Study Component	Category	Description
	Ideal	Other heritage resources worthy of conservation, and which prescribes heritage resources assessment criteria, consistent with the criteria set out in section 3(3) of the National Heritage Resources Act (Act No 25 of 1999), which must be used by a heritage resources authority or a local authority to assess the intrinsic, comparative and contextual significance of a heritage resource and the relative benefits and costs of its protection, so that the appropriate level of grading of the resource and the consequent responsibility for its management may be allocated in terms of section 8 of the said Act.
Visual	Sensitive	Areas within a 2 km buffer from populated places (Amersfoort, Vlakplaats and Daggakraal). Areas within a 500 m buffer zone of major roads. Areas that fall within elevated topographical units (e.g. ridges, crests, hills, etc.).
	Acceptable	Areas not falling within the *Ideal* or the *Sensitive* categories.
	Ideal	Areas within a 2 km buffer zone from already vertically disturbed industrial or mining land.
Risk **a. Toxics**	Sensitive	Not applicable
	Acceptable	Not applicable
	Ideal	1 % fatality
b. Flash Fires	Sensitive	½ Lower Flammable Limit
	Acceptable	Not applicable
	Ideal	Not applicable

3. GENERAL DESCRIPTION OF THE STUDY AREA

3.1. The Biophysical Environment

3.1.1. Geology

The majority of the study area is underlain by Karoo Supergroup sedimentary rocks of the Vryheid and Volksrust Formations of the Ecca Group. These are largely comprised of sandstone, mudstone, shale, siltstone, and coal seams.

The available geological maps covering the study area did not indicate any major structural features such as faults or fractures. Limited tectonic activity is recognised within the study area, and the only evidence of secondary processes is outcrops of intrusive younger dolerite sills mapped in the Karoo sediments.

Four generations of dolerite intrusions are recognised within the study area, based on olivine or plagioclase content, alteration, and texture. The intrusive dolerite has produced large-scale devolatilisation and structural displacement of the coal. These adverse geological conditions caused the closure of the Majuba Colliery in 1993.

Table 3.1 presents the lithostratigraphy of the study area.

Table 3.1 Lithostratigraphy of the study area

Age	Supergroup	Group	Subgroup	Formation	Lithology
Jurassic					Dolerite
Permian	Karoo	Ecca		Volksrust	Mudstone, siltstone, shale
Permian	Karoo	Ecca		Vryheid	Sandstone, siltstone, shale, coal

3.1.2. Hydrogeology

The groundwater potential of the Karoo formations located in the study area is limited in their pristine state due to low permeability and storage capacity. Secondary processes, such as weathering, fracturing, etc., are required to enhance the groundwater potential.

Based on regional data, the hydrogeological resource maps, the following hydrogeological information is available for the formations within the study area: -

Volksrust Formation
- Upper and middle Ecca
- Predominantly argillaceous rocks
- Fractured aquifers
- Borehole yields 0.5 to 2.0 l/s

Vryheid Formation	-	Lower Ecca
	-	Intergranular and fractured aquifers
	-	Borehole yields 0.1 to 0.5 l/s

Groundwater hydrochemistry associated with the sediments is variable; the groundwater salinity associated with the formations in the study area can have electrical conductivity concentrations of < 250 up to 1000 mS/m.

The sandstones of the Vryheid Formation of the Ecca Group can be massive and dense and have limited permeability and storage. It thus offers only moderate groundwater yield, especially in the absence of dolerite intrusions.

Contacts between different rock lithologies and bedding planes within the sediments often yield groundwater. The contact zone between the dolerites and the sandstone lithologies can be high yielding. Fractured fault zones, especially if related to tensional stresses, are potentially rich targets for groundwater development.

Groundwater occurs within the joints, bedding planes, and along dolerite contacts within the sediments (as recognised across the study area).

3.1.3. Hydrology

The region in which the CCGT will be situated has a slope varying between from below 1 to above 100% and contains a number of streams and rivers. Most of these are small drainage lines that flow only periodically but a few are perennial rivers with a constant overview. The steeper slopes and the areas around the rivers are the most sensitive areas from a surface water point of view and hence a large area within the 12 km zone around the pilot UCG plant is sensitive from a hydrological point of view.

3.1.4. Biodiversity

The study area is situated in the Amersfoort Highveld Clay Grassland (Vegmap). This vegetation type comprises undulating grassland plains, with small scattered patches of dolerite outcrops in areas. The vegetation is comprised of short closed grassland cover, largely dominated by a dense *Themeda triandra* sward, often severely grazed to form a short lawn.

The conservation status of the study area is regarded as Vulnerable, with a target of 27%. The vulnerable status that is attributed to the vegetation of the area is determined by the VEGMAP database and is based on various targets as well as the regional status of this vegetation type. It must also be borne in mind that the Vulnerable status will, therefore, only be applicable to natural grasslands of the study area, not the entire study area.

Some 25% of this unit is transformed, predominantly by cultivation (22%). The area is not suited to afforestation. Silver and black wattle and *Salix babylonica* invade drainage areas and the erosion potential is low.

Overgrazing leads to invasion of *Stoebe vulgaris*. Parts of this unit were once cultivated and now lie fallow and have been left to re-vegetate with pioneer grass species. These transformed areas are not picked up by satellite for transformation coverage and the percentage of grasslands still in a natural state may be underestimated.

3.2. The Social Environment

3.2.1. Air Quality

During the screening phase of the project, hourly meteorological data sourced from the UCG Pilot Plant Weather Station was used to determine the atmospheric dispersion potential of the area. The data set spanned the period from October 2006 to August of 2007. Figure 3.1 depicts the wind rose and wind class frequency distribution graphs that were extracted from the data provided. The dispersion potential of the area is briefly described by the wind rose and wind class frequency distribution graph presented in Figure 3.1. The Majuba UCG pilot plant is associated mostly with winds originating from a westerly and easterly direction as is depicted by the wind rose. The field flowing from the west is characterised by high wind speeds greater than 8 m/s, which suggests that pollution emanating from the proposed facility, could be dispersed for large distances eastward from the site. Winds from the east are also noted to occur for 33% of the time, which have a potential to distribute pollutants from the proposed facility in a westerly direction. Calm winds (winds less than 0.5 m/s) are noted to occur 0.6% of the time. Consequently the resultant flow field is from west to east.

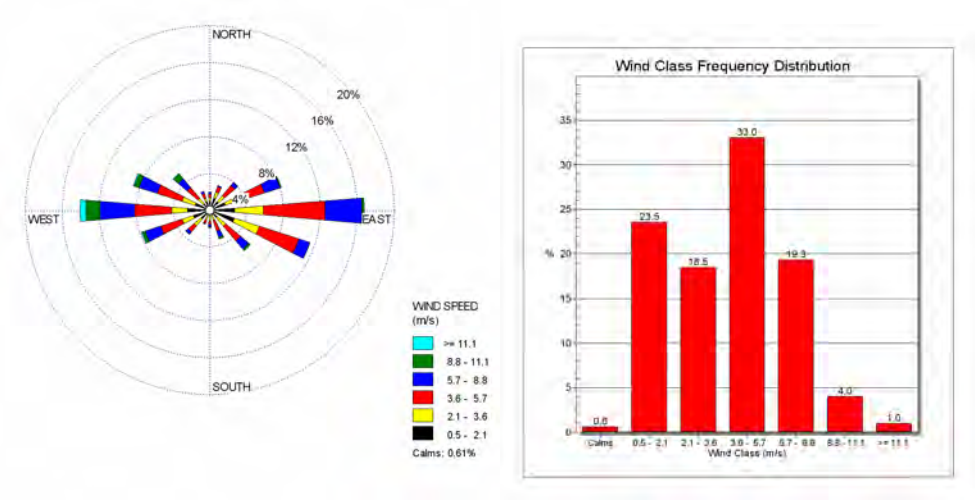

Figure 3.1 The period wind rose and wind frequency distribution for data taken at the Majuba UCG Pilot Plant.

The air quality study criteria used to undertake the sensitivity analysis is summarised as the proximity of the sensitive receptors in the area to other industrial operations in the area and the dispersion potential of the pollutants released into the study area.

The sensitive receptors can be defined as the farms and dwellings that are situated adjacent (eastward) to the existing Majuba power station. The Amersfoort Town is also situated to the north of the Majuba power station. The already existing Majuba power station is a potential source of emissions that is contributing to the background air quality of the area.

3.2.2. Noise

The *noise climate* (ambient noise condition) in the Amersfoort area is quiet and is representative of a rural (farming) noise district (SANS 10103). There is, therefore, a potential for noise impact with the introduction of a new facility such as the CCGT power plant. There are a number of major noise sources in the area namely the existing Majuba power station, the traffic on the main roads and the coal supply railway line to the power station. The noise sensitive sites/areas are Amersfoort town and various farm houses and farm labourer residences in the surrounding area.

3.2.3. Social

The proposed project falls in the Mpumalanga Province in Ward 7 of the Pixley ka Seme Local Municipality (MP 304) within the Gert Sibande District Municipality (DC30).

The Pixley ka Seme Local Municipality lies on the eastern border between Mpumalanga and KwaZulu-Natal. A total of 80 737 people reside within the area in 16 726 households (average 4.8 people per household). Of these residents, 68% of the people live in urban areas, with the remaining 32% residing in largely rural areas. In 2001, just over half (51%) of the people were unemployed, which differs significantly with the unemployment rate of 1996 where it was estimated that only 33% of the population were unemployed. Of those employed, the majority (24%) are employed in the agriculture/forestry and fishing economic sector. This is closely followed by those employed in private households (20%).

According to the IDP of the Pixley ka Seme Local Municipality (2000 Demarcation Data and 2001 Census Data), the ward is characterised by:

- About 5% of the Local Municipality's population falls in this ward;
- One (1) in Five (5) inhabitants is Indian;
- The majority of the population falls within the 15-64 year old age bracket;
- Approximately three quarters of the population do not have a personal income;
- Approximately $^{2}/_{3}^{rd}$ of households have water inside their yards;
- About 75% of the population in the ward has flush toilets;
- 80% of the population have electricity for lighting; and
- The water demand exceeds capacity.

3.2.4. Heritage

- Stone Age

No information about Stone Age habitation of the area is available. There might be two reasons for this. Firstly, it is unlikely that Stone Age people would have occupied the area, as it would have been too cold and no shelters or caves are known to exist in the area. Secondly, no systematic survey of the area has been done and, as a result, no sites have been reported. However, it is quite likely that a detailed survey would reveal traces of these early people's occupation of the area.

- Iron Age

Iron Age people started to settle in southern Africa c. AD 300, with one of the oldest known sites at Silver Leaves, south east of Tzaneen dating to AD 270. However, Iron Age occupation of the eastern highveld area (including the study area) did not start much before the 1500s. Occupation of these areas became possible due to wide-scale climatic changes, as well as the introduction, from the east coast, of cereal crops such as mealies. Some sites dating to the Late Iron Age are know to exist to the north-west of the study area, as well as approximately 15 km due south. These are typically stone walled sites. They were occupied by a number of related people, varying in size from twenty to as many as a few hundred individuals. The people cultivated various crops and kept large herds of cattle.

- Historic period

The historical period in this area started with the arrival of early explorers, hunters and traders, followed later by the Voortrekkers, who settled permanently and started to farm in the area and developed a number of towns. During the Anglo Boer War (1899-1902), some skirmishes took place in the region.

Apart form urban areas, such as Amersfoort, which have origin dates to the late 1880s, most heritage resources in this part of the world would be related to farming and infra-structural development. Most farmsteads were burned down by the British during the Anglo-Boer War, but were later rebuilt. Typically, these consist of the main house, outbuildings, stock enclosures and cemeteries. The housing of labourers were much more informal and once abandoned, quickly disintegrated.

3.2.5. Risk

The main hazards of the project would be exposure to toxic fumes of carbon monoxide and the thermal radiation of the fuel containing carbon monoxide and hydrogen. Carbon monoxide is an odourless and colourless gas having the same density of air. It is extremely flammable and mixes well with air easily forming an explosion hazard. When burnt, carbon monoxide produces carbon dioxide a less toxic material that is considered a simple asphyxiant.

In the presence of finely dispersed metal powders the substance forms toxic and flammable carbonyls. Carbon monoxide may react vigorously with oxygen, acetylene, chlorine, fluorine, nitrous oxide. In the presence of finely dispersed metal powders the substance forms toxic and flammable carbonyls. Carbon monoxide is absorbed into the body by inhalation and acts a chemical asphyxiant by combining with the haemoglobin in the blood displacing the oxygen. Short-term exposure may cause effects on the blood, cardiovascular system and central nervous system. Exposure to concentrations of over 1.3% may result in lowering of consciousness and death. Long-term exposure may have effects on the nervous system and the cardiovascular system, resulting in neurological and cardiac disorders.

Hydrogen is a colourless, odourless gas that is flammable over a wide range of vapour/air concentrations. Hydrogen vapour forms an explosive mixture with air. Vapours or gases may travel considerable distances to ignition source and flash back. Leaking hydrogen may ignite in the absence of any normally apparent source of ignition and if so, burns with a practically invisible flame that can instantly injure anyone coming in contact with it. Hydrogen gas is very light and rises rapidly in the air; concentrations may collect in the upper portions of buildings. Liquid hydrogen can solidify air and may create an explosion hazard.

3.2.6. Visual

The study area for the placement of the CCGT is located in the Amersfoort region of the Mpumalanga province and encompasses the town of Amersfoort, the Majuba coal fired power station and two other predominantly agricultural settlements, namely Vlakplaats and Daggakraal.

The study area has a rural character with dry-land agriculture and cattle and game farming as primary economic activities. It is situated within the grassland biome and the terrain morphological description is strongly undulating plains and hills and lowlands with mountains towards the south-west of the study area. The population density is roughly 30 people per square kilometer, and is primarily concentrated within the town of Amersfoort and the other two main settlements.

The N11 national road and the R23 arterial road affords access to the study area. Standerton and Volksrust are the two major towns in closest proximity to Amersfoort.

4. SENSITIVITY ANALYSIS

4.1. Biophysical Impacts

4.1.1. Hydrogeology

Figure 4.1 shows the areas that are ideal, acceptable, and sensitive from a preliminary hydrogeological perspective. The data conveyed in the figure must be considered preliminary and based on average data and regional information rather than site specific data. It does, however, highlight areas which could be considered more favourable from a hydrogeological point of view.

Areas shown as red in Figure 4.1 should be considered sensitive and of least suitability for development. The red areas to the north have shallow groundwater levels, which are recognised as more vulnerable to potential surface contamination sources. This is due to the limited barrier potential of the unsaturated (vadose[1]) zone, where attenuation of poor quality seep / infiltration can occur.

The available hydrogeological data indicates that groundwater levels to the north of study area are shallow and are thus envisaged to be more vulnerable to potential contamination. The central portion of the study area is underlain by Vryheid Formation geology and thus is recognised to have lower groundwater potential and deep groundwater levels. The southern portion of the study area is underlain by Volksrust Formation rocks, which have greater groundwater potential (when compared to the Vryheid Formation sediments) and moderate groundwater levels.

The central portion of the study area (as envisaged in Figure 4.1, a 3 km radius around the existing Majuba Power Station) including the Farm Roodekopjes, is therefore recognised to be more favourable for the CCGT plant, due to deeper groundwater levels and lower groundwater potential within the Vryheid Formation geology from a hydrogeological perspective.

The yellow zone to the south is recognised as acceptable as the average groundwater levels are between 8 and 15 m below surface but the groundwater potential (average yields 0.5 to 2 l/s) is enhanced within the Volksrust Formation.

The resultant figure (Figure 4.1) reflects the general hydrogeology across the study area, indicating vulnerable more sensitive areas to the north, ideal areas in the center, and acceptable areas to the south. Farms where site specific data was obtained are indicated on the map, thus providing variations to the general trend across the study area. Farms Mezig and Bergvliet have groundwater records which indicate shallow groundwater conditions, thus making these farms more sensitive. It must be noted that this approach assumes the entire

[1] The portion of Earth between the land surface and zone of saturation. It extends from the top of the ground surface to the water table.

farm to be underlain by shallow groundwater, when in reality areas of these farms may still be suitable for the proposed CCGT plant.

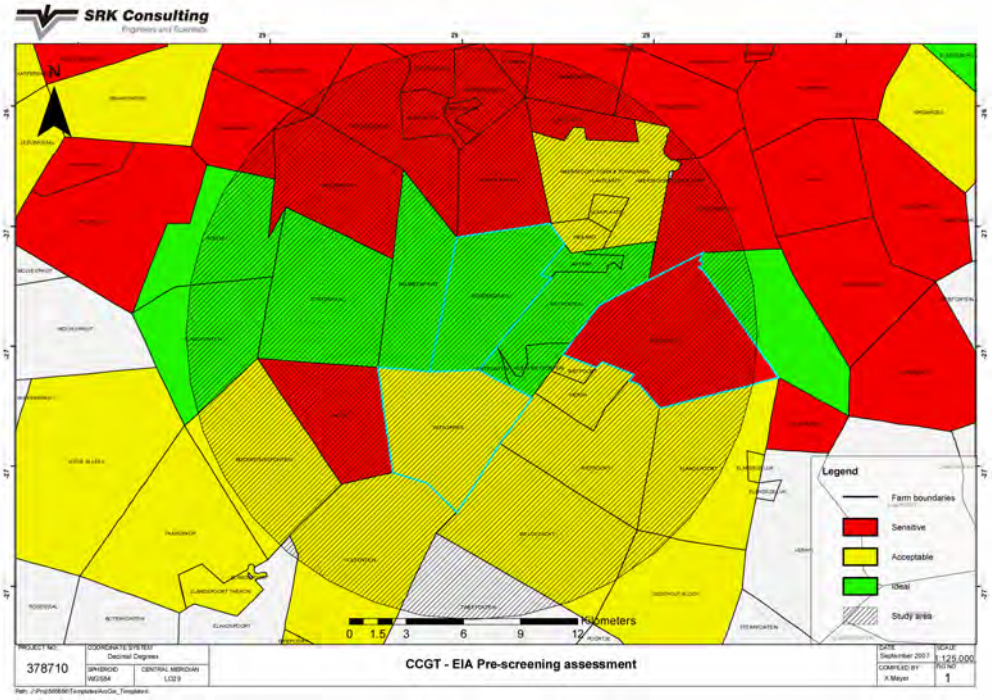

Figure 4.1 Sensitivity map showing areas that are ideal, acceptable and sensitive in terms of hydrogeological impacts.

4.1.2. Hydrology

Figure 4.2 shows the areas that are ideal, acceptable and sensitive from a hydrological point of view. Areas shown as red should be considered sensitive and of least suitability for development. In many cases these areas will require river diversions and water use license applications to DWAF as they likely to be in the floodline. Where the sensitive areas are not near a river they are due to steep slopes that will make stormwater control difficult.

Areas shown as yellow are acceptable but not ideal and from a hydrological point can be developed. Areas shown as green are the most ideal and these areas can be developed with little impact on surface water.

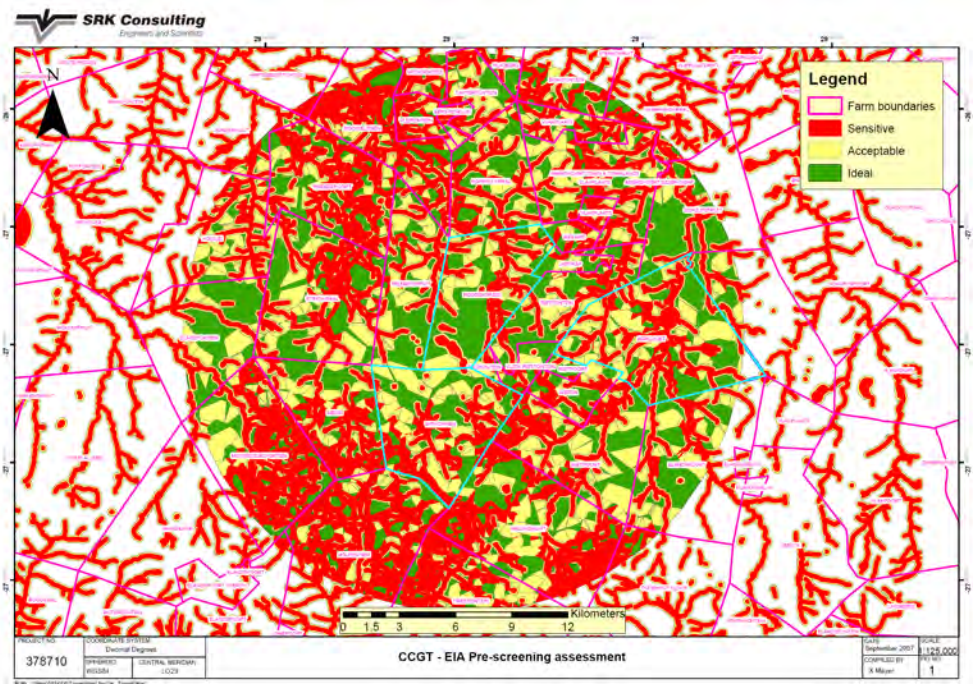

Figure 4.2 Sensitivity map showing areas that are ideal, acceptable and sensitive in terms of hydrological impacts.

4.1.3. Biodiversity

Grassland areas constitute important and sensitive ecological habitats, providing important refuge areas for a high diversity of animals, some of which may be endemic or regionally sensitive. The status of grasslands in the region presents the main problem of this particular assessment as available aerial photography does not accurately reflect the status of grassland regions. This aspect will enjoy particular attention in the Scoping and EIA phases of this particular project. For the moment it was accepted that all areas that could be identified as grassland, are pristine.

The identification of wetlands, rivers, streams and marshes also proved problematic at this stage. Available information will be sourced and the level of detail will be updated.

It is recommended, with a relative high degree of certainty that all areas that constitute wetland or pristine grassland habitat is regarded sensitive and should ideally be excluded from the proposed development.

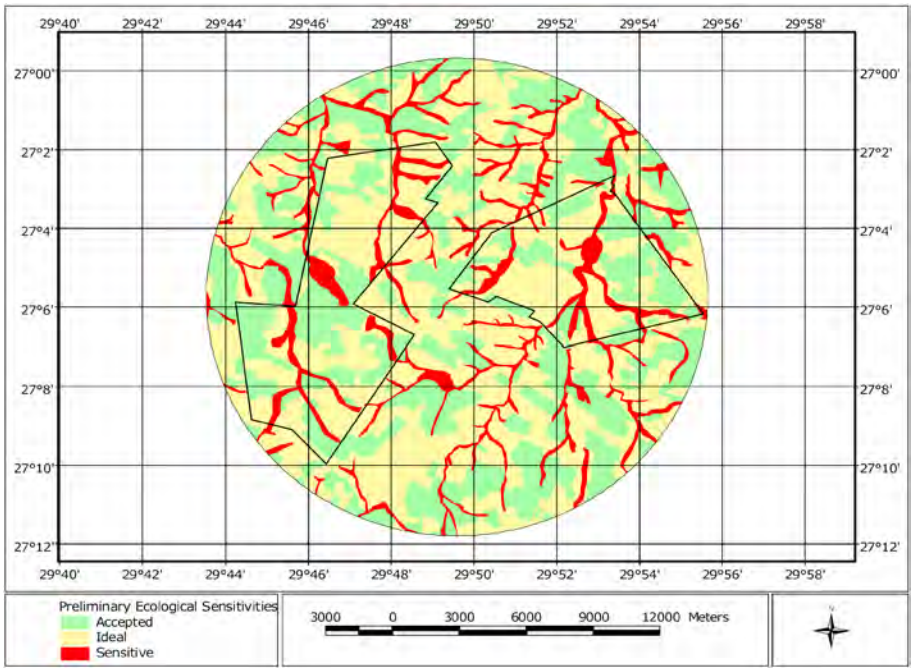

Figure 4.3 Sensitivity map showing areas that are ideal, acceptable and sensitive in terms of biodiversity impacts.

4.2. Social Impacts

4.2.1. Air Quality

The wind field is predominantly west to east although there are periods of significant east to west movements as well. Taking the perimeter of the existing Majuba power station as the point of reference, the sensitive receptors span the eastern to northern segment around the existing power station. There are no sensitive receptors that are apparent around the southern segment of the Majuba power station.

Based upon the preliminary assessment results, three bands of varying sensitivity have been identified. These are the ideal blue zone to the south of the Majuba power station, the yellow zone in the center and the red zone to the north of the Majuba power station (Figure 4.4). This assessment has been based primarily on the presence of sensitive receptors and the dominant wind field in the area and has not taken into account the type of emissions which would be released from the proposed CCGT power plant and associated infrastructure. At this stage of the investigation not enough is known about the potential emissions which could be released during the process to be included into this assessment.

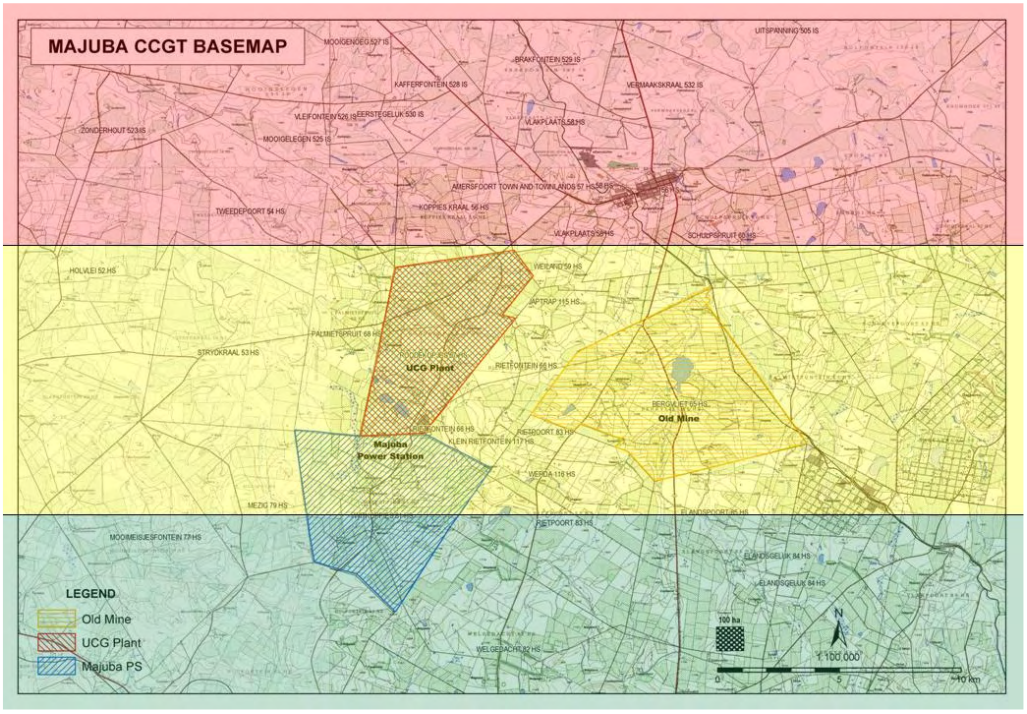

Figure 4.4 Sensitivity map showing areas that are ideal, acceptable and sensitive in terms of air quality impacts.

4.2.2. Noise

The area within a 10 km radius of the Majuba Power Station was analysed in detail. There were also several sectors where there were noise sensitive sites just outside the 10 km limit that could potentially be impacted, and in these cases a 12 km radius was used. National Road N11 was used as an expansion limit in the east, and sections of the Perdekop Road as a desirable expansion limit in the north-west.

The noise sensitive sites/areas are Amersfoort Town and various farm houses and farm labourer residences in the surrounding area. These are relative evenly spread out throughout the area. An analysis of the area within a 10 - 12 km radius of the Majuba Power Station (but maintaining the National Road N11 as an eastern limit) indicated that there was approximately the following number of noise sensitive sites (farmhouse and farm labourer homes) in the given quadrants of the 12 km circle:

Quadrant	**No Noise Sensitive Sites**
North-west	20
North-east	10
South-east	19
South-west	23