Comprehensive Reserve Determination Study for Selected Water Resources (Rivers, Groundwater and Wetlands) in the INKOMATI WATER MANAGEMENT AREA, MPUMALANGA

PROJECT NO: WP 9133

Desktop Ecoclassifation Report

JULY 2008

REPORT NO.: 26/8/3/10/12/002

water & forestry
Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA

RfA06_2010

DEPARTMENT OF WATER AFFAIRS AND FORESTRY

CHIEF DIRECTORATE: RESOURCE DIRECTED MEASURES

COMPREHENSIVE RESERVE DETERMINATION STUDY FOR SELECTED WATER RESOURCES (RIVERS, GROUNDWATER AND WETLANDS) IN THE INKOMATI WATER MANAGEMENT AREA, MPUMALANGA.

SABIE AND CROCODILE SYSTEMS: DESKTOP ECOCLASSIFICATION REPORT: FINAL

Approved for WFA by:

.....
Delana Louw
Technical Project Manager

.....
Adhishri Singh
Administrative Project Manager

Approved for the Chief Directorate: Resource Directed Measures by:

.....
Barbara Weston
Study Manager

.....
Harrison Pienaar
Chief Director

Reports as part of this project:

Report no	Report title
26/8/3/10/12/001	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: Inception report
26/8/3/10/12/002	**Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: Desktop EcoClassification report**
26/8/3/10/12/003	Newsletters
26/8/3/10/12/004	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: Basic Human Needs Reserve report
26/8/3/10/12/005	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: Groundwater report
26/8/3/10/12/006	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: Resource Unit report
26/8/3/10/12/007	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: Desktop Estimation report
26/8/3/10/12/008	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: Wetland report
26/8/3/10/12/009	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: EcoClassification report
26/8/3/10/12/010	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: EWR scenario report
26/8/3/10/12/011	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: Operation scenarios and consequences report
26/8/3/10/12/012	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: EcoSpecs report
26/8/3/10/12/013	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: Socio Economic Present State Evaluation Report
26/8/3/10/12/014	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: Training audit and report
26/8/3/10/12/015	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: Main report
26/8/3/10/12/016	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: Electronic information and data
26/8/3/10/12/016	Comprehensive Reserve Determination Study for selected water resources in the Inkomati WMA, Mpumalanga: Electronic information and data

Bold indicates this report

REFERENCES

This report is to be referred in bibliographies as:

Department of Water Affairs and Forestry (DWAF), 2008. Comprehensive Reserve Determination Study for Selected Water Resources (Rivers, Groundwater and Wetlands) in the Inkomati Water Management Area, Mpumalanga. Sabie and Crocodile Systems: Desktop EcoClassification report. Report produced by Water for Africa. Authored by Louw D & Huggins G P. Report no: 26/8/3/10/12/002

ACKNOWLEDGEMENTS

The EcoQuat model used in this study was designed by RQS. Dr Kleynhans is especially thanked for his guidance, input and participation in the running of the EcoQuat model and the refinement of the EIS. Mr Mick Angliss and Stan Rodgers are thanked for the input and data they provided in populating the model.

The Socio-Cultural Importance model was designed during various projects and updated for these projects by Greg Huggins (Water for Africa)

The evaluation process to determine locality of hotspots, the evaluation matrices, and the presentation of results was developed and designed, prior to this project, by Delana Louw (Water for Africa).

The Water Resource Use Importance was conceptually designed by Toriso Tlou (previous projects) and refined by Delana Louw, Pieter van Rooyen (Water Resources Planning) and Stephen Mallory (Water for Africa).

The specialists from the Project Team involved in the 2005 study were:

- Ms Delana Louw (Water for Africa);
- Mr Greg Huggins (Water for Africa);
- Mr Toriso Tlou (Water for Africa);

The specialists from DWAF: RQS and Mpumalanga Parks Board involved in the 2005 study were:

- Dr CJ Kleynhans
- Ms Christa Thirion
- Dr Johan Engelbrecht
- Mr Francios Roux

EXECUTIVE SUMMARY

INTRODUCTION

The CD:RDM identified the Inkomati Water Management Area (WMA) as requiring a comprehensive Reserve assessment in light of the initiation of the Compulsory Licensing Process in the WMA and the proposed Montrose and Mountain View Dams. These studies require higher levels of confidence in the Reserve determination results as is currently available in certain of the catchments, such as the Sabie-Sand and Crocodile River catchments. This will assist the DWAF to make informed decisions regarding the authorisation of future water use and the magnitude of the impacts of the present and proposed developments.

This report provides the outcomes of the following study:
A Desktop assessment per quaternary catchment of the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS) and Socio-cultural Importance (SCI) as part of the EcoClassification process.

The PES and EIS assessment was undertaken during a previous study (Louw and Singh, 2006). This report is therefore a refinement of the previous assessment which did not include the SCI. The final results of the previous study will be adjusted where necessary. Evaluations are provided on a quaternary scale with the degree of confidence in the evaluations attached to each quaternary.

SOCIO-CULTURAL IMPORTANCE

The Socio Cultural Importance (SCI) was determined from
(a) a site visit that covered points along the river,
(b) extrapolation to sites not visited by reference to available literature as well as to exiting mapping. Given the size of the budget and the geographical scope of the work most of the information used to influence the score was derived from direct observation and consideration of the literature available. A limited number of direct interviews were held with people who are resident proximate to the river.

The SCI was generated by scoring each quaternary, based on the following features:

- Ritual Use (e.g., ceremonial purposes, spiritual/religious activities.).
- Aesthetic Value.
- Resource Dependence (it refers to the goods and services delivered by the river system and peoples dependence on these components).
- Recreational Use.
- Historical/Cultural Value (e.g., Fugitives Drift on the Buffalo or components of the Mzimvubu that have played a central role in Xhosa cultural history).

- Scores were then modified to reflect the adjudged importance of each component relative to the other. The final scores were then combined to generate an overall score between 0 and 5.

The SCI examination of the Sabie and Crocodile systems reveals that there are certain quaternary catchments that score in the “high” and “very high” importance category. To some extent this is a geographical accident in that you have quaternaries that cover both the Kruger Park area as well as some of the former homeland areas. As such they score high in both the aesthetic recreation value (Kruger Park) and the ritual, resource use components as well (subsistence areas). Despite the geographical coincidence it is evident that many of the quaternary areas and associated resource components are highly important in terms of the SCI and as such arguments for improving or at least maintaining the PES are probably well founded.

RECOMMENDATIONS

An evaluation has been undertaken comparing areas of Integrated Importance which consists of Ecological, Socio-Cultural Importance and Present Ecological State, with an importance evaluation of Water Resource Use. Quaternary catchment of a 3 or 4 priority rating would require EWRs of reasonably high confidence and detailed studies are recommended. The high priority areas are illustrated in the maps below and described as follows:.

In the Crocodile system the ‘hotspots’ (red areas) are located in:

- The KNP due to the Very High EIS and SCI as well as the role the river plays to provide international requirements and other users.
- The area downstream of Kwena Dam and the Elands River due to the High and Very high EIS as well as its Water Resource Use importance.

In the Sabie system the hotspots (red areas) are located in:

- The KNP and conservation areas due to the Very High EIS and SCI
- The Sabie River outside the KNP due to the high EIS.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

TERMINOLOGY AND ACRONYMS

BBM	Building Block Methodology
CD: RDM	Chief Directorate: Resource Directed Measures
CMA	Catchment Management Agency
D:RQS	Directorate: Resource Quality Services
DRIFT	Downstream Response to Imposed Flow Transformation
DTM	Digital Terrain Model
DWAF	Department of Water Affairs and Forestry
EC	Ecological Category
EcoSpecs	Ecological Specifications
EIS	Ecological Importance and Sensitivity
EPA	Environmental Protection Agency
EWR	Ecological Water Requirements
FRAI	Fish Response Assessment Index
GAI	Geomorphological Driver Assessment Index
GDP	Gross Domestic Product
GIS	Geographic Information System
GGP	Gross Geographic Product
HAI	Hydrological Driver Assessment Index
HFSR	Habitat Flow Stressor Response
IFR	Instream Flow Requirements
IHI	Index of Habitat Integrity
MAP	Mean Annual Precipitation
MIRAI	Macroinvertebrate Response Assessment Index
MRU	Natural Resource Units
NGO	Non Governmental Organization
NWA	National Water Act
NWRS	National Water Resource Strategy
PAI	Physico Chemical Driver Assessment Index
PES	Present Ecological State
PMT	Project Management Team
PSP	Professional Service Provider
REC	Recommended Ecological Category
RQO	Resource Quality Objectives
RU	Resource Unit
SANBI	South African National Biodiversity Institute
SCI	Socio Cultural Importance
SPATSIM	Spatial and Time Series Information Modelling
ToR	Terms of Reference
TPC	Threshold of Potential Concern
VEGRAI	Riparian Vegetation Response Assessment Index
WHI	Wetland Health Index
WMA	Water Management Area
WRYM	Water Resource Yield Model

1 INTRODUCTION

1.1 BACKGROUND

The National Water Act (NWA, Act No. 36 of 1998, Section 3) requires that the Reserve be determined for rivers, i.e. the quantity, quality and reliability of water needed to sustain both human use and aquatic ecosystems, so as to meet the requirements for economic development without seriously impacting on the long-term integrity of ecosystems. It is therefore imperative that the Reserve be determined and requirements met before other economic activities can be satisfied. As the Department of Water Affairs and Forestry (DWAF) is the custodian of the nation's water resources, it is their responsibility to ensure the adequate protection and effective management of these resources. The Chief Directorate: Resources Directed Measures (CD:RDM) of DWAF is tasked with the responsibility of ensuring that Reserve assessments take place before licensing can proceed.

The CD:RDM identified the Inkomati Water Management Area (WMA) as requiring a comprehensive Reserve assessment in light of the initiation of the Compulsory Licensing Process in the WMA and the proposed Montrose and Mountain View Dams. These studies require higher levels of confidence in the Reserve determination results as is currently available in certain of the catchments, such as the Sabie-Sand and Crocodile River catchments. This will assist the DWAF to make informed decisions regarding the authorisation of future water use and the magnitude of the impacts of the present and proposed developments.

1.2 STUDY AREA

The study area for the Reserve determination is the Inkomati system as represented by WMA 5.

The Inkomati WMA is largely located within the Mpumulanga Province. It can be considered to consist of three largely independent catchments, the Komati, Crocodile (East) and Sabie–Sand River catchments. All these rivers drain the WMA and confluence to form the Inkomati River in Mozambique which flows into the Indian Ocean.

Topographically the WMA is divided by the Great Escarpment (which runs roughly along the Graskop, Sabie, Nelspruit, Barberton axis) into a western plateau and sub-tropical Lowveld in the East. Rainfall varies from over 1200mm per annum in the mountains and the plateau in the west to as low as 400mm per annum in the lower eastern part of the WMA.

The focus of this study is the Crocodile (East) and Sabie-Sand River catchments. The Elands River and the Komati system has been addressed during previous studies (Hill, 2004), (Afridev, 2006)

1.3 PURPOSE OF THIS REPORT

This report provides the outcomes of the following study:
A desktop assessment per quaternary catchment of the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS) and Socio-cultural Importance (SCI) as part of the EcoClassification process.

This assessment was undertaken during a previous study (Louw and Singh, 2006). This report is therefore a refinement of the previous assessment which did not include the SCI. The final results of the previous study will therefore be adjusted where necessary.

Evaluations are provided on a quaternary scale with the degree of confidence in the evaluations attached to each quaternary. The PES and EIS information as generated during the Louw and Singh, 2006, study is provided as Appendix B.

2 SOCIO-CULTURAL IMPORTANCE

The SCI was developed by Greg Huggins and refined (current format) for recent projects.

2.1 SCI OVERVIEW

The Socio Cultural Importance (SCI) was determined from (a) a site visit that covered points long the river, (b) extrapolation to sites not visited by reference to available literature as well as to exiting mapping. The full results are given in Appendix B. A brief overview is however presented below.

2.2 SCI MODEL

The Socio Cultural Importance (SCI) was determined from (a) a site visit that covered points along the river, (b) extrapolation to sites not visited by reference to available literature as well as to exiting mapping. Given the size of the budget and the geographical scope of the work most of the information used to influence the score was derived from direct observation and consideration of the literature available. A limited number of direct interviews were held with people who are resident proximate to the river.

The SCI was generated by scoring each quaternary catchment based on the following features:
Ritual Use: This was scored between 0 -5. The question that was asked was “How much ritual use of the river takes place?” Typically this would be for ceremonial purposes or for spiritual/religious activities. An example would be pools used for traditional initiation purposes. Both intensity and significance of use are valued and the higher of the two scores is adopted. Intensity relates to the number of people likely to make use of the river for ritual use and significance relates to the degree to which the river is of critical importance to people.
Aesthetic Value: This was scored between 0 -5. The question that was asked was “How important is the aesthetic value to people? Does the river stretch add value to people lives as an object of natural beauty? Would changing flows detract from this value?.” Both intensity and significance of appreciation are valued and the higher of the two scores is adopted. Intensity relates to the number of people likely to view the river and appreciate its aesthetic value and significance relates to the degree to which the river is of critical aesthetic importance to people.
Resource Dependence: This was scored between 0 -5. This refers to the goods and services delivered by the river system and peoples dependence on these components. This is usually a critical element of the SCI score and is designed to cater for river resource dependence by those who rely directly on such aspects for their survival. It should be noted that commercial or “for financial gain” usage of resources is excluded from consideration in this instance. Both intensity and significance of use are valued and the higher of the two scores is adopted. Intensity relates to the number of people likely to make use of the river for resource importance and significance relates to the degree to which the river is of critical importance to people. A sustainability modifier is allowed for.
Recreational Use: This was scored between 0 -5. The question that was asked was “Does the river stretch provide recreational facilities to people and would this be affected by changing flows”. . Both intensity and significance of use are valued and the higher of the two scores is adopted. Intensity relates to the number of people likely to make use of the river for recreational purposes and significance relates to the degree to which the river is of critical importance to people.
Historical/Cultural Value: This was scored between 0 -5. The question that was asked was “Does the river have a strong cultural or historical value?” Examples would be Fugitives drift on the

Buffalo or components of the Mzimvubu that have played a central role in Xhosa cultural history. Both intensity and significance of use are valued and the higher of the two scores is adopted. Intensity relates to the number of people likely to appreciate the river for its historical or cultural significance and significance relates to the degree to which the river is of critical importance to people

Scores were then modified to reflect the adjudged importance of each component relative to the other. In the model the following mechanism for arriving at the final score has been adopted.

- All five SCI categories are scored but the category scoring lowest is ignored. This ensures that an SCI score is not penalized for a category that is not relevant to the catchment or resource section under consideration.
- Among the four remaining categories the highest score is counted a second time.
- The double counted category is modified (in its second enumeration) with that reflects the importance of the most important category with that of the least important category. In the Mokolo model a modifier of 0.75 was used. This allows the adjudication process to make an assessment (even if subjective) of how critical the overall SCI of the resource is and weight the score.

By way of example.

- Where the SCI categories scored as follows (prior to modification); (a) Ritual Use = 2, Aesthetic = 2, Resource Dependence = 0, Recreational use = 3, Historical/Cultural Value = 4, Total = 11.
- After modification the score would be: (a) Ritual Use = 2, Aesthetic = 2, Resource Dependence = ignored, Recreational use = 3, Historical/Cultural Value = 4, Historical/Cultural Value recounted with factor of .75 = 3, Total = 14.

The final scores were then combined to generate an overall score between 0 and 5. The meaning of the score is as set out in Table 2.1 below.

Table 2.1 SCI rating

0-0.99	Minimal	Of little or no socio-cultural importance.
1-1.99	Low	Of some importance. PES not critical, but caution should be displayed with regard to negative impact on dependant communities.
2-2.99	Moderate	Of moderate importance. PES should not be allowed to be negative affected without strong motivation.
3-3.99	High	Of high importance. A score in this range motivates for maintain or potentially positive change to PES.
4-5	Very High	Of extreme importance. A score in this range motivates for +ve change to PES

2.3 SCI RESULTS

The model is provided in the electronic database on the worksheet labelled *SCI*.

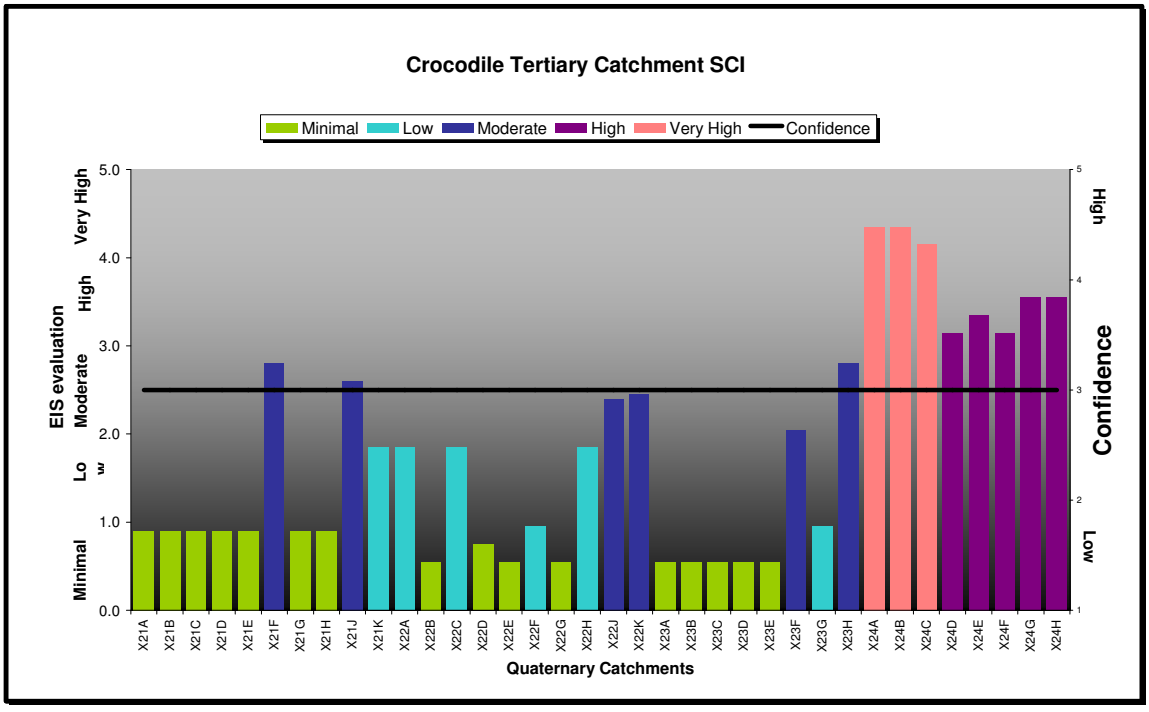
The results are provided as follows:

- SCI per quaternary catchment (Table 2.2).
- Bar graphs (Figure 2.1).
- Catchment maps (Figure 2.2 and Figure 2.3)

Table 2.2 SCI results

QUATERNARY CATCHMENT	RIVER	SCI	CONFIDENCE (0-5)
CROCODILE			
X21A	Crocodile	0.9	3
X21B	Crocodile	0.9	3
X21C	Alexanderspruit	0.9	3
X21D	Crocodile	0.9	3
X21E	Crocodile	0.9	3
X21F	Elands	2.8	3
X21G	Elands	0.9	3
X21H	Ngodwana	0.9	3
X21J	Elands	2.6	3
X21K	Elands	1.9	3
X22A	Houtbosloop	1.9	3
X22B	Crocodile	0.6	3
X22C	Crocodile	1.9	3
X22D	Nels River	0.8	3
X22E	Sand	0.6	3
X22F	Nels River	1.0	3
X22G	Wit River	0.6	3
X22H	Nels River	1.9	3
X22J	Crocodile	2.4	3
X22K	Crocodile	2.5	3
X23A	Noord Kaap	0.6	3
X23B	Noord Kaap	0.6	3
X23C	Queens	0.6	3
X23D	Queens	0.6	3
X23E	Suid Kaap	0.6	3
X23F	Suid Kaap	2.1	3
X23G	Kaap	1.0	3
X23H	Kaap	2.8	3
X24A	Nsikaze	4.4	3
X24B	Nsikaze	4.4	3
X24C	Crocodile	4.2	3
X24D	Crocodile	3.2	3
X24E	Crocodile: Malelane to Hectorspruit	3.4	3
X24F	Crocodile	3.2	3
X24G	Mbyaniti	3.6	3
X24H	Crocodile	3.6	3
SABIE - SAND			
X31A	Sabie	2.3	3
X31B	Sabie	0.9	3
X31C	Mac Mac	0.6	3
X31D	Sabie	2.1	3
X31E	Marite	2.5	3
X31F	Motitsi	0.6	3
X31G	Sabie	2.1	3

QUATERNARY CATCHMENT	RIVER	SCI	CONFIDENCE (0-5)
X31H	Whitewaters	0.6	3
X31J	Noord Sand	2.3	3
X31K	Sabie	4.4	3
X31L	Saringwa	2.8	3
X31M	Sabie	4.2	3
X32A	Groot Sand	3.0	3
X32B	Klein Sand	3.0	3
X32C	Sand	3.2	3
X32D	Mutlumuvi	3.2	3
X32E	Nwarehle	3.2	3
X32F	Mutlumuvi	3.2	3
X32G	Sand	4.0	3
X32H	Sand	4.4	3
X32J	Sand	3.6	3
X33A	Sabie	3.6	3
X33B	Sabie	3.6	3
X33C	Mlondolozi	3.6	3
X33D	Sabie	3.6	3
X40A	Sweni	3.6	3
X40B	Nwanetsi	3.6	3
X40C	Nwasitsontso	4.0	3
X40D	Nwasitsontso	3.6	3



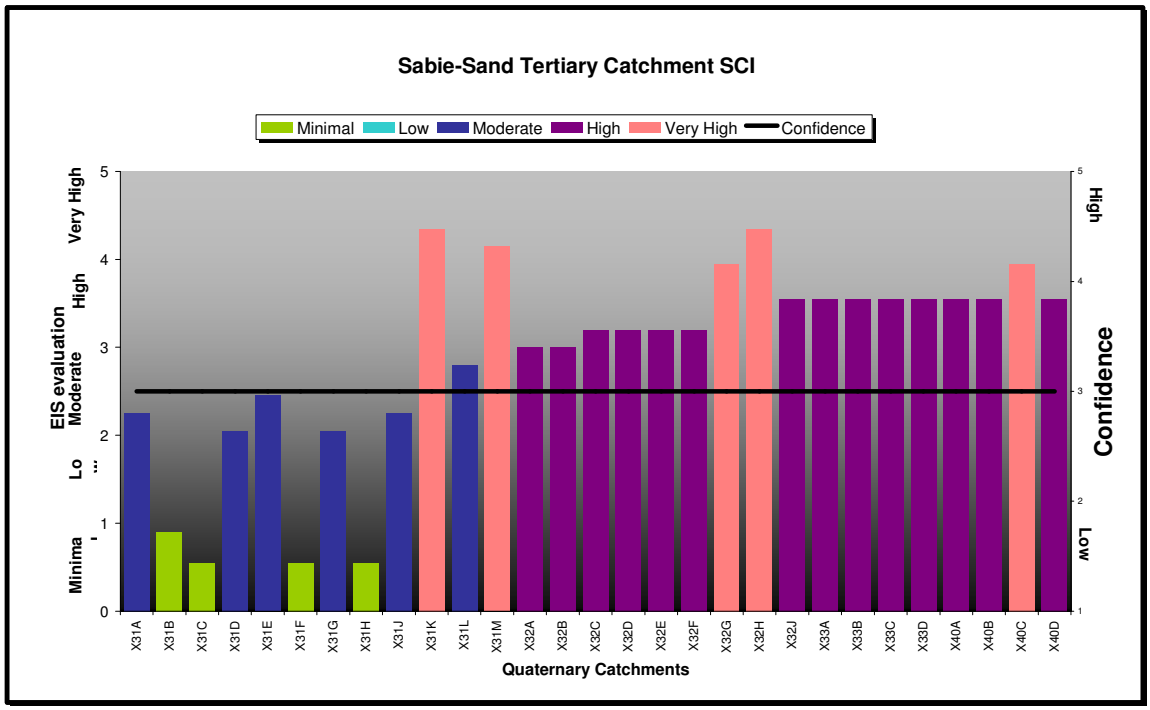


Figure 2-1 SCI and confidence evaluation illustrated as bar graphs

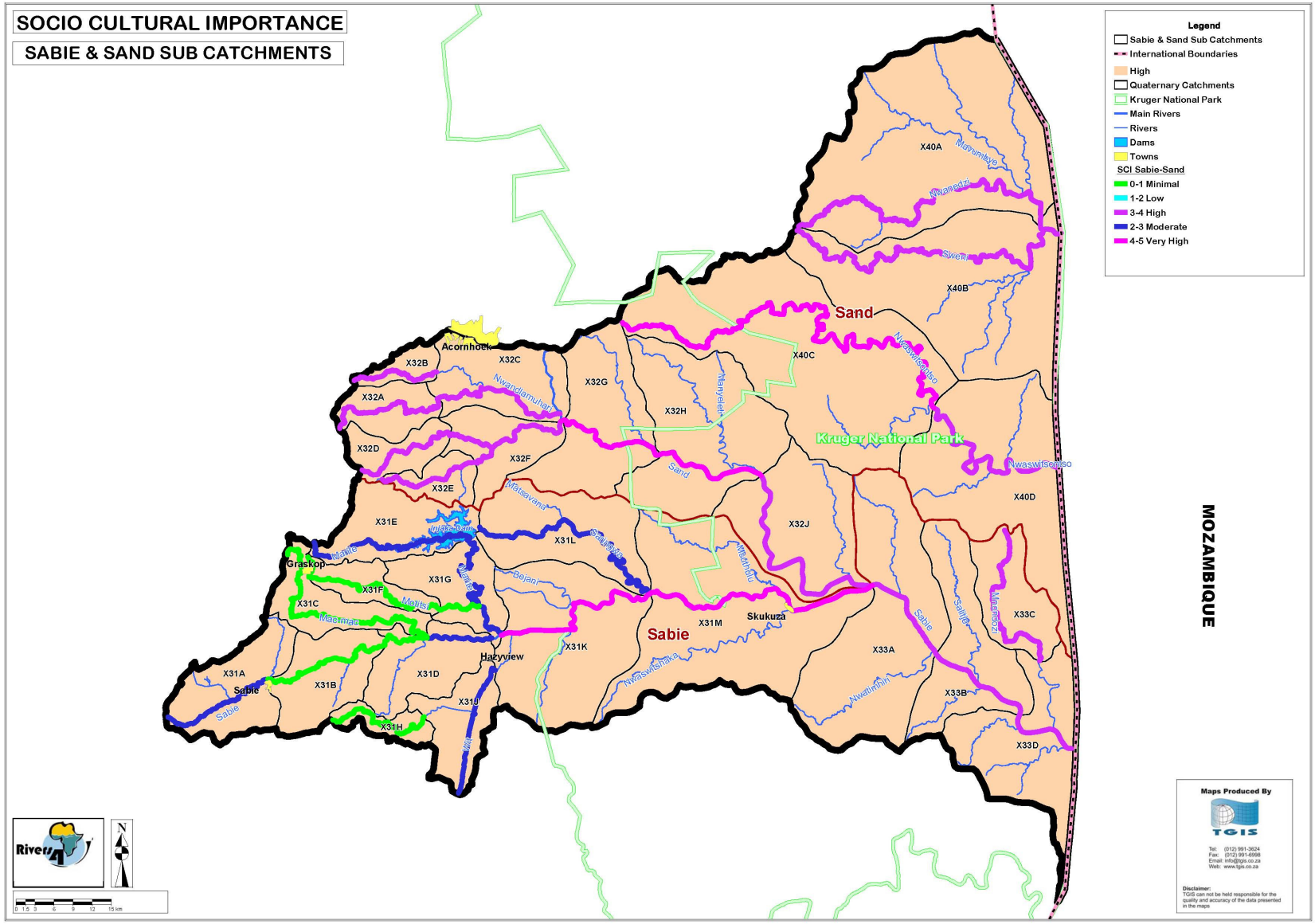


Figure 2-2 Sabie & Sand Sub-catchment: SCI map illustrating SCI rating and confidence

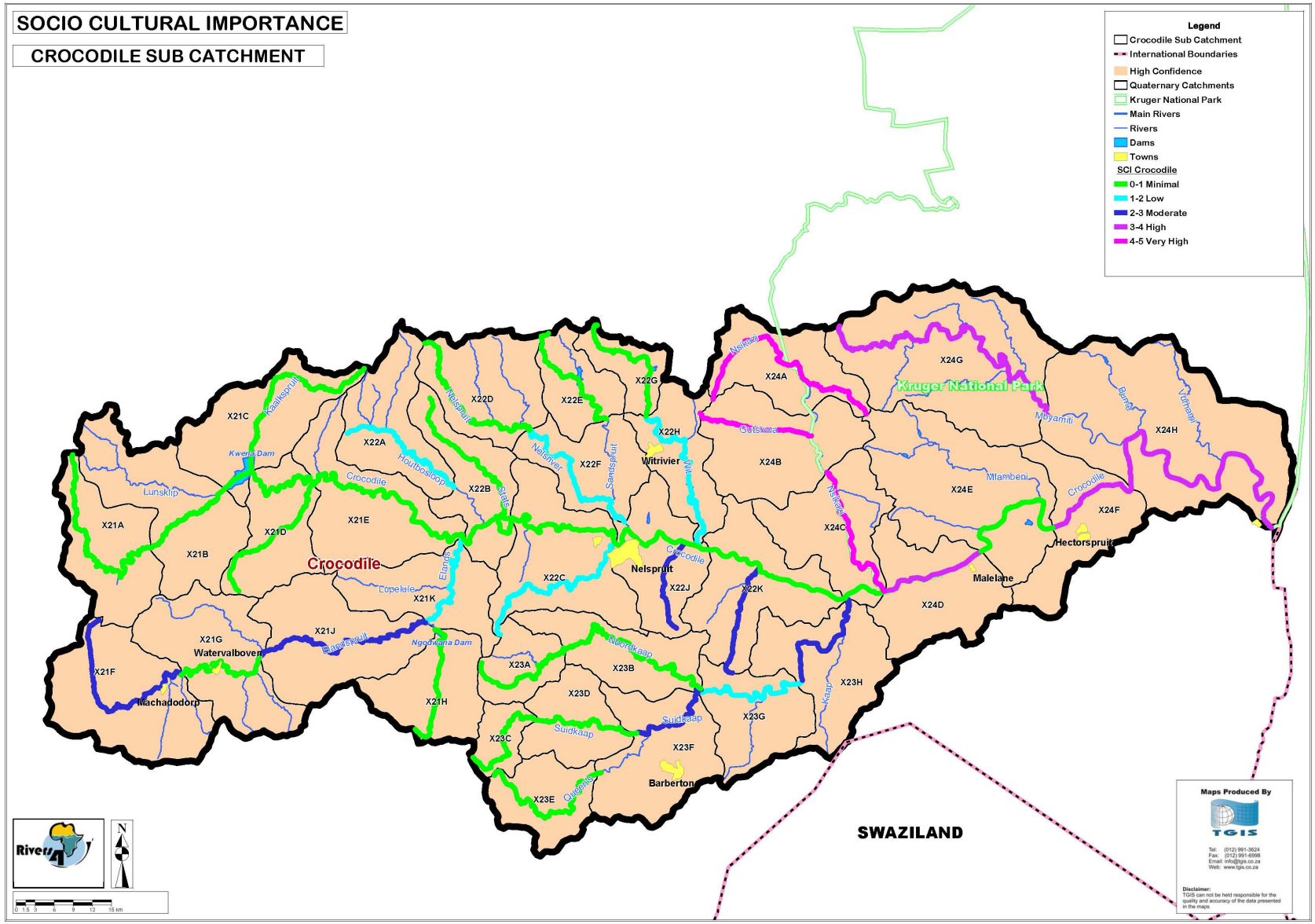


Figure 2-3 Crocodile Sub-catchment: SCI map illustrating SCI rating and confidence

2.4 CONCLUSIONS

The SCI examination of the Sabie and Crocodile systems reveals that there are certain quaternary catchments that score in the “high” and “very high” importance category. To some extent this is a geographical accident in that you have quaternaries that cover both the Kruger Park area as well as some of the former homeland areas. As such they score high in both the aesthetic recreation value (Kruger Park) and the ritual, resource use components as well (subsistence areas). Despite the geographical coincidence it is evident that many of the quaternary areas and associated resource components are highly important in terms of the SCI and as such arguments for improving or at least maintaining the PES are probably well founded.

3 CONCLUSIONS

Recommendations have been made using two matrices (Louw & Huggins, 2007) to provide consistent answers.

3.1 INTEGRATED (ECOLOGICAL AND SOCIO-CULTURAL) IMPORTANCE

The first matrix illustrates a combination of EIS, SCI, and PES, to provide an indication of overall / integrated importance with the emphasis on the restoration potential. The restoration potential refers to the probability of achieving the rehabilitation of the river to an improved state. For example, if a river has very high overall importance, but is in bad condition, the restoration potential is often low.

However, rivers in good condition are scarce, and therefore important in their own right. A river that is in very good condition, but of low EIS, and/or SCI; might still be important from an ecological perspective, as it could be one of a limited number of that type of river that is still in good condition.

According to the matrix (note, the curves have not been fitted, but have been 'hand drawn'), an Integrated Importance value is estimated from 1 (low importance, to 4 high importance).

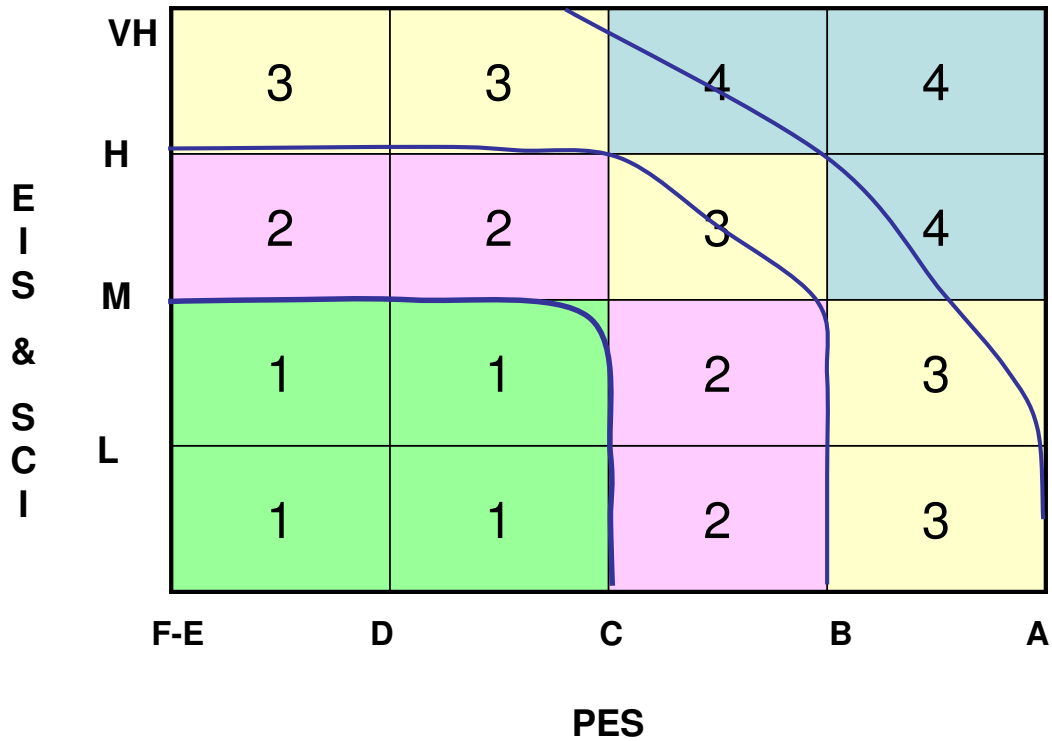


Figure 3-1 Matrix used to determine a combined EIS and PES value which provides an Integrated Importance value on a scale of 0 – 4 (modified from Louw & Huggins, 2007)

The results of the evaluation are listed in the Table 3.1 and illustrated in Figure 3.2 and Figure 3.3. This depicts the areas of Integrated Importance for the rivers assessed on a spatial scale.

Table 3.1 Integrated importance of the river reaches assessed

(Orange lines indicate where the importance rating changed due to the SCI results now incorporated in this analysis)

Quaternary Catchment	River	EIS	SCI	PES	Importance Rating (0 – 4)
CROCODILE					
X21A	Crocodile	VERY HIGH	MINIMAL	B	4
X21B	Crocodile	HIGH	MINIMAL	B	4
X21C	Alexanderspruit	HIGH	MINIMAL	B/C	4
X21D	Crocodile	HIGH	MINIMAL	B/C	3
X21E	Crocodile	HIGH	MINIMAL	B/C	3
X21F	Elands	MODERATE	MODERATE	B	3
X21G	Elands	HIGH	MINIMAL	B	4
X21H	Ngodwana	HIGH	MINIMAL	B	4
X21J	Elands	HIGH	MODERATE	B	4
X21K	Elands	HIGH	LOW	B	4
X22A	Houtbosloop	HIGH	LOW	B	4
X22B	Crocodile	HIGH	MINIMAL	B/C	3
X22C	Crocodile	MODERATE	LOW	C	2
X22D	Nels River	MODERATE	MINIMAL	B	3
X22E	Sand	LOW/MARGINAL	MINIMAL	D	1
X22F	Nels River	HIGH	LOW	C	3
X22G	Wit River	LOW/MARGINAL	MINIMAL	C	1
X22H	Nels River	MODERATE	LOW	C	2
X22J	Crocodile	HIGH	MODERATE	D	2
X22K	Crocodile	HIGH	MODERATE	C	3
X23A	Noord Kaap	MODERATE	MINIMAL	B/C	2
X23B	Noord Kaap	HIGH	MINIMAL	C	3
X23C	Queens	HIGH	MINIMAL	B/C	3
X23D	Queens	MODERATE	MINIMAL	C	2
X23E	Suid Kaap	HIGH	MINIMAL	B/C	3
X23F	Suid Kaap	HIGH	MODERATE	C	3
X23G	Kaap	MODERATE	LOW	C	2
X23H	Kaap	MODERATE	MODERATE	C/D	2
X24A	Nsikaze	LOW/MARGINAL	VERY HIGH	D	3
X24B	Nsikaze	LOW/MARGINAL	VERY HIGH	D	3
X24C	Crocodile	HIGH	VERY HIGH	C	4
X24D	Crocodile	HIGH	HIGH	C	3
X24E	Crocodile: Malelane to Hectorspruit	HIGH	HIGH	C	3
X24F	Crocodile	HIGH	HIGH	C	3
X24G	Mbyaniti	LOW/MARGINAL	HIGH	A/B	4

Quaternary Catchment	River	EIS	SCI	PES	Importance Rating (0 – 4)
X24H	Crocodile	VERY HIGH	HIGH	C	4
SABIE-SAND					
X31A	Sabie	HIGH	MODERATE	B	4
X31B	Sabie	HIGH	MINIMAL	B	4
X31C	Mac Mac	VERY HIGH	MINIMAL	A/B	4
X31D	Sabie	HIGH	MODERATE	B	4
X31E	Marite	HIGH	MODERATE	C	3
X31F	Motitsi	HIGH	MINIMAL	B	4
X31G	Sabie	HIGH	MODERATE	B	4
X31H	Whitewaters	MODERATE	MINIMAL	C	2
X31J	Noord Sand	MODERATE	MODERATE	C/D	2
X31K	Sabie	VERY HIGH	VERY HIGH	C	4
X31L	Saringwa	LOW/MARGINAL	MODERATE	E	1
X31M	Sabie	VERY HIGH	VERY HIGH	B/C	3
X32A	Groot Sand	HIGH	HIGH	C	3
X32B	Klein Sand	HIGH	HIGH	B	4
X32C	Sand	MODERATE	HIGH	C	3
X32D	Mutlumuvi	HIGH	HIGH	C	3
X32E	Nwarehle	HIGH	HIGH	C	3
X32F	Mutlumuvi	MODERATE	HIGH	C	3
X32G	Sand	MODERATE	VERY HIGH	C	4
X32H	Sand	VERY HIGH	VERY HIGH	B	4
X32J	Sand	HIGH	HIGH	B	4
X33A	Sabie	VERY HIGH	HIGH	A/B	4
X33B	Sabie	VERY HIGH	HIGH	A/B	4
X33C	Mlondolozi	LOW/MARGINAL	HIGH	A	4
X33D	Sabie	VERY HIGH	HIGH	A/B	4
X40A	Sweni	MODERATE	HIGH	A	4
X40B	Nwanetsi	MODERATE	HIGH	A	4
X40C	Nwasitsontso	MODERATE	VERY HIGH	A	4
X40D	Nwasitsontso	MODERATE	HIGH	A	4

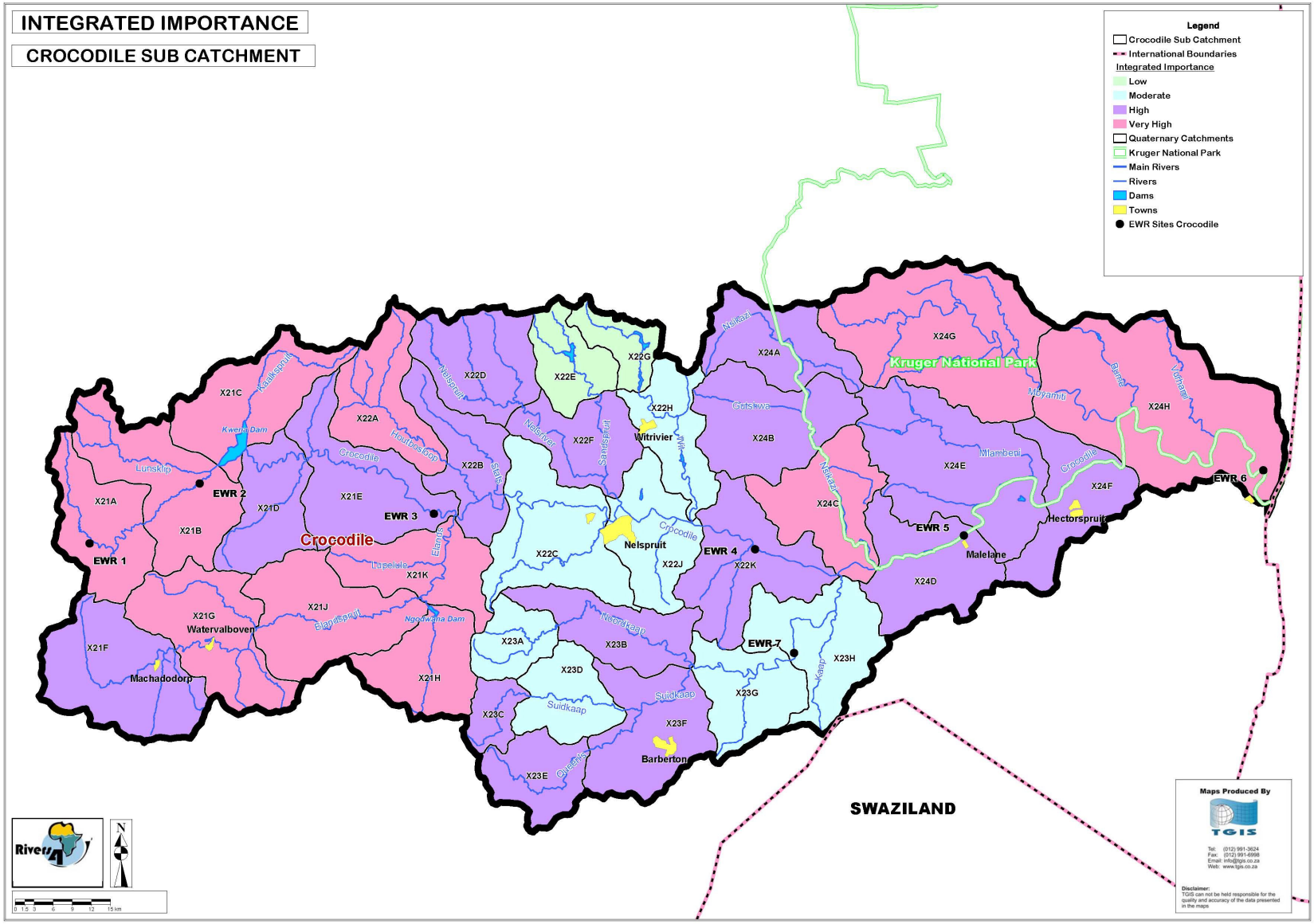


Figure 3-2 Crocodile Sub-catchment: Map illustrating areas of high Integrated Importance

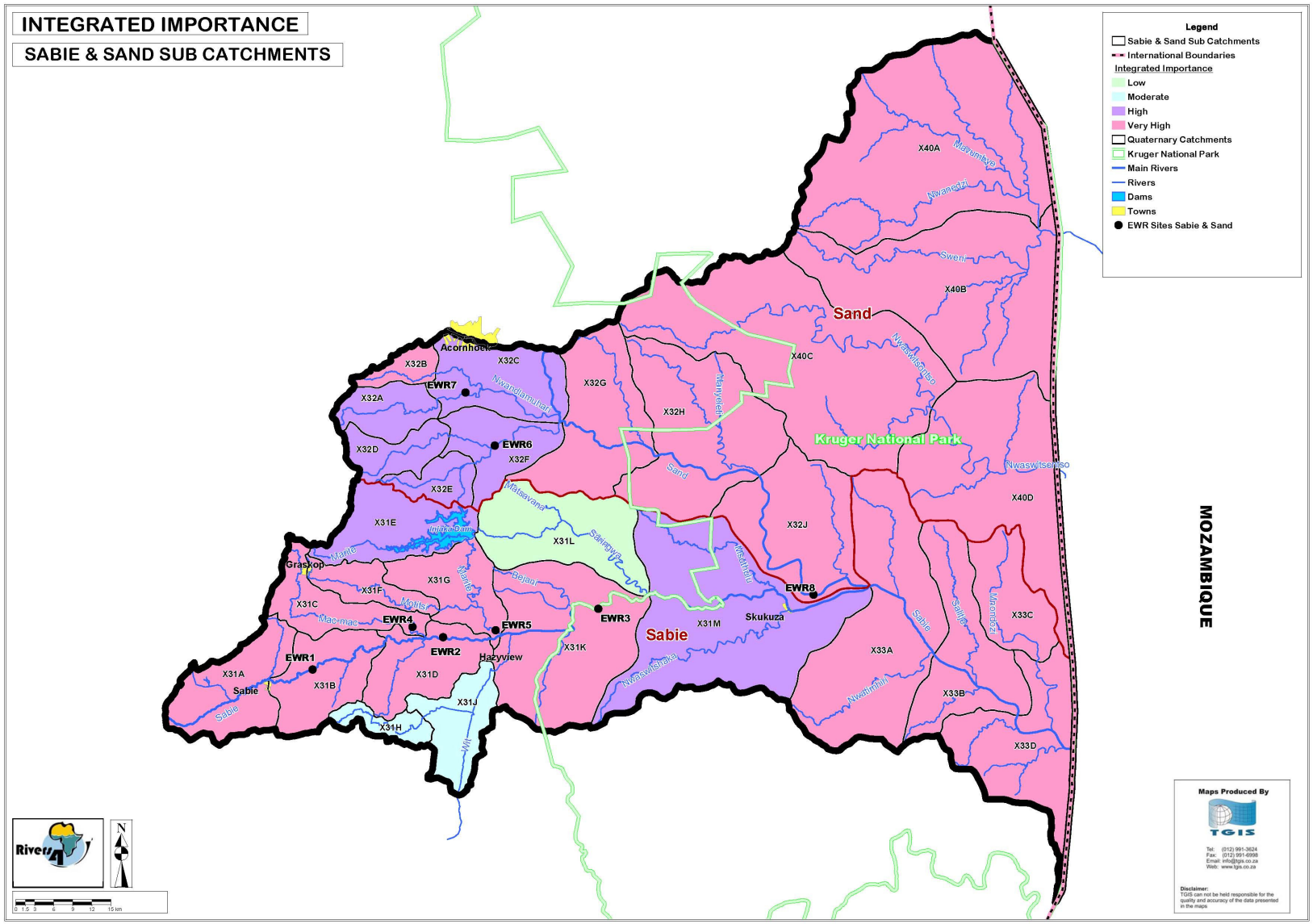


Figure 3-3 Sabie & Sand Sub-catchment: Map illustrating areas of high Integrated Importance

3.2 RECOMMENDATIONS

The second matrix has two axes (Figure 3.4). The X-axis is based on the Integrated Importance value derived from the first matrix Table 3.1 and results illustrated in). The Y-axis depicts an estimate of water resource use (DWAF, 2007), with a 0 being of no importance and 4 being of very high importance (VERY HIGH).

This second matrix was used to identify quaternary catchments which are so called 'hotspots'. A biodiversity/ecological hotspot is a biogeographic region which is a significant reservoir of biodiversity which is threatened with destruction (http://en.wikipedia.org/wiki/Biodiversity_hotspot). In the context used in the Desktop EcoClassification, the hotspot represents a quaternary catchment with a high Integrated Importance which could be under threat due to its importance for water resource use. These hotspots indicate areas where Reserve assessments should ideally result in high confidence recommendations. This then guides the initial estimate of the level of the assessments required, and indicates areas where detailed investigations would be required if development was being considered. It must be noted that a detailed Reserve assessment does not necessarily provide high confidence results. This is usually due to constraints such as lack of available data (hydrology, biota etc).

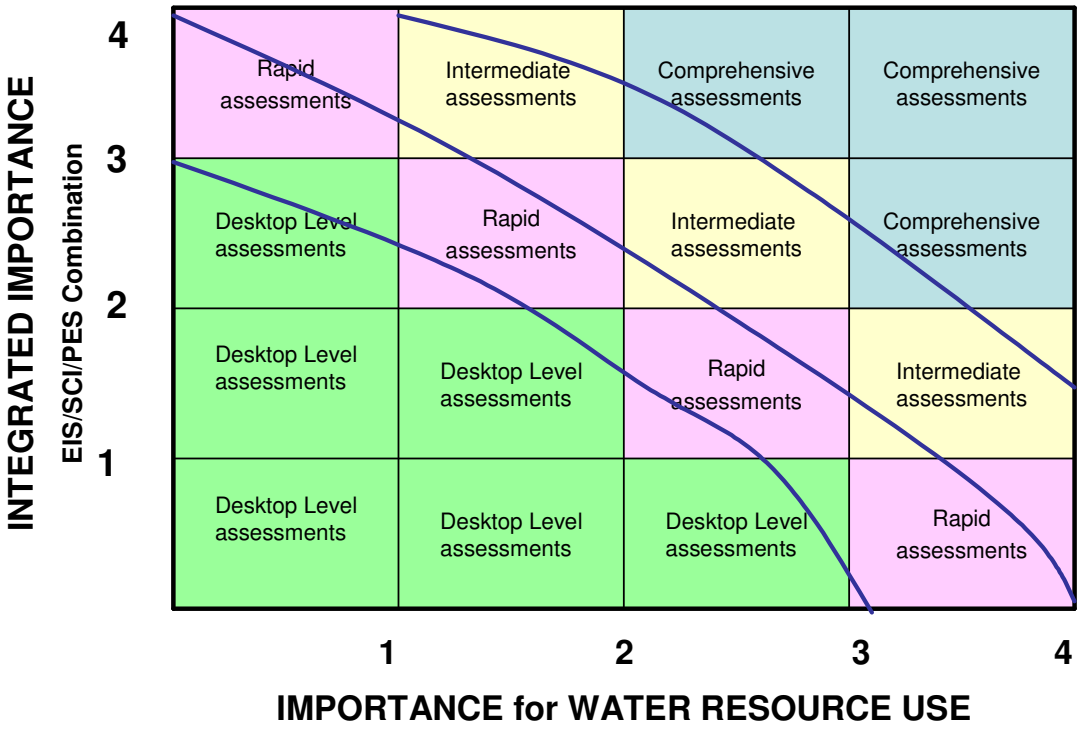


Figure 3-4 Matrix indicating the level of EWR assessments required (modified from Louw & Huggins, 2007)

3.2.1 Importance of Water Resource Use

The priority rating method consists of assigning a qualitative score to a river reach for four variables or factors that represent the status of the instream flow. The scores of the four variables are combined to determine (qualitatively) an overall score which represents the importance of the river reach in terms of the water resource use and guides decision making with regard to what level of assessment is needed. (DWAF, 2007). This process was however not yet formulated during the

2005 study where such an assessment was undertaken for the first time and on a more subjective basis. The evaluation was largely based on the percentage yield that has been allocated, and in some cases, over-allocated. Only areas with a 3 or 4 Water Resource Use importance rating was assessed and measured against integrated importance. The assumption is therefore that any other quaternaries not previously evaluated would be a 1 – 2 WRU importance.

3.2.2 Determine level of EWR

The matrix was used to compare the Integrated importance with the Water Resource Use importance (Louw & Huggins, 2007) and the results are provided in Table 3.2 and Fig 3.5 and Fig 3.6.

Table 3.2 Quaternary catchments of high Integrated Importance and/or high Water Resource Use Importance

(Orange lines indicate where the importance rating changed due to the SCI results now incorporated in this analysis. This implies that the priority rating could change)

Quaternary Catchment	River	Integrated Importance Rating (0 – 4)	Water Resource Use Rating (WRU)	Recommendations PRIORITY RATING	Reasons for Evaluation
CROCODILE					
X21A	Crocodile	4	1-2	3	Very High integrated importance
X21B	Crocodile	4	2-3	4	Very High integrated importance
X21C	Alexanderspruit	4	2-3	3	Very High integrated importance
X21D	Crocodile	3	3-4	4	High integrated importance and High WRU
X21E	Crocodile	3	3-4	4	High integrated importance and High WRU
X21F	Elands	3	1	2	High integrated importance but Low WRU
X21G	Elands	4	2-3	4	Very High integrated importance
X21H	Ngodwana	4	1	2	Very High integrated importance but Low WRU
X21J	Elands	4	2-3	4	Very High integrated importance
X21K	Elands	4	2-3	4	Very High integrated importance
X22A	Houtbosloop	4	1-2	3	Very High integrated importance but Low WRU
X22B	Crocodile	3	2-3	3	High integrated importance and High WRU
X22C	Crocodile	2	4	3	Very High WRU
X22D	Nels River	3	1-2	2	High integrated importance but Low WRU
X22E	Sand	1	1-2	1	Low integrated importance and WRU
X22F	Nels River	3	2	3	High integrated importance
X22G	Wit River	1	4	2	Very High WRU but Low integrated importance
X22H	Nels River	2	1-2	2	Moderate integrated importance and WRU

Quaternary Catchment	River	Integrated Importance Rating (0 – 4)	Water Resource Use Rating (WRU)	Recommendations PRIORITY RATING	Reasons for Evaluation
X22J	Crocodile	2	4	3	Very High WRU and Moderate integrated importance
X22K	Crocodile	3	4	4	High integrated importance and High WRU
X23A	Noord Kaap	2	1-2	2	Moderate integrated importance and WRU
X23B	Noord Kaap	3	1-2	3	High integrated importance and Low WRU
X23C	Queens	3	0-1	1	High integrated importance and Low WRU
X23D	Queens	2	1-2	2	Moderate integrated importance and WRU
X23E	Suid Kaap	3	1-2	3	High integrated importance and WRU
X23F	Suid Kaap	3	3-4	4	High integrated importance and High WRU
X23G	Kaap	2	1-2	2	Moderate integrated importance and WRU
X23H	Kaap	2	1-2	2	Moderate integrated importance and WRU
X24A	Nsikaze	3	1-2	3	High integration importance and Low to Moderate WRU
X24B	Nsikaze	3	1-2	3	High integration importance and Low to Moderate WRU
X24C	Crocodile	4	4	4	Very High integrated importance and Very High WRU
X24D	Crocodile	3	4	4	High integrated importance and Very High WRU
X24E	Crocodile: Malelane to Hectorspruit	3	4	4	High integrated importance and High WRU
X24F	Crocodile	3	4	4	High integrated importance and High WRU
X24G	Mbyaniti	4	0	0	In the KNP so does not require priority rating for EWR assessment
X24H	Crocodile	4	4	4	Very High integrated importance and Very High WRU
SABIE-SAND					
X31A	Sabie	4	1	3	Very High integrated importance and Low WRU
X31B	Sabie	4	1	3	Very High integrated importance and Low WRU
X31C	Mac Mac	4	1	3	Very High integrated importance and Low WRU
X31D	Sabie	4	1-2	3	Very High integrated importance and Low WRU
X31E	Marite	3	1-2	3	High integration importance and Low to Moderate WRU
X31F	Motitsi	4	1	2	Very High integrated importance and Low WRU
X31G	Sabie	4	1-2	3	Very High integrated importance and Low WRU
X31H	Whitewaters	2	1-2	2	Moderate integrated importance and WRU
X31J	Noord Sand	2	1-2	2	Moderate integrated importance and WRU
X31K	Sabie	4	2-3	4	Very High integrated importance and Moderate to High WRU

Quaternary Catchment	River	Integrated Importance Rating (0 – 4)	Water Resource Use Rating (WRU)	Recommendations PRIORITY RATING	Reasons for Evaluation
X31L	Saringwa	1	1-2	1	Low Integrated importance and WRU
X31M	Sabie	3	3-4	4	High integrated importance and High WRU
X32A	Groot Sand	3	0-1	1	High integrated importance but Low WRU
X32B	Klein Sand	4	0-1	2	Very High integrated importance but Low WRU
X32C	Sand	3	1-2	3	High integration importance and Low to Moderate WRU
X32D	Mutlumuvi	3	1-2	3	High integrated importance but Low WRU
X32E	Nwarehle	3	1	1	High integrated importance but Low WRU
X32F	Mutlumuvi	3	3-4	3	High integrated importance and High WRU
X32G	Sand	4	2	3	Very high Integrated importance and Moderate WRU
X32H	Sand	4	2-3	4	Very High integrated importance but Moderate WRU
X32J	Sand	4	2-3	4	Very High integrated importance but Moderate WRU
X33A	Sabie	4	2-3	4	Very High integrated importance but Moderate WRU
X33B	Sabie	4	2-3	4	Very High integrated importance but Moderate WRU
X33C	Mlondolozi	4	0	0	In the KNP so does not require priority rating for EWR assessment
X33D	Sabie	4	2-3	4	Very High integrated importance but Moderate WRU
X40A	Sweni	4	0	0	In the KNP so does not require priority rating for EWR assessment
X40B	Nwanetsi	4	0	0	In the KNP so does not require priority rating for EWR assessment
X40C	Nwasitsontso	4	0	0	In the KNP so does not require priority rating for EWR assessment
X40D	Nwasitsontso	4	0	0	In the KNP so does not require priority rating for EWR assessment

These areas are illustrated spatially on a map (Figure 3.5 and Figure 3.6). These dark and light red quaternaries represent the main river reaches where considerable care should be taken when considering development and which would require intermediate or comprehensive EWR assessment. The EWR sites which were selected have been plotted.

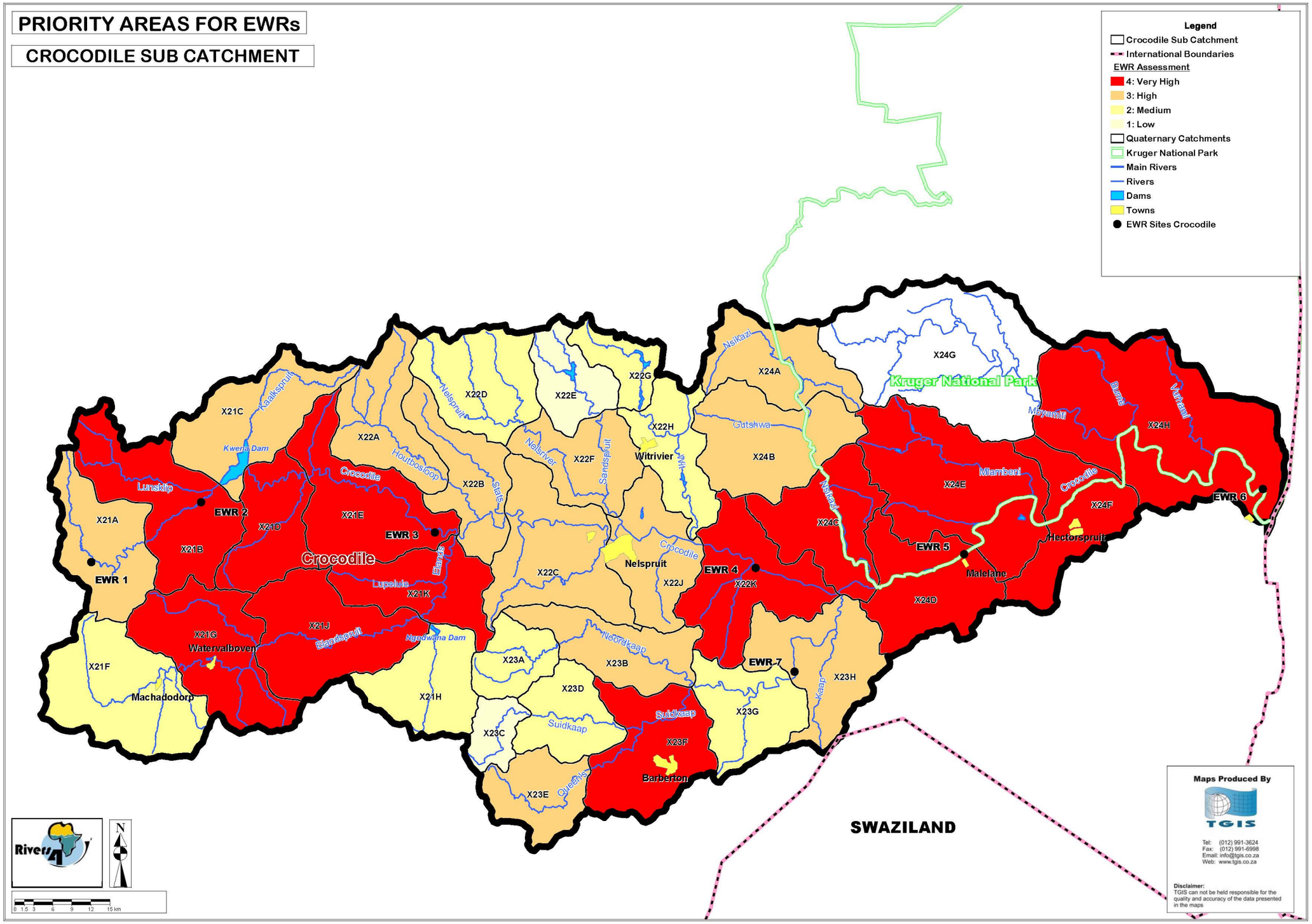


Figure 3-5 Crocodile Sub-catchment: Sections in rivers which are important for Reserve assessment (Hotspots) (derived from overlaying Integrated Importance and Water Resource Use)

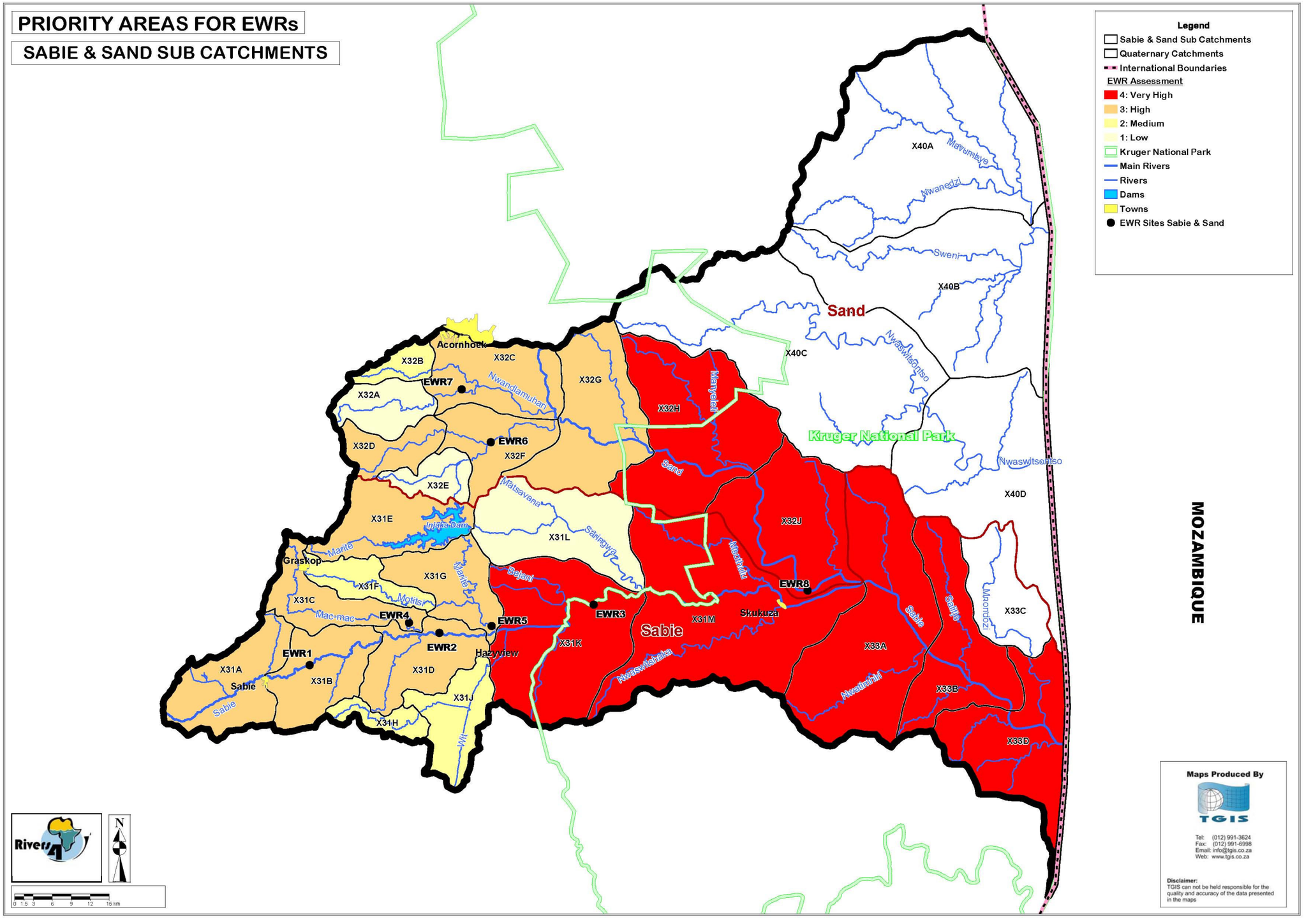


Figure 3-6 Sabie & Sand Sub-catchment: Sections in rivers which are important for Reserve assessment (Hotspots) (derived from overlaying Integrated Importance and Water Resource Use)

In the Crocodile system the 'hotspots' (red areas) are located in:

- The KNP due to the Very High EIS and SCI as well as the role the river plays to provide international requirements and other users.
- The area downstream of Kwena Dam and the Elands River due to the High and Very high EIS as well as its Water Resource Use importance.

In the Sabie system the hotspots (red areas) are located in:

- The KNP and conservation areas due to the Very High EIS and SCI
- The Sabie River outside the KNP due to the high EIS.

4 REFERENCES

Afridev 2006. Main Report. Komati Catchment Ecological Water Requirements Study. Department Water Affairs and Forestry Pretoria Report No. RDM X100-00-CON-COMPR2-1205

Department of Water Affairs and Forestry, South Africa (DWAF). 1999a. Resource Directed Measures for Protection of Water Resources. Volume 3: River Ecosystems Version 1.0, Pretoria.

Department of Water Affairs and Forestry, South Africa (DWAF). 1999b. Department of Water Affairs and Forestry, Report No P C000/00/21599. Report for the Vaal River Irrigation Study 1999.

Department of Water Affairs and Forestry, South Africa (DWAF). 2004. Upper Vaal Water Management Area: Internal Strategic Perspective. Prepared by PDNA, WRP Consulting Engineers (Pty) Ltd, WMB and Kwezi-V3 on behalf of the Directorate: National Water Resource Planning. DWAF Report No P WMA 08/000/00/0304.

Department of Water Affairs and Forestry, South Africa (DWAF). 2007. Resource Directed Measures: Comprehensive Reserve determination study of the Integrated Vaal River System. Water Resource Planning: Water Resource Use Priority Rating of the River Reaches in the Vaal River System. Report produced by WRP Consulting. Authored by Van Rooyen, p and Swart, S. Report no. RDM/C000/00/CON/0607.

Iversen, TM, Madsen, BL, and Bøgestrand, J. 2000. River conservation in the European Community, including Scandinavia. In: “Global Perspectives on River Conservation: Science Policy and Practice", Edited by P.J. Boon, B.R. Davies and G.E. Petts, John Wiley & Sons Ltd.

Hill, L. (ed) 2004: Elands Catchment Comprehensive Reserve Determination Study, Mpumalanga Province, Ecological Classification and Ecological Water Requirements (quantity) Workshop Report, Contract Report for Sappi-Ngodwana, Submitted to the Department: Water Affairs and Forestry, by the Division of Water Environment and Forestry Technology, CSIR, Pretoria. Report No. ENV-P-C 2004-019.

Kleynhans, C.J. 1996. A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River (Limpopo system, South Africa). *Journal of Aquatic Ecosystem Health*, 5, 1-14.

Kleynhans, C.J. 2000. Desktop estimates of the ecological importance and sensitivity categories (EISC), default ecological management classes (DEMC), present ecological status categories (PESC), present attainable ecological management classes (present AEMC), and best attainable ecological management class (best AEMC) for quaternary catchments in South Africa. DWAF report. Institute for Water Quality Studies.

Kleynhans CJ, Louw MD. 2007. Module A: EcoClassification and EcoStatus determination in RiverEco Classification: Manual for EcoStatus Determination (version 2). Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT328/08

Kleynhans, CJ, Thirion, C, Moolman, J and Gaulana, L. 2007. A Level II River Ecoregion classification System for South Africa, Lesotho and Swaziland. Report No. N/000/00/REQ0XXX. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

Louw, MD and Huggins, G. 2007. Desktop Assessment of the Importance and Ecological State of the Maputo River Quaternary catchments. Produced by Water for Africa as part of the Joint Maputo River Basin Water Resources Study – Moçambique, Swaziland and South Africa.

Louw & Singh, April 2006. State of the aquatic ecosystems in the Inkomati WMA. Produced for Contract no WFSP/WRM/CON2006: Undertake an assessment of the current water allocation status and potential for establishing viable water-using enterprises in the Olifants and InKomati WMAs.

Milner, A.M. 1994. System recovery. In, P.Calow & G.E. Petts (eds.): The rivers handbook. Vol. 2. Blackwell Scientific Publications. London.

Noss, R.F. 1990. Indicators for monitoring biodiversity: a hierarchical approach. Conservation Biology 4:355-364.

Resh, V.H., A.V. Brown, A.P. Covich, M.E. Gurtz, H.W. Li, G.W. Minshall, S.R. Reice, A.L. Sheldon, J.B. Wallace & R.C. Wissmar. 1988. The role of disturbance theory in stream ecology. Journal of the North American Benthological Society. 7: 433-455.

Robertson, MP, Villet, MH and Palmer, AR. 2004. A fuzzy classification technique for predicting species' distributions: applications using invasive alien plants and indigenous insects. *Diversity and Distributions* 10: 461–474.

Schulze, R.E., M. Maharaj, S.D. Lynch, B.J. Howe & B. Melvil-Thomson. 1997. South African atlas of agrohydrology and -climatology. Water Research Commission, Pretoria, Report TT82/96.

APPENDIX A: SCI MODEL

Ritual Use

Quat	Intensity of Use	Significance	Modifier	Score	SOURCE, LEVEL & COMMENTS
X21A	0	0	N	0	Commercial Forestry and mixed low density, site visit
X21B	0	0	N	0	Commercial Forestry and mixed low density, site visit
X21C	0	0	N	0	Commercial Forestry and mixed low density, site visit
X21D	0	0	N	0	Commercial Forestry and mixed low density, site visit
X21E	0	0	N	0	Commercial Forestry and mixed low density, site visit
X21F	1	2	N	2	Machadadorp, Low density commercial farm, site vitis
X21G	0	0	N	0	Emgwenya, Forestry Low density mixed farm
X21H	0	0	N	0	Forestry Low Density commercial
X21J	0	0	N	0	Tulluch Moor NR Forestry, Mixed Agric, Mill
X21K	0	0	N	0	Forestry, Ngodwana Starvation Creek NR
X22A	0	0	N	0	Makoboulaan NR, Forestry
X22B	0	0	N	0	Forestry Mixed commercial irrig
X22C	2	2	N	2	Forestry Mixed Agric - HL Hall, Residential - Nelspruit
X22D	1	1	N	1	Site Vist All Forestry
X22E	0	0	N	0	Forestry
X22F	0	0	N	0	Forestry Mixed Farming Residential- Rock Drift
X22G	0	0	N	0	Site Vast All Forestry
X22H	1	1	N	1	Forestry Witrivier, Mixed Farming
X22J	2	1	Y	1	Nelspruit- Farming
X22K	4	3	Y	3	Dense Settlement, Kanyamazane, mixed farming
X23A	0	0	N	0	Forestry
X23B	0	0	N	0	Forestry, Mixed farm, some sugar cane
X23C	0	0	N	0	Forestry
X23D	0	0	N	0	Forestry Mixed Farming
X23E	0	0	N	0	Forestry
X23F	2	2	Y	1	Barberton, Some Forestry Mixed Farming
X23G	1	2	Y	1	Mixed Farming, Sheba mine
X23H	2	2	N	2	Kaapmuiden, Residential, Mixed Farming
X24A	4	4	N	4	Kruger 50% subsistence and Settlement 50%
X24B	4	4	N	4	Kruger 25% subsistence and Settlement 75%
X24C	4	3	Y	3	Kruger 25% subsistence and Settlement 75% - Kanyamazane
X24D	0	0	N	0	Kruger 33% Sugar cane commercial 75%
X24E	0	0	N	0	Kruger 75% Sugar cane commercial 25% TSB
X24F	0	0	N	0	Kruger 33% Sugar cane commercial 75%
X24G	0	0	N	0	KNP 100%
X24H	0	0	N	0	Kruger 75% Sugar cane commercial 25%
X31A	1	1	N	1	Forestry Town of Sabie
X31B	0	0	N	0	Forestry
X31C	0	0	N	0	Forestry
X31D	0	0	N	0	Small Holdings, Tourism, Mixed Farming irrigation, Forestry
X31E	3	3	N	3	Forestry and lower reaches subsistence and settlement
X31F	0	0	N	0	Forestry
X31G	3	3	N	3	Forestry and lower reaches subsistence and settlement
X31H	0	0	N	0	Forestry
X31J	3	3	N	3	Forestry and lower reaches subsistence and settlement
X31K	4	4	N	4	KNP 50% Settlement 50%
X31L	4	4	N	4	Closer Rural settlement and subsistence
X31M	4	4	N	4	KNP 75% Settlement 25%
X32A	3	4	N	4	Upper forestry then dense rural settlement and subsistence
X32B	3	4	N	4	Upper forestry then dense rural settlement and subsistence

Quat	Intensity of Use	Significance	Modifier	Score	SOURCE, LEVEL & COMMENTS
X32C	4	4	N	4	Dense rural Settlement and subsistence
X32D	3	4	N	4	Upper forestry then dense rural settlement and subsistence
X32E	3	4	N	4	Upper forestry then dense rural settlement and subsistence
X32F	4	4	N	4	Dense rural Settlement and subsistence
X32G	4	4	N	4	Dense rural Settlement and subsistence some KNP
X32H	4	4	N	4	KNP 50% Settlement 50% Hluvukani Thulani
X32J	0	0	N	0	Mala Mal KNP 100%
X33A	0	0	N	0	KNP 100%
X33B	0	0	N	0	KNP 100%
X33C	0	0	N	0	KNP 100%
X33D	0	0	N	0	KNP 100%
X40A	0	0	N	0	KNP 100%
X40B	0	0	N	0	KNP 100%
X40C	3	3	N	3	KNP 75% Settlement 25% Welverdiend
X40D	0	0	N	0	KNP 100%

Aesthetics

Quat	Intensity of Appreciation	Significance of Value	Modifier	Score	SOURCE, LEVEL & COMMENTS
X21A	1	0	N	1	Commercial Forestry and mixed low density, site visit
X21B	1	0	N	1	Commercial Forestry and mixed low density, site visit
X21C	1	0	N	1	Commercial Forestry and mixed low density, site visit
X21D	1	0	N	1	Commercial Forestry and mixed low density, site visit
X21E	1	0	N	1	Commercial Forestry and mixed low density, site visit
X21F	3	3	N	3	Machadadorp, Low density commercial farm, site vitis
X21G	1	0	N	1	Emgwenya, Forestry Low density mixed farm
X21H	1	0	N	1	Forestry Low Density commercial
X21J	3	3	N	3	Tulluch Moor NR Forestry, Mixed Agric, Mill
X21K	3	3	N	3	Forestry, Ngodwana Starvation Creek NR
X22A	3	3	N	3	Makoboulaan NR, Forestry
X22B	0	1	N	1	Forestry Mixed commercial irrig
X22C	1	2	N	2	Forestry Mixed Agric - HL Hall, Residential - Nelspruit
X22D	1	1	N	1	Site Vist All Forestry
X22E	1	1	N	1	Forestry
X22F	1	1	N	1	Forestry Mixed Farming Residential- Rock Drift
X22G	1	1	N	1	Site Vast All Forestry
X22H	1	1	N	1	Forestry Witrivier, Mixed Farming
X22J	1	1	N	1	Nelspruit- Farming
X22K	1	1	N	1	Dense Settlement, Kanyamazane, mixed farming
X23A	1	1	N	1	Forestry
X23B	1	1	N	1	Forestry, Mixed farm, some sugar cane
X23C	1	1	N	1	Forestry
X23D	1	1	N	1	Forestry Mixed Farming
X23E	1	1	N	1	Forestry
X23F	2	2	N	2	Barberton, Some Forestry Mixed Farming
X23G	1	1	N	1	Mixed Farming, Sheba mine
X23H	3	3	N	3	Kaapmuiden, Residential, Mixed Farming
X24A	5	5	N	5	Kruger 50% subsistence and Settlement 50%
X24B	5	5	N	5	Kruger 25% subsistence and Settlement 75%
X24C	5	5	N	5	Kruger 25% subsistence and Settlement 75% -

Quat	Intensity of Appreciation	Significance of Value	Modifier	Score	SOURCE, LEVEL & COMMENTS
					Kanyamazane
X24D	5	5	N	5	Kruger 33% Sugar cane commercial 75%
X24E	5	5	N	5	Kruger 75% Sugar cane commercial 25% TSB
X24F	5	5	N	5	Kruger 33% Sugar cane commercial 75%
X24G	5	5	N	5	KNP 100%
X24H	5	5	N	5	Kruger 75% Sugar cane commercial 25%
X31A	2	2	N	2	Forestry Town of Sabie
X31B	2	2	N	2	Forestry
X31C	1	1	N	1	Forestry
X31D	3	3	N	3	Small Holdings, Tourism, Mixed Farming irrigation, Forestry
X31E	2	2	N	2	Forestry and lower reaches subsistence and settlement
X31F	1	1	N	1	Forestry
X31G	1	1	N	1	Forestry and lower reaches subsistence and settlement
X31H	1	1	N	1	Forestry
X31J	1	1	N	1	Forestry and lower reaches subsistence and settlement
X31K	5	5	N	5	KNP 50% Settlement 50%
X31L	1	1	N	1	Closer Rural settlement and subsistence
X31M	5	5	N	5	KNP 75% Settlement 25%
X32A	1	1	N	1	Upper forestry then dense rural settlement and subsistence
X32B	1	1	N	1	Upper forestry then dense rural settlement and subsistence
X32C	1	1	N	1	Dense rural Settlement and subsistence
X32D	1	1	N	1	Upper forestry then dense rural settlement and subsistence
X32E	1	1	N	1	Upper forestry then dense rural settlement and subsistence
X32F	1	1	N	1	Dense rural Settlement and subsistence
X32G	1	1	N	1	Dense rural Settlement and subsistence some KNP
X32H	5	5	N	5	KNP 50% Settlement 50% Hluvukani Thulani
X32J	5	5	N	5	Mala Mala KNP 100%
X33A	5	5	N	5	KNP 100%
X33B	5	5	N	5	KNP 100%
X33C	5	5	N	5	KNP 100%
X33D	5	5	N	5	KNP 100%
X40A	5	5	N	5	KNP 100%
X40B	5	5	N	5	KNP 100%
X40C	5	5	N	5	KNP 75% Settlement 25% Welverdiend
X40D	5	5	N	5	KNP 100%

Resource Dependence

Quat	Number of People Dependant	Significance of Goods and Services	Modifier	Score	SOURCE, LEVEL & COMMENTS
X21A	0	0	N	0	Commercial Forestry and mixed low density, site visit
X21B	0	0	N	0	Commercial Forestry and mixed low density, site visit
X21C	0	0	N	0	Commercial Forestry and mixed low density, site visit
X21D	0	0	N	0	Commercial Forestry and mixed low density, site visit
X21E	0	0	N	0	Commercial Forestry and mixed low density, site visit

Quat	Number of People Dependant	Significance of Goods and Services	Modifier	Score	SOURCE, LEVEL & COMMENTS
X21F	2	1	Y	1	Machadadorp, Low density commercial farm, site vitis
X21G	0	0	N	0	Emgwenya, Forestry Low density mixed farm
X21H	0	0	N	0	Forestry Low Density commercial
X21J	0	0	N	0	Tulluch Moor NR Forestry, Mixed Agric, Mill
X21K	0	0	N	0	Forestry, Ngodwana Starvation Creek NR
X22A	0	0	N	0	Makoboulaan NR, Forestry
X22B	0	0	N	0	Forestry Mixed commercial irrig
X22C	0	0	N	0	Forestry Mixed Agric - HL Hall, Residential - Nelspruit
X22D	0	0	N	0	Site Vist All Forestry
X22E	0	0	N	0	Forestry
X22F	1	1	N	1	Forestry Mixed Farming Residential- Rock Drift
X22G	0	0	N	0	Site Vsit All Forestry
X22H	0	0	N	0	Forestry Witrivier, Mixed Farming
X22J	3	2	Y	2	Nelspruit- Farming
X22K	3	2	Y	2	Dense Settlement, Kanyamazane, mixed farming
X23A	0	0	N	0	Forestry
X23B	0	0	N	0	Forestry, Mixed farm, some sugar cane
X23C	0	0	N	0	Forestry
X23D	0	0	N	0	Forestry Mixed Farming
X23E	0	0	N	0	Forestry
X23F	1	1	N	1	Barberton, Some Forestry Mixed Farming
X23G	0	0	N	0	Mixed Farming, Sheba mine
X23H	2	2	N	2	Kaapmuiden, Residential, Mixed Farming
X24A	4	4	N	4	Kruger 50% subsistence and Settlement 50%
X24B	4	4	N	4	Kruger 25% subsistence and Settlement 75%
X24C	5	3	Y	4	Kruger 25% subsistence and Settlement 75% - Kanyamazane
X24D	0	0	N	0	Kruger 33% Sugar cane commercial 75%
X24E	0	0	N	0	Kruger 75% Sugar cane commercial 25% TSB
X24F	0	0	N	0	Kruger 33% Sugar cane commercial 75%
X24G	0	0	N	0	KNP 100%
X24H	0	0	N	0	Kruger 75% Sugar cane commercial 25%
X31A	2	1	N	2	Forestry Town of Sabie
X31B	0	0	N	0	Forestry
X31C	0	0	N	0	Forestry
X31D	0	0	N	0	Small Holdings, Tourism, Mixed Farming irrigation, Forestry
X31E	2	4	Y	3	Forestry and lower reaches subsistence and settlement
X31F	0	0	N	0	Forestry
X31G	2	4	Y	3	Forestry and lower reaches subsistence and settlement
X31H	0	0	N	0	Forestry
X31J	2	4	Y	3	Forestry and lower reaches subsistence and settlement
X31K	4	4	N	4	KNP 50% Settlement 50%
X31L	4	4	N	4	Closer Rural settlement and subsistence
X31M	2	4	Y	3	KNP 75% Settlement 25%

Quat	Number of People Dependant	Significance of Goods and Services	Modifier	Score	SOURCE, LEVEL & COMMENTS
X32A	2	4	Y	3	Upper forestry then dense rural settlement and subsistence
X32B	4	4	Y	3	Upper forestry then dense rural settlement and subsistence
X32C	4	4	N	4	Dense rural Settlement and subsistence
X32D	3	4	N	4	Upper forestry then dense rural settlement and subsistence
X32E	3	4	N	4	Upper forestry then dense rural settlement and subsistence
X32F	4	4	N	4	Dense rural Settlement and subsistence
X32G	4	4	N	4	Dense rural Settlement and subsistence some KNP
X32H	4	4	N	4	KNP 50% Settlement 50% Hluvukani Thulani
X32J	0	0	N	0	Mala Mala KNP 100%
X33A	0	0	N	0	KNP 100%
X33B	0	0	N	0	KNP 100%
X33C	0	0	N	0	KNP 100%
X33D	0	0	N	0	KNP 100%
X40A	0	0	N	0	KNP 100%
X40B	0	0	N	0	KNP 100%
X40C	2	4	Y	3	KNP 75% Settlement 25% Welverdiend
X40D	0	0	N	0	KNP 100%

Recreational

Quat	Intensity of Use	Significance of Use	Modifier	Score	SOURCE, LEVEL & COMMENTS
X21A	0	0	N	0	Commercial Forestry and mixed low density, site visit
X21B	0	0	N	0	Commercial Forestry and mixed low density, site visit
X21C	0	0	N	0	Commercial Forestry and mixed low density, site visit
X21D	0	0	N	0	Commercial Forestry and mixed low density, site visit
X21E	0	0	N	0	Commercial Forestry and mixed low density, site visit
X21F	2	2	N	2	Machadadorp, Low density commercial farm, site vitis
X21G	0	0	N	0	Emgwenya, Forestry Low density mixed farm
X21H	0	0	N	0	Forestry Low Density commercial
X21J	2	3	N	3	Tulluch Moor NR Forestry, Mixed Agric, Mill
X21K	2	3		3	Forestry, Ngodwana Starvation Creek NR
X22A	2	3		3	Makoboulaan NR, Forestry
X22B	0	0		0	Forestry Mixed commercial irrig
X22C	0	0		0	Forestry Mixed Agric - HL Hall, Residential - Nelspruit
X22D	0	0		0	Site Vist All Forestry
X22E	0	0		0	Forestry
X22F	1	1		1	Forestry Mixed Farming Residential- Rock Drift
X22G	0	0		0	Site Vsit All Forestry
X22H	2	2		2	Forestry Witrivier, Mixed Farming
X22J	2	2		2	Nelspruit- Farming
X22K	2	2		2	Dense Settlement, Kanyamazane, mixed farming
X23A	0	0		0	Forestry
X23B	0	0		0	Forestry, Mixed farm, some sugar cane

Quat	Intensity of Use	Significance of Use	Modifier	Score	SOURCE, LEVEL & COMMENTS
X23C	0	0		0	Forestry
X23D	0	0		0	Forestry Mixed Farming
X23E	0	0		0	Forestry
X23F	1	2		2	Barberton, Some Forestry Mixed Farming
X23G	1	1		1	Mixed Farming, Sheba mine
X23H	1	2		2	Kaapmuiden, Residential, Mixed Farming
X24A	5	5		5	Kruger 50% subsistence and Settlement 50%
X24B	5	5		5	Kruger 25% subsistence and Settlement 75%
X24C	5	5		5	Kruger 25% subsistence and Settlement 75% - Kanyamazane
X24D	5	5		5	Kruger 33% Sugar cane commercial 75%
X24E	5	5		5	Kruger 75% Sugar cane commercial 25% TSB
X24F	5	5		5	Kruger 33% Sugar cane commercial 75%
X24G	5	5		5	KNP 100%
X24H	5	5		5	Kruger 75% Sugar cane commercial 25%
X31A	2	2		2	Forestry Town of Sabie
X31B	0	0		0	Forestry
X31C	0	0		0	Forestry
X31D	3	3		3	Small Holdings, Tourism, Mixed Farming irrigation, Forestry
X31E	1	2		2	Forestry and lower reaches subsistence and settlement
X31F	0	0		0	Forestry
X31G	1	1		1	Forestry and lower reaches subsistence and settlement
X31H	0	0		0	Forestry
X31J	2	2		2	Forestry and lower reaches subsistence and settlement
X31K	5	5		5	KNP 50% Settlement 50%
X31L	2	2		2	Closer Rural settlement and subsistence
X31M	5	5		5	KNP 75% Settlement 25%
X32A	2	2		2	Upper forestry then dense rural settlement and subsistence
X32B	2	2		2	Upper forestry then dense rural settlement and subsistence
X32C	2	2		2	Dense rural Settlement and subsistence
X32D	2	2		2	Upper forestry then dense rural settlement and subsistence
X32E	2	2		2	Upper forestry then dense rural settlement and subsistence
X32F	2	2		2	Dense rural Settlement and subsistence
X32G	5	5		5	Dense rural Settlement and subsistence some KNP
X32H	5	5		5	KNP 50% Settlement 50% Hluvukani Thulani
X32J	5	5		5	Mala Mala KNP 100%
X33A	5	5		5	KNP 100%
X33B	5	5		5	KNP 100%
X33C	5	5		5	KNP 100%
X33D	5	5		5	KNP 100%
X40A	5	5		5	KNP 100%
X40B	5	5		5	KNP 100%
X40C	5	5		5	KNP 75% Settlement 25% Welverdiend
X40D	5	5		5	KNP 100%

Historical

Quat	Historical/Cultural Intensity of Appreciation	Significance of Value	Modifier	Score	SOURCE, LEVEL & COMMENTS
X21A	2	2	N	2	Commercial Forestry and mixed low density, site visit
X21B	2	2	N	2	Commercial Forestry and mixed low density, site visit
X21C	2	2	N	2	Commercial Forestry and mixed low density, site visit
X21D	2	2	N	2	Commercial Forestry and mixed low density, site visit
X21E	2	2	N	2	Commercial Forestry and mixed low density, site visit
X21F	2	4	N	4	Machadadorp, Low density commercial farm, site vitis
X21G	2	2	N	2	Emgwenya, Forestry Low density mixed farm
X21H	2	2	N	2	Forestry Low Density commercial
X21J	2	4	N	4	Tulluch Moor NR Forestry, Mixed Agric, Mill
X21K	1	1	N	1	Forestry, Ngodwana Starvation Creek NR
X22A	1	1	N	1	Makoboulaan NR, Forestry
X22B	1	1	N	1	Forestry Mixed commercial irrig
X22C	1	3	N	3	Forestry Mixed Agric - HL Hall, Residential - Nelspruit
X22D	1	1	N	1	Site Vist All Forestry
X22E	1	1	N	1	Forestry
X22F	1	1	N	1	Forestry Mixed Farming Residential- Rock Drift
X22G	1	1	N	1	Site Vsit All Forestry
X22H	2	3	N	3	Forestry Witrivier, Mixed Farming
X22J	4	4	N	4	Nelspruit- Farming
X22K	2	3	N	3	Dense Settlement, Kanyamazane, mixed farming
X23A	1	1	N	1	Forestry
X23B	1	1	N	1	Forestry, Mixed farm, some sugar cane
X23C	1	1	N	1	Forestry
X23D	1	1	N	1	Forestry Mixed Farming
X23E	1	1	N	1	Forestry
X23F	3	3	N	3	Barberton, Some Forestry Mixed Farming
X23G	1	1	N	1	Mixed Farming, Sheba mine
X23H	4	3	N	4	Kaapmuiden, Residential, Mixed Farming
X24A	4	4	N	4	Kruger 50% subsistence and Settlement 50%
X24B	2	2	N	2	Kruger 25% subsistence and Settlement 75%
X24C	2	3	N	3	Kruger 25% subsistence and Settlement 75% - Kanyamazane
X24D	2	2	N	2	Kruger 33% Sugar cane commercial 75%
X24E	3	3	N	3	Kruger 75% Sugar cane commercial 25% TSB
X24F	2	2	N	2	Kruger 33% Sugar cane commercial 75%
X24G	4	4	N	4	KNP 100%
X24H	4	4	N	4	Kruger 75% Sugar cane commercial 25%
X31A	3	3	N	3	Forestry Town of Sabie
X31B	1	1	N	1	Forestry
X31C	1	1	N	1	Forestry
X31D	2	2	N	2	Small Holdings, Tourism, Mixed Farming irrigation, Forestry
X31E	1	1	N	1	Forestry and lower reaches subsistence and settlement
X31F	1	1	N	1	Forestry
X31G	1	1	N	1	Forestry and lower reaches subsistence and settlement
X31H	1	1	N	1	Forestry
X31J	1	1	N	1	Forestry and lower reaches subsistence and settlement
X31K	3	3	N	3	KNP 50% Settlement 50%
X31L	1	1	N	1	Closer Rural settlement and subsistence
X31M	3	3	N	3	KNP 75% Settlement 25%
X32A	1	3	N	3	Upper forestry then dense rural settlement and subsistence
X32B	1	3	N	3	Upper forestry then dense rural settlement and subsistence
X32C	1	3	N	3	Dense rural Settlement and subsistence
X32D	1	3	N	3	Upper forestry then dense rural settlement and subsistence
X32E	1	3	N	3	Upper forestry then dense rural settlement and subsistence
X32F	1	3	N	3	Dense rural Settlement and subsistence
X32G	1	3	N	3	Dense rural Settlement and subsistence some KNP

Quat	Historical/Culural Intensity of Appreciation	Significance of Value	Modifier	Score	SOURCE, LEVEL & COMMENTS
X32H	1	3	N	3	KNP 50% Settlement 50% Hluvukani Thulani
X32J	4	4	N	4	Mala Mala KNP 100%
X33A	4	4	N	4	KNP 100%
X33B	4	4	N	4	KNP 100%
X33C	4	4	N	4	KNP 100%
X33D	4	4	N	4	KNP 100%
X40A	4	4	N	4	KNP 100%
X40B	4	4	N	4	KNP 100%
X40C	3	3	N	3	KNP 75% Settlement 25% Welverdiend
X40D	4	4	N	4	KNP 100%

SCI rating

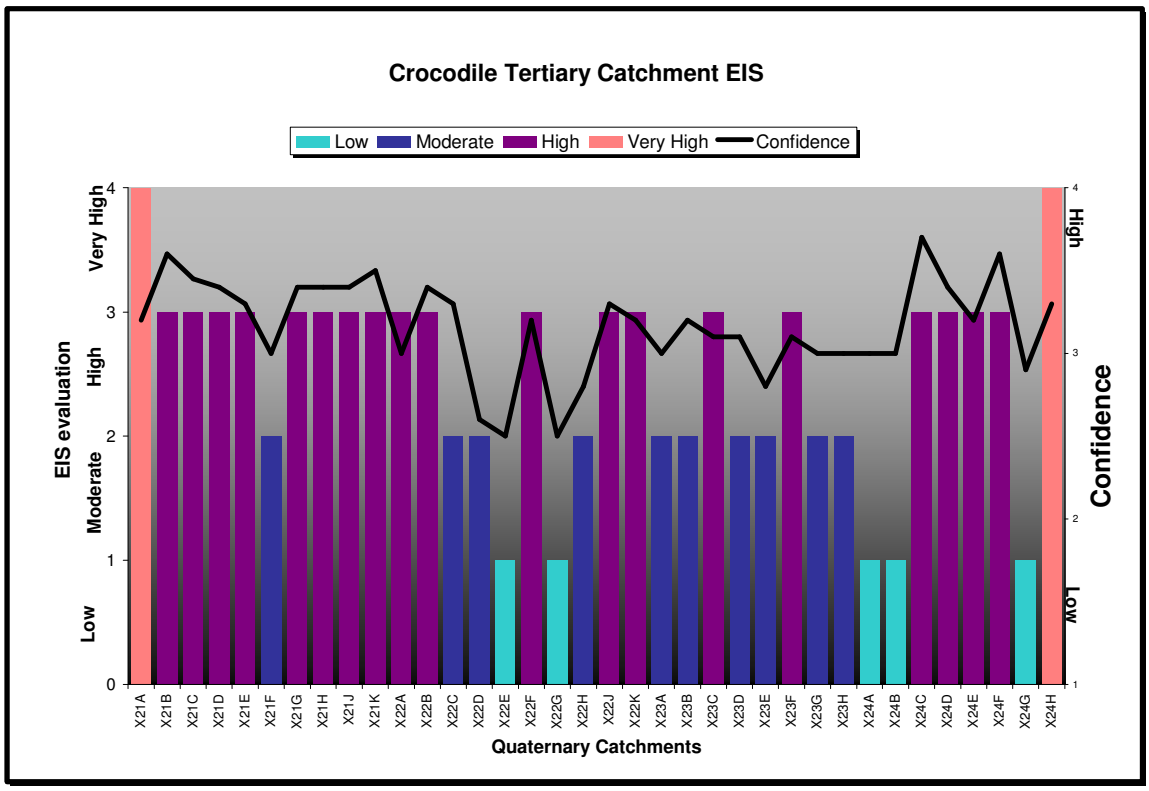
QUATERNARY CATCHMENT	RIVER	Ritual Use (0-5)	Aesthetic Value (0-5)	Resource Dependence (0-5)	Recreational Use (0-5)	Historical/Cultural Value (0-5)	Weighted Score	SOURCE, LEVEL & COMMENTS
X21A	Crocodile	0	1	0	0	2	0.9	Commercial Forestry and mixed low density site visit
X21B	Crocodile	0	1	0	0	2	0.9	Commercial Forestry and mixed low density site visit
X21C	Alexanderspruit	0	1	0	0	2	0.9	Commercial Forestry and mixed low density site visit
X21D	Crocodile	0	1	0	0	2	0.9	Commercial Forestry and mixed low density site visit
X21E	Crocodile	0	1	0	0	2	0.9	Commercial Forestry and mixed low density site visit -Buffelskloof NR
X21F	Elands	2	3	1	2	4	2.8	Machadadorp, Low density commercial farm
X21G	Elands	0	1	0	0	2	0.9	Emgwenya, Forestry Low density mixed farm
X21H	Ngodwana	0	1	0	0	2	0.9	Forestry Low Density commercial
X21J	Elands	0	3	0	3	4	2.6	Tulluch Moor NR Forestry, Mixed Agric, Mill
X21K	Elands	0	3	0	3	1	1.9	Forestry, Ngodwana Starvation Creek NR
X22A	Houtbosloop	0	3	0	3	1	1.9	Makoboulaan NR, Forestry
X22B	Crocodile	0	1	0	0	1	0.6	Forestry Mixed commercial irrig
X22C	Crocodile	2	2	0	0	3	1.9	Forestry Mixed Agric - HL Hall, Residential - Nelspruit
X22D	Nels River	1	1	0	0	1	0.8	Site Vast All Forestry
X22E	Sand	0	1	0	0	1	0.6	Forestry
X22F	Nels River	0	1	1	1	1	1.0	Forestry Mixed Farming Residential- Rock Drift
X22G	Wit River	0	1	0	0	1	0.6	Site Vast All Forestry
X22H	Nels River	1	1	0	2	3	1.9	Forestry Witrivier, Mixed Farming
X22J	Crocodile	1	1	2	2	4	2.4	Nelspruit- Farming
X22K	Crocodile	3	1	2	2	3	2.5	Dense Settlement, Kanyamazane, mixed farming
X23A	Noord Kaap	0	1	0	0	1	0.6	Forestry
X23B	Noord Kaap	0	1	0	0	1	0.6	Forestry, Mixed farm, some sugar cane
X23C	Queens	0	1	0	0	1	0.6	Forestry
X23D	Queens	0	1	0	0	1	0.6	Forestry Mixed Farming
X23E	Suid Kaap	0	1	0	0	1	0.6	Forestry

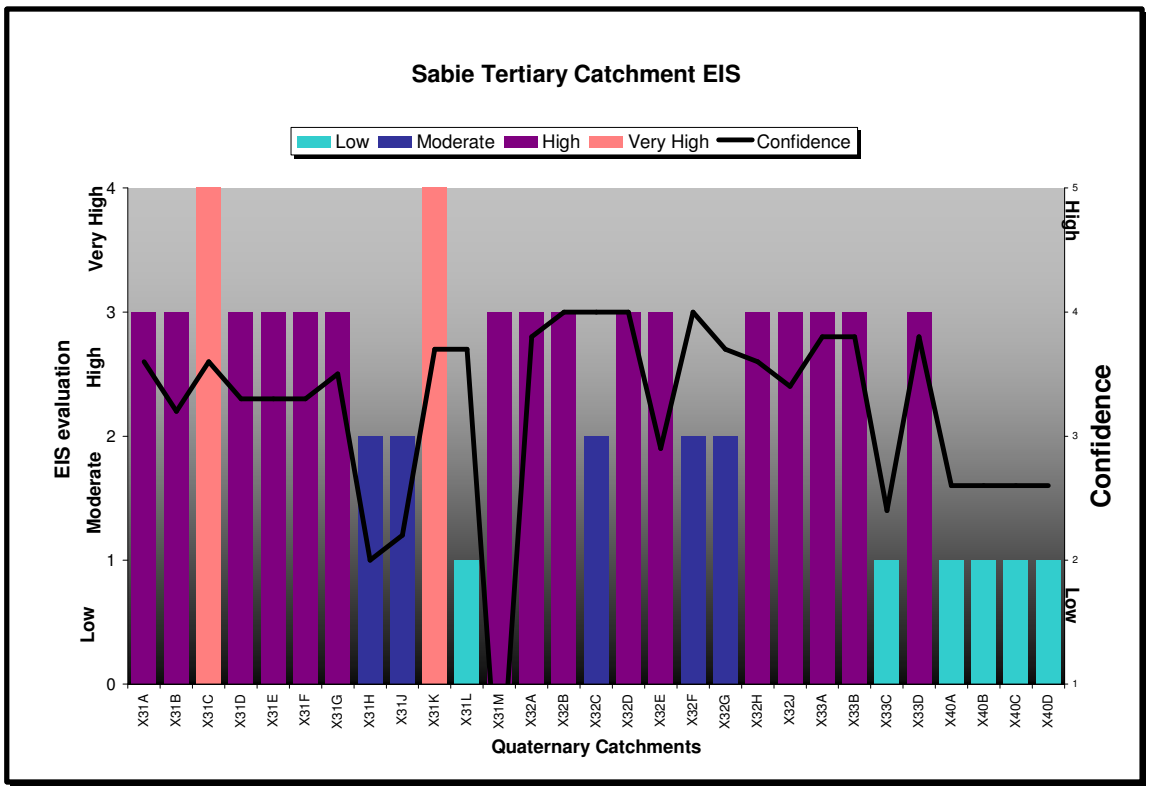
QUATERNARY CATCHMENT	RIVER	Ritual Use (0-5)	Aesthetic Value (0-5)	Resource Dependence (0-5)	Recreational Use (0-5)	Historical/Cultural Value (0-5)	Weighted Score	SOURCE, LEVEL & COMMENTS
X23F	Suid Kaap	1	2	1	2	3	2.1	Barberton, Some Forestry Mixed Farming
X23G	Kaap	1	1	0	1	1	1.0	Mixed Farming, Sheba mine
X23H	Kaap	2	3	2	2	4	2.8	Loisville, Residential, Mixed Farming
X24A	Nsikaze	4	5	4	5	4	4.4	Kruger 50% subsistence and Settlement 50%
X24B	Nsikaze	4	5	4	5	2	4.4	Kruger 25% subsistence and Settlement 75%
X24C	Crocodile	3	5	4	5	3	4.2	Kruger 25% subsistence and Settlement 75% - Kanyamazane
X24D	Crocodile	0	5	0	5	2	3.2	Kruger 33% Sugar cane commercial 75%
X24E	Crocodile: Malelane to Hectorspruit	0	5	0	5	3	3.4	Kruger 75% Sugar cane commercial 25% TSB
X24F	Crocodile	0	5	0	5	2	3.2	Kruger 33% Sugar cane commercial 75%
X24G	Mbyaniti	0	5	0	5	4	3.6	KNP 100%
X24H	Crocodile	0	5	0	5	4	3.6	Kruger 75% Sugar cane commercial 25%
X31A	Sabie	1	2	2	2	3	2.3	Forestry Town of Sabie
X31B	Sabie	0	2	0	0	1	0.9	Forestry
X31C	Mac Mac	0	1	0	0	1	0.6	Forestry
X31D	Sabie	0	3	0	3	2	2.1	Small Holdings, Tourism, Mixed Farming irrigation, Forestry
X31E	Marite	3	2	3	2	1	2.5	Forestry and lower reaches subsistence and settlement
X31F	Motitsi	0	1	0	0	1	0.6	Forestry
X31G	Sabie	3	1	3	1	1	2.1	Forestry and lower reaches subsistence and settlement
X31H	Whitewaters	0	1	0	0	1	0.6	Forestry
X31J	Noord Sand	3	1	3	2	1	2.3	Forestry and lower reaches subsistence and settlement
X31K	Sabie	4	5	4	5	3	4.4	KNP 50% Settlement 50%
X31L	Saringwa	4	1	4	2	1	2.8	Closer Rural settlement and subsistence
X31M	Sabie	4	5	3	5	3	4.2	KNP 75% Settlement 25%
X32A	Groot Sand	4	1	3	2	3	3.0	Upper forestry then dense rural settlement and subsistence
X32B	Klein Sand	4	1	3	2	3	3.0	Upper forestry then dense rural settlement and subsistence
X32C	Sand	4	1	4	2	3	3.2	Dense rural Settlement and subsistence

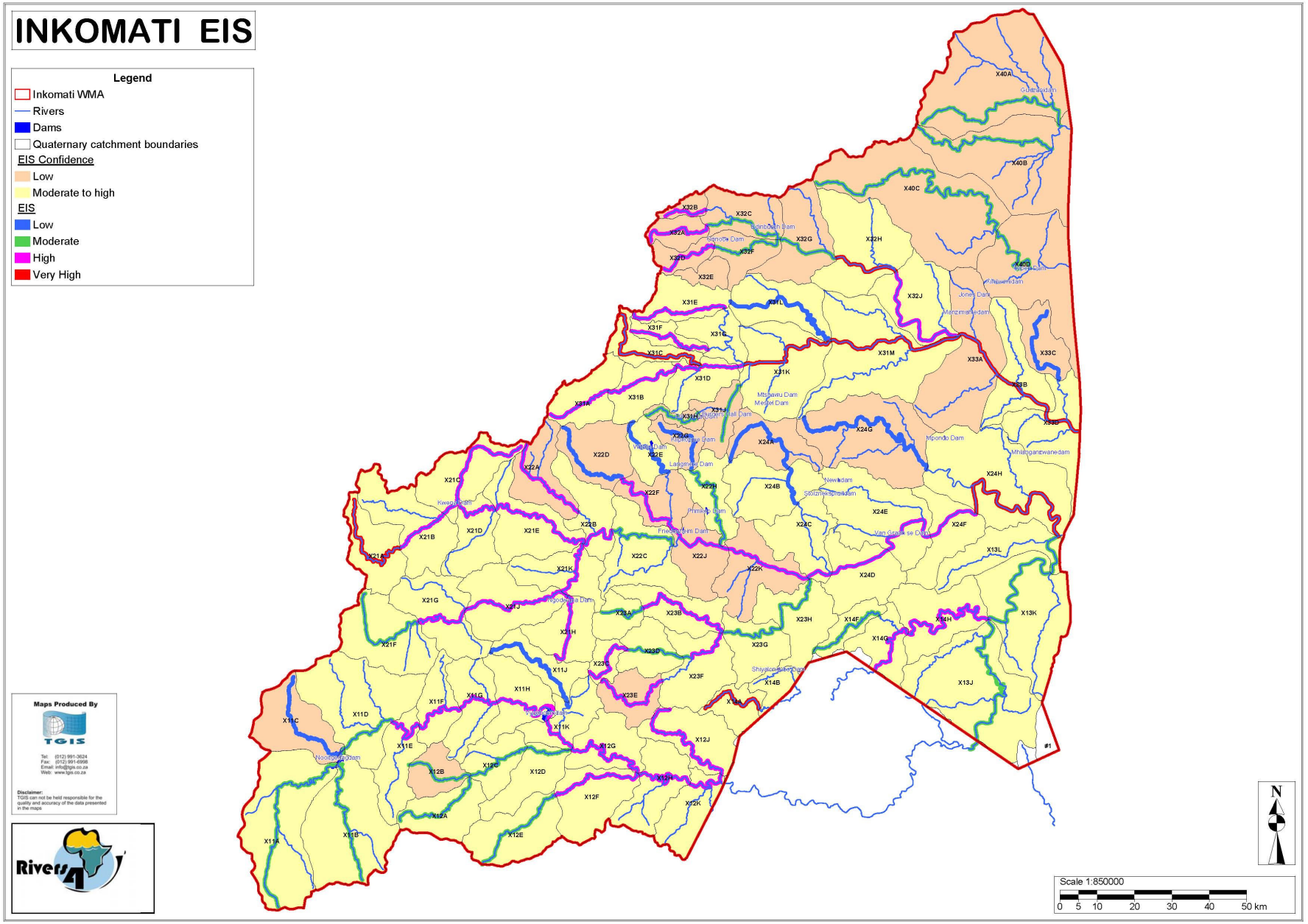
QUATERNARY CATCHMENT	RIVER	Ritual Use (0-5)	Aesthetic Value (0-5)	Resource Dependence (0-5)	Recreational Use (0-5)	Historical/Cultural Value (0-5)	Weighted Score	SOURCE, LEVEL & COMMENTS
X32D	Mutlumuvi	4	1	4	2	3	3.2	Upper forestry then dense rural settlement and subsistence
X32E	Nwarehle	4	1	4	2	3	3.2	Upper forestry then dense rural settlement and subsistence
X32F	Mutlumuvi	4	1	4	2	3	3.2	Dense rural Settlement and subsistence
X32G	Sand	4	1	4	5	3	4.0	Dense rural Settlement and subsistence some KNP
X32H	Sand	4	5	4	5	3	4.4	KNP 50% Settlement 50% Hluvukani Thulani
X32J	Sand	0	5	0	5	4	3.6	Mala Mal KNP 100%
X33A	Sabie	0	5	0	5	4	3.6	KNP 100%
X33B	Sabie	0	5	0	5	4	3.6	KNP 100%
X33C	Mlondolozi	0	5	0	5	4	3.6	KNP 100%
X33D	Sabie	0	5	0	5	4	3.6	KNP 100%
X40A	Sweni	0	5	0	5	4	3.6	KNP 100%
X40B	Nwanetsi	0	5	0	5	4	3.6	KNP 100%
X40C	Nwasitsontso	3	5	3	5	3	4.0	KNP 75% Settlement 25% Welverdiend
X40D	Nwasitsontso	0	5	0	5	4	3.6	KNP 100%

APPENDIX B: 2006 PES EIS RESULTS

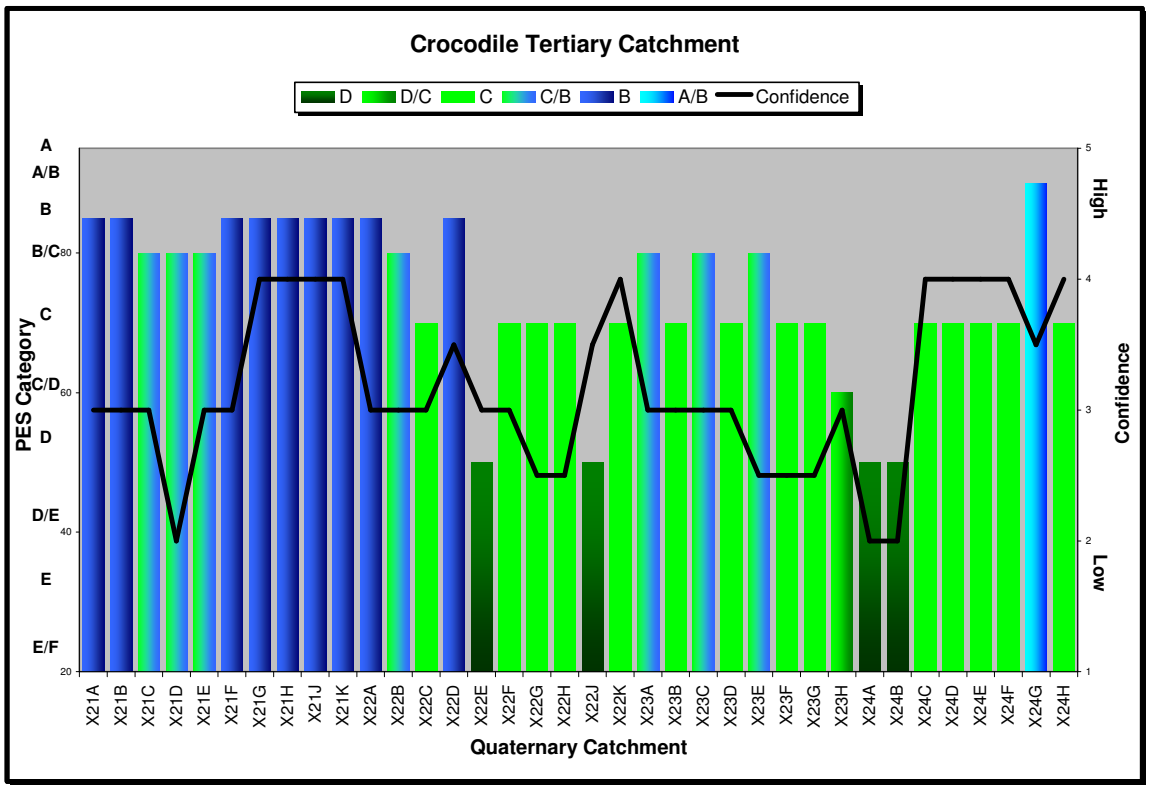
EIS RESULTS

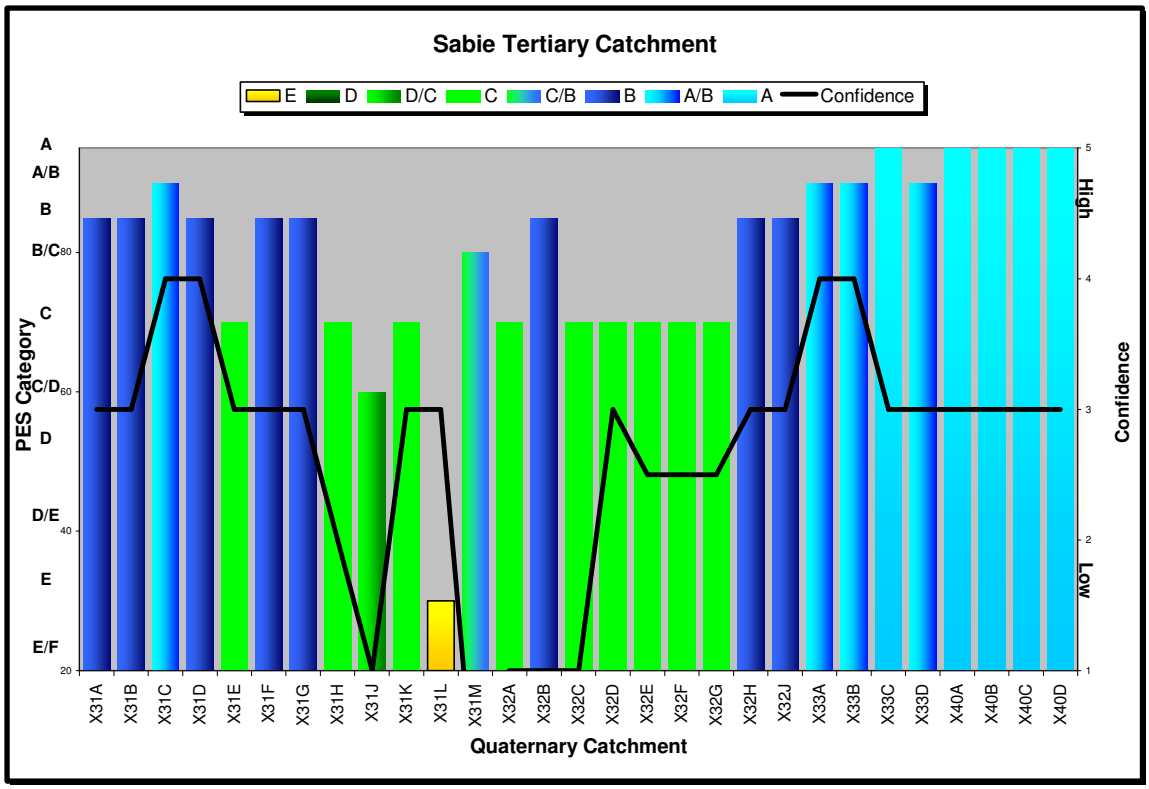


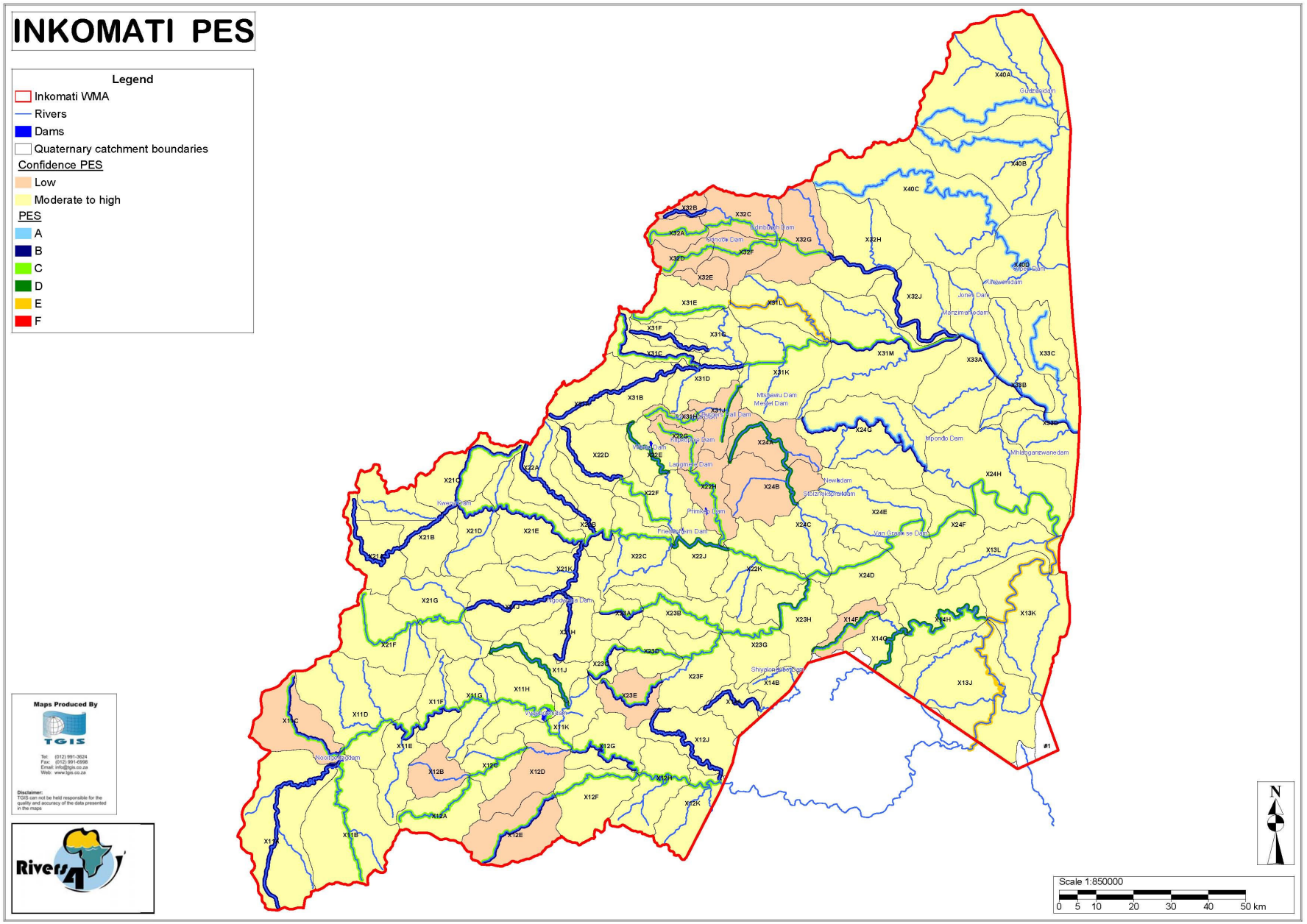



INKOMATI EIS
Legend
Inkomati WMA
Rivers
Dams
Quaternary catchment boundaries
EIS Confidence
Low
Moderate to high
EIS
Low
Moderate
High
Very High
Maps Produced By
TGIS
Disclaimer:
TGIS can not be held responsible for the quality and accuracy of the data presented in the maps
Rivers 4 Africa
N
Scale 1:850000
0 5 10 20 30 40 50 km

PES


Crocodile Tertiary Catchment
D
D/C
C
C/B
B
A/B
Confidence
A
A/B
B
B/C
C
C/D
D
D/E
E
E/F
PES Category
80
60
40
20
High
Low
Confidence
5
4
3
2
1
X21A X21B X21C X21D X21E X21F X21G X21H X21J X21K X22A X22B X22C X22D X22E X22F X22G X22H X22J X22K X23A X23B X23C X23D X23E X23F X23G X23H X24A X24B X24C X24D X24E X24F X24G X24H
Quaternary Catchment


Sabie Tertiary Catchment
E
D
D/C
C
C/B
B
A/B
A
Confidence
A
A/B
B
B/C
C
C/D
D
D/E
E
E/F
PES Category
80
60
40
20
High
Low
Confidence
5
4
3
2
1
X31A X31B X31C X31D X31E X31F X31G X31H X31J X31K X31L X31M X32A X32B X32C X32D X32E X32F X32G X32H X32J X33A X33B X33C X33D X40A X40B X40C X40D
Quaternary Catchment


INKOMATI PES
Legend
Inkomati WMA
Rivers
Dams
Quaternary catchment boundaries
Confidence PES
Low
Moderate to high
PES
A
B
C
D
E
F
Maps Produced By
TGIS
Disclaimer:
TGIS can not be held responsible for the quality and accuracy of the data presented in the maps
Rivers 4 Water
N
Scale 1:850000
0 5 10 20 30 40 50 km