NOISE IMPACT ASSESSMENT OF THE PROPOSED STEELPOORT PUMPED STORAGE SCHEME

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1. INTRODUCTION

1.1. General

Eskom is planning the construction of a pumped storage scheme for the generation of electricity, namely a hydroelectric power station, in the Steelpoort River valley near Roossenekal in Mpumalanga Province. The project is called the Steelpoort Pumped Storage Scheme (PSS). Bohlweki Environmental (Pty) Ltd is undertaking the environmental impact assessment (EIA). As part of the EIA, a noise impact assessment has been undertaken by Jongens Keet Associates (JKA). This report documents the findings of the EIA Phase of the investigation.

1.2. Terms of Reference

The terms of reference (TOR) are as follows:

i) A sufficiently detailed quantitative (by measurement) and qualitative assessment was to be undertaken within the area of influence of the proposed Steelpoort PSS in order to enable a full appreciation of the nature, magnitude, extent and implications of the potential noise impact.

ii) The following elements were to be excluded:
   - a) The overhead power lines from the switchyard to the link point with the existing Eskom grid.
   - b) The water supply pipeline from the planned De Hoop Dam. The Department of Water Affairs and Forestry will undertake the EIA for the pipeline.
   - c) Earth and rock borrow pit sites.
   - d) Access roads. Only the short section from Road D366 to the lower (valley) site, and the section east of Sehlakwane Village to the upper reservoir site were to be evaluated. The likely necessary upgradings of Road D1890 and Road D366 in the Steelpoort River Valley and the local street though Sehlakwane Village were not to be considered.

iii) The level of investigation was to be sufficiently detailed to enable the environmental authority to make an informed decision on the matter.

iv) All aspects of investigation were to conform to the requirements of relevant environmental legislation and noise standards.

v) The potential impacts of the pre-construction, construction and operational phases of the project were to be assessed.

vi) Where relevant, appropriate noise mitigating measures were to be identified. These needed only to be conceptual at this stage.

1.3. Location and Extent of the Study Area

The site being investigated for the construction of the proposed Steelpoort PSS is on the farm Luipershoek 149-JS. The site is on the escarpment ("Thaba Ya Sekhukhune") between the Nebo Plateau and the Steelpoort River valley in Mpumalanga Province (on the border with Limpopo Province) approximately 12-kilometres north-west of Roossenekal and 2-kilometres to the east of Sehlakwane Village. Refer to Figure 1. The core study area was that within the area of influence of the noise generated by the operations at the PSS and appurtenant works. At a minimum, the area within a radius of 5000 metres of the site was evaluated. Where necessary, however, a wider area of influence has been considered.
Figure 1.

2. DETAILS OF THE PROPOSED STEELPOORT PSS

The proposed 1 000 MW pumped storage scheme is planned on the escarpment between the Nebo Plateau and the Steelpoort River valley. The installation will comprise the following components:

i) An upper reservoir on the top of the Nebo plateau. (Upper section of the installation).

ii) A lower reservoir at the foot of the escarpment. (Lower section of the installation).

iii) An underground powerhouse complex with machine hall, transformer hall, access tunnels and associated waterways/caverns that link the two reservoirs. (Lower section of the installation). The machine hall will house 3 reversible pump/turbines, coupled directly with the generator/motors, each with a rated generating output of 334 MW. Two static frequency converters will be provided to start the 3 generator/motors in sequence for pumping duty.

iv) The pump/turbines will be connected to the upper reservoir by a concrete lined headrace tunnel and pressure tunnel. A concrete line extended draft tube and tailrace tunnel will connect the pump/turbines to the lower reservoir. A headrace surge shaft and tailrace surge chamber will not need to be provided.

v) Ancillary works include an Administration Building, Visitors Centre, cooling water system, drainage and dewatering system, compressed air system, standby diesel generator, ventilation system, sewage plant, overflow dams, oil handling plant, lifting equipment, screens, gates with hoists, new access roads, switchyard, transmission lines, and basic water supply pipeline. The cooling water system, drainage and dewatering systems, and the compressed air system will be located within the underground powerhouse complex.

Figure 1

The basic water supply will be provided from the planned De Hoop Dam which will be constructed approximately 20 kilometres downstream on the Steelpoort River from the pumped storage scheme site. The dam is part of the Olifants River Water Resources Development Project (ORWRDP). The construction of the De Hoop Dam is scheduled for completion in Year 2010, before water is needed for the pumped storage scheme, which is planned for commissioning in Year 2014. The 20 kilometre long supply pipeline from the intake (pumping) point at the dam wall to the lower reservoir at the pumped storage scheme will be built by the Department of Water Affairs and Forestry and was not to be considered in this EIA.

There will be no direct access between the lower and the upper sections of the scheme either by road or by personnel access tunnel. Road access from the lower section to the upper section respectively will be along District Road D366 and Road D1890, and then along the main road system, namely Road P169-1 (Route R555), Road P51-3 (Route R33) and Road P62-2 (Route R579) respectively. The final approach to the upper section installations will be from Road P62-2 on the local street system through Sehlakwane Village. There will be little need for regular trips between the two sections as all the necessary electro-mechanical functions of the upper section will be remotely controlled from the control centre in the powerhouse complex.

It may be necessary to upgrade (or even re-align and reconstruct) sections of Road D366 and Road D1890, and the local street through Sehlakwane Village from Road P62-2 to the upper PSS site. It will in all likelihood be necessary to build a new bridge on Road D1890 across the Steelpoort River. As no details have been provided, these road elements of the project have not been assessed in detail.

3. METHODOLOGY

The general procedure used to determine the noise impact was guided by the requirements of the Code of Practice SANS 10328:2003: *Methods for Environmental Noise Impact Assessments.* The level of investigation was the equivalent of an EIA. A comprehensive assessment of all noise impact descriptors (standards) has been undertaken. The noise impact criteria used specifically take into account those as specified in the South African National Standard SANS 10103:2004, *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and Speech Communication* as well as those in the National Noise Control Regulations. The noise impact investigation comprised the following:

i) Determination of the existing situation (prior to the planned Development).
ii) Determination of the situation during and after construction of the PSS.
iii) Assessment of the change in noise climate and impact.
iv) Identification of mitigating measures.

3.1. Determination of the Existing Conditions

This phase comprised the following:

i) The relevant technical details of the proposed PSS, the existing traffic patterns and the existing and planned land use in the study area were reviewed in order to establish a comprehensive understanding of all aspects of the project that will influence the future noise climate in the study area.

ii) Noise measurements to determine the noise footprint of an operational similar PSS were taken in order to determine the likely extent of the noise impact the proposed Steelpoort PSS site. This survey was taken at the Drakensberg PSS site.

iii) Using these data, the limits of the study area for the PSS site were determined and the potential noise sensitive areas, other major noise sources and potential problems in these areas were identified.

iv) Applicable noise standards were established. The National Noise Control Regulations, and the SANS 10103:2004 standards were applied.

v) The existing *noise climate* of the study area was determined by means of a field inspection and a noise measurement survey. The measurement survey appropriately covered the whole extent of the study area, focussing specifically on the identified noise sensitive/problem areas. Measurements were taken at 9 main monitoring sites. The daytime conditions were measured at all sites. Night-time conditions were only measured at some of the locations. The sound pressure level (SPL) (noise) measurements were taken in accordance with the requirements of the Code of Practice SANS 10103:2004, *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and to Speech Communication*. Type 1 Integrating Sound Level meters were used for the noise measurements. All measurements were taken under dry weather and normal traffic (that is mid-week/school term) conditions.

vi) On the general field inspection and at the same time as each individual measurement was being taken, the qualitative nature of the *noise climate* in the area of the measurement site was assessed and recorded. This comprised an appraisal of the general prevailing acoustic conditions based on the subjective response to the sounds as perceived by the listener (i.e. *auditory observation* by the surveyor), as well as identifying those noise incidents, which influenced the noise meter readings during that measurement period. This procedure is essential in order to ensure that that there is a *human* correlation between the noise as perceived by the human ear and that, which is measured by the meter, as well as to establish any anomalies in the general ambient noise conditions.

vii) The existing noise climates along the main roads as related to the current traffic volumes and patterns were established. These traffic noise levels were calculated using the South African National Standard SANS 10210 (SABS 0210) *Calculating and Predicting Road Traffic Noise* for Route. The latest traffic was used as the baseline reference. The calculated 24-hour period noise indicators, as well as those for the daytime period and night-time period provided the main data for the impact assessment. The measured data provided a field check of the acoustic conditions.

3.2. Assessment of Planning/Design Phase and Construction Phase Impacts

Aspects of the pre-design field surveys and construction activities that potentially will have a noise impact were identified and, where appropriate, mitigating measures have been recommended.

3.3 Assessment of Operational Phase Impacts

The main focus of the operational phase assessment was to establish the nature, magnitude and extent of the potential change in *noise climate* in the study area directly related to and within the area of influence of the PSS site. This was done as follows:

i) The likely noise that will be generated by the proposed Steelpoort PSS operations was established from data determined at the Drakensberg PSS and these data were then used to determine the potential footprint of noise impact.

ii) Specific noise impact conditions in the area were determined.

iii) Based on the findings, appropriate noise mitigating measures (site scale) have been investigated and recommendations made. These are conceptual and not detailed to final design level.

4. DETAILS OF THE STUDY AREA

Only the details relevant to the noise impact assessment are given.

4.1. Topography

The main topographical features in the area are the Steelpoort River, which flows in a south to north direction through the study area and the escarpment between the Nebo plateau and the Steelpoort River valley. The terrain to the west of the escarpment (the plateau) is relatively flat but is interlaced with well-defined steep drainage valleys which extend in some instances several kilometres back west from the main north-south edge line of the escarpment. The Steelpoort River valley is contained by the Nebo plateau escarpment to the west and a series of low hills to the east. The valley floor which is up to 4 000 metres wide in places is fairly flat.

4.2. Land Use

The main land uses in the area are:

i) Residential.

  a) The town of Roossenekal is located approximately 13-kilometres to the south-east of the proposed PSS lower site.

  b) Sehlakwane Village is located on the Nebo plateau approximately 2-kilometres west of the proposed upper reservoir site.

  c) There are several farmhouses and farm labourer houses in the valley along the Steelpoort River.

ii) Educational. There are three schools in Sehlakwan, the nearest of which is approximately 4 800 metres west of the proposed upper reservoir site..

iii) Minining/Industrial. The Mapochs Iron Ore Mine is located approximately 9-kilometres to the south-east of the proposed PSS lower site.

iv) Eco-Tourist venues. There are several game lodges and conference centres in the area.

The residential, educational and eco-tourism land uses are considered to be noise sensitive sites.

4.3. Roads

There are a number of major roads and secondary roads servicing the area:

i) Provincial Road P169-1 (Route R555) is a north-south route linking Stoffberg to Steelpoort. It is aligned along the Steelpoort River Valley through the eastern side of the study area.

ii) Provincial Road P62-2 (Route R579) is a north-south route linking from Stoffberg (via Road P51-3) to Sehlakwane Village and then on northwards to Nebo Village. It is aligned through the western side of the study area.

iii) District Road D1890 provides access from Road P169-1 to the farms in the Steelpoort River valley to the north of the PSS site. It is a loop road that intersects at two locations (6-kilometres apart) with Road P169-1.

iv) District Road D366 is the main route through the central portion of the study area. It is aligned along the Steelpoort River for approximately 10-kilometres southwards from its intersection with Road D1890. The road provides direct linkage from Road D1890 (and Road P160-1) to the lower PSS site and to the farms in the Steelpoort River valley to the east and south of the PSS site.

4.4. Railway Lines

There is only one railway line which affects the study area, namely the railway line from the Mapochs Iron Ore Mine to Witbank. At its nearest point the railway line lies approximately 9 000 metres to the south-east of the proposed PSS site. There are only 8 train movements per day on this line and thus it has only a minor influence on the general noise climate of the area except at noise sensitive sites very close to the railway line.

4.5. Factors of Acoustical Significance

The topography of the area will have some effect on the propagation of sound in the study area. The escarpment between the Nebo plateau and the Steelpoort River valley will tend to shield the upper areas to a large degree from noise generated in the valley and *vice versa*. Noise will tend to be channelled up and down the pronounced drainage valleys on the escarpment face. Noise will be easily channelled along the Steelpoort River valley.

The main meteorological aspect that will affect the transmission (propagation) of the noise is the wind. The wind can result in periodic enhancement downwind or reduction upwind of noise levels. Analysis of the wind records for the area indicates that the main prevailing winds blow from the north-eastern quadrant (48%). Approximately 11% *still* periods are experienced annually. The wind directions will be modified by the orientation of the hills and valleys in the respective areas.

5. FINDINGS AND ASSESSMENT OF IMPACT

5.1 Noise Sources

The main noise sources presently affecting the study area and the additional sources that will affect the area once the proposed pumped storage scheme power station is commissioned is commissioned are:

i) Road traffic.
ii) Mapochs Iron Ore Mine.
iii) Mapochs-Witbank railway line.
iv) Steelpoort PSS

5.2. Noise Sensitive Areas/Sites

The noise sensitive areas/sites in the study area that are potentially affected by the construction and operation of the PSS on this site are the urban settlements, farm residences, schools and eco-tourism facilities listed in Section 4.2.2.

5.3. The Residual (Existing) Noise Climate

The determination of the residual (existing) noise climate in the study area is based on the measurements and observations made in the area, and where relevant also from the calculation of the noise from the traffic on the main roads. For details of the noise measurement survey and assessment of the residual noise climate refer to Appendix B.

In overview, the existing situation with respect to the *noise climate* in the study area was found to be as follows:

i) The main sources of noise in the area are from traffic on the main roads, the Mapochs Iron Ore Mine and the Mapochs-Witbank railway line.

ii) The areas relatively far from the main roads and the mine are generally very quiet. Most of the area has a typical rural *noise climate*. Even noise levels in the Sehlakwane Village are lower than those normally experienced in an urban settlement. Refer to Table B1 in Appendix B.

iii) The minor farm roads that penetrate the study area carry small volumes of traffic and the impact of traffic noise from these facilities is minimal.

iv) Ideally the ambient noise level in rural areas should not exceed 45dBA during the daytime period (06h00 to 22h00) and 35dBA during the night-time period (22h00 to 06h00). Refer to the SANS 10103:2004 standards as given in Appendix A.

v) The noise climate close to the main roads is severely degraded and adjacent to the following roads for the distances shown from the road the noise levels exceed acceptable rural residential living conditions as specified in SANS 10103:2004.
   - Road P169-1 (Route R555) - 2000 metres
   - Road P62-2 (Route R579) - 500 metres

vi) The noise from Mapochs Mine has very little influence on the core study area, namely the area within 6 000 metres of the PSS site.

vii) There are relatively few train movements per day on the Mapochs-Witbank railway line and these have no influence on the noise climate of the core study area.

5.4. The Predicted Noise Climate (Pre-construction Phase)

Activities during the planning and design phase that normally have possible noise impact implications are those related to field surveys (such seismic testing and geological test borehole drilling for large building foundations). As these activities are usually of short duration and will take place during the day, they are unlikely to cause any noise disturbance or nuisance in adjacent areas.

5.5. The Predicted Noise Climate (Construction Phase)

This Section summarises the more detailed analysis, which is documented in Appendix C.

Construction will generally be carried out during the daytime only (07h00 to 18h00 or 20h00), although construction of the underground works, namely the powerhouse complex and various tunnels could take place on a 24 hour cycle. It should also be noted that other activities may occasionally extend into the late evening period, while others such as de-watering operations may need to take place over a 24-hour period. It is estimated that the construction of the project will take place over a period of 5 years to 6 years. A large construction camp will be established at the valley site, while a smaller construction camp will be necessary at the upper reservoir site on top of the plateau. The anticipated main sources of construction noise are:

The following are likely to be the main construction related sources of noise for the power station and its infrastructure:

- Construction camp establishment. This will be for the site offices, workshops and the accommodation camp for the workers on site. There will be 2 construction camps, one up on the Nebo Plateau at the upper reservoir site and one in the Steelpoort River Valley at the power station site.
- Drilling and blasting operations for the underground works, namely the power haouse complex, tunnels and shafts.
- Excavation of building basements, foundations and service trenches. Blasting may be required in places but in general pneumatic breakers will be used where rock is encountered.
- Piling operations for large buildings.
- Erection of shuttering for concrete.
- Fixing of steel reinforcing.
- Placing and vibration of concrete. Poker vibrators will be used.
- Stripping of shuttering after concrete pour.
- Erection of structural steelwork.
- Finishing operations on buildings. Cladding, services installation, etc.
- Installation of generating plant, pumps and ancillary plant.
- General movement of heavy vehicles such as concrete delivery vehicles, mobile cranes, mechanical dumpers and water trucks (dust suppression) around the site.
- De-watering pumps. A 24-hour operation may sometimes be necessary.

- Road construction equipment. Scrapers, dozers, compactors, etc. (Construction of the internal road system and new sections of access roads in the immediate vicinity of the PSS site).
- Earth moving and compaction plant constructing the reservoirs.
- Construction site fabrication workshops and plant maintenance workshops.
- Construction material and equipment delivery vehicles.
- Concrete batching plant (including rock crushers) and asphalt batching plant on site.
- Haul trucks on the haul routes from various borrow pits.

The nature of the noise impact from the construction sites is likely to be as follows:

i) Source noise levels from many of the construction activities will be high. The level and character of the construction noise will be highly variable as different activities with different plant/equipment take place at different times, over different periods, in different combinations, in different sequences and on different parts of the construction site. Typical noise levels generated by the various types of construction equipment are given in Table C1a (Appendix C).

ii) Exact daytime period and night-time period continuous equivalent sound pressure levels are not possible to calculate with certainty at this stage as the final construction site layout, work programme, work *modus operandi* and type of equipment have not been finalised. Typical ambient noise conditions from a construction site are as indicated in Table C1b (Appendix C). Ideally the daytime outdoor ambient noise levels should not exceed 45dBA for rural residential areas or 55dBA for urban residential areas (as specified in SANS 10103). For the ambient conditions, there will be no noise disturbance further than 800 metres from the construction activity. Working on a worst case scenario basis, it is estimated that the short term maximum noise levels from general construction operations should not exceed 62dBA at a distance of 1500 metres from the activity site.

iii) Slightly higher ambient noise levels than those normally considered as reasonable are acceptable during the construction period provided that the very noisy construction activities are limited to the daytime and that the contractor takes reasonable measures to limit noise from the work site.

iv) There are likely to be minor noise disturbance and noise nuisance effects at 8 residences near to the valley construction site, while no problems are anticipated at the eastern outskirts of Sehlakwane Village from the upper reservoir site.

v) It has been estimated that the construction activities at the upper (plateau) site and the lower (valley) site will on average respectively generate about 60 and 150 vehicle trips (two way trips) daily. At the most intense stage of construction at the valley site, the daily traffic could peak at 250 vehicles per day. The main percentage of the trips will be concentrated in the morning and evening peak periods. These volumes do not include the haul trucks from the various borrow sites to the construction sites. In general the construction traffic will have a relatively minor effect on the noise climate alongside the main external roads in the area due to the already high noise levels from existing traffic. Ambient traffic noise levels on the access road through Sehlakwane Village to the upper construction site due to the construction traffic will increase only marginally but, because of the character of the traffic (namely heavy vehicles), there is likely to be some nuisance factor with the passing of each vehicle. There are numerous houses close to the road and a school along the route through the Village. Ambient traffic noise along the access route to the valley construction site from Road P169-1 (Route R555), namely along Road D1890 and Road D366, will increase significantly due to construction traffic. There is also likely to be some nuisance factor with the passing of each vehicle. This will generally be contained to the day. There are at least 10 houses along the access route to the site that are affected.

vi) It is unlikely that there will be any significant effect from the general construction noise at the dam, on wildlife and livestock in the area. It is however anticipated that wildlife will naturally move from areas in the immediate vicinity of construction site activity if affected by the noise. It has been also been found that many species of wildlife and farm animals habituate rapidly to altered noise conditions after prior exposure. This is particularly so when noise levels of 100dB are not exceeded as will be the case at the dam. There are likely to be problems under extreme conditions, namely where there are very loud sounds with rapid onset rates such as with blasting. For example, with each explosion there are likely to be startle effects with raptors nesting along the face of the escarpment. This will be so with surface and underground blasting. With the latter, although the airborne noise levels will be very low, impact due to vibration though the rock mass to the escarpment face and the associated the low frequency ground-borne noise generated by the vibration may be significant. Blasting at night may have more pronounced effects.

vii) For all construction work, the construction workers working with or in close proximity to equipment will be exposed to high levels of noise as can be seen from Table C1a (refer to the 5 metre offset noise levels).

viii) There will significant noise from the operations at the rock and earth borrow pits from drilling and blasting and the loading of haul trucks. There will also be the impact of the haul trucks along the haul route between the various borrow pits and the construction sites. As the borrow pit sites have not yet been identified, the extent of the noise impact on surrounding areas and the routes affected cannot be assessed in detail.

ix) There will be localised noise impacts where construction takes place along sections of access route that need upgrading or reconstruction.

The significance rating of the construction phase impacts is analysed in Section C5 of Appendix C.

5.6. The Predicted Noise Climate (Operational Phase)

5.6.1. *PSS Noise Footprint*

With the commissioning of the Steelpoort PSS, the noise climate close to the new facility will alter. The commissioning date is predicted to be 2014. In order to ascertain the likely noise footprint of the Steelpoort PSS, baseline noise measurements were taken at an operational similar type installation, namely the Drakensberg Pumped Storage Scheme (power station) in KwaZulu Natal Province. For details of the survey refer to Appendix C. From observations at this site, it was confirmed that the noise climate at Steelpoort PSS can be expected to be very much the same as that at the Drakensberg PSS. The main noise sources at the Steelpoort PSS will be from:

i) The main PSS operations:

ii) Noise impact from ancillary works (such as waste water purification works).

iii) CSP Plant generated traffic.

The noise climate in the core study area will be as follows:

i) The main and loudest noises will be generated in the power station underground. These noises however will be contained to the underground section of the installation. The main noise sources will be:

   a) Motors.

   b) Generators. Continuous very loud noise during operation.

   c) Turbines. Continuous very loud noise during operation.

   d) Pumps. Continuous very loud noise during operation.

   e) Ventilation fans. Continuous noise during operation.

   f) Noise from pressure balancing in the pipeline. Sporadic noise. During a mode change, when the spherical valve has to open or close, the release or pressurising of the water head results in the emission of a high pitched noise. This noise will only be audible in the underground powerhouse complex.

   g) Synchronous Condenser Operation (SCO) noise. Sporadic noise. When a turbine is running in air and the mode must change to generation or pump, the air is exhausted via a pipeline leading room the turbine top cover down into the drainage galley. The resultant noise from the rapid exit of air is extremely loud. This noise will only be audible in the underground powerhouse complex.

h) "Water hammer" noise. Sporadic noise. With the closing of any of the main valves, there is a pressure surge in the pipeline that, in turn, translates into vibration and low frequency noise. The noise will be barely audible.

ii) The "leakage" of noise from the underground works via the tunnel system will be negligible. This is due to the length of tunnel and fact that the tunnel entrance doors will generally kept closed.

iii) No noise related to PSS operations will be perceivable during generation mode at the inlet (upper reservoir) and outlet works (lower reservoir) as inlet and outlet levels will be well below water surface at the respective reservoirs.

iv) Similarly no noise related to PSS operations will be perceivable during pumping mode at the outlet (upper reservoir) and inlet works (lower reservoir).

v) Pumping operations will generate some vibration up the pressure shafts that, in turn, will be transmitted through the surrounding rock. This is unlikely to be a nuisance problem at distances greater than 300 metres from the shafts.

vi) The main external (at surface outside the underground section) noise sources will be:

a) Underground ventilation system inlets and outlets.
b) Office complex ventilation system.
c) Switchyard building ventilation system.
d) Sewage plant.
e) PSS complex generated traffic. Traffic to offices, stores, visitors centre.

vii) The noise from the ventilation shafts will generally not be audible beyond a 200 metre offset. Predicted noise levels at the given offsets will be:

a) At 1 metre - 71,5dBA.
b) At 100 metres - 39,1dBA.
c) At 200 metres - 32,8dBA.

viii) The noise from the switchyard building ventilation outlet vent will generally not be audible beyond a 300 metre offset. Predicted noise levels at the given offsets will be:

a) At 1 metre - 77,1dBA.
b) At 100 metres - 44,1dBA.
c) At 200 metres - 37,7dBA.
d) At 300 metres - 33,8dBA.

ix) The noise from the sewage works will generally not be audible beyond a 100 metre offset. Predicted noise levels at the given offsets will be:

a) At 1 metre - 71,1dBA.

b) At 100 metres - 26,1dBA.

x) In the Steelpoort Valley there are only 8 farmhouses and farm labourer houses that will be within a 500 metres radius of outer edge of the lower section of the PSS. There are approximately 25 residences within 4 000 metres of the site.

xi) The predicted staffing and traffic data for the operational conditions once the Steelpoort PSS is commissioned were supplied by Eskom. The staffing of the installation will work on a shift basis 24 hours per day, 7 days a week. The core staff component (daytime) will be of the order of 40 personnel. During the night-time there will only be a skeleton staff of technicians. It is likely that the technical staff will be housed in Roossenekal. It has been estimated that the PSS complex, including the administrative offices, stores area and visitors centre could generate about 100 vehicle trips daily. The greater percentage (96%) of these trips will be to the lower site in the Steelpoort River Valley.

5.6.2. *Noise Impact*

The following was ascertained:

i) The loudest noise sources will be located underground in the powerhouse complex and have little effect on the surface.

ii) There are no noise sources above ground at the proposed new installation that will have a significant noise impact on the surrounding areas. It is unlikely that there will be any noise impact at any of the noise sensitive sites in the vicinity of the lower PSS site in the Steelpoort Valley as they will be further than 300 metres away from any of the surface noise sources at the PSS. Note that 300 metres was measured and calculated to be the maximum range of likely impact from the ventilation inlets/outlets and the switchyard building ventilation. It is also unlikely that there will be any noise impact at Sehlakwane Village from operations at the upper reservoir site as the village is approximately 2000 metres west of the site.

iii) The total volume of traffic generated by the PSS will be very small in relation to the total volume of traffic on the main roads that will used by the site traffic. There will be a very small increase (+0,2dBA) in traffic generated noise along Road P169-1 (R555) due to the traffic generated by the lower PSS site. There will be no increase in noise levels along Road P62-2 (R579) due to the upper PSS site generated traffic. The volume of traffic to and from the lower site will be small and mainly concentrated in the morning and evening peak hours. No noise impacts are predicted. There will be very few daily trips to and from the upper reservoir site, and thus no noise impacts are anticipated along the access route through Sehlakwane Village.

5.6.3. ***Impact of other Noise Sources***

There will be no noise impact from main road traffic, the Mapochs Iron Ore Mine and the Mapochs-Witbank railway line on the core study area.

The significance rating of the operational phase impacts is analysed in Section C5 of Appendix C.

6. CONCLUSIONS

The following may be concluded from the foregoing analysis:

i) The residual noise climate of the area is very quiet and there is a potential for noise impact at local noise sensitive sites.

ii) Noise impact during construction could be significant in some areas.

iii) Although not all of the final baseline noise design data for the PSS plant and equipment was available for the analysis, the baseline noise data from a similar facility was available and the assumptions made are considered adequate to give a meaningful analysis of the noise impact situation.

iv) The area of potentially serious noise impact around the planned Steelpoort PSS once operational will be fairly small. It is predicted that any impacts will be contained an area within a distance of about 300-metres of the edge of the PSS works. Although there are 8 noise sensitive sites within this area of influence at the lower site, none will be closer than 500 metres to the main surface noise sources. There will be no noise impacts at Sehlakwane Village from the operations at the upper reservoir site.

v) With the natural growth in traffic, noise levels alongside the main roads will continue to increase and the already degraded noise climate within the area of influence of these roads will worsen. The additional noise from the PSS site generated traffic will be insignificant.

vi) There are practical mitigating measures that can be implemented to prevent or reduce potential impact at the PSS site.

7. MITIGATING MEASURES

Potential noise mitigating measures for the project were assessed.

7.1. Pre-construction Phase

Local residents are to be notified of any potentially noisy field survey works or other works during the planning and design phase and these activities are to be undertaken at reasonable times of the day. These works should not take place at night or on weekends.

During this phase, consideration must be given to the noise mitigating measures required during the construction phase and which should be included in the tender document specifications and the design.

7.2. Construction Phase

The noise mitigating measures to be considered during the construction phase are as follows:

i) Construction site yards, concrete batching plants, asphalt batching plants, construction worker camps (accommodation) and other noisy fixed facilities should be located well away from noise sensitive areas adjacent to the development site.

ii) All construction vehicles and equipment are to be kept in good repair.

iii) Construction activities, and particularly the noisy ones, are to be contained to reasonable hours during the day and early evening.

iv) With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the contractor should liaise with local residents on how best to minimise impact.

v) The effect of blasting on the local nesting raptor population, if relevant, is to be monitored. Refer to Section 5.5.vi.

vi) In general operations should meet the noise standard requirements of the Occupational Health and Safety Act (Act No 85 of 1993).

vii) Construction staff working in areas where the 8-hour ambient noise levels exceed 75dBA should wear ear protection equipment.

7.3. Operational Phase

The following noise mitigating measures, which will need to be considered where appropriate:

i) The design of the PSS is to incorporate all the necessary acoustic design aspects required in order that the overall generated noise level from the new installation does not exceed a maximum equivalent continuous rating level, namely a noise level of 70dBA (just inside the *property projection plane*, namely the property boundary) as specified for industrial districts in SANS 10103. Refer to Appendix A. Notwithstanding this provision, the design is also to take into account the maximum allowable equivalent continuous day and night rating levels of the potentially impacted sites outside the new installation's property.

ii) The latest technology incorporating maximum noise mitigating measures for the PSS components should be designed into the system.

iii) The design process is to consider, *inter alia*, the following aspects:

a) The position and orientation of buildings on the site. The position of the surface facilities that generate the loudest noise should be located far as possible from the noise sensitive sites on adjacent farms.
b) The enclosure of noisy plant in buildings where possible and practical.
c) The design of the buildings to minimise the transmission of noise from the inside to the outdoors.
d) The insulation of particularly noisy plant and equipment.

8. RECOMMENDATIONS

The following are recommended:

i) The National Noise Control Regulations and SANS 10103 should be used as the main guidelines for addressing the potential noise impact on this project.

ii) Once all the plant /equipment technical details and the operating details of the PSS are known, a further more detailed analysis of the noise impact situation should be undertaken in order to confirm the final noise footprint of the installation.

iii) The noise mitigating measures indicated in Section 7 should be applied as guidelines for further design on the project.

9. REFERENCES

1. South African National Standard SANS 10103:2004, *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and to Speech Communication*.
2. South African National Standard SANS 10210 (SABS 0210), *Calculating and Predicting Road Traffic Noise*.
3. South African Bureau of Standards Code of Practice SANS 10328 (SABS 0328), *Methods for Environmental Noise Impact Assessments*.
4. South African National Standard SANS 10357 (SABS 0357), *The Calculation of Sound Propagation by the Concawe Method*.
5. National Noise Control Regulations.

APPENDIX A

GLOSSARY OF TERMS
AND
NOISE IMPACT CRITERIA

APPENDIX A

A1. GLOSSARY OF TERMS

In order to ensure that there is a clear interpretation of this report the following meanings should be applied to the acoustic terminology:

- **Ambient sound level** or **ambient noise** means the totally encompassing sound in a given situation at a given time, and usually composed of sound from many sources, both near and far. Note that ambient noise includes the noise from the noise source under investigation. The use of the word *ambient* should however always be clearly defined (compare with *residual noise*).
- **A-weighted sound pressure, in Pascals**: The root-mean-square sound pressure determined by use of frequency-weighting network A.
- **A-weighted sound pressure level (SPL) (noise level) (L_{pA}), in decibels**: The sound pressure level of A-weighted sound pressure is given by the equation:

  $L_{pA} = 10 \log (p_A/p_o)^2$ where:

  p_A is the A-weighted sound pressure, in Pascals; and

  p_o is the reference sound pressure (p_o = 20 micro Pascals (μPa))

  Note: The internationally accepted symbol for sound pressure level, dB(A), is used.
- **Controlled areas** as specified by the National Noise Control Regulations are areas where certain noise criteria are exceeded and actions to mitigate the noise are required to be taken. Controlled areas as related to roads, airports and factory areas are defined. These Regulations presently exclude the creation of *controlled areas* in relation to railway noise.
- **dB(A)** means the value of the sound pressure level in decibels, determined using a frequency weighting network A. (The "A"-weighted noise levels/ranges of noise levels that can be expected in some typical environments are given in Table A1 at the end of this appendix).
- **Disturbing noise** means a noise level that exceeds the outdoor equivalent continuous rating level for the time period and neighbourhood as given in Table 2 of SANS 10103:2003. For convenience, the latter table is reproduced in this appendix as Table A1.
- **Equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$)** means the value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, has the same mean-square sound pressure as a sound under consideration whose level varies with time.
- **Equivalent continuous rating level ($L_{Req,T}$)** means the equivalent continuous A-weighted sound pressure level during a specified time interval, plus specified adjustments for tonal character and impulsiveness of the sound and the time of day.

- **Equivalent continuous day/night rating level ($L_{R,dn}$)** means the equivalent continuous A-weighted sound pressure level during a reference time interval of 24-hours, plus specified adjustments for tonal character and impulsiveness of the sound and the time of day. (An adjustment of 10dB is added to the night-time rating level).
- **Integrating sound level meter** means a device that integrates a function of the root mean square value of sound pressure over a period of time and indicates the result in dBA.
- **Noise** means any acoustic phenomenon producing any aural sensation perceived as disagreeable or disturbing by an individual or group. Noise may therefore be defined as any *unwanted* sound or sound that is *loud, unpleasant or unexpected*.
- **Noise climate** is a term used to describe the general character of the environment with regard to sound. As well as the ambient noise level (quantitative aspect), it includes the qualitative aspect and the character of the fluctuating noise component.
- **Noise Control Regulations** means the regulations as promulgated by the Department of Environmental Affairs and Tourism that are to be used by the provincial authorities to prepare their specific regulations. The project lies within the area of jurisdiction of Mpumalanga Province and Limpopo Province. As these provinces have not yet promulgated their own regulations, the National Regulations are to be used.
- **Noise impact criteria** means the standards applied for assessing noise impact.
- **Noise level** means the reading on an integrating impulse sound level meter taken at a measuring point in the presence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation, and, if the alleged disturbing noise has a discernible pitch, for example, a whistle, buzz, drone or music, to which 5dBA has been added. (The "A"-weighted noise levels/ranges of noise levels that can be expected in some typical environments are given in Table A2 at the end of this appendix).
- **Noise nuisance** means any sound which disturbs or impairs or may disturb or impair the convenience or peace of any reasonable person considering the location and time of day. This applies to a disturbance which is not quantitatively measurable such as barking dogs, etc. (compared with disturbing noise which is measurable).
- **Residual sound level** means the ambient noise that remains at a position in a given situation when one or more specific noises are suppressed (compare with *ambient noise*).
- **Sound exposure level or SEL** means the level of sound accumulated over a given time interval or event. Technically the sound exposure level is the level of the time-integrated mean square A-weighted sound for stated time or event, with a reference time of one second.
- **Sound (pressure) level** means the reading on a sound level meter taken at a measuring point.

- **SANS 10103** means the latest edition of the South African Bureau of Standards Code of Practice SANS 10103 titled *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and to Speech Communication*.
- **SABS 0210** means the latest edition of the South African Bureau of Standards Code of Practice SABS 0210 titled *Calculating and Predicting Road Traffic Noise*.
- **SANS 10328** means the latest edition of the South African Bureau of Standards Code of Practice SANS 10328 titled *Methods for Environmental Noise Impact Assessments*.
- **Sound** means the aural sensation caused by rapid, but very small, pressure variations in the air. In quantifying the subjective aural sensation, "loudness", the letters dBA after a numeral denote two separate phenomena:
  - "dB", short for *decibel*, is related to the human's subjective response to the change in amplitude (or largeness) of the pressure variations.
  - The "A" denotes the ear's different sensitivity to sounds at different frequencies. The ear is very much less sensitive to low (bass) frequency pressure variations compared to mid-frequencies.

  The level of environmental sound usually varies continuously with time. A human's subjective response to varying sounds is primarily governed by the total sound energy received. The total sound energy is the average level of the fluctuating sound, occurring during a period of time, multiplied by the total time period. In order to compare the effects of different fluctuating sounds, one compares the average sound level over the time period with the constant level of a steady, non-varying sound that will produce the same energy during the same time period. The average energy of sound varying in amplitude is thus equivalent to the continuous, non-varying sound. The two energies are equivalent.

Refer also to the various South African National Standards referenced above and the Noise Control Regulations for additional and, in some instances, more detailed definitions.

TABLE A1: TYPICAL NOISE RATING LEVELS FOR AMBIENT NOISE IN DISTRICTS (NOISE ZONES)

Type of District	Equivalent Continuous Rating Level for Noise ($L_{Req,T}$) (dBA)					
	Outdoors			Indoors with open windows		
	Day-night ($L_{R,dn}$)	Daytime ($L_{Req,d}$)	Night-time ($L_{Req,n}$)	Day-night ($L_{R,dn}$)	Daytime ($L_{Req,d}$)	Night-time ($L_{Req,n}$)
RESIDENTIAL DISTRICTS						
a) Rural districts	45	45	35	35	35	25
b) Suburban districts (little road traffic)	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
NON RESIDENTIAL DISTRICTS						
d) Urban districts (some workshops, business premises and main roads)	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

TABLE A2: NOISE LEVELS/RANGES OF NOISE LEVELS THAT MAY BE EXPECTED IN SOME TYPICAL ENVIRONMENTS

Noise Level dB(A)	Typical Environment	Subjective Description
140	30m from jet aircraft during take-off	
130	Pneumatic chipping and riveting (operator's position)	Unbearable
>120	Hearing damage possible even for short exposure	
120	Large diesel power generator	
105-120	Low level military aircraft flight	
110-120	100 m from jet aircraft during take-off	
110	Metal workshop (grinding work), circular saw	
105-110	High speed train at 300 km/h (peak pass-by level at 7,5m)	
90-100	Printing press room	Very noisy
95-100	Passenger train at 200km/h (peak pass-by level at 7,5m).	Very noisy
95-100	Freight train at 100 km/h (peak pass-by level at 7,5 m)	Very noisy
90-100	Discotheque (indoors)	
75-100	7,5 m from passing motorcycle (50 km/h)	
75-80	10 m from edge of busy freeway (traffic travelling at 120 km/h)	
80-95	7,5 m from passing truck (50 km/h)	
80	Kerbside of busy street	
70	Blaring radio	Noisy
70	3 m from vacuum cleaner	Noisy
60-80	7,5 m from passing passenger car (50 km/h)	
65	Normal conversation	
65	Large busy office	
60	Supermarket/small office	
50	Average suburban home (day conditions)	Quiet
40	Library	
40-45	Average suburban home (night-time)	
30-35	Average rural home (night-time)	
25-30	Slight rustling of leaves	
20	Background in professional recording studio	Very quite
20	Forest (no wind)	
0-20	Experienced as complete quietness	
0	Threshold of hearing at 1000 Hz	

A2. NOISE IMPACT CRITERIA

The international tendency is to express noise exposure guidelines in terms of absolute noise levels. These guidelines imply that in order to ascertain an acceptable living environment, ambient noise in a given type of environment should not exceed a specified absolute level. This is the approach provided by the environmental guidelines of the World Bank and World Health Organisation, which specify 55 dBA during the daytime period (06:00 to 22:00) and 45 dBA during the night-time period (22:00 to 06:00) for residential purposes, determined over any hour. The standards for rural residential which apply to this project specify that an ambient noise level of 45dBA during the day and 35dBA during the night should not be exceeded. SANS 10103 conforms to the described international tendency. The recommended standards to be applied are summarised in Table A1. If the residual noise level in the area already exceeds the maximum recommended maximum, then the new noise source should not increase the existing residual noise level.

Communities generally respond to a change in the ambient noise levels in their environment, and the guidelines set out in SANS 10103 provide a good indication for estimating their response to given increases in noise. The suggested severity criteria for the noise impacts are summarised in terms of the above guidelines in Table A3.

TABLE A3: CATEGORIES OF COMMUNITY/GROUP RESPONSE (CRITERIA FOR THE ASSESSMENT OF THE SEVERITY OF NOISE IMPACT)

Increase in Ambient Noise Level (dBA)	Estimated Community/Group Response	
	Category	Description
0 – 10	Little	Sporadic complaints
5 – 15	Medium	Widespread complaints
10 – 20	Strong	Threats of community/group action
Greater than 15dBA	Very strong	Vigorous community/group action

Changes in noise level are perceived as follows:

- *3dBA:* For a person with average hearing acuity, an increase in the general ambient noise level of 3dBA will be just detectable.
- *5dBA:* For a person with average hearing acuity an increase of 5dBA in the general ambient noise level will be significant, that is he or she will be able to identify the source of the intruding noise. According to SANS 10103 the community response for an increase of less than 5dBA will be ‘little’ with ‘sporadic complaints’. For an increase of equal or more than 5dBA the response changes to ‘medium’ with ‘widespread complaints’.

- *10dBA:* A person with average hearing will subjectively judge an increase of 10dBA as a doubling in the loudness of the noise. According to SANS 10103 the estimated community reaction will change from ‘medium’ with ‘widespread complaints’ to ‘strong’ with ‘threats of community action’.

Also as a general rule-of-thumb for a new noise source introduced into an area is that, if the ambient noise level of the new source is 10dBA less than the existing ambient noise level in the area, the new source will not be audible.

APPENDIX B:

DETAILS OF THE NOISE MEASUREMENT SURVEY AND EXISTING NOISE CLIMATE CONDITION ASSESSMENT

APPENDIX B: DETAILS OF THE NOISE MEASUREMENT SURVEY AND EXISTING NOISE CLIMATE CONDITION ASSESSMENT

B1. GENERAL

The technical details of the noise measurement survey and general noise climate investigation related to the noise impact aspects for the proposed Steelport Pumped Storage Scheme (PSS) that will be located on the Steelpoort River near Roossenekal in Mpumalanga and Limpopo Provinces are dealt with in this Appendix.

The noise impact assessment was undertaken in accordance with the requirements of the South African National Standard SANS 10328 (SABS 0328) *Methods for Environmental Noise Impact Assessments*. Daytime and evening period noise measurements were taken during the week at nine (9) main monitoring sites at appropriate locations to establish the existing ambient noise conditions around the study area. Supplementary noise measurements to establish the baseline noise profiles of the proposed installation that need to be used at the Steelpoort PSS were taken at the Drakensberg Pumped Storage Scheme (Drakensberg Power Station) in KwaZulu Natal Province.

B2. STANDARDS AND MEASUREMENT EQUIPMENT

The sound pressure level (SPL) (noise) measurements were taken in accordance with the requirements of the South African National Standard SANS 10103:2004, *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and Speech Communication*. Two Type 1 Integrating Sound Level Meters, a Bruël and Kjaer Model 2230 meter and a Larson Davis 824 were used for the noise measurements. Both meters were calibrated at the CSIR Acoustical Laboratory within the last 12 months. The calibration status of the meters was also checked before and after completion of the total measurement period of the day. A calibrated signal with a sound pressure level of 94,0dB at 1 kHz and 114,0dB at 1 kHz were applied to the Bruël and Kjaer meter and the Larson Davis meter respectively. A Larson Davis Model CAL200 was used.

For all measurements taken to establish the ambient noise levels, the equivalent noise level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) during that measurement period were recorded. The frequency weighting setting was set on "A" and the time weighting setting of the meters were set on *Impulse* (I). Measurement periods of a minimum of 10 minutes were used where ambient conditions were to be established. Where the power station component was to be isolated, the variation in instantaneous sound pressure level (SPL) over a short period was measured when the power station could be heard to predominate. For these latter measurements the time weighting setting of the meter was also set on *Impulse* (I).

At all the measurement sites, the meters were set up with the microphone height at 1,3 metres above ground level and well clear of any reflecting surfaces (a minimum of 3 metres clearance). For all measurements, a standard windshield cover (as supplied by the manufacturers) was placed on the microphone of each meter.

At the same time as each individual measurement was being taken, the qualitative nature of the *noise climate* in the area of the measurement site was assessed and recorded. This comprised an appraisal of the general prevailing acoustic conditions based on the subjective response to the sounds as perceived by the listener (i.e. *auditory observation* by the surveyor), as well as identifying those noise incidents, which influenced the noise meter readings during that measurement period. This procedure is essential in order to ensure that that there is a *human* correlation between the noise as perceived by the human ear and the noise, which is measured by the meter, as well as to establish any anomalies in the general ambient noise conditions.

B3. MEASUREMENT SITES

The nine main monitoring sites in the study area where the ambient noise conditions were established are:

i) Site 1: On track, at approximately 1000 metres east of Sehlawane Village. Upper section on top of plateau.

ii) Site 2: On track, at north-eastern boundary of Sehlawane Village. Upper section on top of plateau.

iii) Site 3: In Steelpoort Valley. On western side of Road D366 at the entrance to farm a Portion of the farm Luipershoek 149-JS (TG Berry farm entrance), 150 metres north of the Steelpoort River and road-weir crossing of the river.

iv) Site 4: In Steelpoort Valley. On eastern side of Road D366 at the entrance to a Portion of the farm Luipershoek 149-JS (SI Kritzinger farm entrance).

v) Site 5: In Steelpoort Valley. On western side of Road D366 at farm labourer houses on the farm Luipershoek 149-JS. Approximately 1000 metres north of Zanele.

vi) Site 6: In Steelpoort Valley. On northern side of Road D366 at farm labourer houses on the farm Steynsdrift 145-JS. Approximately 800 metres west of the intersection with Road D1890.

vii) Site 7: In Steelpoort Valley. On eastern side of Road D1890 at the entrance to a Portion of the farm Steynsdrift 145-JS (Nick and Cathy Gouws farm entrance).

viii) Site 8: In Steelpoort Valley. On eastern side of Road D1890 at the entrance to a Portion of the farm Tigershoek 140-JS. The site is approximately 3 600 metres north of intersection with Road D366.

ix) Site 9: In Steelpoort Valley. On the farm Mapochsgronde 964-JS on access road to the farmhouse "Eensaam" (on farm 963-JS) approximately 12 000 metres south of the proposed PSS site and approximately 1000 metres west of Road D366. This site was measured in order to indicate that the noise climate in the farming areas along the valley is similar.

B4. MEASUREMENT DATES/TIMES

General observation of the noise conditions in the areas around the study area as well as the site specific sound pressure level (noise) measurements and observations were taken on Friday, 6 October 2006 from 12h00 to 21h00 and Thursday 1 February 2007 during the daytime period from 09h30 to 17h30 and during the evening period from 19h00 to 21h30.

B5. NOISE CLIMATE DETAILS

B5.1. Summary of Ambient Sound Pressure Level Measurements

The results of the ambient noise condition measurement survey are summarised in Table B1. The equivalent sound pressure (noise) level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) are indicated. Note that the equivalent sound pressure (noise) level may, in layman's terms, be taken to be the average noise level over the given period. This "average" is also referred to as the residual noise level (excluding the impacting noise under investigation) or the ambient noise level (if the impacting noise under investigation is included).

The weather conditions on all the survey days were such that the measurements to establish the ambient noise levels were not adversely affected and no specific corrective adjustments needed to be made.

TABLE B1: EXISTING (YEAR 2007) NOISE LEVELS IN THE AREA OF THE STEELPOORT PUMPED STORAGE SCHEME SITE

Measurement Site	Measured Sound Pressure Level (dBA)					
	Daytime Period			Evening Period		
	L_{Aeq}	L_{max}	L_{min}	L_{Aeq}	L_{max}	L_{min}
Site 1	38.7	52.2	27.3	<35 *	-	-
Site 2	41.2	57.7	22.4	34.7	49.0	27.4
Site 3	39.6	58.8	32.7	37.4	49.4	29.7
Site 4	44.3	54.9	29.3	<35 *	-	-
Site 5	34.7	44.4	28.1	32.1	42.9	27.8
Site 6	42.6	54.8	34.6	<35 *	-	-
Site 7	40.2	55.1	30.8	<35 *	-	-
Site 8	42.5	56.4	33.8	38.2	46.4	22.8
Site 9	34.2	52.8	22.7	<35 *	-	-
Note: * - no measurement taken but noise level at the site estimated to be less than (<) 35dBA						

B5.2. Noise Climate Related to the 24 hour Road Traffic

In order to complement the short-term noise measurements in the study area, the existing 24-hour residual noise levels related to the average daily traffic (ADT) flows on roads that directly affect the study area, namely Road P169-1 (Route R555) and Road P62-2 (Route R579), were calculated. These data provide an accurate base for the SANS 10103 descriptors.

The noise levels generated from the traffic on these roads were calculated using the South African National Standard SANS 10210 (SABS 0210), *Calculating and Predicting Road Traffic Noise*. Typical situations were used for the calculation sites. The Year 2006 traffic was used as the baseline for the calculations. The traffic data were obtained from Goba Consulting Engineers and Project Management.

The noise levels at various offsets from the centreline of the specified roads are summarised in Table B2. The noise descriptors used are those prescribed in SANS 10103:2004, namely:

i) Daytime equivalent continuous rating (noise) level ($L_{Req,d}$) (L_d used in Table), namely for the period from 06h00 to 22h00).

ii) Night-time equivalent continuous rating (noise) level ($L_{Req,n}$) (L_n used in Table), namely for the period from 22h00 to 06h00).

The noise levels given are the unmitigated values. A conservative approach has been taken in that a hard intervening ground condition has been modelled to simulate winter conditions (burnt veld). The thick vegetation in the area will generally result in greater attenuation with distance than shown. There will also be greater attenuation with distance than shown where there are houses, other buildings and terrain restraints in the intervening ground between the source and the receiver point.

TABLE B3: EXISTING NOISE CLIMATE ADJACENT TO MAIN ROADS (YEAR 2007)

Road	Noise Levels Alongside Roads at Given Offset from Centreline (SANS 10103 Indicator) (dBA)							
	100m Offset		250m Offset		500m Offset		1000m Offset	
	L_d	L_n	L_d	L_n	L_d	L_n	L_d	L_n
P169-1 (R555)	57.0	48.2	53.0	44.2	50.0	41.2	47.0	38.2
P62-2 (R579)	51.4	42.6	47.4	38.6	44.4	35.6	41.4	32.6

B5.3. Railway Traffic

There is only one railway line which affects the study area, namely the railway line from the Mapochs Iron Ore Mine to Witbank. At its nearest point the railway line lies approximately 9 000 metres to the south-east of the proposed PSS site. There are only 8 train movements per day on this line and thus it has only a minor influence on the general noise climate of the area except at noise sensitive sites very close to the railway line.

B5.4. Prevailing Noise Climate

In overview, the existing situation with respect to the *noise climates* in the study area was found to be as follows:

i) The main sources of noise in the area are from traffic on the main roads, the Mapochs Iron Ore Mine and the Mapochs-Witbank railway line.

ii) The areas relatively far from the main roads and the mine are generally very quiet. Most of the area has a typical rural *noise climate*. Even noise levels in the Sehlakwane Village are low for an urban settlement.

iii) The minor farm roads that penetrate the study area carry small volumes of traffic and the impact of traffic noise from these facilities is minimal.

iv) Ideally the ambient noise level should not exceed 45dBA during the daytime period (06h00 to 22h00) and 35dBA during the night-time period (22h00 to 06h00). Refer to the SANS 10103:2004 standards as given in Appendix A.

v) The noise climate close to the main roads is severely degraded and adjacent to the following roads for the distances shown from the road the noise levels exceed acceptable rural residential living conditions as specified in SANS 10103:2004.

- Road P169-1 (Route R555) - 2000 metres
- Road P62-2 (Route R579) - 500 metres

vi) The train movements on the Mapochs-Witbank railway line have no influence on the general noise climate of the area.

vii) The noise from Mapochs Mine has very little influence on the core study area.

APPENDIX C

ASSESSMENT OF NOISE IMPACT

APPENDIX C: ASSESSMENT OF NOISE IMPACT

C1. GENERAL

C1.1. Background Details

Eskom is planning the construction of a pumped storage scheme (PSS) power station in the Steelpoort River Valley.

The assessment of the noise impact was guided by the requirements of the South African National Standard SANS 10328 (SABS 0328) titled *Methods for Environmental Noise Impact Assessments* and the Noise Control Regulations. A comprehensive assessment using the appropriate noise impact decriptors (standards) has been undertaken. The noise impact criteria used in this investigation specifically take into account those as specified in the South African National Standard SANS 10103:2004, *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and Speech Communication,* as well as those in the National Noise Control Regulations. Relevant aspects of these Regulations and SANS 10103:2004 are provided in Appendix A.

C1.2. Noise Sensitive Areas/Sites

Noise sensitive areas/sites were initially identified from the 1:50 000 scale topo-cadastral mapping of the study area and then as far as possible checked on site. The specific land use (type of farming activity) and position of the all the farmhouses, labourers' houses, guest houses, lodges and other habitations were then as far as possible checked on site. The following 1:50 000 topographical cadastral maps were used:

- SOUTH AFRICA 1:50 000 Sheet 22429DD JANE FURSE Third Edition, 2000.
- SOUTH AFRICA 1:50 000 Sheet 2529BA RITE Third Edition, 2002.
- SOUTH AFRICA 1:50 000 Sheet 2529BB ROOSSENEKAL Fourth Edition, 2002.

The main noise sensitive areas/sites in the study area are:

i) Sehlakwane Village.
ii) Various farmhouses and farm labourer houses on farms.
iii) Guest houses and Lodges in the Steelpoort River valley.
iv) Schools (in Sehlakwane).

C2. ASSESSMENT OF THE PRE-CONSTRUCTION PHASE

Activities during the planning and design stages that have possible impact implications in the study area are related to field surveys (such as seismic testing and geological test borehole drilling for large building foundation investigations). As these survey activities will be of short duration and take place during the day, they are unlikely to cause any noise impact. Blasting during seismic surveys could cause startle effects with some of the wildlife in the area.

C3. ASSESSMENT OF THE CONSTRUCTION PHASE

C3.1. General

The potential noise climate was established in general for the construction of the proposed pumped storage scheme power station inclusive of appurtenant works such as the internal road system, sewage works, switchyard, visitors centre and the construction of new access roads. Although some of the details of the planned development have not yet been finalised, general concepts have been used in the noise impact evaluation, and these are considered adequate to provide a sound basis for the analysis of typical noise conditions and impacts that are likely to prevail on the project. Data related to construction have been sourced from various consultants and the experience that JKA has had working on similar sites.

The location of borrow pit sites for earth and rock materials for the reservoirs and road construction have not yet been identified.

C3.3. Construction Noise Conditions

Eskom estimates that construction could commence by mid-Year 2009 and be completed 5 years later in Year 2014. Construction will generally take place from 07h00 to 18h00 although some activities could at times extend in the night. It is estimated that the work force could peak at 2570. About 66% of these workers will be unskilled and semi-skilled workers. It has been assumed that these workers will be transported on a weekly basis between their homes and the construction camp accommodation by the contractor. About 2500 of the workers will be housed at the lower construction camp and about 70 will be housed at the upper construction camp.

C3.3.1. *Sources of Noise*

The following are likely to be the main construction related sources of noise for the power station and its infrastructure:

i) Construction camp establishment. This will be for the site offices, workshops and the accommodation camp for the workers on site. There will be 2 construction camps, one up on the Nebo Plateau at the upper reservoir site and one in the Steelpoort River Valley at the power station site.

ii) Drilling and blasting operations for the underground works, namely the machine hall, tunnels and shafts.

iii) Excavation of building basements, foundations and service trenches. Blasting may be required in places but in general pneumatic breakers will be used where rock is encountered.

iv) Piling operations for large buildings.

v) Erection of shuttering for concrete.

vi) Fixing of steel reinforcing.

vii) Placing and vibration of concrete. Poker vibrators will be used.

viii) Stripping of shuttering after concrete pour.

ix) Erection of structural steelwork.

x) Finishing operations on buildings. Cladding, services installation, etc.

xi) Installation of generating plant, pumps and ancillary plant.

xii) General movement of heavy vehicles such as concrete delivery vehicles, mobile cranes, mechanical dumpers and water trucks (dust suppression) around the site.

xiii) De-watering pumps. A 24-hour operation may sometimes be necessary.

xiv) Road construction equipment. Scrapers, dozers, compactors, etc. (Construction of the internal road system and new sections of access roads in the immediate vicinity of the PSS site).

xv) Earth moving and compaction plant constructing the reservoirs.

xvi) Construction site fabrication workshops and plant maintenance workshops.

xvii) Construction material and equipment delivery vehicles.

xviii) Concrete batching plant and asphalt batching plant on site.

The level and character of the construction noise will be highly variable as different activities with different plant/equipment take place at different times, over different periods, in different combinations, in different sequences and on different parts of the construction site. Typical noise levels generated by the various types of construction equipment are given in Table C1a.

These noise levels assume that the equipment is maintained in good order. Conservative attenuation conditions (related to intervening ground conditions and screening) have been applied.

TABLE C1a. TYPICAL NOISE LEVELS GENERATED BY CONSTRUCTION EQUIPMENT

Plant/Equipment	Typical Operational Noise Level at Given Offset (dBA)							
	5m	10m	25m	50m	100m	250m	500m	1000m
Air compressor	91	85	77	71	65	57	51	46
Compactor	92	86	78	72	66	58	52	46
Concrete mixer	95	89	81	75	69	61	55	49
Concrete vibrator	86	80	72	66	60	52	46	40
Conveyor belt	77	71	63	57	51	43	37	32
Crusher (aggregate)	90	84	76	70	64	56	50	44
Crane (mobile)	93	87	79	73	67	59	53	47
Dozer	95	89	81	75	69	61	55	49
Loader	95	89	81	75	69	61	55	49
Mechanical shovel	98	92	84	78	72	64	58	52
Pile driver	110	104	97	91	85	77	71	65
Pump	86	80	72	66	60	52	46	40
Pneumatic breaker	98	92	84	78	72	64	58	52
Rock drill	108	102	94	88	82	74	68	62
Roller	84	78	70	64	58	50	44	38
Trucks	-	81	73	67	64	60	57	54

C3.3.2. ***Noise Impact***

The nature of the noise impact from general activities on large construction sites such as the power station contract is likely to be as follows:

i) Source noise levels from many of the construction activities will be high. Noise levels from all work areas will vary constantly and in many instances significantly over short periods during any day working period.

ii) Exact daytime period and night-time period continuous equivalent sound pressure levels are not possible to calculate with certainty at this stage as the final construction site layout, work programme, work *modus operandi* and type of equipment have not been finalised. Typical ambient noise conditions from a construction site are as indicated in Table C1b.

TABLE C1b: TYPICAL NOISE LEVELS GENERATED BY A CONSTRUCTION SITE

Noise Source	Typical Operational Noise Level at Given Offset (dBA)							
	100m	**250m**	**500m**	**800**	**1000m**	**1500m**	**2000m**	**2500m**
Construction site	64	56	49	44	41	36	32	29

iii) There are likely to be noise disturbance effects on people living in the surrounding rural areas for up to 750 metres from the construction. Ideally the daytime outdoor ambient noise levels (as specified in SANS 10103) should not exceed 45dBA for the rural residents. The maximum short-term noise levels from general construction operations at the noise sensitive sites nearest to the construction could be of the order of 85dBA. This would be classed as a noise nuisance.

iv) For all construction work, the construction workers working with or in close proximity to equipment will be exposed to high levels of noise as can be seen from Table C1a (refer to the 5 metre offset noise levels).

The nature of the noise impact from the road construction activities (internal roads and access roads) is likely to be as follows:

i) The level and character of the construction noise will be highly variable as different activities with different plant/equipment take place at different times, over different periods, in different combinations, in different sequences and on different parts of the construction site.

ii) As no specific construction details or possible locations of major ancillary activity sites are available at this stage, the anticipated noise from various types of construction activities cannot be calculated accurately. In general at this stage, it can be said that the typical noise levels of construction equipment at a distance of 15 metres lie in the range of 75 decibels (dBA) to 100dBA. Refer also to Table C1a. Based on data from similar “linear” construction sites, a one-hour equivalent noise level of between 75dBA and 78dBA at a point 50 metres from the construction would be typical for the earthmoving phase.

C3.3.3. ***Noise from Construction Traffic***

The predicted traffic data for the operational conditions during construction were supplied by Goba Consulting Engineers. It has been estimated that the construction activities at the upper (plateau) site and the lower (valley) site will on average respectively generate about 60 and 150 vehicle trips (two way trips) daily. At the most intense stage of construction at the valley site, the daily traffic could peak at 250 vehicles per day. The main percentage of the trips will be concentrated in the morning and evening peak periods. In general the construction traffic will have a relatively minor effect on the noise climate alongside the main external roads in the area due to the already high noise levels from existing traffic. Ambient traffic noise levels on the access road through Sehlakwane to the upper construction site due to the construction traffic will increase only marginally but, because of the character of the traffic (namely heavy vehicles), there is likely to be some nuisance factor with the passing of each vehicle. There are numerous houses close to the road and a school along the route through the Village. Ambient traffic noise along the access route to the valley construction site from Route R555 (namely along Road D1890 and Road D366) due to construction traffic will increase significantly. There is also likely to be some nuisance factor with the passing of each vehicle. This will generally be contained to the day. There are at least 10 houses along the access route to the site that are affected.

C4. ASSESSMENT OF THE OPERATIONAL PHASE

C4.1. General

The main sources of noise in the study area in the future when the new pumped storage scheme power station is commissioned will be from:

i) The proposed pumped storage scheme.
ii) Road traffic.
iii) Mapochs Iron Ore Mine.
iv) Mapochs-Witbank railway line.

C4.2. Predicted PSS Noise Conditions

C4.2.1. *Baseline Noise Measurements*

In order to ascertain the likely noise footprint of the Steelpoort PSS, baseline noise measurements were taken at a similar operational installation, namely the Drakensberg Pumped Storage Scheme (power station) in KwaZulu Natal Province. 23 Sets of noise measurements and observations were taken at the Drakensberg PSS on Monday, 29 January 2007 from 09h30 to 23h30. Measurement Set 1 to Set 18 were taken during the daytime and Set 19 was taken at night when the PSS was in generation mode. The other noise measurements were taken at night when the PSS operation was in pump mode. The measurement sites are described below and the details of the noise measurements at the site are recorded.

i) Set 1: West vent shaft intake @ 1m (on surface). North of office block.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		**L_{Amax}**		**L_{Amin}**		
60.1		62.1		58.5		
Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**
65.5	71.3	66.1	57.8	43.7	39.8	32.5

ii) Set 2: Machine Hall, Pony Motor @ 1m (underground). PSS in generation mode.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		**L_{Amax}**		**L_{Amin}**		
82.5		83.5		81.5		
Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**
77.2	84.8	83.5	81.2	77.9	70.4	61.6

iii) Set 3: Machine Hall, generator level, generator @ 1m (underground). PSS in generation mode.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		**L_{Amax}**		**L_{Amin}**		
91.6		92.4		91.0		
Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**
77.3	91.9	88.8	85.6	88.8	84.3	73.7

iv) Set 4: Machine Hall, pump/turbine level, pump/turbine @ 1m (underground).

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		**L_{Amax}**		**L_{Amin}**		
97.3		98.2		95.7		
Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**
82.0	106.2	101.5	89.6	89.0	89.5	81.9

v) Set 5: Valve Hall (underground).

Sound Pressure (Noise) Level (dBA)		
L_{Aeq}	L_{Amax}	L_{Amin}
76.5	77.3	75.3

Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**
70.1	89.4	76.1	73.0	69.0	62.5	54.1

vi) Set 6: West vent shaft fans exhaust vent @ 1m underground in penstock access tunnel.

Sound Pressure (Noise) Level (dBA)		
L_{Aeq}	L_{Amax}	L_{Amin}
102.6	103.5	101.9

Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**
89.8	94.9	101.3	100.3	98.8	94.2	87.1

vii) Set 7: Outside at portal to tailrace access tunnel (doors closed).

Sound Pressure (Noise) Level (dBA)		
L_{Aeq}	L_{Amax}	L_{Amin}
52.1	56.5	50.8

Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**
61.2	58.1	54.5	51.6	44.5	38.2	37.6

viii) Set 8: Outside at portal to main access tunnel (doors closed).

Sound Pressure (Noise) Level (dBA)		
L_{Aeq}	L_{Amax}	L_{Amin}
37.3	49.6	34.4

Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**
47.6	46.1	37.9	31.2	29.2	28.0	26.3

ix) Set 9: Outside at portal to drainage tunnel (doors closed).

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		L_{Amax}			L_{Amin}	
43.6		49.1			36.4	
Frequency Spectrum Noise Level (linear dB)						
63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
57.4	48.2	36.5	40.5	40.4	33.0	27.1

x) Set 10: Sewage plant @ 1m.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		L_{Amax}			L_{Amin}	
71.1		72.1			70.0	
Frequency Spectrum Noise Level (linear dB)						
63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
61.8	62.5	67.2	68.3	63.9	63.9	63.0

xi) Set 11: At side opening (eastern side) to upper surge tanks. PSS in generation mode.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		L_{Amax}			L_{Amin}	
38.6		42.7			35.7	
Frequency Spectrum Noise Level (linear dB)						
63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
56.6	40.5	39.1	32.5	28.2	25.1	25.2

xii) Set 12: Switchyard, 1m from building ventilation outlets.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		L_{Amax}			L_{Amin}	
77.1		78.0			76.2	
Frequency Spectrum Noise Level (linear dB)						
63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
73.4	74.7	77.1	75.6	73.9	64.0	55.1

xiii) Set 13: Vent shaft (next to office building roof area) @ 1m.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		**L_{Amax}**		**L_{Amin}**		
72.2		74.7		70.0		
Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**
71.5	78.2	75.0	71.4	66.3	54.2	44.3

xiv) Set 14: Small aircon unit (on top of office building) @ 1m.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		**L_{Amax}**		**L_{Amin}**		
63.8		67.8		50.6		
Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**
68.6	62.2	65.4	64.5	55.0	53.3	51.1

xv) Set 15: In front of office block, 1m from switchgear room door (ventilated area). Daytime. Refer also to Set 23.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		**L_{Amax}**		**L_{Amin}**		
69.3		70.8		67.7		
Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**
66.2	68.8	73.9	68.7	61.3	54.4	46.4

xvi) Set 16: 100m north of office building on access road. Daytime. Refer also to Set 22.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		**L_{Amax}**		**L_{Amin}**		
36.9		39.0		35.7		
Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**

xvii) Set 17: East intake vent shaft inlet @1m. Daytime.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		L_{Amax}			L_{Amin}	
67.3		70.1			65.8	
Frequency Spectrum Noise Level (linear dB)						
63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
70.6	75.5	65.8	61.9	61.7	55.8	56.7

xviii) Set 18: At visitors centre. Daytime. PSS in generation mode. Refer also to Set 21.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		L_{Amax}			L_{Amin}	
34.0		48.6			32.3	
Frequency Spectrum Noise Level (linear dB)						
63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz

xix) Set 19: View site parking area at upper surge tanks (20h56). PSS in generation mode.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		L_{Amax}			L_{Amin}	
46.8		49.0			43.5	
Frequency Spectrum Noise Level (linear dB)						
63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz

xx) Set 20: View site parking area at upper surge tanks (22h35). PSS in pump (X1) mode.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		L_{Amax}			L_{Amin}	
44.6		46.8			42.0	
Frequency Spectrum Noise Level (linear dB)						
63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz

xxi) Set 21: At visitors centre (23h05). PSS in pump (X2) mode. Refer also to Set 18.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		L_{Amax}			L_{Amin}	
37.4		43.7			35.8	
Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**

xxii) Set 22: 100m north of office building along access road (23h13). PSS pump (X2) mode. Refer also to Set 16.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		L_{Amax}			L_{Amin}	
48.7		50.9			46.6	
Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**

xxiii) Set 23: In front of office block, 1m from switchgear room door (ventilated area) (23h18). PSS in pump (X2) mode. Refer also to Set 15.

Sound Pressure (Noise) Level (dBA)						
L_{Aeq}		L_{Amax}			L_{Amin}	
69.5		71.0			67.9	
Frequency Spectrum Noise Level (linear dB)						
63Hz	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**
64.8	66.7	73.7	69.2	61.8	54.7	48.9

C4.2.2. *Noise Footprint*

The following was ascertained from the measurements and observations at the Drakensberg PSS:

i) The main and loudest noises are generated in the power station underground. These noises however are contained to the underground section of the installation. The main noise sources are:

   a) Motors.

b) Generators. Continuous very loud noise during operation.

c) Turbines. Continuous very loud noise during operation.

d) Pumps. Continuous very loud noise during operation.

e) Ventilation fans. Continuous noise during operation.

f) Noise from pressure balancing in the pipeline. Sporadic noise. During a mode change, when the spherical valve has to open or close, the release or pressurising of the water head results in the emission of a high pitched noise. This noise can always be heard in the Valve Hall and occasionally in the Machine Hall.

g) Synchronous Condenser Operation (SCO) noise. Sporadic noise. When a turbine is running in air and the mode must change to generation or pump, the air is exhausted via a pipeline leading room the turbine top cover down into the drainage galley. The resultant noise from the rapid exit of air is extremely loud. This situation occurs at least twice on each unit per day.

h) "Water hammer" noise. Sporadic. When the main valves are closed, there is a pressure surge in the pipeline that in turn translates into vibration and low frequency noise. The noise is barely audible.

ii) The "leakage" of noise from the underground works via the tunnel system was found to be negligible. This is due to the length of tunnel and fact that the tunnel entrance doors are generally kept closed. Refer to the measurements taken at the tunnel portals.

iii) No noise related to PSS operations is perceivable during generation mode at the inlet (upper reservoir) and outlet works (lower reservoir).

iv) No noise related to PSS operations is perceivable during pumping mode at the outlet (upper reservoir) and inlet works (lower reservoir).

v) Residents at a house located within 150 metres of the surge tanks (on the plateau), report hearing low level noise (from window vibrations) during pumping operations at night and on weekends. No noise can be heard outside the house. The situation appears to be from ground-borne noise induced by vibration transmitted through the rock medium from the main pumps.

vi) The main external (at surface outside the underground section) noise sources were found to be:

a) Underground ventilation system inlets and outlets.

b) Office complex ventilation system.

c) Switchyard building ventilation system.

d) Sewage plant.

e) PSS complex generated traffic. Traffic to offices, stores, visitors centre

vii) The noise from the ventilation shafts is generally not audible beyond a 200 metre offset. Noise levels at given offsets are:

a) At 1 metre - 71,5dBA.

b) At 100 metres - 39,1dBA.

c) At 200 metres - 32,8dBA.

viii) The noise from the switchyard building ventilation outlet vent is generally not audible beyond a 300 metre offset. Noise levels at given offsets are:

a) At 1 metre - 77,1dBA.

b) At 100 metres - 44,1dBA.

c) At 200 metres - 37,7dBA.

d) At 300 metres - 33,8dBA.

ix) The noise from the sewage works is generally not audible beyond a 100 metre offset. Noise levels at given offsets are:

a) At 1 metre - 71,1dBA.

b) At 100 metres - 26,1dBA.

x) The general external noise climate in the area was found to be quiet, with noise levels typical of a rural farming district.

C4.2.3. ***Predicted Noise Condition at the Steelpoort PSS***

The noise climate at Steelpoort PSS is expected to be very similar to that at the Drakensberg PSS. There are no noise sources above ground at the proposed new installation that will have a significant noise impact on the surrounding area.

C4.3. PSS Generated Traffic

The predicted staffing and traffic data for the operational conditions once the Steelpoort PSS is commissioned were supplied by Eskom. The commissioning date is predicted to be 2014. The staffing of the installation will work on a shift basis 24 hours per day, 7 days a week. The core staff component (daytime) will be of the order of 40 personnel. During the night-time there will only be a skeleton staff of technicians. It is likely that the technical staff will be housed in Roossenekal. It has been estimated that the PSS complex, including the administrative offices, stores area and visitors centre could generate about 100 vehicle trips daily. The greater percentage (96%) of these trips will be to the lower site in the Steelpoort River Valley.

The future (Year 2014) ambient noise situations along the main roads were calculated using the South African National Standard SANS 10210 (SABS 0210), *Calculating and Predicting Road Traffic Noise*. Refer to Table C2. The noise levels at various offsets from the centreline of these roads were established. The noise descriptors used are those prescribed in SANS 10103:2004, namely:

i) Daytime equivalent continuous rating (noise) level ($L_{Req,d}$) (L_d used in Table), namely for the period from 06h00 to 22h00).

ii) Night-time equivalent continuous rating (noise) level ($L_{Req,n}$) (L_n used in Table), namely for the period from 22h00 to 06h00).

The noise levels given are the unmitigated values. A conservative approach has been taken in that a hard intervening ground condition has been modelled to simulate winter conditions (burnt veld). There will be greater attenuation with distance than shown where there are houses, other buildings and terrain restraints in the intervening ground between the source and the receiver.

TABLE C2: PREDICTED NOISE CLIMATE ADJACENT TO MAIN ROADS AT COMMISSIONING OF THE PSS (YEAR 2014)

Road	Noise Levels Alongside Roads at Given Offset from Centreline (SANS 10103 Indicator) (dBA)							
	100m Offset		250m Offset		500m Offset		1000m Offset	
	L_d	L_n	L_d	L_n	L_d	L_n	L_d	L_n
P169-1 (R555)	58.1	49.3	54.1	45.3	51.1	42.3	48.1	39.3
P62-2 (R579)	52.3	43.5	48.3	39.5	45.3	36.5	42.3	33.5

With the natural growth in traffic, noise levels alongside the main roads will continue to increase and the already degraded noise climate will worsen. Compare Table C2 with Table B3.

There will be a very small increase (+0,2dBA) in traffic generated noise along Road P169-1 (R555) due to the lower PSS site generated traffic. There will be no increase in noise levels along Road P62-2 (R579) due to the upper PSS site generated traffic. There will be very few daily trips to and from the upper reservoir site, and thus no noise impacts are anticipated along the access route through Sehlakwane Village. The volume of traffic to and from the lower site will be small and mainly concentrated in the morning and evening peak hours. No noise impacts are predicted.

C7. SIGNIFICANCE RATING OF THE NOISE IMPACT

The following assessment of the potential noise impact of the PSS is based on a rating methodology provided by Bohlweki Environmental. The construction phase and the operational phase are analysed, both with and without mitigating measures (corrective actions).

C5.1. Significance of the Noise Impact during Construction

Rating Criteria	IMPACT: Noise Impact during Construction	
	With Corrective Actions	Without Corrective Actions
Nature/Extent (a)	Local (2)	Local (2)
Duration (b)	Medium term (2)	Medium term (2)
Intensity/Magnitude (c)	Low (1)	Moderate (2)
Probability (d)	Possible (2)	Highly Probable (3)
Total (a+b+c+d)	Low (7)	Medium (9)
Status	Negative	Negative
Corrective action	Refer to Section 7.2 in the main report	

C5.2. Significance of the Noise Impact during Operation

Rating Criteria	IMPACT: Noise Impact during Operation	
	With Corrective Actions	Without Corrective Action
Nature/Extent (a)	Local (2)	Local (2)
Duration (b)	Long term (3)	Long term (3)
Intensity/Magnitude (c)	Low (1)	Low (1)
Probability (d)	Possible (2)	Possible (2)
Total (a+b+c+d)	Medium (8)	Medium (8)
Status	Negative	Negative
Corrective action	Refer to Section 7.3 in the main report	