DEVELOPMENT OF AN ENVIRONMENTAL CONSTRAINTS FRAMEWORK FOR ESKOM DISTRIBUTION'S NEWCASTLE FIELD SERVICES AREA

Final Report

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ENVIRONMENTAL CONSTRAINTS FRAMEWORK REPORT

Compiled for

Eskom

TRANS-AFRICA PROJECTS

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EXECUTIVE SUMMARY

BACKGROUND

Experience has shown that by not considering environmental constraints at Master and Network Planning stage, Eskom Distribution projects have in cetrtain cases failed to successfully pass the Environmental Impact Assessment (EIA) stage. This has resulted in a need for Eskom to revisit previous planning decisions with associated costs incurred in terms of additional time, resources and finances. A further impact of protracted and sometimes confrontational EIA processes is the negative publicity and reduced confidence of authorities and the public in Eskom's commitment to environmental sustainability.

In response, Eskom Distribution has identified the need to build Strategic Environmental Assessment (SEA) into their master planning process. This has taken the form of a GIS based decision support system which can spatially depict the location and level of constraint imposed by environment features on electrical infrastructure and also, the level of potential impacts of the infrastructure on sensitive features. This GIS tool is termed an "Environmental Constraints Framework" (ECF).

Eskom has to date, involved different consulting teams in the development of individual ECFs for its different regions of operation. Currently, through a collaborative effort between the Institute of Natural Resources (INR), and ACER (Africa) Environmental Management Consultants (ACER) with support from S3 Technologies, a standardised ECF tool has been produced which has the following advantages:

- Incorporates and builds upon the best features of previously developed ECFs, to Eskom's requirements.
- Allows for a better interface between the ECFs, so that adjacent ECFs can be integrated if required and important linkages can be observed between FSA's (understanding that geographical features do not coincide with FSA boundaries).
- Optimises the use and processing of national and provincial data, making ECF development more efficient and rapid.
- Allows for a more standardised interpretation and application of the tool by different Planners and Eskom staff operating in different Regions.

THE ECF

The ECF is a GIS based tool set up to generate three main outputs for a FSA.

- The "Environmental" map showing where the environment will be negatively affected by Eskom's infrastructure (Environmental Constraints).
- The "Technical" map showing where Eskom's infrastructure will be negatively affected by the environment (Technical Constraints).
- The "ECF" which is a composite map showing a combination of the above two constraints maps.

The primary focus of the ECF is for use by Eskom's planners in the master planning process. The ECF thus deals with **strategic level** constraints and shows their geographical location as well as colour coding to illustrate the degree (level) of the constraint (see further for constraint definitions). In terms of additional applications, the ECF may also inform network planning, the EIA process for transmission and sub-transmission lines, and the environmental scanning process for distribution lines, to which the EIA regulations do not apply.

CONSTRAINT LEVELS

The ECF is required to represent the constraints posed by numerous different features[1], each one associated with different impacts. Constraint features that represent Environmental and/or Technical constraints are categorised into 4 different levels, explained in the following table.

Level of Constraint	*IMPACT OF THE ENVIRONMENT ON ESKOM*	*IMPACT OF ESKOM ON THE ENVIRONMENT*	*RISKS TO ESKOM*
HIGHEST CONSTRAINT	Features encountered make the project unfeasible (technically / financially/ administratively and/or legally).	Features with the HIGHEST ecological and/or conservation; cultural; socio-economic value, and/or specific legal protection will be impacted. Electrical infrastructure **SHOULD NOT** be developed here. This level of constraint effectively constitutes a '**NO-GO**' for the project.	▪ Likely fatal flaw (project stopper). ▪ Highest costs (time, expertise, finances). ▪ Highest risk that environmental authorisation will not be granted. ▪ Highest likelihood of public resistance and risk to Eskom's reputation. ▪ Mitigation of serious environmental impacts may not be possible.
HIGH CONSTRAINT	Features encountered present a VERY HIGH constraint to the construction, operation and/or maintenance of the infrastructure (technically / financially/ administratively and/or legally)	Features with VERY HIGH ecological and/or conservation; cultural; socio-economic value, and/or specific legal protection will be impacted. Negative impacts are of high significance and difficult to mitigate.	▪ High costs (time, expertise, finances). ▪ High risk that environmental authorisation will not be granted. ▪ High likelihood of public resistance and risk to Eskom's reputation. ▪ High mitigation/ management demands.
MODERATE to HIGH CONSTRAINT	Features encountered present a HIGH constraint to the construction, operation and/or maintenance of the infrastructure (technically/ financially/ administratively and/or legally)	Features with a MODERATE to HIGH ecological and/or conservation; cultural; socio-economic value, and/or specific legal protection will be impacted. Negative impacts are of high or medium significance and will require mitigation.	▪ Moderate to High costs (time, expertise, finances). ▪ Possible risk that environmental authorisation may not be granted. ▪ Moderate to High likelihood of public resistance and risk to Eskom's reputation. ▪ Moderate to High mitigation/ management demands.
LOW CONSTRAINT or NO KNOWN FEATURES (which pose a strategic constraint)	Features encountered that present low constraints. ***OR*** Data unavailable, thus, potential constraints not able to be identified.	Features which impose impacts of low strategic significance will be impacted. ***OR*** Data unavailable thus, potential constraints not able to be identified.	Low level of the risks described above. ***OR*** No known risks according to available data. However as new data becomes available the constraint level (and associated risks) may change.

CONSTRAINT FEATURES IDENTIFIED

The following table shows the features that were identified as either "Environmental" or "Technical" constraints (or both), along with their assigned constraint levels. For the most part, these constraint features are applicable to all FSAs but are indicated as N/A if they are not encountered in a particular FSA. Note that in the ECF output map (shown further below), features with the highest constraint level are shown but they may be underlain with other constraints of a lower constraint level.

[1] Examples of features are wetlands, protected areas, irrigation pivots and airfields.

LIST OF IDENTIFIED ECF CONSTRAINTS WITH ASSIGNED CONSTRAINT LEVEL AND INDICATION OF AVAILABILITY OF GIS DATA (NEWCASTLE ECF MAY 2012)

	CONSTRAINT FEATURE	CONSTRAINT LEVEL	DATA AVAILABLE
1	Dams ≥ 4 ha surface area	**Highest**	✓
2	Irrigation Pivots	**Highest**	✓
3	Restricted Airspace	**Highest**	✓
4	Existing residential areas/ settlement (≥ 3 households per ha)	**Highest**	✓
5	Intersection of two National Roads (500m buffer)	**Highest**	✓
6	Cultural Heritage (National Heritage Sites, Archaeological Sites, Battlefields)	**Highest**	✓
7	Dongas ≥ 4 ha surface area	**Highest**	✓
8	Slopes > 45 degrees	**Highest**	✓
9	Protected Areas declared in terms of the National Environmental Management: Protected Areas Act (NEM:PAA)	**Highest**	✓
10	Forest Vegetation Type (*Eastern Mistbelt Forest, Eastern Scarp Forest*)	**Highest**	✓
11	Critically Endangered Vegetation Types (*Eastern Mistbelt Forest, Eastern Scarp Forest)*	**Highest**	✓
12	Critically Endangered Terrestrial Ecosystems as listed in terms of the NEM: Biodiversity Act. Also erodible* parts of Endangered Ecosystems.	**Highest**	✓
13	Wetlands ranked 1-3 (based on NFEPA wetland ranking**)		✓
14	Wetland Clusters	**Highest**	✓
15	Estuaries	**Highest**	**N/a to Newcastle FSA**
16	Avifauna: Nesting and roosting sites of powerline sensitive bird species with high conservation status, as well as vulture restaurants.	**Highest**	✓
17	Irreplaceable Biodiversity as identified on C Plan (Biodiversity Priority Area 1)	**Highest**	✓
18	Dams ≥ 1 ha < 4 ha surface area	**High**	✓
19	Commercial Forestry	**High**	✓
20	Existing residential areas/ settlement (≥ 1.5 <3 households per ha)	**High**	✓
21	Surface Mining, and associated Infrastructure and Waste Material Dumps (visible at surface ≥ 4 ha)	**High**	✓
22	Landfill Sites	**High**	**X**
23	Railway Marshalling Yards	**High**	**X**
24	Slope (35 – 45 degrees)	**High**	✓
25	Dongas < 4 ha surface area	**High**	✓
26	Endangered Vegetation Types	**High**	✓
27	Endangered Terrestrial Ecosystems as listed in terms of the NEM: Biodiversity Act	**High**	✓
28	Unfragmented Grasslands	**High**	✓
29	Wetlands rank 4 (based on NFEPA wetland ranking)	**High**	✓
30	Highly Significant Biodiversity as identified on C Plan (Biodiversity Priority Area 2)	**High**	✓
31	Private Game Reserves	**High**	✓
32	Projected & planned higher density settlement/ development nodes*	**Moderate to High**	✓
33	Surface Mining, and associated Infrastructure and Waste Material Dumps (visible at surface < 4 ha)	**Moderate to High**	✓
34	Slope (30 – 35 degrees)	**Moderate to High**	✓
35	Commercial sugarcane	**Moderate to High**	✓
36	50 m buffers around dams (environmental constraint only)	**Moderate to High**	✓
37	Wetlands rank 5-6 (based on NFEPA wetland ranking)	**Moderate to High**	✓
38	5 km buffer around formally protected areas and 10 km buffers around world heritage sites	**Moderate to High**	✓
39	Vulnerable Terrestrial Ecosystems listed in terms of the NEM:Biodiversity Act.	**Moderate to High**	✓
40	Important and Necessary Biodiversity as identified on C Plan (Biodiversity Priority Area 3)	**Moderate to High**	✓
41	Protected Area Expansion Strategies	**Moderate to High**	✓

	CONSTRAINT FEATURE	CONSTRAINT LEVEL	DATA AVAILABLE
42	Informally protected areas (national heritage sites and unproclaimed reserves)	**Moderate to High**	✓
43	Dense Vegetation	**Moderate to High**	✓

*Erodible areas are based on Department of Agriculture, Forestry and Fisheries map, where areas have been classed according to susceptibility to water erosion. Four relatively permanent land characteristics determine the susceptibility of land to water erosion. These are slope gradient and length, soil erodibility and rainfall erosivity. In conjunction with the relatively variable factors vegetation cover and management practices, these land characteristics determine erosion hazard. Areas classed as 6, 7 and 8 for erosion susceptibility have been included in the ECF.

** SANBI GIS Metadata detailed report for NFEPA Wetlands provides description of rankings.

SUMMARY OF HIGHEST LEVEL CONSTRAINTS IN THE NEWCASTLE FIELD SERVICES AREA

The ECF map shown above is the combined output of Environmental and Technical Constraints for the Newcastle FSA. The extensive occurrence of constraint features across the Newcastle FSA is testimony to the fact that that planning and EIA processes for this area are, and will continue to be, relatively difficult, requiring substantial resources in terms of time, specialist personnel and finances towards assessments, authorisation processes and mitigation measures.

The Newcastle FSA is dominated by Environmental (as opposed to Technical) constraint features, which in many cases overlie other Environmental and/or Technical constraint features of the same or lower constraint level. **Overall, dominating drivers are formally protected areas, sensitive bird areas (e.g. crane nesting sites), irreplaceable biodiversity (incorporating a number of contributing constraint features) and commercial forestry.**

The features posing the **highest** level of environmental constraint in the Newcastle FSA are:

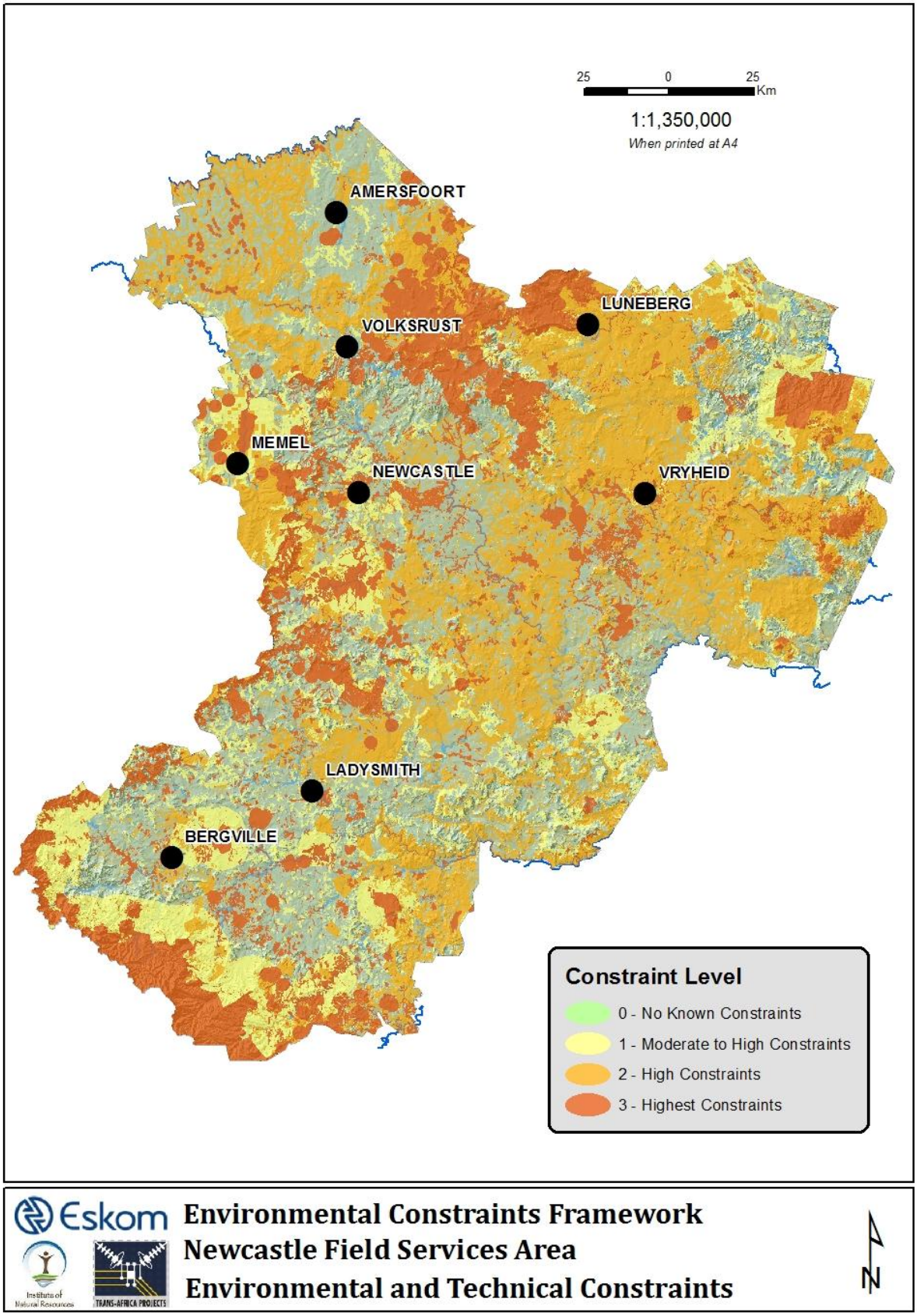
- Formally protected areas.
- Avifauna (critically endangered and endangered bird species that are vulnerable to powerlines).
- Indigenous Forest vegetation.
- Critically Endangered Vegetation Types.
- Critically Endangered Terrestrial Ecosystems.
- Wetlands ranked 1-3.
- Wetland clusters.
- Irreplaceable Biodiversity.
- Archaeological Sites.

The features posing the **highest** level of technical constraint are:

- Dense residential settlement (more than 3 households per hectare).
- Dams (>4 hectares in surface area).
- Centre pivots.
- Airfields.
- Dongas.
- Slopes > 45 degrees.

USE AND APPLICATION OF THE ECF IN MASTER PLANNING

How to use the GIS tool from a technical perspective, is explained in Part III of the main report. The Consultants will provide training/tutorials to hand over the tools to the relevant staff and will also provide support to Eskom Planners as required, when overlaying and interpreting the ECF against proposed plans.



Eskom

Institute of Natural Resources

TRANS-AFRICA PROJECTS

Environmental Constraints Framework
Newcastle Field Services Area
Environmental and Technical Constraints

N

ACKNOWLEDGEMENTS

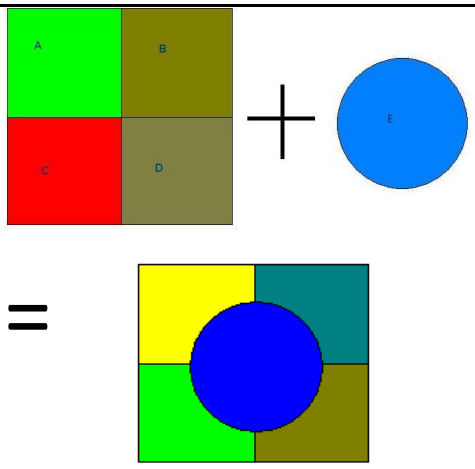
The following organisations and dedicated individuals working within them are gratefully acknowledged for their contributions towards the development of Eskom ECFs to date:

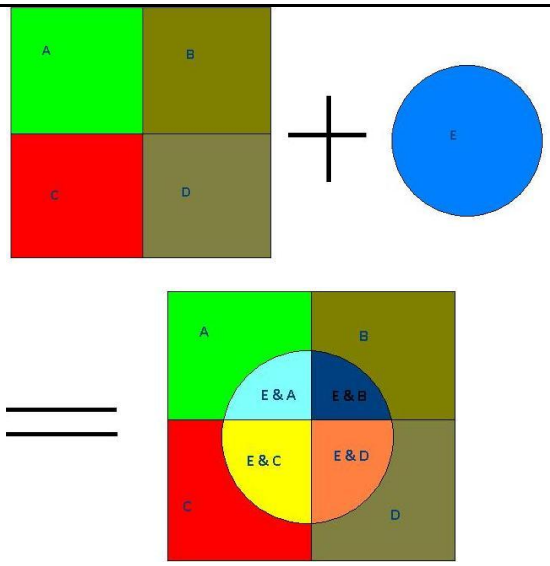
- Amafa aKwa-Zulu Natali
- Civil Aviation Authority
- Endangered Wildlife Trust
- Ezemvelo KZN Wildlife
- KwaZulu-Natal Department of Agriculture, Environmental Affairs and Rural Development.
- Limpopo Department of Economic Development, Environment and Tourism (Limpopo Province South)
- Mpumalanga Parks and Tourism Agency
- Natal Museum
- South African Biodiversity Institute

ACRONYMS AND ABBREVIATIONS

ACER	ACER (Africa) Environmental Management Consultants
CAA	Civil Aviation Authority
CSG	Chief Surveyor General
DAFF	Department of Agriculture, Forestry and Fisheries
ECF	Environmental Constraints Framework
EIA	Environmental Impact Assessment
EKZNW	Ezemvelo KZN Wildlife
ENPAT	Environmental Potential Atlas
EMF	Environmental Management Framework
FSA	Field Services Area
GIS	Geographic Information System
INR	Institute of Natural Resources
MPTA	Mpumalanga Parks and Tourism Agency
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1988)
NEM:PAA	National Environmental Management: Protected Areas Act, 2003 (Act no 57 of 2003)
NFEPA	National Freshwater Ecosystem Priority Areas
PA	Protected Areas
SANBI	South African National Biodiversity Institute
SEA	Strategic Environmental Assessment
S3	S3 Technologies
SoCS	Sites of Conservation Significance
UDP	Ukhahlamba-Drakensberg Park

GLOSSARY OF GIS TERMS

<table>
<tr><th>TERM</th><th>DEFINITION</th><th>EXAMPLE</th></tr>
<tr><td>Attribute</td><td>All features have attributes. In the GIS context, attributes are pieces of information about the feature or characteristics of the feature.</td><td>Name, depth, volume are all examples of attributes of a dam feature.</td></tr>
<tr><td>Attribute Table</td><td>All features stored in a feature class have a record (row) in the feature class's attribute table. This is where information about each feature is stored as attributes (columns). Importantly it is linked to the map feature and so this information can be used to analyze spatial relationships and to customize the way map features are displayed.</td><td><table><tr><th>ID</th><th>Dam Name</th><th>Depth</th><th>Volume</th></tr><tr><td>1</td><td>Pongolapoort</td><td>80</td><td>1000000</td></tr><tr><td>2</td><td>Midmar</td><td>55</td><td>9000000</td></tr></table></td></tr>
<tr><td>Constraint</td><td>A limitation to powerline development</td><td>Dams represent a constraint to development of powerlines because you may not erect pylon infrastructure within a waterbody.</td></tr>
<tr><td>Constraint level</td><td>The level of constraint imposed by a feature – represented by the value (0 – 3) assigned.</td><td>A wetland imposes a higher level of constraint on powerline development (3) than a plantation (2)</td></tr>
<tr><td>Constraint feature</td><td>A particular element on the ground which constitutes a constraint to development</td><td>The protected area or forest is a feature which imposes a constraint on powerline development</td></tr>
<tr><td>Constraint feature class</td><td>A grouping of similar constraint features</td><td>All types of wetlands are incorporated in to one constraint feature class (a storage 'box' if you can think of it that way) called 'Wetlands'.</td></tr>
<tr><td>Feature</td><td>Essentially anything that can be represented on a map. Any element represented by point, line or polygon in a GIS environment, which usually has a spatial context i.e. associated mapping coordinates.</td><td>A grave (point), a river (line), or a game reserve (polygon) are all examples of features</td></tr>
<tr><td>Feature class</td><td>A GIS term for a grouping of similar features into a storage unit</td><td>All river features can be stored in a single 'box' or shapefile as a feature class.</td></tr>
<tr><td>Layer</td><td>A term used to describe a Feature class when added to a GIS map</td><td>By adding the wetland feature class to the map, you have added another layer.</td></tr>
<tr><td>Merge</td><td>A GIS process whereby two or more feature classes are merged to become one feature class. Importantly new features are not created where two features are spatially coincident. Features simply sit on top of each other in the new feature class.</td><td>  </td></tr>
</table>

TERM	DEFINITION	EXAMPLE
Metadata	Information about data. Metadata provides the information one needs to be able to use the data with confidence and with accuracy.	Information such as when data was captured, how it was captured, what coordinate system has been used and how often the data is updated are all examples of metadata.
Polygon	Any multisided shape used to represent a geographical feature which is spread over an area (as opposed to a line or point)	When representing a farm's extent on a map, one would use a polygon.
Raster	A GIS Data type / storage method dividing the coverage into pixels each denoting a value	The Digital Elevation Model used to derive the slope model is a Raster (Grid) layer. A digital photograph is also a raster data set.
Union	A GIS process whereby two or more feature classes are intersected with each other to become one feature class. Importantly a new feature is created where two features are spatially coincident and a new record is added to the attribute table.	
Vector	A GIS data type / storage method using points, lines and polygons to denote features.	All of the data included in this ECF is vector data.

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PART I – MOTIVATION FOR & APPROACH TO THE ECF

1.1 PROJECT BACKGROUND

In simplified terms, electricity delivery from Eskom is preceded by Network Master Plans (5- 20 years before execution of a project on the ground) followed by Network Development Plans (2- 5 year time horizon) that culminate in a list of prioritised projects for implementation. These projects are then subject to preliminary and detailed design during which they must be taken through the Environmental Impact Assessment (EIA) process to obtain Environmental Authorisation[2] before they can be constructed. Past experience has shown that a lack of consideration of environmental constraints at Master Planning stage can result in failure of a project to pass the EIA stage, resulting in a need for Eskom to revisit previous planning decisions. The implications for Eskom are significant costs in terms of additional time, resources and finances. A further impact of protracted and sometimes confrontational EIA processes is the negative publicity and reduced confidence of authorities and the public in Eskom's commitment to environmental sustainability.

In response, Eskom Distribution has at a corporate level, identified the need to build Strategic Environmental Assessment (SEA) into their master planning process. Given the spatial nature of sub-transmission master planning, it became apparent that the outcome of the SEA needed to be a GIS based decision support system which can spatially depict the location and level of constraint imposed by environment features on power-line construction and also, the level of potential impacts from power lines on sensitive features. This outcome or tool was duly termed an "Environmental Constraints Framework" (ECF).

Eskom has to date, involved different consulting teams in the development of individual ECFs for its different regions of operation. Currently, through a collaborative effort between ACER (Africa) Environmental Management Consultants (ACER) and the Institute of Natural Resources (INR)[3], a standardised ECF tool has been produced which has the following advantages:

- Incorporates and builds upon the best features of previously developed ECFs, to Eskom's requirements.
- Allows for a better interface between the ECFs, so that adjacent ECFs can be integrated if required and important linkages can be observed between FSA's (understanding that geographical features do not coincide with FSA boundaries).
- Optimises the use and processing of national and provincial data, making ECF development more efficient and rapid.
- Allows for a more standardised interpretation and application of the tool by different Planners and Eskom staff operating in different Regions.

[2] In terms of the Environmental Impact Assessment Regulations of 2010, published under the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA).
[3] INR has been appointed by Trans-Africa Projects (TAP) on behalf of Eskom, and ACER (Africa) Environmental Management Consultants (ACER) has been appointed by Netgroup.

The ECF has been developed according to SEA principles in three phases viz: Inception, Scoping and ECF (this phase), each culminating in a report[4]. After client acceptance of this ECF report, the consultants will undertake a project handover whereby Eskom Planners and other relevant staff will be taken through a presentation and tutorial(s) on practical application of the ECF tool.

PURPOSE & STRUCTURE OF THIS DOCUMENT

Purpose

This report documents the motivation for the Environmental Constraints Framework (ECF), explains how it was developed and provides guidance on how to use and update it.

Structure

The document is structured into three parts to achieve the purpose described above.

PART I – Motivation for and Approach to Developing the ECF
Provides the project background and theory. It covers the theoretical concepts behind the ECF and explains how it is structured to create an integrated map output representing multiple layers of environmental features each with differing levels of constraint.

PART II –The Environmental Constraints Framework
The ECF is presented in this section. It further details the various base features and data sets that were combined in arriving at the integrated ECF map and the reasons why they are assigned a particular level of constraint.

PART III – Using the ECF
This section provides Guidelines for the application or use of the ECF document by Eskom Planners and other relevant staff. It also discusses how to interpret the ECF outputs and how to keep input data updated.

1.2 PROJECT MOTIVATION AND PURPOSE

1.2.1 Problem Context

As documented in the Inception report, Eskom is challenged with operating within the legal and institutional framework governing environmental management in South Africa. Eskom has responded to the requirements of the legal framework in the following ways:

- *Environmental Policy*

The company has developed a Safety, Health and Environmental Policy (SHE) which states that Eskom's strategic intent "*is to build the powerbase for sustainable growth and development – generating a sustainable foundation for growth and creating value for stakeholders and society,*

[4] INR. 2011. Environmental Constraints Framework for the Newcastle Field Services Area. Eskom Distribution: Eastern Region. Inception Report. Prepared for TAP;

INR, ACER, S3, December 2011. Environmental Constraints Framework for the Newcastle and Pietermaritzburg Field Services Areas. Eskom Distribution: Eastern Region. Draft Environmental Features Report. Prepared for Trans Africa Projects and Netgroup South Africa (Pty) Ltd.

while reducing the safety, health, and environmental impact of our operations"[5]. Further analysis of the policy identifies the following key aspects relating to this project. The policy commits Eskom to:

- Sustainable development.
- Compliance with all environmental policy and legislation.
- Education of staff regarding environmental issues and management.
- Recognition of the need for cost effective resource use in the production, distribution and use of energy. This objective relates directly to the consideration of constraints imposed by the environment on Eskom which translate to a cost.

The above objectives were considered in the project approach and deliverables. The conclusion reflects on the degree to which the project has assisted in achieving the project objectives and these aspects of the company's policy.

- *Planning Process*

Eskom's Capital Investment Process (CIP) is summarised in Figure 1. The process has been adapted to account for the time and budgetary requirements associated with the EIA process. The EIA process is initiated at the point of the Concept Release Approval (CRA) and environmental authorisation is required by the point of the Execute Release Approval Form (ERA) being signed. At this point funds are released for construction.

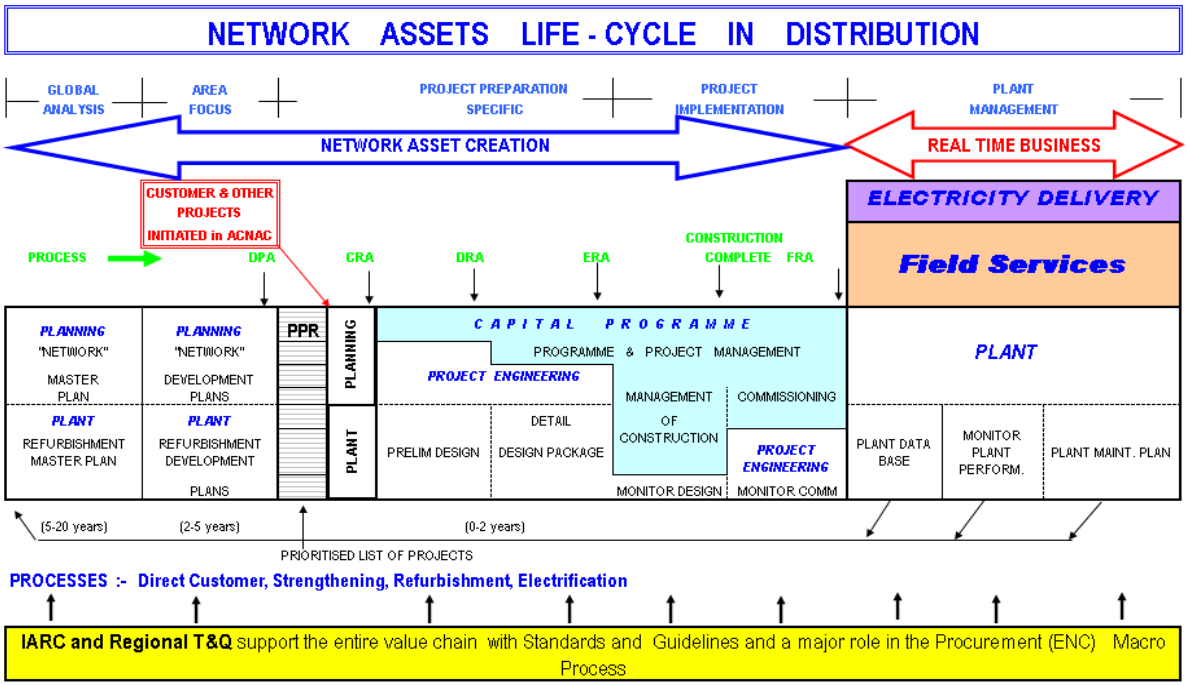


FIGURE 1 SUMMARY OF THE ESKOM CAPITAL INVESTMENT PROCESS

- *Design*

Eskom have adapted the design of transmission line support structures and designed various bird warning measures to reduce the incidences of both bird fatalities and disruption to electricity supply. Eskom has worked closely with specialists and NGOs in the development, testing and monitoring of these designs.

[5] Eskom Safety, Health and Environment (SHE) Policy, 32-94. Revision January 2010.

- *Organisational Capacity*

Eskom have invested in the development of environmental staff who are responsible for among other activities, managing the environmental screening process for distribution lines and the EIA process for transmission infrastructure and other activities 'listed' in the EIA regulations. The environmental section in the Eastern Region has developed training courses undertaken by both internal staff and service providers.

Despite the various initiatives listed above, compliance with the EIA process remains a challenge. The limitations of the process are well documented, and many of the issues relate to the fact that the process is project specific[6]. DEAT (2008) found that "the biggest single issue that affects the effectiveness of EIA negatively in South Africa is that it is often executed without taking sufficient account of the broader context within which the application occurs." Furthermore, it is a requirement that EIA consider cumulative impacts even though the process considers development at a project specific level. Another important requirement of the EIA regulations is the need to consider alternatives in the process.

Environmental parameters and the associated constraints have to date only been considered by Eskom in the EIA process, where the limitations of the EIA process undertaken in the absence of strategic level information is leading to delays in the EIA process and appeals, often on the basis of a failure to properly consider alternatives and deal with cumulative issues.

PROBLEM STATEMENT

Limited consideration by Eskom of environmental constraints early in their planning process for sub-transmission and transmission infrastructure is proving costly, time consuming and affecting the ability of the company to comply with their legal obligations and policy statement.

This situation led to the need for the consideration of environmental constraints earlier in the CIP process i.e. master planning. The overall aim and objectives are summarised in the text box below.

1.2.2 Project Aim and Objectives

PROJECT AIM

Develop a spatial decision support tool that provides for the consideration of Environmental Constraints in the Master Planning for the sub transmission and transmission infrastructure in the Newcastle Field Services Area.

OBJECTIVES

- *The tool must account for the impact of Eskom on the environment, and the environment on Eskom.*
- *Improve efficiency in EIA process through proactive identification and consideration of alternatives. In so doing, reduce risk of time delays to overall project implementation.*
- *Assist in achieving legal compliance.*
- *Reduce costs associated with construction phase and operation/maintenance.*
- *Increase environmental awareness and capacity of Eskom staff.*

This tool has been defined as an ECF. The following section summarises the scope of this tool and the guiding principles applied by the INR and ACER/S3 in the development of the ECFs for the Newcastle and Pietermaritzburg Planning Regions.

[6] DEAT. 2008. Review the effectiveness and efficiency of the environmental impact assessment (EIA) system in South Africa.

1.3 APPROACH AND METHODOLOGY

1.3.1 Project Scope

Having defined the need and purpose of the ECF in Section 1.2, it is important that there is also a clear understanding of the scope of the ECF.

1.3.1.1 Project Area

Eskom's network across South Africa is geographically organised into six regions, which in turn are divided into Field Services Areas (FSA), based on network operational boundaries. The Eastern Region is divided into four FSAs, viz. Empangeni, Newcastle, Pietermaritzburg and Margate as shown in Figure 2. Eskom's Eastern Region is working towards achieving an ECF that will meet its requirements for all four FSAs. An ECF was developed for the Empangeni FSA, based on the same approach as is being followed for the Newcastle and PMB FSAs. An SEA was also undertaken for Margate which had a strong spatial component but which differed somewhat in approach and the final outcome to the Empangeni ECF.

The location and extent of the FSAs are important to understand because they have bearing on the scale of data that can be used to effectively represent environmental features across the FSAs. It is also important because spatial data is often aligned to administrative boundaries, notably municipal, provincial and national boundaries. The FSAs do not all align with administrative boundaries[7], and similarly, neither do natural features.

- *Pietermaritzburg Field Services Area*

The Pietermaritzburg FSA (Figure 2) covers a large area of KwaZulu-Natal incorporating uKhahlamba-Drakensberg, Midlands, South Coast, and areas surrounding Durban. It is a relatively densely populated and developed region, falling within seven District Municipalities (although for the purposes of the ECF, **eThekwini Metropolitan Municipality is excluded**) in turn covering nineteen Local Municipalities. Major land uses outside of urban centres are agriculture (various crops and livestock), sugar cane, commercial forestry, conservation, eco-tourism and traditional authority areas. Of key importance is the Ukhahlamba-Drakensberg Park (UDP) World Heritage Site which has been assigned this status due both to the biodiversity and cultural value of the systems, features and sites occurring within the Park.

- *Newcastle Field Services Areas*

The Newcastle FSA borders on the PMB and Empangeni FSAs. As indicated in Figure 2, while the majority of the total area is located within KwaZulu-Natal (80%), a combined 20% falls within the adjoining provinces of Mpumalanga (17%) and the Orange Free-State (3%). Within KZN, the FSA covers the higher altitudinal zones from the midlands to the top of the escarpment. The area is primarily rural in nature with the main urban centres being Bergville, Newcastle, Ladysmith and Vryheid. Land use is dominated by agricultural and traditional rural uses, interspersed with some mining and conservation areas. The UDP falls within both the Pietermaritzburg and Newcastle FSAs

[7] It should be noted that Eskom is currently working towards restructuring its management regions to align with provincial boundaries.

and is of key importance as discussed above. The FSA also forms a significant part of the upper catchment of KZN's largest river, the Tugela.

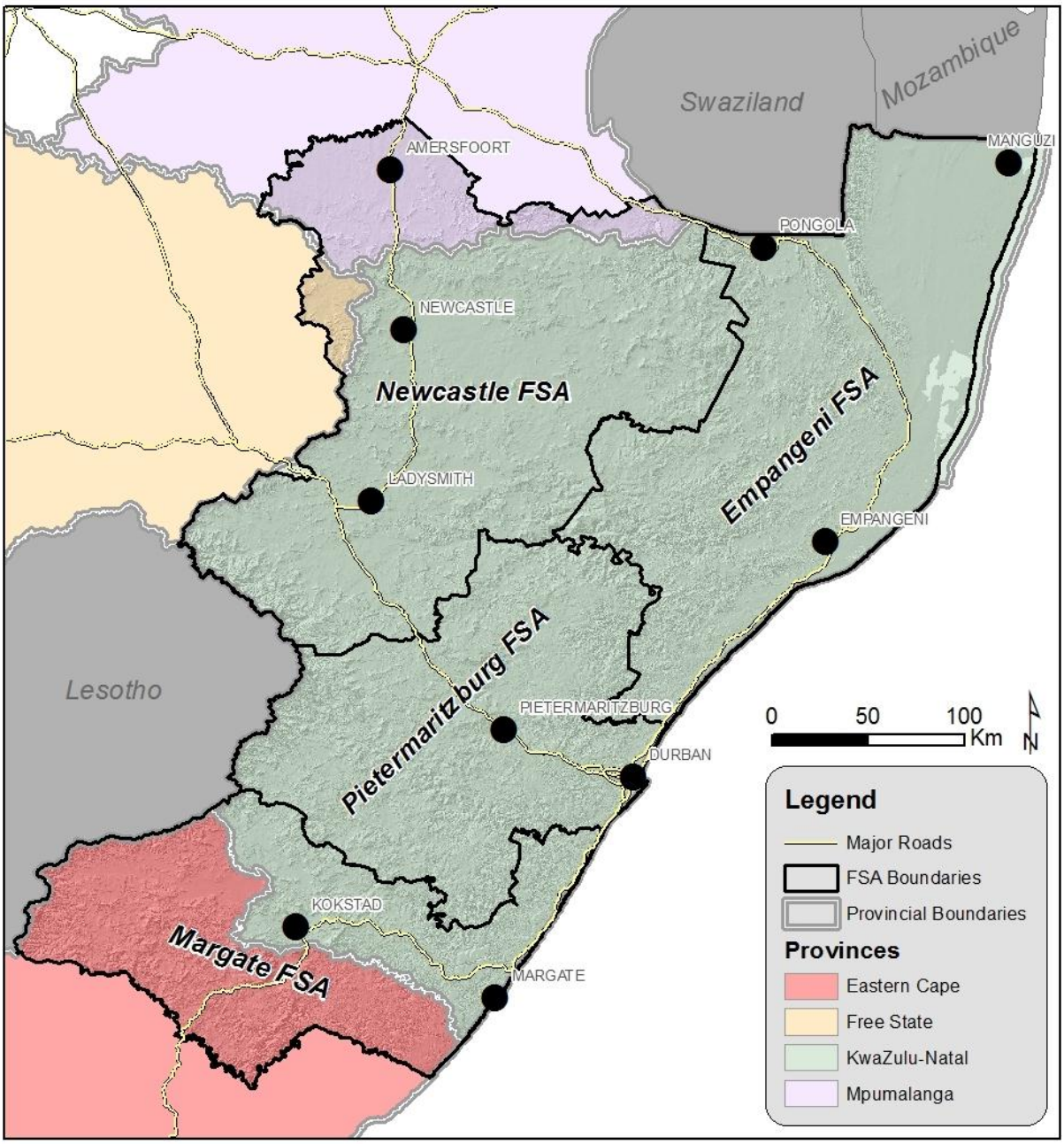


FIGURE 2 LOCATION AND EXTENT OF THE NEWCASTLE/PIETERMARITZBURG FIELD SERVICES AREA

1.3.1.2 Nature of the Environmental Influence

Compliance with the legal framework requires that Eskom considers its impact on the environment such as the destruction of sensitive habitats. The reverse also applies in that certain environment features place constraints on Eskom and need to be considered. For example it is not technically possible to span water bodies greater than 300m in width on flat land. The ECF has therefore been designed to identify and assess the influence of the environment on Eskom and the impact of Eskom on the environment.

1.3.1.3 Nature of Eskom Infrastructure Considered

The focus of the ECF is on master planning which is undertaken for transmission (275kV-765kV) and sub-transmission infrastructure (132kV, 88kV and 33kV). While Eskom are increasingly investigating underground cables, the ECF only considers the development of above ground infrastructure.

1.3.1.4 User Focus

The primary focus of the ECF is for use by planners in the master planning process. The ECF has therefore been designed specifically to suit their needs and identify strategic level constraints. In terms of additional applications, the ECF may also inform network planning, the EIA process for transmission and sub-transmission lines, and the environmental scanning process for distribution lines (to which the EIA regulations do not apply).

1.3.2 Project Phasing

The project involved phases as described below.

- ***Inception Phase***
  The purpose of this phase was to '*establish a common understanding of the desired outcomes, and the approach and methods for achieving these*'. This understanding was developed through engagement between the INR, ACER/S3, Eskom, TAP and NETGroup. Details of this engagement and the resulting understanding are documented in the Inception Report.

- ***Scoping Phase***
  The purpose of this phase was to identify relevant environmental features and data sets to represent them in the ECF. This culminated in an Environmental Features Report (INR, ACER, S3, December 2011) that lists the features to be represented and the consultation process followed in arriving at the list. The consultation process also informed understanding of:
  - The nature of the impact of power lines on the features identified and *vice versa*,
  - The sensitivity/conservation value of the features, and the
  - Resultant level of constraint.

- ***Environmental Constraints Framework***
  This phase is reported in this document and constitutes the primary outcome of the project.

- ***ECF Handover***
  Optimising the value of the ECF requires that there has been widespread involvement of Eskom staff throughout the process, and that there is effective handover once complete. The purpose of this phase is therefore "Transfer of the ECF to facilitate efficient application in the Master Planning Process and institutionalise its use within Eskom". It will involve presentation and demonstration of the ECF to Eskom staff – from planners through to regional fieldworkers.

1.3.3 Alignment with SEA Principles

While the output has been titled an ECF, the driver for the development of this environmental planning tool was the need for SEA in the Master planning process as identified by Eskom Distribution at a corporate level. This section shows how the SEA principles have been accounted for in the development of the ECF (Table 1).

TABLE 1 APPLICATION OF THE SEA PRINCIPLES IN THE DEVELOPMENT OF THE ENVIRONMENTAL CONSTRAINTS FRAMEWORK

SEA PRINCIPLES (DEAT, 2004)	APPLICATION OF SEA PRINCIPLES IN THE EMF PROCESS
i. **SEA is driven by the concept of sustainability**	The ECF is designed to give effect to the concept of sustainability as it aims to identify, prioritize and integrate social, economic and biophysical features in a way that impact to them is avoided – thereby contributing to sustained functioning of these systems in the long term.
ii. **SEA identifies the opportunities and constraints which the environment places on the development of plans and programmes.**	The core purpose of the ECF is to identify and prioritize environmental constraints on the development of Sub-transmission power infrastructure (and thereby also infer opportunities).
iii. **SEA sets the levels of environmental quality or limits of acceptable change.**	The constraint categories are based on the conservation significance of the features identified. These are in turn based on targets and thresholds of acceptable change. So while the SEA does not set targets, existing targets are integrated in the design of the ECF.
iv. **SEA is a flexible process which is adaptable to the planning and sectoral development cycle.**	The ECF has been structured to allow for 5 yearly updates thereby taking into account the dynamism of the legal, institutional and technological context.
v. **SEA is a strategic process.**	This principle has significantly focused the design of the ECF. The value of the ECF lies in ensuring that the most strategically important issues at the FSA scale are highlighted – trying to account for all issues at a detailed level reduces the priority issues and limits the credibility and efficacy of the tool.
vi. **SEA is part of a tiered approach to environmental assessment and management.**	The primary focus of the ECF is the strategic level via the master planning process. Improved consideration of environmental constraints in master planning will improve the more detailed levels of network planning and EIA by: Improving the appropriateness of the routes selected for consideration in EIA process (less conflict), and focussing the EIA process providing initial screening and highlighting those issues that require attention.
vii. **SEA is a participative process.**	Consultation has formed an important role in the development of the ECF and has comprised two elements: ***Internal Consultation – Impact of the Environment on Eskom*** Environmental features impact Eskom at all points in the project life cycle. For example, dams present a challenge to construction, but also to maintenance teams. For certain features, the level of constraint varies between the different departments. In the case of maintenance, dams represent a very high constraint because of the dangers and difficulties of removing power lines from water. These issues are not always understood by planners. It was therefore important to consult across all departments to ensure that the highest level of constraint related to different points in the project life cycle are accounted for. Eskom staff responsible for the development and management of the ECF have also been involved by ACER/S3 and INR in the thinking and design of the product. ***External Consultation – Impact of Eskom on the Environment*** A range of external stakeholders were consulted to identify features impacted by power lines, and more specifically: • Understand the nature of the impact, • Establish the conservation or functional value of the features, • Discuss appropriate levels of constraint. • Identify data sets to represent these features The final phase involves transfer of the ECF to Eskom staff via training events.

viii.	**SEA is set within the context of alternative scenarios.**	The ECF is defined at a point in time. So while it does not consider scenarios in terms of changing factors over time, it is designed to assist in the consideration of alternative routing by master planners.
ix.	**SEA includes the concepts of precaution and continuous improvement.**	***Precaution***: The targets and thresholds within the sustainability framework are set in relation that relate to legal limits established on the basis of the threat or risk to human health and well-being. ***Continuous Improvement***: Given the spatial nature of the ECF, its value is largely dependent on the accuracy and relevance of the data sets used to represent the select features Recommendations are therefore made regarding data sets considered gaps in the current ECF that should be developed/obtained to improve future versions. Guidelines are also provided for updating the ECF on a five yearly basis.

1.3.4 ECF Structure

The structure of the ECF is illustrated in Figure 3. The structure is hierarchical in nature, building through integration of data to arrive at a final ECF layer. The following points explain the structure:

- The structure has two sides which mirror each other. They account for the two scenarios i.e. the impact of Eskom on Environmental features (Technical constraints) and the impact of the Environment on Eskom (Environmental constraints).
- Both sides of the structure have the first four levels in the hierarchy with the fifth level being the final ECF layer at which point the two sides of the structure are integrated.
- The levels are explained as follows:
  - **Level 1**: Constraint features are the basic element on the ground which constitutes a constraint to distribution infrastructure.
  - **Level 2**: Constraint feature classes. This level accounts for a grouping of similar constraint features, or where base data for features has been manipulated to better represent the features.
  - **Level 3**: In line with SEA principles the ECF is structured to collate constraints associated with Environmental Sub-components e.g. biophysical, socio-economic and cultural. While a specific layer has not been developed in the ECF (as it does not affect the overall output), the features have however been classified according to these sub-components.
  - **Level 4**: Technical and Environmental constraint layers. These two layers represent the impact of the environment on Eskom and vice versa, respectively.
  - **Level 5**: Integrated constraints layer - combining the Technical and Environment integrated layers. It is this final layer which informs the selection of alternative routings in the master planning process.

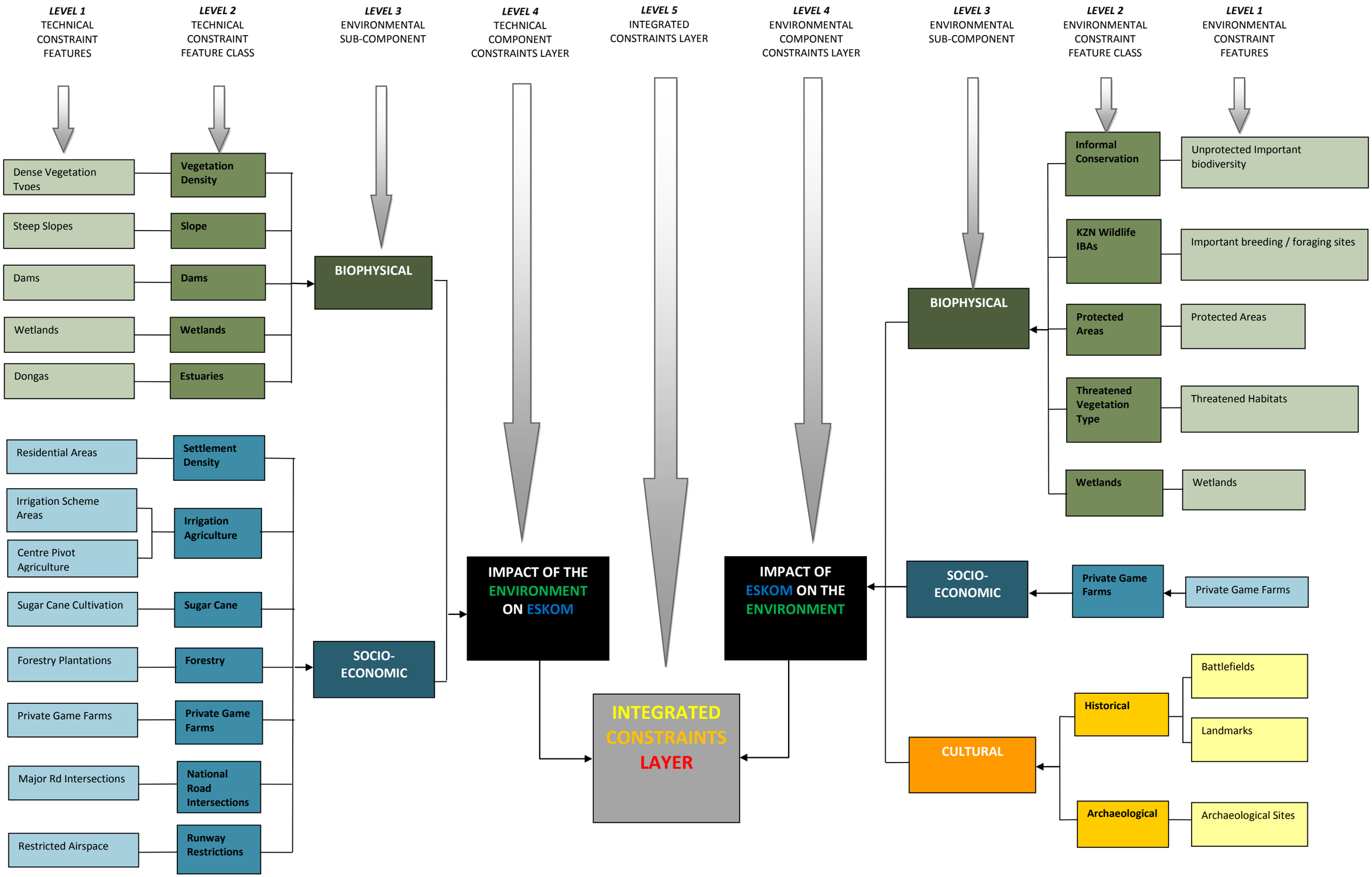


FIGURE 3 GENERIC STRUCTURE OF THE ENVIRONMENTAL CONSTRAINTS FRAMEWORK SHOWING THE TYPES OF BASE LAYERS USED AND HOW THEY ARE COMBINED TO ARRIVE AT THE INTEGRATED ECF

The individual constraints layers were integrated via a union process shown in Figure 4, to arrive at the 'Integrated Component Constraints layers". Certain features, such as wetlands, represent constraints under both scenarios. They present a constraint to powerline development (technical constraint) and are also impacted by powerline construction. The same data set is used on both sides but the level of constraint may differ under the two scenarios, in which case the highest constraint for wetlands is shown in the final ECF layer. The features are represented in a Vector format (points, lines and polygons). This means that the actual boundary of a feature is represented by a line or polygon, as opposed to in a raster format where features are depicted in a pixel format where the boundary of a feature will follow the edge of the boundary pixel, and the accuracy of the boundary of a feature is dependent on the resolution (pixel size) of the raster dataset.

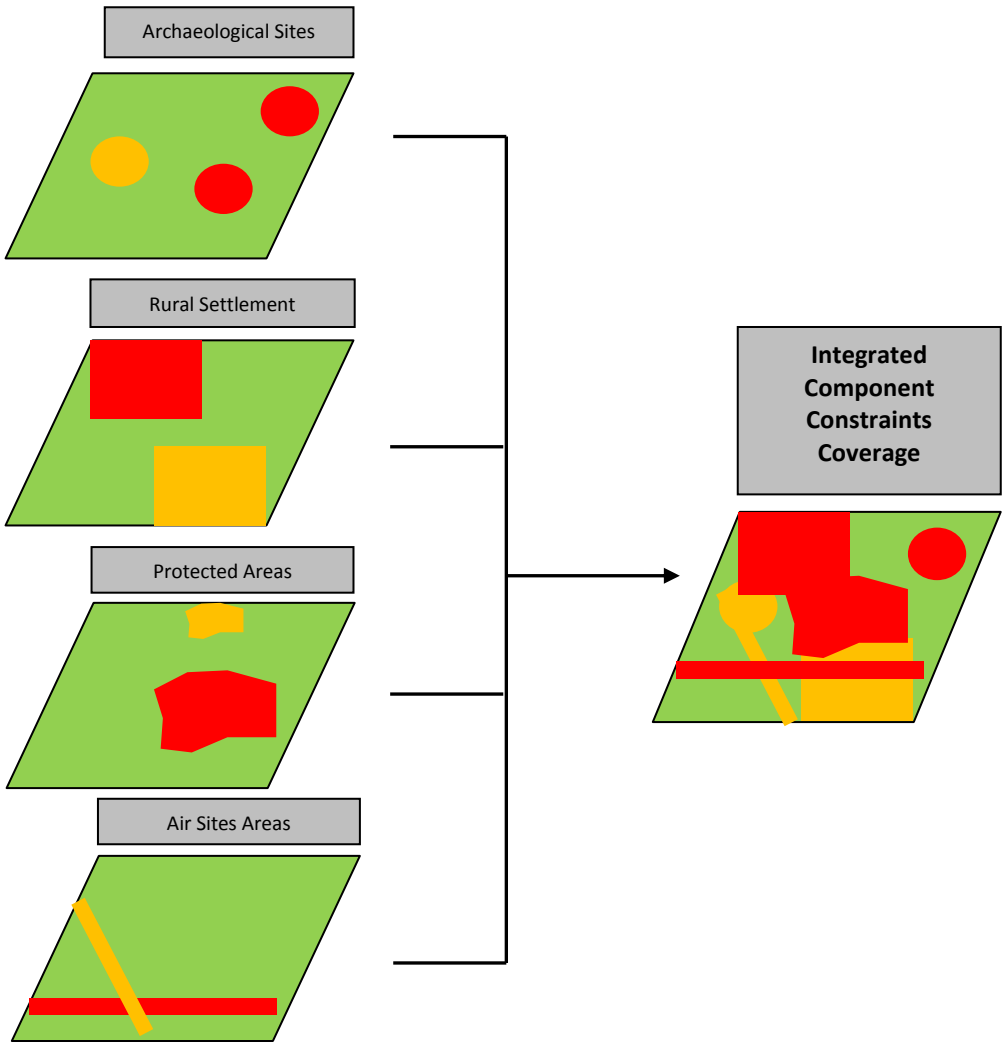


FIGURE 4 EXAMPLE OF THE UNION PROCESS TO INTEGRATE FEATURE CONSTRAINT CLASSES WITH FEATURES OF VARYING CONSTRAINT LEVELS

1.3.5 Constraint Levels

The ECF is required to represent the constraints posed by numerous different features, each one associated with different impacts. A set of criteria was used to define constraints levels and enable them to be assigned in a consistent manner across the varied features, such that constraints can be represented in a standardised way that is useful and easy to interpret by Master Planning.

The criteria considered related to the legal protection, conservation value and the nature of the impact associated with a feature. These are discussed below and the definitions/descriptions of the three constraint categories are provided in Table 2. It should also be noted that two underlying principles were applied in the development of the constraints levels viz:

Underlying principles

- ***There is no "Absolute Constraint"***
  This applies in the case of both the Technical and Environmental scenarios. In terms of the impact of Eskom on the environment, all legislation provides for development within the area/system it is protecting if the required authorisation is obtained from the relevant authority. As an illustration of this - it is possible to develop in a world heritage site, wetland or forest despite the conservation status, if the necessary permit is obtained and regardless of the conservation status of the particular feature concerned. In term of the impact of environmental features on Eskom, it was noted several times in the process that if sufficient funds are made available it would be possible to establish transmission lines across any feature e.g. one could bury lines under Pongola Dam.

  Having noted the above, features designated 'Highest Constraint' should effectively be considered 'no-go' areas (absolute constraints), because while not 'absolute', the mechanisms and status afforded these features are numerous, specific and as high as possible i.e. everything has been done within the scope of the legal and policy framework to prevent development impacting these features. It is in the best interests of Eskom, in terms of adhering to their environmental policy and avoiding damage to their public image, to avoid such areas. Similarly, given the current effort to secure long term electricity supply, Eskom is under pressure to work efficiently. This requires a reduction in capital development costs which will be reduced by avoiding features designated 'highest constraints'.

- ***All Levels Represent High Constraints***
  As defined in the name and description of the constraint levels, all levels are considered high i.e. the levels are therefore a graduation of 'high' constraints as opposed to a graduation of 'high' to 'low' constraints. This serves to:
  - Emphasize the significance of those constraints rated as very high (red) and
  - Acknowledge that the orange and yellow level constraints should not be taken lightly.

  The planner's objective should be to avoid all constraints. As this is not practically possible, the graduation provides for the identification of alternatives which pose the least resistance in terms of cost and impact on the receiving environment.

Criteria considered

With the understanding established in the points above, the following three criteria were considered in developing the categories or level of constraint. The constraint level assigned to a constraint feature may be due to one or more of the following factors:

a) *Legal Protection*

Environmental features are afforded different levels of legal protection. Generally the higher the level of legal protection the higher the feature's conservation value (discussed below), and/or the threat to that feature. Forests are a good example of a biophysical feature for which specific legislation has been promulgated due to the limited extent, high loss and ongoing existing threat to these systems. The National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) also affords protection to terrestrial systems classified as being of a threatened status according to conservation targets. There are also features to which various Acts apply, as in the case of wetlands to which the following Acts apply in terms of their protection:

- National Water Act: requires a Section 21 water use license:
- National Environmental Management Act: EIA regulations: requirement for environmental authorisation.
- Conservation of Agricultural Resources Act: prohibits the draining or cultivation of wetlands.

The number, scope and specific legal restrictions relevant to features were therefore considered in assigning a constraint level.

b) *Conservation Value*

As natural habitat is lost through transformation or degradation, ecosystem function is increasingly compromised, leading to the eventual collapse of the ecosystem. The consequence is a reduction in the ecosystem services which emanate from it and the dependant species. Ecosystem status is measured on the basis of how much of a broad vegetation type's original area remains intact relative to three thresholds (Driver *et al*, 2005). An ecosystem is considered: 'Least Threatened' if more than 80 % of its original extent is intact; 'Vulnerable' if less than 80 % but more than 60 % of its original extent is intact; 'Endangered' if less than 60 % but more than the desired biodiversity target area required is still intact and 'Critically Endangered' if less than the biodiversity target area is still intact. The status of systems has informed the constraint level assigned to features.

c) *Nature of the Impact*

Different development activities impact natural features in different ways. As an example, the direct impact of powerlines on grasslands is caused by the footprint of the pylons and impact of new access roads /tracks. The pylons can be sited to minimize the impact and the construction of access roads mitigated to a degree through rehabilitation. In the case of forests however, it is necessary to clear a significant area through the forest. The direct impact is the loss of habitat, which is compounded by impacts associated with fragmenting the forest patch such as allowing fire and wind intrusion into the forest. The level of impact has therefore been influenced by the nature of the impact by power line development on different features.

The constraints definitions were developed to account for the factors described above. The constraints levels are described for the alternative scenarios i.e. the Impact of Environment on Eskom and the reverse situation (Table 2). The implications for Eskom of the different levels of constraint are also described. These include increased time and cost requirements associated with the need for increased public participation and specialist studies. The level of public opposition will be higher, as will the number of regulatory processes Eskom will need to go through and the risk of the required authorisations/permits not being secured.

TABLE 2 CONSTRAINTS CATEGORIES

Level of Constraint	*IMPACT OF THE ENVIRONMENT ON ESKOM*	*IMPACT OF ESKOM ON THE ENVIRONMENT*	*RISKS TO ESKOM*
HIGHEST CONSTRAINT	Features encountered make the project unfeasible (technically / financially/ administratively and/or legally).	Features with the HIGHEST ecological and/or conservation; cultural; socio-economic value, and/or specific legal protection will be impacted. Electrical infrastructure **SHOULD NOT** be developed here. This level of constraint effectively constitutes a '**NO-GO**' for the project.	▪ Likely fatal flaw (project stopper). ▪ Highest costs (time, expertise, finances). ▪ Highest risk that environmental authorisation will not be granted. ▪ Highest likelihood of public resistance and risk to Eskom's reputation. ▪ Mitigation of serious environmental impacts may not be possible.
HIGH CONSTRAINT	Features encountered present a VERY HIGH constraint to the construction, operation and/or maintenance of the infrastructure (technically / financially/ administratively and/or legally)	Features with VERY HIGH ecological and/or conservation; cultural; socio-economic value, and/or specific legal protection will be impacted. Negative impacts are of high significance and difficult to mitigate.	▪ High costs (time, expertise, finances). ▪ High risk that environmental authorisation will not be granted. ▪ High likelihood of public resistance and risk to Eskom's reputation. ▪ High mitigation/ management demands.
MODERATE to HIGH CONSTRAINT	Features encountered present a HIGH constraint to the construction, operation and/or maintenance of the infrastructure (technically/ financially/ administratively and/or legally)	Features with a MODERATE to HIGH ecological and/or conservation; cultural; socio-economic value, and/or specific legal protection will be impacted. Negative impacts are of high or medium significance and will require mitigation.	▪ Moderate to High costs (time, expertise, finances). ▪ Possible risk that environmental authorisation may not be granted. ▪ Moderate to High likelihood of public resistance and risk to Eskom's reputation. ▪ Moderate to High mitigation/ management demands.
LOW CONSTRAINT or NO KNOWN FEATURES (which pose a strategic constraint)	Features encountered that present low constraints. ***OR*** Data unavailable, thus, potential constraints not able to be identified.	Features which impose impacts of low strategic significance will be impacted. ***OR*** Data unavailable thus, potential constraints not able to be identified.	Low level of the risks described above. ***OR*** No known risks according to available data. However as new data becomes available the constraint level (and associated risks) may change.

1.3.6 General Assumptions and Limitations

As the ECF is a GIS based tool, the large majority of the assumptions and limitations relate to the data used to represent the constraint features. The general issues discussed below are presented as a preface to the specific discussion provided for each of the features that follow in Section 2. While certain of the issues discussed are relevant for many of the data sets used, it is important to note that data sets were excluded if their limitations reduced the level of confidence to a point where they could significantly jeopardise the application of the ECF in master planning.

- **Features with directional elements affecting constraint levels**

Certain features, particularly dams and wetlands, can pose different constraint levels, depending upon the direction in which a powerline crosses that feature. Wetlands are sensitive habitats and may pose the highest level of constraint, if towers are to be placed within the wetland. However, from a technical perspective, the constraint posed by a wetland is much lower if that wetland can be spanned. As illustrated in Figure 5, assuming a span capability of 300m, the wetland represents the highest technical constraint to proposed line A-B, since a portion is not 'spannable' in that direction, whilst the same wetland does not represent the highest constraint to proposed line C-D, which can span the wetland from a different direction.

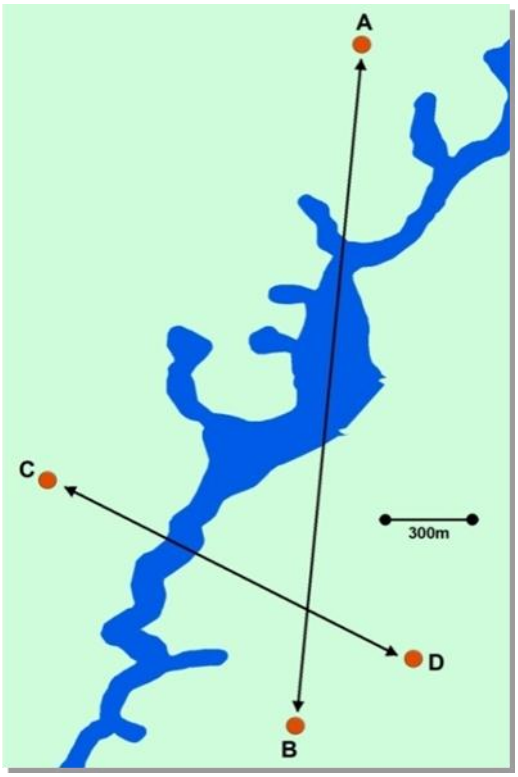


FIGURE 5 THE LEVEL OF CONSTRAINT POSED BY A FEATURE IS DRIVEN NOT ONLY BY THE NATURE OF THE FEATURE, BUT ALSO BY THE DIRECTION OF THE PROPOSED LINE

Work has been done by ACER in collaboration with INR on the development of GIS pre-processing analysis methods and their respective programming, for features with this directional element. However, this has not been successful due to the sheer number of calculations required which are too much for the available computers to handle. Surface area, which gives a general indication of diameter or width, has been used to set thresholds that provide in a general and fairly limited way, an indication of whether the feature is "spanable" or not. Additionally the effect of having several wetlands located close together may render a route unsuitable from a technical point of view because of the difficulty in accessing areas amongst a high density of small wetlands to erect pylons. For this reason, even though they may not constitute a constraint in their own right, eliminating small wetlands from the overall picture is inadvisable. This issue is illustrated in Figure 6.

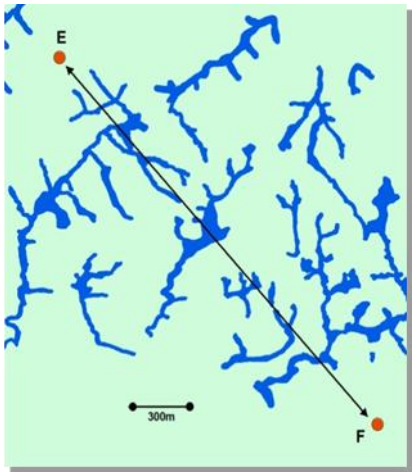


FIGURE 6 THE CUMULATIVE IMPACT OF SEVERAL WETLANDS CLOSE TOGETHER MUST ALSO BE CONSIDERED

- **Date of data capture**

The data represented has been captured at different times. While no data set was excluded on this basis, the confidence associated with a data set is diminished the older it is. This is particularly relevant in the case of the land cover data which forms the base set of many features, or is used in refining certain data sets.

- **Scale and resolution of data**

In some cases, the scale at which data has been captured is too broad to be of relevance to this study. Examples of this are the data sets for geology housed by the Council for Geo sciences. These have been captured at a scale of 1:250 000 which is too coarse to be relevant at the scale of the project area.

- **Accuracy of data**

Spatial data is captured via different methods and using different baselines from which to map the boundary of features. Some of the most common methods are:

- Remote sensing and automated interpretation – where automated analysis is undertaken using satellite imagery. In this process the spectral signature of pixels is interpreted by GIS software in order to identify the feature in question. This is usually undertaken when identifying land cover over large areas.
- Mapping :
  - On screen digitizing using digital aerial imagery as a backdrop. The accuracy of this technique varies according to the resolution of the imagery and whether it is colour or black and white.
  - In field mapping on hardcopy backgrounds which are then captured electronically.
  - Via GPS for which the accuracy can vary depending on the standard of GPS hard and software.

The methods and equipment used affect the accuracy of the final output. In the case of the ECF the full range of mapping techniques have been used in the compiling the data used. This has resulted in varying levels of accuracy and associated confidence. An example of the limitations associated with remote sensing is the conservative result for urban areas in the Land Cover data set, which were shown to extend into rural areas and include roads and their reserves. As a result this land-cover type was excluded from the final set used to represent urban areas.

- **Type of data**

In the majority of the data sets used, the captured boundaries represent the actual boundaries of features. However in certain cases, actual boundaries are not available and at best, features are represented by point data that indicate a rough centre point of the feature. In these cases, features have then been represented in the ECF as a buffered area around this point approximating the area of the feature. Good examples of this are cultural heritage monuments and archaeological sites which, although having been represented as a buffered area of approximately two hectares may in effect be up to several hundred in extent. This limitation reduces the confidence in the consideration of these features in the planning process. What it means is that additional work will be required at an EIA level when a route is located in close proximity to such features.

- **Completeness of data**

The majority of datasets included in the ECF are 100% complete (i.e. all features known to exist are represented in the data). However, certain data sets are acknowledged to be incomplete in view of the fact that not all features are captured e.g. game farms (i.e. there are known features which have not yet been included in the data). They do however represent the best available datasets at this time and have been included in the ECF. The use of the most current datasets available is fundamental to the effectiveness of the ECF and it should be updated as soon as newer information becomes available.

- **Data gaps**

Where no data or very poor data exists for identified strategic constraints, this is discussed in the relevant subsections under Section 2.3.

PART II – THE ENVIRONMENTAL CONSTRAINTS FRAMEWORK

Part II of this document presents the three main outputs for the Newcastle ECF, viz the Technical, Environmental and Combined Constraints layers. This is followed by information on each individual layer of constraint features that has been used to compile the ECF.

2.1 Overview of Technical Constraints Layer

The integrated technical constraints map is provided in Figure 7.

2.1.1 Highest constraints

The features posing the **highest** level of technical constraint are:

- Dense residential settlement (more than 3 households per hectare).
- Dams (>4 hectares in surface area).
- Centre pivots.
- Airfields.
- Dongas.
- Slopes > 45 degrees.

Together, they cover a relatively small extent of the FSA.

Residential settlement contributes the largest surface area of the above mentioned features. Clusters of settlement are scattered widely over the FSA but the largest concentration is found in the central part of the FSA, around major centres of Newcastle, Ladysmith and Vryhied.

Dams are profuse throughout the Newcastle FSA and will influence routing of powerlines.

Centre pivot irrigation is fairly sparsely scattered, with the largest concentration being in the Bergville and neighbouring Winterton areas.

There are several airfields registered with the Civil Aviation Authority (CAA) in the Newcastle FSA. There are likely to also be many unregistered ones but only those that are important for fire fighting purposes have been included in the ECF.

There are some large dongas in the northern part of the FSA which will need to be taken into consideration when routing powerlines, parttiularly where they are clustered as they make access difficult.

KZN is very hilly and slopes > 45 degrees occur in the Drakensberg mountain range to the west and along parts of the major river valleys in the FSA, e.g. Thukela River.

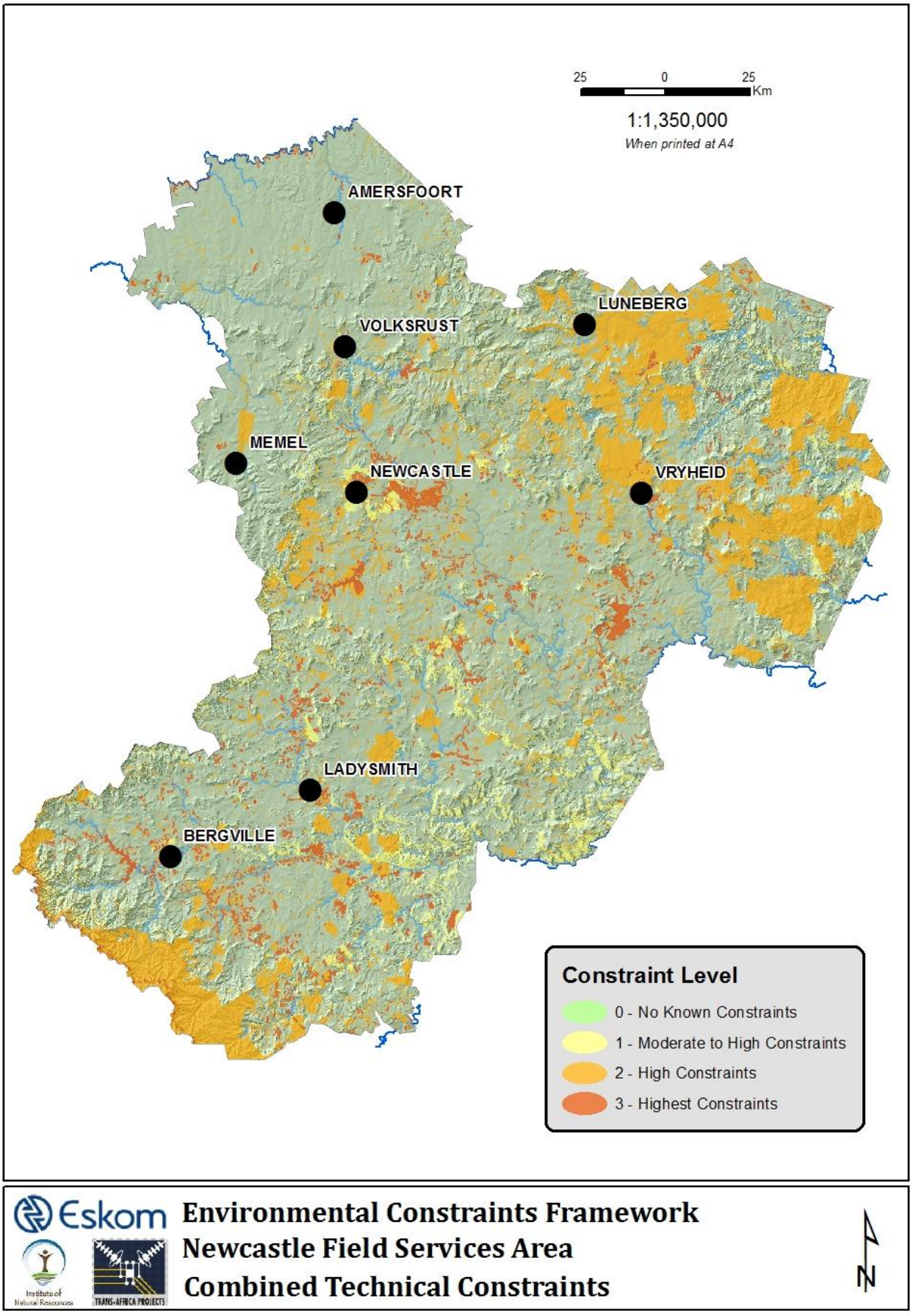


FIGURE 7 INTEGRATED TECHNICAL CONSTRAINTS LAYER

2.1.2 High constraints

Features posing a **high** technical constraint include:

- Commercial forestry.
- Formally and informally protected areas.
- Residential settlement (≥ 1.5 <3 households per hectare).
- Dense vegetation.
- Dams (between 1 and 4 hectares in surface area).
- Wetlands.
- Mined areas.
- Slopes of 35 – 45 degrees.

Together, these features cover a large area across the FSA, particulalrly commercial forestry in the area from Vryhied to the eastern boundary of the FSA.

Protected areas (formal and informal) together also contribute significantly to the extent of high constraint areas in the FSA. Protected areas occur mostly in the western and central parts of the FSA with the biggest protected area being the UDP World Heritage Site in the west of the FSA. Informally protected areas (private game and nature reserves) occur largely in the north and central parts of the FSA.

The steep topography is associated with the Drakensberg escarpment where slopes of 35-45 degrees occur. Similarly, KZN is relatively densely populated compared with the Frees State and Mpumalanga sections of the ECF.

Wetlands are ubiquitous across the FSA, with the biggest clusters being in a band across the FSA 'midlands region'. Dense vegetation also contributes to high constraint areas in the central and south-western parts of the FSA.

Mining is concentrated in the northern sections of the FSA, although it must be understood that the data for mined areas is poor and will require revision as better information becomes available.

2.1.3 Moderate to High constraints

Features posing a **moderate to high** level of technical constraint include:

- Commercial sugarcane.
- Slope (30-35 degrees).
- Dense vegetation.
- Existing residential areas (< 1.5 households per hectare).
- Predicted future growth areas (Data provided by Kayamandi, 2012).

There is very little sugar cane grown in the Newcastle FSA. Slopes of 30-35 degrees are widespread as is residential settlement.

2.2 Overview of Environmental Constraints Layer

The integrated environmental constraints map is provided in Figure 8.

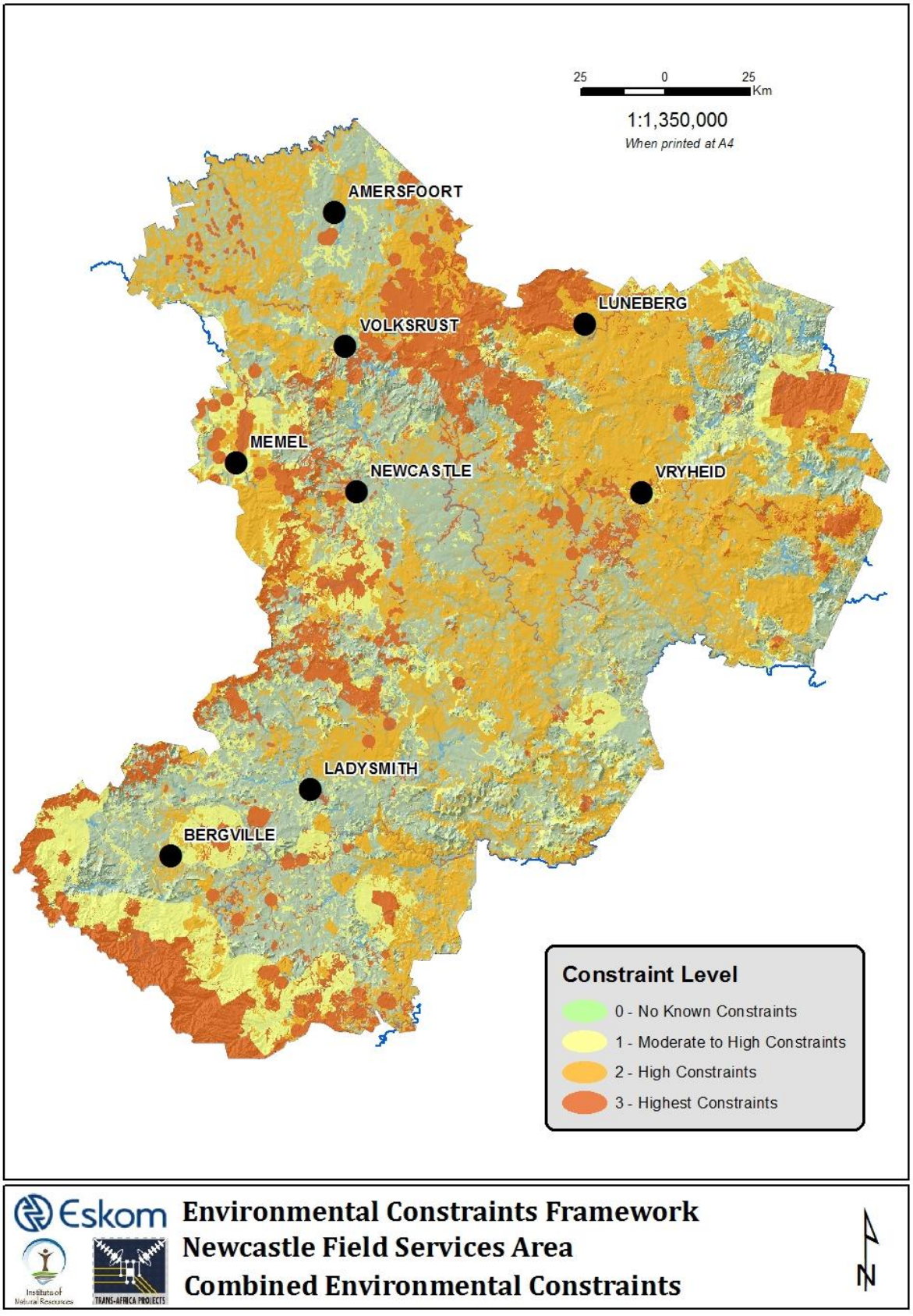


FIGURE 8 INTEGRATED ENVIRONMENTAL CONSTRAINTS LAYER

2.1.4 Highest constraints

The features posing the **highest** level of environmental constraint are:

- Formally protected areas.
- Avifauna (buffered nesting and roosting sites of critically endangered and endangered bird species that are vulnerable to powerlines).
- Indigenous Forest vegetation.
- Critically Endangered Vegetation Types.
- Critically Endangered Terrestrial Ecosystems.
- Wetlands ranked 1-3.
- Wetland clusters.
- Irreplaceable Biodiversity.
- Archaeological Sites.

Together, these features cover a significant extent of the western, central and northern parts of the FSA. Protected areas (including the UDP in the west and Ithala on the eastern boundary) and avifauna are the features that contribute most significantly to the overall extent of high constraint areas in the FSA. There is a significant overlap between wetland areas, avifauna and irreplaceable biodiversity sites. Critically Endangered Terrestrial Ecosystems also overlap significantly with irreplaceable biodiversity. Heritage and cultural sites are concentrated in the UDP area and scattered also across various other parts of the FSA. The sites are normally small in extent.

2.1.5 High constraints

Features posing a **high** level of environmental constraint include:

- Centre Pivot irrigation infrastructure.
- Endangered Vegetation Types.
- Endangered Terrestrial Ecosystems.
- Wetlands ranked 4.
- Avifauna (crane sighting areas).
- Informally protected areas.
- Commercial forestry.

Together, these features cover a fairly large area across the FSA, presenting most dominantly in the central, easten and northen sections of the FSA. Commercial forestry and endangered vegetation types contribute most significantly in terms of high constraints, both being very widespread throughout the FSA. Endangered Terrestrial Ecosystems also contribute but overlap to an extent with endangered vegetation types. Confirmed areas frequented by Cranes also occur fairly abundantly across the FSA. Centre pivot irrigation is fairly sparsely scattered, with the densest concentration occurring in the Bergville and Winterton regions.

2.1.6 Moderate to High constraints

Features posing a **moderate to high** level of environmental constraint include:

- Dams (> 1 hectare).
- Buffers around formally protected areas (10 km around UDP and 5 km around the others).
- Vulnerable Terrestrial Ecosystems.
- Wetlands ranked 5-6 including 30 m buffer.
- Biodiversity Priority Area 3.
- Commercial sugarcane.
- Protected Area Expansion Strategies.

These features are in many cases overlapped by other features assigned with a higher constraint level. The areas presenting a moderate to high constraint level are quite dominant in parts of the west and east of the FSA and represent mostly commercial sugar cane and buffer zones of formally protected areas.

2.3 Overview of ECF (combined technical and environmental constraints)

The integrated ECF which combines the technical and environmental constraints is shown in Figure 9.

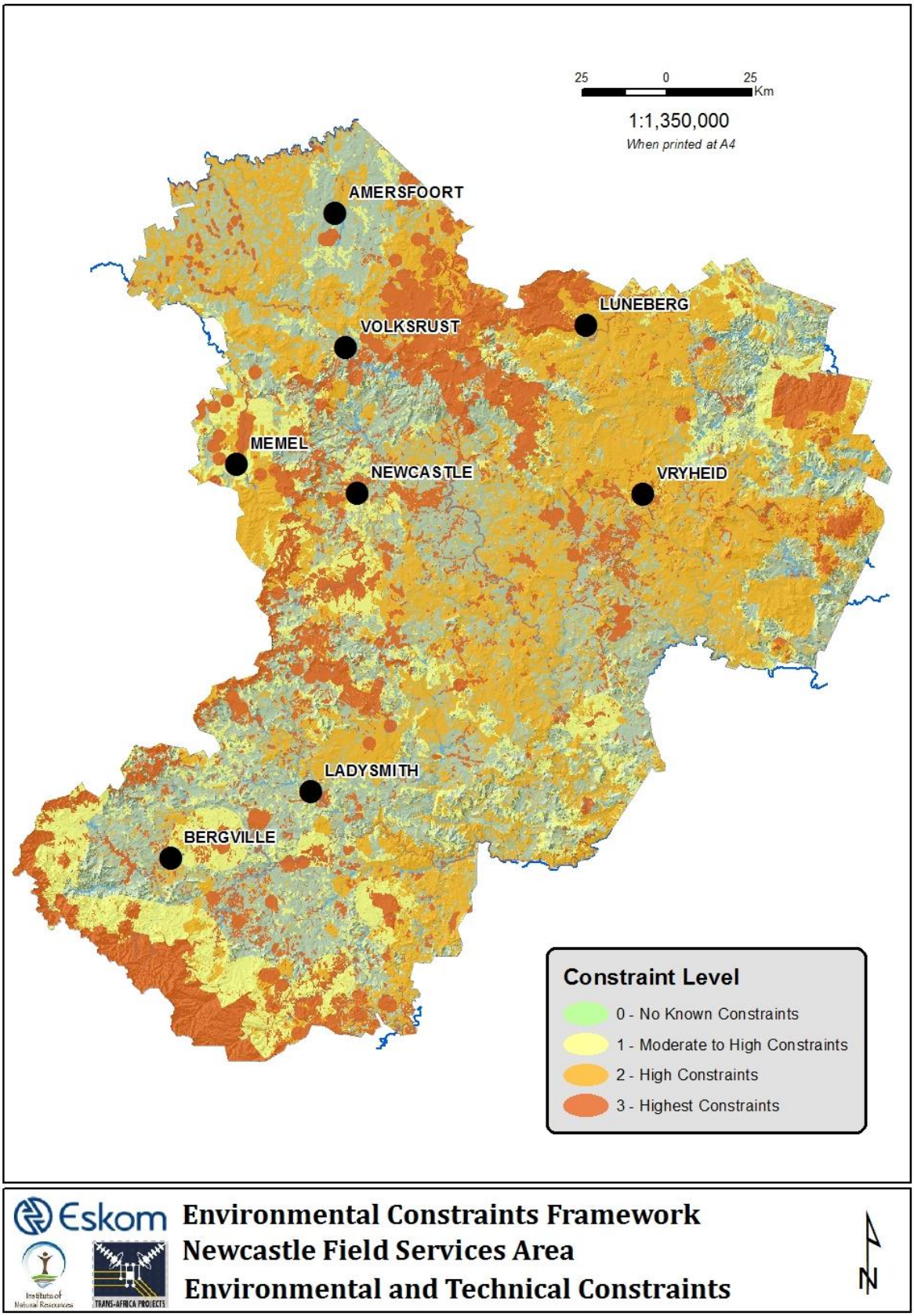


FIGURE 9 COMBINED CONSTRAINTS LAYER (ECF FOR THE NEWCASTLE FSA)

It can be seen that the ECF (combined technical and environmental constraints) map is largely a reflection of the environmental map. This is because there is a relatively high proportion of environmental features presenting **highest** and **high** constraints in this area and in many cases they overlap other features (both technical and environmental) with lower constraint levels. The development of new electrical infrastructure in this FSA will be difficult due to the significant level of constraints presented by the identified features. Eskom will need to be prepared for more difficult and challenging EIA and authorisation processes, which will require more resources in terms of time, specialist personnel and finances towards assessments, authorisation processes and mitigation measures.

2.4 Description of Individual Constraint Features and Associated Data

This section provides information related to the individual features that form the base information which has been integrated to arrive at the final ECF output. The following is provided for each feature:

- Description - of the nature of the impact. Either by the feature on Eskom or vice versa. Where a feature is relevant under both scenarios, both are described.
- Spatial influence - a map showing the spatial occurrence of the feature.
- Data – an explanation of the source of the data used to represent the feature is provided along with a description of the limitations and recommendations for addressing these.

2.4.1 Spatial References & Shapefile Names

Table 3 provides the spatial reference information for data used and Table 4 provides the shapefile name for the individual constraint layers as discussed in the remainder of section 2.4.

TABLE 3 SPATIAL REFERENCE INFORMATION

NEWCASTLE FSA
Projection: Transverse Mercator Central meridian: Lo31° Datum: Hartebeeshoek 1994 False easting: 0m False northing: 0m Prime meridian (Latitude of origin): 0° (Greenwich) Semi Major Axis: 6378137 Semi Minor Axis: 6356752.3142451793 Inverse Flattening: 298.25722356300003

TABLE 4 SHAPEFILE NAMES FOR NEWCASTLE FSA (ID NO'S CORRESPOND TO ATTRIBUTES TABLE OF EACH LAYER)

ID	Title	Shapefile_name
1	Dams	Dams
2	Threatened Terrestrial eco-systems	Threatened_Terrestrial_eco_systems
3	Sensitive vegetation types	Indigenous_and_Sensitive_vegetation_types
4	Dense vegetation areas	Dense_vegetation_areas
6	Commercial forestry	Commercial_forestry
7	Informally protected areas	Informally_protected_areas
9	Fixed irrigation infrastructure	Fixed_irrigation_infrastructure
10	Protected area expansion plans	Protected_area_expansion_strategies
11	Biodiversity Conservation plans	Conservation_plans
12	Unfragmented grasslands	Unfragmented_grasslands

14	Wetlands	Wetlands
14A	Wetland clusters	Wetland_clusters
16	Mined areas	Mined_areas
17	National road intersections	National_road_intersections
18	Formally protected areas	Formally_protected_areas
19	Restricted airspace	Restricted_airspace
20	Slopes	Slopes
21	Dongas	Dongas
22	Avifauna	Avifauna
23	Commerical sugarcane	Commerical_sugarcane
25	Archaeological features	Archaeological_sites
26	Household densities (residential settlement)	Household_densities
28	Future Urban Growth	Theoretical_residential

2.4.2 **Avifauna** [Eskom on Environment]

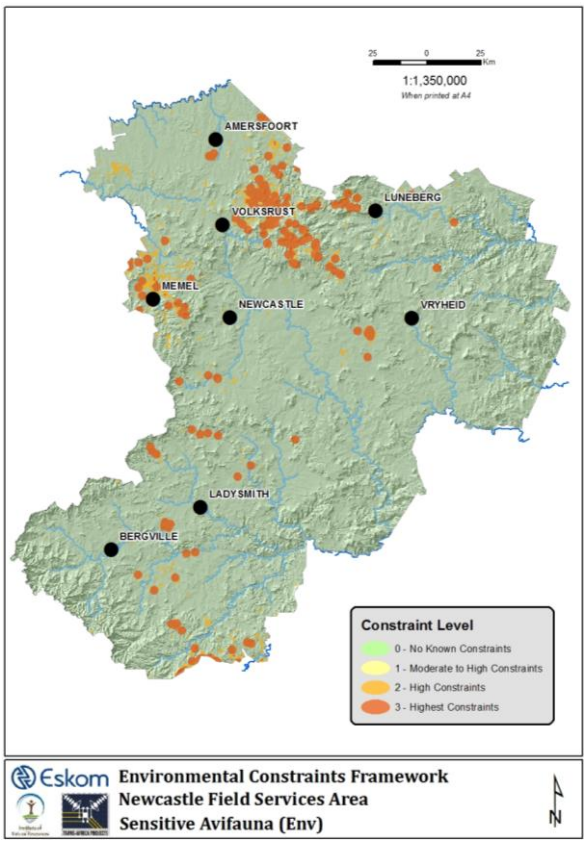
Environmental Component: Biophysical

Description of Constraint: The impact of powerlines on large bird species through collisions is one of the most understood and researched impacts by Eskom on the natural environment through their on-going partnership with the Endangered Wildlife Trust. The main species of concern in this region are the three Crane Species (Wattled, Blue and Grey Crowned) and vultures. All three types of crane are red data species as are several of the vulture species. The level of constraint allocated to the various species given is as follows and varies based on the nature of the data and the bird's habits.

- ***Cranes*** - The risk of impact is highest in the vicinity of nest sites as these are utilised year on year by breeding pairs of cranes which mate for life. The location of these nest sites is well known and use of them monitored on an annual basis. The HIGHEST level of constraint has been allocated to nest sites of all three crane species represented by a 2km radius buffer around the point (the extent of the buffer represents the immediate home range of the birds and is defined based on research). The Crane census data and sighting records have also been used. This information has been collected over a period of 30 years and is therefore considered accurate. The data was analysed by setting a threshold for the number of sightings within a set planning unit (grid square). As the risk of interaction is lower than for nest sites, a lower level of constraint (HIGH) has been allocated than for nest sites.
- ***Vultures*** – Vultures have vast home ranges covering large distances. Vulture restaurants and roost sites have also been allocated the HIGHEST level of constraint as they represent sites where the birds congregate often and in large numbers.

Attribute Description

Field	Constraint	Description
Feat22_NMC	Important Avifauna	Crane nest sites, crane sighting density data, vulture restaurants and roost sites, bald Ibis roost sites, and known important areas for large birds.
Feat22_E	High	Low crane sighting densities.
	Highest	Buffer of 2kms around crane nest sites, high crane sightings density, Bald ibis, vulture and other large bird roosts



Data Origin

Crane data were extracted from the Endangered Wildlife Trust database. Crane Nest sites were buffered by 2 km and vulture roost and nest sites by 1.6 km. Crane sightings data were used to derive a sightings density model from which square kilometre areas with high densities (10 or more sightings) were extracted.

Limitations/ Recommendations

Other large bird species of concern which are impacted via powerline interactions are the Denhams Bustard, Secretary Bird and Blue Korhaan. These species have extensive home ranges and nest sites are not known. Data from the Southern African Bird Atlas Project (SABAP II) records sightings of species per pentad. This data was considered in an attempt to isolate important areas for these species, but proved to be too broad. These species have therefore not been accounted for.

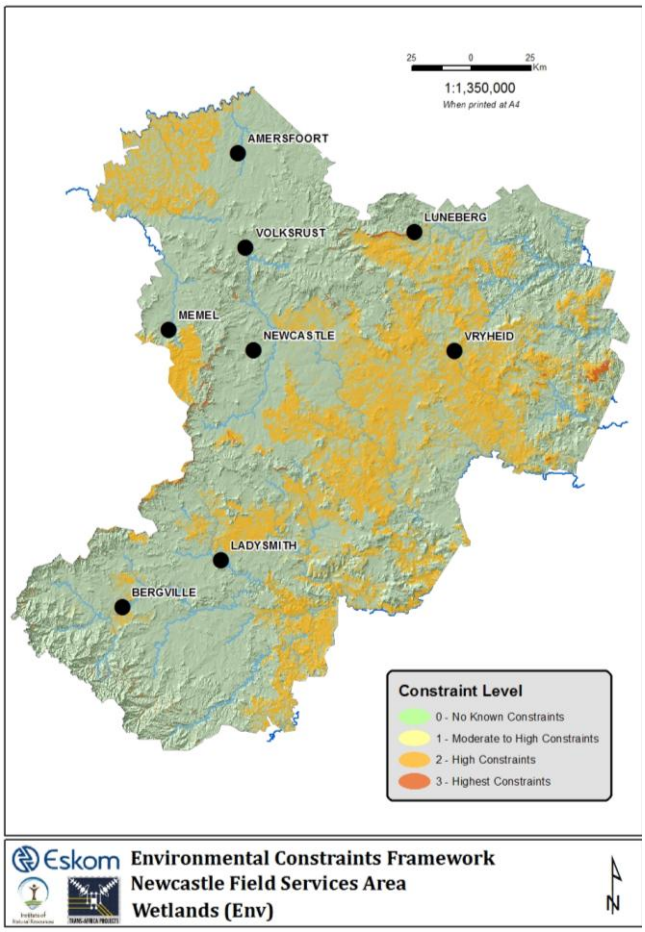
2.4.3 Sensitive Vegetation Types [Eskom on Environment]

Environmental Component: Biophysical

Description of Constraint: Vegetation types with Critically Endangered conservation status were assigned the HIGHEST constraint level as conservation targets for these areas are 100% of remaining areas. No loss of area is therefore considered acceptable. Endangered vegetation types were assigned a HIGH constraint level as negative impacts of power lines and associated infrastructure are to be avoided. Where these features overlap with erodible soils[8], the affected areas are assigned a higher constraint level due to higher potential impacts on natural habitat due to erosion. Forest areas, regardless of conservation status, are considered to be significantly impacted by power line development as these are tall, closed woody communities and the clearance of routes through forest would result in fragmentation, increase in ecologically negative edge effects and reduced ecosystem functionality. In addition, forests are protected under the National Forests Act (86 of 1998). Forests were therefore assigned the HIGHEST constraint level. Definitions of vegetation types' conservation status are taken from a combination of National (Mucina and Rutherford 2006) and Regional (Ezemvelo KZN Wildlife Vegetation Types) data sets since ecosystems can be considered threatened on a national or regional scale.

Attribute Description

Field	Constraint	Description
Feat03_nm	Sensitive Indigenous vegetation	Indigenous Forest Vegetation, Critically Endangered and Endangered Vegetation Types.
Feat03_E	High	Untransformed areas of Endangered Vegetation Types (National or Provincial)
	Highest	Untransformed areas of indigenous forest and Critically Endangered Vegetation Types (National or Provincial)



Data Origin

Vegetation Types were extracted for the study area from the South African National Biodiversity Institute (SANBI) National Vegetation Map (2006) and EKZNW Vegetation (2010) dataset. Forest, Critically Endangered and Endangered vegetation types were selected out. Transformed and degraded areas were removed based on the best available land cover data. Areas with erodible scores of 6, 7 and 8 (Department of Agriculture, Forestry and Fisheries (DAFF) 2011 data) were upgraded to Highest constraint where necessary.

Limitations/ Recommendations

No data is available on the finer scale, e.g. riparian and swamp forests, which are often associated with water courses and would need to be taken into account at the EIA level. Finer scale mapping of indigenous forests is presently being done by various agencies and the ECF should be updated when these data become available. It is recognised that the National vegetation map requires improvements and corrections where necessary. To this end, SANBI convenes a committee to receive and assess comments and suggested improvements, and the ECF will need to be updated accordingly when these become available.

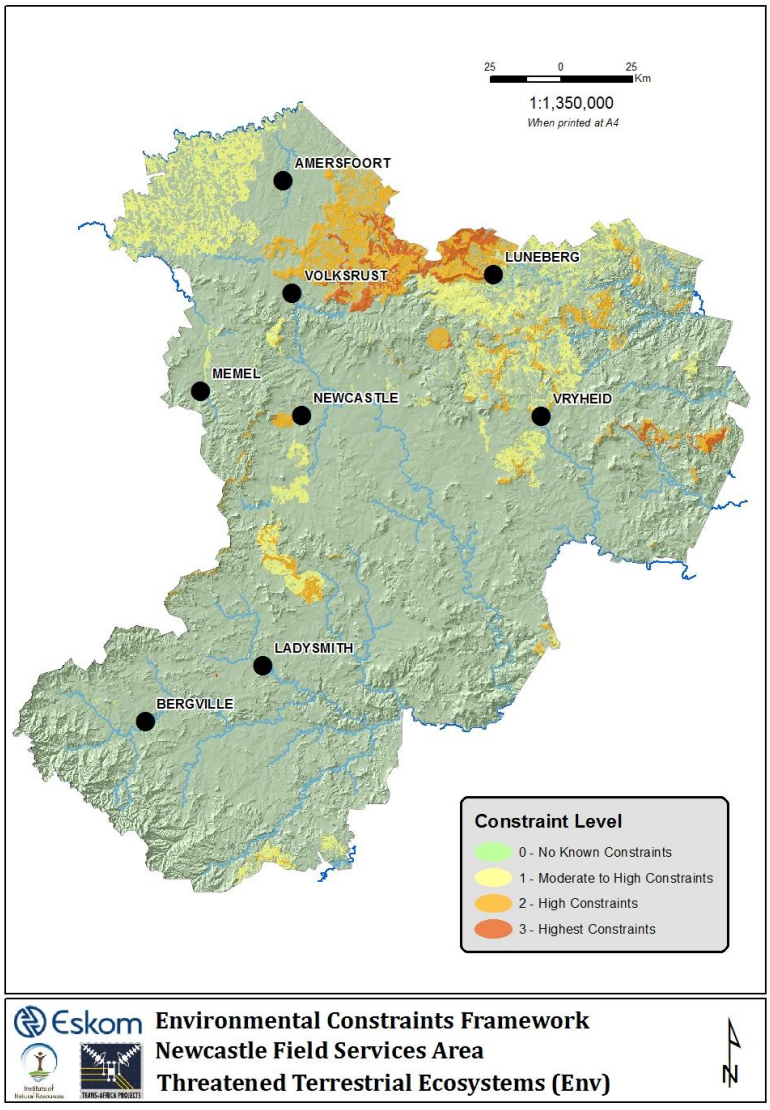
[8] Conforming to erodability classes 6, 7, and 8 of the Department of Forestry and Fisheries (DAFF) "Susceptibility to water erosion map"

2.4.4 Threatened Terrestrial Ecosystems [Eskom on Environment]

Environmental Component: Biophysical
Description of Constraint: The National Environmental Management: Biodiversity Act (Act 10 of 2004) provides for a listing of ecosystems that are threatened and in need of protection. Critically Endangered, Endangered and Vulnerable Ecosystems are included in the EMF and are assigned HIGHEST, HIGH and MODERATE TO HIGH constraint levels, respectively. Where these features overlap with erodible soils[9], the affected areas are assigned a higher constraint level due to higher potential impacts on natural habitat due to erosion.

Attribute Description

Field	Constraint	Description
Feat02_NMC	Threatened Ecosystems	Terrestrial Ecosystems listed in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004)Vulnerable Terrestrial Ecosystems
Feat02_E	Moderate to High	Vulnerable Ecosystems
	High	Endangered Terrestrial Ecosystems and Vulnerable Terrestrial Ecosystems located in potentially erodible areas
	Highest	Critically Endangered Terrestrial Ecosystems and Endangered ecosystems located in potentially erodible areas



Data Origin

Threatened Terrestrial eco-systems were extracted for the study area from the SANBI National Threatened Ecosystem dataset. Transformed and degraded lands were excluded based on the best available land cover data. Endangered ecosystem areas with erodability scores of 6, 7 and 8 (DAFF, 2011) were upgraded to highest constraint where necessary.

Limitations/ Recommendations

Due to the complexity of the process, SANBI has taken a phased approach to listing of threatened ecosystems. The first list of ecosystems consists of threatened ecosystems in the terrestrial environment which is reflected in this ECF. Future phases will deal with threatened ecosystems in the freshwater, estuarine and marine environments and with protected ecosystems in all environments. Under the Biodiversity Act, the published lists of ecosystems will be reviewed at least every five years, and the ECF will need to be updated accordingly. The purpose of listing threatened ecosystems is primarily to reduce the rate of ecosystem and species extinction and to facilitate proactive management of these ecosystems. This includes preventing further degradation and loss of structure, function and composition of threatened ecosystems. The purpose of listing threatened (or protected ecosystems) is not to ensure the persistence of landscape-scale ecological processes or to ensure the provision of ecosystem services, even though listing ecosystems may contribute towards these important goals.

[9] Conforming to erodability classes 6, 7, and 8 of the Department of Forestry and Fisheries (DAFF) "Susceptibility to water erosion map".

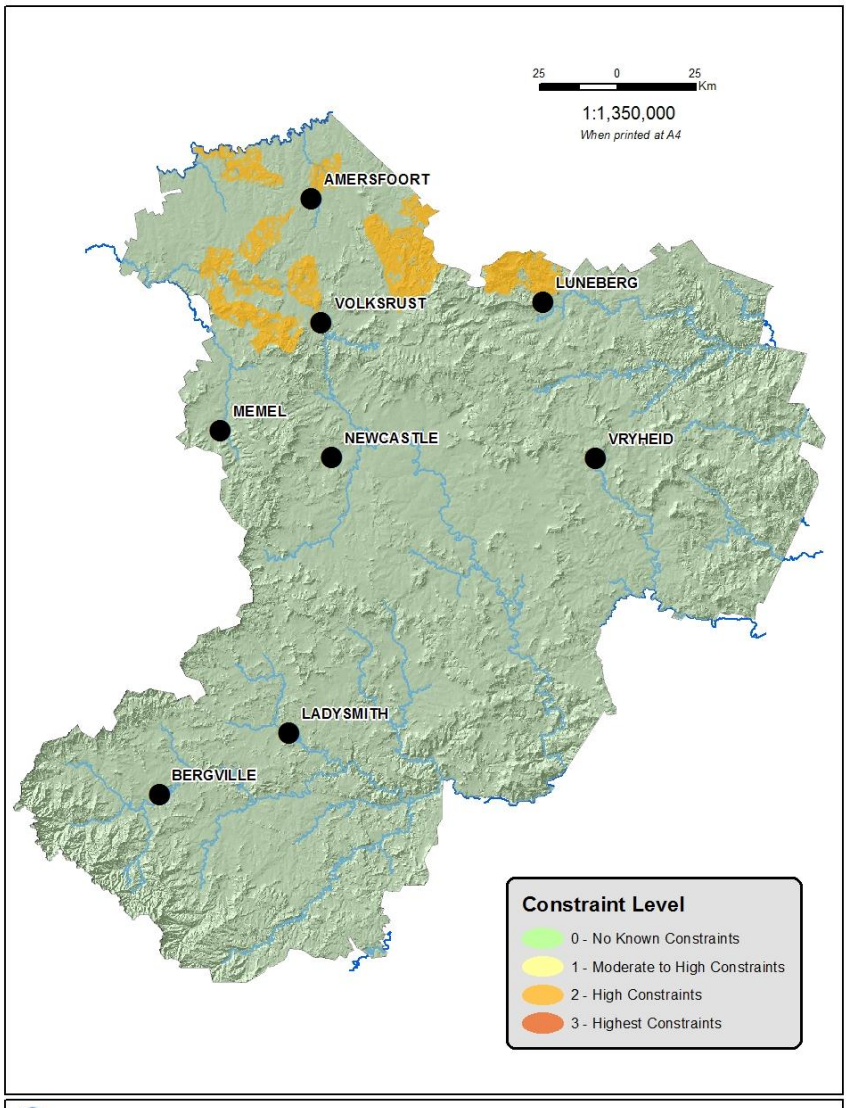
2.4.5 Unfragmented Grasslands [Eskom on Environment]

Environmental Component: Biophysical

Description of Constraint: Grasslands have been established as one of the most threatened ecosystems at a national level and are considered worthy of specific conservation efforts. Of particular conservation value are those grasslands which are untransformed. Unlike forests where the system must be removed to construct a powerline, grasslands can continue to function under power lines. Nevertheless, the actual construction process, and subsequent access for maintenance results in disturbance in these high value systems and they should be avoided. Unfragmented grassland thus have significant value and these have been mapped in Mpumalanga. Much of the untransformed grassland is also accounted for in other biodiversity conservation related features, such as the conservation plan and threatened and protected ecosystems layers. As such, untransformed grasslands in KZN and the OFS are accounted for elsewhere. While important, unfragmented grassland is not officially protected and therefore allocated a HIGH level of constraint.

Attribute Description

Field	Constraint Level	Description
Feat12_NMC	Unfragmented Grasslands	Unfragmented grassland mapped in Mpumalanga Province
Feat12_E	High	All unfragmented grassland mapped in Mpumalanga Province



Data origin

Unfragmented grasslands were extracted for the study area from the Mpumalanga Parks and Tourism Agency (MPTA) database.

Limitations/Recommendations

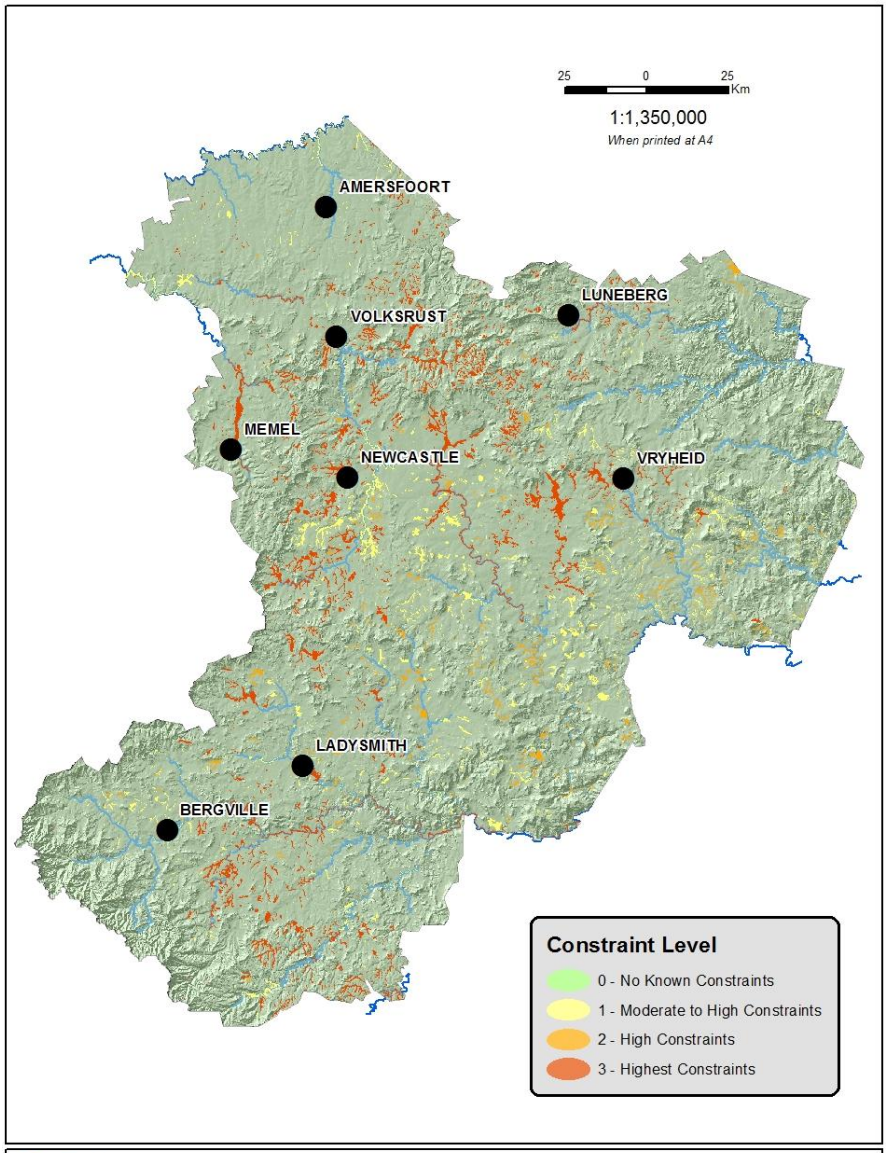
Untransformed grasslands have only been mapped in the Mpumalanga area and thus have only been included in the Newcastle ECF. If this constraint is mapped in the KZN area it should be included in future versions of the other FSAs' ECFs.

2.4.6 **Wetlands** [Eskom on Environment]

Environmental Component: Biophysical
Description of Constraint: Wetlands are considered sensitive ecosystems based on the wide range of ecosystem services they provide and the biodiversity they support. They enjoy protection under a number of Acts such as the Conservation of Agricultural Resources Act, the National Environmental Management Act and the National Water Act and should therefore be avoided where possible. The National Freshwater Ecosystem Priority Areas programme (NFEPA) has applied a systematic conservation approach to prioritise wetlands at a national level according to the conservation state, and the biodiversity and functional value of different wetland types. This has informed the allocation of constraint levels (HIGHEST, HIGH AND MODERATE TO HIGH) to the individual wetlands in the FSA.

Attribute Description

Field	Constraint Level	Description
Feat14_NMC	Wetland Features	Different categories of wetlands
Feat14_E	Moderate to High	NFEPA Ranks 5 - 6
	High	NFEPA Rank 4
	Highest	NFEPA Ranks 1 - 3



Data Origin
Wetlands were extracted for the study area from the NFEPA national dataset/s. All wetlands were buffered by 30m. Level of constraint was assigned based on NFEPA categorisation.

Limitations/ Recommendations
Wetlands included in the NFEPA dataset are sourced from a variety of data bases. These vary in accuracy and completeness and are continuously being updated. Future versions of the ECF should ensure that the most up-to-date wetland data is used.

2.4.7 Wetland Clusters [Eskom on Environment]

Environmental Component: Biophysical

Description of Constraint:

The NFEPA Programme defined wetland clusters as groups of wetlands within 1 km of each other that are embedded in a relatively natural landscape. These clusters are important because they allow for important ecological processes such as migration of biota between wetlands. A goal of NFEPA is to ensure that at least 20% of the wetland cluster area identified for each wetland vegetation group is managed in a way that supports dispersal between wetlands within the cluster, ideally associated with a natural or near-natural condition.

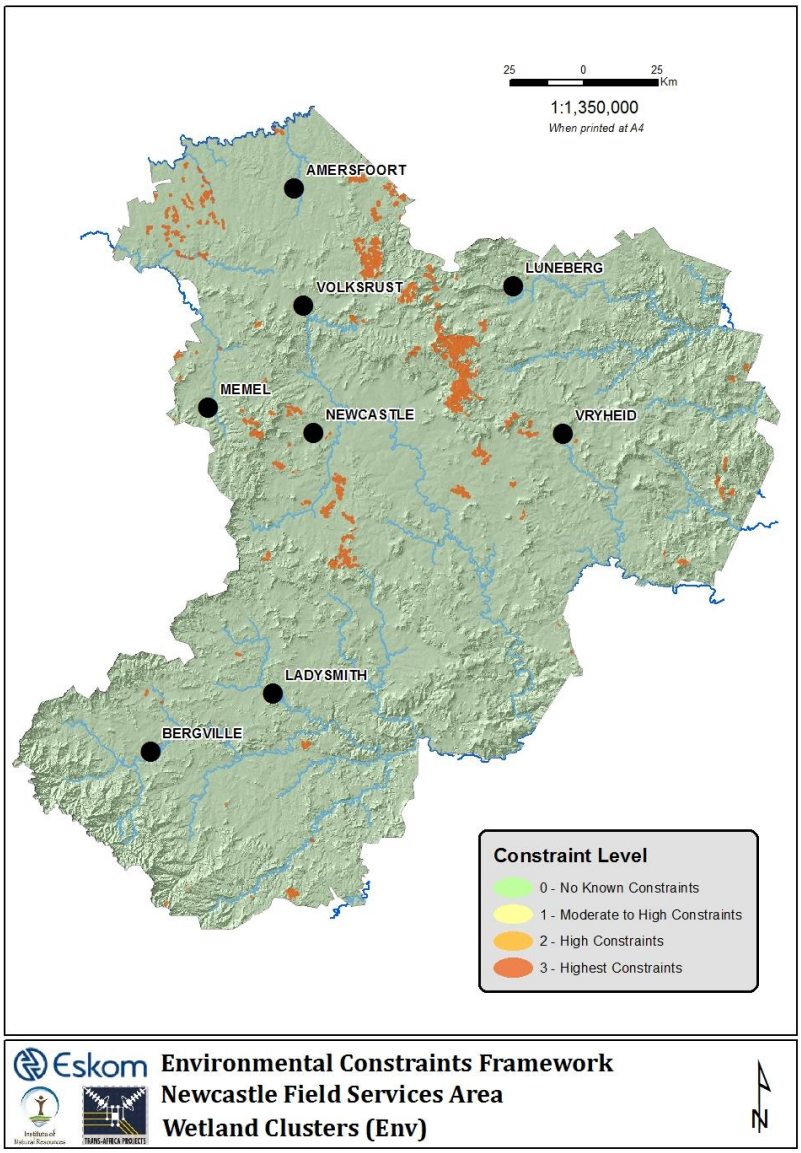
Other criteria for classifying clusters are:

- Comprised of three or more wetlands;
- Area of natural wetlands, compared to that of artificial wetlands, is 50% or more; and
- The majority of the wetland cluster area (i.e. ≥ 50%) is under natural land cover, as determined using the same land cover as that used for modelling condition of tributaries.

Given the biodiversity value of these systems, they have been allocated the HIGHEST level of constraint.

Attribute Description

Field	Constraint Level	Description
Feat14A_NMC	Wetland clusters	Freshwater wetland clusters as defined by NFEPA programme
Feat14A_E	Highest	Wetland clusters



Data Origin

Wetland clusters were extracted for the study area from the NFEPA Wetland Cluster dataset. Constraint level was assigned based on NFEPA designation of wetland as part of a wetland cluster.

Limitations/ Recommendations

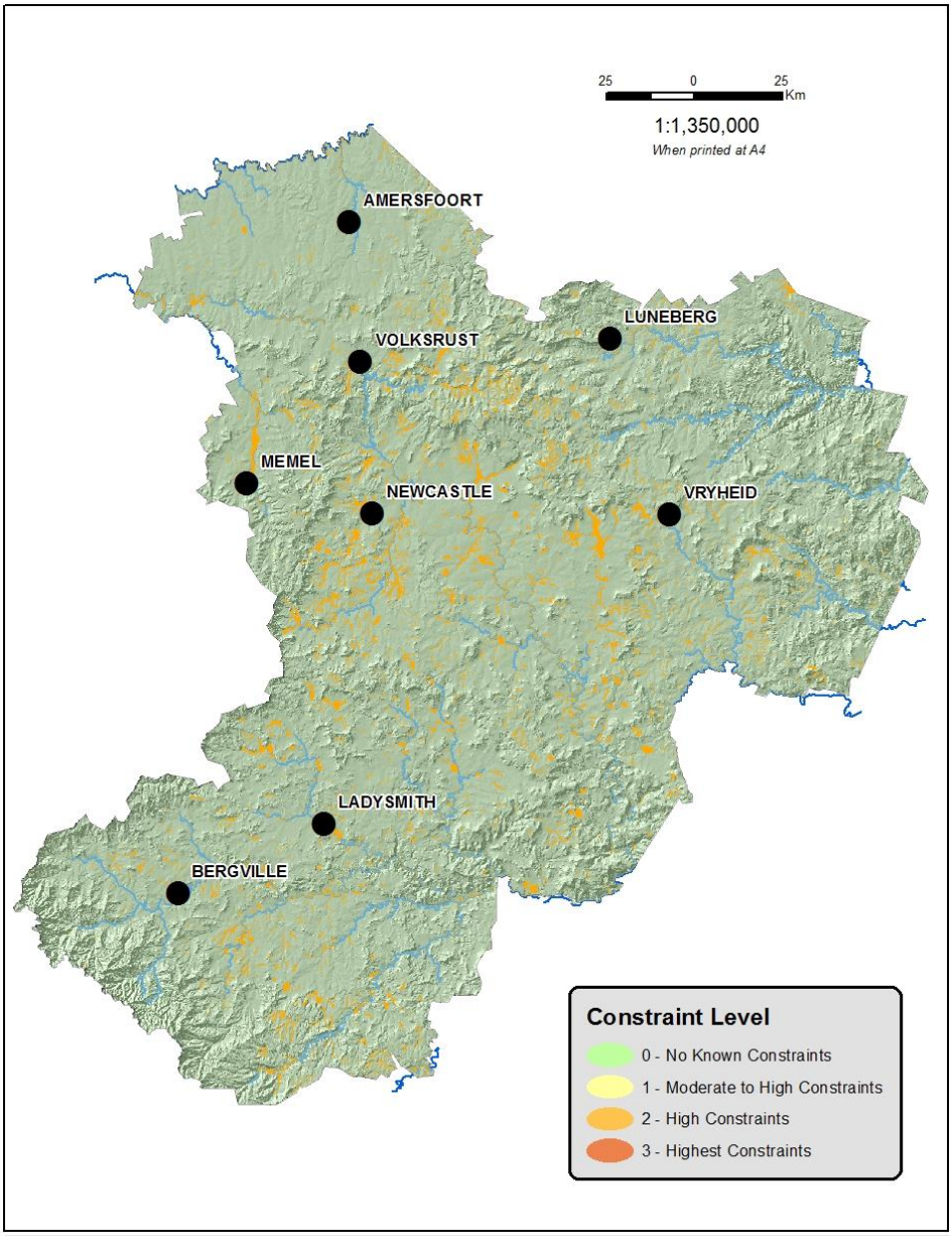
Wetlands included in the NFEPA dataset are sourced from a variety of data bases. These vary in accuracy and completeness and are continuously being updated. Future versions of the ECF should ensure that the most up-to-date wetland data is used.

2.4.8 **Wetlands** [Environment on Eskom]

Environmental Component: Biophysical
Description of Constraint: According to Eskom engineers, it is costly to construct any structure in a wetland due to the poor founding conditions and complications of accessing and working in permanently saturated conditions. The dynamic nature of the wetland soils also presents risk of failure to structures. All wetlands are therefore considered to present a HIGH constraint to the development of the infrastructure.

Attribute Description

Field	Constraint Level	Description
Feat14_NMC	Wetlands	Freshwater wetlands
Feat14_T	High	All wetlands



Data Origin
Wetland areas were extracted for the study area from the NFEPA national wetland dataset. No buffer was applied to the area in terms of it being a technical constraint.

Limitations/ Recommendations
Wetlands included in the NFEPA dataset are sourced from a variety of data bases. These vary in accuracy and completeness and are continuously being updated. Future versions of the ECF should ensure that the most up-to-date wetland data is used.

2.4.9 Biodiversity Conservation Plans [Eskom on Environment]

Environmental Component: Biophysical

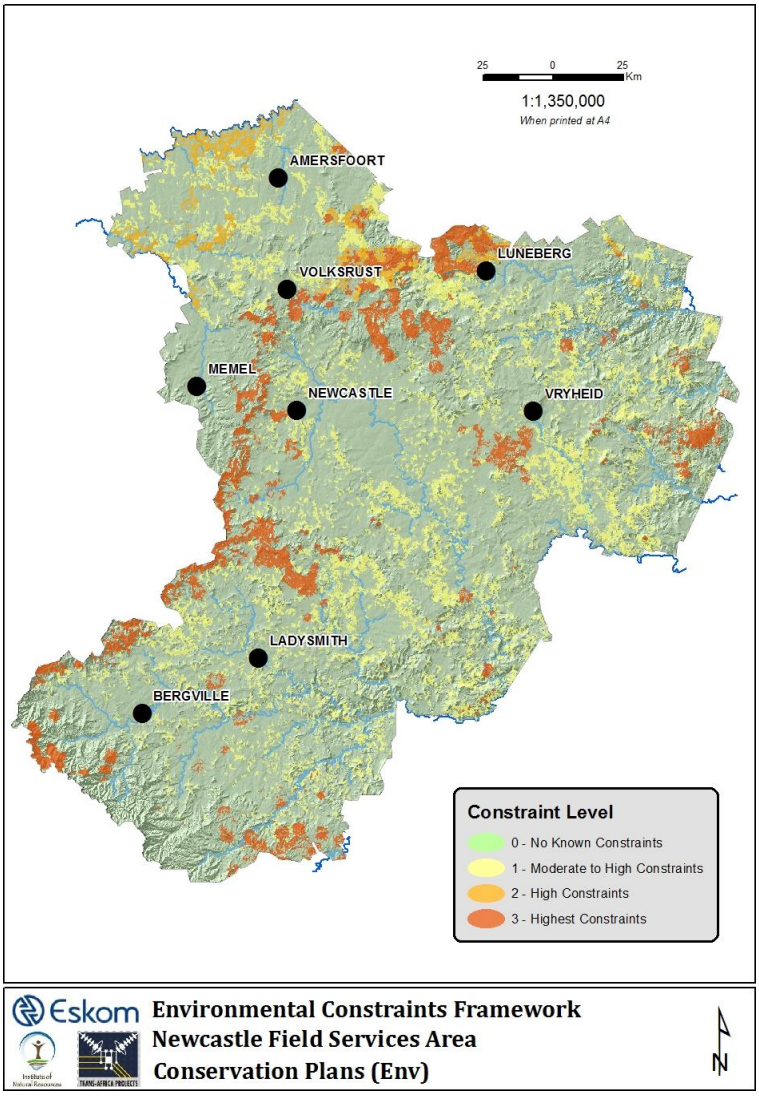
Description of Constraint: South Africa has ratified the International Convention on Biological Diversity, which commits the country to develop and implement a strategy for the conservation, sustainable use and equitable sharing of the benefits of biodiversity. This responsibility is transferred to Provincial Authorities through the NEMA: Biodiversity Act, No 10 of 2004 which requires authorities to compile and implement a 'Bioregional Plan' that ensures the protection of a minimum area of each bioregion with all its representative ecosystems. These biodiversity conservation plans are developed according to the Conservation Planning framework developed by Margules and Pressey (2000) and allow conservation authorities to:

- Determine acceptable goals and targets for the conservation of the Province's biodiversity.
- Identify critical areas of the province that require protection in order to achieve these goals.

The development of Eskom powerlines in such areas, alters the state and conservation value of these areas and thereby reduces the ability to meet conservation targets. Constraint levels have been applied according to the Priority levels set in the Biodiversity Conservation Plans.

Attribute Description

Field	Constraint Level	Description
Feat11_NMC	Biodiversity Conservation Priorities	Priority Areas identified for meeting biodiversity conservation targets.
Feat11_E	Moderate to High	Important and Necessary Biodiversity (Lim & Mpu), Biodiversity priority area 3 (KZN)
	High	Highly Significant Biodiversity (Lim & Mpu) Biodiversity priority area 2 (KZN)
	Highest	Irreplaceable Biodiversity (Lim and Mpu), Biodiversity priority area 1 (KZN)



Data Origin

Provincial conservation plans were used to isolate areas of biodiversity conservation importance. Transformed and degraded areas were clipped out and removed from this layer using the best available land cover data. Constraint level was assigned based on the conservation status assigned by the provincial conservation authority.

Limitations/ Recommendations

Provincial conservation data sets are continually being updated to reflect the transformation of important areas and the subsequent revision of conservation targets. It is thus important that future iterations of the ECF process utilise the most up-to-date conservation planning data to take into account changing importance levels of different areas.

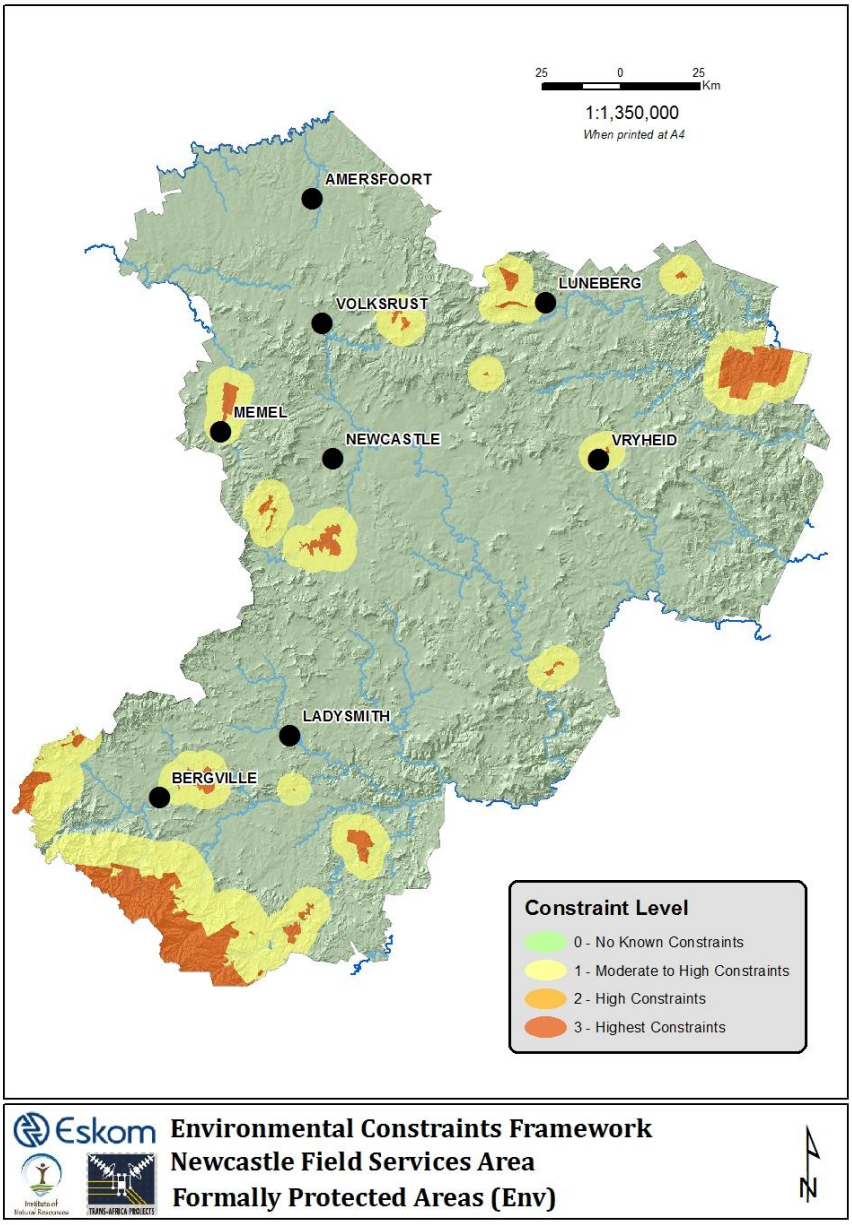
2.4.10 Formally Protected Areas [Eskom on Environment]

Environmental Component: Biophysical & Socio-Economic

Description of Constraint: Protected areas represent areas formally proclaimed for the purposes of conservation based on their natural and/or cultural value. They are afforded protection under the National Environmental Management - Protected Areas Act (57 of 2003) and the World Heritage Act (49 of 1999) in the case of the UDP World Heritage Site. They are thus assigned the HIGHEST constraint level. Buffers of 5 km and 10 km were mapped around protected areas and world heritage sites, respectively, based on the requirements of the 2010 EIA regulations. This reflects the sensitivity of the protected areas to fringe related impacts and to address the visual impact of development close to these natural areas, which can reduce their ecotourism potential. Buffer areas are assigned a MODERATE TO HIGH constraint level.

Attribute Description

Field	Constraint Level	Description
Feat18_NMC	Formally protected areas	All formally protected areas proclaimed under the NEMA Protected Areas Act (57 of 2003) and the World Heritage Act (49 of 1999)
Feat18_E	Moderate to High	Protected area buffer areas
	Highest	Formally protected areas (reserves and stewardship sites)



Data Origin

Formally protected areas were extracted from provincial and national protected area data sets. World heritage sites were buffered by 10Km. National and provincial proclaimed areas were buffered by 5km. Stewardship sites were also buffered by 5km.

Limitations/ Recommendations

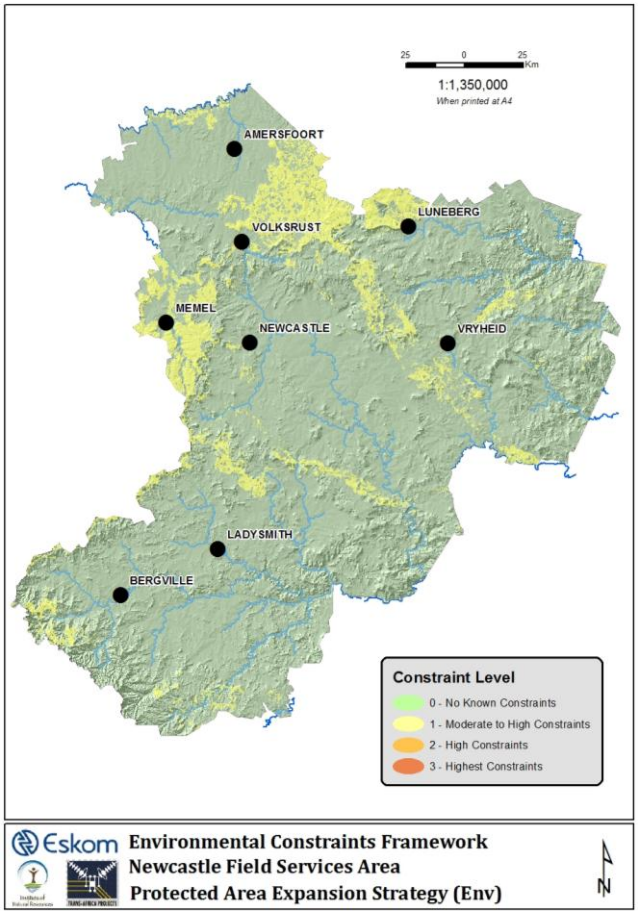
Protected area datasets are currently considered complete and accurate as this data is updated as and when new areas are proclaimed, future iterations of the ECF process should ensure that the most current versions of these data sets are used.

2.4.11 Protected Area Expansion Plans [Eskom on Environment]

Environmental Component: Biophysical
Description of Constraint: As a signatory to the Convention on Biological Diversity, South Africa is obliged to protect a representative proportion of its biodiversity. This commitment has been given effect through a range of policy[10] of which the National Protected Area Expansion Strategy is the primary instrument, and in turn specific legislation of which the National Environmental Management: Protected Areas Act (No. 57 of 2003) is the primary statute for the governance, management, regulation and monitoring of PAs. In response to these legal requirements national and provincial Conservation authorities have identified priority areas outside the existing Protected Areas (PA) network that need to be secured to achieve targets. These priority areas have been mapped and form the provincial PA expansion plans. The development of power lines in these areas impacts the associated biodiversity thereby reducing the conservation value and so too the area available for conservation authorities to meet their targets. There is overlap in some cases between the PA expansion plans and other environmental constraints such as high conservation avifauna and vegetation types because they form the basis for the selection of areas for future PAs. Given that these areas are potential for PA the constraint level is considerably lower than existing PAs i.e. MODERATE TO HIGH.

Attribute Description

Field	Constraint Level	Description
Feat10_NMC	Protected Areas Expansion Plans	Areas identified for future proclamation as protected area in accordance with the National and Provincial Protected Area Expansion Strategies.
Feat10_E	Moderate to High	All areas identified for future proclamation as protected areas.



Data Origin
Areas identified in national and provincial protected area expansion strategies were extracted for the study area. These were included in the ECF as-is and no further processing was carried out.

Limitations/ Recommendations
Although this long term planning data is unlikely to change frequently, future iterations of the ECF process should ensure that the most up to date versions of this data is utilised.

[10] **Policy**: White Paper on the Conservation and Sustainable Use of South Africa's Biological Diversity; National Biodiversity Strategy and Action Plan (NBSAP, DEAT, 2005), National Spatial Biodiversity Assessment (NSBA, Driver *et al*. 2005),
Legislation: National Environmental Management Act: No 57 of 2003 is the primary Act, with supporting legislation including the World Heritage Convention Act, 49 of 1999; Marine Living Resources Act, 18 of 1998; National Forests Act, 84 of 1998.

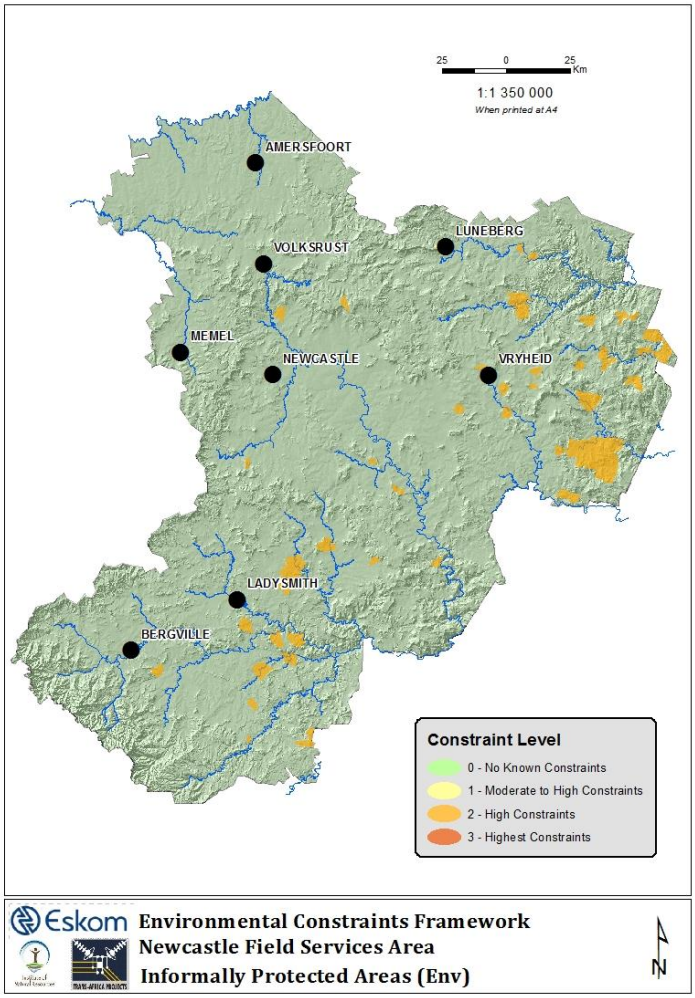
2.4.12 Informally Protected Areas [Eskom on Environment]

Environmental Component: Biophysical & Socio-Economic
Description of Constraint: Informally protected areas which although not proclaimed in terms of the National Environmental Management: Protected Areas Act, 2003 (Act No 57 of 2003), have conservation value which is recognised through other mechanisms such as the Natural Heritage Programme or 'Sites of Conservation Significance' programme which operated within KwaZulu-Natal. Private game reserves generally cover extensive areas which are managed with a focus on conserving natural systems and species and are therefore also included in this category of constraint features. The impact of Eskom is twofold. Construction of powerline infrastructure impacts the biodiversity through disturbance and/or destruction. Secondly, this disturbance during construction and operation may reduce the value of the nature or hunting experience which supports the economic value of private game reserves.

As they do not hold formal status, features in this category are allocated a lower constraint level than formally protected areas. Distinctions are also made between the constraint levels allocated to the features within this category. Natural Heritage Sites are assigned MODERATE TO HIGH constraint levels. Private game reserves generally cover larger areas than the Natural Heritage Sites and SoCS and are actively managed for conservation while these other sites often occur within a landscape/use that is managed for other purposes. Private Reserves have therefore been allocated a higher level of constraint i.e. HIGH.

Attribute Description

Field	Constraint Level	Description
Feat07_NMC	Informally Protected Areas	Natural Heritage Sites, Unproclaimed Reserves and Private Game Reserves.
Feat07_E	Moderate to High	Natural Heritage Sites
	High	Private Game Reserves



Data Origin
Private game reserves for the study area were sourced from provincial nature conservation authorities. These data sets were incorporated as-is with no further processing required. Natural heritage sites were also sourced from provincial conservation authorities.

Limitations/Recommendations
Private game reserves data sets are acknowledged to be incomplete as this specific land use is not easily determined on mixed use properties. Areas managed as conservancies should ideally be included in this layer, however management of these areas varies in efficacy and many conservancies are obsolete. They have thus been excluded.
Data for SoCS (KZN) were assessed for inclusion, however the relevance, accuracy and completeness of this data set is questionable and it has thus been excluded.

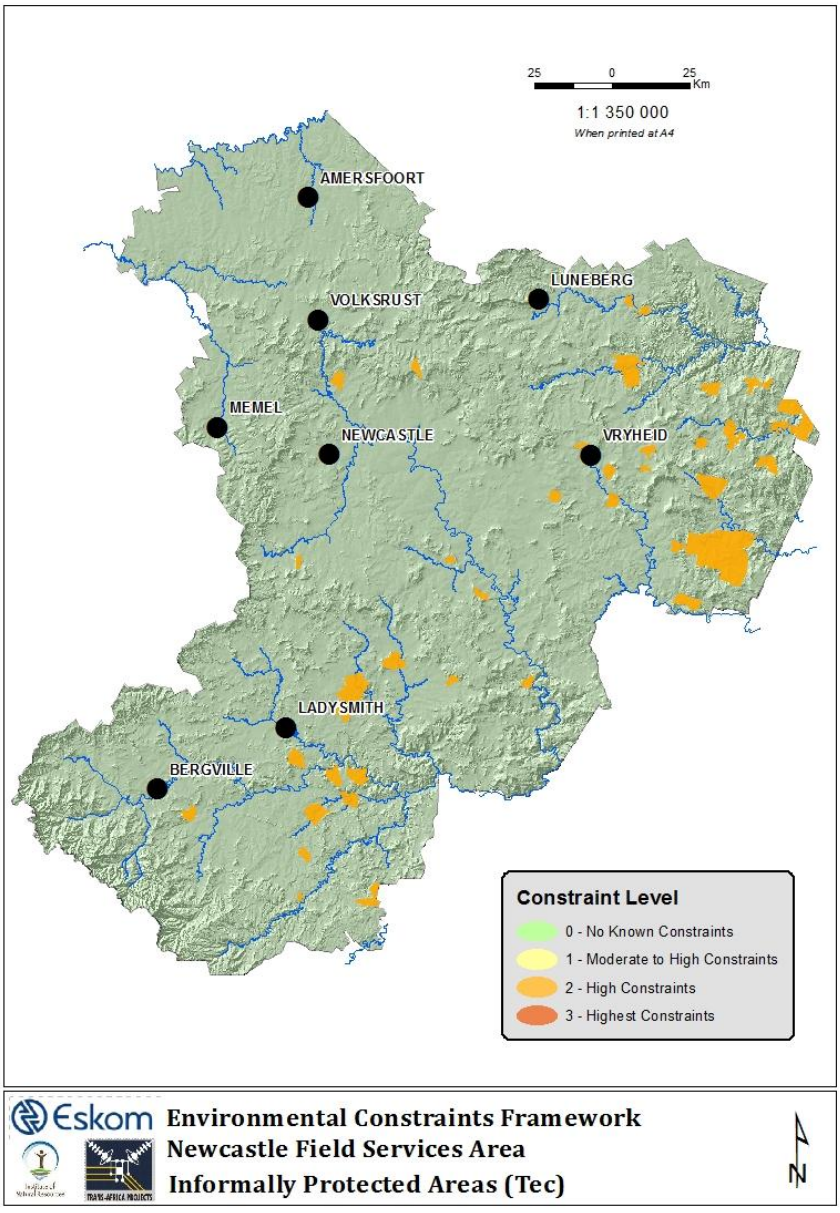
2.4.13 Informally Protected Areas [Environment on Eskom]

Environmental Component: Socio-Economic

Description of Constraint: Private Game Reserves increase the cost, relative to other land-uses, of developing and operating sub-transmission infrastructure in a number of ways. Given the impact on the wilderness experience which supports the eco-tourism based nature of the economic enterprise there is significant resistance to development through these areas, and costs of securing servitudes are also increased. Access for maintenance purposes is complicated by long distance fencing and the presence of wild animals introduces safety concerns for maintenance staff. These areas are assigned a HIGH level of constraint.

Attribute Description

Field	Constraint Level	Description
Feat07_NMC	Informally Protected Areas	Private Game Reserves
Feat07_T	High	Private Game Reserves



Data Origin

Private game reserves for the study area were sourced from provincial nature conservation authorities. These data sets were incorporated as-is with no further processing required. Natural heritage sites were also sourced from provincial conservation authorities.

Limitations/ Recommendations

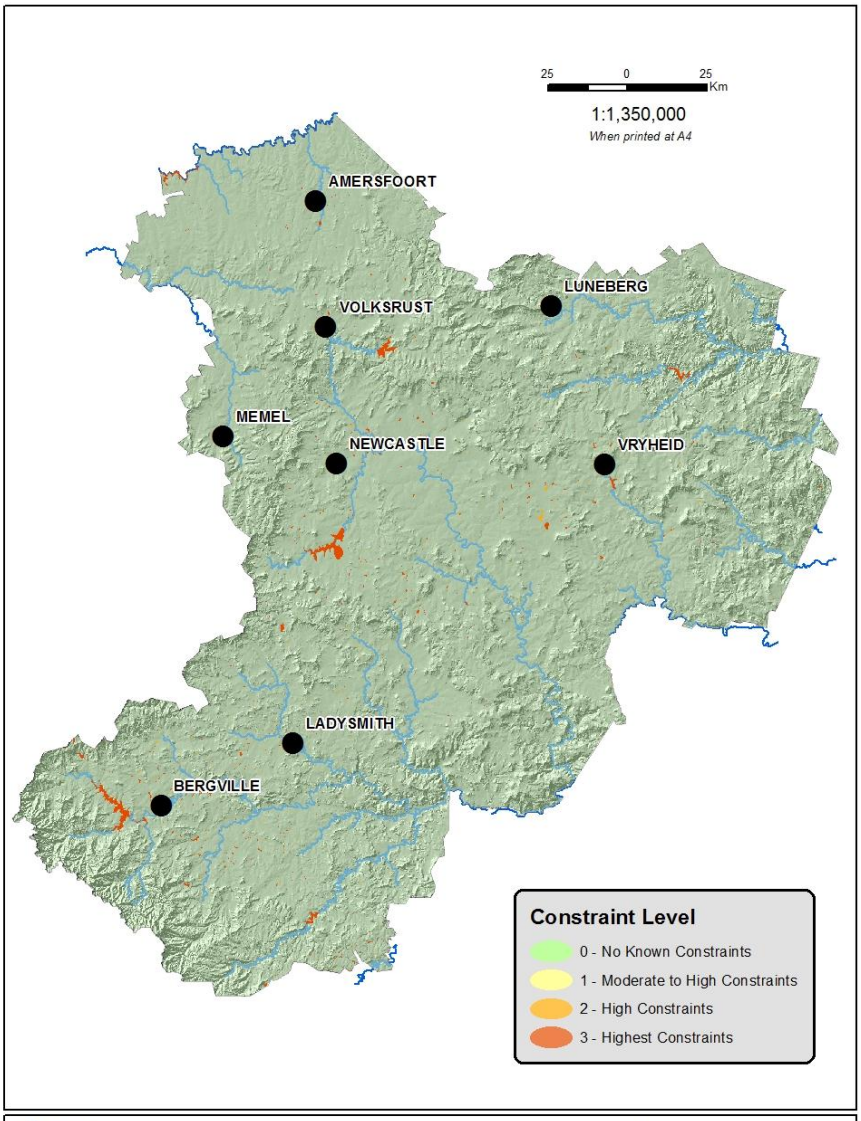
Private game reserves data sets are acknowledged to be incomplete as this specific land use is not easily determined on mixed use properties. Areas managed as conservancies should ideally be included in this layer, however management of these areas varies in efficacy and many conservancies are obsolete. They have thus been excluded. Data for SoCS (KZN) was assessed for inclusion, however the relevance, accuracy and completeness of the point features in this data set are questionable and it has thus been excluded from further analysis

2.4.14 Dams [Environment on Eskom]

Environmental Component: Biophysical & Socio-economic
Description of Constraint: From a safety, access and technical perspective, it is undesirable and (if too big to be spanned) not feasible to construct and maintain lines over large water bodies. Also, minimum clearances over water have to be adhered to, to avoid collision by yachts. Due to the presence of large birds such as geese, herons etc. around water bodies, bird flappers are likely to be required if routing lines over dams, which increases expenses. Eskom staff have proposed that spanning of water bodies greater than 200 m across be avoided. As water bodies are of different shapes, surface area has been used as a surrogate measure for width. Dams >4 ha (200m x 200m) are represented as the HIGHEST constraint. Dams ≥1 ha and ≤ 4 ha are assigned a HIGH constraint level as it is assumed it would be possible to span them if necessary.

Attribute Description

Field	Constraint Level	Description
Feat01_NMC	Dams	All dams ≥1 ha in surface area, occurring in the study area.
Feat01_T	High	Dams ≥1 ha and ≤ 4 ha
	Highest	Dams >4 ha (200m x 200m)



Data Origin
Dams were extracted for the study area from the NFEPA and appropriate land cover datasets. All dams were buffered by 50 metres. Dams of less than 1 Ha (water surface area) were excluded. The area of each dam was then used to assign constraint levels for remaining dams.

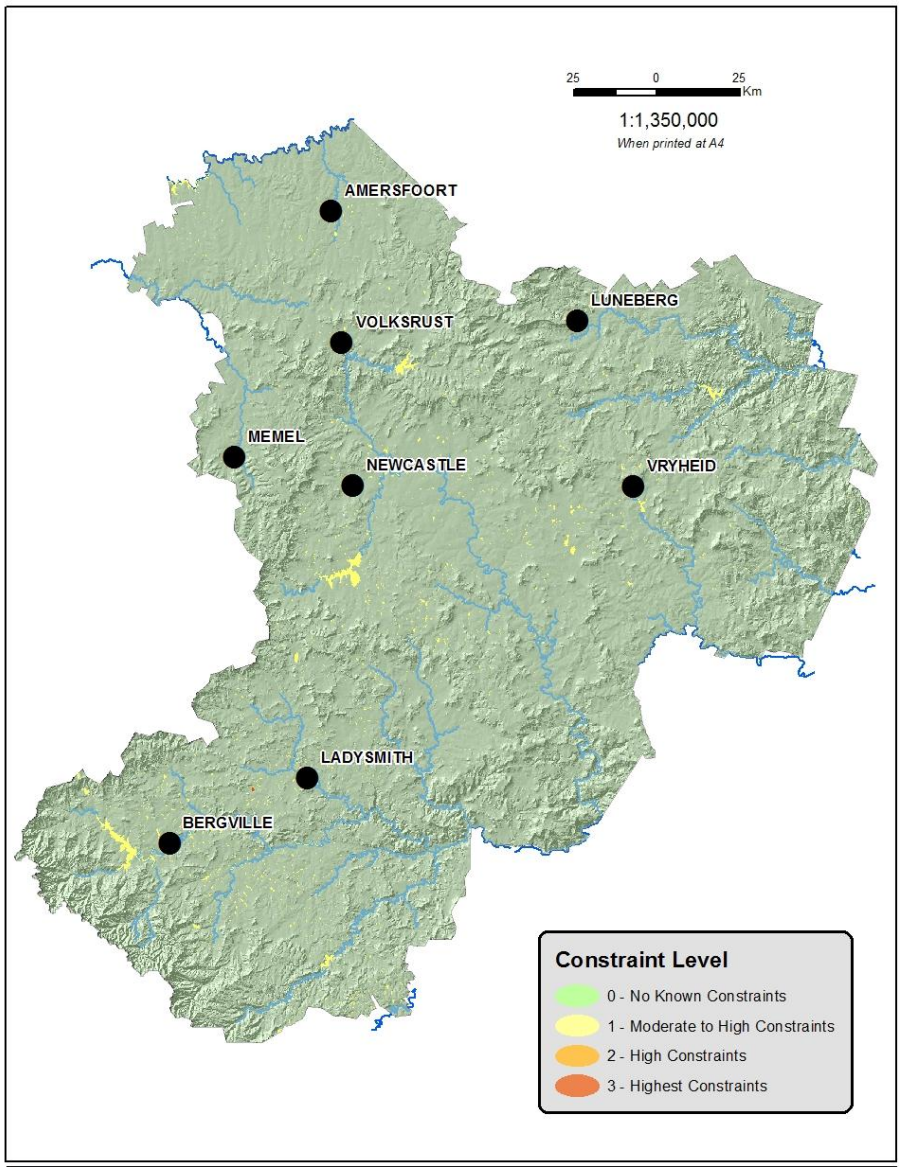
Limitations/ Recommendations
Dams' level of constraint is strongly influenced by their directional component (as explained in the general assumptions and limitations section). An attempt has been made to select out "unspannable" dams using surface area as an indication of width/length, however the accuracy of this method is limited and in some cases where the highest constraint level has been applied, parts of the dam will be narrow enough to be spanned.

2.4.14 **Dams** [Eskom on Environment]

Environmental Component: Biophysical & Socio-economic
Description of Constraint: Most dams, even small ones, attract a large number of birds, especially water birds such as ducks, geese, herons, etc which increases the risk of injury or mortality to birds through collision or electrocution. Bird flappers are likely to be required if routing lines over dams. This increases the expense related to building the line. Dams are often used for recreation and powerlines over dams have a negative visual impact. Where dams and their 50 m buffer areas (including intersecting clusters of dams) present a surface area ≥1 ha, they are assigned a MODERATE to HIGH constraint level.

Attribute Description

Field	Constraint Level	Description
Feat01_NMC	Dams	All dams and/or intersecting clusters of dams ≥1 ha (including buffer area) in surface area, occurring in the study area.
Feat01_E	Moderate to High	Dams + 50 m buffer areas with combined surface area ≥1 ha



Data Origin
Dams were extracted for the study area from the NFEPA and appropriate land cover datasets. All dams were buffered by 50 metres. Dams of less than 1 Ha (water surface area) were excluded. The area of each dam was then used to assign constraint levels for remaining dams.

Limitations/ Recommendations
Dams' level of constraint is strongly influenced by their directional component (as explained in the general assumptions and limitations section). An attempt has been made to select out "unspannable" dams using surface area as an indication of width/length, however the accuracy of this method is limited and in some cases where the highest constraint level has been applied, parts of the dam will be narrow enough to be spanned.

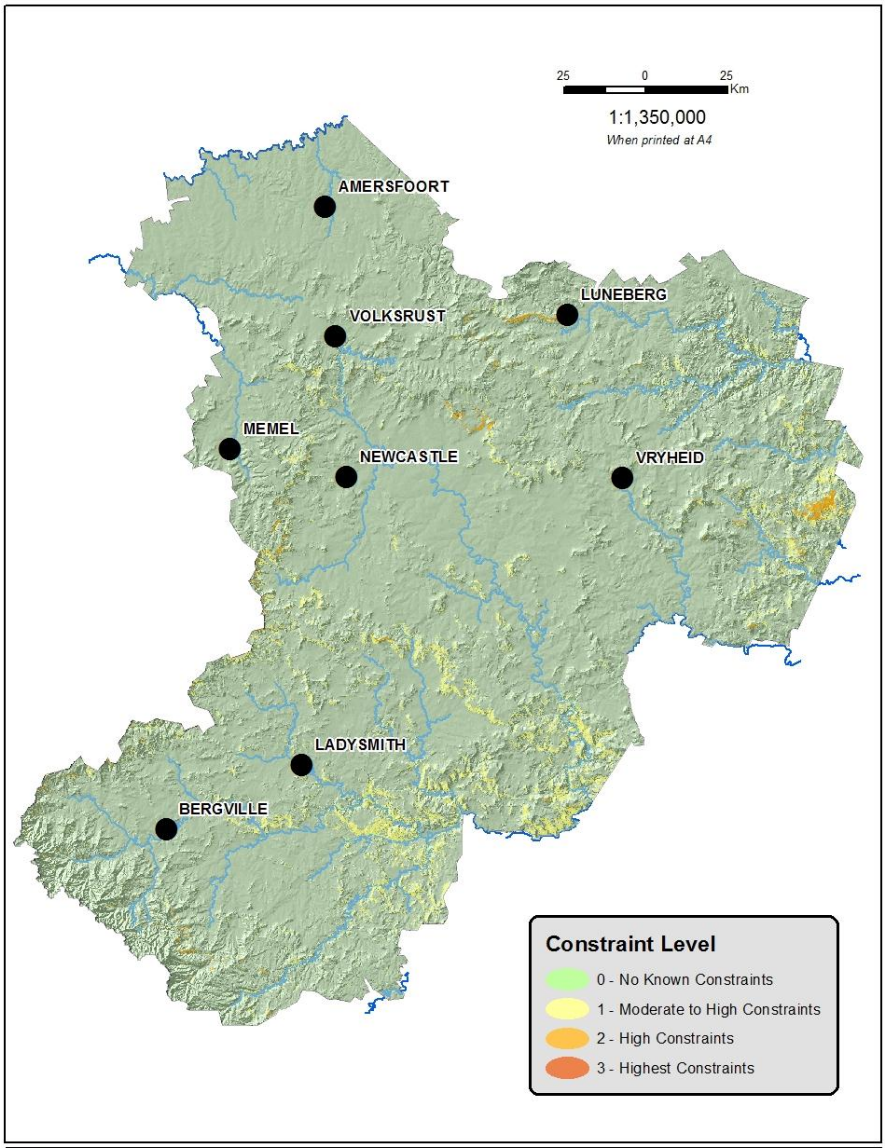
2.4.15 Dense Vegetation [Environment on Eskom]

Environmental Component: Biophysical

Description of Constraint: Dense vegetation provides a constraint to both power line construction and maintenance. Clearing dense vegetation during construction is costly and time consuming. In addition, Eskom engineers reported that additional vehicles are required to fix punctures and run almost permanently when working in dense vegetation. Once operational, the vegetation beneath lines needs to be kept clear to facilitate maintenance and for safety reasons (fire etc). The cost is thus a long term one. The time and cost is significantly higher for forest than other dense vegetation types such as bushveld and thicket because of the size (structure and height) of the individual trees. Consequently all forest types are rated in a higher constraints category (HIGH) than other dense vegetation types which are rated MODERATE TO HIGH.

Attribute Description

Field	Constraint Level	Description
Feat04_NMC	Dense Vegetation	Dense vegetation types
Feat04_T	Moderate to High	Vegetation types with canopy cover of greater than 70%
	High	All forest types



Data Origin

Areas covered by dense vegetation were extracted for the study area from the EKZNW land cover dataset. Areas with a canopy cover of greater than 70% were selected using an attribute query and extracted. Forest areas were extracted from national and provincial vegetation type data sets.

Limitations/ Recommendations

Canopy cover is used as a surrogate for vegetation density. This may not always accurately reflect the difficulty or costs involved with clearing different vegetation types (e.g. thornveld vs. dense woodland). Rapidly expanding densely vegetated areas such as those being colonised by wattle trees may result in areas not captured in this data set. The most current land cover data set available should be used to identify densely vegetated areas.

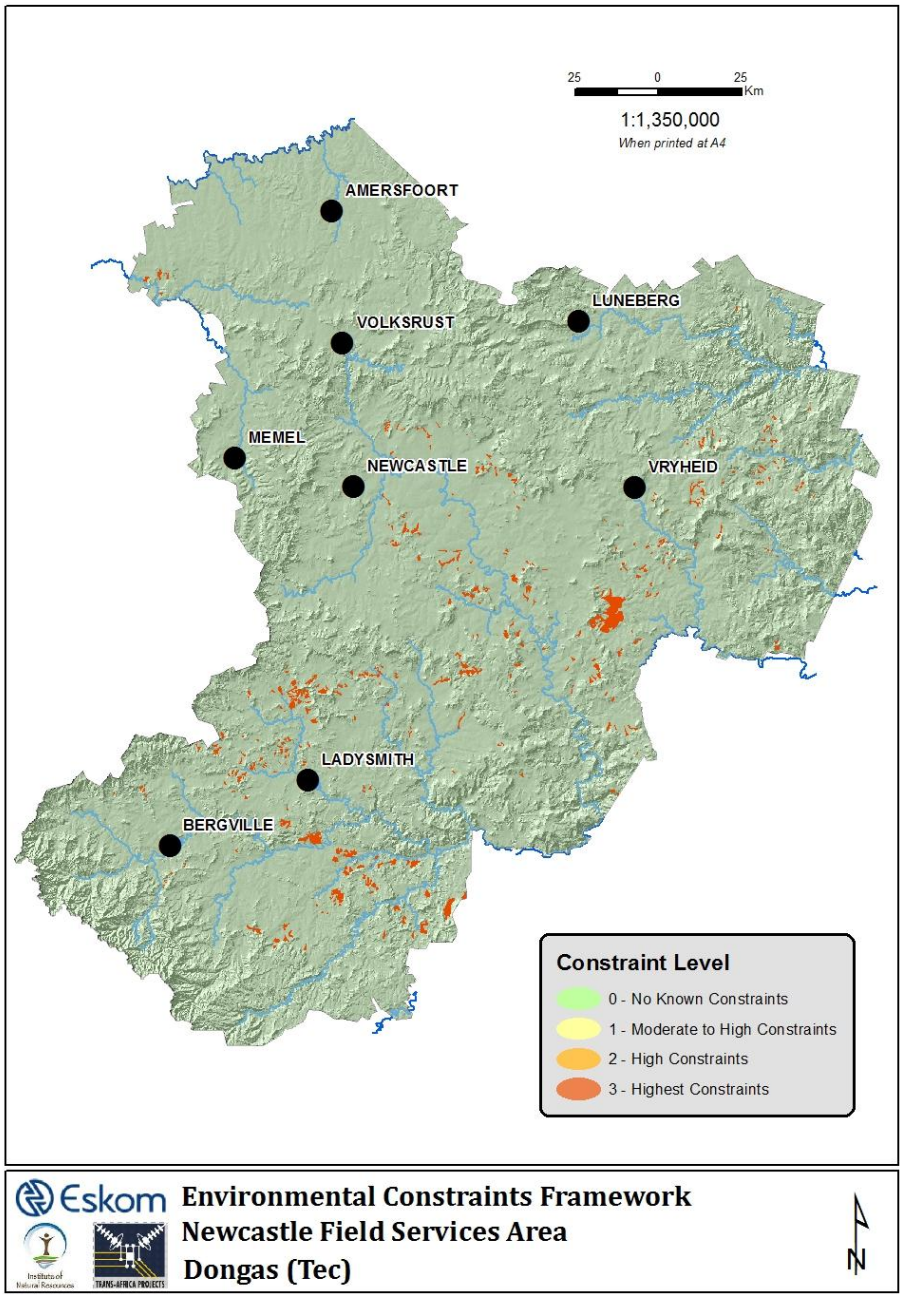
2.4.16 Dongas [Environment on Eskom]

Environmental Component: Biophysical & Socio-economic

Description of Constraint: Dongas present a threat to the technical integrity of sub transmission infrastructure. The instable nature of the soils makes foundation costly and difficult, and if actively eroding there is risk associated with locating infrastructure in close proximity to these features. Where there are where several large dongas of extended length in close proximity, accessing areas between them to locate pylons is difficult and dangerous for construction and maintenance staff. The larger the dongas are, the more difficult it is to span them and access is also likely to be more difficult. Larger dongas have therefore been allocated the HIGHEST and the smaller dongas a HIGH level of constraint. The 4ha threshold is based on that provided by Eskom as applied to dams.

Attribute Description

Field	Constraint Level	Description
Feat21_NMC	Erosion Dongas	Identified erosion dongas
Feat21_T	High	Dongas < 4 ha
	Highest	Dongas > 4 ha



Data Origin

Dongas were extracted for the study area from the DAFF 2011 erosion dongas dataset/s.

All dongas were buffered by 100m and any islands created were removed. Areas between dongas are likely to be unstable and access is restricted.

Limitations/ Recommendations

The DAFF dongas data set is considered to be incomplete, but is the best data currently available for identifying these features.

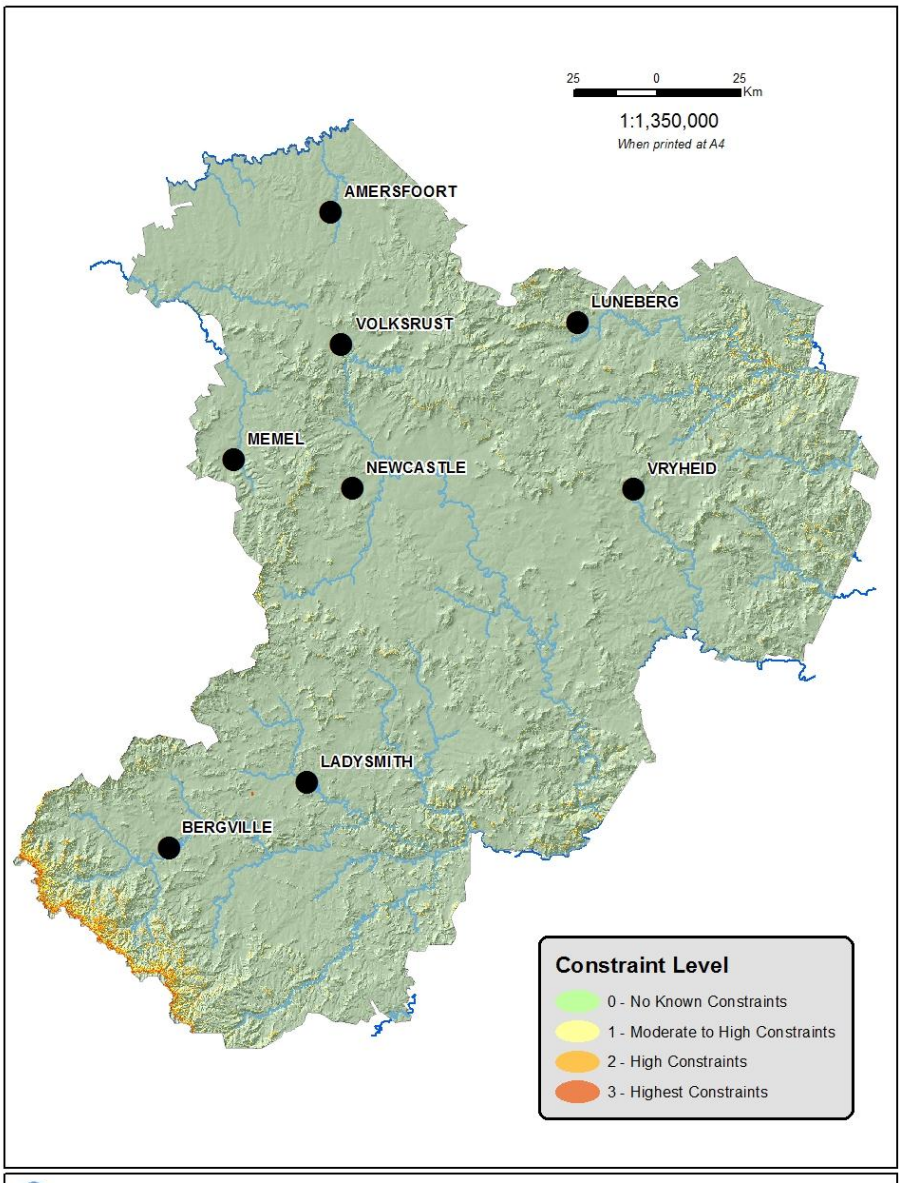
2.4.17 Slope [Environment on Eskom]

Environmental Component: Biophysical

Description of Constraint: Steep slopes increase the time and costs associated with the construction of powerlines because they are difficult to access and work on e.g. in certain instances, machines cannot access of work on steep areas and hand labour is required. This also increases risk of harm to workers. Maintenance of infrastructure built on steep slopes is also difficult and costly. The difficulties and associated time, risk and cost implications increase with the steepness of slope. Eskom staff defined the slope categories in the attribute table and the associated constraint levels.

Attribute Description

Field	Constraint Level	Description
Feat20_NMC	Slope	Areas where steep slopes are encountered
Feat20_T	Moderate to High	Slope 30 - 35 Degrees
	High	Slope 35 - 45 Degrees
	Highest	Slope > 45 Degrees



Data Origin

A slope surface was derived for the study area from the Chief Surveyor General 20m contour dataset. This data was synthesised into a digital elevation model and slopes derived. Slopes were categorised as less than 30 degrees (abandoned), 30-35 degrees, 35-45 degrees and greater than 45 degrees. The three categories representing a constraint to development were extracted.

Limitations/ Recommendations

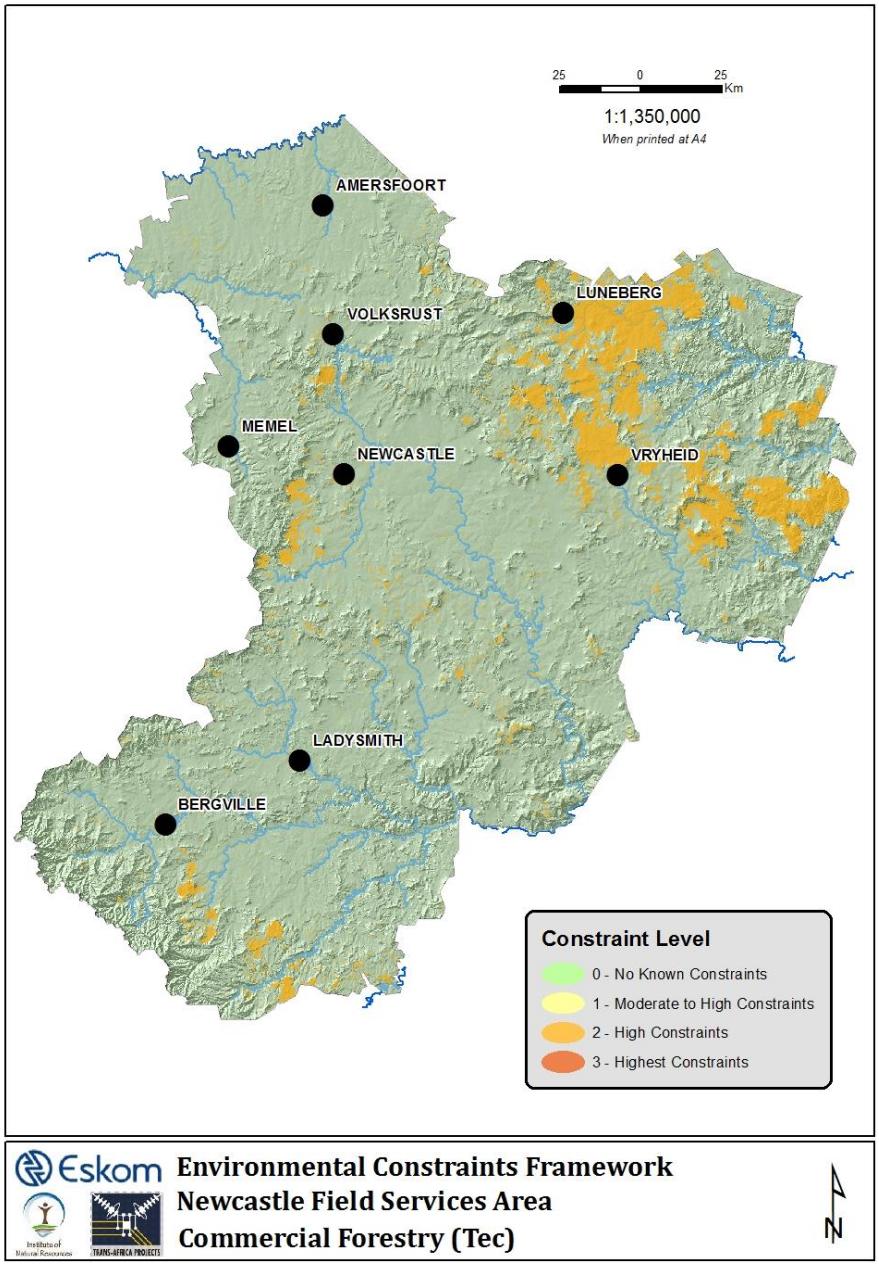
Slope data is derived from merged 20m contour tiles. The processing of this data can result in errors in slope calculation. This error is however considered non-significant at the scale of this project.

2.4.18 Commercial Forestry [Environment on Eskom]

Environmental Component: Socio-economic
Description of Constraint: A cleared servitude under powerlines is required through commercial forestry plantations to ensure that if a tower falls, it does not fall onto trees and vice versa. It also mitigates the impact of fires on the operation of the powerlines. This requires the clearing of timber and compensation for the loss of the existing crop as well as lost opportunity associated with future crops on this productive land. Resistance from forestry companies is generally high given the impact on the industry and the difficulties acquiring permits and suitable areas to plant new land to forestry. This constraint is assigned a HIGH level of constraint, considering the high costs and difficulties in negotiating servitudes.

Attribute Description

Field	Constraint Level	Description
Feat06_NMC	Commercial Forestry	Areas planted to commercial forestry plantations (usually Pine, Gum or Wattle)
Feat06_T	High	All commercial forestry areas



Data Origin
Commercial forestry plantations were extracted for the study area from DAFF forestry and EKZNW Land cover dataset/s. All forestry areas were buffered by 30m dissolving all internal boundaries. All island polygons were selected and deleted.

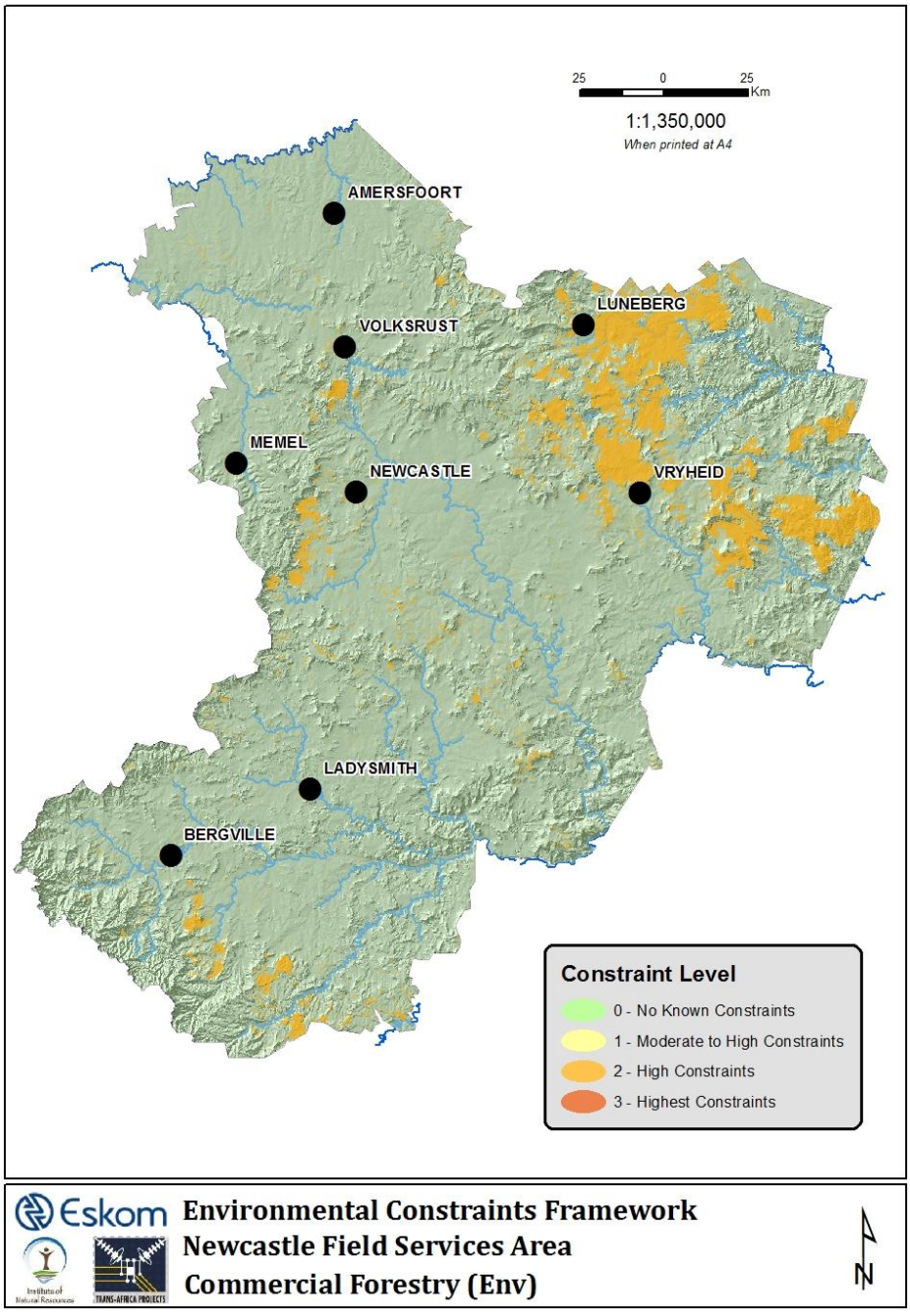
Limitations/ Recommendations
The limitations associated with this layer are those associated with the input data sets. These are however considered insignificant at the scale of this project.

2.4.19 Commercial Forestry [Eskom on Environment]

Environmental Component: Socio-economic
Description of Constraint: The cumulative servitude requirements of the electrical infrastructure can result in a significant loss of productive and high value commercial forestry land. This is undesirable to large forestry companies as it affects their operations financially and logistically. For the smaller farmers, it could in addition make their farming units unviable, with negative impacts on the livelihoods of farm owners and farm labourers. This has been assigned a HIGH constraint level.

Attribute Description

Field	Constraint Level	Description
Feat04_NMC	Commercial Forestry	Areas planted to commercial forestry plantations (usually Pine, Gum or Wattle)
Feat04_E	High	All commercial forestry areas



Data Origin
Commercial forestry plantations were extracted for the study area from DAFF forestry and EKZNW Land cover dataset/s. All forestry areas were buffered by 30m dissolving all internal boundaries. All island polygons were selected and deleted.

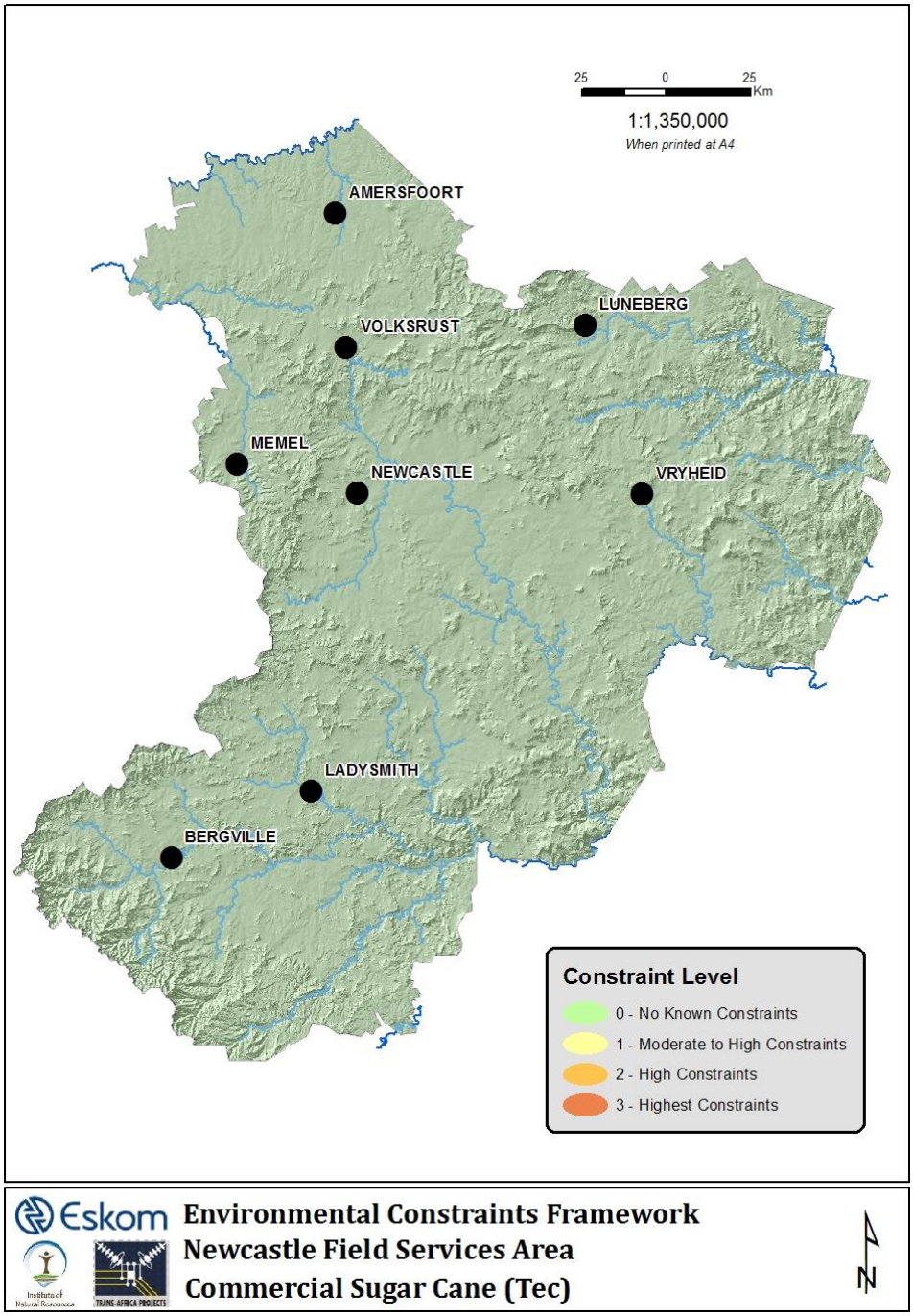
Limitations/ Recommendations
The limitations associated with this layer are those associated with the input data sets (inaccurate capture etc). These are however considered insignificant at the scale of this project.

2.4.20 Commercial Sugar Cane [Environment on Eskom]

Environmental Component: Socio-economic
Description of Constraint: Sugar cane production imposes a cost constraint on Eskom due to the extensive nature of the crop and the practice of burning the crop prior to harvest which makes cane free servitudes a requirement in certain instances i.e. the costs of securing and maintaining a servitude is high. It has been noted however that cane free servitudes are not always required. The level of constraint is consequently lower (MODERATE TO HIGH) than for other intensive agriculture which requires a crop free servitude, such as timber (HIGH).

Attribute Description

Field	Constraint Level	Description
Feat23_ NMC	Sugar Cane	Sugar Cane
Feat23_T	Moderate to High	Sugar Cane



Data Origin
Areas cultivated for the commercial production of sugarcane were extracted for the study area from the EKZNW Land cover dataset.

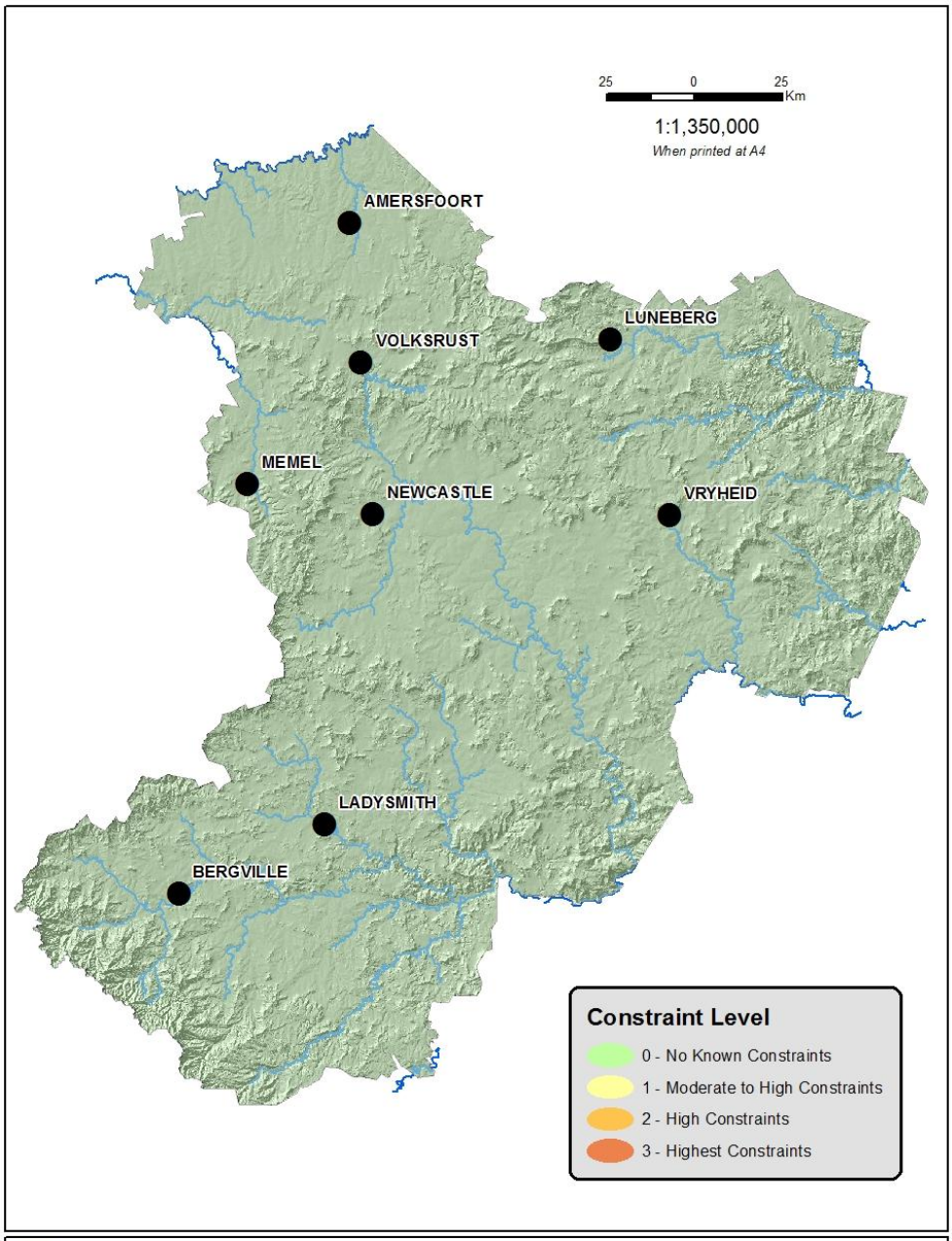
Limitations/ Recommendations
Mis-identification of dense stands of phragmites reeds can result in small inaccuracies in this data set. These are however not considered significant at the scale of this project.

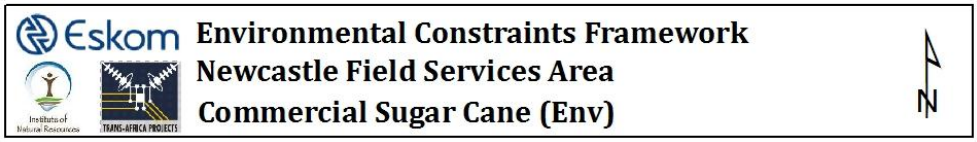
2.4.21 Commercial Sugar Cane [Eskom on Environment]

Environmental Component: Socio-economic
Description of Constraint: Depending on whether a crop free servitude is required and the extent of this through individual farms, there is the potential to jeopardise the available area under sugar production and therefore the financial viability of a farm. The servitude also sterilizes high production agricultural land which is a negative impact on the agricultural sector as a whole. Consequently, this is assigned a MODERATE TO HIGH constraint level.

Attribute Description

Field	Constraint Level	Description
Feat23_NMC	Sugar Cane	Sugar Cane
Feat23_E	Moderate to High	Sugar Cane





Data Origin
Areas cultivated for the commercial production of sugarcane were extracted for the study area from the EKZNW Land cover dataset.

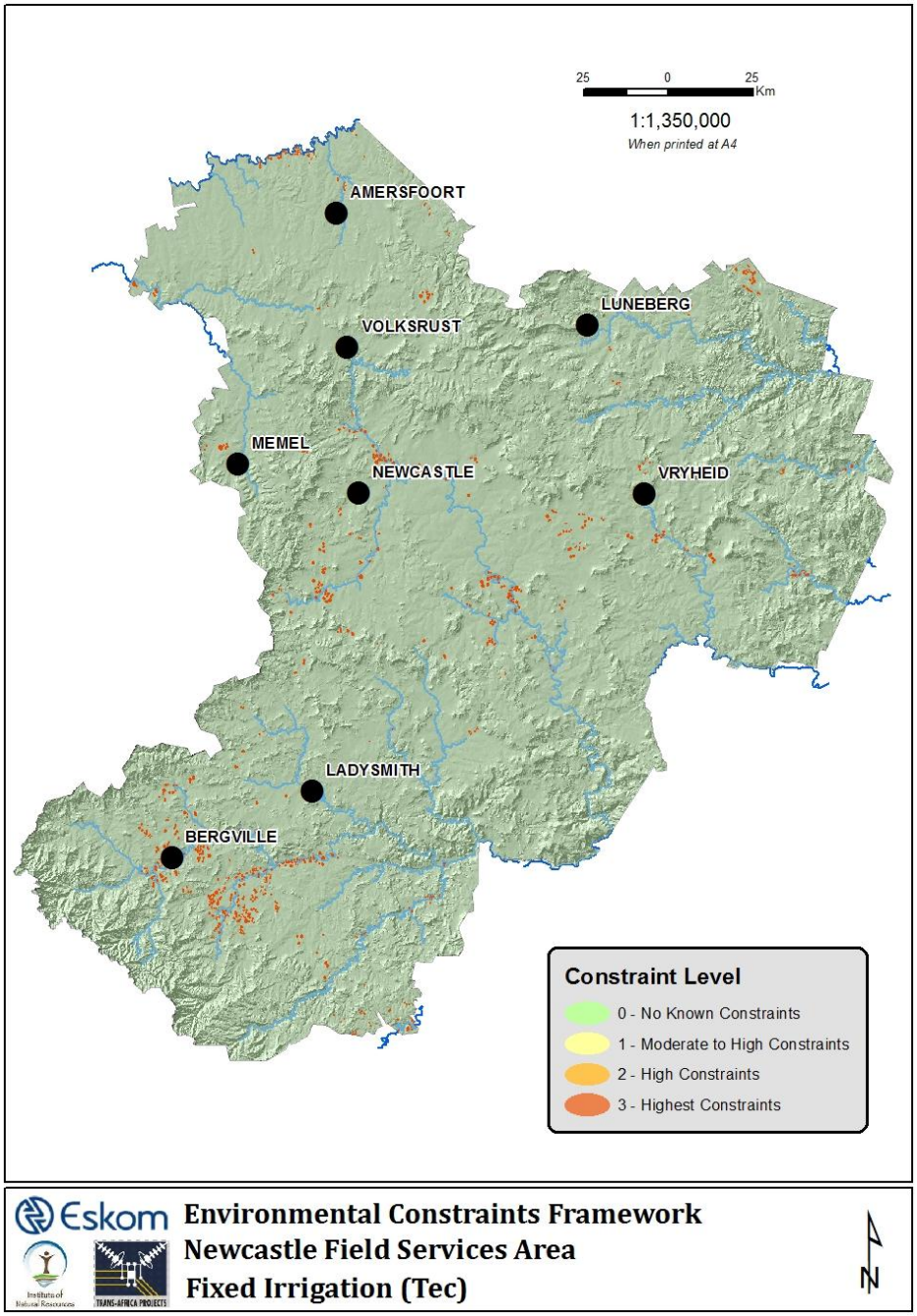
Limitations/ Recommendations
Mis-identification of dense stands of phragmites reeds as sugar cane can result in small inaccuracies in this data set. These are however not considered significant at the scale of this project.

2.4.22 Fixed Irrigation Infrastructure [Environment on Eskom]

Environmental Component: Socio-economic
Description of Constraint: Irrigation scheme areas provide limited scope for the siting of transmission infrastructure because of the risk posed by the pivots of damaging the pylons and vice versa. Where the intense cultivation involves citrus, crop sprayers are also used and powerlines present a risk to this activity. In addition to the technical issue, the high costs to Eskom to compensate for the loss of this highly productive agricultural land under this type of irrigation infrastructure makes it more feasible to avoid these areas. These areas are assigned the HIGHEST constraint level.

Attribute Description

Field	Constraint Level	Description
Feat09_NMC	Irrigation Infrastructure	Areas under formal fixed irrigation infrastructure
Feat09_T	Highest	Areas identified under centre pivot irrigation



Data Origin
Fixed irrigation infrastructure were identified and mapped off SPOT (2008/2010) and Google Earth imagery (latest dates available) dataset/s.

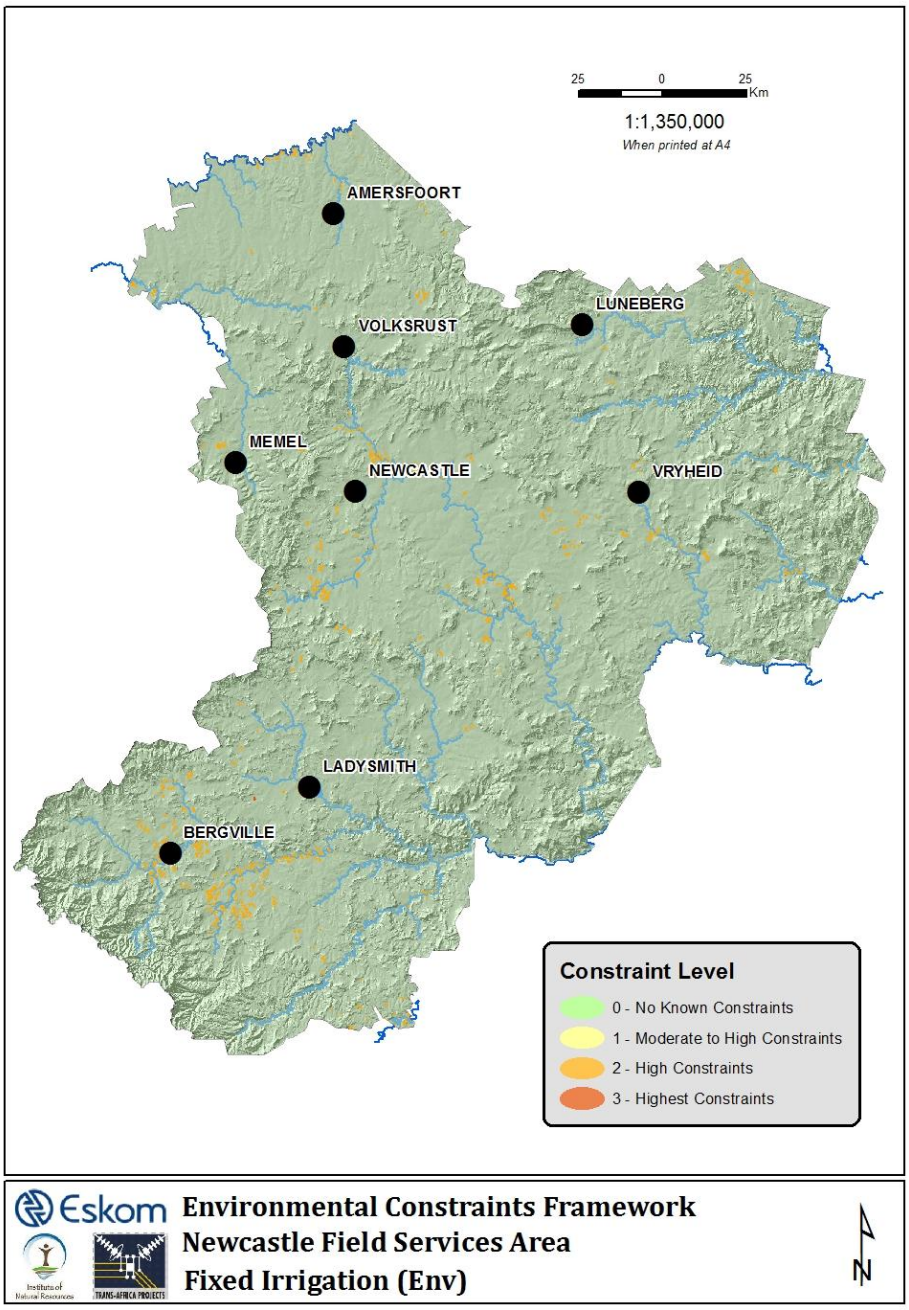
Limitations/ Recommendations
This data set is currently considered complete at a desktop confidence level. As the data was captured for this project, any further iterations of the ECF process should include a review of this data with respect to further irrigation developments that have occurred in the study area.

2.4.23 Fixed Irrigation Infrastructure [Eskom on Environment]

Environmental Component: Socio-economic
Description of Constraint: The loss of highly productive agricultural land under centre pivot irrigation infrastructure would be a serious loss to the individual land owner, his labour and the agricultural sector given the limited extent of highly productive agricultural land. With the current increasing concerns over food security and Department of Agriculture's resistance to lose productive land, such areas should be avoided where possible. A HIGH constraint level has been assigned in this case.

Attribute Description

Field	Constraint Level	Description
Feat09_NMC	Irrigation Infrastructure	Areas under formal fixed irrigation infrastructure
Feat09_E	High	All areas under fixed irrigation infrastructure



Data Origin
Fixed irrigation infrastructure were identified and mapped off SPOT (2008/2010) and Google Earth imagery (latest dates available) dataset/s.

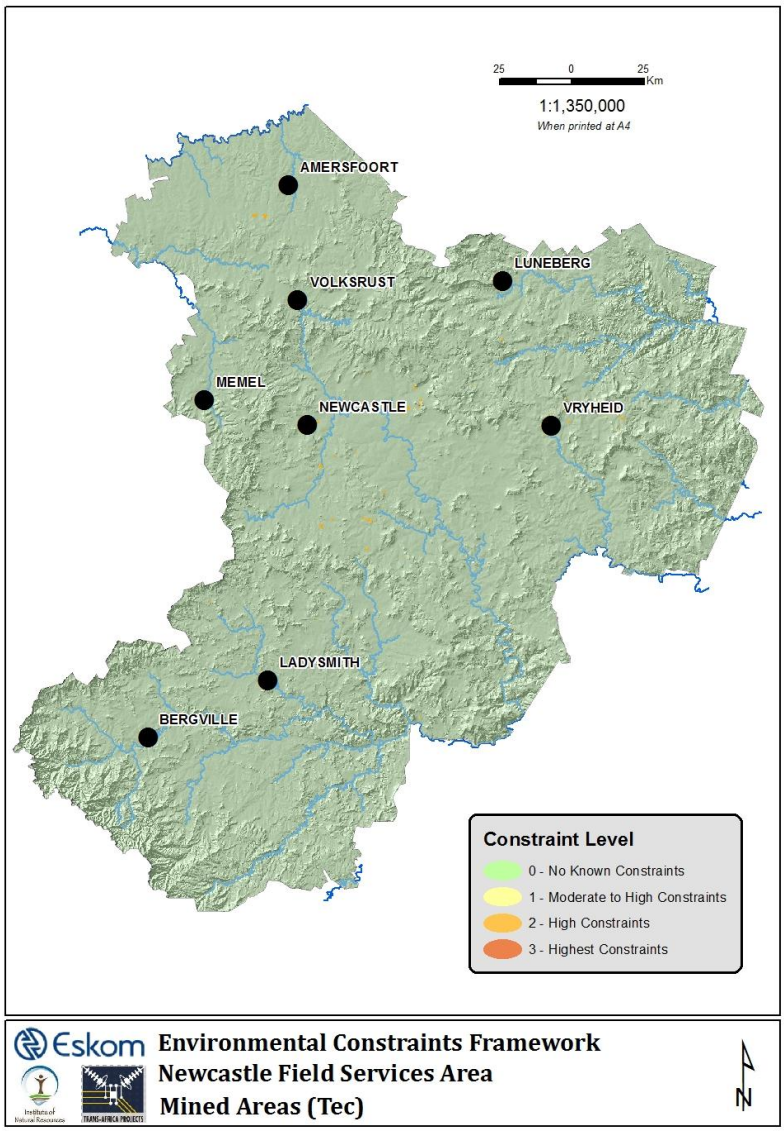
Limitations/ Recommendations
This data set is currently considered complete at a desktop confidence level. As the data was captured for this project, any further iterations of the ECF process should include a review of this data with respect to further irrigation developments that have occurred in the study area.

2.4.24 Mined Areas [Environment on Eskom]

Environmental Component: Socio-economic
Description of Constraint: Undermined areas pose a constraint to the construction and operation of electrical infrastructure as they create unstable founding conditions and may also require the periodic relocation of power lines for continued mining operations. Opencast mines and other surface mining infrastructure, including tailings and slimes dams, also pose constraints and obstacles. Mines however, often require large power inputs in which case routes through the mining areas have to be found. Constraint levels for mined areas ≥ 4 ha are HIGH and those ≤ 4 ha are MODERATE to HIGH (the latter being easier to span). With respect to quarries, only single shot blasting is permitted within 500 m of a power line.

Attribute Description

Field	Constraint Level	Description
Feat16_NMC	Mined areas	Mined areas visible from the surface
Feat16_E	Moderate to High	Mined areas visible from the surface ≤ 4 ha
	High	Mined areas visible from the surface ≥ 4 ha.



Origin
Mined areas were extracted for the study area from best available land cover datasets and from mined surface data provided by MPTA. As with dams, mines were distinguished by area. It is assumed that mined areas greater than 4ha (approx. 200m x 200m) cannot be spanned whereas less than 4ha areas are potentially spannable.

Limitations/ Recommendations
At present, no comprehensive and inclusive mapping data are available for the study area, that meaningfully differentiate between undermined and surface mining areas, or between currently mined areas and areas with future mining licenses/rights. The ECF shows land surfaces affected by existing mines and past mines (information provided by the Mpumalanga Tourism and Parks Agency and extracted from the KZN land cover data set). This is, however, disturbed/transformed land at mine sites that is mapped from satellite imagery based on surface deposits, e.g. tailings, slimes dams and surface infrastructure, and does not indicate the extent of areas mined underground. The Department of Mineral Resources does not have comprehensive strategic mapping available and appears to be only in a position to respond on a case-by-case basis per project application. At present, Eskom deals with the individual mining houses on a case-by-case basis when routes are being selected.

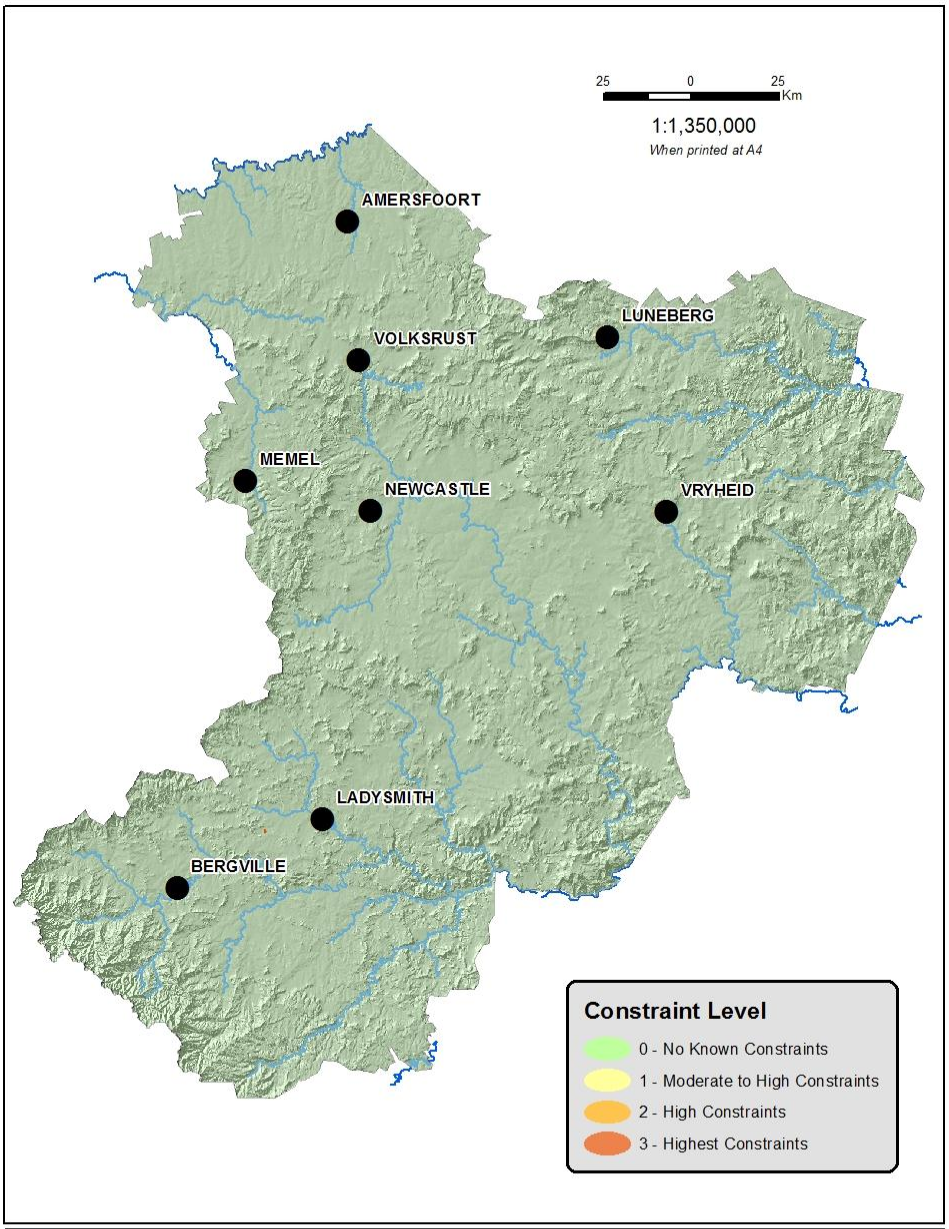
2.4.25 National Road Intersections [Environment on Eskom]

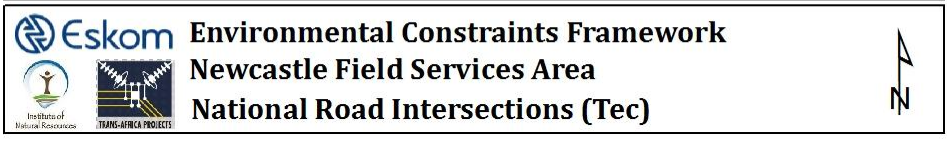
Environmental Component: Socio-economic

Description of Constraint: Powerline development is restricted within 500m of the intersection of two national roads. Eskom's survey guidelines identified the South African National Roads Agency constraint that no powerline may be located within 500m of a National Road intersection. The restricted area is assigned the HIGHEST constraint level, however this has limited spatial influence given the small area affected and infrequent occurrence of these intersections.

Attribute Description

Field	Constraint Level	Description
Feat17_NMC	National Road Intersections	Areas within 500 m of an intersection between two national roads.
Feat17_T	Highest	Within 500 m of an intersection between two national roads.





Data Origin

National road intersections were extracted for the study area from the national road network data set. Intersections were buffered by 500m.

Limitations/ Recommendations

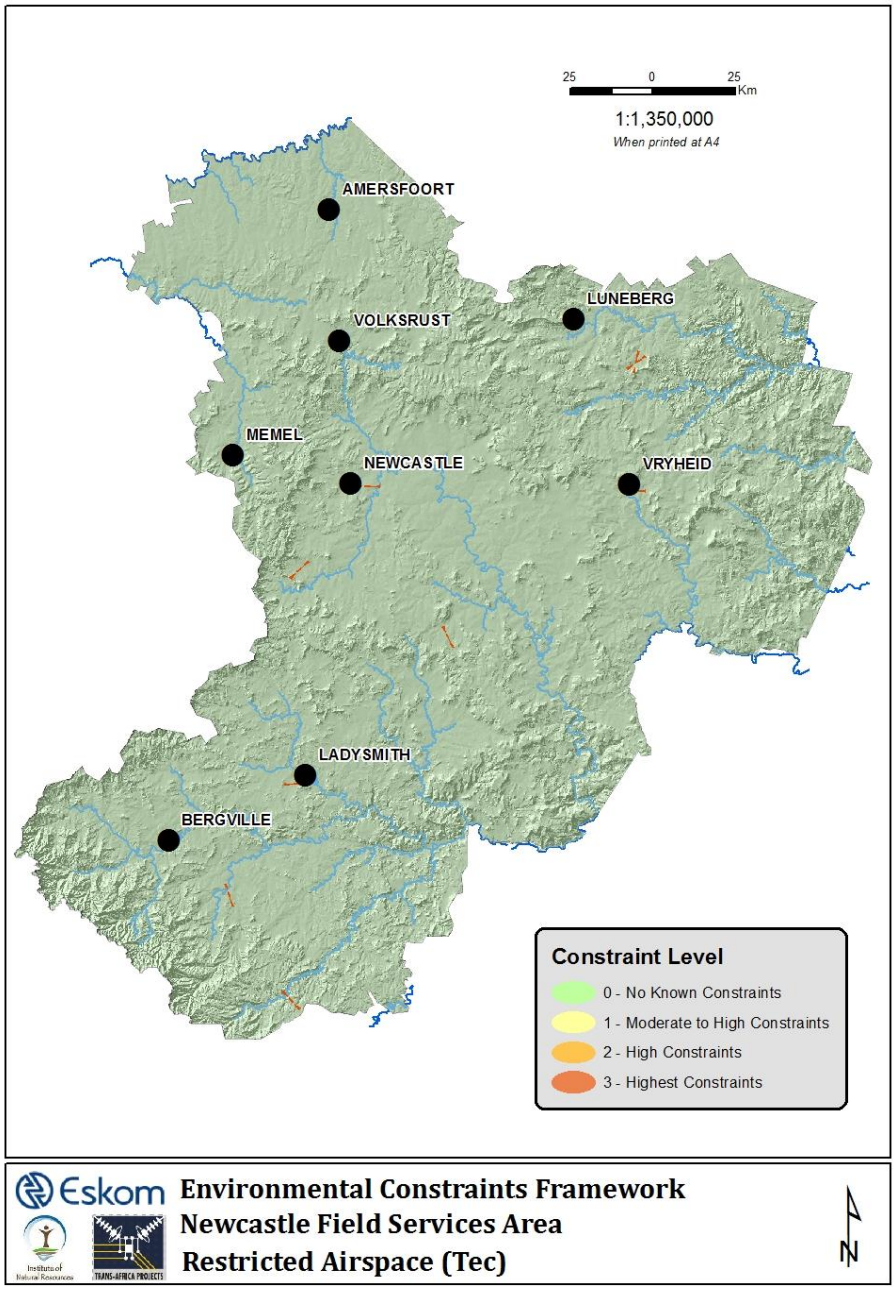
As road developments are continuous, the most current available road data should be used to assess the completeness of this data set in future iterations of the ECF process.

2.4.26 Restricted Airspace [Environment on Eskom]

Environmental Component: Socio-economic
Description of Constraint: The Civil Aviation Authority have defined airspace surrounding airports within which transmission infrastructure is restricted to avoid impacting the flight paths of airplanes approaching or leaving the airport/field. The restricted area is defined by a 3050m long approach surface at either end of airstrips. Additionally, no development is allowed to break through a surface of 1:7 incline measured from 75m from the edge of the runway. These restrictions have been applied to both airports/fields registered with the Civil Aviation Authority (CAA) and unregistered airstrips that have been identified as being important for fire fighting. They are assigned the HIGHEST constraint level.

Attribute Description

Field	Constraint Level	Description
Feat19_NMC	Restricted Airspace	Restricted airspace around registered and important airfields
Feat19_T	Highest	All modelled areas on and surrounding airfields/ports



Data Origin
Registered and important (from a fire fighting perspective) airfields were identified and their spatial extend captured. Based on Eskom's restricted airspace policy, areas which would pose a problem to the operation of these airfields were calculated and captured.

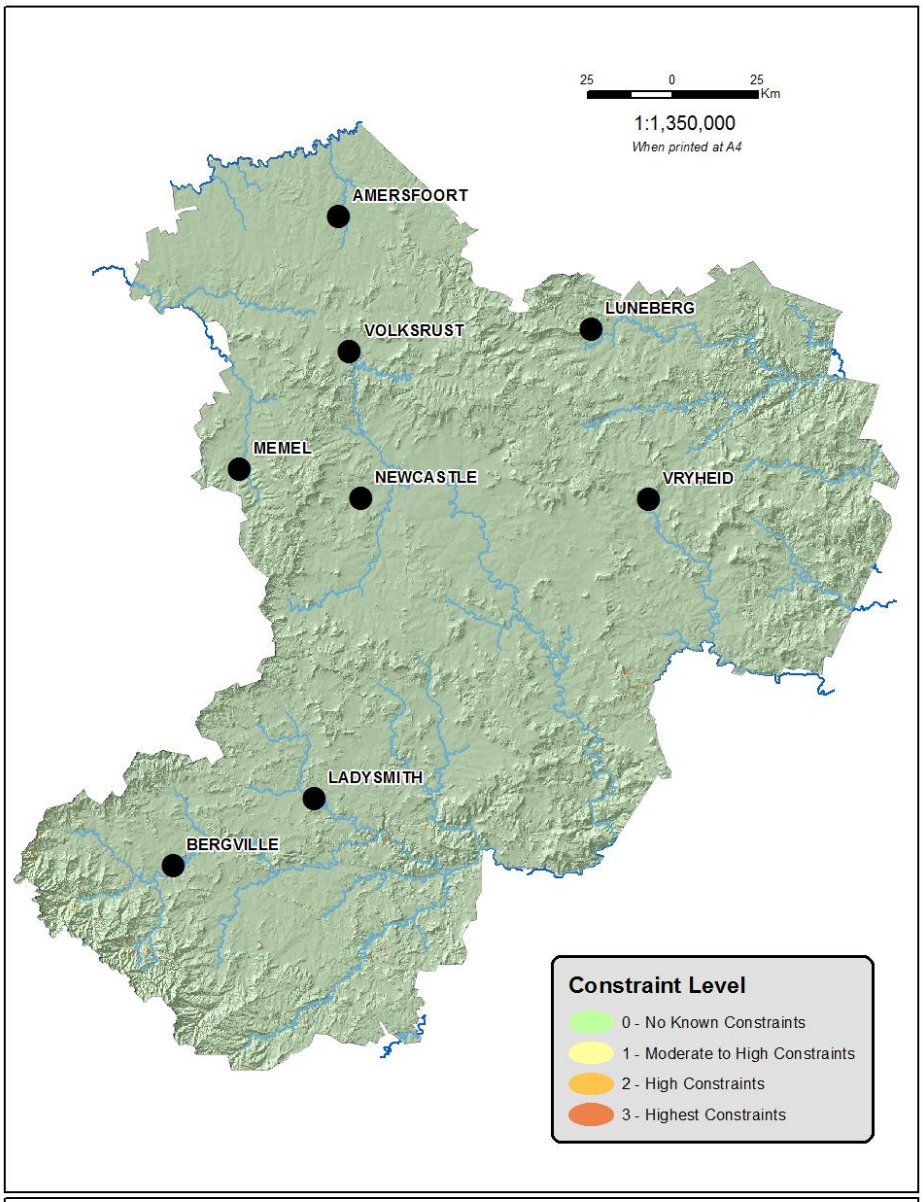
Limitations/ Recommendations
As the data does not include the majority of unregistered airfields, these would need to be identified and dealt with at the EIA stage of a powerline development project.

2.4.27 Archaeological Features [Eskom on Environment]

Environmental Component: Cultural
Description of Constraint: The National Heritage Resources Act, 1999 (Act 25 of 1999) makes it illegal to damage or destroy recognised archaeology sites without a permit (Sec 35 (4)). It is thus important to know where these are located. Typically these sites are small and should thus not impose a realistic constraint to a route. Given their legal protection and the likely destruction should power line infrastructure be developed at these sites, they have been afforded the HIGHEST level of constraint.

Attribute Description

Field	Constraint Level	Description
Feat04_NMC	Archaeological Sites	Sites identified as Archaeological Sites
Feat04_E	Highest	Archaeological sites and 100m buffer



Data Origin
Archaeological sites for KZN were extracted from the Natal Museum and AMAFA archaeological site database. These sites were buffered by 100m.

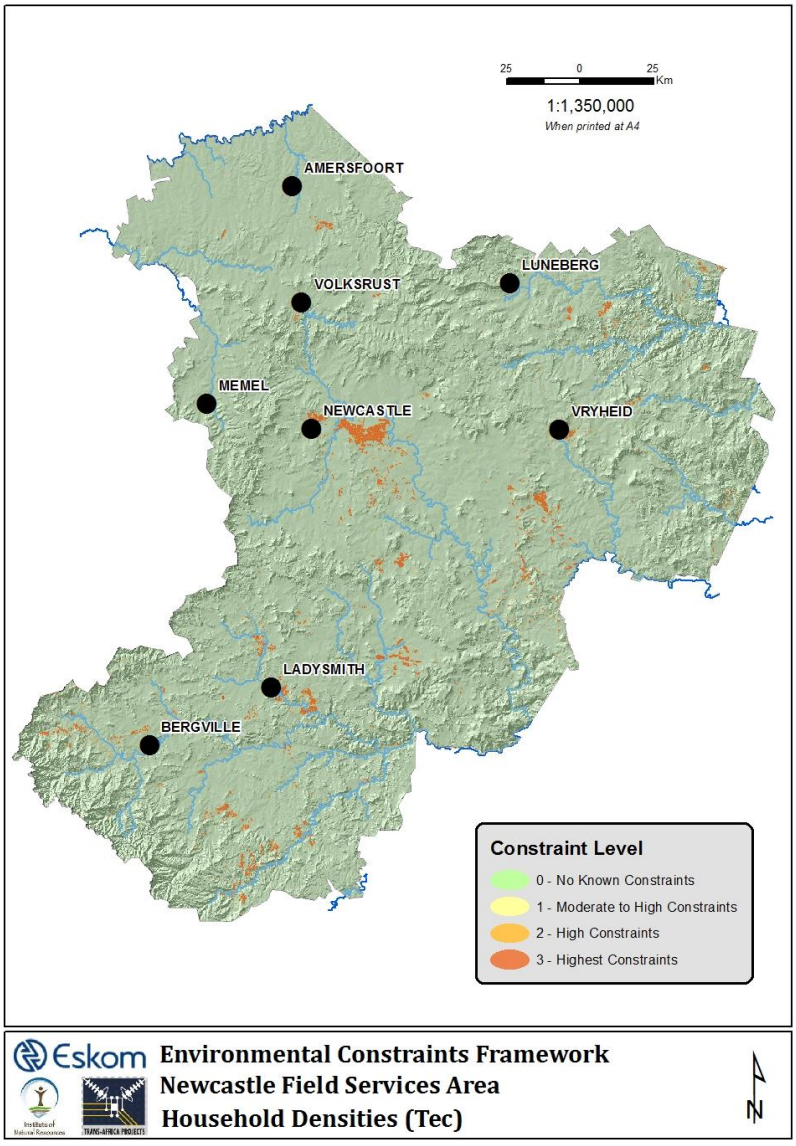
Limitations/ Recommendations
Archaeological sites are largely concentrated where existing research work has been carried out. The sites represented here by no means constitute the sum of sites in the study area with any archaeological value, but only those which have been discovered. Any development work should take note of the requirements of the Act with regards to required actions in the event of finding new sites of archaeological value. Apart from the actual destruction, certain sites may be impacted by the loss of the associated 'sense of place' due to the construction of powerlines in the surrounding landscape. This issue needs to be considered in the EIA process.

2.4.28 Household Densities (Residential Settlement) [Environment on Eskom]

Environmental Component: Socio-economic
Description of Constraint: Residential areas[11] present a host of physical, social and development planning obstacles and costs that constrain routing of large powerline infrastructure through these areas. Eskom guidelines state that a minimum 40 m distance must be maintained between residences and powerlines. With increasing density of households and built environment, the constraint becomes more severe, particularly when resettlement has to be negotiated and compensated. Eskom technical staff have indicated that it is preferable to skirt around highly developed (urban) areas completely than to try to traverse them. Different constraint levels have been assigned to areas with different household densities (see below).

Attribute Description

Field	Constraint Level	Description
Feat04_NMC	Household Density	Settled areas with an average of 1.5 or more households per hectare
Feat04_T	High	>1.5 and < 3 households per hectare
	Highest	≥ 3 households per hectare



Data Origin
Eskom's household survey data was used to establish a housing density layer for the study area. The field service area was gridded with 4ha (200m x 200m) cells. These cells were then assigned the household count and divided by four to establish the number of households per hectare in the cell. Constraint levels were assigned based on these values.

Limitations/ Recommendations
The data used to establish housing densities is likely to lose currency very rapidly. The best available data should be used at every iteration of the ECF process to ensure densities are as accurate as possible.

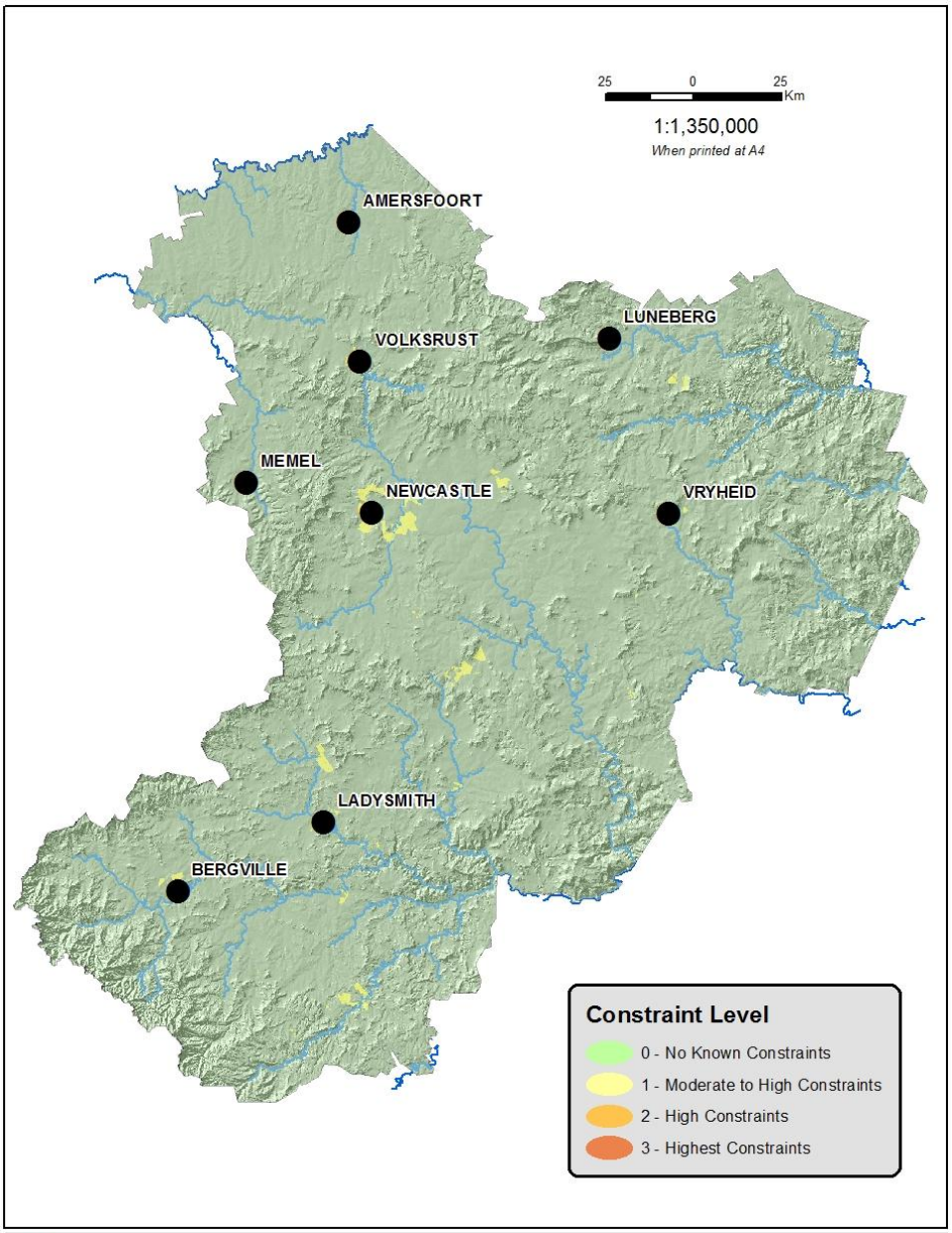
[11] Industrial areas are not included in the ECF as they often require high voltage electrical infrastructure to come into these areas.

2.4.29 Theoretical Residential (future growth areas) [Environment on Eskom]

Environmental Component: Socio-economic
Description of Constraint: Master Planners identify areas earmarked for future growth via consultation with municipalities and development planning authorities, to take into consideration for projections of future electricity demand. These areas would require electricity in the future, but routing through these areas would likely meet with resistance with planning authorities due to their intended land use. The projected nature of the information means that it is allocated a MODERATE TO HIGH level of constraint.

Attribute Data

Field	Constraint Level	Description
Feat28_NMC	Future Urban Growth Areas	Areas identified for future urban residential development
Feat28_T	Moderate to High	Areas identified for future urban development



Data Origin
Theoretical residential growth areas for the study area were extracted from development forecast data provided by Kayamandi. This data was used as is.

Limitations/ Recommendations
The inclusion of forecast data carries significant limitations in that development patterns may change and projected growth may not occur. This should be taken into consideration when using and reviewing the ECF.

PART III – WORKING WITH THE ENVIRONMENTAL CONSTRAINTS FRAMEWORK

Note: The guidelines provided here are drawn up with the assumption that the user will be viewing the ECF data using a GIS. The figures used to illustrate the use of this tool are based on ESRI's ArcGIS 10, but similar functionality is available in most GIS applications. Detailed user guidelines can however not be provided without knowing which GIS application will be used to interrogate the ECF.

3.1 Viewing Individual Constraint Feature Classes

The ECF comprises a multitude of individual layers (constraint feature classes) which are *unioned* to form the three integrated product layers: the integrated technical, integrated environmental constraints, and the overall ECF layer which combines the environmental and technical composite layers.

Figure 10 below illustrates the Indigenous Vegetation Layer with a high constraint level. In the table of contents on the left of Figure 10, all other technical constraint feature classes are listed and available for viewing. In a GIS environment, these can be turned on and off in the map (by using the checkbox in the table of contents), illustrating different combinations of constraint feature classes.

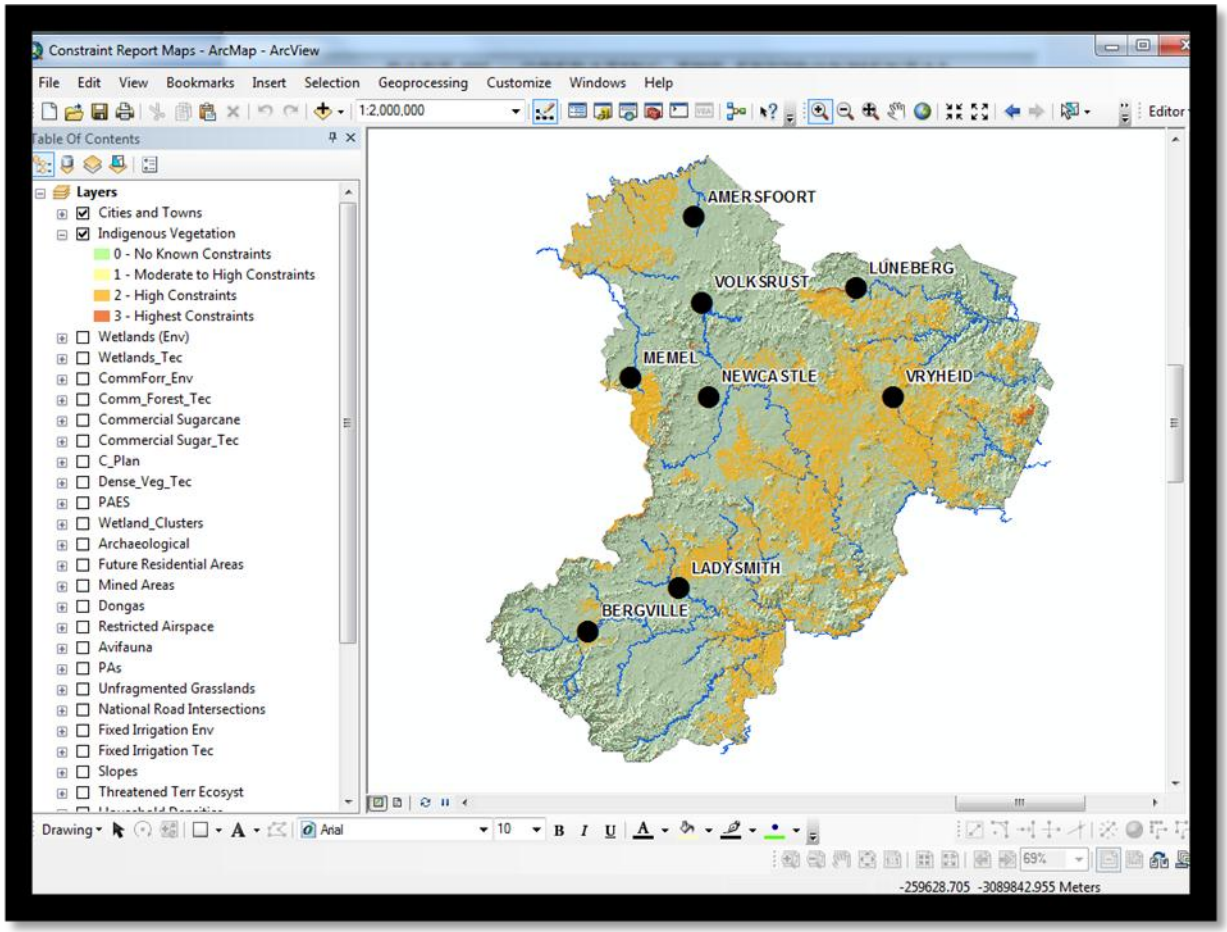


FIGURE 10 SCREENSHOT OF THE ECF SHOWING THE LEVEL AND DISTRIBUTION OF CONSTRAINT IMPOSED BY INDIGENOUS VEGETATION

The attributes of each polygon (which represent an individual constraint feature) can be viewed in the constraint feature class's attribute table. Each polygon represents a feature on the ground. Each polygon is also represented by a row in the attribute table, and information about any constraint feature can be stored in the attribute table. In the case of this model, the information stored is the type of feature and the constraint level which has been assigned to it.

This concept is demonstrated in Figure 11 below. In this illustration, a particular protected area (Weenen Nature Reserve) is represented by the polygon highlighted in blue in the map and its linked attributes by the record highlighted in blue in the attribute table (that it is a protected area – and that it represents the highest level of constraint - 3).

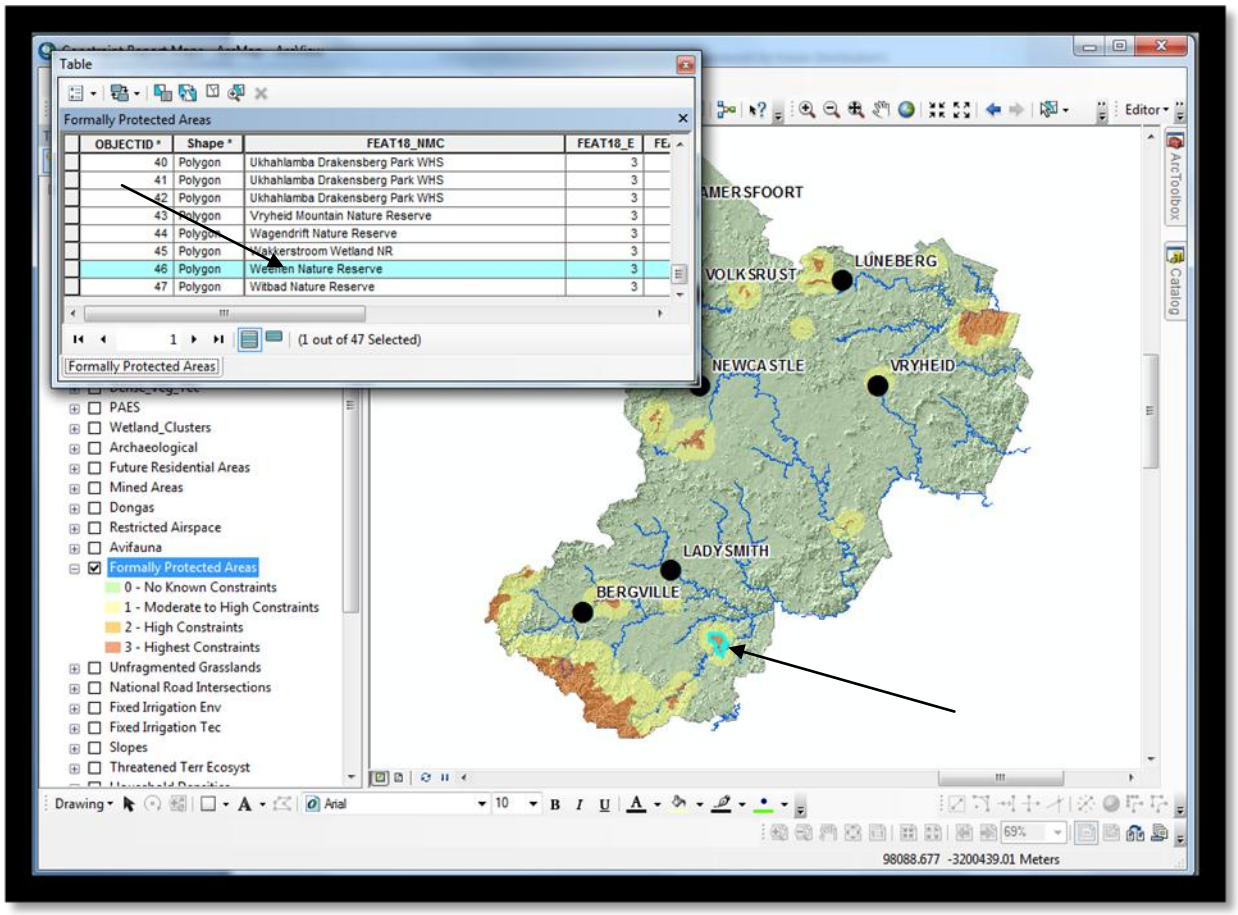


FIGURE 11 PROTECTED AREA FEATURE CLASS DEMONSTRATING THE LINK BETWEEN ATTRIBUTE TABLE AND MAP

3.2 Union Process

In order to amalgamate all constraints into a single layer, a process of unioning (see glossary) was undertaken. When two feature classes are unioned, the features in both are combined into one new feature class. The attribute tables of the two classes are also combined, with the fields (columns) of each feature class retained alongside each other in the new feature class's attribute table. These are the **FeatXX_NMC** field and the **FeatXX_E** and **FeatXX_T** field (where XX represents the Feature Class number – and E represents the Environmental constraint level and T the technical constraint level). This is illustrated in Figure 12.

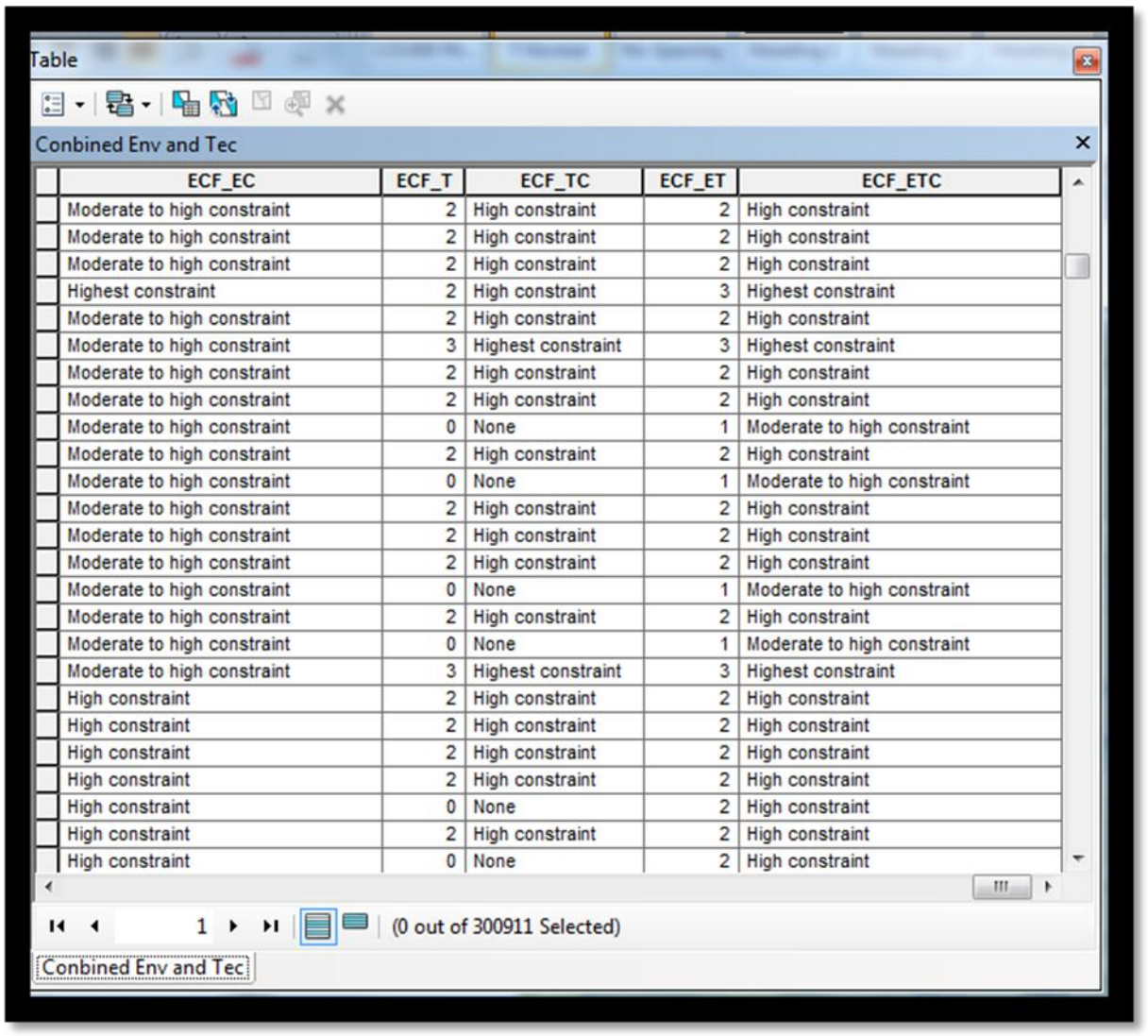
Where features from the two feature classes intersect spatially, a new polygon is created and an associated new record (row) is placed in the attribute table with the values of both features recorded. After all layers have been unioned, the highest level of constraint found in that polygon is carried forward to the combined constraints attribute field (see Figure 13).

Table

Indigenous Vegetation

FID	Shape *	FEAT03_NMC	FEAT03_E	FEAT03_T	FEAT14_NMC	FEAT14_E	FEAT14_T
1462	Polygon	Zululand Lowveld	2	0		0	0
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	2
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	2
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	2
1464	Polygon	Zululand Lowveld	2	0	Unchannelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	1	2
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	2
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	2
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	2
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	2
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	2
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	2
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Unchannelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	2
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	2
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	2
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	0
1464	Polygon	Zululand Lowveld	2	0	Unchannelled valley-bottom wetland	2	2
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	2
1464	Polygon	Zululand Lowveld	2	0	Channelled valley-bottom wetland	2	0

FIGURE 12 THE ATTRIBUTE TABLE OF A FEATURE CLASS CREATED BY UNIONING FEATURE CLASS 03 (INDIGENOUS VEGETATION), FEATURE CLASS 14 (WETLANDS)



ECF_EC	ECF_T	ECF_TC	ECF_ET	ECF_ETC
Moderate to high constraint	2	High constraint	2	High constraint
Moderate to high constraint	2	High constraint	2	High constraint
Moderate to high constraint	2	High constraint	2	High constraint
Highest constraint	2	High constraint	3	Highest constraint
Moderate to high constraint	2	High constraint	2	High constraint
Moderate to high constraint	3	Highest constraint	3	Highest constraint
Moderate to high constraint	2	High constraint	2	High constraint
Moderate to high constraint	2	High constraint	2	High constraint
Moderate to high constraint	0	None	1	Moderate to high constraint
Moderate to high constraint	2	High constraint	2	High constraint
Moderate to high constraint	0	None	1	Moderate to high constraint
Moderate to high constraint	2	High constraint	2	High constraint
Moderate to high constraint	2	High constraint	2	High constraint
Moderate to high constraint	2	High constraint	2	High constraint
Moderate to high constraint	0	None	1	Moderate to high constraint
Moderate to high constraint	2	High constraint	2	High constraint
Moderate to high constraint	0	None	1	Moderate to high constraint
Moderate to high constraint	3	Highest constraint	3	Highest constraint
High constraint	2	High constraint	2	High constraint
High constraint	2	High constraint	2	High constraint
High constraint	2	High constraint	2	High constraint
High constraint	2	High constraint	2	High constraint
High constraint	0	None	2	High constraint
High constraint	2	High constraint	2	High constraint
High constraint	0	None	2	High constraint

FIGURE 13 THE ATTRIBUTE TABLE OF THE COMBINED CONSTRAINTS LAYER DEMONSTRATING THE SELECTION OF THE HIGHEST CONSTRAINT LEVEL

3.3 Querying the ECF

In addition to using visual interpretation of the ECF map, a query tool is available to provide supporting quantified information. The user can draw a line (representing a proposed powerline) from one point to another on the ECF map. A simple report (text) can be generated that indicates exactly which constraint features are intersected by the line, and gives their lengths both in meters and as a percentage of the total length of the line. This allows for quantified comparisons between alternative lines.

From a technical perspective, the query tool[12] takes a polygon layer and extracts information based upon a user defined sketch or line from a polyline layer file. Upon selecting/creating the line and requesting a report (Figure 14) to be generated, the tool asks the user which underlying polygon layer file to use (in

[12] The query tool has initially been created as a plugin for MapWindow GIS (an opensource GIS). It is envisaged that it will be ported to ESRI's ArcGIS in the future. This will be done when comments on whether additional features are to be included are finalised, as duplication of coding is not productive.

our case, the final ECF output layer) (Figure 15). Once selected, the user has the option of whether they would like a report based only upon the sketch/line selected or whether a buffer should also be generated around the line (Figure 15), from which the underlying data will also be extracted and reported on. Once selected, the user then is requested to select which attribute fields they would like to use in reporting (Figure 16), which relates to the layers inputted into the final ECF layer file (e.g. Wetlands, Dams, Threatened Terrestrial Ecosystems). An additional feature requests the user whether or not they would like to 'sync' field names, so that the report will match the field name to the generic/common name of the layer (e.g. Wetlands, Irrigation Pivots). What this does, is selects a csv table from which the user can select what the field names in the shapefile are and what their generic (common) layer names are (Figure 17), so that in the report, the actual layer name is also included, which is more meaningful to the end-user. For example, FEAT14_E relates to Wetlands and by using the sync table, the report will include both original field name (FEAT14) being reported on as well as its actual layer name (Wetlands).

The report is based upon the number of occurrences the line and, if selected, polygons, are made up of for each constraint category i.e. 0 (No known constraints); 1 (Moderate to high constraint); 2 (High constraint); 3 (Highest constraint). Based upon these, lengths and areas are determined and a list of which attributes they consist of, are summarised. Figure 19 shows the user that the report is complete and Figure 20 shows an extract of the report. The report is outputted into an HTML web page format, however can be copied/pasted into a program such as Excel or Notepad for other format saving.

The user is also able to opt not to report on a specific constraint level (Figure 18), which in our case is likely to be where there is 'No known constraints' or constraint value 0. This means the user has the flexibility to select all or only one of the constraints levels, which may be of relevance to them.

NB: The user can select whether or not to save the reported line/polygon layers as shapefiles (see Figure 14 checkbox options).

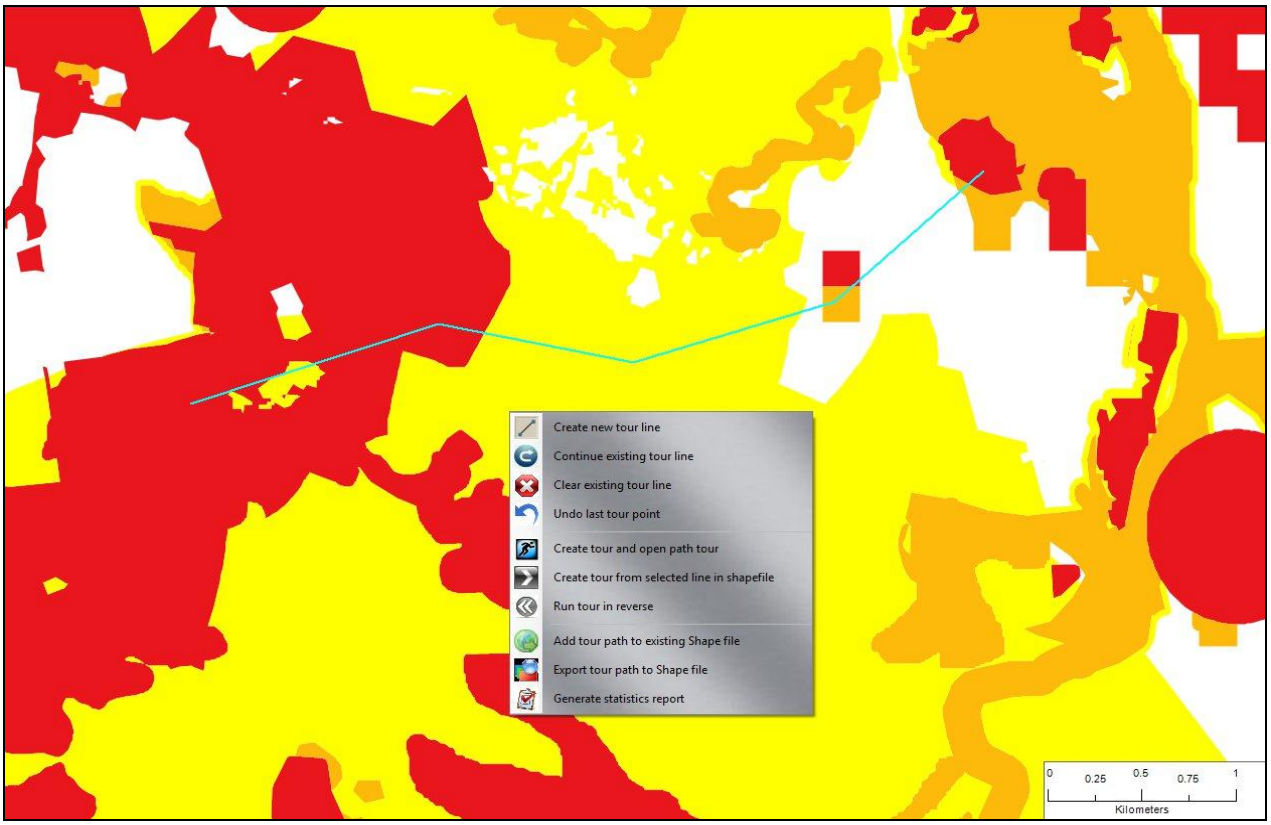


FIGURE 14 USER CREATES LINE AND REQUESTS REPORT TO BE GENERATED

FIGURE 15 USER SPECIFIES THE FILE TO BE REPORTED ON (FINAL ECF)

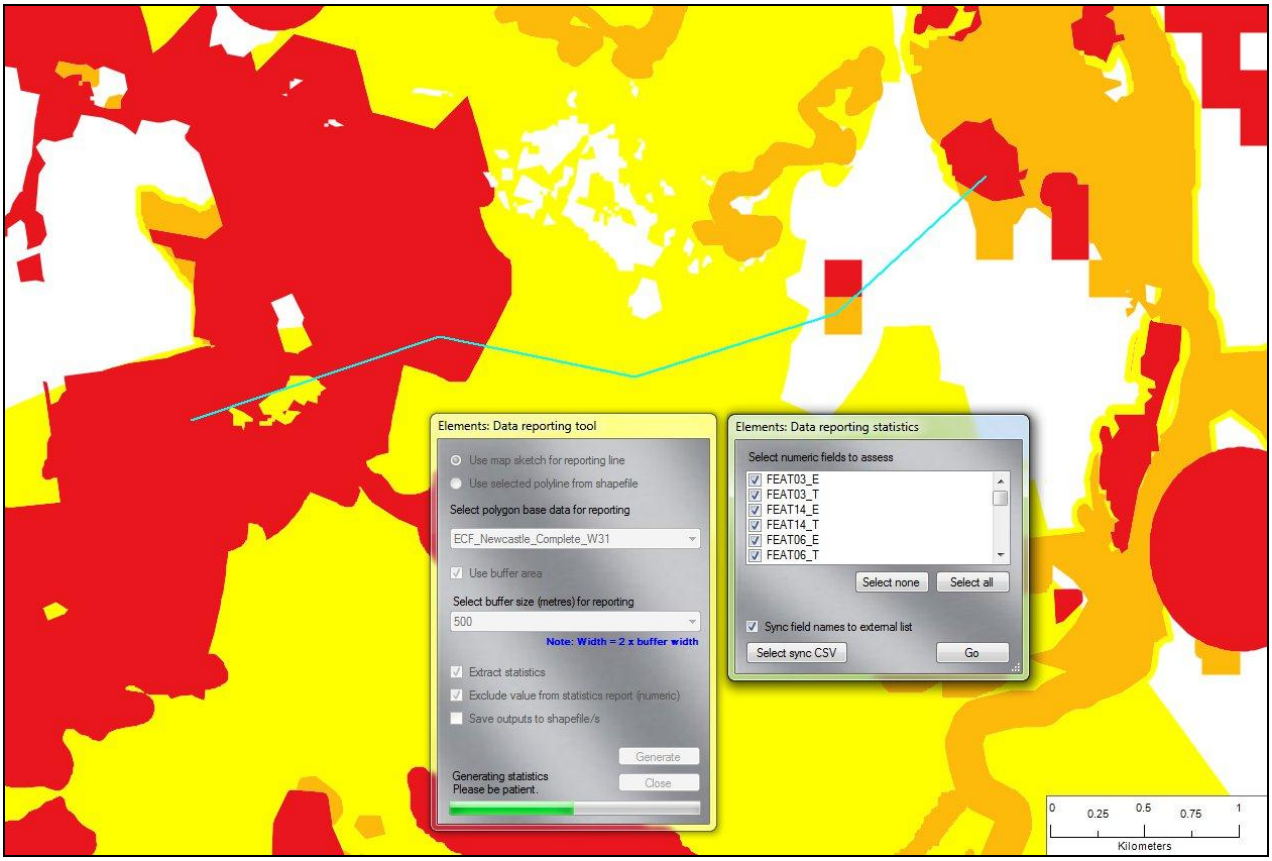


FIGURE 16 USER SELECTS ATTRIBUTE FIELDS (LAYERS) TO BE REPORTED ON

FIGURE 17 THE USER CAN SYNC FIELD NAMES SO COMMON LAYER NAMES SHOW UP ON REPORT

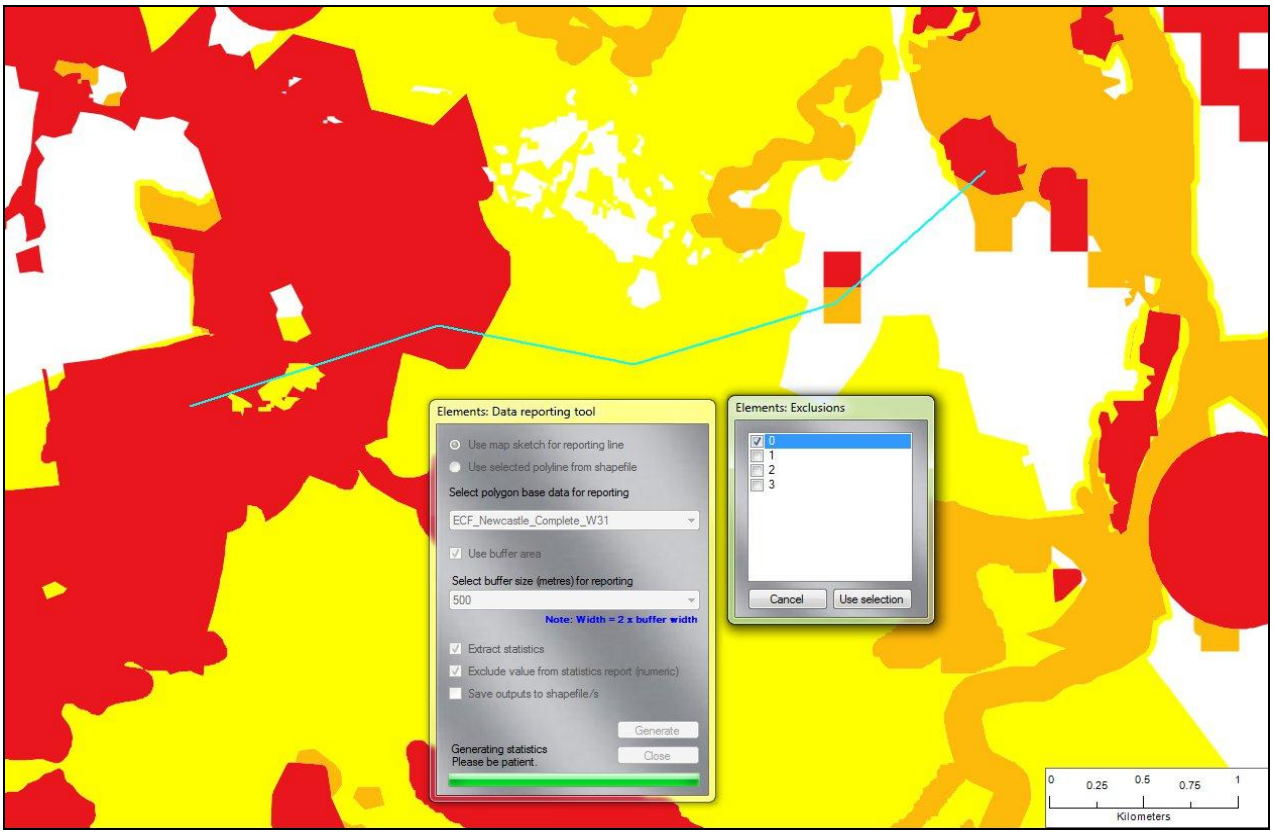


FIGURE 18 THE USER CAN EXCLUDE SPECIFIC CONSTRAINT LEVELS FROM THE REPORT

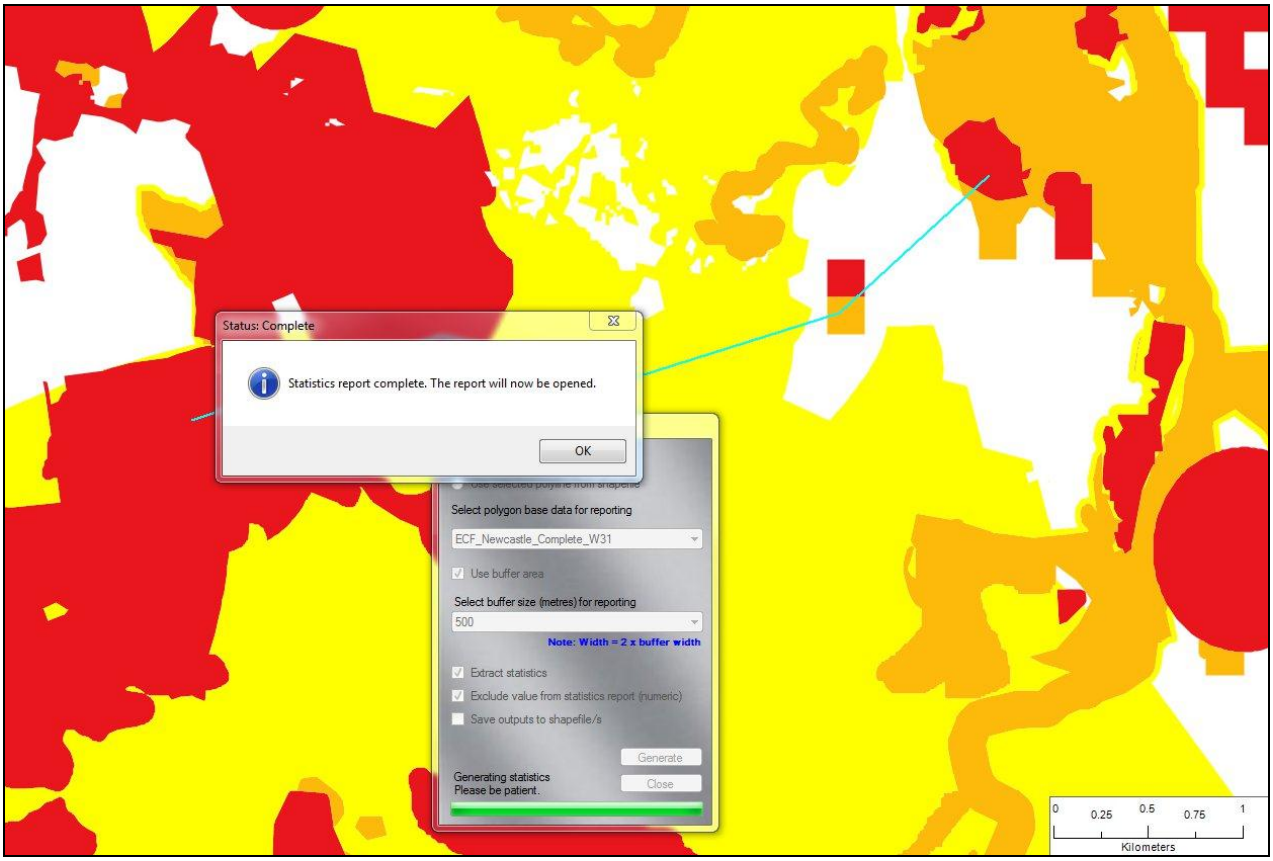


FIGURE 19 THE TOOL INDICATES THAT THE REPORT IS COMPLETE

Developed by S3 Technologies (2012)

in collaboration with *Acer Africa Environmental Consultants and The Institute of Natural Resources*

Line information report (Total length = 5.686km)

Constraint: 1

Occurances: 70

Length (m): 4920.087

Length percentage of all segments: 86.54%

Fields making up constraint/s:

Dense vegetation areas (FEAT04_T)	Conservation plans (FEAT11_E)	Wetlands (FEAT14_E)	Theoretical residential (FEAT28_T)

Constraint: 2

Occurances: 40

Length (m): 4305.981

Length percentage of all segments: 75.74%

Fields making up constraint/s:

Indigenous/Sensitive vegetation types (FEAT03_E)	Wetlands (FEAT14_T)

Constraint: 3

Occurances: 13

Length (m): 1309.23

Length percentage of all segments: 23.03%

Fields making up constraint/s:

Conservation plans (FEAT11_E)

Polygon information report (Total area = 301.13ha)

Constraint: 1

Occurances: 196

Area (hectares): 258.676

Area percentage of all polygons: 85.9%

Fields making up constraint/s:

Dams (FEAT01_E)	Dense vegetation areas (FEAT04_T)	Conservation plans (FEAT11_E)	Wetlands (FEAT14_E)
Slopes (FEAT20_T)	Theoretical residential (FEAT28_T)		

Constraint: 2

Occurances: 174

Area (hectares): 238.224

Area percentage of all polygons: 79.11%

Fields making up constraint/s:

Indigenous/Sensitive vegetation types (FEAT03_E)	Commercial forestry (FEAT06_E)	Commercial forestry (FEAT06_T)	Wetlands (FEAT14_T)
Household densities (FEAT26_T)			

Constraint: 3

Occurances: 47

Area (hectares): 66.556

Area percentage of all polygons: 22.1%

Fields making up constraint/s:

Conservation plans (FEAT11_E)	Archaeological sites (FEAT25_E)

FIGURE 20 EXAMPLE EXTRACT OF REPORT

3.4 Maintaining the ECF

The legal and institutional framework governing environmental management as well as the technology used in environmental mapping and planning is also progressing rapidly. In order to remain relevant it is proposed that the ECF is updated at least on a five yearly basis. This requires that in the next iteration new constraints are also accounted for. Examples are likely to include facilities such as wind farms, of which there are several currently in the planning phase. Changes in legislation may also introduce additional constraints (for example, new Critically Endangered Ecosystems listed in terms of the NEM:Biodiversity Act). Updating the ECF will also require the latest version of the data sets used to construct this version. The contact details for the custodians of the data sets used in this version are provided in Table 5.

TABLE 5 SOURCES FOR GIS DATA – CONTACT DETAILS FOR UPDATING OF DATA

No	Source	Contact detail	Type	Data Set
1	CAA (Civil Aviation Authority)	Make contact with CAA GIS specialist via Ms Lizelle Stroh, Obstacle Specialist Tel: (011) 545 1232; strohl@caa.co.za	Point	❑ Airports (2010) ❑ Heliports (2010) ❑ Micro-light sites (2010)
2	Chief Surveyor General	Private Bag X9028, Cape Town, 8000 Tel: (021) 467 - 4800 Fax: (021) 465-3008	Polygon	❑ Slopes – derived from 20 m contours sets (2010)
3	Amafa	James van Vuuren Deputy Director: Support, Professional, Technical Tel:0824993531 james@heritagekzn.co.za	Point	❑ Cultural heritage sites (KZN)
4	ENPAT (Environmental Potential Atlas (for South Africa)	ENPAT Project Department of Architecture University of Pretoria Pretoria 00002	Polygon	❑ Soils (circa 2000) ❑ Cultural heritage sites (circa 2000)
5	ESKOM	Steve Tait ESKOM Eastern Region	Point	❑ Power stations (2010) ❑ Sub-station (2010)
6	ESKOM	Steve Tait ESKOM Eastern Region	Line	❑ Transmission lines (2010) ❑ High voltage lines (2010)
7	ESKOM	Steve Tait ESKOM Eastern Region	Polygon	❑ Households (circa 2010 - based on SPOT 5 2008 imagery)
8	Kayamandi Development Services	Russell Aird of Kayamandi Tel: 012 430 2888 russell@kayamandi.com	Polygon	❑ Settlements/Residential, Industrial and Commercial Development (circa 2010)
9	Endangered Wildlife Trust	**For Mpumalanga**: Mr Luke Strugnell, EWT, Tel: (+27) 011 486 1102; Cell:(+27) 079 878 3741 Fax: 086 548 6195 **For KZN:** Senior Field Officer: Drakensberg Crane Conservation Project Endangered Wildlife Trust - African Crane Conservation Programme Office: 033 330 6982 Cell: 082 394 7476 Postal address: PO Box 1312, Howick, 3290; email: tanyas@ewt.org.za	Polygon	❑ Sensitive Bird Areas
10	NFEPA (National	Data obtained via Mervyn Lotter,	Polygon	❑ Wetlands and Water bodies

No	Source	Contact detail	Type	Data Set
	Freshwater Ecosystem Priority Areas – SANBI)	MTPA but original source is Gene Nel, CSIR Stellenbosch, Tel: 021-8882484 / 072 1206442		(circa 2008 via MBCP)
11	MBCP (Mpumalanga Biodiversity Conservation Plan)	Mervyn Lotter, Biodiversity Manager, Mpumalanga Tourism & Parks Agency; Tel: 083 299 7618 / 013 235 2395; mervynlotter@mtpa.co.za	Polygon	**(Mpumalanga and Limpopo)** ❑ Conservancies (circa 2006) ❑ Proposed conservancies (circa 2006) ❑ Terrestrial Biodiversity Assessment aka Conservation Plan (circa 2006) ❑ Ecological corridors (circa 2006) ❑ Land cover – Mining (circa 2008) ❑ Land cover – Cultivation (circa 2008) ❑ Land cover – Afforestation (circa 2008) ❑ Threatened Eco-systems (circa 2008) ❑ Protected areas (circa 2008)
12	SANBI (South African National Biodiversity Institute)	**BioDiversity GIS** Tel: +27(0)21 799 8738 Fax: +27(0)21 797 1940 Email: BGIS@SANBI.org http://bgis.sanbi.org/vegmap/project.asp	Polygon	❑ Vegetation mapping (Mucina & Rutherford 2006) ❑ SA Protected areas – National Heritage sites (circa 2008) ❑ Threatened Ecosystems (2011)
13	S3 Technologies	Nigel Berjak, Tel: 033 3423681 Fax 086 6721242	Polygon	❑ Irrigation pivots (2010 - based on SPOT 5 2008 imagery)
14	National Department of Agriculture – AGIS	Tel: 012 3196249 Email: helpdesk@nda.agric.za http://www.agis.agric.za/agisweb/agis.html	Polygon	❑ Land types and soils
15	FAO (Food and Agricultural Organisation) – SOTERSAF (Soils and Terrain database for Southern Africa)	FAO - www.fao.org SOTERSAF - http://www.isric.org/ No telephone numbers	Polygon	❑ WRB Soils and Lithology of Southern Africa

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Department of Environmental Affairs and Tourism (DEAT), 2008. The effectiveness and efficiency of the Environmental Impact Assessment (EIA) system in South Africa (Draft report for review – prepared by Mosakong Management cc In association with: Environomics cc Savannah Pty Ltd. and Environmental Counsel cc)

DRIVER,A., MAZE,K., ROUGET,M., LOMBARD,A.T., NEL,J., TURPIE,J.K., COWLING,R.M., DESMET,P.G., GOODMAN,P.S., HARRIS,J., REYERS,B., SINK,K. & STRAUSS,T. 2004. National Spatial Biodiversity Assessment: priorities for biodiversity conservation in South Africa. Strelitzia [17], 1-45. South African National Biodiversity Institute. Pretoria.

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Mucina, L & Rutherford, M.C. (eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

APPENDIX 1

LIST OF ENVIRONMENTAL CONSTRAINT FEATURES IDENTIFIED BY ESKOM SURVEY SECTION

No Go areas

Aeroplane landing strips no part of the power line may protrude from a 3048m long & 768m wide approach surface measured at a slope of 1:50 at a distance of 60 from the end of any runway.
Building restrictions as per half servitude width (as shown on the clearance chart).
Environmentally sensitive areas can require costly mitigation measures.
Indigenous protected trees, power lines to be located further than the trees falling distance away
Irrigated lands avoid crossing lands irrigated with pipes. Mobile wheel move and centre pivot systems may not have structures placed where their operation would be limited.
Land usage, residential, industrial, agricultural impacts on the cost of property
Large trees are costly to fell & dispose of, routes should be further than their falling distance away,
Mining areas can create unstable soil conditions and may require the periodic relocation of power lines for continued mining operations, locate routes at least 0.5km away.
Power line access has to be considered for construction and maintenance, this may require the use of a helicopter.
Power line angles in the planned power line should not deviate more than 90 degrees from a straight line, generally deviation angles should be less than 60 degrees (the tower limitations must be known)
Power line servitude widths & building restrictions must be known before a route can be selected (as per Eskom clearance chart).
Power line side slope areas of excessive side slope are to be avoided
Power line structure dimensions of the particular power line must be known before a route can be selected this will indicate the expected 'foot print' area of towers and the conductor spacing for side slope considerations. The spread dimensions of stay wires and supports have to be considered when the route is being planned.
Roads, power lines may not be located within 0.5km of national road intersections. Where power lines run parallel to national, provincial & proclaimed roads the road building restriction width applies. Half the servitude width is applied from the edge of other roads.
Rocky areas can present clearance and access problems. Foundations, in hard dolerite type rock, are costly.
Shooting ranges no power lines within a 824m wide strip (wider if more than 12 targets) & 2500m behind the range stop barrier.
Sub tropical fruit trees require special clearances.
Swimming pools, power lines must be located away from pools as the long handled brooms for cleaning can easily come into contact with the conductors
Township developments existing and proposed have to be considered and routes planned in accordance with the cadastral layout.
Water features normal ground clearance is applied but over navigable waters a 15m mast height plus 2,5m plus minimum safety clearance is applied above the high watermark.
Wetlands and adjacent areas should be avoided as they are environmentally sensitive.

Avoid if possible

Arable lands, structures are undesirable as they hamper farming operations and crop spraying. Sometimes structures can be located on the fallow contour banks.
Civil aviation spans higher than 60m above the ground need approval
Crop Compensation Eskom has to reimburse owners for damages and the loss of trees and crops
Dams, crossing should be avoided as here are practical complications when stringing the conductors
Explosive magazines dependent on span lengths, power lines must be more than 30 m away.
Flood lines try to locate structures above 50 year flood plains.
Game reserves when un-avoidable be aware of extra clearances required for giraffe and other mitigation measures may be required.
Graves and cemeteries can be crossed but should be avoided due to public objection.
Orchids allow additional clearance of 3m above estimated height of fruit trees.
Power line access, poor access may require the construction of access roads.

Power line angles in planned lines are to be planned so as to prevent exceeding their limitations by small amounts to optimise the usage & cost
Power lines crossing other power lines lower voltages are built below higher voltage lines. Test clearance with higher conductor at hot design template 50 or 80ºC and lower conductor at cold template design template -5ºC. Crossings should be close to structures but further than overturning distance. Surveyors must be aware of blow out conditions and the proximity to stay wires.
Power lines parallel to one another create induced currents, inter line spacing to be applied according to clearance chart inter line spacing to maintain acceptable voltages.
Quarries only single shot blasting permitted within 500m of a power line.
Road crossings as per clearance chart conditions differ for National, Provincial & Proclaimed roads. Crossings at mid span to the power line should be avoided and one structure should be located closer to the roadway to achieve "broken conductor conditions"
Rocky areas can present clearance and access problems. Foundations are also more costly.
Sports fields should be avoided for public safety.
Sugar cane lands must be avoided where possible as fires interfere with the performance of power lines.
Telkom separation distance is to be applied when paralleling with power lines. Optic fibre lines are not affected by interference or induced currents. Crossings as per specified crossing angles and the clearance of a structure on which a man can stand unsupported is to be applied over telephone poles. (see clearance chart)
Transnet pipe lines structures or parts thereof are not permitted within than 15m of pipelines.

Transnet rail crossings not less than 80 degrees to Eskom centre line. Clearances for each conductor type and structures as per clearance chart.
Transnet services require specific clearances when running parallel and for crossing (see clearance chart). Rail crossings by lower voltages require crossings to be at cuttings to achieve the required clearances.
Tree plantations allow 28m overturning distance to pine and gum or similar trees. Where routes traverse plantations compensation for the lost timber crop id payable.
Trust land must be identified as wayleaves for all properties traversed are required from the occupants (e.g. Ngonyama Trust land) as well as a servitude from the trustees.
Wetlands cause foundation problems
Windmills, bore holes & over head water tanks over turning distance.

APPENDIX 2

LEGAL AND INSTITUTIONAL FRAMEWORK

ENVIRONMENTAL COMPONENT & POLICY/ACT	RELEVANT CHAPTER/SECTION	RESPONSIBLE ORGAN OF STATE
OVERARCHING LEGISLATION		
Integrated Environmental Management ▪ **National Environmental Management Act, No 107 of 1998 (NEMA)**	▪ Chapter 1 - Principles Details the guiding principles for integrated environmental management and co-operative decision making with respect to environmental impact assessment. ▪ Chapter 5 – Integrated Environmental Management Facilitates the integration of the principles into implementation by promoting the use of appropriate tools. Section 24 provides for the promulgation of regulations that establish a requirement for environmental authorisation for development activities that may have a significant negative impact on the environment. ▪ Chapter 7 – Enforcement, Compliance and Protection This chapter (section 28) establishes a requirement for duty of care to prevent pollution or degradation of the environment, and where such damage has been caused, to rectify.	▪ National Department of Environmental Affairs (DEA) ▪ KZN Department of Agriculture, Environment and Rural Development (DEARD)
Impact Assessment ▪ **NEMA - Environmental Impact Assessment Regulations**	▪ Chapter 1 – Purpose of the Regulations To regulate the procedure and criteria for the submission, processing and consideration of applications for environmental authorisation for activities to avoid degradation of the environment, ensure mitigation and management to acceptable levels and optimise positive impacts. Listing Notice 1: No 10: The construction of facilities or infrastructure for the transmission and distribution of electricity:- i) Outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts, or ii) Inside urban areas or industrial complexes with a capacity of 275 kilowatts or more. Listing Notice 2: No 8: The construction of facilities or infrastructure for the transmission and distribution of electricity: with a capacity of more than 275 kilovolts outside of urban areas or industrial complexes.	▪ National Department of Environmental Affairs (DEA) ▪ KZN Department of Agriculture, Environment and Rural Development (DEARD)

ENVIRONMENTAL COMPONENT & POLICY/ACT	RELEVANT CHAPTER/SECTION	RESPONSIBLE ORGAN OF STATE
	NOTE – the activities above account for electricity distribution i.e. they do not include generation activities Listing Notice 3 contains various activities tht may be triggered by the construction of electrical infrastructure, depending on the area where such infrastructure is located (relates to identified protected and sensitive geographical areas).	
SOCIO-ECONOMIC ENVIRONMENT		
Land/Agriculture ▪ **Subdivision of Agricultural Land Act, No 70 of 1970.**	This Act aims to prevent the fragmentation of agricultural land into units that are no longer of a size that can be viably farmed. ▪ Section 2 - Defines situations where the Act does not apply. ▪ Section 3 - Defines what actions related to the agricultural land are prohibited. Any developments that require subdivision of agricultural land have to obtain authorisation from National Department of Agriculture.	▪ National Department of Agriculture, Forestry and Fisheries (DAFF) ▪ Department of Agriculture, Environmental Affairs and Rural Development (DAEARD)
Land/Agriculture ▪ **Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983).**	The Act provides for the control over the utilization of the natural agricultural resources of South Africa in order to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants. This legislation has environmental impact by promoting sustainable use of natural resources in order to ensure long-term productivity of the plant production sector.	
BIOPHYSICAL ENVIRONMENT		
Water Resources ▪ **National Water Act, No 36 of 1998**	The National Water Act (NWA) sets out to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in a sustainable manner for the benefit of all Chapter 4 sets out general principles for regulating water. According to the definition under Section 19, water use relates to the consumption of water as well as to activities that may affect water quality and the condition of the resource itself of which c) and i) listed below would be relevant to the development of powerline infrastructure were they to be located in a wetland or water course: c) impeding/diverting the flow in a watercourse; i) altering a water course;	▪ National Department of Water Affairs (DWA)

ENVIRONMENTAL COMPONENT & POLICY/ACT	RELEVANT CHAPTER/SECTION	RESPONSIBLE ORGAN OF STATE
▪ **Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983).**	6.2 (e) / Regulation 7 Utilization and protection of vleis, marshes, water sponges and water courses: *No user may use a wetland in a way that will cause damage to the natural agricultural resources; wetlands may not be drained or cultivated.*	▪ National Department of Agriculture, Forestry and Fisheries (NDAFF)
Biodiversity ▪ **National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA)**	The Act provides for the management and conservation of South Africa's biodiversity. It protects species (including any animal) and ecosystems and encourages the sustainable use of indigenous biological resources and the equitable sharing among stakeholders of benefits arising from bio-prospecting involving indigenous biological resources. The Act also deals with the protection of threatened or protected ecosystems and species and trade therein (Chapter 4). In terms of Section 52, the Minster may publish a national list of ecosystems that are threatened and in need of protection. In addition, the MEC for Environmental Affairs in a province may also publish a provincial list. The listed ecosystems must be classified according to the level of degradation of their ecological structure, function or composition. They may be: (a) critically endangered ecosystems; (b) endangered ecosystems; (c) vulnerable ecosystems; or (d) protected ecosystems.	▪ Ezemvelo KZN WIldlife
Protected Areas ▪ **World Heritage Convention Act (No 47 of 1999 National Environmental Management Protected Areas Act (No 57 of 2003)**	This Act provides for the implementation of the World Heritage Convention in SAIt applies to the uKhahlamba Drakensberg Park World Heritage Site located in the Newcastle & Pietermaritzburg FSAs. The objectives of the Act are: 3. The objectives of this Act are to (a) provide for (i) the cultural and environmental protection and sustainable development of, and related activities within, World Heritage Sites; and (ii) giving effect to the values of the Convention; Chapters 1 and 2 of the Protected Areas Act apply to world heritage sites. This ensures that in situations of conflict with other legislation, where the issue is the management or development of protected areas, the Protected Areas Act will prevail.	▪ Ezemvelo KZN Wildlife. ▪ Department of Environmental Affairs.

ENVIRONMENTAL COMPONENT & POLICY/ACT	RELEVANT CHAPTER/SECTION	RESPONSIBLE ORGAN OF STATE
	No development activities may take place within a World Heritage Site without the relevant permits and authorisation from the governing authority.	
▪ **National Environmental Management: Protected Areas Act 57 of 2003**	This Act provides for the protection and conservation of ecologically viable areas, representative of South Africa's biological diversity. This protection covers both our natural landscapes and our seascapes and includes even the exclusive economic zone and the continental shelf. It binds relevant to all organs of state. Areas that are protected under the Act are subject to certain restrictions. For instance, no development, construction or farming may be permitted in a "nature reserve" without the prior written approval of the management authority (Section 50(5)). Also, in a "protected environment", the Minister or the MEC may restrict or regulate development that may be inappropriate for the area given the purpose for which the area was declared; and the carrying out of other activities that may impede such purpose (Section 51).	▪ Department of Environmental Affairs ▪ Ezemvelo KZN Wildlife.
▪ **National Forests Act (No 84 of 1998)**	The purpose of this Act is inter alia to promote the sustainable management and development of forests for the benefit of all and to provide special measures for the protection of certain forests and trees. The Minister may set aside protected areas - in which no person may cut, disturb, damage or destroy any forest produce in or remove or receive any produce from a protected area except under licence (or exemption). Likewise, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, or any forest product derived from a protected tree except under a licence (or exemption) granted by the Minister (Sections 10 and 15).	▪ National Department of Agriculture, Forestry and Fisheries (DAFF) ▪ Ezemveko KZN WIldlife
CULTURAL		
Heritage Resources ▪ **KwaZulu-Natal Heritage Act 2008** ▪ **National Heritage Resources Act (No 25 of 1999) and National Heritage**	The KZN Heritage Act provides for the management of heritage resources in this province is with the objectives: – Identification; – Conservation; – Protection; and	▪ Amafa KwaZulu-Natali Heritage Council (Amafa) ▪ The South African Heritage Resources Agency (SAHRA) ▪ The National Heritage Council ▪ The National Monuments Council

ENVIRONMENTAL COMPONENT & POLICY/ACT	RELEVANT CHAPTER/SECTION	RESPONSIBLE ORGAN OF STATE
Council Act 1999 ▪ **National Monuments Act (No 28 of 1969)**	– Administration of the physical and the living or intangible heritage resources of the Province and, generally, with due regard to national and provincial heritage policy and programmes, to promote and coordinate heritage conservation for the benefit of present and future generations. Where the KZN Heritage Act does not regulate a matter pertaining to the protection or management of heritage resources, the provisions of the National Heritage Resources Act No 25 of 1999, and the National Heritage Council Act No 11 of 1999, apply. ▪ *Permits* No heritage resource (known or yet-to-be-identified) within the study area may be altered in any way without a permit from Amafa and / or SAHRA. This includes the erection of fences and interpretive signage; construction or removal of roads or tracks and paving, and so forth. ▪ *Graves* As is the case across most rural areas, people are usually buried outside of formal cemeteries and the identification of graves during development is consequently a commonplace issue. The National Heritage Resources Act prescribes that all graves older than 60 years that are not in formal cemeteries administered by a local authority (such as ancestral graves in rural areas) are defined as heritage objects and are protected. Section 3(b) of NHRA stipulates that: "No person may, without a permit issued by the South African Heritage Resources Agency (SAHRA) (or a provincial heritage resources authority): b) destroy, damage, alter, exhume or remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals." A permit is required from SAHRA if any graves or burial grounds over 60	

ENVIRONMENTAL COMPONENT & POLICY/ACT	RELEVANT CHAPTER/SECTION	RESPONSIBLE ORGAN OF STATE
	years old are to be damaged or disturbed. Graves or burial grounds younger than 60 years are protected in terms of the KwaZulu-Natal Graves and Crematoria Act No.12 of 1996. The Act clearly spells out the roles and responsibilities of local government structures. No grave may be exhumed, altered or moved without the permission of the Minister, or an approved "operator" (see: Definitions in the prelude to Act No.12 of 1996 - Appendix A).The National Heritage Council Act 1999 The National Heritage Council Act No 11 of 1999 was established to protect living heritage, defined as cultural tradition; oral history; performance; ritual; popular memory; skills and techniques; indigenous knowledge systems; and the holistic approach to nature, society and social relationships.	