# APPENDIX 2

# TERMS OF REFERENCE

**APPENDIX 2**

# DEPARTMENT OF WATER AFFAIRS AND FORESTRY

## NATIONAL WATER RESOURCES PLANNING

# ALBANY COAST SITUATION ASSESSMENT

# TERMS OF REFERENCE

**ALBANY COAST SITUATION ASSESSMENT**

**TERMS OF REFERENCE**

## 1. Background

A number of coastal and inland towns in the Albany Coast district experience serious periodic water supply problems, predominantly because of inadequate sources, but also often as a result of poor water quality. The Albany Coast Water Board handles the requirements of part of the area, but has a very small institutional base and cannot operate effectively. An investigation is required to establish the actual nature and extent of water balance problems in the area and to identify possible solutions.

For the purpose of this study the Albany Coast area is defined as the area bounded by, but not including the catchments of, the Great Fish and Sundays Rivers. This includes the whole of primary drainage area P with a total surface area of 5 064 $Km^2$. The towns involved include Port Alfred, Bathurst, Kleinemonde, Kenton on Sea, Bushmans River Mouth, Boknes, Cannon Rocks and Alexandria. The catchments involved comprise those of Kowie, Kariega and Lower Bushmans rivers and the coastal strip to the west of the Bushmans River Mouth.

In general, the knowledge level about the water resources in the Albany Coast area is limited. The following background information on the towns involved was taken from the recently completed Water Resources Situation Assessment Report for the Fish to Tsitsikamma Water Management Area:

1) Grahamstown:
It is supplied with water diverted from the Little Fish River at Hermanuskraal weir and conveyed by means of a tunnel to Glen Melville Dam on the Ecca River. Glen Melville Dam is a balancing dam for raw water supplied to Grahamstown and to the Lower Fish River Irrigation Scheme. It has negligible yield from the Ecca River. The water is treated at a plant near the dam and pumped to Grahamstown. Use in 1995 was about 0,8 million $m^3$. Raw water availability will be adequate for the foreseeable future.

Water also obtained from four local dams, namely Settlers, Howiesonspoort, Jameson and Milner Dams. The combined 1:50 year yield of these dams is 2,2 million $m^3/a$. The water is pumped to an 11 Ml/d treatment works on a hill above Grahamstown and distributed from there.

2) Port Alfred
Obtains water from the Mansfield Dam (0,2 million $m^3$ live storage) and the Sarel Hayward Dam (2,5 million $m^3$ live storage). The latter is an off-channel dam into which water is pumped from a small weir on the Kowie River. Water stored in the dam becomes saline during dry periods because of the marine origins of the shales underlying the dam basin. Regular flushing of the stored water and replacement with fresh water from the Kowie River during periods of high flow is required to counteract this. The combined yield of the two dams is estimated to be 1,6 million $m^3/a$ (Ninham Shand, 1987). Water is pumped from these dams to a water treatment works with a capacity of 6 Ml/d. The scheme is owned and operated by the Port Afred Municipality.

Water is also abstracted from coastal sand dunes near the town. The yield of this scheme is 0,13 million $m^3/a$.

Water from Mansfield Dam is supplied by Port Alfred to Nolukhango in the neighbouring town of Bathurst. Nolukhango previously relied on borehole water which was inadequate in quantity and found to have higher than desirable nitrate concentrations. It is not know if the borehole supply has been abandoned or if it is still used but mixed with the Mansfield Dam water. The other areas of Bathurst rely on private supplies from rainwater tanks or boreholes.

3) Bushman's River Mouth and Kenton-on-Sea:
Supplied by the Albany Coast Water Board from Boreholes and wellpoints in the dunes at Bushman's River mouth and at Diaz Cross. The yield of this scheme is estimated to be 1,1 million $m^3$/a. Because the raw water sources could not meet peak holiday season demand, the supply has been augmented by a reverse osmosis seawater desalination plant. The plant was commissioned in December 1997. It has a capacity of 0,4 Ml/d, or 0,12 million $m^3$/a, and draws water from boreholes in the saline groundwater zone near the Bushman's River mouth. The supply should be adequate to about 2005.

## 2. Purpose of the Study

The purpose of the study is to investigate the water supply problems of the area, through a broad review of existing information and to consider possible solutions that may present themselves for ready implementation. If necessary the study will also produce a situation overview from which the Department can draw up a framework for a more comprehensive investigation which may include consideration of sources outside of the focus area.

## 3. Proposed Scope of Work

The study involves more than just a pure desktop exercise. It will be necessary to contact knowledgeable individuals in the Department and Local Authorities to come to a full understanding of the water situation in the coastal towns and other user sectors. This will include reviewing, where available, the Water Service Development Plans and Integrated Development Plans. Although the primary focus of the work is on unpacking the urban supply sector, the other water use sectors should not be neglected especially where they impact on the available yield of the urban sector. The work will include the following tasks at reconnaissance level:

### 3.1 Background Information

- Collate and present existing information: present sources of water supply, present and projected water requirements by sector, demographics and expected socio-economic development, current and planned land use, institutional and legal aspects and potential water resources.
- Assessment of the accuracy and completeness of the existing information. Identification of gaps and further information required through collaboration with local authorities.
- Limited verification and patching of information, where necessary.

### 3.2 Domestic water supply situation

- Population and livestock distribution, present levels of service where this is known, existing projects and projects in process of implementation.

- Population growth and proposed future levels of service. Water requirements for urban use to be given in the seven categories of usage as undertaken for the Situation Assessment studies, an extract of this information as undertaken for this study is included as Appendix A.
- Area planning and possible grouping of schemes.

3.3 Existing infrastructure

Descriptions of existing bulk water supply infrastructure, its operational condition and upgradability to be provided.

3.4 Agricultural developments and afforestation

- In general, this is to be limited to a broad overview of possible developments with reference to the effect of these developments on the runoff and water requirements.
- Verify the extent of existing developments and identify information gaps. The Department's Dam database records a total number of 46 minor dams used for irrigation having total stored capacity of 12,8 million $m^3$/a. Take note of all development programmes proposed for the area. Assess the feasibility of future developments taking into account available water resources, economic development potential and financial constraints. The assessment should include the effects of dryland farming, irrigation and commercial livestock farming as well as the effects of afforestation (planted forests) and invasive aliens.

3.5 Water requirements

- Present and future water use by the various user sectors is to be assessed. Historical water use information should be presented where available, however, for future projections the national study (Schlemmer *et al*, 2001) to develop water use projections to the year 2025 as undertaken for the Department of Water Affairs and Forestry by a team of specialist should be used.
- Urban and industrial. The work by Schlemmer, Appendix A, to serve as a starting point. However, to improve on this base information the local authorities need to be approached to determine the level of information provided or not provided in their respective Water Service Development Plans. On the question of where the next source of water supply for each town should be, consultation with the Eastern Cape Regional Office is essential.
- Rural, domestic and livestock.
- Agricultural developments and afforestation. Requirements for irrigation (1995) at a 1:50 year assurance was estimated at 7,6 million $m^3$/a. Afforestation was low and hence zero reduction on the 1:50 year assurance of yield.
- For environmental and social requirements (the Reserve) use the desktop estimates that were determined for the Water Situation Assessment Model.

3.6 Water Demand Management

When determining water usage from towns an assessment of the role that water demand management can play on present and future water

requirements needs to be made. A similar assessment with respect to irrigation use needs to be made in terms of best practises and whether there is scope for more efficient water use. The institutional capacity of the authority to implement water demand management needs to be addressed.

3.7 Environmental aspects

The study needs to take cognisance of the Reserve, however, it only needs to apply the Rapid methodology that was used to determine the preliminary Reserve estimates for the NWRS.

3.8 Social aspects

For the schemes identified in the study the following to be established:

- Estimate number of people directly or indirectly affected by the developments.
- Estimate potential health and safety hazards.

3.9 Runoff hydrology, surface water resources and yield analysis

According to the Situation Assessment Report for the Albany Coast area the combined yields of Nuwejaars, Howieson Poort, Settlers, Jamieson and Sarel Haywood Dams is 6,8 million $m^3$/a. An estimate yield from farm dams and run-of-river abstractions of 8,0 million $m^3$/a, the estimated impact on yield of alien vegetation of 2,3 million $m^3$/a giving a total 1:50 year surface water utilised yield in 1995 of 17.1 million $m^3$/a. Sustainable groundwater exploitation potential not contributing to surface water base flow was estimated at 1,6 million $m^3$/a resulting in a total water resource 1:50 year utilised yield in 1995 of 18,7 million $m^3$/a and a total water resources yield potential of 54,6 million $m^3$/a.

What is required is the yield balance per quaternary (16 off) for P10, P20, P30 and P40 taking cognisance of water usage, stream flow reduction activities, local water sources (i.e. farm dams and groundwater) and return flows as they occur spatially in the quaternary. As this is an unregulated catchment it should not be necessary to set up the Water Resources Yield Model. A rapid assessment using monthly hydrological data to allow assessment of cascading water balances for quaternaries should suffice.

- In general the water resources assessments to be done primarily on the basis of WR90.
- The latest hydrological information on this catchment is being reviewed by the Department's Sub-Directorate Water Resources Studies. If more recent hydrological data is available and will impact on the yield then these should be obtained from the Department and used.

3.10 Groundwater resources

- A renewed look into the potential role that groundwater can play needs to be undertaken in this study. The Department will make members of their staff available where necessary and intend to actively participate in this component of the study. The successful PSP needs to co-ordinate, supplement and guide, where necessary, efforts that the Department will be undertaking to improve the knowledge base of the groundwater

potential of the area. A departmental team being led by a water resources planner in Water Resources Planning Systems (WRPS) will provide input into this study. During the briefing session the Department will give greater clarity of their planned involvement. Notwithstanding the Department's intended role in this study the PSP is responsible for reporting on the findings and mapping a way forward. However, in order to utilise local knowledge it is necessary that a provisional amount of R50 000 be provided for a nominated groundwater specialist.

- NWRP is undertaking an Internal Strategy Perspective which includes the Albany Coast and the regional review of the geohydrology of this area will be brought forward to provide a framework for the collation process being undertaken at a localised level.
- It is essential that the successful PSP integrates the findings of the groundwater investigation, being conducted departmentally with his own work.

3.11 Water quality, sedimentation and return flows

- A statement about water quality at source supplying each of the towns listed in the background above is needed.
- As this study is not focused on evaluating yield potential of future developments it is not necessary to do any in depth investigation into sedimentation.
- The effect of return flows in the area is believed to be limited. Available information to be properly accounted for in the water balance.

3.12 Development options for water supply to the coastal towns of the Albany Coast area

The various development options for the supply of water to the coastal towns of the Albany Coast and surrounding villages are to be identified and described. This will involve:

- Review of previously identified schemes.
- Review, grouping and area planning.
- Shortlisting of options utilising all applicable criteria. This can be undertaken on a cursory review based on experience and judgement which can be revisited if a more detailed study is called for.

3.11 Selection of preferred development option

- If no obvious solution presents itself, then the process to follow to assist in arriving at a development option needs to be set out in a framework report which details further investigations to be undertaken.

3.13 Reconciliation of supply and demand

- Under present day condition (2003) an assessment per quaternary on the water balance needs to be done. The balance also needs to take cognisance of seasonal variation of supply and demand. This assessment needs to be confirmed against the experience of knowledgeable individuals. Projections up to 2025 will suffice.

3.14 Study outcomes

At each study management meeting, these to be held monthly, the way forward will be discussed with progress reports tabled at two monthly intervals. At some point in the study a decision, in collaboration with the Client, needs to be taken either on refinement of preferred identified options or drawing up a plan of action for further option identification and analysis.

The level of investigation needs to be pitched at arriving at an assessment of the problems of supply of water to the coastal towns. This problem statement is considered the most important outcome of the study. Following on this is the report following the actions needed to implement the decision taken in the above paragraph.

3.15 Public involvement and community liaison

Need to plan for two meetings. The first to inform stakeholders about the study and at the close of the study a second report back meeting on findings and recommendations. The EC Regional Office will assist to set up these meetings.

## 4. Studies undertaken

Appended is a list of departmental reports, which is provided to give an indication of the documents that will have to be considered in the study:

- P15000/00/0101 Water Resources Situation Assessment for Fish to Tsitsikama Water Management Area – Ninham Shand
- P RSA/00/2200 The distribution of South Africa's population, economy and water usage into the long term future. – February 2001 by Lawrence Schlemmer, MarkData and Eric Hall & Associates.
- P000/00/0177 Boesmansrivier-Besproeiingskema : Uitvoerbaarheidstudie – Interdepartementele komitee
- P000/Gh/0084 Coastal sand aquifers between Boesmansriviermond and Boknes (Gh 3441)
- P000/xx/0188 Potensiële impak v watervoorsieningskema vir Boesmansrivier – Univ.PE
- P000/xx/0288 Boesmansrivier : Uitvoerbaarheidsverslag – Eenheid vir Besproeiingsbeplanning
- P000/00/0188 Albany Coast Water Board : Supplementary water
- P000/xx/0190 Boesmansrivier Besproeiingsprojek : Kosteberaming – De Wet Shand
- P100/xx/0172 Boesmansriviermond :Water reticulation scheme – NS
- P100/xx/0173 Cannon Rocks-Kenton-on-Sea RWS : Technical report – Bowler, Van Heerden
- P100/04/0177 Uitvoerbaarheidstudie v besproeiing in Boesmansriviervallei
- P100/01/0181 Nuwejaarsdam : Kapasiteitsbepaling
- P100/13/2023 Geologiese verkenning : Boesmans-PE kanaal – Geol. Opname
- P300/00/0179 Bushmans River Mouth geohidrological survey
- P400/xx/0171 Municipality Port Alfred : Water supply – Ninham Shand
- P400/xx/0271 Grahamstown : raw water augmentation – SSO
- P400/xx/0173 Port Alfred : Water scheme extensions – SSO

- P400/xx/0175 Port Alfred : Water scheme extensions (Supplementary report ) – SSO
- P400/00/0178 Waterverbruik v. Munis. Grahamstad
- P400/Gh/0079 Groundwater sampling & reconnaissance survey at Grahamstown (Gh 3119)
- P400/xx/0181 Future water requirements of Grahamstown and additional sources – SSO
- P400/xx/0183 Seawater desalination for Port Alfred – UHDE
- P400/xx/0191 Water tussen Alexandra en Visrivier deur Boesmansrivierprojek – Van Wyk & Louw
- P400/xx/0291 Bushmans River Transfer Scheme water for towns in Lower Bushmans River Valley – Van Wyk & Louw

## 5. Evaluation System

The attached document entitled "EXTRACT FROM ITEM 8 OF THE POLICY FOR THE APPOINTMENT OF PROFESSIONAL SERVICE PROVIDERS" sets out the evaluation system that will apply. The proposal submitted to be evaluated by a panel of departmental officials who will use the Evaluation System to assist them in comparing competitive proposals.

A team being led by a knowledgeable water resources planner with a proven track record of managing a multi-disciplinary team of experts and who has delivered studies of high quality on time and within budget would receive maximum benefit in the scoring system.

Curricula vitae of all persons proposed on the study team is required with their accompanying charge out rates.

## 6. Study Duration and briefing session

Technical work should not take more than seven months. A further three months may be taken up by the process of study closure. It is envisaged that the study will commence in August 2003 and be closed in May 2004. Within three months of the study commencing a draft preliminary report on findings need to be presented setting out the courses open to be further investigated. This to firm up on the problem assessment and likely solutions. A similar report is required after six months either towards providing an implementation plan for developing water resources or used to develop a proper situation assessment overview setting out the need for a more comprehensive study. Three months will then be allowed for review, printing and closing the study.

An important consideration in the evaluation of the study proposal is the availability of key personnel to undertake this work during the study period as set out above.

## 7. Study Budget

There is a limited study budget and this study falls into Project Category # 2: contract value between R150 000 and R3 million. The PSP should familiarise himself with the tasks as set out in this TOR. Any uncertainty needs to be raised at the briefing session provisionally set for 19 June 2003. Confirmation of the date and time of the meeting will be included in the notification notice calling for proposals.

## 8. Tax clearance certificate

No contract may be awarded to a person who has failed to submit an original Tax Clearance Certificate from the South African Revenue Service ("SARS") certifying that the taxes of that person to be in order or that suitable arrangements have been made with SARS.

## 9. Costing Considerations

All costs reflected in the study proposal to included VAT.

9.1 Provision for five hard copies of the report and ten CDs containing the report in pdf format to be made.

9.2 A retention amount of R70 000 needs to be provided for in the cash flow of the study. The first release of retention monies of R35 000 to be paid on receipt of the final draft reports and approved as such by the Client, R20 000 when the reports are printed and delivered to the Client and the balance when the study is closed. The Services shall be deemed completed and finally accepted by the Client and the final report shall be deemed approved by the Client as satisfactory ninety calendar days after receipt of the draft final report by the Client unless the Client, within such ninety day period, gives written notice to the PSP specifying in detail deficiencies in the Service, and upon completion of such corrections, the foregoing shall be repeated. On completion of the Service all outstanding retention monies to be released.

9.3 Provisional Sum of R50 000 to be allowed for to undertake work by a nominated groundwater specialist.

9.4 Provision for escalation to be reflected as a separate task in the cost estimates and limited to 2% of the estimate for professional fees.

9.5 No provision for escalation need be made.

9.6 As this is a fast track assignment the need has been identified that monthly study management meetings are required. Formal meetings to be held every alternate month. In total the study should plan for ten study management meetings (four of them to be formal) and two stakeholder meetings. All the formal study management meetings to be held in the Eastern Cape. The Department is flexible with respect to the informal meetings and these can be held at the offices of the PSP to save on study team's time (reduced number of people attending) and travel cost. For informal meetings only notes of a meeting are required instead of a full set of minutes and progress report that are required at the formal meetings.

9.7 It is a requirement that expenditure of HDI involvement should exceed 25%.

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33°00'

33°15'

33°30'

33°45'

34°00'

N

De Mistkraal Dam

Wellington Grove Weirstbu

VOLKERSRIVER

KOMMADAGGA RIVER

CACADU DISTRICT MUNICIPALITY

EASTERN CAPE

AMATOLE DISTRICT MUNICIPALITY

Glen Melville Dam

P10C

Blue Crane Route

P10D

REDDEDCK EAST

New Year's Dam

ALICEDALE

P10A

Milner Dam

Jamestown Dam

GRAHAMSTOWN

Grey Dam

P10B

Makana

P30A

P40A

Ngqushwa

PEDDIE

PARADISE

MPAHLANA

MTATA

P Drainage Region

Kwandwe Dam

Settlers Dam

EMSENGENI

ENON

PATERSON

P10F

P30B

P40B

Golden Ridge Dam

P40D

POMEROY

BATHURST

Sarel Hayward Dam

Mount Wellington Dam

Mansfield Dam

KLEINMONDE

Aberdeen Plain

Cassia's Dam

ADDO

P30C

Ndlambe

P40C

P10G

PORT ALFRED

NELSON MANDELA METROPOLITAN MUNICIPALITY

Sunday's River Valley

P20B

ALEXANDRIA

KENTON-ON-SEA

BUSHMANS RIVER MOUTH

P20A

BOKNES

CANNON ROCKS

COEGA

PORT ELIZABETH

Indian Ocean

**Locality Map**


**Legend:**

- Provincial Boundary
- District Municipality Boundary
- Local Municipality Boundary and Names
- Ndlambe
- P Drainage Region Boundary
- P10D — Quaternary Catchment Boundary and Numbers
- Golden Ridge Dam — Dams
- KOWIE RIVER — Main Rivers
- Main Roads
- BOKNES — Towns
- Rural Settlements
- Makana Local Municipality
- Ndlambe Local Municipality
- Sunday's River Valley Local Municipality
- Blue Crane Route Local Municipality

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CLIENT:

Department of Water Affairs and Forestry
Directorate: National Water Resources Planning

PROJECTION: Transverse Mercator
LO 27
WGS84

5 0 5 10 15 Kilometers

TITLE:

**Albany Coast Situation Assessment Study**

**Figure 1.1**
**Locality and Overview**

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November 2003

EASTERN CAPE

P Drainage Region

P10C
Blue Crane Route
P10D
P10B
P10A
Makana
P30A
P40A
Ngqushwa
P10E
Aberdeen Plain
P30B
P40B
P40D
P10F
P10G
Ndlambe
P40C
P30C
Sunday's River Valley
P20B
P20A

De Mistkraal Dam
Wellington Grows Weir
Glen Melville Dam
Golden Ridge Dam
Grassridge Dam
Settlers Dam
Howiesons Poort Dam
Lake Mentz Dam
Nahoon Dam
Quarry Dam
Settlers Dam
Wellington Dam

Port Elizabeth
Uitenhage
Despatch
Alexandria
Grahamstown
Kenton-on-Sea
Bushmans River Mouth
Boknes
Cannon Rocks
Port Alfred
Bathurst
Fort Beaufort
Adelaide
Bedford
Cradock
Somerset East
Middelburg
Graaff-Reinet
Aberdeen
Jansenville
Willowmore
Steytlerville
Kirkwood
Paterson
Alicedale
Riebeek East
Kleinmonde
Pomeroy

Indian Ocean

25°30' 25°45' 26°00' 26°15' 26°30' 26°45' 27°00'
33°00' 33°15' 33°30' 33°45'

N

## Locality Map


## Legend:

- Provincial Boundary
- P Drainage Region Boundary
- P10D — Quaternary Catchment Boundary and Numbers
- Golden Ridge Dam — Dams
- Main Rivers
- Main Roads
- Towns
- Communities

### Elevation (m)

- 0 - 100 m
- 101 - 200 m
- 201 - 300 m
- 301 - 400 m
- 401 - 500 m
- 501 - 700 m
- 701 - 1000 m

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PROJECTION: Transverse Mercator
LO 27
WGS84

5 0 5 10 15 Kilometers

TITLE:

Albany Coast

EASTERN CAPE

P Drainage Region

P10C
Blue Crane Route

P10D

P10E

P10F

P10G

P10A

P10B

Makana

Aberdeen Plain

Sunday's River Valley

P20B

P20A

P30A

P30B

P30C

P40A

P40B

P40C

P40D

Ndlambe

Ngqushwa

Locality Map

Eastern Cape

Legend:

- Provincial Boundary
- P Drainage Region Boundary
- Local Municipality Boundary and Names
- Ndlambe
- P10D — Quaternary Catchment Boundary and Numbers
- Golden Ridge Dam — Dams
- All Rivers
- KOWIE RIVER — Main Roads
- BOKNES — Towns

Tertiary Drainage Regions and Names

- P10 Bushman River
- P20/P40D Coastal River
- P30 Kagiega River
- P40 Kowie River

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Transverse Mercator
LO 27
WGS84

5 0 5 10 15 Kilometers

TITLE:

Albany Coast

EASTERN CAPE

P Drainage Region

P10C
P10D
P10A
P10B
P10E
P10F
P10G
P20B
P20A
P30A
P30B
P30C
P40A
P40B
P40C
P40D

De Mistkraal Dam
Wellington Grove Weir/Stu
Oakleigh's Dam
Indian Ocean

Locality Map

Eastern Cape

Legend:

- P Drainage Region Boundary
- P10D — Quaternary Catchment Boundary and Numbers
- P300-17 — Registered Farm Dams
- P100-02 Jamieson Dam — Main Dams
- KOWIE RIVER — Main Rivers
- Main Roads
- BOKNES — Towns

Tertiary Drainage Regions and Names

- (P10A to P10G) Bushmans River
- (P20A to P20B & P40D) Boknes River
- (P30A to P30C) Kagiega River
- (P40A to P40C) Kowie River

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Directorate: National Water Resources Planning

Transverse Mercator
LO 27
WGS84

5 0 5 10 15 Kilometers

TITLE:
Albany Coast

EASTERN CAPE

Q9A

Q9E

P10C

P10D

P1A

P10B

P10A

P30A

P40A

P10E

P30B

P4A

P40B

P10F

P40C

P40D

P10G

P1B

P30C

P20B

P20A

R5A

N4B

P Drainage Region

PORT ELIZABETH

Indian Ocean

## Locality Map


## Legend:

- Provincial Boundary
- P Drainage Region Boundary
- P10D — Quaternary Catchment Boundary and Numbers
- Golden Ridge Dam — Dams
- Main Rivers
- Main Roads
- Towns
- P1A — Rainfall Zones
- Rural Settlements

### Mean Annual Precipitation (mm)

- <100 mm
- 100 - 200 mm
- 200 - 300 mm
- 300 - 400 mm
- 400 - 500 mm
- 500 - 600 mm
- 600 - 700 mm
- >700 mm

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CLIENT:

Department of Water Affairs and Forestry
Directorate: National Water Resources Planning

PROJECTION: Transverse Mercator
LO 27
WGS84

5 0 5 10 15 Kilometers

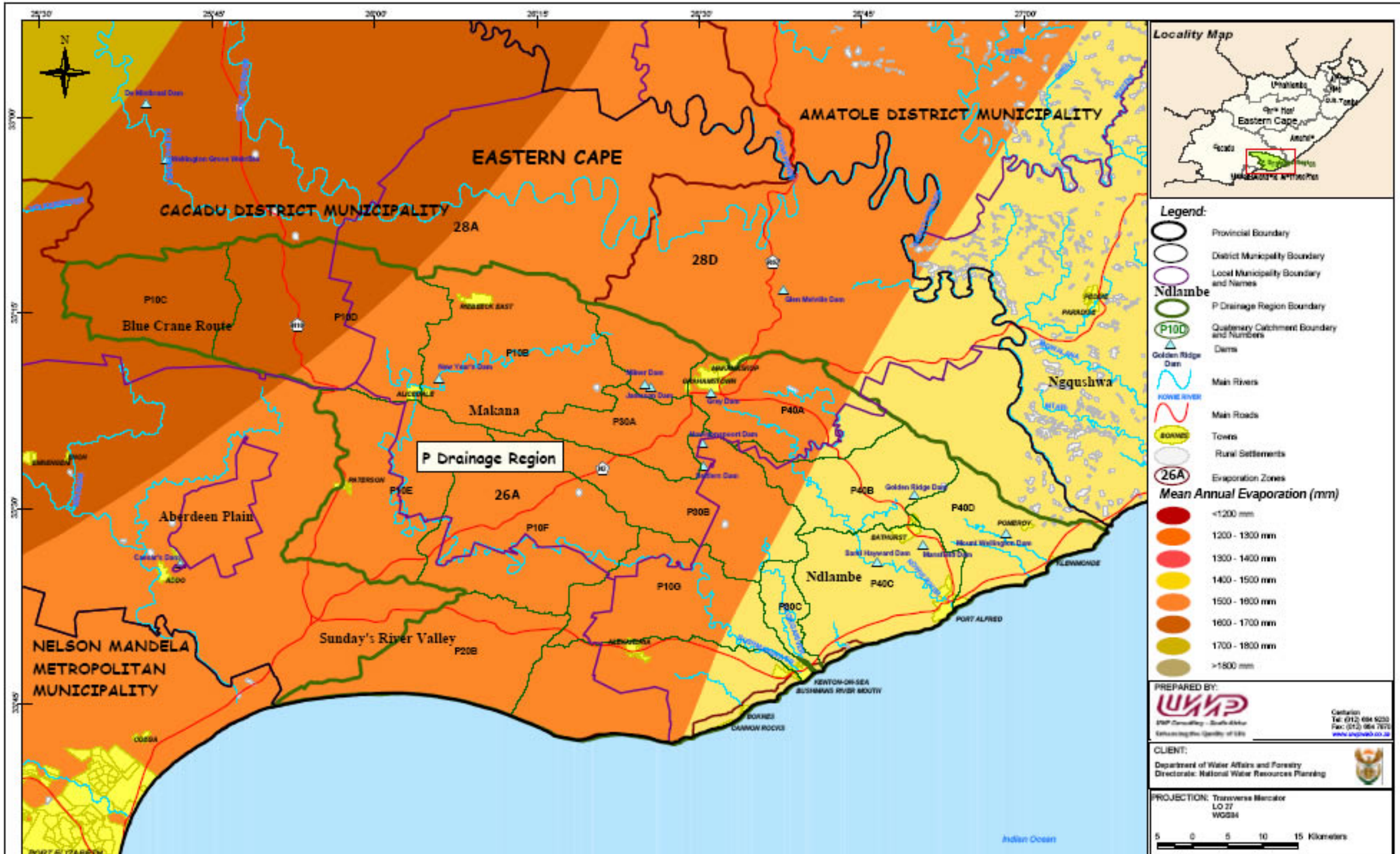
TITLE:

**Albany Coast**
**Situation Assessment Study**

**Figure 4.1**
**Mean Annual Precipitation**

File: W:\Work\23621 Albanycoast\GIS\Prj\f-1.apr

March 2004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EASTERN CAPE
CACADU DISTRICT MUNICIPALITY
AMATOLE DISTRICT MUNICIPALITY
NELSON MANDELA METROPOLITAN MUNICIPALITY
Blue Crane Route
Aberdeen Plain
Sunday's River Valley
Makana
Ndlambe
Ngqushwa
28A
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P10D
P10E
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P40C
P40D
P P Drainage Region
De Mistbrad Dam
Glen Melville Dam
Golden Ridge Dam
Mount Wellington Dam
Sarel Hayward Dam
Mansfield Dam
Settlers Dam
Caesar's Dam
New Year's Dam
Milner Dam
Howieson's Poort Dam
Grassy Dam
ADDO
GRAHAMSTOWN
ALICE
ALEXANDRIA
BATHURST
POMEROY
PORT ALFRED
KENTON-ON-SEA
BUSHMANS RIVER MOUTH
PORT ELIZABETH
Indian Ocean
Locality Map
Eastern Cape
Legend:
Provincial Boundary
District Municipality Boundary
Local Municipality Boundary and Names
P Drainage Region Boundary
Quaternary Catchment Boundary and Numbers
Dams
Main Rivers
Main Roads
Towns
Rural Settlements
Evaporation Zones
Mean Annual Evaporation (mm)
<1200 mm
1200 - 1300 mm
1300 - 1400 mm
1400 - 1500 mm
1500 - 1600 mm
1600 - 1700 mm
1700 - 1800 mm
>1800 mm
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CLIENT:
Department of Water Affairs and Forestry
Directorate: National Water Resources Planning
PROJECTION: Transverse Mercator
LO 27
WGS84
5 0 5 10 15 Kilometers
TITLE:

EASTERN CAPE

AMATOLE DISTRICT MUNICIPALITY

CACADU DISTRICT MUNICIPALITY

NELSON MANDELA METROPOLITAN MUNICIPALITY

Blue Crane Route

Makana

Ngqushwa

Ndlambe

Sunday's River Valley

Aberdeen Plain

P Drainage Region

P10C
P10D
P10B
P10A
P30A
P40A
P40B
P40C
P40D
P30B
P30C
P10E
P10F
P10G
P20B
P20A

Eastern Cape

Legend:

- Provincial Boundary
- District Municipality Boundary
- Local Municipality Boundary and Names
- P Drainage Region Boundary
- P10G Quaternary Catchment Boundary and Numbers
- Golden Ridge Dam — Dams
- Main Rivers
- Main Roads
- Towns
- Rural Settlements

Geology

- Compact Sedimentary strata
- Mainly compact tillite,shale and sandstone (Dwyka formation and Ecca Group)
- Compact,dominantly agrillaceous strata (Cape Supergroup)
- Compact arenaceous andagrillaceous strata (Karoo Supergroup-Beaufort Group within WMA)
- Porous unconsolidated to semi-consolidated sediment
- Mafic/ basic Lavas
- Consolidated porous to compact sedimentary strata
- Compact ,dominantly agrillaceous strata (Cape Supergroup within the WMA)

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Directorate: National Water Resources Planning

PROJECTION: Transverse Mercator
LO 27
WGS84

5 0 5 10 15 Kilometers

TITLE:

**Albany Coast**
**Situation Assessment Study**

**Figure 5.1**
**Geology**

File: W:\Work\25\01 Albanycoast\GIS\Proj\5-1_6-1.apr
November 2003

25°30' 25°45' 26°00' 26°15' 26°30' 26°45' 27°00'

33°00'

33°15'

33°30'

33°45'

34°00'

N

CACADU DISTRICT MUNICIPALITY

EASTERN CAPE

AMATOLE DISTRICT MUNICIPALITY

NELSON MANDELA METROPOLITAN MUNICIPALITY

P Drainage Region

Blue Crane Route

Aberdeen Plain

Sunday's River Valley

Makana

Ndlambe

Ngqushwa

P10C

P10D

P10B

P10A

P10E

P10F

P10G

P20B

P20A

P30A

P30B

P30C

P40A

P40B

P40C

P40D

De Mistkraal Dam

Wellington Grove Weirpool

Cape Recife

Port Elizabeth

Addo

Cannon Rocks

Kenton-on-Sea

Bushmans River Mouth

Port Alfred

Bathurst

Grahamstown

Alicedale

Paterson

Somerset East

Cookhouse

Kleinmonde

Indian Ocean

Locality Map

Eastern Cape

Amatole

Legend:

- Provincial Boundary
- District Municipality Boundary
- Local Municipality Boundary and Names
- P Drainage Region Boundary
- Quaternary Catchment Boundary and Numbers
- Dams
- Main Rivers
- Main Roads
- Towns
- Rural Settlements

Soils

| Depth | Texture | Relief |
|---|---|---|
| Moderate to Deep | Clay Loam | Flat |
| Moderate to Deep | Sandy Loam | Steep |
| Moderate to Deep | Clay Loam | Undulating |
| Moderate to Deep | Sandy Loam | Steep |
| Moderate to Deep | Sandy Loam | Undulating |
| Shallow | Sandy Loam | Undulating |
| Moderate to Deep | Sandy Soil | Steep |
| Moderate to Deep | Sandy Soil | Undulating |

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LO 27
WGS84

5 0 5 10 15 Kilometers

TITLE:

**Albany Coast Situation Assessment Study**

**Figure 6.1**
**Soils**

File: W:/Work/23821 Albanycoast/GIS/Proj/5-1_6-1.apr
November 2003

25°30' 25°45' 26°00' 26°15' 26°30' 26°45' 27°00'

33°00' 33°15' 33°30' 33°45' 34°00'

N

EASTERN CAPE

CACADU DISTRICT MUNICIPALITY

AMATOLE DISTRICT MUNICIPALITY

NELSON MANDELA METROPOLITAN MUNICIPALITY

Blue Crane Route

Makana

Ngqushwa

Ndlambe

Sunday's River Valley

Aberdeen Plain

P10C P10D P10A P10B P10E P10F P10G P20B P20A P30A P30B P30C P40A P40B P40C P40D P20B

P Drainage Region

De Mistkraal Dam
Wellington Grove Weirstu
Glen Melville Dam
New Year's Dam
Milner Dam
Jamieson Dam
Grey Dam
Howiesport Dam
Settlers Dam
Golden Ridge Dam
Saint Hayward Dam
Mansfield Dam
Mount Wellington Dam
Cooper's Dam

REGEOR EAST
ALICEDALE
GRAHAMSTOWN
PEDDIE
PARADISE
BREWANA
MTATA
EMSENGENI
PATERSON
ADDO
BATHURST
POMEROY
KLEINMONDE
PORT ALFRED
KENTON-ON-SEA
BUSHMANS RIVER MOUTH
BOKNES
CANNON ROCKS
COEGA
PORT ELIZABETH

Indian Ocean

Locality Map

Eastern Cape

Legend:

- Provincial Boundary
- District Municipality Boundary
- Local Municipality Boundary and Names
- Ndlambe
- P Drainage Region Boundary
- P10D Quaternary Catchment Boundary and Numbers
- Golden Ridge Dam — Dams
- Main Rivers
- Main Roads
- Rural Settlements
- Towns

Natural Vegetation

- Coastal Tropical Forest Types
- False Bushveld Types
- False Grassveld Types
- False Karoo Types
- Fasle Sclerophylous Types
- Karoo and Karroid Types
- Pure Grass Types
- Temperature and Transitional Forest and scrub Types
- Tropical Bush and Savanna Types (Bushveld)

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LO 27
WGS84

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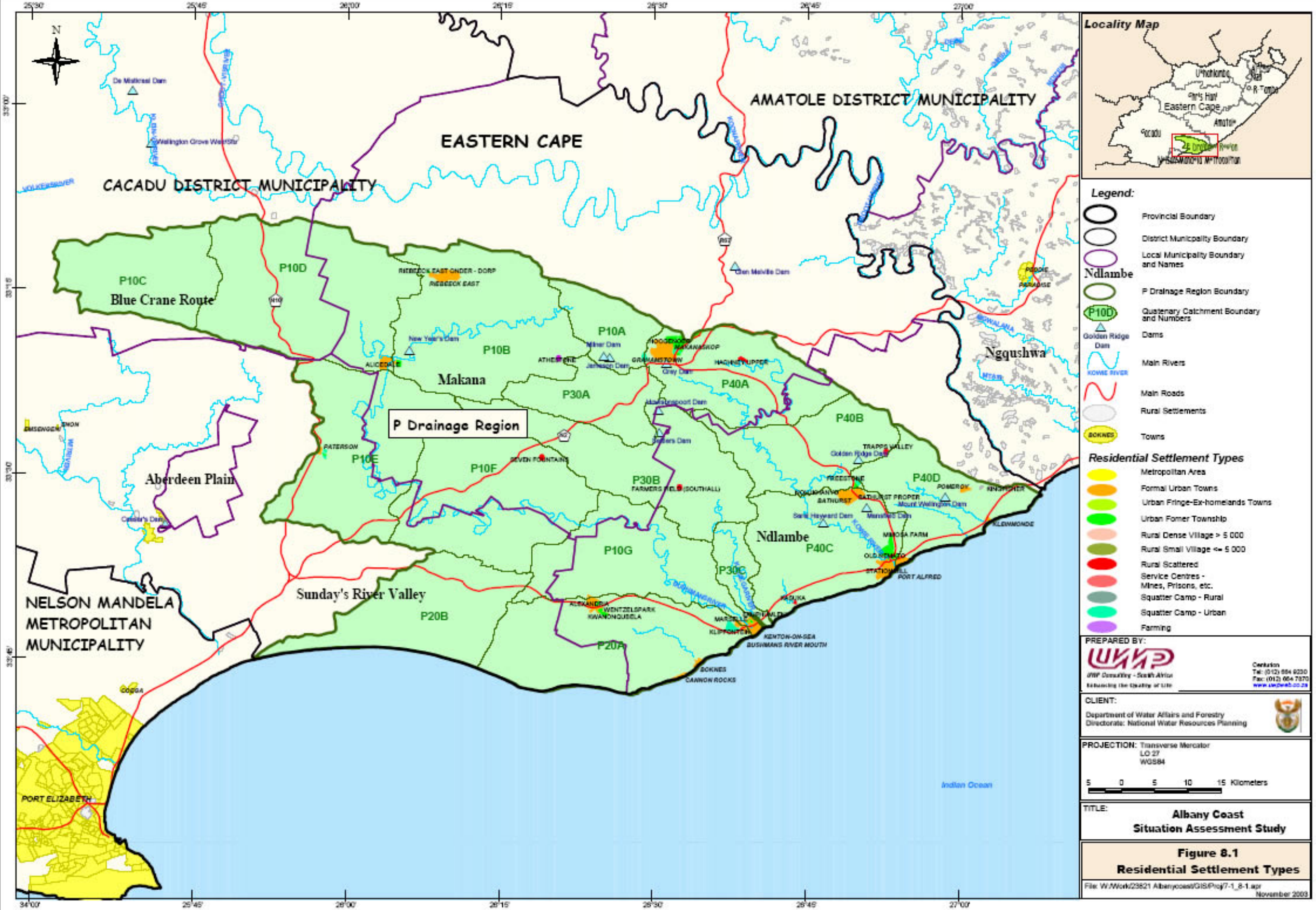
**Albany Coast Situation Assessment Study**

**Figure 7.1**
**Natural Vegetation**

File: W:/Work/23821 Albanycoast/GIS/Proj/7-1_8-1.apr
November 2003


Locality Map
Eastern Cape
Amatole
Cacadu
N
EASTERN CAPE
CACADU DISTRICT MUNICIPALITY
AMATOLE DISTRICT MUNICIPALITY
NELSON MANDELA METROPOLITAN MUNICIPALITY
Blue Crane Route
Makana
Ngqushwa
Ndlambe
Sunday's River Valley
Aberdeen Plain
P Drainage Region
P10C
P10D
P10E
P10F
P10G
P10A
P10B
P20A
P20B
P30A
P30B
P30C
P40A
P40B
P40C
P40D
De Mistkraal Dam
Wellington Grove Waterfall
Glen Melville Dam
New Year's Dam
Milner Dam
Jamieson Dam
Grey Dam
Settlers Dam
Golden Ridge Dam
Farmers Field (Southall)
Mansfield Dam
Mount Wellington Dam
Port Alfred
Port Elizabeth
Indian Ocean
Legend:
Provincial Boundary
District Municipality Boundary
Local Municipality Boundary and Names
Ndlambe
P Drainage Region Boundary
P10D
Quaternary Catchment Boundary and Numbers
Golden Ridge Dam
Dams
Main Rivers
Main Roads
Rural Settlements
Towns
Residential Settlement Types
Metropolitan Area
Formal Urban Towns
Urban Fringe-Ex-homelands Towns
Urban Former Township
Rural Dense Village > 5 000
Rural Small Village <= 5 000
Rural Scattered
Service Centres - Mines, Prisons, etc.
Squatter Camp - Rural
Squatter Camp - Urban
Farming
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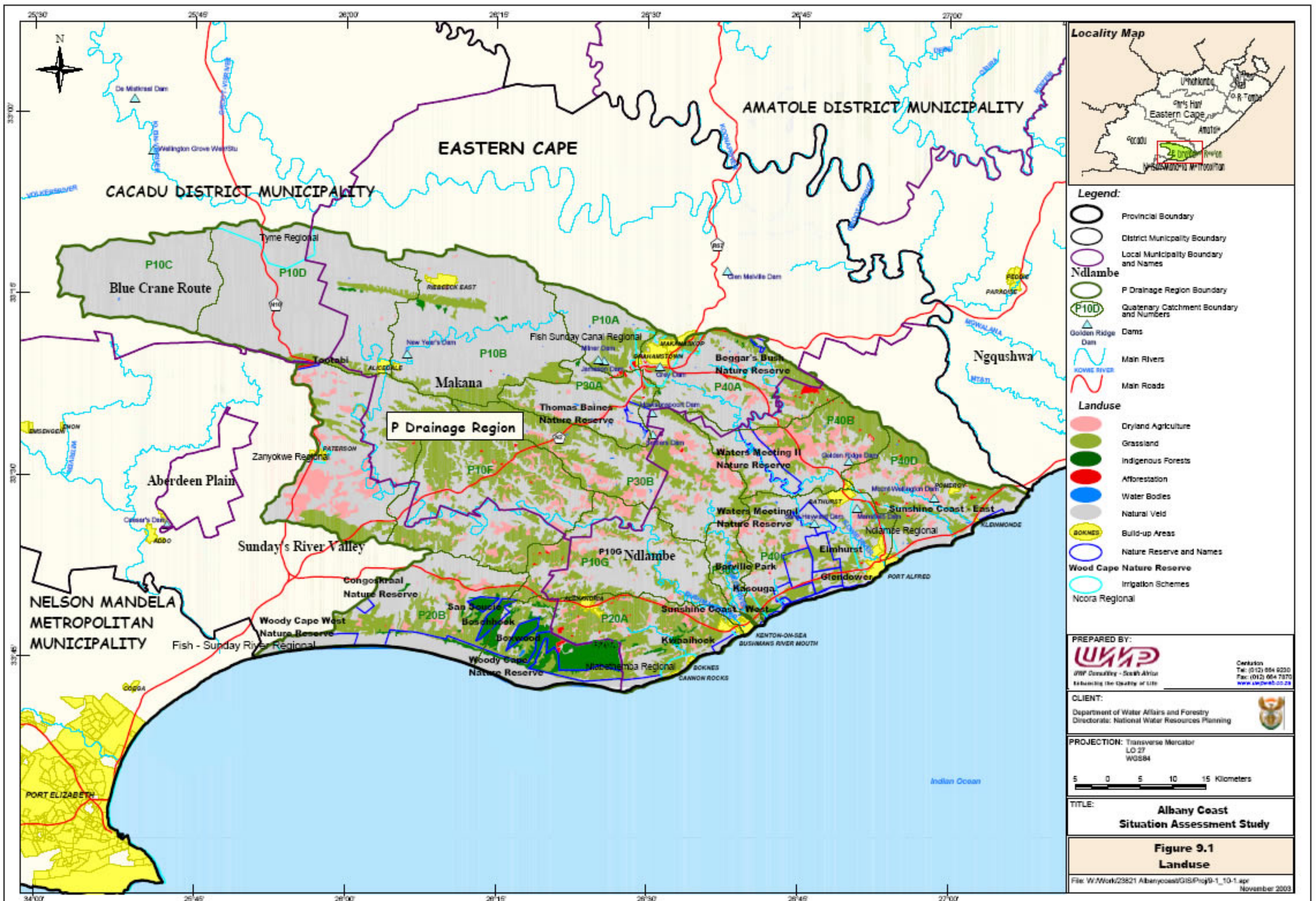
Albany Coast
Situation Assessment Study
Figure 8.1
Residential Settlement Types
File: W:/Work/23821 Albanycoast/GIS/Proj/7-1_8-1.apr
November 2003


Locality Map
Legend:
Provincial Boundary
District Municipality Boundary
Local Municipality Boundary and Names
P Drainage Region Boundary
Quaternary Catchment Boundary and Numbers
Dams
Main Rivers
Main Roads
Landuse
Dryland Agriculture
Grassland
Indigenous Forests
Afforestation
Water Bodies
Natural Veld
Build-up Areas
Nature Reserve and Names
Irrigation Schemes
EASTERN CAPE
CACADU DISTRICT MUNICIPALITY
AMATOLE DISTRICT MUNICIPALITY
NELSON MANDELA METROPOLITAN MUNICIPALITY
P Drainage Region
P10C
Blue Crane Route
P10D
Tyme Regional
P10A
Fish Sunday Canal Regional
P10B
Makana
P30A
Thomas Baines Nature Reserve
P40A
Beggar's Bush Nature Reserve
P40B
P40D
Waters Meeting II Nature Reserve
P10F
P30B
Aberdeen Plain
Zanyokwe Regional
Sunday's River Valley
P10G
Ndlambe
Ndlambe Regional
P40C
Elmhurst
Boknes
Sunshine Coast - East
Sunshine Coast - West
Congoskraal Nature Reserve
Woody Cape West Nature Reserve
P20B
P20A
Fish - Sunday River Regional
Woody Cape Nature Reserve
Ngqushwa
Ncora Regional
Indian Ocean
PORT ELIZABETH
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Directorate: National Water Resources Planning
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LO 27
WGS84
5 0 5 10 15 Kilometers
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Situation Assessment Study
Figure 9.1
Landuse
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