APPENDIX B4:

AVIFAUNA BRIDGING STUDY

UMKHOMAZI WATER PROJECT PHASE 1
ENVIRONMENTAL IMPACT ASSESSMENT

AVIFAUNA BRIDGING STUDY

Blue Swallow adult male at Nesting Locality 1 on Greenridge Farm directly adjacent to Baynesfield Estate (photo: D. Allan)

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UMKHOMAZI WATER PROJECT PHASE 1: ENVIRONMENTAL IMPACT ASSESSMENT
AVIFAUNA BRIDGING STUDY

EXECUTIVE SUMMARY

The proposed uMkhomazi Water Project Phase-1 (uMWP-1) is a mega-water project to be constructed in the KwaZulu-Natal (KZN) Province to augment the water resources of the Mgeni System, which are insufficient to meet the long-term water demands from the Mgeni System. The Mgeni System supplies water to the third-largest economic hub in South Africa (Durban and Pietermaritzburg Areas), which is also the second-most populated area in South Africa. The recent Technical Feasibility Investigations for the uMWP-1 found that the project is technically feasible. After the Environmental Impact Assessment (EIA) Report was submitted some Interested and Affected Parties (I&APs) raised concerns, which resulted in the Department of Environmental Affairs (DEA) rejecting the EIA Report. To conclude the EIA Process additional EIA work and technical analysis will be required including this Avifauna Bridging Study, amongst others. Furthermore, the uMWP-1 is situated in an area of generally high avifaunal sensitivity.

This Assessment comprises an Avifauna Bridging Study building on an initial Avifauna Specialist Study for the uMWP-1 – Raw Water that was undertaken as part of the EIA for the uMWP-1. It primarily addresses several areas of concern and uncertainty identified during the initial study, especially as relates to the 'Critically Endangered' Blue Swallow *Hirundo atrocaerulea*. These areas of concern mainly relate to: 1 - the location of the balancing dam on Baynesfield Estate and its impact on Blue Swallow mist-belt grassland habitat in the eastern part of the project area, 2 – potential negative impacts caused by vibration from tunnel drilling on Blue Swallow nests, and 3 – the impact of re-routing Provincial Road R617 at Smithfield Dam in the western part of the project area on the nearby Impendle Nature Reserve and its breeding Blue Swallow population.

The following three options for the balancing dam have been proposed: Langa, Mbangweni and Baynesfield Balancing Dam options. This Assessment shows that the first two of these options are situated as such that they are not complaint with buffer zones stipulated by conservation authorities on Blue Swallows as necessary for the protection of this species as well as its breeding and foraging habitat. The primary concern in this regard stems from habitat issues but also potential noise and vibration matters, and general disturbance from such balancing dams during and post construction. The location of the Baynesfield Balancing Dam option by contrast is compliant with these buffer requirements.

Four realignment options were developed for the deviation of the R617 at the proposed Smithfield Dam subsequent to the original (EIA) and the proposed road corridor assessed at that time. Some of these realignment options, and apparently the now preferred option, are situated south of the originally proposed realigned route and are of less concern relevant to any impact on Impendle Nature Reserve and its associated breeding Blue Swallows.

This Report also reviews the Vibration Impact Assessment from an avifaunal perspective. The Vibration Impact Assessment confirms the reality of vibration of two types from three sources (impulse, from blasting, and steady-state, from construction and tunnelling) as a potential threat to breeding Blue Swallows in the project area. Essentially only the extreme eastern section of the project area is impacted, especially the Zinty breeding Blue Swallow grassland block on the Baynesfield Estate. Blasting comprises the greatest vibration threat, followed by tunnelling vibrations, with vibration from construction being a relatively minor, but still unacceptable given the critically endangered status of this bird, source of vibration threat. Relevant to blasting, the key mitigation measures recommended relevant to the proposed Langa Balancing Dam borrow pit are: to restrict blasting to the period when the birds are not present (April – September), limit the amount of explosive used per blast, or to use non-explosive methods of rock breaking. Relevant to both blasting and drilling at the tunnel outlet areas, it is recommended that both be restricted to the period when the swallows are absent.

This Report also reviews the Environmental Noise Impact Assessment (ENIA) from an avifaunal perspective. The ENIA confirms the reality of noise as a potential threat to breeding Blue Swallows in the project area.

During daytime construction activities up to 7% of the area of Blue Swallow habitat at Zinty would be potentially at risk from disturbance by noise from construction activities, although this disturbance is apparently not considered significant. Such disturbance, however, should be considered unacceptable from an avifaunal perspective given the critically endangered status of this bird. The ENIA offers no mitigation measures relevant to daytime noise, presumably because none are considered necessary. The ENIA predicts that a far larger proportion of habitat would be potentially impacted by night-time construction activities. The ENIA recommends as mitigation that no night-time construction activities should be permitted within 1500 m of any active nesting sites. It would have been preferred had this buffer been applied to Blue Swallow breeding habitat rather than actual nesting sites.

A key point, however, relevant to both vibration and noise is that essentially no development at all, even if vibration-free and silent, should be considered within the buffer zones stipulated by conservation authorities as necessary for the protection of this species. Vibration and noise also serve as examples of elements contributing to potential cumulative effects of such proposed developments, rendering the strict implementation of these conservation buffers as imperative.

All of the uMWP-1 – Raw Water components would appear acceptable for Environmental Authorisation from an avifaunal perspective, subject to the recommended mitigation measures being implemented, except for the Langa and Mbangweni Balancing Dam options, which should be considered as fatally flawed ('no-go') for the reasons, primarily based on habitat destruction, outlined in detail in this Assessment. In regard to the latter, the Baynesfield Balancing Dam Option is an acceptable alternative from an avifaunal perspective. The outlet for Tunnel option A could likely be considered acceptable from an avifaunal perspective if carefully mitigated.

The fatal flaws inherent to both the Langa and Mbangweni Balancing Dams from an avifaunal perspective cannot be mitigated for as they involve permanent destruction of irreplaceable critical Blue Swallow habitat. Nor would any offset approach seem appropriate for the same reason. In addition, any offset would require the rehabilitation of an unrealistically large extent of previous Blue Swallow habitat – a highly specialized habitat type that is essentially not known to be amenable to rehabilitation once destroyed. Consideration of any 'biodiversity compensation mechanism' in the face of this challenge is beyond the scope of this Avifauna Bridging Study. The rigid preservation of the entire limited amount of remaining habitat of this species would appear the only hope of avoiding the imminent extinction of this critically endangered species in South Africa.

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LIST OF ACRONYMS AND ABBREVIATIONS

DEA	Department of Environmental Affairs
DWS	Department of Water Affairs and Sanitation
EAP	Environmental Assessment Practitioner
EDTEA	Economic Development, Tourism and Environmental Affairs (Provincial Department)
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ENIA	Environmental Noise Impact Assessment
IBA	Important Bird Area
I&APs	Interested and Affected Parties
KZN	KwaZulu-Natal
NEMA	National Environmental Management Act (Act No. 107 of 1998)
PPV	Peak Particle Velocity
R617	Provincial Road R617
Report	Avifauna Bridging Study Report (this Report)
SACNASP	South African Council of Natural Scientific Professions
TBM	Tunnel Boring Machine
uMWP-1	uMkhomazi Water Project Phase 1
WTW	Water Treatment Works

LIST OF UNITS AND SYMBOLS

D	Duration
dBA	Decibel (expression of the relative loudness of the A-weighted sound level in air)
kg	Kilogram
km	Kilometre
M	Magnitude
m	Metre
mm/s	Millimetre per second
m/week	Metre per week
P	Probability
S	Scale
SP	Environmental Significance

1. INTRODUCTION

The proposed uMkhomazi Water Project Phase-1 (uMWP-1) is a mega-water project to be constructed in the KwaZulu-Natal (KZN) Province to augment the water resources of the Mgeni System, which are insufficient to meet the long-term water demands from the Mgeni System. The eThekwini Metropolitan Municipality, and the uMgungundlovu, ILembe and Ugu District Municipalities rely completely, or partially, on the Mgeni System for their water supplies. The Mgeni System supplies water to the third-largest economic hub in South Africa, which is also the second-most populated area in South Africa (about 6 million people).

The Technical Feasibility Investigations for the uMWP-1 were completed at the end of 2015, and found that the project is technically feasible. After the Environmental Impact Assessment (EIA) Report was submitted some Interested and Affected Parties (I&APs) raised concerns, which resulted in the Department of Environmental Affairs (DEA) rejecting the EIA Report. To conclude the EIA Process additional EIA work and technical analysis, will be required, and therefore the following additional EIA Specialist Studies need to be undertaken during the planning phase in order for the EIA Report to be approved:

- Noise and Vibration Impact Assessment;
- Avifauna Bridging Study (this Study);
- Biodiversity Offset Study;
- Invertebrate Study, and
- Re-alignment of Provincial Road R617.

The uMWP-1 is situated in an area of generally high avifaunal sensitivity, with specific reference to the area's importance as a habitat for the endangered Blue Swallows *Hirundo atrocaerulea*. The Blue Swallow is the primary bird species of concern in the project area, since there are so few breeding pairs left in South Africa, and the species is known to be susceptible to disturbance.

An initial Avifauna Specialist Study (WildSkies Ecological Services 2015) was conducted as part of the broader EIA for the uMWP-1, which is discussed in **Sub-section 6.2** below. The aim of this Avifauna Bridging Study (this Study) is, however, to provide additional crucial information related to the status of avifauna of conservation significance, most particularly the critically endangered Blue Swallow, in the uMWP-1 Area. Furthermore, other bird species of conservation concern in the Project Area, including crane species, were also recorded as part of this Study, since this information is essential to allow properly informed decision-making and the potential implementation of the appropriate mitigation hierarchy pertaining to the uMWP-1.

2. SPECIALIST REPORT REQUIREMENTS IN TERMS OF APPENDIX 6 OF THE EIA REGULATIONS (2014)

Table 2-1: Relevant Sections in a Specialist Report

A Specialist Report prepared in terms of the Environmental Impact Assessment Regulations of 2014 must contain:	Relevant section in the Report:
Details of the specialist who prepared the report.	Section 3
The expertise of that person to compile a specialist report including curriculum vitae.	Section 3, Addendum 1
A declaration that the person is independent in a form as may be specified by the competent authority.	Section 4
An indication of the scope of, and the purpose for which, the report was prepared.	Section 7
The date and season of the site investigation and the relevance of the season to the outcome of the assessment.	Section 8
A description of the methodology adopted in preparing the report or carrying out the specialised process.	Section 8
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure.	Section 9.1.2
An identification of any areas to be avoided, including buffers.	Sections 9.1.2, 9.2.1
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.	Figures 5.1, 9.8, 9.9 and 9.10
A description of any assumptions made and any uncertainties or gaps in knowledge.	Section 13
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment.	Sections 9,10, 11, 12 and 14
Any mitigation measures for inclusion in the Environmental Management Programme (EMPr).	Section 16
Any conditions for inclusion in the Environmental Authorisation.	Section 19
Any monitoring requirements for inclusion in the EMPr or Environmental Authorisation.	Section 20
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised.	Section 19
If the opinion is that the proposed activity 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 15
A description of any consultation process that was undertaken during the course of carrying out the study.	Section 16
A summary and copies if any comments that were received during any consultation process.	Section 16
Any other information requested by the competent authority.	n/a

3. DETAILS AND EXPERTIZE OF THE AVIAN SPECIALIST

The author has been employed as a professional ornithologist for some 40 years. This includes seven years with a provincial nature conservation agency (Transvaal Division of Nature Conservation), nine years with the FitzPatrick Institute and the Avian (now Animal) Demography Unit, both at the University of Cape Town, and 21 years in his current position as Curator of Birds at the Durban Natural Science Museum. In addition to a long track record of ornithological research, much of it related to conservation issues, he also has extensive experience in avifaunal specialist studies related to EIAs, and has produced over 80 such specialist studies over the length of his career. Of particular relevance to the uMkhomazi Water Project Phase 1, he has worked extensively in the past on Blue Swallows (and other grassland birds) in the region. He was the project leader of the first national survey of Blue Swallows in South Africa and Swaziland during the period 1986-1987 working under the auspices of the Endangered Wildlife Trust (Allan 1986, 1988, Allan et al. 1987). This initiative also involved him organising and chairing the first National Blue Swallow Workshop at Graskop in January 1987. He was the lead author of the species account for the Blue Swallow in the two-volume Atlas of Southern African Birds (Allan & Earlé 1997). More recently, he has undertaken three specialist avifaunal studies related specifically to Blue Swallows. Two of these related to cell-phone masts at the Hella Hella and Baynesfield Blue Swallow breeding sites (Allan 2005, 2009) and the third related to an application to transform grasslands near Creighton potentially used by Blue Swallows for foraging to cultivation (Allan 2013). The latter investigation resulted in the discovery of a new breeding site for the species. He is also a co-author of the Blue Swallow Biodiversity Management Plan currently being produced under the auspices of Ezemvelo KZN Wildlife having participated in the associated workshop leading up to the production of this management plan (Coverdale et al. in prep.).

His highest academic qualification is a M.Sc. in Zoology from the University of Cape Town and he is currently registered as a Professional Natural Scientist (Reg. No. 115499) with the South African Council of Natural Scientific Professions (SACNASP). A full CV accompanies this Report as a separate document (see **Addendum A**).

4. SPECIALIST DECLARATION OF INDEPENDENCE

I, David Allan, declare that:

1. I act as an independent specialist;
2. I will perform the work relating to the project in an objective manner, even if this results in views and findings that are not favourable to the project proponent;
3. I declare that there are no circumstances that may compromise my objectivity in performing such work;
4. I have expertise in compiling the specialist report relevant to this project, including knowledge of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998; the Act), and regulations and any guidelines that have relevance to the proposed activity;
5. I will comply with the Act, regulations and all other applicable legislation;
6. I will take into account, to the extent possible, the matters listed in Regulation 8;
7. I have no, and will not engage in, conflicting interests in the undertaking of the activity;
8. I undertake to disclose to the project proponent 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 project and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority or project proponent;
9. All the particulars furnished by me in this document are true and correct; and
10. I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

_____

Signature of specialist
Date: 1 June 2018

5. PROJECT DESCRIPTION

The uMWP-1 comprises the key components listed below (also see **Figure 5.1** below).

- Smithfield Dam on the UMkhomazi River, which will involve blasting, major earthworks and general construction activities.

- Deviation of Provincial Road R617 around the dam basin, including a gravel access road for the community on the north-western side of the R617 (all involving road construction activities).

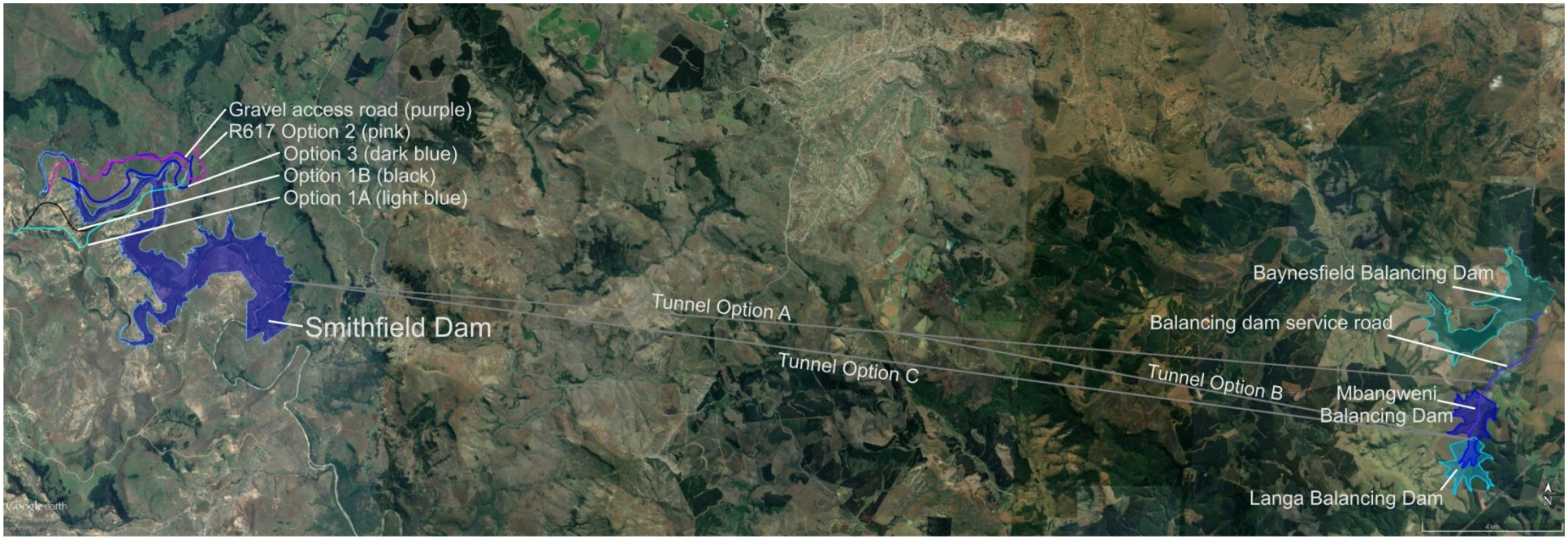
- A tunnel, which will involve drilling, tunnelling, general construction activities and geotechnical investigations, connecting the Smithfield Dam with one of three balancing dam options at Baynesfield Estate (hereafter simply referred to as 'Baynesfield'). Three alternative tunnel routes options are proposed (associated with different options for the eastern outlet of the tunnel). The tunnel route will in addition be serviced by various inlets, outlets and adits, shafts, a spoil site, and access roads along, and close to, its length.

- A balancing dam on Baynesfield, which will involve blasting, major earthworks and general construction activities, to receive the water transferred through the tunnel from Smithfield Dam. Three alternative options (Langa, Mbangweni and Baynesfield Balancing Dams) are proposed for the location of the balancing dam. The balancing dam would also require an access road (involving road construction activities).

- A 2.6 m diameter raw water pipeline connecting the tunnel outlet to a Water Treatment Works (WTW) situated to the east of the balancing dam.

- •A 1.6 m diameter bi-directional raw water pipeline connecting the balancing dam to the afore-mentioned 2.6 m diameter pipeline to supply the WTW during maintenance of the tunnel.

Figure 5.1: The uMWP-1 Area showing the Key Project Components



The proposed Smithfield Dam, the four proposed options for the R617 deviation and the gravel access road, as well as the three proposed balancing dam options, along with a proposed service road (purple line), are apparent in the far west and far east of the project area respectively. The two development nodes are linked by three proposed tunnel route options (straight grey lines). These project components are all shown on **Figure 5.1** above.

6. BACKGROUND

6.1 CONSERVATION STATUS OF THE BLUE SWALLOW

The Blue Swallow *Hirundo atrocaerulea* is listed as 'Critically Endangered' in the latest Red Data Book covering the birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015) and its global conservation status is considered 'Vulnerable' (BirdLife International 2018).This species has undergone a catastrophic decrease in South Africa in recent times. It is now one of the ten most threatened species on the South African mainland. It once occurred in Limpopo and Mpumalanga Provinces but now appears either extinct in these provinces or close to it. It has also entirely disappeared from the northern and central parts of it range in KZN. The population persisting in southern KZN, which includes the birds present in the project area, is the last, or at least the last significant, remaining population in South Africa. This population is estimated at only about 30-40 breeding pairs. The greatest threat to Blue Swallow populations in South Africa has been the destruction and degradation of its grassland habitat brought about mainly by commercial afforestation, agriculture and dense human settlement. The species is a breeding intra-African migrant to South Africa, mainly present October – March, and spending the non-breeding season in central and East Africa.

The Blue Swallow breeding areas relevant to the uMWP-1 project area (Impendle Nature Reserve, Mt Shannon, and Trewirgie and Baynesfield Estate and the areas immediately adjacent to Trewirgie and Baynesfield) are considered as part of a global 'Important Bird and Biodiversity Area' primarily on the basis of the presence of breeding Blue Swallows at these localities (BirdLife South Africa 2018).

6.2 INITIAL AVIFAUNA SPECIALIST STUDY

An initial Avifauna Specialist Study (WildSkies Ecological Services 2015) was conducted as part of the broader EIA for the uMWP-1. It is not the purpose of this Assessment to duplicate the field investigations already done during the initial Avifauna Specialist Study, nor to repeat the contents of that report in this Report. Rather, this Assessment was designed to take the work of the initial specialist study further, especially as relates to the status of Blue Swallows in the project area, and to attempt to provide the additional information on this species called for in a subsequent review by the DEA (see **5.3** below). This Report, therefore, should be read in conjunction with the original Avifauna Specialist Study relevant to a holistic avian assessment covering the project. The original study was reviewed in detail and reference is made to it wherever relevant in this Report.

The initial Avifauna Specialist Study identified several areas of potential concern/uncertainty relevant to avifauna, especially as relates to the Blue Swallow.

Quotes from the Avifauna Specialist Report covering the three key areas of concern/uncertainty are listed below.

- "Blasting, earth-moving and general construction noise and activities at the optional sites for the balancing dam . . . anticipated to have a high significance".

- "The noise and vibration created during tunnelling could affect Blue Swallows breeding on the surface . . . Given its dire conservation status, any of these effects would have highly significant implications for the species".

- "the proposed re-routing of the tar R617 road north of Smithfield dam . . . The proposed route is inside the Impendle Nature Reserve and Important Bird Area. The road will be approximately 900 m (without considering differences in elevation) from the boundary of the area identified as Blue Swallow nesting habitat, and between 2 and 3.7 km (without considering difference in elevation) from 6 actual nests . . . these distances are small enough to warrant concern . . . Further information is required on the extent to which

road construction will increase the ambient noise levels in the area".

6.3 COMMENTS BY DEPARTMENT OF ENVIRONMENTAL AFFAIRS

The DEA in its review of the EIA stressed that the project seemed to pose a threat to the survival of the Blue Swallow at a national level, an issue of both national and international relevance. The DEA review suggested that insufficient information was presented in the EIA and in the Avifauna Specialist Study relevant to the points listed below. These points were deemed necessary for further investigation to properly inform further decision-making are the following.

- Insufficient information was provided on "potential impacts on Blue Swallows or potential mitigation and remedial measures".
- "Furthermore, insufficient information is provided in respect of the potential loss of forage areas within the basin of the proposed balancing dam and what impact this could have on the breeding success of this critically endangered species."
- "Insufficient attention has been given to the consideration of the three alternative locations for the proposed balancing dam and tunnel alignment."

7. PURPOSE AND SCOPE OF THE AVIFAUNA BRIDGING STUDY

In the light of the DEA's comments pertaining to uncertainty and insufficient information, the Department of Water Affairs and Sanitation (DWS) and Umgeni Water initiated a further Avifauna Bridging Study (this Study) with Nemai Consulting acting as the Environmental Assessment Practitioner (EAP) for the uMWP-1. This Avifauna Bridging Study is aimed to provide additional crucial information in assessing the potential impacts of the project components on the local populations of the Blue Swallow. Furthermore, this Avifauna Bridging Study also aims to examine potential mitigation, management and monitoring measures in this regard.

Specific issues addressed include those listed below.

- Collate all existing knowledge of the locations and history of Blue Swallow breeding sites and foraging areas in the project area. This information to be sourced from the literature, available reports and sources in Ezemvelo KZN Wildlife, the Blue Swallow Working Group, informed landowners, etc.
- Undertake field surveys to update and confirm the current status of Blue Swallows in the project area.
- Undertake a comparative analysis of the three alternative locations for the proposed balancing dam (Langa, Mbangweni and Baynesfield Balancing Dam options) and three alternative tunnel alignment options from an avifaunal perspective. This is to include an assessment of the potential loss of forage areas within the dam basin of the proposed balancing dam and the impact this could have on the persistence and breeding success of Blue Swallows.
- Examine the potential impact of the construction of Smithfield Dam and the re-routing of the R617 on Blue Swallows and other threatened bird species.
- Liaise with the Noise and Vibration Specialists pertaining to: 1 – investigating the potential of disturbance to breeding Blue Swallows stemming from tunnel drilling and other relevant project activities; 2 – identifying relevant mitigation measures to manage potential noise and vibration impacts on Blue Swallows and their nest sites; 3 – devising a Monitoring and Evaluation Programme for noise and vibration during the construction and operational phases (should Environmental Authorisation be granted).
- Although the Blue Swallow is the avian species of primary concern, other bird species of conservation relevance (Red Data species), including crane species, should also be taken into consideration.
- The Avifauna Bridging Study must ensure that the requirements of the relevant environmental authorities that have specific jurisdiction over avifauna are satisfied. These authorities include the DEA, the KZN Department of Economic Development, Tourism and Environmental Affairs (EDTEA), and Ezemvelo KZN Wildlife.
- A risk-averse and cautious approach should be adopted under conditions of uncertainty (precautionary approach).

8. METHODOLOGY

8.1 DESKTOP STUDIES

Electronic copies of the initial Avifauna Specialist Report (WildSkies Ecological Services 2015) and additional relevant background material on the project, including from the original EIA Report were obtained through Nemai Consulting. Nemai Consulting and other team members also provided Google Earth kml/kmz files covering the locations of project components.

Existing knowledge of the locations and history of Blue Swallow breeding sites and foraging areas in the project area was obtained from past and present staff of Ezemvelo KZN Wildlife (Brent Coverdale, Steve McKean and Athol Marchant). Most of this information came through Nemai Consulting but additional up-to-date information was obtained directly from these Ezemvelo KZN Wildlife sources. Additional information was obtained from two members of the Blue Swallow Working Group monitoring team: Derek Clark and John Kennedy (the latter also a Trustee of Baynesfield Estate). Barbara Seele also provided information on the status of Blue Swallows on her family farm Trewirgie.

8.2 FIELD INVESTIGATIONS

The Fieldwork for this Avifauna Bridging Study was focused in the eastern part of the project area, centred on the farms Baynesfield and Trewirgie and also extending to directly adjacent properties where relevant. This focus on the eastern part of the project area was because the primary causes of concern relevant to Blue Swallows, i.e. issues related to tunnelling and the balancing dams, were concentrated in this region. In this area and relevant to Baynesfield, some attention was also paid to examining the relevant wetland habitat along the Mbangweni River and along the Mlazi River just downstream of its confluence with the Mbangweni River. The small existing dam along the Mbangweni River and the large dam along the Mlazi River upstream of its confluence with the Mbangweni River were also examined. These areas are directly relevant to assessing the three options under consideration for the balancing dam. This Avifauna Bridging Study also assessed the potential value of the wetland areas along the Mbangweni River for foraging Blue Swallows and examined the water bird populations inhabiting these aquatic habitats.

Additional fieldwork, however, was also undertaken in other parts of the project area. For example, around Smithfield Dam to determine the potential impact of the construction of the dam and the associated diversion of the R617 on the Blue Swallows breeding in the adjacent Impendle Nature Reserve (and Mount Shannon), as well as relevant to potential impacts on other Red Data bird species. The Vibration Specialist was accompanied on his visit to Impendle Nature Reserve and Mount Shannon during the course of fieldwork associated specifically with the Vibration Impact Assessment. The Invertebrate Specialist, Lukas Niemand, kindly provided details of Red Data bird species encountered during his fieldwork in the Smithfield Dam Area.

All fieldwork was undertaken during the period November 2017 to January 2018. This was during the peak period when the migratory Blue Swallow is present and breeding in the sub-region, i.e. September – April (primarily October – March). Specific dates when all fieldwork was undertaken are: 24 and 29 November and 3, 8, 9 and 16 December 2017, and 1, 3, 4, 7, 10, 13, 15 and 20 January 2018, i.e. 14 days in total.

8.2.1 Blue Swallow Habitat and Nest Holes

The fieldwork, initially guided by the existing information, allowed for the determination of the remaining patches of natural primary mist-belt grassland in the eastern section of the project area. The precise boundaries of these relevant patches were determined using Google Earth Pro allowing a digital capturing of this habitat information.

A large and particularly time-consuming component of the fieldwork comprised verifying the known, and searching for new, Blue Swallow pairs and nests in these suitable patches of primary natural mist-belt grassland in the eastern regions of the project area (centred on Baynesfield and Trewirgie). The following key protocols were followed during these searches, which also took account of the nest monitoring protocols outlined in Marchant (2006):

- All the investigations were conducted on foot.
- The searches focused on verifying known, and searching for new, subterranean holes in which Blue Swallows construct their nests. Blue Swallows in the project area use the following three types of subterranean holes for nesting: 1 - Antbear *Orycteropus afer* burrows (see **Figure 8.1** below), 2 - naturally occurring sinkholes ('solution cavities') along the courses of subterranean streams (see **Figure 8.2** below), and 3 - and artificial excavations specifically dug for the species to nest in (see **Figure 8.3** below). All these holes are typically rather inconspicuous in the landscape and the location of previously unknown holes requires fairly meticulous searching. Some holes, however, are signposted by tall shrubs, especially tree ferns, growing out of them due to the protection from fire (see **Figure 8.4** below) and sinkholes are typically restricted to watercourses.
- The searches were also targeted at directly locating the Blue Swallows themselves and noting their behaviour relevant to potential breeding in the area. Blue Swallows typically fly around human intruders close to their breeding sites, frequently also uttering alarm calls when doing so.

Figure 8.1: An Antbear Burrow supporting an Active Blue Swallow nest on Greenridge Farm directly adjacent to Baynesfield (Nesting Locality 1)

Figure 8.2: A Natural Sinkhole with two old Blue Swallow nests at Baynesfield (Nesting Locality 2)

Figure 8.3: An Artificially Dug Hole with an old Blue Swallow Nest at Trewirgie (Nesting Locality 4)

Figure 8.4: A Tree Fern growing out of an Antbear Burrow on Baynesfield Estate

In the instances where a tree fern growing out of an Antbear burrow it assist in locating otherwise inconspicuous holes in open grassland (see **Figure 8.4** above).

The following information was recorded for all the holes located and examined during this Study.

- The date and time that the hole was examined.
- The geographical co-ordinates of the hole using a GPS unit.
- Each hole was photographed.
- The compass orientation of the hole ('aspect') using a GPS unit. Sinkholes typically lack such orientation, however, having vertical sides.
- The hole type (Antbear burrow, sinkhole or artificial hole).
- Whether the entrance to the hole was overgrown with vegetation or not. Holes overgrown with vegetation are typically not used by the Blue Swallows as they cannot easily access the interior of these holes.
- Each hole was ranked on a scale of 1 to 5 relevant to its subjective suitability for use by nesting Blue Swallows, with 1 representing the least suitability and 5 the highest suitability. Aspects taken into account in assigning such a ranking included the dimensions and depth of the hole (older holes tend to silt up and/or collapse), and the extent to which the entrance was overgrown with vegetation.
- Any evidence of Blue Swallow nests in the burrow interior. The interior was examined using a small hand-held torch (see **Figure 8.5** below). The state and, where relevant, contents of all nests located were recorded and each nest was also photographed using flash photography.

- Each hole examined was allocated a unique number.

Figure 8.5: The Small Hand-held Torch that was used to examine the dark interior of the holes (Nesting Locality 4)

The torch beam (see **Figure 8.5** above) illuminated an active Blue Swallow nest in an Antbear burrow at Trewirgie (Nesting Locality 4).

In some areas, the high density of Antbear burrows practically precluded both searching for all holes present and the recording of all details relevant to each and every hole seen. In such cases, often only a selection of the 'best' holes were recorded and examined. This was particularly the case close to known active nests, where the location and details of additional holes in the immediate area was essentially irrelevant. The time taken in collecting such information would have potentially caused unnecessary disturbance to the active breeding attempt. In addition, time limitations meant that searches for potential nest holes did not cover the entire suitable habitat available and a large number of holes were certainly not located.

8.2.2 Other Red Data Bird Species

Lists of all bird species, including Red Data species other than the Blue Swallow, were compiled during fieldwork throughout the project area. Details recorded relevant to these additional Red Data species included: species, date, locality, the number and, where relevant, ages/sexes of the birds, habitat, and activity of the birds as well as any evidence of breeding.

9. KEY FINDINGS – BLUE SWALLOWS

9.1 EASTERN PART OF THE PROJECT AREA

9.1.1 Blue Swallow Habitat and Nest Holes

9.1.1.1 Blue Swallow Habitat Patches

The remaining patches of primary natural mist-belt grassland in the eastern part of the project area, i.e. on Baynesfield and Trewirgie, and immediately adjacent properties are shown in **Figure 9.1** below. For ease of communication the labels 'Baynesfield' and 'Trewirgie' as used from here onwards also refer the properties immediately adjacent to these two sites. These areas represent the Blue Swallow breeding and foraging habitat in the area. On both Baynesfield and Trewirgie the Blue Swallows breed only on the two largest habitat patches present at both properties, colloquially known as 'Zinty' (sometimes 'Zinti') and the 'Amphitheatre'. The higher-lying areas of the Zinty block are colloquially called 'Upper Zinty' and the lower-lying areas as 'Lower Zinty'. A polygon provided by Ezemvelo KZN Wildlife encircling apparent Blue Swallow breeding habitat in the Baynesfield Area was particularly inaccurate with reference to the Zinty grassland block, especially in its exclusion of the Lower Zinty Area. For this reason this polygon was not incorporated in this Report as the habitat polygons presented here are considered far more accurate.

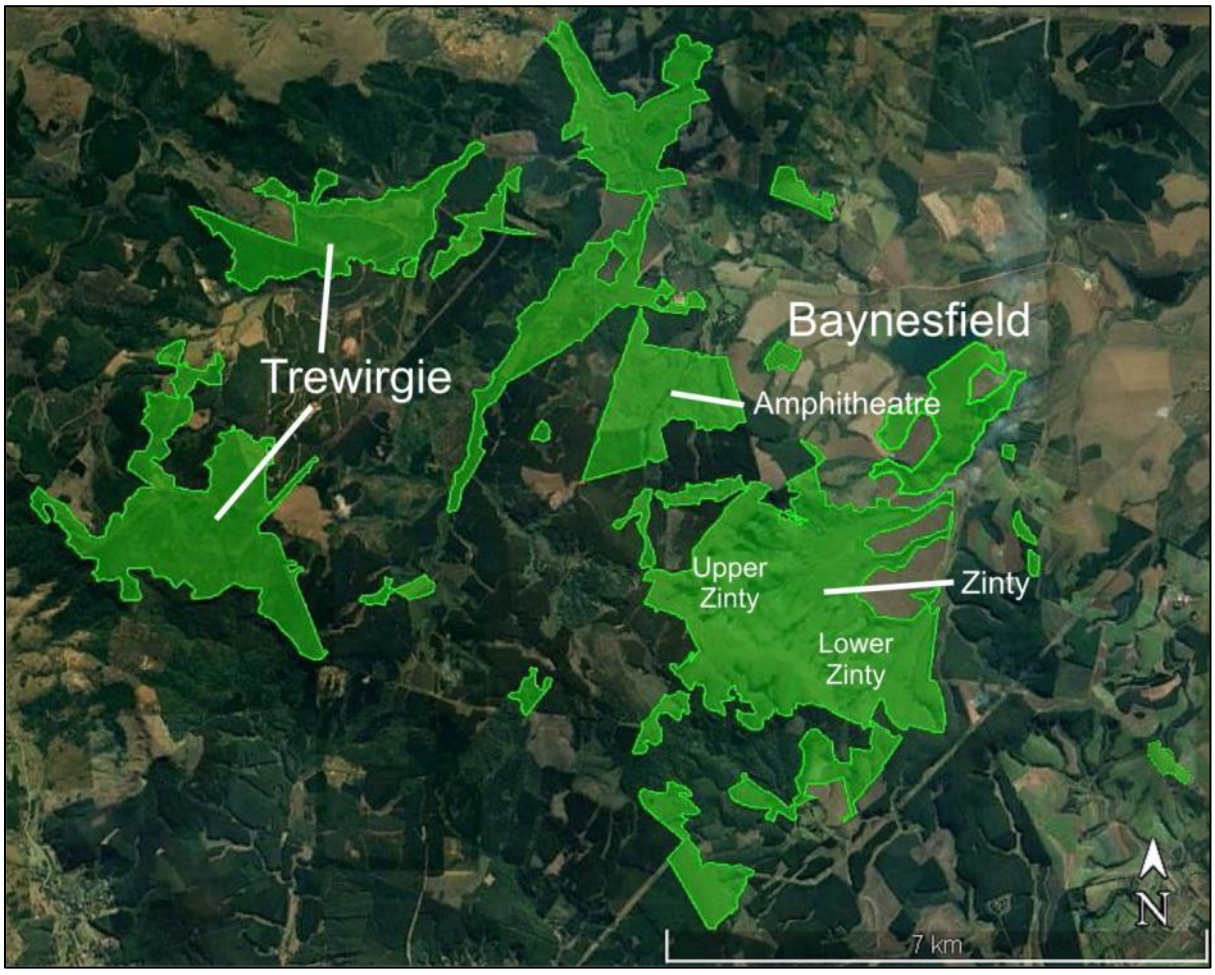


Figure 9.1: The Remaining Patches of Primary Natural Mist-belt Grassland in the Eastern Part of the Project Area

The Baynesfield Estate and Trewirgie, and the immediately adjacent properties as shown on **Figure 9.1** above, all comprise suitable Blue Swallow habitat. The photos in **Figures 9.2** to **9.5** below provide photos illustrate these mist belt grassland habitats.

Figure 9.2: View from Lower Zinty looking up to Upper Zinty on Baynesfield

Figure 9.3: View from Upper Zinty looking down to Lower Zinty on Baynesfield

Figure 9.4: View of the Amphitheatre on Baynesfield

Figure 9.5: View of One of the Two Large Blocks of Primary Mist-belt Grassland on Trewirgie

9.1.1.2 Details of the Holes Located

The locations of the 147 holes located, plotted, examined and numbered in the eastern part of the project area, i.e. on Baynesfield and Trewirgie are shown in **Figure 9.6** below, overlain on the polygons representing the primary natural mist-belt grasslands providing suitable Blue Swallow habitat. Full details of these holes are presented in **APPENDIX 1.**

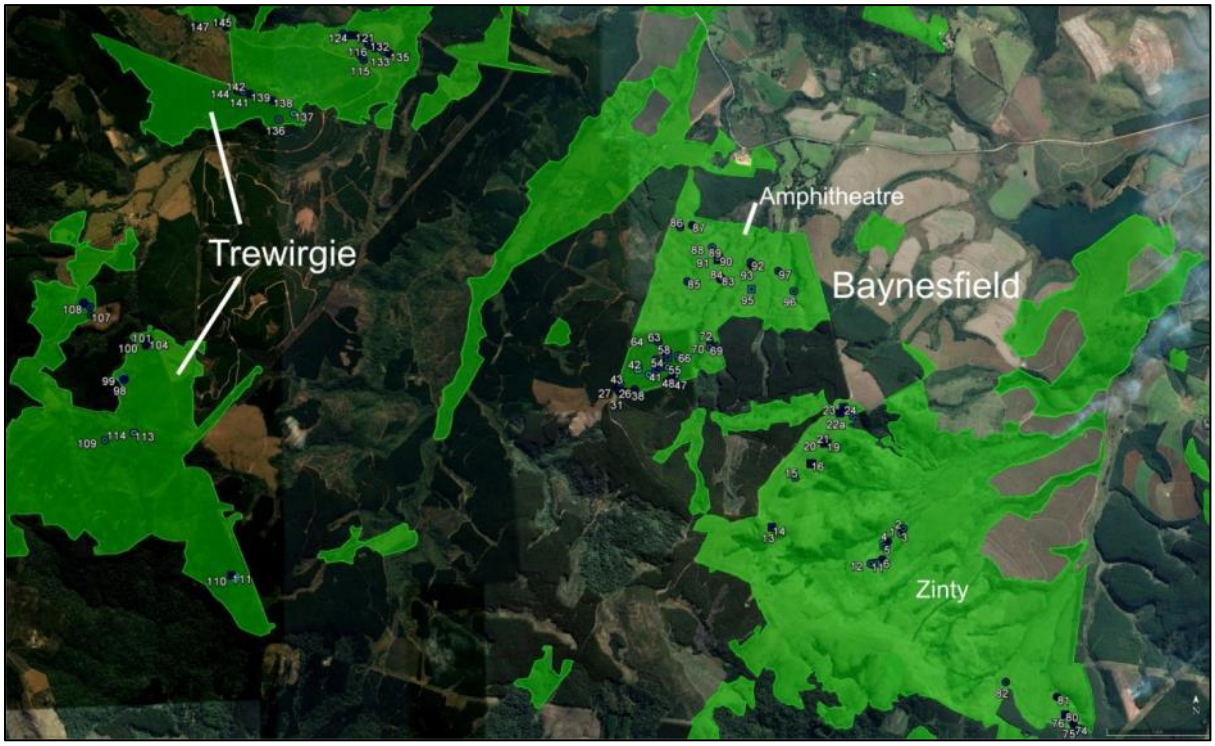


Figure 9.6: The Locations of the 147 Holes located, plotted, examined and numbered in the Eastern Part of the Project Area

Baynesfield and Trewirgie are overlain on the polygons in **Figure 9.6** above representing the primary natural mist-belt grasslands providing suitable Blue Swallow habitat.

Of these 147 holes, 97 are located on the Baynesfield Estate and 50 on Trewirgie. A total of 114 of these 147 holes are Antbear burrows (69 on Baynesfield and 45 on Trewirgie), 29 are sinkholes (28 on Baynesfield and one on Trewirgie) and four are artificial holes (all on Trewirgie). It should be noted that Antbear burrows are far-and-away the most common type of hole at both Baynesfield and Trewirgie. Only one suitable sinkhole is located on Trewirgie and only artificial holes are situated on Trewirgie.

Information on the aspect of holes, i.e. the direction in which the hole faces, where relevant, is presented in **Table 8.1** below. Most holes (79%; 98/124) faced an arc from east to north. The hole aspect was typically correlated with the aspect of the slope upon which the hole is located.

Table 9-1: Aspects of the Holes Located at Baynesfield and Trewirgie, and on the Immediately Adjacent Properties

Aspect	Baynesfield	Trewirgie	TOTALS
East	21	5	**26**
North-east	26	16	**42**
North	16	14	**30**
North-west	4	8	**12**
West	1	2	**3**
South-west	1	1	**2**
South	6	1	**7**
South-east	1	1	**2**
TOTALS	**76**	**48**	**124**

Information on whether or not holes were overgrown with vegetation, and hence inaccessible to breeding Blue Swallows, is presented in **Table 9.2** below. An appreciable proportion of holes were overgrown at both localities, especially at Trewirgie (Baynesfield 32%, Trewirgie 57%). Nevertheless, there were a far larger number of accessible holes present than there were breeding pairs of Blue Swallows at both localities. In addition, and as mentioned above, a large number of holes were also not documented during this Assessment.

In **Table 9.2** below details are given of whether or not holes were overgrown with vegetation, and hence inaccessible to breeding Blue Swallows, at Baynesfield and Trewirgie, and immediately adjacent properties.

Table 9-2: Details of whether or not holes were overgrown with vegetation

Overgrown	Baynesfield	Trewirgie	TOTALS
No	66	21	**87**
Yes	31	28	**59**
TOTALS	**97**	**49**	**146**

Relevant to the ranking of the holes located, **Table 9.3** below summarises the information in this regard. Holes ranked as 1 or 2 are likely unsuitable for breeding Blue Swallows, while those ranked 3 to 5 are likely suitable to highly suitable. A total of 67% of holes categorized are deemed suitable to highly suitable for breeding (61% at Baynesfield and 79% at Trewirgie). Again, and as mentioned above, it should borne in mind that many holes were not located and assessed during these searches, and many of these are also certainly suitable for breeding Blue Swallows.

Table 9-3: Suitability ranking of the holes located at Baynesfield and Trewirgie, and Immediately Adjacent Properties, for Breeding Blue Swallows

Rank	Baynesfield	Trewirgie	TOTALS
1	14	2	**16**
2	24	8	**32**
3	34	13	**47**
4	17	16	**33**
5	8	9	**17**
TOTALS	**97**	**48**	**145**

This information suggests that the availability of holes suitable for nesting by Blue Swallows was not a limiting factor at Baynesfield and Trewirgie, and directly adjacent properties.

9.1.1.3 Details of the Blue Swallow Nests Located

The locations of all the Blue Swallows nesting sites at Baynesfield and Trewirgie, and directly adjacent properties, known prior to this investigation as provided by Ezemvelo KZN Wildlife (white squares n = 28 sites) are shown in **Figure 9.7** below. Three of these nesting sites appear to be located in habitat other than primary natural mist-belt grassland – these are likely to represent inaccurately recorded co-ordinates. Six locations where Blue Swallow nests were located during this Assessment are also shown as blue circles.in **Figure 9.7** below.

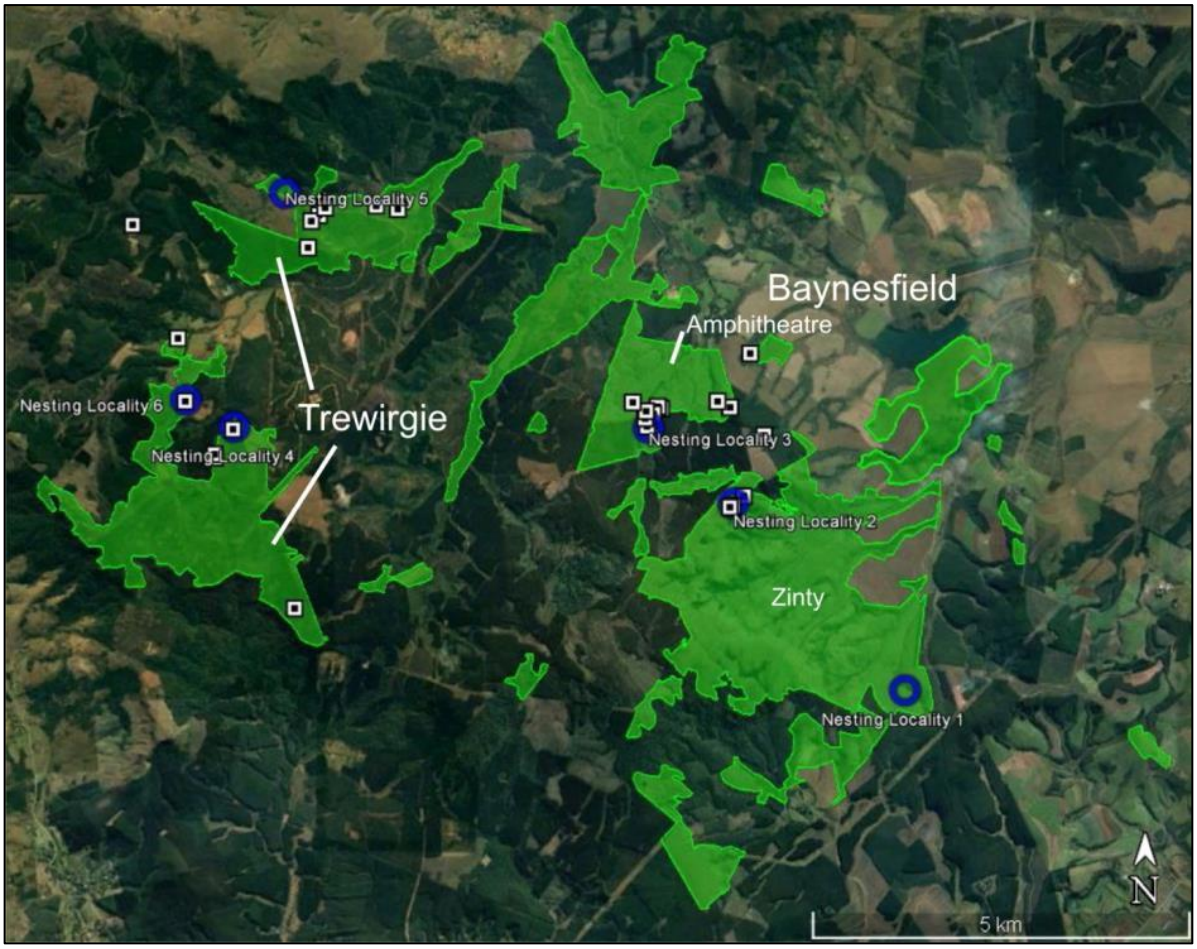


Figure 9.7: The Locations of all the Blue Swallows Nesting Sites at Baynesfield and Trewirgie, and Directly Adjacent Properties

Details of the six locations where Blue Swallow nests were located during this Assessment are as follows:

- Nesting Locality 1 – Nest in Hole No. 81, pair of adults present.
- Nesting Locality 2 – Two old nests in Hole No. 20, no birds seen in the vicinity.
- Nesting Locality 3 – Nest in Hole No. 72, pair of adults present.
- Nesting Locality 4 – Nest in Hole No. 105 (plus old alternate nests in Hole Nos 98 and 100), pair of adults present.
- Nesting Locality 5 – Nest in Hole No. 147 (plus old alternate nest in Hole No. 145), pair of adults present.
- Nesting Locality 6 – Old nest in Hole No. 106, no birds seen in the vicinity.

Only Nesting Localities 1 (Greenridge in Lower Zinty) and 3 (Amphitheatre), both on Baynesfield and adjacent property, and 4 (Trewirgie) and 5 ('Paynes' on Mondi property, with parts of this large grassland block centred on Trewirgie north and directly adjacent properties also colloquially known as 'Upper Umlaas' and 'Lower Umlaas'), both on Trewirgie and adjacent property, were confirmed occupied during this investigation. In the past, two pairs of breeding Blue Swallows have apparently been recorded at the Amphitheatre (Marchant 2012) but only a single pair could be confirmed as breeding there during this Assessment.

Nesting Localities 2 (Upper Zinty, Baynesfield) and 6 (Trewirgie) appeared unoccupied. During this

Study it was noted that most of the Baynesfield portion of Zinty had not been recently burnt, nor was it apparently being grazed by cattle, and the grassland there was tall, dense and moribund. It is possible that the absence of occupancy at Nesting Locality 2 on Upper Zinty was related to the lack of burning and grazing of this block during the recent past. Nesting Locality 1, which is currently active, on the farm Greenridge directly adjacent to Baynesfield and part of Lower Zinty, by contrast, had obviously been burnt during the previous winter and was also being actively grazed by cattle. The grassland at Nesting Localities 3 (Amphitheatre, Baynesfield), 4 (Trewirgie) and 5 (Mondi, directly adjacent to Trewirgie) also appeared to have been recently burnt.

The grassland at Nesting Locality 6 (on Trewirgie), however, appeared to have been burnt recently but there was nevertheless no indication of current occupancy of this locality. It seems likely that this locality is an alternate nest site associated with Nesting Locality 4 and does not represent a different pair of Blue Swallows. The same could conceivably apply to Nesting Localities 1 and 2 on Zinty, with a single pair (?) significantly moving their nesting site from Upper Zinty to Lower Zinty to exploit the recently burnt and grazed area on the Greenridge portion of Lower Zinty. The size of the Zinty block, however, might suggest that it could support two pairs of Blue Swallows if conditions there were uniformly optimal. Unfortunately the Blue Swallow monitoring history at Zinty throws little light on this issue, as apparently little attention has been paid to searching for Blue Swallow nests at Lower Zinty since about the late 1990s, with most attention being paid to the Upper Zinty area (John Kennedy pers. comm.). The historical record of Blue Swallow monitoring at Upper Zinty, however, has suggested that the Upper Zinty area alone could potentially have supported two Blue Swallow nesting pairs in the past (Marchant 2012).

It should be borne in mind that although this seems a small number of breeding pairs, with a total persisting South African population of only some 30-40 breeding pairs of Blue Swallows, this nevertheless represents a significant proportion of the remaining total. Taken with the Impendle Nature Reserve population also potentially impacted by the uMWP-1 (see Section 9.2.1 below), it can be appreciated that approximately one quarter of the remaining Blue Swallow population in South Africa lies in or close to the project footprint.

9.1.2 Habitat Sensitivities and Buffers Relevant to the Blue Swallows

The three sources below provide clear stipulations as to appropriate buffers areas around Blue Swallow breeding habitat. The original avifauna specialist report (WildSkies Ecological Services 2015) also alludes to these buffer-area stipulations.

- Wakelin & Hill (2007) state that: “The *status quo* of the primary grasslands, within a 4 km radius of all Blue Swallow nests sites, must be protected and maintained.”
- Evans & Bouwman (2010) state that: “In order to conserve this threatened species, habitat transformation (excluding rehabilitation) should not be allowed within an absolute minimum of 1.5 km radius of a blue swallow nest. Ezemvelo KZN Wildlife (the provincial government conservation authority in KwaZulu-Natal) specifies that land-use changes should preferably not take place within a 2 km radius of any blue swallow nest (Evans *et al*., 2003).”
- This Ezemvelo KZN Wildlife requirement is repeated by Marchant (2012b): “Inappropriate land-use change should not occur within 2 km of active nest sites.”

It is important to note that the first of these stipulations refers only to protecting primary grassland, and does not concern itself with other habitat types, within the 4 km buffer zone. The second and third stipulations, by contrast, refer to any “habitat transformations” or “inappropriate land-use changes” respectively within the more restricted 1.5 – 2 km buffer zones.

These boundaries of these buffer zones relevant to the three Blue Swallow nesting localities at

Baynesfield and the three balancing dam options are shown in **Figure 9.8** below superimposed on the Blue Swallow habitat and nesting localities in this area.

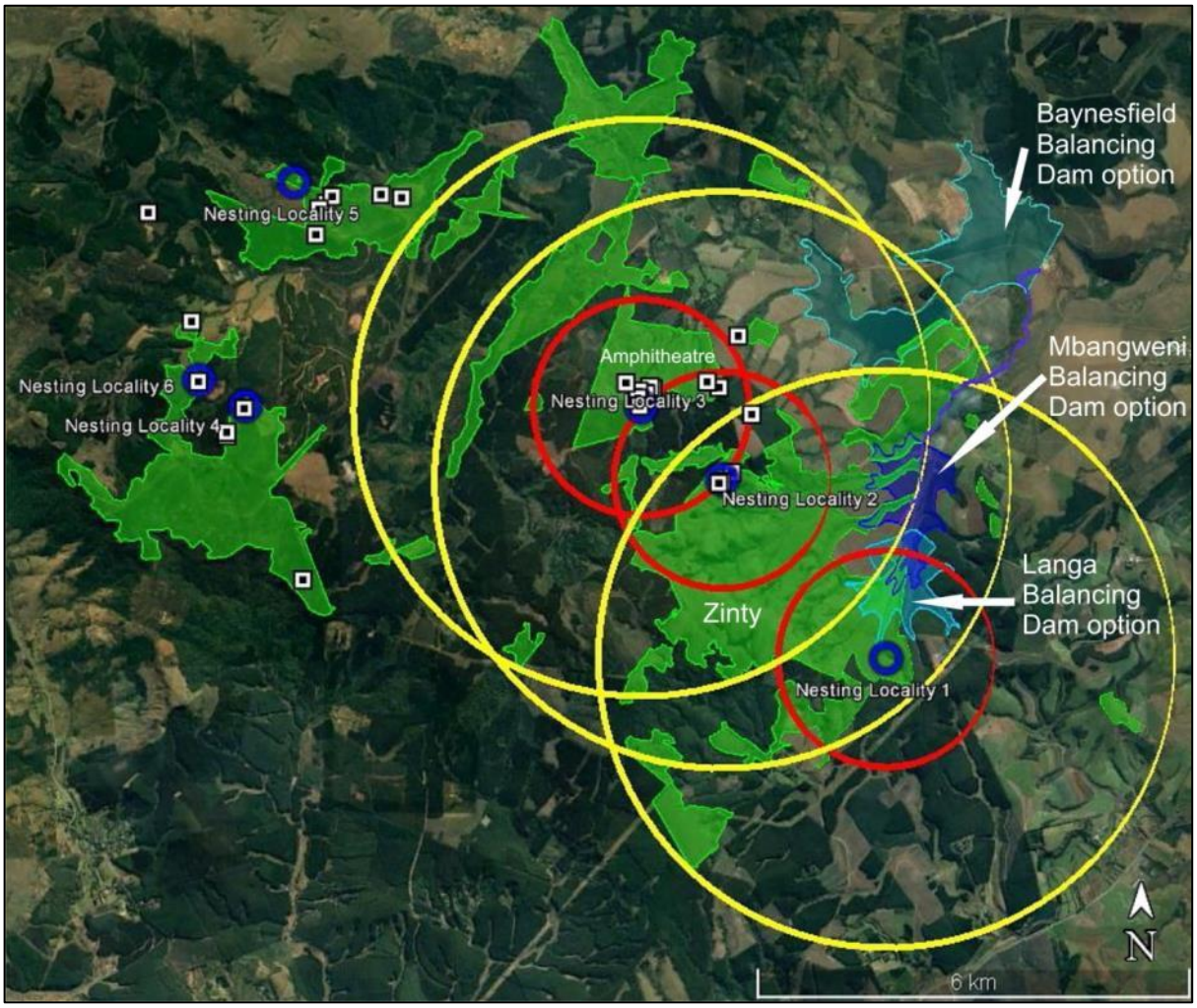


Figure 9.8: The Boundaries of the 1.5 km (red lines) and 4 km (yellow lines) Buffer Zones around the three Blue Swallow Nesting Localities at Baynesfield

The three balancing dam options (Baynesfield, Mbangweni and Langa Balancing Dam options), as well as the Blue Swallow grassland habitat patches and all nesting localities (past and present) at Baynesfield and Trewirgie are also shown on **Figure 9.8** above..

Most of Langa Balancing Dam Basin lies within the 1.5 km buffer area around Nesting Locality 1. In addition, an area of primary grassland that would be inundated by this dam lies within the 4 km buffer area around Nesting Locality 2 and even slightly around Nesting Locality 3. Part of Mbangweni Balancing Dam basin also lies within the 1.5 km buffer area around Nesting Locality 1. Several areas of primary grassland that would be inundated by this dam lie within the 4 km buffer areas of all three of Nesting Localities 1, 2 and 3. The Baynesfield Balancing Dam does not lie within the 1.5 km buffer of any Blue Swallow nests, nor does its inundation area overlap significantly with primary grassland relevant to the 4 km buffer areas of Nesting Localities 1, 2 and 3.

Applying circular buffer zones around currently active nests, however, is likely not the optimal approach for determining appropriate buffer zones around Blue Swallow breeding sites. Blue Swallows regular shift nest sites locally within their individual breeding habitat patches. A preferable approach, especially taking a long-term view, therefore would be to apply buffers around the outer edge of the large breeding Blue Swallow habitat patches to accommodate such regular nest-site re-locations. The implementation of such an approach is reflected in **Figure 9.9**

below, i.e. applying the 1.5 km buffer boundary around the outer boundaries of the Blue Swallow breeding habitat patches (Zinty and Amphitheatre) supporting Nesting Localities 1, 2 and 3 relevant to the locations of the three balancing dam options.

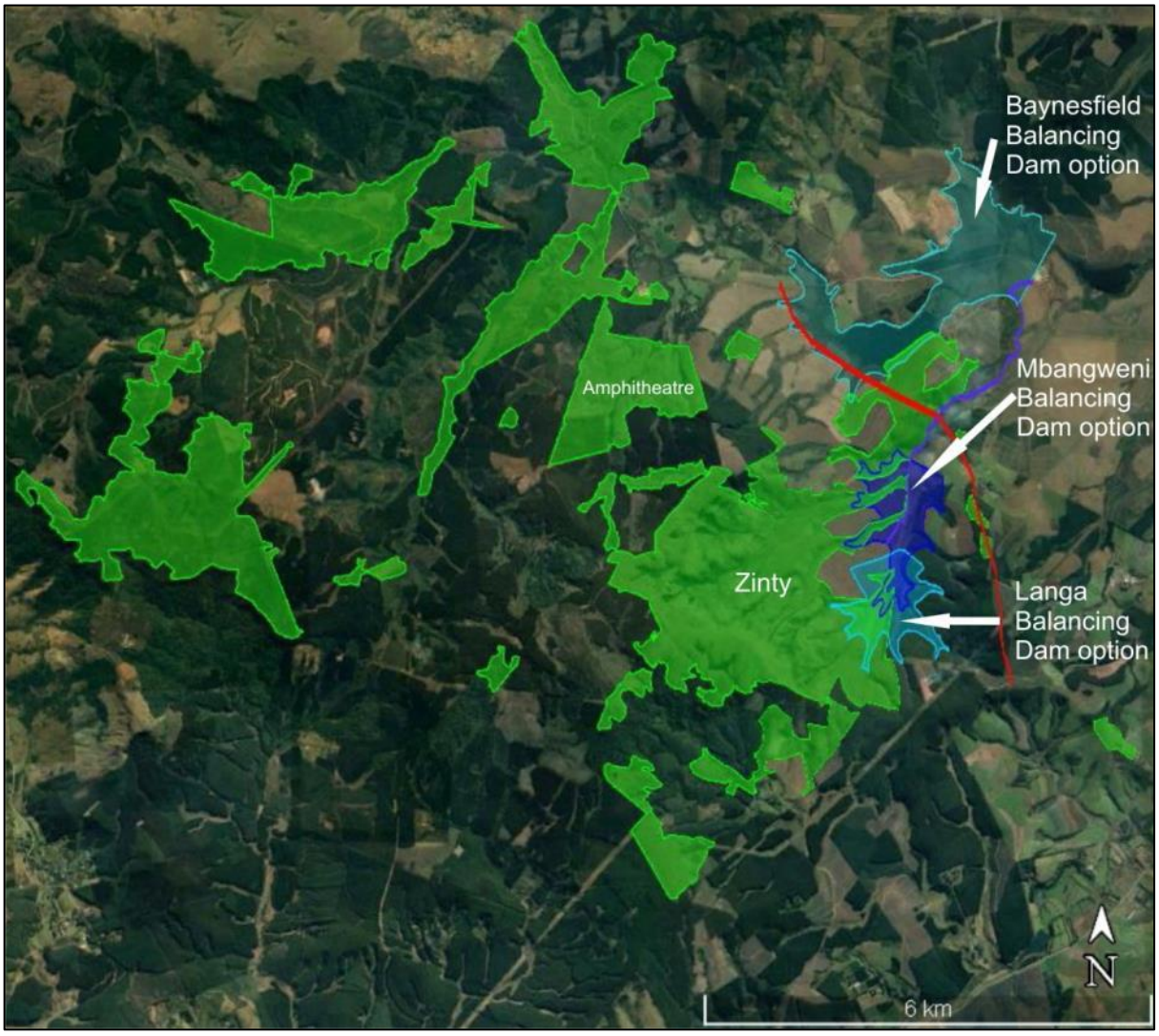


Figure 9.9: The 1.5 km Buffer (red line) around the Outer Boundaries of the Breeding Blue Swallow Habitat Patches supporting Nesting Localities 1, 2 and 3 relevant to the locations of the three Balancing Dam Options

By applying this approach, it is clear that all of the basins of both Langa and Mbangweni Balancing Dams lie entirely within the 1.5 km buffer zone around the outer boundaries of the main Blue Swallow breeding habitat patches (Zinty and Amphitheatre) supporting Nesting Localities 1, 2 and 3. By contrast, the Baynesfield Balancing Dam Option's basin essentially lies outside the 1.5 km buffer relevant to any habitat modification, as well as the 4 km buffer relevant to the transformation of primary grassland.

The original Avifauna Specialist Study (WildSkies Ecological Service 2015) initially identified the profound problems associated with the Langa and Mbangweni Balancing Dam options and stated that: "There is no doubt that it would be better for avifauna and particularly Blue Swallows if this area was not used for the balancing dam". This Avifauna Bridging Study reinforces and confirms this initial conclusion, especially in the light of the discovery of active breeding by Blue Swallows at Nesting Locality 1 very close to both of these balancing dam options (Langa and Mbangweni). The original Avifauna Specialist Study also identified that any balancing dam will most likely be associated with additional disturbance factors, e.g. recreational activities, which can be expected to further

compound the impact on the Blue Swallows and their habitat.

9.2 Western Part of the Project Area

9.2.1 Blue Swallow Habitat and Nest Holes as well as Buffers Relevant to the Blue Swallows

The features relevant to this Assessment as applies to the western part of the project area are shown in **Figure 9.10** below. These features the following:

- Smithfield Dam and the tunnel route options (grey lines) extending to the east of the dam.
- Four route options (Options 1A, 1B, 2 and 3) for the R617 deviation, as well as the routes of a gravel access road to service local communities.
- The patch of primary natural mist-belt grassland on Impendle Nature Reserve (green polygon) which provides breeding and foraging habitat for Blue Swallows on the reserve.
- Known past and present Blue Swallow nesting sites in this mist-belt grassland patch (white squares represent the nest sites originally supplied by Ezemvelo KZN Wildlife for the original Avifauna Specialist Study, while the white circles represent nesting sites supplied by this agency more recently for this Assessment). As with the situation in the eastern part of the project area at Baynesfield and Trewirgie, and directly adjacent properties, a much larger number of past Blue Swallow nesting sites are shown (i.e. 13) than the actual number of breeding pairs of this species present in any single year. Impendle typically supports up to about five breeding pairs of Blue Swallows annually (Marchant 2014). Blue Swallow nest sites from the nearby Mount Shannon site are also shown.
- The 1.5 km (red circles) and 4 km (orange circles) buffer zones around the three Blue Swallow nest sites situated within the Impendle Nature Reserve that are closest to the project development footprint. Following the reasoning related to buffer zones as applied in the eastern part of the project area (see above), also shown are the 1.5 km (red line) and 4 km (orange line) buffer boundaries from the outer boundary of the Blue Swallow breeding habitat patch relevant to the locations of the project developments in this area (Springfield Dam and associated roads, and tunnel options).

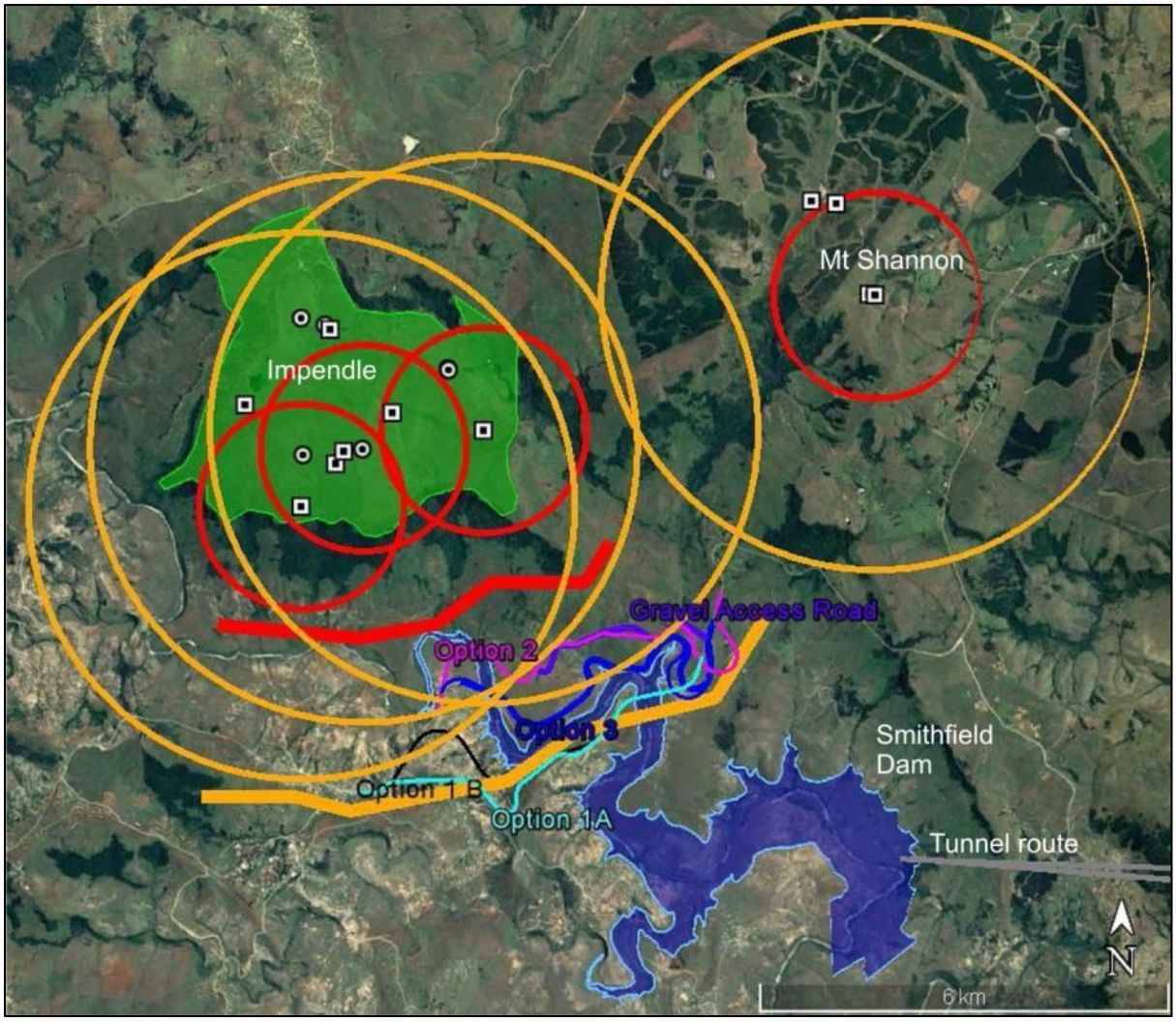


Figure 9.10: Features relevant to this Assessment as apply to the Western Part of the Project Area

The full details of the features shown in Figure 9.10 above are outlined in the main text of this paragraph (**9.2.1**) above.

Key features to note are the following:

- The three tunnel route options are situated very distant from any Blue Swallow breeding sites in the western part of the project area and it is unlikely that tunnel construction would have any negative impact on these breeding areas.
- The Smithfield Dam walls are also situated very distant from any Blue Swallow breeding sites in the western part of the project area and it is unlikely that the construction of the dam walls would have any negative impact on these breeding areas.
- The Mount Shannon Blue Swallow breeding areas are particularly distant from the project footprint and are unlikely to be negatively impacted by any project components.
- All project components will be situated beyond the 1.5 km buffer zone from Blue Swallow breeding habitat at Impendle Nature Reserve (relevant to the stipulation of Evans & Bouwman 2010).
- Some of the project components, i.e. all or some of the R617 road deviations, the gravel road and the uppermost extent of the inundation area of Smithfield Dam, are within the 4 km buffer zone. It is important to note, however, that the habitat in these areas, i.e. the

low-lying regions along the uMkhomazi River, do not comprise mist-belt Blue Swallow breeding and foraging habitat. This is a critical distinction relevant to the contrasting situation in the eastern part of the project area, i.e. the project components will not affect the status quo of primary natural mist-belt grassland directly supporting breeding and foraging Blue Swallows relevant to the stipulation of Wakelin & Hill (2007). In addition, it would appear that the preferred R617 road deviation options (Options 1A and 1B) are situated furthest away from the Impendle Nature Reserve, further reducing any cause for concern in this regard. It should also be noted that the Blue Swallow habitat at the Impendle Nature Reserve is not just situated relatively distant from the project components in this area but is also located at a higher altitude, i.e. 'perched' on a plateau above the low-lying uMkhomazi River valley.

This finding that the project components in the western part of the project area, especially the construction of Smithfield Dam itself, is not of extreme conservation concern relevant to avifauna considerations, confirms a similar conclusion in the original Avifauna Specialist Study (WildSkies Ecological Service 2015), especially given that the preferred route options for the R617 deviation are now situated further from the Impendle Nature Reserve that originally proposed.

10. VIBRATION IMPACT ASSESSMENT

10.1 VIBRATION AS A POTENTIAL THREAT TO BREEDING BLUE SWALLOWS

The following discussion pertinent to potential ground-borne vibration concerns relevant to breeding Blue Swallows draws on the Vibration Impact Assessment for the uMWP-1 – Raw Water (Kroch & Heyns 2018) relevant to the engineering aspects of vibration.

Ground vibration could stem from the following three sources:

- Explosive blasting related to construction activities, e.g. in the establishment of tunnel outlets and associated with quarrying,
- General construction activities, e.g. from vibratory rollers, breaker excavators, large bulldozers, haul trucks, jack-hammers, etc., and
- Drilling of the actual water-transfer tunnel using a large underground rail-mounted drilling rig (a Tunnel Boring Machine (TBM)).

The vibrations could manifest in the following two different forms:

- Sudden impulse vibrations, e.g. from blasting, and
- Constant or continuous steady-state vibrations, e.g. from construction activities or the tunnel-drilling rig.

These two different forms of vibration disturbance could elicit different responses from nesting Blue Swallows. Impulse vibrations, which by their nature are transient, could result in sudden startle responses from the birds. Habituation by the birds to such disturbance is less likely than to a constant source of disturbance due to its transient nature. Such startle responses may or may not be so severe as to cause permanent abandonment of a breeding attempt. Steady-state vibrations, which by their nature are more long-term, are on the one hand potentially more disturbing to the birds due to their constant nature but on the other hand are potentially less disturbing due to their being less likely to elicit a sudden startle response and the greater possibility of the birds habituating (becoming accustomed) to such disturbance. In general, however, a permanent source of disturbance to birds is more significant in terms of its negative impact than a transient one.

Another potential threat to breeding Blue Swallows stemming from vibration could be potential nest collapse. Blue Swallow nests are typically directly attached to soil under overhangs in underground cavities. These localities are also typically very moist. Nest collapse is thus known as a major natural source of Blue Swallow nesting failure, especially associated with heavy rain. Vibration, even at very low levels, could exacerbate this problem to a significant degree. However, overall it might be expected that vibration high enough to damage a Blue Swallow nest structure would in any event also be high enough to cause enough disturbance to the birds themselves to cause them to abandon any breeding attempt. The Vibration Impact Assessment confirms that humans report vibrations as disturbing at a threshold below the limit where structure damage to buildings manifests.

The ground composition influences the strength and extent of vibration impacts – the harder the rock/soil, the stronger the vibrations propagate. The ground composition in the project area apparently is best classed as mainly ‘soft rock’ (shale and diamictite).

As pointed out in the Vibration Impact Assessment (Kroch & Heyns 2018), relevant empirical studies of the direct impacts of vibration *per se* on wild birds (never mind Blue Swallows themselves) are essentially non-existent. However, as small open-country birds that nest at (indeed below) ground level they can be expected to be particularly sensitive to any source of disturbance that they may perceive as potentially linked to possible predation. Vibration (and noise) would be precisely the type

of cue they can be expected to be particularly attuned to, as vibration could be associated with the approach of a predator (or possibly the imminent collapse or partial collapse of their underground nesting cavity). As with the potential disturbance to birds from vibrations, the potential impact of vibrations on nest structure integrity is also a subject that has not received empirical investigation. Vibrations, both impulse (e.g. from blasting) and continuous (e.g. from railways), can have negative impacts on human comfort and human structures, and information is available on such relationships. These are turned to here as 'proxies' to allow some subjective indication of the potential for the perception by and impact of vibrations on the birds.

It should be noted that many species of swallows nest under concrete bridges carrying road and rail links, including routes carrying very high intensities of road and rail traffic. These are now indeed the most usual nesting locations for colonially nesting swallows such as the South African Cliff Swallow *Petrochelidon spilodera*. These breeding swallows seem unperturbed and unaffected by the high intensity of vibration intrinsic to these structures in terms of both a direct disturbance factor and in terms of potential structural damage to the integrity of their nests. It is likely that both habituation to the vibrations and imprinting on such sites as nestlings play a part in the characteristic use of these nesting sites by these species. Blue Swallows are known to nest under road bridges and culverts in other parts of Africa (e.g. Tanzania) but such behaviour is not shown in South Africa. This suggests that the Blue Swallow may have some capacity to withstand vibrations when breeding. Relevant to potential structural damage to nests, however, it should be noted that nests built under bridges/culverts would be protected from dampness, unlike Blue Swallow nests situated in natural cavities, i.e. the latter may still be highly vulnerable to vibrations manifesting in such moist settings.

The large number of uncertainties relevant to assessing the potential disturbance to breeding Blue Swallows by vibrations render it even more important to apply a precautionary approach in this Assessment, especially given the highly precarious conservation status of the Blue Swallow.

10.2 Impulse Vibrations

Measurements of natural background ground vibration levels in the project area recorded a maximum vibration level of 1.7 mm/s Peak Particle Velocity (PPV) on a single occasion (Table 6-2 in Kroch & Heyns 2018). This was very much an outlying figure though and the next highest measurement, over many hours of measurement, of 0.57 mm/s was more than three times lower. The Vibration Impact Assessment (Kroch & Heyns 2018) therefore selected 0.57 mm/s as an apparently acceptable threshold for nesting Blue Swallows relevant to impulse (essentially blasting) vibrations. As stated in the Vibration Impact Assessment, this represents in the middle range of being "distinctly perceptible" by humans (but not disturbing). A follow-up assessment done as part of the Vibration Impact Assessment (*Appendix C* of that report) examined vibrations associated with a road bridge. The maximum recorded vibration level was 0.4 mm/s (also in the range "distinctly perceptible" by humans). This was taken to confirm that that 0.57 mm/s threshold was appropriate.

A map presented in the Vibration Impact Assessment (Figure 8-1 in that report and reproduced here as **Figure 10.1** below) shows impulse vibration radii (red circles) of 1 200 m from three localities where blasting is expected (for charges <90 kg) that exceed the tolerance threshold for Blue Swallows. Of these three localities, the locality associated with blasting for the borrow-pit location (associated with the Langa Balancing Dam) is the most concerning as it clearly impacts a large area of the main Zinty breeding Blue Swallow grassland block. Indeed Nesting Locality 1 lies within this blasting radius. This clearly demonstrates the very real danger posed by blasting vibrations to breeding Blue Swallows in this part of the project area.

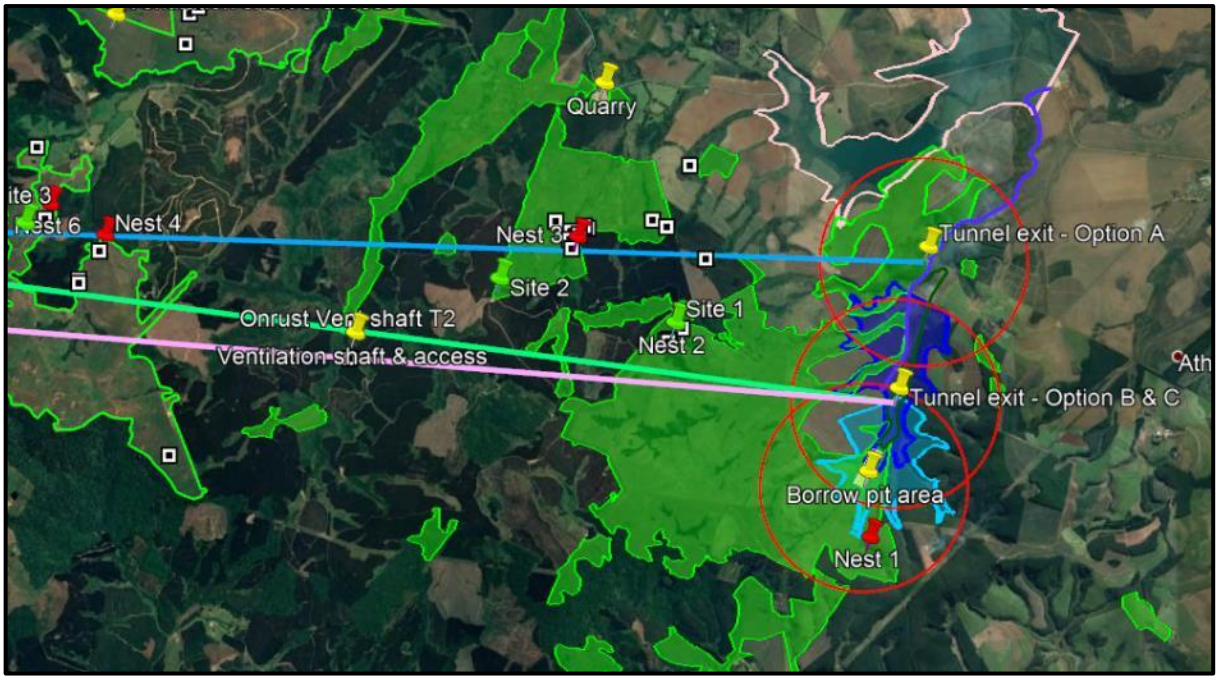


Figure 10.1: Projected Blast Radii (red circles) around the three Potential Blasting Sites in the Eastern Portion of the Project Area (taken directly from Kroch & Heyns 2018 Figure 8-1).

Relevant to the western part of the project area (Figure 8-2 in Kroch & Heyns 2018), the Vibration Impact Assessment shows that impulse vibration from blasting should have no impact on nesting Blue Swallows in that region, including at the Impendle Nature Reserve. This is due to the wide separation of the potential blasting sites and the Blue Swallow nesting areas.

10.3 STEADY -STATE VIBRATIONS

Relevant to the steady-state vibrations associated with general construction activities and tunnelling, it was decided to use a figure based on the vibrations emanating from a haul truck as measured at 50 m. This was based on the observation that one of the active Blue Swallow nests in the project area (Nesting Locality 5) was situated 50 m from a gravel road along which large forestry trucks commuted. This figure translated to 0.1 mm/s, which falls in the lower range of "barely perceptible". Nevertheless, it might be argued that vibration from a truck passing a locality along a road is better likened to an "impulse", rather than a "steady-state", vibration. It is of relevance/interest to note that the highest steady-state vibration recorded during the measurements of natural background ground vibration levels in the project area was 0.056 mm/s (Table 6-2 in Kroch & Heyns 2018). This is essentially in the range classed as "Imperceptible" and demonstrates that the current steady-state background vibration level experienced by the Blue Swallows is essentially non-existent. Any change upwards into even the levels of lowest steady-state vibration would be novel to the birds.

A map presented in the Vibration Impact Assessment (Figure 8-5 in that report and reproduced here as **Figure 10.2** below) shows the areas of Blue Swallow natural grassland predicted to be impacted by ground vibrations in excess of the steady-state threshold associated with general construction activities along the proposed road servicing the Mbangweni and Langa Balancing Dam options. These areas, although relatively small, are of concern due to the critically endangered status of the Blue Swallow (and as similar to the position outlined for noise disturbance as discussed in the following section covering the ENIA.

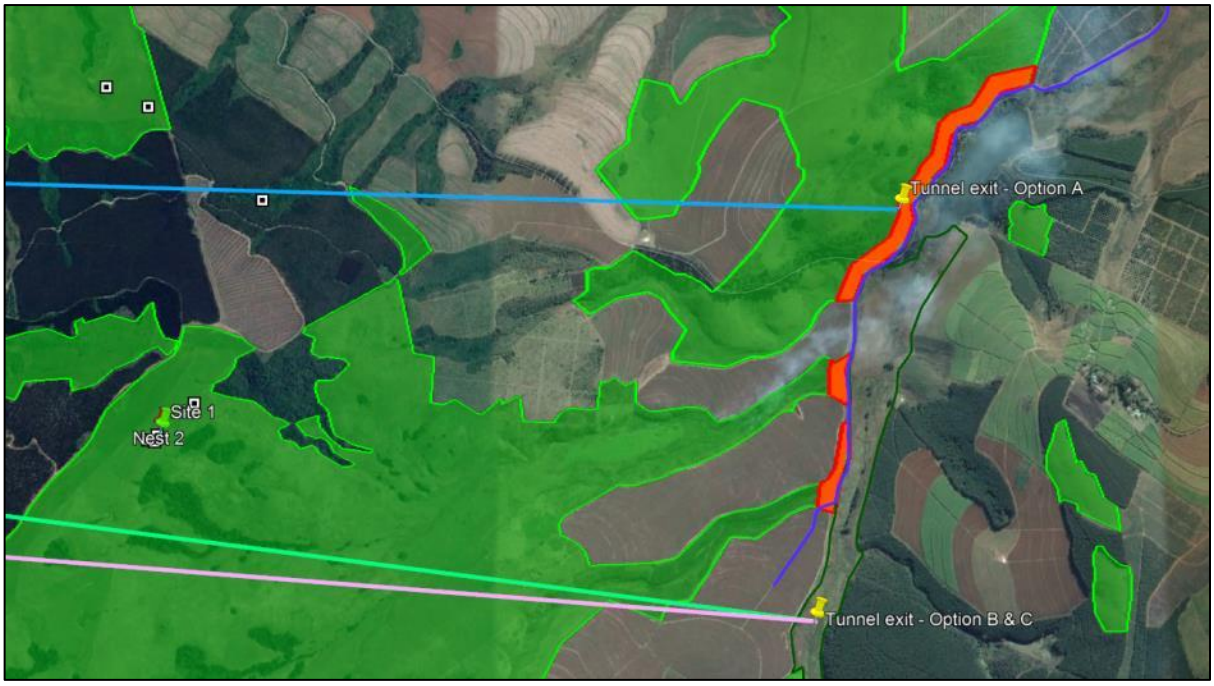


Figure 10.2: Areas (in orange) of Blue Swallow Habitat that will be subjected to Ground Vibrations in excess of the Steady State Threshold (taken directly from Kroch & Heyns 2018 Figure 8-5).

Relevant to potential damage to Blue Swallow nest structures through vibration, the most severe category relevant to building damage ("buildings extremely susceptible to vibration damage") was selected as a threshold: 3.05 mm/s, which corresponds to the lower threshold of being "disturbing to humans". But as mentioned above it might be expected that vibrations in this range would in any event also be high enough to cause such disturbance to the birds themselves to cause them to abandon any breeding attempt.

Turning to steady-state vibrations associated with tunnel drilling, the Vibration Impact Assessment suggests that ground vibrations due to tunnelling may exceed the ambient ground vibrations (0.056 mm/s) within 110 m and the threshold radius (0.1 mm/s) within 70 m. These distances of 110 m and 70 m are the distance from the source of the vibration through the ground. This means that only areas of Blue Swallow habitat close to the tunnel outlets in the eastern part of the project area would be impacted by such vibration (see **Figure 10.3** taken from Figure 8-10 in Kroch & Heyns 2018). It should be noted in particular that:

- The Blue Swallow population nesting in the Trewirgie Area and the Baynesfield Amphitheatre areas would apparently thus be completely unaffected by vibrations from tunnel drilling (despite Tunnel Option A traversing directly below currently active Blue Swallow nest sites at both localities), and

- Tunnel Options B and C would impact on the Zinty Blue Swallow breeding block. This thus represents a third impact from vibration on Blue Swallow breeding habitat.

The projected positions along the tunnel alignments are shown in **Figure 10.3** below where the threshold (red shading) and background (blue shading) ground vibrations would be exceeded by the underground tunnel-drilling rig in the eastern portion of the project area (taken directly from Kroch & Heyns 2018 Figure 8-10).

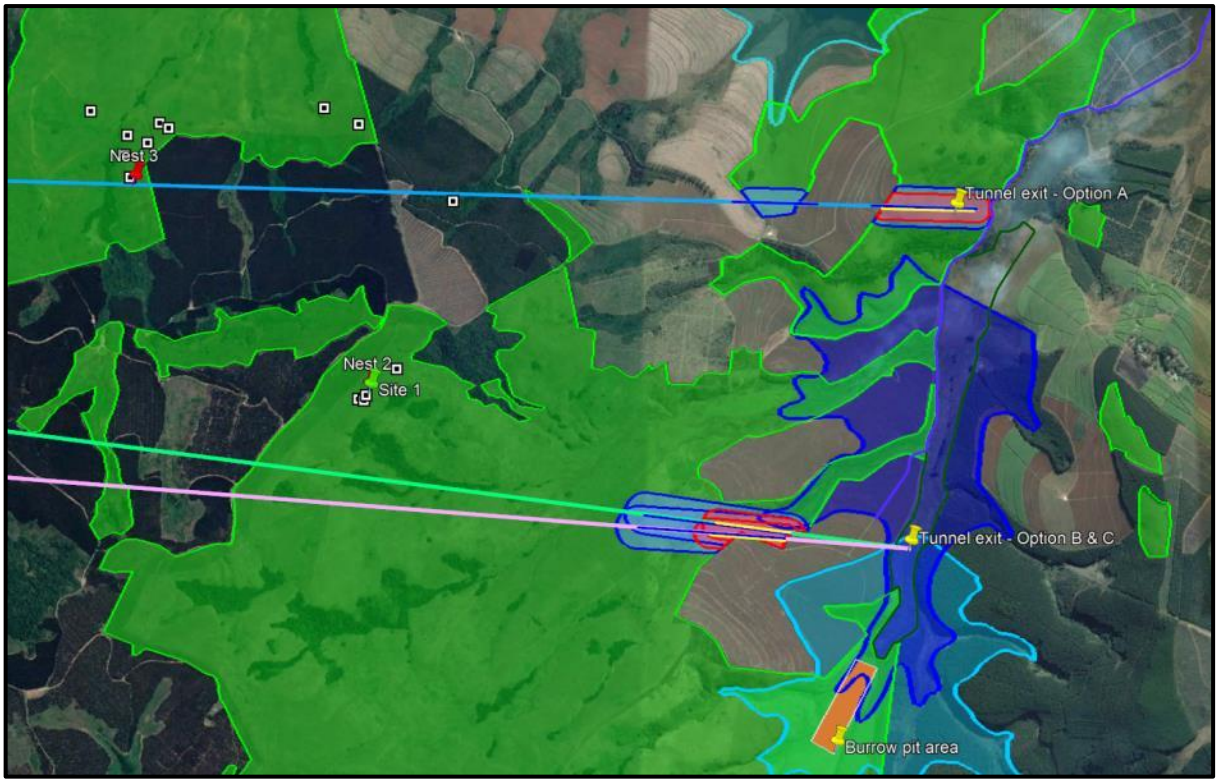


Figure 10.3: Projected positions along the Tunnel Alignment Options where the Threshold and Background Ground Vibrations would be exceeded by the Underground Tunnel Drilling Rig in the Eastern Portion of the Project Area

The time necessary to drill through these sections impacted by tunnel-drilling vibration is estimated at about 3-6 weeks (at an estimated speed of 130 m/week).

Tunnel-drilling vibration impacts at the opposite end of the tunnel, in the western part of the project area, is ignored, appropriately, in the Vibration Impact Assessment due to the wide distance between the tunnel inlet point and any Blue Swallow breeding habitat in that area.

11. ENVIRONMENTAL NOISE IMPACT ASSESSMENT

The ENIA (De Jager 2018) included a brief review on the impacts of noise on animals including birds and this will not be repeated here. No direct empirical information is available on the effects of noise on the Blue Swallows in particular. As a small passerine, Blue Swallows may have an absolute audibility threshold that is slightly less sensitive than in humans. It is known that birds, like other animals including humans, can be negatively impacted by noise. Such impacts can include physical damage to ears, increased stress, flight or flushing, changes in foraging, and other behavioural reactions, avoidance of noisy areas, changes in reproductive success, as well as changes in vocal communication. A review by Ortega (2012) is cited in this regard. It should be noted that noise and vibration are frequently related, with individual sources generating both phenomena.

The ENIA confirms the reality of noise as a potential threat to breeding Blue Swallows in the project area. Noise from construction activities at Langa and Mbangweni Balancing Dam options will extend into the surrounding primary natural Blue Swallow breeding and foraging mist-belt grassland. This includes the Zinty block of this habitat, especially if construction activities occur at night, and will indeed reach Nesting Locality 1 itself. This is also without considering any other potential construction activities in this area related to tunnel construction, road building, etc.

The ENIA suggests that during daytime construction activities up to 7% of the area of Blue Swallow habitat at Zinty would be potentially at risk from disturbance by noise from construction activities (see **Figure 11.1** below, taken from Figure 7-3 in De Jager 2018), although this disturbance is apparently not considered significant. Such disturbance, however, should be considered unacceptable from an avifaunal perspective given the critically endangered status of this bird. This undesirability is perhaps especially so given the statement in the ENIA reflecting some variability and unpredictability of noise impacts: "For environmental noise weather plays an important role, the greater the separation distance, the greater the influence of the weather conditions, so, from day to day, a road 1 000 m away can sound very loud or can be completely inaudible." The ENIA offers no mitigation measures relevant to daytime noise, presumably because none are considered necessary (see Table 8-1 in the ENIA).

Figure 11.1: Projected Conceptual Daytime Construction Activities - Contours of Noise Rating Levels (Eastern Part of the Project, taken directly from De Jager 2018 Figure 7-3).

The ENIA predicts that a far larger, but unquantified (see **Figure 11.2** below, taken from Figure 7-4 in De Jager 2018s, and **Figure 11.3** below taken from data provided by De Jager) proportion of habitat would be potentially impacted by night-time construction activities.

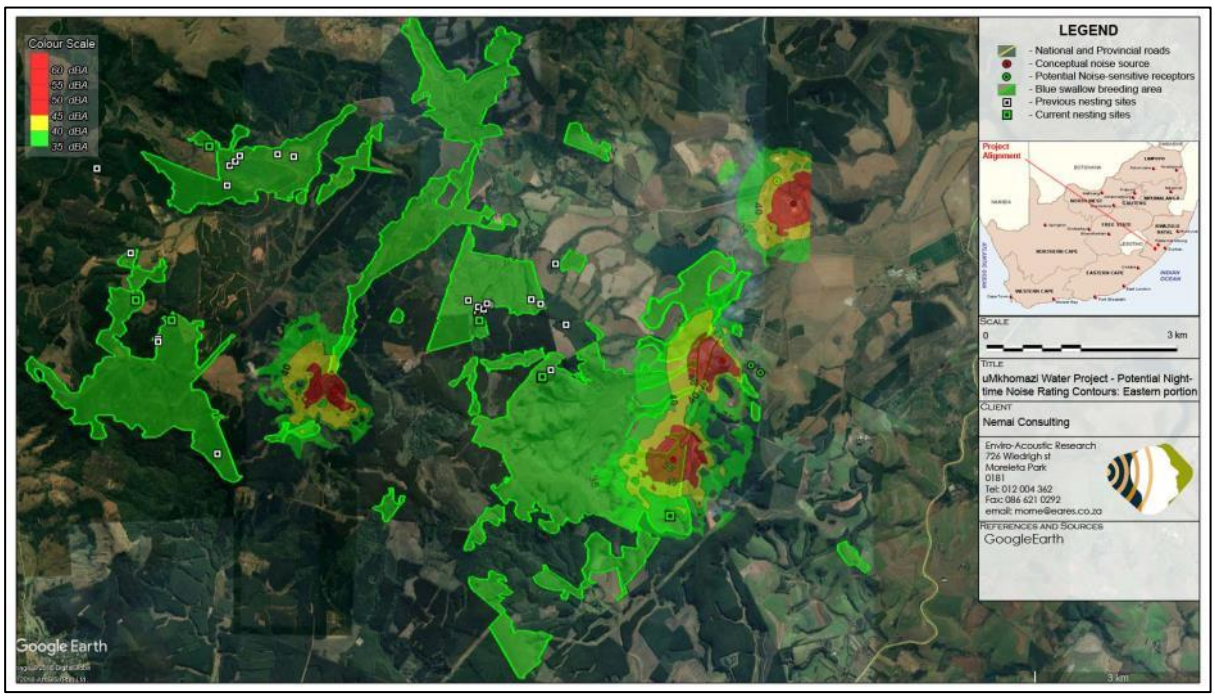


Figure 11.2: Projected Conceptual Night-time Construction Activities - Contours of Noise Rating Levels in the Eastern Part of Project Area; taken directly from De Jager 2018 Figure 7-4)

The sound contours shown in **Figure 11.3** below are in increments of 5 dBA with the outermost contour representing the extent of penetration by 30 dBA sounds (from information provided by De Jager). The locations of Nesting Localities 1 and 2 are also shown in **Figure 11.3** below with the former essentially lying on the 35 dBA contour.

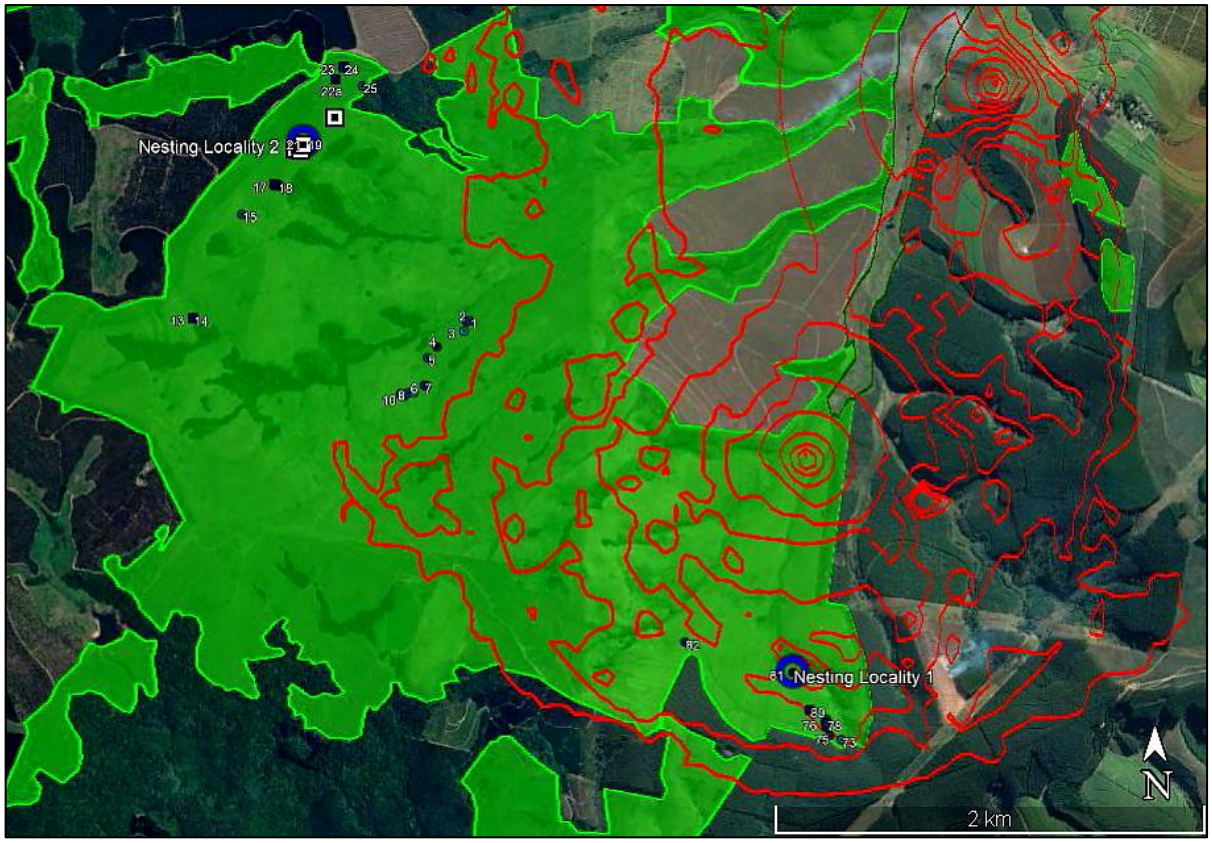


Figure 11.3: Projected Map showing the Extensive Penetration of Construction Related Sound Contours into the Main Zinty Blue Swallow Primary Grassland Breeding Habitat Block

The ENIA initially recommended that as mitigation no night-time construction activities should be permitted within 1 000 m of any active Blue Swallow nesting sites. This recommendation, however, flew in the face of the 1.5-2 km and 4 km buffers stipulated for Blue Swallow nests and as discussed earlier in this Report (refer **9.1.2** above). When this was conveyed to the Noise Specialist the ENIA Report was amended to reflect a figure of 1 500 m in this regard (although not uniformly in that report). It would have been preferred had this buffer been applied to Blue Swallow breeding habitat rather than actual nesting sites for the reasons discussed earlier in this Report (see 9.1.2 above).

A key point, however, relevant to both vibration and noise is that essentially no development at all, even if vibration-free and silent, should be considered within the buffer zones stipulated by conservation authorities as necessary for the protection of this species. Vibration and noise also serve as examples of elements contributing to potential cumulative effects of such proposed developments rendering the strict implementation of these conservation buffers as imperative.

Daytime and night-time noise pollution stemming from the construction of the Smithfield Dam walls in the western part of the project area is not expected to extend anywhere close to the Blue Swallow breeding and foraging habitat at the Impendle Natural Reserve or Mount Shannon (see Figures 7-7 and 7-8 in the ENIA Report). The ENIA, however, does not seem to address potential noise pollution associated with the construction of the R617 deviation, or the gravel service road west of Smithfield Dam and closer to the Impendle Nature Reserve. It is unlikely, however, that the R617 deviation or the gravel service road would present significant noise concerns relevant to breeding Blue Swallows in the western part of the project area.

12. OTHER BIRD SPECIES, INCLUDING RED DATA SPECIES

The 182 bird species recorded in the project area during this Avifauna Bridging Study are listed in **APPENDIX 2**. Red Data and endemic species are identified in **APPENDIX 4**.

The results of the water bird count made on 8 December 2017 along the Mbangweni River and along the Mlazi River just downstream of its confluence with the Mbangweni River, as well as at the small existing dam along the Mbangweni River and the large dam along the Mlazi River upstream of its confluence with the Mbangweni River are presented in **APPENDIX 3**. A total of 108 individuals of 21 water bird species were recorded during this count. The only Red Data species encountered was a Grey Crowned Crane.

Full details of all records of the 12 Red Data bird species (excluding Blue Swallow) encountered are provided in **APPENDIX 4**. Also included are the records of Red Data bird species contributed by Lukas Niemand in the Smithfield Dam area and his records included Southern Bald Ibis *Geronticus calvus* and Bush Blackcap *Lioptilus nigricapillus,* which were not recorded during the fieldwork for this Study. The localities where all these Red Data bird species were recorded in the eastern and western parts of the project area respectively are shown **Figures 12.1** and **12.2** below. The original Avifauna Specialist Study (WildSkies Ecological Service 2015) also provides detail of Red Data species recorded or expected in the project area, which is not duplicated here.

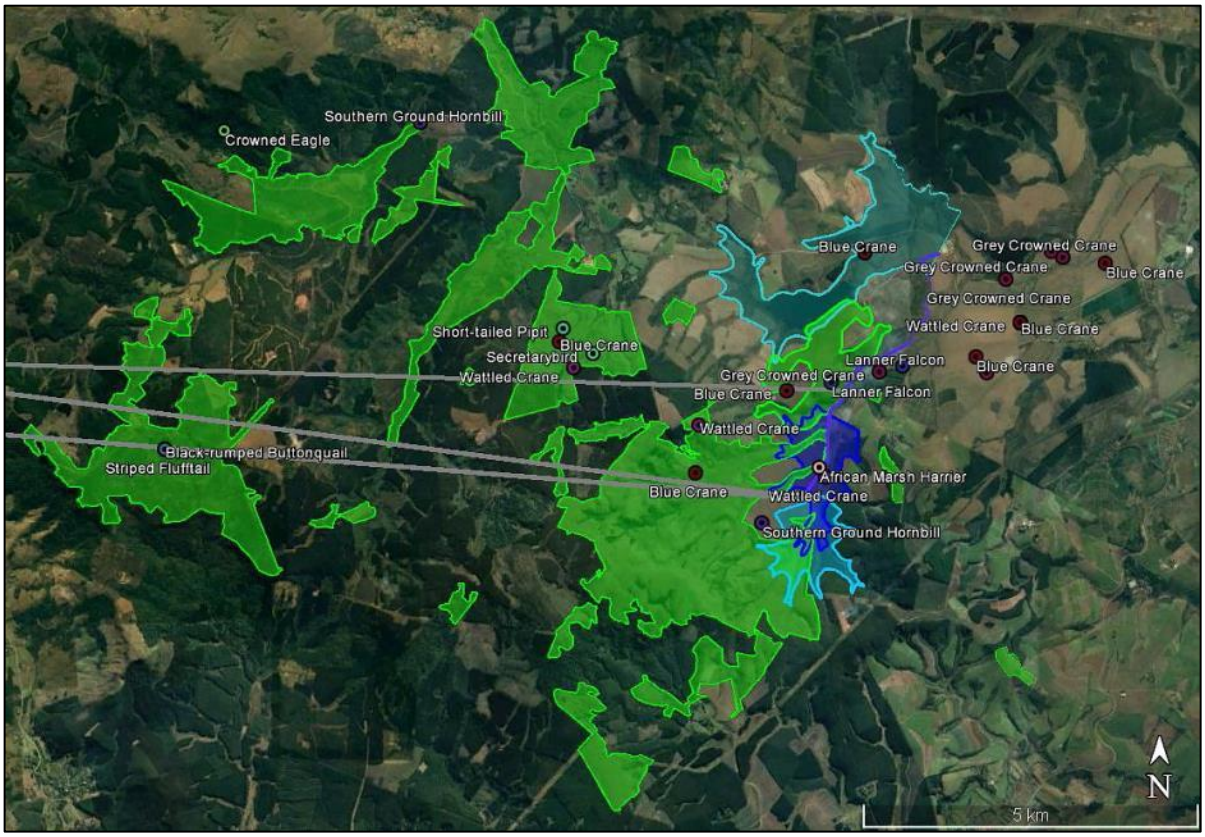


Figure 12.1: Localities of Red Data Bird Species (excluding Blue Swallow) recorded during this Assessment in the Eastern Part of the Project Area

The localities of Red Data bird species (excluding Blue Swallow) recorded during this Assessment in the eastern part of the project area, that are shown on **Figure 12.1** above, are superimposed on the Blue Swallow breeding habitat (green polygons) and the key project components, i.e. tunnel (grey lines) and balancing dam options, and balancing dam service road (purple line) all shown on **Figure 12.1** above.

Other than Blue Swallow, the most significant Red Data species encountered in the eastern part of the project area was a pair of Wattled Cranes recorded several times on Baynesfield Estate. This species shares the same 'Critically Endangered' status as the Blue Swallow (Taylor *et al.* 2015). This species apparently is not normally recorded on Baynesfield (Derek Clark and Brent Coverdale pers. comm.). Further observations are required in order to determine if this pair of Wattle Cranes is resident on the property. There is no evidence that they breed on Baynesfield Estate.

Relevant to other crane species, Blue Cranes, including at least two breeding pairs with fledged young, and Grey Crowned Cranes, including at least two pairs, were recorded on Baynesfield Estate (see **Figure 12.1** above and **APPENDIX 4**). The original Avifauna Specialist Study (WildSkies Ecological Service 2015) also noted the presence and significance of Blue and Grey Crowned Cranes in this area.

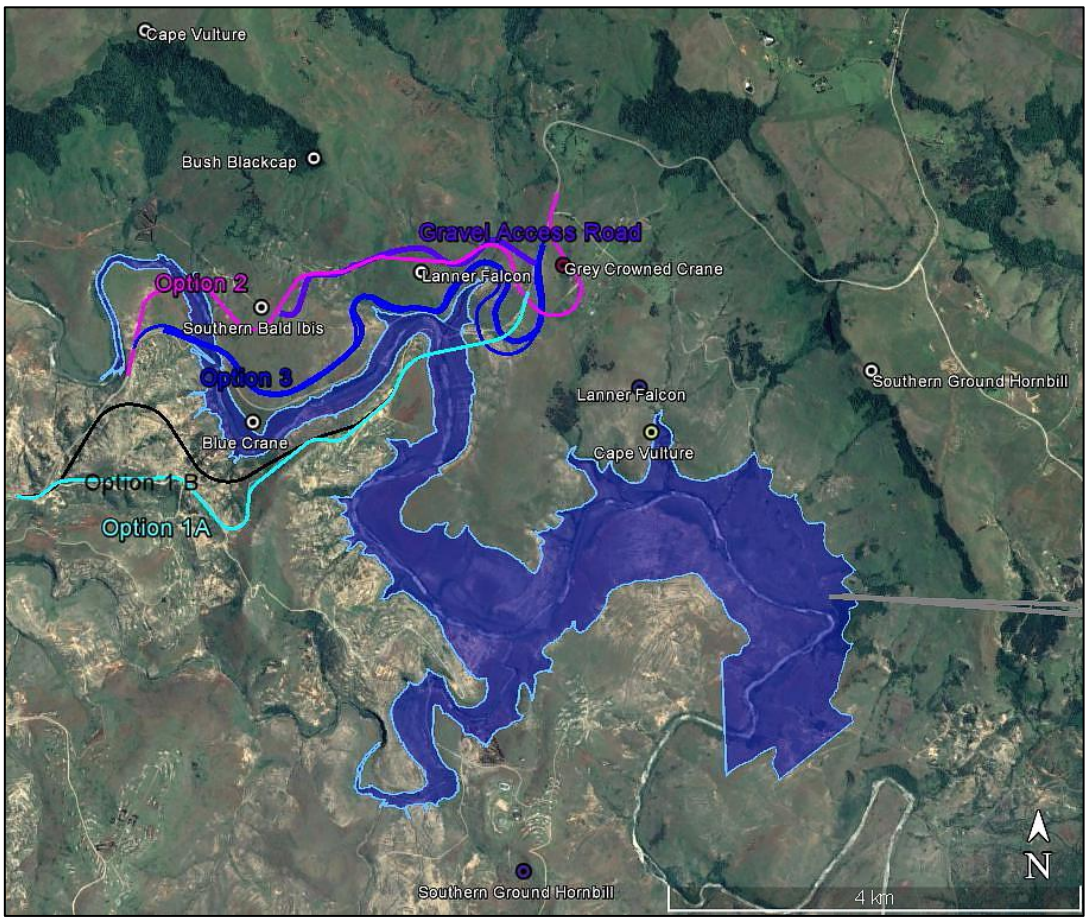


Figure 12.2: Localities of Red Data Bird Species (excluding Blue Swallow) recorded during this Assessment in the Western Part of the Project Area

The coloured symbols in **Figure 12.2** above are D. Allan records, and the white symbols in **Figure 12.2** above are L. Niemand records. These symbols (coloured and white) are superimposed on the key project components, i.e. Smithfield Dam, Tunnel (grey lines) and road options in **Figure 12.2** above.

Relevant to the western part of the study area, the most significant records of Red Data species were of a pair of Grey Crowned Cranes and the presence of Southern Bald Ibis (see **Figure 12.2** above and **APPENDIX 4**). The latter species likely roosts and possibly breeds on cliffs along the uMkhomazi River, including some that will be affected by the inundation of Smithfield Dam. The Lanner Falcon is another Red Data species that likely breeds on cliffs along the uMkhomazi River. Both of these species breed during winter to early spring and this Assessment was timed too late in the year to confirm nesting by these two species in the project area. Additional follow-up work in the coming winter-spring period is recommended in this regard.

13. ASSUMPTIONS MADE AND UNCERTAINTIES OR GAPS IN KNOWLEDGE

This Avifauna Bridging Study and other associated studies, e.g. the Vibration Impact Assessment and ENIA, have gone a long way in reducing the previous uncertainties and gaps in knowledge associated with the original EIA. The exact status of Blue Swallows in the project area, relevant to the eastern part of the project area, has been elucidated and updated in the necessary detail. Although certain empirical unknowns remain as to the potential impact and thresholds of vibration and noise impacts on breeding and foraging Blue Swallows, due to a total absence of such information and the lack of feasibility of gathering such information within the constraints faced by this project, at least the reality of these two threats has been confirmed. The precautionary principle has been applied throughout to account for unavoidable uncertainties and assumptions.

14. CONSIDERATION OF THE ALTERNATIVE BALANCING DAM, TUNNEL ROUTE AND THE R617 DEVIATION OPTIONS

The consideration of alternative options is relevant to the following three aspects of the uMWP-1: Balancing Dams, Tunnel Routes and the R617 Deviation), as discussed in **13.1** to **13.3** below:

14.1 BALANCING DAMS

Relevant to the choice of balancing dam from the three suggested options (Langa, Mbangweni and Baynesfield Balancing Dams), this Assessment clearly shows that Baynesfield Balancing Dam is the obvious choice from an avifaunal perspective.

14.2 TUNNEL ROUTES

Since the Baynesfield Balancing Dam Option is the obvious choice from an avifaunal perspective, Tunnel Option A is the obvious choice in that regard as its outlet is closest to the Baynesfield Balancing Dam Option. From an avifaunal perspective, its outlet is also the most distant from the main Zinty Blue Swallow breeding habitat patch, as well as from Nesting Locality 1, compared with the outlet for Tunnel Options B and C. Unfortunately the outlet for Tunnel Option A is situated both in primary natural grassland and within the 1.5 km Blue Swallow breeding habitat buffer, although the outlet for Tunnel Options B and C is even further within this buffer. The outlet for Tunnel option A, however, due to its relatively small footprint, and the fact that it is not situated in the main Zinty grassland block could likely be considered acceptable from an avifaunal perspective. This acceptability though would be subject to carefully mitigation by reducing the size of its footprint to an absolute minimum and restricting construction activities to the period when Blue Swallows are not present (April-September). In addition, any potential steps that could be taken to move the tunnel outlet out of natural grassland and further away from the Zinty grassland block would be beneficial.

14.3 PROVINCIAL ROAD R617 DEVIATION

Of the four options most recently suggested for the R617 deviation, all, including the preferred option, which is 1B, would appear acceptable from an avifaunal perspective. Essentially, the options that occur furthest from the Impendle Nature Reserve, including option 1B, are the most preferred from an avifaunal perspective.

15. MITIGATION MEASURES

15.1 EASTERN PART OF THE PROJECT AREA

Potential mitigation measures pertaining to the eastern part of the project area are discussed in **14.1.1** to **14.1.3** below.

15.1.1 Baynesfield Balancing Dam

Further clarification is required as to confirmation that the Baynesfield Balancing Dam Option will be the chosen before any mitigation measures specific to the Baynesfield Balancing Dam are proposed. Minor mitigation should be required in this regard, however, as this balancing dam option lies outside any area of direct concern relevant to Blue Swallows (or other Red Data bird species).

The issue of the tunnel outlet (Tunnel Option A) occurring in both primary natural grassland and within the 1.5 km Blue Swallow habitat buffer also calls for mitigation. As mentioned in Section 14.2 above, the relevant mitigation would involve reducing the size of the footprint of the tunnel outlet to an absolute minimum and restricting construction activities to the period when Blue Swallows are not present (April-September). In addition, any potential steps that could be taken to move the tunnel outlet out of natural grassland and further away from the Zinty grassland block would be beneficial.

15.1.2 Vibration

The Vibration Impact Assessment (Kroch & Heyns 2018) shows clear predicted impacts from all three sources of two types of vibration examined: impulse (blasting) and steady-state (construction and tunnelling) vibrations. The key mitigation measures recommended relevant to the proposed Langa Balancing Dam borrow pit pertaining to blasting are: to restrict blasting to the period when the birds are not present (April – September), limit the amount of explosives used per blast, or to use non-explosive methods of rock breaking. It is recommended that both blasting and drilling at the tunnel outlet areas be restricted to the period when the swallows are absent.

15.1.3 Noise

Although the ENIA (De Jager 2018) suggests that during daytime construction activities up to 7% of the area of Blue Swallow habitat at Zinty would be potentially at risk from disturbance by noise from construction activities, this disturbance is apparently not considered significant, and no mitigation measures are suggested presumably because none are considered necessary (see Table 8-1 in the ENIA). As mentioned above (see Section 11), however, such disturbance should be considered unacceptable from an avifaunal perspective given the critically endangered status of the Blue Swallows. Mention is made in the ENIA of “acoustic screens” but these are not formally recommended.

The ENIA predicts that a far larger proportion of habitat would be potentially impacted by night-time construction activities, and recommended that no night-time construction activities should be permitted within 1500 m of any active nesting sites. As mentioned above, it would have been preferred had this buffer been applied to Blue Swallow breeding habitat rather than actual nesting sites for the reasons discussed earlier in this Report (refer **Section 11** above).

Given that the ENIA showed that noise pollution would extend into Blue Swallow nesting habitat, it might have been expected that mitigation measures in terms of limiting such potential disturbance to the period when the birds are absent (April – September), as in the Vibration Impact Assessment might have been considered.

15.2 Western Part of the Project Area

Potential mitigation measures pertaining to the western part of the project area are discussed in **15.2.1** and **15.2.2** below:

15.2.1 Provincial Road R617 Deviation

Once the final R617 deviation route has been decided upon, a final brief field examination should be undertaken to identify any avifaunal elements that may require mitigation during the road construction period.

15.2.2 Smithfield Dam

As mentioned above (see Section12), the Smithfield Dam Basin, which will be inundated, should be examined during the winter to spring period to confirm if any significant bird species are breeding on cliffs along the uMkhomazi River (or in tall trees along the river itself). Where possible, impoundment of the dam should be timed to avoid the sensitive breeding period of such birds to minimise the risk of drowning active breeding attempts (some search-and-rescue actions may be required in this regard).

16. CONSULTATION PROCESSES

The following people were consulted with relevance to gathering background and other information relevant to this avifauna bridging study (see also under 'Acknowledgements' below).

- Derek Clark and John Kennedy (both of the Blue Swallow Working Group monitoring team and the latter also a Trustee of the Baynesfield Estate) and Myles van Deventer (Managing Director) – all relevant to the Baynesfield Estate.
- Barbara Seele of Trewirgie Farm.
- Brent Coverdale, Athol Marchant and Steve McKean, current or past employees of Ezemvelo KZN Wildlife.
- Other members of the EIA Team, including Rudi Kroch - Vibration Specialist, Morné De Jager - Noise Specialist, Lukas Niemand - Invertebrate Specialist, Steven van Staden - Biodiversity Offset Study, and Alan Main - R617 deviation.

17. IMPACT ASSESSMENT

The Vibration Impact Assessment Report (Kroch & Heyns 2018) presents impact tables designed to summarize the key relevant environmental impacts (essentially related to Blue Swallows). These impact tables are based on the following criteria based on Koch & Heyns 2018, see also **Table 17.1** below):

- Occurrence:
    - Probability of occurrence, and
    - Duration of occurrence
- Severity:
    - Magnitude of impact, and
    - Scale/extent of impact

The Environmental Significance (SP) was assessed according to the following equation (see below for the scaling factors):

$$SP = (M + D + S) \times P$$

Where:

SP = Environmental Significance
M = Magnitude
D = Duration
S = Scale
P = Probability

Overall environmental significance is rated according to the following assessment scale:

- More than 60 indicates a High [H] Environmental Significance;
- Between 30 and 60 points indicates Moderate [M] Environmental Significance, and
- Lower than 30 indicates a Low Environmental Significance [L].

Table 17-1: Criteria and Scoring of Environmental Impacts relevant to Probability, Scale, Duration and Magnitude of Potential Threats from an Avifaunal Perspective.

Probability	Duration
5 Definite/ don't know 4 Highly probable 3 Medium probability 2 Low probability 1 Improbable 0 None	5 Permanent 4 Long term (full operational life) 3 Medium term 2 Short term 1 Immediate
Scale	**Magnitude**
5 International 4 National 3 Regional 2 Local 1 Site only 0 None	10 Very high/ don't know 8 High 6 Moderate 4 Low 2 Minor

The information presented covering the potential impact of vibrations is reproduced below and supplemented with identical assessments from this report related to the re-routing of the R617 and the construction of the Baynesfield, Mbangweni and Langa Balancing Dams (see **Table 17.2** to **17.5** below). **Table 17.5** below was taken directly from the Vibration Impact Assessment Report.

Table 17-2: Environmental Impact of the Re-routing of the R617 before and after Mitigation from an Avifaunal Perspective

Re-routing of the R617	Environmental Significance					
	Magnitude	Duration	Scale	Probability	TOTAL	Significance
Before mitigation	8	5	4	3	51	M
After mitigation	4	5	4	2	26	L

Table 17-3: Environmental Impact of the Baynesfield Balancing Dam Option before and after Mitigation from an Avifaunal Perspective

Baynesfield Balancing Dam Option	Environmental Significance					
	Magnitude	Duration	Scale	Probability	TOTAL	Significance
Before mitigation	4	5	4	2	26	L
After mitigation	2	5	4	2	22	L

Table 17-4: Environmental Impact of the Langa and Mbangweni Balancing Dam Options before and after Mitigation from an Avifaunal Perspective

Langa and Mbangweni Balancing Dam Options	Environmental Significance					
	Magnitude	Duration	Scale	Probability	TOTAL	Significance
*Before mitigation**	10	5	4	5	95	H
*After mitigation**	10	5	4	5	95	H

** No mitigation feasible as the construction of these two dams and their associated infrastructure involves permanent destruction of critical habitat.*

Table 17-5: Environmental Impact of the Tunnel Option A Outlet from an Avifaunal Perspective

Tunnel Option A	Environmental Significance					
	Magnitude	Duration	Scale	Probability	TOTAL	Significance
Before mitigation						
Before mitigation	8	5	4	3	51	M
After mitigation – reducing size of footprint	6	3	4	3	39	M
After mitigation – moving out of primary grassland/outside of	4	2	4	2	20	L

Tunnel Option A	Environmental Significance					
	Magnitude	Duration	Scale	Probability	TOTAL	Significance
1.5 km buffer						

Table 17-6: Environmental Impact of Vibration before and after Mitigation from an Avifaunal Perspective

Vibration	Environmental Significance					
	Magnitude	Duration	Scale	Probability	TOTAL	Significance
Before mitigation						
Blasting	10	3	2	4	60	H
Construction	8	3	2	4	52	M
Tunnelling	8	2	2	4	48	M
After mitigation						
Blasting	10	3	2	2	30	M
Construction	8	3	2	2	26	L
Tunnelling	8	2	2	2	24	L

Although the ENIA Report (De Jager 2018) outlines an identical impact assessment methodology, it is not comprehensively applied to the information presented in the same way as the information above and therefore cannot be reproduced here.

18. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that:

- All of the uMWP-1 – Raw Water Component, with the exception of the Langa and Mbangweni Balancing Dam options, would appear acceptable for Environmental Authorisation from an avifaunal perspective, subject to the recommended mitigation measures being implemented.
- The Langa and Mbangweni Balancing Dam Options should be considered as fatally flawed ('no-go) for the reasons, primarily based on habitat destruction, as outlined in detail in this Report (see **Section 9.1.2** above).
- The Baynesfield Balancing Dam Option is an acceptable alternative from an avifaunal perspective.
- The outlet for Tunnel option A could likely be considered acceptable from an avifaunal perspective if carefully mitigated (see Section 14.2 above)
- The fatal flaws inherent to both the Langa and Mbangweni Balancing Dam options cannot be mitigated for as they involve permanent destruction of irreplaceable critical habitat for Blue Swallows.
- Any offset approach would also seem inappropriate for the same reason, i.e. the permanent destruction of irreplaceable critical habitat.
- In addition, any offset would require the rehabilitation of an unrealistically large extent of previous Blue Swallow habitat, which is a highly specialized habitat type that is essentially not known to be amenable to rehabilitation once destroyed.
- Consideration of any 'biodiversity compensation mechanism' in the face of this challenge is beyond the scope of this Avifauna Bridging Study.
- The rigid preservation of all of the limited amount of remaining habitat of the Blue Swallow would appear the only hope of avoiding the imminent extinction of this species in South Africa.

It is recommended that:

- The uMWP-1 – Raw Water Component, all the parts of which except for the Langa and Mbangweni Balancing Dam options seem acceptable from any avifaunal perspective, implements the Baynesfield Balancing Dam option and does implement the Langa and Mbangweni Balancing Dam options.
- The outlet for Tunnel option A, if implemented, should carefully mitigated by reducing the size of its footprint to an absolute minimum and restricting construction activities to the period when Blue Swallows are not present (April-September). In addition, any potential steps that could be taken to move the tunnel outlet out of natural grassland and further away from the Zinty grassland block would be beneficial.

19. REASONED OPINION PERTAINING TO ENVIRONMENTAL AUTHORISATION FOR THE UMWP-1 OR PORTIONS THEREOF

A reasoned opinion is given below as to whether the propose activity (the uMWP-1), or portions thereof should be authorised and any conditions of the Environmental Authorisation:

All of the uMWP-1 – Raw Water Component would appear acceptable for Environmental Authorisation from an avifaunal perspective, subject to the recommended mitigation measures being implemented, except for the Langa and Mbangweni Balancing Dam options, which should be considered as fatally flawed ('no-go') for the reasons, primarily based on habitat destruction, as outlined in detail in this Report (see **Section 9.1.2** above). The Baynesfield Balancing Dam Option, however, is an acceptable alternative from an avifaunal perspective. The outlet for Tunnel option A could likely be considered acceptable from an avifaunal perspective if carefully mitigated (see Section 14.2 above).

20. MONITORING REQUIREMENTS

Clarification and confirmation of the selected balancing dam option and tunnel route option are required before a detailed Monitoring Programme covering the Blue Swallows in the project area can be devised. In general terms, however, a generic monitoring programme of the Blue Swallows should follow the outline described below.

All monitoring protocols should following the procedures outlined in Marchant (2006).

The areas that should be monitored for Blue Swallows should include:

- Impendle Nature Reserve.
- The Mt Shannon Blue Swallow area.
- The Blue Swallow areas at Baynesfield and Trewirgie, and immediately adjacent areas.

The monitoring effort should co-ordinate closely with that of the Blue Swallow Working Group and the workers of this group already monitoring these sites. For example, the Blue Swallow population on Impendle Nature Reserve is typically monitored by Ezemvelo KZN Wildlife (EKZNW) staff directly.

The monitoring effort should begin annually in October when the birds return to South Africa and conclude in March when they migrate away again.

The primary aims of the monitoring effort should be to:

- Determine the number of active breeding pairs in the areas being monitored.
- Plot the precise locations of the nest sites used.
- Monitor the breeding success at each active nest.

In addition and of particular importance, the monitoring effort associated with the uMWP-1 – Raw Water Project should monitor the direct impact of the relevant project components on the Blue Swallows. In this regard, flexibility will be required, with on-site monitoring required at the times and places coinciding with the implementation of key relevant project components. This is likely to be particularly relevant related to potential vibration and noise aspects in the eastern part of the project area as discussed in Sections 10 and 11 above. Close coordination with an Avifaunal Specialist experienced with Blue Swallows will be essential throughout the construction period.

Relevant to other Red Data bird species, the need for further investigation of cliff-nesting species at the appropriate times of year in the impoundment area of Smithfield Dam in the western part of the project area is also mentioned in **Section 12** above. This should be followed up by further monitoring during the period when actual impoundment occurs in case any 'search-and-rescue' operations are required in this regard (see also Section 15.2.2 above).

21. ACKNOWLEDGEMENTS

The following parties are thanked for their assistance during the course of this Assessment:

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APPENDIX 1: DETAILS OF THE 147 HOLES LOCATED DURING THIS ASSESSMENT IN THE EASTERN PART OF THE PROJECT AREA (BAYNESFIELD AND TREWIRGIE, AND IMMEDIATELY ADJACENT PROPERTIES)

Hole No.	Locality	Co-ordinates	Date	Hole Type	Rank (1-5)	Aspect	Overgrown?
1	Baynesfield	29° 47.341 S 30° 16.821 E	29-Nov-17	Antbear hole	2	E	Yes
2	Baynesfield	29° 47.343 S 30° 16.812 E	29-Nov-17	Antbear hole	3	E	Yes
3	Baynesfield	29° 47.367 S 30° 16.804 E	29-Nov-17	Antbear hole	1	S	Yes
4	Baynesfield	29° 47.407 S 30° 16.726 E	29-Nov-17	Antbear hole	4	N	No
5	Baynesfield	29° 47.434 S 30° 16.699 E	29-Nov-17	Antbear hole	2	E	Yes
6	Baynesfield	29° 47.505 S 30° 16.696 E	29-Nov-17	Antbear hole	4	E	No
7	Baynesfield	29° 47.504 S 30° 16.689 E	29-Nov-17	Antbear hole	3	E	No
8	Baynesfield	29° 47.522 S 30° 16.659 E	29-Nov-17	Antbear hole	1	E	Yes
9	Baynesfield	29° 47.523 S 30° 16.641 E	29-Nov-17	Antbear hole	2	E	Yes
10	Baynesfield	29° 47.530 S 30° 16.633 E	29-Nov-17	Antbear hole	2	E	No
11	Baynesfield	29° 47.526 S 30° 16.621 E	29-Nov-17	Antbear hole	2	S	Yes
12	Baynesfield	29° 47.525 S 30° 16.622 E	29-Nov-17	Antbear hole	3	E	No
13	Baynesfield	29° 47.334 S 30° 16.020 E	29-Nov-17	Sinkhole	5	N	No
14	Baynesfield	29° 47.335 S 30° 16.021 E	29-Nov-17	Sinkhole	4	n/a	Yes
15	Baynesfield	29° 47.073 S 30° 16.161 E	29-Nov-17	Antbear hole	2	E	No
16	Baynesfield	29° 46.997 S 30° 16.255 E	29-Nov-17	Sinkhole	5	n/a	No
17	Baynesfield	29° 46.999 S 30° 16.259 E	29-Nov-17	Sinkhole	5	n/a	No
18	Baynesfield	29° 47.001 S 30° 16.265 E	29-Nov-17	Sinkhole	5	n/a	No
19	Baynesfield	29° 46.892 S 30° 16.350 E	29-Nov-17	Sinkhole	4	E	No
20	Baynesfield	29° 46.892 S 30° 16.339 E	29-Nov-17	Sinkhole	5	N	No
21	Baynesfield	29° 46.892 S 30° 16.357 E	29-Nov-17	Sinkhole	4	S	Yes
22a	Baynesfield	29° 46.733 S 30° 16.433 E	29-Nov-17	Sinkhole	5	S	Yes
22b	Baynesfield	29° 46.701 S 30° 16.455 E	29-Nov-17	Sinkhole	4	n/a	Yes
23	Baynesfield	29° 46.702 S 30° 16.456 E	29-Nov-17	Sinkhole	4	n/a	Yes
24	Baynesfield	29° 46.703 S 30° 16.457 E	29-Nov-17	Sinkhole	4	n/a	Yes
25	Baynesfield	29° 46.750 S 30° 16.511 E	29-Nov-17	Antbear hole	2	S	Yes
26	Baynesfield	29° 46.616 S 30° 15.087 E	3-Dec-17	Antbear hole	4	NE	No
27	Baynesfield	29° 46.615 S 30° 15.091 E	3-Dec-17	Antbear hole	3	NE	No
28	Baynesfield	29° 46.619 S 30° 15.091 E	3-Dec-17	Antbear hole	3	NE	No
29	Baynesfield	29° 46.618 S 30° 15.094 E	3-Dec-17	Antbear hole	1	NE	No
30	Baynesfield	29° 46.622 S 30° 15.099 E	3-Dec-17	Antbear hole	3	NE	No
31	Baynesfield	29° 46.631 S 30° 15.101 E	3-Dec-17	Antbear hole	2	NE	No
32	Baynesfield	29° 46.611 S 30° 15.101 E	3-Dec-17	Antbear hole	1	NE	No
33	Baynesfield	29° 46.622 S 30° 15.113 E	3-Dec-17	Antbear hole	3	N	No
34	Baynesfield	29° 46.620 S 30° 15.115 E	3-Dec-17	Antbear hole	3	NE	No
35	Baynesfield	29° 46.620 S 30° 15.115 E	3-Dec-17	Antbear hole	3	NE	No
36	Baynesfield	29° 46.623 S 30° 15.124 E	3-Dec-17	Antbear hole	3	N	No
37	Baynesfield	29° 46.621 S 30° 15.138 E	3-Dec-17	Antbear hole	1	NE	No
38	Baynesfield	29° 46.628 S 30° 15.164 E	3-Dec-17	Antbear hole	3	N	Yes
39	Baynesfield	29° 46.612 S 30° 15.189 E	3-Dec-17	Antbear hole	4	N	No
40	Baynesfield	29° 46.607 S 30° 15.186 E	3-Dec-17	Antbear hole	2	W	No
41	Baynesfield	29° 46.530 S 30° 15.271 E	3-Dec-17	Antbear hole	1	n/a	Yes
42	Baynesfield	29° 46.502 S 30° 15.207 E	3-Dec-17	Sinkhole	1	E	Yes
43	Baynesfield	29° 46.579 S 30° 15.100 E	3-Dec-17	Antbear hole	2	E	Yes
44	Baynesfield	29° 46.589 S 30° 15.095 E	3-Dec-17	Antbear hole	1	E	Yes
45	Baynesfield	29° 46.602 S 30° 15.089 E	3-Dec-17	Antbear hole	3	NE	No
46	Baynesfield	29° 46.600 S 30° 15.082 E	3-Dec-17	Antbear hole	2	NE	Yes
47	Baynesfield	29° 46.566 S 30° 15.425 E	3-Dec-17	Antbear hole	3	N	No
48	Baynesfield	29° 46.559 S 30° 15.414 E	3-Dec-17	Antbear hole	3	E	No
49	Baynesfield	29° 46.550 S 30° 15.410 E	3-Dec-17	Antbear hole	3	NE	No
50	Baynesfield	29° 46.546 S 30° 15.409 E	3-Dec-17	Antbear hole	2	NE	Yes
51	Baynesfield	29° 46.557 S 30° 15.401 E	3-Dec-17	Antbear hole	1	NE	No
52	Baynesfield	29° 46.564 S 30° 15.380 E	3-Dec-17	Antbear hole	3	N	No
53	Baynesfield	29° 46.505 S 30° 15.313 E	3-Dec-17	Sinkhole	3	n/a	Yes
54	Baynesfield	29° 46.492 S 30° 15.345 E	3-Dec-17	Antbear hole	3	E	No
55	Baynesfield	29° 46.491 S 30° 15.387 E	3-Dec-17	Antbear hole	1	N	No
56	Baynesfield	29° 46.439 S 30° 15.388 E	3-Dec-17	Sinkhole	3	n/a	No
57	Baynesfield	29° 46.440 S 30° 15.384 E	3-Dec-17	Sinkhole	3	n/a	No

Hole No.	Locality	Co-ordinates	Date	Hole Type	Rank (1-5)	Aspect	Overgrown?
58	Baynesfield	29° 46.423 S 30° 15.387 E	3-Dec-17	Sinkhole	3	n/a	Yes
59	Baynesfield	29° 46.417 S 30° 15.383 E	3-Dec-17	Sinkhole	2	n/a	No
60	Baynesfield	29° 46.414 S 30° 15.383 E	3-Dec-17	Sinkhole	2	n/a	Yes
61	Baynesfield	29° 46.409 S 30° 15.376 E	3-Dec-17	Sinkhole	4	S	No
62	Baynesfield	29° 46.449 S 30° 15.315 E	3-Dec-17	Antbear hole	3	NE	No
63	Baynesfield	29° 46.356 S 30° 15.328 E	3-Dec-17	Antbear hole	3	N	No
64	Baynesfield	29° 46.343 S 30° 15.287 E	3-Dec-17	Sinkhole	1	n/a	Yes
66	Baynesfield	29° 46.429 S 30° 15.449 E	3-Dec-17	Antbear hole	2	E	No
67	Baynesfield	29° 46.445 S 30° 15.456 E	3-Dec-17	Antbear hole	1	E	No
68	Baynesfield	29° 46.528 S 30° 15.431 E	3-Dec-17	Sinkhole	1	N	Yes
69	Baynesfield	29° 46.385 S 30° 15.642 E	3-Dec-17	Antbear hole	2	NW	No
70	Baynesfield	29° 46.381 S 30° 15.658 E	3-Dec-17	Antbear hole	3	NW	No
71	Baynesfield	29° 46.379 S 30° 15.681 E	3-Dec-17	Antbear hole	2	NW	No
72	Baynesfield	29° 46.352 S 30° 15.641 E	3-Dec-17	Antbear hole	3	NW	No
73	Greenridge	29° 48.396 S 30° 17.896 E	9-Dec-17	Antbear hole	1	SW	No
74	Greenridge	29° 48.386 S 30° 17.862 E	9-Dec-17	Antbear hole	3	N	Yes
75	Greenridge	29° 48.365 S 30° 17.852 E	9-Dec-17	Antbear hole	4	NE	No
76	Greenridge	29° 48.353 S 30° 17.850 E	9-Dec-17	Antbear hole	4	NE	No
77	Greenridge	29° 48.353 S 30° 17.852 E	9-Dec-17	Antbear hole	3	N	No
78	Greenridge	29° 48.354 S 30° 17.854 E	9-Dec-17	Antbear hole	3	NE	No
79	Greenridge	29° 48.344 S 30° 17.852 E	9-Dec-17	Antbear hole	3	NE	No
80	Greenridge	29° 48.321 S 30° 17.805 E	9-Dec-17	Sinkhole	5	n/a	No
81	Greenridge	29° 48.227 S 30° 17.755 E	9-Dec-17	Antbear hole	5	NE	No
82	Greenridge	29° 48.150 S 30° 17.444 E	9-Dec-17	Antbear hole	3	E	No
83	Baynesfield	29° 46.019 S 30° 15.712 E	16-Dec-17	Antbear hole	2	NE	No
84	Baynesfield	29° 46.027 S 30° 15.706 E	16-Dec-17	Antbear hole	4	E	No
85	Baynesfield	29° 46.039 S 30° 15.505 E	16-Dec-17	Antbear hole	3	NE	No
86	Baynesfield	29° 45.753 S 30° 15.462 E	16-Dec-17	Antbear hole	3	E	No
87	Baynesfield	29° 45.742 S 30° 15.534 E	16-Dec-17	Antbear hole	4	NE	No
88	Baynesfield	29° 45.858 S 30° 15.656 E	16-Dec-17	Antbear hole	2	N	No
89	Baynesfield	29° 45.913 S 30° 15.697 E	16-Dec-17	Sinkhole	2	n/a	Yes
90	Baynesfield	29° 45.919 S 30° 15.699 E	16-Dec-17	Sinkhole	2	n/a	Yes
91	Baynesfield	29° 45.924 S 30° 15.690 E	16-Dec-17	Sinkhole	4	n/a	No
92	Baynesfield	29° 45.937 S 30° 15.892 E	16-Dec-17	Antbear hole	3	SE	No
93	Baynesfield	29° 45.948 S 30° 15.891 E	16-Dec-17	Antbear hole	4	NE	No
94	Baynesfield	29° 45.954 S 30° 15.907 E	16-Dec-17	Sinkhole	2	n/a	Yes
95	Baynesfield	29° 46.079 S 30° 15.895 E	16-Dec-17	Sinkhole	2	n/a	Yes
96	Baynesfield	29° 46.089 S 30° 16.151 E	16-Dec-17	Antbear hole	2	NE	No
97	Baynesfield	29° 45.984 S 30° 16.058 E	16-Dec-17	Antbear hole	3	N	No
98	Trewirgie	29° 46.557 S 30° 12.079 E	1-Jan-18	Artificial hole	5	E	No
99	Trewirgie	29° 46.550 S 30° 12.076 E	1-Jan-18	Artificial hole	0	n/a	No/a
100	Trewirgie	29° 46.378 S 30° 12.213 E	1-Jan-18	Antbear hole	5	N	Yes
101	Trewirgie	29° 46.362 S 30° 12.213 E	1-Jan-18	Antbear hole	2	N	No
102	Trewirgie	29° 46.357 S 30° 12.214 E	1-Jan-18	Antbear hole	4	N	Yes
103	Trewirgie	29° 46.353 S 30° 12.227 E	1-Jan-18	Antbear hole	5	NW	No
104	Trewirgie	29° 46.354 S 30° 12.230 E	1-Jan-18	Antbear hole	5	N	Yes
105	Trewirgie	29° 46.348 S 30° 12.231 E	1-Jan-18	Antbear hole	5	N	No
106	Trewirgie	29° 46.155 S 30° 11.834 E	3-Jan-18	Artificial hole	5	N	No
107	Trewirgie	29° 46.216 S 30° 11.879 E	3-Jan-18	Antbear hole	3	NE	Yes
108	Trewirgie	29° 46.173 S 30° 11.875 E	3-Jan-18	Antbear hole	3	NE	Yes
109	Trewirgie	29° 46.876 S 30° 11.964 E	7-Jan-18	Antbear hole	2	E	No
110	Trewirgie	29° 47.600 S 30° 12.753 E	7-Jan-18	Artificial hole?	0	n/a	No
111	Trewirgie	29° 47.588 S 30° 12.735 E	7-Jan-18	Sinkhole	5	E	Yes
112	Trewirgie	29° 46.837 S 30° 12.140 E	7-Jan-18	Antbear hole	3	NW	Yes
113	Trewirgie	29° 46.837 S 30° 12.141 E	7-Jan-18	Antbear hole	1	W	Yes
114	Trewirgie	29° 46.837 S 30° 12.143 E	7-Jan-18	Antbear hole	4	N	No
115	Trewirgie	29° 44.872 S 30° 13.539 E	13-Jan-18	Antbear hole	3	NE	Yes
116	Trewirgie	29° 44.853 S 30° 13.522 E	13-Jan-18	Antbear hole	3	NE	Yes
117	Trewirgie	29° 44.836 S 30° 13.521 E	13-Jan-18	Antbear hole	2	NE	Yes
118	Trewirgie	29° 44.836 S 30° 13.510 E	13-Jan-18	Antbear hole	3	N	Yes
119	Trewirgie	29° 44.835 S 30° 13.509 E	13-Jan-18	Antbear hole	3	N	No

Hole No.	Locality	Co-ordinates	Date	Hole Type	Rank (1-5)	Aspect	Overgrown?
120	Trewirgie	29° 44.793 S 30° 13.571 E	13-Jan-18	Antbear hole	3	NW	Yes
121	Trewirgie	29° 44.779 S 30° 13.569 E	13-Jan-18	Antbear hole	3	E	Yes
122	Trewirgie	29° 44.733 S 30° 13.412 E	13-Jan-18	Antbear hole	3	NW	Yes
123	Trewirgie	29° 44.741 S 30° 13.455 E	13-Jan-18	Antbear hole	4	NE	Yes
124	Trewirgie	29° 44.742 S 30° 13.488 E	13-Jan-18	Antbear hole	4	NW	No
125	Trewirgie	29° 44.761 S 30° 13.539 E	13-Jan-18	Antbear hole	4	NE	No
126	Trewirgie	29° 44.780 S 30° 13.569 E	13-Jan-18	Antbear hole	2	E	No
127	Trewirgie	29° 44.784 S 30° 13.565 E	13-Jan-18	Antbear hole	3	N	Yes
128	Trewirgie	29° 44.787 S 30° 13.566 E	13-Jan-18	Antbear hole	3	NE	No
129	Trewirgie	29° 44.798 S 30° 13.592 E	13-Jan-18	Antbear hole	4	NE	Yes
130	Trewirgie	29° 44.810 S 30° 13.607 E	13-Jan-18	Antbear hole	4	NE	Yes
131	Trewirgie	29° 44.806 S 30° 13.610 E	13-Jan-18	Antbear hole	4	NE	No
132	Trewirgie	29° 44.825 S 30° 13.657 E	13-Jan-18	Antbear hole	2	NE	Yes
133	Trewirgie	29° 44.824 S 30° 13.661 E	13-Jan-18	Antbear hole	4	NE	Yes
134	Trewirgie	29° 44.820 S 30° 13.669 E	13-Jan-18	Antbear hole	4	NW	Yes
135	Trewirgie	29° 44.837 S 30° 13.694 E	13-Jan-18	Antbear hole	5	NE	No
136	Trewirgie	29° 45.186 S 30° 13.023 E	13-Jan-18	Antbear hole	2	S	Yes
137	Trewirgie	29° 45.153 S 30° 13.113 E	13-Jan-18	Antbear hole	1	SE	Yes
138	Trewirgie	29° 45.085 S 30° 12.984 E	13-Jan-18	Antbear hole	4	SW	Yes
139	Trewirgie	29° 45.050 S 30° 12.848 E	13-Jan-18	Antbear hole	4	NW	No
140	Trewirgie	29° 45.051 S 30° 12.845 E	13-Jan-18	Antbear hole	4	NW	Yes
141	Trewirgie	29° 45.039 S 30° 12.805 E	13-Jan-18	Antbear hole	2	N	No
142	Trewirgie	29° 45.037 S 30° 12.782 E	13-Jan-18	Antbear hole	3	N	Yes
143	Trewirgie	29° 45.034 S 30° 12.778 E	13-Jan-18	Antbear hole	2	N	Yes
144	Trewirgie	29° 45.034 S 30° 12.771 E	13-Jan-18	Antbear hole	4	N	No
145	Mondi	29° 44.698 S 30° 12.701 E	15-Jan-18	Antbear hole	5	NE	No
146	Mondi	29° 44.684 S 30° 12.698 E	20-Jan-18	Antbear hole	4	NE	No
147	Mondi	29° 44.678 S 30° 12.649 E	21-Jan-18	Antbear hole	4	W	No

APPENDIX 2: DETAILS OF THE 182 BIRD SPECIES RECORDED IN THE PROJECT AREA DURING THIS ASSESSMENT

The 182 bird species recorded in the project area during this Assessment are listed below, where: CR = Critically Endangered, E = Endangered, V = Vulnerable, NT = Near-threatened, LC – Least Concern, End. = Endemism, E = endemic to South Africa, Lesotho and Swaziland, NE – near-endemic to South Africa, Lesotho and Swaziland. Bayn. = Baynesfield and adjacent properties, Trew. = Trewirgie and adjacent properties, Smith. Dam = Smithfield Dam Area.

Common Name	Scientific Name	Red Data Reg., Glob.	End.	Bayn.	Trew.	Smith. Dam
Red-winged Francolin	*Scleroptila levaillantii*			Y	Y	
Natal Spurfowl	*Pternistis natalensis*			Y		
Red-necked Spurfowl	*Pternistis afer*			Y		
Common Quail	*Coturnix coturnix*			Y	Y	Y
Helmeted Guineafowl	*Numida meleagris*			Y		
Egyptian Goose	*Alopochen aegyptiaca*			Y		Y
South African Shelduck	*Tadorna cana*			Y		
Spur-winged Goose	*Plectropterus gambensis*			Y		Y
African Black Duck	*Anas sparsa*					Y
Yellow-billed Duck	*Anas undulata*			Y		Y
Red-billed Teal	*Anas erythrorhyncha*			Y		
Hottentot Teal	*Anas hottentota*			Y		
Kurrichane Buttonquail	*Turnix sylvaticus*			Y		
Black-rumped Buttonquail	*Turnix nanus*	EN, LC			Y	
Black-collared Barbet	*Lybius torquatus*			Y		Y
Crested Barbet	*Trachyphonus vaillantii*					Y
Southern Ground-Hornbill	*Bucorvus leadbeateri*	EN, VU		Y	Y	Y
African Hoopoe	*Upupa africana*			Y		
Green Wood-hoopoe	*Phoeniculus purpureus*					Y
Malachite Kingfisher	*Alcedo cristata*			Y		
Pied Kingfisher	*Ceryle rudis*			Y		
Speckled Mousebird	*Colius striatus*			Y	Y	Y
Red-chested Cuckoo	*Cuculus solitarius*			Y	Y	Y
Black Cuckoo	*Cuculus clamosus*			Y	Y	Y
Klaas's Cuckoo	*Chrysococcyx klaas*					Y
African Emerald Cuckoo	*Chrysococcyx cupreus*				Y	
Diederik Cuckoo	*Chrysococcyx caprius*			Y		Y
Burchell's Coucal	*Centropus burchellii*			Y		
African Palm Swift	*Cypsiurus parvus*			Y		
Alpine Swift	*Tachymarptis melba*			Y		Y
Common Swift	*Apus apus*				Y	Y
African Black Swift	*Apus barbatus*			Y	Y	Y
Little Swift	*Apus affinis*			Y		
Horus Swift	*Apus horus*				Y	Y
White-rumped Swift	*Apus caffer*					Y
Knysna Turaco	*Tauraco corythaix*		E	Y	Y	
Speckled Pigeon	*Columba guinea*			Y		Y
African Olive Pigeon	*Columba arquatrix*			Y	Y	Y
Laughing Dove	*Streptopelia senegalensis*					Y
Cape Turtle Dove	*Streptopelia capicola*			Y	Y	Y
Red-eyed Dove	*Streptopelia semitorquata*			Y		Y
Grey Crowned Crane	*Balearica regulorum*	EN, EN		Y		Y
Blue Crane	*Anthropoides paradiseus*	NT, VU		Y		
Wattled Crane	*Bugeranus carunculatus*	CR, VU		Y		
Buff-spotted Flufftail	*Sarothrura elegans*			Y		
Red-chested Flufftail	*Sarothrura rufa*			Y		
Striped Flufftail	*Sarothrura affinis*	VU, LC			Y	
Black Crake	*Amaurornis flavirostra*			Y		
Common Moorhen	*Gallinula chloropus*			Y		
Red-knobbed Coot	*Fulica cristata*			Y		

Common Name	Scientific Name	Red Data Reg., Glob.	End.	Bayn.	Trew.	Smith. Dam
African Snipe	Gallinago nigripennis			Y		
Wood Sandpiper	*Tringa glareola*			Y		
Three-banded Plover	*Charadrius tricollaris*			Y		
Blacksmith Lapwing	*Vanellus armatus*			Y		
Western Osprey	*Pandion haliaetus*			Y		
African Cuckoo Hawk	*Aviceda cuculoides*			Y		
European Honey Buzzard	*Pernis apivorus*			Y		
Yellow-billed Kite	*Milvus aegyptius*			Y	Y	Y
African Fish Eagle	*Haliaeetus vocifer*			Y	Y	Y
Cape Vulture	*Gyps coprotheres*	EN, EN				Y
African Marsh Harrier	*Circus ranivorus*	EN, LC		Y		
African Harrier-Hawk	*Polyboroides typus*			Y		
Black Sparrowhawk	*Accipiter melanoleucus*			Y		
Steppe Buzzard	*Buteo buteo*			Y	Y	Y
Jackal Buzzard	*Buteo rufofuscus*		NE	Y	Y	Y
Wahlberg's Eagle	*Hieraaetus wahlbergi*			Y		Y
Long-crested Eagle	*Lophaetus occipitalis*			Y	Y	
Crowned Eagle	*Stephanoaetus coronatus*	VU, NT			Y	
Secretary Bird	*Sagittarius serpentarius*	VU, VU		Y		
Lanner Falcon	*Falco biarmicus*	VU, LC		Y		Y
Peregrine Falcon	*Falco peregrinus*				Y	
Little Grebe	*Tachybaptus ruficollis*			Y		Y
White-breasted Cormorant	*Phalacrocorax lucidus*					Y
Black-headed Heron	*Ardea melanocephala*			Y		
Western Cattle Egret	*Bubulcus ibis*					Y
Hadeda Ibis	*Bostrychia hagedash*			Y	Y	Y
African Sacred Ibis	*Threskiornis aethiopicus*			Y		
White Stork	*Ciconia ciconia*			Y	Y	Y
Black-headed Oriole	*Oriolus larvatus*			Y		
Fork-tailed Drongo	*Dicrurus adsimilis*			Y	Y	Y
African Paradise Flycatcher	*Terpsiphone viridis*			Y	Y	Y
Black-backed Puffback	*Dryoscopus cubla*			Y	Y	Y
Black-crowned Tchagra	*Tchagra senegalus*			Y	Y	Y
Southern Boubou	*Laniarius ferrugineus*			Y	Y	Y
Bokmakierie	*Telophorus zeylonus*					Y
Orange-breasted Bush-Shrike	*Chlorophoneus sulfureopectus*					Y
Olive Bush-Shrike	*Chlorophoneus olivaceus*			Y	Y	Y
Cape Batis	*Batis capensis*			Y	Y	
Cape Crow	*Corvus capensis*			Y		Y
Pied Crow	*Corvus albus*					Y
White-necked Raven	*Corvus albicollis*				Y	Y
Common Fiscal	*Lanius collaris*			Y	Y	Y
Southern Black Tit	*Parus niger*			Y		
Brown-throated Martin	*Riparia paludicola*			Y		Y
Banded Martin	*Riparia cincta*					Y
Barn Swallow	*Hirundo rustica*			Y	Y	Y
White-throated Swallow	*Hirundo albigularis*			Y	Y	Y
Blue Swallow	*Hirundo atrocaerulea*	CR, VU		Y	Y	
Greater Striped Swallow	*Cecropis cucullata*			Y	Y	Y
Lesser Striped Swallow	*Cecropis abyssinica*					Y
Rock Martin	*Hirundo fuligula*					Y
Common House Martin	*Delichon urbicum*					Y
Black Saw-wing	*Psalidoprocne pristoptera*			Y	Y	Y
Dark-capped Bulbul	*Pycnonotus tricolor*			Y	Y	Y
Sombre Greenbul	*Andropadus importunus*			Y	Y	Y
Terrestrial Brownbul	*Phyllastrephus terrestris*			Y		
Cape Grassbird	*Sphenoeacus afer*		NE	Y	Y	Y
Broad-tailed Warbler	*Schoenicola brevirostris*			Y	Y	
Little Rush Warbler	*Bradypterus baboecala*			Y		
African Reed Warbler	*Acrocephalus baeticatus*			Y		
Lesser Swamp Warbler	*Acrocephalus gracilirostris*			Y		
Dark-capped Yellow Warbler	Iduna natalensis			Y	Y	Y

Common Name	Scientific Name	Red Data Reg., Glob.	End.	Bayn.	Trew.	Smith. Dam
Garden Warbler	Sylvia borin					Y
Cape White-eye	*Zosterops virens*		NE	Y	Y	Y
Lazy Cisticola	*Cisticola aberrans*			Y	Y	Y
Wailing Cisticola	*Cisticola lais*			Y	Y	Y
Levaillant's Cisticola	*Cisticola tinniens*			Y	Y	
Croaking Cisticola	*Cisticola natalensis*			Y	Y	
Neddicky	*Cisticola fulvicapilla*			Y	Y	Y
Zitting Cisticola	*Cisticola juncidis*				Y	Y
Pale-crowned Cisticola	*Cisticola cinnamomeus*			Y	Y	
Wing-snapping Cisticola	*Cisticola ayresii*			Y	Y	Y
Tawny-flanked Prinia	*Prinia subflava*			Y	Y	Y
Drakensberg Prinia	*Prinia hypoxantha*		E	Y	Y	Y
Bar-throated Apalis	*Apalis thoracica*			Y	Y	Y
Yellow-breasted Apalis	*Apalis flavida*				Y	
Green-backed Camaroptera	*Camaroptera brachyura*			Y	Y	Y
Rufous-naped Lark	*Mirafra africana*					Y
Cape Rock Thrush	*Monticola rupestris*		E			Y
Kurrichane Thrush	*Turdus libonyanus*			Y		
Olive Thrush	*Turdus olivaceus*			Y	Y	Y
Southern Black Flycatcher	*Melaenornis pammelaina*			Y		
Fiscal Flycatcher	*Sigelus silens*		NE			Y
African Dusky Flycatcher	*Muscicapa adusta*			Y		
Cape Robin-Chat	*Cossypha caffra*			Y	Y	Y
African StoneChat	*Saxicola torquatus*			Y	Y	Y
Mountain Wheatear	*Oenanthe monticola*			Y		Y
Familiar Chat	*Cercomela familiaris*					Y
Mocking Cliff Chat	*Thamnolaea cinnamomeiventris*					Y
Red-winged Starling	*Onychognathus morio*				Y	Y
Cape Glossy Starling	*Lamprotornis nitens*					Y
Violet-backed Starling	*Cinnyricinclus leucogaster*			Y		
Pied Starling	*Lamprotornis bicolor*		E			Y
Wattled Starling	*Creatophora cinerea*					Y
Common Myna	*Acridotheres tristis*					Y
Amethyst Sunbird	*Chalcomitra amethystina*			Y	Y	Y
Collared Sunbird	*Anthodiaeta collaris*				Y	
Southern Double-collared Sunbird	*Cinnyris chalybeus*		NE	Y	Y	
Greater Double-collared Sunbird	*Cinnyris afer*		E	Y		Y
Spectacled Weaver	*Ploceus ocularis*			Y		Y
African Golden Weaver	*Ploceus xanthops*			Y		
Southern Masked Weaver	*Ploceus velatus*			Y		
Village Weaver	*Ploceus cucullatus*			Y	Y	Y
Red-billed Quelea	*Quelea quelea*			Y		Y
Southern Red Bishop	*Euplectes orix*			Y	Y	Y
Yellow Bishop	*Euplectes capensis*			Y	Y	
Fan-tailed Widowbird	*Euplectes axillaris*			Y	Y	Y
Red-collared Widowbird	*Euplectes ardens*			Y	Y	Y
Thick-billed Weaver	*Amblyospiza albifrons*					Y
Orange-breasted Waxbill	*Amandava subflava*			Y		
African Quail-finch	*Ortygospiza fuscocrissa*			Y		
Common Waxbill	*Estrilda astrild*			Y	Y	Y
African Firefinch	*Lagonosticta rubricata*			Y	Y	Y
Bronze Mannikin	*Lonchura cucullata*			Y		
Pin-tailed Whydah	*Vidua macroura*			Y		Y
Dusky Indigo Bird	*Vidua funerea*			Y		
House Sparrow	*Passer domesticus*			Y	Y	Y
Cape Sparrow	*Passer melanurus*			Y		Y
Southern Grey-headed Sparrow	*Passer diffusus*			Y		Y
African Pied Wagtail	*Motacilla aguimp*					Y
Cape Wagtail	*Motacilla capensis*			Y	Y	Y
Cape Longclaw	*Macronyx capensis*			Y	Y	
African Pipit	*Anthus cinnamomeus*			Y		Y
Plain-backed Pipit	Anthus leucophrys			Y	Y	

Common Name	Scientific Name	Red Data Reg., Glob.	End.	Bayn.	Trew.	Smith. Dam
Long-billed Pipit	Anthus similis					Y
Short-tailed Pipit	*Anthus brachyurus*	VU, LC		Y		
Cape Canary	*Serinus canicollis*			Y	Y	Y
Yellow-fronted Canary	*Crithagra mozambica*			Y	Y	Y
Brimstone Canary	*Crithagra sulphurata*			Y		
Streaky-headed Seedeater	*Crithagra gularis*			Y		Y
Cinnamon-breasted Bunting	*Emberiza tahapisi*					Y
Cape Bunting	Emberiza capensis			Y		
TOTALS		**13**	**10**	**140**	**77**	**110**

APPENDIX 3: RESULTS OF THE WATER BIRD COUNTS MADE ON 8 DECEMBER 2017

Results of the water bird counts made on 8 December 2017 along the Mbangweni River and along the Mlazi River just downstream of its confluence with the Mbangweni River, as well as at the small existing dam along the Mbangweni River and the large dam along the Mlazi River upstream of its confluence with the Mbangweni River are listed below:

Water Bird Species	Upper Mbangweni	Lodge Dam	Lower Mbangweni and Mlazi	Big Dam	TOTALS
Egyptian Goose			10		**10**
South African Shelduck			2		**2**
Spur-winged Goose		1	1	8	**10**
Yellow-billed Duck	1		3		**4**
Red-billed Teal			9		**9**
Hottentot Teal			7		**7**
Malachite Kingfisher	1				**1**
Grey Crowned Crane			1		**1**
Red-chested Flufftail			1		**1**
Black Crake	1				**1**
Common Moorhen			2		**2**
Red-knobbed Coot		2			**2**
African Snipe			1		**1**
Wood Sandpiper			5		**5**
Three-banded Plover			3		**3**
Blacksmith Lapwing			12	2	**14**
African Fish Eagle		2			**2**
Black-headed Heron			1		**1**
Hadeda Ibis		4	20		**24**
African Sacred Ibis			1		**1**
White Stork				7	**7**
TOTALS	**3**	**9**	**79**	**17**	**108**

APPENDIX 4: DETAILS OF RED DATA BIRD SPECIES RECORDED IN THE PROJECT AREA

The records contributed by the Invertebrate Specialist (Lukas Niemand) are also included here in the list below:

Red Data Species	Date	y_gcs	x_gcs	Habitat	Activity	Details	Observer
African Marsh Harrier	20-Jan-18	-29.783767	30.299585	Wetland	Flying	1 juvenile flying low over wetland	D. Allan
Black-rumped Buttonquail	7-Jan-18	-29.78143	30.198733	Natural grassland	Flushed	1	D. Allan
Blue Crane	24-Nov-17	-29.764388	30.330548	Maize field	Roosting	9 adults with Wattled Cranes	D. Allan
Blue Crane	24-Nov-17	-29.756455	30.343647	Maize field	Feeding	2 adults	D. Allan
Blue Crane	24-Nov-17	-29.768982	30.32371	Maize field	Roosting	2 adults with 2 young	D. Allan
Blue Crane	24-Nov-17	-29.773536	30.294567	Maize field	Roosting	2 adults with 2 young	D. Allan
Blue Crane	29-Nov-17	-29.784531	30.280505		Flying	4 flying and calling	D. Allan
Blue Crane	3-Dec-17	-29.767044	30.259524		Flying	2 adults flying and calling	D. Allan
Blue Crane	8-Dec-17	-29.755094	30.306571	Maize field	Feeding	2 adults with 2 young	D. Allan
Blue Crane		-29.748765	29.892496		Flying		L. Niemand
Bush Blackcap		-29.725815	29.898652				L. Niemand
Cape Vulture	10-Jan-18	-29.749704	29.932433		Soaring	1 adult	D. Allan
Cape Vulture		-29.714671	29.881777			2	L. Niemand
Crowned Eagle	13-Jan-18	-29.738902	30.207835	Afromontane forest	Heard	1 heard calling	D. Allan
Grey Crowned Crane	24-Nov-17	-29.754873	30.335344	Maize field adjacent to wetland	Feeding	2 adults	D. Allan
Grey Crowned Crane	24-Nov-17	-29.758603	30.328308		Flying	2 adults	D. Allan
Grey Crowned Crane	24-Nov-17	-29.771096	30.325392	Maize field	Feeding	1 adult	D. Allan
Grey Crowned Crane	29-Nov-17	-29.771001	30.308834	Dam	Roosting	1 adult in dead tree at dam	D. Allan
Grey Crowned Crane	8-Dec-17	-29.755682	30.337103	Maize field adjacent to wetland	Feeding	1 adult	D. Allan
Grey Crowned Crane	10-Jan-18	-29.73516	29.923622	Small dam	Feeding	2 adults	D. Allan
Lanner Falcon	24-Nov-17	-29.770207	30.312413		Flying	1 immature	D. Allan
Lanner Falcon	8-Dec-17	-29.772421	30.301418		Flying	1 adult flying	D. Allan
Lanner Falcon	10-Jan-18	-29.745831	29.931249	Natural grassland	Perched	1 adult perched on pylon	D. Allan
Lanner Falcon		-29.735754	29.909394			Pair	L. Niemand
Secretary Bird	16-Dec-17	-29.768612	30.264688	Natural grassland	Feeding	1 adult	D. Allan
Short-tailed Pipit	16-Dec-17	-29.765267	30.260092	Natural grassland	Flushed	1 bird, unconfirmed	D. Allan
Southern Bald Ibis		-29.738782	29.893373			1	L. Niemand

Red Data Species	Date	y_gcs	x_gcs	Habitat	Activity	Details	Observer
Southern Ground Hornbill	24-Nov-17	-29.79119	30.290753	Maize field	Feeding	2adults	D. Allan
Southern Ground Hornbill	15-Jan-18	-29.737783	30.238058	Old clear-felled plantation	Feeding	3 adults	D. Allan
Southern Ground Hornbill	10-Jan-18	-29.78791	29.919542	Natural grassland	Feeding	2 adults and 1 immature on steep slope	D. Allan
Southern Ground Hornbill		-29.7444	29.954501				L. Niemand
Striped Flufftail	7-Jan-18	-29.78143	30.198735	Natural grassland	Flushed	1 adult male	D. Allan
Wattled Crane	24-Nov-17	-29.764388	30.330546	Maize field	Roosting	2 adults with Blue Cranes	D. Allan
Wattled Crane	29-Nov-17	-29.778152	30.281025		Flying	2 adults flying and calling	D. Allan
Wattled Crane	29-Nov-17	-29.785063	30.30051		Flying	2 adults flying up valley at dusk	D. Allan
Wattled Crane	3-Dec-17	-29.770513	30.261716		Flying	2 adults flying and calling	D. Allan