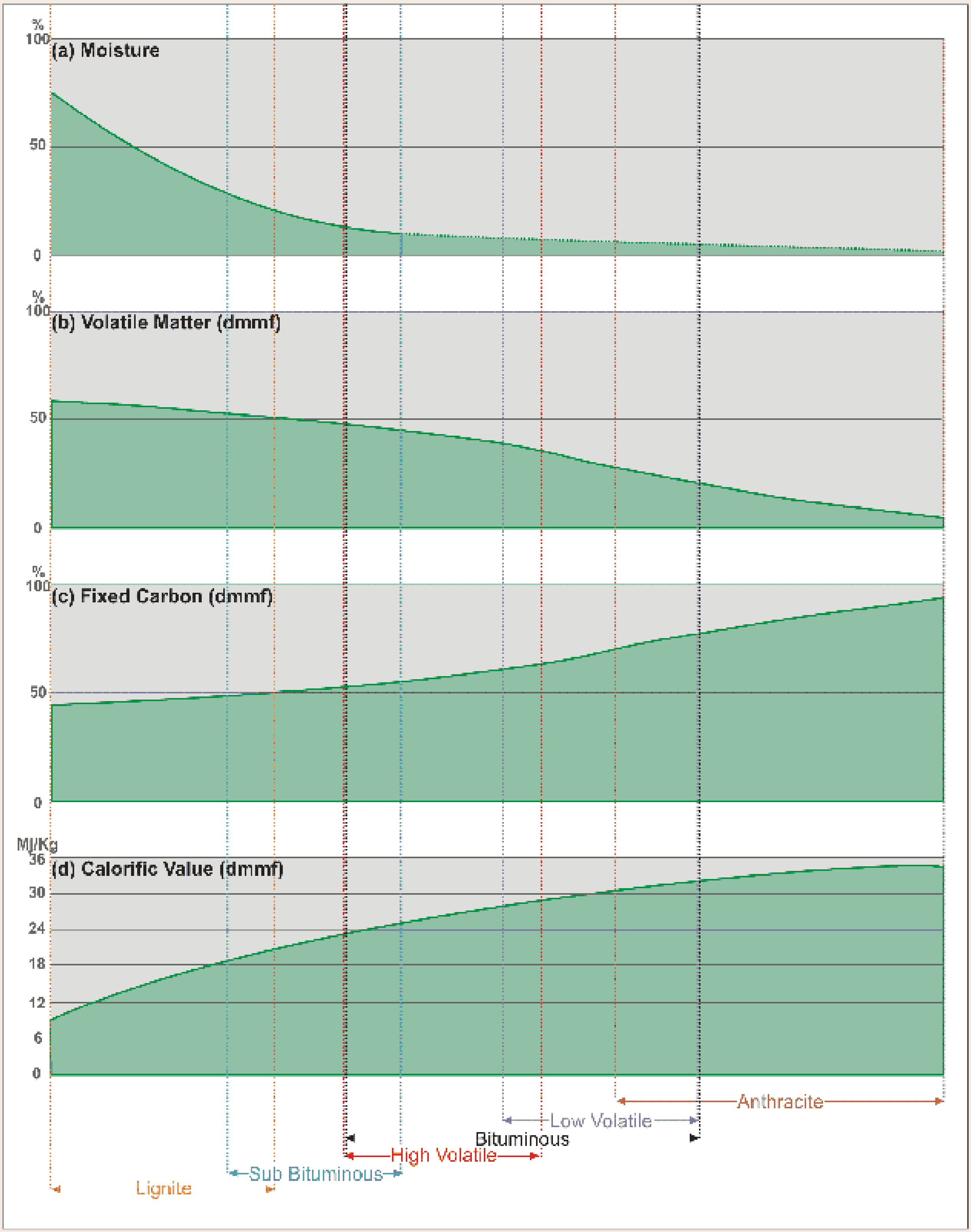
Increased burial and heating sees the conversion of lignite into sub-bituminous coal (Figure 3). The properties of this coal range between those of lignite and those of bituminous coal. They have carbon content between 35% and 45% and a moisture content of up to 10% (Table 1 and Figure 4). This coal generally has lower sulphur content than the other types of coal, making it attractive for use because it burns cleaner.

Further subjection to pressure and temperature converts these coals into high ranking coal. This coal has even higher carbon and lower moisture contents. Bituminous coal forms after its sub-bituminous predecessor. It often displays well-defined lamellae and has a carbon content of 45% to 85% (Table 1 and Figure 4). It is primarily used as fuel in steam-electric power generation. Alternatively coking coal is produced from low-ash, low-sulphur bituminous coal and is used for the production of coke for the steel industry.

Coke is a porous fuel formed when volatile hydrocarbons in the coal are driven off by baking at high temperatures, so that the fixed carbon and residual ash are fused together. It is solid and burns steadily and thoroughly. It is used as a fuel and a reducing agent in the smelting and reduction of iron ore in a blast furnace. Coke is also very dense and so will not collapse from the weight of the iron ore. The quality parameters associated with coke are illustrated in Figure 5.

GRAPHIC REPRESENTATION OF VARIATION OF COAL PARAMETERS WITH RANK

Figure 4

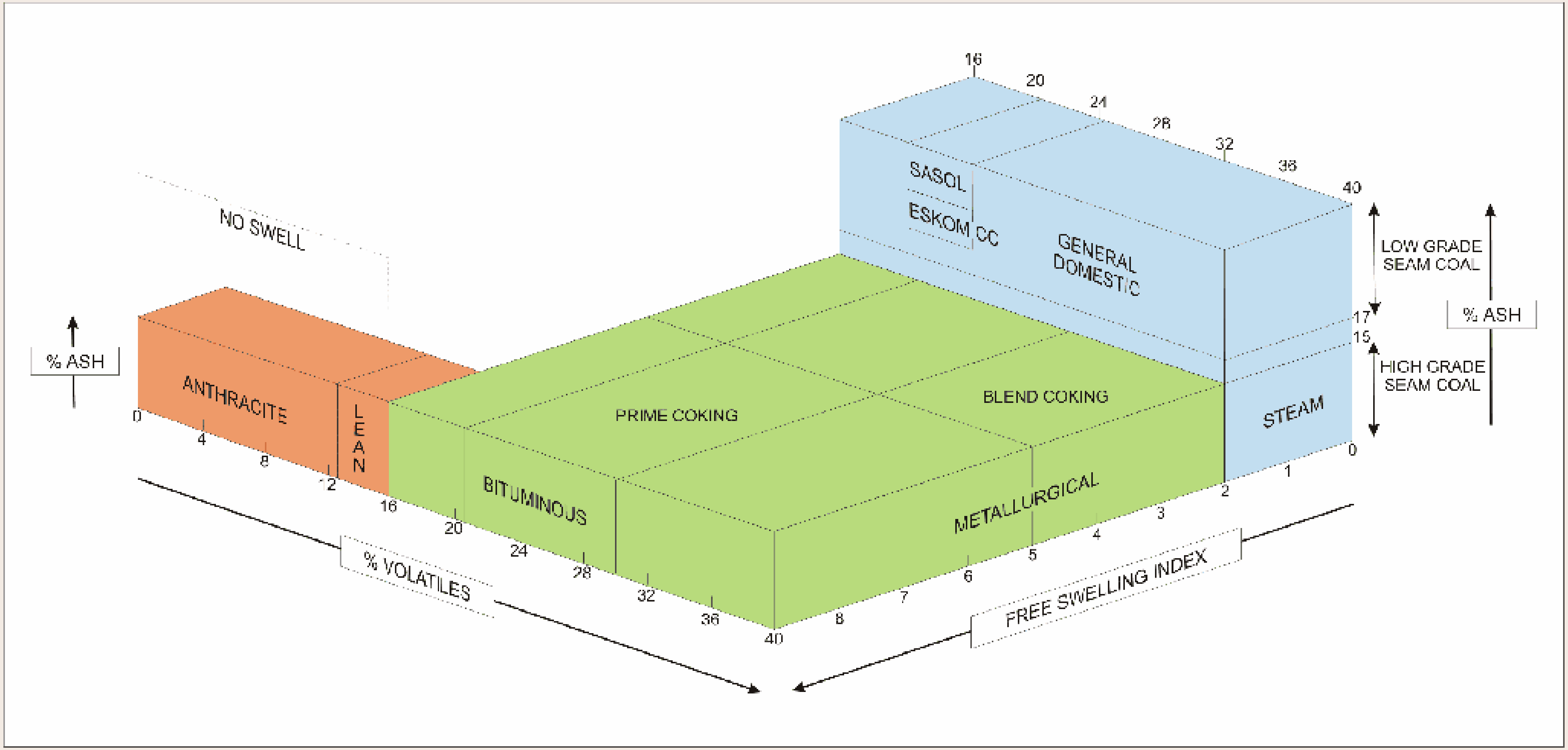


Source: Verwyn

KWAZULU NATAL COAL RESOURCES

COAL RANK AND QUALITY BLOCK DIAGRAM

Figure 5



Source: Mintek

The highest rank coal is anthracite (Figure 3). It has a correspondingly high carbon (Table 1 and Figure 4) and energy content and a low moisture content. It is used primarily for residential and commercial space heating as it burns cleanly, does not deteriorate and does not produce volatile gases. In addition, it can be stored on the ground for long periods of time without creating environmental problems. It is also used in water treatment plants and for the purification of municipal water.

Ultimately, the subjection of anthracite to higher metamorphic conditions will result in the formation of graphite.

5.3 Coal Preparation

Coal extracted from the earth, known as run-of-mine (ROM) coal, often contains unwanted impurities such as rock and dirt and comprises a range of different sized fragments. Coal users, however, need coal of consistent quality and size fraction. The process whereby ROM coal is turned into saleable clean coal product of consistent size and quality suitable for particular end-users is called coal preparation. Coal preparation covers a wide range of processes that can be applied, of which some improve the quality of coal to meet market requirements. Typically, the processes employed include:-

- crushing and breaking;
- coal sizing and classification;
- storage and handling;
- coal cleaning or beneficiation; and
- refuse and tailing disposals.

The process employed depends on the properties of the coal and its intended use. It may require only simple crushing or require a complex treatment process to reduce impurities. Coal preparation can also bring considerable environmental benefits, including reduced emission of sulphur dioxide (SO_2), carbon dioxide (CO_2) and particulates, through the supply of clean coal of consistent quality to downstream coal utilisation processes.

5.3.1 Crushing and Breaking

The first step in coal preparation is the reduction of ROM coal into various sizes to prepare the ROM for a cleaning process. Size reduction is also aimed at liberating coal and non-coal components to facilitate improved coal recovery. The process of size reduction of ROM coal is carried out using crushers and breakers (Figure 6). There are various types of crushers and breakers, and the choice is dependent on the nature of the coal and other rocks and the fineness of coal desired from the crushing process. Typical crushing and breaking devices include:-

- **Feeder Breakers**: this is a rotation drum fitted with picks that fracture the coal. The coal is delivered by a scraper conveyor and the drum rotates in the same direction as the coal flow. Feeder breakers are commonly used underground, however, there are some in use on surface in the coal preparation circuit;
- **Rotary Breakers**: this device has an outer fixed shell with an inner rotating drum fitted with perforated plates. Typical rotational speed of the drum is 12-18rpm. Lifter plates pick up the run-of-mine coal which then falls across the diameter of the drum. The softer coal breaks and passes through the perforations while the harder rock is transported to the exit. The rotary breaker achieves two functions, size reduction and beneficiation by removal of rock; and
- **Roll Crushers**: these consist of either a single rotating roll and a stationary anvil (plate), or two rolls rotating at the same speed towards one another. The roll faces are usually toothed or corrugated. A common form of crusher is the two stages or quad roll crusher whereby the product from the first twin roll crusher falls into the second twin roll crusher set at a smaller aperture, with the result that a large-scale reduction can be achieved in one machine. A typical application would be crushing ROM material down to 50mm.

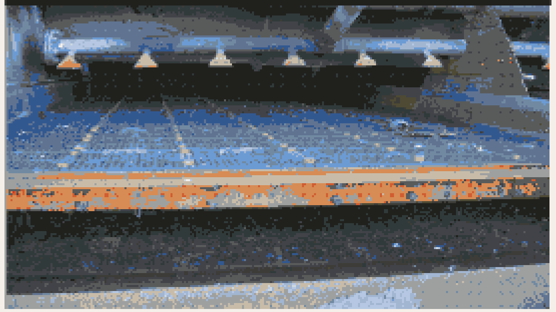
TYPICAL COAL PLANT AND EQUIPMENT

Figure 6

Feed-Hopper, Crusher and Conveyor Belt

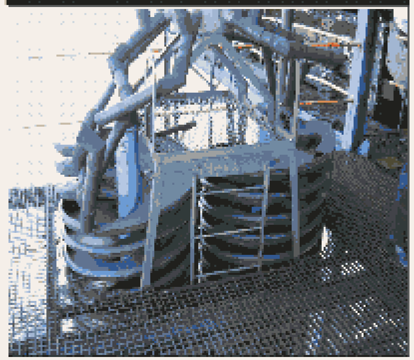
Milling Machine

Screening Machine



General View of a Coal Preparation Plant

Spiral



Dense Medium Separator

Cyclones

Source: Photos

Crushing may also be required after the coal cleaning process when large size coal is crushed to meet market requirements. Roll crushers or hammer mills are usually used in this case. The hammer mill consists of a set of free swinging hammers rotating on a shaft that strike the coal and throw it against a fixed plate.

5.3.2 Coal Sizing and Classification

Classification by size is one of the fundamental operations of coal preparation. Screens are used to classify the crushed ore into a broad range of size fractions. This is required as the various cleaning processes are dependent on the coal size to be processed. The ROM coal on entering the coal preparation plant will be screened (sieved) into three or four sizes which then go through to the appropriate cleaning process. The main screen types currently in use are static screens and vibrating screens.

The most common application of a static screen is the sieve bend constructed as an arc or bend, with the sieve surfaces offering very steep to progressively lower angles to the flow of material. The most common application of sieve bends is to remove large volumes of water prior to material passing to a vibrating dewatering screen.

Vibrating screens are widely used to size and dewater coal in the range 200mm-0.25mm. A wide range of screen sizes and designs are available to meet the specific requirements of each application. Vibrating screens become less effective with decrease in the sizes of the feed (ROM and processed coal).

5.3.3 Storage and Handling

Coal is typically stored and stockpiled at three points in the preparation and handling chain:-

- raw coal storage and stockpiling between the mine and the preparation plant (Figure 7). Typically raw coal storage occurs after crushing and usually takes the form of open stockpiles (conical, elongated or circular), silos (cylindrical) or bunkers. It is common for seam blending to be carried out at this stage in order to supply a homogenous product to the preparation plant. Blending may be as simple as sequentially depositing different coals onto a conical stockpile to sophisticated operations using stacker conveyors and bucket wheel reclaimers;
- clean coal storage and stockpiling between the preparation plant and the rail or road load point (Figure 7). The clean coal storage system is designed to allow for rapid loading of rail cars or road trucks (Figure 7). Clean coal silos are usually constructed over a rail track allowing unit trains of up to 100 cars to be drawn slowly under the silo and filled to a known weight. In-motion weighing is usually used to maintain a continuous operation. and
- clean coal storage at ports which may or may not be controlled by the mine.

5.3.4 Coal Cleaning or Beneficiation

The process of coal cleaning, also known as coal beneficiation, is used for the separation of usable coal from the ROM coal. The value adding process is the core of the coal preparation process and determines largely if the coal produced will meet market requirements. There are two major principles applied in coal processing. The choice of the cleaning process to be used is determined largely by the variability in size of the coal feed (ROM) and the size range of coal desired in the final product. The two principles that pre-dominate in coal preparation are as follows:-

- separation based on difference in relative density ("RD") between coal and associated mineral matter; pure coal has an RD of approximately 1.3 and associated mineral matter commonly has a RD of greater than 2.2. Coal cleaning is therefore achieved by separating the low density material (saleable product) from the high density material (refuse). There are two basic methods employed using this principle.

TYPICAL COAL STORAGE AND LOADING FACILITIES

Figure 7

ROM Coal Stockpile

Product Storage Silos

Rapid Rail Loading Facility

Source: Leeuw Vaalkrantz Colliery

in separation one of the systems uses water, where the movement of crushed ROM coal in water results in the lighter coal having a greater acceleration than the heavier rock. The second method is to immerse the ROM coal in a liquid with a density between coal and rock with the result that the coal floats and the rock sinks (dense medium separation). The sizes of the ROM separated using the principle of RD is greater than 0.5mm; and

- separation based on difference in surface properties between coal and associated minerals; coal is hydrophobic, whilst associated mineral matters are generally hydrophilic. The method is used mostly for ROM coal size of less than 0.5mm because it is impractical to separate fine coal using the RD method. The usual method employed in this principle is froth flotation.

Other separation methods which include magnetic, electrostatic, chemical or biological coal-cleaning processes have also attracted considerable interest but, in general, these have yet to achieve commercial viability.

5.3.4.1 Density Separation Using Water Medium

There are various methods employed using the principle of density separation in a water medium. Some of which include:-

- **Jig Cleaning**: This method is a water based process that relies on the pulsation of water through the particle bed to stratify particles of different density. The higher RD shale particles, forming the lower layers, are separated from the clean coal using a shale discharge system. Jig cleaning is designed to clean ROM with sizes ranging from 150mm – 12mm. The jig is a relatively low-cost, simple cleaning system generally considered efficient only for coals that are relatively easy to clean. However, jig cleaning has been subject to continuous improvement since the 1970s;
- **Concentrating Tables**: These consist of a riffled rubber deck carried on a supporting mechanism, connected to a head mechanism that imparts a rapid reciprocating motion in a direction parallel to the riffles. The slide slope of the table can be adjusted. A cross flow of water is provided by means of a launder mounted along the upper side of the deck. The feed enters just ahead of the water supply and is fanned out over the table deck by differential motion and gravitational flow. The raw coal particles are stratified into horizontal zones (or layers). The clean coal overflows the lower side of the table, and the discard is removed at the far side. Tables operate over the size range 5mm - 0.5mm;
- **Spirals**: Spirals utilize a principle whereby raw fine coal is carried down a spiral path in a stream of water and centrifugal forces direct the lighter coal particles to the outside of the stream and the heavier waste particles to the inside. A splitter device at the discharge end separates the fine coal from the fine refuse. Spirals are used as a cleaning device on 2mm - 0.1mm size fractions (Figure 6); and
- **Water-only Cyclones**: This method takes water-borne raw coal which is then fed tangentially under pressure into a cyclone, resulting in a whirlpool effect and centrifugal forces move the heavier material to the cyclone wall and from there they are transported to the underflow at the apex (or spigot). The lighter particles (coal) remain in the centre of the whirlpool vortex and are removed upwards via a pipe (vortex finder) and report to the overflow. The exact density of separation can be adjusted by varying pressure, vortex finder length and diameter, and apex diameter. The water-only cyclone typically treats material in the 0.5mm - 0.1mm size range and is operated in two stages to improve separating efficiency.

5.3.4.2 Dense Medium Separation (DMS)

The DMS method simulates the effect of using a heavy liquid of appropriate density to effect a float/sink separation of coal from associated mineral matter (Figure 6). In commercial practice, this is achieved by using a suspension of finely ground dense solids (e.g. magnetite with RD of 5.2) in water.

There are two classes of dense medium separators, the bath-type or vessel-type separator for coarse coal in the range 75mm - 12mm and the cyclone-type separator cleaning coal in the range 5mm - 0.5mm.

The bath-type separators can be deep or shallow baths where the float material is carried over the lip of the bath and the sink material is extracted from the bottom of the bath by scraper chain or paddle wheel.

The cyclone-type separator enhances the gravitational forces with centrifugal forces. The centrifugal acceleration is about twenty times greater than the gravity acceleration acting upon the particles in the bath separator (this acceleration approaches 200 times greater than the gravity acceleration at the cyclone apex). These large forces allow small sized coal to be affectively treated.

The products from the dense medium separators, namely clean coal and refuse, both pass over drain and rinse screens where the magnetite medium is removed and returned to the separators. The diluted magnetite from the rinsing screens is passed through magnetic separators to recover the magnetite for re-use. The magnetic separators consist of rotating stainless steel cylinders containing fixed ceramic magnets mounted on the stationary drum shaft. The drum is immersed in a stainless steel tank containing the dilute magnetite suspension. As the drum rotates, magnetite adheres to the area near the fixed internal magnets. The magnetite is carried out of the bath and out of the magnetic field and falls from the drum surface via a scraper to a stock tank.

Another DMS system worthy of mention is the Large Coal Dense Medium Separator (LARCODEMS) which was developed in the United Kingdom (UK) as a replacement for the Baum jig. The LARCODEMS is a cyclonic DMS device capable of accepting ROM coal of size up to 120mm. It has been used widely in the UK and also in South Africa.

5.3.4.3 Froth Flotation

Froth flotation is a physio-chemical process that depends upon the selective attachment of air bubbles to coal particle surfaces and the non-attachment of refuse particles. This process involves the use of suitable reagents to establish a hydrophobic (water-repellent) surface on the solids to be floated. Air bubbles are generated within a tank (or cell) and as they rise to the surface the reagent-coated fine coal particles adhere to the bubble, the non-coal refuse remains at the bottom of the cell. The coal bearing froth is removed from the surface by paddles and is then dewatered by filtration or centrifuge. The refuse (or tailings) pass to a discharge box and are usually thickened before being pumped to a tailings impoundment pond.

The reagents used in the froth flotation of coal are generally frothers and collectors. Frothers are used to facilitate the production of a stable froth (i.e. froths that do not break up). They are chemicals that reduce the surface tension of water. The most commonly used frother in coal flotation is methyl isobutyl carbinol (“MIBC”). The function of a collector is to promote contact between coal particles and air bubbles by forming a thin coating over the particles to be floated, which renders the particle water-repellent. At the same time the collector must be selective, that is, it must not coat the particles that are not to be floated (i.e., the tailings). The most commonly used collector in coal flotation is fuel oil. Froth flotation is almost certainly still the most commonly used process for the preparation of ROM coal with sizes less than 0.6mm.

5.3.4.4 Briquetting

Briquetting of coal is the process of compressing relatively worthless fine coal or slack to form a “patent fuel” called briquette. In order to form a stable briquette, a binder is necessary. Usually coal tars and pitches are the binders used.

High-moisture, low-rank coals may be upgraded by thermal drying and subsequent removal of a portion of the inherent or “locked in” moisture. However, the product from this process is friable and prone to the re-absorbtion of moisture and spontaneous combustion. Briquetting of low-rank coal allows for a stable, transportable product to be made. Briquetting is also used in the anthracite industry, where large-sized products have a significantly higher selling price.

Coal briquetting has also been used in emerging economies where briquettes are used as cooking fuel in rural areas. The process of manufacture usually involves a devolatilizing step whereby excess gas or volatile matter is driven off prior to briquetting in order to produce a “smokeless” domestic fuel.

The briquetting process, therefore, usually has the following steps:-

- **Coal Drying**: Moisture content is critical because it has an impact on the strength of the briquette. Methods used are direct drying (a flash dryer using hot gas) and indirect drying (a disc dryer using steam heat);
- **Devolatilizing**: This is only applicable to low-rank high-volatile coals. The equipment used is a retort or a beehive type coke oven;
- **Crushing**: The coal is often crushed because smaller particle sizes result in a stronger briquette;
- **Binders**: Binders are required to ensure that the briquette has adequate strength to withstand normal handling. The types of binders that have been used are coke oven pitch, petroleum asphalt, ammonium lignosulphorate and starch. The typical addition rate is 5% to 15% by weight. The fine coal and binder are mixed in a pug mill or paddle mixer at an elevated temperature;
- **Briquette Manufacture**: The coal-binder mixture is fed to a double roll press with indented surfaces. A variety of briquette shapes can be made depending on the type of roller indentation. The most common form of briquette is the pillow shape. The pressure increases the apparent density of the coal-binder mix by 1.5 to 3 times;
- **Coating and Baking**: With some binders (ammonium lignosulphorate and petroleum asphalt) a heat treatment in the range of 300°C is necessary to harden the briquettes. The heat treatment oven is an enclosed conveyor and heated with hot gases; and
- **Cooling/quenching**: The cooling oven is an enclosed conveyor with recirculating air passing to reduce the briquette temperature to an ambient condition. Off-gases are collected, scrubbed and discharged to the atmosphere. Quenching with water is sometimes used to cool the briquettes.

Briquetting of soft brown coal with a high moisture content of 60% to 70% is a somewhat different process than that described above. The brown coals are frequently upgraded by briquetting, which involves crushing, screening and drying the coal to approximately 15% moisture, and extrusion pressing without binder into compacts. Large quantities of coal are treated in this way in Germany, India, Poland and Australia. The dryer used is a steam-heated rotary tube dryer. Following extrusion pressing, the compacted coal is cut and cooled before being transferred to belt conveyors by railcars, road trucks or storage.

Briquetting plants handle large quantities of highly combustible material associated with potentially explosive mixtures of coal dust and air. Dust control, collection and handling as well as good housekeeping are all of considerable importance for safe operation.

5.3.5 Waste and Tailings Disposal

Waste disposal is an integral part of a modern coal preparation plant. Both coarse refuse and fine tailings in the form of slurry must be transported and disposed of in an environmentally responsible way.

Coarse refuse is transported by truck, conveyor belt or aerial ropeway to the solids disposal area, which usually forms the walls of the tailings impoundment. The refuse can also be returned to the open pit.

Innovative cost-effective forms of transporting the coarse waste are now being used, namely, crushing and transportation by pumping in slurry form to an impoundment pond and also by a pneumatic system to underground storage.

It is necessary to select a disposal site which has a minimal amount of exposed surface while at the same time provides for good stability. A structure that is exposed on all sides permits more surface drainage, with a greater tendency for silt formation in nearby water courses, and also a greater probability of spontaneous combustion. To minimize both these effects, greater quantities of cover material, compacting and sealing, are required. The ideal disposal construction is the valley-fill type operation.

5.4 Coal Usage and Product Types

Coal is used in a number of industries including:-

- power stations to generate electricity,
- petrochemical industries,
- metallurgical industries, and
- domestic use for heating and cooking

The type of coal used is determined by the quality of the product required and the characteristics of the coal type. Table 2 summaries the type of coal used in the various industries:-

Table 2 : Coal Type and Associated Uses

TYPES	USE
Lignite	Power generation.
Sub-bituminous	Power generation and in the manufacture of cement and refined coal tar.
Bituminous	Power generation and in the manufacture of cement, iron, steel and refined coal tar.
Anthracite	Mostly used for domestic heating and cooking and industries requiring smokeless fuel.

5.4.1 Power Station Report

Steam coal, also known as thermal coal, is used in power stations to generate electricity. Coal is first milled to a fine powder, to increase the surface area, thus enabling it to burn faster. In these pulverised coal combustion (PCC) chamber systems, the powdered coal is blown into the combustion chamber of a boiler where it is burnt at high temperature. The heat energy produced convert water, in tubes lining the boiler, into steam.

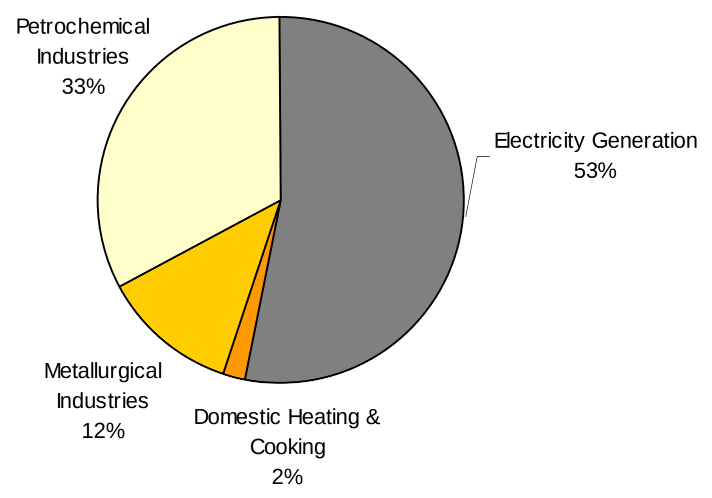
The high pressure steam is passed into a turbine containing thousands of propellers or blades. The steam pushes these blades causing the turbine shaft to rotate at high speed. A generator is mounted at one end of the turbine shaft and consists of carefully wound wire coils. Electricity is generated when these are rapidly rotated in a strong magnetic field.

The electricity generated is transformed into the higher voltage, up to 400,000 volts (V). When it nears the point of consumption in the domestic market, the electricity is transformed to a safer voltage of between 100V and 250V.

Modern PCC technology is well-developed and accounts for over 90% of coal-fired capacity worldwide. Improvements continue to be made in conventional PCC power station design and new combustion techniques are being developed. These developments allow more electricity to be produced from less coal i.e. improving the thermal efficiency of the power station.

Coal currently supplies 39% of the world's electricity. In South Africa 53% of coal produced is used for electricity generation (Figure 8).

Figure 8 : Uses of South African Coal



The typical coal quality specifications required for power generation are listed in Table 3.

Table 3 : Typical Coal Quality Specifications by Use

CONSUMPTION SECTORS	COAL TYPE	CV (MJ/kg)	GROSS CV (MJ/kg)	MOISTURE CONTENT (%)	ASH CONTENT (%)	VOLATILE MATTER (%)	FIXED CARBON (%)	TOTAL SULPHUR (%)
Power Stations	Bituminous	20.71	20.63	3.70	30.10	22.50	43.70	0.97
Petrochemical	Bituminous	21.34	21.25	4.80	25.80	22.30	47.10	0.97
Metallurgical Industries	Anthracite	32.06	31.99	2.30	7.70	5.50	84.50	0.74
	Bituminous	29.76	29.68	2.50	10.70	31.60	55.20	0.81
Domestic (Small industries and households)	Anthracite	29.40	29.31	2.60	15.20	7.00	75.20	0.98
	Bituminous	27.32	27.24	3.10	14.20	26.60	56.10	0.72
Exports	Anthracite	30.92	30.82	2.30	11.00	7.00	79.70	1.06
	Metallurgical Bituminous	31.04	30.99	2.60	7.50	31.70	58.20	0.57
	Steam Bituminous	27.71	27.93	3.00	13.30	26.60	57.10	0.61

*All figures quoted in an air-dry basis.

5.4.2 Syn Fuels / Petrochemicals

Coal is converted into a liquid fuel through a process known as liquefaction. The liquid fuel can be refined to produce transport fuels and other oil products, such as plastics and solvents. There are two key methods of liquefaction:-

- direct coal liquefaction – where coal is converted to liquid fuel in a single process, by mixing a coal derived recycle solvent with the ground coal to form a coal-oil slurry feed. The slurry is then heated to 450°C in a hydrogen atmosphere for an hour, until a liquid is formed;
- indirect coal liquefaction – where coal is first gasified and then converted to liquid.

In this way, coal can act as a substitute for crude oil, a valuable role in a world ever more concerned with energy security. The cost effectiveness of coal liquefaction depends to a large extent on the world oil price with which, in an open market economy, it has to compete. If the oil price is high, coal liquefaction becomes more competitive.

There have been instances in the past where the isolation of a country from reliable, secure sources of crude oil has forced the large-scale production of liquid fuels from coal. Germany produced substantial amounts of coal-derived fuels during the Second World War, as did embargoed South Africa between the mid – 1950's and 1980's. South Africa continues large scale production of liquid fuels to this present day.

The only commercial scale coal liquefaction process currently in operation world wide is the indirect Sasol (Fischer-Tropsch) process. South Africa leads the world in coal liquefaction technologies in the indirect liquefaction and currently supplies about a third of its domestic liquid fuel requirements from coal. China was experiencing growth in coal liquefaction as a way of utilizing the country's enormous reserves of coal and lessening dependence on imported oil. However, inadequate water resources are considered to be a constraint.

The typical coal quality specifications required for synfuel generation are listed in Table 3.

5.4.3 Metallurgical

Coal is essential for iron and steel production; some 64% of steel production worldwide comes from iron made in blast furnaces which use coal. A blast furnace uses iron ore, coke (made from specialist coking coals) and small quantities of limestone. Some furnaces use cheaper steam coal – known as pulverised coal injection or PCI – in order to save costs.

Coke is a solid carbonaceous residue derived from low-ash, low-sulfur bituminous coal from which the volatile constituents are driven off by baking in an oven without oxygen at temperatures as high as 1,000 °C so that the fixed carbon and residual ash are fused together. Coke is used as a fuel and as a reducing agent in smelting iron ore in a blast furnace. Coke from coal is grey, hard and porous and has a heating value of 29.6 MJ/kg. By-products of this conversion of coal to coke include coal tar, ammonia, light oils, and "coal-gas".

The raw materials for the production of steel– iron ore, coke and fluxes – are fed into the top of the blast furnace. Air is heated to about 1,200°C and is blown into the furnace through nozzles in the lower section. The air causes the coke to burn producing carbon monoxide, which creates the chemical reaction. The iron ore is reduced to molten iron by removing the oxygen. A tap at the bottom of the furnace is periodically opened and molten iron and slag is drained.

The iron is taken to a basic oxygen furnace (BOF) where steel scrap and more limestone are added and 99% pure oxygen is blown onto the mixture. The reaction with the oxygen raises the temperature to 1,700°C, oxidises the impurities, and leaves almost pure liquid steel. Approximately 630kg of coke produces 1t of steel. BOFs currently produce about 63% of the world's steel. A further 34% of steel is produced in electric arc furnaces (EAF). Much of the electricity used in EAF is produced from coal.

Pulverised coal injection (PCI) allows coal to be injected directly into the blast furnace. A wide variety of coals can be used in PCI, including steam coal.

Coal is also used as an energy source in cement production. Large amounts of energy are required to produce cement. Kilns usually burn coal in the form of powder and consume around 450kg of coal for about 900kg of cement produced.

Coal combustion products (CCP) can also play an important role in concrete production. CCPs are the by-products generated from burning coal in coal-fired power plants. These by-products include:-

- fly ash;
- bottom ash;
- boiler slag; and
- flue gas desulphurisation gypsum.

The typical coal quality specifications required for the metallurgical industry are listed in Table 3.

5.4.4 Domestic

The domestic use of coal in heating and cooking in homes has been in existence as far back as the discovery of coal. Worldwide the domestic use of coal now accounts for a fraction of the use of the coal produced. Health concerns are important since the use of low grade coals in the South African domestic markets and within its existing social environments, exacerbate respiratory and other air and dust pollution related problems.

Anthracite is the preferred coal type for domestic use because of it’s a high carbon and low sulphur content. It is a "smokeless" fuel unlike some of the lower grades of coal. It burns cleaner, hotter and longer than any other coal.

The typical coal quality specifications required for domestic use are listed in Table 3.

6 KWAZULU-NATAL'S COAL DEPOSITS

KwaZulu-Natal coals in general are characterised by thin seams of high quality. The coal, however, within the fields located in the east of the province are notably younger and comprise thick coal zones.

6.1 Geology of KwaZulu-Natal's Coalfields

KwaZulu-Natal's coal is situated within five coalfields, namely from west to east, Klip River, Utrecht, Vryheid, Nongoma and Somkele (Figure 1). By national standards the reserves are small and seams are characteristically thin with numerous geological related obstructions. Faulting is often present which may cause mining problems. Seams are mainly developed within the Ecca Group of the Karoo Sequence (Figure 9) with the exception of Somkele and eastern Nongoma, which are located in the Beaufort Group. Faults are frequently associated with various dolerite intrusions related to the Karoo basalts. Post-Ecca dolerite intrusions riddle the area, either obliterating the coal by burning seams or enhancing overall rank and quality. Owing to this, the coal in the fields is generally of a high quality, ranking largely as anthracite.

The metamorphic effect of sills on coals is controlled by intrusion thickness, temperature of intrusion and position of the sill relative to the coal. Intrusions may also sometimes cause displacement of the relatively flat-lying sediments and seams. Intrusions have compromised the original coal resources. The oldest, prominent and persistent sill in the area is the Zuinguin Sill. The sill phases generally precede dyke emplacement. Earlier dykes are concordant and persistent, while younger intrusions tend to be erratic and have sinuous form.

The coalfields can broadly be divided into two groups. The Klip River, Utrecht and Vryheid Coalfields are situated within deeply-incised topography within the main Karoo Basin. Owing to this the coal seams rapidly deepen from surface away from the outcrop. Most of the seams present can be correlated across fields, particularly those of Utrecht and Vryheid.

To the east, the Nongoma and Somkele Coalfields are different in character and do not correlate with the former group. These lack discrete seams. Both are preserved in a fault-bounded environment, with Nongoma lying within the main Karoo Basin and Somkele lying on the southern extremity of the Lebombo monocline. The sediments within these coalfields are dominated by carbonaceous mudstone and shale with seams striking north. The upper coals of these fields are part of the Beaufort Group (Emakwezini Formation) and are a southern extension of the Kangwane-Swaziland Beaufort Group Coalfields.

6.1.1 Klip River Coalfield

The Klip River Coalfield is the most economically important and largest of the coalfields, with an extent of 6,000km^2, 50% of which bears economically extractable coal. Faulting in the area is known to have disturbed the coal horisons by, in some cases, over 137m in the vertical plane. Two economic seams are present, namely the Top Seam (0.5 to 3.3m thick) of bright coal and the Bottom Seam (0.5 to 1.3m thick) with comparatively less coal (Figure 10). Although the quality varies across the seams they both yield a generally high grade product with ranks from bituminous coal to anthracite. The best quality coals are produced in the central part of the field, with qualities decreasing and seams thinning to the north and south. Devolatilization of the coal by doleritic intrusion has caused the formation of lean coal and anthracite for domestic use. Methane gas trapped within fissures associated with dyke intrusions can be hazardous.

The Top Seam is often considered the correlation of the Alfred Seam within the Utrecht and Vryheid Coalfields. Similarly the Bottom Seam is considered the equivalent of the Gus Seam.

* A Dictionary of Mining, Mineral and Related Terms. Thrush, P.W. and Burea of Mines. US Department of Interior.1968.

KWAZULU NATAL COAL RESOURCES

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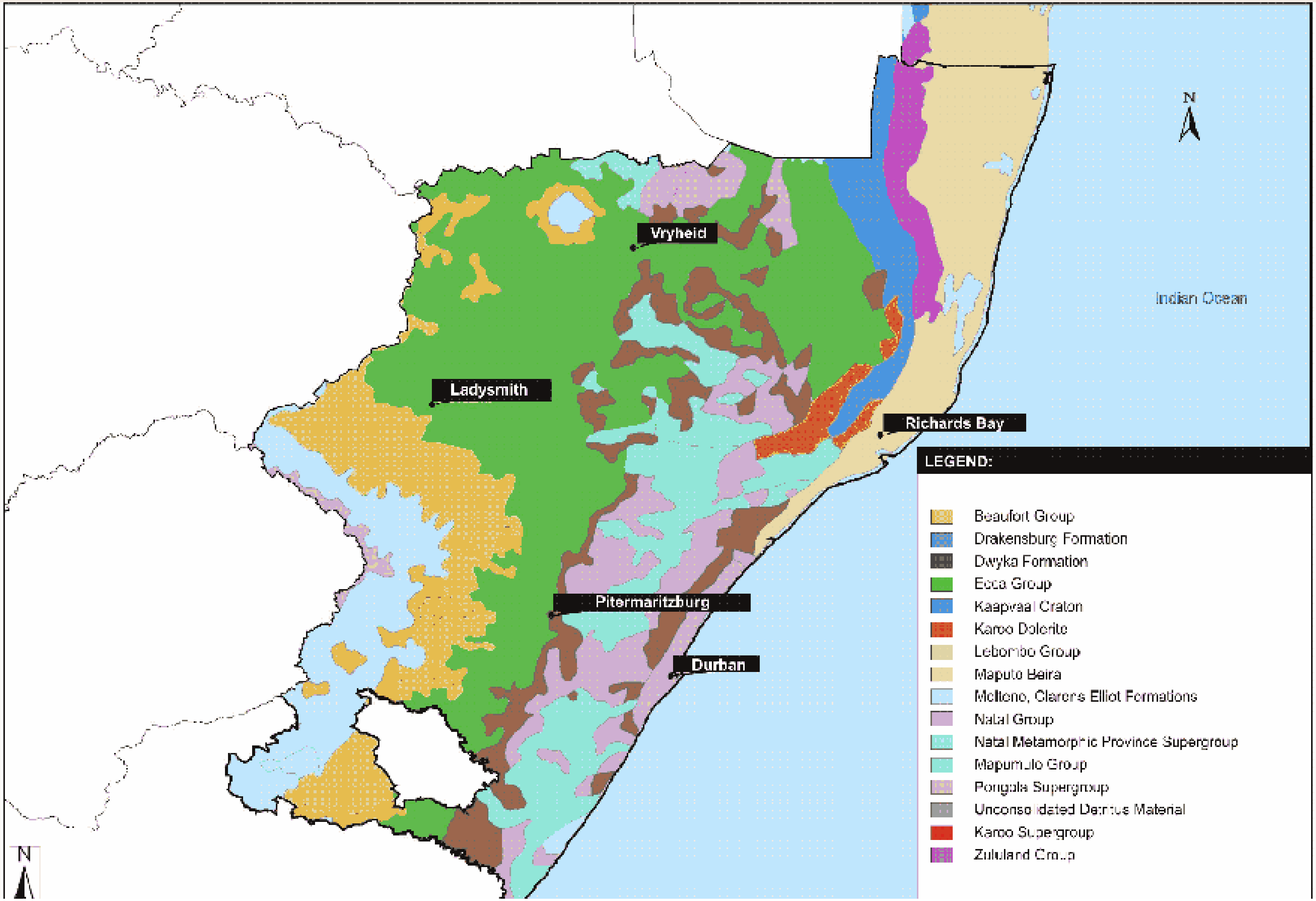
TRADE & INVESTMENT KWAZULU NATAL

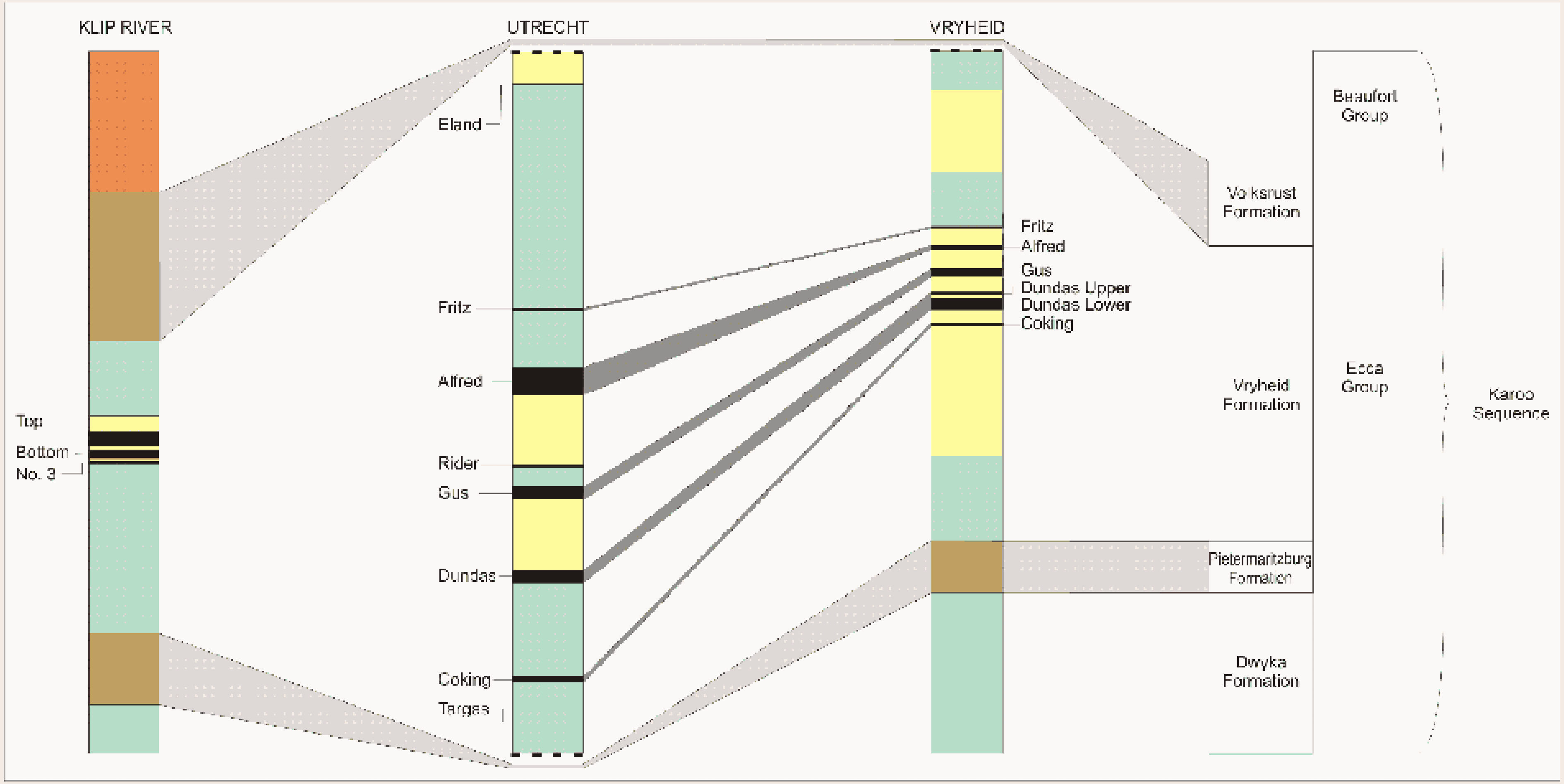
GEOLOGY OF KZN Figure 9



KWAZULU NATAL COAL RESOURCES

TYPICAL STRATIGRAPHIC COLUMNS FOR THE KLIP RIVER, UTRECHT AND VRYHEID COALFIELDS

Figure 10



Source: Geological Society of South Africa

LEGEND:

- Beaufort Group sediments
- Shale/Mudstone
- Siltstone/Sandstone/Shale
- Sandstone
- Tillite/Diamictite
- Coal seam

The roof and floor conditions of the seams are variable across their extent, consisting of sandstone and shale. The seams are separated by coarse-grained cross-bedded sandstone that fines up to carbonaceous shale. This forms a competent (strata or rock structure combining sufficient firmness and flexibility to transmit pressure, and by flexure under thrust, to lift a superincumbent load*) roof to the bottom seam while the roof of the Top Seam is considerably weaker and composed of micaceous sandy shale. Floors of both seams are composed of incompetent (applied to strata, a formation or a rock structure not combining sufficient firmness and flexibility to transmit a thrust and to lift a load by bending *) micaceous or sandy shale.

6.1.2 Utrecht Coalfield

Utrecht has an area of 5,000km^2 lying in areas which are capped by dolerite. The quality of the coal varies from high rank, low volatile anthracite to coking coal. Four economic seams are present in the Vryheid Formation of the Ecca Group, namely the Coking, Dundas, Gus and Alfred Seams (Figure 10). These are underlain by the dolerite-invaded lower portions of the Karoo sequence. Other seams such as Targas, Rider, Fritz and Eland are too thin to be mined based on current mining equipment capabilities. The relative position of the seams is dependant on the elevation and thickness of sills.

The Coking Seam above the Targas Seam is generally less than 1m thick, with a maximum thickness of 1.5m. It is comprised of bright, thinly-banded coal and includes sandy or silty lenses where it thickens. The overall quality is good, yielding moderately good coking coal which requires little beneficiation. The roof and floor rocks are competent, medium-coarse or medium-fine grained sandstone.

The Dundas Seam, lying 15m above the Coking Seam, has a maximum thickness of 2.6m. It yields bituminous coal and export-quality anthracite. It consists of dull and bright coal in the upper portion, bright coal in the central region and a mixed coal and shale zone at the bottom. In the west the seam thickness is highly variable. The roof consists of competent medium-grained sandstone while the floor is mostly unstable shale.

The Gus Seam lies 17m above the Dundas Seam and is the most economically important seam. It has a maximum thickness of 3.3m of bright coal. In the north it splits into an upper, better developed seam and a lower seam from which it is separated by sandstone. The Gus Seam is divided into three distinct quality zones separated by consistent shale parting. The three quality zones include:-

- an upper mainly dull zone;
- central bright zone; and
- bottom poor quality zone.

In the east the seam is thin, yet the absence of the bottom and poorer top portions improves its quality. Both the roof and floor are of variable competence.

The Alfred Seam lies 14m above the Gus Seam. With average and maximum thicknesses of 1.9m and 3.8m respectively, this seam consists of dull to dull-lustrous coal interbedded with bright coal. The poorer quality predominates but high quality coal can be found in the area 25km east of Utrecht. The seam is best developed in; a down-faulted block to the south of Utrecht. Roof conditions are moderately competent except in areas adjacent to dykes, while the floor is comprised of medium to coarse-grained sandstone.

6.1.3 Vryheid Coalfield

The Vryheid Coalfield is separated from the Utrecht Coalfield by an area barren of coal. This coal was removed by erosion. It has a surface area of 2,500km^2 of which 15% is coal-bearing. Dolerite sills have had a marked effect on the topography of the area. The main coal zone is found within the Vryheid Formation (Middle Ecca) of the Karoo Sequence, resting above the glacial Dwyka Formation. Sedimentary facies are characterized by a series of coal-capped, upward-fining cycles.

* A Dictionary of Mining, Mineral and Related Terms. Thrush, P.W. and Burea of Mines. US Department of Interior.1968.

The rank of the coal varies from moderate to high quality. Historically Vryheid has locally been a consistent producer of high quality metallurgical coal and anthracite. Seams have been affected by displacement and devolatilization due to the presence of intrusions. A total of nine discrete seams have been identified in the main coal zone. These are identical in name and character to those found in Utrecht with the addition of the Bonas Seam (Figure 10).

The 1m thick Coking Seam is generally thin but of a high grade as it is in Utrecht. The sediments forming the parting between this seam and the overlying Dundas Seam are fine to medium-grained sandstone and exist as an excellent marker bed (Figure 10).

The Dundas Seam in this field contains two splits in the north and central parts, namely the Lower and Upper Seams. The Lower Seam reaches a maximum thickness of 2.5m of interbedded bright and dull coal that often has a thin shale and sandstone parting on the top portion. Coking or steam coal is produced from this. Roof and floor conditions are variable. Fine-grained, shaly sandstone often with a thin mudstone band is found in the roof on the coal contact while the floor comprises micaceous mudstone. Where the Lower split thickens to 1.5m, the quality drops. The 1m thick Upper Seam makes for good coking coal. Poor, generally incompetent fine grained micaceous shale roof and floor conditions prevail. In the south the upper portion is often replaced by carbonaceous mudstone.

The Gus Seam ranges in thickness from 0.5 to 2.0m (Figure 10). The coal is finely interbedded bright and lustrous coal with a thin sandy or silty lens near top. A thin shaly horizon on the coal contact gives rise to extraction problems. To the east no exploitable coal reserves exist as the coal is replaced by carbonaceous shale.

The highest quality anthracite produced in South Africa is found here, again because of devolatilization by dolerite intrusions. The roof of the seam is coarse-grained, well-banded and competent sandstone. The floor however is not competent and consists of fine to medium grained sandstone often interbedded with thin, shaly bands.

The Alfred Seam is of a poorer quality than the other seams. Moderate steam coal and low-grade, coking coal are produced. Poor roof conditions exist while the floor is competent, medium-grained and well-bedded sandstone.

Most minor seams, such as the Targas Seam, situated beneath the Coking Seam, are sporadic. The Fritz Seam above the Alfred Seam could possibly be economic because of its good quality, bright coal, but it is generally thin.

6.1.4 Nongoma Coalfield

Coal within the Nongoma Coalfield (Figure 11) is preserved in a graben within the Vryheid and Emakwezini Formations. In some areas grades have not been affected by dykes but rather by a locally high geothermal gradient giving rise to anthracitic conditions. As a result the coal throughout the field grades as anthracite.

Nongoma is divided into two areas with distinctly different lithologies, namely Nongoma West and Nongoma East. The western field is unique and displays no characteristics similar to any other coalfield. Within this field coal is restricted to three seams within the Vryheid Formation of the Ecca Group. The M-1 Seam overlies a weak siltstone floor and averages only 20cm in thickness. It is only viably extracted using opencast methods. Overlying this seam is a 1m parting which in turn is overlain by the M Seam. This seam is the only economical seam present in the west and is 1.0-1.2m thick. Separated overhead by a siltstone parting is the M+1 Seam. As with the M-1 Seam, this seam only averages 20cm and is only extracted when opencast methods are employable. A weak siltstone roof overlies this, followed by a more coherent sandstone roof.

To the east the Nongoma coal lies within the Emakwezini Formation of the Beaufort Group. The seams have been grouped into three zones based on size and character, namely the A, B and C zones. The lowermost zone, that is the A Zone, contains the prominent and thick (up to 4.0m) A Seam. At some points this seam is split into Seams A1 and A2, with the latter being the thicker of the two. Lower stringers are thin and impersistent.

Separating this zone from the B Zone overhead is a sandstone succession and a weak shale floor. The B Zone is often referred to as the Mining Zone, characterised by thick seams amenable to beneficiation and a weak shale floor and roof. Four seams exist within this zone, namely Seams B1, B2, B3 and B4, and are separated mainly by black carbonaceous shale. B1 averages at the greatest thickness of 4m while the remaining seams average around 2.5m.

The successive C Zone coal seams are minor, irregularly spaced and tend to be laterally discontinuous. These seams may be locally mineable by opencast means. Stringers above this zone are sometimes classified into a fourth, D Zone. Nongoma East is correlatable with the neighbouring Somkele Coalfield.

6.1.5 Somkele Coalfield

Somkele lies 50km east of the Nongoma Coalfield, which is bounded by intense faulting striking southwest. Dolerite intrusions are numerous and coal qualities are generally high (anthracite).

Three distinct seams exist within the Main Coal Zone namely the Lower, Main (Middle) and Upper Seams which lie at a relatively shallow depth from the surface (Figure 11). The Upper Seam is split into the Upper Seam 1 and Upper Seam 2. The corresponding designations to the northwest are the A, B, C and D zones of the Nongoma East Coalfield. The only economical seam is the Main Seam, which has a maximum thickness of 17.8m. The Main Coal Zone is overlain by sandstone interbedded with thin carbonaceous shales and mudstones which also underlie the lowermost seam.

7 KWAZULU-NATAL'S COAL MINING INDUSTRY IN RELATION TO SOUTH AFRICA

In general, KwaZulu-Natal can be said to be a proven but problematic coal resource district. In the past, mining of various coal deposits in the Province has been challenging because of the geological setting which makes the deposits structurally complicated. Furthermore, the original depositional history of the coal was one that led to the development of a number of thin seams which for commercial purposes are less than one metre thick and have been considered to be below the minimum efficient mining width. When combined with the extreme topography of the Province, access to these seams is difficult.

However, the Province continues to produce anthracite, bituminous and coking coals in lower volumes and the proximity to South Africa's shipping facilities at Richard's Bay and Durban is an advantage for the KwaZulu-Natal coal producers since the railage and road transport distances are relatively short compared to other coalfields in the country. This makes the export market and its associated international rand hedge prices very attractive.

7.1 Coal Resources and Reserves

The South Africa's coal resources are situated within a series of 16 coalfields within the central and eastern portions of the country (Table 4).

Table 4 : Estimated Coal Resources and Reserves by Province

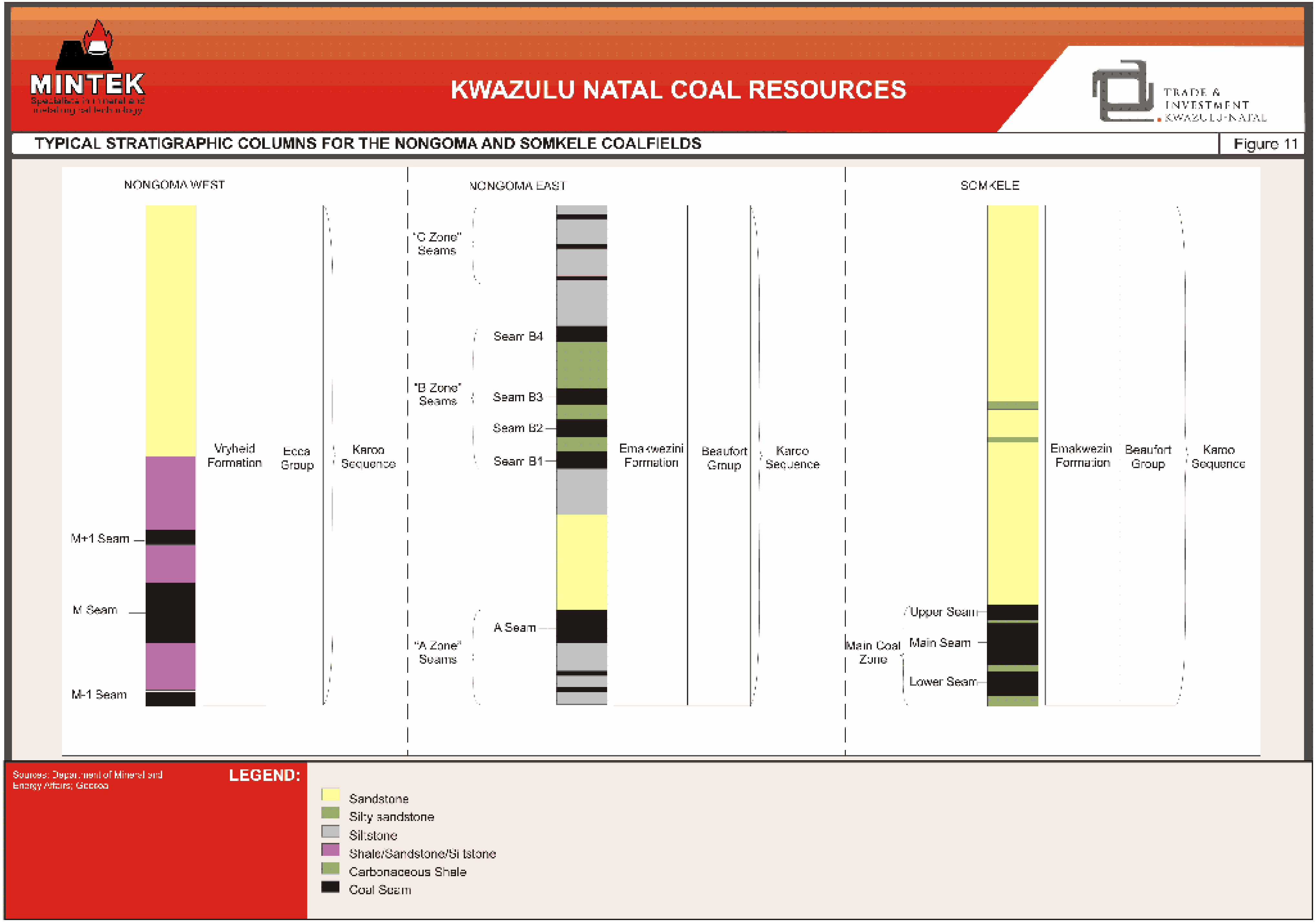
PROVINCE	COALFIELD	AREA (Ha)	IN SITU COAL (Mt)	REMAINING RESERVES* (1997) (Mt)	% OF RESOURCES CONVERTED TO RESERVES
Mpumalanga	Witbank	568,451	17,730	11,344	64%
	Highveld	1,110,362	16,909	10,182	60%
	Ermelo	1,152,259	8,000	4,924	62%
	TOTAL MPUMALANGA	**2,831,072**	**42,639**	**26,450**	**62%**
KwaZulu-Natal	Klip River	320,893	1,695	1,056	62%
	Utrecht	301,483	950	598	63%
	Vryheid	158,000	222	91	41%
	Nongoma	143,971	257	161	63%
	Somkele	342,640	467	227	49%
	TOTAL KWAZULU-NATAL	**1,266,987**	**3,591**	**2,133**	**59%**
Free State	South Rand	497,604	2,721	569	21%
	Sasolburg	208,494	4,757	1,960	41%
	Free State	2,087,920	16,250	4,920	30%
	TOTAL FREE STATE	**2,794,018**	**23,728**	**7,449**	**31%**
Limpopo	Springbok Flats	532,721	6,500	3,250	50%
	Ellisras	223,664	114,875	14,677	13%
	Mopane/Tshipise/Pafuri	1,213,291	1,711	344	20%
	Kruger Lebombo	600,000			
	Tuli	85,162	256		0%
	TOTAL LIMPOPO	**2,654,838**	**123,342**	**18,271**	**15%**
	GRAND TOTAL	**9,546,915**	**193,300**	**54,303**	

*This data was the last review date, cited in Pinheiro, 1999.

Figure 12, shows that, although Limpopo has the largest percentage of resources in the country, the location of these resources are far from the markets and the extensive quantities of low grade coal results in the province's associated economically mineable reserves being half that of the resources. In contrary, KwaZulu-Natal's reserves increase in relation to the remainder of the reserves in the country.

According to this study, the majority of KwaZulu-Natal's resources, as well as the province's mineable reserves, occur within the Klip River Coalfield (Figure 13). Table 4 indicates that, on average for the province, approximately 60% of the resources have been converted into reserves, indicating that they were economic at the time.

The Vryheid Coalfield shows a conversion rate of approximately 40%. This is due to the hilly terrain and large associated topographic elevation difference rendering much of the coal subeconomic. The Somkele Coalfield has a conversion rate (approximately 50%). This is most likely due to the fact that, to date, no formal mining operations have extracted coal from this field.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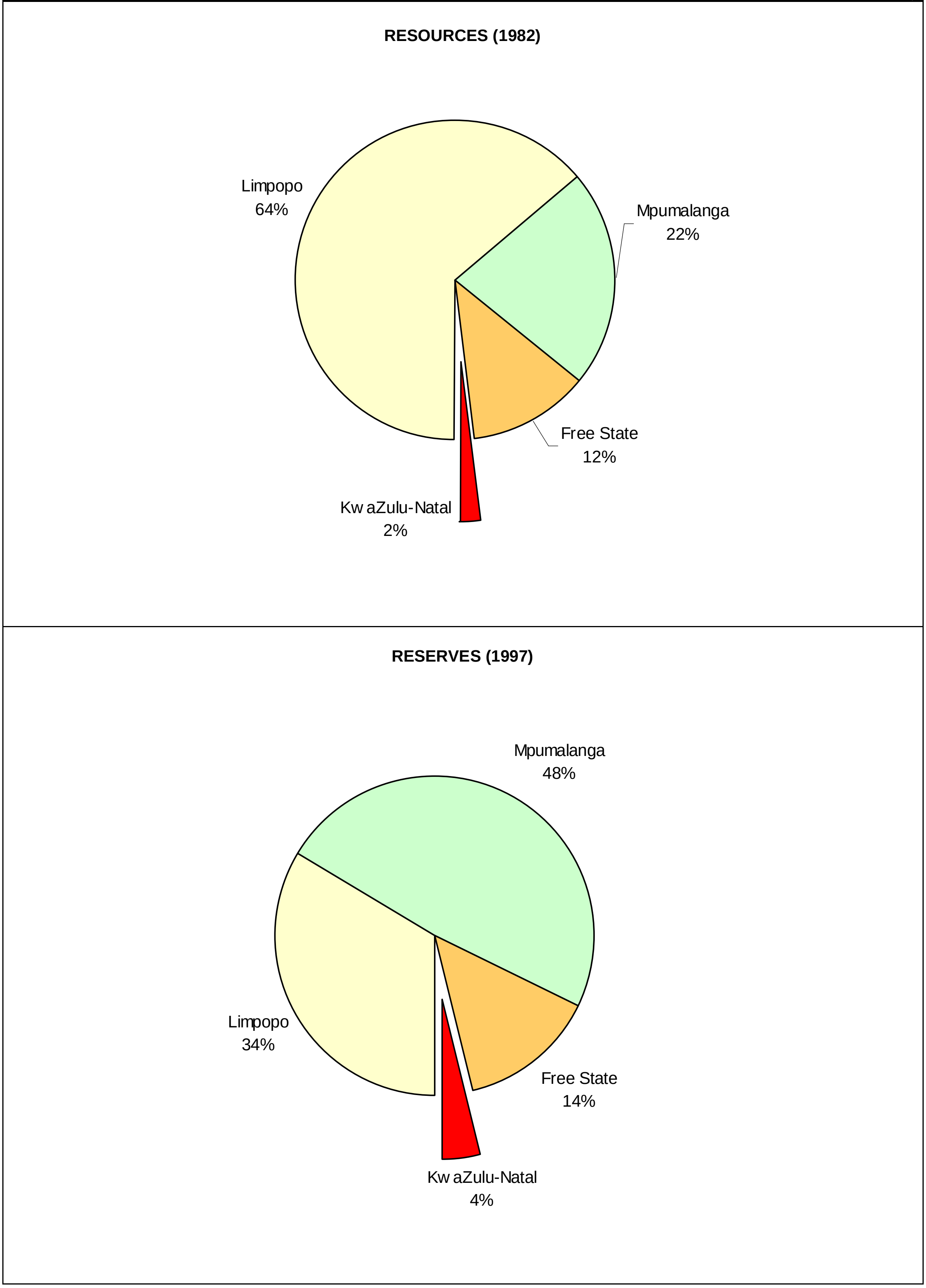
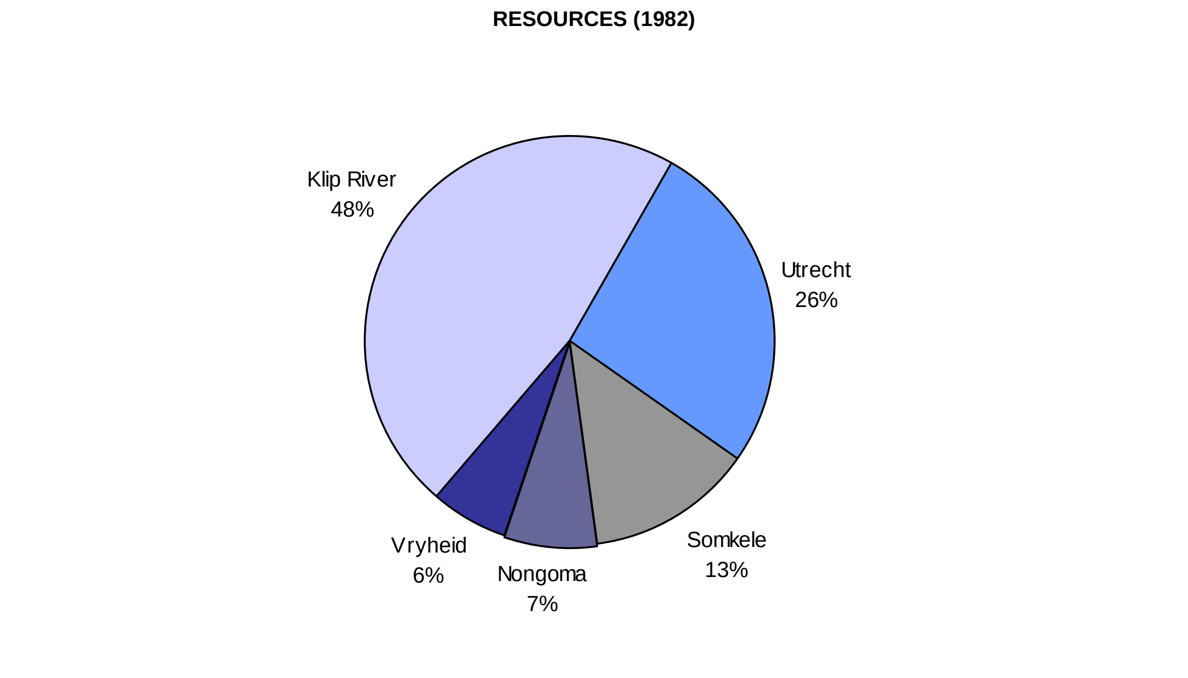
TYPICAL STRATIGRAPHIC COLUMNS FOR THE NONGOMA AND SOMKELE COALFIELDS
Figure 11
NONGOMA WEST
M+1 Seam
M Seam
M-1 Seam
Vryheid Formation
Ecca Group
Karoo Sequence
NONGOMA EAST
"C Zone" Seams
"B Zone" Seams
"A Zone" Seams
Seam B4
Seam B3
Seam B2
Seam B1
A Seam
Emakwezini Formation
Beaufort Group
Karoo Sequence
SOMKELE
Upper Seam
Main Seam
Lower Seam
Main Coal Zone
Emakwezin Formation
Beaufort Group
Karoo Sequence
Sources: Department of Mineral and Energy Affairs; Geoscience
LEGEND:
Sandstone
Silty sandstone
Siltstone
Shale/Sandstone/Siltstone
Carbonaceous Shale
Coal Seam

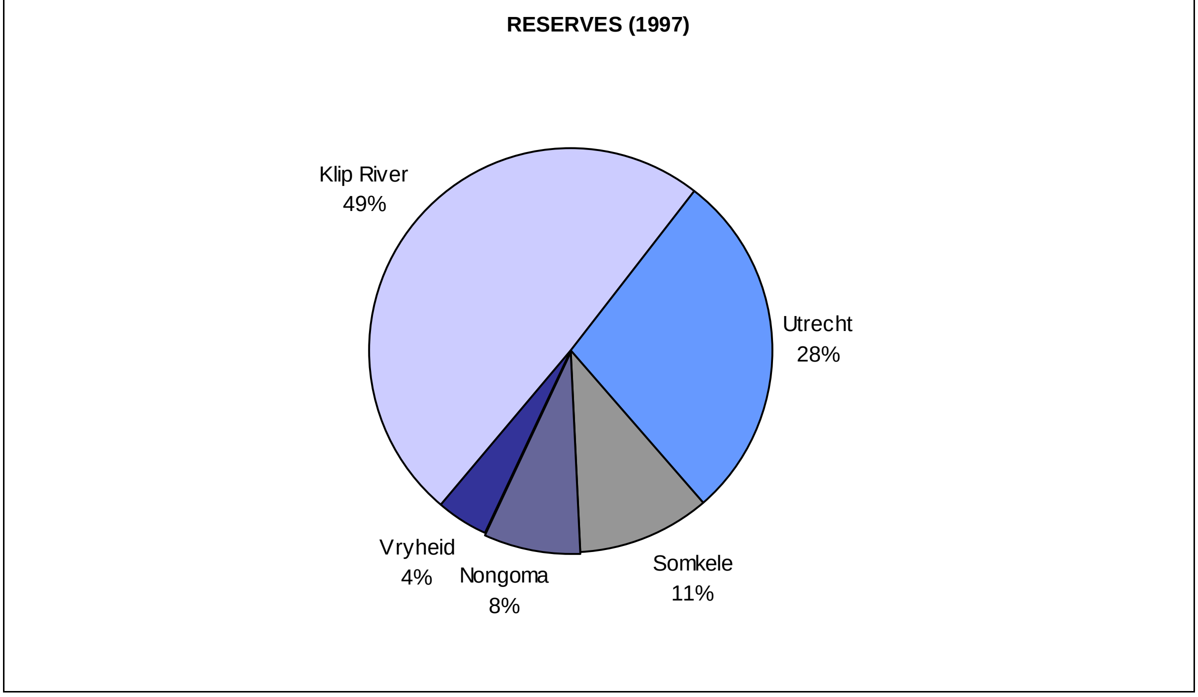
Figure 12 : Remaining Coal Resources and Reserves by Province as a Percentage



Source: H.J. Pinheiro, 1999

Figure 13 : Remaining KwaZulu-Natal Coal Resources and Reserves by Coalfield as a Percentage





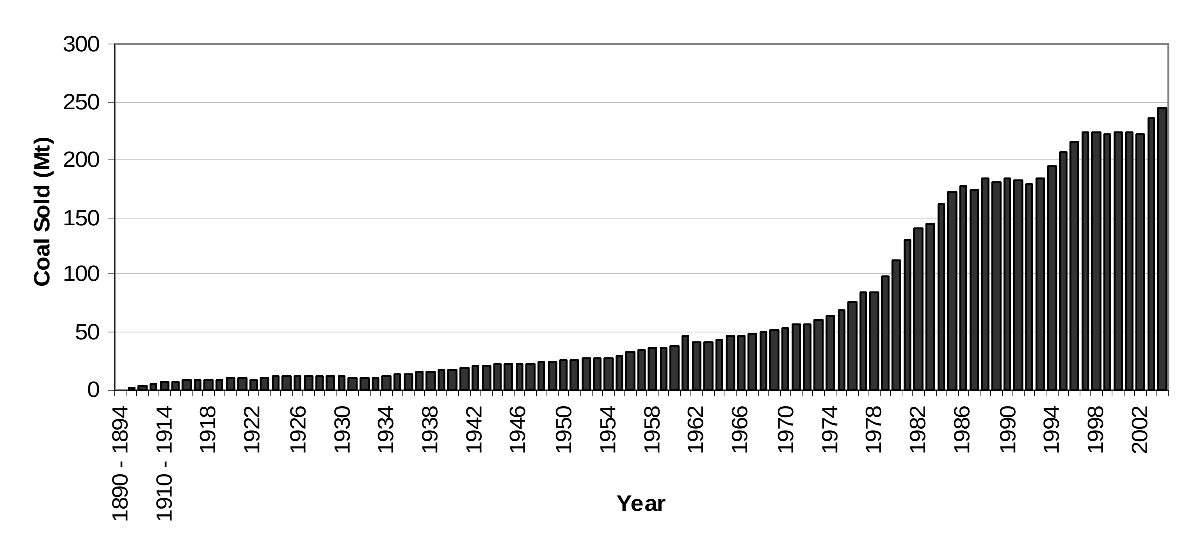
Source: H.J. Pinheiro, 1999

7.2 Production Tonnages and Current Status

South Africa has produced coal for over one hundred years. The total coal production from the country is indicated in Figure 14.

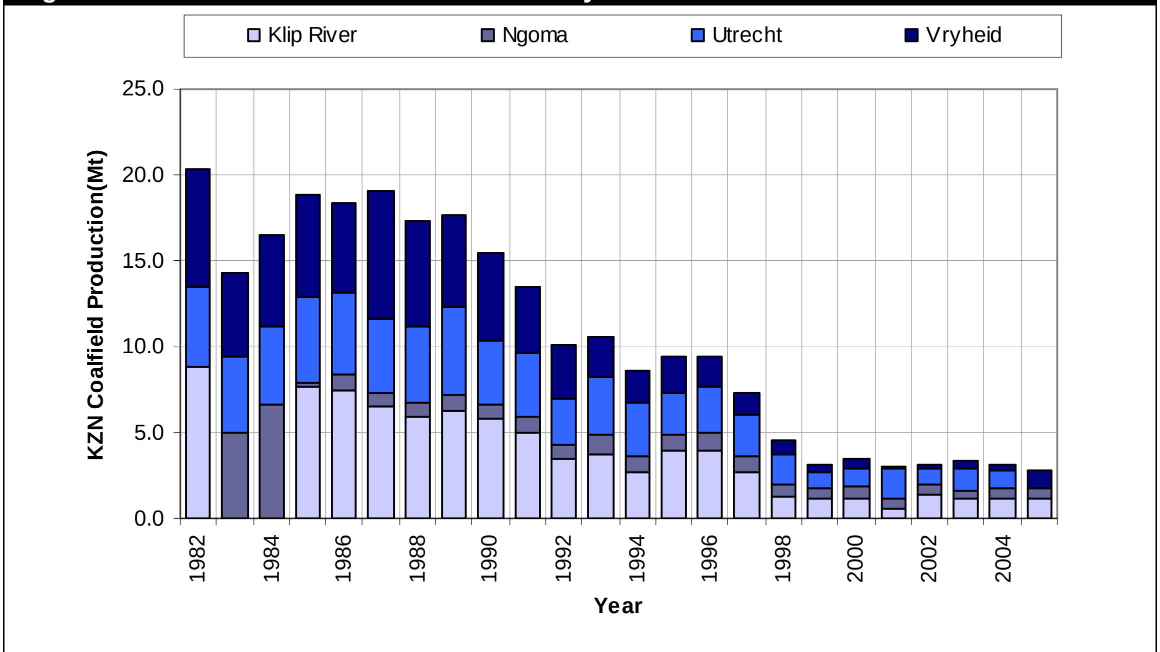
KwaZulu-Natal's contribution to South Africa's coal production commenced in the late 1800's. Historically, the Province made a significant contribution to the country's production figures. Since 1982, however, the production from the Province has decreased steadily (Figure 15).

Figure 14 : Total South African Coal Production



Source: Department of Minerals and Energy. Minerals Bureau. (1985-2006)

Figure 15 : KwaZulu-Natal Coal Production by Coalfield



(Note: No production tonnages have been extracted from the Somkele Coalfield.)
Source: Department of Minerals and Energy. Minerals Bureau. (1985-2006)

Some of the reasons for its closure of the coal mines include the following:-

- difficult mining conditions as a result of narrow seams, large topographic differences, highly faulted ground conditions and numerous occurrences of dolerite dykes (Figure 16). This resulted in low extraction rates and tonnages, high mining costs and few opportunities for opencast mining;
- the abolition of the coal marketing controls approximately 15 years ago. These controls had prevented the sale of coal produced within a province from being sold outside of that particular province. This abolition resulted in the cheap coal produced in Mpumalanga being sold into the KwaZulu-Natal market. Although the Mpumalanga coals had further to travel to reach the KwaZulu-Natal market, the combined mining and transport costs for this coal was still significantly less that the high cost coal produced within KwaZulu-Natal;

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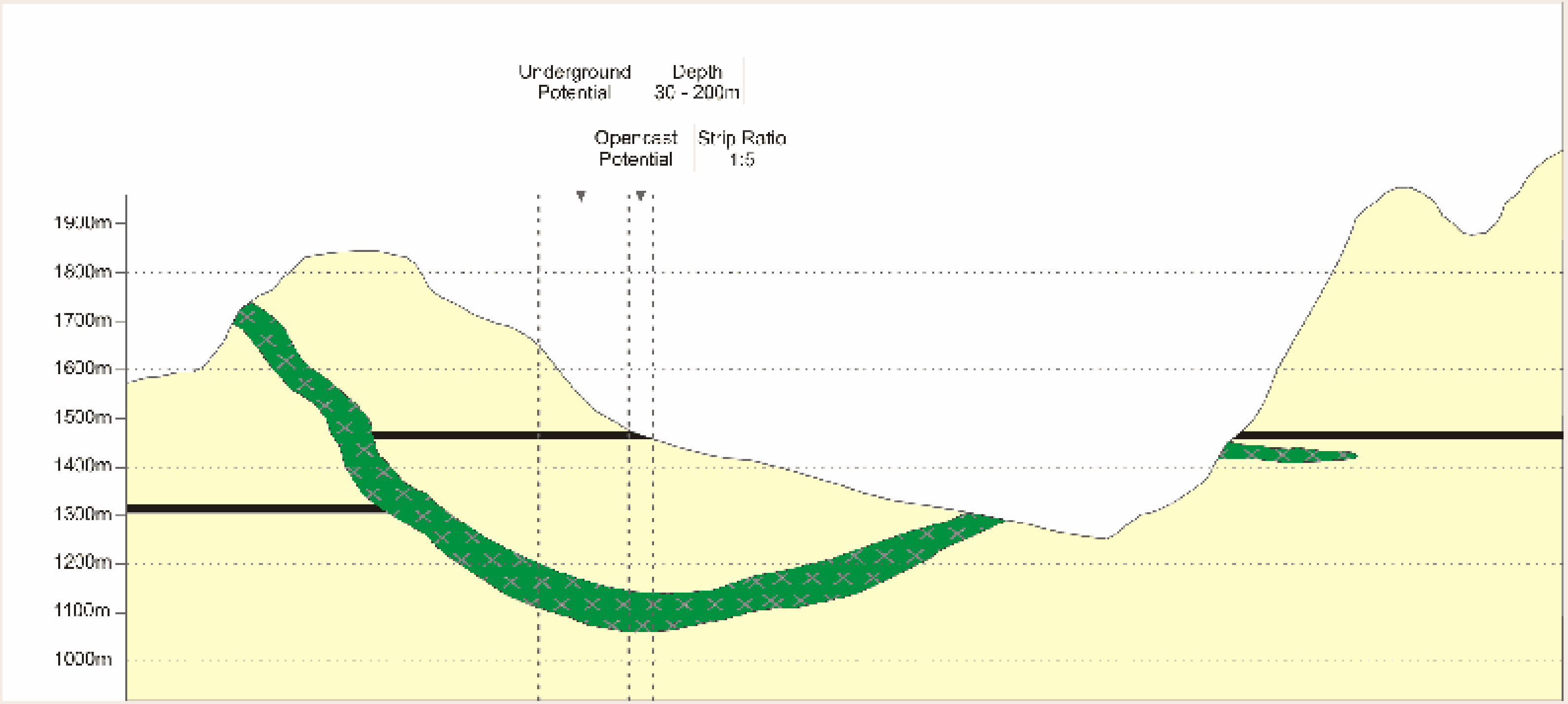
TYPICAL CROSS SECTION THROUGH A KZN COALFIELD INDICATING TOPOGRAPHIC RELIEF AND COAL SEAM

Figure 16

LEGEND:

- Coal
- Dolerite
- Karoo Supergroup Sediments



Source: Geological Society of South Africa

- the decrease in the demand for export anthracite from KwaZulu-Natal. Other sources of cheaper, better quality anthracite were being supplied into the global market;
- closure of the South Works at the Newcastle steelworks in 1982 which consumed significant amounts of coking coal;
- old and aging mines reaching their limits of extraction; and
- a significant gas explosion in one of the collieries.

In contrast, the Witbank and associated coalfields have been the focus of mining operations as these deposits host thick seams with few structural obstacles. These conditions enable high tonnage opencast mines, often serviced by draglines, and large underground mines. The net result is low cost mines;

7.3 Qualities

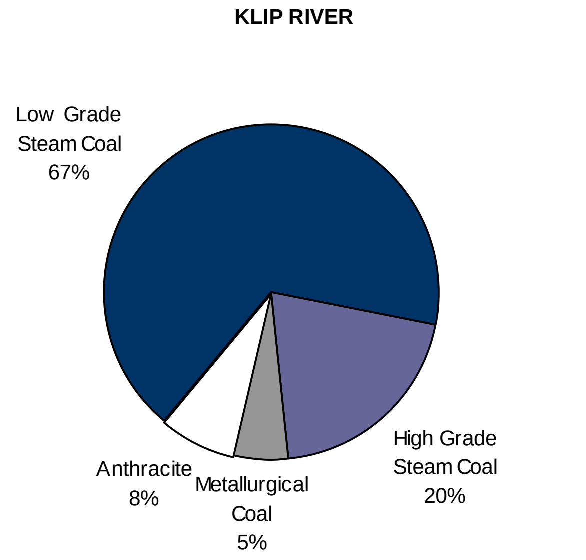
KwaZulu-Natal is renowned for its production of anthracite and coking coal. The split of the various types of products remaining as reserves in the respective coalfields is highlighted in Figure 17. Unfortunately, data for the Somkele and Nongoma Coalfields was not available. Figure 17 indicates that although production has focussed on high quality coal, the majority of the remaining reserves comprise of low grade steam coal.

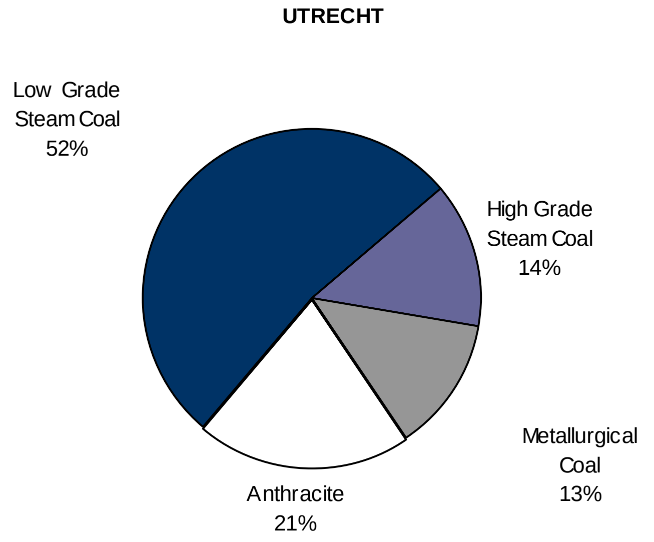
7.4 Operating and Defunct Mines

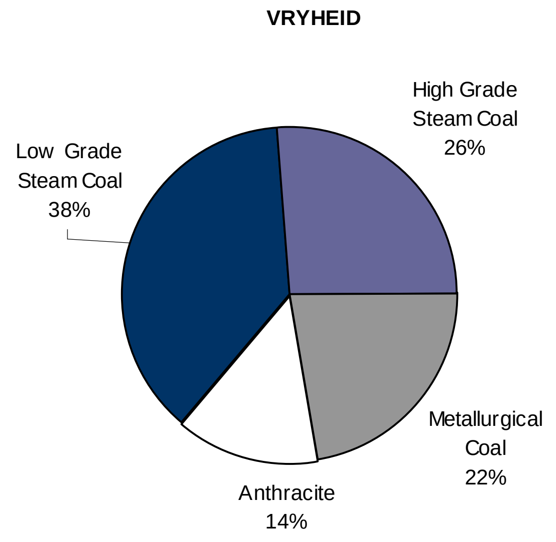
Since 1979, a total of 66 coal mines have operated in the province. Of these, 10 are currently operational. Table 5 provides summary information on each of the collieries, whilst detailed information sheets are included on each operating mine in Appendix 1. The locations of the mines are indicated on Figure 18.

The number of operating mines in KwaZulu-Natal's Coalfields is significantly less than those in the other fields. This is a result of the difficult mining conditions associated with the KwaZulu-Natal coal seams compared to those in the Mpumalanga Coalfield (Figure 19).

Figure 17 : KwaZulu-Natal's Remaining Coal Reserves by Coalfield







Source: Department of Minerals and Energy. Minerals Bureau. (1985-2006)

Table 5 : Summary Information on Operating Mines in KwaZulu-Natal

MINE NAME	HOLDING COMPANY	HOLDING COMPANY TYPE	COALFIELD	COAL TYPE	MINE TYPE	SEAM
Aviemore Colliery	Slater Coal (Pty) Ltd	SA, Private	Klip River	Anthracite, Lean Bituminous	Opencast, Underground	Alfred, Gus
Springlake Colliery	Petmin Ltd	SA and UK Listed	Klip River	Anthracite	Underground	Bottom
Durnacol (Durban Navigation Colliery)	Mining Contractors VHD	SA, Private	Klip River	Coking	Underground	Top, Bottom
Magdalena Colliery	Zinoju Investments (Pty) Ltd	SA, Private, BEE	Klip River	Bituminous	Opencast	Unknown
Zululand Anthracite Colliery	Riversdale Mining Ltd	Australia Listed	Nongoma	Anthracite	Underground	Unknown
Leeuw Vaalkrantz Colliery	Leeuw Mining & Exploration (Pty) Ltd	SA, Private, BEE	Vryheid	Anthracite	Underground	Alfred, Gus
Wheal Lynn Mine	Lashco Mining Company	SA, Private	Vryheid	Coking	Underground	Dundas
Rietvlei Colliery	Hlobane Carbon Products (Pty) Ltd	SA, Private, BEE	Vryheid	Coking, Bituminous	Opencast, Underground	Gus, Dundas
Robertse Colliery			Vryheid			
Brockwell Anthracite Colliery Ltd			Vryheid			

MINE NAME	UG MINING METHOD	2005 TONNAGE	CV	GROSS CV	MOIST (%)	ASH (%)	VOLATILE (%)	FIXED C (%)	TOTAL S (%)
Aviemore Colliery	Bord & Pillar	55,000	30.55	30.35	1.60	12.50	6.90	79.00	2.09
Springlake Colliery	Bord & Pillar	690,000	29.71	29.52	3.00	11.90	4.90	80.20	1.99
Durnacol (Durban Navigation Colliery)	Longwall, Pillar Extraction	421,000	30.64	30.49	1.50	11.50	30.10	56.90	1.46
Magdalena Colliery		204,000	29.30		1.60	16.50	13.30	68.60	1.20
Zululand Anthracite Colliery		591,000	33.10	33.03	1.30	7.60	5.40	85.70	0.72
Leeuw Vaalkrantz Colliery	Bord & Pillar	268,000	31.63	31.56	1.00	12.00	20.20	66.80	0.70
Wheal Lynn Mine	Bord & Pillar	268,000	31.40		1.30	1.40	22.90	64.40	1.11
Rietvlei Colliery	Unknown	160,000	30.87	30.79		14.00	25.70	60.30	0.80
Robertse Colliery									
Brockwell Anthracite Colliery Ltd									

MINE NAME	SI	AL	FE	PO	TI	CA	MG	K	NA	S	P	DT	ST	HT	FT	VIT	INERT	HEAT ALT	GR	REFL
Aviemore Colliery																				
Springlake Colliery	47.00	35.40	7.91	0.87	1.45	2.18	0.82	1.73	1.47	1.09	0.05	1,600	1,600	1,600	1,600	48	46	1	5	3.56
Durnacol (Durban Navigation Colliery)	45.80	30.90	8.46	0.87	1.59	5.45	1.09	1.59	0.92	2.74	0.04	1,260	1,300	1,360	1,430	53	4	10	33	0.84
Magdalena Colliery												1,360		1,380	1,400					
Zululand Anthracite Colliery																				
Leeuw Vaalkrantz Colliery	51.80	34.00	5.33	0.16	1.96	0.71	0.45	2.56	0.49	0.87	0.01	1,600	1,600	1,600	1,600	41	1	15	43	1.15
Wheal Lynn Mine												1,400		1,400	1,400					
Rietvlei Colliery	53.60	32.50	6.10	0.20	1.80	1.20	0.70	1.70	0.97	1.30	0.01	1,600	1,600	1,600	1,600	58	1	11	30	0.99
Robertse Colliery																				
Brockwell Anthracite Colliery Ltd																				

Source: Department of Minerals and Energy. Minerals Bureau. (1985-2006)

CV: Calorific Value; C: Carbon; Si: Silicon; Al: Aluminium; Fe: Iron; Po: Polonium; Ti: Titanium; Ca: Calcium; Mg: Magnesium; K: Potassium; Na: Sodium; P: Phosphorus; DT: Deformation temperature; ST: Sphere temperature; HT: Hemisphere temperature; FT: Flow temperature; VIT: Vitrinite; INERT: Inertinite; HEAT ALT: Heat alternate; GR: Graphitized material; REF: Vitrinite random reflectance.

KWAZULU NATAL COAL RESOURCES

LOCATION OF OPERATING AND DEFUNCT COAL MINES AND MINED-OUT AREAS IN KZN

Figure 18

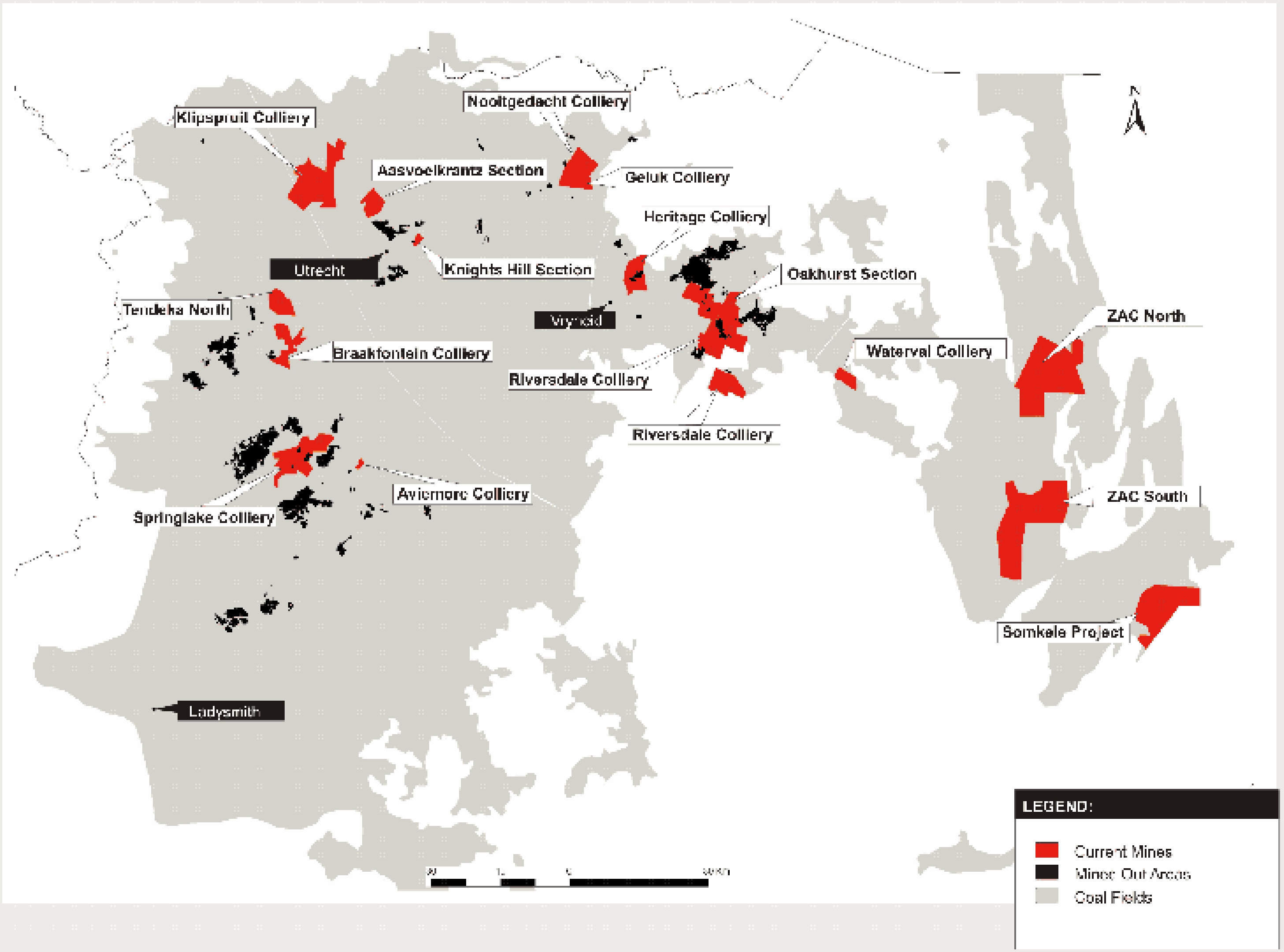
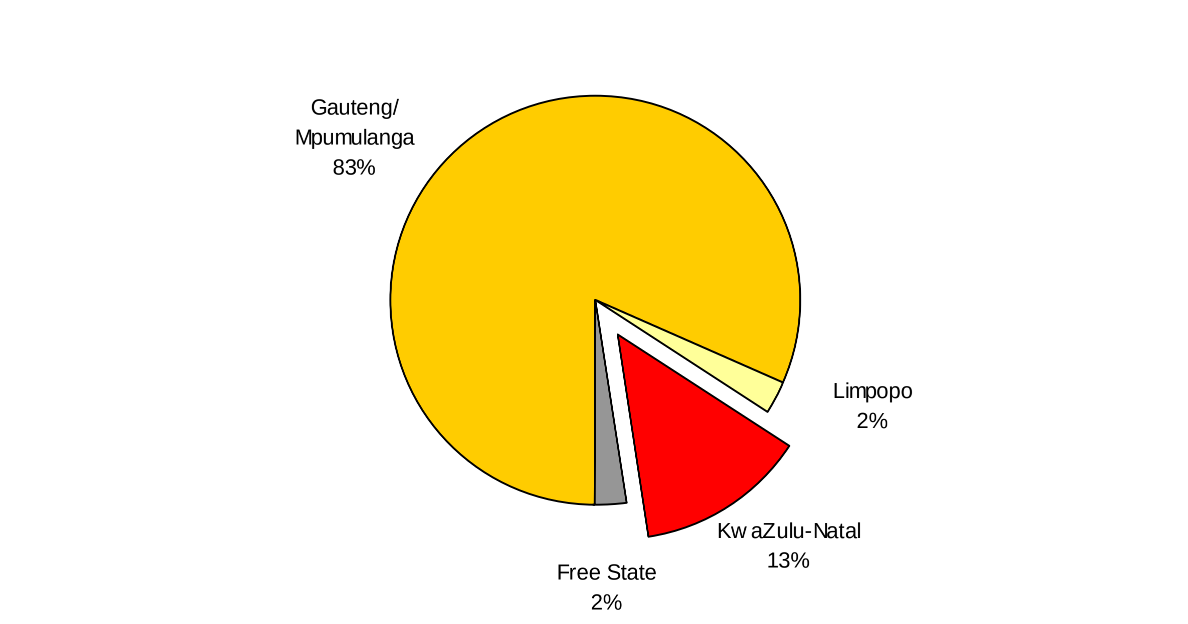


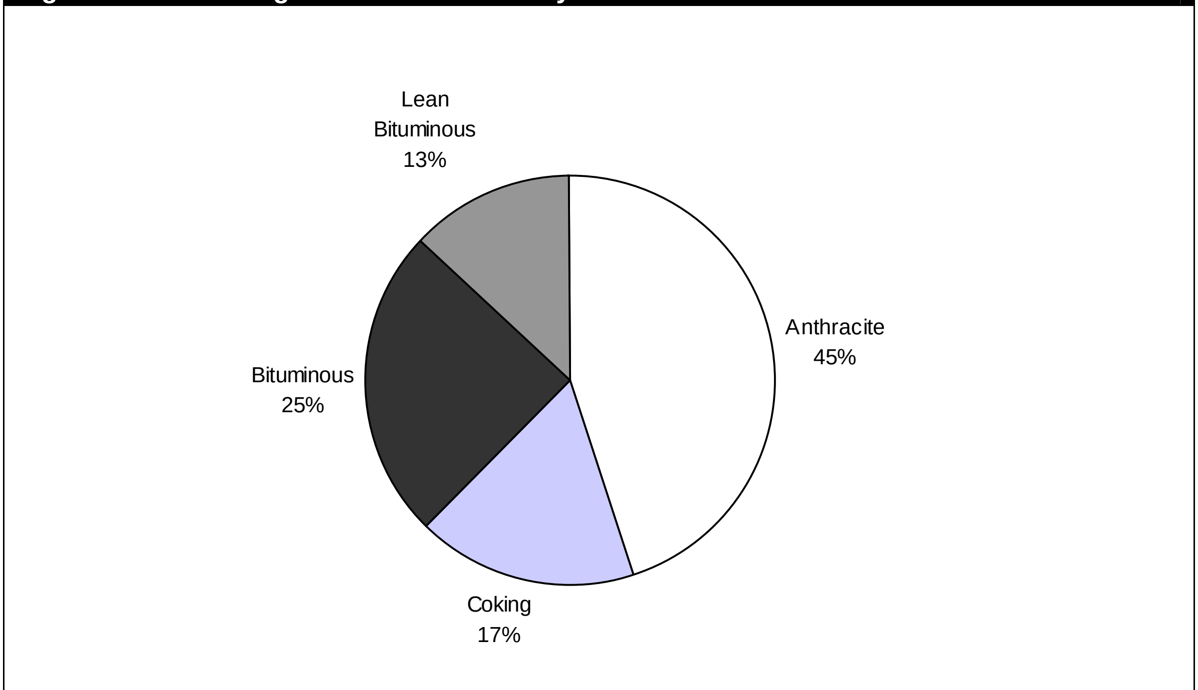
Figure 19 : Percentage of Operating Coal Mines in South Africa in 2005



Source: Department of Minerals and Energy. Minerals Bureau. (2006)

Since 1979, the majority of the KwaZulu-Natal mines have produced anthracite (Figure 20). This is also the case for the current operating mines.

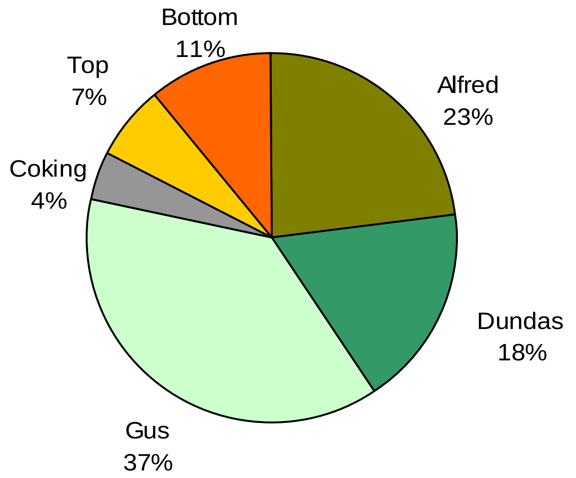
Figure 20 : Percentage of Coal Produced by Coal Mines in KwaZulu-Natal



Source: Department of Minerals and Energy. Minerals Bureau. (1985-2006)

Since 1979, the majority of the mines have extracted coal from the Gus Seam and to a slightly lesser extent the Alfred and Dundas Seams within the Utrecht and Vryheid Coalfields (Figure 21). Only a small number of operations have extracted coal from the Top and Bottom Seams of the Klip River Coalfield. The other seams present in the respective coalfields are generally too thin to be extracted economically.

Figure 21 : Producing Coal Seams by Percentage of Mines in KwaZulu-Natal



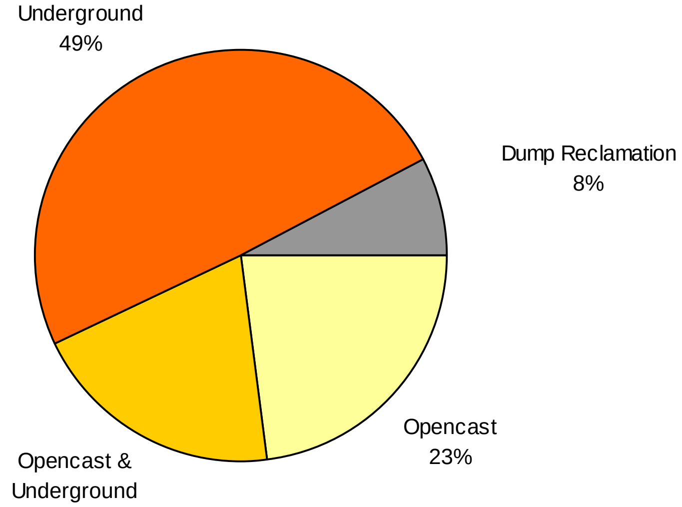
Source: Department of Minerals and Energy. Minerals Bureau. (1985-2006)

Underground mines predominate in KwaZulu-Natal (Figure 22). This extraction method is necessitated by the elevation differences in the province (Figure 16). Coal is typically flat lying and outcrops on the scarp slopes of the hilly terrain. As a result of the stripping ratio increasing rapidly with the slope of the hill, opencast mining can only take place economically for a very short distance into the side of the slope. Thereafter, underground mining must take place. Although the slope acts as a hindrance to opencast mining it is an advantage for underground operations as no capital intensive inclined shaft is required to access the coal. A simple adit into the hillside is sufficient and is typically excavated straight into the coal outcrop. This means that no waste rock needs to be excavated prior to mining.

In the flatter lying areas to the south, and especially near the east coast, opencast mining has greater potential.

Dump reclamation activity has been carried out on the old defunct mines KwaZulu-Natal. This coal, although historically discarded, now meets certain low-grade coal specifications. The added advantage of it being located on surface makes this type of operation economically viable.

Figure 22 : Mining Method by Percentage of Mines in KwaZulu-Natal

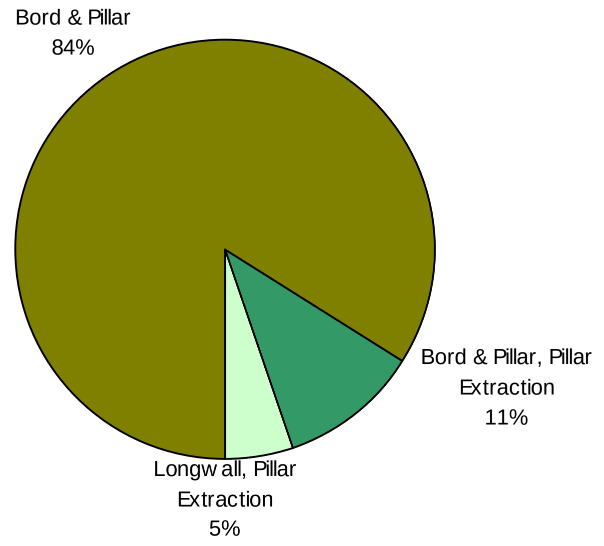


Source: Department of Minerals and Energy. Minerals Bureau. (1985-2006)

Over 80% of the underground mines utilise the bord and pillar mining method (Figure 23). Although this mining method only allows for extraction rates of 60%-75%, depending on depth from surface and seam height, it allows for the extraction of seams to a minimum of one metre and flexibility required to traverse dolerite dykes. Longwalling allows for 100% coal extraction but requires extended lengths of uninterrupted coal face and a minimum seam height of 1.5m. This is not typical of KwaZulu-Natal's coal seams and hence is not common practise in the province.

The use of pillar extraction in bord and pillar mines increases the overall extraction rate but precludes these areas being entered for mining again at a later date. It is successfully practised in the Witbank area.

Figure 23 : Percentage of Underground Mining Methods used in KwaZulu-Natal



Source: Department of Minerals and Energy. Minerals Bureau. (1985-2006)

8 INFORMATION COMPILATION

MINTEK obtained extensive publicly available information and captured this into Mintek's spatially-enabled database. Data sources include the Department of Minerals and Energy and Council for Geoscience. Specific information about data sources is available in the metadata records on the GIS CD..

8.1 Data

A professional GIS at Mintek was used for data management and analysis. Data were prepared for delivery on CD for ease of use. If they are required in any other form, for example for loading in the KZN provincial spatial database, this can be arranged through Mintek.

The GIS CD consists of a desktop GIS, QGIS, which can be installed off the CD, some map projects that can be opened in QGIS, and GIS data. In the root folder of the CD is a README.html file that can be opened in a browser for brief instructions and to browse through the metadata for each dataset. The metadata describes amongst other things the source and processing history of each data set as well as explanations for each field or attribute.

Coal data are linked mainly to farms. Building and other material data (in their separate studies) are linked to deposits and potential surfaces.

8.2 Data descriptions

Several data sets are supplied on the GIS CD. Some of these provide background map orientation while others were used directly in the analysis of resource potential. Each one is described fully, including its source, in its metadata file on the GIS CD. Some are mentioned below:

- The 1:500000 river database was obtained from DWAF Resource Quality Services.
- 20m contours are from the Chief Department Surveys and Mapping (CDSM) of the Department of Land Affairs. These were used in the analysis of coal potential but are not included in the CD as they are freely available from the CDSM.
- Administrative boundary and infrastructure data was obtained from the Demarcation Board on its SAExplorer 3 CD.
- Farm boundaries with farm names and numbers are from the Demarcation Board's SA Explorer 3 CD, although their original custodian is the Surveyor General. These farm names and numbers in this data set were assumed to be correct, so these fields in other tables were made to match records from this data set.
- Extensive data manipulation was required to get data from CGS to link properly to farms as there were many inconsistencies in CGS farm names and numbers.
- Coalfield boundaries were obtained from CGS. These were enhanced with coalfield boundaries digitised from the Barker & Associates Coalfield Map of South Africa (2004) and were further extended to incorporate areas where boreholes intersected coal.
- Coal borehole coordinates and coal seam intersection data were obtained from CGS. This data set also described whether the coal is weathered or burnt by dolerite. These data were the basis of the analysis of coal potential and likely mining method (Section 9.1).
- Mined out areas indicate where coal has been extracted by historical mining activities. These areas were obtained from the DME section for Mine Health and Safety and were digitised from tracings on 1:50000 topographic sheets. This mined-out area database in incomplete. Mined out areas are labelled by mine name and are for information only.
- Operating and defunct mines are represented in the 'mines' layer in the GIS. For some mines the mining lease boundaries were digitised from the Barker & Associates Coalfield Map of South Africa (2004). The rest are represented by small circles at the coordinates given in the CGS mines database or at the centroid of the farm given in the CGS database. Coal characteristics, production and mine history are delivered in this data set.
- To date the New Order Mining Rights have not been obtained. This information is of a sensitive nature, as it may advantage other opportunistic mining companies. It is for this reason that the DME are hesitant to divulge this information.
- Points representing known deposits and mines of Building Material and Other Materials in their respective parts of the study were sourced by Mintek and are part of the GIS.
- A methodology was used to generate potential surfaces for each material for the Building Materials and Other Minerals reports. In the Mintek database these are available as raster data sets. They

were converted to vector data sets (shapefiles) classified by potential class for ease of use with simple GIS viewers.

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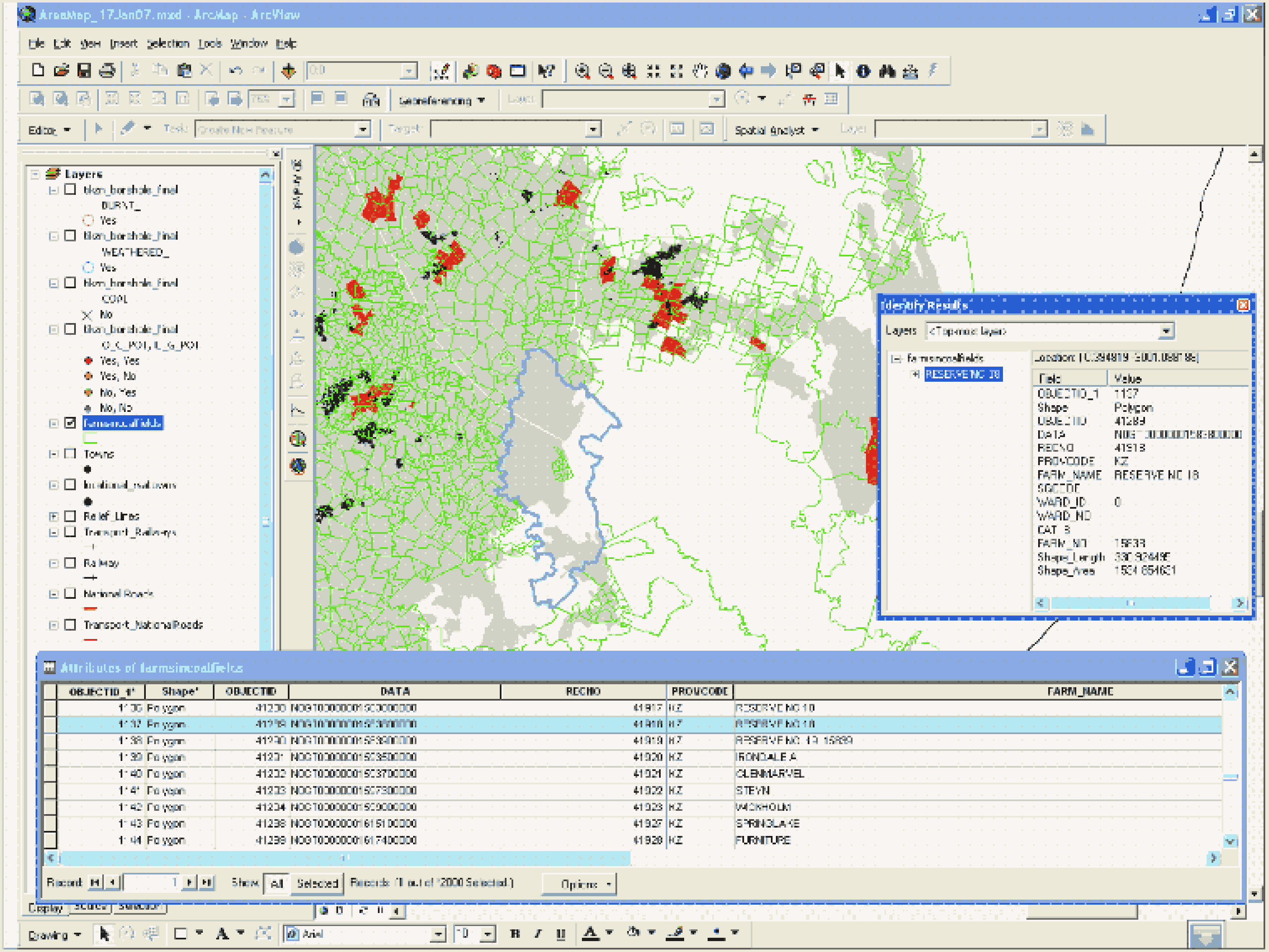
KWAZULU NATAL COAL RESOURCES

TRADE & INVESTMENT KWAZULU-NATAL

EXAMPLE OF FARMS DATABASE FROM GIS

Figure 24



Source: Mintek

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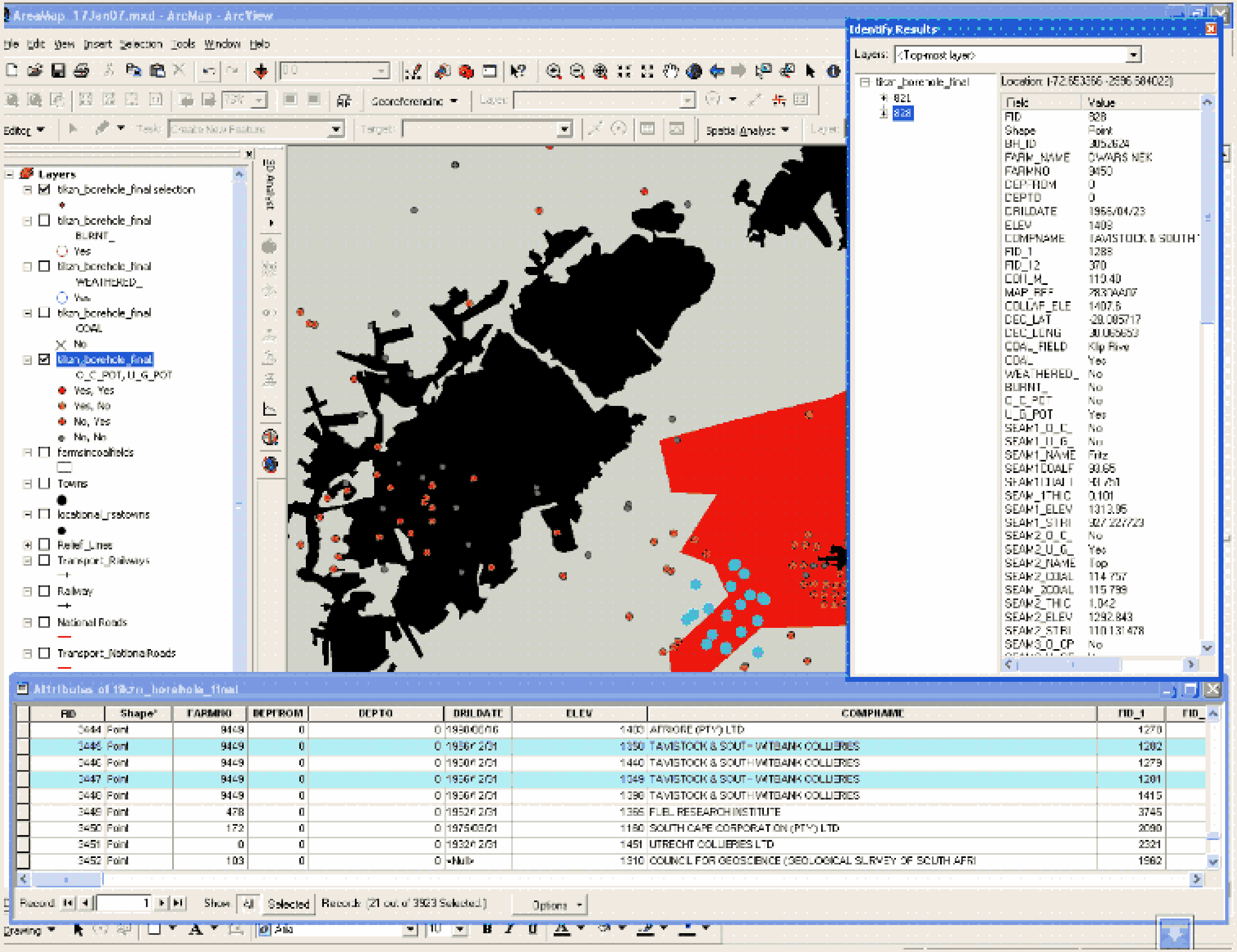
EXAMPLE OF BOREHOLE DATABASE FROM GIS

Figure 25



Source: Mintek

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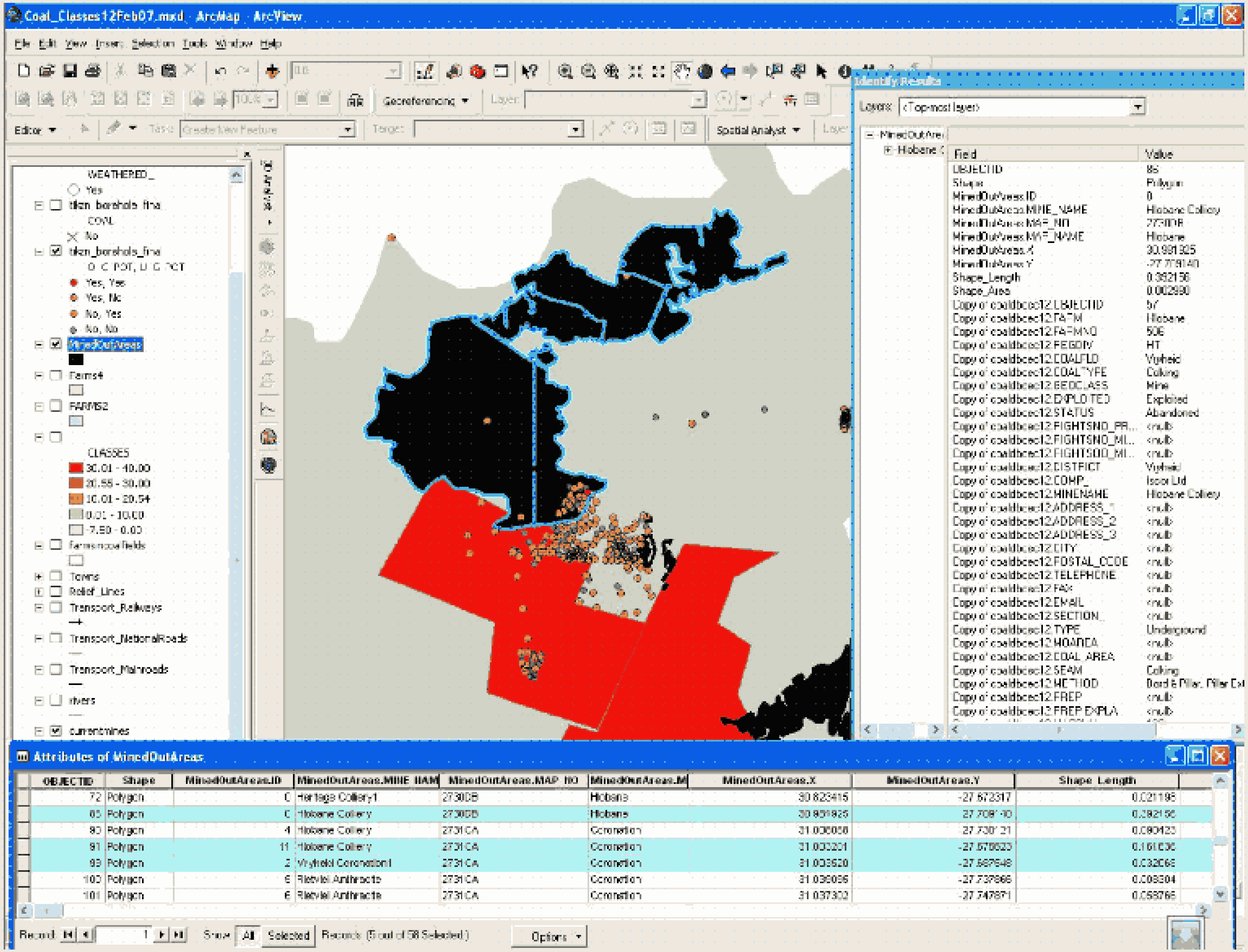
EXAMPLE OF MINING DATABASE FROM GIS

Figure 26



Source: Mintek

9 INTERPRETATION

The borehole database was the primary information source used to identify areas with potential for future mine development and to calculate the resources within the Province. In order to assess the extensive area covered by the coalfields in a relatively short time, firstly, a scheme was devised to identify boreholes which could be mined using opencast and underground mining methods. Thereafter, these boreholes were scrutinized within the context of the farm on which they were located in order to estimate reconnaissance coal resources. The farms were also ranked according to a rating scheme specifically designed to meet the objectives of this investigation and to identify high potential areas. These methods and schemes are described below.

9.1 Identification of Boreholes with Potential for Mining

Opencast mining is typically economic for high-grade coal seams to a maximum stripping ratio of: $5m^3$ of overburden: $1m^3$ coal. The stripping ratio was calculated for each seam within each borehole to identify where this figure was less than 5:1. The field describing opencast potential for that seam, and for the borehole as a whole, was then marked “Yes”. In this manner all boreholes with opencast potential were identified on the GIS with an orange filled circle symbol (Figure 27).

From a mining perspective underground coal seams can be viable if the following criteria are met:-

- minimum seam thicknesses > 1m; and
- coal depth from surface is between 30m – 200m.

This query was applied to all seams within all the boreholes. Where these criteria were met the seam and the borehole fields indicating underground mining potential were allocated with “Yes”. These boreholes were highlighted on the GIS using a yellow filled circle symbol (Figure 27).

Farms within the coalfields were investigated further with respect to coal tonnage and the rating scheme, if:-

- one or more boreholes indicated mining potential (either opencast and/or underground); or
- they were situated within 2,000m of such a borehole.

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LOCATION OF BOREHOLES INDICATING OPENCAST AND UNDERGROUND MINING POTENTIAL

Figure 27

9.2 Estimation of Coal Reconnaissance Tonnages

Reconnaissance coal tonnages were estimated on a farm-by-farm basis and recorded into an Excel spreadsheet. In order to estimate the tonnage on the farm the following items were taken into account:-

- the coal seam thickness for the seam with mining potential;
- the distance from the borehole (point of intersection) over which coal continuity will be assumed. This distance must be less than 2,000m for multiple thin seam deposits and less than 4,000m for thick seam deposits;
- topographic relief over the area for which coal is being estimated must meet the opencast and underground mining criteria, as discussed in Section 9.1; and
- percentage of the farm for which coal continuity may be assumed.

The coal thickness for each seam with potential is multiplied by the percentage of the area of the farm assumed to have coal to calculate the coal volume. This is then multiplied by a relative density of 1.55kg/m^3 to calculate the coal tonnage. The tonnage pertaining to each seam is recorded separately. This tonnage is then reduced by 40% to take into account geological losses, based on past experiences.

9.3 Rating Scheme

A rating scheme was designed to identify areas (farms) of high potential for further exploration and possible future mine development. The scheme was applied on a farm-by-farm basis and allocates values for the various criteria. These criteria include the following:-

- number of boreholes. The higher the number of boreholes on a particular farm, the greater the confidence in the coal present. Each borehole is included as a single unit in the rating scheme, but the number was capped at 15;
- the furthest distance from the point of intersection. Small distance provided greater confidence with respect to the coal;
- tonnage in multiple seams. More seams that could be mined had a greater potential than an area which had only one mineable seam;
- small isolated tonnage. Boreholes located a large distance away from other potential areas had a lower potential than the boreholes found closer or amongst other high potential areas;
- opencast and underground potential confirmed by a borehole on the farm under investigation;
- defunct mines on the farm under investigation. Farms which already had defunct mines on them, had a greater potential as these mines would be reassessed to determine whether they were economic to re-open in the near future;
- operating mine on the farm under investigation. Farms which already had operating mines, have a lower rating as these mines might be extended by their current owners or the current owners might already have the mining rights to continue mining in the near future.

The high potential farms are shown in Figure 28.

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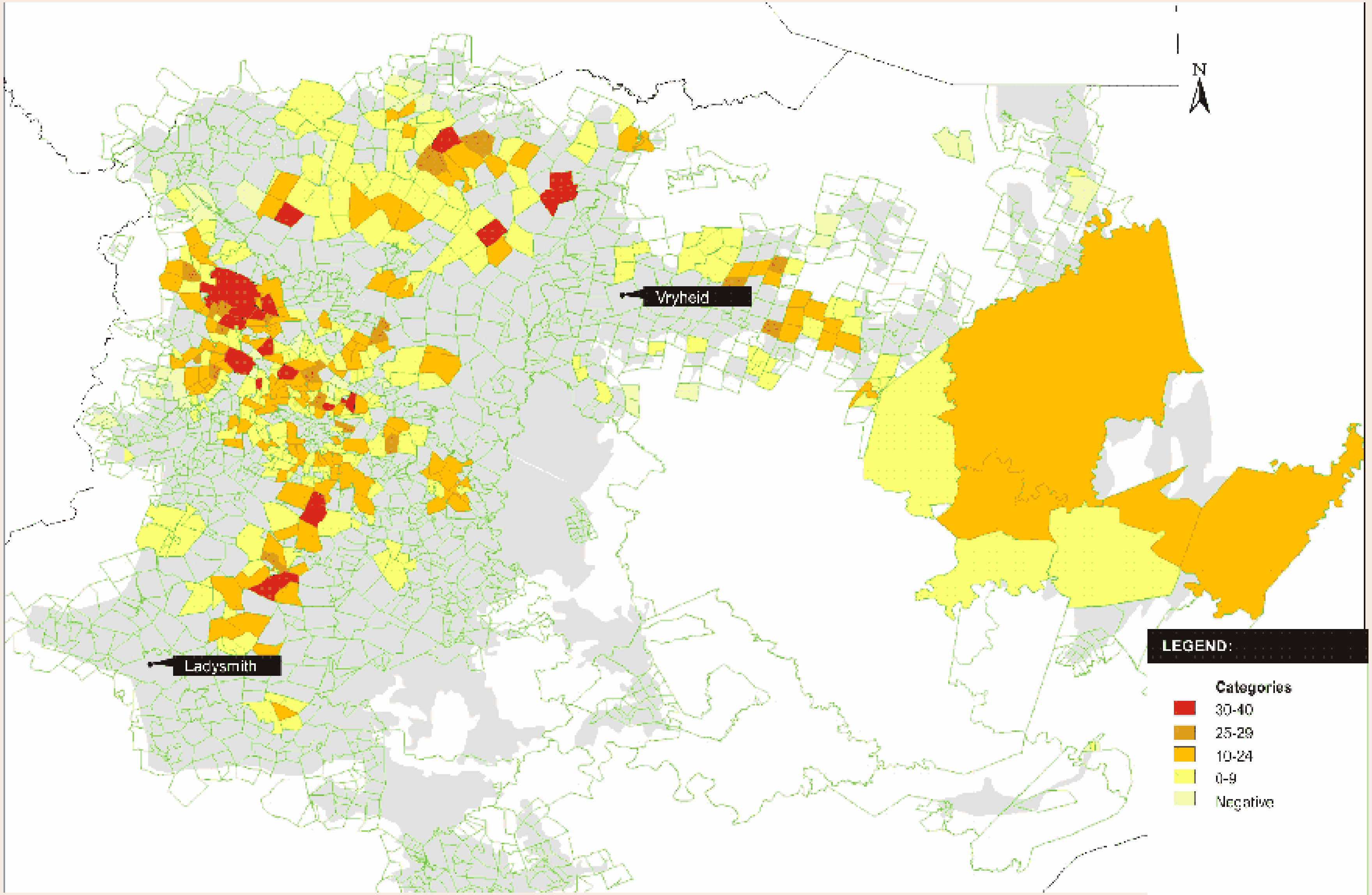
GRAPHICAL REPRESENTATION OF RATING RESULTS

Figure 28



RESULTS

9.4 List of Coal Resource Farms

Resources were calculated for each farm in the coalfields that had potential identified by the boreholes. This information was captured in a list, reflecting, amongst others:-

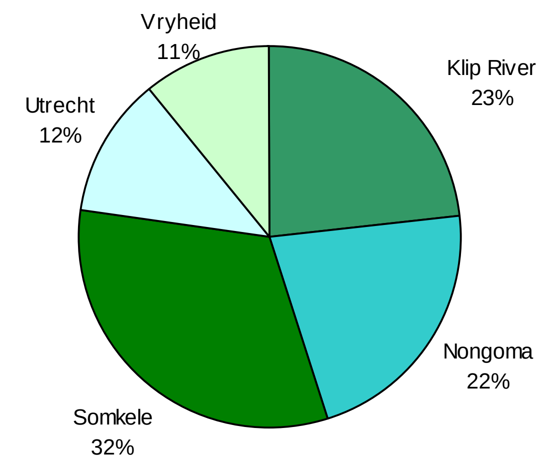
- total tonnages;
- opencast tonnages;
- underground tonnages; and
- rating scheme.

This comprehensive list of 462 potential farms can be found in Appendix 3.

9.5 KwaZulu-Natal's Coal Resources

The total remaining coal resources for KwaZulu-Natal were calculated for each coalfield in areas with potential for economic extraction (Table 8). The majority of the Province's resources are located in the Somkele Coalfield, (Figure 29). Klip River and Nongoma ranked 2nd and 3rd, respectively, with remaining coal resources. The large proportion of remaining coal resources in the Somkele Coalfield and the Nongoma Coalfield are largely due to the fact that these coalfields seams occur in zones, rather than thin seams.

Figure 29: Percentage of Remaining KwaZulu-Natal Coal Resources by Coalfield



Source: This Study

Table 9 shows the comparison of the estimates of the total resource for KwaZulu-Natal in 2007 to the resources estimated in 1997. It should be noted, however, that the quoted 1997 values were recorded prior to the inception of the SAMREC Code and therefore has not been classified into resources and reserves. As a result of the utilisation of the boreholes across the Province to estimate the coal tonnage, the resultant values are a more accurate reflection. The Nongoma and Somkele Coalfields have much higher resources. This is largely as a result of the modest understanding and exploration of these coalfields at the time. The results of the assessment are shown graphically in Figure 29.
As a result of this study adopting the new reporting standards, the resource quantities quoted in this report are not necessarily comparable in previous studies and must be considered as standalone numbers.

Table 6 : Estimated KwaZulu-Natal Coal Resource for 2007

COALFIELD	GTIS* 2007 (Mt)	GEOLOGICAL LOSSES AT 40%	IN SITU RECCONNAISSANCE COAL RESOURCES (TTIS*) (Mt)	TOTAL 1997 (Mt) (TTIS)	2007-1997 DIFFERENCE
Klip River	4,461	1,784	2,677	1,695	982
Nongoma	4,116	1,646	2,470	257	2,213
Somkele	6,133	2,453	3,680	467	3,213
Utrecht	2,265	906	1,359	950	409
Vryheid	2,084	834	1,250	222	1,028
GRAND TOTAL	**19,059**	**7,623**	**11,436**	**3,591**	**7,845**

*GTIS: Gross Tonnes in Situ
**TTIS: Total Tonnes in Situ

The majority of the farms identified with potential for economic coal extraction occur within the Klip River Coalfield. The Klip River Coalfield accounts for 313 (68%) of the farm entries (Figure 31) of the total 490 identified potential farms. This is probably due to the great size of the coalfield and the vast number of boreholes drilled in the Klip River Coalfield. The Somkele and Nongoma Coalfields have far fewer potential farms, 10 and 12 potential farms respectively. This is due to the smaller size of the coalfield in proportion to the Klip River Coalfield, to fewer number of boreholes drilled, and to the larger farms that occur in the area of these coalfields. Note that although the total number in the Klip River Coalfield is the highest it only relates to 23% of the resource tonnage (Figure 29).

9.6 High Ranking Coal Farms

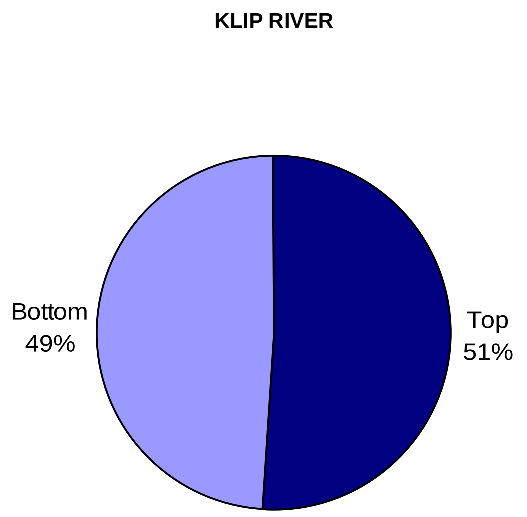
All the farms listed in Appendix 3 have been identified as prospectus for economic coal extraction. However, Figure 32 shows that the majority of the potential farms have a ranking between 0 and 10, with very few farms falling into the 31 to 40 category. Klip River has the highest number of potential farms falling in the 31 to 40 category, and therefore has the highest number of high potential farms. Vryheid, Nongoma and Somkele Coalfields have no potential farms in the 31 to 40 category. This study suggests that the most prospective areas for coal resources to be re-evaluated are in the western areas of KwaZulu-Natal but this is also partly due to the volume of historical information that was used and incorporated into the GIS database. Since the best way to generate renewed interest in the Province's coal industry is to provide access to historical information this study represents a method of demonstrating where that information exists. For coal resource companies and those wanting to move into the KwaZulu-Natal coal sector as new entrants this will assist in reducing the need for green fields exploration.

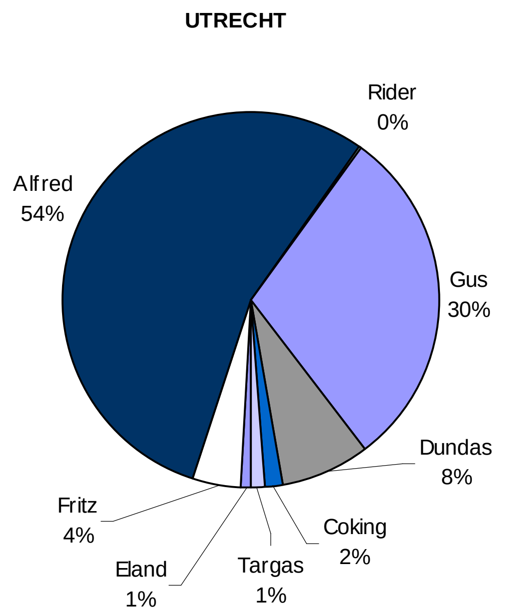
The 18 top-rated areas are summarised in Table 7. The farm with the highest rating is Roy Point 2959 and occurs in the Klip River Coalfield. The majority of the high potential farms occur in the Klip River Coalfield, with only two farms occurring in the Utrecht Coalfield. In the past the majority of the mining activity occurred in the Klip River Coalfield, but due to its large size, it still hosts large volumes of coal resources.

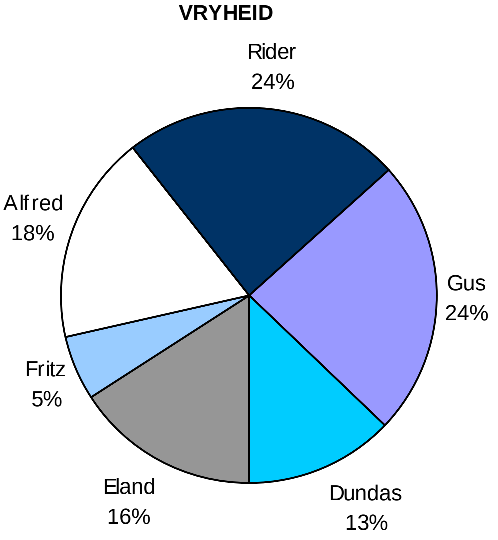
Table 7 : Top 18 Farms, all with Ratings above 30

FARM NAME	FARM NUMBER	COALFIELD	RATING
Roy Point	2959	Klip River	37.71
Newcastle Townland	4702	Klip River	37.50
Braak Fontein	4278	Klip River	35.94
Tiger Kloof	3333	Klip River	35.50
Yarl	2962	Klip River	35.50
Nooitgedacht	90	Utrecht	33.66
Avalon	14869	Klip River	32.51
Rendsburg	80	Utrecht	32.50
Tuam	13485	Klip River	32.50
Uithoek	1335	Klip River	32.02
Lot A of Loch End	10896	Klip River	31.74
Walmsley	4266	Klip River	31.09
Klip Rand	3723	Klip River	30.54
Leicester	2970	Klip River	30.50
Zoetmelksrivier	86	Utrecht	30.50
Vaalbank	103	Klip River	30.50
Geluk	17067	Utrecht	30.50
Klein Fontein	1262	Klip River	30.42

Figure 30 : Percentage of Tonnages in KwaZulu-Natal 's Coalfield Seams

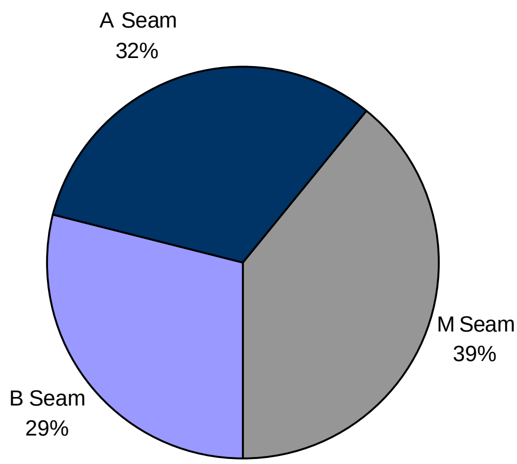




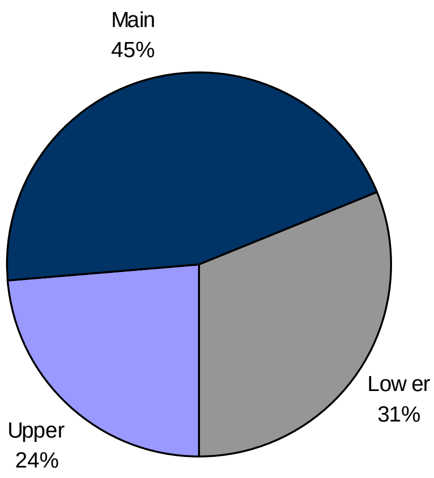


KwaZulu-Natal's Tonnages in the Coalfield Seams

NONGOMA

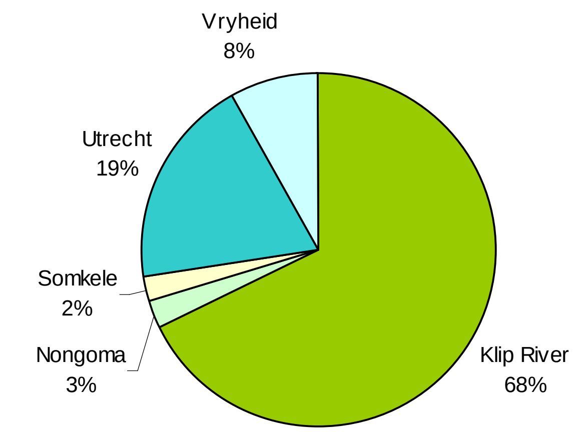


SOMKELE



Source: This Study

Figure 31 : Percentage of Farms with Potential



Source: This Study

These farms ranked the highest because:-

- they have the large tonnages;
- they have both opencast and underground potential;
- 10 of the 18 farms has a defunct mine; and
- they have a large number of borehole data which increases the confidence in the resource estimation.

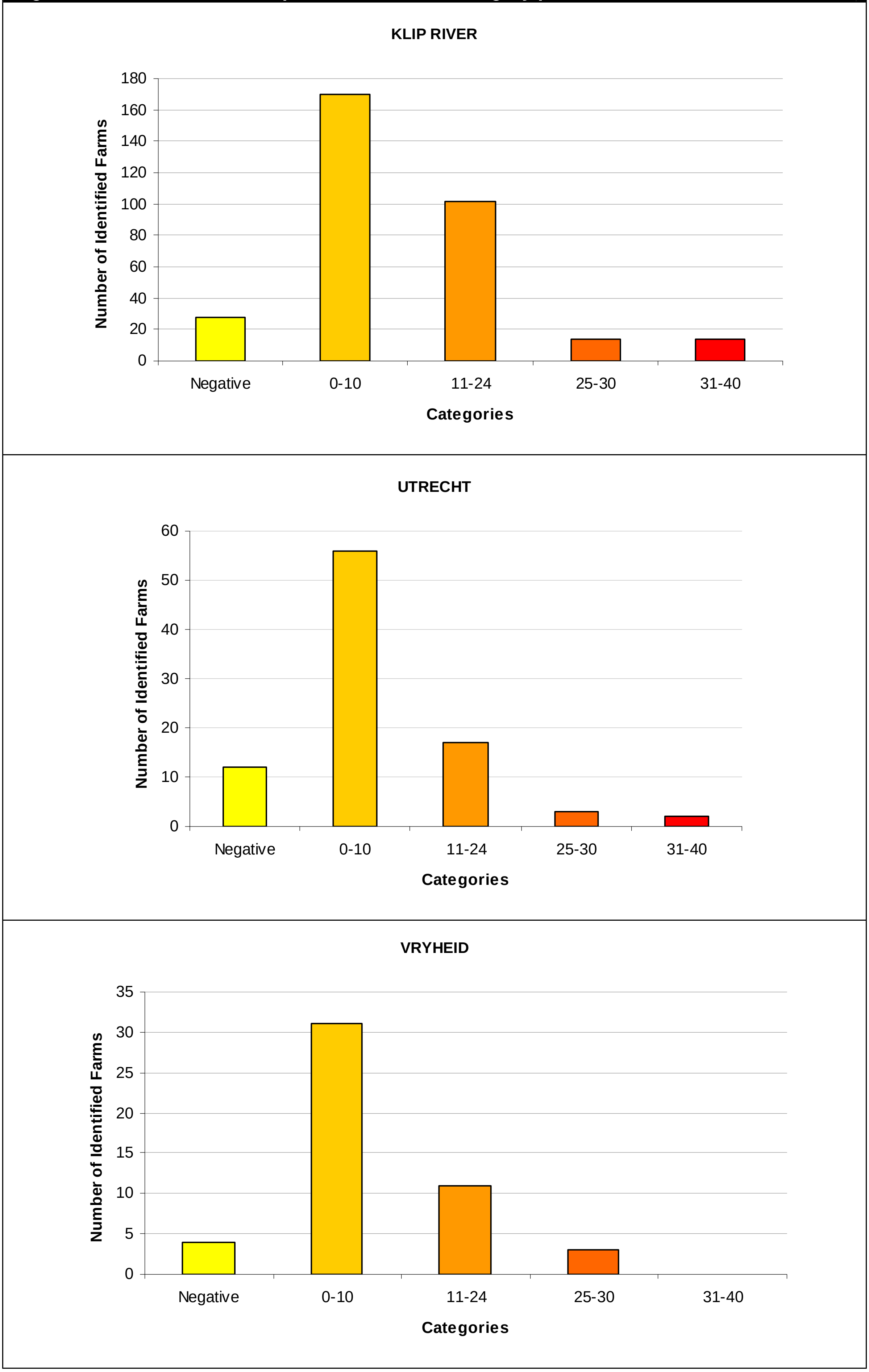
The areas with the highest rating are shown in Appendix 4. These are the "hot" areas identified for further surface exploration. Further drilling and sampling in these high potential areas will increase the confidence in resources with the potential to convert them into reserves.

9.7 Consultants Outlook

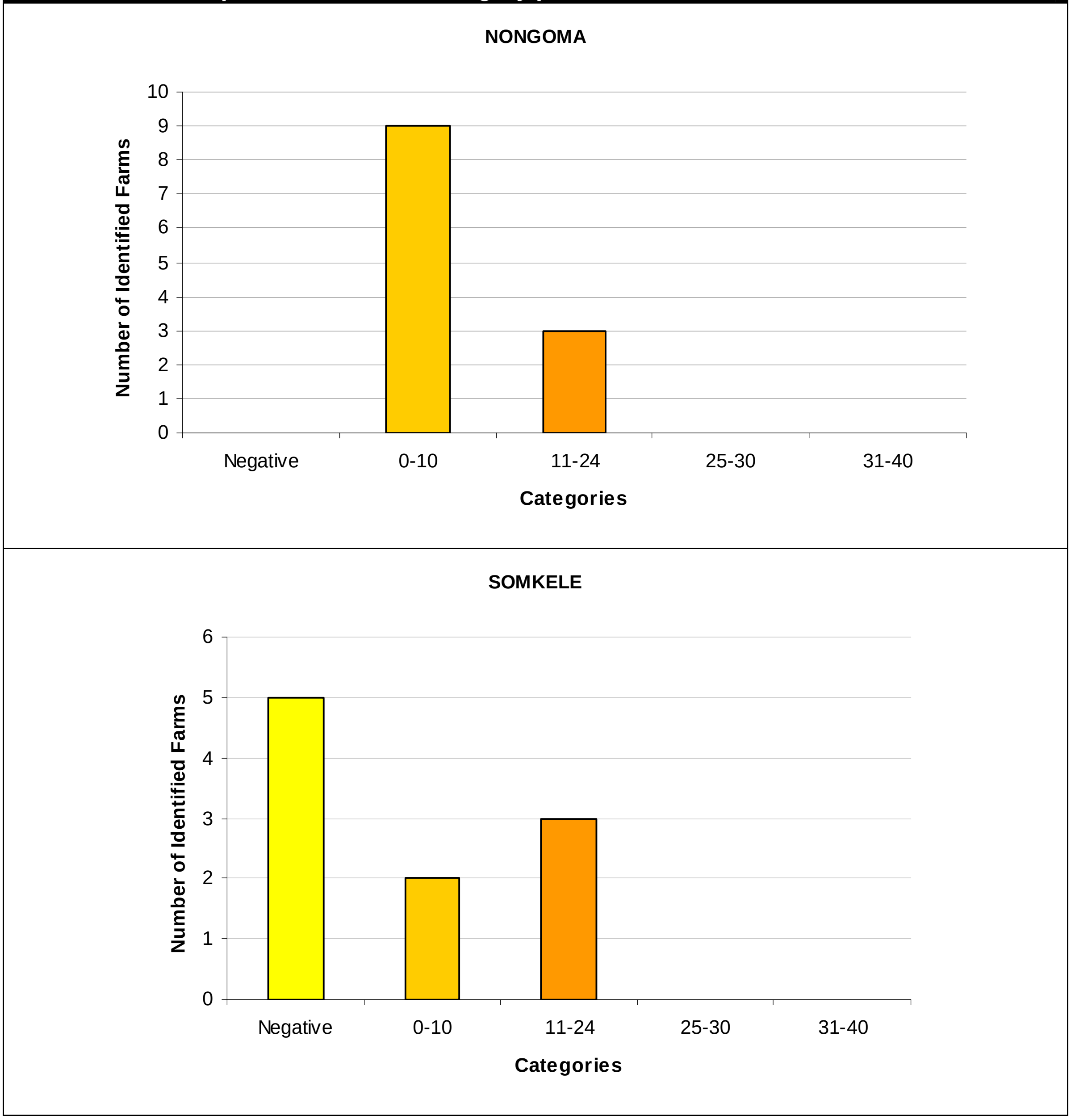
A geologist residing in the coalfields area, who has over 20 years experience in KwaZulu-Natal Coal was contacted. He believes that the coal industry in KwaZulu-Natal is currently booming with a few main players sweeping up the available land with coal with it. It is understood that the majority of Vryheid already has mining rights applications which have been accepted. Some suggestions have been included into the rating scheme. These areas, amongst others, are listed below:-

- Braakfontein Area;
- Magdalena Colliery;
- Aviemore Colliery;
- Platberg and Elandsberg Areas;
- Dannhauser Area;
- Koedelager Area; and
- The area between Volksrust and Paulpietersburg.

Figure 32 : Number of Farms per Classification Category per Coalfield



Number of Farms per Classification Category per Coalfield



Source: This Study

10 ENVIRONMENTAL ISSUES

10.1 KwaZulu-Natal Situation

Over time there has been a marked increase in coal production in South Africa. This has resulted in an increase in discards and slurry. The environmental controls at the onset of coal mining were not a priority resulting in reckless dumping of mine waste by the mines.

In 2003 a project was commissioned by the DME to assess the amount of discard coal in South Africa. The results were obtained from a questionnaire (Appendix 5) submitted by mines with existing dumps. The survey excluded ownerless and derelict mines. This information was then collated in a GIS. Unfortunately Mintek was unable to obtain these GIS shape files as this information is not publicly available. However, a summary report of this information was made available. The results shown in this report is a summary regarding only KwaZulu-Natal.

This report identified that in the past there was no compacting of the dumps resulting in spontaneous combustion. The other major problems resulting from this mismanagement of the coal dumps, identified in the DME report, are the pollution of the:-

- ground water;
- runoff; and
- atmosphere.

A list of defunct mines with available environmental information is included in Table 8. The further analysis that has been done has been based on these defunct mines.

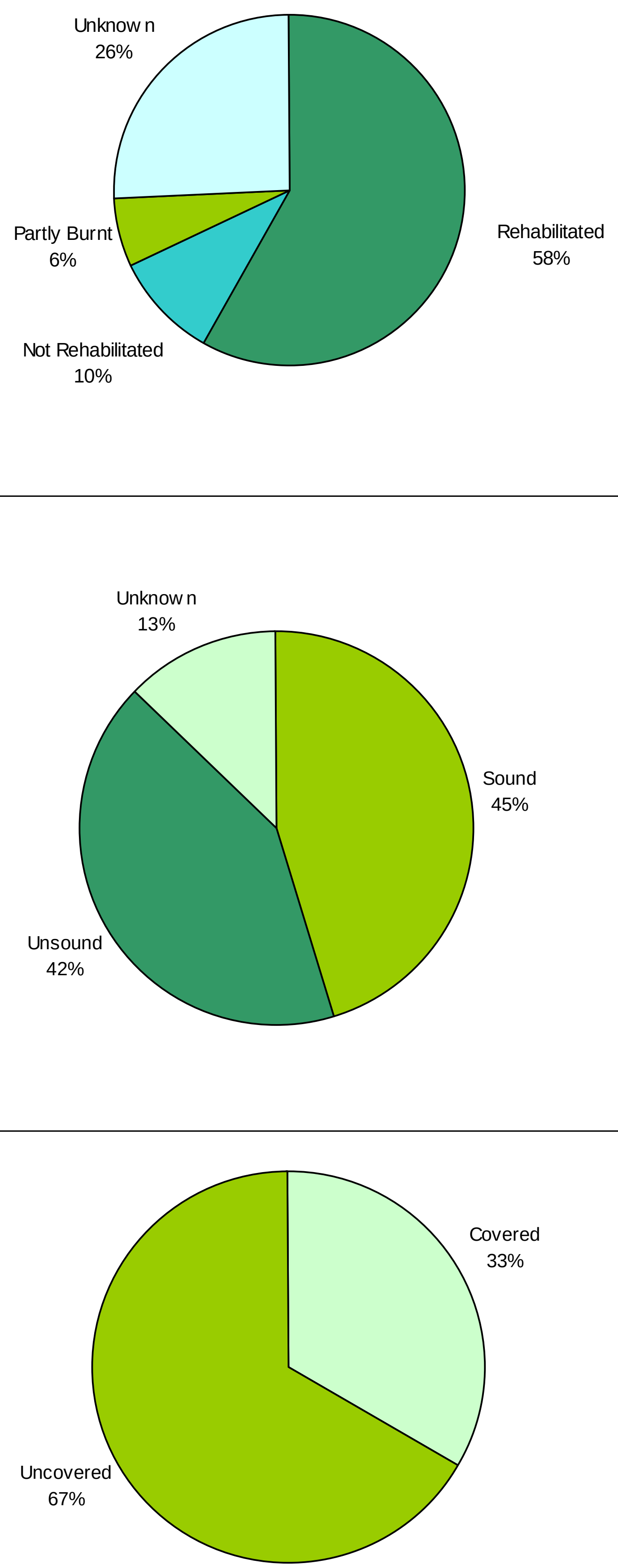
The majority of the dumps in KwaZulu-Natal have been rehabilitated. Figure 33 also shows the proportion of unsound and uncovered mine dumps. Further mismanagement of these higher risk mine dumps could lead to a significant increase in the proportion of non-rehabilitated and partly-burnt mine dumps. The significant proportion of unknown mine dumps is of concern and poses a high risk to effective environmental management of the mine dumps.

The closure funds for the defunct mines are listed in Table 8. There is a significant differential between mining companies regarding the value of the closure funds.

Table 8 : Defunct Collieries in KwaZulu-Natal and their Respective Dumps

<table>
<tr><th>COLLIERY</th><th>DUMP NAME</th><th>CLOSURE COST (ZAR)</th></tr>
<tr><td>Kilbarchan Colliery</td><td>Kilbarchan Dump</td><td>702,810</td></tr>
<tr><td>Zululand Anthracite</td><td>ZAC Discard</td><td>1,200,000</td></tr>
<tr><td rowspan="4">Durnacol</td><td>No 1 Dump</td><td>840,000</td></tr>
<tr><td>No 3 Dump</td><td>2,150,000</td></tr>
<tr><td>No 7 Dump</td><td>2,700,000</td></tr>
<tr><td>No 8 Dump</td><td>1,000,000</td></tr>
<tr><td rowspan="10">Hlobane Colliery</td><td>High Carbon Products Dump</td><td>1,600,000</td></tr>
<tr><td>Gus Dump</td><td>2,800,000</td></tr>
<tr><td>Mountain Adit Dump</td><td>408,000</td></tr>
<tr><td>No 1 Dump</td><td rowspan="7">8,800,000</td></tr>
<tr><td>Slimes Dam No 1</td></tr>
<tr><td>Slimes Dam No 2</td></tr>
<tr><td>Slimes Dam No 3</td></tr>
<tr><td>Slimes Dam No 4</td></tr>
<tr><td>Slimes Dam No 5</td></tr>
<tr><td>Slimes Dam No 6</td></tr>
<tr><td rowspan="2">Natal Ammonium Colliery</td><td>Natal Ammonium Dump</td><td>3,150,000</td></tr>
<tr><td>Natal Cambrian Dump</td><td>9,596,000</td></tr>
</table>

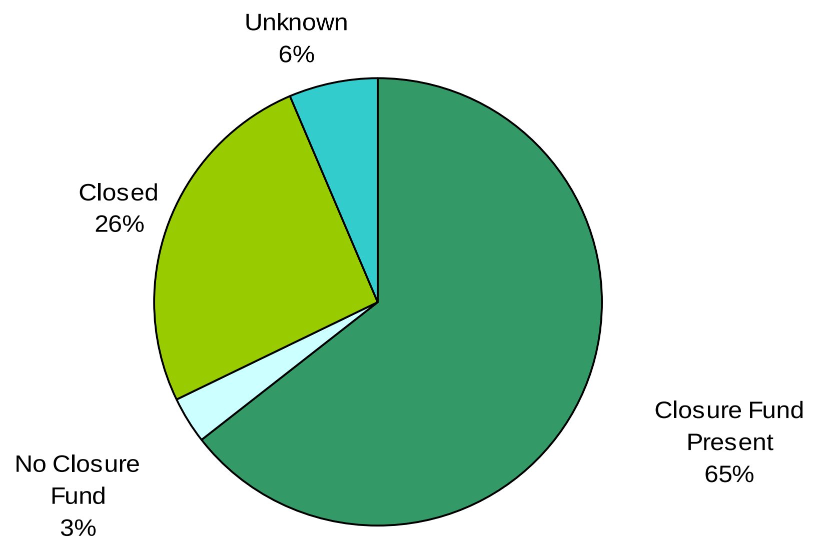
Figure 33 : Percentage of the Environmental Status of the Defunct Mine Dumps



Source: DME 2003

Figure 34 shows the status of these closure funds. A promising fact is that over a quarter of the mine dump closure funds have been closed. There is a small portion of the mine dumps that currently do not have closure funds allocated to them, and this may pose a problem in the future, unless government intervention is sought.

Figure 34: Proportion of Closure Fund Statuses for the Defunct Mines



Source: DME 2003

10.2 The Way Forward

Over the last eight years the laws around environmental management have become much firmer. In order to manage the dumps to give them a long-term value the following are suggested:-

- compact the layers of discard and soil to restrict the access of air to the dump;
- clad the edges of the dump with soil to further restrict the access of air to the dump;
- dumps with high CV's could be retreated to obtain "middlings" coal products; and
- constant monitoring of the dumps will alert one to any unforeseen problems.

11 CONCLUSIONS

KwaZulu-Natal has over 11,000Mt remaining reconnaissance coal resources. The majority of the coal resources are located in the Somkele, Klip River and Nongoma Coalfields. Although the Klip River Coalfield has been mined extensively over the years, there still remains a large amount of resources in the coalfield.

COALFIELD	GTIS 2007 (Mt)	GEOLOGICAL LOSSES AT 40%	IN SITU RECCONNAISSANCE COAL RESOURCES (TTIS) (Mt)	TOTAL 1997 (Mt) (TTIS)	2007-1997 DIFFERENCE
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GRAND TOTAL	**19,059**	**7,623**	**11,436**	**3,591**	**7,845**

*GTIS: Gross Tonnes In Situ
**TTIS: Total Tonnes In Situ

A total of 490 farms, listed in Appendix 3, have been identified as having potential for eventual economic coal extraction. The majority of the potential farms have ranked between 0 and 10, with very few farms which fall in the 31 to 40 category.

This study has demonstrated that KwaZulu-Natal has a large remaining resource base which has potential for development. The Klip River Coalfield has the greatest percentage of high potential projects and therefore this area should be the focus of future investment. The location of groups of high potential farms should be used to the advantage of the operators.

In order to promote the coal industry within KwaZulu-Natal, the Province's distinct advantages must be focused upon. These include:-

- proximity to the export points through the ports of Richards Bay and Durban. With the increasing costs and unreliability of rail transport, as well as the increasing road transport costs associated with the diesel price, KwaZulu-Natal offers a cost advantage; and
- ability to produce high quality niche market coals including low phosphorous anthracite and coking coal.

The focus of the Province's promotion of its coal industry must be on small-medium scale underground and opencast mining operations (eg. 50,000tpm) to extract and beneficiate niche products.

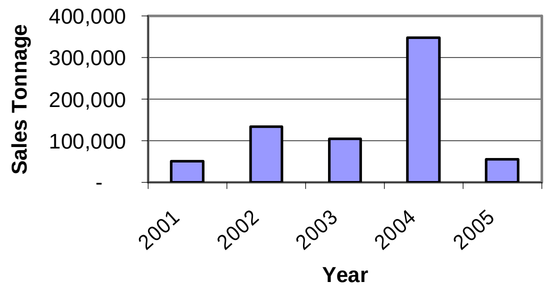
Small-medium scale mining may also have additional economic potential if a number of separate mining operations supply ROM coal to a central processing facility. In this way the small tonnages produced by the individual mines can be amalgamated into a critical mass at the plant and then be sold into the market. This diverse number of operations would decrease the risk of coal supply to the plant and decrease the capital required for each mine. The plant may be owned and operated by a separate company or owned on a share basis by the surrounding mines. Alternatively, portable plants may be utilised and moved from deposit to deposit as tonnages are extracted.

This type of mining is probably not suited for major companies but are highly prospective for small and medium operators.

Appendix 1 : Operating Mine Information Sheets

MINE INFORMATION SHEET			
Mine Name	Aasvoelkrantz Section		
Current Status	Closed		
Current Owner	Kangra Group		
Coalfield	Utrecht		
Seam/s	Gus		
Coal Product	Steam Coal		
Mining Method	Underground		
Coal Prepartation Method	Crushing / screening / double of single stage washing		
Point of Sale	30% exported from Richards Bay & 70% inland market		
Brief History	**Date**	**Event**	
Total Sales Tonnage			
Product Size			
Average Sales Quality	**CV**		
	Ash		
	Vols		
	S		
General Comments	No information available		

MINE INFORMATION SHEET		
Mine Name	Aviemore Colliery	
Current Status	Operating	
Current Owner	Slater Coal	
Coalfield	Klip River	
Seam/s	Gus	
Coal Product	Anthracite	
Mining Method	Underground	
Coal Prepartation Method		
Point of Sale	Export from Richards Bay & Inland market	
Brief History	**Date**	**Event**
	2004	Change from only mining the Gus seam to mining both the Gus and Alfred seam
	2004	Change from mining underground to opencast
Total Sales Tonnage	2001	50,000
	2002	135,000
	2003	105,000
	2004	348,000
	2005	55,000
Product Size	Large nut, small nut, pea, duff.	
Average Sales Quality	**CV**	302,225
	Ash	12,85
	Vols	7,075
	S	2
General Comments	No information available	



MINE INFORMATION SHEET		
Mine Name	Klipspruit Colliery	
Current Status	Operating	
Current Owner	Kangra Group	
Coalfield	Utrecht	
Seam/s	Gus	
Coal Product	Steam coal	
Mining Method	Underground	
Coal Prepartation Method	Crsuhing, screening, washing and re-screening at the railhead.	
Point of Sale	50% exported from Richards bay & 50% inland market	
Brief History	**Date**	**Event**
	1987	Commenced production
Total Sales Tonnage		
Product Size		
Average Sales Quality	**CV**	
	Ash	
	Vols	
	S	
General Comments	No information available	

MINE INFORMATION SHEET		
Mine Name	Knights Hill Section	
Current Status	Operating/Planned mine	
Current Owner	Kangra Group	
Coalfield	Utrecht	
Seam/s	Gus	
Coal Product	Steam Coal	
Mining Method	Underground	
Coal Prepartation Method	Crushing / screening / double of single stage washing	
Point of Sale	30% exported from Richards Bay & 70% inland market	
Brief History	**Date**	**Event**
Total Sales Tonnage		
Product Size		
Average Sales Quality	**CV**	
	Ash	
	Vols	
	S	
General Comments	No information available	

MINE INFORMATION SHEET			
Mine Name	Braakfontein Colliery		
Current Status	Operating		
Current Owner	Leeuw Mining and Exploration		
Coalfield	Klip River		
Seam/s	Seam 2		
Coal Product	Steam Coal		
Mining Method	Opencast / underground		
Coal Prepartation Method	Crushing / screening / double of single stage washing		
Point of Sale	Export from Richards Bay & Inland market		
Brief History	**Date**	**Event**	
Total Sales Tonnage			
Product Size			
Average Sales Quality	**CV**		
	Ash		
	Vols		
	S		
General Comments	No information available		

MINE INFORMATION SHEET			
Mine Name	Geluk Colliery		
Current Status	Operating/closed for care and maintenance		
Current Owner	Utrecht & Dundee Coalfields		
Coalfield	Utrecht		
Seam/s	Dundas		
Coal Product	Anthracite		
Mining Method	Underground		
Coal Prepartation Method			
Point of Sale			
Brief History	**Date**	**Event**	
Total Sales Tonnage			
Product Size			
Average Sales Quality	**CV**		
	Ash		
	Vols		
	S		
General Comments	No information available		

MINE INFORMATION SHEET

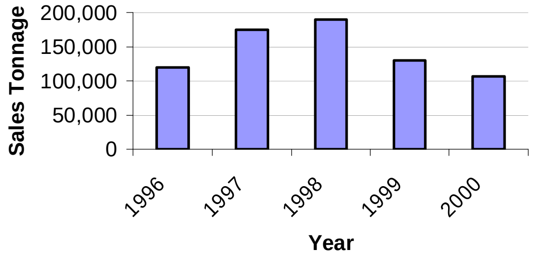
Mine Name	Heritage Colliery
Current Status	Closed with Reserves
Current Owner	Vryheid Coalfields Mines
Coalfield	Vryheid
Seam/s	Dundas
Coal Product	Anthracite
Mining Method	Underground
Coal Prepartation Method	Crushing, screening and washing, with rescreening at the railhead.
Point of Sale	

Brief History

Date	Event
1995	Change of ownership from Savage and Lovemore Mining (Pty) Ltd to Lonrho Management Services Ltd
1995	Change in seams mined from Alfred, Gus and Dundas to Dundas only
1999	Change in Controlling Company from Duiker Mining to Century Carbon Mining Ltd
2001	Operation temporarily ceased
2002	Change in Ownership top SA Carbon Holdings

Total Sales Tonnage

1996	120,000
1997	175,000
1998	190,000
1999	130,000
2000	107,000
2002	



Product Size	small nut, pea, duff, fine

Average Sales Quality

CV	28.6275
Ash	17.75
Vols	7.65
S	0.38

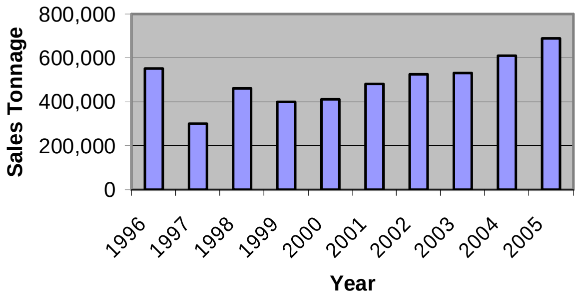
General Comments	No information available

MINE INFORMATION SHEET			
Mine Name	Nooitgedacht		
Current Status	Operating		
Current Owner	Utrecht & Dundee Coalfields		
Coalfield	Utrecht		
Seam/s	Coking		
Coal Product	Anthracite		
Mining Method	Underground		
Coal Prepartation Method			
Point of Sale	Inland market		
Brief History	**Date**	**Event**	
Total Sales Tonnage			
Product Size			
Average Sales Quality	**CV**		
	Ash		
	Vols		
	S		
General Comments	No information available		

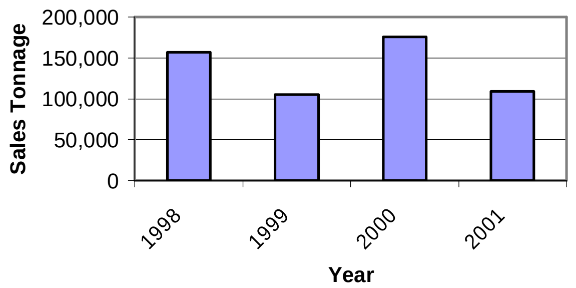
MINE INFORMATION SHEET		
Mine Name	Oakhurst Section	
Current Status	Closed with Reserves	
Current Owner	Vryheid Coalfields Mines	
Coalfield	Vryheid	
Seam/s	Gus	
Coal Product	Anthracite	
Mining Method	Underground	
Coal Prepartation Method	Washing	
Point of Sale		
Brief History	**Date**	**Event**
	1988	Change in Mining method to only opencast, mining only the Alfred seam
	1995	Change in Contriolling Company to KwaZulu Mines
	1995	Mining only the Gus seam
	1995	Change in mining method to underground
	1998	Change in name to Nyembe/Oakhurst Colliery
	1999	Change in Controlling Company to Century Carbon Mining
	2002	Change in ownership to SA Carbon Holdings
Total Sales Tonnage	1986	754
Product Size	large nuts, small nut, pea, duff	
Average Sales Quality	**CV**	30.9175
	Ash	13
	Vols	5.7975
	S	0.86
General Comments	No information available	

MINE INFORMATION SHEET		
Mine Name	Riversdale Colliery	
Current Status	Operating	
Current Owner	Richards Bay Minerals	
Coalfield	Klip River	
Seam/s	Gus	
Coal Product	Lean bituminous / anthracite	
Mining Method	Uunderground	
Coal Prepartation Method	Crushing / screening / double of single stage washing	
Point of Sale	Export from Richards Bay & Inland market	
Brief History	**Date**	**Event**
Total Sales Tonnage		
Product Size		
Average Sales Quality	**CV**	>30
	Ash	11-12
	Vols	4-10
	S	<1.0
General Comments	No information available	

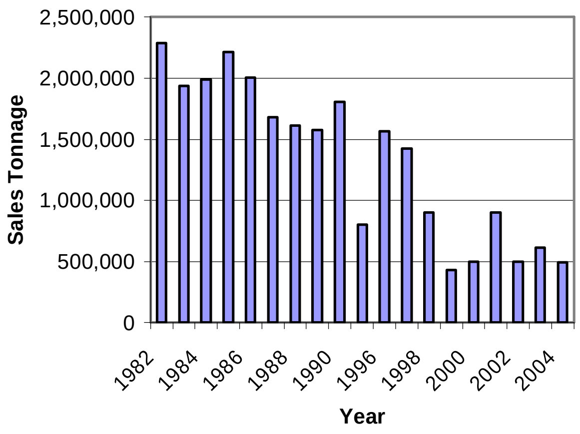
MINE INFORMATION SHEET		
Mine Name	Springlake Colliery	
Current Status	Operating	
Current Owner	Afriore	
Coalfield	Klip River	
Seam/s	Bottom Seam	
Coal Product	Anthracite	
Mining Method	Mechanised bord and pillar	
Coal Prepartation Method	Washing	
Point of Sale	Export from Richards Bay & Inland market	
Brief History	**Date**	**Event**
	1993	Change in controlling company from Natal Coal Exploration to Tweewaters Fue
	1998	Change in ownership to Afriore (Pty) Ltd
	2003	Change in ownership to Springlake Holdings Ltd
Total Sales Tonnage	1996	550,000
	1997	300,000
	1998	460,000
	1999	400,000
	2000	412,000
	2001	480,000
	2002	524,000
	2003	530,000
	2004	609,000
	2005	690,000
Product Size	large nut, small nut, pea, duff,	
Average Sales Quality	**CV**	29.94
	Ash	12.34
	Vols	7.03
	S	2.01
General Comments	No information available	



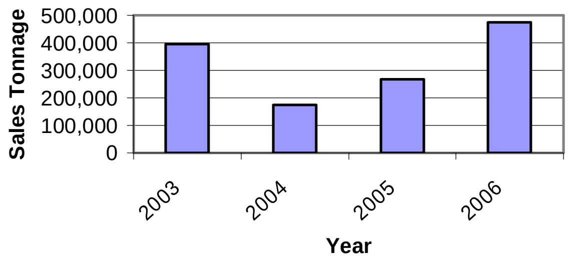
MINE INFORMATION SHEET		
Mine Name	Tendeka North	
Current Status	Closed with Reserves	
Current Owner	Utrecht and Dundee Coalfields	
Coalfield	Klip River	
Seam/s	Top	
Coal Product	Lean bituminous	
Mining Method	Opencast and Underground	
Coal Prepartation Method		
Point of Sale		
Brief History	**Date**	**Event**
	2002	Mine closed for Care and maintenance
	2002	Change of ownership from CBR Mining Pty Ltd to Slater Coal
	2003	Operations ceased
Total Sales Tonnage	1998	157,000
	1999	105,000
	2000	176,000
	2001	109,000
	2002	
	2003	
Product Size		
Average Sales Quality	**CV**	
	Ash	
	Vols	
	S	
General Comments	No information available	



MINE INFORMATION SHEET		
Mine Name	Umgala Section	
Current Status	Operating	
Current Owner	Kangra Group	
Coalfield	Utrecht	
Seam/s	Gus/Alfred	
Coal Product	Anthracite	
Mining Method	Underground	
Coal Prepartation Method	Crushing / screening / double of single stage washing	
Point of Sale	100% exported from Richards Bay	
Brief History	**Date**	**Event**
	1991	Mine operations temporarily suspended
	1991	Change in mining method to both Underground and Opencast
	1996	Change in Controlling compeny to GENCOR through Ingwe Coal Corp Ltd.
	1996	Change in name from Umgala Section to Welgedacht Mine
	1999	Combined the Umgala Section and the Zimbutu Section
	2000	Change in Mining method to only Opencast
	2004	Mining Operations suspended in Nov 2004
	2005	Change in Controlling compeny to Kangra Group (Pty) Ltd
Total Sales Tonnage	1982	2,286,000
	1983	1,936,000
	1984	1,990,000
	1985	2,210,000
	1986	2,004,000
	1987	1,679,000
	1988	1,611,000
	1989	1,576,000
	1990	1,805,000
	1995	803,000
	1996	1,564,000
	1997	1,426,000
	1998	900,000
	1999	432,000
	2000	500,000
	2001	900,000
	2002	500,000
	2003	612,000
	2004	495,000
Product Size		
Average Sales Quality	**CV**	
	Ash	
	Vols	
	S	
General Comments	No information available	

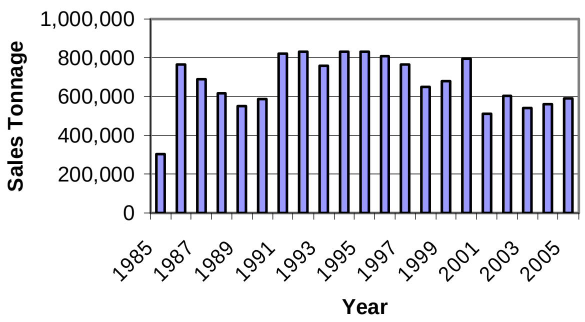


MINE INFORMATION SHEET		
Mine Name	Vaalkranz Colliery	
Current Status	Operating	
Current Owner	Leeuw Mining and Exploration	
Coalfield	Klip River	
Seam/s	Gus / Alfred	
Coal Product	Anthracite	
Mining Method	Underground	
Coal Prepartation Method	Bord and pillar. High medium double stage cyclone washing plant operation producing	
Point of Sale	Export from Richards Bay & Inland market	
Brief History	**Date**	**Event**
Total Sales Tonnage	2003	396,000
	2004	175,000
	2005	268,000
	2006	474,000
Product Size		
Average Sales Quality	**CV**	
	Ash	13.55
	Vols	5.3
	S	0.91
General Comments	Mined opened after Anglo Coal sold their remaining KZN reserves to LME.	
	Combined with Enyati and mined from the same shaft.	



MINE INFORMATION SHEET		
Mine Name	Waterval Colliery	
Current Status	Closed with Reserves	
Current Owner	Vryheid Coalfields Mines	
Coalfield	Vryheid	
Seam/s	Dundas	
Coal Product	Anthracite	
Mining Method	Underground	
Coal Prepartation Method		
Point of Sale		
Brief History	**Date**	**Event**
	1999	Change of ownership to Century Carbon Mining Ltd
	2002	Change of ownership to SA Carbon Holdings
Total Sales Tonnage		
Product Size	Cobble, Large nut, Small nut, Pea, Duff, Spiral	
Average Sales Quality	**CV**	30,02
	Ash	12,675
	Vols	6,03
	S	1,143
General Comments	No information available	

MINE INFORMATION SHEET		
Mine Name	Zululand Anthracite Colliery	
Current Status	Operating	
Current Owner	Petmin Limited	
Coalfield	Nongoma	
Seam/s	Main	
Coal Product	Anthracite	
Mining Method	Underground	
Coal Prepartation Method	Washing	
Point of Sale	Both Export from Richards Bay	
Brief History	**Date**	**Event**
	1985	Commenced production
	1994	Change in controlling company from GENCOR to Ingwe Coal Corporated
	1997	Change in controlling company from Trans-Natal Coal Corporation Ltd to Billiton SA Ltd.
	2005	Sold to Khulani Resources (BEE)
Total Sales Tonnage	1985	303,000
	1986	765,000
	1987	687,000
	1988	616,000
	1989	549,000
	1990	587,000
	1991	821,000
	1992	832,000
	1993	756,000
	1994	830,000
	1995	831,000
	1996	808,000
	1997	765,000
	1998	650,000
	1999	680,000
	2000	792,000
	2001	510,000
	2002	604,000
	2003	540,000
	2004	561,000
	2005	591,000
Product Size	70x40mm, 45x20mm, 20x0mm, 10x0.5mm, Middling	
Average Sales Quality	**CV**	1.35
	Ash	12.06
	Vols	5.58
	S	0.88
General Comments	This is a large mine. There is good infrastructure on the mine, and a washing plant siding on Richards Bay Line	



Appendix 2 : Complete List of Farms with Mining Potential

FARM NAME	FARM NO	FARM AREA (km^2)	COALFIELD	RATING RESULT
A OF ROOIPOORT	10745	4	Klip River	5
ACOL	5494	3	Klip River	17
ADENDORFF	14290	5	Klip River	14
ALLEEN 2	4280	4	Klip River	0
ALLEEN NO 1	15592	4	Klip River	-5
AMALINDA OF PADDAVLEI	8230	6	Klip River	3
ANGORA HILL	9807	3	Klip River	9
ANNANDALE	2960	12	Klip River	22
AVALON	14869	8	Klip River	33
B OF GIFKOP	10377	0	Klip River	2
BANFF	8716	8	Klip River	10
BANNOCKBURN	8868	6	Klip River	15
BANNOCKBURN NO 2	8549	1	Klip River	5
BEESES FONTEIN	2421	13	Klip River	2
BEREFORD	3573	1	Klip River	6
BERESFORD	3573	3	Klip River	2
BERGHEIM	16324	4	Klip River	15
BISMARCK	8561	8	Klip River	8
BLACKBANK	8715	8	Klip River	13
BLACKWATER VALE	8685	0	Klip River	3
BORDEAUX	16341	3	Klip River	12
BOSCH BERG	1135	30	Klip River	4
BOSCH HOEK	1312	34	Klip River	4
BOSCH HOEK	3345	13	Klip River	29
BRAAK FONTEIN	4278	13	Klip River	31
BRAAKWATER SOUTH OF BRAAKWATER	7910	4	Klip River	8
BRACK HOEK	2271	12	Klip River	12
BRAZIL	13143	6	Klip River	17
BROADFIELDS OF LOCH END	10789	5	Klip River	4
BUCCLEUGH	8712	2	Klip River	11
BUFFALO RIVER	4308	13	Klip River	10
BULWER	4250	3	Klip River	3
BURNSIDE	3287	33	Klip River	23
CARDWELL	4340	12	Klip River	4
CARNARVON	4264	14	Klip River	19
CARRICK	7298	7	Klip River	17
CAVAN	8794	8	Klip River	2
CECIL	8378	4	Klip River	-7
CELLE	8671	4	Klip River	10
CHELMSFORD (Combined)	8642	6	Klip River	7
CHERHAM PARK	16213	8	Klip River	11
CHRISTIANA	9369	4	Klip River	10
CHURCH	4697	0	Klip River	5
CINDERFORD	2252	12	Klip River	9
CLEOPATRA'S NEEDLE	5837	3	Klip River	2
CLEVELAND	15597	4	Klip River	15
CLIFTON	8936	7	Klip River	18
CLONEEN	7591	8	Klip River	9
COALFIELD	2273	8	Klip River	7
COALFIELDS	5648	36	Klip River	17
CORBY ROCK	11509	7	Klip River	16
CORK	12210	2	Klip River	-4
COTSWOLD	4332	16	Klip River	7
CRAIG	2989	12	Klip River	8
CRAIGHEAD	15739	16	Klip River	1
CRONJE'S FLAT	7506	4	Klip River	11

FARM NAME	FARM NO	FARM AREA (km^2)	COALFIELD	RATING RESULT
DARTRY	6968	3	Klip River	29
DAVELS SPRUIT	3742	0	Klip River	5
DAVELSVLAKTE	8464	6	Klip River	13
DE WET STREAM	3309	12	Klip River	3
DEVON	7575	3	Klip River	3
DIAMOND	9125	8	Klip River	15
DIEPSLUITEN	4270	4	Klip River	10
DONDOLA A	8493	3	Klip River	10
DOORN KOP	2963	0	Klip River	-7
DOORNKRAAL	1296	31	Klip River	6
DOORNPLAAT	2392	12	Klip River	6
DOORNSLUITEN	14366	16	Klip River	27
DOUBLE KRAAL	6754	5	Klip River	6
DOVERCOURT (Combined)	7934	7	Klip River	7
DRIE FONTEIN	1092	32	Klip River	22
DRIFT	8684	3	Klip River	7
DROOG PLAATS	3744	3	Klip River	8
DROOGE PLAATS	7681	8	Klip River	17
DROOGMYNKEEL	4093	1	Klip River	5
DRYCUT A	8198	4	Klip River	24
DUMAIN	3323	15	Klip River	10
DUMFIRMLINE	3321	14	Klip River	-7
DWARS NEK	9450	5	Klip River	8
EAST LYNNE	7670	4	Klip River	13
EASTKEAL	5138	8	Klip River	7
EBENEZER	8113	2	Klip River	7
ELANDS JAGT	1372	32	Klip River	3
ELANDS LAAGTE	1239	34	Klip River	12
ELANDSVLEI	16322	7	Klip River	3
ELIZABETH	3726	4	Klip River	5
EXMOOR	8095	7	Klip River	19
FAIRBREEZE A	9210	4	Klip River	19
FAIRBREEZE B	9884	4	Klip River	19
FLINT	9356	4	Klip River	3
FORTS	8502	6	Klip River	14
FOUNTAIN DALE	3608	2	Klip River	15
FOUNTAINDALE NO 3	4272	6	Klip River	24
GARDENS	7239	3	Klip River	-2
GARDINIA	8486	7	Klip River	12
GEDULT	3700	0	Klip River	5
GEDULT A NO 2	8038	2	Klip River	4
GEDULT B NO 2	8608	2	Klip River	11
GEFKOP A	5880	4	Klip River	2
GERTS KLOOF	8535	2	Klip River	7
GLADSTONE	4331	10	Klip River	29
GLEN BARTON	3343	16	Klip River	-3
GLEN CALDER	8260	17	Klip River	18
GLENALGY	9095	3	Klip River	15
GLENCOE	3507	14	Klip River	10
GOEDE GELOOF	8703	5	Klip River	14
GOEDE HOOP	3857	4	Klip River	8
GORDON	9481	6	Klip River	17
GORDON'S LUCK	12072	1	Klip River	3
GOUDINE	8789	1	Klip River	9
GOWAN BRAE NO 2	10675	2	Klip River	5
GOWRIE	2248	12	Klip River	11
GROENE HOEK	3860	0	Klip River	8
GROOTGELUK	8534	8	Klip River	11
GUELDERLAND	15608	8	Klip River	-7
HARTE RIVIER	3324	15	Klip River	1

FARM NAME	FARM NO	FARM AREA (km^2)	COALFIELD	RATING RESULT
HATTING DALE	3626	1	Klip River	4
HAYFIELD	8568	3	Klip River	8
HAZELDENE	12649	29	Klip River	17
HEILBRON	15594	4	Klip River	7
HEILBRON NO 2	8148	2	Klip River	13
HENLEY	7465	8	Klip River	14
HERONS COURT	8521	7	Klip River	14
HESOMDALE	5129	7	Klip River	10
HILL TOP	9314	5	Klip River	14
HORN RIVER	4305	9	Klip River	15
INKRUIP	5273	8	Klip River	2
INNISKILLING	8590	3	Klip River	5
INVARY	2967	12	Klip River	12
IRONSTONE BRAE	8597	2	Klip River	8
JACK'S CORNER	9440	0	Klip River	6
JONONO	5164	4	Klip River	8
JORDAANS STROOM	3310	16	Klip River	-7
JUBILEE NO 1	9642	3	Klip River	6
KAKANINIS KRAAL	3724	1	Klip River	14
KALEBAS VLAKTE	3749	7	Klip River	11
KELVIN GROVE	4474	0	Klip River	5
KEMPENFELDT	3541	5	Klip River	2
KEMPS HOEK	4271	1	Klip River	5
KENMARE	9808	2	Klip River	9
KILBARCHAN	16266	1	Klip River	1
KILKEEL	9132	9	Klip River	3
KLEIN FONTEIN	1262	34	Klip River	30
KLEINE FONTEIN	1263	26	Klip River	15
KLIP HOEK	3753	0	Klip River	3
KLIP RAND	3723	4	Klip River	31
KLIP RAND	8627	8	Klip River	5
KLIP ROTS	10958	3	Klip River	9
KLIP RUGH	4092	2	Klip River	5
KLIPFONTEIN	185	17	Klip River	9
KNOCKBREX	9018	5	Klip River	23
KNOWESLEY	8926	3	Klip River	24
KOPIJ ALEEN	8816	6	Klip River	7
KROMDRAAI	8626	8	Klip River	0
KWAGGASDRIFT	96	44	Klip River	10
LANGLAAGTE	6898	1	Klip River	3
LANGSAAN	16200	3	Klip River	10
LANGTON	8327	8	Klip River	-7
LEEUW KUIL	3743	1	Klip River	5
LEICESTER	2970	29	Klip River	31
LENNOXTON(combined)	2968	2	Klip River	15
LENTEVLEI	16524	8	Klip River	7
LEO KOP	2418	12	Klip River	13
LEOKOP EAST 8793	8793	8	Klip River	14
LILY DALE	8528	9	Klip River	5
LISBELLAW	12066	6	Klip River	18
LISBETHDALE	4255	13	Klip River	5
LISNABIN	9057	5	Klip River	12
LOCH LOMOND	7577	4	Klip River	8
LONGLANDS	15523	5	Klip River	3
LOT A OF LOCH END	10896	3	Klip River	27
LOT W	8610	3	Klip River	4
LYELL	2393	12	Klip River	22
MACALMAN	15567	9	Klip River	24
MACALMAN	4254	1	Klip River	8
MACCLESFIELD	8418	7	Klip River	10

FARM NAME	FARM NO	FARM AREA (km^2)	COALFIELD	RATING RESULT
MADADENI	15961	26	Klip River	21
MAGDALENA	7574	3	Klip River	10
MAIRIC 15989	15989	2	Klip River	-7
MANOR PARK	8147	5	Klip River	3
MARIA	3740	4	Klip River	19
MATTANDU	2987	12	Klip River	22
MAUCHLINE	2396	12	Klip River	3
MEADOWBANK	4130	4	Klip River	8
MEADOWSTREAMS	14701	2	Klip River	9
MELROSE	11067	4	Klip River	5
MENTEITH	3328	16	Klip River	3
MIDDEL PUNT A	7903	1	Klip River	8
MILNEDALE	9094	5	Klip River	16
MINSTER B	8292	3	Klip River	7
MOOI KRANTZ	9562	7	Klip River	21
MOOIDOORN HOEK	3722	0	Klip River	18
MORGENSTOND	3347	16	Klip River	18
MOUNT JOHANNA	10987	4	Klip River	3
MOUNT NONNIE	11669	3	Klip River	17
MOUNTAIN TOP	8954	4	Klip River	2
MOURNE	9168	4	Klip River	7
MOY	7549	8	Klip River	23
NELLIE	8853	6	Klip River	12
NEWCASTLE TOWNLANDS	4702	83	Klip River	33
NGISANA	13992	7	Klip River	24
NIEKIRK'S KRAAL	1167	19	Klip River	12
NIL DESPERANDUM A	8771	1	Klip River	-7
NIL DESPERANDUM B	8894	7	Klip River	11
NKANGALA OF TANGENT	8569	4	Klip River	10
NO NAME	15159	2	Klip River	6
NORTHFIELD	8615	2	Klip River	8
ONE TREE	8599	8	Klip River	19
OPMERKZAAMHEID	1394	17	Klip River	13
ORIBI VLAKTE	7829	2	Klip River	8
OUTFALL	2414	10	Klip River	7
PAARDE BERG	1068	26	Klip River	4
PAARDE-VOET-PAD	1374	8	Klip River	6
PADADORS	8597	2	Klip River	8
PADDAFONTEIN	3214	6	Klip River	2
PEACH HILL	13672	8	Klip River	5
PIETS RUST	8329	4	Klip River	3
PLATBERG	1241	21	Klip River	20
PLATBERG	16318	11	Klip River	8
POMEROY	4294	2	Klip River	-7
POONA	7511	4	Klip River	9
POONGA'S KRAAL	3325	13	Klip River	-3
POTSDAM	2394	13	Klip River	6
PRESTWICK	2415	12	Klip River	10
RAMSGATE (Combined)	8560	7	Klip River	10
REDCLIFFE	4319	15	Klip River	-7
REDMAIN (combined)	14492	3	Klip River	-7
RIVER BANK	8185	3	Klip River	5
RIVER BANK B	7537	3	Klip River	7
ROCKY DALE	8516	5	Klip River	11
ROCKY SPRUIT A	8842	7	Klip River	18
ROCKYDALE	4277	0	Klip River	5
ROODEKOP 7	7	29	Klip River	-4
ROOI POORT B	7545	4	Klip River	3
ROY POINT	2959	12	Klip River	33

FARM NAME	FARM NO	FARM AREA (km^2)	COALFIELD	RATING RESULT
RUIGTE FONTEIN	1179	11	Klip River	7
RUSTON	9012	8	Klip River	12
RUTLAND	9434	4	Klip River	7
SANDFORD	7931	7	Klip River	-5
SCHROEDERS HOPE	8865	4	Klip River	5
SCHUINS HOOGTE	2250	12	Klip River	15
SCUUR RAND NO 1	7331	1	Klip River	3
SCUUR RAND NO 2	7332	7	Klip River	17
SEELANDKOP	16199	5	Klip River	9
SERPENTINE NO 1		4	Klip River	-7
SERPENTINE NO 2	9702	3	Klip River	-4
SLIEVE DONALD	9229	5	Klip River	-5
SLOOTEN HOEK	3745	2	Klip River	10
SOLMAR	16680	3	Klip River	6
SOLMAR NO 2	13553	2	Klip River	26
SPECTACLE SPRUIT (Combined)	9079	7	Klip River	17
SPIESDALE	9313	8	Klip River	19
ST GEORGE	4248	5	Klip River	27
STEIN COAL SPRUIT	1171	1	Klip River	9
STEIN COAL SPRUIT	1171	13	Klip River	26
STEIN COAL SPRUIT 1171	1171	17	Klip River	12
STEIN COAL SPRUIT 1171	11671	37	Klip River	8
STONTON	3691	0	Klip River	2
STONY BRAES	4475	3	Klip River	4
STONY KLOOF	4314	3	Klip River	3
STRASSBURG	2391	12	Klip River	10
STRIIJBANK	8449	2	Klip River	7
STRUISLAAGTE	13066	4	Klip River	4
STRUISVOGEL POORT	6897	8	Klip River	2
SUNSHINE	4450	5	Klip River	7
SURREY	7936	17	Klip River	26
SWARTZKLOOF	1064	15	Klip River	9
SWEETWATERS	8748	4	Klip River	15
THE BEND	14326	3	Klip River	15
THE CORNER	4659	0	Klip River	3
THE JUNCTION	5081	7	Klip River	9
THE NECK	10548	21	Klip River	0
THIRST	11196	8	Klip River	12
TIGER KLOOF	3333	15	Klip River	31
TRANSVAALIA OF DONDOLA	8697	2	Klip River	3
TREKBOER	4225	6	Klip River	3
TRY AGAIN	8674	7	Klip River	5
TUAM	13485	7	Klip River	33
TWEEDIE DALE	9078	6	Klip River	14
TWEEFONTEIN	16423	4	Klip River	3
UITHOEK	1335	29	Klip River	27
UITSIG	16857	2	Klip River	8
UITZICHT	4112	0	Klip River	3
UITZIGHT NO 2	4276	1	Klip River	3
UMGEN	9449	0	Klip River	9
UNKNOWN (next to Potsdam)	UNKNOWN		Klip River	2
VAALBANK	3737	2	Klip River	-4
VAALBANK	103	22	Klip River	31
VAN NIEKERK'S STROOM	15790	6	Klip River	9
VERDRIET	8828	7	Klip River	29
VREDA	9922	8	Klip River	5
WALMSLEY	4266	10	Klip River	31
WARM HOEK	14976	3	Klip River	-3

FARM NAME	FARM NO	FARM AREA (km^2)	COALFIELD	RATING RESULT
WASBANK	1076	31	Klip River	9
WATERFALL	3335	17	Klip River	17
WATERVAL	420	10	Klip River	3
WATERVAL	157	27	Klip River	12
WEIHOEK	171	21	Klip River	13
WELGELEGEN	16225	36	Klip River	9
WELTEVREDEN	3625	1	Klip River	27
WHITE HOUSE	14178	3	Klip River	-7
WICKHOLM	15990	28	Klip River	4
WILD DUCK VLEI A	7871	0	Klip River	5
WILD DUCK VLEI B	8806	2	Klip River	8
WINKLE	5054	7	Klip River	10
WOODLANDS	16323	12	Klip River	8
WOODLANDS	8485	6	Klip River	21
WYKEHAM	7582	8	Klip River	13
WYKOM	2368	10	Klip River	8
WYKOM	15763	2	Klip River	3
YARL	2962	12	Klip River	31
ERINDALE 809	809	3	Nongoma	3
GROOTGELUK	52	25	Nongoma	1
KEZA	713	2	Nongoma	5
LANGVERWACHT	476	11	Nongoma	3
RESERVE NO 12	15832	2186	Nongoma	17
RESERVE NO 20	15840	536	Nongoma	3
UITKIJK	315	2	Nongoma	6
UITKYK	743	12	Nongoma	7
UITKYK	835	4	Nongoma	2
UITKYK	834	5	Nongoma	8
XIMBA 16506	16506	298	Nongoma	3
ZUNGU 16507	16507	320	Nongoma	13
ATHERFOLD	11162	2	Somkele	-2
GROOTDRAAI	707	19	Somkele	-4
MAGUT A	817	41	Somkele	-2
MERCHISTON		2	Somkele	-7
PLATBERG	1241	488	Somkele	8
RESERVE NO 12	15832	2186	Somkele	19
RESERVE NO 3	15822	790	Somkele	17
RESERVE NO 3	7638	216	Somkele	11
RONDEKOP		24	Somkele	-7
SUB B OF 231 EMPANGENI	12094	2	Somkele	1
AANGELEGEN	293	8	Utrecht	5
ALTEMOOI	17091	8	Utrecht	20
ALTEMOOI	382	9	Utrecht	7
ALTONA	162	20	Utrecht	22
BLOEMHOF	127	1	Utrecht	5
BOSCH	384	8	Utrecht	5
BOSCHHOEK	183	22	Utrecht	10
BRAKFONTEIN	116	30	Utrecht	25
BRAKSPRUIT	485	11	Utrecht	-7
DAGERAAD	49	26	Utrecht	7
DAGWACHT	17093	13	Utrecht	10
DONKERHOEK	398	11	Utrecht	5
DORPSGRONDEN VAN UTRECHT	266	23	Utrecht	7
DRIEFONTEIN	380	23	Utrecht	10
DUMBE	436	1	Utrecht	7
DUMMY	78	25	Utrecht	7
EIKENDAL	416	0	Utrecht	3
ELANDSBERG	89	19	Utrecht	5
FRISCHGEWAAGD	74	27	Utrecht	5

FARM NAME	FARM NO	FARM AREA (km^2)	COALFIELD	RATING RESULT
GAATWEL	118	17	Utrecht	2
GELIJKWATER	55	9	Utrecht	12
GELUK	17067	17	Utrecht	31
GOLDEN REEF	313	26	Utrecht	1
GOUVERNMENTSHOEK	67	29	Utrecht	12
GROENKLOOF	372	13	Utrecht	8
GROOTGEWACHT	76	31	Utrecht	7
GUMTREESPRUIT	424	14	Utrecht	3
HOLBAK	410	7	Utrecht	11
HOOGKYK	397	1	Utrecht	5
JACKHALSDRAAI	299	29	Utrecht	1
JERICHO	400	4	Utrecht	0
KAALPOORT	391	14	Utrecht	3
KILPSPRUIT	178	30	Utrecht	6
KLIPFONTEIN	31	32	Utrecht	5
KLIPPLAAT	373	7	Utrecht	-7
KLIPPLAATDRIFT	120	30	Utrecht	24
KWAMAGWAZA	289	4	Utrecht	-2
KWEEKSPRUIT	22	25	Utrecht	3
LANGVERWACHT	383	13	Utrecht	5
LEEUWFONTEIN	94	37	Utrecht	13
LUSTHOF	309	13	Utrecht	6
MAGDALENA	443	2	Utrecht	5
MOOIFONTEIN	366	8	Utrecht	5
MOOIHOEK	15	6	Utrecht	-2
MOOIHOEK	34	23	Utrecht	12
MOOIPLAATS	352	9	Utrecht	18
NAAUWHOEK	283	9	Utrecht	-7
NOOITGEDACHT	388	21	Utrecht	8
NOOITGEDACHT	90	24	Utrecht	29
NOYEESBOOM	68	20	Utrecht	8
ONVERWACHT	169	5	Utrecht	2
PAARDEPOORT	77	20	Utrecht	6
PARADISE	54	44	Utrecht	11
PARIS	267	20	Utrecht	20
PAULPIETERSBURG TOWNLANDS	0	33	Utrecht	12
PIVAANSPOORT	10	8	Utrecht	3
PUNTJE	330	11	Utrecht	7
RENDSBURG	80	33	Utrecht	33
RENSBURG	282	16	Utrecht	5
RETIREMENT	348	11	Utrecht	-5
RIDDERSHOF	159	23	Utrecht	15
RONDEKOPPIE	419	8	Utrecht	11
RUST-FONTEIN	129	6	Utrecht	-7
RUSTVERWACHT	151	32	Utrecht	5
RUSTVERWACHT	81	17	Utrecht	14
SPITSKOP	164	23	Utrecht	9
STRYDFONTEIN	407	14	Utrecht	-4
SWEETHOME	387	10	Utrecht	3
TIVERTON	20	17	Utrecht	8
TOWNLANDS OF MARTHINUS WESSELSTROOM	121	88	Utrecht	7
TUSSCHENBIJ	167	21	Utrecht	16
TWIJVELHOEK	174	17	Utrecht	8
UITZICHT	284	10	Utrecht	-2
VAALBANK	104	25	Utrecht	3
VAALBANK	38	21	Utrecht	3
VAN DYKS BOSCH	385	3	Utrecht	-5
VERGELEGEN	35	0	Utrecht	5

FARM NAME	FARM NO	FARM AREA (km^2)	COALFIELD	RATING RESULT
VREDEHOF	17	20	Utrecht	5
WANORDE	6	10	Utrecht	3
WASBAK	149	15	Utrecht	6
WATERFALL	417	0	Utrecht	3
WATERFALL	374	4	Utrecht	3
WATERVAL	51	26	Utrecht	13
WATERVAL	420	10	Utrecht	-4
WELGEVONDEN	93	33	Utrecht	8
WELGEVONDEN	50	18	Utrecht	5
WELTEVREDEN	414	10	Utrecht	3
WONDERFONTEIN	404	4	Utrecht	5
ZOETMELKSRIVIER	86	24	Utrecht	26
ZWARTKOP	91	40	Utrecht	5
ALOEBOOM	254	13	Vryheid	26
BONA ESPERANZA	736	8	Vryheid	5
DAGERAAD	288	17	Vryheid	13
DOORNKLOOF	425	11	Vryheid	6
DOORNKOP	172	17	Vryheid	-2
DRIEFONTEIN	151	16	Vryheid	12
DRIEHOEK	710	8	Vryheid	3
ERFSTUK	4	30	Vryheid	15
FRISCHGEWAAGD	401	8	Vryheid	8
GELUK	723	9	Vryheid	5
GELUK	234	13	Vryheid	6
GELUK	377	6	Vryheid	5
GROOTGEWACHT	76	18	Vryheid	3
KOUDELAGER	115	18	Vryheid	19
LANG GELEGEN	704	26	Vryheid	3
MAKALUSI	245	19	Vryheid	7
MISTY VALLEY	831	20	Vryheid	9
MOOIKLIP	239	23	Vryheid	-1
ONGEMAAKT	301	15	Vryheid	7
RENDSBURG 80	80	17	Vryheid	17
RIETFONTEIN	212	12	Vryheid	-2
RIETVLEI	150	16	Vryheid	26
RUSTENBURG	257	19	Vryheid	7
SCHEEPERS NEK 687	738	7	Vryheid	5
SPITZKOP 70	70	20	Vryheid	18
STERKSTROOM A	344	8	Vryheid	-2
TOOVENAARS RUST	518	18	Vryheid	8
UITZICHT	176	12	Vryheid	12
UMKOESBERG	478	11	Vryheid	8
VAALBANK	206	15	Vryheid	5
VAALBANK	206	15	Vryheid	5
VAALBANK 38	38	16	Vryheid	16
VERGELEGEN 35	35	12	Vryheid	29
WATERVAL	84	20	Vryheid	5
WATERVAL	180	10	Vryheid	5
WELTEVREDEN	490	14	Vryheid	2
ZALFLAGER	525	13	Vryheid	13

Appendix 3 : Information Sheets on High Potential Farms

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Specialists in mineral and metallurgical technology

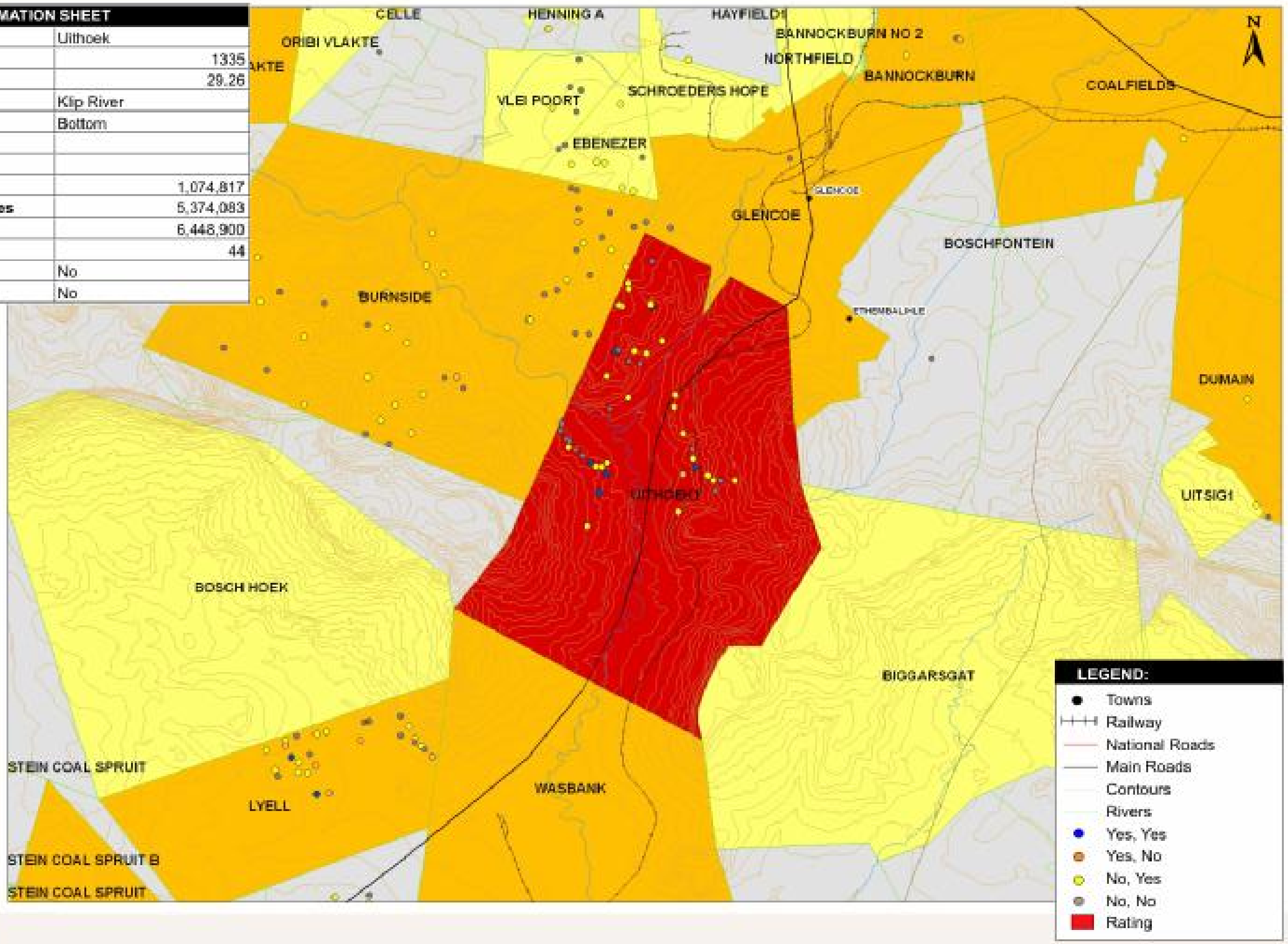
KWAZULU-NATAL COAL RESOURCES

TRADE & INVESTMENT KWAZULU-NATAL

UITHOEK

APPENDIX 4 A

FARM INFORMATION SHEET	
Farm Name	Uithoek
Farm Number	1335
Area (Ha)	29.26
Coalfield	Klip River
Seams	Bottom
TOP: Opencast Tonnages	
TOP: Underground Tonnages	
BOTTOM: Opencast Tonnages	1,074,817
BOTTOM: Underground Tonnages	5,374,083
Total Tonnages	6,448,900
No. Boreholes	44
Defunct Mine	No
Current Mine	No



Source: Mintek

SCALE:
0.9 0 0.9 1.8 km

KWAZULU-NATAL COAL RESOURCES

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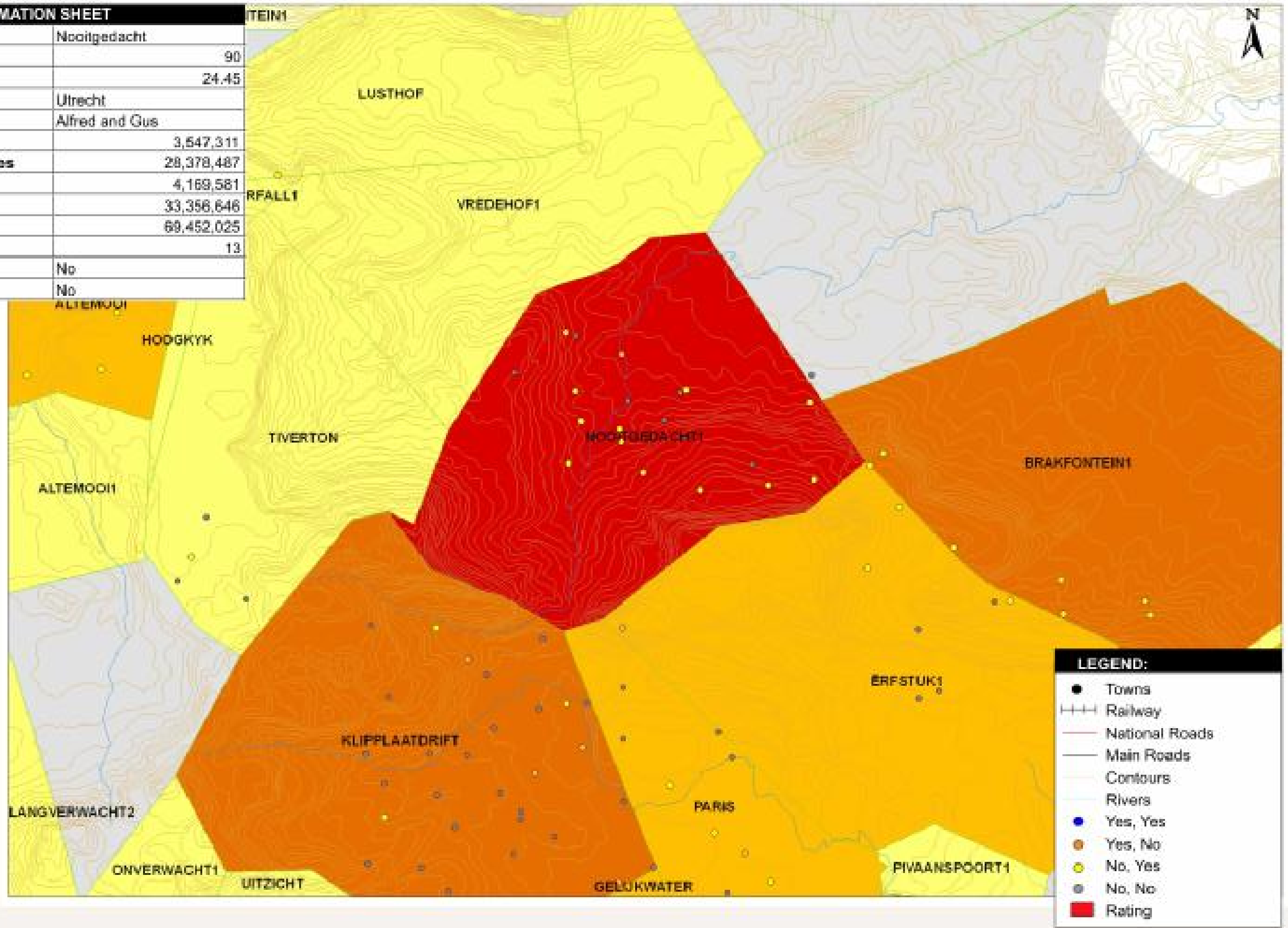
TRADE & INVESTMENT KWAZULU-NATAL

NOOITGEDACHT

APPENDIX 4 B

FARM INFORMATION SHEET	
Farm Name	Nooitgedacht
Farm Number	90
Area (Ha)	24.45
Coalfield	Utrecht
Seams	Alfred and Gus
ALFRED: Opencast Tonnages	3,547,311
ALFRED: Underground Tonnages	28,378,487
GUS: Opencast Tonnages	4,169,581
GUS: Underground Tonnages	33,356,646
Total Tonnages	69,452,025
No. Boreholes	13
Defunct Mine	No
Current Mine	No



Source: Mintek

SCALE:
0.75 0 0.75 1.5 km

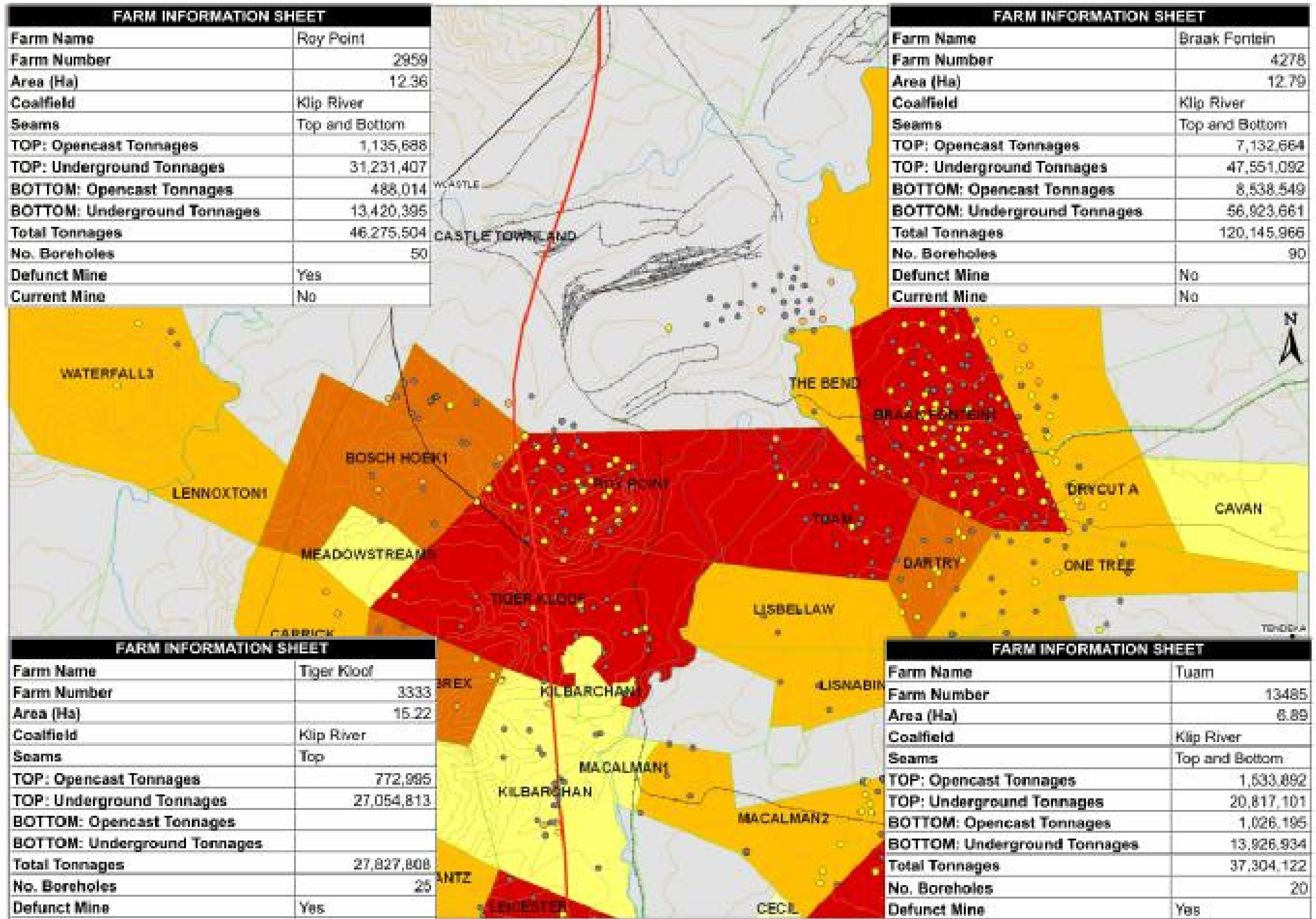
MINTEK

KWAZULU-NATAL COAL RESOURCES

TRADE & INVESTMENT KWAZULU-NATAL

ROY POINT, TUAM, BRAAKFONTEIN AND TIGERS KLOOF

APPENDIX 4 C



LEGEND:

- Towns
- Railway
- National Roads
- Main Roads
- Contours
- Rivers
- Yes, Yes
- Yes, No
- No, Yes
- No, No
- Rating

Source: Mintek

SCALE: 1 0 1 2 km

FARM INFORMATION SHEET

Farm Name	Roy Point
Farm Number	2959
Area (Ha)	12.36
Coalfield	Klip River
Seams	Top and Bottom
TOP: Opencast Tonnages	1,135,688
TOP: Underground Tonnages	31,231,407
BOTTOM: Opencast Tonnages	488,014
BOTTOM: Underground Tonnages	13,420,395
Total Tonnages	46,275,504
No. Boreholes	50
Defunct Mine	Yes
Current Mine	No

FARM INFORMATION SHEET

Farm Name	Braak Fontein
Farm Number	4278
Area (Ha)	12.79
Coalfield	Klip River
Seams	Top and Bottom
TOP: Opencast Tonnages	7,132,664
TOP: Underground Tonnages	47,551,092
BOTTOM: Opencast Tonnages	8,538,549
BOTTOM: Underground Tonnages	56,923,661
Total Tonnages	120,145,966
No. Boreholes	90
Defunct Mine	No
Current Mine	No

FARM INFORMATION SHEET

Farm Name	Tiger Kloof
Farm Number	3333
Area (Ha)	15.22
Coalfield	Klip River
Seams	Top
TOP: Opencast Tonnages	772,995
TOP: Underground Tonnages	27,054,813
BOTTOM: Opencast Tonnages	
BOTTOM: Underground Tonnages	
Total Tonnages	27,827,808
No. Boreholes	25
Defunct Mine	Yes
Current Mine	No

FARM INFORMATION SHEET

Farm Name	Tuam
Farm Number	13485
Area (Ha)	6.89
Coalfield	Klip River
Seams	Top and Bottom
TOP: Opencast Tonnages	1,533,892
TOP: Underground Tonnages	20,817,101
BOTTOM: Opencast Tonnages	1,026,195
BOTTOM: Underground Tonnages	13,926,934
Total Tonnages	37,304,122
No. Boreholes	20
Defunct Mine	Yes
Current Mine	No

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KWAZULU-NATAL COAL RESOURCES

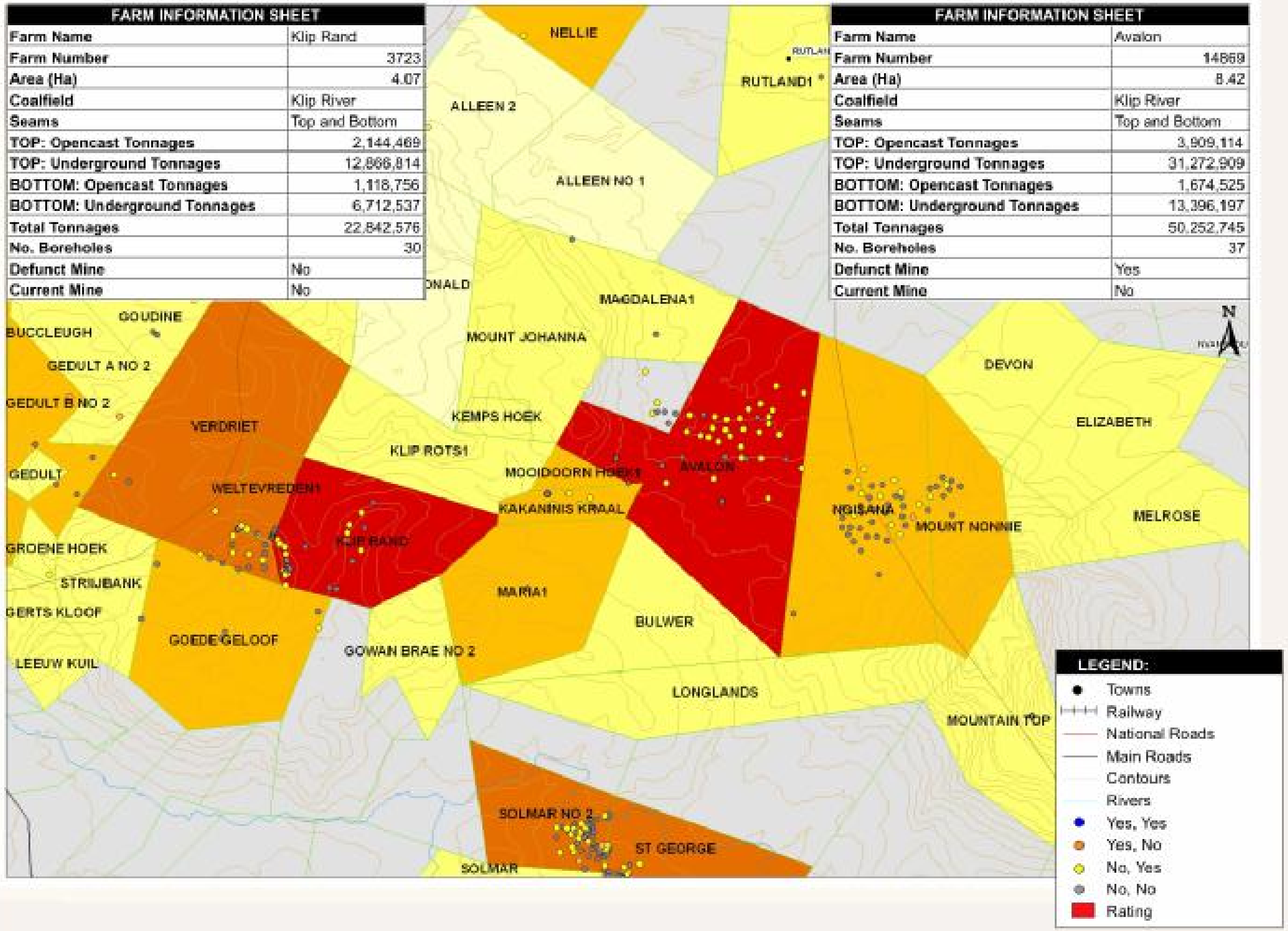
TRADE & INVESTMENT KWAZULU-NATAL

AVALON AND KLIP RAND

APPENDIX 4 D

FARM INFORMATION SHEET	
Farm Name	Klip Rand
Farm Number	3723
Area (Ha)	4.07
Coalfield	Klip River
Seams	Top and Bottom
TOP: Opencast Tonnages	2,144,469
TOP: Underground Tonnages	12,866,814
BOTTOM: Opencast Tonnages	1,118,756
BOTTOM: Underground Tonnages	6,712,537
Total Tonnages	22,842,576
No. Boreholes	30
Defunct Mine	No
Current Mine	No

FARM INFORMATION SHEET	
Farm Name	Avalon
Farm Number	14869
Area (Ha)	8.42
Coalfield	Klip River
Seams	Top and Bottom
TOP: Opencast Tonnages	3,909,114
TOP: Underground Tonnages	31,272,909
BOTTOM: Opencast Tonnages	1,674,525
BOTTOM: Underground Tonnages	13,396,197
Total Tonnages	50,252,745
No. Boreholes	37
Defunct Mine	Yes
Current Mine	No



Source: Mintek

SCALE: 0.75 0 0.75 1.5 km

KWAZULU-NATAL COAL RESOURCES

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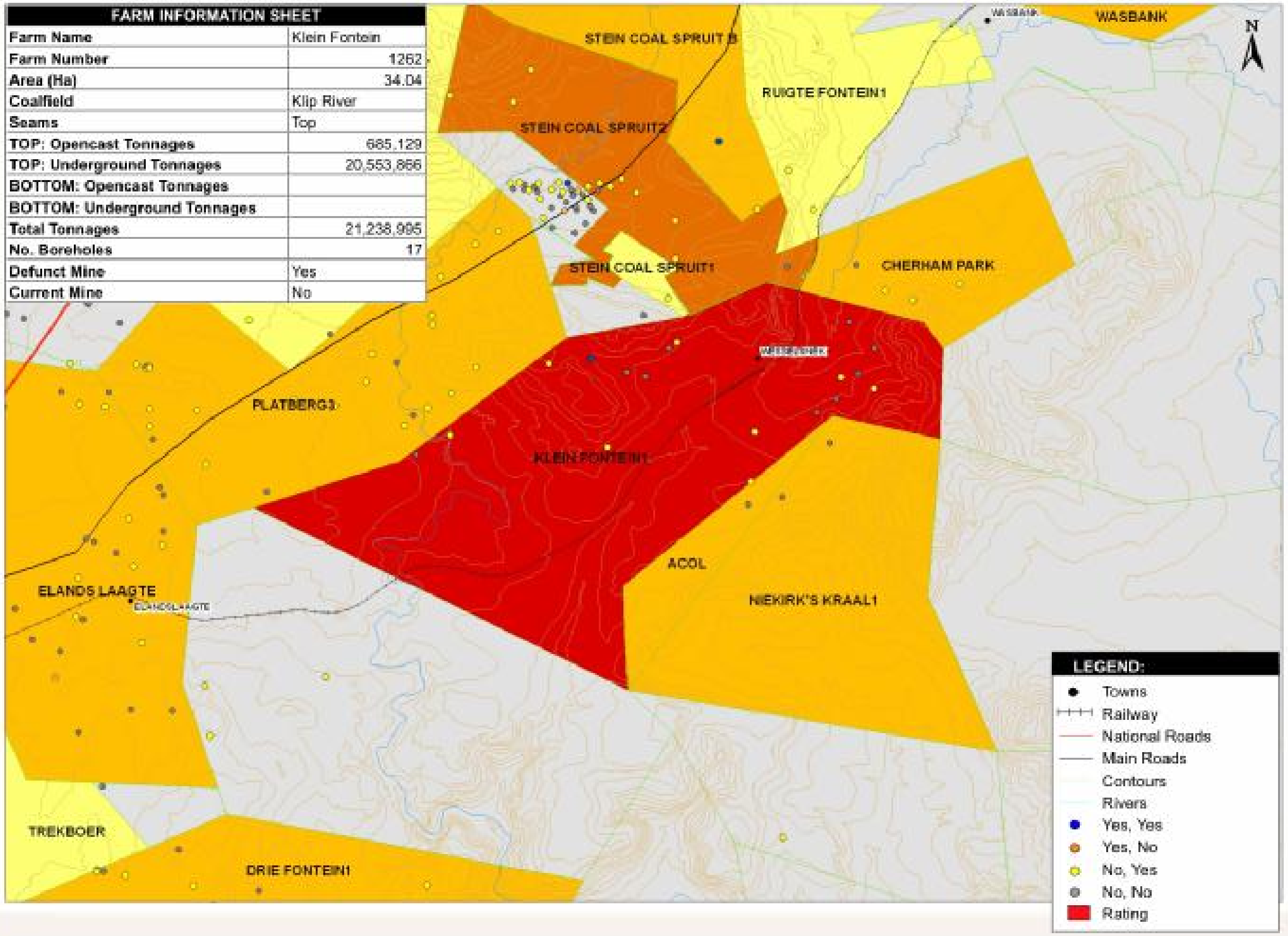
TRADE & INVESTMENT KWAZULU-NATAL

KLEIN FONTEIN

APPENDIX 4 E

FARM INFORMATION SHEET	
Farm Name	Klein Fontein
Farm Number	1262
Area (Ha)	34.04
Coalfield	Klip River
Seams	Top
TOP: Opencast Tonnages	685,129
TOP: Underground Tonnages	20,553,866
BOTTOM: Opencast Tonnages	
BOTTOM: Underground Tonnages	
Total Tonnages	21,238,995
No. Boreholes	17
Defunct Mine	Yes
Current Mine	No



Source: Mintek

SCALE:
1 0 1 2 km

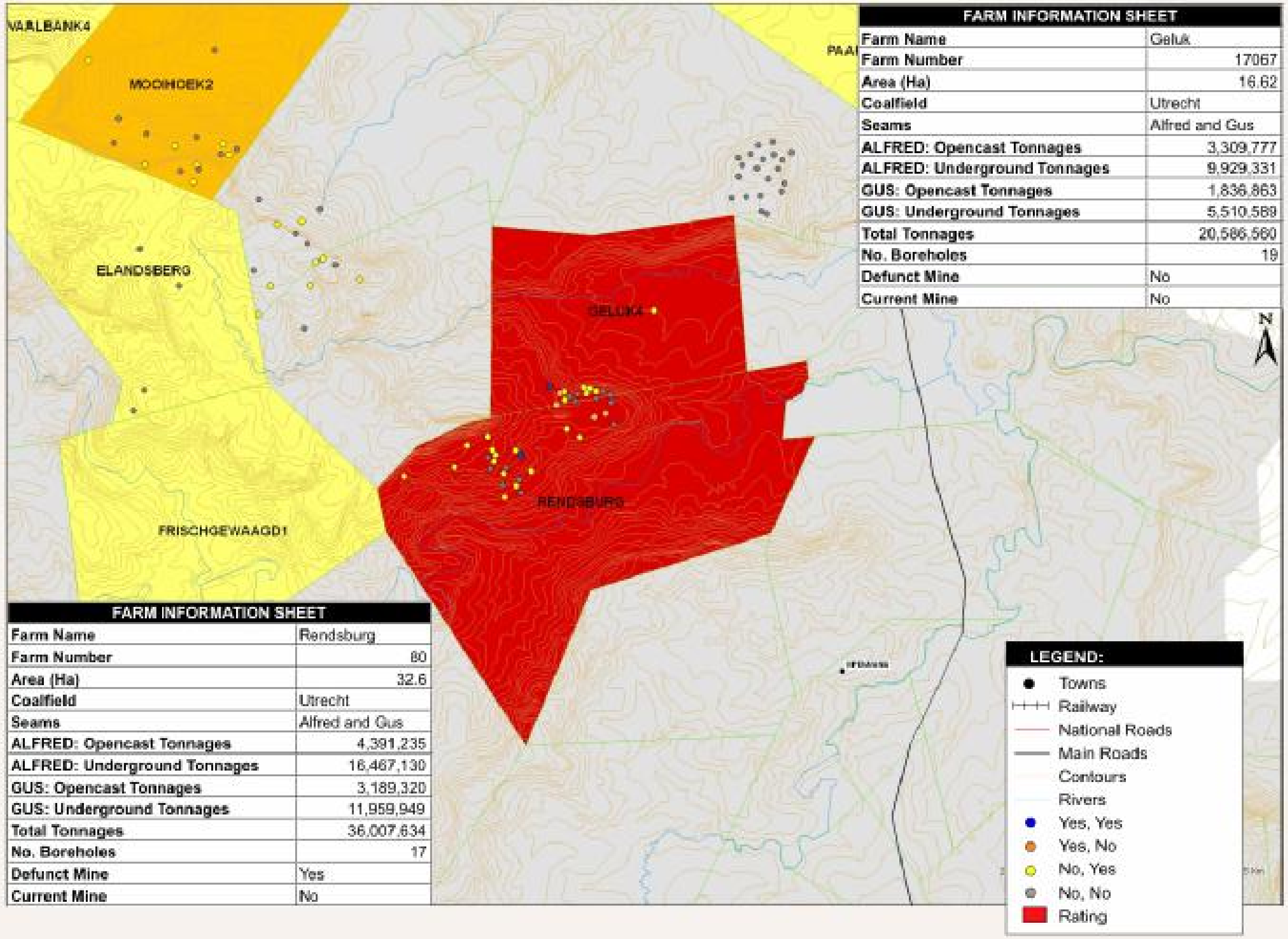
KWAZULU-NATAL COAL RESOURCES

MINTEK

TRADE & INVESTMENT KWAZULU-NATAL

RENSBURG AND GELUK

APPENDIX 4 F



FARM INFORMATION SHEET	
Farm Name	Geluk
Farm Number	17067
Area (Ha)	16.62
Coalfield	Utrecht
Seams	Alfred and Gus
ALFRED: Opencast Tonnages	3,309,777
ALFRED: Underground Tonnages	9,929,331
GUS: Opencast Tonnages	1,836,863
GUS: Underground Tonnages	5,510,589
Total Tonnages	20,586,560
No. Boreholes	19
Defunct Mine	No
Current Mine	No

FARM INFORMATION SHEET	
Farm Name	Rendsburg
Farm Number	80
Area (Ha)	32.6
Coalfield	Utrecht
Seams	Alfred and Gus
ALFRED: Opencast Tonnages	4,391,235
ALFRED: Underground Tonnages	16,467,130
GUS: Opencast Tonnages	3,189,320
GUS: Underground Tonnages	11,959,949
Total Tonnages	36,007,634
No. Boreholes	17
Defunct Mine	Yes
Current Mine	No

Source: Mintek

SCALE:

1.25 0 1.25 2.5 km

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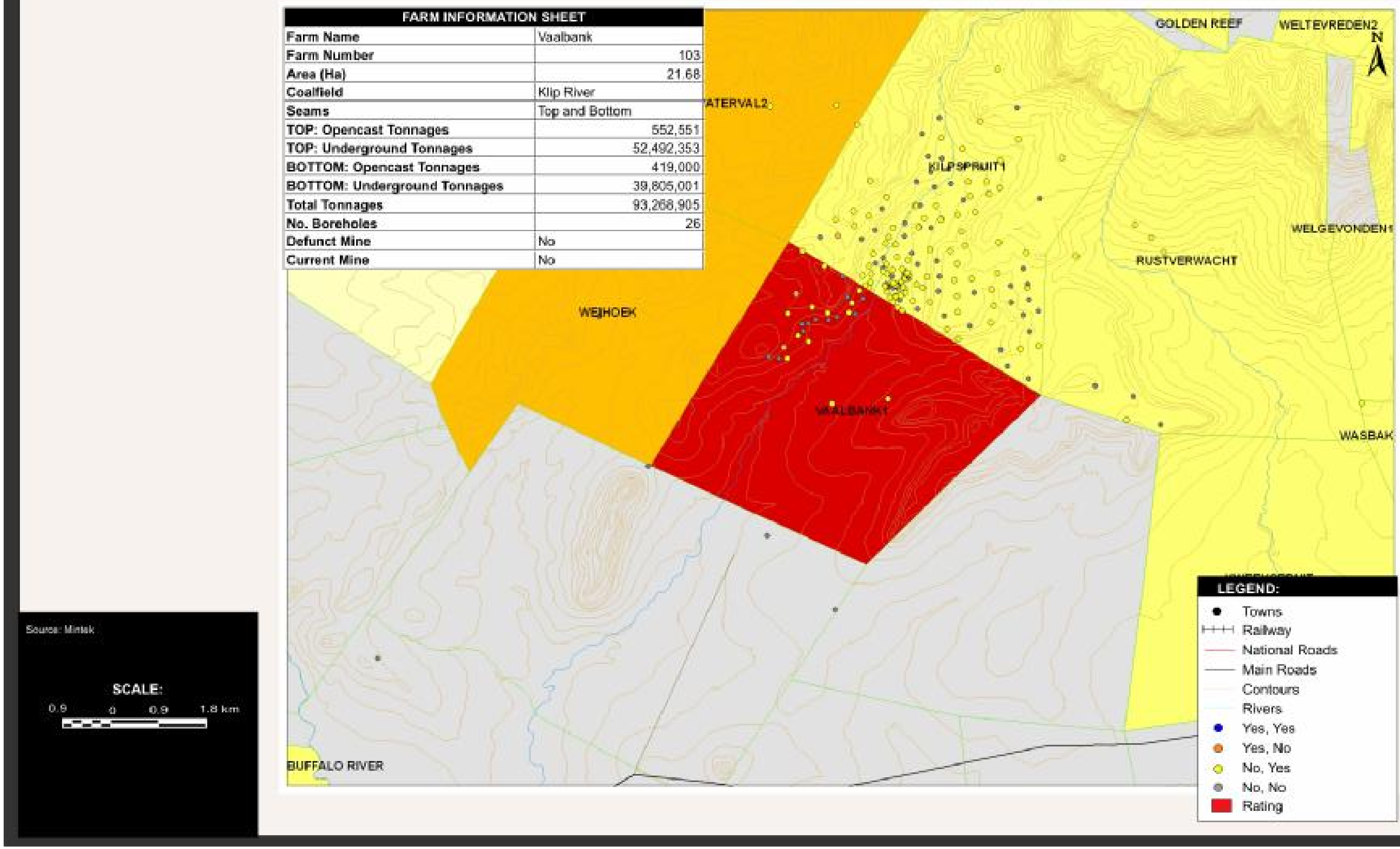
VAALBANK

APPENDIX 4 G

FARM INFORMATION SHEET	
Farm Name	Vaalbank
Farm Number	103
Area (Ha)	21.68
Coalfield	Klip River
Seams	Top and Bottom
TOP: Opencast Tonnages	552,551
TOP: Underground Tonnages	52,492,353
BOTTOM: Opencast Tonnages	419,000
BOTTOM: Underground Tonnages	39,805,001
Total Tonnages	93,268,905
No. Boreholes	26
Defunct Mine	No
Current Mine	No



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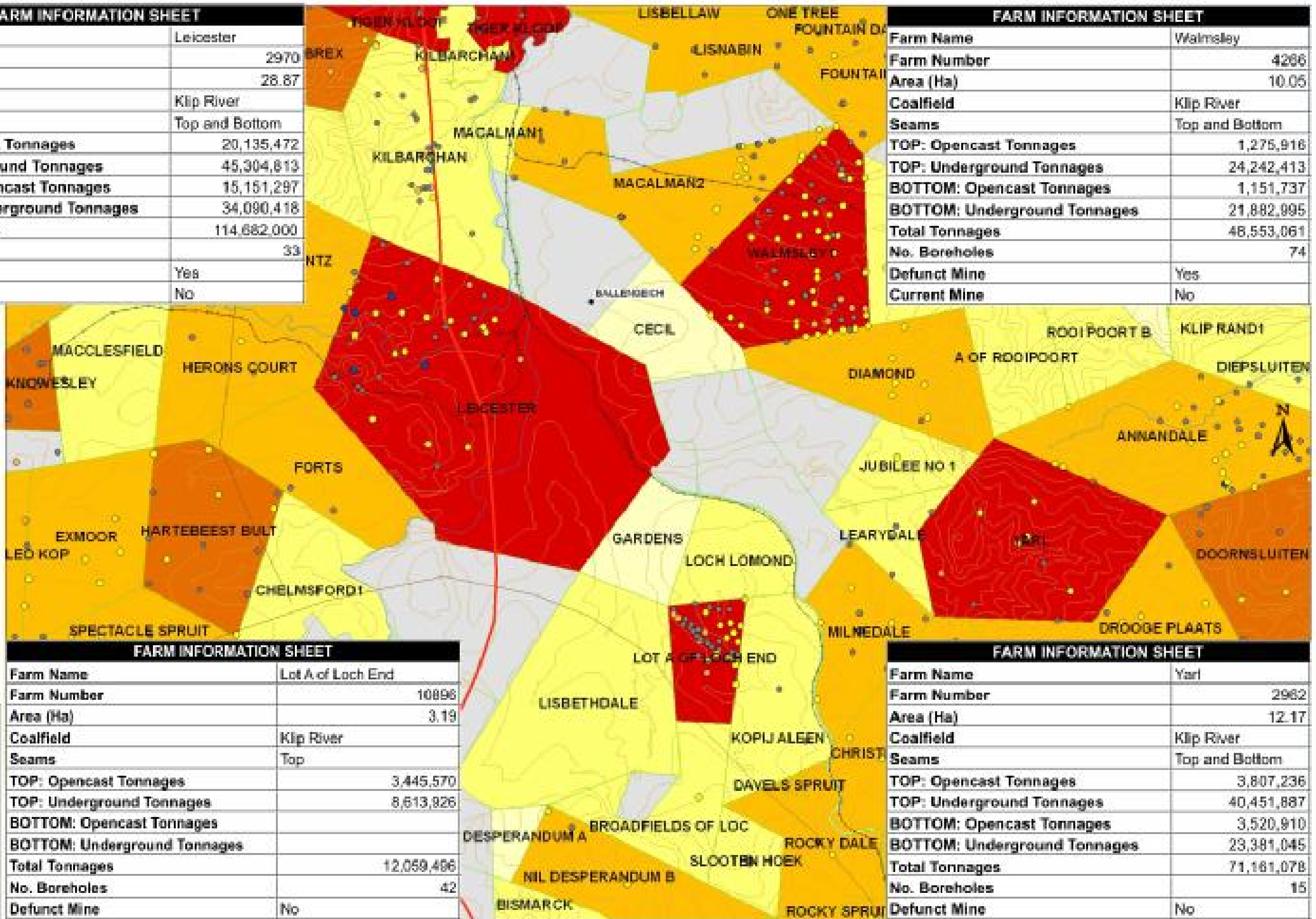
WALMSLEY, LEICESTER, YARL AND LOT A LOCH END

APPENDIX 4 H



FARM INFORMATION SHEET

Farm Name	Leicester
Farm Number	2970
Area (Ha)	28.87
Coalfield	Klip River
Seams	Top and Bottom
TOP: Opencast Tonnages	20,135,472
TOP: Underground Tonnages	45,304,813
BOTTOM: Opencast Tonnages	15,151,297
BOTTOM: Underground Tonnages	34,090,418
Total Tonnages	114,682,000
No. Boreholes	33
Defunct Mine	Yes
Current Mine	No

FARM INFORMATION SHEET

Farm Name	Walmsley
Farm Number	4266
Area (Ha)	10.05
Coalfield	Klip River
Seams	Top and Bottom
TOP: Opencast Tonnages	1,275,916
TOP: Underground Tonnages	24,242,413
BOTTOM: Opencast Tonnages	1,151,737
BOTTOM: Underground Tonnages	21,882,995
Total Tonnages	48,553,061
No. Boreholes	74
Defunct Mine	Yes
Current Mine	No

LEGEND:

- Towns
- Railway
- National Roads
- Main Roads
- Contours
- Rivers
- Yes, Yes
- Yes, No
- No, Yes
- No, No
- Rating

Source: Mintek

SCALE:

1 0 1 2 km

FARM INFORMATION SHEET

Farm Name	Lot A of Loch End
Farm Number	10896
Area (Ha)	3.19
Coalfield	Klip River
Seams	Top
TOP: Opencast Tonnages	3,445,570
TOP: Underground Tonnages	8,613,926
BOTTOM: Opencast Tonnages	
BOTTOM: Underground Tonnages	
Total Tonnages	12,059,496
No. Boreholes	42
Defunct Mine	No
Current Mine	No

FARM INFORMATION SHEET

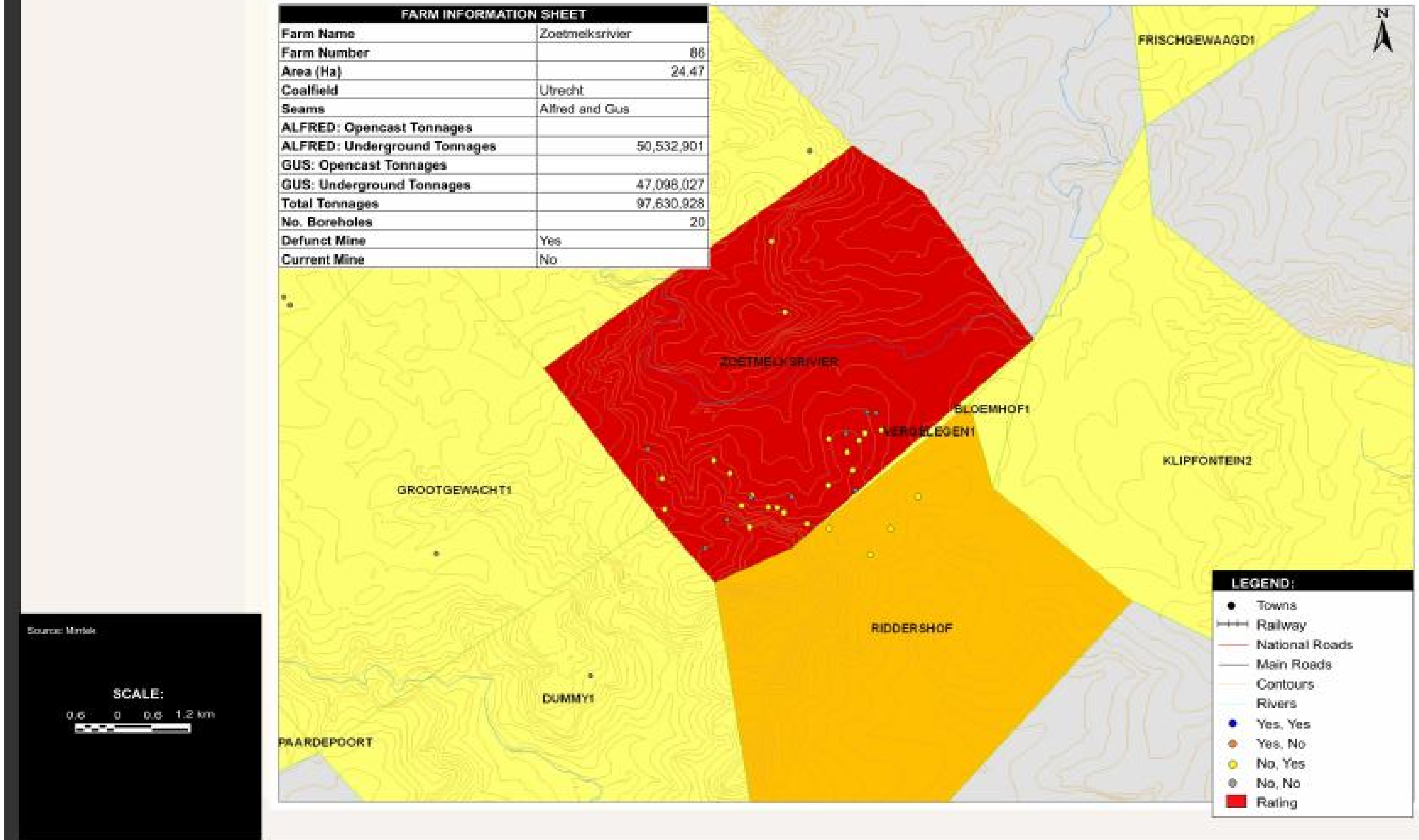
Farm Name	Yarl
Farm Number	2962
Area (Ha)	12.17
Coalfield	Klip River
Seams	Top and Bottom
TOP: Opencast Tonnages	3,807,236
TOP: Underground Tonnages	40,451,887
BOTTOM: Opencast Tonnages	3,520,910
BOTTOM: Underground Tonnages	23,381,045
Total Tonnages	71,161,078
No. Boreholes	15
Defunct Mine	No
Current Mine	No

KWAZULU-NATAL COAL RESOURCES

ZOETMELKSRIVIER

APPENDIX 4 I

FARM INFORMATION SHEET	
Farm Name	Zoetmelksrivier
Farm Number	86
Area (Ha)	24.47
Coalfield	Utrecht
Seams	Alfred and Gus
ALFRED: Opencast Tonnages	
ALFRED: Underground Tonnages	50,532,901
GUS: Opencast Tonnages	
GUS: Underground Tonnages	47,098,027
Total Tonnages	97,630,928
No. Boreholes	20
Defunct Mine	Yes
Current Mine	No



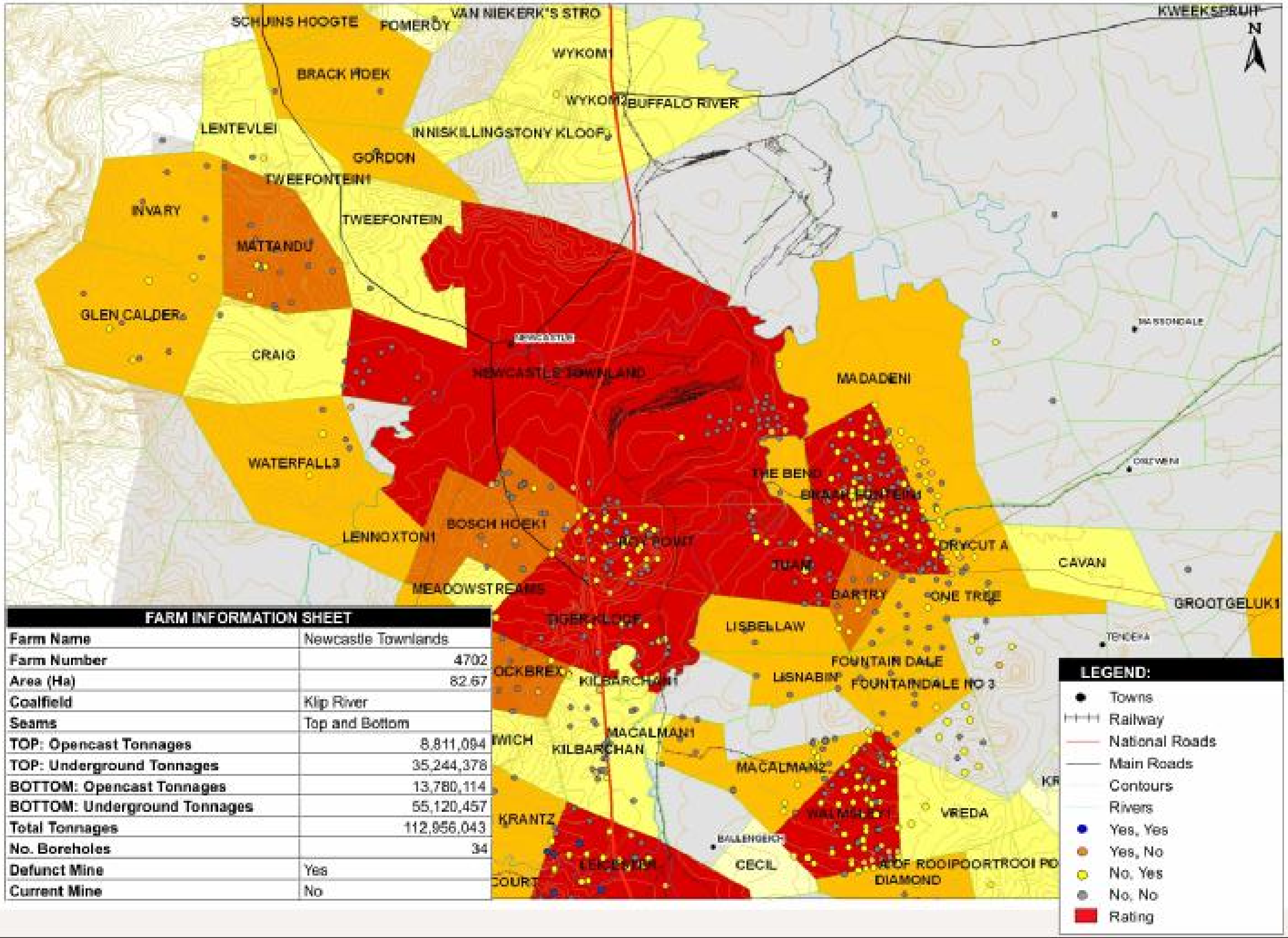
MINTEK

KWAZULU-NATAL COAL RESOURCES

TRADE & INVESTMENT KWAZULU-NATAL

NEWCASTLE TOWNLANDS

APPENDIX 4 J



FARM INFORMATION SHEET	
Farm Name	Newcastle Townlands
Farm Number	4702
Area (Ha)	82.67
Coalfield	Klip River
Seams	Top and Bottom
TOP: Opencast Tonnages	8,811,094
TOP: Underground Tonnages	35,244,378
BOTTOM: Opencast Tonnages	13,780,114
BOTTOM: Underground Tonnages	55,120,457
Total Tonnages	112,956,043
No. Boreholes	34
Defunct Mine	Yes
Current Mine	No

Appendix 4 : Questionnaire on the Environmental Status of the Coal Dumps in SA

Pro-Forma Questionnaire   Annexure 1   Page 1

PROJECT FOR THE USTILISATION OF COAL DISCARD/DUFF & SLURRY (COAL)	
SECTION 1	
GENERAL INFORMATION	
	Fill in your replies in blocks bellow
1.1 Name and Address	
Full Name of Mine	
Name of Mining House/Group/Holding Company *(if applicable)*	
Physical Address *(farm name, number and magisterial district)*	
Postal Address	
1.2 Contact Details Of Mine:	
Telephone:	
Facsimile:	
E-mail address:	
1.3 Details Of Responsible Person:	
Name:	Designation:
Telephone:	
Facsimile:	
E-mail:	
1.4 Details of Questionnaire Facilitator	
Name: B Rip / D Van Wyk	Badger Mining & Consulting (Pty) Ltd
Telephone:	011 472 0677/8
Facsimile:	011 472 0700
E-mail:	secretary@badgermining.co.za
1.5 Return Instructions	
This questionnaire should be completed and returned by post, fax or e-mail to the offices of Badger Mining & Consulting by You are welcome and (encouraged) to contact the Questionnaire Facilitator should you have any queries.	
1.6 Declaration	
I hereby certify that to the best of my knowledge the particulars furnished in this return are true and correct.	
Date	
Respondent, duly authorised	
Manager	

PROJECT FOR THE UTILISATION OF COAL DISCARD/DUFF & SLURRY (COAL)	
SECTION 2	
TECHNICAL INFORMATION	
The following part of the questionnaire should be completed separately for each discard / duff / slurry dump.	
2.1 Official Name of Dump (if any)	
2.2 Descriptive location (e.g. in a valley, in an old opencast working, proximity to water courses proximity to local infrastructure.	
2.3 Co-ordinates & Plans (LO co-ordinates of dump corner points)	
File name and format	
2.4 Co-ordinates & Plans of Mine Boundary	
File name and format	
2.5 Current Status (Describe, active, defunct, etc)	
2.6 Historical Status (Historical description, specifically for pre-export dump, i.e. date started, original source of discard, type of plant, (specify single or double stage) subsequent source of discard and type of plant estimate of unwashed material, raw, minus ½ inch, and various grades.)	
2.7 Current Condition (describe e.g. compacted, rehabilitated, devolatilsed, burning, burnt out)	
287 Current Size of discard/duff/slurry dumps	
1 Discard aerial extent (hectares)	
Discard Volume (cu meters)	
Discard Bulk Density (g/cc)	
Discard Tonnage (tons)	
2 Duff aerial extent (hectares)	
Duff Volume (cu meters)	
Duff Bulk Density (g/cc)	
Duff Tonnage (tons)	
3 Slurry Aerial extent (hectares)	
Slurry Volume (cu meters)	
Slurry Bulk Density (g/cc)	
SlurryTonnage (tons)	
2.9 Current rate of disposal(tpa)	
Coarse	
Duff	
Slurry	
Total	
Age of Dump (years)	
Projected life of dump (years)	
210 Method Of Disposal	
Describe method: (historical and current practice) free-tipping, (belt or vehicle), compacted, co-disposal, integrated disposal	
2.11 Source Material	
Describe material: (raw coal, washed caol, discard coal, hand picked waste, other)	
2.12 Process	
(hand picking, screening, jig, DMS, spiral other)	

PROJECT FOR THE UTILISATION OF OAL DISCARD/DUFF & SLURRY (COAL)			
SECTION 3			
QUALITATIVE INFORMATION			
The following part of the questionnaire should be completed separately for each discard / duff / slurry dump.			
Official Name of Dump *(if any)*			
2.13 Raw Air Dry Analysis			
	Coarse	Duff	Slurry
Ash (%)			
Moisture (%)			
Volatiles (%)			
Fixed Carbon (%)			
Sulphur (%)			
Calorific Value (MJ/kg)			
Hardgrove Index			
Indes of Abrasion (mg/Fe 4kg charge)			
Ultimate Analysis (Dry basis)			
Carbon			
Nitrogen			
Hydrogen			
Oxygen			
Total Sulphur			
Ash Analyses			
SiO_2			
Al_2O_3			
Fe_2O_3			
P_2O_5			
TiO_2			
CaO			
MgO			
K_2O			
Na_2O			
SO_3			
Should this information be readily available in an alternative format, please attach to the questionnaire and / or list the electronic file name page 6			
File name and format			
2.14 Utilisation (describe)			
(completely reclaimed, partially reclaimed, potentially reclaimable, sterilised, e.g. stored underground)			
File name and format			
2.15 Washed Air Dry Analysis			
Attach either hard or electronic copies of any available washabilities			
File name and format			
2.16 Size Distribution			
Attach size distribution information of the discard / slurry / duff (if available)			
File name and format			
2.17 Crushing and Liberation			
Attach crushing and liberation test results of coarse discard (including chemical analysis) in your preferred format.			
File name and format			
ANY OTHER TEST RESULTS			
If other tests have been conducted on the Discard / Duff / Slurry please attach the information in your preferred format.			
File name and format			
Examples: bulk density, thermo gravimetric, spontaneous combustion			
Complete "List of Electronic Data" on page 6			

PROJECT FOR THE UTILISATION OF COAL DISCARD/DUFF & SLURRY (COAL)	
SECTION 4	
ENVIRONMENTAL INFORMATION	
4.1 COP's & EMP's	
Is the dump operated in terms of a code of practice? (If not specify exception)	
Is this dump operation included in an approved EMPR?	
(if not) specify exception:	
Is this dump currently environmentally sound?	
(If not) specify exception, i.e. acid mine drainage, entrapment of pristine run off water, contamination of adjoining land, wetlands, water courses, source of dust, smoke, gasses, noise, physical.	
Is the closure cost of the dump fully provided for in terms of the EMPR?	
Please state the estimated closure cost and the date of evaluation.	
Can a monetary value be attached to the current potential utilisation of the discard / duff / slurry	
Is the dump currently an asset or liability of the mine?	
(briefly state reasons):	

Appendix 5 : Reference List

DATE	AUTHOR	TITLE
	Council for Geoscience	3 x Borehole Database
1983	DME	Coal Reserves of the Republic of South Africa, an evaluation at the end of 1982
1985-2006	DME	Operating and Developing Coal Mines in the RSA
1986	GSSA	The Mineral Deposits of Southern Africa.
1998	C.P. Snyman	Coal: The Mineral Resources of South Africa
1998	F.S.J De Jager	Bulletin 74
1999	H.J. Pinheiro	Bulletin 113
2002	Oliver Barker	Bulletin 114
2003	DME	Potential Government Intervention to Significantly Reduce the Amount and Impact of Discard Coal
2004	SABS	SANS: South African National Standard: South African Guide to systematic valuation of the Coal Reserves

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