APPENDIX 2: IMAGE COLLAGE OF SELECTED PLANT SPECIES RECORDED FROM THE STUDY AREA AND IMMEDIATE SURROUNDS

Blepharis subvolubilis

Clematis brachiata

Xanthium strumarium

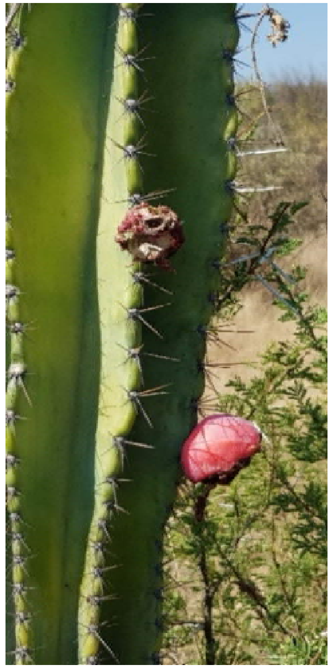
Aloe castanea

Gardenia volkensii

Aloe cf. *burgersfortensis*

Aloe marlothii

Boscia albitrunca



Cereus jamacuru

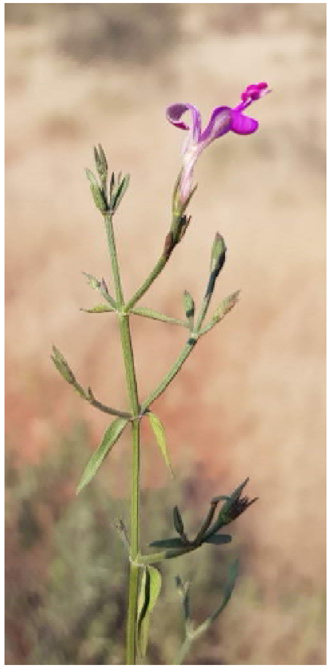

Drimia altissima


Hibiscus cannabinus


Karomia species


Cylindropuntia imbricata


Cynanchum viminale


Dicliptera species


Dicoma tomentosa


Euphorbia cf. *schinzii*

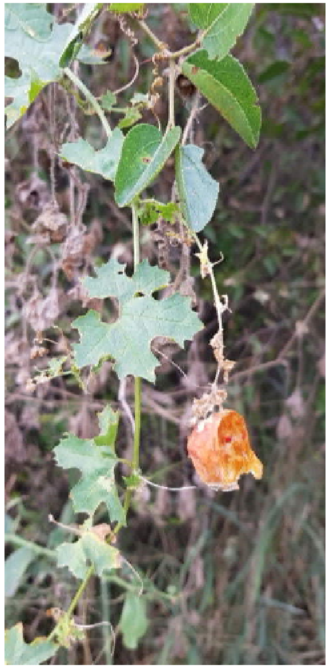

Euphorbia cf. *trigona*

Opuntia humifusa

Peponium caledonicum

Stapelia cf. *gettliffei*

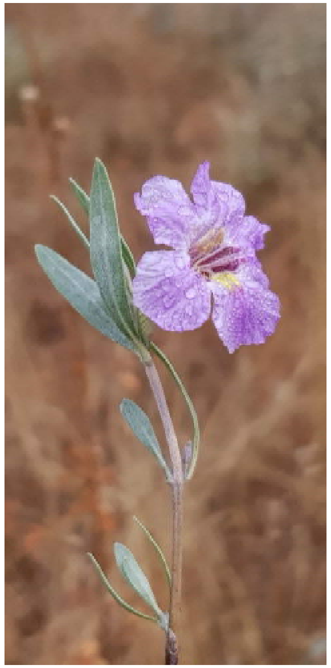
Holubia saccata



Momordica balsamina

Opuntia leucotricha

Peponium caledonicum



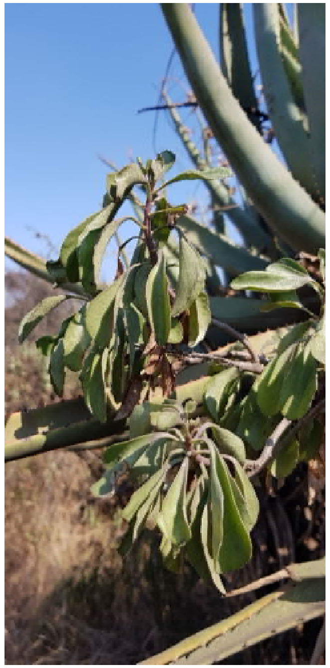
Petalidium oblongifolium

Sansevieria hyacinthoides

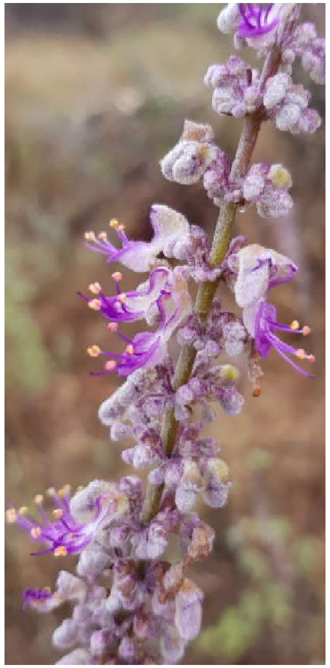
Stapelia cf. *giganteum*

Sterculia rogersii

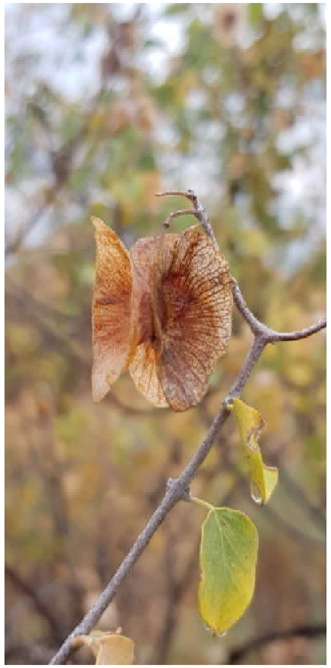
Sterculia rogersii



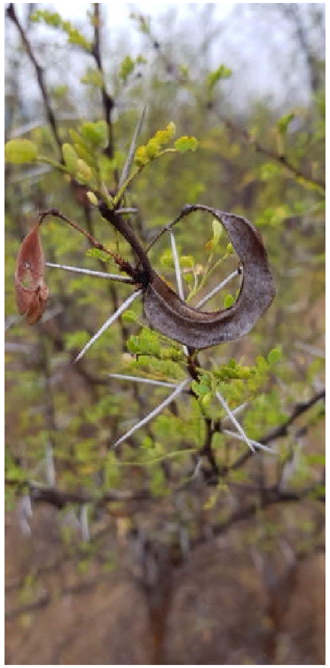
Senecio pleistocephalus



Tetradenia brevispicata



Triaspis glaucophylla



Vachellia exuvialis

Aristida cf. *rhiniochloa*

Sclerocarya birrea (Marula)


Agave sisalana


Aloe species


Cynanchum viminale


Adenia fruticosa (stem)


Adenia fruticosa (leaf)


Cissus cactiformis


Euphorbia cf. *lydenburgensis*


Kleinia stapeliiformis


Grewia bicolor

APPENDIX 3: LIST OF PROTECTED TREE SPECIES UNDER THE NATIONAL FOREST ACT, 1998 (ACT NO. 84 OF 1998)

Binomial name	*Common Name (English)*	*National Tree Number*
Adansonia digitata	Baobab	467
Afzelia quanzensis	Pod mahogany	207
Balanites maughamii **subsp.** ***maughamii***	**Torchwood**	**251**
Barringtonia racemosa	Powder-puff tree	524
Boscia albitrunca	**Shepherd's tree**	**122**
Brachystegia spiciformis	Msasa	198.1
Breonadia salicina	Matumi	684
Bruguiera gymnorrhiza	Black mangrove	527
Cassipourea swaziensis	Swazi onionwood	531.1
Catha edulis	Bushman's tea	404
Ceriops tagal	Indian mangrove	525
Cleistanthus schlechteri var. *schlechteri*	False tamboti	320
Colubrina nicholsonii	Pondo weeping thorn	453.8
Combretum imberbe	Leadwood	539
Curtisia dentata	Assegai	570
Elaeodendron transvaalensis	Bushveld saffron	416
Erythrophysa transvaalensis	Bushveld red balloon	436.2
Euclea pseudebenus	Ebony guarri	598
Ficus trichopoda	Swamp fig	54
Leucadendron argenteum	Silver tree	77
Lumnitzera racemosa var. *racemosa*	Tonga mangrove	552
Lydenburgia abotti	Pondo bushman'sTea	407
Lydenburgia cassinoides	Sekhukhunibushman's tea	406
Mimusops caffra	Coastal red milkwood	583
Newtonia hildebrandtii var. *hildebrandtii*	Lebombo wattle	191
Ocotea bullata	Stinkwood	118
Ozoroa namaquensis	Gariep resin tree	373.2
Philenoptera violacea	Apple-leaf	238
Pittosporum viridiflorum	Cheesewood	139
Podocarpus elongates	Breede River yellowwood	15
Podocarpus falcatus	Outeniqua yellowwood	16
Podocarpus henkelii	Henkel's yellowwood	17
Podocarpus latifolius	Real yellowwood	18
Protea comptonii	Saddleback sugarbush	88
Protea curvata	Serpentine sugarbush	88.1
Prunus africana	Red stinkwood	147
Pterocarpus angolensis	Wild teak	236
Rhizophora mucronata	Red mangrove	526
Sclerocarya birrea **subsp.** ***caffra***	**Marula**	**360**
Securidaca longepedunculata	Violet tree	303
Sideroxylon inerme subsp. *inerme*	White milkwood	579
Tephrosia pondoensis	Pondo poison pea	226.1
Vachellia (Acacia) erioloba	Camel thorn	168
Vachellia (Acacia) haematoxylon	Grey camel thorn	169
Warburgia salutaris	Pepper-bark tree	488
Widdringtonia cedarbergensis	Clanwilliam cedar	19
Widdringtonia schwarzii	Willowmore cedar	21

Species indicated in **bold** *were recorded from the development footprints during the site inspection period*

APPENDIX 4: LIMPOPO ENVIRONMENTAL MANAGEMENT ACT (ACT NO 7 OF 2003) CONSERVATION SCHEDULES FOR PLANT SPECIES

Species indicated in **bold** *were recorded from the development footprint during the site inspection period, or are regarded highly likely to persist on the site (apart from opportunistic or migratory purposes).*

Schedule 2	
Prohibited Aquatic Growth	
Common Name	*Scientific Name*
Azolla	*Azolla* spp
Kariba Weed	*Salvinia molesta*
Parrot's Feather	*Myriophyllum aquaticum*
Pond Weed	*Egeria densa*
Water Hyacinth	*Eichhornia crassipes*
Water Lettuce	*Pistia stratiotes*
Schedule 11	
Specially Protected Plants	
Common Name	*Scientific Name*
All cultivated seedlings of indigenous cycads	*Encephalartos* spp
Schedule 12 Trees and Shrubs	
Common Name	*Scientific Name*
The following *Adenia* species	*Adenia fruticosa simpliciflora*
Baobab	*Adansonia digitata*
Beech	*Faurea macnaughtonii*
Bitter False Thorn	*Albizia amara sericocephala*
The following *Boscia* species	*Boscia angustifolia* var. *corymbosa*
	Boscia foetida minima
Borassus Palm	*Borassus aethiopicum*
Brackenridgea	*Brackenridgea zanguebarica*
Capper Bush	*Capparis sepiaria* var. *subglabra*
The following Combretum species:	*Combretum collinum taborense*
	Combretum padoides
	Combretum petrophilum
	Combretum vendae
Forest Bastard Currant	*Allophylus ainifolius*
The following *Elephantorrhiza* species:	*Elephantorrhiza praetermissa*
The following *Grewia* species:	*Grewia rogersii*
The following *Hibiscus* species	*Hibiscus articulates*
	Hibiscus barnardii
	Hibiscus sabiensis
Large Cape Myrtle	*Myrsine pillansii*
Largeleaved Dragon Tree	*Dracaena hookerana*
Large-leaved Saucerberry	*Cordia africana*
The following *Maytenus* species:	*Maytenus oxycarpa*
	Maytenus pubescens
The following *Ochna* species	*Ochna glauca*
Pepperbark Tree	*Warburgia salutaris*
Pincushion	*Leucospermum saxosum*
The following *Rhus* species	*Rhus batophylla*
Sand ironplum	*Drypetes mossambicensis*
Salati Palm	*Borassus aethiopicum*
Stinkwood, Black	*Ocotea bullata*
Stinkwood, Transvaal	*Ocotea kenyensis*
Tamboti	*Spirostachys africana*
The following *Tarenna* species	*Tarenna zygoon*
Transvaal Red Balloon	*Erythrophysa transvaalensis*
Venda Beadstring	*Alchornea laxiflora*
Wild Banana	*Ensete ventricosum*
Wild Teak	*Pterocarpus angolensis*
Yellowwood, Outeniqua	*Podocarpus latifolius*
Yellowwood, Real	*Podocarpus falcatus*

Succulents	
All species of Aloes indigenous to the Province, **excluding** the following species:	
Common Name	*Scientific Name*
Aculeata	*Aloe aculeata*
Aloe, Catstail	*A. castanea*
Aloe, Krans	*A. arborescens*
Aloe, Mountain	*A. marlothii*
Ammophilla	*A. ammophilla*
Davyana	*A. davyana*
Fosteri	*A. fosteri*
Globuligemma	*A. globuligemma*
Grandidentata	*A. grandidentata*
Greatheadii	*A. greatheadii*
Lutescens	*A lutescens*
Mutans	*A. mutans*
Parvibracteata	*A. parvibracteata*
Transvaalensis	*A. transvaalensis*
Wickensii	*A. wickensii*
All species of *Brachystelma*	*Brachystelma* spp
All species of *Ceropegia*	*Ceropegia* spp
All species of *Duvalia*	*Duvalia* spp
The following *Euphorbia* species:	*Euphorbia barnardii,*
	E. divicola,
	E. grandialata,
	E. groenewaldii,
	E. louwii,
	E. restricta,
	E. rowlandii,
	E. tortirama
	E. waterbergensis
Ghaap	*Hoodia lugardii*
All species of Ghaap	*Tavaresia* spp
All species of *Huernia*	*Huernia* spp
All species of *Huerniopsis*	*Huerniopsis* spp
The following Impala Lilies	*Adenium multiflorum*
	A. olefolium
Kudu Lily	*Pachypodium saundersii*
All species of *Orbeanthus*	*Orbeanthus* spp
All species of *Orbeas*	*Orbea* spp
All species of *Orbeopsis*	*Orbeopsis* spp
All species of *Pachycymbiums*	*Pachycymbium* spp
All species of *Riocreuxias*	*Riocreuxia* spp
All species of *Stapeliads*	*Stapelia* spp
Stone Plant	*Lithops* leslieii
Other Plants	
Common Name	*Scientific Name*
The following *Agapanthus* species	*Agapanthus coddii, A. dyeri*
The following *Anacampseros* species	*Anacampseros bemenkampii* (now *A. rhodesica*)
All species of *Anomatheca*	*Anomatheca* spp
The following *Anthericum* species	*Anthericum cyperaceum*
The following Arum Lilies:	*Zantedeschia jucunda, Z.pentlandii, Z. rehmannii*
The following *Babiana* Species	*Babiana hypogea* var. *longituba*
Batesiana Gasteria	*Gasteria batesiana*
Blue Squill	*Scilla natalensis (Merwillea plumbea)*
Clivia	*Clivia caulescens*
The following *Cyathula* species	*Cyathula natalensis*
The following *Eragrostis* species	*Eragrostis arenicola*
The following *Eriosema* species	*Eriosema transvaalense*
The following *Eulophia* species	*Eulophia coddii*
	E. leachii

The following *Felicia* species	*Felicia fruticosa brevipendunculata*
The following *Festuca* species	*Festuca dracomontana*
All species of Fire Lily	*Cyrtanthus* spp
The following *Freylinia* species	*Freylinia tropica*
The following *Gladiolus* species	*Gladiolus macneilii*
The following *Habernaria* species	*Habernaria kraenzliniana*
The following *Heinsia* species	*Heinsia crinita*
The following *Hermstaedtia* species	*Hermstaedtia capitata*
The following *Hippocratea* species	*Hippocratea parvifolia*
The following *Hymenodictyon* species	*Hymenodictyon parvifolium parvifolium*
The following *Hyptis* species	*Hyptis spicigera*
The following *Inula* species	*Inula paniculata*
The following *Jasminum* species	*Jasminum abyssinbicum*
The following *Kalanchoe* species	*Kalanchoe crundallii*
	K. rogersii
The following *Kniphofia* species	*Kniphofia coralligemma*
	K. crassifolia
	K. rigidifolia
The following *Kotschya* species	*Kotschya thymodora*
The following *Melinus* species	*Melinus tenuissima*
The following *Mondia* species	*Mondia whitei*
The following *Monsonia* species	*Monsonia lanuginosa*
The following *Neobulosia* species	*Neobulosia tysonii*
The following *Nervillia* species	*Nervillia umbroza*
The following *Nymphaea* species	*Nymphaea lotus*
The following *Oberonia* species	*Oberonia distichia*
The following *Oreosyce* species	*Oreosyce africana*
Paint Brush	*Haemanthus montanus*
The following *Peristrophe* species	*Peristrophe cliffordii*
	P. gililandorum
	P. transvaalensis
The following *Phyllanthus* species	*Phyllanthus pinnatus*
The following *Pilea* species	*Pilea rivularis*
The following *Plinthus* species	*Plinthus rehmannii*
The following *Polycarpea* species	*Polycarpia eriantha* var. *effusa*
The following *Polystachya* species	*Polystachia albescens imbricata*
The following *Portulaca* species	*Portulaca foliosa*
	P. trianthemoides
The following *Rhyncosia* species	*Rhyncosia vendae*
Royal Paint Brush (Blood lily)	*Scadoxis puniceus*
The following *Sartidia* species	*Sartidia jucunda*
The following *Schizagyrium* species	*Schizagyrium brevifolium*
All species of South African Orchid	Family *Orchidaceae*
The following *Stadmania* species	*Stadmania oppositifolia*
The following *Streptocarpus* species	*Streptocarpus decipiens*
The following *Strophanthus* species	*Strophanthus luteolus*
The following *Sutera* species	*Sutera maerantha*
The following *Thorncroftia* species	*Thorncroftia media*
All species of Tree Ferns *Cyathea* species	*Cyathea* spp
All species of Tree Moss	*Porothamnium, Pilotrichella* and *Papillaria* spp
The following *Trilepisium* species	*Trilepisium madagascariensis*
The following *Tristachya* species	*Tristachya trifaria*
The following *Turbina* species	*Turbina shirensis*
The following *Watsonia* species	*Watsonia densiflora*
	W. transvaalensis
	W. wilmsii
Wild Ginger	*Burmannia madagascariensis*
Wild Ginger	*Siphonochilus aethiopicus*
The following *Xylopia* species	*Xylopia parviflora*

APPENDIX 5: LEGISLATIVE BACKGROUND

This report has been prepared in terms of the *National Environmental Management Act* No. 107 of 1998 (NEMA) and is compliant with Regulation 385 Section 33 – Specialist reports and reports on specialised processes under the Act. Relevant clauses of the above regulation include:

Regulation 33.(1): An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialised process.

Regulation 33.(2): A specialist report or a report on a specialised process prepared in terms of these Regulations must contain:

(a) Details of:
  (i) The person who prepared the report, and
  (ii) The expertise of that person to carry out the specialist study or specialised process;
(b) A declaration that the person is independent in a form as may be specified by the competent authority;
(c) An indication of the scope of, and the purpose for which, the report was prepared;
(d) A description of the methodology adopted in preparing the report of carrying out the specialised process;
(e) A description of any assumptions made and any uncertainties or gaps in knowledge;
(f) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
(g) Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;
(h) A summary and copies of any comments that were received during any consultation process;
(i) Any other information requested by the competent authority.

Compliance with provincial, national, and international legislative aspects is strongly advised during the planning, assessment, authorisation, and execution of this particular project. Legislative aspects of which cognisance were taken during the compilation of this report are summarised in, but not necessarily limited to the following:

Legislation	Relevance
Biodiversity Act (No. 10 of 2004)	To provide for management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act 1998; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute; and for matters connected therewith.
Conservation of Agricultural Resources Act 43 of 1983	The conservation of soil, water resources and vegetation are promoted. Management plans to eradicate weeds and invader plants must be established to benefit the integrity of indigenous life.
Constitution of the Republic of South Africa (Act 108 of 1996)	The Bill of Rights, in the Constitution of South Africa (No. 108 of 1996), states that everyone has a right to a non-threatening environment and requires that reasonable measures are applied to protect the environment. This protection encompasses preventing pollution and promoting conservation and environmentally sustainable development. These principles are embraced in NEMA and given further expression.
Convention on Biological Diversity, 1995	International legally binding treaty with three main goals; conserve biological diversity (or biodiversity); ensure sustainable use of its components and the fair and equitable sharing of benefits arising from genetic resources.
Environmental Conservation Act (No. 73 of 1989)	To provide for effective protection and controlled utilization of the environment and for matters incidental thereto.
National Environmental Management Act (No. 107 of 1998)	Requires adherence to the principles of Integrated Environmental Management (IEA) to ensure sustainable development, which, in turn, aims to ensure that environmental consequences of development proposals be understood and adequately considered during all stages of the project cycle and that negative aspects be resolved or mitigated, and positive aspects enhanced.
National Environmental Management Act (No 10 of 2004)	Restriction of activities involving alien species, restricted activities involving certain alien species totally prohibited and duty care relating to listed invasive species.
Protected Areas Act (No. 57 of 2003)	To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial, and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.
National Forest Act of 1998	Provides for the protection of certain tree species, groups of trees, woodland or forests as declared by the minister and prohibits the destruction of indigenous trees in any natural forest without a licence

Legislation	Relevance
Limpopo Environmental Management Act (Act No.7 of 2003)	To consolidate and amend the environmental management legislation of or assigned to the Province, and to provide for matters incidental thereto.

APPENDIX 6: IMPACT ASSESSMENT METHOD

To ensure standardisation of the Impact Assessment Process and the successful integration of specialist findings, a standard ratings approach is employed to ascertain the significance of anticipated and likely impacts on the receiving environment.

The potential environmental impacts associated with the project will be evaluated according to its nature, extent, duration, intensity, probability, and significance of the impacts, whereby:

Nature: A brief written statement of the environmental aspect being impacted upon by a particular action or activity;

Extent: Determines the spatial/ geographical scale over which the impact will be expressed. Typically, the severity and significance of an impact have different scales. This is often useful during the detailed assessment phase of a project in terms of further defining the determined significance or intensity of an impact. For example, high at a local scale, but low at a regional scale;

Duration: Indicates what the temporal scale of the impact will be;

Intensity: Defines the likelihood of an impact actually occurring; and

Cumulative: In relation to an activity, implies the impact of an activity that, in itself, may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

Table 34: Criteria and numerical for rating environmental impacts

Score	*Rating*	*Description*
Intensity (I) - defines the magnitude of the impact		

16	High	*Natural, cultural, and social functions and processes are altered to the extent that it permanently cease. Impact affects the continued viability of the systems/ components and the quality, use, integrity, and functionality of the systems/ components permanently ceases and are irreversibly impaired (system collapse). Rehabilitation and remediation is often impossible. If possible, rehabilitation and remediation is often unfeasible due to extremely high costs.*
		Impact may cause:
		• Loss of human life
		• Deterioration in human health
		• High impacts to ecosystems and environment resulting in:
		  o Critical/ severe local scale (or larger) modification, degradation and/or collapse
		  o Critical / severe local scale (or larger) modification, (reduction in level) of ecosystem services and/ or loss of ecosystem services

12	Moderately High	*Natural, cultural, and social functions and processes are altered to the extent that they are severely impaired and may temporarily cease. Impact affects the continued viability of the systems/ components and the quality, use, integrity, and functionality of the systems/ components are severely impaired and may temporarily cease. Rehabilitation and remediation will likely be at a high financial cost, but is often possible.*
		Impact may cause:
		• Loss of livelihoods
		• Individual economic loss
		• Moderately-high impacts to ecosystems and environment
		  o Large local scale (or larger) modification, degradation and/ or collapse
		  o Large local scale (or larger) modification (reduction in level) of ecosystem services and/ or loss of ecosystem services

8	Moderate	Affected environment is altered, but natural, cultural, and social functions and processes continue, albeit in a slightly modified way. Impact alters the quality, use and integrity of the systems/ components, but the systems/ components still continue to function, but in a moderately modified way (integrity and functionality impaired by major key processes/ drivers somewhat intact/ maintained) • Moderate impacts to ecosystems and environment: • Moderate local scale (or larger) ecosystem modification/ degradation and/ or collapse • Moderate local scale (or larger) modification (reduction in level) of ecosystem services and/ or loss of ecosystem services

Table 34: Criteria and numerical for rating environmental impacts		
Score	*Rating*	*Description*
4	Moderately Low	*Affected environment is altered, but natural, cultural, and social functions and processes continue albeit in a slightly modified way. Impact alters the quality, use and integrity of the systems/ components but the systems/ components still continue to function, although in a slightly modified way. Integrity, function, and major key processes/ drivers are slightly altered but are still intact/ maintained.* Moderate-low impacts to ecosystems and environment: • Small, but measurable local scale (or larger) ecosystem modification/ degradation • Small, but measurable local scale (or larger) modification (reduction in level) of ecosystem services and/ or loss of ecosystem services
1	Low	*Impact affects the environment in such a way that natural, cultural, and social functions and processes are not affected.* Negative change to onsite characteristics but with no impact on: • Human life • Human health • Local water resources, local ecosystem services and/ or key ecosystem controlling variables • Threatened habitat conservation/ representation • Threatened species survival

Table 35: Quantification of impact criteria		
Score	*Status*	*Description*
Extent (E) - Relates to the geographical/ spatial extent of the impact		
5	Global	The scale/ extent of the impact is global/ worldwide
4	National	The scale/ extent of the impact is applicable to the Republic of South Africa
3	Regional	Impact footprint includes the greater surrounding area within which the site is located (e.g. between 20 – 200 km radius of the site
2	Local	Impact footprint extends beyond the cadastral boundary of the site to include the areas adjacent and immediately surrounding the site (e.g. between a 0 – 20 km radius of the site)
1	Site	Impact footprint remains within the boundary of the site
Duration (D) - relates to the temporal scale/ duration of the impact		
5	Permanent	The impact will continue indefinitely and is irreversible
4	Long term	The impact and its effects will continue of a period in excess of 30 years. However, the impact is reversable with relevant and applicable mitigation and management actions
3	Medium term	The impact and its effects will last for 10 - 30 years. The impact is reversible with relevant and applicable mitigation and management actions
2	Medium-short term	The impact and its effects will continue or last for a period of a relatively long construction period and/ or a limited recovery time after this construction period, thereafter it will be entirely negated (3 - 10 years). The impact is fully reversible
1	Short term	The impact and its effects will only last for as long as the construction period and will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 - 3 years). The impact is fully reversible
Probability (P) - relates to the likelihood of the impact occurring		
1	Definite	More than 75 % change of occurrence. The impact is known to occur regularly under similar conditions and settings
0.75	Highly Probable	The impact has a 41 – 75 % change of occurring and thus is likely to occur. The impact is known to occur sporadically in similar conditions and settings
0.5	Possible	The impact has a 10 – 40 % change of occurring. This impact may/ could occur and is known to occur in low frequencies under similar conditions and settings
0.2	Unlikely	The possibility of the impact occurring is low with less than 10 % chance of occurring. The impact has not been known to occur under similar conditions and settings
0.1	Improbable	The possibility of the impact occurring is negligible and only under exceptional circumstances

Significance is determined through a synthesis of impact characteristics. Significance is also an indication of the importance of impacts in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicate the level of significance of the impact. Impact significance is calculated as the impact intensity, extent and duration against the probability, likelihood of the impact taking place, i.e.:

Impact significance - (impact intensity + impact extent + impact duration) x impact probability

Table 36: Impact significance categories

Indicator	*Class*	*Description*
+ Positive	Any value	Any positive / beneficial 'impact', i.e. where no harm will occur due to the activity being undertaken
- Negative	Low 0 - 4.9	A low impact has no permanent impact of significance. Mitigation measures are feasible and are readily instituted as part of a standing design, construction, or operating procedure
	Moderately low 5 - 7.9	Mitigation is possible with additional design and construction inputs
	Moderate 8 - 12.9	The design of the site may be affected. Mitigation and possible remediation are needed during the construction and/ or operational phases. The effects of the impact may affect the broader environment
	Moderately high 13 - 17.9	Generally unacceptable unless offset/ compensated for by positive gains in other aspect of the environment that are of critically high importance (i.e. national or international importance only). Strict conditions and high levels of compliance and enforcement are required. The potential impact will affect a decision regarding the proposed activity and requires that the need and desirability of the project be clearly substantiated to justify the associated ecological risks
	High 18 - 26	Permanent and importance impacts likely to be a fatal flaw. Impacts should be avoided and limited opportunity for offset/ compensatory mitigation
Status		Denotes the perceived effect of the impact in the affected area
Positive (+)		Beneficial impact
Negative (-)		Deleterious or adverse impact
Neutral (/)		Impact is neither beneficial nor adverse

It is important to note that the status of an impact is assigned based on the *status quo* - i.e. should the project not proceed. Therefore, not all negative impacts are necessarily equally significant

APPENDIX 7: SHORTLIST OF ANTICIPATED AND RECORDED BIRD DIVERSITY

A shortlist of bird species **expected** and **observed** on the study area.
Scientific names and colloquial names were used according to Gill et al. (2021).
Also provided is the global and regional conservation status of each species (IUCN, 2021; Taylor et al., 2015). (CR - Critically Endangered, EN - Endangered, VU - Vulnerable, NT - Near threatened). N = number of submitted cards to SABAP2.

Ref	Common Name	Species Name	Global Status	Regional Status	Observed (April/May 2021)	Full Protocol		Ad hoc Protocol	
						%	N	%	N
78	Abdim's Stork	*Ciconia abdimii*	-	NT		0.76	1.00	0.00	0.00
432	Acacia Pied Barbet	*Tricholaema leucomelas*			X	39.69	52.00	10.71	9.00
95	African Black Duck	*Anas sparsa*			X	6.11	8.00	2.38	2.00
380	African Black Swift	*Apus barbatus*			X	9.16	12.00	2.38	2.00
52	African Darter	*Anhinga rufa*				3.05	4.00	0.00	0.00
655	African Dusky Flycatcher	*Muscicapa adusta*				3.82	5.00	3.57	3.00
833	African Firefinch	*Lagonosticta rubricata*			X	3.82	5.00	0.00	0.00
149	African Fish Eagle	*Haliaeetus vocifer*			X	6.87	9.00	1.19	1.00
160	African Goshawk	*Accipiter tachiro*			X	2.29	3.00	0.00	0.00
323	African Green Pigeon	*Treron calvus*				3.05	4.00	0.00	0.00
424	African Grey Hornbill	*Lophoceros nasutus*			X	10.69	14.00	0.00	0.00
171	African Harrier-Hawk	*Polyboroides typus*				5.34	7.00	1.19	1.00
418	African Hoopoe	*Upupa africana*			X	20.61	27.00	5.95	5.00
228	African Jacana	*Actophilornis africanus*				0.76	1.00	0.00	0.00
387	African Palm Swift	*Cypsiurus parvus*			X	29.77	39.00	2.38	2.00
682	African Paradise Flycatcher	*Terpsiphone viridis*			X	12.21	16.00	4.76	4.00
685	African Pied Wagtail	*Motacilla aguimp*				13.74	18.00	2.38	2.00
692	African Pipit	*Anthus cinnamomeus*				16.03	21.00	3.57	3.00
576	African Stonechat	*Saxicola torquatus*				3.82	5.00	0.00	0.00
247	African Wattled Lapwing	*Vanellus senegallus*				2.29	3.00	0.00	0.00
386	Alpine Swift	*Tachymarptis melba*				6.11	8.00	0.00	0.00
772	Amethyst Sunbird	*Chalcomitra amethystina*			X	38.93	51.00	17.86	15.00
119	Amur Falcon	*Falco amurensis*				0.76	1.00	0.00	0.00
533	Arrow-marked Babbler	*Turdoides jardineii*			X	13.74	18.00	1.19	1.00
656	Ashy Flycatcher	*Muscicapa caerulescens*				9.16	12.00	0.00	0.00
493	Barn Swallow	*Hirundo rustica*			X	31.30	41.00	10.71	9.00
622	Bar-throated Apalis	*Apalis thoracica*				3.05	4.00	0.00	0.00
451	Bearded Woodpecker	*Chloropicus namaquus*				3.82	5.00	0.00	0.00
203	Black Crake	*Zapornia flavirostra*				4.58	6.00	0.00	0.00
344	Black Cuckoo	*Cuculus clamosus*				2.29	3.00	0.00	0.00
513	Black Cuckooshrike	*Campephaga flava*				2.29	3.00	0.00	0.00

Ref	Common Name	Species Name	Global Status	Regional Status	Observed (April/May 2021)	Full Protocol		Ad hoc Protocol	
						%	N	%	N
511	Black Saw-wing	*Psalidoprocne pristoptera*				0.76	1.00	0.00	0.00
712	Black-backed Puffback	*Dryoscopus cubla*			X	35.11	46.00	3.57	3.00
650	Black-chested Prinia	*Prinia flavicans*			X	22.90	30.00	2.38	2.00
146	Black-chested Snake Eagle	*Circaetus pectoralis*			X	6.11	8.00	1.19	1.00
431	Black-collared Barbet	*Lybius torquatus*			X	34.35	45.00	9.52	8.00
69	Black-crowned Night Heron	*Nycticorax nycticorax*				0.76	1.00	0.00	0.00
715	Black-crowned Tchagra	*Tchagra senegalus*				9.16	12.00	0.00	0.00
841	Black-faced Waxbill	*Brunhilda erythronotos*			X	19.08	25.00	1.19	1.00
55	Black-headed Heron	*Ardea melanocephala*			X	6.87	9.00	3.57	3.00
521	Black-headed Oriole	*Oriolus larvatus*			X	18.32	24.00	1.19	1.00
245	Blacksmith Lapwing	*Vanellus armatus*			X	24.43	32.00	11.90	10.00
860	Black-throated Canary	*Crithagra atrogularis*			X	6.87	9.00	1.19	1.00
130	Black-winged Kite	*Elanus caeruleus*				11.45	15.00	1.19	1.00
839	Blue Waxbill	*Uraeginthus angolensis*			X	72.52	95.00	28.57	24.00
863	Brimstone Canary	*Crithagra sulphurata*				5.34	7.00	0.00	0.00
823	Bronze Mannikin	*Spermestes cucullata*				16.03	21.00	7.14	6.00
145	Brown Snake Eagle	*Circaetus cinereus*				3.82	5.00	0.00	0.00
714	Brown-crowned Tchagra	*Tchagra australis*			X	22.14	29.00	8.33	7.00
402	Brown-hooded Kingfisher	*Halcyon albiventris*			X	31.30	41.00	4.76	4.00
509	Brown-throated Martin	*Riparia paludicola*			X	7.63	10.00	1.19	1.00
731	Brubru	*Nilaus afer*			X	13.74	18.00	2.38	2.00
4131	Burchell's Coucal	*Centropus burchellii*				2.29	3.00	0.00	0.00
601	Burnt-necked Eremomela	*Eremomela usticollis*			X	9.16	12.00	1.19	1.00
873	Cape Bunting	*Emberiza capensis*				3.82	5.00	0.00	0.00
523	Cape Crow	*Corvus capensis*				4.58	6.00	7.14	6.00
531	Cape Penduline Tit	*Anthoscopus minutus*				0.76	1.00	0.00	0.00
581	Cape Robin-Chat	*Cossypha caffra*			X	5.34	7.00	1.19	1.00
786	Cape Sparrow	*Passer melanurus*			X	27.48	36.00	5.95	5.00
737	Cape Starling	*Lamprotornis nitens*			X	58.02	76.00	17.86	15.00
316	Ring-necked Dove	*Streptopelia capicola*			X	32.06	42.00	5.95	5.00
106	Cape Vulture	*Gyps coprotheres*	EN	EN		0.76	1.00	0.00	0.00
686	Cape Wagtail	*Motacilla capensis*			X	11.45	15.00	1.19	1.00
799	Cape Weaver	*Ploceus capensis*				0.76	1.00	0.00	0.00
1172	Cape White-eye	*Zosterops virens*			X	14.50	19.00	1.19	1.00
568	Capped Wheatear	*Oenanthe pileata*				0.76	1.00	0.00	0.00
450	Cardinal Woodpecker	*Dendropicos fuscescens*			X	21.37	28.00	5.95	5.00
484	Chestnut-backed Sparrow-Lark	*Eremopterix leucotis*			X	3.82	5.00	0.00	0.00
658	Chestnut-vented Warbler	*Curruca subcoerulea*			X	14.50	19.00	0.00	0.00

Ref	Common Name	Species Name	Global Status	Regional Status	Observed (April/May 2021)	Full Protocol		Ad hoc Protocol	
						%	N	%	N
673	Chinspot Batis	*Batis molitor*			X	31.30	41.00	0.00	0.00
872	Cinnamon-breasted Bunting	*Emberiza tahapisi*			X	19.08	25.00	1.19	1.00
771	Collared Sunbird	*Hedydipna collaris*				2.29	3.00	0.00	0.00
196	Common Buttonquail	*Turnix sylvaticus*			X	2.29	3.00	0.00	0.00
154	Common (Steppe) Buzzard	*Buteo buteo vulpinus*				3.82	5.00	0.00	0.00
507	Common House Martin	*Delichon urbicum*				1.53	2.00	2.38	2.00
734	Common Myna	*Acridotheres tristis*			X	67.94	89.00	44.05	37.00
421	Common Scimitarbill	*Rhinopomastus cyanomelas*				8.40	11.00	1.19	1.00
843	Common Waxbill	*Estrilda astrild*			X	25.19	33.00	13.10	11.00
594	Common Whitethroat	*Curruca communis*			X	0.76	1.00	0.00	0.00
439	Crested Barbet	*Trachyphonus vaillantii*			X	25.95	34.00	4.76	4.00
174	Crested Francolin	*Dendroperdix sephaena*			X	16.79	22.00	3.57	3.00
711	Crimson-breasted Shrike	*Laniarius atrococcineus*			X	32.82	43.00	10.71	9.00
242	Crowned Lapwing	*Vanellus coronatus*			X	13.74	18.00	2.38	2.00
821	Cut-throat Finch	*Amadina fasciata*				4.58	6.00	1.19	1.00
545	Dark-capped Bulbul	*Pycnonotus tricolor*			X	69.47	91.00	23.81	20.00
630	Desert Cisticola	*Cisticola aridulus*			X	4.58	6.00	0.00	0.00
352	Diederik Cuckoo	*Chrysococcyx caprius*				13.74	18.00	3.57	3.00
310	Double-banded Sandgrouse	*Pterocles bicinctus*				0.76	1.00	0.00	0.00
464	Dusky Lark	*Pinarocorys nigricans*				0.76	1.00	0.00	0.00
89	Egyptian Goose	*Alopochen aegyptiaca*			X	30.53	40.00	5.95	5.00
321	Emerald-spotted Wood Dove	*Turtur chalcospilos*				33.59	44.00	10.71	9.00
404	European Bee-eater	*Merops apiaster*				18.32	24.00	2.38	2.00
570	Familiar Chat	*Oenanthe familiaris*			X	7.63	10.00	0.00	0.00
373	Fiery-necked Nightjar	*Caprimulgus pectoralis*				7.63	10.00	0.00	0.00
665	Fiscal Flycatcher	*Melaenornis silens*				2.29	3.00	2.38	2.00
517	Fork-tailed Drongo	*Dicrurus adsimilis*			X	45.80	60.00	19.05	16.00
395	Giant Kingfisher	*Megaceryle maxima*			X	5.34	7.00	2.38	2.00
874	Golden-breasted Bunting	*Emberiza flaviventris*			X	16.79	22.00	1.19	1.00
447	Golden-tailed Woodpecker	*Campethera abingoni*				11.45	15.00	0.00	0.00
785	Great Sparrow	*Passer motitensis*				0.76	1.00	0.00	0.00
440	Greater Honeyguide	*Indicator indicator*			X	8.40	11.00	1.19	1.00
502	Greater Striped Swallow	*Cecropis cucullata*			X	19.08	25.00	1.19	1.00
419	Green Wood Hoopoe	*Phoeniculus purpureus*				8.40	11.00	5.95	5.00
830	Green-winged Pytilia	*Pytilia melba*			X	9.16	12.00	0.00	0.00
339	Grey Go-away-bird	*Crinifer concolor*			1	59.54	78.00	16.67	14.00
54	Grey Heron	*Ardea cinerea*				9.92	13.00	3.57	3.00
657	Grey Tit-Flycatcher	*Myioparus plumbeus*				9.16	12.00	0.00	0.00

Ref	Common Name	Species Name	Global Status	Regional Status	Observed (April/May 2021)	Full Protocol		Ad hoc Protocol	
						%	N	%	N
628	Grey-backed Camaroptera	*Camaroptera brevicaudata*			X	3.05	4.00	2.38	2.00
723	Grey-headed Bushshrike	*Malaconotus blanchoti*				14.50	19.00	0.00	0.00
401	Grey-headed Kingfisher	*Halcyon leucocephala*				0.76	1.00	0.00	0.00
557	Groundscraper Thrush	*Turdus litsitsirupa*			X	9.92	13.00	1.19	1.00
84	Hadada Ibis	*Bostrychia hagedash*			X	44.27	58.00	13.10	11.00
396	Half-collared Kingfisher	*Alcedo semitorquata*	-	NT		0.00	0.00	1.19	1.00
72	Hamerkop	*Scopus umbretta*			X	10.69	14.00	0.00	0.00
192	Helmeted Guineafowl	*Numida meleagris*			X	25.19	33.00	0.00	0.00
384	Horus Swift	*Apus horus*				0.76	1.00	0.00	0.00
784	House Sparrow	*Passer domesticus*			X	63.36	83.00	48.81	41.00
596	Icterine Warbler	*Hippolais icterina*				0.76	1.00	0.00	0.00
152	Jackal Buzzard	*Buteo rufofuscus*				1.53	2.00	0.00	0.00
348	Jacobin Cuckoo	*Clamator jacobinus*				4.58	6.00	2.38	2.00
835	Jameson's Firefinch	*Lagonosticta rhodopareia*			X	11.45	15.00	2.38	2.00
586	Kalahari Scrub Robin	*Cercotrichas paena*				7.63	10.00	0.00	0.00
351	Klaas's Cuckoo	*Chrysococcyx klaas*			X	6.11	8.00	0.00	0.00
91	Knob-billed Duck	*Sarkidiornis melanotos*				0.76	1.00	0.00	0.00
552	Kurrichane Thrush	*Turdus libonyana*			X	16.79	22.00	4.76	4.00
114	Lanner Falcon	*Falco biarmicus*	-	VU	X	19.85	26.00	8.33	7.00
871	Lark-like Bunting	*Emberiza impetuani*				0.76	1.00	0.00	0.00
317	Laughing Dove	*Spilopelia senegalensis*			X	85.50	112.00	58.33	49.00
706	Lesser Grey Shrike	*Lanius minor*				2.29	3.00	0.00	0.00
442	Lesser Honeyguide	*Indicator minor*			X	0.76	1.00	0.00	0.00
792	Lesser Masked-weaver	*Ploceus intermedius*				9.92	13.00	1.19	1.00
503	Lesser Striped Swallow	*Cecropis abyssinica*			X	27.48	36.00	3.57	3.00
604	Lesser Swamp Warbler	*Acrocephalus gracilirostris*			X	1.53	2.00	1.19	1.00
347	Levaillant's Cuckoo	*Clamator levaillantii*				1.53	2.00	0.00	0.00
410	Little Bee-eater	*Merops pusillus*			X	29.77	39.00	17.86	15.00
59	Little Egret	*Egretta garzetta*				3.05	4.00	4.76	4.00
6	Little Grebe	*Tachybaptus ruficollis*				2.29	3.00	0.00	0.00
609	Little Rush Warbler	*Bradypterus baboecala*				1.53	2.00	0.00	0.00
158	Little Sparrowhawk	*Accipiter minullus*				3.05	4.00	0.00	0.00
385	Little Swift	*Apus affinis*			X	17.56	23.00	2.38	2.00
621	Long-billed Crombec	*Sylvietta rufescens*			X	40.46	53.00	5.95	5.00
138	Long-crested Eagle	*Lophaetus occipitalis*				0.76	1.00	0.00	0.00
852	Long-tailed Paradise Whydah	*Vidua paradisaea*				19.85	26.00	4.76	4.00
724	Magpie Shrike	*Urolestes melanoleucus*				0.76	1.00	0.00	0.00
397	Malachite Kingfisher	*Corythornis cristatus*				0.76	1.00	0.00	0.00

Ref	Common Name	Species Name	Global Status	Regional Status	Observed (April/May 2021)	Full Protocol		Ad hoc Protocol	
						%	N	%	N
661	Marico Flycatcher	*Melaenornis mariquensis*			X	24.43	32.00	2.38	2.00
755	Marico Sunbird	*Cinnyris mariquensis*				8.40	11.00	1.19	1.00
607	Marsh Warbler	*Acrocephalus palustris*			X	0.76	1.00	0.00	0.00
573	Mocking Cliff Chat	*Thamnolaea cinnamomeiventris*				2.29	3.00	0.00	0.00
688	Mountain Wagtail	*Motacilla clara*			X	2.29	3.00	0.00	0.00
318	Namaqua Dove	*Oena capensis*			X	29.77	39.00	14.29	12.00
183	Natal Spurfowl	*Pternistis natalensis*			X	10.69	14.00	0.00	0.00
637	Neddicky	*Cisticola fulvicapilla*			X	19.08	25.00	1.19	1.00
719	Orange-breasted Bushshrike	*Chlorophoneus sulfureopectus*			X	17.56	23.00	0.00	0.00
838	Orange-breasted Waxbill	*Amandava subflava*			X	3.05	4.00	0.00	0.00
662	Pale Flycatcher	*Melaenornis pallidus*				1.53	2.00	0.00	0.00
498	Pearl-breasted Swallow	*Hirundo dimidiata*			X	3.05	4.00	0.00	0.00
365	Pearl-spotted Owlet	*Glaucidium perlatum*			X	2.29	3.00	0.00	0.00
113	Peregrine Falcon	*Falco peregrinus*			X	0.76	1.00	0.00	0.00
522	Pied Crow	*Corvus albus*			X	70.99	93.00	47.62	40.00
394	Pied Kingfisher	*Ceryle rudis*				3.05	4.00	0.00	0.00
846	Pin-tailed Whydah	*Vidua macroura*			X	13.74	18.00	5.95	5.00
694	Plain-backed Pipit	*Anthus leucophrys*				0.76	1.00	0.00	0.00
57	Purple Heron	*Ardea purpurea*				0.76	1.00	0.00	0.00
850	Purple Indigobird	*Vidua purpurascens*				2.29	3.00	0.00	0.00
337	Purple-crested Turaco	*Gallirex porphyreolophus*				8.40	11.00	0.00	0.00
844	Quailfinch	*Ortygospiza atricollis*			X	3.82	5.00	1.19	1.00
642	Rattling Cisticola	*Cisticola chiniana*			X	28.24	37.00	13.10	11.00
708	Red-backed Shrike	*Lanius collurio*				9.16	12.00	1.19	1.00
837	Red-billed Firefinch	*Lagonosticta senegala*			X	9.92	13.00	0.00	0.00
748	Red-billed Oxpecker	*Buphagus erythrorynchus*			X	23.66	31.00	3.57	3.00
805	Red-billed Quelea	*Quelea quelea*			X	20.61	27.00	2.38	2.00
97	Red-billed Teal	*Anas erythrorhyncha*				0.00	0.00	1.19	1.00
501	Red-breasted Swallow	*Cecropis semirufa*				2.29	3.00	0.00	0.00
343	Red-chested Cuckoo	*Cuculus solitarius*				8.40	11.00	0.00	0.00
813	Red-collared Widowbird	*Euplectes ardens*				2.29	3.00	0.00	0.00
224	Red-crested Korhaan	*Lophotis ruficrista*				1.53	2.00	1.19	1.00
314	Red-eyed Dove	*Streptopelia semitorquata*			X	37.40	49.00	7.14	6.00
644	Red-faced Cisticola	*Cisticola erythrops*			X	5.34	7.00	0.00	0.00
392	Red-faced Mousebird	*Urocolius indicus*			X	38.17	50.00	13.10	11.00
820	Red-headed Finch	*Amadina erythrocephala*				9.92	13.00	8.33	7.00
212	Red-knobbed Coot	*Fulica cristata*				0.76	1.00	0.00	0.00
745	Red-winged Starling	*Onychognathus morio*			X	25.95	34.00	17.86	15.00

Ref	Common Name	Species Name	Global Status	Regional Status	Observed (April/May 2021)	Full Protocol		Ad hoc Protocol	
						%	N	%	N
50	Reed Cormorant	*Microcarbo africanus*				6.11	8.00	0.00	0.00
940	Rock Dove	*Columba livia*				40.46	53.00	23.81	20.00
123	Rock Kestrel	*Falco rupicolus*				3.82	5.00	1.19	1.00
506	Rock Martin	*Ptyonoprogne fuligula*				4.58	6.00	1.19	1.00
458	Rufous-naped Lark	*Mirafra africana*				2.29	3.00	0.00	0.00
460	Sabota Lark	*Calendulauda sabota*			X	16.03	21.00	1.19	1.00
789	Scaly-feathered Weaver	*Sporopipes squamifrons*			X	29.01	38.00	9.52	8.00
774	Scarlet-chested Sunbird	*Chalcomitra senegalensis*				2.29	3.00	0.00	0.00
847	Shaft-tailed Whydah	*Vidua regia*				1.53	2.00	0.00	0.00
177	Shelley's Francolin	*Scleroptila shelleyi*				3.82	5.00	0.00	0.00
551	Sombre Greenbul	*Andropadus importunus*				5.34	7.00	0.00	0.00
707	Southern Fiscal	*Lanius collaris*			X	38.17	50.00	21.43	18.00
82	Southern Bald Ibis	*Geronticus calvus*	VU	VU		0.00	0.00	1.19	1.00
664	Southern Black Flycatcher	*Melaenornis pammelaina*				6.11	8.00	0.00	0.00
527	Southern Black Tit	*Melaniparus niger*			X	17.56	23.00	0.00	0.00
709	Southern Boubou	*Laniarius ferrugineus*			X	41.22	54.00	11.90	10.00
4142	Southern Grey-headed Sparrow	*Passer diffusus*			X	32.82	43.00	4.76	4.00
803	Southern Masked Weaver	*Ploceus velatus*			X	54.96	72.00	19.05	16.00
808	Southern Red Bishop	*Euplectes orix*			X	12.21	16.00	7.14	6.00
4129	Southern Red-billed Hornbill	*Tockus rufirostris*				5.34	7.00	1.19	1.00
426	Southern Yellow-billed Hornbill	*Tockus leucomelas*			X	41.22	54.00	7.14	6.00
390	Speckled Mousebird	*Colius striatus*			X	58.02	76.00	21.43	18.00
311	Speckled Pigeon	*Columba guinea*			X	22.90	30.00	4.76	4.00
791	Spectacled Weaver	*Ploceus ocularis*				8.40	11.00	0.00	0.00
368	Spotted Eagle-Owl	*Bubo africanus*				3.05	4.00	0.00	0.00
654	Spotted Flycatcher	*Muscicapa striata*				11.45	15.00	1.19	1.00
275	Spotted Thick-knee	*Burhinus capensis*			X	6.11	8.00	0.00	0.00
88	Spur-winged Goose	*Plectropterus gambensis*				1.53	2.00	0.00	0.00
62	Squacco Heron	*Ardeola ralloides*				0.76	1.00	0.00	0.00
867	Streaky-headed Seedeater	*Crithagra gularis*				5.34	7.00	0.00	0.00
63	Striated Heron	*Butorides striata*				2.29	3.00	0.00	0.00
403	Striped Kingfisher	*Halcyon chelicuti*				1.53	2.00	1.19	1.00
185	Swainson's Spurfowl	*Pternistis swainsonii*			X	15.27	20.00	0.00	0.00
134	Tawny Eagle	*Aquila rapax*	EN	EN		0.76	1.00	0.00	0.00
649	Tawny-flanked Prinia	*Prinia subflava*			X	54.96	72.00	17.86	15.00
804	Thick-billed Weaver	*Amblyospiza albifrons*				2.29	3.00	0.00	0.00
238	Three-banded Plover	*Charadrius tricollaris*			X	9.16	12.00	0.00	0.00
133	Verreaux's Eagle	*Aquila verreauxii*	-	VU		0.76	1.00	0.00	0.00

Ref	Common Name	Species Name	Global Status	Regional Status	Observed (April/May 2021)	Full Protocol		Ad hoc Protocol	
						%	N	%	N
851	Village Indigobird	*Vidua chalybeata*				9.16	12.00	7.14	6.00
797	Village Weaver	*Ploceus cucullatus*			X	38.17	50.00	21.43	18.00
736	Violet-backed Starling	*Cinnyricinclus leucogaster*				6.11	8.00	2.38	2.00
840	Violet-eared Waxbill	*Granatina granatina*			X	6.87	9.00	1.19	1.00
137	Wahlberg's Eagle	*Hieraaetus wahlbergi*				3.05	4.00	0.00	0.00
359	Western Barn Owl	*Tyto alba*				1.53	2.00	0.00	0.00
61	Western Cattle Egret	*Bubulcus ibis*			X	51.15	67.00	29.76	25.00
80	White Stork	*Ciconia ciconia*			X	1.53	2.00	0.00	0.00
107	White-backed Vulture	*Gyps africanus*	CR	CR		1.53	2.00	0.00	0.00
763	White-bellied Sunbird	*Cinnyris talatala*			X	62.60	82.00	28.57	24.00
47	White-breasted Cormorant	*Phalacrocorax lucidus*				5.34	7.00	0.00	0.00
780	White-browed Sparrow-Weaver	*Plocepasser mahali*			X	73.28	96.00	28.57	24.00
588	White-browed Scrub Robin	*Cercotrichas leucophrys*			X	36.64	48.00	3.57	3.00
727	White-crested Helmetshrike	*Prionops plumatus*				4.58	6.00	0.00	0.00
100	White-faced Whistling Duck	*Dendrocygna viduata*				1.53	2.00	2.38	2.00
409	White-fronted Bee-eater	*Merops bullockoides*			X	35.88	47.00	14.29	12.00
524	White-necked Raven	*Corvus albicollis*				15.27	20.00	0.00	0.00
383	White-rumped Swift	*Apus caffer*			X	10.69	14.00	0.00	0.00
582	White-throated Robin-Chat	*Cossypha humeralis*			X	14.50	19.00	2.38	2.00
495	White-throated Swallow	*Hirundo albigularis*			X	4.58	6.00	0.00	0.00
814	White-winged Widowbird	*Euplectes albonotatus*				25.95	34.00	9.52	8.00
599	Willow Warbler	*Phylloscopus trochilus*				3.82	5.00	0.00	0.00
496	Wire-tailed Swallow	*Hirundo smithii*				5.34	7.00	1.19	1.00
600	Yellow-bellied Eremomela	*Eremomela icteropygialis*				2.29	3.00	0.00	0.00
550	Yellow-bellied Greenbul	*Chlorocichla flaviventris*				0.76	1.00	0.00	0.00
96	Yellow-billed Duck	*Anas undulata*				2.29	3.00	0.00	0.00
129	Yellow-billed Kite	*Milvus aegyptius*				9.16	12.00	3.57	3.00
625	Yellow-breasted Apalis	*Apalis flavida*			X	19.85	26.00	1.19	1.00
859	Yellow-fronted Canary	*Crithagra mozambica*			X	54.20	71.00	11.90	10.00
437	Yellow-fronted Tinkerbird	*Pogoniulus chrysoconus*			X	12.21	16.00	1.19	1.00
788	Yellow-throated Bush Sparrow	*Gymnoris superciliaris*			X	2.29	3.00	0.00	0.00
629	Zitting Cisticola	*Cisticola juncidis*				4.58	6.00	0.00	0.00

APPENDIX 8: SPECIALIST CURRICULUM VITAES

CURRICULUM VITAE OF RIAAN A. J. ROBBESON (PR.SCI.NAT.)

Date of Birth: 13th April 1969
Nationality: South African
Address: PO Box 77448, Eldoglen, 0171
Cellular Contact: +27 (0)82 3765 933
Telephone Contact: +27 (0)12 658 5579
Email: riaan@bathusi.org

Consulting experience: 23 years
Name of Firm: Bathusi Environmental Consulting cc
Position: Member, Specialist Investigator (Ecology and Botany)
Years with BEC: 20 years
Profession: Environmental Scientist, Ecologist, Botanist

Education

DEGREE / DIPLOMA	FIELD	INSTITUTION
B.Sc.	Botany and Zoology (major subjects), Geography, Chemistry, Genetics	University of Pretoria (1987 – 1991)
B.Sc. (Hons)	Botany	University of Pretoria (1992)
M.Sc.	Plant Ecology	University of Pretoria (1994 – 1998)
Visual Basic Programming	Computer Programming and Basic Programme Development	Unischool (University of Pretoria), 1999

Affiliations

CLASS	PROFESSIONAL SOCIETY	YEAR OF REGISTRATION
Pr.Sci.Nat.	South African Council of Natural Scientific Professions (SACNASP) (Ecological Scientist & Botanical Scientist, Reg no: 400005/03)	2003
Cert.Sci.Nat.	South African Council of Natural Scientific Professions (SACNASP) (Zoological Scientist)	2021

Key Attributes

Riaan has always been a passionate ecologist. Since a young age his interest in ecology and his passion and understanding of the natural environment has guided him towards a lifelong commitment to a profession in the natural sciences. After obtaining his B.Sc. degree, with zoology and botany as major subjects in 1990, he committed to post-graduate studies, ultimately obtaining his Masters degree in Plant Ecology at the University of Pretoria in 1998, while working as a research assistant and team member of the National Grassland Biome Project between 1994 and 1998. His involvement in specialist environmental studies followed naturally after graduation in 1998, and he has since been passionately involved in numerous ecological studies with the main emphasis on botanical assessments as part of environmental applications.

Between 1997 and 1999 Riaan was a co-founder of EkoInfo cc and contributed to the general management and consulting responsibilities. In 1999 Riaan, as the sole member, established Bathusi Environmental Consulting cc with the objective of conducting ecological studies with a holistic approach and a strong emphasis of the inclusion of faunal disciplines. Towards this objective, the development of working relations with numerous other specialists was, and still remains, a major priority. Inter-disciplinary collaboration on numerous projects enabled Riaan to acquire a working knowledge of these disciplines, including invertebrates, mammals, herpetofauna and birds.

During his career that spans 20 years, Riaan has acquired extensive experience in the evaluation of the status and reaction of the natural environment to development, across the ecological spectrum of plants, animals, and biophysical attributes of the receiving environment. In addition to pure scientific investigations and ecological investigations, he has also successfully developed and implemented several biodiversity monitoring programmes on mining areas. In addition to a vast knowledge of the Grassland and Savanna Biomes, Riaan also utilises every possible opportunity to expand his knowledge of other biomes of southern Africa; he also contributed to international projects in Botswana, Lesotho, and Mozambique. Riaan displays an enthusiastic, always willing and 'can do' approach to projects and is able to work either as part of a team environment, or in isolation.

Apart from being committed to his professional career, other personal interests of Riaan include wildlife and sports photography, birding (currently at 556 species), and a life-long passion for sport. He is the holder of five Comrades bronze medals between 2005 and 2010. He is also a frequent competitor in ultra-endurance mountain bike events across South Africa and socially plays golf and squash.

Relevant Computer Skills

- ⇒ MS Word
- ⇒ MS Excel
- ⇒ MS Access
- ⇒ GIS Arcview 3.2 (a)
- ⇒ Google Earth
- ⇒ Adobe Photoshop CS & Lightroom 2.6
- ⇒ Visual Basic Programming

Employment Record

POSITION	COMPANY	JOB DESCRIPTION	DURATION
Research Assistant	University of Pretoria	Botanical surveys, plant identifications, data capturing, data analysis, report compilation, phytosociological descriptions, Post graduate Masters Publications	1994 - 1998
Member	EkoInfo cc	Project acquisition, site investigations, data analysis, report compilation, GIS mapping, selected peer review for publications and specialist reports	1995 - 1999
Member	Bathusi Environmental Consulting	Project acquisition, project management, site investigations, data analysis, report compilation, GIS mapping, selected peer review for publications and specialist reports, financial administration	1999 - present

Experience & Project Contributions

The development of accurate and comprehensive biodiversity studies that forms an integral part of successful environmental applications for a wide range of clients represents a major focus of BEC. To achieve this objective Riaan is committed to effective acquisition of projects, involvement and management of other specialist investigators as well as the ecological integration and interpretation of biodiversity data and reports to present a holistic overview of the ecological receiving environment.

Riaan has contributed to more than 400 environmental projects and reports that include a range of specialist fields, including biodiversity impact assessments and scoping reports, biodiversity Fatal Flaw assessments, environmental audits, ecological screening assessments, botanical assessments, vegetation sampling, classification, description and mapping, the development and implementation of environmental monitoring programmes, Red Data flora assessments, invasive species management programmes, compilation of Environmental Management Programme Reports, etc.

The range of clients that are assisted by BEC include environmental companies, private developers, mining houses (gold, diamond, iron, coal, sand), parastatals, traditional coal-energy producers, alternative energy producers (coal-fired, UCG, solar), property developers, etc.

Languages

English: RWS - Excellent
Afrikaans: RWS – Excellent

Selected Reports and Projects

The following projects are presented as a brief selection of the contributions to more than 400 projects and reports between 1999 and 2019.

⇒ Biodiversity Impact Assessments (EIAs):

- Terrestrial Biodiversity (flora, fauna, avifauna) Impact Assessments of the proposed NEO 1 20MW Solar PV Plant that will be situated in the Mafeteng District of the Kingdom of Lesotho. 2018. For Royal HaskoningDHV. In collaboration with Pachnoda Consulting and Ecocheck Environmental Services.
- Terrestrial Biodiversity (flora, fauna, avifauna) Impact Assessments for the proposed Mutsho Power Project near Makhado, Limpopo Province. 2018. For Savannah Environmental. In collaboration with Pachnoda Consulting and Ecocheck Environmental Services.
- Biodiversity Impact Assessment and development of the biodiversity EMP for the proposed Kalkaar Solar Project in the Northern Cape Province. 2014. For SLR Consulting on behalf of SolarReserve, South Africa.
- Terrestrial biodiversity Impact Assessments of the proposed Tshivhaso Power Station near Lephalale in the Limpopo Province (Savanna Environmental). 2016. For Savannah Environmental. In collaboration with Pachnoda Consulting and Ecocheck Environmental Services.
- Terrestrial biodiversity Impact Assessments of the proposed expansion of the existing Kao Diamond Mine in the Kingdom of Lesotho (EIMS). 2016. For Savannah Environmental. For Environmental Impact Management Services (EIMS). In collaboration with Ecocheck Environmental Services.
- Biodiversity Impact Assessments of the Medupi Power Station near Lephalale in the Limpopo Province. 2006. For Royal HaskoningDHV, previously Bohlweki Environmental. In collaboration with Ecocheck Environmental Services.
- Impact Assessment for a proposed holiday destination in the Okavango Delta in the Republic of Botswana (@Land Landscape Architects). 1997. In collaboration with Ekotrust cc.
- Terrestrial Impact Assessment for a proposed hunting concession in the Okavango Delta in the Republic of Botswana (Ekotrust). 1997.
- Terrestrial Biodiversity Impact Assessment for the GOPE Diamond Mine in the Central Kalahari Game Reserve in the Republic of Botswana. 2008. For Marsh Vikela. In collaboration with Ecocheck Environmental Services.
- Botanical Assessments for the proposed expansion of a holiday destination in Mozambique (EkoInfo cc). 2005. In collaboration with EkoInfo cc and Ecocheck Environmental Services.
- Terrestrial biodiversity Impact Assessments of the proposed Steelpoort Pumped Storage Scheme. 2007. For Royal HaskoningDHV, previously Bohlweki Environmental. In collaboration with Ecocheck Environmental Services.

⇒ Biodiversity Scoping Assessments:

- Terrestrial Biodiversity (flora, fauna, avifauna) Scoping Assessments of the proposed NEO 1 20MW Solar PV Plant that will be situated in the Mafeteng District of the Kingdom of Lesotho. 2018. For Royal HaskoningDHV. In collaboration with Pachnoda Consulting and Ecocheck Environmental Services.
- Terrestrial Biodiversity (flora, fauna, avifauna) Scoping Assessments for the proposed Mutsho Power Project near Makhado, Limpopo Province. 2018. For Savannah Environmental. In collaboration with Pachnoda Consulting and Ecocheck Environmental Services.

⇒ Biodiversity Screening Assessments:

- Ecological Screening Assessments of 14 K-Routes for the Gauteng Province Department of Roads and Transport as part of the road expansion project. 2018. For Royal HaskoningDHV. In collaboration with Feathers Environmental Services.
- Terrestrial biodiversity screening assessment of the proposed Enviroblast Titanobel development in Gauteng Province. 2016. For Mills & Otten Environmental Consultants.
- Ecological Screening Assessment of the proposed Waterberg Heavy Haul railway project. 2015. For Royal HaskoningDHV

⇒ Environmental Management Programme Reports (EMPR's):

- Development of an Environmental Management Report for the Alkantpan Runway as part of the Copperton Wind Energy Project in the Northern Cape Province (fauna and avifauna). For Terramanzi Group. 2019. In collaboration with Pachnoda Consulting and Ecocheck Environmental Services.

- Development of Animal Conflict Resolution approach for the Alkantpan Runway as part of the Copperton Wind Energy Project in the Northern Cape Province (fauna and avifauna). For Terramanzi Group. 2019. In collaboration with Pachnoda Consulting and Ecocheck Environmental Services.
- Development of Biodiversity Action Programme report for the Matla Mine in the Mpumalanga Province. 2014. For Groundwater Consulting Services (GCS). In collaboration with Pachnoda Consulting and Ecocheck Environmental Services.
- Development of an Environmental Management Programme for the proposed Aspen Lakes residential development in Gauteng Province. 2014. For Mills & Otten Environmental Consultants.
- Development of Off-Site Mitigations recommendations for the proposed Majuba Power Station Ashing Expansion Project in the Mpumalanga Province. 2014. For Eskom. In collaboration with Ecocheck Environmental Services.
- Environmental Management Programme for the Vygeboom Power Line. 2019. For Royal HaskoningDHV (previously SSI).

⇒ Biological/ Biodiversity Monitoring Reports:
- Deployment of a biological monitoring programme to ascertain the breeding status of Grey-headed Gulls at the proposed Zenprop Skymall Property near O.R. Tambo International Airport in Gauteng Province. 2017. For Mills and Otten Environmental Consulting cc. In collaboration with Pachnoda Consulting.
- Development and deployment of a biennial faunal monitoring programme for the Letšeng Diamond Mine in the Kingdom of Lesotho (Letšeng Diamonds). Since 2015, ongoing. For Letšeng Diamonds. In collaboration with Pachnoda Consulting, Ecocheck Environmental Services and Enviro-Insight.
- Development and deployment of biodiversity monitoring programme at the Woestalleen Colliery properties in the Mpumalanga Province (Woestalleen Colliery, NuCoal). 1997 – 2008. In collaboration with EkoInfo cc.
- Floristic monitoring surveys within the Blesbokspruit river in the Gauteng Province to determine the effect of acid mine drainage. In collaboration with EkoInfo cc.
- Development and implementation of a biodiversity monitoring programme for the Ghaghoo Diamond Mine in Botswana. 2013. For VDDB Engineers, Marsh Vikela, Ghagoo Diamond Mine. In collaboration with Ecocheck Environmental Services.

⇒ Biodiversity Basic Assessment Reports:
- Terrestrial biodiversity Basic Assessment report for the proposed Etna – Trade powerline in the Gauteng Province (Eskom). 2016. In collaboration with Ecocheck Environmental Services.
- Ecological Basic Assessment of the proposed expansion of the Rietspruit Dam near Ventersdorp in the North-West Province. 2015. For Royal HaskoningDHV.

⇒ Species at Risk Assessments and Studies:
- Ecological status of the (Near Threatened) *Trachyandra erythrorrhiza* community in Esther Park from 2011 (ongoing) as part of compliance for the Bombela Concession Company. 2018. For Bombela Concession Company.
- Final walkdown and marking of protected tree species within the Thabametsi Power Project development footprint, the Medupi-Thabametsi 400 kV line, the Matimba-Thabametsi 400kV Line and the Thabametsi 33 kV line. 2018. For Savannah Environmental. In collaboration with Feathers Environmental Services and Ecocheck Environmental Services.
- Medicinal plants survey on a portion of the Farm Vlakfontein 30-IR in the Gauteng Province. 2017. For Mills & Otten Environmental Consultants.
- Final walkdown and marking of protected tree species within the Masa – Selomo 400 kV lines in the Limpopo Province. 2016. For Babcock International. In collaboration with Ecocheck Environmental Services.
- Search and rescue operation of medicinal plants at the proposed Vorna Valley development in Midrand, Gauteng Province. 2016. For Abland Developers.
- Protected species survey for the proposed water facility expansion at Giyani in the Limpopo Province. 2015. For EIMS.
- Red Data flora investigation for the proposed Irene Development within the Gauteng Province. 2004. For Mills & Otten Environmental Consultants.

⇒ Alien and Invasive Species Management Programmes:
- Development of a management plan for invasive fauna species at the Duvha Power Station in Gauteng Province. 2018. For Eskom. In collaboration with Ecocheck Environmental Services.
- Development of a management plan for alien and invasive plants at the Duvha Power Station in Mpumalanga Province. 2017. For Eskom.

- Development of a management plan for alien and invasive plants at the Majuba Power Station in Mpumalanga Province. 2017. For Eskom.
- Development of a management plan for alien and invasive plant at the Mercedes Benz (South Africa) Plant in Centurion, Gauteng Province. 2017. For Ingen Engineers.
- Survey of alien and invasive plant species for Exxaro Mining Properties in the Mpumalanga Province. 2018. For Ulwando.

⇒ Biodiversity Sensitivity Analysis:

- Sensitivity analysis for the proposed Mogale 1 (Doornbosch 308) development in Gauteng Province. 2016. For Greenergy.

⇒ Ecological Baseline Assessments and Descriptions:

- Baseline ecological assessment of the Mothae Diamond Mine in the Kingdom of Lesotho. 2017. For Sustain Consulting, Mothae Diamond Mine. In collaboration with Ecocheck Environmental Services.
- Baseline assessment of the proposed Tshwane Freight Terminal in the Gauteng Province. 2016
- Botanical assessments for the proposed Mmamabula Power Lines in the Republic of Botswana. 2006. For EkoInfo cc.
- Botanical surveys in the Tswalu Desert Reserve. 1997. For Ekotrust.
- Ecological Baseline Assessment of the proposed Golwe Development near Vhuri Vhuri in the Limpopo Province. 2007. For AgriDev Consultants. In collaboration with Ecocheck Environmental Services.

⇒ Biodiversity Risk Assessments:

- Risk assessment for the Sappi Enstra Mill in the Gauteng Province. 2016. For WSP Group.
- Assessment of potential damage to trees adjacent to ATC tower infrastructure in Lyttelton and Waterkloof in the Gauteng Province. 2015. For ATC.

⇒ Research, interpretation, analysis of aerial photographs and other:

- Sitting member of the Environmental Monitoring Committee (EMC) for Medupi Power Station (Eskom). 2007 – 2019. For Eskom (Medupi).
- Peer review of the biodiversity impact assessment report for the National Road 3: Keeversfontein to Warden expansion. 2014. For Cave Klapwijk & Associates.
- Development and deployment of provincial floristic surveys to correlate remote sensing vegetation degradation patterns in the Gauteng Province. 1999. For ISCW. In collaboration with EkoInfo cc.
- Development and deployment of provincial floristic surveys to correlate remote sensing vegetation degradation patterns in the Mpumalanga Province (ISCW). 1999. For ISCW. In collaboration with EkoInfo cc.
- Determination of the effect of uncontrolled fires in selected areas within the Sabi Sands Reserve as part of insurance claims. 2001. For Deneys Reitz Attorneys. In collaboration with EkoInfo cc.
- Determination of the impact of Quelea control actions in wetlands on the vegetation in selected wetland regions in the Free State Province. 2000. For ISCW. In collaboration with EkoInfo cc.
- Establishing wind and visual breaks through planting of trees at selected properties of Woestalleen Colliery in the Mpumalanga Province. 2002. For Woestalleen Colliery. In collaboration with EkoInfo cc.
- Ground truthing of landcover mapping procedures within the Gauteng Province. 2004. For SEF.
- Herpetological assessment of the proposed Moruladal Development in the Gauteng Province. 2004. For Mills & Otten Environmental Consultants.
- Assessment of Bushbabies at the proposed Wittkoppen Ext 112 in the Gauteng Province. 2004. For Mills & Otten Environmental Consultants. In collaboration with Ecocheck Environmental Services cc.
- Avifaunal surveys for the proposed H2 Power Plant Development near Bronkhorstspruit in the Mpumalanga Province. 2017. For Feathers Environmental Services.

⇒ Green Certification

- Ecological Green Building Certification for the proposed Woodmead Development in Gauteng Province. 2018. For Mills & Otten Environmental Consultants.

⇒ GIS and related

- Mapping and GIS digitising of maps for the National VEGMAP project. 2000. For Ecotrust.

Selected Reference Contact List

Company	Name	Telephone	email
Babcock South Africa	Donovan Fredrighi	011 739 8200	donovan.fedrighi@babcock.co.za
Bombela Operating Company	Thapelo Mndaweni	011 253 0044	Thapelo.Mndaweni@bombelaop.co.za
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EIMS	Liam Withlow	011 789 7170	liam@eims.co.za
EIMS, Savannah SA	John von Mayer	011 656 3237	johnpaul.eims@gmail.com
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Environamic	Ettienne van der Lith	082 781 9454	info@environamic.co.za
Environmental Assurance	Corrie Retief	012 460-9768	corrie@envass.co.za
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Eskom (Duvha Power Station)	Boitumelo Rathlogo	013 690 0320	RatlhoBT@eskom.co.za
Eskom (Medupi Power Station)	Emile Marell	082 560 4618	MarellEm@eskom.co.za
Feathers Environmental Consulting	Megan Diamond	082 683 0970	megan@feathersenv.co.za
ISCW/ LNR	Lianda Lotter	012 808 8000	lotterl@arc.agric.za
LEAP – Landscape Architects and Environmental Planners	Gwen Theron	012 344 3582	gwen.theron@telkomsa.net
Letšeng Diamond Mine	Bongani Nthloko	+27 710 554 078	ntlokob@letseng.co.ls
Mills & Otten	Kirstin Otten	011 486 0062	kirstin@millsandotten.co.za
Pachnoda Consulting cc	Lukas Niemand	012 365-3217	lukas@pachnoda.co.za
Royal HaskoningDHV	Bronwyn Griffiths	021 936 7714	bronwen.griffiths@rhdhv.com
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Savannah SA	Sharon Meyer	011 656 3237	sharon@savannahsa.com
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SolarReserve South Africa	Leanna Janse van Rensburg	011 582 6901	Leanna.JansevanRensburg@solarreserve.com
Sustain Consulting	Anneli Botha	011 560 9629	anneli@sustainconsulting.co.za
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TerraManzi	Kelly Armstrong	021 701 5228	kelly@terramanzi.co.za
Ulwando	Charles Verster	082 653 6081	charles@ulwando.co.za
WSP Group/ Lidwala Consulting	Ashlea Strong	011 361 1300	Ashlea.Strong@WSPGroup.co.za

* *please note that this list represents an abridged selection of companies, additional contact details can be provided upon request*

Certification

I, the undersigned, certify that to the best of my knowledge and belief, the above data correctly describe me, my qualifications and experience.

Riaan A. J. Robbeson (Pr.Sci.Nat.)

CURRICULUM VITAE OF LUKAS J. NIEMAND (PR.SCI.NAT.)

Name:	LUKAS JURIE NIEMAND
Company:	Pachnoda Consulting cc (Director)
Date of Birth:	1974-03-12
Nationality:	South African
Languages:	English and Afrikaans

EDUCATIONAL QUALIFICATIONS

1992	Hoërskool Hartbeespoort, Hartbeespoort - Senior Certificate.
1996	University of Pretoria, Pretoria - B.Sc. (Zoology and Entomology).
1997	University of Pretoria, Pretoria - B.Sc. (Hons) (Entomology).
2001	University of Pretoria, Pretoria - M.Sc. (Restoration Ecology/Zoology).

MEMBERSHIP IN PROFESSIONAL SOCIETY

⇒ Professional Natural Scientist (Pr. Sci. Nat.) (Reg. no. 400095/06 - Ecology & Zoology)
⇒ BirdLife South Africa (1039913)
⇒ Hartbeespoort Natural Heritage Society

COMPANY E1PERIENCE

Pachnoda Consulting CC is a small enterprise based in Pretoria, South Africa providing specialised consulting services and products in the terrestrial ecological milieu for mining companies, environmental consultants, developers, and other industry related institutions throughout Africa and abroad.

Pachnoda Consulting envisions a holistic approach to ensure the sustainable development and preservation of natural resources based on accepted scientific methods. Since its establishment in 2007, it has produced several ecological assessments, including botanical and faunal surveys spanning all nine provinces in South Africa and a number of African countries. It provides a broad range of quality services that specialises in ornithology (avifauna), entomology (invertebrates) and general zoology. In addition, it values a long-standing relationship with various non-governmental and tertiary institutions notably the University of Pretoria, Endangered Wildlife Trust, the Agricultural Research Council and the South African Biodiversity Institute.

CORE SERVICES

⇒ Objective and quantified ecological assessments (a holistic eco-system approach based on approved scientific methods) in accordance with International Best Practice (e.g. International Finance Corporation's Performance Standards & Millennium Challenge Corporation's Guidelines)
⇒ Ecological due diligence and risk assessments;
⇒ Taxon-specific surveys in the botanical, mammalian, avifaunal and invertebrate fields;
⇒ Bird impact studies for power lines and renewable energy plants;
⇒ Biodiversity action plans; and
⇒ Mapping and modelling of species distributions and ecological sensitivities.

MEMBER

Lukas Niemand is director and founding member of Pachnoda Consulting. He has been involved in the discipline of consultant ecologist since 2000, and his core services include ecological studies with emphasis on ornithological (the study of birds), faunal and entomological (the study of invertebrates) assessments.

He has travelled extensively to many remote places as far afield as Marion Island, and has worked on numerous international projects pertaining to the African continent (South Africa, Lesotho, Mozambique, Burundi, Congo-Brazzaville, Liberia, Zambia, Tanzania, Guinea and Ethiopia). He worked on projects earmarked for the urban and mining sector and has been involved in linear projects, monitoring programmes, biodiversity action plans as well as specific investigations regarding species with rare/elusive life-history traits (e.g. threatened species).

He is also registered with the panel of the Birds and Renewable Energy division of BirdLife South Africa.

PROJECTS

A Work conducted in South Africa

1 General Ecological Assessments (Fauna, Flora and Red Data Scans, including both functional and compositional aspects) for urban, residential, recreational and light industrial developments:

⇒ Belvedere Trust, Proposed retirement village on Amorosa Agricultural Holdings, Roodepoort, Gauteng (2004);
⇒ City of Joburg Property Development Company, Proposed upgrade and development of the Orlando Dam Intersection, Soweto, Gauteng (2004);
⇒ PDNA, Proposed NASREC development, Johannesburg, Gauteng (2004);
⇒ 17 Shaft Conference and Education Centre, Proposed establishment of the Veteran's Heritage Education Centre, Crown Mines, Gauteng (2004);
⇒ GAUTRANS, Proposed re-alignment of Road D781 and construction of a road bridge over the Rietvleispruit, Kempton Park, Gauteng (2004);
⇒ Mr. N. Lang, Ecological Opinion on the proposed establishment of a township, Muldersdrift, Gauteng (2004);
⇒ AGES, Proposed Equestrian Centre, Leeufontein 299 IR, Gauteng (2004);
⇒ PDNA, Proposed new bridge and re-alignment of a portion of provincial road P101-2 (R51), Laversburg, Gauteng (2004);
⇒ Blenneerville Investment (Pty) Ltd, Proposed construction of a residential and commercial development on of Paradiso Estate, Tweefontein 372 JR, Gauteng (2004);
⇒ Les Roches (Pty) Ltd, Proposed zoning of holdings 1, 2 & 3 of Hyde Park Agricultural Holdings, Gauteng (2004);
⇒ Celebration North Riding (Pty) Ltd, Proposed mixed land-use development, North Riding, Gauteng (2005);
⇒ Wilderness Safaris, Proposed upgrade of the Manzengwenya Dive Camp, Greater St. Lucia Wetlands Park, KwaZulu-Natal (2005);
⇒ Wilderness Safaris, Proposed upgrade of the Rocktail Bay Camp, Greater St. Lucia Wetlands Park, KwaZulu-Natal (2005);
⇒ GAEA Projects, Corridor Assessment for the proposed Sibaya Precinct, KwaZulu-Natal (2005);
⇒ Computer Domain Holdings (Pty) Ltd, Red Data Floral Scan on portion 3 of the farm Elandshoek, portions 12 & 27 of the farm Groot Suikerboschkop, and portions 5 & 10 of the farm Palmietfontein, Dullstroom (2005);
⇒ Zong's Property Investments, Proposed establishment of a residential development on a portion of Pomona Estates Agricultural Holdings, Pomona, Gauteng (2005);
⇒ GJ van Zyl Trust, Proposed development of a resort on the Farm Witpoort 216 JS, Mpumalanga (2005);
⇒ Mr. Howard Walker, Proposed subdivision of the Farm Lunsklip 105 JT, and the Farm Morgenzon 122 JT, for the establishment of a private resort, Dullstroom, Mpumalanga (2005);
⇒ Lavender Manor cc, Proposed establishment of a retail, commercial and Lavender Manor Township on part of farm Rietfontein 189 IQ, Muldersdrift, Gauteng (2005);
⇒ Geo Pollution Technologies, Proposed establishment of a residential development: Noordwyk Ext 65 & 80 on Erand Agricultural Holdings, Midrand, Gauteng (2005);
⇒ Mr. A. Le Roux, Proposed Cradle View Country Estate, Muldersdrift, Gauteng (2006);
⇒ Viking Bay Development Company (Pty) Ltd, Proposed Viking Bay freshwater marina and hotel development, Vaal Dam, Gauteng (2006);
⇒ Land for Africa (Pty) Ltd, Ecological Opinion for the proposed establishment of a residential township on holding 122 Erand Agricultural Holding Extension 1, Halfway House, Midrand, Gauteng (2006);
⇒ Brickot Developments cc, Ecological opinion for the proposed Bethal Retirement Village on the remainder of portion 3 of the farm Mooifontein 108 IS, Bethal, Mpumalanga (2006);
⇒ Brawild (Pty) Ltd, Red Data Scan for the proposed Annlin Ex 117, Pretoria, Gauteng (2006);
⇒ Mbombela Local Municipality, Ecological Opinion for the proposed extension of the Lowveld Botanical Gardens, Nelspruit, Mpumalanga (2006);
⇒ Aurecon, Desktop biodiversity assessment and wetland scan: upgrade of the River View waste water treatment works, eMalahleni, Mpumalanga province. Report compiled in association with Imperata Consulting (2009);
⇒ Teurlings Environmental, Ecological evaluation for rectification as per Section 24G of NEMA on Portion 437 of the Farm Zwavelpoort 373 JR, Bronberg area, Gauteng (2017);
⇒ Kyllinga Consulting/ AdiEnvironmental - Ecological Assessment (with emphasis on terrestrial fauna) for the proposed Rockdale development, Middelburg, Mpumalanga (2017);
⇒ Envirolution Consulting, Ecological evaluation for the proposed V& S Asphalt Plant at Putfontein, Gauteng (2018);
⇒ Batho Earth - An ecological evaluation (fauna & flora) on Portion 24 of Erf 2440 in Newcastle, KwaZulu-Natal (2018);
⇒ De Castro & Brits Ecological Consultants/ Bucandi Environmental - Matopie Ecological Assessment as part of the Section 24G rectification process for unauthorised construction activities on Portion 27 of the Farm Kloppersbos 128 JR, Dinokeng, Gauteng Province (2018);
⇒ Knight Piésold/ Afri-Active Mechanical & Electrical - Ecological and Avifaunal assessment for the Lanark PV Solar Facility near Dendron (Mogwadi), Limpopo Province (2018);
⇒ Teurlings Environmental, Ecological Evaluation for Plot 82 on the Farm Klipkop (Del la Mas), Bronberg Area, Gauteng (2018);
⇒ De Castro & Brits Ecological Consultants/ Bucandi Environmental - Terrestrial Ecological Assessment for the expansion of the Hesters Rust Quarry near Welkom, Free State Province (2019);
⇒ Exigent Environmental - Ecological Evaluation (with emphasis on vegetation) on Portions 77, 169 and RE 76 of the Farm Zandfontein 317 JR, Andeon, Gauteng (2018);
⇒ SRK Consulting, Terrestrial ecological assessment for the proposed development of the Sandton field and Study Centre, Sandton, Gauteng (2018);
⇒ Teurlings Environmental, Ecological Management and Rehabilitation (including alien plant management plan) for rectification as per Section 24G of NEMA on Portion 437 of the Farm Zwavelpoort 373 JR, Bronberg area, Gauteng (2019);

⇒ Batho Earth, Ecological evaluation for the Mahlakwane Trick Stop at Steelpoort, Limpopo Province (2019);
⇒ EkoInfo/NGT Holdings, Vertebrate faunal assessment for the proposed Madimatle Cave recreation plan near Thabazimbi, Limpopo Province (2019);
⇒ De Castro & Brits Ecological Consultants/ Bucandi Environmental - Ecological Assessment for the Hubner Hog development on Portion 224 of the Farm Honingnestkrans 269 JR, Dinokeng, Gauteng Province (2019);
⇒ NuLeaf Planning & Environmental, Ecological evaluation for the Tuna park open space project, Nigel, Gauteng (2019);
⇒ Kyllinga Consulting, Fauna assessment for the proposed residential development on Portion 58 of the Farm Zwavelpoort 373 JR , Bronberg area, Gauteng (2019);
⇒ Envirolution Consulting, Ecological evaluation for a Tyre recycling plant on Portion 156 of Farm Zandspruit 191 IQ, Gauteng (2020);
⇒ Adienvironmental/Kyllinga consulting, Ecological assessment for the proposed light industrial development on Portion 58 of the Farm Vaalbank 289 JS, Middelburg, Mpumalanga (2020).

2 Mining and Industrial related projects (ecological assessments):

⇒ Lonmin Platinum (Western Platinum Limited), Ecological Assessment for the proposed MK3 Shaft Complex on the farm Wonderkop 400 JQ, Rustenburg, North West Province (2004);
⇒ Impala Platinum Limited, Ecological Assessment for prospecting SEMPs on the farms Buffelshoek 386 KT, Kalkfontein 367 KT, Spitskop 333 KT, Steelpoortpark 366 Kt and Tweefontein 360 KT and Hackney 116 KT (all Sekhukhuneland), Mpumalanga and Limpopo Province (2004);
⇒ Transnet Limited, Terrestrial Faunal Ecological Opinion: Phase 1B expansion of the Sishen-Saldanha Iron ore export corridor, Saldanha Bay, Western Cape (2005);
⇒ Trans-Caledon Tunnel Authority (TCTA), Ecological Assessment for borrow pit SEMPs on the TCTA pipeline, Vaal Marina to Secunda (2005);
⇒ Boynton Platinum (Pty) Ltd, Ecological Assessment for the proposed establishment of platinum mines on the farms Tuschenkomst 135 JP, Witkleifontein 136 JP and Ruighoek 169 JP, North West Province (2005);
⇒ Impala Platinum Holdings, Ecological Assessment for prospecting SEMPs on the Impala Platinum Bafokeng Mining Complex, North West Province (2005);
⇒ Ceramic Industries Limited, Ecological Assessment of the Rietspruit Clay Quarries, Vanderbijlpark, Gauteng (2005);
⇒ Ekurhuleni Metropolitan Municipality, Ecological Assessment Report for the proposed GLB Landfill Site on the farm Zesfontein 27 IR, Benoni, Gauteng (peer reviewed, 2006);
⇒ Ceramic Industries Limited, Ecological Assessment of the Leeukuil Clay Quarries, Vanderbijlpark, Gauteng (2006);
⇒ Council for Geoscience, Habitat sensitivity assessment scoping report for Bon Accord quarry on a portion of the farm de Onderstepoort 300-JR, Tshwane, Gauteng (2007);
⇒ Natural Scientific Services cc, Botanical survey for the SASOL Mafutha coal project near Lephalale, Limpopo Province, RSA (2008);
⇒ SRK Consulting, Ecological assessment on Vlakfontein area, NW of Ogies, Mpumalanga. Report compiled in association with EkoInfo (2009);
⇒ Fraser Alexander, Biodiversity action plan for Lonmin Limpopo & Platinum, North West & Limpopo Province, RSA (2008-2009);
⇒ Envirolution Consulting (Pty) Ltd., Ecological screening report and site selection process for an Eskom general landfill and hazardous waste storage facility near Lephalale, Limpopo Province, RSA (2009);
⇒ Envirolution Consulting (Pty) Ltd., Ecological assessment for the proposed construction of an Eskom general landfill and hazardous waste storage facility at the Matimba Power Station, Limpopo Province, RSA (2009);
⇒ Shangoni/Vergenoeg Mining Company, Ecological assessment for the proposed construction of a slurry pipeline and waste rock dump at the Vergenoeg Mine, Gauteng (2011);
⇒ ENVASS, An ecological evaluation (vertebrate & avifaunal component) for the proposed alternative energy plant on Portion 3, 4 & 5 of the Farm Groenwater 453, Northern cape (2012); and
⇒ ENVASS, Ecological evaluation (vertebrate & avifaunal component) for the proposed alternative energy plant on !xun & khwe, Northern cape (2012).
⇒ Mulilo & CSIR, Ecological evaluation (vertebrate & avifaunal component) for seven proposed PV plants near Kenhardt, Northern Cape (2016);
⇒ Shangoni & Aquila Resources (Vegetation, vertebrate & avifaunal component) for the mining of Iron Ore at Meletse Mountain near Thabazimbi, including the compilation of a habitat occurrence model for a threatened fern species (*Cheilanthes deltoidea silicicola*) and an offset strategy (2016);
⇒ De Castro and Brits/Clearstream Environmental, Terrestrial ecological assessment for the Impumelelo Mine (SASOL) expansion areas between Secunda and Greylingstad, Mpumalanga (2016);
⇒ EkoInfo/AngloCoal - Biodiversity assessment (vertebrates and invertebrates) for Kriel Coal Mine Lease Area (18 000ha), Kriel, Mpumalanga (2017);
⇒ De Castro & Brits Ecological Consultants/ Cleanstream Environmental, Bio-monitoring survey for Exxaro Glisa coal mine: Vertebrate Wetland Fauna Assessment, Belfast, Mpumalanga (2018).
⇒ De Castro & Brits Ecological Consultants/ Cleanstream Environmental - Ecological follow-up survey of the Stuart Colliery with emphasis on surface infrastructure, Delmas, Mpumalanga (2018);
⇒ EkoInfo/Ethical Exchange - Biodiversity assessment (with inputs related to fauna) for the application of a prospecting permit at the Boschpoort Granite Mine, North-West Province (2019);
⇒ EkoInfo/Seriti - Biodiversity baseline assessment (vertebrates and invertebrates) for the Kriel Colliery's post mined and rehabilitated areas, Kriel, Mpumalanga (2019);

⇒ De Castro & Brits Ecological Consultants, Vertebrate Fauna Assessment for Glencore's Wonderfontein Mine complex Mineral Rights Area, Wonderfontein, Mpumalanga (2019);
⇒ Bathusi Environmental/ENVASS, Terrestrial fauna and avifaunal survey and impact assessment for the mining of heavy mineral sands at areas known as Die Kom and Grouwduin se Kop, near Koekenaap, Western Cape (2019);
⇒ De Castro & Brits Ecological Consultants/ Cleanstream Environmental, Bio-monitoring survey for Exxaro Glisa coal mine: Vertebrate Wetland Fauna Assessment, Belfast, Mpumalanga (2020);
⇒ De Castro & Brits Ecological Consultants/Cleanstream Environmental, Vertebrate Fauna Assessment on 376.5ha of Kriel Colliery Pit F, Kriel, Mpumalanga (2020).

3 Avifaunal and Invertebrate Assessments:

⇒ Lavender Manor cc, Red Data Bird Assessment for the proposed establishment of a retail, commercial and Lavender Manor Township on part of the farm Rietfontein 189 IQ, Muldersdrift, Gauteng (2004);
⇒ Helga Schneider & Associates, Avifaunal & Invertebrate Red Data Assessment for the proposed rezoning & subdivision on Erf 6486 Orange Farm Ext 2, Johannesburg, Gauteng (2005);
⇒ TOWNDEV, Avifaunal and Arachnid Assessment for the proposed subdivision of Grootfontein 349 JR, Rievlei Dam, Gauteng (2006);
⇒ Prof. Van Rensburg, Red Data Invertebrate Scan for the proposed Rietvalleirand Extension 59, Gauteng (2006);
⇒ Group Five Property Development, Invertebrate Assessment for the proposed Buccleuch Ex 1, Gauteng (2006);
⇒ Zong's Property Investments, Avifaunal and Metisella meninx assessment for the establishment of a residential development on a portion of Pomona Estates Agricultural Holdings, Pomona, Gauteng (2006);
⇒ Waterval Islamic Institute, Avifaunal and Invertebrate Assessment for the proposed Northern Golf Course Development, Midrand, Gauteng (2006);
⇒ Ekurhuleni Metropolitan Municipality, Avifaunal & Invertebrate Red Data Assessment for the proposed low-cost housing development on Olifantsfontein 410 JR, Gauteng (2006);
⇒ City of Tshwane Metropolitan Municipality, Invertebrate Red Data Scan for the proposed flood remediation and river upgrade at Soshanguve, Gauteng (2006);
⇒ AGES, Invertebrate assessment for the proposed mining activities on the farm Thorncliffe 374 KT, 1strata Eastern Mines, Mpumalanga (2007)
⇒ AGES, Mammal and invertebrate assessment for the proposed Kalplats project, Stella, North West Province (2007)
⇒ Exigent Engineering Consultants, Invertebrate assessment for the proposed Derdepoort 1 11, Derdepoort, Gauteng (2007);
⇒ Exigent Engineering Consultants, Invertebrate and Avifaunal scan for the proposed Cutty Sark hotel extension, Scottburgh, Kwazulu-Natal (2007);
⇒ Strategic Environmental Focus, African Grass Owl assessment on the proposed Cradle View country estate on portion 60 of the farm Driefontein 179 IQ, Muldersdrift, Gauteng (2007);
⇒ GEOLAB, Ecological assessment for the West Rand Gold Operations (WERGO) Witfontein tailings disposal facility, Mintails, Gauteng, RSA (2008);
⇒ Coastal Environmental Services, Avifaunal Assessment for the proposed mining of heavy minerals at Port Durnford (Exxaro KZN-Sands), KwaZulu-Natal (2008);
⇒ SRK & Natural Scientific Services cc, A feasibility study for the mining of coal north of the Limpopo Province. Avifaunal & invertebrate assessment, Rio Tinto Exploration, Limpopo Province, RSA (2009);
⇒ Eskom/Baagi Environmental, An environmental management plan (avifaunal & faunal component) for the proposed Dinaledi - Spitskop 400 kV transmission line, North West Province (2010);
⇒ Eskom/Baagi Environmental, An avifaunal impact report for the proposed 400 kV Ariadne-Venus transmission line between Estcourt and Pietermaritzburg, KwaZulu-Natal (2010);
⇒ Eskom/Baagi Environmental, An avifaunal impact assessment report for a 275 kV power line between the substations of Glockner and Kookfontein, Vanderbijlpark, Gauteng (2010);
⇒ Groundwater Consulting Services (Pty) Ltd/EkoInfo, An invertebrate and avifaunal specialist report for the proposed expansion of Exxaro's Glisa coal mine, Belfast, Mpumalanga (2010);
⇒ Eskom/Baagi Environmental, An environmental management plan (avifauna component) for the proposed 400 kV Medupi-Massa transmission lines, Limpopo Province (2011);
⇒ Eskom/Baagi Environmental, An avifaunal and fauna impact assessment report for the proposed 400 kV Arnott-Gumeni transmission line, Mpumalanga Province (2012);
⇒ Eskom/Baagi Environmental, An environmental management plan (avifaunal component) for the proposed 400 kV Ngwedi transmission line and substation, North West Province (2012);
⇒ Exxaro/EkoInfo, An avifaunal and invertebrate assessment (as part of a Biodiversity Assessment and action plan) for the Gravelotte MagVanTi Mining Area, Limpopo Province (2012);
⇒ Groundwater Consulting Services (Pty) Ltd/EkoInfo, An invertebrate and avifaunal specialist report for the proposed Paardeplaats coal mine area, Belfast, Mpumalanga (2012);
⇒ Groundwater Consulting Services (Pty) Ltd/EkoInfo, An invertebrate and avifaunal specialist report for the proposed Leeuwpan coal mine area, Belfast, Mpumalanga (2013);
⇒ Eskom/Baagi Environmental, An environmental management plan (avifaunal component) for the proposed Medupi - Borutho 400 kV transmission line, Limpopo Province (2012);
⇒ Eskom/Baagi Environmental, An environmental management plan (avifaunal component) for the proposed Gromis - Oranjemund 400 kV transmission line, Northern Cape (2013);
⇒ Eskom/Baagi Environmental, An environmental management plan (avifaunal component) for the proposed Ariadne - Eros 400 kV transmission line, KwaZulu-Natal (2014);

- ⇒ Eskom/Baagi Environmental, An avifaunal and fauna impact assessment report for the proposed 400 kV Nzhelele - Triangle Project, Musina, Limpopo Province (2014);
- ⇒ Exxaro/EkoInfo, An avifauna and invertebrate investigation for the proposed Zonderwater Coal Project, Lephalale, Limpopo Province (2014);
- ⇒ Eskom/Baagi Environmental, An environmental management plan (avifaunal component) for the proposed Everest - Merapi 400 kV transmission line, Free State Province (2015);
- ⇒ Malelane Safari Resort Investments, An avifaunal investigation for the proposed safari lodge near Malelane Gate, Kruger National Park (2015);
- ⇒ Exigent, An avifaunal investigation for the proposed Zamokuhle Development within the Pongola Game Reserve, Mkuzi, KwaZulu-Natal (2016);
- ⇒ Bathusi Environmental/ Savannah Environmental, Avifaunal baseline survey and impact assessment as part of a terrestrial biodiversity impact assessment for the proposed Tshivhaso Coal-fired power plant near Lephalale, Limpopo Province (2016);
- ⇒ Eskom/Baagi, Avifauna and fauna assessment for the proposed Mahikeng main transmission substation and 400kV Pluto to Mahikeng powerline within the Merafong City Local Municipality of Gauteng Province and the Ditsobotla, JB Marks and Mafikeng Local Munisipalities of the North West Province (2018);
- ⇒ Bathusi Environmental/ Savannah Environmental, Avifaunal baseline survey and impact assessment as part of a terrestrial biodiversity impact assessment for the proposed Mutsho power project near Makhado, Limpopo Province (2018);
- ⇒ Savannah Environmental/ ABO Wind Lichtenburg 1 PV - Avifaunal baseline Assessment for the 100MW Lichtenburg 1 PV Solar Facility, Lichtenburg, North-West Province (2018);
- ⇒ Savannah Environmental/ ABO Wind Lichtenburg 2 PV - Avifaunal baseline Assessment for the 100MW Lichtenburg 2 PV Solar Facility, Lichtenburg, North-West Province (2018);
- ⇒ Savannah Environmental/ ABO Wind Lichtenburg 3 PV - Avifaunal baseline Assessment for the 100MW Lichtenburg 3 PV Solar Facility, Lichtenburg, North-West Province (2018);
- ⇒ Bathusi Environmental/ Mills & Otten - African Grass-Owl (*Tyto capensis*) and general bird assessment on the Remainder Portion 332 of the Farm Knopjeslaagte 385 JR, Gauteng (2018);
- ⇒ Nyengere Solutions/ Waterberg Joint Venture - Avifauna, Invertebrate and Bat benchmark surveys for the proposed Waterberg mining project (dry season), Makgabeng, Central Limpopo Province (2018);
- ⇒ Knight Piésold/ Afri-Active Mechanical & Electrical - Avifaunal baseline assessment for the Lanark PV Solar Facility near Dendron (Mogwadi), Limpopo Province (2018);
- ⇒ Nyengere Solutions/ Waterberg Joint Venture - Avifauna, Invertebrate and Bat benchmark surveys for the proposed Waterberg mining project (wet season), Makgabeng, Central Limpopo Province (2019);
- ⇒ Eskom/Bathusi Environmental, environmental management plan; Avifaunal Component for the dismantling of the Grootpan-Brakfontein double circuit powerline near Ogies, Mpumalanga (2019);
- ⇒ Bathusi Environment/Terramanzi, Conflict resolution actions for the proposed Alkantpan Airstrip on a Portion of the Farm Smous Pan 105: Avifaunal Component, Copperton, Northern Cape (2019);
- ⇒ Eskom/EkoInfo, Avifaunal and general terrestrial fauna assessment for a 400kV powerline as required for the East Coast Gas Project, Richards Bay, KwaZulu-Natal (2019).

4 Other Assessments: Facilitation, project management and conduction of environmental scoping exercises, Environmental Impact Assessments, Environmental Management Plans, Feasibility Reports, for a range of projects and issues such as:

- ⇒ Planning and facilitation of environmental awareness workshops (Winterveltd Workshops for the Department of Environmental Affairs and Tourism);
- ⇒ Compilation and evaluation of EIA reports and Environmental Management Plans (EMPs) for both the private and public sector (e.g. Scoping Report for the relocation of oxidation ponds for the Moqhaka Local Municipality and the installation of an underground additive tank for Sasol Oil (Pty) Ltd).
- ⇒ Urban Renewal Projects: Bekkersdal Urban Renewal Project and the Greater Evaton Urban Renewal Project for the Gauteng Department of Housing.
- ⇒ Douglas Collieries (Inkwe Collieries), Biodiversity Assessment and database compilation of the Douglas Collieries (2005);
- ⇒ Orion Group, Ecological Sensitivity Map for the proposed golf course and related facilities, Mont-Aux-Sources (2005);
- ⇒ Johannesburg Roads Agency, Alien Eradication and Rehabilitation Programme for the proposed upgrade of 14th Avenue, Randburg, Gauteng (2006);
- ⇒ City of Joburg Property Development Company, Ecological Management Plan for the Orlando Dam intersection, Soweto, Gauteng (2006);
- ⇒ GJ van Zyl Trust, Alien Eradication Programme for the proposed development of a resort on the Farm Witpoort 216 JS, Mpumalanga (2006);
- ⇒ GJ van Zyl Trust, Fire Management Plan for the proposed development of a resort on the Farm Witpoort 216 JS, Mpumalanga (2006); and
- ⇒ Khutala Collieries (Inkwe Collieries), Biodiversity Assessment and database compilation (2006)

5 Linear Assessments:

- ⇒ Trans-Caledon Tunnel Authority (TCTA), Proposed Vaal River Eastern Subsytem Augmentation (VRESAP) pipeline from Vaal Marina to Secunda (2005);

- ⇒ PBA International (in association with Bathusi EC), Ecological Scoping Report for the proposed Eskom Delta-Epsilon 765 kV Transmission lines (2007);
- ⇒ Bohlweki Environmental (in association with Bathusi EC), Ecological Scoping Report for the proposed Eskom Malelane-Boulders 132 kV Distribution line (2007);
- ⇒ Bohlweki Environmental (in association with Bathusi EC), Ecological Scoping Report for the proposed Eskom Marathon-Delta 132 kV Distribution line (2007);
- ⇒ Strategic Environmental Focus, Avifaunal EIA Report for the proposed Eskom Hendrina-Prairie-Marathon 400 kV Transmission line, Mpumalanga (2007);
- ⇒ Natural Scientific Services cc, Botanical survey for the proposed upgrade of the Transnet railway line between Hotazel, Northern Cape and the Port of Ngqura, Eastern Cape, RSA (2008);
- ⇒ Envirolution Consulting (Pty) Ltd, Ecological Report for the proposed Eskom Apollo-Lepini 400kV transmission line (2009);
- ⇒ Arcus Gibb, An ecological investigation for the Tumelo 132 kV distribution line and power line near Kagiso, Gauteng (2010);
- ⇒ AECOM, Fauna assessment for the proposed upgrade of the Moloto Road through Gauteng, Mpumalanga and Limpopo Provinces (2016);
- ⇒ Envirolution consulting, Terrestrial ecological assessment and rehabilitation plan for the proposed Meyersdal pipeline located within the Meyersdal Nature Estate, Alberton, Gauteng (2017);
- ⇒ Envirolution consulting, Terrestrial ecological assessment for the Witpoortjie distribution line, Witpoortjie, Gauteng (2017);
- ⇒ Envirolution consulting, Terrestrial ecological assessment and rehabilitation plan for a sewer pipeline at the Pomona Spruit system, Kempton Park, Gauteng (2017);
- ⇒ Shangoni Management Services/ Ekurhuleni Metropolitan Municipality - Ecological Evaluation for the upgrade of the Serengeti Sewer Pump Station and rising main, Ekurhuleni Metropolitan Municipality, Pomona, Gauteng (2018);
- ⇒ AdiEnvironmental/Kyllinga Consulting, Ecological Assessment for the Empuluzi - Methula Phase 1 bulk water supply scheme, Mpuluzi, Mpumalanga (2018);
- ⇒ SRK Consulting, Ecological Evaluation for the proposed Baviaanspoort pipeline, northern Pretoria, Gauteng (2019).

B Work conducted in other African countries:

- ⇒ Rural Maintenance, Invertebrate study for four mini-hydroelectric generation plants, Northern Malawi, Africa (2010);
- ⇒ Impacto, An avifaunal study (Phase 1) for the proposed Mpanda Nkwua Dam in the Zambezi River, Mozambique, Tete Province (2010);
- ⇒ Conseil Régional des Pays de la Loire, An avifaunal investigation of the Rusizi and Ruvubu National Parks (Burundi), and the feasibility of establishing an avi-tourism network with specific emphasis on the protection of important flyways used by Palearctic birds - of - prey (2010);
- ⇒ Impacto, An avifaunal study (Phase 2) for the proposed Mpanda Nkwua Dam in the Zambezi River, Mozambique, Tete Province (2011);
- ⇒ Rural Maintenance, Invertebrate scan for the expansion of coal mining activities at Kayelekera, Northern Malawi, Africa (2011);
- ⇒ Rural Maintenance, Invertebrate study for a mini-hydroelectric plant at the Chisanga Falls, Nyika National Park, Malawi (2011);
- ⇒ Impacto/ERM/Enviro-Insight, Avifaunal investigation for the proposed Ncondezi Coal Mine, Tete Province, Mozambique (2011);
- ⇒ Enviro-Insight, Avifaunal investigation for the Riversdale Coal Mine complex, Tete Province, Monzambique (2011);
- ⇒ Anadarko Petroleum/ERM/Enviro-Insight, Avifaunal investigation for the proposed Anadarko Mozambique Area 1 Liquefied Natural Gas plant in northern Mozambique, Cabo Delgado Province, Mozambique (2012);
- ⇒ Coffey Environments/EkoInfo, Avifaunal investigation for the mining of iron ore by Baobab Resources, Tete Province, Mozambique (a scoping-level assessment); and
- ⇒ SRK/Flora, Fauna and Man Ecological Services, An avifaunal and invertebrate assessment for the establishment of a potash mine at Konkoati, Republic of the Congo (2012);
- ⇒ China Union/ERM/Enviro-Insight, Avifaunal investigation for the proposed mining of iron ore in Bong County, Liberia (2012);
- ⇒ SRK/Flora, Fauna and Man Ecological Services, An invertebrate assessment for the mining of iron ore by DMC Congo Mining/Exxaro at Mayoko, Republic of the Congo (2012);
- ⇒ Western Cluster/ERM/Enviro-Insight, Avifaunal investigation for the proposed mining of iron ore at Bomi Hills, ,Bomi County, Liberia (2013);
- ⇒ SRK/Flora, Fauna and Man Ecological Services, An invertebrate assessment for the establishment of an ecological offset for the DMC Congo Mining/Exxaro Iron Ore Mine at Mayoko, Republic of the Congo (2013);
- ⇒ Western Cluster/ERM/Enviro-Insight, Avifaunal investigation for the proposed mining of iron ore at Bea Mountain, Grand Cape Mount County, Liberia (2013);
- ⇒ Western Cluster/ERM/Enviro-Insight, Avifaunal investigation for the proposed mining of iron ore at Mano River, Grand Cape Mount County, Liberia (2013);
- ⇒ Anadarko Petroleum/ERM/Enviro-Insight, DUAT Area Terrestrial Ecology Baseline Augmentation: Avifaunal Component with emphasis on determining important flyways for emblematic non-passerine birds where the potential risk of avian collisions to approaching aircraft is eminent during the establishment of an airstrip, Cabo Delgado Province, Mozambique (2012);
- ⇒ Anadarko Petroleum/ERM/Enviro-Insight, Regional Terrestrial Baseline Report, Avifaunal Component for the Mozambique Gas development with emphasis on critical habitat as per the IFC PS6, Cabo Delgado Province, Mozambique (2012);
- ⇒ WSP/Flora, Fauna and Man Ecological Services, An invertebrate assessment for the establishment of a phosphate mine, Hinda Phosphate Project, Republic of the Congo (2014);
- ⇒ De Beers/Bathusi Environmental, An avifaunal monitoring report for the Letseng Diamond Mine, Lesotho (2015);
- ⇒ ASCOM Mining/ Flora, Fauna and Man Ecological Services, An Invertebrate and Avifaunal survey for the proposed mining of gold in western Ethiopia, Ethiopia (2015);
- ⇒ Western Power/Ecotone - A faunal investigation for the proposed development of a hydro-powered generation plant at Sioma, western Zambia (2015);

⇒ Aureus Mine/Enviro-Insight, An avifaunal investigation for the proposed mining of gold at the New Liberty Gold Mine, Liberia (2015 - 2016);
⇒ SRK/ Flora, Fauna and Man Ecological Services, An invertebrate and avifaunal screen for the proposed mining of phosphate substances at Dougou, part of a mining license extension of the Kola Project, Republic Of Congo (2016);
⇒ De Beers/Bathusi Environmental, An avifaunal monitoring report (second monitoring session) for the Letseng Diamond Mine, Lesotho (2017);
⇒ Western Power/Ecotone - A follow-up wet season faunal investigation for the proposed revised infrastructure for the development of a hydro-powered generation plant at Sioma, western Zambia (2018);
⇒ ASCOM Mining/ Flora, Fauna and Man Ecological Services, An Invertebrate and Avifaunal dry season survey for the proposed mining of gold in western Ethiopia, Ethiopia (2018);
⇒ SRK/ The Biodiversity Company, An Avifaunal dry season survey for the proposed mining of gold at Siguiri, Guinea, (2018);
⇒ Enviro-Insight/ERM, Critical Habitat Review and assessment of threatened Orthoptera taxa as per IFC PS6 at Pugu Hills and Ruvu forest Reserves along the proposed Yapi Merkezi railway line, near Dar-es-Salaam, Tanzania (2019);
⇒ De Beers/Bathusi Environmental, An avifaunal monitoring report (third monitoring session) for the Letseng Diamond Mine, Lesotho (2019);

C Additional Experience:

⇒ Monitoring and evaluation of the rehabilitation programme for the mining company Richards Bay Minerals (RBM) with special reference to vegetation, bird, small mammal and millipede assemblages.
⇒ Other responsibilities include assessment of the ecological standard operating procedures (SOP) according to RBM's environmental management programme in compliance with ISO 14001 environmental standards accreditation process.
⇒ Participated in the annual relief programme on the S.A Agulhas voyage to Subantarctic Marion Island (Prins Edward group). Took part in the research to estimate the population dynamics and demography of the alien house mouse (Mus musculus) on the island (under supervision of the University of Pretoria).
⇒ Participated in the preparation of a conservation management plan for a game and trout farm in conjunction with Mpumalanga Parks Board (in charge of the bird section) for the farm Nu-Scotland Bavaria.
⇒ Lead a successful professional bird tour (party of 12) to the Eastern Zimbabwean highlands and adjacent Mashonaland Plato (10 days).
⇒ Lead a successful professional bird tour (party of 9) to the Cape Peninsula, Karoo and West Coast (10 days).
⇒ Lead a successful professional bird tour (party of 12) to the Swaziland and Northern Zululand (10 days).
⇒ Lead a successful professional bird tour (party of 15) to the Namibia (10 days).
⇒ Lead a successful professional bird tour (party of 14) to the Eastern Drakensberg and Lesotho (10 days).

EMPLOYMENT HISTORY:

March 2007 – Current: of Director of Pachnoda Consulting cc
2004- January 2007: Strategic Environmental Focus (Pty) - Terrestrial Ecologist
2003 – 2004: Enviro-Afrik (Pty) Ltd– Environmental Consultant
2001 – 2003: University of Pretoria - Research Assistant

PUBLICATIONS:

⇒ McEWAN, K.L., ALE1ANDER, G.J., NIEMAND, L.J. & BREDIN, I.P. 2007. The effect of land transformation on diversity and abundance of reptiles. Paper presented at the 50th Anniversary Conference of the Zoological Society of Southern Africa.
⇒ NIEMAND, L. 1997. Distribution and consumption of a rust fungus *Ravenelia macowaniana* by micro-lepidopteran larvae across an urban gradient: spatial autocorrelation and impact assessment. Hons publication, University of Pretoria, Pretoria
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⇒ VAN AARDE, R.J., WASSENAAR, T.D., NIEMAND, L., KNOWLES, T., FERREIRA, S. 2004. Coastal dune forest rehabilitation: a case study on small mammal and bird assemblages in northern KwaZulu-Natal, South Africa. In: Martínez, M.L. & Psuty, N. (Eds.) *Coastal sand dunes: Ecology and Restoration*. Springer-Verlag, Heidelberg.
⇒ VAN AARDE, R., DELPORT, J. & NIEMAND, L. 1999. Of frogs and men. *Mechanical Technology,* June: 32-33.
⇒ VAN AARDE, R., DELPORT, J. & NIEMAND, L. 1999. Gone Frogging. *Getaway,* January: 80-83.

PRESENTATIONS, CONFERENCES & PUBLIC AWARENESS

⇒ Co-presenter at the Wetland Training Course (30 July – 3 August 2007) entitled: "Wetland-associated fauna". University of Pretoria, Pretoria.
⇒ Co-presenter and lecturer of the pre-conference training course (entitled "Can rehabilitation contribute towards biodiversity?") at the 3rd Annual LaRSSA (Land Rehabilitation Society of Southern Africa) Conference (8-11 September 2015), Glenburn Lodge, Muldersdrift, Gauteng.
⇒ Technical advisor to the Go/Weg magazine in response to bird and ecological related queries from the public/readers.

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CONDITIONS, LIMITATIONS AND ASSUMPTIONS

⇒ Findings, results, observations, conclusions and recommendations presented in this report are based on the authors' best scientific and professional knowledge as well as the interpretation of information available to them at the time of compiling this report.

⇒ Due care and diligence was exercised by the authors in rendering services, preparing this document and executing responsibilities as specialist consultants.

⇒ It is assumed that third party information (obtained from government, academic/research institution, non-governmental organisations) is accurate and true.

⇒ Even though care is taken to ensure the accuracy of surveys, data analysis and other aspects of this report, it should be noted that ecological/ biodiversity studies, notably for EIA purposes, are limited in time, budget and scope. It is not the purpose of this report to present exhaustively detailed information. Decisions and discussions are therefore, and to some extent, based on reasonable and informed decisions and assumptions that are extracted from *bona fide* information sources and from deductive reasoning (Precautionary Principle).

⇒ In order to obtain a comprehensive understanding of the dynamics of terrestrial ecological and diversity patterns, with particular reference to endemic, rare, or threatened species in any area, biodiversity assessments should always consider investigations at different time scales (across seasons/years) and through replication. However, such long-term studies are generally not part of the terms of reference for EIA assessments.

⇒ Results presented in this report are based on a snapshot investigation of the study area and not on detailed and long-term investigations of all environmental attributes and the varying degrees of biological diversity that may be present in the study area. Specifically, no discipline-specific, long-term survey methods were used in the collation of data from the site. Although as much as possible data was obtained from opportunistic observations during the brief survey period, these surveys are customarily limited by budgetary and time constraints – results presented in this report need to be interpreted with these limitations in mind.

⇒ Background information that were used to inform and augment the assessment was limited to data and GIS coverage available for the project site on a relevant scale. A paucity of site-specific data is typical of these data sources and should be accepted as a norm.

⇒ Notably, rare and endemic species normally do not occur in great densities and, because of customary limitations in the search and identification of Red Listed species, the detailed investigation of these species was not possible. Results are ultimately based on estimations and specialist interpretation of imperfect data.

⇒ It is emphasised that information, as presented in this document, only have bearing on the sites as indicated on accompanying maps. This information cannot be applied to any other area, however similar in appearance or any other aspect, without proper investigation.

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ACRONYMS & ABBREVIATIONS

Table 37: Acronyms and abbreviations in the report

ADU	Animal Demography Unit, Department of Biological Sciences, University of the Western Cape
BEC	Bathusi Environmental Consulting cc
CBD	Convention on Biological Diversity
CITES	Convention of International Trade in Endangered Species
CR	Critically Endangered
DD	Data Deficient
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EN	Endangered
End	Endemic Species
GIS	Geographic Information Systems
GPS	Global Positioning System (handheld device)
IBA	Important Bird Area
IUCN	International Union for Conservation of Nature
LC	Least Concern
mmasl	Mean Meters Above Sea Level, or m.
NEnd	Near Endemic Species
NT	Near Threatened
Pr.Sci.Nat	Professional Natural Scientist (registered at SACNASP)
SABAP	South African Bird Atlas Project
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
SSC	Species of Special Concern
VU	Vulnerable

GLOSSARY OF TERMS

Table 38: Glossary of terms for the report

Abundance	The quantity, number or amount of a species present in a particular area or sample
Ad hoc	Random, non-sequential, opportunistic observations
Altitude	Expressed as mean meters above sea level (mmasl), or meter (m)
Amphibian	Cold-blooded vertebrate animal of a class that comprises the frogs, toads, newts, salamanders and caecilians
Antelope	Swift running, deer-like ruminant with smooth hair and upward-pointing horns
Anthropogenic	Human induced
Austral	Southern hemisphere
Avifauna	Birds
Biodiversity	Diversity among and within plant and animal species in an environment
Carnivore	Flesh eating animal
Commute	Travel between destinations, normally on a daily basis

Composition	Constituents (animals or plants) of a sample, or area
Conspecific	Animals or plants belonging to the same species
Data Deficient	Species has been categorized (UICN) as offering insufficient information for a proper assessment of conservation status to be made
Density	Number of individuals in a given area
Disjunct	Disjoined or distinct from one another
Diversity	Number of species in a given area
Dominance	The predominance (abundance, numbers) of one or more species in a plant or animal community
Dwarf shrub	A plant that bears hibernating buds on persistent shoots near the ground, usually woody plants with perennating buds borne close to the ground, usually less than 25 centimetres above soil surface
Ecology	The branch of biology that deals with the relations of organisms to one another and to their physical surroundings
Endemic	Restricted to a certain geographic area
Granivore	Animals that eat seeds as the main part of their diet
Herbaceous	Vascular plants that have no persistent woody stems above ground
Herbivorous	Animals that eat plants
Herpetofauna	Amphibians and Reptiles
Hibernate	An animal or plant that spends the winter in a dormant state
Insectivorous	Animals that feed on insects as the main part of their diet
Invertebrate	An animal lacking a backbone, such as an arthropod, mollusc, annelid, coelenterate, etc
Lepidoptera	Butterflies
Mesic	An environment or habitat) containing a moderate amount of moisture
Mammal	A warm-blooded vertebrate animal of a class that is distinguished by the possession of hair or fur, females that secrete milk for the nourishment of the young and (typically) the birth of live young
Nocturnal (animal)	Animals that are active during night periods
Omnivorous	Animals that feed on a variety of foot of both animal and plant origin
Passerine	Relating to or denoting birds of a large order distinguished by having feet that are adapted for perching, including all songbirds
Predator	Animals that naturally preys on other animals, species
Primate	Animals characterized by large brains relative to other mammals, as well as an increased reliance on stereoscopic vision at the expense of smell, the dominant sensory system in most mammals
Putative species	Species that are assumed to exist, or reputed to have existed
Rainfall	Expressed as millimetre (mm)
Red Data	A taxon included in the UICN list of threatened species
Reptile	Tetrapod animals in the class Reptilia, comprising today's turtles, crocodilians, snakes, amphisbaenians, lizards, etc
Rodent	Gnawing mammal of an order that includes rats, mice, squirrels, hamsters, porcupines and their relatives, distinguished by strong constantly growing incisors and no canine teeth. They constitute the largest order of mammals
Scavenger	An animal that feeds on carrion, dead plant material, or refuse materials
Subterranean	Existing, living under the earth's surface
Territorial	The sociographical area that an animal of a particular species consistently defends against conspecifics (or, occasionally, animals of other species). Animals that defend territories in this way are referred to as territorial. Territoriality is only shown by a minority of species.
Temperature	Expressed as Degrees Celsius (°C)
Threatened	Species (including animals, plants, fungi, etc.) which are vulnerable to endangerment in the near future. Species that are threatened are sometimes characterised by the population dynamics measure of critical dispensation, a mathematical measure of biomass related to population growth rate

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⇒ BRAHM (Botanical Research and Herbarium Management System (newposa.sanbi.org, accessed 2020/12/28)
⇒ Field guide to the Orchids of northern South Africa and Swaziland (McMurtry, et. al., 2008)
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⇒ Field guide to Wild Flowers of the Highveld (van Wyk & Malan, 1998)
⇒ Guide to Aloes of South Africa (van Wyk & Smith, 1996)
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⇒ Poisonous plants of South Africa (van Wyk, van Heerden, van Oudtshoorn, 2005)
⇒ Probleem Plante van Suid Afrika (Bromilow, 1996)
⇒ Problem plants and alien weeds of South Africa (Bromilow, 2010)
⇒ Red Data List of southern African Plants (Hillton-Taylor, 1995)
⇒ South Africa's National Listed Invasive Species (www.invasives.org)
⇒ Succulents of southern Africa (Frandsen, 2017)
⇒ The Vegetation of South Africa, Lesotho, and Swaziland (Mucina & Rutherford, 2006)
⇒ Trees and shrubs of Mpumalanga and Kruger National Park (Schmidt, Lotter & McClellan, 2002)
⇒ Wild flowers of Northern South Africa (Fabian & Germishuizen, 1997)
⇒ Wild flowers of the Limpopo Valley (van der Walt, 2009)
⇒ www.sabap2.birdmap.africa

Appendix E5:
Avifauna

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

ENVIRONMENTAL AUTHORISATION FOR THE PROPOSED 100MWP PHOTOVOLTAIC PLANT ASSOCIATED WITH THE TUBATSE FERROCHROME SMELTER, STEELPOORT, FETAKGOMO TUBATSE LOCAL MUNICIPALITY, LIMPOPO.

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
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Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Royal HaskoningDHV			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	2	Percentage Procurement recognition	
Specialist name:	Paul da cruz			
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Professional affiliation/registration:	EAPASA			
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2. DECLARATION BY THE SPECIALIST

I, ________________Paul da Cruz________________, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Royal HaskoningDHV

Name of Company:

11.10.2021

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, ___Paul da Cruz______________________________, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Royal HaskoningDHV

Name of Company

11.10.21

Date

Signature of the Commissioner of Oaths

12/10/2021

Date

CERTIFIED TRUE COPY OF THE ORIGINAL
Malcolm Roods
Commissioner of Oaths
BA(Hons) LLB
(011) 798 6001
PO Box 867, Gallo Manor 2052
21 Woodlands Drive, Woodmead
12/10/2021

REPORT

EIAR Phase Avifaunal Assessment for a 100MWp Photovoltaic Plant at the Tubatse Chrome Smelter, Steelpoort

Client: Samancor Chrome Ltd

Reference: MD5462-ZZ-XX-RP-Z-0001

Status: S0/01

Date: 10/12/2021

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Document title:	EIAR Phase Avifaunal Assessment for a 100MWp Photovoltaic Plant at the Tubatse Chrome Smelter, Steelpoort
Document short title:	Tubatse Solar Avifaunal - EIAR Phase
Reference:	MD5462-ZZ-XX-RP-Z-0001
Status:	01/S0
Date:	10/12/2021
Project name:	Environmental Impact Assessment for the Establishment of a Solar Based Electricity Generation System – 100MWp Photovoltaic Plant at the Tubatse Ferrochrome Smelter, Steelpoort
Project number:	MD5462
Author(s):	Paul da Cruz

Drafted by:	Paul da Cruz
Checked by:	Luke Strugnell
Date:	12-10-2021
Approved by:	Luke Strugnell
Date:	12-10-2021

Classification
Project related

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Executive Summary

Introduction

Samancor Chrome Ltd. has appointed RHDHV to undertake an Environmental Impact Assessment (EIA) Study for the proposed development of a 100MWp[1] Solar Power (Photovoltaic - PV) Generation Facility at the Samancor Tubatse Ferrochrome Smelter in Steelpoort, Limpopo Province. As part of the EIA studies being conducted for the proposed development, the need to undertake a study that assesses the impact of the proposed development on birds has been identified, particularly in the context of PV panel arrays and overhead power lines which could exert an impact on birds in the development area. The current study is being conducted in the Impact (EIAR) phase of the project and follows the avifaunal report compiled for the Environmental Scoping Phase of the project.

Aims of the EIAR-phase Avifaunal Assessment

The aims of the EIAR phase avifaunal study are to:

- Investigate and quantify the occurrence (species composition and relative abundance) of bird species on the study sites and wider study area;
- Assess aspects of bird behaviours on the site, especially relating to movement corridors, breeding of larger species and concentrations of roosting / foraging areas; and
- Detail and assess the impacts of the proposed development components on the birds in the study area.

Project Technical Description

The solar fields comprise of solar PV installations on various properties located around the Tubatse Smelter. The DC to AC transformation takes place at each solar field by means of a containerised inverter/transformer module.

The solar fields connect to the East and West Plant substations by means of power corridors to evacuate the AC power. The power corridors will comprise of overhead lines or underground cables, or a combination thereof, at a voltage level of 33 kV.

The proposed connections onto the East and West Plant Substations will comprise of 33 kV indoor switchgear blocks located next to these substations. The purpose of these blocks would be to collect the feeders from the solar fields and combine them into one or two feeders to be connected onto the existing 33 kV substation infrastructure.

The PV panels are mono or bifacial type with a rating of 560 W each. The panels are arranged on fixed tilt structures with a tilt angle of 23 degrees. The height of the structures is 0,8m. Each site consists of one or more power blocks. The power blocks consist of standard modules consisting 2-rows of 28-panels connected in a series and parallel configuration on support structures. The modules are grouped into power blocks to a capacity of approx. 7 MW DC / 6 MW AC power. The DC wiring of the modules and strings are connected into combiner boxes and into the centralised inverter/transformer in each power block.

The infrastructure required to connect the various solar PV generation sites to the Samancor 33 kV power grid is accommodated in the power corridors. Overhead line or underground cable technology can be used

[1] During the Scoping Phase the capacity of the development was 60MW but was altered to 100MW in the EIAR-phase by the proponent.

for the power evacuation in these corridors. The proposed width of the power corridors is 11m for a single corridor and 22 m in cases where the corridor needs to double up to accommodate the proposed 100 MW power flow. Power lines comprising of a wood pole tower construction is proposed for the 33 kV power lines. In cases where there is a double power corridor, either two wood pole lines will be used or a single steel monopole with a double circuit configuration. The height of the single circuit wood pole construction is 11m-13m and the steel monopoles are typically 20m tall.

General Bird Species Occurrence and Abundance

The study area can be said to support a species composition typical of mesic woodland / savannah that is present over large parts of north-eastern South Africa within the Limpopo and Mpumalanga Provinces. The species composition of the study area is also characterised by certain elements of the more arid woodlands / savannahs that typify the western-central interior of southern Africa, with certain species commonly occurring in the study area being close to the eastern or north-eastern limits of their distributions. The absence of significant waterbodies or wetlands in the study area limits the number and abundance of waterbirds and is related to the presence of the Steelpoort River and a number of artificial waterbodies which support limited number of waterbirds that favour open water with limited waterbird species that are associated with reedbeds and littoral habitats present along the Steelpoort River and at the Tubatse Dam. An important component of the overall species composition, although occurring in generally low densities, is the presence of a handful of raptor species which are at the top of the food chain and act as apex avian predators in the environment of the study area. These raptor species are typically species most-commonly occurring with modified / partly transformed rural habitats in north-eastern South Africa (as opposed to large protected areas).

Of the larger birds present on the site, raptors were noted to comprise a significant portion Raptors are significant in an avifaunal context for a number of reasons. Certain raptor species were listed as being priority species for the site, but with the exception of the Lanner Falcon (*Falco biarmicus*), none of the priority raptor species were recorded on the development sites or in their immediate vicinity. Two sightings of Verreaux's Eagle were recorded while field lists were being compiled for two of the adjacent pentads to the study area. The risk of the solar power PV arrays and the associated power lines affecting this species is thus assessed to be low. A low raptor species diversity was encountered on the development sites and in the wider study area, with a total of six species encountered.

As with the general species assemblage on the site, raptors will be impacted to a certain degree by the loss of habitat in which to forage (hunt). However, the limited related aerial extent of the combined development footprint in a study area and wider context will minimise the significance of the impact in the context of the range and territories of the raptors that inhabit the site. Sufficient natural / modified natural habitat should remain in the wider area to prevent significant impacts on these raptors and is unlikely to have impacts on the development from being able to proceed to be developed.

The potential confirmation of breeding of a pair of Wahlberg's Eagles in close proximity to Site 4 does however have implications for the development, as the maintenance of a buffer than encompasses a certain portion of the solar array footprint on Site 4.

The degradation of the aquatic environment of the Steelpoort Reiver has been likely to limit the suitability of the river for waterbirds and a limited number of true waterbirds were observed along the river. Observations did reveal a number of waterbirds flying along the river and its riparian corridor. The birds were observed flying along the river's course, often in a north-easterly (downstream direction). Such waterbirds were observed flying at relatively low altitude. Observations of the ephemeral watercourse revealed no waterbirds flying along it from the Steelpoort River in the direction of the Tubatse Dam. The CWAC count at the Tubatse

Royal HaskoningDHV

Dam revealed a very low number of waterbirds and species diversity at the dam. The dam is primarily utilised by piscivorous waterbirds that favour open water habitats, with a low species richness and low density of birds. Large numbers of waterbirds are thus unlikely to move between the dam and the Steelpoort River. Due the elevated topographical position of the Tubatse Dam in relation to the Steelpoort Valley floor, any waterbirds moving between the dam and the river are likely to do so at high altitudes in relation to the valley floor and in very small numbers, and thus there would be a relatively low risk of collision of waterbirds associated with the PV solar arrays. The CWAC surveys undertaken at the artificial waterbodies on the sites did not display a high species diversity or large number of birds. Due to the lined nature of these waterbodies and their steep sides, these waterbodies do not provide any suitable habitat for waders and any other species that favour littoral or wetland habitats. Like the Tubatse Dam, the vast majority of birds recorded at these artificial waterbodies were open water species. the waterbodies are utilised as roosting sites by a number of species that are resident in the area, and accordingly these birds will move to and from the waterbodies and thus the new developments could impact the waterbirds utilising the waterbodies.

Occurrence of Priority Species

None of the species identified as priority species in the Scoping-phase avifaunal assessment were recorded in the study area, with the exception of the Lanner Falcon which was recorded on numerous occasions on certain of the development site in both the Scoping- and EIAR-phase field visits. The Verreaux's Eagle was recorded out of the study area, but in sufficiently close proximity to assume that pair(s) would visit the area. Other priority species are likely to be very occasional visitors to the area.

Overall, the impact of the proposed development on the identified suite of priority species is likely to be very low, due to the lack of suitable habitat in the vicinity of the development sites, the high human disturbance / transformation factor and the very occasional nature of occurrences of these species within the study area. In this way the potential presence of priority species is unlikely to have any impact on the ability of the proponent to develop the solar arrays on the five development sites.

Assessment of Impacts

Loss of Habitat

One of the primary impacts associated with the development of a PV-based solar power generation facility is its physical transformation of large areas of natural vegetation – in many cases PV facilities involve the complete removal of vegetation from the inclusive footprint of the installed. It is understood that such an approach would be adopted for the proposed development especially in areas where rocky outcropping or uneven terrain occur. On Site 5, two of the smaller watercourses that drain the site are proposed to be transformed into 4.5m-wide culverts, thus resulting in further habitat loss.

The habitat transformation associated with the clearing of all vegetation could result in a number of impacts on birds, including:

- direct habitat loss which would be particularly significant for species with restricted ranges or very specific habitat requirements,
- habitat fragmentation and/or modification; and
- disturbance / displacement of species (e.g. through construction / maintenance activities).

The nature of the development of solar panels (arrays) on the respective sites entails that all vegetation will be cleared as part of the levelling of the array footprints. Accordingly, the array footprints will become completely transformed, although a pioneer grass layer may subsequently develop under the panels. In this context, and at the scale of each site, the development of the arrays will have a significant impact on the bird assemblage (abundance and species density) on the sites, and most birds that currently occur on the woodland on the sites will no longer be able to inhabit the sites once construction (vegetation clearing) has commenced. At a wider study area scale (i.e. a 2km radius of the development sites), the habitat transformation impact will be less significant, as large parts of the study area will still be characterised by residual woodland habitat, and certain ecological linkages will be retained between the sites if the vegetation clearing is limited to the development footprint.

The nature of the development – split across five different sites entails that the total combined footprint will not form part of one single continuous area but will rather consist of several land parcels in different parts of the study area. The fragmented layout of the development in being split into 5 distinct sites will entail that habitat destruction will be limited to the solar array and ancillary infrastructure footprint, and thus natural habitat will be retained in areas located immediately adjacent to, or between sites. This is an important factor in limiting the impact of the proposed development on avifauna in the study area. Although the numbers of birds will be reduced in the study area through loss of habitat, the retention of intervening areas of natural habitat will reduce the impact of habitat transformation, allowing the bird species composition in the study area to remain similar to pre-development levels provided that vegetation clearing outside of the infrastructure footprint is prevented. The retention of adjacent habitat will also assist in the maintaining of bird movement corridors between residual areas of natural habitat, particularly in the context of the linkage of the large unimpacted areas of natural habitat to the south and south-west of the sites with the Steelpoort River and associated riparian zone.

Collision Impacts

One of the other significant direct impacts relating to the development and operation of solar panel arrays is bird trauma or mortality that is caused by collisions with PV panels, with the possible reasons for collisions being polarised light pollution and/or relating to waterbirds mistaking large arrays of PV panels as wetlands or waterbodies – the so-called “lake effect”. Certain of the arrays are located in close proximity to a number of artificial waterbodies that exist in the vicinity of the Smelter, in particular a cluster of these associated with the water treatment works. a certain assemblage of waterbird species inhabits these artificial waterbodies. The presence of these existing waterbodies in direct proximity to the newly developed solar arrays could arguably exacerbate the potential for waterbirds travelling over the sites to mistake the arrays for water bodies. However, it is important to consider that a relatively small overall number of birds and species diversity inhabit and utilise these water bodies This potential impact is thus not considered to be significant and the potential for large numbers of waterbirds or threatened species to be attracted to the solar arrays through the lake effect is expected to be low.

Construction-related Disturbance and Displacement Impacts

The construction of the solar panel arrays over a large area will be a massive undertaking that will involve bulk earthworks, the removal of vegetation, and in some cases the removal of outcropping or underlying bedrock that could generate significant noise, Noise from human activities (in particular from infrastructure and construction sites) has a strong impact on the physiology and behaviour of birds. This is a temporary impact that will last for the duration of the construction in that particular development site/s but may lead to the temporary displacement of birds and the abandonment of breeding efforts. This would be particularly significant for larger species of birds which occur in lower densities due to the occurrence of large territories.

Wahlberg’s Eagle Nesting Impacts

A potential nest site for a Wahlberg’s Eagle nest was located in close proximity to Site 4 along the ephemeral watercourse that drains from the south. The confirmed presence of breeding at this location was not able to be ascertained due to the timing of the site assessments that were limited by the EIA timeframes and it remains unknown whether the pair is actively nesting and egg-laying at this site.

If breeding was occurring at this site, breeding activities in the next (spring 2022) or subsequent breeding seasons could be adversely affected if Site 4 is developed. Although the Wahlberg's Eagle is not a threatened species, it is an apex predator in the context of the site and the disturbance of breeding is potentially significant. The nest site is located 220m from the closest part of the Site 4 boundary and 230m from the closest proposed solar arrays on Site 4. The construction of the solar arrays in particular could cause breeding at the next site to be abandoned due to the high level of noise associated with construction activities, especially vegetation clearing and site levelling and the erection of the arrays. The sensitivity of this species to disturbance in the vicinity of the nest site is unknown, however it must be assumed that as eagles, the pair would be sensitive to such disturbance to a certain degree. Accordingly mitigation measures have been specified in this context. Due to the degree of uncertainty associated with the nest site and the occurrence of nesting at this location It is accordingly important that the potential presence of the breeding at the suspected nest site be confirmed prior to construction, in order to determine what mitigation measures need to be applied.

Power Line-related Impacts

The power line alignment for the various sites has been refined and altered by the engineering design team since the Environmental Scoping phase as part of the concept design that has been undertaken in advance of the EIAR-phase of the project. The various power line corridors traverse different areas in joining the development sites and associated solar PV panel arrays with the two substations located at the Smelter. Certain sections of the proposed power line corridors would pose a greater risk of bird-related impacts. The Site 5 power line connects to the solar array in immediate proximity to the stormwater dam that is located to the north of the R555 road and the smelter. The stormwater dam forms one of a number of artificial waterbodies that are clustered in relatively close proximity, including the settling ponds associated with the water treatment works and the brine dams. To the south of the R555 the power line would also run in very close proximity to two brine dams. Although all of these waterbodies are artificial, they attract a certain assemblage of waterbirds. The Site 4 power line would need to span the watercourse that drains northwards between Sites 3 and 4. The proposed Site 4 power line is not proposed to continue to run in parallel to the existing power lines, rather being diverted to the south-west before bending sharply northwards to run in parallel to the boundary of Site 4. A bend tower would accordingly need to be placed within the riparian zone of the watercourse, very close to the channel A power line crossing this watercourse could exert a greater risk of collision impact.

Mitigation Measures

Wahlberg's Eagle Nest Location

It is very important for the presence of breeding at the nest location during the current (2021-2022) breeding season to be confirmed. Accordingly it is recommended that an avifaunal specialist undertake monitoring of the nest location and in the wider study area to determine the presence of breeding at this location, or at any other nesting sites within the study area. This monitoring of the nest site must continue (as part of the general recommended pre-, during- and post-construction (operational) avifaunal monitoring on the development sites and wider study area) for each subsequent year in which construction occurs.

Should breeding be confirmed at the suspected nest location, the following mitigation measures are recommended:

- A 350m buffer of the nest site in which no development should occur is recommended; 350m is the distance of southern part of the truck depot from the nest location, and which the pair appears to tolerate human activity. This would result in the restriction of a portion of the Site 4 solar arrays not being developed.

- The highest risk of impact on breeding would be related to high noise construction activities. The impact of the construction activities on Site 4 would not be an issue if construction of Site 4 and Site 3 (the closest development sites to the nest location) were to occur during the periods in which Wahlberg's Eagles are not present within South Africa – i.e. the period between April and August. Accordingly the construction of the arrays on Sites 3 and 4, in particular the early phases of construction (i.e. vegetation clearing, earth levelling, any required bedrock extraction / blasting, and other noisy activities including road construction and erection of large structures must be timed to occur during the months of April to August when the species is not present or has completed breeding.

Even if breeding does not occur at the nest location, the following mitigation measure must be adhered to:

- The watercourse and its associated riparian zone, especially the reach to the south-east of Site 4 must be maintained as a no-go area that must not be affected by any construction activities or plant / people access during construction, except for the stringing activities for the construction of the proposed power line. Access to the riparian zone of the watercourse must be directly prohibited through the erection of fencing.

Power Line-related Mitigation

A number of impacts, and thus priority spans of the proposed power line alignments have been identified that are associated with a higher risk of potential avifaunal impacts, in particular collision-related impacts. The following mitigation measures are specified for certain power line spans / sections on the development site:

- **Site 1 power line in the section between the R555 and the north-western edge of the Steelpoort residential area**: unless there are clear technical reasons not to do so, the proposed power line must be aligned to run parallel to the existing power line that is aligned along the western edge of the residential area. This measure will reduce fragmentation of natural habitat that would result, will place the power line where an existing power line to which birds are accustomed is present, will avoid a new crossing of the watercourse and resultant destruction of sensitive riparian habitat, and will place the power line closer to a transformed urban area which will minimise the potential impact on birds.
- **Site 5 power line located to the north of the R555 road**: the section of the Site 5 power line located to the north of the R555 road must be changed to be underground cabling. If this is technically-not feasible or prohibitively expensive, then the spans of the power line located to the north of the R555 road must be fitted with bird diverter devices.
- **Site 5 power line located to the south of the R555 road**: Due to the presence of a brine dam located to the south of the R555, adjacent to which the power line is proposed to be aligned, the spans of the power line located adjacent to, and within 200m of the edge of the brine dam must be fitted with bird diverter devices.
- **Site 4 power line located to the east of Site 4 that crosses the watercourse**: the current alignment of the Site 4 power line would necessitate the placement of a bend tower within the riparian zone of the watercourse crossed and very close to the channel of the watercourse, resulting in unnecessary disturbance of sensitive riparian habitat along an important bird movement corridor. Accordingly, the proposed power line must be realigned to firstly span the watercourse in one span and to run adjacent to one of the two power lines that span the watercourse in this area. Ideally design and engineering should consider piggybacking the proposed power line on one of the existing lines that cross the watercourse to avoid the further impacting of the riparian zone of the watercourse at this location.

Protection of residual Woodland

In order to protect the habitat integrity of the Steelpoort River riparian zone on the southern bank of the river, as well as that of the watercourse located between the river and the R555 road, these areas, and the other areas of remnant woodland vegetation must be included within the fenced off footprint of the arrays.

- The riparian zone of the Steelpoort River located to the north of Site 5
- The riparian zone of the watercourse and flanking woodland located between Site 4 and the HH waste disposal dam and Site 3
- The watercourse and riparian zone that bisects Site 5
- Remnant woodland between the R37 link road and the solar panel arrays on Site 1
- Remnant woodland located between the northern boundary of Site 2 and the rail shunting yards
- The watercourse located immediately west of Site 2

Recommended Monitoring Regime

It is advised that monitoring be conducted in the pre-construction and post construction phases of the project as detailed below:

Pre-Construction:

Pre-construction monitoring on the site must be focussed on the conformation of the active use of the Wahlberg's Eagle nest near Site 4. It is thus very important for the presence of breeding at the nest location during the current (2021-2022) breeding season to be confirmed. Accordingly it is recommended that an avifaunal specialist undertake monitoring of the nest location and in the wider study area to determine the presence of breeding at this location, or at any other nesting sites within the study area. It is recommended that monitoring is conducted in the early summer of 2021 /22 to confirm whether the nest site is being used, and in the latter stages of the nesting period to determine the success or otherwise of breeding.

This monitoring of the nest site must continue (as part of the general recommended pre-, during- and post-construction (operational) avifaunal monitoring on the development sites and wider study area) for each subsequent year in which construction occurs.

During Construction:

Should any part of construction at Sites 3 and 4 be undertaken during the period of Wahlberg's Eagle breeding (September to March), the nest site and any other nest sites located must be monitored in the manner described above.

Post Construction (Operation):

Operational Monitoring must be undertaken and focus on the following aspects / areas on the development site and wider area:

- Breeding at the Wahlberg's Eagle nest site must be undertaken during the species' breeding period in order to determine how the presence of the development affects breeding.
- Assessment of habitat loss on bird species richness and relative abundance must be undertaken through the application of the same data collection and observation techniques as were applied in the EIAR-phase field assessments. Surveys conducted twice a year in the first two years of operation must be conducted as a minimum.
- Quantifying bird mortalities – Regular searches for carcasses of any bird fatalities associated with the operational solar facility must be undertaken, by an avifaunal specialist or a suitably qualified ECO. Search focus must be directed at the areas / components of the development highlighted as high risk for collisions, including all new power line alignments, the arrays in the vicinity of the

existing water bodies on the site, and the arrays located closest to the Steelpoort riparian corridor. The methods detailed in the BLSA Guidelines must be applied.

Conclusion

The avifaunal assemblage in the study area has been studied and assessed, and it can be concluded that the development of the solar facility will not have highly significant impacts on the avifaunal environment in a wider study area context despite more significant localised impacts. The exclusion of certain sensitive areas from the development footprint, especially the riparian corridors on the site is a critical mitigation measure that in association with the active protection of these and other areas of residual woodland on the development sites will minimise the impacts of habitat loss and which will ensure that habitat connectivity is maintained.

A series of mitigation measures have been stipulated, and provided these are implemented, the development can proceed without resulting in significant impacts on the avifaunal assemblage on the site, in particular on priority species and other sensitive species such as raptors.

Specialist Declaration

I, Paul da Cruz, declare that I –

- act as a specialist consultant in the field of avifaunal assessment
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2010; and
- will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not.

Acronyms

Acronym	Acronym description
AC	Alternating Current
A.m.s.l.	Above mean sea level
BARESG	Birds and Renewable Energy Specialist Group
BESS	Battery Energy Storage System
BLSA	BirdLife South Africa
CAR	Coordinated Avifaunal Roadcounts Project
CBA	Critical Biodiversity Area
CWAC	Coordinated Waterbird Counts Project
DC	Direct Current
DFFE	Department of Forestry Fisheries and the Environment (formerly DEFF / DEA)
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
ESA	Ecological Support Area
EWT	EWT – Endangered Wildlife Trust
IBA	Important Bird Area
IPP	Independent Power Producer
ITCZ	Intertropical convergence zone
IUCN	International Union for the Conservation of Nature
LCPv2	Limpopo Conservation Plan v2
MAP	Mean Annual Precipitation

MWp	Mega Watt Peak
PV	Photovoltaic
SANBI	South African National Biodiversity Institute
SABAP1/2	Southern African Bird Atlas Project 1 / 2
SP	Significance points

Glossary

Glossary Term	Glossary Text
Accipter	Family of raptors, including goshawks and sparrowhawks.
Avifauna	The birds of a particular region, habitat, or geological period.
Azonal	A type or class of vegetation with physical and vegetative characteristics that are a response to localised edaphic (soil related) factors such as volumes and duration of activation of water and salts, rather than to macroclimatic and geological patterns on a landscape level, that would normally be the determining factors for vegetation community development. In such cases the stresses and problems that plants would encounter in a wetland or saltmarsh environment, for example, are sufficiently unique and in some cases so extreme that only highly adapted species that are sufficiently enabled to deal with those stresses and problems are encountered in these environments, thus forming their own typical vegetation composition.
Earthing Wire	Wire at the top of power line towers not connected to the conductors.
Ecotone	A narrow and relatively sharply defined transition zone between two different communities. Ecotones are typically species rich.
Endemic (Endemism)	Species whose normal breeding and non-breeding ranges are entirely within a certain region – in this report endemism refers to southern Africa.
Frugivore	A bird that primarily feeds on fruit.
Granivores	Birds that feed on grains and seeds.
Herbaceous	A plant having little or no woody tissue and persisting usually for a single growing season.
Intertropical Convergence Zone (ITCZ)	An area where the Northern and Southern Hemispheric trade winds converge, usually located between 10 degrees North and South of the equator. It is a broad area of low pressure where both the Coriolis force and the low-level pressure gradient are weak, occasionally allowing tropical disturbances to form. It fluctuates in location, following the sun's rays, so that during the Southern Hemisphere summer, the ITCZ moves southward over southern Africa.
Intra African	A migrant that visits southern Africa from other parts of Africa.

Macrophyte (Macrophytic)	An aquatic plant that grows in or near water. Macrophytic plants can be emergent, submerged, or floating.
Mesic	Relating to an environment or habitat containing a moderate amount of moisture, as opposed to xeric (arid) or hydric environments.
Microphyllous	Referring to plants and trees with small leaves, as opposed to broad-leafed plants. A microphyll is termed as a leaf 25-75mm long.
Migrant	In a southern African avifaunal context, birds that typically visit the subcontinent, usually in the summer months, spending the southern hemisphere winter in other parts of Africa (Intra-African migrant) or the Palaearctic.
Passerine	Largest order of birds, which are characterised by feet adapted for perching (three toes forward-facing and 1 backward facing).
Palaearctic	Zoogeographical region that incorporates Europe, northern Asia and northern Africa.
Piscivorous	Fish-eating.
Raptor	A bird of prey, e.g., eagle, buzzards, falcons, etc.
Red Data species	Species whose continued existence is threatened. Red Data Book species are classified into different categories of perceived risk.
Riparian Zone	the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.
Sward	Cover of grassy vegetation within a grassland.
Understorey	The part of the forest / woodland which grows at the lowest height level below the canopy.

1 Introduction

Samancor Chrome Ltd. has appointed RHDHV to undertake an Environmental Impact Assessment (EIA) Study for the proposed development of a 100MWp Solar Power (Photovoltaic - PV) Generation Facility at the Samancor Tubatse Ferrochrome Smelter in Steelpoort, Limpopo Province. As part of the EIA studies being conducted for the proposed development, the need to undertake a study that assesses the impact of the proposed development on birds has been identified, particularly in the context of PV panel arrays and overhead power lines which could exert an impact on birds in the development area. The current study is being conducted in the Impact (EIAR) phase of the project and follows the avifaunal report compiled for the Environmental Scoping Phase of the project.

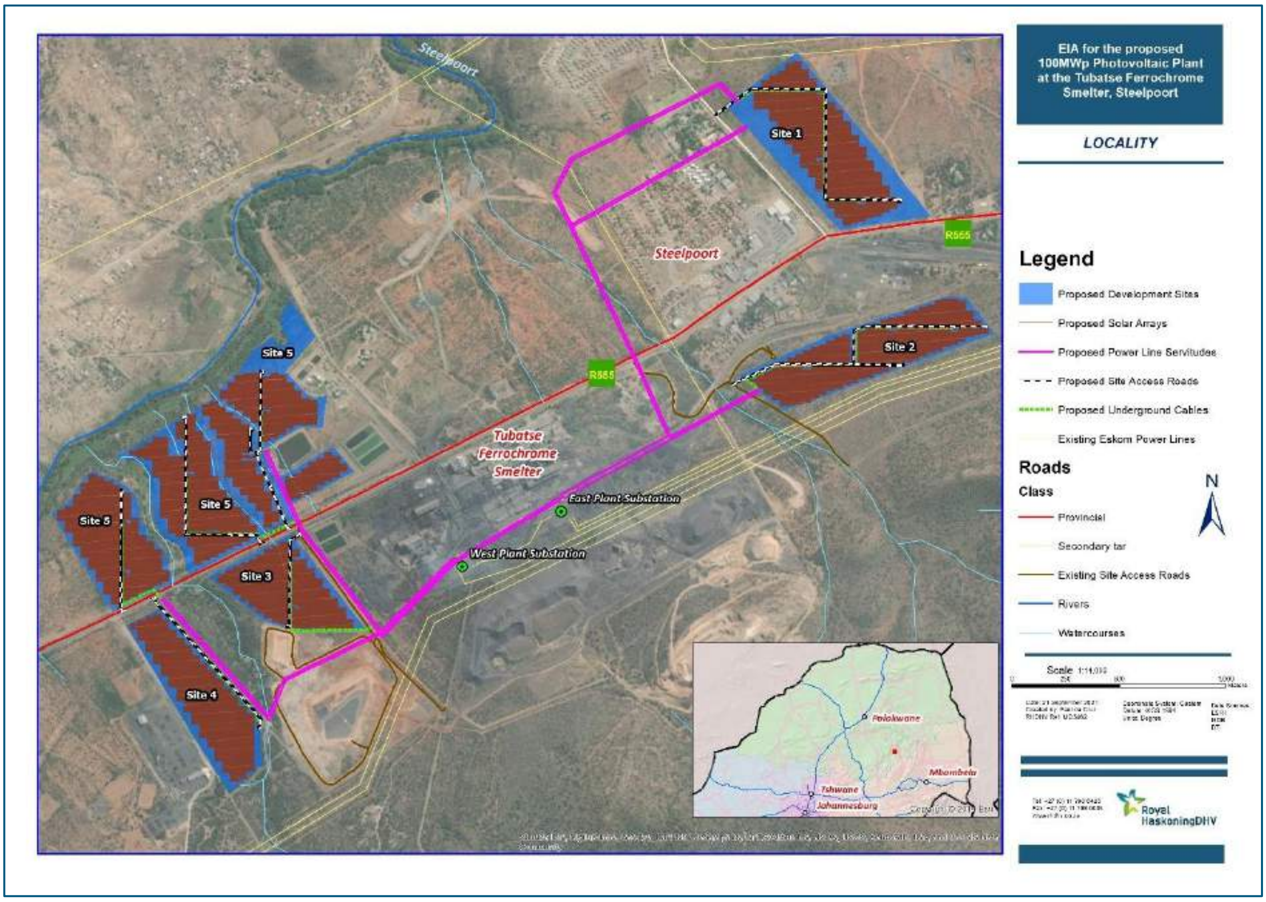

Figure 1 - Locality and layout of proposed development components

1.1 Aims of the EIAR-phase Avifaunal Assessment

The aims of the EIAR phase avifaunal study are to:

- Investigate and quantify the occurrence (species composition and relative abundance) of bird species on the study sites and wider study area;
- Assess aspects of bird behaviours on the site, especially relating to movement corridors, breeding of larger species and concentrations of roosting / foraging areas;
- Detail and assess the impacts of the proposed development components on the birds in the study area;

- Outline all mitigation measures related to the impacts identified; and
- Outline further pre-construction and post construction assessment and monitoring.

1.2 Assumptions and Limitations

This avifaunal assessment has complied with the BirdLife South Africa Birds and Solar Energy Guidelines as far as possible (refer to Section 2.2). It should be noted that the guidelines stipulate that for solar development sites which are assessed as medium-level sensitivity, the Regime 2 level of assessment should be undertaken. The Regime 2 stipulates that a minimum of two site assessments should be undertaken, with one timed to occur during the seasonal period of maximum bird occurrence on the site. Due to EIA timeframe restrictions, a summertime (rainy season) assessment could not be undertaken, and accordingly the two EIAR phase site visits were planned to be a winter and spring site visit. Due to constraints beyond the control of the author, the winter site visit could only be undertaken in early September, with the spring site visit timed to occur as late as possible, in the last week of September.

However two scoping-phase site visits were undertaken in early April in which bird occurrence was recorded and assessed, and accordingly these allowed a more representative seasonal assessment of bird occurrence on the sites to be acquired. Accordingly the inability to undertake a mid-summer assessment is a partial limitation, but it is not anticipated to be a significant limiting factor in the ability of the assessment to assess avifaunal impacts associated with the proposed development.

On the final day of the second EIAR-phase assessment suspected nesting site of a pair of Wahlberg's Eagles (*Hieraaetus wahlbergi*) was located to the south of Site 4. It is strongly suspected that the pair were preparing to nest at this location, but to EIA timeframes the site has not been able to be revisited to confirm the presence of breeding / nesting at this site. The Wahlberg's Eagle, although not identified in the Scoping-phase avifaunal study as a priority species as it is not threatened, is an important avian predator in the context of the study area and impacts associated with the development on an actively breeding pair would be locally significant. Mitigation measures have been specified on the basis that the pair is actively breeding at this location; however it has been recommended that further pre-construction monitoring to ascertain the presence of breeding of the pair be undertaken during the current (2021/22) breeding season to have further confidence in the specification of associated mitigation measures.

2 Legislative and Policy Context

2.1 Compliance of Report with Appendix 6 of the EIA Regulations

Table 1 below outlines the stipulations of with Appendix 6 of the EIA Regulations and the relevant sections of this report. Appendix 6 of the Regulations outlines the content that all specialist reports prepared in support of EIAs should contain.

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Table 1 – Compliance of the Scoping-phase Avifaunal Report with Appendix 6 of the EIA Regulations

Section of Appendix 6	Stipulation:	Relevant Section of the Report
1a	A specialist report prepared in terms of these Regulations must contain— (a) details of— (i) the specialist who prepared the report;	Title page
1a	A specialist report prepared in terms of these Regulations must contain— (a) details of— (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix A
1b	A specialist report prepared in terms of these Regulations must contain— a declaration that the specialist is independent in a form as may be specified by the competent authority;	Specialist Declaration (pg. 1)
1c	A specialist report prepared in terms of these Regulations must contain— an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1. Aims of the EIAR-phase Avifaunal Assessment.
1cA	A specialist report prepared in terms of these Regulations must contain— an indication of the quality and age of base data used for the specialist report;	Section 3.2 – Site Assessment and Data collection
1cB	A specialist report prepared in terms of these Regulations must contain— -a description of existing impacts on the site, -cumulative impacts of the proposed development, and -levels of acceptable change;	Section 6: Bird Species Occurrence on the Development Sites Section 7.6 – Cumulative Impacts Section 7: Impact Assessment
1d	A specialist report prepared in terms of these Regulations must contain— the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 3.2 – Site Assessment. Section 1.2 – Assumptions and Limitations
1e	A specialist report prepared in terms of these Regulations must contain— a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 3 – Methodology for Assessment.
1f	A specialist report prepared in terms of these Regulations must contain—	Section 6.5 – Refined Sensitivity Assessment

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Section of Appendix 6	Stipulation:	Relevant Section of the Report
	details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	
1g	A specialist report prepared in terms of these Regulations must contain— an identification of any areas to be avoided, including buffers;	Section 8 – Mitigation Measures
1h	A specialist report prepared in terms of these Regulations must contain— a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 6.5 – Refined Sensitivity Assessment
1i	A specialist report prepared in terms of these Regulations must contain— a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.2. – Assumptions and Limitations.
1j	A specialist report prepared in terms of these Regulations must contain— a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 6 – sub-sections on implications for development
1k	A specialist report prepared in terms of these Regulations must contain— any mitigation measures for inclusion in the EMPr;	Section 8 – Mitigation Measures
1l	A specialist report prepared in terms of these Regulations must contain— any conditions for inclusion in the environmental authorisation;	Section 9 – Conclusion
1m	A specialist report prepared in terms of these Regulations must contain— any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 8.4 – Recommended Construction and Operational Avifaunal Monitoring -
1ni)	A specialist report prepared in terms of these Regulations must contain— a reasoned opinion— whether the proposed activity, activities or portions thereof should be authorised;	Section 9 – Conclusion
1niA)	A specialist report prepared in terms of these Regulations must contain—	

Section of Appendix 6	Stipulation:	Relevant Section of the Report
	a reasoned opinion— regarding the acceptability of the proposed activity or activities;	
1nii)	A specialist report prepared in terms of these Regulations must contain— a reasoned opinion - if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 9 – Conclusion
1o	A specialist report prepared in terms of these Regulations must contain— a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
1p	A specialist report prepared in terms of these Regulations must contain— a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A – refer to 1o above.
1p	A specialist report prepared in terms of these Regulations must contain— any other information requested by the competent authority.	N/A – no such information has been requested by the competent authority.

2.2 BirdLife South Africa Birds and Solar Energy - Best Practice Guideline

The solar energy industry as a renewable power generation source is expanding rapidly in southern Africa, however experiences in other parts of the world suggest that, like many other energy sources, solar power may affect birds in different ways, through the alteration of habitat, the displacement of populations from preferred habitat, collision and burn mortality associated with elements of the solar hardware and ancillary infrastructure. It is important to note, however that the nature and implications of these effects are poorly understood.

In order to fully understand and successfully avoid and minimise the possible negative impacts of solar energy on the region's birds, it is essential that sufficient, project- and site-specific data are gathered to both inform the avifaunal impact assessment process and build the scientific birding community's understanding of the impacts and potential mitigation measures (Jenkins *et al,* 2017).

Accordingly, the Birds and Renewable Energy Specialist Group (BARESG), convened by BirdLife South Africa and the Endangered Wildlife Trust (EWT) has developed a set of guidelines and monitoring protocols for evaluating utility-scale solar energy development proposals. The guidelines are aimed at environmental assessment practitioners, avifaunal specialists, developers and regulators and propose a tiered assessment process, including a number of different tiers of assessment and monitoring (Jenkins *et al,* 2017):

- Preliminary avifaunal assessment
- Data collection
- Impact Assessment
- Monitoring

The guidelines detail the recommended means and standards required to achieve the following aims:
a) To inform the current environmental impact assessment processes.
b) To develop the collective understanding of the effects of solar energy plants on southern African birds.
c) To identify the most effective means to mitigate these impacts.

A gradient of survey and monitoring requirements for avifaunal studies is recommended by the guidelines based on the proposed technology, size of footprint, the amount of available data, and the estimated sensitivity of the receiving environment (refer to Figure 2). The assessment and monitoring regime adopted is dependent on the level of sensitivity of the study area, as determined through the preliminary avifaunal assessment.

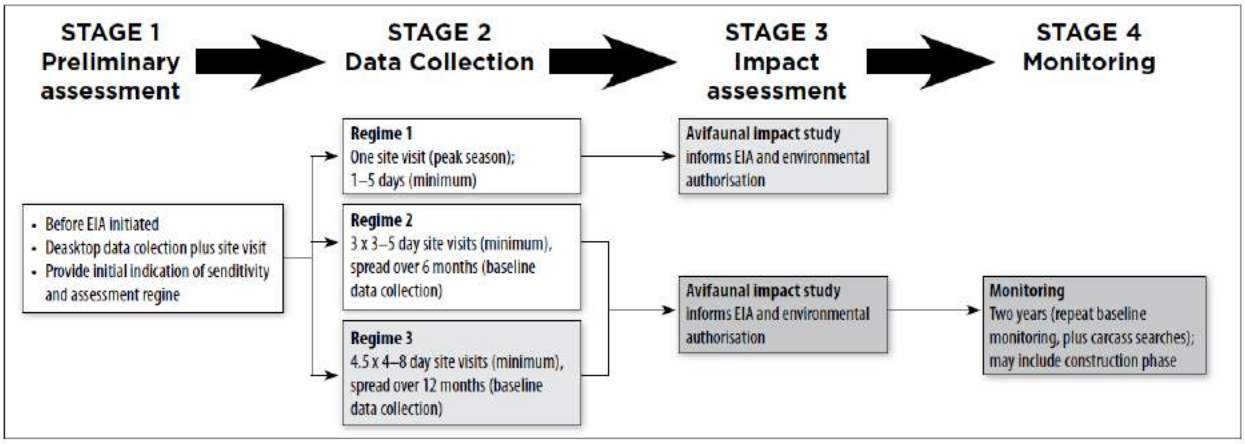

Figure 2 - Recommended multi-tier process for assessing the potential and realised impacts of proposed solar energy developments in South Africa (Jenkins et al, 2017)

The guidelines have been followed in the compilation of this report, as detailed in Section 3.

3 Methodology for Assessment

The EIAR-phase avifaunal assessment has primarily been undertaken as a field-based assessment, supported by desktop-based analysis of existing datasets. The methodology for conducting the study is detailed below.

This avifaunal assessment has attempted to comply with the BirdLife South Africa Birds and Solar Energy Guidelines as far as possible (refer to Section 2.2 above). The guidelines stipulate that the data collection and field assessment should be undertaken during the season of peak bird occurrence in the study area. Due to EIA timing restrictions this was not possible, as this season is expected to be mid-to late summer. The methodology outlined below complies as far as possible with the methodology outlined in the Best Practice Guidelines.

3.1 Site Assessment and Data Collection

As per the BLSA Birds and Solar Energy Guidelines for sites displaying a moderate level of avifaunal assessments two separate site assessment visits were conducted to the study area. These were planned as a mid-winter and early spring site visit, but due to budget approval restrictions, the mid-winter site visit had to be postponed to early September and the second site visit was conducted in the last week of September.

The field assessments consisted of a number of components, to achieve the objectives of the EIAR-phase assessment as detailed below:

- **SABAP2 field list compilation** – As described in the Avifaunal Scoping Report, the development sites are located over two pentads, with the majority of the development sites being located in the pentad 2440_3010. The SABAP2 protocol was followed for each of the two pentads for each EIAR phase site visit. In this way bird occurrence on the development sites was captured through the checklist approach.
- **Walked Transects and Fixed-Point Observations** – Walked Transects and Fixed-Point Observations were undertaken across the development sites. The observations were conducted by the author (one person). Birds were both visually identified and by call. A total of 32 fixed point-based or transect-based monitoring sites were pre-selected used to collect data on bird species occurrence over the five sites

(refer to Figure 3). The highest number of such transects and fixed points were selected on Site 5, due to this being the largest of the development sites. Although a mix of fixed-point monitoring and transects was preferred for all sites, on the sites characterised by dense woodland, walked transects were deemed to be less effective and more fixed-point observations were undertaken. In order to provide a baseline against which construction and post construction (operational) avifaunal monitoring results could be compared with the pre-construction data, for each of the sites one or more off-site transects or fixed-point monitoring sites (i.e. locations outside of the proposed development footprint) was selected to allow data to be collected from areas close to the development, but undeveloped once the development has commenced. These can be used as control site in future if required. A set protocol was followed whereby each bird / group of birds was recorded during the period in which the transect was walked or within a 15-minute observation period at each fixed point, including the distance of the bird(s) within a pre-set series of distance bands, the number of birds observed, sex and age (if able to be determined) and bird behaviour. Data was then captured electronically for use and analysis.

- **CWAC Waterbird Counts at Waterbodies** – The Co-ordinated Waterbird Counts (CWAC) protocol[2] was utilised (i.e. CWAC cards were populated) to gather data regarding waterbird species composition and numbers at two locations where waterbodies that were identified as being potentially significant for waterbird occurrence and movement are present in the study area. CWAC counts were undertaken at the Tubatse Dam and at the artificial waterbodies clustered in and around the Water Treatment Works at the Smelter.
- **Incidental Observations** – Incidental observations of bird occurrence and specially bird behaviours were conducted. Incidental observations were conducted at the Steelpoort River in order to understand bird movements along the river. A series of night-time (post-dusk) observations were conducted in order gain an understanding of the assemblage of nocturnal birds present on the sites. The use of a spotlight was used to locate birds by sight, and all calls of all nocturnal species were recorded. All raptor sightings were recorded with the GPS location of the sighting.
- **Power line Walkdowns** – Power line walkdowns of as many of the existing power line servitudes in the vicinity of the sites were undertaken in order to check for bird carcasses as a result of fatalities (electrocutions or collisions with overhead lines). This included the power lines to the south of Site 2 and stretches of the same power lines located to the south of Sites 3 and 4, the power lines to the north of Site 1 and on Site 1, the power line aligned parallel to the eastern site boundary of Site 4, certain power lines on Site 5 and several power line servitudes that cross the watercourse between Sites 3 and 4.

3.2 Identification and Assessment of Bird Species Occurrence and Relative Abundance in the Study Area

The data collected during the field assessments was collated and analysed in order to determine the patterns and status of bird species occurrence and relative abundance across the study area and on the five respective development sites. The species recorded during the EIAR-phase field assessments were added to the study area bird species list. In addition the latest SABAP2 datasets for the study area were analysed to determine occurrence and to analyse reporting rates for the recorded species, in particular priority species.

The implications of the trends of bird species diversity and abundance for the development were analysed and discussed.

[2] *No CWAC sites are located in the immediate vicinity of the development sites or wider study area.*

3.3 Identification of Issues and Impacts, and Mitigation

All identified impacts delating to the proposed development of the solar power plant and associated infrastructure, in particular power lines, were assessed in detail. Where necessary impacts were examined at the level of a certain group of birds (i.e. waterbirds, raptors and priority species) and in some case in the context of a particular species.

Based on the assessment of impacts, a detailed requisite set of mitigation measures have been detailed. This includes recommendations for further monitoring.

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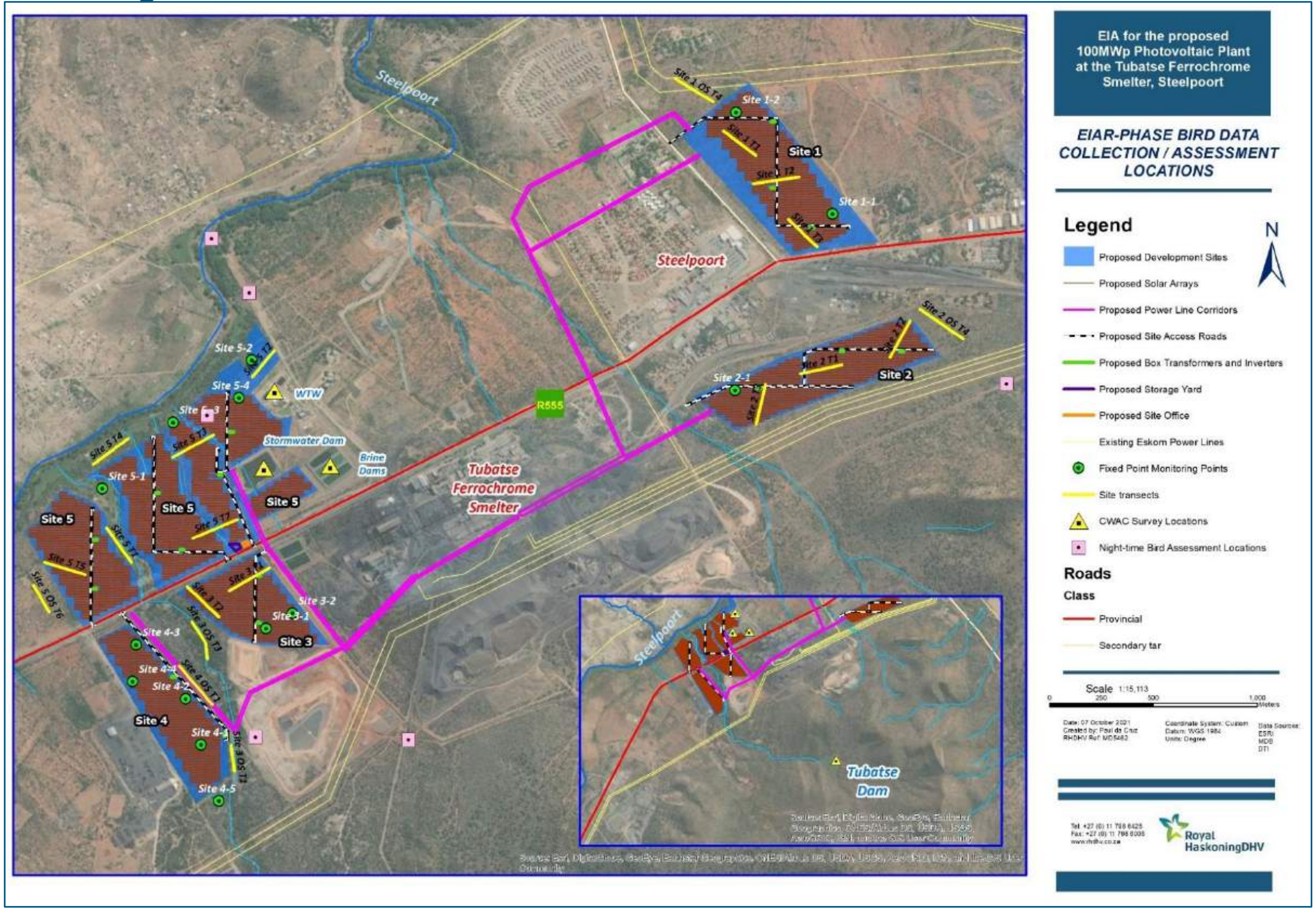

Figure 3 – EIAR-phase bird data collection and assessment locations

4 Project Technical Description

The solar fields comprise of solar PV installations on various properties located around the Tubatse Smelter. The DC to AC transformation takes place at each solar field by means of a containerised inverter/transformer module.

The solar fields connect to the East and West Plant substations by means of power corridors to evacuate the AC power. These corridors are indicated on the figure above. The power corridors will comprise of overhead lines or underground cables, or a combination thereof, at a voltage level of 33 kV.

The proposed connections onto the East and West Plant Substations will comprise of 33 kV indoor switchgear blocks located next to these substations. The purpose of these blocks would be to collect the feeders from the solar fields and combine them into one or two feeders to be connected onto the existing 33 kV substation infrastructure.

The PV panels are mono or bifacial type with a rating of 560 W each. The panels are arranged on fixed tilt structures with a tilt angle of 23 degrees. The height of the structures is 0,8m. Each site consists of one or more power blocks. The power blocks consist of standard modules consisting 2-rows of 28-panels connected in a series and parallel configuration on support structures. The modules are grouped into power blocks to a capacity of approx. 7 MW dc / 6 MW AC power. The DC wiring of the modules and strings are connected into combiner boxes and into the centralised inverter/transformer in each power block.

The infrastructure required to connect the various solar PV generation sites to the Samancor 33 kV power grid is accommodated in the power corridors. Overhead line or underground cable technology can be used for the power evacuation in these corridors. The proposed width of the power corridors is 11m for a single corridor and 22 m in cases where the corridor needs to double up to accommodate the proposed 100 MW power flow. Power lines comprising of a wood pole tower construction is proposed for the 33 kV power lines. In cases where there is a double power corridor, either two wood pole lines will be used or a single steel monopole with a double circuit configuration. The height of the single circuit wood pole construction is 11m-13m and the steel monopoles are typically 20m tall.

4.1 Site Location and Description

The Study Area is located within the Steelpoort River Valley within the south-eastern part of the Limpopo Province located close to the provincial border with Mpumalanga Province. The Steelpoort Valley is an area characterised by a mix of intensive mining / industrial activities and rural human settlements. The five development sites are centred around the small settlement of Steelpoort and the nearby Tubatse Ferrochrome Smelter. The R555 provincial road linking the towns of Middelburg and Stoffberg to the south-west and Burgersfort and Ohrigstad to the north-east runs along the valley and close to the development sites.

The wider study area is accordingly a mix of rural and industrial character, with areas of natural character occurring in the hills flanking either side of the valley. The study area is indicated in the map in Figure 1 and Figure 3.

5 Summary of Scoping-phase Avifaunal Findings

In order to contextualise the methodology and findings of the EIAR-phase assessment, it is important to summarise the key findings of the Scoping-phase avifaunal assessment.

5.1 Habitats for Birds in the Study Area

Due to a mix of land use and land cover, combined with terrain present in the study area, there are a mix of habitats that occur in the study area. The spatial distribution of habitat types is shown in Figure 3.The habitat types are:

- **Woodland (bushveld)**

Woodland (Bushveld) is the predominant *natural* habitat type in the study area. Woodland micro-habitats differ across the study area and across the site. Four woodland micro-habitats occur:

- thicket in rocky (‘rugged’) terrain
- open woodland on sandy soils
- tall woodland on sloping ground
- dense riparian thickets

- **Rivers, Watercourses and Riparian Habitat**

The Steelpoort River is the primary drainage feature in the study area. It is a perennial river, rising in the area to the north of Middelburg. The Steelpoort River as the primary river (drainage feature) in the wider area is likely to be a locally important bird movement corridor. The movement corridor is likely to be a flyway for certain species (especially waterfowl) and for smaller passerines that will move along its riparian corridor. A watercourse drains into the Steelpoort Valley from the hilly terrain to the east, draining to the east of Site 4 and west of Site 3 and draining across Site 5. Although being a seasonal or ephemeral watercourse, it is characterised by a distinct, but narrow riparian zone characterised by larger trees than the surrounding woodland. Although not as distinct and significant as the riparian zone of the Steelpoort River, this watercourse’s riparian zone acts as an important movement corridor for birds, linking the Steelpoort River and the hilly terrain to the east in a context of fragmentation of the woodland habitat in the area. Other watercourses are present close to the development sites, including a smaller watercourse to the south of Site 1 and a smaller watercourse that drains into the Steelpoort River in the northern part of Site 5.

Other habitat types include:

- Other waterbodies – including the Tubatse Dam located to the south of the development sites and the Smelter in hilly terrain and several artificial ponds settling dams in the vicinity of the Smelter.
- Cleared areas / formerly cultivated land.
- Other anthropogenic habitats (e.g. structures, power lines, urban developments).

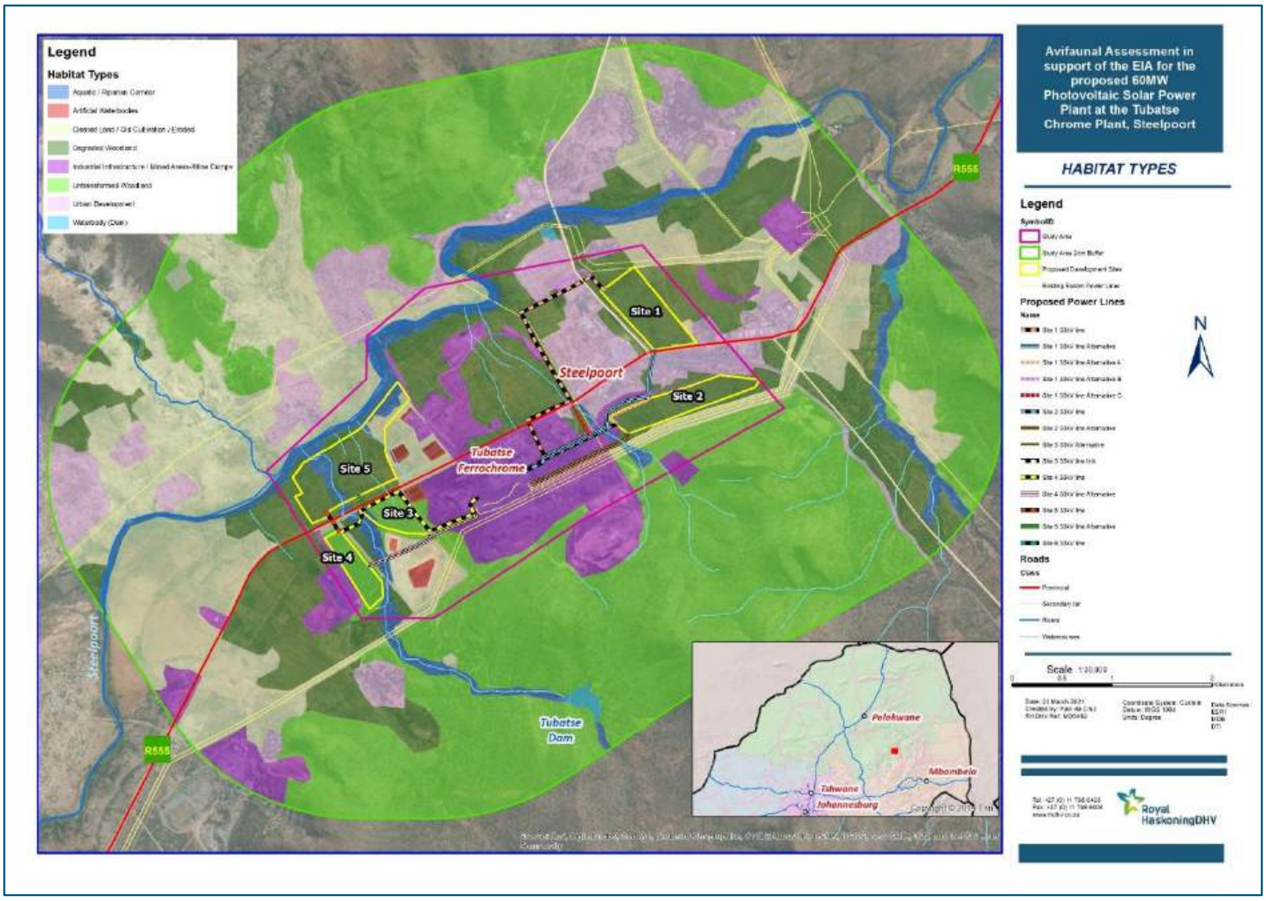

Figure 4 – Habitat Types in the wider Study Area

5.2 Assessment of Avifaunal Sensitivity

The overall avifaunal sensitivity of the study area needs to be determined for a number of reasons, including the need to determine the level of assessment and assessment regime required for the development that will be undertaken in the EIAR-phase of the development. According to the BirdLife South Africa Birds and Solar Energy Guidelines the overall sensitivity of the receiving environment to the avifaunal impacts of solar energy development is essentially a function of the number of priority species present, the regional, national or even global importance of the affected area for these species (both individually and collectively), and the perceived susceptibility of these species (both individually and collectively) to the anticipated impacts of development (Jenkins *et al,* 2017).

A desktop-based sensitivity assessment conducted in the Scoping-phase Avifaunal Assessment identified a number of threatened bird species that could occur in the wider area. A habitat-based sensitivity assessment was undertaken, and habitats of high sensitivity in the form of riparian corridors, aquatic habitat in the form of rivers and dams and untransformed woodland were identified and mapped (Figure 5). The majority of the study area and development site is comprised of moderate sensitivity or low sensitivity habitat type with a high degree of transformation in certain parts of the study area. It is important to note that in addition to the level of transformation, there is a high degree of human presence and activity and very high ambient noise levels, especially as one moves closer to the Tubatse Ferrochrome Smelter. These factors collectively are likely to discourage certain larger bird species that are particularly sensitive to human activity.

The desktop assessment of species occurrence has not identified the development sites or study area as being important areas inhabited by populations of threatened or highly range-restricted or habitat-restricted species, or as foraging / roosting / nesting / aggregating locations for those species. The likelihood of the *regular* occurrence of most of the priority bird species identified is deemed to be low, due to the human presence and disturbance factor, and due to the spatial occurrence of habitat types on the site, most of which are not regularly likely to host these priority species. Most of the priority species are species which range widely, and which may occasionally range onto the site, or more likely the less transformed hillside woodlands adjacent to the site.

The Steelpoort River has however been identified as a locally significant bird movement corridor. The river is a large perennial river that drains a wide, but enclosed valley. Although the natural riparian vegetation has been completely removed along large reaches of the river in the study area, thus minimising its utility as a mobility corridor for smaller passerines, the river and riparian corridor is still likely to be utilised as a movement corridor for waterfowl in particular, utilising the river to move between different river reaches or other waterbodies such as dams in vicinity of the river.

The high human disturbance and transformation factor, the habitat types found in the study area and the nature of priority species occurrence in the study area, would indicate that the overall avifaunal sensitivity of the development sites and study area would be low. However the presence of the Steelpoort River as a locally important bird movement corridor meets one of the criteria for medium sensitivity and this is significant in the context of the development sites due to the close proximity of Site 5 to this corridor. The preliminary assessment of the Scoping-phase avifaunal study, indicated that the study area displays **a medium avifaunal sensitivity**.

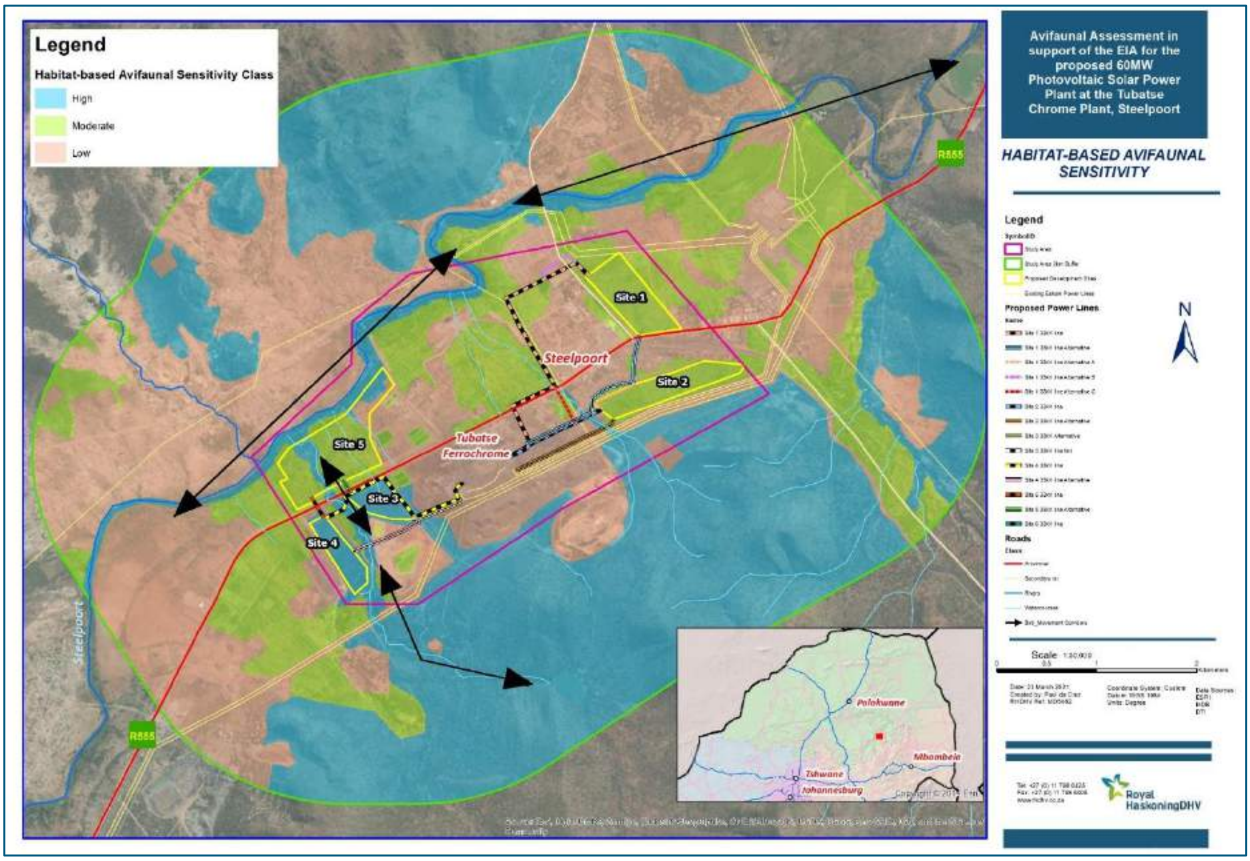

Figure 5 – Areas of habitat-based sensitivity and bird movement corridors in the Study Area

5.3 Bird Species Occurrence

A bird species list for the study area was compiled in the Scoping-phase of the project and has been updated based on the outcomes of the EIAR-phase field assessments (Appendix B). The bird species list was primarily compiled on data from the SABAP2 project[3].

The species composition of the study area is representative of the habitats present in the study area. The majority of bird species are typical of savannah (woodland or bushveld), the predominant habitat type within the study area. A relatively small number of species are associated with aquatic habitats, representing the presence of a perennial river and a number of artificial waterbodies (dams) within the wider study area. A small number of species more typically associated with grassland habitats do occur in the study area and have taken advantage of the modification of woodland habitat through clearing of woody vegetation.

The study area species list contains a number of larger bird species, including certain raptor and stork species. These species are significant as species from these groups of birds are often threatened (see Section 7.2 below) and are typically prone to being impacted by power lines, an important component of the proposed development.

5.3.1 Occurrence of Red Data Species

A number of Red Data species have either been recorded or could potentially occur within the study area. The latest list of Red Data List bird species is contained within the 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al,* 2015). Table 2 lists the bird species in the study area species list that have been designated as Red Data species. Red Data species are very important in the context of the proposed development, as any impacts on these threatened species will be potentially significant at the population level. In addition certain of these species are large birds that are vulnerable to collisions with infrastructure, especially power lines.

Table 2 – Red Data List Birds recorded or potentially occurring within the study area

Scientific Name	Common Name	Regional Threat Category
Ciconia abdimii	Abdim's Stork	Near Threatened
Ciconia nigra	Black Stork	Vulnerable
Geronticus calvus	Southern Bald Ibis	Vulnerable
Sagittarius serpentarius	Secretarybird	Vulnerable
Gyps coprotheres	Cape Vulture	Endangered
Gyps africanus	White-backed Vulture	Endangered
Falco biarmicus	Lanner Falcon	Vulnerable
Polemaetus bellicosus	Martial Eagle	Endangered

[3] The SABAP2 project is a citizen science project that utilises the inputs of several hundred volunteers to map the distribution of birds across several southern African countries. SABAP2 is the follow-up project to the Southern African Bird Atlas Project (SABAP1), which took place from 1987-1991. The second bird atlas project started on 1 July 2007 and thus represents nearly fourteen years of data. The project aims to map the distribution and relative abundance of birds in southern Africa. To gather data, volunteers select a geographical 'pentad' on a map and record all the bird species seen within a set time frame, in order of species seen. This information is uploaded to the SABAP2 database and is used for research and analysis by several different agencies, including the SANBI, BLSA, as well as academics and students at various universities http://sabap2.birdmap.africa/

Scientific Name	Common Name	Regional Threat Category
Alcedo semitorquata	Half-collared Kingfisher	Near threatened
Coracias garrulus	European Roller	Near threatened

5.3.2 Occurrence of Endemic Species

Table 3 lists the endemic species have been recorded within the study area. Endemic species are of importance due to their limited distribution and impacts on their populations (especially at cumulative level) could be significant It should be noted that species endemic to the southern African sub-region have been listed. A distinction has been drawn between birds completely endemic to the sub-region, as well as those species whose distributions mostly fall within the sub-region (near endemic).

Table 3 – Endemic or Near Endemic species recorded or potentially occurring within the study area

Scientific Name	Common Name	Endemism Status
Geronticus calvus	Southern Bald Ibis	Endemic
Gyps coprotheres	Cape Vulture	Endemic
Buteo rufofuscus	Jackal Buzzard	Endemic
Pternisits natalensis	Natal Spurfowl	Near Endemic
Lophotis ruficrista	Red-crested Korhaan	Near Endemic
Pterocles bicinctus	Double-banded Sandgrouse	Near Endemic
Centropus burchellii	Burchell's Coucal	Near Endemic
Tockus leucomelas	Southern Yellow-billed Hornbill	Near Endemic
Tricholaema leucomelas	Acacia Pied Barbet	Near Endemic
Mirafra sabota	Sabota Lark	Near Endemic
Anthoscopus minutus	Cape Penduline-Tit	Near Endemic
Monticola rupestris	Cape Rock Thrush	Endemic
Cossypha humeralis	White-throated Robin-Chat	Endemic
Cercotrichas paena	Kalahari Scrub-Robin	Near Endemic
Parisoma subcaeruleum	Chestnut-vented Tit-Babbler	Near Endemic
Bradornis mariquensis	Marico Flycatcher	Near Endemic
Sigelus silens	Fiscal Flycatcher	Endemic
Laniarius ferrugineus	Southern Boubou	Endemic
Laniarius atrococcineus	Crimson-breasted Shrike	Near Endemic
Cinnyris afer	Greater Double-collared Sunbird	Endemic
Cinnyris chalybeus	Southern Double-collared Sunbird	Endemic
Passer melanurus	Cape Sparrow	Near Endemic

Scientific Name	Common Name	Endemism Status
Passer motitensis	Great Sparrow	Near Endemic
Sporopipes squamifrons	Scaly-feathered Finch	Near Endemic
Amadina erythrocephala	Red-headed Finch	Near Endemic
Uraeginthus granatinus	Violet-eared Waxbill	Near Endemic
Vidua regia	Shaft-tailed Whydah	Near Endemic
Emberiza impetuana	Lark-like Bunting	Near Endemic
Emberiza capensis	Cape Bunting	Near Endemic
Zosterops virens	Cape White-eye	Endemic

5.3.3 Identification and Occurrence of Priority Bird Species

Based on the species list compiled for the study area and the sensitivity analysis, a number of ‘priority species’ with respect to the proposed development have been identified. The identification of priority species has also considered the conservation or endemism status of the species, as well as whether the species would be vulnerable to collisions with overhead power lines or be impacted by PV-based solar power development. Species recorded in the wider area have been included as these could easily move into the study area. The priority species are:

- Abdim’s Stork (*Ciconia abdimii*)
- Black Stork (*Ciconia nigra*)
- Southern Bald Ibis (*Geronticus calvus*)
- Secretarybird (*Sagittarius serpentarius*)
- Cape Vulture (*Gyps coprotheres*)
- White-backed Vulture (*Gyps africanus*)
- Peregrine Falcon (*Falco peregrinus*)
- Lanner Falcon (*Falco biarmicus*)
- Verreaux’s Eagle (*Aquilla verreauxii*)
- Tawny Eagle (*Aquila rapax*)
- Martial Eagle (*Polemaetus bellicosus*)

Although the likelihood of the occurrence of certain of these species is likely to be very low, their threat status, twinned with their ability to range extensively over large territories or areas of occurrence entails that they could occur in the study area and should be considered. The avifaunal assessment in the EIAR-phase will focus on the assessment of these species as the species that are most at risk from the proposed development.

6 Bird Species Occurrence on the Development Sites

6.1 General Bird Species Occurrence and Abundance

The results of the transects and fixed-point observations across the five development sites and their surrounds, as well as the field lists (cards) compiled as part of the SAPAB2 data submissions, and the incidental observations have enabled a general picture of the avian species occurrence in terms of species assemblage and abundance in the study area to be identified. A total of 32 fixed point-based or transect-based monitoring sites were used to collect data over the five sites (refer to Figure 3). The highest number of such transects and fixed points were selected on Site 5, due to this being the largest of the development sites. Although a mix of fixed-point monitoring and transects was preferred for all sites, on the sites characterised by dense woodland, walked transects were deemed to be less effective and more fixed-point observations were undertaken. In order to provide a baseline against which construction and post construction (operational) avifaunal monitoring results could be compared with the pre-construction data, for each of the sites one or more off-site transects or fixed-point monitoring sites (i.e. locations outside of the proposed development footprint) was selected to allow data to be collected from areas close to the development, but undeveloped once the development has commenced Although a detailed statistical analysis of the data collected did not form part of the remit of this EIA study, a protocol based on the recording of species including number of birds observed, distance based on a set number of distance band and behaviour was applied. A total of 103 species (detailed in the study area species list – Appendix B) was recorded during the avifaunal monitoring, representing a significant portion of the bird species list for the site.

The study area can be said to support a species composition typical of mesic woodland / savannah that is present over large parts of north-eastern South Africa within the Limpopo and Mpumalanga Provinces. The species composition of the study area is also characterised by certain elements of the more arid woodlands / savannahs that typify the western-central interior of southern Africa, with certain species commonly occurring in the study area being close to the eastern or north-eastern limits of their distributions (e.g. Black-faced Waxbill – *Estrilda erythronotos,* Crimson-breasted Shrike – *Laniarius atrococcineus,* and Kalahari Scrub-Robin – *Cercotrichas paena*). The absence of significant waterbodies or wetlands in the study area limits the number and abundance of waterbirds, and as discussed in Section 6.3 below, is related to the presence of the Steelpoort River and a number of artificial waterbodies which support limited number of waterbirds that favour open water with limited waterbird species that are associated with reedbeds and littoral habitats present along the Steelpoort River and at the Tubatse Dam. An important component of the overall species composition, although occurring in generally low densities, is the presence of a handful of raptor species which are at the top of the food chain and act as apex avian predators in the environment of the study area. These raptor species are typically species most-commonly occurring with modified / partly transformed rural habitats in north-eastern South Africa (as opposed to large protected areas).

Figure 6 – A Golden-breasted Bunting – one of the more commonly occurring birds on the development sites

The site observations indicated a handful of species to be the most abundantly occurring within the study area and on the development sites. An overall tally of number of records (refer to Appendix C)of each species during such data gathering revealed that the White-bellied Sunbird (*Cinnyris talatala*) and to a lesser degree the Blue Waxbill (*Uraeginthus angolensis*) are the most abundantly occurring species across the study area and these two species were recorded in all transects / at fixed points with the exception of two / three transects / fixed points respectively. Their abundance is also indicated in that for most transects / fixed points, records of multiple sets of the same species were recorded. The abundance of the White-bellied Sunbird in the study area can be partly attributed to the extremely large number of flowering aloes that occur in high densities across most of the sites but could also have a seasonal bias in that the transect / fixed point monitoring when large numbers of trees and other plants were in flower, thus providing an extensive food source for this species. The Blue Waxbill is one of the most common granivores within the mesic and drier woodlands / savannahs of southern Africa.

The other most abundantly occurring species as revealed by the results of the transect / fixed point data gathering were the Southern Boubou (*Laniarius ferrugineus*), Laughing Dove (*Spilopelia senegalensis*), Pied Crow (*Corvus albus*), White-browed Scrub-Robin (*Cercotrichas leucophrys*), White-browed Sparrow Weaver (*Plocepasser mahali*) and the Dark-capped Bulbul (*Pycnonotus tricolor*). A further suite of common 'Bushveld' bird species was recorded at slightly lower overall recording rates on all of the development sites irrespective of the type of woodland and level of degradation, typified by species such as Yellow-fronted Canary (*Crithagra mozambica*), Long-billed Crombec (*Sylvietta rufescens*), Acacia Pied Barbet (*Tricholaema leucomelas*), Black-chested Prinia (*Prinia flavicans*), Southern Masked Weaver (*Ploceus velatus*) and Red-faced Mousebird (*Urocolius indicus*).

Certain species were slightly more common on individual (development) sites, for example the dense closed low woodland habitat on Sites 3&4 supported a greater density of Southern Boubou, for example, and White-throated Robin Chat (*Cossypha humeralis*) – both species associated with dense thickets or woodland. Sites 3&3 also included transects along the ephemeral watercourse that drains between the two sites and thus the records for these sites also include a suite of birds commonly associated with the riparian corridor. The small finch Jameson's Firefinch (*Lagonosticta rhodopereia*) was revealed to be very common in the grassy substrate that lines the channel and its surrounds but was uncommon elsewhere on the site. This characteristic is likely to be mimicked for other finches and granivores, especially birds such as widows, queleas and bishops that will seasonally move onto the sites in mid to late summer to feed on the seeding grasses.

Figure 7 – A small group of Grey Go-away Birds feeding on the flowers of a Senegalia nigrescens tree

Certain of the sites located closer to the urban habitats of Steelpoort or the peri-urban areas located on the northern bank of the Steelpoort River were characterised by a greater abundance of certain species typically associated with urban habitats, such as Laughing Doves, White-browed Sparrow Weavers, Pied Crows and Common Mynas (*Acridotheres tristis*). The two sites located closest to Steelpoort (Sites 1&2) thus displayed the highest number of records of these species, as compared to other sites. There is a very high density of Pied Crows in the vicinity of Steelpoort town, and the numerous power line servitudes that occur in its immediate surrounds. Sites 1 and 2 thus were characterised by a relatively high density of Pied Crow sightings, often with numerous birds present at one time. This may account for the slightly lower density of raptors recorded on these two sites, with the combined presence of human activity and disturbance factor and the abundance of large numbers of Pied Crows posing a significant nuisance factor. Observations soon after dawn on Site 5 revealed very large numbers of Common Mynas flying north-westwards from the direction of the Tubatse Smelter – presumably where a communal roost is located – over the Steelpoort

River to the peri-urban areas on the northern side of the river where these birds are very common. During a 15-minute period upwards of 150 birds were observed flying from the Smelter in small flocks of around 5-10 birds.

Certain night-time observations of birds were undertaken across both the Scoping- and EIAR-phase site visits. Night-time observations were undertaken (through the use of a spotlight, and through the recording of audio - calls) at the following locations:

- The pipeline servitude close to the Steelpoort River to the north of the WTW (post-dusk and pre-dawn; conducted in Scoping).
- Site 5 close to the borehole to the west of the WTW (post-dusk).
- Power line servitude located to the south of Site 2 (pre-dawn and post-dusk).
- The area of the HH Waste Facilities and the adjacent hilly ground to the south of Site 3 (post-dusk).

A small number of nocturnal species was recorded during these night-time observations. The most commonly recorded species that was also encountered during the day on Site 1 was the Spotted Thick-knee (*Burhinus capensis*), along with the Fiery-necked Nightjar (*Caprimulgus pectoralis*). One incidence of the call of a Rufous-cheeked Nightjar (*Caprimulgus rufigena*) was recorded in the footslopes located to the south of Site 2. No owl species were recorded, but it is highly likely that the Spotted Eagle-Owl (*Bubo africanus*) and the Barn Owl (*Tyto alba*) occur in the study area. Apart from the general loss of habitat that is discussed for all species below, the proposed development is unlikely to adversely affect night birds, especially if the facility remains unlit at night.

It is important to note that due to EIAR-timing restrictions, no detailed avifaunal monitoring was able to be undertaken during the period of likely peak bird biomass occurrence in the study area. This is likely to occur in mid- to late summer when large numbers of seed-eating birds such as certain widow, bishop, whydah, indigobird species and likely most importantly Red-billed Queleas (*Quelea quelea*) are likely to move into the study area to breed and to forage, especially in summers of good rainfall. Although the sward on many of the sites is degraded due to overgrazing, riparian areas including that of the Steelpoort River and the ephemeral watercourse draining between Sites 3 & 4 and which bisects Site 5 are likely to be characterised by an abundance of grass species such as *Panicum maximum* which would attract significant numbers of such granivores. The timing of the EIAR-site visits was also too early to record most migratory species (whether Intra-African or Palearctic) that would seasonally supplement the resident birds in the study area. A number of such species could occur commonly to abundantly in the study area, including species such as Barn Swallow (*Hirundo rustica*), a number of cuckoo species, Red-backed Shrikes (*Lanius collurio*) and certain warbler species.

6.1.1 Implications for Development

The transformation of the five development sites will have a significant localised impact on these bushveld / woodland species, as explored further in Section 7.1.1 below. As described in that section when considered at a larger scale, this localised habitat loss impact can be contextualised and mitigated by the retention of habitat in the immediate vicinity into which displaced birds could move. None of the most commonly occurring species are either threatened or range-restricted, and the impacts of the proposed development should be viewed in this context, and therefore the loss of habitat and territories for the woodland bird assemblage is not highly significant on its own.

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6.2 Presence of Raptors

Of the larger birds present on the site, raptors were noted to comprise a significant portion Raptors are significant in an avifaunal context for a number of reasons. Firstly they provide vital ecosystems services in many areas raptors are amongst the most common top predators and are likely to shape the species assemblages of birds and mammals (Ritchie et al. 2013), as well as their behaviours (Shultz and Noë 2002; Willems and Hill 2009). Due to the territorial nature of many species they often occur at relatively low densities and are thus vulnerable to disturbance. Raptors are threatened in many ways, with the major factor affecting raptors being the strong human population increase throughout sub-Saharan Africa, with the strongest and most widespread declines having been reported from rural areas, where former wildlands with few people have made way for transformed habitats. Other factors such as poisoning and collision and electrocution from electricity infrastructure being major threats.

Certain raptor species were listed as being priority species for the site, but with the exception of the Lanner Falcon, none of the priority raptor species were recorded on the development sites or in their immediate vicinity. Two sightings of Verreaux's Eagle were recorded while field lists were being compiled for two of the adjacent pentads to the study area[4]. The proximity of the records to the development sites is significant as it is strongly suggestive that the study site would form part of the territory of a resident pair of these birds (on both occasions a pair of eagles was observed), and that the hilly terrain located immediately to the south of the development sites could form part of the areas in which these birds would hunt. No Rock Hyraxes (*Procavia capensis*) were observed on the development sites or in the hilly terrain adjacent to the site, and in addition there is not a high density of small livestock (i.e. goats) which could also form part of the prey of these eagles on the development sites or their immediate vicinity and this suggests that the resident pair would range occasionally over the development sites rather than actively occurring on them. The risk of the solar power PV arrays and the associated power lines affecting this species is thus assessed to be low.

A low raptor species diversity was encountered on the development sites and in the wider study area, with a total of six species encountered. The raptor species encountered on the development sites included (Figure 8):

- Black-chested Snake Eagle
- Wahlberg's Eagle
- African Fish Eagle
- Lanner Falcon
- Black-winged Kite
- Rock Kestrel
- Little Sparrowhawk

[4] *The pentads were 2440_3005 (record on the 30th September 2021) and 2445_3015 (record on the * April 2021)*

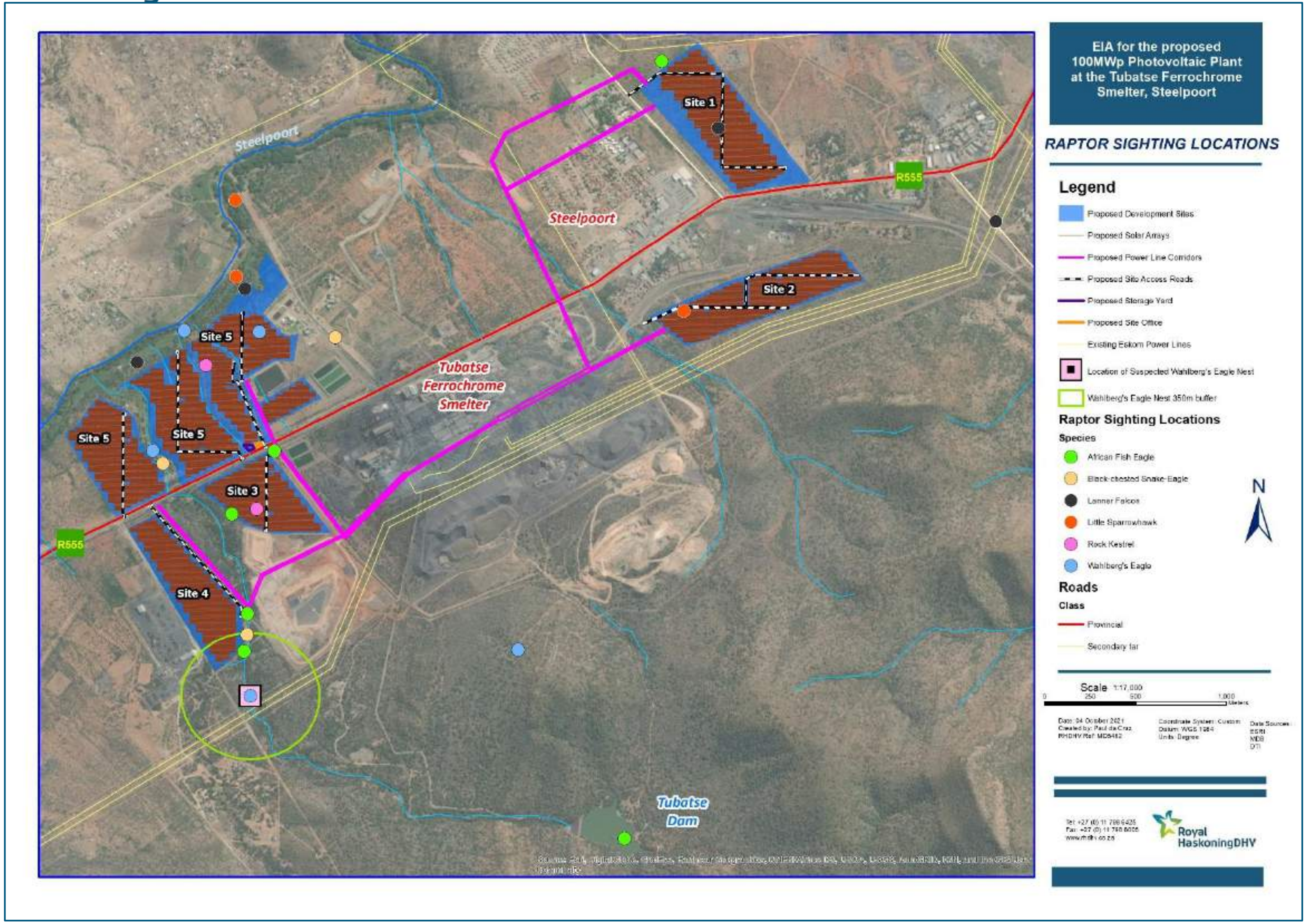

Figure 8 – Raptor Sighting Locations in the Study Area

Of these species, only the Lanner Falcon was included in the list of priority species. Figure 8 indicates the location of all raptor sightings on the development sites and the surrounds. There were a number of Lanner Falcon sightings, mostly in the eastern part of the study area, close to the town of Steelpoort and its surrounds and in the vicinity of the Steelpoort River riparian zone. Sightings occurred during both the Scoping-phase (April 2021) and EIAR-phase site visits. This suggests that at least one bird is resident in the area. The species appears to favour the Steelpoort riparian zone (where there is a high density of prey species) and the vacant areas surrounding Steelpoort, being associated with the various power lines to hunt its avian prey. Sites 1 and 5 are proposed to be developed in the area in which the species was most regularly observed, and along with other raptors, the transformation of habitat could lessen the available area in which the bird hunts. This impact would be mitigated by the non-development of the Steelpoort riparian corridor.

The Black-chested Snake-Eagle is one of the more commonly occurring larger raptor species over the northern parts of South Africa and Limpopo. The species was observed on several occasions during both the Scoping- and EIAR-phase field assessments, typically a single bird in flight at a relatively low altitude over the site. The sightings were primarily in the vicinity of Sites 4 and 5. Accordingly the development sites are likely to form part of the territory of a resident bird, with the bird hunting over the woodland in these areas. The transformation of the woodland on the sites would thus have an effect on the area available to the resident bird(s) in which to hunt, but the relatively low overall area that would be transformed would limit the significant of the impact on these birds.

African Fish Eagles were recorded on a number of occasions during the EIAR-phase field assessments, always at high altitudes when observed from the development sites. A pair was recorded at the Tubatse Dam located in the hilly terrain to the south of the development sites. This dam is stocked with fish and a pair observed at the dam is likely to utilise the dam for hunting and could possibly even nest in the mature woodland in the hilly terrain surrounding the dam. The artificial waterbodies surrounding the site could attract these piscivorous birds but would not be used for fishing as these waterbodies do not hold fish. The birds could also be likely to frequent the Steelpoort River and its riparian zone,

The last larger raptor which was recorded in the study area was the Wahlberg's Eagle (Figure 9). The eagle species is an Intra-African migrant, arriving in southern Africa in July and August to nest, with breeding occurring in spring and early summer. The species was commonly recorded in the study area during both of the EIAR-phase site assessments, mostly in the air, generally soaring in a northerly or north-easterly direction into the wind the that prevailed during the site assessments. A single bird was sometimes observed, but a pair was also observed. Most importantly, during the undertaking of fixed-point observation located to the south of Site 4, a pair of these birds was observed mating in a tree within the riparian zone of the watercourse that drains between Sites 3 and 4. The area was thus carefully searched and what appeared to be a nest structure (Figure 10 and Figure 11) was located in close proximity to the tree in which the birds were mating. The nest structure was located approximately 5-6m above the ground in a *Senegalia nigrescens* tree and consisted of twigs and small branches placed untidily in the fork of the tree below the canopy. The nest was estimated to be about 75m in diameter. The nest observed accords with the literature that describes Wahlberg Eagle nesting; The nest is built by both sexes staring soon after arrival is a small, robust platform of thin sticks that is lined with green leaves prior to egg laying. The outside diameter of the nest is 30-70cm. The nest remains small, despite repeated annual usage. The nest is typically placed in a major fork in a tree, usually along a dry river and often in a Jackalberry (*Diospyros mespiliformis*) or *Senegalia (Acacia) nigrescens* tree. Importantly, pairs can have more than one (up to five) nest sites per territory.

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Figure 9 – A Wahlberg's Eagle interacting with a mobbing Pied Crow on the site

The observation was made on the last day of the second EIAR-phase site visit and accordingly it was not possible to revisit the site to ascertain whether this was indeed a Wahlberg's Eagle nest and whether the pair observed were adding material to this particular nest in preparation for egg-laying. The mating in close proximity to a structure that appears to be an eagle's nest structure, allied with the relatively high frequency of sightings of the species on the site is strongly suggestive that this is an active breeding site, and is suggestive that this nest is being utilised for breeding.

The nest is located 220m from the closest point of Site 4, and thus the development of the site (in particular construction with associated noisy activities associated with vegetation clearing and operation of heavy machinery) on the site could potentially cause the nest to be abandoned. The potential impact of the development in the context of the nest site is discussed in Section 7.4 below.

Figure 10 – The position of the suspected Wahlberg's Eagle nest

Figure 11 -The suspected Wahlberg's Eagle nest

6.2.1 Implications of Raptor Occurrence on the Development Sites for the Development

As with the general species assemblage on the site, raptors will be impacted to a certain degree by the loss of habitat in which to forage (hunt). However, the limited related aerial extent of the combined development footprint in a study area and wider context will minimise the significance of the impact (see Section 7.1.1) in the context of the range and territories of the raptors that inhabit the site. Sufficient natural / modified natural habitat should remain in the wider area to prevent significant impacts on these raptors and is unlikely to have impacts on the development from being able to proceed to be developed.

The potential confirmation of breeding of a pair of Wahlberg's Eagles in close proximity to Site 4 does however have implications for the development, as the maintenance of a buffer than encompasses a certain portion of the solar array footprint on Site 4.

6.3 Water bird Occurrence and Birds associated with the Artificial Water Bodies on the Site

One of the key avifaunal sensitivity associated with the study area is the presence of the Steelpoort River as a significant local bird movement corridor, especially for larger waterbirds and the Scoping-phase avifaunal study identified this as a significant aspect of the avifaunal sensitivity in the study area. In addition to this the potential for waterbirds to move between the river corridor and the Tubatse Dam located in the hilly terrain to the south of the Smelter and development sites was also raised as a potential movement of waterbirds within the study area. Furthermore, there are a number of artificial waterbodies in the vicinity of the Smelter and thus certain of the development sites, in particular Site 5. These artificial waterbodies are primarily lined ponds or dams, including the dams associated with the Smelter's Water Treatment Works, along with a stormwater dam, a number of brine dams and two dams associated with the HH Waste Facility that is located to the south-west of the Smelter and closest to Sites 3 & 4. Although lined and not offering suitable littoral habitat favoured by many waterbirds, these waterbodies were nonetheless noted in the Scoping-phase avifaunal field assessment to hold a few waterbird species. With the development of the concept design that indicated the presence of arrays and a proposed power line located in close proximity to certain of these waterbodies identified the possibility of impacts on the waterbirds visiting these water bodies.

Accordingly, the assessment of the waterbird assemblage at these various waterbodies was included in the EIAR-phase avifaunal field assessment. This was undertaken using the CWAC (Co-ordinated Waterbird Counts) methodology that is used by the Animal Demography Unit of the University of Cape Town to act as an effective long-term waterbird monitoring tool, benefiting conservation efforts worldwide CWAC was created as part of South Africa's commitment to international waterbird conservation. Numerous counts are conducted each year as part of the CWAC project at selected wetlands and waterbodies[5]. Although none of the artificial waterbodies or the Tubatse Dam would constitute a potential CWAC site, the method is useful for counting the number of birds at the waterbodies on the site. Accordingly, the CWAC methodology was applied at the Tubatse Dam and at the waterbodies associated with the Smelter's WTW. Due to the difficulty posed by the presence of riparian vegetation and thickets, the CWAC methodology was not applied along the Steelpoort River, but a number of ad hoc observations of the river were conducted to determine the presence of waterbirds, in particular for the presence of birds flying along the river. The results of the surveys revealed a relatively low density and species richness of waterbirds at all waterbodies that were surveyed, as discussed further below.

[5] *https://cwac.birdmap.africa/index.php*

6.3.1 Waterbird Occurrence along the Steelpoort River and Bird Movement along the River

The Steelpoort River in the vicinity of the development sites is currently being highly degraded in a co-ordinated and systematic function by the conducting of sand mining with large earth moving equipment. This mining is occurring along the northern bank of the river, and much of the marginal, lower and upper zones (as defined by the DWS's VEGRAI riparian assessment template) of the rivers riparian corridor have been severely transformed. This has resulted in the loss of riparian vegetation along certain reaches of the river. The disturbance, along with likely similar disturbances upstream have resulted in a high silt load and highly turbid water within the river. The degradation of the aquatic environment has been likely to limit the suitability of the river for waterbirds and a limited number of true waterbirds were observed along the river. The most commonly occurring species were the Egyptian Goose (*Alopochen aegyptiaca*), Grey Heron (*Ardea cinerea*), Reed Cormorant (*Microcarbo africanus*), along with several other species, including Little Grebe (*Tachybaptus ruficollis*), Yellow-billed Duck (*Anas undulata*), African Black Duck (*Anas sparsa),* Green-backed (Striated) Heron (*Butorides striata*). Three kingfisher species were recorded along the river including Giant (*Megaceryle maxima*), Pied (*Ceryle rudis*) and Malachite (*Corythornis cristatus*).

Observations did reveal a number of waterbirds flying along the river and its riparian corridor. The birds were observed flying along the river's course, often in a north-easterly (downstream direction). Such waterbirds were observed flying at relatively low altitude and included the Egyptian Goose and Reed Cormorants, recorded on a number of occasions, along with the presence of numerous small flocks of Western Cattle Egrets (*Bubulcus ibis*), Yellow-billed Ducks and a Hamerkop (*Scopus umbretta*). A dusk observation of the river's riparian corridor revealed that three Black-headed Herons (*Ardea melanocephala*) arrived at dusk and settled into a large riparian tree on the southern bank to roost. Other (non waterbirds) were observed to be flying along the river, including various weaver and widows along with one sighting of what is assumed to be the resident Wahlberg's Eagle pair at a low altitude flying downstream along the river. The observations do support the conclusion that the river is an important movement corridor for waterbirds, however for a much lower number of species and overall number of birds that could potentially have moved along the river. The exclusion of the Steelpoort River's riparian corridor from the development footprint (including power lines) is an important mitigation measure that is likely to greatly minimise any potential impact of the development on the waterbirds (along with other birds) that regularly move along the river. The low altitude at which most of the birds fly is likely to prevent any occurrence of the 'lake effect' of birds moving along the river mistaking the PV solar panel arrays for waterbodies.

Observations of the ephemeral watercourse revealed no waterbirds flying along it from the Steelpoort River in the direction of the Tubatse Dam. As discussed below the Tubatse Dam was found to harbour a relatively low number of waterbirds. Large numbers of waterbirds are thus unlikely to move between the dam and the Steelpoort River. Due the elevated topographical position of the Tubatse Dam in relation to the Steelpoort Valley floor, any waterbirds moving between the dam and the river are likely to do so at high altitudes in relation to the valley floor and in very small numbers, and thus there would be a relatively low risk of collision of waterbirds associated with the PV solar arrays.

6.3.2 Waterbird Occurrence at the Tubatse Dam

The CWAC count at the Tubatse Dam revealed a very low number of waterbirds and species diversity at the dam. The primary waterbirds recorded included a number of Reed and White-breasted (*Phalacrocorax lucidus*) Cormorants, Darter (*Anhinga rufa*) a pair of Egyptian Geese and a number of furtive reedbed-inhabiting waterbird species including three Striated (Green-backed) Herons, a Black-crowned Night-Heron (*Nycticorax nycticorax*) and a number of Black Crakes (*Zapornia flavirostra*). Earlier observations at the Tubatse Dam during the Scoping-phase site visit in April revealed a similar assemblage of birds. The CWAC count at the dam recorded a pair of African Fish Eagles display calling over the dam. It is highly likely that this dam that is stocked with fish is regularly utilised for hunting by the pair, and it appears likely that this is the focal area of the species' occurrence in the study area, as evidenced also by records of the species from the development sites being birds soaring at very high altitude or where a call was heard, and the bird could not be located by sight.

The conclusion drawn from the assessment of Tubatse Dam is that the dam is primarily utilised by piscivorous waterbirds that favour open water habitats, with a low species richness and low density of birds. As described above, the altitude of the dam in relation to the development sites in the Steelpoort Valley twinned with the low density of waterbirds visiting the dam will negate any potential for collision of birds moving between the Steelpoort Valley and the Dam.

Figure 12 – A Striated (Green-backed) Heron at the Tubatse Dam wall

6.3.3 Waterbird Occurrence at the Artificial Waterbodies located close to the Smelter

A late afternoon CWAC survey was undertaken at the artificial waterbodies near the Smelter, and which are located close to the proposed Site 5 proposed solar PV arrays. The survey included the two lined dams at the Water Treatment Works, the lined stormwater dam, and the three brine dams. Due to the lined nature of these waterbodies and their steep sides, these waterbodies do not provide any suitable habitat for waders and any other species that favour littoral or wetland habitats. Like the Tubatse Dam, the vast majority of birds recorded at these artificial waterbodies were open water species. No birds other than a pair of Blacksmith Lapwings (*Vanellus armatus*) were observed at the two lined ponds at the water treatment works. The stormwater dam is the largest of these waterbodies and was observed to hold several White-breasted Cormorants, a Darter, and three Cape Teals (*Anas capensis*). A greater number of waterbirds were observed at the brine dams, with a total of 5 Cape Teals and a total of 19 Little Grebes, in addition to several pairs of Blacksmith Lapwings, a pair of Egyptian Geese. The brine dams were also visited by a Three-banded Plover (*Charadrius tricollaris*) and a Common Sandpiper (*Actitis hypoleucos*). Closer to dusk the dam was visited by several swallows and martins including Greater Striped Swallows (*Cecropis cucullata*), Wire-tailed Swallows (*Hirundo smithi*) and Brown-throated Martins (*Riparia paludicola*). No birds apart from a further pair of Egyptian Geese were observed to fly into the dams just prior to dusk, but all birds present, were likely to have roosted at the waterbodies.

Other incidental observations of waterbirds from the surrounds revealed a similar assemblage of species, with the presence of a Grey Heron and a single Glossy Ibis (*Plegadis falcinellus*).

The record of the Cape Teals at the waterbodies is noteworthy in a species distribution context as the record presented as strongly out of range for this species with the closest records in the SABAP2 database being in the Polokwane and Belfast (eMakhazeni) areas. This species favours open saline or brackish wetlands and does inhabit sewage and effluent ponds and thus the brine dams present suitable habitat. The record of the single Glossy Ibis similarly registered as out of range on the SABAP2 database, with most records of this species being on the Highveld to the southwest and on the Polokwane Plateau, and no records for Sekhukhuneland.

Figure 13 – Cape Teals and Little Grebes at one of the Brine Dams

In conclusion, the artificial waterbodies are inhabited / utilised by a low number of species and relatively low overall number of birds. However, the waterbodies are utilised as roosting sites by a number of species that are resident in the area, and accordingly these birds will move to and from the waterbodies. Incidental observations are suggestive that the waterbodies may occasionally be utilised by species that would not regularly occur in the wider area to rest / roost. In the context of the development of solar arrays close to the stormwater dam in particular and the development of the proposed Site 5 power line adjacent to this dam, these new developments could impact the waterbirds utilising the waterbodies and these potential impacts and mitigation are discussed in Sections 7 and 8 respectively.

6.3.4 Implications of Waterbird Occurrence and Density on the Development Sites for the Development

As described above, neither a high species density of waterbirds, or high numbers of birds overall characterises the natural or artificial surface water features on the site. Although certain mitigation measures have been specified relating to certain of the development components (refer to Section 8.2), the impacts of the proposed development on waterbirds are not expected to be of any significance that would render the development unable to proceed.

6.4 Occurrence of Priority Species

As discussed above, none of the species identified as priority species in the Scoping-phase avifaunal assessment were recorded in the study area, with the exception of the Lanner Falcon which was recorded on numerous occasions on certain of the development site in both the Scoping- and EIAR-phase field visits. The Verreaux's Eagle was recorded out of the study area, but in sufficiently close proximity (on two occasions) in the areas to the north-west (approximately 7km distant in Ga-Mapodila) and to the south-east (approximately 10km distant along the D737 road) to suggest that a resident pair(s) are likely to range into the study area. Birds ranging over the development site are highly unlikely to hunt over the development sites as their primary prey (Rock Hyraxes) are not present on the development sites. This species may hunt other prey such as goats, but no goats are present on any of the development sites. The likelihood of Verreaux's Eagles occurring in the immediate vicinity of the development sites and interacting with the proposed infrastructure is thus deemed to be very low.

The absence of the other priority species from the site assessment records conducted for the study does not entail that these would not be present. The two vulture species could arguably visit livestock carcasses on the development sites, but the very high human presence in the Steelpoort area would make this unlikely. Birds would rather be likely to range at high altitudes over the hilly ground on the margins of the Steelpoort Valley, away from the development sites. Tawny and Martial Eagles as well as Peregrine Falcons are likely to be occasional visitors to the study area, whilst the high degree of human presence and habitat transformation is likely to significantly reduce the potential for the occurrence of the Secretarybird on the development sites. The habitat on the development sites and their immediate surrounds is not suitable for the Southern Bald Ibis or the White and Abdim's Storks. The Black Stork may visit certain of the waterbodies on the site that hold fish and other aquatic prey such as amphibians, but the degradation of the Steelpoort River and the altitude and physical distance of the Tubatse Dam away from the development sites entail that this species would be very unlikely to interact with the development infrastructure.

6.4.1 Implications of Priority Species Occurrence on the Development Sites for the Development

Overall, the impact of the proposed development on the identified suite of priority species is likely to be very low, due to the lack of suitable habitat in the vicinity of the development sites, the high human disturbance / transformation factor and the very occasional nature of occurrences of these species within the study area. In this way the potential presence of priority species is unlikely to have any impact on the ability of the proponent to develop the solar arrays on the five development sites.

6.5 Refined Sensitivity Assessment

A primarily desktop-based sensitivity assessment was undertaken in the Scoping-phase avifaunal study. The assessment identified areas of high sensitivity to be rivers (i.e. the Steelpoort River) and associated riparian zones, along with the largest of the ephemeral watercourse and its associated riparian zone that bisects Site 5, and which drains in between Sites 3 & 4. Waterbodies were also identified to be areas of high avifaunal sensitivity. Natural woodland in the study area was assigned a moderate level of sensitivity while degraded woodland was assigned a low level of sensitivity.

The results of the EIAR-phase avifaunal study have confirmed that the Steelpoort River and its riparian corridor, along with the ephemeral watercourse and its riparian corridor should be assigned a high degree of avifaunal sensitivity. There are various reasons for this that include:

- The Steelpoort River, although being actively degraded through sand mining, is still an important local movement corridor and habitat for (an albeit low species density) waterbirds. The river's riparian corridor, especially on the southern side of the river is characterised by large riparian trees, *Phragmites mauritianus* reedbeds and dense thickets that provide a heterogenous matrix of micro-habitats that support a high density of species.
- The availability of moisture for much of the year in both the riparian corridors of the Steelpoort River and the ephemeral watercourse allows the growth of a dense grassy and thicket substrate that supports high number of seedeaters and other birds into the late summer and ensuing autumn and early winter months.
- In the context of the continuing disturbance, transformation and fragmentation of the surrounding woodland habitats (to which the proposed development would contribute if approved), these riparian corridors perform critical ecological linkage functions, allowing birds to move along them and to provide excellent foraging opportunities.
- The presence of large trees provides nesting (breeding) opportunities for many larger bird species. This is particularly evident within the suspected presence of the Wahlberg's Eagle nest that is located along the ephemeral watercourse to the south of Site 4.

Figure 14 – A Retz's Helmet-Shrike in the riparian zone of the Steelpoort River

The presence of the suspected Wahlberg's Eagle nest site has been assigned a 350m wide buffer as part of the mitigation of the impacts of the development and this buffer area has been included in the area of high sensitivity.

The results of the data collection conducted during the EIAR-phase site assessments are suggestive that there is less of a distinction in terms of bird species richness and relative abundance between areas of woodland that were designated as being degraded and those designated as being more intact. Those development sites and their surrounds at which data collection was undertaken that are located in areas of degraded woodland (e.g. areas on Sites 1, 2 and 5) did not show a markedly lower bird species richness and relative abundance as compared to more intact woodland (Sites 3 and 4) This may be explained by the process of 'opening up' of woodland from which woody vegetation is removed, thereby creating more open, less dense thicket that is favoured by more bird species. Accordingly, all areas of residual woodland habitat have been designated as being **moderately sensitive**.

The designation of all artificial waterbodies as being highly sensitive may have been slightly overstated. The results of the observations and data collection for waterbird occurrence and abundance for both the Tubatse Dam and the assemblage of artificial waterbodies located to the north of the Smelter have indicated that these are mainly inhabited / visited by a relatively low number of primarily piscivorous waterbird species, primarily those species that prefer open water habitats, with very limited habitat available for shoreline waders and birds which prefer shallower water, due to the lined nature of all of the artificial ponds, and due to the input of a constant pumped source of water into the Tubatse Dam that does not allow water levels to fluctuate (thereby exposing areas of mudflats and shallower water). As such the artificial waterbodies located on, and close to the development sites have been altered to a **moderate level of avifaunal sensitivity**.

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7 Assessment of Impacts

There are a number of potential impacts of the proposed development on avifauna. The impacts can be broken up into two categories, based on the main development components – impacts associated with the development of a PV solar power facility and impacts associated with power lines.

7.1 Impacts associated with PV Solar Arrays

7.1.1 Loss of Habitat

One of the primary impacts associated with the development of a PV-based solar power generation facility is its physical transformation of large areas of natural vegetation – in many cases PV facilities involve the complete removal of vegetation from the inclusive footprint of the installed. It is understood that such an approach would be adopted for the proposed development especially in areas where rocky outcropping or uneven terrain occur. On Site 5, three of the smaller watercourses that drain the site are proposed to be transformed into 4.5m-wide culverts, thus resulting in further habitat loss.

The habitat transformation associated with the clearing of all vegetation could result in a number of impacts on birds, including:

- direct habitat loss which would be particularly significant for species with restricted ranges or very specific habitat requirements,
- habitat fragmentation and/or modification; and
- disturbance / displacement of species (e.g. through construction / maintenance activities).

Since the conclusion of the Environmental Scoping Phase of the Project, a concept design has been completed. This design indicates the layouts of the solar panel arrays on each of the five sites, as well as the location of ancillary infrastructure that includes power lines (linking each of the five sites with two substations located at the Tubatse Smelter), access roads, underground cabling, and other infrastructure such as site offices, storage yards and culverted watercourses. The approximate footprint of the solar arrays, and areas that would be completely cleared of vegetation would be as follows for each of the five sites:

Table 4 – Approximate footprints of the solar panel arrays on the development sites

Site Name	Size (ha)
Site 1:	22.14
Site 2	21.39
Site 3	13.72
Site 4	16.78
Site 5	53.74
Total	**127.77**

Table 5 indicates that an approximate total of 128ha of vegetation would be cleared to develop the solar arrays on the five development sites. The nature of the development – split across five different sites entails that the 128ha will not form part of one single continuous area but will rather consist of several land parcels in different parts of the study area. This in turn means that there are differing levels of degradation of natural habitat across the different land parcels that will be transformed. Based on the assessment of habitat undertaken in the Scoping-phase avifaunal study and based on field assessments undertaken during the

EIAR-phase, the woodland on Sites 3 and 4 is arguably least degraded, as these sites are currently fenced off and not exposed to intensive livestock grazing twinned with frequent burning and the removal of woody vegetation that occurs on the other sites. However, degradation of woodland has been indicated to not necessarily adversely affect bird assemblage (density and species composition) on the respective sites as the closed nature of much of the woodland on Sites 3 and 4 arguably limits bird species diversity as a smaller number of woodland species inhabit such woodland as opposed to the more open woodland with a grassier substrate on the other sites (refer to Sections 6.1and 6.5). This is borne out by the findings of the assessment of bird species occurrence and density on the respective development sites as undertaken by fixed point monitoring and walked transects which indicated a similar density of small passerines and other woodland species on Sites 1, 2 and 5 as opposed to Sites 3 and 4.

The nature of the development of solar panels (arrays) on the respective sites entails that all vegetation will be cleared as part of the levelling of the array footprints. Accordingly, the array footprints will become completely transformed, although a pioneer grass layer may subsequently develop under the panels. In this context, and at the scale of each site, the development of the arrays will have a significant impact on the bird assemblage (abundance and species density) on the sites, and most birds that currently occur on the woodland on the sites will no longer be able to inhabit the sites once construction (vegetation clearing) has commenced.

Only a very small number of birds (most likely to be granivores – seed eaters) such as weavers, widows, waxbills, and some gamebirds such as Helmeted Guineafowl (*Numida meleagris*) etc. would be likely to forage within the arrays. It is important to note that none of the affected species have restricted ranges or very specific habitat requirements; all of the commonly occurring woodland species that have been commonly recorded on the five development sites are very well-represented in the wider surrounding area where woodland habitat has been retained and will be present once the development becomes available. Certain species that are present on the development sites may however not commonly occur or be present in the more broad-leafed woodland of the hilly terrain to the south and south-east, as opposed to the microphyllous (thornveld) vegetation that occurs within the Steelpoort Valley – e.g. Kalahari Scrub Robin, Black-faced Waxbill or Chestnut-vented Warbler (*Curruca subcoerulea*). Due to the greater level of transformation of the Steelpoort Valley such thornveld vegetation has experienced greater levels of transformation. However, none of the affected species which favour thornveld have limited distributions and the loss of habitat at the scale of the proposed development will not have a population-level impact.

At a wider study area scale (i.e. a 2km radius of the development sites), the habitat transformation impact will be less significant, as large parts of the study area will still be characterised by residual woodland habitat, and as discussed below, certain ecological linkages will be retained between the sites if the vegetation clearing is limited to the development footprint. The retention of such linkages is significant, as habitat loss impacts are heightened when the site of a proposed development will directly affect important areas of ecological connectivity, or in habitat for threatened species. In this context, the active protection of such sensitive areas (especially riparian corridors) located immediately adjacent to the development footprint is proposed.

The fragmented layout of the development in being split into 5 distinct sites will entail that habitat destruction will be limited to the solar array and ancillary infrastructure footprint, and thus natural habitat will be retained in areas located immediately adjacent to, or between sites. This is an important factor in limiting the impact of the proposed development on avifauna in the study area. Although the numbers of birds will be reduced in the study area through loss of habitat, the retention of intervening areas of natural habitat will reduce the impact of habitat transformation, allowing the bird species composition in the study area to remain similar to pre-development levels provided that vegetation clearing outside of the infrastructure footprint is prevented. The retention of adjacent habitat will also assist in the maintaining of bird movement corridors between residual areas of natural habitat, particularly in the context of the linkage of the large unimpacted areas of natural habitat to the south and south-west of the sites with the Steelpoort River and associated riparian zone. Accordingly, various parcels of land adjacent to the sites and arrays have been identified as being critical to ensuring ecological connectivity between areas of residual habitat. Such areas are indicated in Figure 16. Such areas include:

- The riparian zone of the Steelpoort River located to the north of Site 5.
- The riparian zone of the watercourse and flanking woodland located between Site 4 and the HH waste disposal dam and Site 3.
- The downstream reach of the same (above) watercourse and riparian zone that bisects Site 5.
- Remnant woodland between the R37 link road and the solar panel arrays on Site 1.
- Remnant woodland located between the northern boundary of Site 2 and the rail shunting yards
- The watercourse located immediately west of Site 2.

As discussed in the impacts mitigation section below (refer to Section 8.3) it is strongly recommended that these areas, along with the riparian corridor of the Steelpoort River be maintained as areas of natural woodland. The exclusion of areas of sensitive habitat from a biodiversity perspective from the development sites that was undertaken in the Scoping-phase of the project may in practice result in the further degradation of the sensitive riparian habitats if these areas are left open to access by members of the public and livestock and accordingly a stipulation has been made that these areas be fenced into the solar development sites.

Figure 15 – Helmeted Guineafowls foraging in a disturbed area (a pipeline servitude) to the north-east of Site 5

7.1.2 Other Potential Impacts associated with the Development of Solar Arrays

One of the other significant direct impacts relating to the development and operation of solar panel arrays is bird trauma or mortality that is caused by collisions with PV panels, with the possible reasons for collisions being polarised light pollution and/or relating to waterbirds mistaking large arrays of PV panels as wetlands or waterbodies – the so-called “lake effect” (Walston *et al*, 2016). Although no evaporation ponds are proposed to be developed in association with the solar power development, certain of the arrays are located in close proximity to a number of artificial waterbodies that exist in the vicinity of the Smelter, in particular a cluster of these associated with the water treatment works.

As described in Section 6.3.3, a certain assemblage of waterbird species inhabits these artificial waterbodies. The presence of these existing waterbodies in direct proximity to the newly developed solar arrays could arguably exacerbate the potential for waterbirds travelling over the sites to mistake the arrays for water bodies. However, it is important to consider that a relatively small overall number of birds and species diversity inhabit and utilise these water bodies. Furthermore, when considered in a wider (regional) context, the Sekhukhuneland-Lydenburg area is not associated with significant water bodies or wetlands, primarily due to the nature of the terrain which is often highly mountainous and rocky and thus does not typically attract wide range of waterbirds that would be attracted to large natural wetlands, floodplains, pans or dams. The presence of large number of over-flying waterbirds that could be attracted to the panels in the manner of the ‘lake effect’ would thus be highly unlikely in the study area. This potential impact is thus not considered to be significant and the potential for large numbers of waterbirds or threatened species to be attracted to the solar arrays through the lake effect is expected to be low.

Nonetheless as part of the proposed operational monitoring of bird-related impacts on the development site, the solar arrays must be monitored for collision-related impacts, as discussed further in Section 8.4.

7.1.3 Construction-related Disturbance and Displacement Impacts

The construction of the solar panel arrays over a large area will be a massive undertaking that will involve bulk earthworks, the removal of vegetation, and in some cases the removal of outcropping or underlying bedrock. Construction will thus be very noisy, will at times generate large volumes of dust, and will involve the use and co-ordination of large numbers of plant and other vehicles. Sources of loud noise are likely to have varied, but definite impacts on birds; Noise from human activities (in particular from infrastructure and construction sites) has a strong impact on the physiology and behaviour of birds. This impact related to the masking of signals used for communication, breeding and for hunting (Bottalico *et al,* 2015). The presence of a noise source in an area implies a decrease in bird density. The decrease happens because birds tend to leave the areas where their signals are masked by the noise source (Bottalico *et al,* 2015).

In the context of the study area, it is important to note however that the Smelter provides a significant source of noise to the ambient noise levels in the area. The baseline is thus altered from a natural setting, especially for parts of certain of the development sites that are located closest to the Smelter (parts of Sites 3 & 5). Nonetheless, construction activities, in particular the above-mentioned high noise generating activities would be likely to lead to the displacement and disturbance of birds, even in areas not being developed that are located adjacent to the development site. This is a temporary impact that will last for the duration of the construction in that particular development site/s but may lead to the temporary displacement of birds and the abandonment of breeding efforts. This would be particularly significant for larger species of birds which occur in lower densities due to the occurrence of large territories. The presence of a suspected Wahlberg’s Eagle nest has been discussed in Section 6.2 and Section 7.2.4. The undertaking of construction when such species are not breeding is important. The majority of bird species breed in the summer months, and accordingly it is thus recommended that construction activities, in particular earth moving, rock removal and vegetation clearing occur in the winter months when most bird species are not breeding and there is a lower number and species diversity on the site due to the absence of migratory species.

7.2 Species-specific Impacts

7.2.1 Raptor-specific Impacts

As discussed in Section 6.2 above, the presence of a number of raptor species on the site was discussed. This section accordingly assesses how the proposed development is likely to impact these raptor species. The Wahlberg's Eagle-related impacts are discussed separately in Section 7.2.4 below.

The Lanner Falcon was that only raptor recorded on the site to be included in the list of priority species. There were a number of Lanner Falcon sightings, mostly in the eastern part of the study area, close to the town of Steelpoort and its surrounds and in the vicinity of the Steelpoort River riparian zone. Sightings occurred during both the Scoping-phase (April 2021) and EIAR-phase site visits. This suggests that at least one bird is resident in the area. The species appears to favour the Steelpoort riparian zone (where there is a high density of prey species) and the vacant areas surrounding Steelpoort, being associated with the various power lines to hunt its avian prey. Sites 1 and 5 are proposed to be developed in the area in which the species was most regularly observed, and along with other raptors, the transformation of habitat could lessen the available area in which the bird hunts. This impact would be mitigated by the non-development of the Steelpoort riparian corridor in which its arguably most productive hunting area would remain undisturbed. The development of the five development sites is thus assessed to be associated with a low level of impact on this species.

The Black-chested Snake-Eagle was observed on several occasions during both the Scoping- and EIAR-phase field assessments, typically a single bird in flight at a relatively low altitude over the site. The sightings were primarily in the vicinity of Sites 4 and 5. Accordingly the development sites are likely to form part of the territory of a resident bird, with the bird hunting over the woodland in these areas. The transformation of the woodland on the sites would thus have an effect on the area available to the resident bird(s) in which to hunt, but the relatively low overall area that would be transformed would limit the significant of the impact on this species. The development of the five development sites is thus assessed to be associated with a low level of impact on this species.

African Fish Eagles were recorded on a number of occasions during the EIAR-phase field assessments, always at high altitudes when observed from the development sites. A pair was recorded at the Tubatse Dam located in the hilly terrain to the south of the development sites. This dam is stocked with fish and a pair observed at the dam is likely to utilise the dam for hunting and could possibly even nest in the mature woodland in the hilly terrain surrounding the dam. The artificial waterbodies surrounding the site could attract these piscivorous birds but would not be used for fishing as these waterbodies do not hold fish. The birds could also be likely to frequent the Steelpoort River and its riparian zone but were not recorded in the vicinity of the river. The pair that is assumed to be a resident pair is likely to occur primarily in the vicinity of the Tubatse Dam, moving between this dam and other dams in which fish are present that are located in the wider vicinity. It is highly unlikely that the species would visit the artificial waterbodies located close to the Smelter as these waterbodies are not expected to hold any fish. The Tubatse Dam is located at sufficient distance and altitude in relation to the development site that the development would be unlikely to exert an impact on this species.

Of the other raptor species recorded, loss of hunting habitat would be the most significant impact, especially for the Little Sparrowhawk. However, the non-development of the Steelpoort riparian corridor in which this species is most likely and regularly to hunt is a strong ameliorating factor. Certain raptor species, for example the Black-winged Kite could benefit from the development. This species is often encountered in modified habitats such as road reserves, and as such the modified habitat of the solar arrays and their margins could arguably provide suitable hunting areas, especially with the development of new power lines that would present new hawking locations.

7.2.2 Impacts on Waterbirds

Waterbirds were noted to inhabit / visit a number of surface water features in the vicinity of the development sites, the most significant of which is the Steelpoort River.

The exclusion of the Steelpoort River's riparian corridor from the development footprint (including power lines) is an important mitigation measure that is likely to greatly minimise any potential impact of the development on the waterbirds (along with other birds) that either forage within the river's aquatic habitats, roost in its riparian corridor or regularly move along the river. The low altitude at which most of the birds fly is likely to prevent any occurrence of the 'lake effect' of birds moving along the river mistaking the PV solar panel arrays for waterbodies. The development is thus not expected to have an impact on the river's waterbird assemblage, provided no construction activities occur within the riparian corridor.

Tubatse Dam located to the south of the development sites is primarily utilised by piscivorous waterbirds that favour open water habitats, with a low species richness and low density of birds. The altitude of the dam in relation to the development sites in the Steelpoort Valley twinned with the low density of waterbirds visiting the dam will negate any potential for collision of birds moving between the Steelpoort Valley and the Dam.

Lastly the artificial waterbodies located to the north of the Smelter and in close proximity to the solar arrays on Site 5 and its proposed power line raise the prospect of a higher degree of impact for waterbirds visiting these waterbodies. The artificial waterbodies are inhabited / utilised by a low number of species and relatively low overall number of birds. However, the waterbodies are utilised as roosting sites by a number of species that are resident in the area, and accordingly these birds will move to and from the waterbodies. Incidental observations are suggestive that the waterbodies may occasionally be utilised by species that would not regularly occur in the wider area to rest / roost. In the context of the development of solar arrays close to the stormwater dam in particular and the development of the proposed Site 5 power line adjacent to this dam, these new developments could impact the waterbirds utilising the waterbodies through displacement during the construction period, and in operation through collision with the proposed section of power line that has been aligned immediately adjacent to the stormwater dam. The collision risk would appear to be most acute in low light conditions at the end and start of the day when waterbirds arrive to roost or depart.

As solar arrays are proposed to effectively surround the stormwater dam and be located immediately adjacent to the western side of the brine dams, the panels could also pose a collision risk for waterbirds, especially during low light conditions as discussed above. The relatively low number of birds visiting these artificial waterbodies would render the potential impacts less significant that a scenario in which large numbers of waterbirds were frequenting the waterbodies, and the potential impact is not considered highly significant. Nonetheless certain mitigation measures have, and operational monitoring of collisions has been recommended at these waterbodies.

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7.2.3 Impacts on Priority Species

As discussed in Section 6.4, none of the species identified as priority species in the Scoping-phase avifaunal assessment were recorded in the study area, with the exception of the Lanner Falcon which was recorded on numerous occasions on certain of the development site in both the Scoping and EIAR-phase field visits. The Verreaux's Eagle was recorded out of the study area, but in sufficiently close proximity to suggest that a resident pair(s) are likely to range into the study area. Birds ranging over the development site are highly unlikely to hunt over the development sites as their primary prey (Rock Hyraxes) are not present on the development sites. This species may hunt other prey such as goats, but no goats are present on any of the development sites. The likelihood of Verreaux's Eagles occurring in the immediate vicinity of the development sites and interacting with the proposed infrastructure is thus deemed to be very low. Of the other priority species, all were likely to be very occasional visitors to the site, in many cases ranging high above the sites, or very unlikely to visit the study area due to absence of suitable habitat or high human presence in the area. The likelihood of the development impacting the priority species (other than the Lanner Falcon) has thus been assessed to be very low.

7.2.4 Wahlberg's Eagle Breeding Impacts

As described in Section 6.2 above, a potential nest site for a Wahlberg's Eagle nest was located in close proximity to Site 4 along the ephemeral watercourse that drains from the south. The confirmed presence of breeding at this location was not able to be ascertained due to the timing of the site assessments that were limited by the EIA timeframes and it remains unknown whether the pair is actively nesting and egg-laying at this site.

If breeding was occurring at this site, breeding activities in the next (spring 2022) or subsequent breeding seasons could be adversely affected if Site 4 is developed. The significance of such an impact can be examined in the overall conservation status context of the species. The species is not listed as threatened in the latest (2015) assessment of Red Data bird species in South Africa, Lesotho and eSwatini (Swaziland) (Taylor *et al.* 2015). The species is also not listed in the Eskom Red Data Book (Taylor *et al*, 2015) in any of the appendices as a special interest species or as a previously assessed species or an additional species that requires monitoring. The species text in Roberts states that certain regional populations are decreasing, and notes that in north-eastern South Africa an approximate 40% population decrease was observed over 10 years. Globally the species is listed as Least Concern. This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (extent of occurrence <20,000 km^2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population trend appears to be stable, and hence the species does not approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size is very large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure) (Birdlife International, 2021). Being one of the apex avian predators in the study area does make this a significant species in a local context and the impacts on the development on a potentially breeding pair needs to be assessed.

The nest site is located 220m from the closest part of the Site 4 boundary and 230m from the closest proposed solar arrays on Site 4. The construction of the solar arrays in particular could cause breeding at the next site to be abandoned due to the high level of noise associated with construction activities, especially vegetation clearing and site levelling and the erection of the arrays. The sensitivity of this species to disturbance in the vicinity of the nest site is unknown, however it must be assumed that as eagles, the pair would be sensitive to such disturbance to a certain degree. It must be noted that the nest site is not located in an entirely undisturbed area – in addition to the presence of the Smelter which adds a constant level of ambient noise to this area, the nest is located in relatively close proximity to the truck depot (330m to the boundary of the depot) to the north-west, and around 770m to the northern HH waste disposal dam where construction is currently occurring. The area is thus characterised by a relatively high degree of human activity, noise and existing habitat transformation, and in this context the eagle pair thus can be assumed to have a reasonable degree of tolerance to disturbance in the context of the surrounding activities.

It is difficult to determine whether the operation of the arrays on Site 4 would adversely affect breeding at the suspected nest site. As discussed above, the pair appears to have a reasonable tolerance for high levels of noise and human presence within a 300m -1,3km radius (1.3km is the distance of the Smelter from the nest site), should breeding be currently occurring at the nest location. Accordingly, the transformation of woodland on Sites 3 and 4 would lessen the area available for foraging but may not cause breeding to be abandoned if noisy activities do not occur at the arrays during operation. Operation of PV solar arrays is not typically associated with high levels of noise, and the presence of solar arrays on Site 4 would arguably not deleteriously affect breeding, provided the riparian zone of the watercourse remains an area in which human activity is restricted. Along with other raptors that frequent the study area, the loss of foraging habitat may affect the occurrence of this species in the study area, although suitable habitat would remain in the surrounding area.

Due to the degree of uncertainty associated with the nest site and the occurrence of nesting at this location It is accordingly important that the potential presence of the breeding at the suspected nest site be confirmed prior to construction, in order to determine what mitigation measures need to be applied (refer to Section 8.1). The nest site may be one of multiple nest sites in the pair's territory, and thus may not be always utilised. It is thus important for pre-construction monitoring to determine whether the nest is actively utilised and to accordingly specify mitigation measures.

7.3 Impacts associated with Power Lines

Power lines have been dealt with separately as they constitute a significant component of the proposed development and can be associated with significant impacts on birds. Each of the five development sites is associated with a power line of varying length that will carry power generated at the PV sites to two existing substations at the Tubatse Ferrochrome Smelter.

Power lines are large structures and can have significant negative, as well as some positive impacts on birds. The primary power line-related impacts on birds are listed below:

- Electrocutions, leading to bird mortalities
- Collisions with overhead wires, leading to bird mortalities
- Habitat Destruction
- Disturbance
- New nesting and roosting opportunities (positive impact)
- Impacts by birds on the electrical infrastructure (streamers causing shorts on the line)

It must be noted that as part of the EIAR-phase avifaunal assessment on the sites, walkdowns of certain of the power line alignments in the study area, especially those power lines located close to the development sites and those along which new power lines are proposed to be developed were undertaken. No bird carcasses were noted along any of the spans which were walked, which is suggestive that the study area has a low risk of bird collision. However, this does not guarantee that no collisions of larger birds with power lines (especially newly developed power lines) would not occur, and there are a number of spans of the proposed power lines which have been identified as being associated with a higher risk of bird-related (especially collision-related impacts), as discussed below.

7.3.1 Power line-related Site-specific Impacts

The power line alignment for the various sites has been refined and altered by the engineering design team since the environmental Scoping-phase as part of the concept design that has been undertaken in advance of the EIAR-phase of the project. Certain of the alternatives presented in the Scoping-phase have been removed and the only site with alignment alternatives is Site 1 where two alternative alignments for passing through the residential area of Steelpoort. The various power line corridors traverse different areas in joining the development sites and associated solar PV panel arrays with the two substations located at the Smelter.

As the substations are located in very close proximity to the Smelter and its associated operations, much of the power line alignments would run in close proximity to the area in which the Smelter operations take place. This area is highly transformed with the presence of the smelter and slag dumps and due to the absence of any vegetation along with the high disturbance factor associated with the plant and its operations has a very low degree of bird species occurrence. Such alignments include the portion of the power line corridors from Sites 1 & 2 that are located between the Smelter and the truck loading area, and the portion of the Site 3, 4 & 5 power line corridors that are located between the Smelter and the access road to the HH Waste Disposal Facility and Leachate Pond. These sections of the power lines pose a very low potential for bird-related, and collision impacts due to the transformation and disturbance factors.

The majority of the Site 1 power line alignment, including the two alternative sections are proposed to traverse, or run-in immediate proximity to urban developed (residential) areas within Steelpoort. Such areas being transformed due harbour a certain assemblage of birds – much altered from a natural species composition, but not typically containing collision-prone or threatened species which would not typically occur within transformed urban residential settings. The sections of the alternative corridors for the Site 1 power line that run from the R37 link road to the edge of the residential areas are deemed low risk. The power line corridor runs south , running roughly 140m from the edge of the residential area to the point at which the power line crosses the R555 road. Due to the proximity of the proposed power line to an urban area and mitigated by the presence of an existing power line that runs parallel to the western edge of the housing complexes, this part of the Site 1 proposed power line, and the section to the south of the R555 road that also traverses transformed, light industrial landuses is also considered low risk from a bird impact perspective.

However other sections of the proposed power line corridors would pose a greater risk of bird-related impacts. The Site 5 power line connects to the solar array in immediate proximity to the stormwater dam that is located to the north of the R555 road and the smelter. The stormwater dam forms one of a number of artificial waterbodies that are clustered in relatively close proximity, including the settling ponds associated with the water treatment works and the brine dams. To the south of the R555 the power line would also run in very close proximity to two brine dams. Although all of these waterbodies are artificial, they attract a certain assemblage of waterbirds – mainly species associated with open water habitats - as described in Section 6.3.3 above. These waterbirds fly to and from the various water bodies, likely arriving from the north where the Steelpoort River – a waterbird movement corridor – is located.

Certain species may use the waterbodies as roosting sites, and accordingly arriving / departing from the water bodies in low light conditions. The presence of power lines located in close proximity to the stormwater dam and the brine dams would thus pose a greater possibility of bird strike / collision impacts. There is a low density of waterbirds that would be likely to occur at these artificial waterbodies (as suggested by the waterbird survey results) and accordingly the overall significance of the collision risk posed by power lines located immediately adjacent to the stormwater dam and brine dams has been assessed to be moderate. In spite of the lower level of significance of bird-related impacts associated with the section of the Site 5 power line, mitigation measures in the form of the proposal to install underground cabling rather than an overhead line, or to install bird diverters (flappers) on the power line sections have been stipulated as mitigation measures (see Section 8.2).

The Site 4 power line corridor would traverse an area that is cleared of woody between the HH waste facility and the leachate pond. It is important to note that the HH waste facility is proposed to be expanded northwards towards the proposed power line corridor. In addition there is an existing power line along with the proposed Site 4 power line would run. The HH water facility waterbody and the leachate pond are not currently utilised by waterbirds and a number of inspections of these waterbodies have not revealed any waterbirds at these waterbodies (although during the time of the assessment the leachate pond was empty). This section of the Site 4 power line is not considered to be a high risk of bird impacts. To the west the power line would need to span the watercourse that drains northwards between Sites 3 and 4. The proposed Site 4 power line is not proposed to continue to run in parallel to the existing power lines, rather being diverted to the south-west before bending sharply northwards to run in parallel to the boundary of Site 4. A bend tower would accordingly need to be placed within the riparian zone of the watercourse, very close to the channel. The development of the new power line parallel to one of two existing power lines, especially at the watercourse crossing, is strongly preferred and a proposed realignment is discussed in Section 8.2.

Royal HaskoningDHV

7.4 Impact Rating Matrix

Table 5 – Impact Rating Matrix Table for Habitat Loss

<table>
<tr><th>Phase</th><th>Potential Aspect and/or Impact</th><th>Mitigation</th><th>Scale (S)</th><th>Duration (D)</th><th>Magnitude (M)</th><th>Probability (P)</th><th colspan="2">Significance Points (M+D+S)xP</th></tr>
<tr><td rowspan="3">Construction</td><td rowspan="3">Aspect:
Construction of the solar power plant utilising the current layout – i.e. developing all five of the development sites.
Impact:
Direct transformative impact on natural habitat related to construction of solar panel arrays cable trenching and internal access roads, as well as other construction-related activities including uncontrolled movement of vehicles and other construction machinery. The impact would relate to the loss of habitat for the current bird species inhabiting / visiting the development site and surrounding area.</td><td>Without</td><td>2</td><td>4</td><td>6</td><td>5</td><td>60</td><td>Moderate Significance</td></tr>
<tr><td>With</td><td>1</td><td>4</td><td>6</td><td>5</td><td>55</td><td>Moderate Significance</td></tr>
<tr><td colspan="7">Key mitigation measures:
▪ Clearing of vegetation to be completed in a phased manner.
▪ Construction activities must not encroach beyond the development footprint.
▪ Construction staff must not enter any areas of residual woodland or other natural habitat outside of the development footprint.</td></tr>
<tr><td rowspan="3">Operation</td><td rowspan="3">Aspect:
Operation of the solar power plant utilising the current layout - i.e. developing all five of the development sites.</td><td>Without</td><td>1</td><td>4</td><td>6</td><td>5</td><td>55</td><td>Moderate Significance</td></tr>
<tr><td>With</td><td>1</td><td>4</td><td>6</td><td>5</td><td>55</td><td>Moderate Significance</td></tr>
<tr><td colspan="7"></td></tr>
</table>

Phase	Potential Aspect and/or Impact	Mitigation	Scale (S)	Duration (D)	Magnitude (M)	Probability (P)	Significance Points (M+D+S)xP
	Impact: Permanent transformative impact on natural vegetation that would lead to the relate to the loss of habitat for the current bird species inhabiting / visiting the development site and surrounding area.	**Key mitigation measures:** ▪ Retention of residual natural vegetation on the parts of the five development sites that do not fall within the solar array or other infrastructure footprint. ▪ Active protection of sensitive habitats through fencing off from public access – i.e. the Steelpoort River riparian zone on the southern bank of the river and the ephemeral watercourse and its associated riparian zone. ▪ Non-development of the 350m buffer of the Wahlberg's Eagle nest should active nesting be confirmed to be occurring on the site.					

Table 6 – Impact Rating Matrix Table for Power line related and collision-related impacts

Phase	Potential Aspect and/or Impact	Mitigation	Scale (S)	Duration (D)	Magnitude (M)	Probability (P)	Significance Points (M+D+S)xP	
Operation	**Aspect:** Development (operation) of the solar power plant utilising the current layout – i.e. developing all five of the development sites, as well as the development of power lines linking each of the five development sites to the two substations at the Smelter. **Impact:** Bird fatalities due to collisions with overhead power lines or with PV panels.	**Without**	2	4	8	3	42	**Moderate Significance**
		With	2	4	6	2	24	**Low Significance**
		Key mitigation measures: ▪ Use of underground cables rather than an overhead line along the Site 5 power line alignment to the north of the R555. ▪ Realignment of the Site 1 power line to run immediately adjacent to the existing power line. ▪ Realignment of the Site 4 power line to run parallel to the existing power line where it crosses the watercourse (thus removing the proposed bend tower from the watercourse's riparian corridor). ▪ Placing of bird flight diverters along key spans (as identified in Section 8.2).						

7.5 Cumulative Impacts

The development sites are located in close and relatively proximity to the town of Steelpoort. In the medium to long term the town is likely to expand, with the development of more commercial and residential areas, which would expand into currently undeveloped areas around the town. The proposed development would accordingly form one part of a trend of increasing areas of natural habitat that are transformed from a natural state. Such trends are not unexpected in the radius of existing urban (and industrial) developments, within which the study is located.

The cumulative loss of natural habitat through the different causes of land transformation, were these to all materialise in the near future, would combine to reduce the habitat available to the bird species that currently inhabit the area. The wider area would accordingly be likely to be characterised by a loss in species diversity and richness as the area becomes increasingly developed. This trend may be aggravated by the continued and increasing utilisation and harvesting of natural resources by residents in the area who would continue to remove woody vegetation (especially trees and larger shrubs) for firewood. Such natural resource use that leads to degradation of woodland habitats would be particularly pronounced in sensitive habitats for bird such as riparian corridors, thus worsening the impacts of increasing transformation of natural habitats.

8 Mitigation Measures

8.1 Mitigation Measures related to the Presence of the Wahlberg Eagle Nest close to Site 4

A suspected Wahlberg's Eagle (*Hieraaetus wahlbergi*) nest site has been located in relatively close proximity (230m) to the nearest solar arrays on the southern part of Site 4. Due to the timing restrictions of the assessment, it has not been able to be determined whether the pair actively nests at this location. Although the development of the solar arrays on Site 4 would not directly affect the nest site, and the operation of the PV panels would be unlikely to affect nesting activities, construction activities and the associated noise and disturbance factor would be likely to adversely affect breeding activities, phonetically leading to the abandonment of the nest of they were to occur during the breeding and nesting season.

It is thus very important for the presence of breeding at the nest location during the current (2021-2022) breeding season to be confirmed. Accordingly it is recommended that an avifaunal specialist undertake monitoring of the nest location and in the wider study area to determine the presence of breeding at this location, or at any other nesting sites within the study area. It is recommended that a drone be used to photograph the nest from above. This monitoring of the nest site must continue (as part of the general recommended pre-, during- and post-construction (operational) avifaunal monitoring on the development sites and wider study area) for each subsequent year in which construction occurs.

Should breeding be confirmed at the suspected nest location, the following mitigation measures are recommended:

- A 350m buffer of the nest site in which no development should occur is recommended; 350m is the distance of southern part of the truck depot from the nest location, and which the pair appears to tolerate human activity. This would result in the restriction of a portion of the Site 4 solar arrays not being developed.
- The highest risk of impact on breeding would be related to high noise construction activities. The impact of the construction activities on Site 4 would not be an issue if construction of Site 4 and Site 3 (the closest development sites to the nest location) were to occur during the periods in which

Wahlberg's Eagles are not present within South Africa – i.e. the period between April and August. Accordingly the construction of the arrays on Sites 3 and 4, in particular the early phases of construction (i.e. vegetation clearing, earth levelling, any required bedrock extraction / blasting, and other noisy activities including road construction and erection of large structures must be timed to occur during the months of April to August when the species is not present or has completed breeding.

Even if breeding does not occur at the nest location, the following mitigation measure must be adhered to:

- The watercourse and its associated riparian zone, especially the reach to the south-east of Site 4 must be maintained as a no-go area that must not be affected by any construction activities or plant / people access during construction, except for the stringing activities for the construction of the proposed power line. Access to the riparian zone of the watercourse must be directly prohibited through the erection of fencing.

8.2 Power line-related Mitigation Measures

As discussed in Section 8.1 above, a number of impacts, and thus priority spans of the proposed power line alignments have been identified that are associated with a higher risk of potential avifaunal impacts, in particular collision-related impacts. The following mitigation measures are specified for certain power line spans / sections on the development site:

- **Site 1 power line in the section between the R555 and the north-western edge of the Steelpoort residential area**: unless there are clear technical reasons not to do so, the proposed power line must be aligned to run parallel to the existing power line that is aligned along the western edge of the residential area. This measure will reduce fragmentation of natural habitat that would result, will place the power line where an existing power line to which birds are accustomed is present, will avoid a new crossing of the watercourse and resultant destruction of sensitive riparian habitat, and will place the power line closer to a transformed urban area which will minimise the potential impact on birds.
- **Site 5 power line located to the north of the R555 road**: the section of the Site 5 power line located to the north of the R555 road must be changed to be underground cabling. If this is technically-not feasible or prohibitively expensive, then the spans of the power line located to the north of the R555 road must be fitted with bird diverter devices.
- **Site 5 power line located to the south of the R555 road**: Due to the presence of a brine dam located to the south of the R555, adjacent to which the power line is proposed to be aligned, the spans of the power line located adjacent to, and within 200m of the edge of the brine dam must be fitted with bird diverter devices.
- **Site 4 power line located to the east of Site 4 that crosses the watercourse**: the current alignment of the Site 4 power line would necessitate the placement of a bend tower within the riparian zone of the watercourse crossed and very close to the channel of the watercourse, resulting in unnecessary disturbance of sensitive riparian habitat along an important bird movement corridor. Accordingly, the proposed power line must be realigned to firstly span the watercourse in one span and to run adjacent to one of the two power lines that span the watercourse in this area. Ideally design and engineering should consider piggybacking the proposed power line on one of the existing lines that cross the watercourse to avoid the further impacting of the riparian zone of the watercourse at this location.

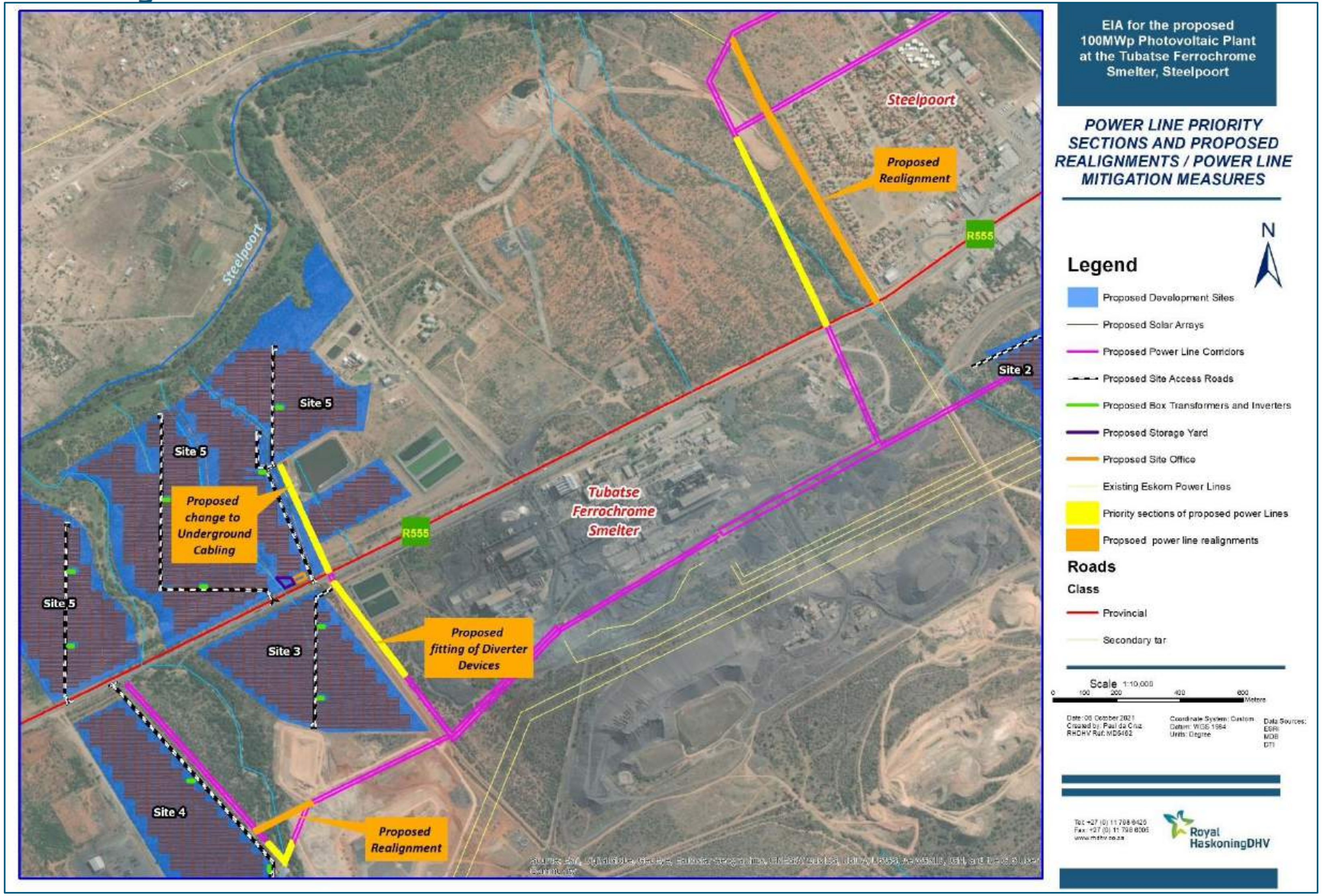

Figure 16 – Power line priority sections and proposed location of realignment and other mitigation measures

8.3 Protection of Residual Natural Woodland

In order to reduce the severity of the impact associated with the physical transformation / loss of natural woodland habitat associated with the development of PV arrays and ancillary infrastructure of the five development sites, it is key to maintain residual woodland habitat that is located adjacent to, and in some cases in between sites located adjacent to one another. The maintaining of areas of residual woodland is key to ensuring that the ecological integrity of residual areas (including in particular from an avifaunal perspective) is maintained. Section 7.1 above has identified several important areas of residual woodland that would ensure that habitat connectivity between the residual areas of natural habitat that would remain in the vicinity of the development sites once the solar arrays have been developed. The exclusion of areas of sensitive habitat from a biodiversity perspective from the development sites that was undertaken in the Scoping-phase of the project may in practice result in the further degradation of the sensitive riparian habitats if these areas are left open to access by members of the public and livestock and accordingly a stipulation has been made that these areas be fenced into the solar development. One of the key degrading factors that adversely affects areas of residual woodland in the Steelpoort area to which access is not restricted is the intensive grazing of cattle twinned with the removal of woody vegetation for firewood. This is particularly pronounced on Site 5 where residents of the peri urban areas located to the north of the river use the sites for cattle grazing and actively fell trees for firewood. The current site layout for Site 5 indicates that Clear Vu fencing associated with the solar arrays will not include the Steelpoort riparian zone located to the north of Site 5 or the watercourse that bisects Site 5. These areas will thus remain open to the public and will continue to be affected by the indiscriminate removal of woody vegetation. The Scoping-phase avifaunal report noted that the northern bank of the Steelpoort River has been completely stripped of riparian vegetation to the north and south-west of Site 5. Left unprotected, such a scenario is likely to eventuate on the southern bank of the river's riparian zone, as well as to the remaining woody vegetation located along the watercourse that bisects Site 5. Under this scenario, the value of these riparian zones as bird movement corridors would be greatly diminished.

Accordingly in order to protect the habitat integrity of the Steelpoort River riparian zone on the southern bank of the river, as well as that of the watercourse located between the river and the R555 road, these areas, and the other areas (detailed below and as indicated in Figure 17) of remnant woodland vegetation must be included within the fenced off footprint of the arrays.

- The riparian zone of the Steelpoort River located to the north of Site 5
- The riparian zone of the watercourse and flanking woodland located between Site 4 and the HH waste disposal dam and Site 3
- The watercourse and riparian zone that bisects Site 5
- Remnant woodland between the R37 link road and the solar panel arrays on Site 1
- Remnant woodland located between the northern boundary of Site 2 and the rail shunting yards
- The watercourse located immediately west of Site 2

The protection of these areas would have great value in the context of the continued loss and transformation of residual natural habitat in the study area and could presumably contribute to the offset of biodiversity loss and habitat on the development sites. Fencing these sites would perform a dual purpose of allowing woodland vegetation to be retained, through which birds could move between larger areas of woodland vegetation, as well as allowing the riparian woodland along the southern bank of the Steelpoort River and larger watercourse to recover over time, thus enhancing the habitat integrity of certain reaches of the riparian zones.

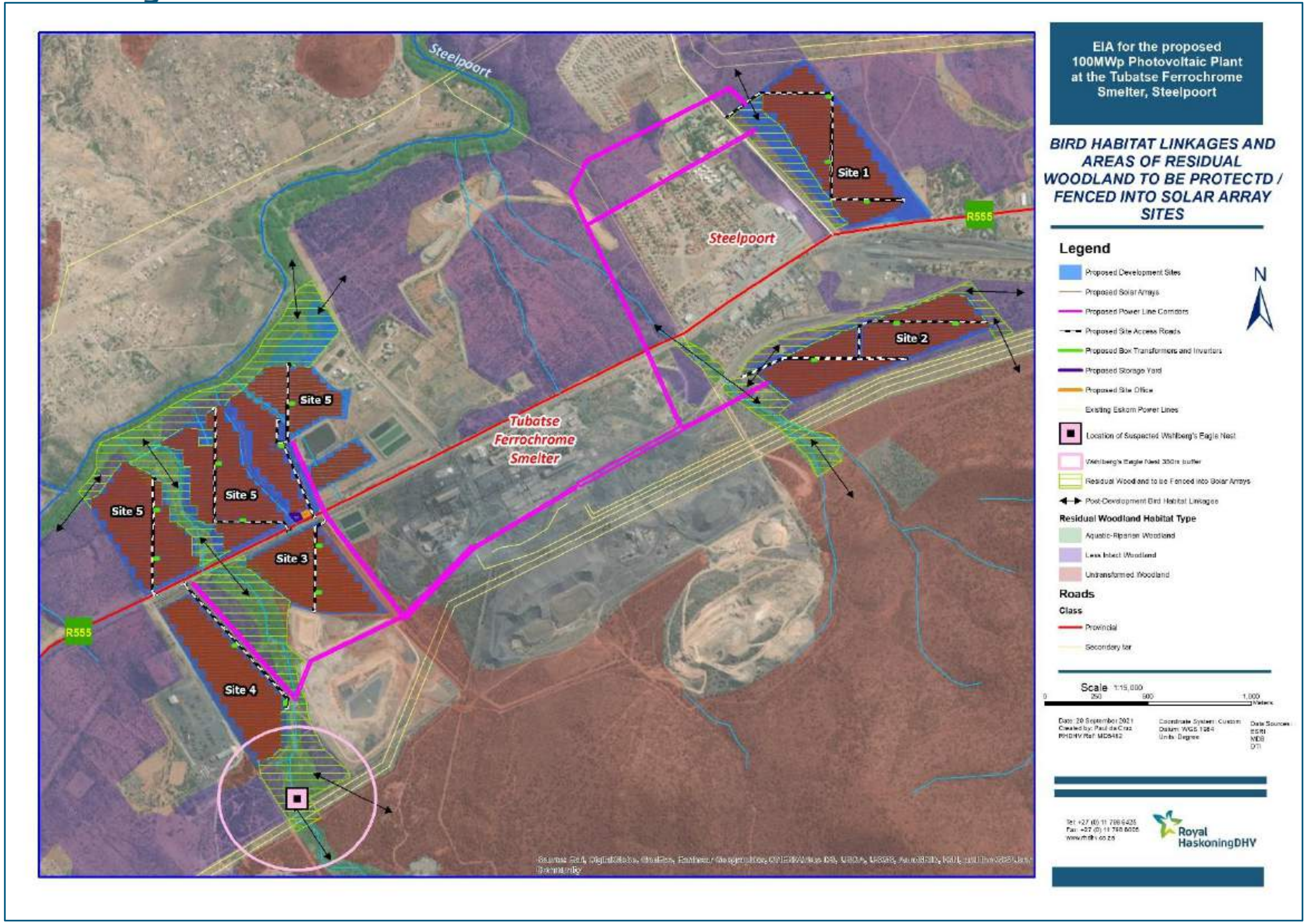

Figure 17 – Bird habitat linkages on the development site and areas of residual woodland proposed to be protected

8.4 Recommended Pre-Construction and Operational Avifaunal Monitoring Regime

The development of solar power generation facilities is a relatively recent phenomenon in South Africa, and such facilities have only been in place for the last decade, concentrated in certain parts of the country. The localised impacts of such facilities are still poorly understood.

As such it is advised that monitoring be conducted in the pre-construction and post construction phases of the project as detailed below:

Pre-Construction:

Pre-construction monitoring on the site must be focussed on the conformation of the active use of the Wahlberg's Eagle nest near Site 4. It is thus very important for the presence of breeding at the nest location during the current (2021-2022) breeding season to be confirmed. Accordingly it is recommended that an avifaunal specialist undertake monitoring of the nest location and in the wider study area to determine the presence of breeding at this location, or at any other nesting sites within the study area. It is recommended that monitoring is conducted in the early summer of 2021 /22 to confirm whether the nest site is being used, and in the latter stages of the nesting period to determine the success or otherwise of breeding.

This monitoring of the nest site must continue (as part of the general recommended pre-, during- and post-construction (operational) avifaunal monitoring on the development sites and wider study area) for each subsequent year in which construction occurs.

During Construction:

Should any part of construction at Sites 3 and 4 be undertaken during the period of Wahlberg's Eagle breeding (September to March), the nest site and any other nest sites located must be monitored in the manner described above.

Post Construction (Operation):

Operational Monitoring must be undertaken and focus on the following aspects / areas on the development site and wider area:

- Breeding at the Wahlberg's Eagle nest site must be undertaken during the species' breeding period in order to determine how the presence of the development affects breeding.
- Assessment of habitat loss on bird species richness and relative abundance must be undertaken through the application of the same data collection and observation techniques as were applied in the EIAR-phase field assessments. Surveys conducted twice a year in the first two years of operation must be conducted as a minimum.
- Quantifying bird mortalities – Regular searches for carcasses of any bird fatalities associated with the operational solar facility must be undertaken, by an avifaunal specialist or a suitably qualified ECO. Search focus must be directed at the areas / components of the development highlighted as high risk for collisions, including all new power line alignments, the arrays in the vicinity of the existing water bodies on the site, and the arrays located closest to the Steelpoort riparian corridor. The methods detailed in the BLSA Guidelines must be applied.

9 Conclusion

The avifaunal assemblage in the study area has been studied and assessed, and it can be concluded that the development of the solar facility will not have highly significant impacts on the avifaunal environment in a wider study area context despite more significant localised impacts. The exclusion of certain sensitive areas from the development footprint, especially the riparian corridors on the site is a critical mitigation measure that in association with the active protection of these and other areas of residual woodland on the development sites will minimise the impacts of habitat loss and which will ensure that habitat connectivity is maintained.

A series of mitigation measures have been stipulated, and provided these are implemented, the development can proceed without resulting in significant impacts on the avifaunal assemblage on the site, in particular on priority species and other sensitive species such as raptors.

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Appendix A – Expertise and CV of Author

Curriculum Vitae

Paul da Cruz

Associate

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Paul offers a varied set of skills and a wide set of experience in different disciplines. He performs the role of an environmental specialist in the disciplines of freshwater (wetland) assessment, visual impact assessment and avifaunal assessment, as well as EIA project management. As the GIS specialist for the Environmental Team he undertakes GIS-based spatial analysis and has developed a GIS-based screening tool for EIA Regulation Listing Notice 3 Activities. Paul also undertakes ECO environmental auditing.

Paul's extensive wetland assessment experience was gained during work undertaken for the Mondi wetlands project and ensuing work in the consulting field in South Africa over 15 years.

He worked in the UK for three years in regulatory and water resources assessment roles for both the Environment Agency in England and SEPA. During this period he gained excellent experience and skills relating to catchment management planning, hydro-ecological risk assessment, water resource regulations and water resources strategies.

Nationality

South African / Portuguese

Years of Experience

19 years

Years with Royal HaskoningDHV

9 years

Qualifications

1998 BA (Hons) Geography and Environmental Studies, University of Witwatersrand, Johannesburg, South Africa

Professional Registrations

EAPASA

Memberships

Wetland Society of South Africa

Professional experience at RHDHV (selected key projects)

Development of Environmental Management Frameworks and Exclusion Standards for: John Taolo Gaetsewe, Waterberg and uMkhanyakude Districts

> Start Date: 2019
> Client: Department of Agriculture, Land Reform and Rural Development

Position: Technical Lead for the Waterberg EMF

- Assigned Tasks: Report Writing and Supervision of all Waterberg EMF technical deliverables.
- Participated in the Stakeholder Consultation for the Project
- Part of the core sub-team responsible for developing the exclusion standards methodology and deliverables for the project.

Environmental Impact Assessment for the Establishment of a Solar Based Electricity Generation System – 100MWp Photovoltaic Plant at the Tubatse Ferrochrome Smelter, Steelpoort

> Start Date: 2021
> Client: Samancor Chrome Ltd

Position: Specialist

- Assigned Tasks: Undertook the scoping and EIAR-phase avifaunal studies.
- Provided visual impact inputs to the EIA Report
- Provided GIS analysis and mapping support for the Project

Basic Assessment for the proposed Planning & Design for the Maintenance and/or Upgrade of the Patrol Roads and Fencing on the Borders between RSA, Swaziland & Mozambique – Phases 1& 2

> Start Date: 2017
> Client: National Department of Public Works

Position: BA Project Manager for Phase 1 and Freshwater (Wetland) Specialist for the Phase 1&2 Projects

- Assigned Tasks: Undertook the wetland component of the Freshwater Study for the project (Phases 1&2).
- Managed the Basic Assessment Process for the Phase 1 component (KZN-Mozambique border)
- Provided GIS analysis and mapping support for the Phases 1&2 BA and WULA Processes
- Undertook the Application for Amendment of the Phase 1 Environmental Authorisation (2020)

ESIA for the proposed NEO1 20MW Photovoltaic Power (PV) Generation Development Project in Mafeteng, Lesotho

> Start Date: 2018
> Client: One Power Consortium

Position: Freshwater (Wetland) Specialist

- Assigned Tasks: Undertaking the Freshwater Study for the ESIA
- Compilation of a Post-authorisation wetland rehabilitation plan and monitoring protocol
- Undertaking the Visual Impact Assessment for the ESIA.

EIA for the P166 Bypass Road in Mbombela

> Start Date: 2012
> Client: Endecon Ubuntu (SANRAL)

Position: EIA Project Manager and Specialist

- Assigned Tasks: Managed the EIA, including tasks such as overseeing the public participation process and compiling the EIA Report.
- As a specialist undertook the Visual and Surface Water Specialist Studies

EIA for the Underground Coal Gasification (UCG) Project at the Majuba Power Station, Mpumalanga

> Start Date: 2008
> Client: Eskom Holdings SOC Ltd

Position: Specialist

- Assigned Tasks: Undertook the detailed wetland impact and functional assessments.
- Updating of the visual impact assessment.

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Environmental Impact Assessment (EIA) and Waste Management Licence for the Matimba Power Station Ash Disposal Facility, South Africa

> Start Date: 2012
> Client: Eskom Holdings SOC Ltd

Position: Specialist

- Assigned Tasks: Undertook the Visual Specialist Study in support of the EIA
- Undertook the Surface Water Specialist Study for the Water Use Licence.

Basic Assessment for the Proposed Ten New PV Solar Developments at the Bokpoort Farm near Groblershoop, Northern Cape

> Start Date: 2019
> Client: ACWA Power

Position: Specialist

- Undertook the surface water specialist study

EIA for the proposed 100MW Concentrated Solar Power Plant in Groblershoop, South Africa

> Start Date: 2014
> Client: Lereko Metier Capital Growth Fund Manager (Pty) Ltd

Position: Specialist

- Assigned Tasks: Undertook the visual impact assessment study
- Undertook the surface water specialist study

Proposed Forest Park Apartments Residential Development in La Lucia, eThekwini Municipality

> Start Date: 2019
> Client: Penguin Property Investments

Position: Specialist

- Assigned Tasks: Undertook the Freshwater Study (Wetland and Riparian Delineation)

Construction of the LongLake Logistics Park Development, Modderfontein, Johannesburg

> Start Date: 2019
> Client: Fortress Investments

Position: Environmental Control Officer (ECO)

- Assigned Tasks: Undertaking the ECO (environmental auditing) of the construction site for a period of 12 months.

Geometric Improvements to 11 Intersections in the City of Johannesburg

> Start Date: 2019
> Client: Johannesburg Roads Agency (JRA)

Position: Environmental Control Officer (ECO)

- Assigned Tasks: Compiled EMPrs for the Northern and Southern Contract Sites
- Undertook the ECO (environmental auditing) of the intersection upgrade sites.

Development of Precinct Plans for the Port Elizabeth and East London Airports

> Start Date: 2019
> Client: Airports Company South Africa (ACSA)

Position: Specialist

- Assigned Tasks: Undertaking the Surface Water and Terrestrial Ecology Component of the Precinct Planning

Development of Precinct Plans for the Ekurhuleni Metropolitan Municipality

> Start Date: 2017
> Client: Ekurhuleni Metropolitan Municipality

Position: Specialist

- Assigned Tasks: Undertook the Surface Water and Terrestrial Ecology Component of the Precinct Planning

Route Determination for Various K-Route Roads in Gauteng Province

> Start Date: 2017
> Client: Gauteng Department of Roads and Transport

Position: Freshwater Specialist

- Assigned Tasks: Undertaking the Surface Water Component of the Environmental Screening Studies of the various planned routes

Basic Assessment and Water Use Application for decommissioning and replacement of a section of the Firham-Platrand Power Line, Mpumalanga

> Start Date: 2017
> Client: Eskom Holdings SOC Ltd

Position: Specialist

- Assigned Tasks: Undertaking the Freshwater (wetland) study for the BA and WUA processes, including the compilation of a wetland rehab plan and risk assessment

Basic Assessment for the Development of a Battery Storage Site (Substation) near Mount Fletcher, Eastern Cape

> Start Date: 2018
> Client: Eskom Holdings Limited

Position: Freshwater Specialist

- Assigned Tasks: Undertook the Freshwater Study (wetland assessment) for the Project

Basic Assessment and Water Use Application for the new Lydenburg - Merensky 132kV Power Line, South Africa

> Start Date: 2013
> Client: Eskom Holdings SOC Ltd

Position: Specialist

- Assigned Tasks: Undertaking the Surface Water, Avifaunal and Visual Studies for the Basic Assessment

Basic Assessment for the Proposed Waterborne Sewer in Mayflower Village, South Africa

> Start Date: 2014
> Client: Mpumalanga Department of Rural Development
> Position: Specialist

- Assigned Tasks: Undertook the surface water (wetland delineation) specialist study for the Basic Assessment

Basic Environmental Impact Assessment for the Development of Mzinti Feedlot at Nkomazi Local Municipality, South Africa

> Start Date: 2014
> Client: Mpumalanga Department of Rural Development

Position: Specialist

- Assigned Tasks: Undertook the surface water (wetland delineation) specialist study for the Basic Assessment

Basic Assessment for the Eskom 132kV Power Line from Mbumbu Substation to the Proposed Tsakani Substation, Mpumalanga, South Africa

> Start Date: 2014
> Client: Eskom Holdings SOC Ltd

Position: Specialist

- Assigned Tasks: Undertook the visual and surface water specialist studies as part of the Basic Assessment.

Kwameyi-Teekloof Water Supply - Wetland Delineation Study, South Africa

> Start Date: 2014
> Client: Isambulluo Environmental Consultants (Sibgem Management and Consulting Engineering)

Position: Project Manager & Specialist

- Assigned Tasks: Undertook the wetland assessment and delineation study for a proposed bulk water supply project in the Harding area, KZN

Design, Construction & Rehabilitation Work at Rietspruit Dam, Ventersdorp, South Africa

> Start Date: 2014
> Client: Department of Water Affairs and Forestry

Position: Specialist

- Assigned Tasks: Undertook a wetland delineation assessment as part of an environmental screening study

Impendle Bulk Water Supply Investigation, KZN

> Start Date: 2011
> Client: uMgungundlovu District Municipality
> Project Value: R185,000,000.00

Position: Specialist

- Assigned Tasks: Undertook wetland assessments (Wetland Health and Functionality Assessments) in support of the Water Use Licence

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75MW CSP project in Bokpoort, South Africa

> Start Date: 2013
> Client: ACWA Power Solafrica Bokpoort CSP Power Plant (Pty) Ltd

Position: Specialist

- Assigned Tasks: Undertook the Surface Water Study for a proposed water pipeline, in support of the BA

Gamma-Kappa 765kV Power Line EIA, South Africa

> Start Date: 2012
> Client: Nzumbulo Heritage Solutions

Position: Surface Water Specialist

- Assigned Tasks: Undertook the Surface Water Study.

Luiperdshoek Basic Assessment (BA) and Water Use Licence Application (WULA) for Eskom, South Africa

> Start Date: 2012
> Client: Eskom Holdings SOC Ltd

Position: Specialist

- Assigned Tasks: Undertook the Avifaunal study in support of the Basic Assessment

Basic Assessment (BA) and Environmental Management Programme Report (EMPR) Amendment for Black Mountain Mine, South Africa

> Start Date: 2012
> Client: Black Mountain Mining (Pty) Ltd

Position: Specialist

- Assigned Tasks: Visual Impact Assessment Specialist Input.

Basic Assessment (BA) for the proposed 23 km 132KV line from Kliphoek to Panbult, South Africa

> Start Date: 2012
> Client: Eskom Holdings SOC Ltd

Position: Specialist

- Assigned Tasks: Undertook the Wetland and Avifauna Specialist Studies

Ekangala Quarry Mining Application and S24G Rectification

> Start Date: 2012
> Client: City of Tshwane Metropolitan Municipality

Position: Specialist

- Assigned Tasks: Undertook the wetland delineation study and compiled the Wetland Rehabilitation Plan

Wetland Assessment Specialist Study for proposed Letaba NDP projects in Limpopo Province

> Start Date: 2012
> Client: Nzumbulo Heritage Solutions

- Assigned Tasks: Undertook the Surface Water Study.

Mooidraai - Smitskloof 132/22kV Environmental Impact Assessment, South Africa

> Start Date: 2012
> Client: Eskom Holdings SOC Ltd

Position: Specialist

- Assigned Tasks: Undertook the Avifaunal Study

EIA for the proposed Upgrade to the Mkuze Airport

> Start Date: 2016
> Client: Umhlosinga Development Agency (KZN Treasury)

Position: Visual Impact Specialist

- Assigned Tasks: Undertook the Visual Impact Assessment for the Project

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Appendix B – Study Area Bird Species List

Count	SABAP Ref	Common Name	Common Name	Genus	Species	Endemic	Threat Status	Site Record	Transect and FP Monitoring Record	SABAP 2 Record (Site Pentads)	Additional SABAP 2 Record (surrounding pentads)	Priority Species
1	6	Grebe	Little	Tachybaptus	ruficollis			X		X		
2	47	Cormorant	White-breasted	Phalacrocorax	lucidus			X		X		
3	50	Cormorant	Reed	Microcarbo	africanus			X	X	X		
4	52	Darter	African	Anhinga	rufa			X		X		
5	54	Heron	Grey	Ardea	cinerea			X		X		
6	55	Heron	Black-headed	Ardea	melanocephala			X		X		
7	57	Heron	Purple	Ardea	purpurea						X	
8	59	Egret	Little	Egretta	garzetta						X	
9	61	Egret	Western Cattle	Bubulcus	ibis			X		X		
10	62	Heron	Squacco	Ardeola	ralloides						X	
11	63	Heron	Striated (Green-backed)	Butorides	striata			X		X		
12	69	Night Heron	Black-crowned	Nycticorax	nycticorax			X		X		
13	72	Hamerkop	Hamerkop	Scopus	umbretta			X		X		
14	78	Stork	Abdim's	Ciconia	abdimii		**NT**				X	**X**
15	79	Stork	Black	Ciconia	nigra		**VU**					**X**
16	80	Stork	White	Ciconia	ciconia					X	X	
17	82	Ibis	Southern Bald	Geronticus	calvus	**E**	**VU**				X	**X**
18	83	Ibis	Glossy	Plegadis	falcinellus			X	X	X		
19	84	Ibis	Hadeda	Bostrychia	hagedash			X	X	X		
20	88	Goose	Spur-winged	Plectropterus	gambensis					X	X	
21	89	Goose	Egyptian	Alopochen	aegyptiacus			X	X	X		
22	91	Duck	Knob-billed	Sarkidiornis	melanotos						X	
23	95	Duck	African Black	Anas	sparsa			X		X		
24	96	Duck	Yellow-billed	Anas	undulata			X		X		
25	97	Teal	Red-billed	Anas	erythrorhyncha					X		
26	98	Teal	Cape	Anas	capensis			X		X		
27	100	Duck	White-faced	Dendrocygna	viduata						X	

Count	SABAP Ref	Common Name	Common Name	Genus	Species	Endemic	Threat Status	Site Record	Transect and FP Monitoring Record	SABAP 2 Record (Site Pentads)	Additional SABAP 2 Record (surrounding pentads)	Priority Species
28	105	Secretarybird	Secretarybird	Saggitarius	serpentarius		VU					X
29	106	Vulture	Cape	Gyps	coprotheres	E	EN				X	X
30	107	Vulture	White-backed	Gyps	africanus		EN			X	X	X
31	113	Falcon	Peregrine	Falco	peregrinus					X		X
32	114	Falcon	Lanner	Falco	biarmicus		VU	X	X	X		X
33	119	Falcon	Amur	Falco	amurensis						X	
34	123	Kestrel	Rock	Falco	rupicolus			X	X	X		
35	129	Kite	Yellow-billed	Milvus	aegyptius					X		
36	130	Kite	Black-winged	Elanus	caeruleus			X	X	X		
37	133	Eagle	Verreaux's	Aquila	verreauxii		VU				X	X
38	134	Eagle	Tawny	Aquila	rapax		EN				X	X
39	137	Eagle	Wahlberg's	Hireaaetus	wahlbergi			X	X	X	X	
40	138	Eagle	Long-crested	Lophaetus	occipitalis					X		
41	142	Eagle	Martial	Polemaetus	bellicosus		EN					X
42	144	Buzzard	Lizard	Kaupifalco	monogrammicus						X	
43	145	Snake-eagle	Brown	Circaetus	cinereus						X	
44	146	Snake-eagle	Black-chested	Circaetus	pectoralis			X	X	X		
45	149	Fish-eagle	African	Haliaeetus	vocifer			X	X	X		
46	152	Buzzard	Jackal	Buteo	rufofuscus	E					X	
47	154	Buzzard	Steppe	Buteo	vulpinus						X	
48	158	Sparrowhawk	Little	Accipiter	minulus			X	X	X		
49	160	Goshawk	African	Accipiter	tachiro					X		
50	171	Harrier-Hawk	African	Polyboroides	typus						X	
51	174	Francolin	Crested	Dendroperdix	sephaena			X	X	X		
52	177	Francolin	Shelley's	Scleroptila	shelleyi						X	
53	183	Spurfowl	Natal	Pternistis	natalensis	NE		X		X		
54	185	Spurfowl	Swainson's	Pternistis	swainsonii			X	X	X		
55	192	Guineafowl	Helmeted	Numida	meleagris			X	X	X		
56	196	Buttonquail	Kurrichane	Turnix	sylvaticus					X		

Count	SABAP Ref	Common Name	Common Name	Genus	Species	Endemic	Threat Status	Site Record	Transect and FP Monitoring Record	SABAP 2 Record (Site Pentads)	Additional SABAP 2 Record (surrounding pentads)	Priority Species
57	203	Crake	Black	Zapornia	flavirostra			X		X	X	
58	212	Coot	Red-knobbed	Fulica	cristata						X	
59	224	Korhaan	Red-crested	Lophotis	ruficristata	NE					X	
60	228	Jacana	African	Actophilornis	africanus						X	
61	238	Plover	Three-banded	Charadrius	tricollaris			X		X		
62	242	Lapwing	Crowned	Vanellus	coronatus			X		X		
63	245	Lapwing	Blacksmith	Vanellus	armatus			X	X	X		
64	247	Lapwing	African Wattled	Vanellus	senegallus			X	X	X		
65	258	Sandpiper	Common	Actitis	hypoleucos			X		X		
66	275	Thick-knee	Spotted	Burhinus	capensis			X	X	X		
67	310	Sandgrouse	Double-banded	Pterocles	bicinctus	NE		X	X	X	X	
68	311	Pigeon	Speckled	Columba	guinea			X	X	X		
69	314	Dove	Red-eyed	Streptopelia	semitorquata			X	X	X		
70	316	Turtle-dove	Cape	Streptopelia	capicola			X	X	X		
71	317	Dove	Laughing	Streptopelia	senegalensis			X	X	X		
72	318	Dove	Namaqua	Oena	capensis			X		X		
73	319	Dove	Tambourine	Turtur	tympanistria						X	
74	321	Wood-dove	Emerald-spotted	Turtur	chalcospilos			X	X	X		
75	323	Green-pigeon	African	Treron	calvus						X	
76	940	Dove	Rock	Columba	livia					X		
77	337	Turaco	Purple-crested	Gallirex	porphyreolophus			X		X		
78	339	Go-away-bird	Grey	Crinifer	concolor			X	X	X		
79	343	Cuckoo	Red-chested	Cuculus	solitarius					X		
80	344	Cuckoo	Black	Cuculus	clamosus						X	
81	347	Cuckoo	Levaillant's	Clamator	levaillantii						X	
82	348	Cuckoo	Jacobin	Clamator	jacobinus					X		
83	351	Cuckoo	Klaas's	Chrysococcyx	klaas			X	X	X		
84	352	Cuckoo	Diderick	Chrysococcyx	caprius					X		
85	359	Owl	Western Barn	Tyto	alba					X		

Count	SABAP Ref	Common Name	Common Name	Genus	Species	Endemic	Threat Status	Site Record	Transect and FP Monitoring Record	SABAP 2 Record (Site Pentads)	Additional SABAP 2 Record (surrounding pentads)	Priority Species
86	365	Owlett	Pearl-spotted	Glaucidium	perlatum					X	X	
87	368	Eagle-owl	Spotted	Bubo	africanus						X	
88	372	Nightjar	Rufous-cheeked	Caprimulgus	rufigena			X		X	X	
89	373	Nightjar	Fiery-necked	Caprimulgus	pectoralis			X		X		
90	380	Swift	African Black	Apus	barbatus					X		
91	383	Swift	White-rumped	Apus	caffer			X	X	X	X	
92	384	Swift	Horus	Apus	horus						X	
93	385	Swift	Little	Apus	affinis			X	X	X		
94	386	Swift	Alpine	Tachymarptis	melba			X	X	X	X	
95	387	Palm-swift	African	Cypsiurus	parvus			X	X	X		
96	390	Mousebird	Speckled	Colius	striatus			X	X	X		
97	392	Mousebird	Red-faced	Urocolius	indicus			X	X	X		
98	394	Kingfisher	Pied	Ceryle	rudis			X		X	X	
99	395	Kingfisher	Giant	Megaceryle	maxima			X		X		
100	396	Kingfisher	Half-collared	Alcedo	semitorquata		NT				X	
102	399	Kingfisher	Woodland	Halcyon	senegalensis						X	
103	401	Kingfisher	Grey-headed	Halcyon	leucocephala						X	
104	402	Kingfisher	Brown-hooded	Halcyon	albiventris			X	X	X		
105	403	Kingfisher	Striped	Halcyon	chelicuti						X	
106	404	Bee-eater	European	Merops	apiaster			X		X		
107	409	Bee-eater	White-fronted	Merops	bullockoides			X		X		
108	410	Bee-eater	Little	Merops	pusillus			X	X	X		
109	412	Roller	European	Coracias	garrulus		NT				X	
110	418	Hoopoe	African	Upupa	africana			X	X	X		
111	419	Wood Hoope	Green	Phoeniculus	purpureus			X		X		
112	421	Scimitarbill	Common	Rhinopomastus	cyanomelas			X	X	X		
113	424	Hornbill	African Grey	Lophoceros	nasutus			X	X	X		
114	426	Hornbill	Southern Yellow-billed	Tockus	leucomelas	NE		X	X	X		
115	4129	Hornbill	Soutern Red-billed	Tockus	rufirsotrs					X		

Count	SABAP Ref	Common Name	Common Name	Genus	Species	Endemic	Threat Status	Site Record	Transect and FP Monitoring Record	SABAP 2 Record (Site Pentads)	Additional SABAP 2 Record (surrounding pentads)	Priority Species
116	431	Barbet	Black-collared	Lybius	torquatus			X	X	X		
117	432	Barbet	Acacia Pied	Tricholaema	leucomelas	**NE**		X	X	X		
118	437	Tinkerbird	Yellow-fronted	Pogoniulus	chrysoconus			X		X		
119	439	Barbet	Crested	Trachyphonus	vaillantii			X	X	X		
120	440	Honeyguide	Greater	Indicator	indicator			X		X		
121	441	Honeyguide	Scaly-throated	Indicator	variegatus						X	
122	442	Honeyguide	Lesser	Indicator	minor					X		
123	447	Woodpecker	Golden-tailed	Campethera	abingoni			X	X	X		
124	450	Woodpecker	Cardinal	Dendropicos	fuscescens			X	X	X		
125	451	Woodpecker	Bearded	Chloropicos	namaquus			X		X	X	
126	458	Lark	Rufous-naped	Mirafra	africana						X	
127	460	Lark	Sabota	Calendulauda	sabota	**NE**		X	X	X		
128	464	Lark	Dusky	Pinarocorys	nigricans			X		X		
129	484	Sparrowlark	Chestnut-backed	Eremopterix	leucotis					X	X	
130	493	Swallow	Barn	Hirundo	rustica			X		X		
131	495	Swallow	White-throated	Hirundo	albogularis			X		X	X	
132	496	Swallow	Wire-tailed	Hirundo	smithii			X	X	X		
133	498	Swallow	Pearl-breasted	Hirundo	dimidiata					X	X	
134	501	Swallow	Red-breasted	Hirundo	semirufa						X	
135	502	Swallow	Greater Striped	Cecropis	cucullata			X	X	X		
136	503	Swallow	Lesser Striped	Cecropis	abyssinica			X	X	X		
137	506	Martin	Rock	Ptyonoprogne	fuligula			X	X	X		
138	507	House-Martin	Common	Delichon	urbicum			X		X		
139	509	Martin	Brown-throated	Riparia	paludicola			X		X		
140	511	Saw-wing	Black	Psalidoprocne	holomelaena						X	
141	513	Cuckooshrike	Black	Campephaga	flava			X		X	X	
142	517	Drongo	Fork-tailed	Dicrurus	adsimilis			X	X	X		
143	521	Oriole	Black-headed	Oriolus	larvatus			X	X	X		

Count	SABAP Ref	Common Name	Common Name	Genus	Species	Endemic	Threat Status	Site Record	Transect and FP Monitoring Record	SABAP 2 Record (Site Pentads)	Additional SABAP 2 Record (surrounding pentads)	Priority Species
144	522	Crow	Pied	Corvus	albus			X	X	X		
145	523	Crow	Cape	Corvus	capensis					X		
146	524	Raven	White-necked	Corvus	albicollis					X	X	
147	527	Tit	Southern Black	Melaniparus	niger			X	X	X		
148	531	Penduline-tit	Cape	Anthoscopus	minutus	NE					X	
149	533	Babbler	Arrow-marked	Turdoides	jardinei			X	X	X		
150	545	Bulbul	Dark-capped	Pycnonotus	tricolor			X	X	X		
151	546	Brownbul	Terrestrial	Phyllastrephus	terrestris					X		
152	550	Greenbul	Yellow-bellied	Chlorocichla	flaviventris					X	X	
153	551	Greenbul	Sombre	Andropadus	importunus					X		
154	552	Thrush	Kurrichane	Turdus	libonyanus			X	X	X		
155	557	Thrush	Groundscraper	Turdus	litsipsirupa			X	X	X		
156	1105	Thrush	Olive	Turdus	olivaceus						X	
157	559	Rock-thrush	Cape	Monticola	rupestris	E					X	
158	568	Wheatear	Capped	Oenanthe	pileata						X	
159	570	Chat	Familiar	Cercomela	familiaris			X		X		
160	573	Cliff-chat	Mocking	Thamnolaea	cinnamomeiventris						X	
161	576	Stonechat	African	Saxicola	torquatus					X		
162	579	Robin-chat	Red-capped	Cossypha	natalensis			X		X		
163	581	Robin-chat	Cape	Cossypha	caffra			X		X	X	
164	582	Robin-chat	White-throated	Cossypha	humeralis	E		X	X	X		
165	586	Scrub-robin	Kalahari	Cercotrichas	paena	NE		X	X	X		
166	588	Scrub-robin	White-browed	Cercotrichas	leucophrys			X	X	X		
167	594	Whitethroat	Common	Sylvia	communis					X	X	
168	596	Warbler	Icterine	Hippolais	icterina						X	
169	599	Warbler	Willow	Phylloscopus	trochilus						X	
170	600	Eremomela	Yellow-bellied	Eremomela	icteropygialis						X	

Count	SABAP Ref	Common Name	Common Name	Genus	Species	Endemic	Threat Status	Site Record	Transect and FP Monitoring Record	SABAP 2 Record (Site Pentads)	Additional SABAP 2 Record (surrounding pentads)	Priority Species
172	604	Swamp-warbler	Lesser	Acrocephalus	gracilirostris					X		
173	607	Warbler	Marsh	Acrocephalus	palustris			X		X		
174	609	Rush-warbler	Little	Bradypterus	baboecala						X	
175	621	Crombec	Long-billed	Sylvietta	rufescens			X	X	X		
176	622	Apalis	Bar-throated	Apalis	thoracica						X	
177	625	Apalis	Yellow-breasted	Apalis	flavida			X	X	X		
178	627	Camaroptera	Green-backed	Camaroptera	brachyura			X	X	X		
179	628	Camaroptera	Grey-backed	Camaroptera	brevicaudata					X		
180	629	Cisticola	Zitting	Cisticola	juncidis					X		
181	630	Cisticola	Desert	Cisticola	aridulus					X		
182	637	Neddicky	Neddicky	Cisticola	fulvicapilla			X	X	X		
183	642	Cisticola	Rattling	Cisticola	chiniana			X	X	X		
184	644	Cisticola	Red-faced	Cisticola	erythrops			X	X	X		
185	648	Cisticola	Lazy	Cisticola	aberrans			X		X	X	
186	649	Prinia	Tawny-flanked	Prinia	subflava			X	X	X		
187	650	Prinia	Black-chested	Prinia	flavicans			X	X	X		
188	654	Flycatcher	Spotted	Muscicapa	striata						X	
189	655	Flycatcher	African Dusky	Muscicapa	adusta						X	
190	656	Flycatcher	Ashy	Muscicapa	caerulescens			X		X		
191	657	Tit-flycatcher	Grey	Myioparus	plumbeus			X	X	X		
192	658	Warbler	Chestnut-vented	Curruca	subcoerulea	NE		X	X	X		
193	661	Flycatcher	Marico	Melaenornis	mariquensis	NE		X	X	X		
194	662	Flycatcher	Pale	Melaenornis	pallidus					X		
195	664	Flycatcher	Southern Black	Melaenornis	pammelaina					X		
196	665	Flycatcher	Fiscal	Melaenornis	silens	E		X		X		
197	673	Batis	Chinspot	Batis	molitor			X	X	X		
198	682	Paradise-flycatc	African	Terpsiphone	viridis			X	X	X		
199	685	Wagtail	African Pied	Motacilla	aguimp			X		X		

Count	SABAP Ref	Common Name	Common Name	Genus	Species	Endemic	Threat Status	Site Record	Transect and FP Monitoring Record	SABAP 2 Record (Site Pentads)	Additional SABAP 2 Record (surrounding pentads)	Priority Species
201	688	Wagtail	Mountain	Motacilla	clara					X	X	
202	692	Pipit	African	Anthus	cinnamomeus			X		X		
203	694	Pipit	Plain-backed	Anthus	leucophrys						X	
204	696	Pipit	Striped	Anthus	lineiventris			X		X		
205	699	Pipit	Bushveld	Anthus	caffer						X	
206	707	Fiscal	Southern	Lanius	collaris			X	X	X		
207	708	Shrike	Red-backed	Lanius	collurio						X	
208	706	Shrike	Lesser Grey	Lanius	minor						X	
209	709	Boubou	Southern	Laniarius	ferrugineus	E		X	X	X		
210	711	Shrike	Crimson-breasted	Laniarius	atrococcineus	NE		X		X		
211	712	Puffback	Black-backed	Dryoscopus	cubla			X	X	X		
212	714	Tchagra	Brown-crowned	Tchagra	australis			X	X	X		
213	715	Tchagra	Black-crowned	Tchagra	senegalus					X		
214	719	Bush-shrike	Orange-breasted	Chlorophoneus	sulfureopectus			X	X	X		
215	721	Bush-shrike	Gorgeous	Telophorus	viridis						X	
216	723	Bush-shrike	Grey-headed	Malaconotus	blanchoti			X		X		
217	724	Shrike	Magpie	Urolestes	melanoleucus						X	
218	727	Helmet-shrike	White-crested	Prionops	plumatus					X		
219	728	Helmet-shrike	Retz's	Prionops	retzii			X		X		
220	731	Brubru	Brubru	Nilaus	afer			X		X		
221	734	Myna	Common	Acridotheres	tristis			X	X	X		
222	736	Starling	Violet-backed	Cinnyricinclus	leucogaster					X		
223	737	Starling	Cape	Lamprotornis	nitens			X	X	X		
224	745	Starling	Red-winged	Onychognathus	morio			X	X	X		
225	748	Oxpecker	Red-billed	Buphagus	erythrorynchus			X	X	X		
226	755	Sunbird	Marico	Cinnyris	mariquensis			X		X		
227	758	Sunbird	Greater Double-collared	Cinnyris	afer	E					X	
228	760	Sunbird	Southern Double-collared	Cinnyris	chalybeus	E					X	
229	763	Sunbird	White-bellied	Cinnyris	talatala			X	X	X		

Count	SABAP Ref	Common Name	Common Name	Genus	Species	Endemic	Threat Status	Site Record	Transect and FP Monitoring Record	SABAP 2 Record (Site Pentads)	Additional SABAP 2 Record (surrounding pentads)	Priority Species
230	771	Sunbird	Collared	Hedydipna	collaris					X		
231	772	Sunbird	Amethyst	Chalcomitra	amethystina			X	X	X		
232	774	Sunbird	Scarlet-chested	Chalcomitra	senegalensis			X		X		
233	780	Sparrow-weave	White-browed	Plocepasser	mahali			X	X	X		
234	784	Sparrow	House	Passer	domesticus			X		X		
235	785	Sparrow	Great	Passer	motitensis	NE					X	
236	786	Sparrow	Cape	Passer	melanurus	NE		X		X		
237	788	Bush Sparrow	Yellow-throated	Gymnoris	superciliaris						X	
238	789	Weaver	Scaly-feathered	Sporopipes	squamifrons	NE		X	X	X		
239	791	Weaver	Spectacled	Ploceus	ocularis			X	X	X		
240	792	Masked-weave	Lesser	Ploceus	intermedius			X		X		
241	793	Weaver	Red-headed	Anaplectes	rubriceps			X		X		
242	797	Weaver	Village	Ploceus	cucullatus			X	X	X		
243	799	Weaver	Cape	Ploceus	capensis					X		
244	801	Weaver	Golden	Ploceus	xanthops						X	
245	803	Masked-weave	Southern	Ploceus	velatus			X	X	X		
246	804	Weaver	Thick-billed	Amblyospiza	albifrons			X		X		
247	805	Quelea	Red-billed	Quelea	quelea			X		X		
248	808	Bishop	Southern Red	Euplectes	orix			X		X		
249	812	Bishop	Yellow-crowned	Euplectes	afer						X	
250	813	Widowbird	Red-collared	Euplectes	ardens						X	
251	814	Widowbird	White-winged	Euplectes	albonotatus			X	X	X		
252	820	Finch	Red-headed	Amadina	erythrocephala	NE		X		X		
253	821	Finch	Cut-throat	Amadina	fasciata			X		X		
254	823	Mannikin	Bronze	Spermestes	cucullatus			X	X	X		
255	830	Pytilia	Green-winged	Pytilia	melba			X	X	X		
256	833	Firefinch	African	Lagonosticta	rubricata			X		X		
257	835	Firefinch	Jameson's	Lagonosticta	rhodopareia			X	X	X		
258	837	Firefinch	Red-billed	Lagonosticta	senegala			X		X		

Count	SABAP Ref	Common Name	Common Name	Genus	Species	Endemic	Threat Status	Site Record	Transect and FP Monitoring Record	SABAP 2 Record (Site Pentads)	Additional SABAP 2 Record (surrounding pentads)	Priority Species
259	838	Waxbill	Orange-breasted	Amandava	subflava			X		X		
260	839	Waxbill	Blue	Uraeginthus	angolensis			X	X	X		
261	840	Waxbill	Violet-eared	Granatina	granatina	NE		X		X		
262	841	Waxbill	Black-faced	Estrilda	erythronotos			X	X	X		
263	843	Waxbill	Common	Estrilda	astrild			X	X	X		
264	844	Quailfinch	African	Ortygospiza	atricollis			X		X		
265	846	Whydah	Pin-tailed	Vidua	macroura			X	X	X		
266	847	Whydah	Shaft-tailed	Vidua	regia	NE					X	
267	850	Indigobird	Purple	Vidua	purpurascens						X	
268	851	Indigobird	Village	Vidua	chalybeata					X		
269	852	Whydah	Long-tailed Paradise	Vidua	paradisea			X		X		
270	859	Canary	Yellow-fronted	Crithagra	mozambica			X	X	X		
271	860	Canary	Black-throated	Crithagra	atrogularis						X	
272	863	Canary	Brimstone	Crithagra	sulphuratus			X	X	X		
273	867	Seedeater	Streaky-headed	Crithagra	gularis			X	X	X	X	
274	871	Bunting	Lark-like	Emberiza	impetuana	NE					X	
275	872	Bunting	Cinnamon-breasted	Emberiza	tahapisi					X		
276	873	Bunting	Cape	Emberiza	capensis	NE					X	
277	874	Bunting	Golden-breasted	Emberiza	flaviventris			X	X	X		
278	1172	White-eye	Cape	Zosterops	virens	E		X		X		
279	4131	Coucal	Burchell's	Centropus	burchelli	NE					X	
280	4142	Sparrow	Southern Grey-headed	Passer	diffusus			X	X	X		

Appendix C – Summary of Species Records from the Fixed Point Monitoring and Transects

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No	Common Name	S1 Tr T1	S1 Tr T2	S1 Tr T3	S1 OS T4	S1 FP 1-1	S1 FP 1-2	S2 Tr T1	S2 Tr T2	S2 Tr T3	S2 Tr OS T4	S2 FP 2-1	S3 Tr T2	S3 Tr T1	S3 FP 3-1	S3 OS Tr T1	S4 OS Tr T3	S4 TR OS T1	S4 FP 4-1	S4 FP 4-2	S4 FP 4-3	S4 FP 4-4	S4 FP 4-5	S5 Tr T1	S5 Tr T2	S5 Tr T3	S5 Tr OS T4	S5 Tr T5	S5 OS Tr T6	S5 Tr T7	S5 FP 5-1	S5 FP 5-2	S5 FP 5-3	
		Number of Records of each species per transect / fixed point																																
47	Reed Cormorant																																1	1
83	Glossy Ibis																								1									1
84	Hadeda Ibis		1			1				1																								3
89	Egyptian Goose																																1	1
114	Lanner Falcon		1																															1
123	Rock Kestrel																									1								1
130	Black-winged Kite											1																		1				2
137	Wahlberg's Eagle																	1					1	1					1					4
146	Black-chested Snake Eagle												1	1										1										3
149	African Fish Eagle				1									1		1							1											4
158	Little Sparrowhawk											1																						1
174	Crested Francolin							1		3													1		1							1		7
185	Swainson's Spurfowl				1			1																		1								3
192	Helmeted Guineafowl		1							2															1									4
245	Blacksmith Lapwing													1												1				1				3
247	African Wattled Lapwing																																	0
275	Spotted Thick-knee		1																															1
310	Double-banded Sandgrouse																									1								1
311	Speckled Pigeon																				1													1
314	Red-eyed Dove										1																							1
316	Cape Turtle Dove																					1												1
317	Laughing Dove	3	3	3	1			2	3	1	5	1						1					1		1						1	1	1	28
321	Emerald-spotted Wood Dove																	1					2			1			1			1		6
339	Grey Go-away-bird				1					1										1	1			1		1	1			2				9

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No	Common Name	S1 Tr T1	S1 Tr T2	S1 Tr T3	S1 OS T4	S1 FP 1-1	S1 FP 1-2	S2 Tr T1	S2 Tr T2	S2 Tr T3	S2 Tr OS T4	S2 FP 2-1	S3 Tr T2	S3 Tr T1	S3 FP 3-1	S3 OS Tr T1	S4 OS Tr T3	S4 TR OS T1	S4 FP 4-1	S4 FP 4-2	S4 FP 4-3	S4 FP 4-4	S4 FP 4-5	S5 Tr T1	S5 Tr T2	S5 Tr T3	S5 Tr OS T4	S5 Tr T5	S5 OS Tr T6	S5 Tr T7	S5 FP 5-1	S5 FP 5-2	S5 FP 5-3	
351	Klaas's Cuckoo								1	1																								2
383	White-rumped Swift																		1															1
385	Little Swift															1	1		2	1						1		1						7
386	Alpine Swift																		1	2														3
387	African Palm Swift				1				1			1			1								1						1		1		1	8
390	Speckled Mousebird	1	1					2	1		3		1										1											10
392	Red-faced Mousebird				1													1				1	1			1					1	1	2	9
402	Brown-hooded Kingfisher				1					1																			1			1	1	5
410	Little Bee-eater																						1		1	1								3
418	African Hoopoe								1																								1	2
421	Common Scimitarbill								1																									1
424	African Grey Hornbill											1																						1
426	Southern Yellow-billed Hornbill									1																								1
431	Black-collared Barbet								1																								1	2
432	Acacia Pied Barbet	1	1		1		1				2							1	1							1				1			1	11
439	Crested Barbet								1																									1
447	Golden-tailed Woodpecker																			1														1
450	Cardinal Woodpecker									2		1											1											4
460	Sabota Lark	1																											2	2				5
496	Wire-tailed Swallow																														1			1
502	Greater Striped Swallow				1														1									1					1	4
503	Lesser Striped Swallow		1													1		2	1	1						1						1		8
506	Rock Martin																					1												1
517	Fork-tailed Drongo				1			1			1												1								1			5
521	Black-headed Oriole			1																														1
522	Pied Crow		2	3	2	4			1	1	3	2						1			1			1		2						2	1	26

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No	Common Name	S1 Tr T1	S1 Tr T2	S1 Tr T3	S1 OS T4	S1 FP 1-1	S1 FP 1-2	S2 Tr T1	S2 Tr T2	S2 Tr T3	S2 Tr OS T4	S2 FP 2-1	S3 Tr T2	S3 Tr T1	S3 FP 3-1	S3 OS Tr T1	S4 OS Tr T3	S4 TR OS T1	S4 FP 4-1	S4 FP 4-2	S4 FP 4-3	S4 FP 4-4	S4 FP 4-5	S5 Tr T1	S5 Tr T2	S5 Tr T3	S5 Tr OS T4	S5 Tr T5	S5 OS Tr T6	S5 Tr T7	S5 FP 5-1	S5 FP 5-2	S5 FP 5-3	
527	Southern Black Tit									1																								1
533	Arrow-marked Babbler										1																							1
545	Dark-capped Bulbul				1			1	1	2	1					2	1		1	1	2		2	1	2							1	2	21
552	Kurrichane Thrush										1																							1
557	Groundscraper Thrush						1																											1
582	White-throated Robin Chat							1		1	1						1			1			3			1	1	1				1	1	13
586	Kalahari Scrub Robin			1			1																	1										3
588	White-browed Scrub Robin	3	1					2		2	1			1		1		2	1	2					2	2	1	1	1			1	1	25
601	Burnt-necked Eremomela						1																		1							1	1	4
621	Long-billed Crombec				2		1	2	1	1							1		1			1	1		1	2			1				1	16
625	Yellow-breasted Apalis									1	1					1	1						1									1	1	7
627	Green-backed Camaroptera															1																		1
637	Neddicky							2	2									1		1	1	1												8
642	Rattling Cisticola	1	1		1																				1	1			1				1	7
644	Red-faced Cisticola																																1	1
649	Tawny-flanked Prinia	1					1	1	1								1			1	1			1	1	1							1	11
650	Black-chested Prinia		1	1	1		3	2	1	1	1							1								2			1	1			1	17
657	Grey Tit Flycatcher																	1																1
658	Chestnut-vented Warbler		1				1	2				1														1						1	1	8
661	Marico Flycatcher			1	1		2	2				1															1				1			9
673	Chinspot Batis							1		1					1		1			1														5
685	African Pied Wagtail																														1			1
686	Cape Wagtail														1									1	1			1						4
707	Common Fiscal			1	1			1		1																								4
709	Southern Boubou			1	1		2	2	2	3	2	1	2			2		2	1	1	1	2	2	1					1				1	30
712	Black-backed Puffback																1		1													1		3

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No	Common Name	S1 Tr T1	S1 Tr T2	S1 Tr T3	S1 OS T4	S1 FP 1-1	S1 FP 1-2	S2 Tr T1	S2 Tr T2	S2 Tr T3	S2 Tr OS T4	S2 FP 2-1	S3 Tr T2	S3 Tr T1	S3 FP 3-1	S3 OS Tr T1	S4 OS Tr T3	S4 TR OS T1	S4 FP 4-1	S4 FP 4-2	S4 FP 4-3	S4 FP 4-4	S4 FP 4-5	S5 Tr T1	S5 Tr T2	S5 Tr T3	S5 Tr OS T4	S5 Tr T5	S5 OS Tr T6	S5 Tr T7	S5 FP 5-1	S5 FP 5-2	S5 FP 5-3	
714	Brown-crowned Tchragra							2								1			1														1	5
719	Orange-breasted Bush Shrike																																1	1
734	Common Myna				1	2	1	1		1											1										3	2	1	13
737	Cape Starling			1	1			2	1																									5
745	Red-winged Starling							1	2																						1			4
748	Red-billed Oxpecker																									1			1			1		3
763	White-bellied Sunbird	3	3	1	4	2	3	2	1	5	3	2	1	1		1	2	4	2	2	1	4	3	1	2	3	2		2	2	3	1	1	67
772	Amethyst Sunbird																1						1											2
780	White-browed Sparrow Weaver	1		1	1	1	2	3	2	1	3	1													1		1				1	2	1	22
789	Scaly-feathered Weaver			2	1	1																								1			1	6
791	Spectacled Weaver						1																											1
797	Village Weaver							1	1			1																					1	4
803	Southern Masked Weaver	1	1	1		1	1	2	1	1	6	1																		1	1		2	20
814	White-winged Widow																														1			1
823	Bronze Mannikin											1																						1
830	Green-winged Pytilia		1															1																2
835	Jameson's Firefinch						1									1	3	1				1	1	3										11
839	Blue Waxbill	2	2		3	2	1	1	1	2	2	2	1	2	1	1		1	1	1	1	3	1	1	3	2	1		2	3	1	2	1	47
841	Black-faced Waxbill	1					1			1															1									4
843	Common Waxbill																															1		1
846	Pin-tailed Whydah										1																					1		2
859	Yellow-fronted Canary	1			1		2		1		2					2				1	1			1		1			1		1	1	1	17
863	Brimstone Canary																																1	1
867	Streaky-headed Seed-eater																	1					1					1						3
874	Golden-breasted Bunting														1			1	1		1												1	5
4142	Southern Grey-headed Sparrow				1		1					1																				2		5

No	Common Name	S1 Tr T1	S1 Tr T2	S1 Tr T3	S1 OS T4	S1 FP 1-1	S1 FP 1-2	S2 Tr T1	S2 Tr T2	S2 Tr T3	S2 Tr OS T4	S2 FP 2-1	S3 Tr T2	S3 Tr T1	S3 FP 3-1	S3 OS Tr T1	S4 OS Tr T3	S4 TR OS T1	S4 FP 4-1	S4 FP 4-2	S4 FP 4-3	S4 FP 4-4	S4 FP 4-5	S5 Tr T1	S5 Tr T2	S5 Tr T3	S5 Tr OS T4	S5 Tr T5	S5 OS Tr T6	S5 Tr T7	S5 FP 5-1	S5 FP 5-2	S5 FP 5-3	
	Totals	**20**	**23**	**18**	**33**	**14**	**28**	**41**	**29**	**39**	**41**	**20**	**6**	**7**	**5**	**16**	**14**	**24**	**17**	**18**	**13**	**15**	**28**	**15**	**21**	**30**	**8**	**6**	**17**	**15**	**19**	**28**	**38**	

Appendix D– Impact Rating Methodology

Avifaunal Impacts have been assessed through use of an impact assessment methodology that will be used by all specialists and utilised by the EAP in the Environmental Impact Assessment Report.

The methodology utilised is detailed below.

The potential environmental impacts associated with the project will be evaluated according to its nature, extent, duration, intensity, probability and significance of the impacts, whereby:

- **Nature**: A brief written statement of the environmental aspect being impacted upon by a particular action or activity;
- **Extent**: The area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales. This is often useful during the detailed assessment phase of a project in terms of further defining the determined significance or intensity of an impact. For example, high at a local scale, but low at a regional scale;
- **Duration**: Indicates what the lifetime of the impact will be;
- **Intensity**: Describes whether an impact is destructive or benign;
- **Probability**: Describes the likelihood of an impact actually occurring; and
- **Cumulative**: In relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows:

Table 7 –Aspects of the assessment of Occurrence and Severity

Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude (severity) of impact

To assess each of these factors for each impact, the following four ranking scales are used:

Table 8 – Criteria for ranking of Impacts

Probability	Duration
5 - Definite/ don't know	5 - Permanent
4 - Highly probable	4 - Long-term
3 - Medium probability	3 - Medium-term (8 - 15 years)
2 - Low probability	2 - Short-term (0 - 7 years) (impact ceases after the operational life of the activity)
1 - Improbable	1 – Immediate
0 – None	0 - None
Scale	**Magnitude**
5 - International	10 - Very high/ don't know
4 - National	8 - High
3 - Regional	6 - Moderate
2 - Local	4 - Low
1 - Site only	2 - Minor
0 - None	0 - None

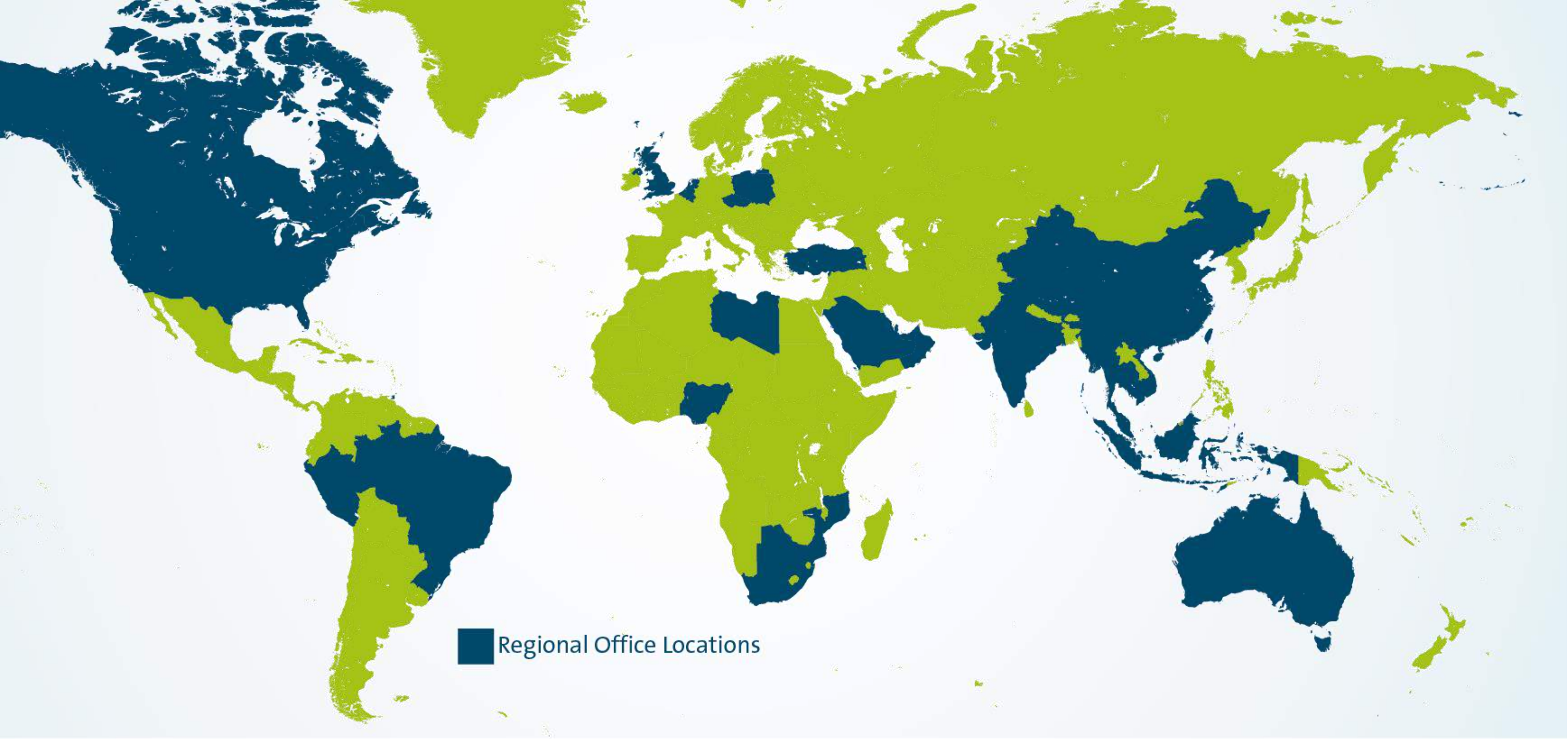
Once these factors have been ranked for each impact, the significance of the two aspects, occurrence and severity, must be assessed using the following formula:

SP (significance points) = (magnitude + duration + scale) x probability

The maximum value is 100 SP. The impact significance is then rated as follows:

Table 9 – Impact Significance

SP >75	Indicates high environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 – 75	Indicates moderate Environmental significance	An impact or benefit which is sufficiently important to require management, and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates low environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that constitutes an improvement over pre-project conditions



Royal HaskoningDHV is an independent, international engineering and project management consultancy with over 138 years of experience. Our professionals deliver services in the fields of aviation, buildings, energy, industry, infrastructure, maritime, mining, transport, urban and rural development and water.

Backed by expertise and experience of 6,000 colleagues across the world, we work for public and private clients in over 140 countries. We understand the local context and deliver appropriate local solutions.

We focus on delivering added value for our clients while at the same time addressing the challenges that societies are facing. These include the growing world population and the consequences for towns and cities; the demand for clean drinking water, water security and water safety; pressures on traffic and transport; resource availability and demand for energy and waste issues facing industry.

We aim to minimise our impact on the environment by leading by example in our projects, our own business operations and by the role we see in "giving back" to society. By showing leadership in sustainable development and innovation, together with our clients, we are working to become part of the solution to a more sustainable society now and into the future.

Our head office is in the Netherlands, other principal offices are in the United Kingdom, South Africa and Indonesia. We also have established offices in Thailand, India and the Americas; and we have a long-standing presence in Africa and the Middle East.

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Enhancing Society Together

Peer Review

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13th October 2021

RE: Professional Opinion on the Quality of EIAR Phase Avifaunal Assessment for a 100MWp Photovoltaic Plant at the Tubatse Chrome Smelter, Steelpoort

To whom it may concern

I have been appointed by Royal Haskoning DHV in my capacity as a professional avifaunal scientist to review the EIAR report produced by Paul da Cruz dated 12 October 2021.

Having read the report and appendices I have made a few comments on the report. Most are small comments with no material changes to the report. Paul da Cruz is to be commended for a very thorough report that has addressed the issues fairly and logically. I felt that the quality of the fieldwork was good and that Paul did a thorough job of investigating the environment and recording birds to the best of his ability.

The partial limitation of not conducting a survey in the summer, while not ideal, is acceptable to me as combined with the two scoping site visits Paul did 4 site visits to assess avifauna. This is in excess of the required minimum and for that reason the report is acceptable. I do not feel that a summer site visit would have changed any of the impacts or mitigation measures.

To this end I find no shortcoming on this EIAR report and am satisfied that it addresses all of the potential issues and covers all of the sensitive avifaunal species, impacts and mitigation measures fairly.

I have no trouble endorsing it as a thorough and robust report.

Regards

Luke Strugnell

Pri.Sci.Nat. 400181/09

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

ENVIRONMENTAL AUTHORISATION FOR THE PROPOSED 100MWP PHOTOVOLTAIC PLANT ASSOCIATED WITH THE TUBATSE FERROCHROME SMELTER, STEELPOORT, FETAKGOMO TUBATSE LOCAL MUNICIPALITY, LIMPOPO.

Kindly note the following:

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3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
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Attention: Chief Director: Integrated Environmental Authorisations
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Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Ecological Logistics PTY Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100%
Specialist name:	Luke Strugnell			
Specialist Qualifications:	BSC hons Zoology (Rhodes)			
Professional affiliation/registration:	SACNASP 400181/09			
Physical address:	12 Gavin ave, Pine Park, Johannesburg, 2194			
Postal address:	same			
Postal code:	2194	Cell:	0798783741	
Telephone:	0118887138	Fax:		
E-mail:	luke@ecologicallogistics.co.za			

2. DECLARATION BY THE SPECIALIST

I, _Luke Strugnell____________________, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Ecological Logistics Pty Ltd

Name of Company:

12 October 2021

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, __Luke Strugnell____________________, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Ecological Logistics Pty Ltd

Name of Company

12 October 2021

Date

Signature of the Commissioner of Oaths

Date

LUKE BERNARD STRUGNELL
Ecological Logistics PTY Ltd
Curriculum Vitae

BACKGROUND

Date of birth:	19th March 1982
Qualifications:	BSC – Zoology and Environmental Science-Rhodes University
	BSC(hons)- African Vertebrate Diversity-Rhodes University
Occupation:	Specialist avifaunal consultant
Profession registration:	South African Council for Natural Scientific Professions 400181/09

CONTACT DETAILS

Cell number: 079 878 3741
Email: luke@ecologicallogistics.co.za
Postal: 12 Gavin Ave, Pine Park, Johannesburg, 2194

PROFESSIONAL EXPERIENCE

Positions held to date:

- ✓ 2009-2011- Senior Avifaunal Consultant- Endangered Wildlife Trust
- ✓ 2011-2014- Urban Conservation Manager- Endangered Wildlife Trust
- ✓ September 2014 to 2016: Independent avifaunal specialist – Senior Consultant at WildSkies Ecological Services (Pty) Ltd
- ✓ **2016-current- Director and Owner of Ecological Logistics PTY LTD.**

Background:

Luke has 15 years experience in the conservation sector in South Africa. Of those 11 years have been in various roles related to energy infrastructure and consulting on bat and bird impact assessments. Luke has gained a great deal of knowledge on this sector and is well placed to deliver results to clients. Ecological Logistics was started as a company to assist various specialists with their fieldwork and equipment needs and has just turned 5 years old. Luke has run the company and has overseen the work since leaving WildSkies. There are few people in South Africa who have more experience running monitoring projects on Wind and Solar facilities than Luke. See below for the full list of projects Luke has been involved with.

Consulting Projects:

Specialist Bird and Bat Impact Assessment studies have been completed for the following projects

Avifaunal Impact Assessment Studies for infrastructure:

- Johannesburg Strengthening 400KV Power lines
- Appollo- Verwoerdburg 400KV Power line
- Phoebus- Kwagga 400KV Power line
- Ariadne-Eros 400KV Power line

- Mogwase- 400KV Power line
- Malelane- Boulders 132KV Power line
- Nondabuyo-Ndumo 132KV Power line
- Randfontein 132KV Power line
- Sasol Intergration 132KV Power line
- Marathon- Kiepersol 132KV Power line
- Dumasi- 132KV Power line
- Invubu-Melmoth 132KV Power Line
- NMPP Electrical Infrastructure
- Graceview- Slagment 88KV Power line
- Graceview- Eyestone 88KV Power line
- Honingklip 88KV Power line
- Randjiesfontein 88KV Power line
- Kimberly Strengthening 400KV Power line
- City of Tswane Wildebees 400KV/132KV Power line
- Delmas 44KV Power line and substation
- Vlakfontein 132KV Power line and substation
- Garona 50KV Power line
- Aries 50KV Power line
- Helios 50KV Power line
- Juno 50KV Power line
- Cathedral Peak Power line
- Firham Platrand 88KV deviation
- Etna Ennerdale Power line
- Lydenburg Merensky Power line
- Kroonstad 66KV Power line
- Cookhouse Wind Energy facility
- Port Elizabeth Wind Energy facility
- De Aar Solar PV Energy facility
- Golden Valley Wind Energy facility
- Boikarabello Power Station-bird and bat specialist
- Dassieklip Wind Energy facility
- Dorper Wind Farm
- Jefferys Bay Wind Farm
- Kouga Wind Farm
- Cookhouse West Wind Farm
- Sere Wind Farm
- Bonnievale Solar Facility
- Lanseria Waste Water Treatment works
- Bayview Wind Energy facility
- Grahamstown Wind Energy facility
- Zeus- Mercury 765KV EMP
- Bravo- 132KV EMP
- Grassridge Poseidon- 400KV EMP
- Tsitsikam 132KV EMP

These above projects were done as lead specialist and author while working at Endangered Wildlife Trust, WildSkies Ecological Services and Ecological Logistics.

Post Construction monitoring of Wind Energy facilities (carcass searching birds and bats)

- Kouga Wind Energy facility
- Sere Wind Energy facility
- Amakhala Wind Energy facility
- Tsitsikamma Wind Energy facility
- Nojoli Wind Energy facility
- Gibson Bay Wind Energy facility
- Dorper WEF
- Cookhouse West WEF

These contracts were done either under WildSkies Ecological Services or under Ecological Logistics and included all aspects of the post construction monitoring. Staff were employed directly in some cases or via enterprise development companies in other cases. All involved the running of the necessary trials and management of the data and staff.

References:

Jon Smallie
082 444 8919
jon@wildskies.co.za

Leon Baben
083 627 8983
leonb@aeci.co.za

Lourens Leeuwner
072 775 5111
lourensl@ewt.org.za

Appendix E6:
Heritage and Palaeontology

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

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Environment House
473 Steve Biko Road
Arcadia

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Email: EIAAdmin@environment.gov.za

nLl

1. SPECIALIST INFORMATION

Specialist Company Name:	PGS Heritage Pty Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100
Specialist name:	Wouter Fourie			
Specialist Qualifications:	BA(Hon) Archaeology			
Professional affiliation/registration:	APHP and ASAPA			
Physical address:	906 Bergarend Street, Waverley, Pretoria			
Postal address:	PO Box 32542, Totiusdal			
Postal code:	0134	Cell:	0828523575	
Telephone:	0123325305	Fax:		
E-mail:	wouter@pgsheritage.co.zaz			

2. DECLARATION BY THE SPECIALIST

I, _Wouter Fourie_, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

PGS Heritage

Name of Company:

22/09/2021.

Date

MAC

3. **UNDERTAKING UNDER OATH/ AFFIRMATION**

I, Wouter Fourie swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

PGS HERITAGE.

Name of Company

27/09/2021.

Date

70D43174

Signature of the Commissioner of Oaths

2021-09-22

2021-09-22

Date

PROPOSED 100MW PV PLANT AT THE SAMANCOR CHROME OPERATIONS, STEELPOORT, LIMPOPO

Heritage Impact Assessment

Issue Date: 20 May 2021
Revision No.: 2.0 (6 September 2021)
Project No.: 514HIA

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Head Office:
906 Bergarend Streets
Waverley, Pretoria,
South Africa

Directors: HS Steyn, PD Birkholtz, W Fourie

Declaration of Independence

I, Wouter Fourie, declare that –

General declaration:

- I act as the independent heritage practitioner in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting heritage impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations, and all other applicable legislation;
- I will consider, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan, or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected from a heritage practitioner in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realise that a false declaration is an offence in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

- I do not have and will not have any vested interest (either business, financial, personal, or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;

HERITAGE CONSULTANT: PGS Heritage (Pty) Ltd
CONTACT PERSON: Wouter Fourie
Tel: +27 (0) 12 332 5305
Email: wouter@pgsheritage.com

SIGNATURE: ______________________

ACKNOWLEDGEMENT OF RECEIPT

Report Title	***Proposed 100MW PV Plant at the Samancor Chrome Operations, Steelpoort, Limpopo***		
Control	**Name**	**Signature**	**Designation**
Author	**Wouter Fourie**		**Principal Heritage Specialist**
Reviewed			

CLIENT: Royal Haskoning DHV (Pty) Ltd

CONTACT PERSON: Malcolm Roods
Tel: +27 (0) 11 798 6000
E-mail: Malcolm.Roods@rhdhv.com

SIGNATURE: ______________________________

EXECUTIVE SUMMARY

PGS Heritage (Pty) Ltd (PGS) was appointed by Royal Haskoning DHV (Pty) Ltd (RHDHV) to undertake a Heritage Impact Assessment (HIA) which will serve to inform the Environmental Impact Assessment (EIA) and Environmental Management Programme (EMPr) for the 100MW PV Plant at the Samancor Chrome Operations, Steelpoort, Limpopo.

Heritage resources are unique and non-renewable and as such, any impact on such resources must be seen as significant. The HIA has shown that the study area and surrounding area has some heritage resources situated within the proposed development boundaries. Through data analysis and a site investigation, the following issues were identified from a heritage perspective.

The HIA has shown that the study area and surrounding area has some heritage resources situated within the proposed development boundaries. Through data analysis and a site investigation, the following issues were identified from a heritage perspective.

Heritage Sites

During the field work several heritage features and resources were identified and logged. A total of 57 points of interest were logged that resulted in the delineation and identification of 24 separate heritage sites. These consist of **five burial grounds** (Site 1-1, 1-7, 2-1, 2-2 and 2-3 this is indicated as a stone feature that could possibly be a grave) with **a High heritage significance and a heritage grading of IIIA**. The **nine historic recent structures**. These are 1-2, 1-3, 1-4, 1-5, 1-6, 2-4, 2-5, 5-5 and 5-7, vary in significance from **medium to low and a grading of IIIB**. The archaeological finds consisting of 9 archaeological sites (Site 3-1, 3-2, Site 4-1, 4-2, and Sites 5-1, 5-2, 5-3, 5-4 and 5-6) has in most cases a rating of **Medium significance and a grading varying between IIIC and IIIA at the highest**. Site 5-8 represents a possible memorial now in disuse it was rated as having a Low heritage significance but with a possible local significance.

Burial Grounds and graves

Burial grounds have a high heritage rating and a heritage grading of IIIA. According to the SAHRA graves management policy a buffer of at least 30-meters must be kept around burial grounds and graves

Archaeological sites

The identified archaeological sites have a low to high heritage significance. Sites alternatives 2, 3 and 5 will have the least impact on identified archaeological sites, although mitigation work will be required for sites 3 and 5 as identified in the management guidelines of this report. The archaeological site identified on site 4 will require extensive mitigation work to mitigate the impact before any development

If any of the identified archaeological site are to be disturbed a Phase 2 archaeological mitigation process must be implemented. This will include, surface collections, test excavations and analysis of recovered material. A permit issued under s35 of the NHRA will be required to conduct such work.

On completion of the mitigation work the developer can apply for a destruction permit with the backing of the mitigation report

Palaeontological Impacts

The SAHRIS Palaeo sensitivity Map rates the palaeontological sensitivity of the geology as low and will only require the inclusion of a chance finds procedure in the EMPr.

However, if fossil remains are discovered during any phase of construction, either on the surface or exposed by fresh excavations the Chance Find Protocol must be implemented by the ECO in charge of these developments. These discoveries ought to be protected (if possible, in situ) and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that suitable mitigation (e.g., recording and collection) can be carry out by a palaeontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.

Preferred alternatives

From a heritage perspective the first management principle is conservation in situ. The locality of burial grounds and graves on alternatives Site 1 and Site 2 will require the adjustment of designs for these alternatives, but do not exclude the whole area.

The position and significance of the archaeological sites at site alternatives 3, 4 and 5 will required the implementation of mitigation as described in section 7, however these mitigation measures will be costly for site alternative 4 due to the extent and significance of the archaeological site.

General

It is the author’s considered opinion that overall impact on heritage resources can be mitigated to Low with the implementation of mitigation measures. Provided that the recommended mitigation measures are implemented, the impact would be acceptably Low or could be totally mitigated to the degree that the project could be approved from a heritage perspective. The management and mitigation measures as described in Section 7 of this report have been developed to minimise the project impact on heritage resources.

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TERMINOLOGY AND ABBREVIATIONS

Archaeological resources

This includes:

- material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;
- rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
- wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation; and
- features, structures, and artefacts associated with military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic, or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place;
- carrying out any works on or over or under a place;
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
- constructing or putting up for display signs or boards;
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

Early Stone Age

The archaeology of the Stone Age between 700 000 and 3 300 000 years ago.

Fossil

Mineralised bones of animals, shellfish, plants, and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance and can include (but not limited to) as stated under Section 3 of the NHRA,

- places, buildings, structures, and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa;

Holocene

The most recent geological time period which commenced 10 000 years ago.

Late Stone Age

The archaeology of the last 30 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron-working and farming activities such as herding and agriculture.

Middle Iron Age

The archaeology of the period between 900-1300AD, associated with the development of the Zimbabwe culture, defined by class distinction and sacred leadership.

Middle Stone Age

The archaeology of the Stone Age between 30 000-300 000 years ago, associated with early modern humans.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Table 1 – List of abbreviations used in this report

Abbreviations	Description
AIA	Archaeological Impact Assessment
APHP	Association of Professional Heritage Practitioners
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EIAs practitioner	Environmental Impact Assessment Practitioner
ESA	Earlier Stone Age
GN	Government Notice
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
IAIASA	International Association for Impact Assessment South Africa
LCTs	Large Cutting Tools
LIA	Late Iron Age
LSA	Late Stone Age
MIA	Middle Iron Age
MSA	Middle Stone Age
NEMA	National Environmental Management Act, 1998 (Act No 107 of 1998)
NHRA	National Heritage Resources Act, 1999 (Act No 25 of 1999)
NCW	Not Conservation Worthy
PGS	PGS Heritage (Pty) Ltd
PHRA	Provincial Heritage Resources Authority
PIA	Palaeontological Impact Assessment
PSSA	Palaeontological Society of South Africa
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System

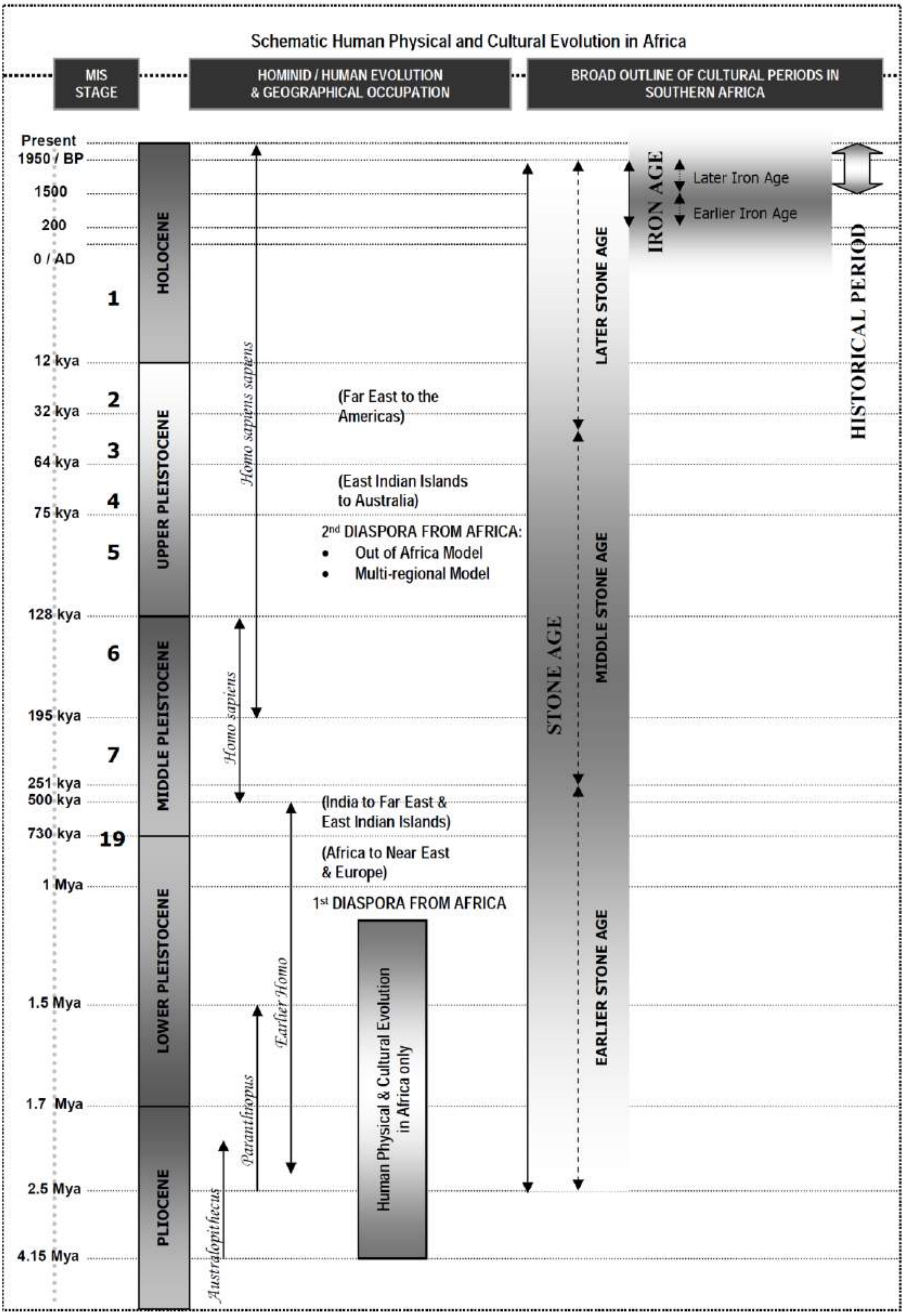

Figure 1 – Human and Cultural Timeline in Africa (Morris, 2008)

1 INTRODUCTION

PGS Heritage (Pty) Ltd (PGS) was appointed by Royal Haskoning DHV (Pty) Ltd (RHDHV) to undertake a Heritage Impact Assessment (HIA) which will serve to inform the Environmental Impact Assessment (EIA) and Environmental Management Programme (EMPr) for the 100MW PV Plant at the Samancor Chrome Operations, Steelpoort, Limpopo.

1.1 Scope of the Study

The aim of the study is to identify possible heritage sites and finds that may occur in the proposed development area. The HIA aims to inform the EIA in the development of a comprehensive EMPr to assist the project applicant in responsibly managing the identified heritage resources in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

This HIA was compiled by PGS.

The staff at PGS have a combined experience of nearly 70 years in the heritage consulting industry. PGS and its staff have extensive experience in managing HIA processes. PGS will only undertake heritage assessment work where they have the relevant expertise and experience to undertake that work competently.

Wouter Fourie, the Project Coordinator and author is registered with the ASAPA as a Professional Archaeologist and is accredited as a Principal Investigator; he is further an Accredited Professional Heritage Practitioner with the Association of Professional Heritage Practitioners (APHP).

Ruan van der Merwe field archaeologist holds a BA (Hons) in Archaeology.

Wynand van Zyl field archaeologist holds a BA (Hons) in Archaeology.

1.3 Assumptions and Limitations

Not detracting in any way from the comprehensiveness of the research undertaken, it is necessary to realise that the heritage resources located during the desktop research and fieldwork do not necessarily represent all the possible heritage resources present within the area.

Such observed or located heritage features and/or objects may not be disturbed or removed in any way until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well.

The overall visibility for fieldwork was hampered by dense vegetation on all 5 alternative sites, with site alternative 4 and 5 extremely overgrown.

1.4 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

- Notice 648 of the Government Gazette 45421- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified
- National Environmental Management Act (NEMA), Act 107 of 1998 – Appendix 6
- National Heritage Resources Act (NHRA), Act 25 of 1999

1.4.1 Notice 648 of the Government Gazette 45421

Although minimum standards for archaeological (2007) and palaeontological (2012) assessments were published by SAHRA, GN.648 requires sensitivity verification for a site selected on the national web based environmental screening tool for which no specific assessment protocol related to any theme has been identified. The requirements for this Government Notice (GN) are listed in **Table 2** and the applicable section in this report noted.

Table 2 - Reporting requirements for GN648

GN 648	Relevant section in report	Where not applicable in this report
2.2 (a) a desktop analysis, using satellite imagery;	section 4.5	
2.2 (b) a preliminary on-site inspection to identify if there are any discrepancies with the current use of land and environmental status quo versus the environmental sensitivity as identified on the national web-based environmental screening tool, such as new developments, infrastructure, indigenous/pristine vegetation, etc.	4.1	-
2.3(a) confirms or disputes the current use of the land and environmental sensitivity as identified by the national web-based environmental screening tool;	section 4.1	-
2.3(b) contains motivation and evidence (e.g., photographs) of either the verified or different use of the land and environmental sensitivity;	section 4.1	-

1.4.2 NEMA – Appendix 6 requirements

The HIA report has been compiled considering the NEMA Appendix 6 requirements for specialist reports as indicated in the table below. For ease of reference, the table below provides cross-references to the report sections where these requirements have been addressed. It is important to note, that where something is not applicable to this HIA, this has been indicated in the table below.

Table 3 - Reporting requirements as per NEMA Appendix 6 for specialist reports

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
1.(1) (a) (i) Details of the specialist who prepared the report	Page 2 of Report – Contact details and company	-
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 1.2 – refer to **Appendix B**	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 2.1	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 3	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 3	-
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 3 and **Appendix A**	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative;	Section 5	
(g) An identification of any areas to be avoided, including buffers	Section 4.6	
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;		
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.3	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 8	
(k) Any mitigation measures for inclusion in the EMPr	Section 7.11	
(l) Any conditions for inclusion in the environmental authorisation		None required
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 7.11	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 8	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
(n)(ii) If the opinion is that the proposed activity, activities, or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 8	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study		Not applicable. A public consultation process was handled as part of the EIA and EMP process.
(p) A summary and copies if any comments that were received during any consultation process		Not applicable. To date no comments regarding heritage resources that require input from a specialist have been raised.
(q) Any other information requested by the competent authority.		Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	NEMA Appendix 6 and GN648	

1.4.3 The National Heritage Resources Act

- National Heritage Resources Act (NHRA) Act 25 of 1999
  - Protection of Heritage Resources – Sections 34 to 36; and
  - Heritage Resources Management – Section 38

The NHRA is utilized as the basis for the identification, evaluation, and management of heritage resources and in the case of Cultural Resource Management (CRM) those resources specifically impacted on by development as stipulated in Section 38 of NHRA. This study falls under s38(8) and requires comment from the relevant heritage resources authority that includes the South African Heritage Resources Authority (SAHRA) and the Limpopo Heritage Resources Authority (LiHRA).

2 SITE LOCATION AND DESCRIPTION

2.1 Locality and Site Description

The project area is located on portions of the farm Goudmyn 337KT and Olifantspoortje 319KT within the Fetakgomo Local Municipality of the Sekhukhune District Municipality, Limpopo Province. The sites are in and around the town of Steelpoort (**Figure 2**).

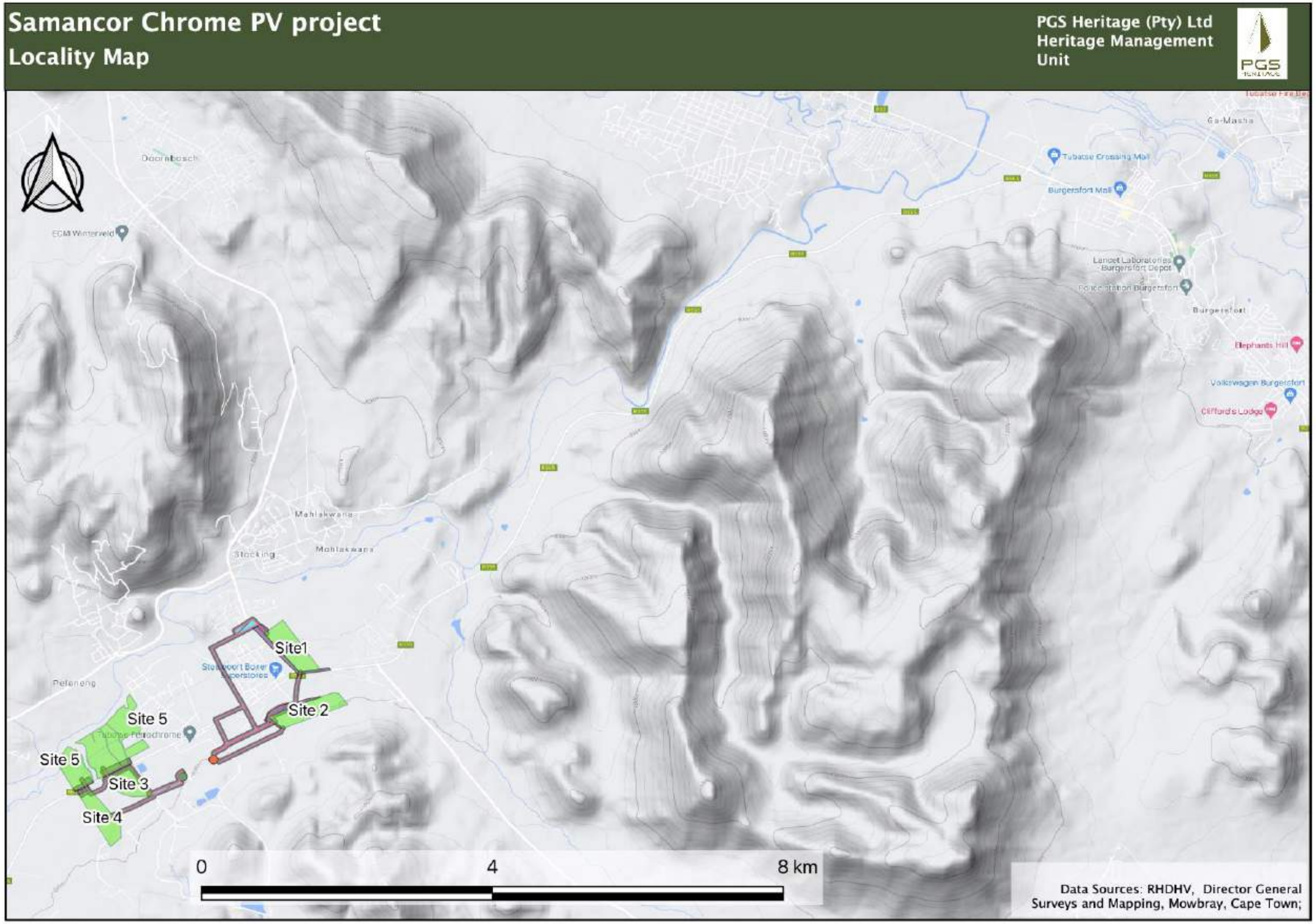

Figure 2 – Locality map of the proposed development footprints and alternatives

2.2 Project description

The proposed PV plant converts the solar radiation into electric energy by using photovoltaic solar arrays. The name plate rating of the plant will be a minimum of 100MWp.

The plant will be spread over several sites shown in the site plan.
Each of the PV plants will consist of the following infrastructure:

- Solar PV panels that will be able to deliver up to 100MWp to the Samancor grid.
- Inverters that convert direct current (DC) generated by the PV modules into alternating current (AC) to be exported to the electrical grid.
- Inverter and transformer combination – each power block will have a centralised inverter which converts the DC power generated by the PV panels, to AC power and a transformer which transforms the power to a higher voltage of 33 kV to facilitate transmitting the power over longer distances to connect to the East and West Plant Substations; and
- Instrumentation and Control consisting of hardware and software for remote plant monitoring and operation of the facility.

Associated infrastructure includes:

- Mounting structures for the solar panels in a fixed tilt configuration.
- Cabling between the structures, to be lain underground where practical.
- New 33 kV powerlines (either overhead lines or underground cables) between the various sites and the Tubatse East and West substation buildings.
- Containerized switchgear substation at Tubatse East and West MV substations for connecting to the Tubatse substation busbars.
- Water provision infrastructure (i.e. storage tank/ s, etc.) for PV panel cleaning.
- Battery Energy Storage System (BESS).
- Internal access roads (4- 6 m wide roads will be constructed but existing roads will be used as far as possible) and fencing (approximately 1.8 m in height), gates and access control.

3 METHODOLOGY

The applicable maps, tables, and figures are included as stipulated in the NHRA (no 25 of 1999), the NEMA (no 107 of 1998). The HIA process consisted of three steps:

Step I – Literature Review and sensitivity analysis[1]: The background information to the field survey relies greatly on previous studies completed for the project to determine known sensitivities, as well as the heritage background research completed for this report.

[1] *According to Notice 648 of the Government Gazette 45421*

Step II – Physical Survey: A physical survey was conducted by vehicle through the proposed project area by a qualified heritage specialist. The survey was conducted between March and April 2021, aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

Step III – The final step involved the recording and documentation of relevant archaeological resources, the assessment of resources in terms of the HIA criteria and report writing, as well as mapping and constructive recommendations.

3.1 Site Significance

Site significance classification standards use is based on the heritage classification of s3 in the NHRA and developed for implementation keeping in mind the grading system approved by SAHRA for archaeological impact assessments. The update classification and rating system as developed by Heritage Western Cape (2016) is implemented in this report.

Site significance classification standards prescribed by the Heritage Western Cape Guideline (2016), were used for the purpose of this report (**Table 4** and **Table 5**).

Table 4 - Rating system for archaeological resources

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
I	Heritage resources with qualities so exceptional that they are of special national significance. Current example: Mapungubwe Cultural Landscape	May be declared as a National Heritage Site managed by SAHRA. Specific mitigation and scientific investigation can be permitted in certain circumstances with sufficient motivation.	Highest Significance
II	Heritage resources with special qualities which make them significant, but do not fulfil the criteria for Grade I status. Current example: Schoemansdal, Louis Trichardt, Soutpansberg District	May be declared as a Provincial Heritage Site managed by LiHRA. Specific mitigation and scientific investigation can be permitted in certain circumstances with sufficient motivation.	Exceptionally High Significance
III	Heritage resources that contribute to the environmental quality or cultural significance of a larger area and fulfils one of the criteria set out in section 3(3) of the Act but that does not fulfil the criteria for Grade II status. Grade III sites may be formally protected by placement on the Heritage Register.		
IIIA	Such a resource must be an excellent example of its kind or must be sufficiently rare. Current examples: Koni ruins, Lydenburg	Resource must be retained. Specific mitigation and scientific investigation can be permitted in certain circumstances with sufficient motivation.	High Significance
IIIB	Such a resource might have similar significances to those of a Grade III A resource, but to a lesser degree.	Resource must be retained where possible where not possible it must be fully investigated and/or mitigated.	Medium Significance
IIIC	Such a resource is of contributing significance.	Resource must be satisfactorily studied before impact. If the recording already done (such as in an HIA or permit application) is not sufficient, further recording or even mitigation may be required.	Low Significance

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
NCW	A resource that, after appropriate investigation, has been determined to not have enough heritage significance to be retained as part of the National Estate.	No further actions under the NHRA are required. This must be motivated by the applicant or the consultant and approved by the authority.	No research potential or other cultural significance

Table 5 - Rating system for built environment resources

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
I	Heritage resources with qualities so exceptional that they are of special national significance. Current examples: Robben Island	May be declared as a National Heritage Site managed by SAHRA.	Highest Significance
II	Heritage resources with special qualities which make them significant in the context of a province or region, but do not fulfil the criteria for Grade I status. Current examples: Moorddrift Monument, Potgietersrus	May be declared as a Provincial Heritage Site managed by LiHRA.	Exceptionally High Significance
II	Such a resource contributes to the environmental quality or cultural significance of a larger area and fulfils one of the criteria set out in section 3(3) of the Act but that does not fulfil the criteria for Grade II status. Grade III sites may be formally protected by placement on the Heritage Register.		
IIIA	Such a resource must be an excellent example of its kind or must be sufficiently rare. These are heritage resources which are significant in the context of an area.	This grading is applied to buildings and sites that have sufficient intrinsic significance to be regarded as local heritage resources; and are significant enough to warrant that any alteration, both internal and external, is regulated. Such buildings and sites may be representative, being excellent examples of their kind, or may be rare. In either case, they should receive maximum protection at local level.	High Significance
IIIB	Such a resource might have similar significances to those of a Grade III A resource, but to a lesser degree. These are heritage resources which are significant in the context of a townscape, neighbourhood, settlement, or community.	Like Grade IIIA buildings and sites, such buildings and sites may be representative, being excellent examples of their kind, or may be rare, but less so than Grade IIIA examples. They would receive less stringent protection than Grade IIIA buildings and sites at local level.	Medium Significance
IIIC	Such a resource is of contributing significance to the environs. These are heritage resources which are significant in the context of a streetscape or direct neighbourhood.	This grading is applied to buildings and/or sites whose significance is contextual, i.e., in large part due to its contribution to the character or significance of the environs. These buildings and sites should, consequently, only be regulated if the significance of the environs is sufficient to warrant protective measures, regardless of whether the site falls within a Conservation or Heritage Area. Internal alterations should not necessarily be regulated.	Low Significance

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
NCW	A resource that, after appropriate investigation, has been determined to not have enough heritage significance to be retained as part of the National Estate.	No further actions under the NHRA are required. This must be motivated by the applicant and approved by the authority. Section 34 can even be lifted by LiHRA for structures in this category if they are older than 60 years.	No research potential or other cultural significance

4 CURRENT STATUS QUO

4.1 Site Description

The five alternatives evaluated were overgrown and dense vegetation characterised most of the sites. A mix of grass and bushveld dominate the alternative sites. While sites 4 and 5 has dense riverine vegetation in the drainage lines that flows towards the Steelpoort river.

Figure 3 – View of the general conditions at site alternative 4

Figure 4 – View of the general conditions at site alternative 3

Figure 5 – View of the general conditions at site alternative 3

Figure 6 – View of the general conditions at site alternative 5

5 HISTORICAL BACKGROUND

5.1 Archaeological Overview of the Study Area and Surroundings

DATE	DESCRIPTION
The Study Area and Surroundings during the Stone Age	
The South African Stone Age is the longest archaeologically-identified phase identified in human history and lasted for millions of years.	
2.5 million - 250 000 years ago	The Early Stone Age is the first and oldest phase identified in South Africa's archaeological history and comprises two technological phases. The earliest of these technological phases is known as Oldowan, which is associated with crude flakes and hammerstones and dates to some 2 million years ago. The second technological phase in the earlier stone age of Southern Africa is known as the Acheulian and comprises more refined and better-made stone artefacts such as the cleaver and bifacial hand axe. The Acheulian dates back to approximately 1.5 million years ago. Stone artefacts dating to the Early Stone Age have been identified by previous archaeological surveys on some of the farms included in the study area and immediate surrounds, including Onverwacht 292KT, Hendrikplaats 281KT and Winterveld 293KT (Pistorius 2005; 2006)
250 000 to 40 000 years ago	The Middle Stone Age is the second oldest phase identified in South Africa's archaeological history. This phase is associated with flakes, points and blades manufactured by means of the so-called 'prepared core' technique. During previous archaeological surveys, scatters of Middle Stone Age lithics have been identified on some of the farms included in the study area and immediate surrounds, including Onverwacht 292KT, Hendrikplaats 281KT and Winterveld 293KT (Pistorius 2005; 2006)
40 000 years ago to the historic past	The Later Stone Age is the third archaeological phase identified and is associated with an abundance of very small artefacts known as microliths. A well-known feature of the Later Stone Age is rock art in the form of rock paintings and engravings. Stone artefacts dating to the Early Stone Age have been identified by previous archaeological surveys on some of the farms included in the study area and immediate surrounds, including Onverwacht 292KT, Hendrikplaats 281KT and Winterveld 293KT (Pistorius 2005; 2006)
The Study Area and Surroundings during the Iron Age	
The arrival of early farming communities during the first millenium, heralded in the start of the Iron Age for South Africa. The Iron Age is that period in South Africa's archaeological history associated with pre-	

DATE	DESCRIPTION
colonial farming communities who practiced cultivation and pastoralist farming activities, metal working, cultural customs such as lobola and whose settlement layouts show the tangible representation of the significance of cattle (known as the Central Cattle Pattern) (Huffman, 2007).	
AD 450 – AD 750	The Mzonjani facies of the Kwale Branch of the Urewe Ceramic Tradition is the earliest Iron Age presence for which archaeological evidence had been found in the surroundings of the study area. The key features on the decoration of the ceramics from this facies comprise punctuates on the rim and spaced motifs on the shoulder of the vessel (Huffman, 2007). No sites associated with the Mzonjani facies are known to be located within the study area or its immediate surroundings.
AD 750 – AD 1000	The Doornkop facies of the Happy Rest Sub-branch of the Kalundu Ceramic Tradition is the second Iron Age presence in the study area and surroundings. The key features on the decoration of the ceramics from this facies comprise multiple herringbone bands in neck (Huffman, 2007). No significant sites associated with the Doornkop facies are known to be located within the study area. This said, one site with Doornkop pottery and burnt floors was identified by a previous survey on the farm Maandagshoek 254 KT, which is located immediately north of the study area (Roodt 2006).
AD 1000 – AD 1300	The Eiland facies of the Happy Rest Sub-branch of the Kalundu Ceramic Tradition is the third Iron Age presence for which archaeological evidence had been found in the surroundings of the study area. The key features on the decoration of the ceramics from this facies comprise fine herringbone with ladder stamping (Huffman, 2007). No significant sites associated with the Eiland facies are known to be located within the study area. This said, one site with Eiland pottery was identified by a previous survey on the farm Maandagshoek, which is located immediately north of the study area.
AD 1300 – AD 1500	The Kgopolwe facies of the Happy Rest sub-branch of the Kalundu Ceramic tradition is the fifth Iron Age presence for which archaeological evidence had been found in the surroundings of the study area. The key features on the decoration of the ceramics from this facies comprise multiple incised bands separated by colour and lip decoration on bowls (Huffman, 2007). Sites with Kgopolwe facies ceramics have been identified in the surroundings of the study area. In fact, one of the sites identified during the present fieldwork contains Kgopolwe pottery (see site MDK 7).
AD 1650 - AD 1840	The Marateng facies of the Moloko Branch of the Urewe Ceramic Ceramic Tradition is the sixth Iron Age facies to be identified within the surroundings of the study area. The key features of the decoration used on the ceramics from this facies include incised arcades on upper shoulder separating black and red (Huffman, 2007). The Marateng facies can be associated with modern Pedi.

DATE	DESCRIPTION
	One of the sites identified during the present fieldwork contains Marateng pottery (see site MDK 3).

5.2 Aspects of the History of the Study Area and Surroundings

5.2.1 Late Iron Age and Historic Black Settlement

5.2.2 The situation during the early nineteenth century

According to Bergh (1999), the Pedi, Roka, Koni and Tau were settled in the wider region during the start of the nineteenth century. As confirmation of this, Schoeman (1997) indicates that when the Bapedi settled in the Sekhukhuneland region during the second half of the seventeenth century (Schoeman, 1997), a number of groups such as the Kwena, Roka, Koni and Tau had preceded them there.

The Kwena of Mongatane was the first of these groups to settle in this wider area. Upon reaching the Olifants River, they split up into two groups. The first of these was under the leadership of Masabela, who established the first permanent Sotho settlement in Sekhukhuneland. The second group under Kope, decided to proceed upstream along the Olifants River and subsequently established themselves near present-day Groblersdal. It was this second group under Kope that later became known as the BaKopa.

With time the Phasa, related to the group of Masabela, also moved into the Sekhukhuneland region. Although both these groups referred to themselves as the Roka, other groups of a similar name were also found here. After the settlement of the Roka, and by approximately 1700, various Koni and Tau groups also moved into the area.

5.2.3 Khumalo Ndebele

The Khumalo Ndebele of Mzilikazi was a Northern-Nguni group that moved out of KwaZulu-Natal during 1821. They first settled at the confluence of the Vaal and Olifants Rivers from where they moved further north and fought with the Ndzundza-Ndebele of Magodongo who resided near present-day Stoffberg. The Ndzundza-Ndebele were defeated, and Mzilikazi and his followers settled temporarily in these parts (Bergh, 1999).

During their short residence in the area, the Khumalo-Ndebele attacked the Koni of Makopole in the vicinity of present-day Lydenburg, before attacking the Bapedi of Maroteng in 1822.

Mzilikazi then turned his attention to the area between the Olifants and Steelpoort Rivers, which was the heartland of the Bapedi. In the ensuing military activities, the Pedi paramount leader Phetedi, as well as most of his brothers, were killed. However, one of the brothers managed to escape northwards and survived. He was Sekwati.

Sekwati returned to the area in 1828 and settled at Phiring, from where he started to rebuild the Maroteng kingdom.

According to Smith (1967), the Khumalo-Ndebele stayed in the wider surroundings of the present study area for approximately a year, and during this time raided or destroyed much of the grain and livestock of the surrounding communities.

5.2.4 Bapedi

As mentioned before, the Bapedi settled in the Sekhukhuneland region during the second half of the seventeenth century (Schoeman, 1997).

During the later stages of the 1700s and early period of the 1800s, the Morateng group of the Bapedi became the most dominant force in the area, subjecting many of the other communities and groups. They reached their zenith during the rule of Thulare (ca. 1790 – ca. 1820).

Although the heartland of the BaPedi kingdom was the area between the Olifants and Steelpoort Rivers, their influence stretched much further than that. For example, the winter pasture of Sekwati was located in the areas directly to the east of the Steelpoort River.

5.3 Voortrekkers and the establishment of Ohrigstad and Lydenburg

In an effort to get further away from British influence, and at the same time closer to the market at Delagoa Bay, the Voortrekker leader Andries Hendrik Potgieter together with a large following, moved from areas only recently established after the Great Trek such as Potchefstroom, Pretoria and the Magaliesberg to the vicinity of Ohrigstad. It is estimated that by August 1845, there were already a thousand Voortrekkers resident in the surroundings of Ohrigstad (Botha, 1958).

Figure 7 - Andries Hendrik Potgieter (Pienaar, 1990:136).

Attention now focused on the establishment of a town, and as early as 30 July 1845 a meeting was held at the new town named Ohrigstad. The meeting was aimed at reorganising the Voortrekker government and also establishing a new *Volksraad* (Botha, 1958).

The wider areas surrounding the town also became increasingly settled by the new arrivals. During the period between August 1845 and December 1847, a total of 406 individual farms were proclaimed.

Due to a number of reasons, including the prevalence of malaria, the settlement of Ohrigstad began to decline. As a result, the *Volksraad* came together on 19 September 1849 in the higher-lying town of Krugerspos and decided that a new town was to be established in a healthier area. On 20 September 1849, the decision was made to name the new town "Leidenburg", and on 23 January 1850, the *Volksraad* in Potchefstroom decided that the new town was to be established on the farm Rietspruit (Botha, 1958:91).

The Lydenburg district was proclaimed as an independent state, namely the Republic of Lydenburg, on 17 December 1856 (Duvenage, 1966).

5.3.1 *Relations between the Voortrekkers and Bapedi during Sekwati's reign*

In July 1845 the Voortrekker leader A.H. Potgieter negotiated a settlement with Sekwati. This settlement was aimed at allowing Potgieter's followers to settle and establish farms in present-day Mpumalanga. However, relations turned sour when the *Volksraad* negotiated and made a separate agreement with the Swazi kingdom to allow white farmers to settle in the areas falling under Sekwati's rule. Sekwati was very unhappy about this agreement in that he felt that as the Swazi never managed to subject him, he still had the only say in terms of the land in question.

Nonetheless, farmers started establishing farms over large parts near Ohrigstad and Lydenburg, as well as quite close to Sekwati's residence and capital.

Although the initial stages (1845 to 1846) of contact between the Bapedi of Sekwati and the Boers was characterised by peace, this issue regarding the land negotiations started to have a negative impact on the relationship.

By August 1852, relations had so deteriorated that Potgieter led a commando against Sekwati. The commando, assisted by black forces, was not able to defeat the Pedi at their Phiring stronghold and lay a siege around the town in an attempt to subjugate them. The siege also proved unsuccessful and the commando left. Although the military activities did not curtail the power and influence of Sekwati, he decided to relocate his capital to the more defensive Thaba Mosego in the Leolo Mountains.

Due to the failure of the military actions taken against Sekwati, as well as the secession of the Lydenburg Republic in 1856, the Boers from these parts started making a strong motion in favour of a peaceful settlement with Sekwati. In October 1857, a commission was appointed to investigate the possible resolution of peace with the Pedi leader. Issues regarding land and boundaries were also to be discussed. On 17 November 1857, the Boers and Sekwati concluded a peace agreement. According to the terms of the agreement, the Steelpoort River was established as the boundary between the Bapedi and the Boer Republic. However, the agreement did not solve all the problems as it did not stipulate or rule on the issue of Boer farms already existing to the west of the Steelpoort River, nor did it indicate how far south the boundary of the Pedi land reached.

After the signing of the agreement, during the late 1850s, relative peace settled over the area. However, the 1860s and 1870s were characterised by friction between the Bapedi and the white farmers. These unfriendly relations worsened and culminated in open warfare during the latter part of the 1870s.

5.3.2 Relations between the Whites and Bapedi during Sekhukhune's reign

When Sekhukhune succeeded Sekwati as ruler of the Bapedi in 1861, his first priority was to strengthen his power base by eliminating or fighting any threats to his throne. Apart from the direct threats to his throne, Sekhukhune also felt threatened by a number of groups that used to be under Pedi influence. For example, both the Ndzundza-Ndebele and Bakopa started functioning independently from the Pedi during this time.

As a means of strengthening his position, Sekhukhune remained at peace with the Boers, and subsequently made an agreement with the Lydenburg Republic, which in effect upheld the same provisions contained in the 1857 agreement, with the exception that no ruling was made in terms of the Steelpoort River as the boundary.

During October 1863, Sekhukhune also sent Pedi forces to assist a Boer attack on the Ndzundza. However, the attack was a failure (Bergh, 1999).

Nevertheless, a number of factors again soured the relationship between the Bapedi and the whites (Bergh, 1999). During this time Sekhukhune sent some of his people to settle on the farms south and east of the Steelpoort River. In terms of the present study area, it is interesting to note that groups under Vroetepe and Marobele were sent to the banks of the Dwars Rivers to settle there to grow crops on the rivers' banks (Van Rooyen, 1950).

When a farmer named Jancowitz, who had bought a farm in the vicinity of Mafolofolo, was prohibited from marking the beacons on his property (or from collecting wood there) by followers of Sekhukhune's younger brother Johannes Dinkwanyane, Sekhukhune decided to send his warriors to assist his brother.

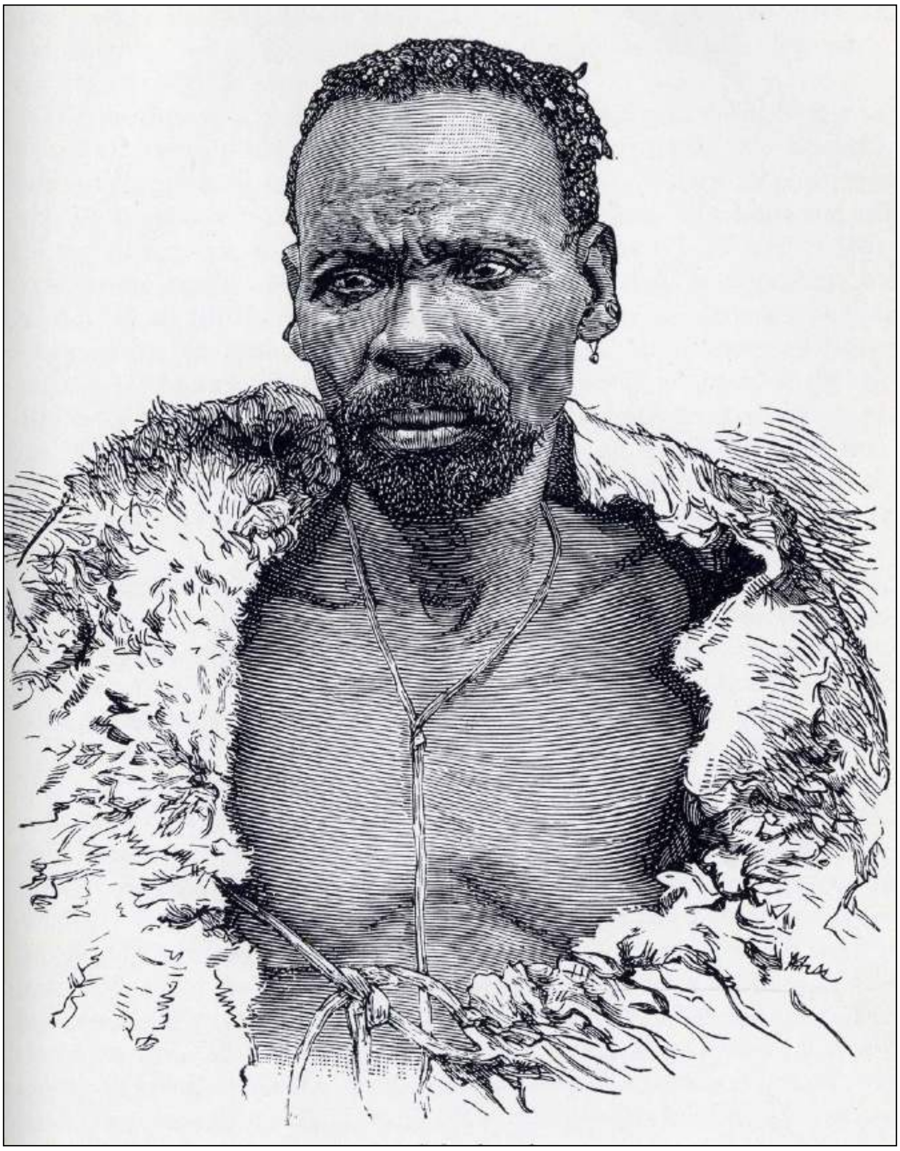

Figure 8 – Sekhukhune, ruler of the Bapedi (Grosskopf, 1957).

The Boers from the surrounding areas identified the incident as a threat and grouped themselves into lagers. They subsequently asked the government for assistance. On 16 May 1876, the *Volksraad* declared war on the Bapedi. After a number of successes, the forces of the Zuid-Afrikaansche Republiek attacked Tshate, the new capital of Sekhukhune. As the first attacks proved unsuccessful, the decision was made to place the town under siege. Although a peace agreement was signed on 16 February 1877, Sekhukhune was not in agreement with all of the provisions. The subsequent British annexation of Transvaal allowed Sekhukhune a measure of strategic space. Although negotiations were undertaken with the new British authorities, the relations between the British and the Bapedi eventually resulted in the outbreak of war. The war ended in the attack on Sekhukhune's capital Tshate on 28 November 1879. Although Sekhukhune managed to escape, he was captured on 2 December 1879, and imprisoned at Pretoria (Bergh, 1999).

Most of the significant battles of the wars between the Bapedi of Sekhukhune and the Z.A.R. as well as the British authorities, such as the decisive Tshate battle of 28 November 1879, took place far away from the study area. For example, Tshate, the scene of this battle and also capital of Skhukhune, was located 18.3 km north-west of the present study area.

5.4 Archival/historical maps

The examination of historical data and cartographic resources represents a critical tool for locating and identifying heritage resources and in determining the historical and cultural context of the study area. Relevant topographic maps and satellite imagery were studied to identify structures, possible burial grounds or archaeological sites present in the footprint area.

Topographic maps (1:50 000) for various years (1963,1979 and 1999) were assessed to observe the development of the area, as well as the location of possible historical structures and burial grounds. The maps were also used to assess the possible age of structures located, to determine whether they could be considered as heritage sites. Map overlays were created showing the possible heritage sites identified within the areas of concern, as can be seen below (**Figure 9**).

The relevant topographical maps include:

- First Edition of 2430CA Steelpoort Topographic Map 1:50000, surveyed in 1963 and drawn in 1965 by the Trigonometrical Survey Office and published by the Government Printer in 1965.
- Second Edition of 2430CA Steelpoort Topographic Map 1:50000, published by the Chief Directorate, Surveys ad Mapping in 1979.

All the map sheets consulted depict the points in the project area with huts and other structures, as well as old agricultural fields. Historical roads are also depicted.

Furthermore, no SG Diagrams are available for the Farm Goudmyn 337 from the Chief Surveyor-General database (http://csg.dla.gov.za/).

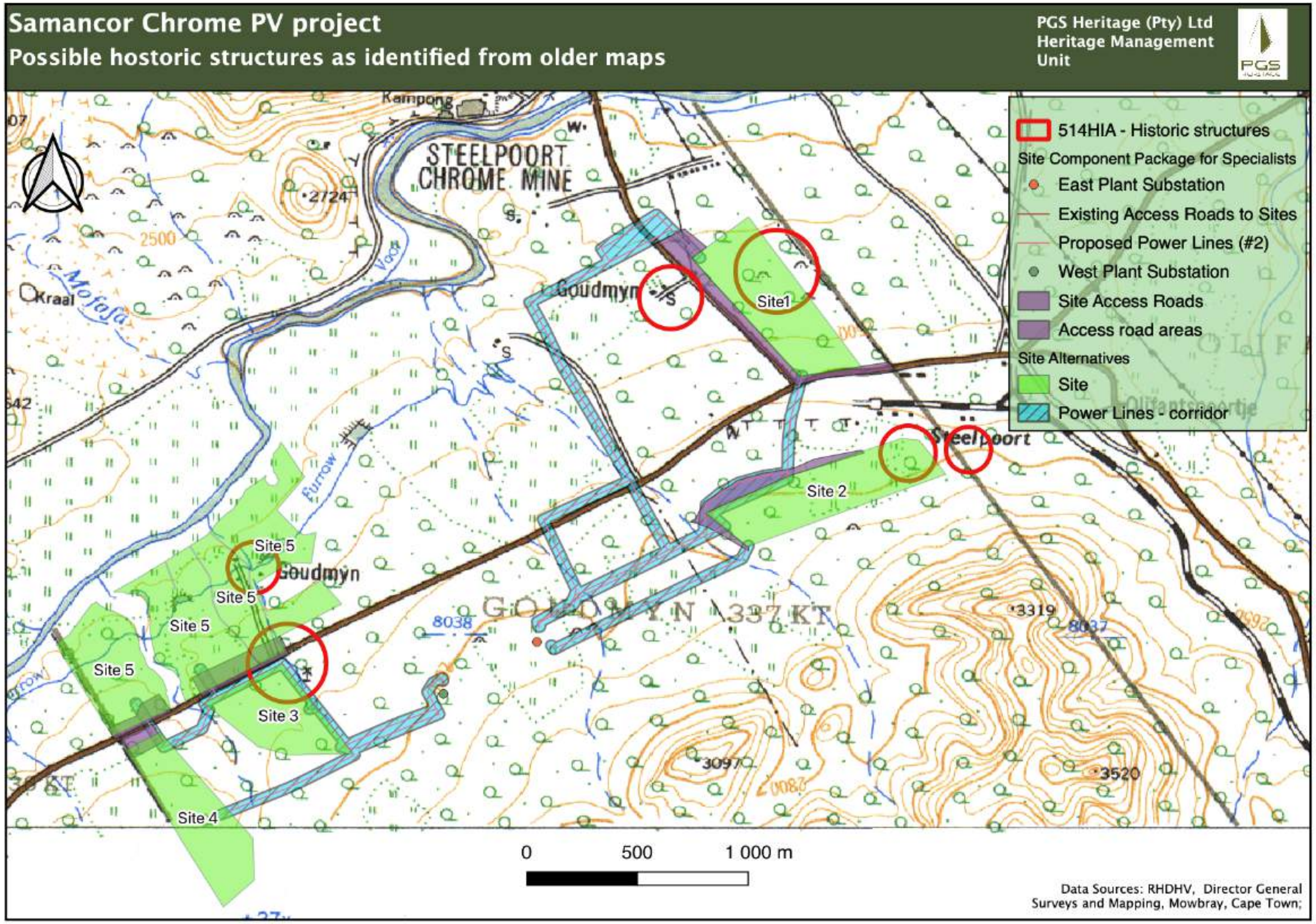

Figure 9 – First Edition of 2430CA Steelpoort Topographic Map 1:50000 dating to 1963, with several possible heritage features (red polygons) located in the project area.

5.5 Findings of the historical desktop study

The findings can be compiled as follows and have been combined to produce a heritage sensitivity map for the project based on the desktop assessment.

5.5.1 Heritage Screening

A Heritage Screening Report was compiled by the Department of Environmental Affairs National Web-based Environmental Screening Tool as required by Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended According to the Heritage Screening Report, the project area has a low to high archaeological and cultural heritage sensitivity (**Figure 10**) and a medium palaeontological sensitivity (**Figure 11**).

5.5.2 Heritage Sensitivity

The sensitivity maps were produced by overlying:

- Satellite Imagery.
- Current Topographical Maps; and
- First to third edition Topographical Maps dating from the 1960s to 1970s.

This enabled the identification of possible heritage sensitive areas that included:

- Dwellings.
- Clusters of dwellings (homesteads, huts, and farmsteads);
- Archaeological Sensitive areas; and
- Structures/Buildings.

By superimposition and analysis, it was possible to rate these structure/areas according to age and thus their level of protection under the NHRA. Note that these structures refer to possible tangible heritage sites as listed in ***Table 6***.

Table 6 -Tangible heritage sites in the study area

Name	Description	Legislative protection
Archaeology - Iron Age Sites	Older than 100 years	NHRA Sect 3 and 35
Architectural Structures	Possibly older than 60 years	NHRA Sect 3 and 34
Graves and Burial Grounds	60 years or older	NHRA Sect 3 and 36

Additionally, evaluation of satellite imagery has indicated the following areas that may be sensitive from a heritage perspective. The analysis of the studies conducted in the area assisted in the development of the following landform type to heritage find matrix in **Table 7**.

Table 7 - Landform type to heritage find matrix

LANDFORM TYPE	HERITAGE TYPE
Crest and foot hill	LSA and MSA scatters, LIA settlements
Crest of small hills	Small LSA sites – scatters of stone artefacts, ostrich eggshell, pottery, and beads
Watering holes/pans/rivers	ESA, MSA and LSA sites, LIA settlements
Farmsteads	Historical archaeological material
Ridges and drainage lines	LSA sites, LIA settlements
Forested areas	LIA sites

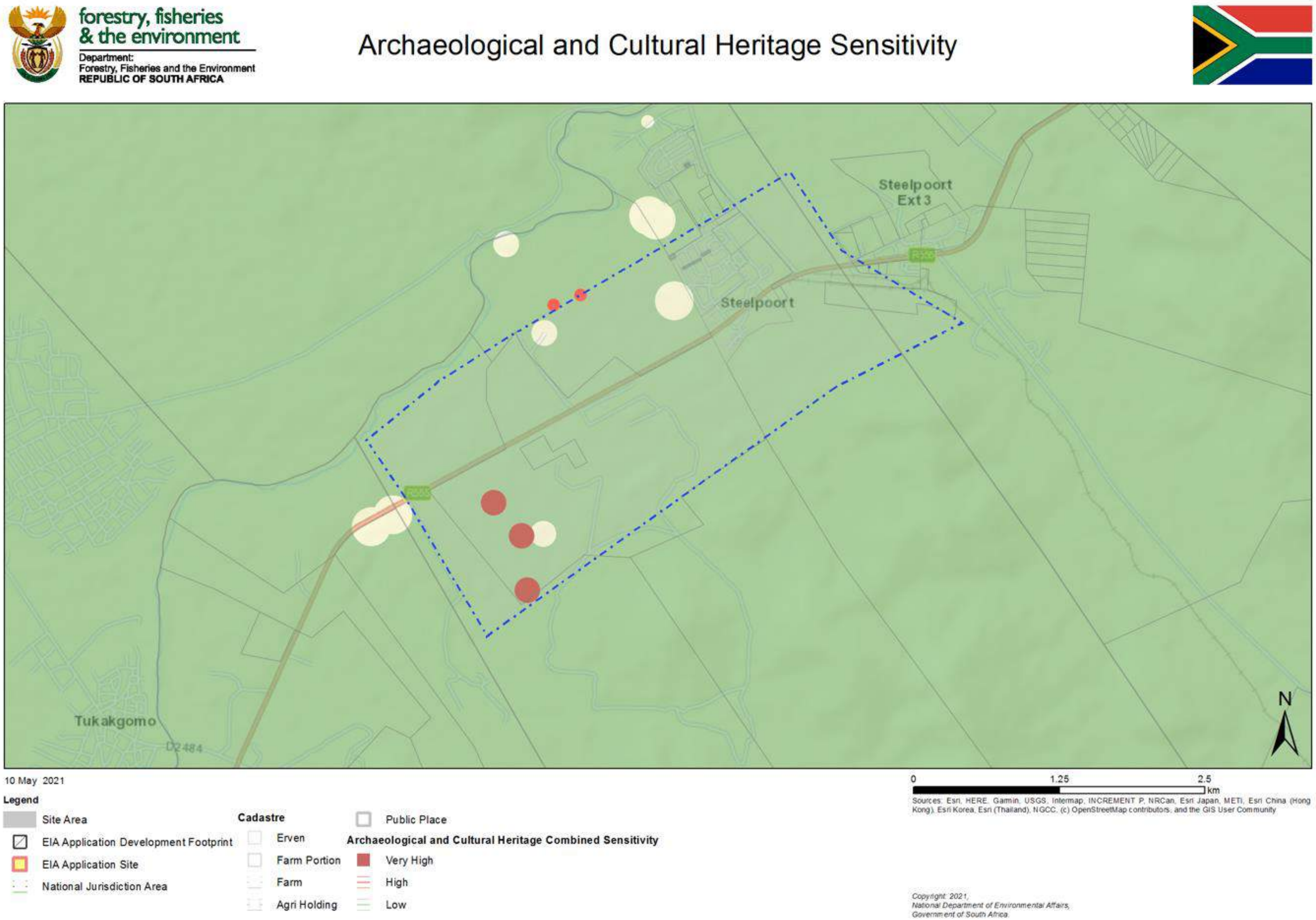

Figure 10 - Heritage Screening map for archaeology and cultural heritage. Source: Department of Environmental Affairs

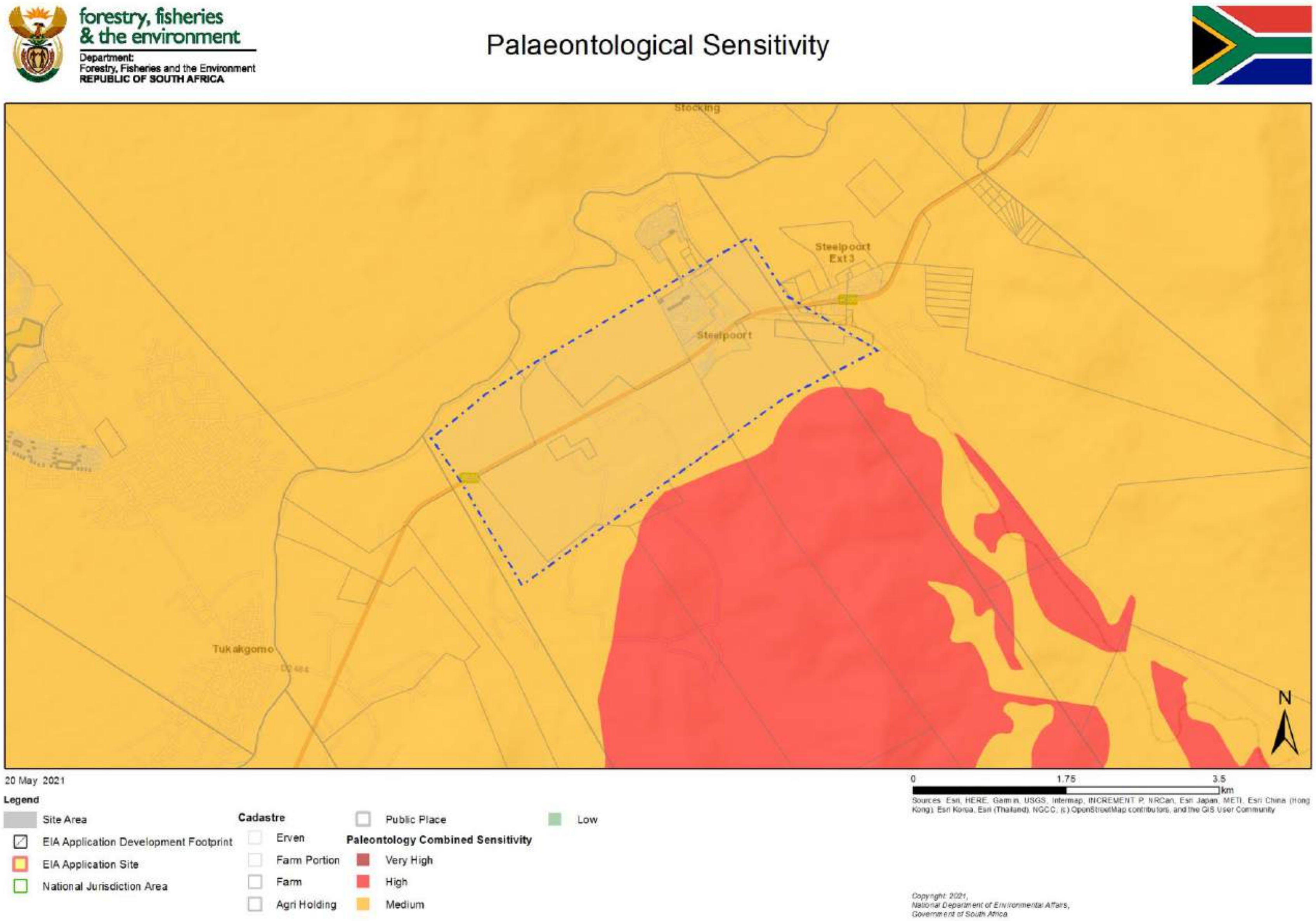

Figure 11 - Heritage Screening map for palaeontological sensitivity. Source: Department of Environmental Affairs

6 FIELDWORK AND FINDINGS

A controlled surface survey was conducted on foot on **15, 19 and 26 April 2021** by two archaeologist and heritage specialists from PGS. The tracklogs (in red) for the survey are indicated in **Figure 12**.

During the field work several heritage features and resources were identified and logged. A total of 57 points of interest were logged that resulted in the delineation and identification of 24 separate heritage sites. These consist of **five burial grounds** (Site 1-1, 1-7, 2-1, 2-2 and 2-3 this is indicated as a stone feature that could possibly be a grave) with **a High heritage significance and a heritage grading of IIIA**. The **nine historic recent structures**. These are 1-2, 1-3, 1-4, 1-5, 1-6, 2-4, 2-5, 5-5 and 5-7, vary in significance from **medium to low and a grading of IIIB**. The archaeological finds consisting of 9 archaeological sites (Site 3-1, 3-2, Site 4-1, 4-2, and Sites 5-1, 5-2, 5-3, 5-4 and 5-6) has in most cases a rating of **Medium significance and a grading varying between IIIC and IIIA at the highest**. Site 5-8 represents a possible memorial now in disuse it was rated as having a Low heritage significance but with a possible local significance[2].

The following sections provides a breakdown of the different heritage resources identified and provides a heritage significance grading for each site.

[2] *The site numbering convention is done by grouping the sites per alternative development areas. Site 1 in development area 1 is thus numbered: Site 1-1*

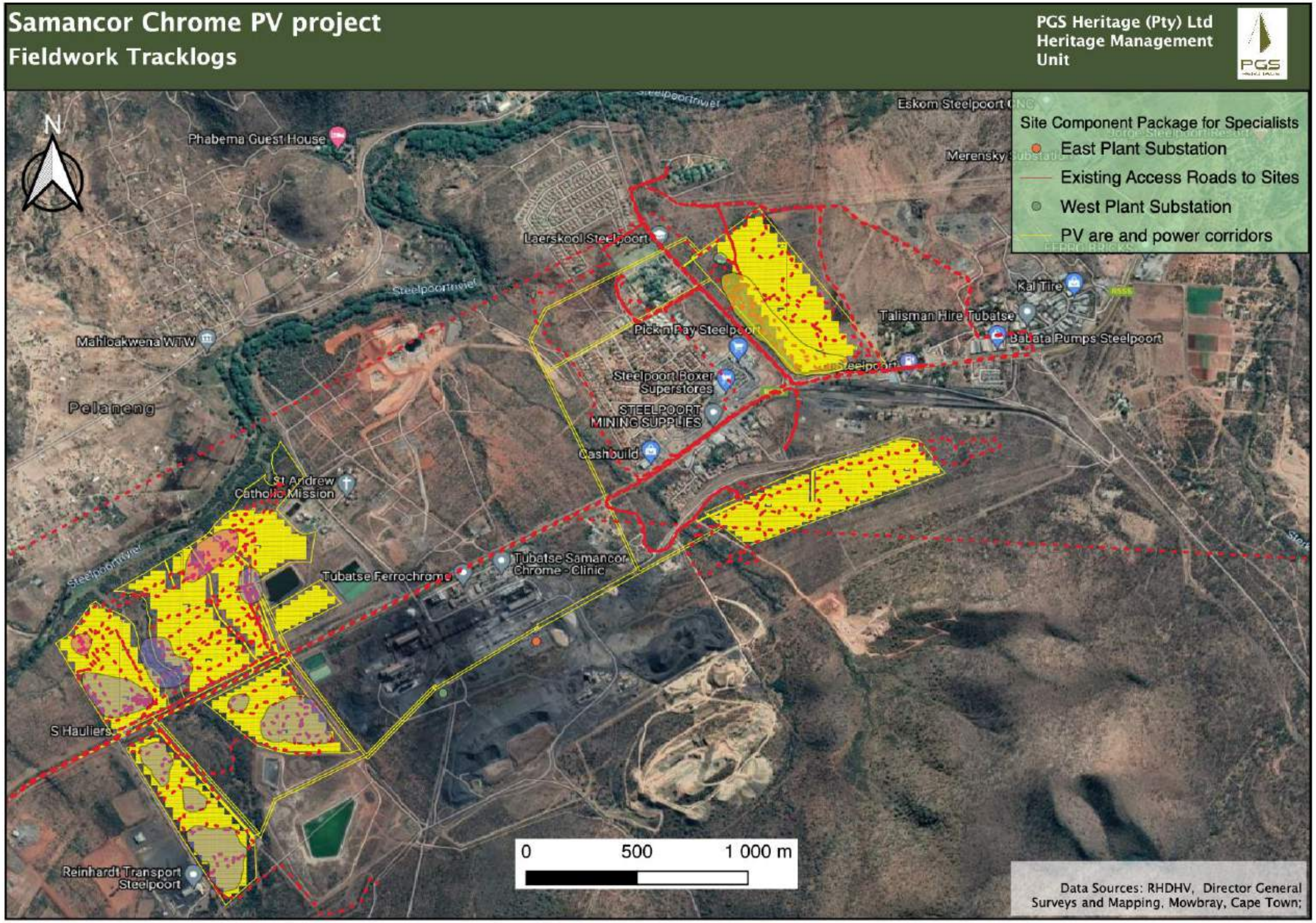

Figure 12 – Map indicating tracklogs of the fieldwork conducted for the study

Table 8 - Sites identified during the heritage survey for Alternative 1

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 1-1	24°43'30.81"S	30°12'22.39"E	Large cemetery situated within site 1 of the study area. The cemetery contains more than 120 graves of which the oldest is dated to the 1940. The graves are a combination of packed stone, granite, and brick packed graves.	High	IIA

Figure 13 – site 1-1 a large cemetery containing 120 graves.

Figure 14 – Alternate view of cemetery at site 1-1

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 1-2	24°43'40.40"S 24°43'49.07"S 24°43'48.96"S	30°12'27.94"E 30°12'34.52"E 30°12'38.44"E	Packed stone feature. Site 1-2 forms part of a large series of low packed stone features that resemble stone walling. These features are however degraded, and half buried making any substantial interpretation difficult.	Medium	IIIB

Figure 15 –Packed stone feature.

Figure 16 –Alternate view showing high concentration of Aloes

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 1-3	24°43'46.97"S	30°12'46.82"E	Cement water trough located on the eastern edge of the study area at Alternative 1. Probably part of a past farmstead.	Low	NCW

Figure 17 - Cement water trough at Site 1-3

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site1-4	24°43'42.35"S	30°12'37.73"E	Series of broken-down structures and foundations. These structures were built using brick. Cement and packed stone elements. Site 1-4 seems historical in age.	Low	IIIC

Figure 18 – A series of broken-down structure and foundations.

Figure 19 – Alternate view of Site 1-4

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 1-5	24°43'36.91"S	30°12'38.41"E	Site 1-5 marks a packed stone feature of possible foundation.	Low	IIIC

Figure 45 – Packed stone feature or foundation at Site 1-5

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 1-6	24°43'27.28"S	30°12'29.81"E	Broken down foundation hidden among tall grass cover.	Low	IIIC

Figure 47 –Broken down foundation hidden among tall grass at Site 1-6

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 1-7	24°43'37.01"S	30°11'52.61"E	SB009 marks a small cemetery located directly underneath the proposed powerline layout. The cemetery contains about 20 graves of various styles including granite and packed stone graves. Some graves are enclosed by metal bars. The oldest date located was 1966. The cemetery is divided into two separate sections on either side of a small stream.	High	IIIA

Figure 20 – Small cemetery at Site 1-7

Figure 21 – Alternate view of Site 1-7

Table 9 - Sites identified during the heritage survey for Alternative 2

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 2-1	24°44'16.08"S	30°12'20.28"E	Cemetery situated along proposed route of the powerline west of Alternative 2 2. This cemetery contains about 18 graves of various styles including packed stone and granite graves. The oldest marked grave dates to 1952.	High	IIIA

Figure 22 – Cemetery at Site 2-1

Figure 23 – Alternate view of cemetery at Site 2-1

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 2-2	24°44'18.22"S	30°12'26.44"E	Possible graves at Site 2-2. These packed stone features are hidden and overgrown.	High	IIIA

Figure 24 – Possible graves

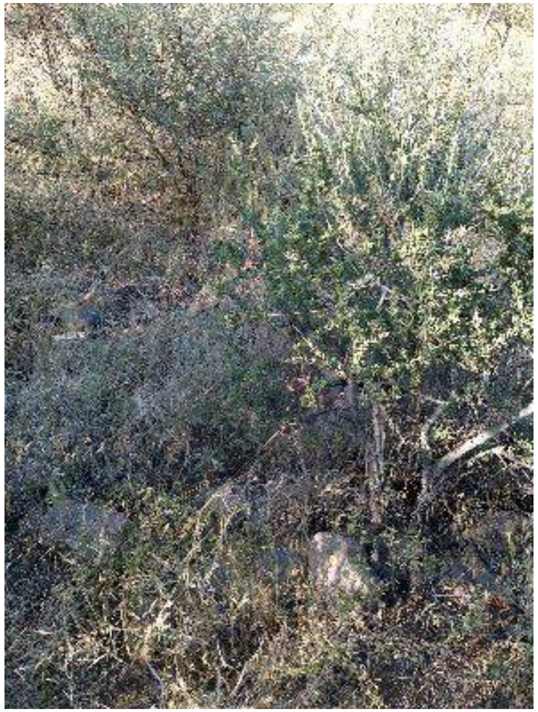

Figure 25 – Alternate view of Possible graves at Site 2-2

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 2-3	24°44'8.82"S	30°12'29.99"E	Site 2-3 marks a packed stone feature that could possibly be an historical grave location.	Medium	IIIA

Figure 34 –Packed stone feature at Site 2-3

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 2-4	24°44'18.81"S	30°12'25.76"E	Site 2-4 marks an area with multiple packed stone features. These features are degraded making any identification difficult.	Low	IIIC

Figure 26 – Packed stone feature at Site 2-4

Figure 27 – Packed stone feature

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 2-5	24°44'3.70"S	30°13'1.78"E	Site 2-5 marks two large cement features. The first is a rectangular brick and cement structure with multiple small reservoirs built into the centre. The second is a large cement water reservoir that is still half filled with water. These structures are not being used anymore but probably relates to the mining activity within the area.	Low	NCW

Figure 35 – Cement structure at Site 2-5

Figure 36 – Large cement water reservoir at Site 2-5

Table 10 - Sites identified during the heritage survey of Alternative 3

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 3-1 and 3-2	24,7438924S 24,74595S	30,18716E 30,18650E	The area is characterised by several low stone wall foundations, grain bin platforms and a general background scatter of ceramics. The ceramics herringbone decoration is indicative of the material identified on site alternative 4 and 5. Although a small sample the motives can be associated with the Doornkop faeces of the Iron Age.	Medium	IIIB

Figure 28 – Exposed archaeological deposit with ceramics

Figure 29 – Herringbone decoration

Table 11 - Sites identified during the heritage survey of Alternative 4

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 4-1 and 4-2	24,75067S 24,75069S 24,74860S	30,18457E 30,18317E 30,18148E	The site covers an area of approximately 300-400 meters on the eastern section of alternative 4. The archaeological remains are characterised by low stone walling, numerous grain bin platforms. A few huts out lines could be decern in the thick undergrowth. A low-density ceramic scatter is present over the site with numerous decorate shards found. Most of these shards have a herringbone motive in single and double bands.	Medium to High	IIIA

Figure 30 – Well defined grain bin platforms

Figure 31 – Herringbone decoration

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating

Figure 32 – Lower grinder

Figure 33 – Stone foundations of a hut and surrounding wall

Table 12 - Sites identified during the heritage survey of Alternative 5

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 5-1	24°44'34.11"S 24°44'32.51"S	30°10'40.10"E 30°10'39.99"E	This cluster is located on the northwest corner of the study area of alternative 5. The area sits near a natural drainage line and can be described as a rocky area due to the consistent erosion taking place around this area. A widespread moderate density scatter of MSA lithic material was identified within this area.	Low	IIIC

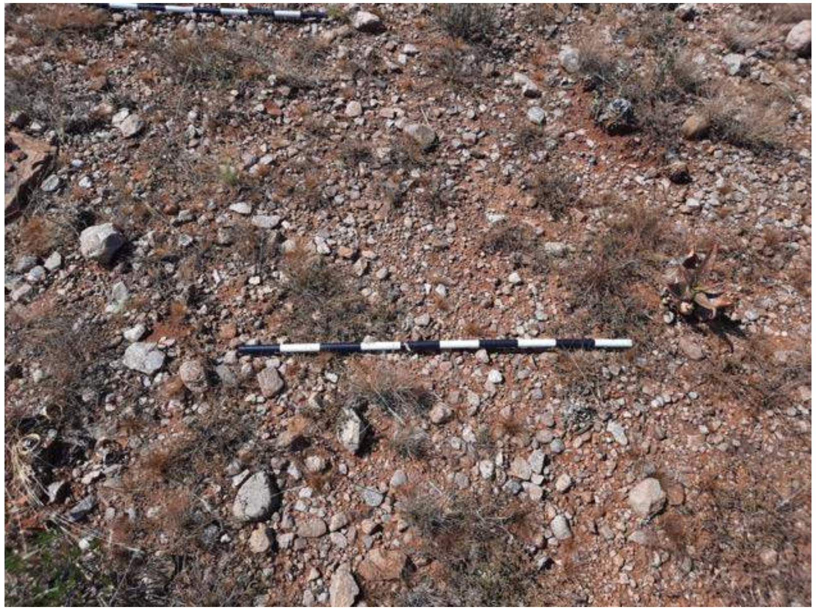

Figure 34 – Rocky terrain containing most of the lithic artefacts.

Figure 35 – Lithic assemblage

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 5-2	24°44'42.14"S 24°44'42.85"S 24°44'42.11"S 24°44'43.22"S	30°10'49.10"E 30°10'50.11"E 30°10'42.88"E 30°10'44.71"E	The site is situated towards the southwest corner of the study area at Site 5. This area is dominated by multiple series of low packed stone features including what seems to be remnants of stone walling, circular features, and possible grain bin stands. The area is overgrown and makes identifying the full extent of these features difficult. Remnants of low packed stone features among the tall grass as well as an open area devoid of stone features indicative of a cattle byre.	Medium	IIIB

Figure 36 –Packed stone feature among aloes

Figure 37 – Alternate view of Site 5-2

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating

Figure 38 – Site 5-2 - Low packed stone feature.

Figure 35 – Packed stone feature, Possible grain bin stand.

Figure 39 – Upper Grindstone located at Site 5-2

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 5-3	24°44'38.61"S	30°10'42.15"E	Situated near the southern edge of the study area close to the main road running towards Burgersfort. Site 5-3 is characterised as a similar pattern to the other clustered areas where a combination of low packed stone features together with a concentration in aloes indicate the presence of archaeological material. marks an area with multiple packed stone features. These features resemble grain bin stands.	Medium	IIIB

Figure 40 – Packed stone feature, Possible Grain Bin stand

Figure 41 – Circular packed stone feature.

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating

Figure 59 – Large rock with multiple Grinding cupules

Figure 58 – Small rocky hill with low packed stone features and a concentration of aloes

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 5-4	24°44'21.79"S 24°44'21.04"S 24°44'20.22"S 24°44'18.62"S 24°44'16.99"S 24°44'22.47"S	30°10'57.93"E 30°11'0.09"E 30°10'58.99"E 30°10'59.63"E 30°11'3.37"E 30°10'57.00"E	This cluster of sites are all located within the large drainage line that runs downstream towards the Steelpoort river. This area is dominated by a moderate scatter of MSA Lithic artefacts. The highest density scatter was with 10-15 lithic artefacts per m².	Medium	IIIB

Figure 42 – General site around drainage line.

Figure 43 – Erosion around drainage line exposing the original riverbed.

Figure 44 – sample Lithic assemblage for Site 5-4

Figure 45 – sample Lithic assemblage for Site 5-4

Figure 46 – sample Lithic assemblage for Site 5-4

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 5-5	24°44'21.77"S	30°11'7.16"E	Recent historic stone-built weir and drainage line is in an overgrown gully area.	Low	NCW

Figure 47– Watergate at Site 5-5

Figure 48 – Canal/Furrow feature that extends across the entire study area.

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 5-6	24°44'26.03"S	30°11'6.95"E	The position in Site 5-6 indicates a small number of ceramic sherds that were located next to the small gravel road. Some of the ceramics have indicative decoration associated with the Doornkop faeces of the Iron Age.	Medium	IIIB

Figure 49 – Ceramic sherds located at Site 5-6

Figure 50 – Ceramic sherds located next to road at Site 5-6

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
Site 5-7	24°44'31.96"S	30°11'5.76"E		Low	IIIC

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
			Site 5-7 marks a dumping area that seems to contain historical material. The material found was extremely fragmented therefor an estimated age could not be obtained		

Figure 51 – Waste dump

Figure 52 – Waste dump alternate view

Site 5-8	24,74151S	30,18555E	The site 5-8 seems to be a former local monument or grave that was exhumed. The memorial plinth and headstone are still present, but a large hole is left where the possible burial was done. Research on SAHRIS could not show any permits or registration of a memorial in the vicinity of this site.	Low	IIIC

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating

 *Figure 53 – View of remains of the grave dressing*	 *Figure 54 – No inscriptions or information on the plinth*

6.1 Sensitivity assessment outcome

From the desktop assessment high to low heritage sensitive areas were identified. Many of the heritage sensitive areas identified during the desktop search consisted of old structures and buildings that fall outside the study area.

During the field work several heritage features and resources were identified and logged. A total of 57 points of interest were logged that resulted in the delineation and identification of 24 separate heritage sites. These consist of five burial grounds (**Site 1-1, 1-7, 2-1, 2-2** and **2-3**) with a High heritage significance and a heritage grading of IIIA. The nine historic recent structures (**Site 1-2, 1-3, 1-4, 1-5, Site 2-**3-5**, and Site 5-5**) vary in significance from medium to low and a grading of IIIB. The archaeological finds consisting of 9 archaeological sites (**Site 3-**1-2**, Site 4-**1-2**, and Sites 5-**1-3, **5-6**) has in most cases a rating of Medium significance and a grading varying between IIIC and IIIA at the highest. **Site 5-8** represents a possible memorial now in disuse it was rated as having a Low heritage significance but with a possible local significance.

7 PALAEONTOLOGY

According to the PalaeoMap of SAHRIS the Palaeontological Sensitivity of the proposed area of the project footprint occurs (**Figure 55**) there is a low chance of finding fossils in this area.

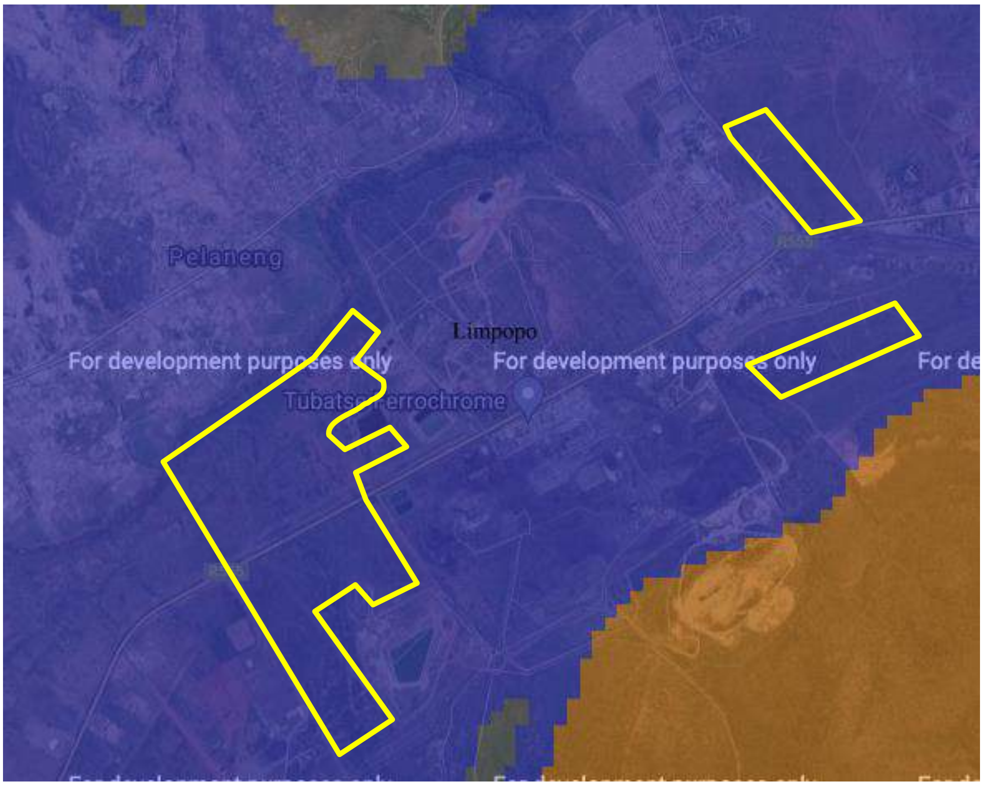

Figure 55 - Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences). Approximate location of the proposed development is indicated in yellow.

As per the requirements of the SAHRIS a chance finds protocol is included in section 7.9 of this report.

8 IMPACT ASSESSMENT

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the management and approval process; secondly, it shows the primary impact characteristics, as defined above, used to evaluate impact significance.

The impacts will be ranked according to the methodology described below. Where possible, mitigation measures will be provided to manage impacts. To ensure uniformity, a standard impact assessment methodology will be utilised so that a wide range of impacts can be compared with each other. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology was used to describe impacts for each of the assessment criteria. A summary of each of the qualitative descriptors along with the equivalent quantitative rating scale for each of the criteria is given in **Table 13**.

Table 13 - Quantitative rating and equivalent descriptors for the impact assessment criteria

RATING	SIGNIFICANCE	EXTENT SCALE	TEMPORAL SCALE
1	VERY LOW	Proposed site	Incidental
2	LOW	Study area	Short-term
3	MODERATE	Local	Medium/High-term
4	HIGH	Regional / Provincial	Long-term
5	VERY HIGH	Global / National	Permanent

A more detailed description of each of the assessment criteria is given in the following sections.

8.1 Significance Assessment

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e., the size) of area affected by atmospheric pollution may be extremely large (1 000 km^2) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common. A more detailed description of the impact significance rating scale is given in **Table 14** below.

Table 14 - Description of the significance rating scale

RATING		DESCRIPTION
5	Very high	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	High	Impact is of substantial order within the bounds of impacts, which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	Moderate	Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	Very low	Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity are needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or several ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale.
0	No impact	There is no impact at all - not even a very low impact on a party or system.

8.2 Spatial Scale

The spatial scale refers to the extent of the impact i.e., will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail in **Table 15.**

Table 15 - Description of the significance rating scale

RATING		DESCRIPTION
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of impacts possible and will be felt at a regional scale (District Municipality to Provincial Level).
3	Local	The impact will affect an area up to 10 km from the proposed site.
2	Study Site	The impact will affect an area not exceeding the Eskom property.
1	Proposed site	The impact will affect an area no bigger than the ash disposal site.

8.3 Duration Scale

To accurately describe the impact, it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in

Table 16**.**

Table 16 - Description of the temporal rating scale

RATING		DESCRIPTION
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.
3	Medium/High term	The environmental impact identified will operate for the duration of life of facility.
4	Long term	The environmental impact identified will operate beyond the life of operation.
5	Permanent	The environmental impact will be permanent.

8.4 Degree of Probability

Probability or likelihood of an impact occurring will be described as shown in **Table** 17 below.

Table 17 - Description of the degree of probability of an impact occurring

RATING	DESCRIPTION
1	Practically impossible
2	Unlikely
3	Could happen
4	Very Likely
5	It's going to happen / has occurred

8.5 Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used as discussed in **Table 18**. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 18 - Description of the degree of certainty rating scale

RATING	DESCRIPTION
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.
Don't know	The consultant cannot, or is unwilling, to make an assessment given available information.

8.6 Quantitative Description of Impacts

To allow for impacts to be described in a quantitative manner in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus, the total value of the impact is described as the function of significance, spatial and temporal scale as described below:

$$\textbf{\textit{Impact Risk}} = \frac{\text{(SIGNIFICANCE} + \textit{Spatial} + \text{Temporal)}}{\textbf{\textit{3}}} \times \frac{\text{Probability}}{\textbf{\textit{5}}}$$

An example of how this rating scale is applied is shown in **Table 19**.

Table 19 - Example of Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
	LOW	Local	Medium/High-term	Could Happen	
Impact to air	2	3	3	3	1.6

Note: The significance, spatial and temporal scales are added to give a total of 8, that is divided by 3 to give a criteria rating of 2,67. The probability (3) is divided by 5 to give a probability rating of 0,6. The criteria rating of 2,67 is then multiplied by the probability rating (0,6) to give the final rating of 1,6.

The impact risk is classified according to five classes as described in the **Table 20** below.

Table 20 - Impact Risk Classes

RATING	IMPACT CLASS	DESCRIPTION
0.1 – 1.0	1	**Very Low**
1.1 – 2.0	2	**Low**
2.1 – 3.0	3	**Moderate**
3.1 – 4.0	4	**High**
4.1 – 5.0	5	**Very High**

Therefore, with reference to the example used for air quality above, an impact rating of 1.6 will fall in the Impact Class 2, which will be a low impact.

8.7 Heritage Impacts

During the field work several heritage features and resources were identified and logged. A total of 57 points of interest were logged that resulted in the delineation and identification of 24 separate heritage sites. These consist of **five burial grounds** (Site 1-1, 1-7, 2-1, 2-2 and 2-3 this is indicated as a stone feature that could possibly be a grave) with **a High heritage significance and a heritage grading of IIIA**. The **nine historic recent structures**. These are 1-2, 1-3, 1-4, 1-5, 1-6, 2-4, 2-5, 5-5 and 5-7, vary in significance from **medium to low and a grading of IIIB**. The archaeological finds consisting of 9 archaeological sites (Site 3-1, 3-2, Site 4-1, 4-2, and Sites 5-1, 5-2, 5-3, 5-4 and 5-6) has in most cases a rating of **Medium significance and a grading varying**

between IIIC and IIIA at the highest. Site 5-8 represents a possible memorial now in disuse it was rated as having a Low heritage significance but with a possible local significance.

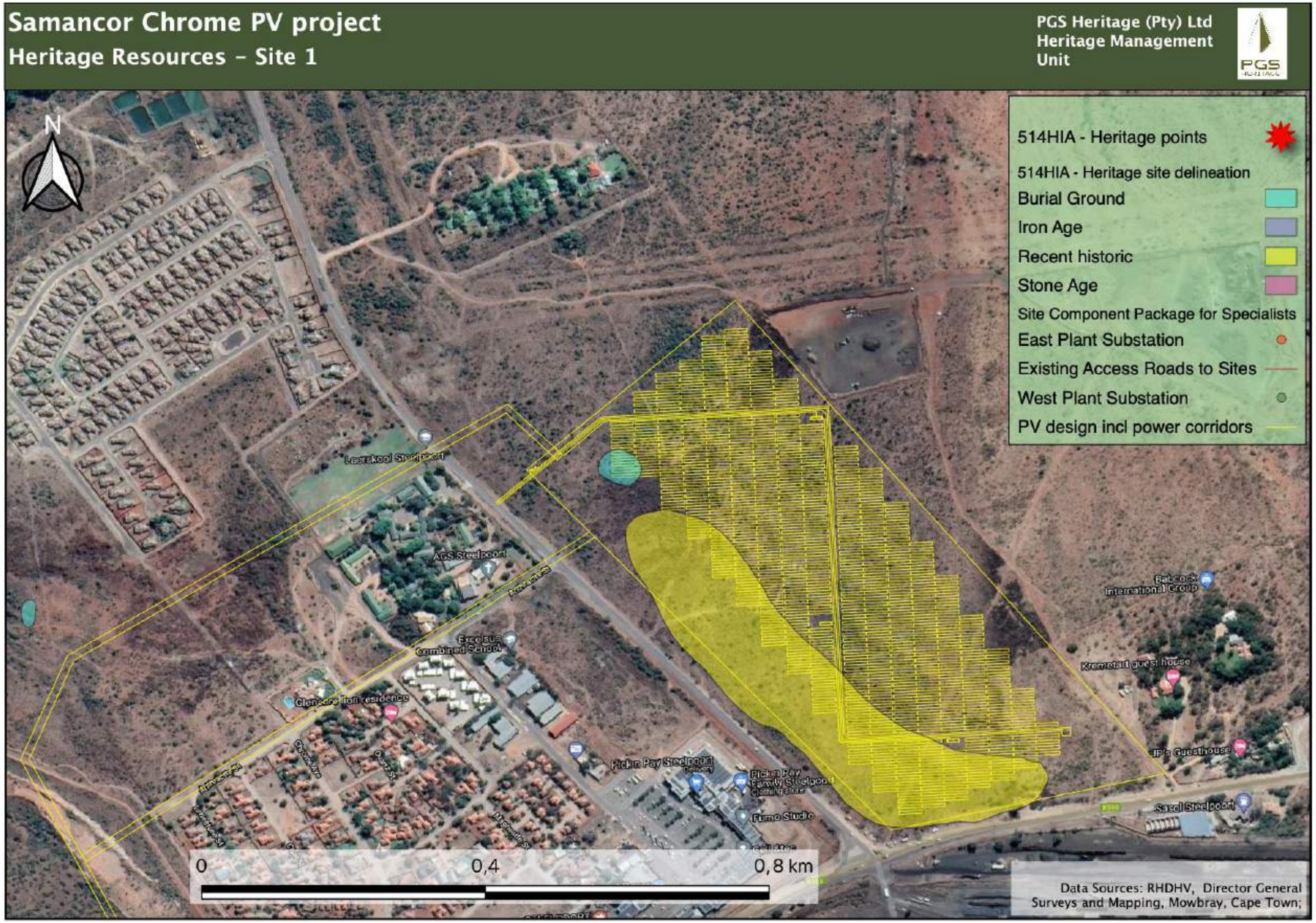

Figure 56 – Locality of the heritage resource in relation alternative site 1

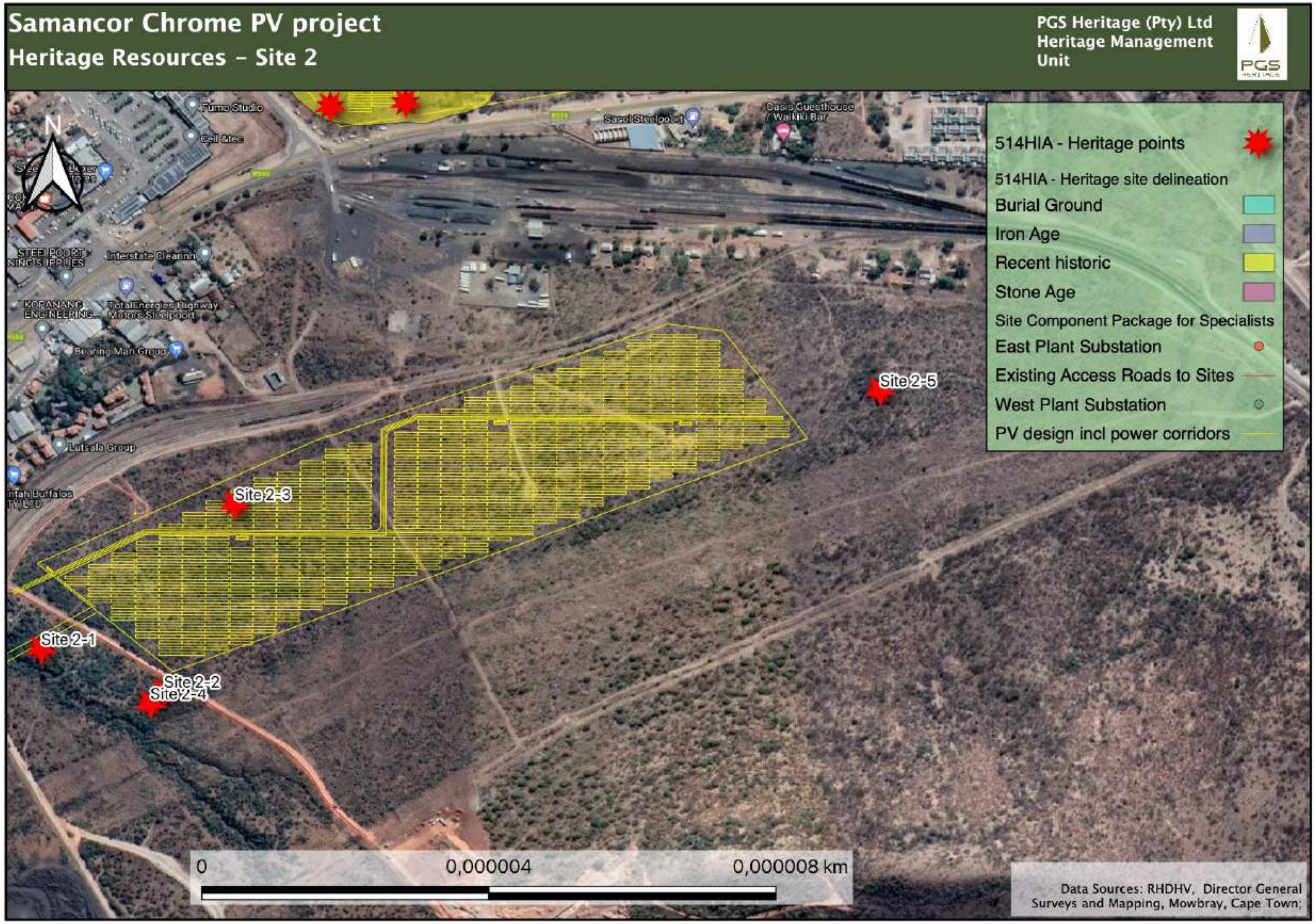

Figure 57 – Locality of the heritage resource in relation alternative site 2

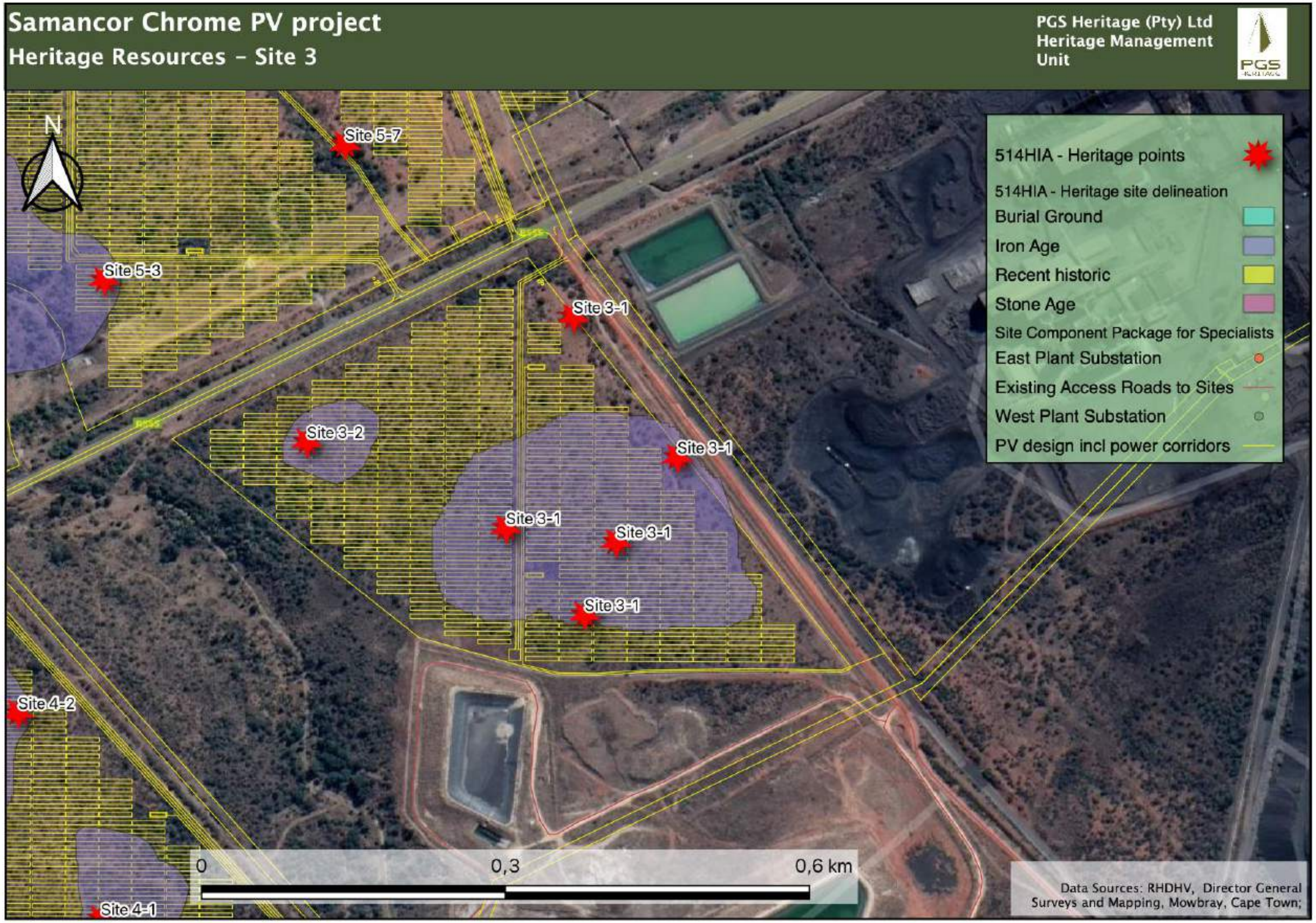

Figure 58 – Locality of the heritage resource in relation alternative site 3

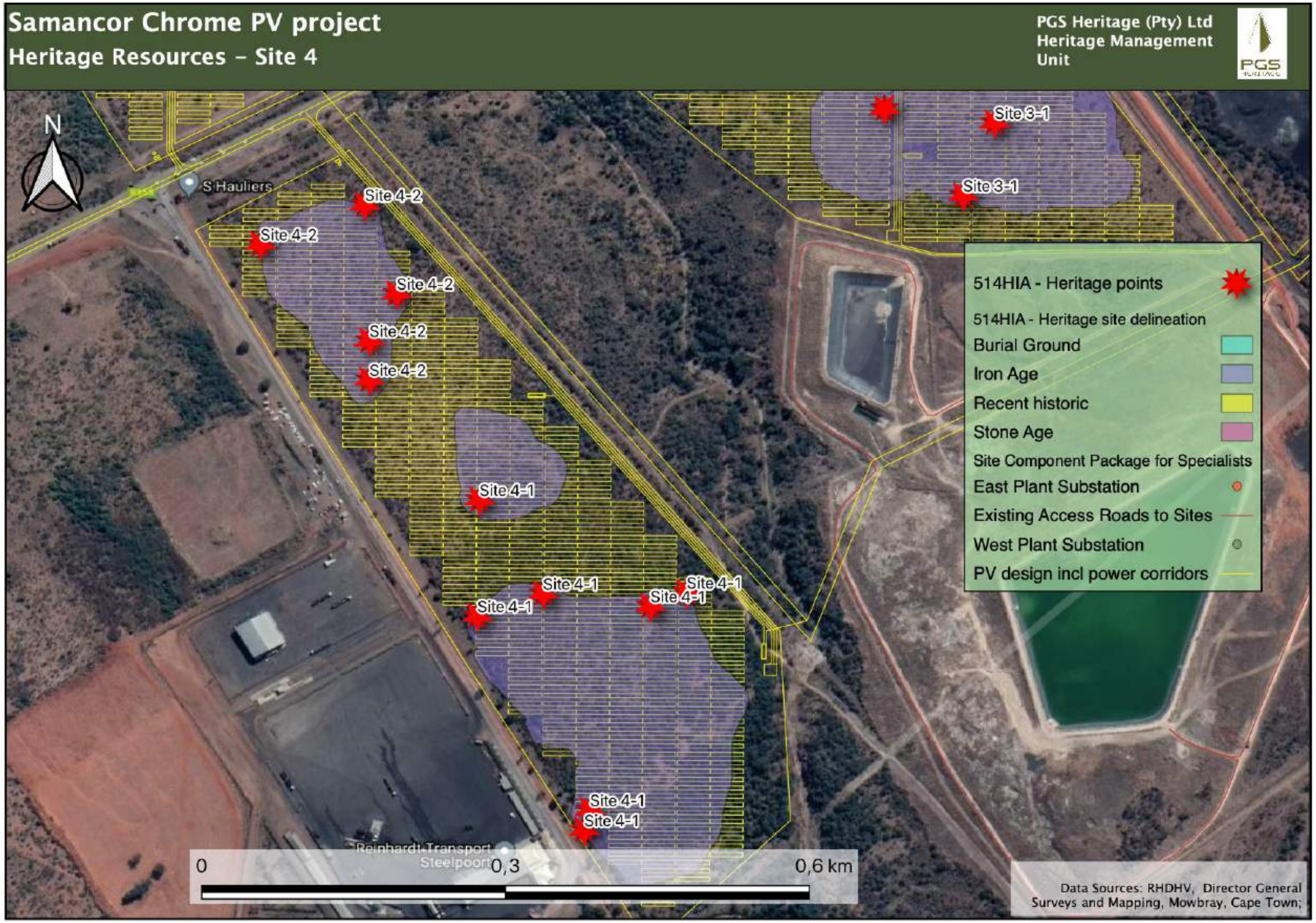

Figure 59 – Locality of the heritage resource in relation alternative site 4

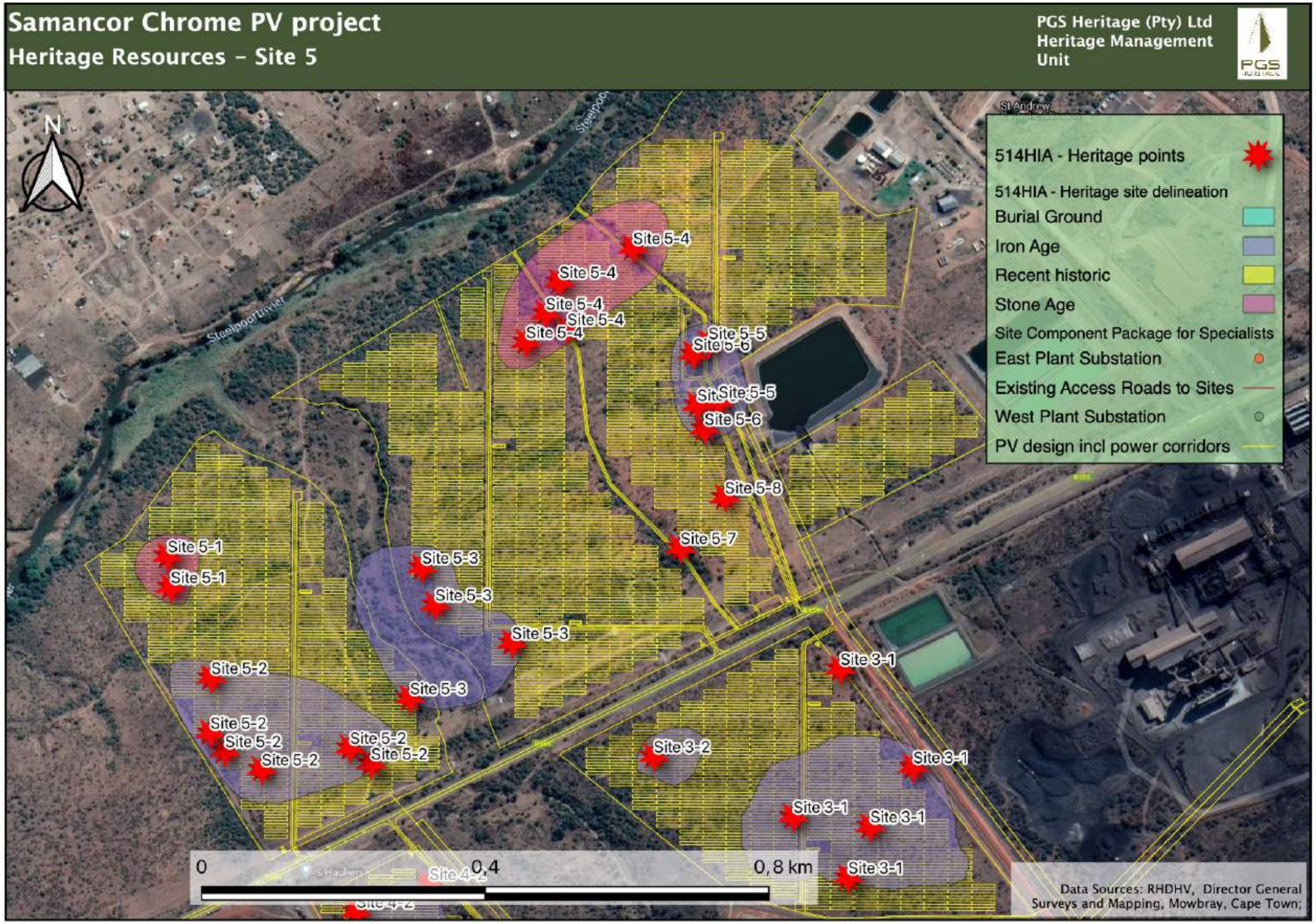

Figure 60 – Locality of the heritage resource in relation alternative site 5

8.8 Impact Assessment Table

Table 21 - Impact Assessment Table (pre-mitigation)

IMPACT	IMPACT DIRECTION	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
Impact on burial ground and graves	Negative	VERY HIGH	Isolated Sites / proposed site	Permanent	Very Likely	
		5	1	5	4	2,93
Impact on archaeological sites	Negative	VERY HIGH	Study Area	Permanent	It's going to happen / has occurred	
		5	2	5	5	4,00
Palaeontological resources	Negative	VERY LOW	Isolated Sites / proposed site	Permanent	Unlikely	
		1	1	5	2	0,93

Table 22 - Impact Assessment Table (post-mitigation)

IMPACT	IMPACT DIRECTION	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
Impact on burial ground and graves	Negative	LOW	Isolated Sites / proposed site	Permanent	Practically impossible	
		2	1	5	1	0,53
Impact on archaeological sites	Negative	MODERATE	Isolated Sites / proposed site	Permanent	Unlikely	
		3	1	5	2	1,20
Palaeontological resources	Negative	LOW	Isolated Sites / proposed site	Short-term	Unlikely	
		2	1	2	2	0,67

8.9 Management recommendations and guidelines

8.9.1 Construction phase

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camp areas and small-scale infrastructure development associated with the project.

It is possible that cultural material will be exposed during construction and may be recoverable, keeping in mind delays can be costly during construction and as such must be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, however foundation holes do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project and these must be catered for. Temporary infrastructure developments, such as construction camps and laydown areas, are often changed or added to the project as required. In general, these are low impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

During the construction phase, it is important to recognize any significant material being unearthed, making the correct judgment on which actions should be taken. It is recommended that the following chance find procedure should be implemented.

8.9.2 Chance find procedure

- A heritage practitioner / archaeologist should be appointed to develop a heritage induction program and conduct training for the ECO as well as team leaders in the identification of heritage resources and artefacts.
- An appropriately qualified heritage practitioner / archaeologist must be identified to be called upon if any possible heritage resources or artefacts are identified.
- Should an archaeological site or cultural material be discovered during construction (or operation), the area should be demarcated, and construction activities halted.
- The qualified heritage practitioner / archaeologist will then need to come out to the site and evaluate the extent and importance of the heritage resources and make the necessary recommendations for mitigating the find and the impact on the heritage resource.
- The contractor therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the materials and data are recovered.
- Construction can commence as soon as the site has been cleared and signed off by the heritage practitioner / archaeologist.

8.9.3 Possible finds during construction and operation (mining activities)

The study area occurs within a greater historical and archaeological site as identified during the desktop and fieldwork phase. Soil clearance for infrastructure as well as the proposed reclamation activities, could uncover the following:

- High density concentrations of stone artefact
- unmarked graves

8.10 Timeframes

It must be kept in mind that mitigation and monitoring of heritage resources discovered during construction activity will require permitting for collection or excavation of heritage resources and lead times must be worked into the construction time frames. **Table 23** gives guidelines for lead times on permitting.

Table 23 - Lead times for permitting and mobilisation

Action	Responsibility	Timeframe
Preparation for field monitoring and finalisation of contracts	The contractor and service provider	1 month
Application for permits to do necessary mitigation work	Service provider – Archaeologist and SAHRA	3 months
Documentation, excavation, and archaeological report on the relevant site	Service provider – Archaeologist	3 months
Handling of chance finds – Graves/Human Remains	Service provider – Archaeologist and SAHRA	2 weeks
Relocation of burial grounds or graves in the way of construction	Service provider – Archaeologist, SAHRA, local government and provincial government	6 months

8.11 Heritage Management Plan for EMPr implementation

Table 24 - Heritage Management Plan for EMPr implementation

Area and site no.	Mitigation measures	Phase	Timeframe	The responsible party for implementation	Monitoring Party (frequency)	Target	Performance indicators (monitoring tool)
General project area	Implement a chance to find procedures in case where possible heritage finds are uncovered.	Construction and operation	During construction and operation	Applicant ECO Heritage Specialist	ECO (monthly / as or when required)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 34-36 and 38 of NHRA	ECO Monthly Checklist/Report
Burial grounds and graves	These sites should be demarcated with a 30-meter buffer as a no-go area. It is recommended that consultation with regards to Site 5-8 is done with the local authorities before construction commence to determine the site's social significance.	Construction through to Operational	During Construction and Operation	Applicant Environmental Control Officer (ECO) Heritage specialist	Monthly	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	ECO Monthly Checklist/Report
Identified archaeological sites	If any of the identified archaeological sites on Alternatives 3,4 and 5 are to be impacted a Phase 2 archaeological mitigation process must be implemented. This will include, surface collections, test excavations and analysis of recovered material. A permit issued under s35 of the NHRA will be required to conduct such work. On completion of the mitigation work the developer can apply for a destruction permit with the backing of the mitigation report	Pre-construction	Pre-construction	Applicant Archaeologist	None	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35 of NHRA	Final report to be used by the develop to apply for a destruction permit under s35 of the NHRA
Palaeontological finds	If fossil remains are discovered during any phase of construction, either on the surface or exposed by fresh excavations the Chance Find Protocol must be implemented by the ECO in charge of these developments.	Construction	Construction	Applicant ECO Palaeontologist	Monthly	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35 of NHRA	Final report to be used by the develop to apply for a destruction permit under s35 of the NHRA

9 CONCLUSIONS

The HIA has shown that the study area and surrounding area has some heritage resources situated within the proposed development boundaries. Through data analysis and a site investigation, the following issues were identified from a heritage perspective.

9.1 Heritage Sites

During the field work several heritage features and resources were identified and logged. A total of 57 points of interest were logged that resulted in the delineation and identification of 24 separate heritage sites. These consist of **five burial grounds** (Site 1-1, 1-7, 2-1, 2-2 and 2-3 this is indicated as a stone feature that could possibly be a grave) with **a High heritage significance and a heritage grading of IIIA**. The **nine historic recent structures**. These are 1-2, 1-3, 1-4, 1-5, 1-6, 2-4, 2-5, 5-5 and 5-7, vary in significance from **medium to low and a grading of IIIB**. The archaeological finds consisting of 9 archaeological sites (Site 3-1, 3-2, Site 4-1, 4-2, and Sites 5-1, 5-2, 5-3, 5-4 and 5-6) has in most cases a rating of **Medium significance and a grading varying between IIIC and IIIA at the highest**. Site 5-8 represents a possible memorial now in disuse it was rated as having a Low heritage significance but with a possible local significance.

9.1.1 Burial Grounds and graves

Burial grounds have a high heritage rating and a heritage grading of IIIA. According to the SAHRA graves management policy a buffer of at least 30-meters, as no-go area, must be kept around burial grounds and graves

9.1.2 Archaeological sites

The identified archaeological sites have a low to high heritage significance. Sites alternatives 2, 3 and 5 will have the least impact on identified archaeological sites, although mitigation work will be required for sites 3 and 5 as identified in the management guidelines of this report. The archaeological site identified on site 4 will require extensive mitigation work to mitigate the impact before any development.

If any of the identified archaeological site are to be disturbed a Phase 2 archaeological mitigation process must be implemented. This will include, surface collections, test excavations and analysis of recovered material. A permit issued under s35 of the NHRA will be required to conduct such work.
On completion of the mitigation work the developer can apply for a destruction permit with the backing of the mitigation report.

9.1.3 Palaeontological Impacts

The SAHRIS Palaeo sensitivity Map rates the palaeontological sensitivity of the geology as low and will only require the inclusion of a chance finds procedure in the EMPr.

However, if fossil remains are discovered during any phase of construction, either on the surface or exposed by fresh excavations the Chance Find Protocol must be implemented by the ECO in charge of these developments. These discoveries ought to be protected (if possible, in situ) and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that suitable mitigation (e.g., recording and collection) can be carry out by a palaeontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.

9.2 Preferred alternatives

From a heritage perspective the first management principle is conservation in situ. The locality of burial grounds and graves on alternatives Site 1 and Site 2 will require the adjustment of designs for these alternatives, but do not exclude the whole area.

The position and significance of the archaeological sites at site alternatives 3, 4 and 5 will required the implementation of mitigation as described in section 7, however these mitigation measures will be costly for site alternative 4 due to the extent and significance of the archaeological site.

9.3 General

It is the author’s considered opinion that overall impact on heritage resources can be mitigated to Low with the implementation of mitigation measures. Provided that the recommended mitigation measures are implemented, the impact would be acceptably Low or could be totally mitigated to the degree that the project could be approved from a heritage perspective. The management and mitigation measures as described in Section 7 of this report have been developed to minimise the project impact on heritage resources.

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10.2 Archival References

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National Archives, URU 745 1274
National Archives, URU 816 560

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National Archives, Photograph, SAB, 17509

10.3 Historic Topographic Maps

All the historic and early topographic maps used in this report were obtained from the Directorate: National Geo-spatial Information of the Department of Rural Development and Land Reform in Cape Town.

10.4 Internet

www.sanbi.org

10.5 Contemporary Cartographic Data

MapSource and Google Earth were used to depict contemporary cartographic data.

Appendix A

Project team CV's

WOUTER FOURIE

Professional Heritage Specialist and Professional Archaeologist and Director PGS Heritage

Summary of Experience

Specialised expertise in Archaeological Mitigation and excavations, Cultural Resource Management and Heritage Impact Assessment Management, Archaeology, Anthropology, Applicable survey methods, Fieldwork and project management, Geographic Information Systems, including *inter alia* -

Involvement in various grave relocation projects (some of which relocated up to 1000 graves) and grave "rescue" excavations in the various provinces of South Africa

Involvement with various Heritage Impact Assessments, within South Africa, including -

- Archaeological Walkdowns for various projects
- Phase 2 Heritage Impact Assessments and EMPs for various projects
- Heritage Impact Assessments for various projects
- Iron Age Mitigation Work for various projects, including archaeological excavations and monitoring
- Involvement with various Heritage Impact Assessments, outside South Africa, including -
- Archaeological Studies in Democratic Republic of Congo
- Heritage Impact Assessments in Mozambique, Botswana, and DRC
- Grave Relocation project in DRC

Key Qualifications

BA [Hons] (Cum laude) - Archaeology and Geography - 1997

BA - Archaeology, Geography and Anthropology - 1996

Professional Archaeologist - Association of Southern African Professional Archaeologists (ASAPA) - Professional Member

Accredited Professional Heritage Specialist – Association of Professional Heritage Practitioners (APHP)

CRM Accreditation (ASAPA) -

- Principal Investigator - Grave Relocations
- Field Director – Iron Age
- Field Supervisor – Colonial Period and Stone Age
- Accredited with Amafa KZN

Key Work Experience

2003- current - Director – Professional Grave Solutions (Pty) Ltd

2007 – 2008 - Project Manager – Matakoma-ARM, Heritage Contracts Unit, University of the Witwatersrand

2005-2007 - Director – Matakoma Heritage Consultants (Pty) Ltd

2000-2004 - CEO– Matakoma Consultants

1998-2000 - Environmental Coordinator – Randfontein Estates Limited. Randfontein, Gauteng

1997-1998 - Environmental Officer – Department of Minerals and Energy. Johannesburg, Gauteng

Worked on various heritage projects in the SADC region including, Botswana, Mozambique, Malawi, Mauritius, Zimbabwe, and the Democratic Republic of the Congo

Appendix E7:
Climate Change

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

ENVIRONMENTAL AUTHORISATION FOR THE PROPOSED 100MWP PHOTOVOLTAIC PLANT ASSOCIATED WITH THE TUBATSE FERROCHROME SMELTER, STEELPOORT, FETAKGOMO TUBATSE LOCAL MUNICIPALITY, LIMPOPO.

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1.

SPECIALIST INFORMATION

Specialist Company Name:	Royal HaskoningDHV (Pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	3	Percentage Procurement recognition	
Specialist name:	Yolandi Meyer			
Specialist Qualifications:	BSc (Hons) Environmental Science and Development			
Professional affiliation/registration:				
Physical address:	The Boulevard Umhlanga, 19 Park Lane, Umhlanga Rocks			
Postal address:	PO Box 1243			
Postal code:	4320	Cell:	083 57 99820	
Telephone:	087 350 6660	Fax:	–	
E-mail:	yolandi.meyer@rhdhv.com			

2. DECLARATION BY THE SPECIALIST

I, Yolandi Meyer, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

ymeyer

Signature of the Specialist

Royal HaskoningDHV (Pty) Ltd

Name of Company:

21.09.2021

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Yolandi Meyer, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Royal HaskoningDHV (Pty) Ltd

Name of Company

21.09.2021

Date

Signature of the Commissioner of Oaths

COMMISSIONER OF OATHS
Lynn du Toit
Bid Officer
The Boulevard Umhlanga
19 Park Lane, Umhlanga Rocks, 4319
Tel: 087 350 6660

Date: 21.09.2021

21.09.2021

Date

Royal HaskoningDHV
Enhancing Society Together

REPORT

Phase 1 Climate Change Impact Assessment

Establishment of a 100MWp Photovoltaic Plant associated with the Tubatse Ferrochrome Smelter, Steelpoort, Fetakgomo Tubatse Local Municipality, Limpopo.

Client: Samancor Chrome

Reference: MD5323-RHD-ZZ-XX-RP-Z-0001_CC
Status: Draft/P01.01
Date: Wednesday, 20 October 2021

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Document title:	Phase 1 Climate Change Impact Assessment
Document short title:	
Reference:	MD5323-RHD-ZZ-XX-RP-Z-0001_CC
Status:	P01.01/Draft
Date:	Wednesday, 20 October 2021
Project name:	Climate Change Impact Assessment
Project number:	MD5323
Author(s):	Yolandi Meyer

Drafted by:	Yolandi Meyer
Checked by:	Malcolm Roods
Date:	15 October 2021
Approved by:	Luke Moore
Date:	19 October 2021

Classification
Project related

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Royal HaskoningDHV

ANNEXURES

Declaration of Interest

I, Yolandi Meyer, declare that I –

- act as a specialist consultant in the field of climate change
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2010; and
- will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not.

1 INTRODUCTION

Royal HaskoningDHV was requested by Samancor to conduct a Climate Change Impact Assessment for a proposed 100MWp Photovoltaic (PV) Plant project associated with the Tubatse Ferrochrome Smelter, Steelpoort, Fetakgomo Tubatse Local Municipality, Limpopo.

The proposed project is located within the Fetakgomo Tubatse Local Municipality (FTLM), found in the north eastern part of the Sekhukhune District Municipality (SDM) and forms part of the Limpopo Province. One of the main activities in the district is mining. FTLM is characterized by a large presence of mining activities along the R555 and R37 provincial roads. Minerals found within the FTLM include platinum, chrome, vanadium, andalusite, silica and magnetite (FTLM IDP 2020/2021).

Samancor's core business is the mining and smelting of chrome ore and as such, their Tubatse Ferrochrome Smelter is located to the south west of the town of Steelpoort. The project area is located on opposite sides of the R555 and to the south of the Steelpoort River.

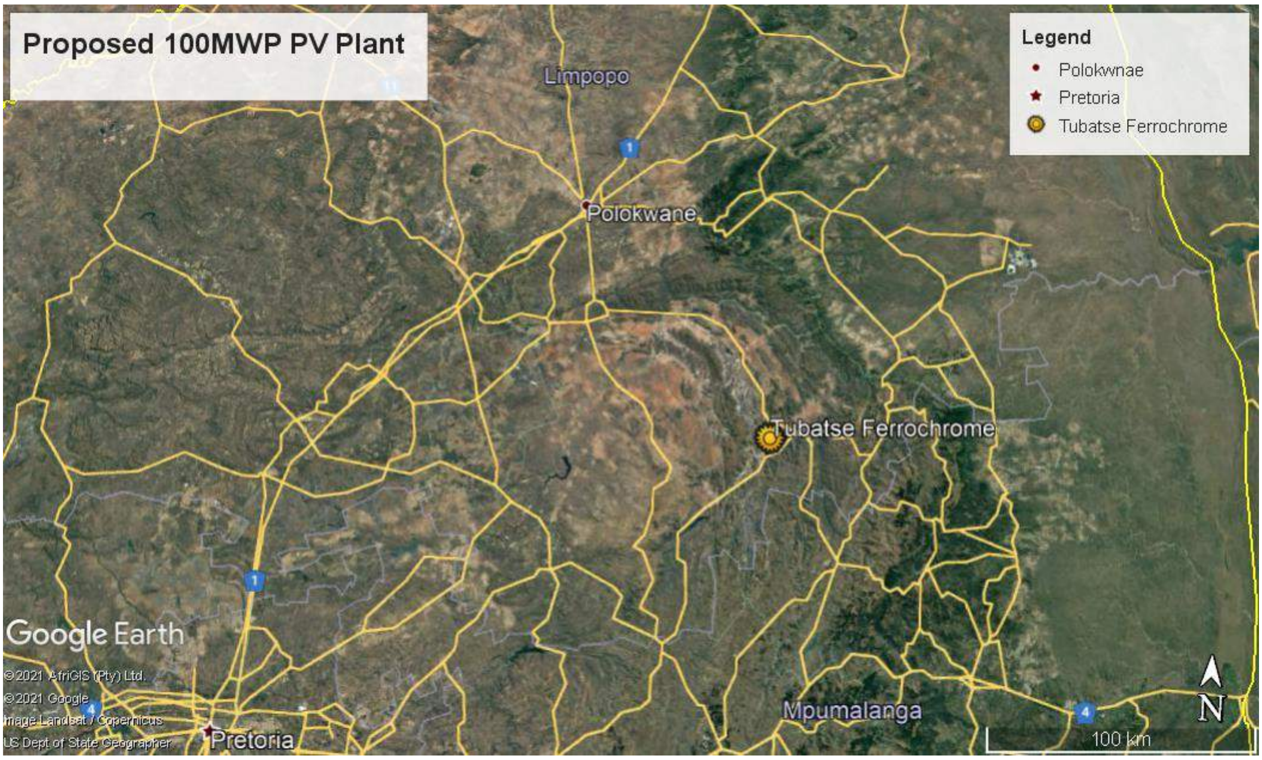

Figure 1: Location of the Tubatse Chrome Plant in Steelpoort, Limpopo (Source: Google Earth™)

A climate change impact assessment is required as part of the Environmental Impact Assessment (EIA) process, and is aimed at:

- understanding the potential contribution (both positive and negative) of the proposed PV Project to climate change;
- recognising the Project's vulnerability to projected climate change;
- identifying any impacts of the Project on climate change related risks and vulnerabilities in the immediate surrounds; and
- quantifying the influence that climatic change will have on the overall environmental impact of the PV Project.

This report has been developed in terms of the Appendix 6 of the EIA Regulations 2014 (as amended).

Table 1:Content of Specialist Reports

1. A specialist report prepared in terms of these Regulations must contain-	Checklist for Compliance
a) details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix A
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page v
c) A. an indication of the quality and age of the base data used for the specialist report; B. a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment e) an indication of the scope of, and the purpose for which, the report was prepared;	c) Section 5, 6 and 7 Cumulative impacts – 7.3 d) N/A e) Section 1 and 2
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 6, 7 & 8
g) an identification of any areas to be avoided, including buffers;	N/A
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2.5 and 9.2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities	Section 6 & 7
k) any mitigation measures for inclusion in the Environmental Management Programme (EMPr);	Section 7 and 9.1
l) any conditions for inclusion in the environmental authorisation;	None
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 7 and 9.1
n) a reasoned opinion- (i) whether the proposed activity, activities or portions thereof should be authorised; and (ii) regarding the acceptability of the proposed activity or activities; and (iii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q) any other information requested by the competent authority.	N/A
2. Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

1.1 Project Description

The energy sector in south Africa contributes close to 80% towards the country's total greenhouse gas emissions of which 50% are from electricity generation and liquid fuel production alone (DMRE, 2019). In the case of Samancor, the rising electricity tariffs in South Africa, combined with the load shedding patterns experienced across the country, has a negative impact on the production and revenue of the Samancor business. This together with the recent announcement by the President of South Africa to allow for an increase to 100MWp embedded generation threshold has motivated Samancor Chrome to consider renewable energy generation at their smelter plants. Implementing solar Photovoltaic (PV) generation will result in improved availability of supply and reduced utility bills as well as going ‘green’ in terms of environmental considerations. The Project will entail construction of a 100MWp PV Plant that will include operation of the plant and generation of solar power. The Project will be spread over 5 sites shown in the site plan below.

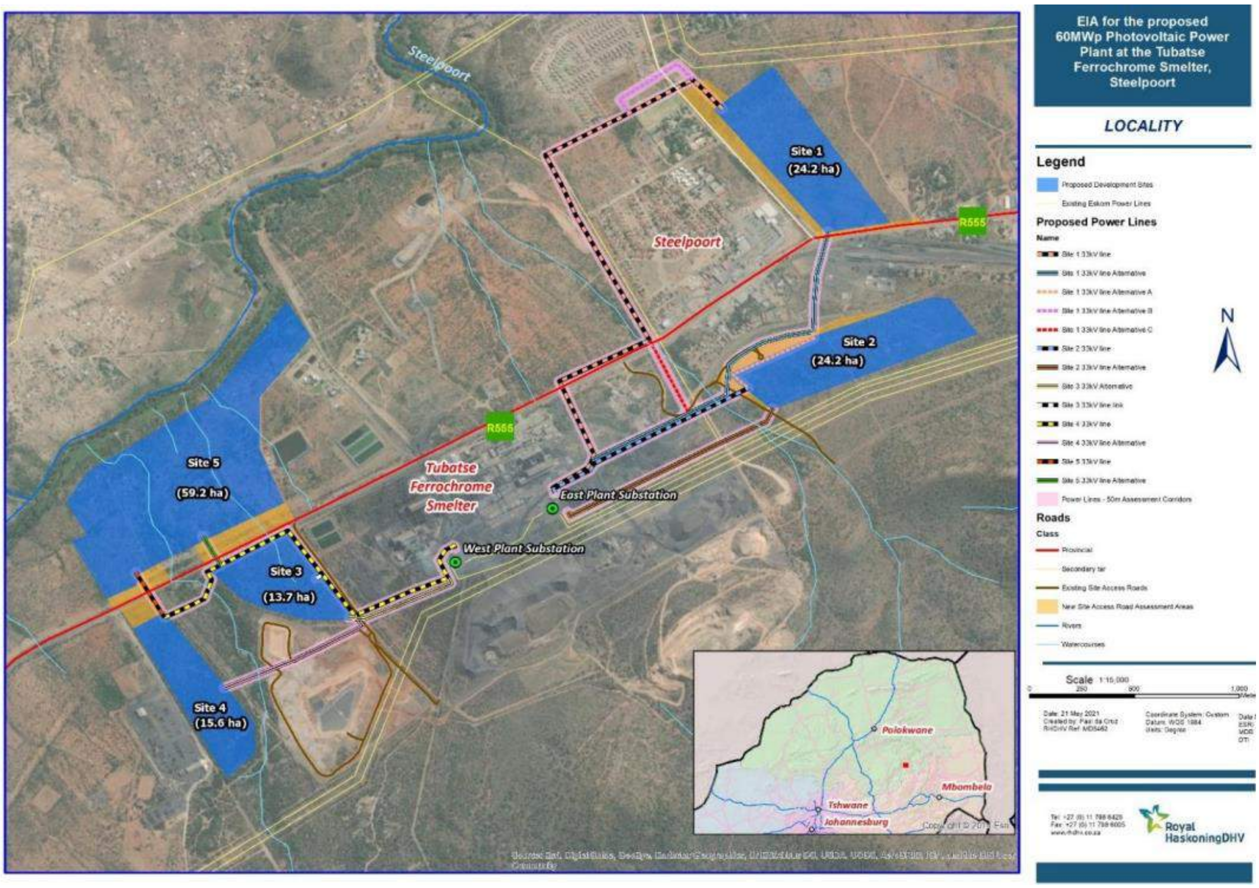

Figure 2: Site alternatives

The planned generation capacity for the proposed PV Plant is 100MW Alternating Current (AC) and will be fed into the Samancor electrical network *via* the Tubatse East and West substations at 33 kV behind the Eskom utility supply meters (RHDHV, 2021). The figure below shows the extent of the proposed infrastructure in relation to the Tubatse Smelter operations.

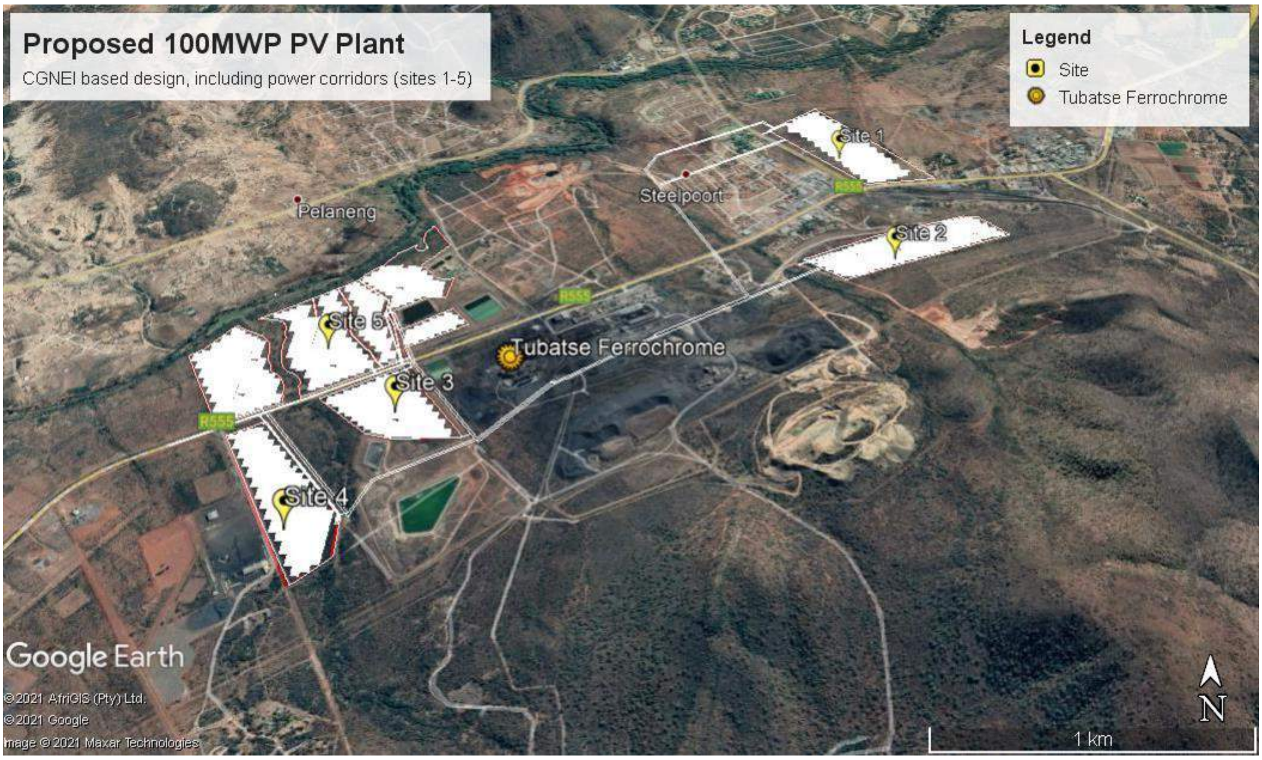

Figure 3: Extent of the proposed infrastructure in relation to the Tubatse plant

The Project will consist of the following infrastructure:

- Solar PV panels that will be able to deliver up to 100MWp to the Samancor grid;
- The photovoltaic panels are mono or bifacial type with a rating of 560 W each;
- The panels are proposed to be of the fixed tilt installation type with a tilt angle of 23 degrees;
- The height of the structures is 0,8m;
- Each site consists of one or more power blocks. The power blocks consist of standard modules consisting 2-rows of 28-panels connected in a series and parallel configuration on support structures. The modules are grouped into power blocks to a capacity of approx. 7 MW DC / 6 MW AC power.
- Inverter and transformer combination – each power block will have a centralised inverter which converts the DC power generated by the PV panels, to AC power and a transformer which transforms the power to a higher voltage of 33 kV to facilitate transmitting the power over longer distances to connect to the East and West Plant Substations; and
- Instrumentation and Control consisting of hardware and software for remote plant monitoring and operation of the facility.

Associated infrastructure includes:

- A welded mesh, “clear view” type fence is proposed for the solar sites. The proposed height of the fence is 1.8 m;
- Fence mounted security and area lighting;
- Internal access roads (4- 6 m wide roads will be constructed but existing roads will be used as far as possible);
- Provision is made for stormwater drainage infrastructure on Site 5, draining stormwater from the R555 to the Steelpoort River;
- A guard house is proposed at the entrance to each site with a 500 litre water tank and a chemical ablution facility;

- Cabling between the structures, to be lain underground where practical;
- New 33 kV powerlines (either overhead lines or underground cables) between the various sites and the Tubatse East and West substation buildings;
- Containerized switchgear substation at Tubatse East and West MV substations for connecting to the Tubatse substation busbars; and
- Battery Energy Storage System (BESS).

2 METHODOLOGY

The climate change impact assessment for the proposed 100MWp PV Plant considers three main aspects:

1. **Climate resilience of the project** - “the extent in which the Project itself is able to cope with or withstand impacts of climate change”
2. **Climate resilience through the project** - “the extent in which the Project contributes to addressing climate related risks outside of the project”
3. **Potential GHG mitigation impact of the project -** “the extent in which the Project will increase or reduce the greenhouse gas (GHG) emissions”

This translates into an investigation of the components indicated on the diagram depicted in Figure 3.

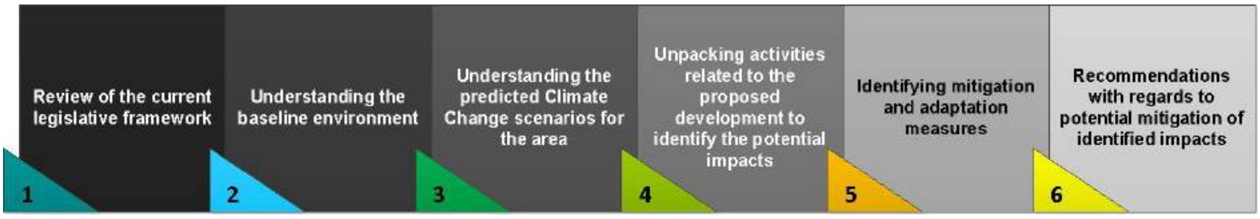

Figure 4: Methodology

2.1 The Impacts of Climate Change on the Project

As for any infrastructure projects, solar PV installations need to recognise how climate change is likely to play out in terms of patterns of climate variability and extreme weather events, and the risks posed by climate and weather events to the project i.e. the climate resilience of the project. Specifically, projections of future climates need to be consulted and interpreted in terms of likely threats to the physical infrastructure and operations of the plant. Indirect impacts must also be considered. This includes the impacts that climate change responses (e.g. disinvestment in carbon-intensive industries) might have on the conceptualisation of the project.

2.2 The Project’s Impacts on the Environment

The immediate and direct impacts of the PV Plant on the local or regional integrity of environmental conditions i.e. climate resilience through the project, will be assessed in the specialist assessments detailing the project’s impacts on agriculture, biodiversity, heritage and freshwater resources. However, one also has to consider how a future climate will affect the availability of operational resources requirements in consideration of potentially variable biophysical and socio-economic conditions.

2.3 Mitigation of Climate Change

The assessment of the Project's impacts on the environment is supplemented by a quantification of the potential GHG emissions from the Project, within the context of the national GHG emissions reduction commitments. Greenhouse gas emissions are categorised into three groups or 'Scopes'. Scope 1 covers direct emissions from owned or controlled sources. Scope 2 covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company. Scope 3 includes all other indirect emissions that occur in a company's value chain (Carbon Trust, 2021). The emissions footprint will be limited to 'territorial' emissions, i.e. those generated within the project boundaries (Scope 1 & 2) and excluding the emissions related to materials and product sourcing (Scope 3). Recommendations will be made with regards to non-territorial emissions.

NOTE: Since the project is still in the feasibility stage and only conceptual design has been completed, the Climate Change impact Assessment (CCIA) will be split in two phases. The Phase 1 CCIA will investigate (1) The Impacts of Climate Change on the Project, (2) The Project's Impacts on the Environment and (3) provide a high level quantification of the potential GHG emissions from the Project. The Phase 2 CCIA will only be completed once the detailed design and construction plan is available and will include a detailed assessment of the potential GHG emissions from the Project, within the context of the national GHG emissions reduction commitments.

2.4 Impact Rating

The impacts identified will be rated according to four descriptive criteria, namely Extent (E), Duration (D), Intensity (I) and Probability (P), with the significance determined by the cumulative rating of all four categories. This is achieved through application of a scoring exercise as per Table 1. A cumulative score is then used as an indicator of significance, as per Table 2.

Table 2: Scoring system for the impact rating exercise

Nature	Category	
Extent (E)	0	None
	1	Site only
	2	Local
	3	Regional
	4	National
	5	International
Duration (D)	0	None
	1	Immediate
	2	Short-term (0 - 7 years) (impact ceases after the operational life of the activity)
	3	Medium-term (8 - 15 years)
	4	Long-term
	5	Permanent
Magnitude (M)	0	None
	2	Minor
	4	Low
	6	Moderate
	8	High
	10	Very high/don't know
Probability (P)	0	None

Nature	Category	
	1	Improbable
	2	Low probability
	3	Medium probability
	4	Highly probable
	5	Definite/don't know
IMPACT is Cumulative **Significance = (E + D + M) x P**	The maximum value is 100 significance points (SP). Status determines if positive / negative	

Table 3: Significance Categories

SP>75 High environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP (30 – 75) Moderate environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP<30 Low environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
Positive impact	An impact that constitutes an improvement over pre-project conditions

2.5 Assumptions, Uncertainties, Exclusions and Gaps in Knowledge

In view of the large uncertainties associated with econo-political decisions and macro-economic policy related to power generation and international finance, this assessment will not consider the effects of the Project on aspects such as foreign direct investment or indirect impacts on tourism within a globalised economic system.

Care has been taken to use the best available information and data in terms of the the GHG inventory. However, it should be noted that the ‘secondary’ calculations are reliant on the accuracy of the baseline data. The dependencies of GHG emissions quantification preclude a formal assessment at this stage due to detailed designs not being available at this time.

3 What is Climate Change?

In order to assess information relevant to the understanding of human induced climate change, potential impacts of climate change and options for mitigation and adaptation, the World Meteorological Organization and the United Nations Environment Programme established the Intergovernmental Panel on Climate Change (IPCC). Since its founding in 1988, the IPCC has completed a number of assessment reports, developed methodology guidelines for national greenhouse gas inventories, special reports and technical papers. There have been a number of IPCC reports through the years and the most recent work (IPCC AR6 of 2021) currently presents the most up-to-date assessment of the current state of research on climate change.

Climate change refers to any change in the average long-term climatic trend and is a natural part of the earth system. Human activities since the Industrial Revolution have, however, succeeded in altering the composition of the atmosphere to such an extent that it will absorb and store increasing amounts of energy in the troposphere within the coming century. This will result in the atmosphere heating up, thereby altering weather and climate patterns. The main findings of the IPCC's sixth Assessment Report (AR) shows that global warming will reach 1.5°C by the early 2030s, with 2°C being exceeded this century if emissions continue at their current levels (IPCC, 2021). This will lead to a cascade of effects, including changes to precipitation, seasons, microclimates and habitat suitability. It is also reported that human activity is causing an accelerated rate of climate change around the world and that this phenomenon won't slow down unless we severely curb our greenhouse gas emissions at a global scale (IPCC, 2021).

The impact of climate change has the potential to adversely affect the economic, natural resources and social sectors of the Limpopo Province, as for the rest of South and Southern Africa. Changes to both weather patterns and longer-term climate will induce changes to how land can be used, and how exposed economic activities and people will be to climate and weather-related threats. Warmer temperatures, for example, will affect crop selection for agriculture, habitat suitability for wildlife, water availability for mining, energy usage by urban populations and the spread of diseases. Climate change furthermore leads to indirect impacts as social and economic sectors attempt to adapt to the changing climate. Global efforts at mitigation will, for example, force a shift towards forms of energy with lower global warming potentials; thereby altering the foundations of coal-based economies.

Earth's globally averaged temperature for 2020 made it the 2nd-hottest year in National Oceanic and Atmospheric Administration's (NOAA)'s) 138-year climate record, behind 2016 (warmest) and bumping 2019 down to the third hottest year. It was also Earth's 44th consecutive year with global temperatures, at least nominally, above the 20th-century average, according to scientists from NOAA's National Centres for Environmental Information (NCEI). The average temperature across the globe in 2020 was 1.76 degrees F (0.98 of a degree C) above average — just 0.04 of a degree F (0.02 of a degree C) cooler than the 2016 record. The world's seven warmest years have all occurred since 2014. **https://www.noaa.gov/news/2020-was-earth-s-2nd-hottest-year-just-behind-2016**

Globally, the YTD (January through August 2021) ranked as the sixth warmest year ever recorded, at 0.82 of a degree C above the 20th-century average of 14.0 degrees C. The Northern Hemisphere's YTD was also sixth warmest while the Southern Hemisphere's ranked ninth warmest.
https://www.noaa.gov/news/august-2021-was-earths-sixth-warmest-august-on-record

4 CLIMATE CHANGE POLICY AND FRAMEWORK

This section highlights an overview of the policy and legislative context in respect of addressing climate change at international, national and provincial levels.

4.1 The United Nations Framework Convention on Climate Convention

The United Nations Framework Convention on Climate Convention (UNFCCC) came into force on 21 March 1994. The aim of the Convention is to stabilize GHG concentrations at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system. This level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

In their actions to achieve the objective and to implement its provisions, the Convention also sets out some guiding principles:

1. To protect the climate system for the benefit of present and future generations;
2. To give consideration to the specific needs and special circumstances of developing country Parties especially those that are particularly vulnerable to the adverse effects of climate change;
3. The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects;
4. To promote sustainable development; and
5. To cooperate to promote a supportive and open international economic system that would lead to sustainable economic growth and development in all Parties, particularly developing country Parties, thus enabling them better to address the problems of climate change.

In addition, both developed and developing countries accept a number of general commitments and commits all Parties to formulate, implement, publish and update adaptation measures, as well as to cooperate on adaptation. In addition, these Parties have already highlighted the 5 key elements of a future climate change deal i.e. shared vision, mitigation, adaptation, finance and technology.

The importance of adaptation was reiterated in the Copenhagen Accord, which emphasizes that enhanced action and international cooperation on adaptation is urgently required to ensure the implementation of the Convention by enabling and supporting the implementation of adaptation actions aimed at reducing vulnerability and building resilience in developing countries, especially in those that are particularly vulnerable, especially least developed countries, small island developing States and Africa.

Under the negotiating process towards Cancun, countries made progress in defining a comprehensive adaptation framework, which will enable all countries to share knowledge and lessons learned from adaptation and developing countries to develop and implement adaptation measures supported through scaled-up financial support, technology and capacity-building. The final elements of the framework remain to be agreed through the negotiations.

4.2 The Paris Climate Agreement

In December 2015, the Paris Agreement adopted, after four years since the launch of the process to develop the legal instrument under the Ad hoc Working Group on the Durban Platform for Enhanced Action (ADP). The Agreement is a landmark environmental pact that was adopted by nearly every nation to address climate change and its negative effects. The agreement includes commitments from all major GHG-emitting countries to cut their climate-altering pollution and to strengthen those commitments over time. It brings all nations into a common cause based on their historic, current and future responsibilities and reaffirms the goal of limiting global temperature increase well below 2°C, while urging Parties to “pursue efforts” to limit the increase to 1.5°C.

4.3 The Kyoto Protocol

The Kyoto Protocol is an international treaty which extends the 1994 United Nations Framework Convention on Climate Change (UNFCCC) that commits state parties to reduce greenhouse gas emissions, based on the scientific consensus that (1) global warming is occurring and (2) that human-made CO_2 emissions are driving it. It aims to strengthen the international response to climate change. Adopted by consensus at the third session of the Conference of the Parties (COP-3) in December 1997, it contains legally binding emissions targets for Annex I (industrialized) countries. The targets for the first commitment period of the Kyoto Protocol cover emissions of the six main greenhouse gases, namely:

- Carbon dioxide (CO2);
- Methane (CH_4);
- Nitrous oxide (N_2O);

- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulphur hexafluoride (SF_6).

The Protocol promises to move the international community one step closer to achieving the Convention's ultimate objective of preventing dangerous anthropogenic interference with the climate system. In December 2012, the Doha Amendment to the Kyoto Protocol was adopted for a second commitment period, starting in 2013 and lasting until 2020. However, the Doha Amendment w only entered into force in December 2020 as a total of 144 instruments of acceptance were required for entry into force of the amendment.

The amendment includes:

- New commitments for Annex I Parties to the Kyoto Protocol who agreed to take on commitments in a second commitment period from 1 January 2013 to 31 December 2020;
- A revised list of GHG to be reported on by Parties in the second commitment period; and
- Amendments to several articles of the Kyoto Protocol which specifically referenced issues pertaining to the first commitment period and which needed to be updated for the second commitment period.

4.4 Sendai Framework for Disaster Risk Reduction (2015)

The Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted at the Third UN World Conference in Sendai, Japan, on March 18, 2015. The Sendai Framework is the successor instrument to the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters. One of the lessons learned from the HFA is that more dedicated action needs to be focused on tackling underlying disaster risk drivers, such as the consequences of climate change and variability. As such, the Sendai Framework considers the incorporation of disaster risk reduction measures into programmes within and across all sectors, as appropriate, related to, among other things, the adaptation to climate change.

The present Framework aims to achieve the following outcome over the next 15 years:

- The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.

To attain the expected outcome, the following goal must be pursued:

- Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience.

In an effort to achieve the expected outcome and goal, there is a need for focused action. The following four priority areas have been identified across sectors by States at local, national, regional and global levels:

- Priority 1: Understanding disaster risk.
- Priority 2: Strengthening disaster risk governance to manage disaster risk.
- Priority 3: Investing in disaster risk reduction for resilience.
- Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

4.5 Constitution of the Republic of South Africa The South African Constitution (Act No. 108 of 1996)

The South African Constitution (Act No. 108 of 1996) provides an overall framework governing the development and implementation of climate change adaptation and mitigation strategies. Section 24 in the Constitution's Bill of Rights provides as follows:

Everyone has the right -

a) *To an environment which is not harmful to their health or well-being;*
b) *To have the environment protected for the benefit of present and future generations through reasonable legislative and other measures that:*
   i. *prevent pollution and ecological degradation;*
   ii. *promote conservation; and*
   iii. *secure ecologically sustainable development and use of natural resources while.*

4.6 Thabametsi Judgement

Although neither legislation nor policy, the Thabametsi Judgement, is considered the current standard against which CCIAs are measured in South Africa. Environmental approval was sought for a 1200 MW Thabametsi coal-fired power station that would have been built in its first phase at 557 MW outside Lephalale in Limpopo province. In March 2017, in a landmark judgment, the Pretoria High Court set aside the environmental approval for the plant, holding that the Environment Minister was obliged to consider climate impacts in her decision, but had failed to do so. This was South Africa's first climate change court case (CER, 2020).

The case of Earthlife Africa Johannesburg v Minister of Environmental Affairs and others ("the Thabametsi case") created legal precedent which confirmed that climate change is an issue that has to be considered during the EIA phase and has compelled certain projects to include an analysis of climate change issues in the EIA. Before this case, there was no specific legal obligation to do so, but the Thabametsi case clarified that climate change does need to be considered and suggested this should consist of three primary elements: i) the extent to which a project will contribute to climate change over the life of the project by quantifying its GHG emissions; ii) the impact of climate change on the project; and iii) how these impacts may be avoided, mitigated or remedied.

4.7 Presidential Commission on Climate Change

The South African Presidential Climate Commission (PCC), has been requested to make recommendations on South Africa's draft updated Nationally Determined Contribution (NDC). The nationally determined contribution (NDC) is a statement of South Africa's plans for reducing greenhouse gas emissions and adapting to the effects of climate change, as well as how to finance those plans. The NDC focuses in particular on the next decade, and contains targets for emission reductions and climate actions to be undertaken by 2025 and 2030.

In March 2021, South Africa published a draft of its updated NDC, which would strengthen the country's target range for 2030. The draft update proposed revising the 2030 NDC target from 398-614 MtCO2e to 398-440 MtCO2e (incl. LULUCF), lowering the upper bound by 28% compared to the previous NDC.

In June 2021, the PCC recommended that the country's NDC be strengthened to 350-420 MtCO2e (incl. LULUCF). The lower bound is based on the adoption of no-regrets policies and is consistent with 1.5°C according to some of the analysis considered by the Commission. The upper bound is 2°C compatible according to some analysis (including from the CAT's September 2020 assessment). The Commission noted that South Africa would need support to achieve this update target, especially the lower bound of the range.

South Africa Target emissions and 1.5˚C compatible emissions for 2030 ($MtCO_2e$) Climate Action Tracker

Original NDC		Draft NDC Update		PCC Recommendations		CAT 1.5˚C modelled pathway level	CAT 1.5˚C fair share contribution
Incl. LULUCF	Excl LULUCF*	Incl. LULUCF	Excl LULUCF*	Incl. LULUCF	Excl LULUCF*	Excl LULUCF*	Excl LULUCF*
398-614	414-630	398-440	414-456	350-420	366-436	364	350

*CAT analysis

Source: Climate Tracker, 2021

South Africa's Nationally Determined Contribution (NDC) is structured around the three goals of the UNFCCC's Paris Agreement related to mitigation, adaptation and means of support. These goals are:

- Temperature Goal: to hold global warming well below 2 °C above preindustrial levels, while pursuing an
- ambitious 1.5°C.
- Resilience Goal: to increase the resilience of communities and businesses to the impacts of climate change, understanding that emission reductions will lower the cost of future climate impacts.
- Financial Goal: to direct finance flows (including private finance) towards low emission and climate resilient development

4.8 National Environmental Management Act (NEMA) (Act No. 107 of 1998, as amended)

In order to understand what exactly must be protected in terms of the Section 24 of the Constitution, the term environment is defined by the National Environmental Management Act (NEMA) (Act 107 of 1998, as amended) as:

the surroundings within which humans exist and that are made up of -

(i) the land, water and atmosphere of the earth;
(ii) micro-organisms, plant and animal life;
(iii) any part or combination of (i) and (ii) and the interrelationships among and between them; and
(iv) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and wellbeing.

Chapter Five (5) of NEMA prescribes the process for authorisation under the heading Integrated Environmental Management (IEM) and sets out the aims of IEM. Section 24 of NEMA deals with the authorisation of EIAs and includes the impact of the proposed development on socio-economic conditions as well as listed activities. Section 24(O) deals with the conditions that must be taken into consideration in the decision-making process for environmental authorisation and the official must consider all relevant factors. These factors include:

(i) *any pollution, environmental impacts or environmental degradation likely to be caused if the application is approved or refused;*
(ii) *measures that may be taken-(aa) to protect the environment from harm as a result of the activity which is the subject of the application; and (bb) to prevent, control, abate or mitigate any pollution, substantially detrimental environmental impacts or environmental degradation;*
(iii) *the ability of the applicant to implement mitigation measures and to comply with any conditions subject to which the application may be granted;*
(iv) *where appropriate, any feasible and reasonable alternatives to the activity which is the subject of the application and any feasible and reasonable modifications or changes to the activity that may minimise harm to the environment;*
(v) *any information and maps compiled in terms of section 24(3), including any prescribed environmental management frameworks, to the extent that such information, maps and frameworks arc relevant to the application;*
(vi) *information contained in the application form, reports, comments, representations and other documents submitted in terms of this Act to the Minister. Minister of Minerals and Energy, MEC or competent authority in connection with the application;*
(vii) *any comments received from organs of state that have jurisdiction over any aspect of the activity which is the subject of the application; and*
(viii) *any guidelines, departmental policies and decision-making instruments that have been developed or any other information in the possession of the competent authority that are relevant to the application.*

It is with this in mind that the wide interpretation thereof needs to include the reflection of climate change in the environmental authorisation of an activity.

4.9 The National Development Plan

The National Development Plan (NDP) aims to eliminate poverty and reduce inequality by 2030. The NDP highlights climate change as one of the key responses and acknowledges South Africa's role as a contributor to GHG emissions. In addition, it notes that South Africa is particularly vulnerable to the effects of climate change on health, livelihoods, water and food with a disproportionate impact on the poor, especially women and children. It sets the long-term vision for the country that will need to be implemented by all spheres of government and sectors of society in order to achieve the goals set forth in the document.

Chapter 5: Environmental Sustainability and Resilience, focuses on ensuring environmental sustainability and an equitable transition to a lower carbon economy and includes a number of objectives and actions which are specifically linked to climate change. These include:

- Achieve the peak, plateau and decline trajectory for GHG emission, with the peak being reached around 2025;
- By 2030, an economy-wide carbon price should be entrenched;
- Carbon price, building standards, vehicle emissions, standards and municipal regulations to achieve scale in stimulating renewable energy, waste recycling and in retrofitting buildings;
- Carbon pricing mechanisms, supported by a wider suite of mitigation policy instruments to drive energy efficiency;
- Zero emission building standards by 2030;
- All new buildings to meet the energy efficiency criteria set out in SANS 204;
- Absolute reductions in the total volume of waste disposed to landfill each year;
- At least 20 000MW of renewable energy should be contracted by 2030;
- Improved disaster preparedness for extreme climate events;

- Increased investment in new agricultural technologies, research and the development of adaptation strategies for the protection of rural livelihoods and expansion of commercial agriculture;
- Channel public investment into research, new agricultural technologies for commercial farming as well as for the development of adaptation strategies and support services for small-scale and rural farmers;
- An independent Climate Change Centre in partnership with academia and other appropriate institutions, to be established by government to support the actions of government, business and civil society; and
- Put in place a regulatory framework for land use, to ensure conservation and restoration of protected areas.

There are also strong climate change links with other chapters in the National Development Plan, including Chapter 3: Economy and Employment, which includes a focus on the green economy, transition to a low carbon economy and society, and fostering motivation in green product and service development; Chapter 4: Economy Infrastructure, which includes the efficient and effective implementation of the environmental impact management governance system for new developments and the implementation of Strategic Infrastructure Projects (SIPs) proactive authorisation process. Chapter 6 focuses on the promotion of an integrated and inclusive rural economy and Chapter 8: Transforming Human Settlements focuses on green cities and sustainable development.

4.10 The National Climate Change Response White Paper, 2011 and the National Climate Change Bill, 2018

The National Climate Change Response (NCCR) White Paper (2011) and the National Climate Change Bill - NCCB (2018) presents the South African Government's vision for an effective climate change response and the long-term transition to a climate-resilient and lower-carbon economy and society.

Main Objectives are to:

- provide for the coordinated and integrated response to climate change and its impacts by all spheres of government in accordance with the principles of cooperative governance;
- provide for the effective management of inevitable climate change impacts through enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to building social, economic, and environmental resilience and an adequate national adaptation response in the context of the global climate change response;
- make a fair contribution to the global effort to stabilise greenhouse gas concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system within a timeframe and in a manner that enables economic, employment, social and environmental development to proceed in a sustainable manner.

The NCCR focuses on three key aspects: adaptation, mitigation, and mainstreaming sustainable and "climate resilient" development. It also includes the development of a Monitoring and Evaluation System that will serve as the national tracking and reporting structure for South African climate change responses.

The White Paper sets out South Africa's climate change response strategy to achieve the NCCR Objective and is structured around the following strategic priorities:

- Risk reduction and management
- Mitigation actions with significant outcomes
- Sectoral responses
- Policy and regulatory alignment
- Integrated planning

- Informed decision-making and planning
- Technology research, development and innovation
- Facilitated behaviour change
- Behaviour change through choice
- Resource mobilisation

The NCCB focuses on three key aspects namely climate change response of province and municipalities; national adaption to impacts of climate change; and GHG emissions and removals.

4.11 National Climate Change Adaptation Strategy

South Africa's National Climate Change Adaptation Strategy (NCCAS) was approved in August 2020 and supports the country's ability to meeting its obligations in terms of the Paris Agreement on Climate Change. The NCCAS provides a common vision of climate change adaptation and climate resilience for the country, and outlines priority areas for achieving this vision. The NCCAS goes beyond water, agriculture and commercial forestry, health, biodiversity and ecosystems, human settlements (urban, rural and coastal), and disaster risk reduction and management sectors to include transportation and infrastructure, energy, mining, oceans and coast.

The current NCCR represents the first iteration of South Africa's ongoing efforts to adapt to climate change and contribute to the global mitigation effort. One of the actions to achieve climate change considerations is that all public infrastructure (including transport and energy infrastructure) be planned, designed, operated and managed after explicitly taking current and predicted future climate change impacts into account.

4.12 Disaster Management Act (Act No. 57 of 2002, as amended)

The South African government has responded to the negative consequences of disasters by developing the Disaster Management Act (Act No. 57 of 2002) to deal with the management of disaster risk and disaster impact.

The purpose of the Act is to provide for:

- an integrated and co-ordinated disaster management policy that focuses on preventing or reducing the risk of disasters, mitigating the severity of disasters, emergency preparedness, rapid and effective response to disasters and post-disaster recovery and rehabilitation;
- the establishment and functioning of national, provincial and municipal disaster management centres;
- disaster management volunteers; and matters incidental thereto

The Disaster Management Act was recently amended through the Disaster Management Amendment Act (Act No. 16 of 2015). The amendments make provision for, among other things, measures to reduce the risk of disaster through adaptation to climate change.

4.13 Integrated Resource Plan for Electricity

The Integrated Resource Plan (IRP) for Electricity was promulgated in 2011 and constitutes a 20 year (2010 to 2030) electricity capacity plan for South Africa to guide decision making around electricity policy and the future make up of generation capacity in proportion to electricity sourced from coal, nuclear, hydro/pumped storage, imported gas, wind and solar, including Concentrated Solar Power (CSP) and Photovoltaic (PV). The IRP aims to effectively reduce South Africa's dependence on coal-based electricity generation from 90% to 65% by 2030 and transition to alternative generation options with 14% generated from renewable sources including wind and hydropower at 5% each, PV at 3% and CSP at 1%.

At the time of promulgation, it was envisaged that the IRP would be a "living plan" to be revised regularly and as such the IRP was updated in 2019. Besides capacity additions, a number of assumptions changed since the promulgation of IRP 2010–2030. Key assumptions that changed include the electricity demand projection, Eskom's existing plant performance, as well as new technology costs. One of the key decisions of the updated IRP is the application of annual build limits on renewables (wind and solar) which, according to the IRP, does not significantly impact the projected capacity up to the year 2030.

4.14 Limpopo Climate Change Response Strategy 2016-2020

Vision: A low carbon economy province that is resilient to impacts of a changing climate through concerted implementation of policies and programs that minimize greenhouse gas emissions, socio-economic threats and environmental risks while maximizing the benefits from opportunities which may arise from climate change.

Mission: Development by strengthening its adaptive capacity and building resilience of the society and ecosystems while reducing greenhouse gas emissions from all source sectors.

Objectives:

- Raise the profile and understanding of how the province can proactively and positively respond to climate change;
- Develop a common climate change agenda for Limpopo, articulate a shared vision and build on the strengths of the province to deliver on this vision through collaboration and partnerships;
- Slow the increase of GHG emissions by implementing a range of mitigation programs such as increased energy efficiency in all sectors, development of renewable energy sources and sustainable use of natural resources;
- Improve public awareness and preparedness for future climate change throughout the province; and
- Promote long term, integrated planning across different sectors and organisations to better manage provincial response to climate change in Limpopo.

4.15 Limpopo Green Economy Plan 2016-2020

The 2016-2020 Limpopo Green Economy Plan aims to increase employment and grow the economy through the creation of green jobs. The plan envisages a green economy in agriculture, construction, manufacturing, infrastructure, science and technology, and services including activities that help to protect and restore ecosystems and biodiversity; reduce energy, materials, and water consumption through high efficiency and avoidance strategies; de-carbonize the economy; and minimize or altogether avoid degeneration of all forms of waste and pollution. The principal objective of Limpopo Green Economy Plan is to support and direct the re-orientation and growth of the economy to become increasingly competitive and resilient by generating green jobs, improving environmental quality, creating enabling conditions for green growth, changing behavioural and production patterns, and building a new economic/environmental paradigm for Limpopo. These will be implemented through specified initiatives in the key focus areas such as sustainable production and consumption, sustainable waste management practices, clean energy and energy efficiency, resource conservation and management, agriculture, food production and forestry, green buildings and the built environment, sustainable transport and infrastructure and green municipalities.

5 Climate Change Profile

The Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), indicates that each of the last four decades have been successively warmer than any decade that preceded it since 1850.

Global surface temperature in the first two decades of the 21st century (2001-2020) was 0.99°C higher than 1850-1900. Global surface temperature was 1.09°C higher in 2011–2020 than 1850–1900 (IPCC, 2021).

The report further outlines Africa as the most vulnerable continent. Some of the observed impacts in recent years, show that Africa will experience extreme weather and climate events including droughts and floods which will have significant impacts on economic sectors, natural resources, ecosystems, livelihoods, and human health.

The report further revealed that southern Africa will suffer a decrease in water resources due to climate change. Drought-affected areas are projected to increase in extent, with the potential for adverse impacts on multiple sectors such as agriculture, water supply, energy production and health. Regionally, it is projected that climate change will result in large increases in irrigation water demand. The beneficial impacts of increased annual runoff in some areas are likely to be tempered by the negative effects of increased precipitation variability and seasonal runoff shifts on water supply, water quality and flood risk.

The report notes, in terms of the East Southern Africa (ESAF) region (where the project site is located), that there is:

- Observed decreases in mean precipitation;
- Observed and projected increases in heavy precipitation and pluvial flooding;
- Observed and projected increase in aridity, agricultural and ecological droughts;
- Observed increase in meteorological drought, projected increase in meteorological droughts from 1.5°C, higher confidence at higher Global Warming Levels (GWL);
- Projected increases in fire weather conditions; increases in mean wind speed; increase of average tropical cyclone wind speeds and associated heavy precipitation and of the proportion of category 4-5 tropical cyclones.

Analyses of climate data from 26 weather stations across South Africa found that, between 1960 and 2003 the country's average annual temperatures increased by about 0.13ºC per decade, with varying increases across the seasons (Kruger and Shongwe, 2004 as cited in Rankoana, 2020).

There are three major gases that are influenced by human activities and that are of interest with respect to greenhouse gas emissions, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The official national GHG inventory for South Africa for the year 2000-2017 calculated that national emissions increased by 103 316 Gg CO_2-eq (or 22.8%) from the 452 347 Gg CO_2-eq in 2000 without compensating for Forestry and Other Land Use (FOLU) (DEA, 2020). Emissions (including FOLU) were estimated at 513 140 Gg CO_2-eq in 2017 and showed an increase of 17.9% since 2000 (DEA, 2020).

The Energy sector remains the largest contributor (79.1% in 2017) to emissions (excluding Forestry and Other Land Use (FOLU)) and is responsible for 90.3% of the increase over the 17-year period. Overall, 2000 to 2017 GHG emission results revealed an increase in emissions from the energy, Industrial Processes and Product Use (IPPU) and waste sectors, with a decrease in the net Agriculture, Forestry and Other Land Use (AFOLU) sector due to an increasing Land sink. There was an annual average increase of 2% between 2000 and 2010, and this slowed to 0.7% between 2010 and 2014. Emissions stabilised between 2014 and 2017, with an average annual decline of 0.4% (DEA, 2020).

According to the Limpopo Climate Change Strategy (LCCS) 2016-2020 (Thivhafuni, 2016). The industrial sector dominates the energy picture of Limpopo Province at 63.8% of total energy consumption and 82.4% of total electricity consumption for the Province. Electricity is the main source of fuel in the industrial sector combined at 51%. Coal contributes 46% and heavy furnace oil 1.5%. Transport-related energy consumption for this sector is examined as part of the transport sector. The transport sector accounts for 29% of all energy consumption in the Limpopo Province.

The LCCS further noted that GHG emissions associated with provincial sources and included in the provincial emission inventory are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). To date there is no official GHG inventory published for the Limpopo Province. The current GHG inventory included in the LCCS was conducted in accordance with approved principles and standards of both the International Local Government GHG Emission Analysis Protocol (IEAP) and the Global Protocol for Community scale GHG Emission Inventories (GPC) and should be viewed as a first level emission inventory. Sub-sectors in the land use, land use change and forestry (LULUCF) sector with emissions and removals for afforestation and deforestation are not included in the provincial total.

Table 4 below provides an overview of the emissions considered in the first level GHG inventory. Scope 1 emissions are all direct emissions sources located within the geographical boundary of Limpopo Province, while Scope 2 emissions are indirect emissions that result from sources located within the geographical boundary of Limpopo Province.

Table 4: Scope 1 emission sources categories (Source: Thivhafuni, 2016)

Scope 1	Source Category	
All direct emissions sources located within the geographical boundary of Limpopo Province	Consumption based emission source	Fossil Fuel - Residential
		Fossil Fuel -Industrial
		Fossil Fuel - Transport
		Fossil Fuel - Agriculture
		Fossil Fuel - General
	Generation based emission source	Matimba Power Station
Scope 2	**Source Category**	
Indirect emissions limited to electricity consumption within the Province, but the associated emissions	Electrical Residential	
	Fossil Industrial	
	Electrical Transport	
	Electrical Agriculture	
	Electricity General	

***NOTE:** The table above excludes the Medupi Power Station which was not fully operational at the time of the compilation of the LCCS. Construction activities commenced in May 2007 and commissioning was delayed. Unit 6 was synchronized in 2015, the first unit to generate power at the station, followed by unit 5 in April 2017, unit 4 in November 2017, unit 3 in June 2019 and unit 2 in November 2019 (GEM, 2021). Commercial operation of unit 1 has been postponed from 2020 to 2021. Once it is fully operational it is projected to emit 32 million tons of Carbon dioxide equivalent a year (GEM, 2021).

GHG emissions are attributed to four defined sectors: energy; industrial processes; waste and agriculture. Emissions for energy have further been broken down into four sub-sectors i.e. Industrial, residential, transport, agriculture and other sources) as a significant percentage of total emissions are attributed to these sub-sectors.

Provincial emissions, across all sectors examined, were approximately 45 603 542 metric tonnes of carbon dioxide equivalent ($MTCO_2eq$) in 2013. The energy sector is the largest single source of provincial GHG emissions at 67% (30 450 066 tCO_2-eq). The industrial and waste sectors contribute 19% (8 581 225 tCO_2e) and 9% (4 300 883 tCO_2e) respectively to the provincial GHG emissions (Thivhafuni, 2016).

The promotion of energy conservation and demand management initiatives can significantly reduce emissions. Increasing the use of alternative energy (i.e. wind, hydro, solar) in the supply mix will lower the demand for non-renewable sources and reduce greenhouse gases. Solar energy systems are dependent on sunlight and therefore highly suitable for Limpopo as the province has 80-95% sunlight presence during the daytime. It should also be noted that renewable energy developments such as the current proposed Solar PV plant are more aligned with the more ambitious NDC targets recently submitted to the UNFCCC.

5.1 Observed Climate, Hazards and Extreme Events

The Limpopo Province is characterised by four climatic regions, the subtropical plateau which is a flat elevated interior area that is hot and dry with winter rain, the moderate eastern plateau with warm to hot and rainy summers and cold dry winters, the escarpment region with colder weather because of the altitude and rain all year around; and the subtropical Lowveld region, of hot-rainy summers and warm-dry winters, also known as the South African Bushveld (Limpopo Department of Agriculture, 2008; Tshiala et al, 2011:142 as cited in Thivhafuni, 2016).

The graphs below have been sourced from *World Weather Online* and provides a further overview of the prevailing conditions.

5.1.1 Temperature

The graph below shows the maximum, minimum and average temperature from 2009 to 2021 for the Steelpoort area. From Figure 5 it can been seen that there has been a slight increase in maximum temperatures. Average temperatures for January increased slightly from 21ºC and 20ºC in 2009 and 2010 respectively to 23ºC in 2018 and 2019. In 2020 and 2021 average temperatures for January declined to 21ºC and 22ºC. Average winter temperatures have seen a slight increase. The average July temperature from July 2009 to July 2014 was 12.16ºC, compared to July 2015 to July 2020 which averaged 13.5ºC.

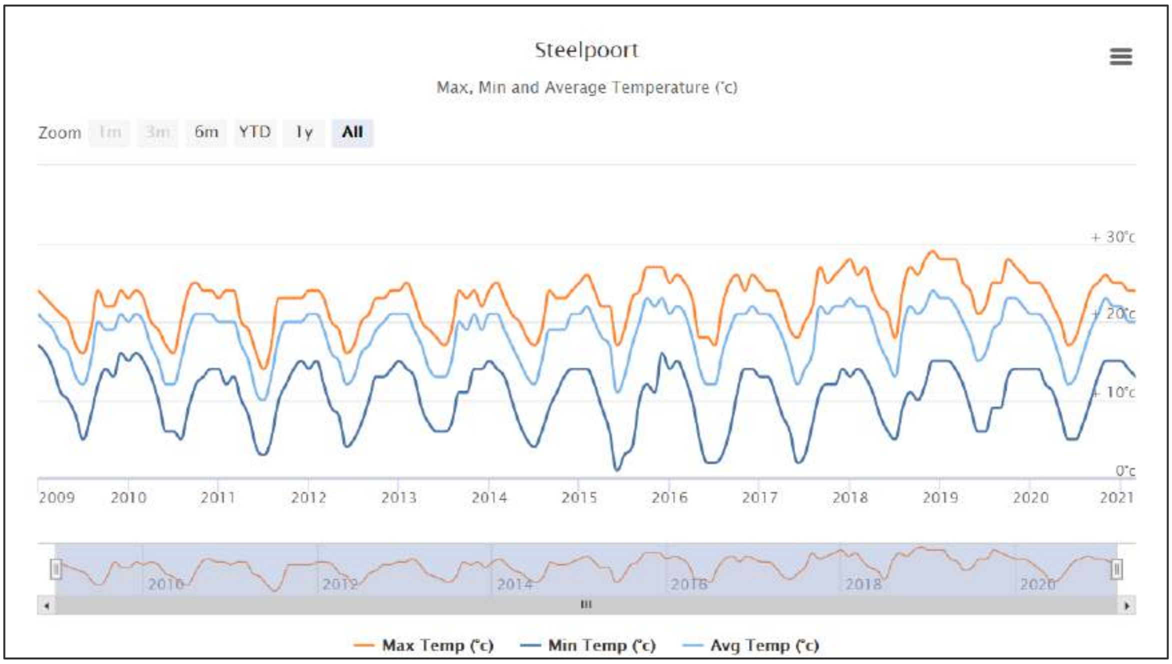

Figure 5: The maximum, minimum and average temperature from 2009 to 2021 for Steelpoort (Source: worldweatheronline.com)

5.1.2 Precipitation

Tubatse Chrome falls within a summer rainfall region, receiving most of its rainfall during the summer months. The lowest rainfall levels are experienced during the winter months (June – August). The Figure 6 below shows the average rainfall amount from 2009 to 2021 for the Steelpoort area. January 2009 and January 2010 averaged 630.59mm and 668.7mm respectively with January 2018 only averaging 48.3mm. However, January 2019, 2020 and 2021 averaged 193.3mm, 210.8mm and 336.3mm respectively.

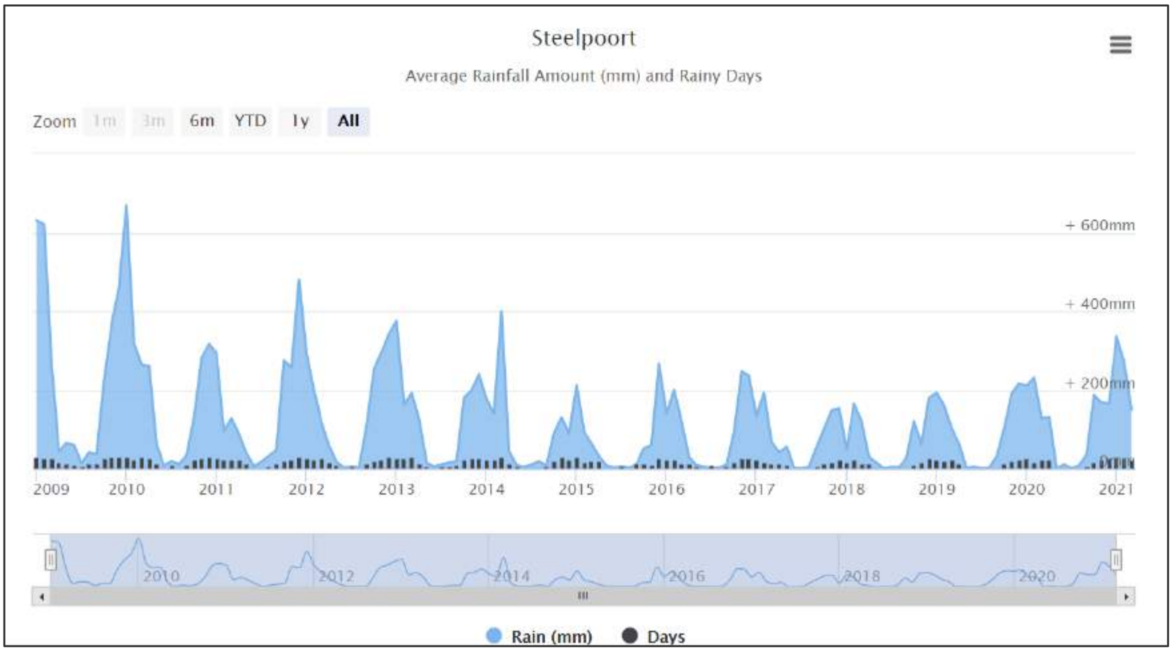

Figure 6: The average rainfall amount from 2009 to 2021 for Steelpoort (Source: worldweatheronline.com)

5.1.3 Air Quality

Tubatse Chrome has an on-site meteorological monitoring station that measures various meteorological parameters such as wind speed, wind direction, surface temperature, humidity and rainfall data. (Sunderland & Enslin, 2018) and also conduct their own air quality monitoring. The prevailing wind direction is from the south east. In terms of current air quality issues, the FTLM IDP notes there are currently three chrome smelters within the FTLM. It is therefore expected that the area is likely to have pollutants like sulphur dioxide, nitrous oxides, chromium (VI) and particulate matter. This is supported by Sunderland & Enslin (2018). Their study notes that the industrial and agricultural operations within the Steelpoort area are likely to contribute to ambient dust in the area and that it is also likely that domestic fuel burning will contribute to ambient NO2, SO2, CO and PM concentrations in the area, given the proximity of low-income areas to the plant. The transportation of minerals also impacts on the air quality. Other pollutants like pesticides are expected to emanate from the farms around Ohrigstad towards Burgersfort, of which the extent has not yet been determined. The FTLM IDP further notes that the district currently has three passive air quality monitoring stations being monitored by an independent company and that pollutants being monitored include SO_2, NO_X and fallout dust.

5.2 Hazards and Extreme Events

Mpandeli et al. (2015) describes the Sekhukhune District as being characterized by low rainfall and periodic flooding as well as recurrent droughts especially in 1981/1984, 1988/1989, 1991/92 and in the 2004. Droughts could have an indirect effect on the project as it significantly affects people's vulnerability, and the project would need to avoid exacerbating the situation by depriving people of livelihoods or access to water resources.

A number of climate-related disasters and major occurrences have occurred over the years within the Limpopo Province and within the Sekhukhune District. The list below was compiled from open source media:

- Every year between June and September, veldfires is a major problem in the area. Every year between June and September the area between Mostelus and Maserumpark experiences veldfires resulting in loss of cropland, also in the area between Tswaing and Thbampshe the annual veldfires result in the loss of livestock and destruction of grazing land.
- 1996, 2002, 2005 and 2008, Floods – Floods were recorded to have occurred in Greater Marble Hall.
- 2007/2008, Floods - The areas noted to be affected by flooding in Fetakgomo are Pelangwe (2007), Atok and Strydkraal in 2007/08 and in Apel in 2008.
- 2008, Cholera - The Musina area in the Limpopo Province experienced a cholera outbreak during November 2008.
- 2010, Floods - Some parts of the Province received heavy rains in particularly the Vhembe and Sekhukhune districts.
- Veld and forest fires, 2010 - Waterberg District experienced two significant veld and forest fires on 13 July 2010. The second fire took place on 9 October 2010 in Alma, Verdrag, Velgevonden and Rankiespaas-Alma farms in the Thabazimbi Local Municipality. Eighty thousand hectares of land was destroyed.
- 2011, Floods – A National State of Disaster was declared by the President in a number of provinces, including Limpopo, on 21 January 2011 as a result of heavy rains and floods.
- 2012, Floods – Limpopo suffered extensive destruction in January 2012 due to severe storms with heavy rain, wind, hail and flooding.
- 2013, Floods - In January 2013 heavy rainfall and severe flooding affected areas in the Vhembe and Mopani District Municipalities. Eskom, also reported flooding affecting their infrastructure and operations in these areas.
- 2013, Floods – A Local State of Disaster was declared in the Mopani District Municipality due to flooding in October 2013.
- 2014, Floods – A Local State of Disaster was declared in the Waterberg District Municipality due to flooding in March 2014.
- 2015, Drought – A Provincial State of Disaster was declared for the Limpopo Province in November 2015.
- 2016, Floods – A Local State of Disaster was declared in the Vhembe District Municipality due to flooding in May 2016.
- 2016, Thunderstorm – A Local State of Disaster was declared in the Mopani District Municipality due to thunderstorms in June 2016.
- 2018, Drought – A National State of Disaster was declared in March 2018.
- 2020, Drought – A National State of Disaster was declared in March 2020.
- 2020, COVID-19 - A National State of Disaster was declared in March 2020.

Various disaster risks have been identified and assessed during 2018/2019 as set out in the risk profile of Fetakgomo Tubatse Local Municipality. The list below provides an overview of the types of climate related hazards that may affect the project site.

- Severe Storms
- Riverine Floods

Royal HaskoningDHV

- Water pollution
- Drought
- Lightning
- Air pollution
- Pest Infestations – Alien Vegetation
- Land Degradation

The Think Hazard tool, developed by the Global Facility for Disaster Reduction and Recovery, also notes the following hazard for the Sekhukhune District Municipality.

Wildfire	High
Water scarcity	Medium
Extreme heat	Medium
River flood	Low
Earthquake	Low
Cyclone	Low
Urban flood	Very low
Landslide	Very low

Figure 7: Hazards identified for the Sekhukhune District Municipality (GFDRR, 2020)

Based on the above, in summary, the main climate-related disaster risks related to the project site are veldfires, drought and severe storms.

5.3 Climate Change Projections

With the recent release of IPCC AR6 there has been a notable shift from "climate change is human-induced with high confidence" (AR5) to "climate change is unequivocally human-induced" (AR6). General Circulation Models analysed in IPCC AR5 projected that mean annual global temperatures will increase by 0.3 to 2.5°C by 2050, relative to the 1985-2005 climatological average (Stocker et al., 2013b as cited in Davis-Reddy & Vincent, 2017). Methodological advances and new datasets contributed approximately 0.1ºC to the updated estimate of warming in AR6 (IPCC, 2021). The estimated increase in global surface temperature since the release of AR5 is in principle, noted to be due to further warming since 2003–2012 (+0.19 [0.16 to 0.22] °C). Of importance to the project are the climatic patterns and weather extremes that might affect the facility directly or indirectly – specifically precipitation, extreme temperatures and droughts. In order to evaluate the impact of these factors, the assessment will consider the existing climatic patterns and their evolution over time as global climate change manifests.

The below figure provides a comparison of current and future climates for the project area and is based on the Koppen-Geiger climate classification (Beck et al., 2018). Based on the classification below, the project area is expected to transition from a more Subtropical Monsoon climate to a Hot Semi-Arid climate, which would entail a shift from high summer rainfall and low winter rainfall to lower rainfall all year round. Similarly, there will be a shift in temperature from very hot to cool with very hot dry summers to very hot summers and mild winters.

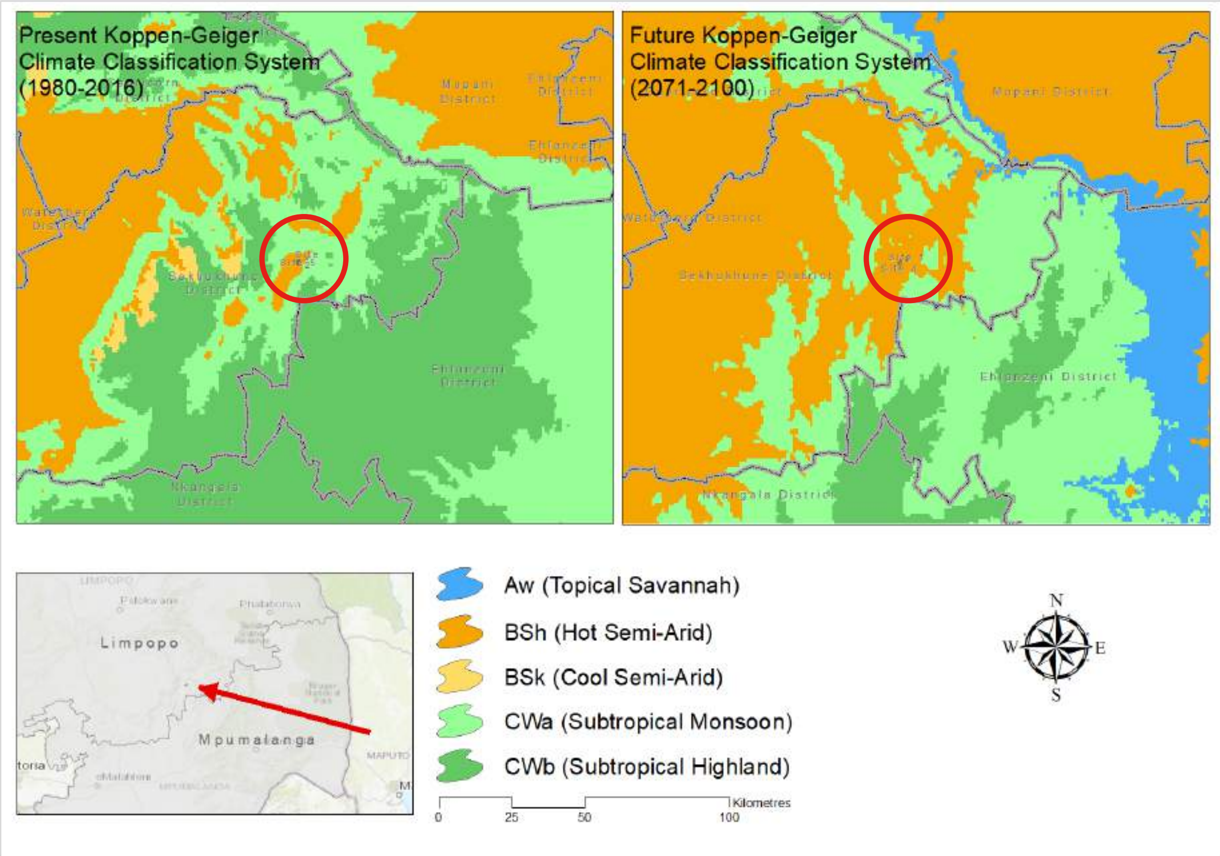

Figure 8: A comparison of current and future Koppen-Geiger climate classification for the project area (Beck et al., 2018)

South Africa has been experiencing acute climate change impacts since at least 2011 and is becoming increasingly aware of future impacts that it must prepare for (DEA, 2011). The country is located in one of the three regions of the African continent that is most likely to suffer significant adverse impacts from climate change (Kirby, 2014). The country will experience progressively warmer and drier summers, wetter and milder winters and more frequent extreme weather, particularly heavy rainfall and heat waves.

The Climate Risk and Vulnerability Handbook published by the Council of Scientific and Industrial Research (CSIR) state that changes in rainfall will vary across the region and over time. The Handbook specifies that no models indicate mean wetter futures throughout the simulated period and for maximum temperatures all scenarios suggest an increase in the future. Further projections suggest that the annual frequency of very hot days (number of days when the maximum temperature exceeds 35°C) will increase into the future. An increase in the frequency of extreme rainfall events (20mm of rain falling within 24 hours) is also expected to occur over the north-east corner of South Africa, this is driven by modelled changes in the landfall of tropical cyclones originating in the Indian Ocean.

Downscaled climate change projections for the period 2025-2045 were also obtained from the University of Cape Town's Climate Systems Analysis Group to identify climate change trends for the area. The Representative Concentration Pathway (RCP) 4.5 scenario was selected. According to the IPCC, emissions in RCP 4.5 are expected to peak around 2040 and requires that carbon dioxide (CO_2) emissions start declining by approximately 2045, which aligns with the lifespan of the PV plant, which is 25 years. The scenarios support the projections above, anticipating higher temperatures and drought extremes as well as an increase in the frequency of extreme rainfall events.

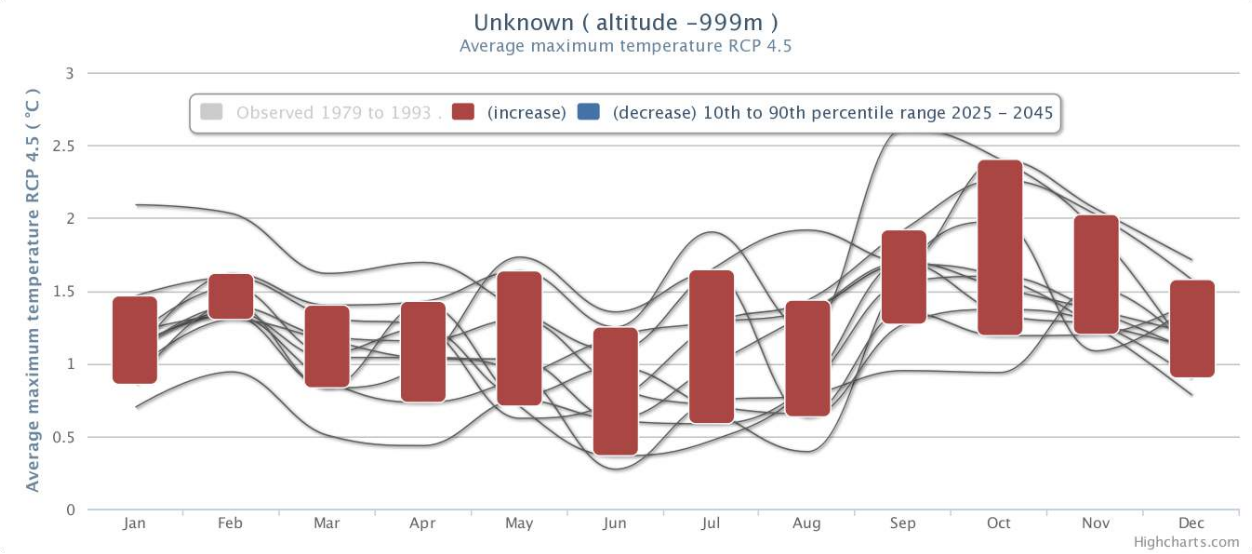

Figure 9: Average Maximum temperatures projected for the project area for RCP 4.5

Furthermore, the Annual State of the Climate and World Meteorological Organization (WMO) Extreme Climate Indices provide a comprehensive overview of the climate of South Africa during 2019, compared to previous years. A set of 27 core indices were developed by the WMO to track extremes in surface temperature and precipitation. However, not all of the indices are relevant to the South African climate (SAWS, 2020b). The data sets analysed consist of a set of 26 homogenised temperature time series for the period 1931–2020 and 701 rainfall time series for 1921-2020. In the case of rainfall data, the analysis does not necessarily include the data up to 2020. There are several reasons for that, e.g. significant periods of non-measurement from manual stations due to Covid-19 related restrictions. However, the long-term trends of the stations with recent missing data are deemed to be still valid or realistic due to the long period over which the trends were estimated (SAWS, 2020b).

Some of the main conclusions from the results of the analyses contained in the reports (SAWS, 2020; Zide, 2020) are the following:

- For surface temperature there is a general warming trend over South Africa over the period 1931 – present. Annual maximum temperatures are showing an increase in especially the western half of the country, while annual highest daily minimum temperatures are showing significant increases, especially along the coast and parts of the northern interior. The lowest minimum temperature per year shows significant increases almost countrywide. Generally, cool days are decreasing and hot days increasing. Similarly, cold nights are decreasing and warm nights increasing, but not significantly in the central interior. However, the annual maximum warm spells have increased significantly over the western and central interior. In contrast, the maximum annual cold spell lengths have decreased countrywide.
- Compared with surface temperature, where all the extreme indices can be linked to a general warming trend, mixed trends are presented by the trends in extreme rainfall indices analysed over the period 1921 to 2019. Most indices can be associated with a decreasing trend in annual rainfall in isolated regions in the eastern and far northern interior, with weaker drying signals in the south-west, while increases in rainfall are shown in the southern interior. The annual maximum daily and five-daily rainfalls show significant increases in the central and southern interior. Trends in the intensity of rainfall on rainy days show mixed signals, but there are clear decreases in the far north-eastern interior and increases in the central and south-eastern parts. Trends in days with daily rainfall above the specific thresholds of 10mm and 20mm mostly indicate increases in the western

and southern interior and decreases in the east and north-east. However, in the case of the 25mm threshold, increases are apparent over the central and southern interior and spreading eastwards, while decreases are only apparent in the far north. The annual maximum dry spells are increasing over most of the summer rainfall areas but decreasing in the south-western interior, which can indicate that winter rainfalls in the regions with predominantly summer rainfall are diminishing. The annual maximum spells of wet days are decreasing in the north-eastern half of South Africa but there are signals of significant increases in the south-eastern interior. There are also indications that in general, over most of South Africa, daily rainfalls that are considered to be relatively high are increasing.

The Department of Environmental Affairs (DEA) (now known as the Department of Forestry, Fisheries and the Environment) has undertaken the Long-Term Adaptation Scenarios Flagship Research Programme (LTAS) which aimed at responding to the South African National Climate Change Response White Paper by developing national and subnational adaptation scenarios for the country under plausible future climate conditions (DEA, 2013). As part of LTAS, climate trends and projections were done at both a national and local scale, in relation to six hydrological zones of South Africa (Figure 8).

Figure 10: The six hydrological zones (Source: DEA, 2013)

The proposed development is located within the Limpopo Water Management Area which fall within Zone 1. Zone 1 includes activities such as irrigated agriculture and livestock farming as well as power generation and increasing mining operations due to the vast untapped mining potential in the area (DWA, 2021). These activities have high water requirements and with the growing population and economic growth, this Zone will have an increasing impact on water demand due to likely reduction in rainfall and significant increased temperatures which are expected due to climate change (DEA, 2013).

A summary of the LTAS findings is provided below:

Observed Climate Trends for South Africa (1960-2010)

- Mean annual temperatures have increased by at least 1.5 times the observed global average of 0.65°C reported by the Fourth Assessment Report (AR4) of the IPCC for the past five decades.
- Maximum and minimum daily temperatures have been increasing annually, and in almost all seasons. A notable exception is the central interior (Zone 3, Vaal), where minimum temperatures have been increasing less strongly, and some decreases have been observed.
- High and low temperatures (i.e. hot and cold extremes) have respectively increased and decreased in frequency in most seasons across the country, particularly in the western and northern interior.
- The rate of temperature change has fluctuated, with the highest rates of increase occurring from the middle 1970s to the early 1980s, and again in the late 1990s to middle 2000s.

- Rainfall has shown high inter-annual variability, with smoothed rainfall showing amplitude of about 300mm, about the same as the national average.
- Annual rainfall trends are weak overall and nonsignificant, but there is a tendency towards a significant decrease in the number of rain days in almost all hydrological zones. This implies a tendency towards an increase in the intensity of rainfall events and increased dry spell duration.
- There has also been a marginal reduction in rainfall for the autumn months in almost all hydrological zones.
- Extreme rainfall events show a tendency towards increasing in frequency annually, and especially in spring and summer, with a reduction in extremes in autumn.
- Overall, rainfall trends are similar in all the hydrological zones, with rainfall being above average in the 1970s, the late 1980s, and mid to late 1990s, and below average in the 1960s and in the early 2000s, reverting to the long-term mean towards 2010.

Projected rainfall and temperature changes for South Africa (to 2050 and beyond)

- All modelling approaches project warming trends until the end of this century, but most approaches project the possibility of both drying and wetting trends in almost all parts of South Africa.
- Very significant warming, as high as 5–8°C, over the South African interior by the end of this century. Warming would be somewhat reduced over coastal zones.
- A general pattern of a risk of drier conditions to the west and south of the country and a risk of wetter conditions over the east of the country.
- Many of the projected changes are within the range of historical natural variability, and uncertainty in the projections is high.
- Effective global mitigation action is projected to reduce the risk of extreme warming trends, and to reduce the likelihood of extreme wetting and drying outcomes by at least mid-century.
- High resolution regional modelling suggests even larger benefits of effective global mitigation by the end of this century, when regional warming of 5–8°C could be more than halved to 2.5–3°C.
- Overall, there is far greater certainty in temperature than in rainfall projections.

Projected climate futures for South Africa (2015–2035, 2040–2060 and 2070–2090)

South Africa's climate future up to 2050 and beyond can be described using four fundamental climate scenarios at national scale, with different degrees of change and likelihood that capture the impacts of global mitigation and the passing of time.

1. **Warmer (3°C above 1961–2000) and Wetter** with substantially greater frequency of extreme rainfall events.
2. **Warmer (<3°C above 1961–2000) and Drier**, with an increase in the frequency of drought events and somewhat greater frequency of extreme rainfall events.
3. **Hotter (>3°C above 1961–2000) and Wetter**, with substantially greater frequency of extreme rainfall events
4. **Hotter (>3°C above 1961–2000) and Drier**, with a substantial increase in the frequency of drought events and greater frequency of extreme rainfall events.

In both wetter and drier futures, a higher frequency of flooding and drought extremes could be expected, with the range of extremes significantly increased under unconstrained emissions scenarios. Figure 9 gives rainfall projections for these scenarios for Zone 1.

Scenario	Limpopo/ Olifants/Inkomati
1: warmer/ wetter	↑ spring and summer
2: warmer/ drier	↓ summer, spring and autumn
3: hotter/ wetter	Strongly ↑ spring and summer
4: hotter/ drier	Strongly ↓ summer, spring and autumn

Figure 11: Rainfall projections for Zone 1 (Source: DEA, 2013)

In summary, available information suggests that most of the Limpopo River Basin will become hotter and significantly drier as average temperatures are projected to increase by 2-3°C by 2050 and by 3-6°C by 2080–2100 (Petrie et al., 2014). In terms of rainfall, both wetter and drier futures are expected, with a higher frequency of flooding and drought extremes.

The below figure provides a comparison of current and future climates for the project area and is based on the Koppen-Geiger climate classification (Beck et al., 2018). Based on the classification below, the project area presently has a predominantly Subtropical highland climate. This oceanic climate, also known as a maritime climate or marine climate, is the Köppen classification of climate typical of west coasts in higher middle latitudes of continents, generally featuring mild summers (relative to their latitude) and cool but not cold winters, with a relatively narrow annual temperature range and few extremes of temperature. This is expected to transition to a Hot Semi-Arid climate in the future. These climates tend to have hot, sometimes extremely hot, summers and warm to cool winters, with some to minimal precipitation.

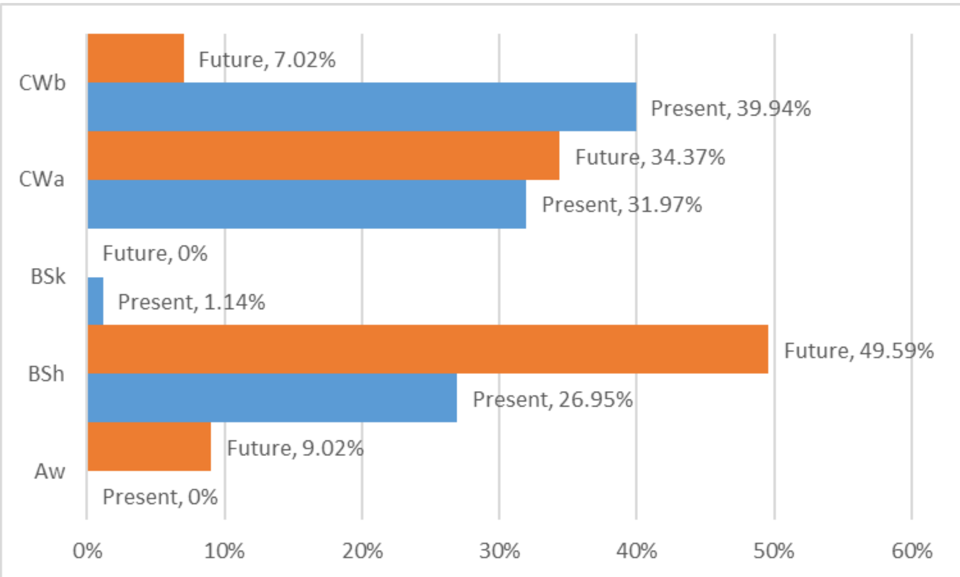

Figure 12: Present and future (2100) ratio of Koppen-Geiger climate classification categories (Beck et al., 2018).

Based on the above, the Limpopo Province would therefore experience regular droughts and heat intensity, water shortages and flooding, as well as spread of diseases with adverse effects on the economy, natural resources, infrastructure, human health and community livelihoods. Water shortages are already a key feature in the drier Limpopo Province and the situation is going to become even more severe as a result of climate change. Important water use sectors such as agriculture and electricity generation (i.e. the energy sector) will face severe effects from climate change.

5.4 General Implications for the Project

The observed trends confirm the general regional pattern of universally increasing temperature indices, and a possibility of decreased overall availability of moisture due to increasingly erratic rainfall and increased evaporation.

The climatic changes will alter the functioning of the natural ecological systems, due to the higher temperatures and lower water availability. The effects will include increased desiccation, species migration, higher wind speeds, increased erosive effects from wind and runoff, etc. The facility's performance may be affected by increased temperatures and increased dust mobilisation that reduce the efficiency of the panels, and intense rainfall, hail or wind that threatens its physical integrity. Furthermore, drier conditions will also mean higher levels of dust settling on the panels, making more regular cleaning necessary, which in turn would increase the water usage.

6 AVOIDED GHG EMISSIONS

A study conducted by the United Nations Renewable Energy Lab (NREL,2012) Comparing life cycle stages and proportions of GHG emissions from each stage for PV and coal shows that, for coal-fired power plants, fuel combustion during operation emits the vast majority of GHGs. The project lifespan considered for the NREL study was 30 years. For PV power plants, the majority of GHG emissions are upstream of operation in materials and module manufacturing and construction activities.

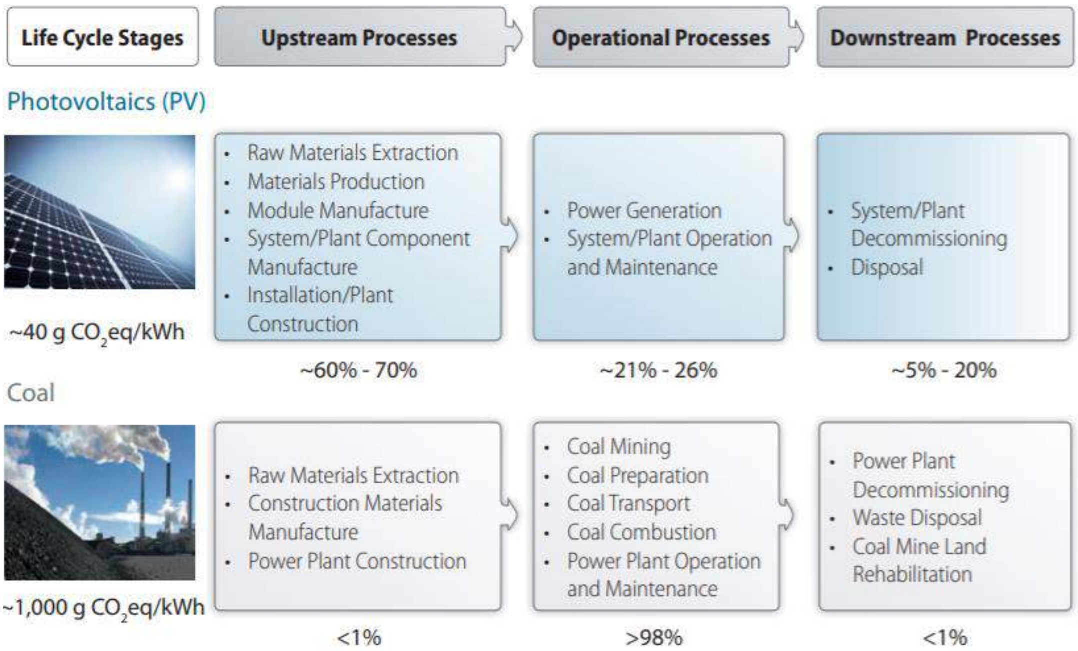

Figure 13: Comparison of life cycle stages and proportions of GHG emissions from each stage for PV and coal fired power plants (NREL,2012)

This is supported by another more recent study (Tawalbeh et al., 2021) that explores and compares the emissions of greenhouse gas (GHG) from various PV systems with fossil fuel energy resources. The results revealed that the negative environmental impacts of PV systems could be substantially mitigated. The carbon footprint emission from PV systems was found to be in the range of 14–73 g CO2-eq/kWh, which is 10 to 53 orders of magnitude lower than emission reported from the burning of oil (742 g CO2-eq/kWh from oil). It was concluded that the carbon footprint of the PV system could be decreased further using novel manufacturing materials. The study further notes that the recycling of solar cell materials can also contribute up to a 42% reduction in GHG emissions.

Given the latest national GHG emissions total of 513 140 Gg CO_2e (2017), the project under scrutiny, being a solar PV installation, is expected to have a negligible Scope 1 and 2 emissions profile – i.e. within the project boundaries - and excluding Scope 3 emissions embodied in materials and transport to the site. Emissions during operation will be limited to maintenance activities that require energy other than what is available on site, such as liquid fuels for vehicles. When considering Scope 3 emissions, it has been shown that the embodied emissions of a solar PV installation are relatively low, as compared to conventional coal, gas, bioenergy or hydropower facilities (Pehl, et al., 2017).

Calculations provided in the table below indicate that the project will contribute to the national GHG emissions mitigation target, along with the added benefit of having lower embodied emissions as compared to fossil fuel-based electricity generation options. A Phase 2 CCIA must be completed once the detailed design and construction plan is available and must include a detailed assessment of the potential GHG emissions from the Project, within the context of the national GHG emissions reduction commitments.

The CO_2 reduction potential was calculated using the United Nations Framework Convention on Climate Change (UNFCCC) Clean Development Mechanism (CDM) ACM0002 methodology[1]. The baseline scenario of the proposed project is the electricity delivered by the project activity that would have otherwise imported from the Eskom grid had the 100MW ac solar PV generation facility not been connected. The calculations refer to Scope 1 and 2 emissions from the operational phase. Scope 1 and 2 construction emissions will still be factored in a Phase 2 CCIA once the information becomes available.

6.2 Calculation Results

The following assumptions were used in performing the calculations:

- Calculations performed for solar PV plant operating life of 25 years,
- Solar PV facility commissioned in 2022 (2022 is referred to as year 1 in calculations),
- Grid emission factor reduction of 2% per year,
- Solar PV facility emits zero emissions as there will be no onsite combustion of fossil fuels during operation of the facility, and
- Solar PV facility annual output of 180GWh with a 1.5% degradation rate in the first year of operation and 0.4% in the remaining operational years.

An Eskom combined grid CO_2 emission factor of **0.9871 t** CO_2/MWh obtained from the Institute for Global Environmental Strategies (IGES CDM) Project Database[2] was used to calculate the baseline emissions. The database provides 'official grid emission factors published by host country governments or published as CDM standardized baseline approved by the CDM Executive Board[3]'. The emission factor can also be

[1] *https://cdm.unfccc.int/methodologies/DB/XP2LKUSA61DKUQC0PIWPGWDN8ED5PG*
[2] *https://pub.iges.or.jp/pub/iges-list-grid-emission-factors*
[3] *Institute for Global Environmental Strategies (2021). List of Grid Emission Factors version 10.10. Available at: https://pub.iges.or.jp/pub/iges-list-grid-emission-factors*

calculated using Eskom historic generation data per plant obtained from the Eskom website[4] as well as all the installed renewable generation in the grid[5].

It was estimated that the grid emission factor would reduce by 2% per year over the 25-year solar PV facility operational period due to addition of more renewable generation into the grid. The table below shows the calculated CO_2 reduction for the first operational year and the total reduction over the 25 years.

Table 5: CO2 reduction potential of the 100MW ac Solar PV Facility

	Unit	Baseline (Eskom Grid)	Solar PV Facility
Net power delivered to the grid[6] (year =1)	MWh/yr	177 300	177 300
Eskom grid CO_2 emission factor (year =1)	t CO_2/MWh	0.97	0
CO_2 emission (year = 1)	t CO_2/yr	171 512	0
Total CO_2 emission (year = 25)	t CO_2	3 255 814	0
CO_2 reduction (year = 1)	t CO_2/yr	**171 512**	
Total CO_2 reduction (year = 25)	t CO_2	**3 255 814**	

The CO_2 reduction potential of the solar PV facility will be **171 512** ton of CO_2 in the first year of operation and a total of **3 255 814** ton of CO_2 over 25 years. The South Africa national carbon budget is targeted at 350 Mt CO_2- eq for 2025 according to the nationally determined contribution (NDC) recommended by South Africa's Presidential climate commission in July 2021[7]. Considering the 2025 NDC, the solar project will marginally decrease the targeted greenhouse gas emissions by a factor of about **0.05%.**

In comparison, a similar project i.e. the Kathu Grid Connected 100MW Solar Park in the Northern Cape, South Africa was estimated to average 238 080 tCO2 (238.08 kt CO2eq/GWh) of avoided GHG emission per year. The NDP proposes that at least 20 000 MW of renewable energy should be contracted by 2030, of which at least 3% (600 MW) should be from Solar PV according to the IRP. By implication, the use of solar radiation for electricity production, as compared to the local ESKOM grid, will result in an emissions reduction. The proposed project will therefore contribute 16.7% (as it is a 100MW Solar PV plant) to the national mitigation objective of 600MW related to sourcing energy from solar PV installations.

6.3 Assumptions and limitations

The proposed 100MW PV plant is still in the planning phase. Thus, there are some uncertainties regarding detailed construction data and material use. Based on published reports (NREL, 2012; Tawalbeh et al., 2021), it was determined that the contribution of GHG emissions from the construction of the 100 MW PV plant is likely to be negligible and the majority of emissions will likely be from transport during construction.

The CCIA makes use of data obtained during the desktop review for the GHG inventory and the associated impact assessment. Certain assumptions were made to ensure the development of the most accurate and extensive GHG inventory, and the associated impact assessment.

These assumptions include the following:

- It is assumed that the following aspects of the 100MW PV Plant will contribute to immaterially towards the GHG footprint of the Plant during the construction phase:
    - Mobile combustion of diesel and/or petrol fuels in onsite trucks or machinery
    - Stationary combustion from back-up generators

[4] CDM calculations (eskom.co.za)
[5] https://www.eskom.co.za/IR2021/pages/default.aspx
[6] Assumed all power generated can be delivered to the grid
[7] https://climateactiontracker.org/blog/south-africas-presidential-climate-commission-recommends-stronger-mitigation-target-range-for-updated-ndc-close-to-15c-compatible/

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- Quantity of construction and municipal waste generated, including the distance transported to landfill

Uncertainties that remain in this assessment are:

- The dependencies of GHG emissions quantification preclude a detailed assessment at this stage due to detailed designs not being available at this time. However, given the limited construction activities and anticipated low significance of on-site emissions, is deemed not to be a fatal flaw preventing the approval of the proposal.

The project will contribute to the national GHG emissions mitigation target and have the added benefit of lower embodied emissions as compared to fossil fuel-based electricity generation options. It is not anticipated that the project will exhaust a substantive or material portion of the national carbon budget as defined in the latest NDCs, and that this will be offset through avoided emissions.

7 VULNERABILITY ASSESSMENT

This Chapter summarises the issues identified for further investigation and considered the aspects indicated in Section 5.4 above. An assessment of the of the findings is provided in Chapter 8 below to detail the understanding of the impacts of Climate Change on the Project as well as the impacts of the facility on the social and biophysical environment.

7.1 Impacts of Climate Change on the Project

The facility's performance may be affected by increased temperatures and increased dust mobilisation that reduce the efficiency of the panels, and intense rainfall, hail or wind that threatens its physical integrity. Neither of these categories of effects are likely fatal flaws and can be managed as part of the routine planning and management of the project. Appropriate site management such as erosion control through vegetation management and soil stabilisation will manage the risk sufficiently, as long as regular monitoring can ensure early detection of issues.

7.1.1 Impacts on the facility on the Biophysical and Social Environment

Preliminary links have been identified between the PV Plant and its social and biophysical environment as related to drivers and effects of climate change. An assessment of the potential links between the construction and operation of the Project, and its biophysical and social impacts, as contextualised by climate change, is provided below. Important inputs into the assessment are the two main climatic stressors that are expected to play the biggest role in future – water availability and increased temperatures.

Table 6: Assessment of links between climate change and environmental effects on the project

Climate Change concerns	Relation to proposed development	Assessment of impacts	Mitigation options
Surface and groundwater			
River, wetlands and other freshwater resources supply drinking water for people and animals and are a vital resource for farming and industry. Lower	Use of water (construction & operation).	Water is to be sourced from a sustainable source. Alternatively, water will be trucked in from a municipal source. During construction it is proposes that 1 x 15 000L tanker mainly to be used for dust suppression and 1 x 15 000L	Limit water use to sustainable levels.

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Climate Change concerns	Relation to proposed development	Assessment of impacts	Mitigation options
than normal precipitation levels and increased drought result in water shortages.		tanker which will mainly be used for the drilling activities and other use. The total water consumption for a single cleaning cycle is approximately 1200m3 per cleaning cycle. Recycled de-mineralised water will be provided from the SCR Reverse Osmosis plant during operations which can also be seen as a water re-use initiative in that no new water will have to be abstracted from a ground or surface water resource. The RO plant is currently connected to the grid. However, the long term plan is to convert it run on electricity from the PV plant.	
Water resources will degrade under drier, hotter climate regime.	Erosion and sedimentation of the non-perennial watercourses and the Steelpoort River	The Freshwater Ecological Assessment (FWA) identified some freshwater ecosystems on site. The FWA defines these as watercourses with associated riparian zones of varying degrees of development. These systems are associated with proposed sites 3, 4 and 5. The expected drier hotter climate may lead to erosion and sedimentation of watercourses which in turn can alter the natural drainage lines and runoff patterns. Both these impacts are subject to the adequacy of mitigation measures in the form of soil cover and storm water management during construction and operation. It is important that the species selection for revegetation work remains sensitive to anticipated climatic conditions – i.e. groundcover and tree introduction must be drought and heat resistant.	Revegetation must consider drought and heat resistant species. Monitoring of erosion must be included in the construction and operational management plans. Adequate storm water measures as described in the FWA and the Hydrological Assessment must be implemented
Extreme rainfall events leading to localised flooding.	Impediment and/or exacerbation of natural stormwater run-off, polluted overflows and access to site.	The increased hardened surfaces of the solar arrays can potentially exacerbate localised flooding during extreme rainfall events. Flooding can also threaten the physical integrity of the plant and surrounding environment. This in turn can result in damage to the surrounding environment by debris, impacting on water availability (due to impendent) and water quality (due to polluted overflows). Access by staff to and from the site may also be compromised during extreme flooding.	Appropriate site management such as regular site monitoring during heavy rain, proper stormwater management systems (as discussed in the Hydrological Assessment) and maintenance thereof can ensure early detection of issues. Appropriate Emergency Procedures should be developed and

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Climate Change concerns	Relation to proposed development	Assessment of impacts	Mitigation options
		As noted by the Hydrological Assessment, site 5 in particular, has a major drainage line running through it and flooding in this zone will be significant. It will not be possible to develop the area within the floodlines and is therefore a no-go area.	implemented on site during construction and operation (Note that detailed mitigation options are evaluated under the Hydrological Assessment).
Biodiversity			
Increased pressure to find microclimatic refuge and surface water as natural habitat and water sources deteriorate due to desertification and degradation.	Exclusion and/or interruption of wildlife and bird movement (especially for waterbirds), associated with the Steelpoort River and other identified water sources with regards to water use (refer to Surface and Groundwater).	The Avifaunal Assessment regards the project area as medium in terms of Avifaunal sensitivity. The Biodiversity Assessment indicates that the preservation of habitat with a high ecological connectivity, for example all drainage lines and the riparian thicket corridor along the Steelpoort River is regarded as a high priority in order to maintain and facilitate existing animal dispersal corridors across the study area. The facility may therefore cause an impediment to sensitive faunal and avifaunal movement.	Limit interruption of access to water sources. Wildlife-friendly fencing, with ground-level openings of at least 150mm and no electrification of the lower section. Limit water use to sustainable levels and revegetate and monitor erosion during construction and operation to minimise deterioration of water sources (Note that detailed mitigation options are evaluated under the Biodiversity and Avifaunal Assessments).
Desertification will reduce carbon stored in biomass.	Desertification and soil erosion (refer to Soils and Agriculture).	N/A (see related impact category)	N/A
Soils and Agriculture			
Progressive reduction in water availability and desertification that increases erodibility and threat of serious erosion when intense rainfall follows a period of drought.	Localised disruption of run-off pattern (panel array, access road, cabling). Reduction in vegetation cover will have a negligible effect on the sequestration effect of natural biomass, and hence a negligible impact on the national GHG accounts.	The project site will be subject to increased intensity runoff due to the concentrating effect of the installed PV panels. This will increase the risk of soil erosion and the resultant sedimentation of nonperennial river. Both these impacts are subject to the adequacy of mitigation measures in the form of soil cover and storm water management during construction and operation. It is important that the species selection for revegetation work remains sensitive to anticipated climatic conditions – i.e. groundcover and tree introduction must be drought and heat resistant.	Revegetation and monitoring of erosion must be included in the construction and operational management plans.
Heritage			

Climate Change concerns	Relation to proposed development	Assessment of impacts	Mitigation options
Damage or destruction of heritage resources when intense rainfall follows a period of drought or if persistent drought leads to desertification and degradation of the surrounding environment.	The Heritage impact assessment (HIA) has shown that the study area and surrounding area has some heritage resources situated within the proposed development boundaries.	Extreme weather events like severe storms or long periods of drought may lead to the damage or loss of the associated heritage resources. The project site will be subject to increased intensity runoff due to the concentrating effect of the installed PV panels. This will increase the risk of damage or destruction of heritage resources.	Mitigation measure provided in the HIA must be adhered to. Appropriate site management such as regular site monitoring during heavy rain, proper stormwater management systems (as discussed in the Hydrological Assessment) and maintenance thereof can ensure early detection of potential damage to any heritage resources. A monitoring plan should be put in place to ensure that the identified resources are protected and that should any changes or damage be noted, the proper authorities be contacted.
Air quality and emissions			
Use of fossil fuels will increase GHG emissions.	Increased GHG emissions	The use of fossil fuels on site is inevitable, as construction equipment and vehicles typically operate on liquid fuels. These emit various GHG, depending on the nature of the fuels, the equipment or machinery in use and the efficiency of use. The total GHG emissions footprint is therefore highly sensitive to operational and design parameters. Major construction activities will include basic earthworks (preparing access roads, laying of cabling, stormwater attenuation and preparation of foundations) and limited above-ground installations (powerlines and solar panel arrays). Given this limited scale of the development, and duration of the construction phase, the total on-site (territorial) emissions contribution can be assumed as insignificant relative to other GHG sources such as industrial facilities. Further quantification is therefore not necessary.	Currently, the use of fossil fuels for manufacturing and transport is unavoidable, but it’s contribution to global GHG emissions can be mitigated through the use of less carbon intensive alternatives and construction methods that reduce the overall needs for transportation and materials haulage. Construction activities must avoid the use of old or improperly functioning equipment that use fossil fuels in an inefficient manner or that release fugitive emissions. Site administration (e.g. site camp) can also be run off renewable energy sources as far as possible.

Climate Change concerns	Relation to proposed development	Assessment of impacts	Mitigation options
Vehicle movement and construction activities will mobilise dust, which may be exacerbated by increased air temperature and drought conditions	Construction activities will affect human activities where dust is mobilised.	Easterly winds predominate, accompanied by strong winds occurring within the north and north-easterly sectors. Excessive dust generated on Site 1 will therefore be blown towards Steelpoort, possibly leading to air quality concerns. Although wind speeds will increase as anticipated climatic changes take effect, the impact is likely to be limited to the construction period, meaning that longer-term climate changes are not a concern.	Appropriate road maintenance, activity staging and revegetation activities must be imposed to reduce the extent of bare surfaces or travel speeds on roads. The use of water for dust suppression must be considered in context of reduced water availability.
Fires			
Warmer, drier conditions expected in the region may increase the risk and extent of wildfires	Wildfire can result in damage or loss of property and lives.	Wildfires have been noted as a concern in the region. Warmer, drier conditions expected may increase the risk and extent of wildfires that may affect the site.	No fires should be permitted on site during the construction or operational phase of the project. Emergency Procedures should be developed and implemented on site during construction and operation. Fire breaks to be created annually prior to fire season.
Human vulnerability			
Energy security will be affected by increased uncertainty in the current energy sector	National energy security will be improved by increasing the solar power inputs into the national power grid.	The installation of the envisaged 100MWp PV Plant will reduce Samancor's reliance on government-supplied electricity and hence improve the country's energy security and carbon footprint.	No mitigation required.

7.2 Cumulative Impacts

GHG Emissions are inherently cumulative in nature to the global atmosphere. Whilst the impact of the PV Plant to the surrounding environment might be small or negligible, the combined or cumulative effects of multiple developments may have a greater impact. According to the Renewable Energy EIA Application Database for SA there are no proposed renewable energy projects within 30km of the project site. The closest project situated to the south-east of the study area consists of five hydropower stations to be established on the farms: Doornhoek 535LT, Tambotieboom 686 KS, De Hoop 886 KS, Loskop 81 JS and Blyderivierpoort 595 KS.

The project is expected to have a positive level of change to the total amount of GHG emissions released over the lifespan of the project.

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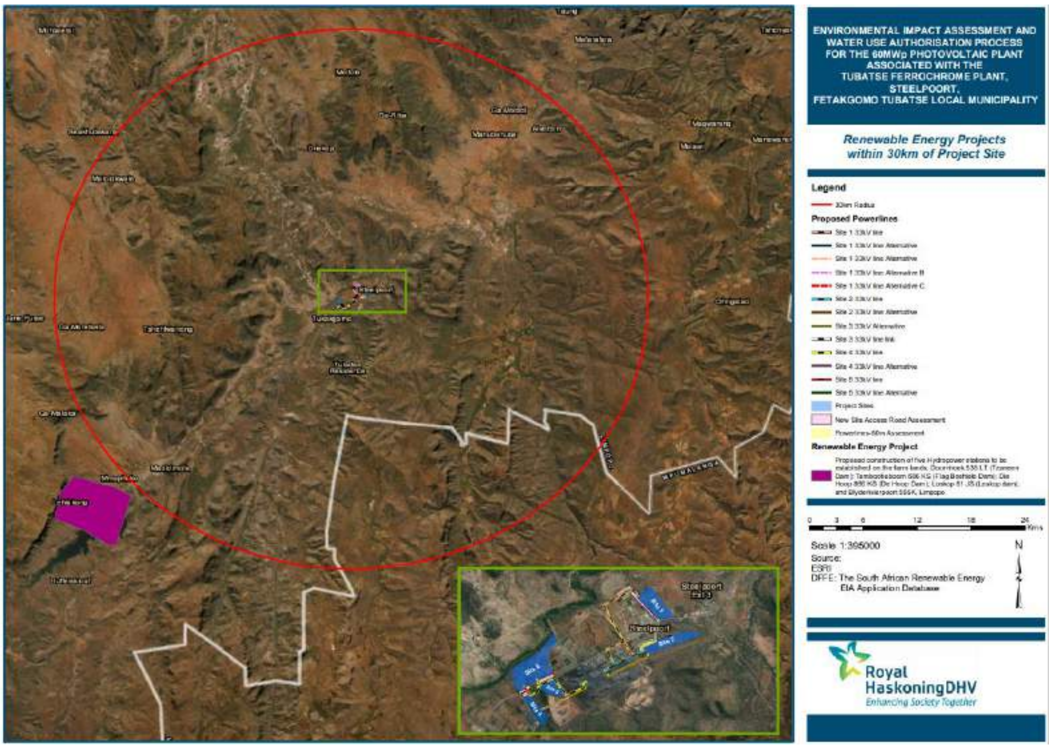

Figure 14: Proposed renewable energy projects within 30km of the project site (Source: Renewable Energy EIA Application Database for SA)

7.3 Impacts of the No-go Alternative

The no-go alternative is the option of not establishing a new photovoltaic plant at the identified sites in the Limpopo Province. South Africa currently relies heavily on fossil fuels as a primary energy source and the energy sector therefore remains the largest contributor (79.1% in 2017) of GHG emissions. Coal combustion in South Africa is the main contributor to carbon dioxide emissions, which is the main greenhouse gas that has been linked to climate change.

It is important to note that the Integrated Resource Plan (IRP) aims to effectively reduce South Africa's dependence on coal-based electricity generation from 90% to 65% by 2030 and transition to alternative generation options with 14% generated from renewable sources including wind and hydropower at 5% each, PV at 3% and CSP at 1%. With growing concerns about the impacts of climate change, the development of large-scale renewable energy supply schemes such as the current proposed PV plant, is strategically important in reducing the country's GHG emissions. Without the implementation of this project, Samancor will stay reliant on coal-based fossil fuels for its operations, therefore continuing contribution to the country's GHG emissions, not supporting the fight against climate change. Therefore, the no-go option is not considered as a feasible option on this proposed project.

8 IMPACT RATING

The impacts identified in the assessment above are consequently rated in terms of Extent, Duration, Intensity and Probability, as per the scheme depicted in Table 1. All impacts are rated from the perspective of the surrounding communities, a construction period of one year and for an assumed project lifespan of 25 years. Eight impacts are rated for significance (Table 5), and residual impact determined in anticipation of mitigation measures (Table 6).

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Table 7: Impact Significance rating (without mitigation)

Impact	Extent	Duration	Magnitude	Probability	Significance	
Water availability	3	4	8	4	60	Moderate environmental significance
Flooding	2	1	6	4	36	Moderate environmental significance
Movement of animals and birds related to water use	2	2	4	2	16	Low environmental significance
Soil erosion and sedimentation of water resources	3	4	6	4	52	Moderate environmental significance
Heritage resources	1	5	6	3	36	Moderate environmental significance
Dust mobilisation	2	2	6	5	50	Moderate environmental significance
Wildfires	2	2	8	3	36	Moderate environmental significance
GHG emissions	2	2	2	5	30	Moderate environmental significance
Energy security	4	4	8	5	80	Positive
Avoided GHG emissions	4	4	6	5	70	Positive

Table 8: Impact Significance rating (with mitigation)

Impact	Extent	Duration	Magnitude	Probability	Significance	
Water availability	1	2	4	2	14	Low environmental significance
Flooding	2	1	4	2	14	Low environmental significance
Movement of animals and birds related to water use	1	2	2	2	10	Low environmental significance
Soil erosion and sedimentation of water resources	1	2	2	2	10	Low environmental significance
Heritage resources	1	5	2	2	16	Low environmental significance
Dust mobilisation	1	1	2	4	16	Low environmental significance
Wildfires	2	2	2	3	18	Low environmental significance
GHG emissions	2	2	2	5	30	Moderate environmental significance
Energy security	4	4	8	5	80	Positive
Avoided GHG emissions	4	4	6	5	70	Positive

The impact significance rating identifies that two impacts may be of ‘low environmental significance’ and three of ‘moderate environmental significance’, preceding mitigation. The remaining impacts, namely the effects on national energy security and avoided GHG emissions, are considered as ‘Positive’.

When reasonable mitigation measures are applied, the one impact with definite probability i.e. GHG emissions, remains as ‘moderate environmental significance’’. GHG emissions can only be reduced to an extent, given the reliance on fossil fuels, but the impact is of limited severity, and hence not a serious concern.

9 CONCLUSION

The impact assessment indicates the following relevant points:

- The climatic trends and projections indicate that water availability and temperature stress are likely to affect the region in future, and these effects must be taken into account.
- The project will contribute to the national GHG emissions mitigation by reducing national emissions – and will compensate for the small amount of emissions associated with the construction phase.

- A Phase 2 CCIA must be completed once the detailed design and construction plan is available and must include a detailed assessment of the potential GHG emissions from the Project, within the context of the national GHG emissions reduction commitments.

9.1 Potential Mitigation Measures

The following recommendations are provided with regards to potential mitigation of the identified impacts:

Measure to mitigate the impact of the project on climate change (Emissions-related mitigation):

- Appropriate road maintenance, activity staging and revegetation activities must be imposed to reduce the extent of bare surfaces or travel speeds on roads. The use of water for dust suppression must also be considered in context of reduced water availability.

Measures to mitigate the impact of climate change on the project (Vulnerability-related mitigation):

- Vegetation along the borders of the site must as far as reasonably possible, not be removed, in order to act as a form of wind buffer for dust mitigation. It is further recommended that ground cover must be (re-) established to prevent erosion and dust. Revegetation must consider drought and heat resistant species.
- Soil erosion risk will increase due to the variability of rainfall combined with higher temperatures. Construction plans and operational runoff management must take this into consideration.
- An Emergency Preparedness Plan must be developed and implemented for the construction and operational phase to deal with any climate related disaster occurrences such as a major floods or water shortage due to prevailing drought conditions. The plan must include emergency contact details, a list of emergency equipment on site and maintenance schedule, emergency operational procedures, evacuation routes and points. Construction and operational staff have regular tool-box-talks regarding emergency procedures.
- Effective stormwater management systems must be implemented on site and should consider extreme climate events that will increase in future. Run-off of pollutants and debris from site must be mitigated through the use of proper demarcated and bunded storage areas for hazardous substances and waste storage.

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Details of the specialist who prepared the report and curriculum vitae

Report Prepared by
Yolandi Meyer

Qualifications
BComm (Environmental Science) (North West University),
BSc Hons (Environmental Science and Development) (North West University),
Green Star SA Accredited Professional
Greenroads™ Sustainable Transportation Professional (expired)

Professional affiliations
None

Years of Experience
13

Yolandi Meyer is currently a Disaster Management Consultant with RHDHV. She completed her Honours in Environmental Science and Development at the North West University in 2007 and is currently completing her MSc in Environmental Science with Disaster Management at the North West University.

She began her employment as an Environmental Consultant in March 2008, where she gained experience in Environmental Impact Assessments, developing EMPrs, Public Participation and ECO monitoring activities. She been involved in various projects related to Disaster Risk Management including Risk Assessments, Preparedness Plans, Evacuation Planning, Climate Response Strategies, Disaster Management Information Systems and Disaster Management Centres.

Curriculum Vitae – Yolandi Meyer

Curriculum Vitae

Yolandi Meyer

Disaster Management Consultant

Digital Services, Southern Africa

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M: 083 579 9820

Yolandi Meyer is currently a Disaster Management Consultant in the Digital Services team. She completed her Honours in Environmental Science and Development at the North West University, Potchefstroom Campus in 2007. She is curently completing her MSc in Environmental Science with Disaster Risk Science at the North West University. Her thesis is focused on the implementaion of technology for post-disaster damage and needs assessments.

She began her employment as an Environmental Consultant in March 2008, where she gained experience in Environmental Impact Assessments, developing EMPrs, Public Participation and ECO monitoring activities as well as onsite environmental issues.

In addition to expanding her Environemtal related experience, she has been involved in various projects related to Disaster Risk Management, including Risk Assessments; Preparedness Plans; Evacuation Planning; Climate Response Strategies and Impact Assessments; Disaster Management Information Systems; and Disaster Management Centres. She has experience in fieldwork related to Post-Disaster Damage Assessements as well as Household surveys as part of the National Upgrade Support programme. She has also been involved as a programme manager on various infrastructure projects.

Degree

In Progress - MSc Environmental Science with Disaster Risk Science

2007 - BSc (Hons) Environmental Science and Development

2006 - BCom Environmental Science

Nationality

South African

Years of experience

13

Years with Royal HaskoningDHV

4

Previous employers

11/2017 – Present	**RHDHV, Project Manager and Disaster Risk Management Consultant**
11/2011 – 10/2017	**Aurecon, Project Manager and Environmental Consultant**
03/2008 – 10/2011	**Kerry Seppings Environmental Management Specialists cc, Environmental Consultant and Project Manager**

Additional Training and Workshops

2021	Nature-based Solutions for Disaster and Climate Resilience, Certificate (SDG Academy, UN Environment Programme)
2017	Amendments to the 2014 EIA regs (Smith • Ndlovu • Summers Attorneys)
2016	DWS Training: Section 21 (c) & (i) General Authorisation (DWS, Dr Roets)
2015	Certificate of Training, Environmental Law (Business Success Solutions)
2014	New 2014 NEMA Regulations (Shepstone and Wylie)
2014	Greenroads Sustainable Transportation Professional exam (Greenroads Foundation)
2013	Green Buildings South Africa Professional Accreditation Course (GBCSA)
2012	CESA Accredited Project Management Course (PMBOK), (Aurecon)
2011	Tools for Wetland Assessments (Rhodes University)
2010	New 2010 NEMA Regulations (DEA)
2010	NEM: Integrated Coastal Management Act 2008 24 of 2008 (Garlicke & Bousfield)
2010	NEM: Waste Act 2008 and Waste Management Licensing (Garlicke & Bousfield)
2009	Distribution Environmental Screening Document (DESD) Training (ESKOM)

Languages:

	Speak	**Read**	**Write**
Afrikaans	Excellent	Excellent	Excellent
English	Excellent	Excellent	Excellent

Royal HaskoningDHV

Professional experience

RHDHV

Hodari Africa. Desktop analysis of natural hazards for new Information and Data Centre in Lagos, Nigeria 06/2021 – 07/2021.
Responsibilities included performing a desktop analysis on all the relevant natural hazards that may affect the proposed project site. As part of the Eko Atlantic Shoreline Protection Reclamation Project in Lagos, Nigeria, one of the sites have been identified for the development a proposed new Information and Data Centre. Royal HaskoningDHV has been requested by Hodari Africa to conduct a site-specific analysis of the natural hazards that may potentially affect the proposed new Information and Data Centre.

Samoa Port Authority / Asian Development Bank. Enhancing the Safety, Security and Sustainability of Apia Port, Samoa. 10/2020 – in progress (3year appointment).
Responsibilities included research and report writing for the development of the multi-hazard preparedness plan. The Client appointed RHDHV to undertake a project to enhance the safety, security and sustainability of Apia Port, Samoa. The Project aims to improve the climate resilience, safety and efficiency of Apia Port through the simplification and streamlining of relevant physical and non-physical components of the Port's operation. This includes the development of a green port policy (GPP), a green port practice manual (GPPM) and a multi-hazard disaster preparedness plan (MHDPP), alongside green port initiatives (GPIs), to promote environmentally sustainable practices for the Samoa Ports Authority (SPA).

King Cetshwayo District Municipality. Development of a Disaster Management Risk Assessment. 09/2020 – 08/2021.
Responsibilities included project management, research and report writing. Appointed to conduct a disaster risk assessment and develop the subsequent Disaster Management Plan (DMP) for the King Cetshwayo District Municipality. Through the development of the Disaster Management Plan, the King Cetshwayo District Municipality highlights its current position and preparedness in response to disaster occurrences. The project also entails the development of risk maps so that the municipality will know the exact areas/communities affected by the different hazards identified.

Stichting Deltares - End client: World Bank. Madagascar: Urban resilience adaptation strategies for greater Antananarivo. 01/2020 – 01/2021.
Responsibilities included research and report writing related to disaster evacuation planning and design. This project entailed the assessment and pre-feasibility study of green infrastructure solutions and disaster evacuation planning and design to mitigate flood risk and strengthen resilience in Antananarivo, Madagascar. The objectives of the project were to enhance urban living conditions and flood resilience in selected low-income neighbourhoods of Greater Antananarivo; Contribute to achieving the first Focus Area (i.e. increasing resilience and reducing fragility) of the Country Partnership Framework between the World Bank and the Government of Madagascar; and develop a pre-feasibility study to support the World Bank's ongoing efforts, together with the Government of Madagascar, in reducing the negative impacts of flooding. The scope included identifying the challenges in Antananarivo (Context); Community and stakeholder engagement; Site identification for disaster evacuation planning; Identification of potential Nature-based Solutions (NbS) for flood mitigation and disaster evacuation; and Prefeasibility and design of scenarios.

Sysman - End client: Ekurhuleni Metropolitan Municipality. Implementation of Disaster Information Management System (ZA-DIMS). 01/2020 – 08/2021, ongoing maintenance and support.
Responsible for system scoping, technical reports and presentations. The project entails the implementation of the RHDHV Disaster Information Management System (ZA-DIMS) for the Ekurhuleni Metropolitan Municipality. ZA-DIMS is an application that advances the integration of the incident management lifecycle. The system supports disaster

management role-players through coordinating activities, processing information, standardisation of information and communicating with stakeholders. ZA-DIMS was developed as a configurable platform that integrates mobile data collection tools with web data management, workflow and web GIS to support disaster management role-players.

Internal RHDHV. Disaster Information Management System (ZA-DIMS) development. 2018 - ongoing
Project Lead. Responsible for system scoping, technical reports and presentations. ZA-DIMS is an application that advances the integration of the incident management lifecycle. The system supports disaster management role-players through coordinating activities, processing information, standardisation of information and communicating with stakeholders. ZA-DIMS was developed as a configurable platform that integrates mobile data collection tools with web data management, workflow and web GIS to support disaster management role-players. This was developed as part of a legislative requirement for municipalities in South Africa to have a system to manage Disaster Management information and communication.

Internal RHDHV. Rural Roads Asset Management System (ZA-RAMS) development. 2018 - ongoing
Project Administrator. Responsible for general project administration, technical report writing and presentations. This system receives data from mobile applications and calculates various metrics and results to define a specific standard view of the road network for a given area. This was developed as part of a legislative requirement for municipalities in South Africa to have a system to manage their maintenance budget.

Internal RHDHV. Smart Information Management System (SIMS) development. 2018 - ongoing
Project Administrator. Responsible for general project administration, technical report writing and presentations**.** This project involves the creation of a generic web-based portal that can be used in conjunction with a mobile data capturing tool to facilitate digital data capturing and management. The tool has been used in several projects. This tool allows assessments to be captured using a mobile application. The data is automatically uploaded to the web portal where automatic reports can be sent out and data manipulated.

Mobi Ventures. Mobi-Claw panic mobile app development. 2017- ongoing
Project Administrator. Responsible for general project administration, technical report writing and presentations**.** MobiClaw co-ordinate a Tactical Rapid Response to any emergency you may have. A simple touch of a button on their user-friendly MOBI-CLAW 911 App triggers an alert that delivers personal protection, fast. When a distress signal is sent, they know who you are, where you are and their professional operators will dispatch the right first responders to you. Our team provides the backend system infrastructure to support their time critical tactical response.

Impilo Yabantu. Schools Assessment Phase 2. 12/2017 – 11/2018
Project Administrator. Responsible for general project administration, technical report writing and presentations**.** This project involves the design of tools and management processes to help improve efficiency and accuracy of assessment data. The tools include a web-based portal to view assessments, manual and automated reporting functionality as well as human resource tracking tools to aid in project management.

Aurecon - End client: Eastern Cape Department of COGTA. New Provincial Disaster Management Centre, Bisho, Sub-Contractor for rollout of Disaster Information Management System. 11/2017 - 06/2018.
Disaster Risk Management Technical Assistant and Project Manager. Aurecon was appointed by the Eastern Cape Department of COGTA and RHDHV had been sub-contracted by Aurecon to assist with the supply, delivery, installation, commissioning and training of a computerised Disaster Management System at the new Eastern Cape Provincial Disaster Management Centre in Bisho. Responsibilities included project administration, research and report writing.

AURECON

Eastern Cape Department of COGTA. New Provincial Disaster Management Centre, Bisho, Sub-Contractor for rollout of Disaster Information Management System – 06/2017 to 10/2017.
Disaster Risk Management Technical Assistant and Project Manager. Aurecon was appointed by the Eastern Cape Department of COGTA for the supply, delivery, installation, commissioning and training of a computerised Disaster Management System at the new Eastern Cape Provincial Disaster Management Centre in Bisho. Responsibilities included tender documentation, project administration, research and report writing.

EThekwini Municipality: Water and Sanitation - Environmental Authorisation proposed Eastbury Drive Trunk Sewer Upgrade, Mount Edgecombe, Ethekwini Municipality, KwaZulu-Natal - **05/2016 to 11/2018.**
Environmental Consultant and Project Manager. The project entailed the undertaking of a Basic Assessment Process and the development of a site specific EMPr for the replacement of a 150m long of the existing ø300mm section of the sewer with a ø450mm pipe.

Huawei/MTN. Environmental Screening exercise for several sites within the KZN province. 2017.
Environmental Consultant responsible for undertaking of several environmental screening exercises to confirm the environmental authorization and other related licensing requirements for the proposed erection of cell phone masts on a number of sites identified within the Province of KZN. This involved the compilation of environmental screening reports for submission to the relevant authorities.

Vodacom – Environmental Screening exercise for several sites within the KZN province - 2017
Environmental Consultant responsible for undertaking of several environmental screening exercises to confirm the environmental authorization and other related licensing requirements for the proposed erection of cell phone masts on a number of sites identified within the Province of KZN. This involved the compilation of environmental screening reports for submission to the relevant authorities

Weatherboard Sawmill - Air Emissions License and New Package Plant, Creighton, KwaZulu-Natal - **03/2016 – ongoing.**
Environmental Consultant responsible for advising client on environmental authorisation processes and license requirements related to their Sawmill and any new developments.

Msunduzi Municipality - Informal Settlement Household Surveys as part of the National Upgrade Support Programme, Phase 2 – 11/2016.
Project Assistant and Fieldwork Supervisor responsible for teams conducting household surveys. This involved planning of fieldwork programmes and ensuring targets are met as well as general administration related to fieldwork. Also responsible for ensuring mobile devices are in working order and assisting field teams with troubleshooting.

Sarah Baartman District Municipality - Informal Settlement Household Surveys as part of the National Upgrade Support Programme, 09/2016.
Fieldworker, responsible for conducting household surveys. Also responsible for ensuring mobile devices are in working order and assisting field teams with troubleshooting.

Dube TradePort Corporation - Pre-feasibility study for the use of water and energy recovery, recycling, and waste to energy systems - 07/2016.
Environmental Consultant responsible to provide a preliminary overview of the environmental authorisation processes and license requirements related to the proposed conceptual interventions developed as part of the investigation of the potential to recover energy, water and recyclables from waste streams within the Dube Trade Port (DTP) and surrounding aerotropolis areas.

National Department of Human Settlements - Technical Assessment of the Government Catalytic Projects, National (RSA) - 01/2016 to 04/2016.
Environmental Consultant part of the KZN team responsible for the review of the Technical Assessment of a number of Catalytic Projects within the KZN Province. More specifically responsible for conducting an environmental screening exercise for each project to identify the status of environmental work completed and in progress, identifying environmental risks and further authorisations required.

Ugu District Municipality. Development of a Climate Change Response Strategy. 2016
Responsibilities include research and local point of contact. Main objective of the study was development a Climate Change Response Strategy and entailed the compilation of a comprehensive survey in order to assess the vulnerability of the district's sectors to climate change. This process further entailed a combination of desktop research, stakeholder engagement and targeted fieldwork to inform the strategy.

Hitachi - Feasibility study for the implementation of Hitachi's Remix Water System Durban, KwaZulu-Natal - 06/2015 to 04/2016.
Environmental consultant (project assistant and local contact) involved in undertaking a feasibility study for the implementation of Hitachi's Remix Water System to supply potable water to the eThekwini Municipality, in KwaZulu-Natal. Part of the feasibility study included an overview of the environmental permitting process and license requirements. Hitachi tasked Aurecon with the first components of the pre-application phase. These components were structured to inform future environmental impact assessments and water use license applications, future project programmes, the identification of future specialist studies, and the preparation of the terms of reference for each study. Aurecon engaged with Authorities and stakeholders regarding other environmental permitting requirements that may be applicable to this proposal, and have documented the outcomes in this report.

Transnet Capital Projects - Environmental Authorisation for the proposed jockey booster pump station and alteration of the substation at Berth 1, Island View, Durban, KwaZulu-Natal - 06/2015 to 05/2016.
Environmental Consultant and Project Manager. This project involved the undertaking of a Basic Assessment process and compilation of a site specific EMPr for the proposed jockey booster pump station and alteration of the substation at Berth 1, Island View, Durban, Kwazulu-Natal. The project also required a Water Use License in the form of a General Authorisation.

KwaZulu-Natal Provincial Treasury - **Mtubatuba Comprehensive Electrification Plan (MCEP) - 05/2015 to 03/2016.**
Environmental Consultant. This project was identified as requiring an Environmental screening to assess if there are any further environmental assessments to be undertaken. The KwaZulu-Natal Provincial Treasury has acquired the services of and is funding the appointment of Aurecon and SMEC to support the Mtubatuba Local municipality in their planning and organizing of the municipal implementation plan targeting strategic deliverables against the Mtubatuba Comprehensive Electrification Plan (MCEP). The municipality has specifically identified Nkunduzi Village as the first priority for this project.

Indaka Local Municipality - **Disaster Management Plan - 05/2015 to 06/2016**.
Disaster Risk Management Technical Lead. Appointed to conduct a disaster risk assessment and develop the subsequent Disaster Management Plan (DMP) for the Indaka Local Municipality. Through the development of the Disaster Management Plan, the Indaka Local Municipality highlights its current position and preparedness in response to emergencies. Project coordination and administration, assisting with disaster management workshops, research and report writing.

Kwadukuza Local Municipality - **Disaster Management Plan - 05/2015 to 06/2016**.

Disaster Risk Management Technical Lead. Appointed to conduct a disaster risk assessment and develop the subsequent Disaster Management Plan (DMP) for the Kwadukuza Local Municipality. Through the development of the Disaster Management Plan, the Kwadukuza Local Municipality highlights its current position and preparedness in response to emergencies. Project coordination and administration, assisting with disaster management workshops, research and report writing.

UMuziwabantu Local Municipality - **Review and update of UMuziwabantu Local Municipality Disaster Management Plan - 05/2015 to 06/2016**.

Disaster Risk Management Technical Lead. Aurecon was appointed to conduct a disaster risk assessment and develop the subsequent Disaster Management Plan (DMP) for the UMuziwabantu Municipality. Through the review and update of the Disaster Management Plan, the UMuziwabantu District Municipality highlights its current position and preparedness in response to emergencies compared to its position in 2012. Project coordination and administration, assisting with disaster management workshops, research and report writing.

Alexander Construction Trust - New Provincial Disaster Management Centre, Bisho, Selected Sub-Contractor for ICT Installation – 04/2015 to 04/2016.

Disaster Risk Management Technical Assistant and Project Manager. Aurecon was appointed by the Alexander Construction Trust for the ICT Installation at the New Eastern Cape Provincial Disaster Management Centre in Bisho. Responsibilities included project administration, research and report writing.

Msunduzi Municipality - Informal Settlement Household Surveys as part of the National Upgrade Support Programme, Phase 1 – 08/2015 to 10/2015.

Project Assistant and Fieldwork Supervisor responsible for teams conducting household surveys. This involved planning of fieldwork programmes and ensuring targets are met as well as general administration related to fieldwork. Also responsible for ensuring mobile devices are in working order and assisting field teams with troubleshooting.

Fezile Dabi District Municipality - Fire master plan for the Fezile Dabi District Municipality - 06/2014 to 06/2015.

Disaster Risk Management Technical Assistant. The project entailed the development of a fire master plan to pursue compliance with relevant standards and legislation. Project coordination and administration, research and report writing.

ILembe District Municipality - Review and update of ILembe District Municipality Disaster Management Plan and Framework. 01/2014 to 12/2015 Ongoing Maintenance and Support.

Disaster Risk Management Technical Assistant and Project Manager. Aurecon was appointed to conduct a disaster risk assessment and develop the subsequent Disaster Management Plan (DMP) for the ILembe Municipality as well as review and update of the disaster risk management policy framework. Through the review and update of the Disaster Management Plan and Framework, the ILembe District Municipality highlights its current position and preparedness in response to emergencies compared to its position in 2008 and 2010. The project also involved and upgrade of their Disaster Management Information System. Project coordination and administration, assisting with disaster management workshops, research and report writing.

South African National Biodiversity Institute - Coordination and Provision of Project Management Services for the Implementation of the SANBI'S three-year Infrastructure Programme. 05/2013 - ongoing, appointment extended for another 3 years.

Programme Manager for KZN Region. The Department of Environmental Affairs has allocated budget towards an infrastructure programme for the South African National Biodiversity Institute (SANBI) that includes infrastructural maintenance, refurbishments, upgrades, replacements and/or new infrastructure. Projects were identified for implementation at each of SANBIs existing campuses and sites across the country. Aurecon was appointed as a professional service provider to coordinate and provide project management services for the implementation of the 3-year infrastructure programme. The range of services require liaison with relevant SANBI officials (e.g. Gardens, Supply

Chain Management, Finance), other SANBI-appointed professionals and developing cost-effective site-specific solutions for the design and implementation of infrastructure projects that will vary across the various campuses (including ten existing and two proposed new sites). Services also include the Project Initiation and Briefing stages through to Project Close-Out, whilst ensuring that projects are implemented in accordance with all relevant current and possible future legislation and regulations. Project services also include providing technical advice and guidance for all current and proposed tourism and infrastructure-related EPWP-funded projects being managed and implemented within the SANBI'S national botanical gardens.

OR Tambo District Municipality - Municipality Information Management and Communication System; Phase 1 and 2 - 05/2013 to 12/2014 Ongoing Maintenance and Support.
Disaster Risk Management Technical Assistant and Project Manager. Aurecon was appointed by the OR Tambo District Municipality for the supply, delivery, installation, commissioning and training of a computerised Disaster Management centre. Project administration, research and report writing.

Emalahleni Local Municipality - Disaster Management Plan - 01/2013 to 06/2015. Technical Assistant.
Disaster Risk Management Technical Assistant and Project Manager. Appointed to conduct a disaster risk assessment and develop the subsequent Disaster Management Plan (DMP) for the Emalahleni Local Municipality. Through the development of the Disaster Management Plan, the Emalahleni Local Municipality highlights its current position and preparedness in response to emergencies. The project also involved writing of Business Plan to secure funding for the Emalahleni Local Municipality Disaster Management Centre. Project coordination and administration, assisting with disaster management workshops, research and report writing.

UMzimkhulu Local Municipality - **Review and update of UMzimkhulu Local Municipality Disaster Management Plan - 01/2013 to 02/2014**.
Disaster Risk Management Technical Lead and Project Manager. Aurecon was appointed to conduct a disaster risk assessment and develop the subsequent Disaster Management Plan (DMP) for the UMzimkhulu Municipality. Through the review and update of the Disaster Management Plan, the UMzimkhulu Local Municipality highlights its current position and preparedness in response to emergencies compared to its position in 2008. The project also involved determining the level of readiness of the Umzimkhulu Municipality Fire Services. A baseline evaluation was done of the Umzimkhulu Local Municipal Fire and Emergency Services and recommendations made for the establishment of Fire and Emergency Services for the Umzimkhulu Municipality's area of jurisdiction. Project coordination and administration, assisting with disaster management workshops, research and report writing.

Harry Gwala District Municipality - **Municipality Information Management and Communication System - 11/2012 to 04/2013 Ongoing Maintenance and Support**.
Disaster Risk Management Technical Assistant and Project Manager. Appointed by the Harry Gwala District Municipality for the supply, delivery, installation, commissioning and training of a computerised Disaster Management centre. Project administration, research and report writing.

Chris Hani District Municipality - **Municipality Information Management and Communication System; Phase 1, 2 and 3** - **11/2012 to 11/2015 Ongoing Maintenance and Support.**
Disaster Risk Management Technical Assistant and Project Manager. Appointed by the Chris Hani District Municipality for the supply, delivery, installation, commissioning and training of a computerised Disaster Management centre. Project administration, research and report writing.

Fezile Dabi District Municipality - **Review and update of Fezile Dabi District Municipality Disaster Management Plan - 09/2012 to 10/2012**.
Disaster Risk Management Technical Assistant. Appointed to conduct a disaster risk assessment and develop the subsequent Disaster Management Plan (DMP) for the Fezile Dabi Municipality. Through the review and update of the

Disaster Management Plan, the Fezile Dabi District Municipality highlights its current position and preparedness in response to emergencies compared to its position in 2008 and 2010. Assisting with research and report writing.

Ugu District Municipality - Business Plan for Ugu District Municipality Disaster Management Centre - 08/2012 to 09/2012. *Disaster Risk Management Technical Assistant*. Appointed to assist with writing of Business Plan to secure funding for the Ugu District Municipality Disaster Management Centre. Project administration, research and report writing.

Kwadukuza Local Municipality - Industrial Substation Upgrade - 07/2012.
Environmental Consultant. This project was identified as requiring assistance with an environmental query with regards to Environmental Management Programme and bunding of transformers. Liaison between DAEA and engineers.

Dark Fibre Africa - C-Mgt Duct Install - 06/2012.
Environmental Consultant. The project entailed the undertaking of a feasibility study to confirm all the environmental authorization and other related licensing requirements for the proposed development of the Dark Fibre Africa routes (long haul project from Kloof to Pietermaritzburg).

National Disaster Management Centre - NDMC Flood Damage Verification Process - 05/2012 to 08/2012.
Disaster Risk Management Technical Assistant and Project Administrator. During the month of June 2011 and January 2012 South Africa experienced storms and heavy rains which resulted in infrastructural damage in four provinces. One of which included Kwa-Zulu Natal and to this effect a provincial state of disaster was declared in KZN. Aurecon was appointed to verify damages within the KZN Inland and Northern regions. An assessment verification team consisting of engineers and engineering technicians was established by Aurecon to determine the accurate costs for the damages incurred by provinces and municipalities and also what kind of services are needed to normalise the situation. Project coordination and administrator, research and report writing.

Intelligent Incident Management Portal (IIMP) and MOBENZI. 03/2012 – ongoing.
Disaster Risk Management Technical Assistant and Project Manager. In order to dynamically address the needs of our clients, Aurecon's Intelligent Incident Management Portal (IIMP) provides a Cloud Computing solution individually configured specifically for the client's needs. The IIMP is an integrated solution which supports all government and municipal departments and through this approach also promotes a shared services concept. The core solution includes, a mobile data capture application, auto generated sms notifications and emailed reporting, document management, photo library, disaster management information system, web-based GIS, asset management, call taking and dispatching and business intelligence. This solution has been implemented for a number of clients throughout South Africa. Project administration, research and report writing.

Ugu District Municipality - Councillor Training - 01/2012 to 05/2012.
Disaster Risk Management Technical Assistant and Project Manager. Appointed to conduct Disaster Management training for the Ugu District Municipality and Local Municipalities. Project coordination and administration.

Harry Gwala District Municipality - Review and Update of the Harry Gwala District Municipality Disaster Management Plan and Framework - 12/2011 to 03/2012.
Disaster Risk Management Technical Assistant. Appointed to conduct a disaster risk assessment and develop the subsequent Disaster Management Plan (DMP) for the Harry Gwala Municipality as well as review and update of the disaster risk management policy framework. Through the review and update of the Disaster Management Plan and framework, the Harry Gwala District Municipality highlights its current position and preparedness in response to emergencies compared to its position in 2008. Project coordination and administration, assisting with disaster management workshops, research and report writing.

Umuziwabantu Local Municipality - Umuziwabantu Local Municipality Disaster Management Plan - 11/2011 to 09/2012.
Disaster Risk Management Technical Assistant. Appointed to conduct a disaster risk assessment and develop the subsequent Disaster Management Plan (DMP) for the Umuziwabantu Municipality. Project coordination and administration, research and report writing.

KSEMS

Plascon SA - Waste License Application for the Installation of a new solvent recovery plant at Plascon SA (PTY) Ltd, Mobeni - 11/2010 to 10/2011.
Environmental Consultant and Project Manager. This project involved the submission of a Basic Assessment Report and site specific EMPr to obtain a Waste License for Plascon's new solvent recovery plant.

Revertex Chemicals - Waste License Application for the New Effluent Plant at Revertex Chemicals - 04/2009 to 10/2011.
Environmental Consultant and Project Manager. This project involved the undertaking of a full Scoping and Environmental Impact Assessment as well as the compilation of a site specific EMPr to obtain a Waste License for the construction of a new effluent plant at Revertex, Chemicals.

Nampak Wiegand Glass - Environmental Auhorisation for the Reconstruction of Furnace Two at Nampak Wiegand Glass, Germiston - 05/2010 to 10/2011.
Environmental Consultant and Project Manager. This project involved the undertaking of a Basic Assessment Process and compilation of a site specific EMPr for the reconstruction second furnace at Nampak Wiegand Glass, Germiston.

Salt Rock Beach Estate - Environmental Auhorisation for the Reconstruction of the seawall in front of the Salt Rock Hotel - 04/2009 to 10/2011.
Environmental Consultant and Project Manager. This project involveld the undetaking of a Basic Assessment Process which was then upgraded to a full Scoping and Environmental Impact Assessment in 2010, including the development of a site specific EMPr for the reconstruction of the damaged seawall in front of the Salt Rock Hotel.

DE Consulting Engineers - Environmental Auhorisation for the Construction of a Pedestrian Bridge across the Golokodo River - 06/2010 to 10/2011.
Environmental Consultant and Project Manager. The project entailed the undertaking of a Basic Assessment Process and the development of a site specific EMPr for the construction of a pedestrian bridge over the Golokodo River. It also involved Environmental Construction Officer services for the monitoring of construction activities to ensure compliance with the EMPr.

ESKOM - Environmental Implementation Plan for the Umfolozi-Ncwane 88kv powerline and Ncwane 88/88kV switching station - 11/2010 to 10/2011.
Environmental Consultant and Project Manager. This Project entailed the development of an Environmental Implementation Plan for the construction of the Umfolozi-Ncwane 88kv powerline and Ncwane 88/88kV switching station. It also involved Environmental Construction Officer services for the monitoring of construction activities to ensure compliance with the EMPr and Environmental Implementation Plan.

ESKOM - Environmental Implementation Plan for the Okuku-Hlabisa 88kV Sub-Transmission Line & Hlabisa 88/22kV 20MVA Substation - 08/2010 to 10/2011.
Environmental Consultant and Project Manager. This project entailed the development of an Environmental Implementation Plan for the construction of the Okuku-Hlabisa 88kV Sub-Transmission Line & Hlabisa 88/22kV 20MVA Substation. Manage ECO monitoring during construction of the Okuku-Hlabisa 88kV Sub-Transmission Line & Hlabisa

88/22kV 20MVA Substation. It also involved Environmental Construction Officer services for the monitoring of construction activities to ensure compliance with the EMPr and Environmental Implementation Plan.

ESKOM - Environmental Auhorisation for the Construction of the Midlands 132/11kV substation and associated 132kV feeder lines - 10/2009 to 10/2011.
Environmental Consultant. The project entailed the undertaking of Full Scoping and Environmental Impact Assessment as well as the development of a site specific EMP for the construction of the Midlands 132/11kV substation and associated 132kV feeder lines.

ESKOM - Environmental Auhorisation for the Construction of the new 20MVA 132/22 kV Gunjaneni Substation and the associated 25km (Total) 132kV loop-in loop-out powerline - 03/2011 to 10/2011.
Environmental Consultant and Project Manager. The project entailed the undertaking of a Basic Assessment Process and the development of a site specific EMPr for the construction of the new 20MVA 132/22 kV Gunjaneni Substation and the associated 25km (Total) 132kV loop-in loop-out powerline.

ESKOM - Environmental Auhorisation for the Construction of the new 20MVA132/22 kV Mt Elias Substation and the associated approximately 16km 132kV power line supply said substation - 03/2011 to 10/2011.
Environmental Consultant and Project Manager. The project entailed the undertaking of a Basic Assessment Process and the development of a site specific EMPr for the construction of the new 20MVA132/22 kV Mt Elias Substation and the associated 16km 132kV power line supply said substation.

SBA Engineers - Environmental Auhorisation for the Reconstruction of a Culvert on Road 3, Redcliffe, Verulam - 02/2011 to 10/2011.
Environmental Consultant and Project Manager. The project entailed the undertaking of a Basic Assessment Process and the development of a site specific EMPr for the reconstruction of a Culvert on Road 3, Redcliffe, Verulam.

BJFC Consulting Engineers - Environmental Auhorisation for the Construction of a Pedestrian Bridge across the Mposa River - 09/2010 to 09/2011.
Environmental Consultant and Project Manager. The project entailed the undertaking of a Basic Assessment Process and the development of a site specific EMPr for the construction of a pedestrian bridge over the Mposa River. It also involved Environmental Construction Officer services for the monitoring of construction activities on a monthly basis to ensure compliance with the EMPr.

CBI Engineers - Environmental Auhorisation for the Lower Malukazi Sewerage Reticulation, Isipingo, Durban - 10/2010 to 10/2011.
Environmental Consultant and Project Manager. The project entailed the undertaking of a Basic Assessment Process and the development of a site specific EMPr for the construction of the Lower Malukazi Sewerage Reticulation, Isipingo, Durban. This application assessed the construction of nine pipelines with diameters ranging from 160mm to 315mm that measured a total of 6425 metres.

eThekwini Municipality Rural Area Based Management - Environmental Auhorisation and ECO Monitoring for the Development of a Multi-Purpose Centre in Mnini, South of Durban - 01/2009- 10/2011.
Environmental Consultant and Project Manager. This projects entailed the undertaking of a Basic Assessment Process and development of a site specific Environmental Management Programme for the for the development of a Multi-Purpose Centre in Mnini, South of Durban. It also involved Environmental Construction Officer services for the monitoring of construction activities on a fortnightly basis to ensure compliance with the EMPr.

BJFC Consulting Engineers - Environmental Auhorisation for the Construction of a Pedestrian Bridge across the Nsuze River - 09/2010 to 09/2011.
Environmental Consultant and Project Manager. The project entailed the undertaking of a Basic Assessment Process

and development of a site specific Environmental Management Programme for the construction of a pedestrian bridge over the Nsuze River. It also involved Environmental Construction Officer services for the monitoring of construction activities on a monthly basis to ensure compliance with the EMPr.

CBI Engineers - Environmental Management Programme for the proposed upgrade of the Secondary and Tertiary Roads within the Lower Malukazi Informal Settlement - 03/2011 to 04/2011.
Environmental Consultant and Project Manager. The project involved the development of a site specific EMPr for the upgrade of the Secondary and Tertiary Roads within the Lower Malukazi Informal Settlement.

SBA Engineers - Environmental Auhorisation for the Namibia Sewage and Water Reticulation - 02/2010 to 04/2011.
Environmental Consultant and Project Manager. The project entailed the undertaking of a Basic Assessment Process and development of a site specific Environmental Management Programme for the construction of the Sewage and Water Reticulation for the Namibia area in KwaNdengezi, Durban.

Megapak - Environmental Management Programme for the proposed new paved storage area & parking area at Megapak, Pinetown - 06/2011.
Environmental Consultant and Project Manager. The project involved the development of a site specific EMPr for the construction of a new paved storage area & parking area at Megapak, Pinetown.

Sasol Gas - Environmental Management Programme for the SWN Piggability Project - 04/2011 to 05/2011.
Environmental Consultant and Project Manager. The project involved the development of a site specifiic EMPr for the Sasol Gas SWN Piggability Project, Witbank.

Hillcrest Retirement Country Estate - Construction Monitoring for the Construction of the Hillcrest Retirement Country Estate - 07/2011 to 10/2011.
Senior Environmental Consultant and Project Manager: Appointed to manage ECO monitoring on a monthly basis for the construction of the Hillcrest Retirement Country Estate.

Samani - Environmental Authorisation for the Construction of the Mkomazi River Pedestrian Bridge - 11/2010 – 06/2011.
Environmental Consultant and Project Manager. The project required an Environmental Construction Officer for the monitoring of construction activities on a monthly basis for the construction of the Mkomazi River Pedestrian Bridge.

Prop 2000 - Amendment of Environmental Authorisation for the Uvongo Office Park - 04/2010 to 04/2011.
Environmental Consultant. The project involved applying for the Amendment of an Environmental Authorisation for the construction of the Uvongo Office Park to include the construction of a basement level. This included additional public participation and compilation of an Environmental Report.

Heartland Leasing - SHE Verification Audit for the Umbogintwini Industrial Complex - 04/2010 and 04/2011.
Environmental Consultant. The project involved the undertaking of an audit to verify data collected by SHE officers for companies located within the industrial complex.

Sasol Gas - Environmental Auhorisation for the Proposed Sasol Gas Pipeline at Pulp United, Alton Industrial Area, Richards Bay - 01/2010 to 10/2010.
Environmental Consultant. The project entailed the undertaking of Full Scoping and Environmental Impact Assessment as well as the development of a site specific EMP for the construction the proposed Sasol Gas pipeline at Pulp United, Alton Industrial Area, Richards Bay.

Eyethu Engineers - Environmental Auhorisation for the New Mountain Road Accesses, Umzimkhulu Local Municipality - 06/2009 to 06/2010.
Environmental Consultant. The project entailed the undertaking of a Basic Assessment Process and development of a site specific Environmental Management Plan for the upgrade of 4 roads within the New Mountain Road area within the Umzimkhulu Local Municipality.

Umdoni Municipality - Environmental Auhorisation for the upgrade and repair of approximately 30 roads within the Umdoni Municipal Area - 06/2009 to 05/2010.
Environmental Consultant. The project entailed the undertaking of several Basic Assessment Processes and the development of a number of site specific Environmental Management Plan for the upgrade and repair of roads and causeways damaged by a severe storm within the Umdoni Municipal Area.

Bridgewater Architects - Environmental Management Plan for Lot 578, Simbithi Eco-Estate - 05/2010.
Environmental Consultant. The project involved the development of a site specific EMP for Lot 578 within Simbithi Eco-Estate.

Customizing Centre - Update of Legal Register - 04/2010 to 05/2010.
Environmental Consultant. The project entailed the update of a legal register for Customizing Centre to ensure compliance with the environmental requirements.

NCP Alcohols - Close Out Audit Report for construction of an internal gas pipeline, NCP Alcohols, Sea Cow Lake - 06/2010 to 07/2010.
Environmental Consultant. The project involved the undertaking of a close out audit for the construction of an internal gas pipeline at NCP Alcohols, Sea Cow Lake, to ensure compliance with the Environmental Authorisation and Environmental Management Plan.

SFCE Engineers - Post Construction Audit for the upgrade of Lupin Lane from Gravel to Hard Surface (tar) - 06/2010 to 08/2010.
Environmental Consultant. The project involved the undertaking of a post construction audit for the upgrade of Lupin Lane from Gravel to Hard Surface, to ensure compliance with the EMP and Environmental Authorisation.
Sasol Gas - Environmental Authorisation Compliance Audit - Sasol Gas RODs review - 08/2008 to 02/2009.
Environmental Consultant. The project involved the review all the Environmental Authorisations issued to Sasol Gas in Germiston, to assess Sasol's compliance with the Authorisations.

ZAI Engineers - Environmental Authorisation for the Proposed New Richards Bay Fire Station - 03/2009 to 10/2009.
Environmental Consultant. The project entailed the undertaking of a Basic Assessment Process and development of a site specific Environmental Management Plan for the proposed new Richards Bay Fire Station.

Hibiscus Coast Municipality - Environmental Authorisation for the Hibberdene Garden Refuse Transfer Station - 11/2008 to 06/2009.
Environmental Consultant. The project entailed the undertaking of a Basic Assessment Process and development of a site specific Environmental Management Plan for the construction of the Hibberdene Garden Refuse Transfer Station.

Bridgewater Architects - Environmental Management Plan for Lot 197, Simbithi Eco-Estate - 06/2009.
Environmental Consultant. The project involved the development of a site specific EMP for Lot 197 within the Simbithi Eco-Estate.

ESKOM - Environmental Management Plan for the Eshowe/ Gingindlovu 88kV Line - 05/2009 to 07/2009. Environmental Consultant. The project involved the development of a site specific EMP for the refurbishment of the Eshowe/ Gingindlovu 88kV Line.

Imbazo Trading – Feasibility Study for the Expansion of a Warehouse - 08/2009 to 10/2009. Environmental Consultant. The project entailed the undertaking of a feasibility study to confirm all the environmental authorization and other related licensing requirements for the proposed Expansion of a warehouse at Portion 577 & 578 (of 27) of the Farm Upper end of Langefontein No. 9.

Mr Ramnarain - Feasibility Study for Construction of Warehouse - 05/2009 to 06/2009.
Environmental Consultant. The project entailed the undertaking of a feasibility study to confirm all the environmental authorization and other related licensing requirements for the proposed development of a Warehouse at 90 Prince Mhlangane Road.

JB Contractors - Feasibility Study for the Upgrade of Low Cost Housing Units in Umlazi BB - 03/2009 to 04/2009.
Environmental Consultant. The project entailed the undertaking of a feasibility study to confirm all the environmental authorization and other related licensing requirements for the proposed upgrade of low cost housing units in Umlazi BB.

Abour Town – Environmental Construction Monitoring for the Construction of Abour Town in Amanzintoti - 11/2008 to 12/2009.
Environmental Consultant. The project required an Environmental Construction Officer for the monitoring of construction activities on a fortnightly basis for the construction of the Abour Town in Amamzintoti.

Sentinel Logistics - Feasibility Study for LOT 4583 of Reservoir Hills - 06/2008 to 07/2008.
Environmental Consultant. The project entailed the undertaking of a feasibility study to confirm all the environmental authorization and other related licensing requirements for the proposed development of LOT 4583 Of Reservoir Hills for the construction of a warehouse.

Peer Review

INDEPENDENT PEER REVIEW

Establishment of a 100MWp Photovoltaic Plant associated with the Tubatse Ferrochrome Smelter, Steelpoort, Fetakgomo Tubatse Local Municipality, Limpopo.

Prepared for:
Royal HaskoningDHV

THEMIS ENVIRONMENTAL

19 October 2021

Themis Environmental (Pty) Ltd | 59 Exmouth Road, Plumstead, Cape Town, 7800 | luke@themisenv.com | +27 71 879 0732

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LIST OF TABLES

1. INTRODUCTION

Themis Environmental (Pty) Ltd ('Themis') was appointed by Royal HaskoningDHV ('RHDHV') to undertake an independent peer review of the Climate Change Impact Assessment (CCIA) for the proposed 100 megawatt-peak (MWp) Photovoltaic (PV) plant linked to the Tubatse Ferrochrome Smelter ('the project'). The proposed project site is in Steelpoort, Fetakgomo Tubatse Local Municipality, Limpopo. Concerning the proposed project's scope, our understanding is that it will entail the construction and operation of a 100 MWp PV plant — distributed between five sites — and the generation of solar-powered electricity.

1.1. Review process & disclaimer

The findings of this review and the opinions provided therein are based on documentation and information provided to Themis by RHDHV. To-date, this includes the draft CCIA report that forms part of the project's environmental impact assessment (EIA). We note that no primary research was undertaken for this review, which was framed and evaluated within the following policy, legal, and good international industry practice (GIIP):

- The peer review guidelines[1] and criteria as defined by the Department of Forestry, Fisheries, and the Environment (DFFE);
- Requirements for specialist reports in terms of Appendix 6 of the EIA Regulations 2014 (as amended).
- Alignment of the CCIA report with the outcomes and legal precedent set by the Thabametsi Case judgement;
- The application of GIIP in terms of the methodology related to both the project impact on climate change as well as the project vulnerability assessment; and
- The context of climate change regarding the NEMA EIA impact criteria.

The following sections provide detail on: i) the review's objective and approach; ii) legal and policy precedents; iii) findings; and iv) concluding remarks.

1.2. Objective and approach

The overarching objective of this review is to determine whether data and information has been communicated in a comprehensible, accessible, and readable manner. To this end, the review aims to determine a consolidated rating (refer to Table 2) based on: i) sufficiency of information; ii) reliability of the analysis; iii) relevance for decision-making; and iv) identification of information gaps or deficiencies. These criteria were applied to the following aspects of the CCIA:

- The methodology of and approach to the assessment;
- Description of the receiving environment
- Identification and evaluation of climate change impacts; and
- Mitigation measures proposed to minimise or offset identified impacts.

[1] DEAT (2004) Review in Environmental Impact Assessment, Integrated Environmental Management, Information Series 13, Department of Environmental Affairs and Tourism (DEAT), Pretoria.

2. LEGAL AND POLICY PRECEDENTS

2.1. The Thabametsi Case

The case of Earthlife Africa Johannesburg vs. Minister of Environmental Affairs and others ("the Thabametsi case") created legal precedent which confirmed that climate change is an issue that must be considered during the EIA phase and has compelled certain projects to include an analysis of climate change issues in the EIA. Before this case, there was no specific legal obligation to do so, but the Thabametsi case clarified that climate change must be considered. Three primary elements inform the judgment's recommendations: i) the extent to which a project will contribute to climate change over the life of the project by quantifying its GHG emissions (cumulative and life cycle); ii) the impact of climate change on the project; and iii) how these impacts may be avoided, mitigated, or remedied.

The project will contribute to climate change and is inherently exposed to climate change impacts. Therefore, the provisions of the Thabametsi case must be considered and adhered to.

3. PEER REVIEW FINDINGS

The findings of this peer review are contained in the following sections, beginning with the NEMA EIA Regulations and the Thabametsi judgement. Thereafter, Section 4 provides ratings of specific report aspects.

3.1. NEMA EIA Regulations 2014

Appendix 6 of the EIA Regulations 2014 (as amended) defines the minimum contents and requirements for specialist reports. Table 1 summarises these requirements and highlights the CCIA's compliance in this regard.

Table 1. Overview of the requirements for specialist reports in terms of the NEMA EIA Regulations 2014

Component of regulations	Compliance
1. A specialist report prepared in terms of these Regulations must contain- a) details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	✓
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	✓
c) A. an indication of the quality and age of the base data used for the specialist report; B. a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment e) an indication of the scope of, and the purpose for which, the report was prepared;	✓
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	✓
g) an identification of any areas to be avoided, including buffers;	Not relevant
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Not relevant
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	✓
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities	✓

Component of regulations	Compliance
k) any mitigation measures for inclusion in the Environmental Management Programme (EMPr);	✓
l) any conditions for inclusion in the environmental authorisation;	None identified
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	✓
n) a reasoned opinion- (i) whether the proposed activity, activities or portions thereof should be authorised; and (ii) regarding the acceptability of the proposed activity or activities; and (iii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	✓
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not relevant
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not relevant
q) any other information requested by the competent authority.	Not relevant
2. Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Not relevant

4. RATING OF REPORT ASPECTS

Table 2 below shows the rating continuum for individual aspects of the CCIA report under consideration.

Rating	Legend	Description
Good		This/these aspect(s) of the report is sufficient, reliable, and relevant for decision-making.
Fair		There is room for improvement concerning this/these aspects of the report, but the materiality of these issues is negligible in terms of sufficiency, reliability, and relevance.
Revision needed		Revision of this/these report aspects is required to reach a reasonable level of sufficiency, reliability, and relevance.
Deficient		Material concerns regarding the sufficiency, reliability, and relevance of the report have been identified that may result in fatal flaws.

Table 2. Rating of individual report aspects

Report aspect		Rating	Comment
Methodology	GHG emissions inventory	Revision needed	We note that since detailed designs of the proposed project infrastructure were not available at the time of reporting, both the methodology and outputs of the GHG inventory (i.e., the impact of the project on climate change) require revision when the abovementioned details are available. While the comparison between the project under consideration and similar studies is informative, full compliance with this aspect of the peer review requires an accurate quantification of anticipated GHG emissions during

Report aspect		Rating	Comment
			construction and operation. Our opinion is that since the operation phase of the project entails the production of electricity from renewable sources, most of the Scope 1 and 2 emissions will likely be emitted during the construction phase. For this review, consideration was given to the nature of the project, especially avoided emissions when compared to electricity generated from fossil fuels, as would be the case if an equivalent amount of energy was drawn from the Eskom grid. In the latter case, the emissions profile and therefore the project's impact on/contribution to climate change would be significantly higher. Our rating of this aspect of the report is therefore 'revision needed'. Our recommendation in this regard is to prioritise the project's detailed design to be able to update the interim GHG inventory as soon as possible for consideration by the Competent Authority. This approach will improve the sufficiency, reliability, and relevance of this aspect of the CCIA.
	Impact assessment	Good	The review finds the impact assessment methodology sufficient, reliable, and relevant for decision-making. We note that alignment between the methodology employed by the authors of the EIR and the CCIA would be ideal for consistency and ease of reference.
Description of receiving environment		Good	The review finds the CCIA's description of the receiving environment robust and detailed. The climate change profile of the project summarises the relevant observed and projected climatic parameters (precipitation, temperature, etc.), climate change hazards, and anticipated impacts of the above on the project. Our rating is therefore that this aspect of the report is sufficient, reliable, and relevant for decision-making.
Impact identification		Good	The impacts of climate change on the proposed project are well defined, particularly when combined with the vulnerability assessment component. In the absence of detailed information to inform the GHG emissions inventory, cumulative impacts of the project on climate change are challenging to assess and review. Like the comments above regarding the GHG methodology, the cumulative impacts section will need to be revisited once the interim GHG inventory has been revised.
Mitigation measures		Good	The review finds the proposed mitigation measures robust and detailed. Our recommendation to achieve full compliance with the parameters of sufficiency,

Report aspect	Rating	Comment
		reliability, and relevance are to consolidate the mitigation measures proposed in the Vulnerability Assessment component with the list of overall mitigation measures under the Conclusion section.

5. CONCLUDING REMARKS

Based on the sections above, we conclude our review of the CCIA for the project as follows:

- The report is well structured and sufficiently detailed for the purposes of decision-making
- Concerning the requirements of the Thabametsi Judgment, we find that the project meets these requirements to a reasonable degree, with the exception of the interim GHG emissions inventory (see the point below)
- The interim nature of the GHG emissions inventory is noted but must be emphasised with the Competent Authority as well as during the stakeholder engagement process (i.e., with I&APs). The updated inventory must be prioritised to supplement the CCIA report and provided to stakeholders as soon as possible, including statements concerning the amount of CO_2e that the project will consume relevant to national targets, and compared against avoided emissions.
- The point above notwithstanding, our recommendations relate to minor additions to certain portions of text to achieve full compliance.

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

ENVIRONMENTAL AUTHORISATION FOR THE PROPOSED 100MWP PHOTOVOLTAIC PLANT ASSOCIATED WITH THE TUBATSE FERROCHROME SMELTER, STEELPOORT, FETAKGOMO TUBATSE LOCAL MUNICIPALITY, LIMPOPO.

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	(EME)
Specialist name:	Luke Moore			
Specialist Qualifications:	MA, BSocSci (Hons), BA			
Professional affiliation/registration:	SACNASP, IAIAsa, SSAG			
Physical address:	59 Exmouth Road, Plumstead, 7800			
Postal address:	As above			
Postal code:	7800	Cell:	071 879 0732	
Telephone:		Fax:		
E-mail:	luke@themisenv.com			

2. DECLARATION BY THE SPECIALIST

I, Luke Moore, declare that –.

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Themis Environmental (Pty) Ltd

Name of Company:

14 October 2021

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Luke Richard Moore, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Themis Environmental (Pty) Ltd

Name of Company

14 October 2021

Date

.... 7163919-5
L. MFENE SGT

Signature of the Commissioner of Oaths

14 October 2021

Date

SUID AFRIKA... STAS... ...ERDER
14 OCT 2021
STATION COMMANDER
PINELANDS
SOUTH AFRICAN POLICE SERVICES

Curriculum Vitae: Luke Richard Moore

59 Exmouth Road, Plumstead, Cape Town, 7800
+27 71 879 0732 | luke@themisenv.com

CAREER SUMMARY

Luke focuses on climate change adaptation in developing countries and is a specialist in integrated coastal management. He has expertise that spans 12 years in solutions that foster resilience in high-risk coastal areas through green and blue infrastructure, as well as ecosystem-based adaption. Geographically, Luke has worked in over 25 developing countries in sub-Saharan Africa, the Pacific, the Caribbean, various small island developing states (SIDS), as well as parts of Asia and Latin America. Luke has undergraduate, Honours and Master's degrees in Geography and Environmental Management from Rhodes University, the University of KwaZulu-Natal, and the University of the Western Cape. Luke is an experienced team lead and project manager, providing advisory services to national and subnational governments, development facilitation institutions, multilateral organisations, and private sector clients. He supports these sectors and clients with the following core technical expertise: i) design and development of Green Climate Fund climate finance projects and programmes for various United Nations and other accredited entities; ii) climate change risk and impact assessment; iii) integrated coastal and estuarine management; iv) strategic environmental planning; and v) environmental, social and governance (ESG) due diligence.

GEOGRAPHIC EXPERIENCE

Botswana, Brazil, Cote d'Ivoire, Djibouti, Dominica, Eritrea, Ethiopia, Kenya, India, Lesotho, Liberia, Malawi, Mauritius, Mozambique, Peru, Samoa, Somalia, South Africa, South Sudan, Sudan, Tanzania, Tonga, Uganda, United Arab Emirates, Vanuatu, Zambia, Zimbabwe

EMPLOYMENT HISTORY

June 2021 – present	**EBS Advisory** *Senior Climate Risk Specialist*
September 2020 – present	**Themis Environmental/Freelance Environmental Consultant** *Director/Climate Change Specialist*
March 2019 – August 2020	**C4 EcoSolutions Pty Ltd** *Team Lead, Senior Climate Change & Environmental Consultant*
June 2016 – June 2018	**ICLEI Local Governments for Sustainability** *Senior Professional Officer*
January 2013 – May 2016	**Royal HaskoningDHV** (formerly SSI Engineers and Environmental Consultants) *Senior Environmental Consultant: Rivers, Deltas & Coasts*
February 2009 – December 2012	**SSI Engineers and Environmental Consultants** *Environmental Consultant: Strategic and Sustainability Services*

TERTIARY EDUCATION

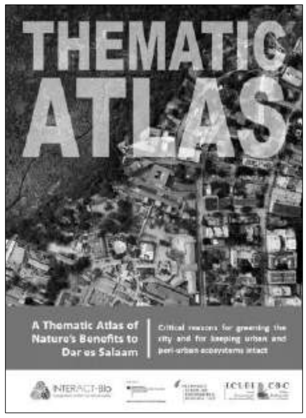
2019	**University of the Western Cape**	Master of Arts: Geography and Environment Science (*cum laude*)	UNIVERSITY *of the* WESTERN CAPE
2008	**University of KwaZulu-Natal**	Bachelor of Social Science Honours: Geography & Environmental Management (*cum laude*)	UNIVERSITY OF KWAZULU-NATAL
2007	**Rhodes University**	Bachelor of Arts: Geography and Environmental Science	RHODES UNIVERSITY *Where leaders learn*

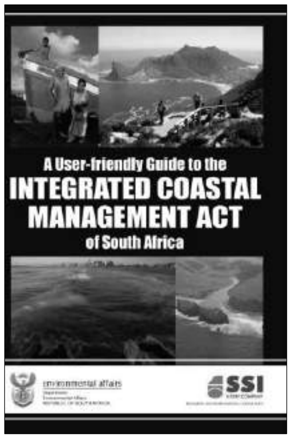
59 Exmouth Road, Plumstead, Cape Town, 7800

+27 71 879 0732 | luke@themisenv.com

PUBLICATIONS, PAPERS AND PRESENTATIONS (ABRIDGED)

1. **Moore, L., Steynor, A., Waagsaether, K., Spires, M., and Marie, A. 2021. Exploring the opportunities and constraints to the development of locally applicable water management technology in three sub-Saharan African cities. *Environmental Science and Policy* 120, pp.108-117. Online.**
2. Van Wyk, E., Moore, L., Berghöfer, A., Karutz, R., Maree, G., and Kyessi, A. 2021. Mainstreaming nature-based solutions in developing cities: a capacity perspective on transformative change. Submitted to the *Journal of Local Environment Special Issue on Urban Sustainable Transformations*.
3. Moore, L. 2019. *Ambitions for greening solid waste management: perspectives from urban(ising) Africa*. South African Institute of International Affairs Policy Insight 69, June 2019. Online.
4. **Karutz, R., Berghöfer, A., Moore, L., and van Wyk, E. 2018. *A thematic atlas of nature's benefits to Dar es Salaam*. Helmholtz Centre for Environmental Research – UFZ, Leipzig, and ICLEI Africa Secretariat, Cape Town. Online.**
5. Moore, L., Schroder, C., Wanda, M., and Robinson, K. 2018. *State of Knowledge on Coastal Cities in the Western Indian Ocean*. Report for the Western Indian Ocean Marine Science Association.
6. Moore, L. 2016. *A Place for Subnational Governments at the International Climate Negotiating Table*. South African Institute of International Affairs Policy Briefing 156, November 2016. Online
7. Moore, L. 2014. *Land Chapter*. Dube Tradeport State of the Environment Report 2013/14. Dube Tradeport. 93-99. Online
8. Moore, L. 2013. *Oceans & Coasts Chapter*. State of Environment Outlook Report for the Western Cape Province 2013. Western Cape Department of Environmental Affairs and Development Planning. Cape Town. 35pp. Online
9. Celliers, L., Breetzke, T., and Moore, L. 2012. *Oceans and Coasts Chapter*. South Africa Environment Outlook 2011/12. Department of Environmental Affairs. Available: Online
10. **Celliers, L., Breetzke, T., Moore, L. and Malan, D. 2009. A User-friendly Guide to South Africa's Integrated Coastal Management Act. The Department of Environmental Affairs and SSI Engineers and Environmental Consultants. Cape Town, South Africa, 100 pp. Online**





LANGUAGE PROFICIENCY

LANGUAGE	LEVEL SPOKEN	LEVEL READ	LEVEL WRITTEN
English	5	5	5
Afrikaans	3	4	3
isiXhosa	3	2	2

MEMBERSHIP OF PROFESSIONAL SOCIETIES

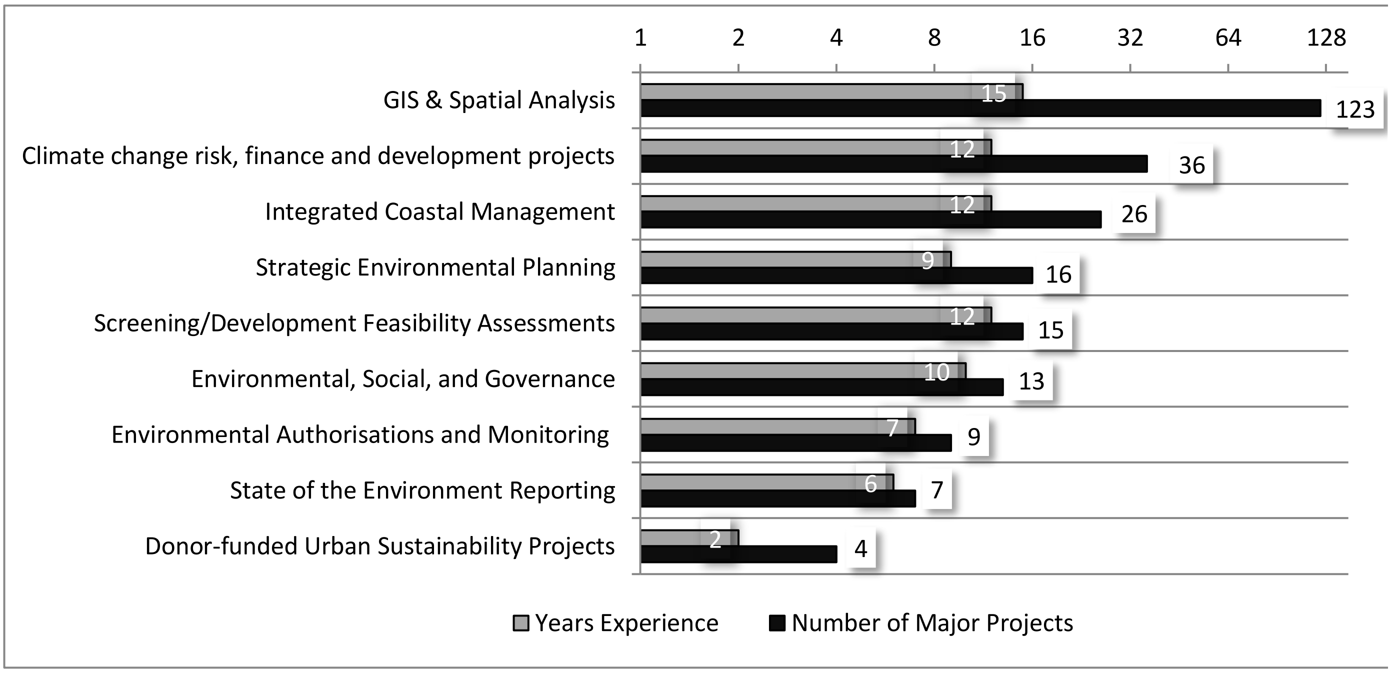
2019 – present:	South African Council of Natural Science Professionals (SACNASP, reg. no. 120250)
2008 – present:	Society of South African Geographers (SSAG)
2009 – present	International Association of Impact Assessment (IAIAsa)

CONTINUING PROFESSIONAL DEVELOPMENT/SHORT COURSES (ABRIDGED)

2021	Climate Change Mitigation in Developing Countries – University of Cape Town (student)
2021	Oxford Climate Emergency Programme – University of Oxford/Saïd Business School (assessor)

PARTNERS, CLIENTS AND DONORS (ABRIDGED)

APPENDIX A: ABRIDGED PROJECT EXPERIENCE



Field	Climate finance/development projects
Projects	▪ A water-energy-food (WEF) nexus approach to climate resilience in Lesotho (GCF Simplified Approval Process Concept Note, Funding Proposal, and Feasibility Study), 2021 ▪ Climate change adaptation strategies for cold-chain storage in East Africa (GCF technical specialist report), 2021 ▪ Global low-carbon society research profile: South Africa, 2021 ▪ Peer review: climate change impact assessment for photovoltaic solar farms in South Africa, 2021 ▪ Climate change risk assessment for Wanza Farm, Mozambique, 2021 ▪ Establishing resilient, low-carbon agricultural systems in Tonga, Vanuatu, and Samoa (GCF Concept Note), 2020 ▪ Monrovia Metropolitan Climate Resilience Project (full GCF submission package), 2019/20 ▪ Strengthening Early-warning and Climate Information Services in Sudan (GCF Simplified Approval Process submission package), 2019/20 ▪ SADC Hydrological Cycle Observation System (SADC-HYCOS) Phase IV (GCF Concept Note) 2018-19 ▪ Climate-proofed Water Supply and Sanitation for Livingstone, Zambia (GCF Funding Proposal) 2019 ▪ Strengthening Climate Information Systems for Climate Change Adaptation in the Greater Horn of Africa through regional cooperation (GCF Concept Note and SAP Funding Proposal) 2019-20 ▪ Developing Climate Resilient Integrated Coastal Zone Management (ICZM) in Dominica (GCF Concept Note) 2019-20
Project Roles	Team lead, project lead, technical lead
Clients	Global Water Partnership, United Nations Environment Programme, United Nations Development Programme, Pacific Community, African Development Bank

Curriculum Vitae: Luke Richard Moore

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Field	Environmental Authorisations and Monitoring in terms of the National Environmental Act (NEMA)
Projects	Environmental Impact Assessment for the Tinley Manor Southbanks Development (2015) Matimba Coal Fly Ash Disposal Expansion EIA (2015) Upgrade of D9 Road at Jozini (2012) Basic Assessment for Phase 2 of the Durban Beachfront Upgrade (2012) Environmental Monitoring: eThekwini Central Beaches Redevelopment (2010)
Project Roles	Environmental control officer/auditor, environmental assessment practitioner
Clients	Parastatals, Provincial Departments, Metropolitan Municipalities, Private Sector

Field	Environmental Screening Investigations/Development Feasibility Assessments
Projects	▪ Feasibility (FEL-2) Studies for the Proposed Coal Rail Infrastructure from Lephalale to Ermelo (2015) ▪ Environmental Screening Investigation for Waste to Energy Sites in Port Elizabeth (2014) ▪ Environmental Screening Investigation for the Durban Northern Rail Corridor (2013) ▪ Environmental Screening Investigation for the Richards Bay Minerals Zulti South Mine (2013) ▪ Coastal Specialist Report for the Proposed Nonoti Beach Development (2012)
Project Roles	Lead author, co-contributor, GIS modelling and spatial analysis, environmental risk assessment
Clients	National Departments, Metropolitan Municipalities, Local Municipalities, Private Sector

Field	Regional, multi-year donor funded sustainability projects
Projects	▪ Integrated Action on Biodiversity (INTERACT-Bio) 2016-2020 ▪ Urban Natural Assets for Africa: Coasts for Life (UNA Coasts) 2018-2020 ▪ African Water Adaptation through Knowledge Empowerment (AWAKE) 2017-2018 ▪ Urban Natural Assets for Africa: Rivers for Life (UNA Rivers) 2016-2019 ▪ Sustainable, Urban Resilient Water for Africa (SUReWater 4 Africa) 2012-2017
Project Roles	Technical lead, project manager, lead researcher, lead GIS analyst
Clients	International Climate Initiative Germany (IKI), European Commission/Europe Aid, African Development Bank, Global Environmental Facility

Field	Integrated Coastal Zone Management
Projects	▪ State of Knowledge of the Coastal Cities of the Western Indian Ocean (2018) ▪ Coastal Access By-law for the Western Cape (2017) ▪ Coastal Overlay Zones for the City of Cape Town (2016) ▪ Western Cape Provincial Coastal Management Programme (2015) ▪ Overberg District Municipality Coastal Management Line (2015) ▪ Alfred Nzo District Municipality Coastal Management Programme (2015) ▪ Northern Cape Provincial Coastal Management Programme (2015) ▪ Overberg District Municipality Coastal Management Programme (2015) ▪ Eastern Cape Provincial Coastal Management Programme (2013)
Project Roles	Lead author, co-author, project manager, stakeholder engagement, client liaison, GIS modelling and spatial analysis
Clients	Provincial Departments, Metropolitan Municipalities, District Municipalities, Local Municipalities

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Field	**Strategic Environmental Planning**
Projects	▪ Two Rivers Urban Park Redevelopment (2016) ▪ Umhlatuze Ulundi Vryheid Corridor Plan (2016) ▪ Hibiscus Coastal Local Municipality SDF (2016) ▪ Cape Functional Region SDF (2015) ▪ Compensation Local Area Plan (2015) ▪ Msunduzi Airport Precinct Plan (2015) ▪ Scottburgh Urban Renewal (2014) ▪ iLembe District Municipality EMF (2011/12)
Project Roles	Lead author, co-contributor, GIS modelling and spatial analysis
Clients	Provincial Departments, Metropolitan Municipalities, District Municipalities

Field	**State of the Environment Reporting**
Projects	▪ Dube Tradeport State of the Environment Report (2016) ▪ City of Johannesburg State of the Environment Report (2014) ▪ Dube Tradeport State of the Environment Report (2014) ▪ North West Province Environmental Outlook (2014) ▪ State of the Environment Report for the Western Cape (2013) ▪ South Africa Environment Outlook (2012) ▪ Gauteng State of the Environment Report (2011)
Project Roles	Lead author, co-author, implementation of DPSIR framework, GIS modelling and spatial analysis
Clients	National Departments, Parastatals, Provincial Departments, Metropolitan Municipalities

Field	**Environmental, Social, and Governance (ESG) Assignments**
Projects	Sanddraai Social Impact Assessment (2015) Environmental and Social Impact Study for Envalor Biofuel, Mozambique (2014) Baseline Social Impact Assessment for the Proposed Pretoria Bus Rapid Transit System (2013) Renosterberg Social Impact Assessment, De Aar (2013) Social Economic Impact Assessment for 765kV Power line from Gamma to Kappa Stations (2012) Social Economic Impact Assessment for 765kV Power line from Kappa to Omega Stations (2012)
Project Roles	Lead author of socioeconomic baselines, fieldwork, stakeholder engagement, GIS modelling and spatial analysis
Clients	Metropolitan Municipalities, Private Sector

CONTACTABLE CLIENT REFERENCES ARE AVAILABLE ON REQUEST

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