

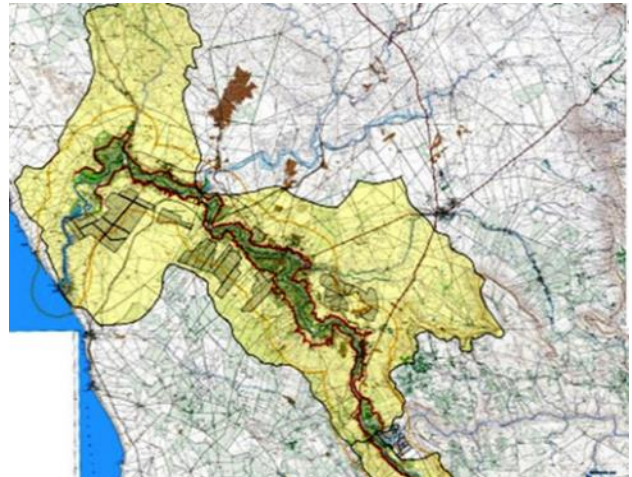


**water & sanitation**

Department:  
Water and Sanitation  
**REPUBLIC OF SOUTH AFRICA**

Post Feasibility Bridging Study for the Proposed Bulk Conveyance Infrastructure  
from the Raised Clanwilliam Dam (WP0485)

## **Existing Infrastructure and Current Agricultural Development Sub-Report**



Department of Water and Sanitation  
Directorate: Options Analysis

**POST FEASIBILITY BRIDGING STUDY FOR THE PROPOSED BULK CONVEYANCE  
INFRASTRUCTURE FROM THE RAISED CLANWILLIAM DAM**

**APPROVAL**

**Title** : Existing Infrastructure and Current Agricultural  
Development Sub-Report

**Consultants** : Aurecon South Africa (Pty) Ltd

**Report status** : Final

**Date** : June 2018

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**water & sanitation**

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Water and Sanitation  
REPUBLIC OF SOUTH AFRICA

**DEPARTMENT OF WATER AND SANITATION**

Directorate: Options Analysis

**Post Feasibility Bridging Study for the Proposed Bulk Conveyance  
Infrastructure from the Raised Clanwilliam Dam**

**EXISTING INFRASTRUCTURE AND CURRENT  
AGRICULTURAL DEVELOPMENT SUB-REPORT**

**June 2018**

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## Post Feasibility Bridging Study for the Proposed Bulk Conveyance Infrastructure from the Raised Clanwilliam Dam

Reports produced as part of this project are indicated below.

**Bold** type indicates this report.

Report Index	Report Number	Report Title
1		Inception Report
2	P WMA 09/E10/00/0417/2	Capacity Building & Training Year 1
3	P WMA 09/E10/00/0417/3	Capacity Building & Training Year 2
4	P WMA 09/E10/00/0417/4	Water Requirements Assessment
5	P WMA 09/E10/00/0417/5	Distribution of Additional Available Water
<b>6</b>		<b>Existing Infrastructure and Current Agricultural Development Sub-Report</b>
7	P WMA 09/E10/00/0417/6	Existing Conveyance Infrastructure and Irrigated Land
8		Suitable Agricultural Areas and Land Ownership Report
9		Evaluation of Development Options Sub-Report
10	P WMA 09/E10/00/0417/10	Suitable Areas for Agricultural Development
11		Right Bank Canal Design Sub-Report
12		Conceptual Design Sub-Report
13		Environmental Screening Sub-Report
14		Jan Dissels and Ebenhaeser Schemes Design Sub-Report
15	P WMA 09/E10/00/0417/13	Feasibility Design
16	P WMA 09/E10/00/0417/7	Topographical Surveys
17	P WMA 09/E10/00/0417/8	Geotechnical Investigations
18	P WMA 09/E10/00/0417/9	Soil Survey
19		Financial Viability of Irrigation Farming Sub-Report
20	P WMA 09/E10/00/0417/11	Agricultural Production and Farm Development
21		Right Bank Canal Cost Analysis Sub-Report
22		Socio-Economic Impact Analysis Sub-Report
23	P WMA 09/E10/00/0417/12	Socio-Economic Impact Analysis
24	P WMA 09/E10/00/0417/14	Record of Implementation Decisions Report
25	P WMA 09/E10/00/0417/1	Main Report
26	P WMA 09/E10/00/0417/15	Historically Disadvantaged Farmers Report

**Concise Description of the Content of Study Reports**

<b>Report Index</b>	<b>Report Number</b>	<b>Report Title and Description of Content</b>
1		<p><b>Inception</b>                      The report forms part of the contract and stipulates the scope of work for the study, the contract amount and the contract period. It contains a detailed description of tasks and methodology, a study programme, human resource schedule, budget and deliverables. The Capacity Building and Training Plan has been included.</p>
2	P WMA 09/E10/00/0417/2	<p><b>Capacity Building &amp; Training Year 1</b>                      Describes the range of capacity building and training activities planned for the study, and the activities undertaken during the first year of the study, including field-based training, training workshop 1 and mentorship of DWS interns through secondment.</p>
3	P WMA 09/E10/00/0417/3	<p><b>Capacity Building &amp; Training Year 2</b>                      Describes the range of capacity building and training activities planned for the study, and the activities undertaken during the second year of the study, including field-based training, training workshop 2 and mentorship of DWS interns through secondment.</p>
4	P WMA 09/E10/00/0417/4	<p><b>Water Requirements Assessment</b>                      Provides an analysis of the existing water use and current water allocations in the study area, and addresses ecological water requirements, water use for irrigated agriculture and projections for future use, current domestic and industrial water use and projections for future use, water use for hydropower and water losses in the water supply system.</p>
5	P WMA 09/E10/00/0417/5	<p><b>Distribution of Additional Available Water</b>                      Confirms the volume of additional water available for development, after water has been reserved for the current water uses, as well as making recommendations on how the additional yield should be distributed among water use sectors and water users.</p>
6		<p><b>Existing Infrastructure and Current Agricultural Development Sub-Report</b>                      Provides an overview of the extent and general condition of the current bulk water storage and conveyance infrastructure. This report also provides an overview of the locality and extent of the existing agricultural areas determined by reviewing Geographic Information System (GIS) data obtained from various sources.</p>
7	P WMA 09/E10/00/0417/6	<p><b>Existing Conveyance Infrastructure and Irrigated Land</b>                      An update of the Sub-Report, providing a refinement of the current agricultural water requirements following evaluation of the current crop types, an assessment of the desirability of diverting releases for downstream irrigators via the Clanwilliam Canal and Jan Dissels River, to meet the summer ecological flows in the lower Jan Dissels River, and presents an Implementation Action Plan with costs.</p>

Report Index	Report Number	Report Title and Description of Content
8		<p><b>Suitable Agricultural Areas and Land Ownership Sub-Report</b>                      Description of the collection of information and the preparation undertaken for the analysis of options, which includes a summary of existing irrigated areas and water use, cadastral information, land ownership, environmental sensitivity, soils suitability, water quality considerations and constraints, and the initiation of the process to identify additional areas suitable for irrigation.</p>
9		<p><b>Evaluation of Development Options Sub-Report</b>                      Describes the salient features, costs and impacts of identified potential irrigation development options for new irrigation development in the lower Olifants River. This provides the background and an introduction to the discussions at the Options Screening Workshop held in December 2018.</p>
10	P WMA 09/E10/00/0417/10	<p><b>Suitable Areas for Agricultural Development</b>                      Describes the supporting information, process followed and the salient features, costs and impacts of identified potential irrigation development options for new irrigation development in the lower Olifants River. Recommends the preferred options to be evaluated at feasibility level.</p>
11		<p><b>Right Bank Canal Feasibility Design Sub-Report</b>                      Describes the Design Criteria Memorandum, based on best practice in engineering and complying with recognised codes and standards. Description of route alignments and salient features of the new Right Bank canal. Feasibility-level design of bulk infrastructure, including evaluation of capacities, hydraulic conditions, canal design, surface flow considerations, canal structures, power supply and access roads. Operational considerations and recommendations.</p>
12		<p><b>Conceptual Design Sub-Report</b>                      Describes the scheme layouts at a conceptual level and infrastructure components to be designed, alternatives to consider or sub-options, and affected land and infrastructure, as well as the updated recommended schemes for new irrigation development.</p>
13		<p><b>Environmental Screening Sub-Report</b>                      Describes and illustrates the opportunities and constraints, and potential ecological risks/impacts and recommendations for the short-listed bulk infrastructure development options at reconnaissance level. Describes relevant legislation that applies to the proposed irrigation developments.</p>

<b>Report Index</b>	<b>Report Number</b>	<b>Report Title and Description of Content</b>
14		<p><b>Jan Dissels and Ebenhaeser Schemes Feasibility Design Sub-Report</b>                      Describes the Design Criteria Memorandum, based on best practice in engineering and complying with recognised codes and standards. Description of route alignments and salient features of the Jan Dissels and Ebenhaeser schemes. Feasibility-level design of bulk infrastructure, including evaluation of capacities, hydraulic conditions, intake structures, balancing dams and reservoirs, rising mains and gravity pipelines and trunk mains where relevant, power supply and access roads. Operational considerations and recommendations.</p>
15	P WMA 09/E10/00/0417/13	<p><b>Feasibility Design</b>                      Description of the approach to and design of selected bulk infrastructure at feasibility level, with supporting plans and implementation recommendations.</p>
16	P WMA 09/E10/00/0417/7	<p><b>Topographical Surveys</b>                      Describes the contour surveys for the proposed identified bulk infrastructure conveyance routes and development areas, the surveying approach, inputs and accuracy, as well as providing the survey information.</p>
17	P WMA 09/E10/00/0417/8	<p><b>Geotechnical Investigations</b>                      Presents the findings of geotechnical investigations of the various identified sites, as well as the approach followed, field investigations and testing, laboratory testing, interpretation of findings and geotechnical recommendations.</p>
18	P WMA 09/E10/00/0417/9	<p><b>Soil Survey</b>                      Describes the soil types, soil suitability and amelioration measures of the additional area covering about 10 300 ha of land lying between 60 to 100 m above river level, between the upper inundation of the raised Clanwilliam Dam and Klaver.</p>
19		<p><b>Financial Viability of Irrigation Farming Sub-Report</b>                      Describes the findings of an evaluation of the financial viability of pre-identified crop-mixes, within study sub-regions, and advises on the desirability of specific crops to be grown in these sub-regions. It includes an evaluation of the financial viability of existing irrigation farming or expanding irrigation farming, as well as the identification of factors that may be obstructive for new entrants from historically disadvantaged communities.</p>
20	P WMA 09/E10/00/0417/11	<p><b>Agricultural Production and Farm Development</b>                      This report will focus on policy, institutional arrangements, available legal and administrative mechanisms as well as the proposed classes of water users and the needs of each. This would include identifying opportunities for emerging farmers, including grant and other types of Government and private support, and a recommendation on the various options and opportunities that exist to ensure that land reform and water allocation reform will take place through the project implementation.</p>



<b>Report Index</b>	<b>Report Number</b>	<b>Report Title and Description of Content</b>
21		<b>Right Bank Canal Cost Analysis Sub-Report</b> Provides an economic modelling approach to quantify the risk of the failure of the existing main canal and the determination of the economic viability of the construction of the new right bank canal to reduce the risk of water supply failure.
22		<b>Socio-Economic Impact Analysis Sub-Report</b> Describes the socio-economic impact analysis undertaken for the implementation of the new irrigation development schemes, for both the construction and operational phases. This includes a description of the social and economic contributions, the return on capital investment, as well as the findings of a fiscal impact analysis.
23	P WMA 09/E10/00/0417/12	<b>Socio-Economic Impact Analysis</b> Synthesis of agricultural economic and socio-economic analyses undertaken, providing an integrated description of agricultural production and farm development and socio-economic impact analysis, as well as the analysis of the right bank canal costs and benefits.
24	P WMA 09/E10/00/0417/14	<b>Record of Implementation Decisions</b> Describes the scope of the project, the specific configuration of the schemes to be implemented, the required implementation timelines, required institutional arrangements and the required environmental and other approval requirements and mitigation measures, to ensure that the project is ready for implementation.
25	P WMA 09/E10/00/0417/1	<b>Main Report</b> Provides a synthesis of approaches, results and findings from the supporting study tasks and interpretation thereof, culminating in the study recommendations. Provides information in support of the project funding motivation to be provided to National Treasury.
26	P WMA 09/E10/00/0417/15	<b>Historically Disadvantaged Farmers Report</b> Describes the activities undertaken by an independent consultant to evaluate existing HDI Farmers policies and legislative context, identify, map and analyse prospective HDI farmers and potential land for new irrigation, as well as propose a mechanism for the identification and screening of HDI farmers.

# Executive Summary

An overview of the extent and general condition of the current water infrastructure is required as input for the development of infrastructure options, for the distribution of additional water from a raised Clanwilliam Dam. This report provides the overview which includes the current conveyance infrastructure (the Clanwilliam Canal and the Lower Olifants Canal), the Clanwilliam Dam, the Bulshoek Weir and the Ebenhaezer Scheme. Information required was obtained by conducting a literature review of previous studies done in the study area, verification by a field trip and public meetings, and confirmation of additional information with stakeholders such as the water user associations.

It was found that the condition of the canals ranged from fair to very poor. Those sections of the existing canals that need urgent rehabilitation will be identified and used to develop an Implementation Action Plan as part of the *'Existing Conveyance Infrastructure and Irrigated Land'* Report.

This report also provides an overview of the existing agricultural development by reviewing GIS data obtained from various sources, such as the *'Feasibility Study for the Raising of Clanwilliam Dam'* (DWAF, 2008), and the Western Cape Provincial Department of Agriculture's *Cape Farm Mapper*, etc.

The locality and extent of the existing agricultural areas is provided. The *'Existing Conveyance Infrastructure and Irrigated Land'* Report will refine the current agricultural water requirements following an evaluation of the current crop types.

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## Acronyms

CBA	Critical biodiversity area
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
GIS	Geographical information system
GWS	Government water scheme
HDPE	High density polyethylene
LORGWS	Lower Olifants River Government Water Scheme
LORWUA	Lower Olifants River Water User Association
MAR	Mean annual runoff
NPV	Net present value
P&G	Preliminary and General
uPVC	Unplasticised polyvinyl chloride
VAT	Value added tax
WCDoA	Western Cape Department of Agriculture (Provincial)
WUA	Water User Association

# 1 Introduction

## 1.1 Study Background and Objective

The Clanwilliam Dam is situated near the town of Clanwilliam, on the Olifants River in the Western Cape Province. The planned raising of the Clanwilliam Dam by the Department of Water and Sanitation (DWS) will result in an increase in the capacity of the dam from 122 million m<sup>3</sup> to 344 million m<sup>3</sup>, with an additional yield of 82.1 million m<sup>3</sup>/a. This increased capacity will provide additional water for irrigation and for other uses.

The objective of this study is to provide recommendations on the bulk conveyance infrastructure required for the equitable distribution of water from the existing dam, as well as the additional water which will be available from the raised Clanwilliam Dam.

## 1.2 Report Objectives

This report is focused on the review and confirmation of the extent of the existing bulk conveyance infrastructure and current agricultural development in the supply area. This report aims to:

1. Provide an overview of the extent and general condition of the current water infrastructure, which includes obtaining the following information:
  - a. Identification of the sections of the existing Clanwilliam and Lower Olifants canals that need urgent rehabilitation to avoid serious disruptions of the water supply; and
  - b. Maintenance or upgrade projects planned for the canal systems.
2. Obtain and present information regarding the current agricultural development, which includes:
  - a. The locality and extent of the agricultural areas; and

- b. The potential for further agricultural development adjacent to the existing development and the suitability of these areas in terms of topography, soil type, crops, ownership, etc.

The *'Existing Conveyance Infrastructure and Irrigated Land'* Report, which has the same objectives, will build on this report by including the following information:

- Investigation of the supply of water to the lower Jan Dissels catchment irrigation area, via the Clanwilliam Canal as suggested in the Jan Dissels River Compulsory licensing reports; and
- The water requirements and allocations for the various areas and reconciliation with the information obtained in the Current Water Use and Allocation Report.

### 1.3 Study Area

The study area mainly comprises the Clanwilliam Dam supply area, which is within the Cederberg and Matzikama Local Municipalities, and includes the towns of Clanwilliam, Klawer, Lutzville, and Vredendal. The study area may potentially include portions of the Olifants River valley upstream of Clanwilliam Dam. Some activities may even extend the study area to the larger catchment area, such as the Jakkals River.

For the purposes of this study, the Olifants River catchment's study area, shown in **Figure 1.1** has been separated into three relatively homogeneous regions, namely:

- Region 1: Catchment area upstream of Clanwilliam Dam;
- Region 2: Catchment area downstream of Clanwilliam Dam and upstream of Bulshoek Weir;
- Region 3: Catchment area downstream of Bulshoek Weir to the estuary.



Figure 1.1 | The study area zones and municipalities



## 1.4 Report Structure

This report comprises an executive summary and **Section 1** to **Section 5**. The different sections have been structured as follows:

**Section 1** provides the background to this study and the purpose of this report.

**Section 2** describes the approach and methodology followed to carry out this task.

**Section 3** describes the extent of the current water infrastructure and provides the assessment of their existing condition.

**Section 4** describes the evaluation of the current agricultural development.

**Section 5** summarises the findings of this report and the items that will be included for the *'Existing Conveyance Infrastructure and Irrigated Land'* Report.

## 2 Approach and Methodology

In order to provide an overview and determine the condition of the current water infrastructure, a literature review on previous studies and initiatives was undertaken, which included the 'Feasibility Study for the Raising of Clanwilliam Dam' (DWAF, 2008), the 'Provide Support to Compulsory Licensing in the Jan Dissels River Catchment: Western Cape' (DWAF, 2008) and the 'Western Cape Olifants / Doring River Irrigation Study' (WCDoA, 2005). In addition to the literature review on previous studies, various newspaper and magazine articles that describe the impacts of canal breaks on the irrigation community were consulted.

In November 2017, the project team conducted a field trip to the study area. During this field trip, the project team met with the Lower Olifants River Water User Association (LORWUA), Clanwilliam Water User Association (WUA), officials from the local DWS and the Provincial Government Western Cape Department of Agriculture (WCDoA) who provided insight to various operational issues experienced in the schemes. Public meetings were also held in Ebenhaezer, Clanwilliam and Vredendal in February 2018, where concerns of the communities in the study area were raised. The project team also obtained additional information from these stakeholders following both the field trip and the public meetings.

The supply of water to the lower Jan Dissels irrigation area via the Clanwilliam canal, as suggested in the Jan Dissels River Compulsory licensing reports, will be investigated in the 'Existing Conveyance infrastructure and Irrigated Land' Report.

A GIS mapping exercise was undertaken to obtain information on the current agricultural development in the study area. Shapefiles showing the existing extent of the cultivated and irrigated areas were obtained from the 'Validation and Verification of existing lawful water uses within the Berg Olifants WMA', also referred to as the V&V Study. The Crop Census data of 2013 provided shapefiles on the crop types, and soil mapping was extracted from the 'Feasibility Study for the Raising of Clanwilliam Dam' (DWAF, 2008). At this stage, it was considered that the existing soil map covers the study area sufficiently and that it would not be necessary to extend the soil survey to beyond the lateral extent of 60 m above the level of the

river or existing canals. However, this would be revisited later if required, if it is for example found that the bulk conveyance of additional water becomes more expensive than considering new irrigation areas beyond the lateral extent of 60 m above the Olifants River or canal systems.

# 3 Existing Infrastructure

**Figure 3.1** provides an overview of the existing conveyance infrastructure discussed in this report.

## 3.1 Clanwilliam Dam

The Clanwilliam Dam was originally constructed in 1935 with a capacity of 69.86 million m<sup>3</sup>. The Dam was raised in 1962 by 6.10 m to increase the capacity to 128 million m<sup>3</sup>. The Dam basin currently has a live storage capacity of 122 million m<sup>3</sup>. The current mean annual runoff (MAR) at the dam is 360 million m<sup>3</sup>. The dam currently supplies approximately 11 000 ha of scheduled water downstream of the dam. There are 318 ha scheduled allocations from the dam basin.

Due to proposed betterments to improve the safety of the dam wall, the opportunity to raise the dam was investigated. The Feasibility Study, concluded in 2008, found that a 13 m dam raising would be economically viable as a substantial increase in yield from the dam of 70 million m<sup>3</sup> (based on the increase in firm yield) could be achieved, thereby increasing the current storage volume to 344 million m<sup>3</sup>, i.e. nearly a 1 MAR capacity dam.

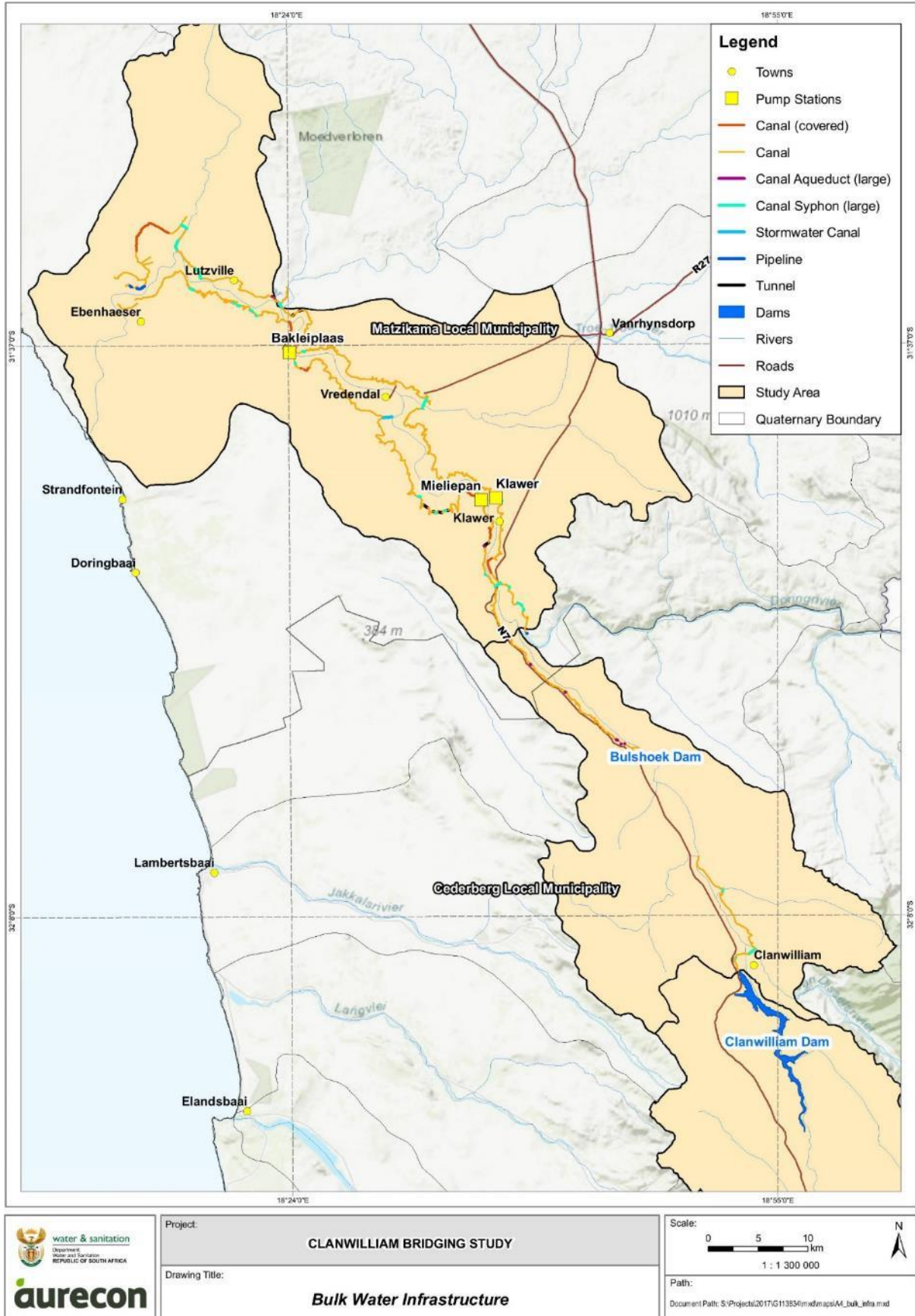


Figure 3.1 | Existing bulk water infrastructure

During a recent visit to the study area in November 2017, the Clanwilliam Dam was 39% full (**Figure 3.2**). The dam's water level may be allowed to drop to 6% before the next rain season.



**Figure 3.2 | Low water levels in the Clanwilliam Dam in November 2017**

The only power station in the area is a small privately-owned hydro-electric installation (non-consumptive water user) on the right bank at Clanwilliam Dam which supplies electricity to the town of Clanwilliam (**Figure 3.3**). In 1998, Clackson Power (Pty) Ltd bought the hydropower station from the Cederberg Municipality. On 17 April 2001, the DWS and Clackson Power entered into an operations agreement that the power station will not consume any water, but that it will make use of water released from the Clanwilliam Dam, as and when water is released, for power generation. On 28 March 2008, Clackson Power registered with NERSA to generate 1.5 MW hydropower.

The plant provides base load and helps to stabilise the current voltage variations in Clanwilliam. Turbines of 1.7 MW capacity have been installed, but only 1.1 MW is currently generated. There is therefore capacity for expansion, as well as significant demand for additional power generation (as the cost of power generation is lower than Eskom's).

Provision has been made in the proposed new outlet works on the left bank to supply the hydropower plant. The plant has to move to the left bank. Although the construction of civil

structure to accommodate the hydropower plant is not occurring at the same time as the raising of the Clanwilliam Dam, the latest civil design drawings indicate spatial provision for the structure in the future. The flow to the hydro power plant will increase due to larger volumes of water allocated to downstream uses. All normal flows released to the river passes through the plant.



**Figure 3.3 | Existing turbine on the right bank of Clanwilliam Dam**

### **3.1.1 Operating Rules – Clanwilliam Dam Releases**

The Clanwilliam Dam is operated at a draft that exceeds its historical firm yield. In most years, it is drawn down to between 5% to 20% of its full supply capacity. As its capacity is only 33% of the present-day mean annual runoff, it usually fills during the wet winter months. Releases from the Clanwilliam Dam are dependent on the water demand from the Clanwilliam WUA and the LORWUA.

The government notice (no. 1152) issued in Government Gazette No. 41216 on 31 October 2017 currently limits the use of water in the catchment area above and below the Clanwilliam Dam. This is in light of the recent water shortage due to below normal rains experienced over the past 3 seasons up to 2017. These limitations placed by the government notice are for this extreme drought event and should not be regarded as normal.

The notice also enforces that all water user sector groups and individuals abstracting water from the Olifants River catchment area, dams and/or rivers that form part of the system, must install electronic recording, monitoring or water measuring devices to enable monitoring of abstraction, storage and use of existing lawful water. In addition, links need to be established with any monitoring or management system, and records of the water use need to be kept.

The restricted releases from the Clanwilliam Dam are also to be further limited to operating and applied rules agreed to by the National Water Resources Infrastructure Branch: Southern Operations of the Department (and/or delegated officials) and the LORWUA. These agreed rules are to be reviewed on a weekly basis.

Placing a limitation on the taking of water use as set out in this notice was instituted without allowing the affected water users and other role players to comment on the matter. The notice is effective from its date of publication in the Gazette and remains applicable until the Clanwilliam Dam recovers to above 85%, at which point the DWS Western Cape Regional Head must lift the water restrictions.

### 3.2 Clanwilliam Canal

The Clanwilliam Canal, approximately 18 km in length, originates at the Clanwilliam Dam wall (**Figure 3.4**), passes through Clanwilliam town and crosses the Jan Dissels River. The canal, which was built during 1940, supplies water for irrigation.

The Clanwilliam Canal is owned by the DWS; however, the Clanwilliam WUA is responsible for the canal's operation and maintenance. Water off-takes from the canal are set twice in one season and farmers currently pay total charges of R811.16 per hectare per annum (**Table 3.1**). Farmers making use of the canal pay for their scheduled allocations and receive a rebate only on government charges in cases of severe restrictions.

In the Clanwilliam scheme, there are 564 ha scheduled allocations from the Clanwilliam Canal and 665 ha allocated from the Olifants River. Water from the canal to water users is supplied at a rate of 0.83 l/s/ha, thus the maximum capacity required is 1685 m<sup>3</sup>/h. However, the maximum carrying capacity of the canal is accepted as 1700 m<sup>3</sup>/h (0.47 m<sup>3</sup>/s), which means that during peak periods the canal is close to full capacity. Although, according to discussions with the Clanwilliam WUA in November 2017, the canal currently has some spare capacity. Canal losses are estimated as 20%.





Figure 3.4 | Start of the Clanwilliam Canal

Table 3.1 | Clanwilliam WUA annual water tariffs

Clanwilliam WUA Canal	2017 / 2018 (per hectare)
Catchment Management Agency	R244.00
Infrastructure	R291.58
Water Research	R5.95
WUA Management	R77.76
WUA Audit	R13.18
WUA Canal Maintenance	R178.69
<b>Total (excluding VAT)</b>	<b>R811.16</b>

The canal has a uniform profile. A recent site visit to the canal revealed that the Clanwilliam Canal has patch repairs along most of its length (**Figure 3.5**). In many canal sections, the stone aggregate in the concrete canal lining was exposed due to the aggressive water. The canal lining was on average less than 100 mm thick.



**Figure 3.5 | Typical condition of concrete lining along the Clanwilliam Canal**

### **3.2.1 Condition Assessment**

The DWS appointed LTE Consulting and Pula Strategic Resource Management to conduct a condition assessment of the Clanwilliam Canal (DWS, 2016a).

The key study outputs included: (1) the verification of existing assets according to location, type and size, and (2) an evaluation of the condition of the infrastructure and the associated requirements to rehabilitate, repair or replace assets for effective water supply to irrigation farmers and other users.

The comprehensive study assessed the condition of the canal lining, shoulders, berms and stormwater management, supers and culverts, fences and safety, bridges, service roads, siphons, measuring infrastructure, long-weirs, outlets, emergency spills and rejects, and balancing dams. It found that the condition of the infrastructure generally ranged from fair to poor.

The study proposed short-term, medium-term and longer-term interventions. The short-term actions (1 to 3 years) include *inter-alia* resolving the maintenance backlog, replacement of broken canal lining panels and relining of very poor canal sections. The medium-term actions (4 to 6 years) include repairing berms and stormwater management structures, repairing service roads, reinstatement of safety measures, repairing siphons and water meter structures. The longer-term actions (7 to 9 years) include upgrades to the balancing dams, service points,

emergency spills and new canal sections, as well as renewal of the aged infrastructure, and replacement of the entire canal. Estimated costs of these intervention actions are indicated in **Table 3.2** below. The amount indicated in **Table 3.2** for the long-term interventions will not be sufficient. This amount will have to be investigated further and will need to be revised in the 'Existing Conveyance Infrastructure and Irrigated Land' Report.

**Table 3.2 | Estimated cost to repair, upgrade and maintain the Clanwilliam WUA infrastructure (DWS, 2016a)**

Term	Period	2016 Amount (incl. fees, P&G's, contingencies, VAT)
Short-term	1 – 3 years	R 30 425 202
Medium-term	4 – 6 years	R 6 864 542
Longer-term	7 – 9 years	R 1 405 038

### 3.3 Olifants River (Vanrhynsdorp) Government Water Scheme (ORGWS)

The Olifants River (Vanrhynsdorp) Government Water Scheme (ORGWS), which forms the backbone of the local economy, consists of the canal system fed from Bulshoek Weir with water released from the Clanwilliam Dam. The canal system (the Lower Olifants Canal) supplies irrigation, industrial, and domestic water to the Matzikama Municipality for the following towns and communities: Vredendal, Klawer, Lutzville, Koekenaap, Ebenhaezer, Papendorp, Strandfontein, Doring Bay and Vanrhynsdorp. The Tronox Mine at Brand-se-Baai and its smelter near Koekenaap are also supplied with water from the canal system.

The LORWUA is responsible for the general operation and maintenance of the canal, whereas the DWS is responsible for upgrading and refurbishment, including repairs of major breaks. The transfer of the operation and maintenance of the Olifants River (Vanrhynsdorp) State Irrigation Scheme from the Department of Water Affairs and Forestry (DWAF) (now DWS) to the LORWUA was approved in 2001. The LORWUA was established with the purpose of taking over the operation and maintenance of the Bulshoek Weir and the canal distribution system of the scheme. Upon approval of the transfer, certain powers and duties in terms of the National Water Act of 1998 were delegated to the LORWUA.

### 3.4 Bulshoek Weir

The Bulshoek Weir was constructed across the Olifants River about 26 km downstream of Clanwilliam town. The weir, with a capacity of 5.754 million m<sup>3</sup>, together with a system of unlined canals, comprised the irrigation scheme for 8 500 ha of land along the Olifants River,

Van Rhynsdorp District, which was completed in 1923. The weir's catchment area is 2 679 km<sup>2</sup> in extent.

The Bulshoek Weir, completed in 1920, is a stone-masonry gravity structure (**Figure 3.6**). A series of connected arches and buttresses supporting a bridge deck and a gantry for the spillway gate hoists make up the dam wall. Sixteen gates are positioned between the buttresses on top of the ogee-shaped crests.

The dam is operated at close to its full supply capacity to divert water into the irrigation canal. Seepage through and under the Bulshoek Weir is pumped back into the canal supplying water to the LORWUA during dry periods.



**Figure 3.6 | Bulshoek Weir**

Leakage through the foundation of the dam has been a problem since its completion, as indicated by grouting records from as early as the 1930s (Schall, cited by Oosthuizen and Brink 2015). A 1998 investigation documented large, deep cavities in the foundation where substantial flows were visible on the surface of the tail water. From 1999 to 2001, local operational and maintenance staff attempted to reduce the leak by using a geofabric upstream, sealing the downstream cavities with sand, and channelling the major leaks through pipes. The leak was estimated at 800 l/s as noted by Oosthuizen and Brink (2015); however, Mr R

Nieuwoudt's (DWS) assessment is that the leak was more in the order of 400-500 l/s. Although the flow was substantially decreased after each attempt, the leakage would gradually increase afterwards (Oosthuizen and Brink, 2015). The first two formal Dam Safety Inspections by the (then) Sub-Directorate: Dam Safety of DWAF, noted cracks in the masonry balustrade on the top of the dam, as well as at one of the spillway gates, which indicated problems with the foundations.

The Bulshoek Weir is founded on the quartzitic sandstone and sandstone of the Table Mountain Group of the Cape Supergroup. Seepage water moving along the sandstone's sub-horizontal bedding planes is intercepted by a fault in the foundation that runs parallel to the dam wall. The leaking water also washed fine material from the bedding planes and created cavities in the foundation. Since the bedding planes are continuous over large areas, the shear strength loss could eventually spread along the entire base of the dam.

From November 2003 until February 2005, the DWS undertook remedial work on the Bulshoek Weir, with the main objective to protect the dam from structural failure. A concrete apron was provided downstream of the existing structure and doweled into the rock foundation to increase the sliding resistance of the structure. As part of the remedial work undertaken, mass concrete retaining walls were provided on each flank to reduce potential further erosion of the foundation rock downstream. Instrumentation comprising survey beacons, targets and bench marks was provided, as well as 3D Crack Tilt Gauges. The mechanical and electrical equipment for operating the spillway gates was refurbished at the same time.

The work performed was originally not intended to prevent or limit leakage from the structure; but rather to address leakage as part of the planned work to be done during the raising of the Clanwilliam Dam, while (it was foreseen that) its construction team would be available in the area. It was envisaged that a grouting programme would be designed to reduce the leakage. However, no provision was made either in the priced Bill of Quantities or the grouting tender, which was prepared for the Clanwilliam Dam (Swart 2018, personal communication, 14 May).

The leakage amount differs depending on the water level in the dam. At full supply level in the dam (5.5 m), an estimated 2 400 m<sup>3</sup>/h is lost. It was also noted that there is a large leak (250 m<sup>3</sup>/h) on the southern flank of the dam.

During the 2004 drought period, a pumping system (two pumps, pipework and electrical works) was installed for R600 000, in order to recover some of the leaked water (**Figure 3.7**). Water is pumped straight into the canal while it is operational; otherwise water is pumped into the reservoir of the Bulshoek Weir. Operational costs for the pumping system are approximately R60 000 per month.



Figure 3.7 | Pumping system installed at Bulshoek Weir to recover leakage

### 3.5 Lower Olifants Canal

Downstream of the Bulshoek Weir, water is diverted into the Lower Olifants Canal (**Figure 3.8**) which is the main conveyance system in the Olifants River (Van Rhynsdorp) Government Water Scheme (GWS). The canals and tunnels were mainly constructed during the 1930s.



Figure 3.8 | The Lower Olifants Canal

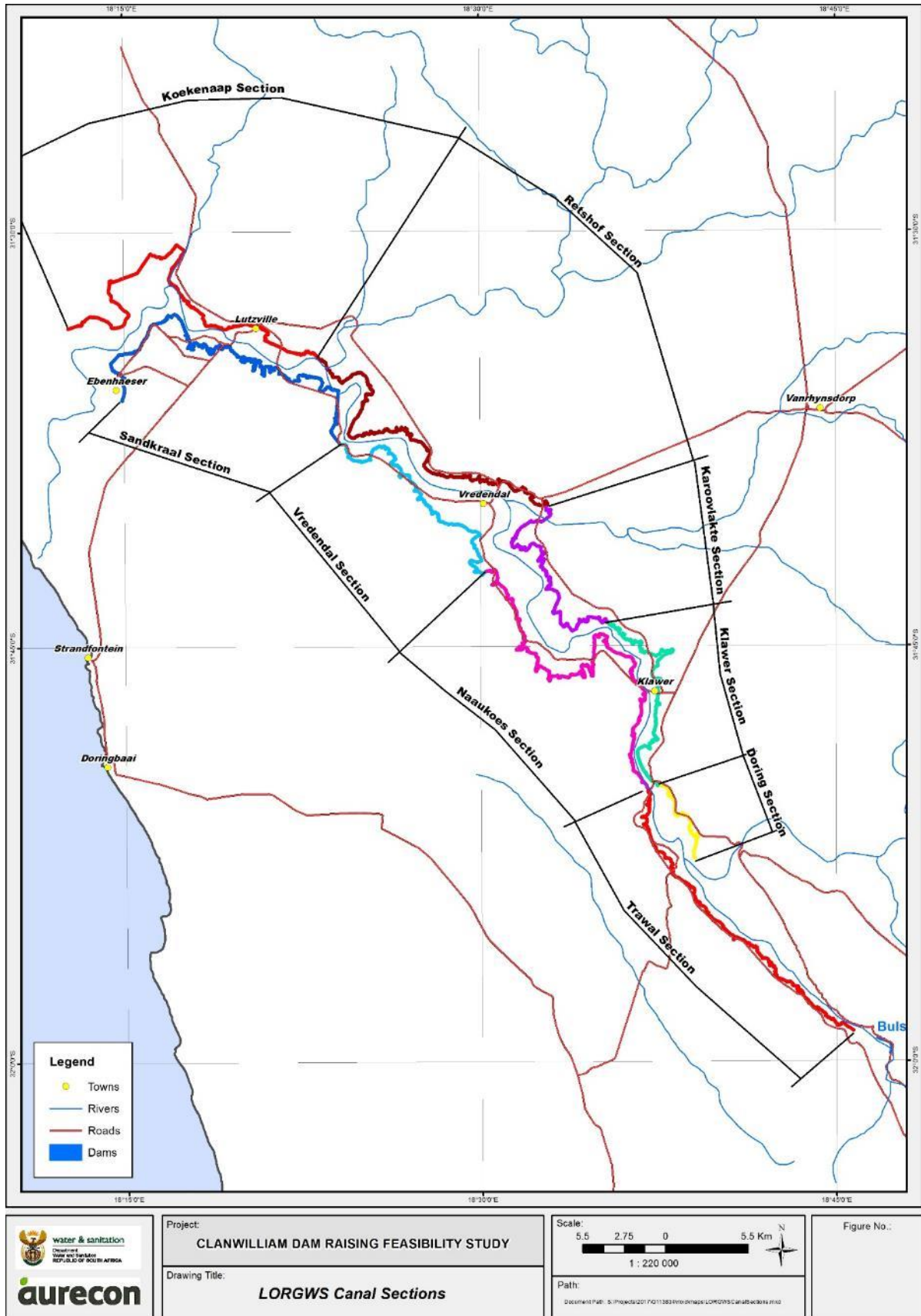


Figure 3.9 | The Lower Olifants Canal sections

The canal runs on the left bank (western side) of the Olifants River for approximately 21 km, before it crosses the river with a siphon, and then runs on both sides of the river (**Figure 3.9**), with a small section of the canal running upstream along the right bank. The canals continue towards Lutzville, becoming gradually smaller downstream. Water is abstracted at numerous points along the canal (approximately 600 off-takes). Secondary canals distribute water from near Lutzville towards the coast. The lead time for water to travel in the canal from the Bulshoek Weir to the last point at Ebenhaezer is about three days. The total length of the canal system is approximately 237 km. A summary of the lengths and capacities of the different canal sections is provided in **Table 3.3** (LORWUA, 2004).

**Table 3.3 | Canal section lengths and capacity**

Section	Length (m)	Capacity (m <sup>3</sup> /s)
Trawal	32 632	8.57
Naauwkoes	33 011	5.52
Naauwkoes/Vredendal	11 888	3.26
Vredendal/Sandkraal	21 400	1.40
Sandkraal	26 570	1.24
Klawer/Karoovlakte	29 826	2.90
Karoovlakte/Retshof	12 398	5.59
Retshof	30 592	1.92
Koekenaap	14 907	1.42
Koekenaap	15 229	1.82
Doringrivier	8 657	0.47

The system is currently over-allocated. The maximum release into the canal is 26 000 m<sup>3</sup>/h (7.2 m<sup>3</sup>/s). The canal was designed for a maximum abstraction rate of 280 m<sup>3</sup>/ha/week. However, this was increased to 325 m<sup>3</sup>/ha/week in some sections where bricks were used to raise the canal walls, which equates to a water allocation of 8 200 m<sup>3</sup>/ha/a released in the canal from 1 October to 30 April, equivalent to two-thirds of the scheduled allocations of 12 200 m<sup>3</sup>/ha/a. The remainder of the allocation is released during the remaining months of the year, if water is available. During the 2014/2015 season, even less water than usual was allocated to the farmers due to a drought, i.e. 5 100 m<sup>3</sup>/ha/a, which equates to 42% of the 12 200 m<sup>3</sup>/ha/a scheduled.



Besides supplying irrigation water, the Lower Olifants Canal also supplies water for domestic use (to the Matzikama Municipality) and various industries. The annual allocation to the various water use categories is summarised in **Table 3.4**. In addition, there are approximately 349 unmetered 25 mm house connections from the canal system. These unmetered connections abstract an estimated 383 900 m<sup>3</sup> per week (i.e. on average 1 100 m<sup>3</sup> per week per connection) (LORWUA, 2004).

**Table 3.4 | Water use allocation**

*(R Nieuwoudt 2018, personal communication, 15 June)*

Water Use Category	Area (ha)	Scheduled Allocation (m <sup>3</sup> /ha)	Annual Allocation (m <sup>3</sup> )
Scheduled irrigation	9 013	12 200	109 958 600
Ebenhaezer small farmers	257	12 200	3 135 400
Emerging farmers	240	12 200	2 928 000
Matzikama Municipality	-	-	5 151 000
Industries	-	-	3 200 000
<b>Total</b>	<b>9 510</b>		<b>124 373 000</b>

### 3.5.1 Operating Rules

The LORWUA is responsible for the operation and maintenance of the water conveyance system from Bulshoek Weir to Ebenhaezer and Koekenaap, in addition to the existing waterworks infrastructure at Bulshoek Weir; but is not responsible for managing the internal distribution system of the Ebenhaezer small-scale farmers. The Lower Olifants Canal operates for between 38 and 42 weeks during the year, and the rest of the year is reserved for maintenance on the canal.

The existing system allows abstractions from the canal as requested by irrigators, i.e. a demand system. The 600 or so off-takes are set on a weekly basis (**Figure 3.10**) – irrigators must apply for a specific volume of water for the next week as well as the period in which the water must be supplied to his/her property. Flows are controlled by sluices and are measured with V-notches on all outlets where the stream exceeds 150 m<sup>3</sup>/h. A telemetry system is used where automatic control gates are installed on the main canals. There are five automatic sluices: one at Bulshoek Weir, and two at the left and right bank bi-furcation works respectively. There are additional telemetric controlled outlets at the municipality, Namakwa Sands and

Ebenhaezer Dam. The LORWUA is investigating further automation of the secondary distribution canals.



**Figure 3.10 | Typical canal off-take**

The water level in the canal varies continuously, and surplus and deficit flow conditions can occur frequently. The variation increases with further progression down the canal, which can lead to considerable operational water losses if not managed properly. Irrigators compensate for this variation by building their own small balancing dams.

The LORWUA irrigators currently pay water tariffs of approximately R3 600 per hectare per year (incl. VAT). A breakdown of the composition of the tariffs as well as a comparison between the 2016/2017 and 2017/2018 years is provided in **Table 3.5**.

Two quotas are in effect, *viz.* an annual allocation of 12 200 m<sup>3</sup>/ha/a and a weekly quota (or maximum extraction rate) of 325 m<sup>3</sup>/ha/week. During years of drought, both quotas are reduced and restrictions are imposed on water users. If the quota for the next year is uncertain, farmers become more conservative in irrigation development. If there is insufficient water to meet full irrigation requirements, the existing use is reduced by a percentage, according to the water available. The quota is based on an assessment of the state of the Clanwilliam Dam after the rainy season each year during the latter half of September, which considers factors such as the rainfall in the catchment, inflow and extent of snow during winter in the catchment.

**Table 3.5 | LORWUA annual water tariffs**

(J Matthee 2018, personal communication, 12 February)

LORWUA Irrigators	2016/2017 (per hectare)	2017/2018 (per hectare)	Percentage Difference
O&M (LORWUA)	R 2 194.00	R 2 316.86	5.60%
Water Research Fund (DWS)	R 6.00	R 5.89	-1.83%
Contribution to Reserve Fund for Major Canal Failures (LORWUA)	R 200.00	R 200.00	0.00%
Infrastructure Charge (DWS)	R 295.14	R 361.12	22.36%
WMA (DWS)	R 242.78	R 244.0	0.50%
<b>Subtotal</b>	<b>R 2 937.92</b>	<b>R 3 127.87</b>	<b>6.47%</b>
VAT (14%)	R 411.31	R 437.90	6.47%
<b>Total</b>	<b>R 3 349.23</b>	<b>R 3 565.78</b>	<b>6.47%</b>

### 3.5.2 Maintenance

Several major breaks have been experienced along the Lower Olifants Canal due to ageing infrastructure (see **Table 3.6**). The largest break happened in January 2015 with a repair cost of R11.5 million, and the most recent one in January 2017 with a repair cost of R2.4 million. The LORWUA reported (J Matthee 2018, personal communication, 12 February) that it spends approximately R4.2 million per annum on normal maintenance with its own teams, and contracts out approximately R5.8 million per annum on more serious repairs.

**Table 3.6 | Major canal breaks and associated repair costs**

(J Matthee 2018, personal communication, 12 February)

Date of Major Canal Break	Repair Cost
2006	R1.9 million
March 2010	R1.9 million
December 2010	R2.4 million
January 2015	R11.5 million
January 2017	R2.4 million

The 2015 break was as a result of a 180 m long failure in the soil supporting the concrete lining near Klawer (**Figure 3.11**). The canal collapse cost the agriculture sector an estimated R100 million (Creamer Media, 2017). Following this break, the WCDoA committed to a R4 million

proactive maintenance programme for the canal, in which funds are released on an emergency basis, given the importance of infrastructure to the agriculture sector in the area. The plan involved the LORWUA assisting WCDoA in identifying the most critical areas for maintenance. In 2016, R1.2 million was spent to fix a 1200 m section near Verdeling, and in 2017, repair work on a 1400 m section near Vredendal was earmarked as a priority area.



**Figure 3.11 | Lower Olifants Canal break in 2015 (IOL, 2015)**

The 2017 break was caused by an electronic malfunction of the telemetry system which controls the water level in the canal. This resulted in an overflow at certain canal sections and washed away the soil supporting the canal lining. An 18 m section of canal was replaced and about 250 000 m<sup>3</sup> of water was lost (Kriel, 2017).

After more than 80 years of usage, the concrete lining has become frail and prone to damage, which results in canal breaks occurring frequently.

### 3.5.3 Condition Assessment

Two condition assessments of the Lower Olifants Canal were carried out independently by Element Consulting (LORWUA, 2004), and by LTE Consulting and Pula Strategic Resource Management (DWS, 2016b).

#### **a) *An Investigation into the Rehabilitation of the Canal Downstream of Bulshoek Dam (LORWUA, 2004)***

The report by Element Consulting Engineers undertaken in 2004 surveyed the canal system and focussed on three aspects, viz. the hydraulic components of the canals; a visual inspection and structural investigation of the canal to determine the short- to long-term rehabilitation requirements; and an economic investigation on the different rehabilitation scenarios in terms of their net present value (NPV).

A hydraulic investigation of the canal revealed that the existing measurement tables for the various flow gauging structures were adequate, except for the Right bank weir, Retshof weir, Holrivier measurement plate and the Koekenaap weir. The use of a flow formula was recommended instead of using the existing tables. More accurate measurement for the water balance could be attained using additional measurement structures. Discontinuous flow recording in the canal system results in inadequate control and no data for a proper water balance. Existing measurement structures should be made part of a telemetry system. The existing operational system only allows abstractions from the canal as requested by users. It was recommended that feedback on actual water quantities (vs the monitoring of flow rate) should be incorporated in the operations of the canal system. In 2004, the average existing water balance showed that only 52% (80% of the maximum allowed abstractions) of the total flow in the canal went to abstractions through sluices. It was advised that a proper telemetry system be installed to review and increase the confidence in the water balance, by minimising unaccounted for losses with structural repair work and by monitoring data. As previously mentioned, the LORWUA has since installed a telemetry system whereby automatic control gates are installed on the main canals.

A structural investigation of the canal was also conducted. It was found that structural defects, ranging from exposed aggregate on concrete surfaces to large structural cracks, exist along 63% of the canal length.

Certain sections of the canal were identified as critical sections (**Table 3.7**). These sections are situated on embankments and in the event of a failure in the canal, the embankment and adjacent orchards would be subjected to flooding and erosion. As these are high risk sections, maintenance of the critical sections should take priority.

The visual inspection identified short-term rehabilitation of structural defects, which would cost in the order of R2.8 million (incl. VAT) (2004 cost). The proposed medium-term rehabilitation measures consisted of critical sections as identified by the LORWUA (R40.5 million, incl. VAT) (2004 cost)). A possible long-term measure would involve rehabilitating the canal with in-situ cast concrete lining at an estimated cost of R721.5 million (incl. VAT) (LORWUA, 2004).

**Table 3.7 | Critical sections of the canal as identified**

<b>Section</b>	<b>Approx. Chainage of Critical Section</b>	<b>Length of Critical Section (m)</b>
Trawal	0 – 3 000	3000
	27 500 – 32 500	5000
Klawer	0 – 3000	3000
	15 400 – 18 000	2600
Naauwkoes	4 000 – 4 300	300
	7 500 – 8 800	1300
	11 000 – 15 000	4000
Karoovlakte	8 750 – 12 250	3500
	16 500 – 17 750	1250
Retshof	1 000 – 3 000	2000
	6 000 – 9 500	3500
	18 000 – 31 000	13000
Vredendal	15 500 – 16 600	1100
	21 000 – 22 400	1400
Sandkraal	800 – 1 100	300
	1 500 – 3 000	1500
	4 500 – 5 500	1000
	12 000 – 19 500	7500
	22 500 – 26 500	4000
	27 600 – 28 500	900
Koekenaap	9 000 – 11 200	2200
	12 500 – 16 000	3500

**b) Condition Assessment Audit of Irrigation Scheme Infrastructure: Olifants River Van Rhynsdorp GWS (Bulshoek Dam) (DWS, 2016b)**

Similar to what was done for the Clanwilliam Canal, LTE Consulting and Pula Strategic Resource Management (DWS, 2016b) carried out a condition assessment of the irrigation infrastructure owned by DWS in the LORGWS. It found that the condition of the infrastructure generally ranged from good to very poor. However, a large proportion of the infrastructure is in poor to very poor condition, thus requiring urgent rehabilitation or repair.

The study proposed similar intervention actions for the repair, upgrade and maintenance of the conveyance infrastructure. The estimated costs for these intervention actions are provided in **Table 3.8**.

**Table 3.8 | Estimated cost to repair, upgrade and maintain the irrigation infrastructure (DWS, 2016b)**

Term	Period	2016 Amount (incl. fees, P&G's, contingencies, VAT)
Short-term	1 – 3 years	R 1 085 928 785
Medium-term	4 – 6 years	R 1 050 102 607
Longer-term	7 – 9 years	R 1 500 120 986

**c) Comparison of the Condition Assessments**

The DWS (2016b) condition assessment accounts for any maintenance, rehabilitation and repairs undertaken by the LORWUA since the LORWUA (2004) study was first conducted.

**Table 3.9** provides a comparison of the costs estimated in the two studies.

**Table 3.9 | Comparison of estimated costs between LORWUA (2004) and DWS (2016b)**

Term	LORWUA (2004)	DWS (2016b)
Short-term	R 2 810 132	R 1 085 928 785
Medium-term	R 40 530 260	R 1 050 102 607
Longer-term	R 721 448 761	R 1 500 120 986

It is evident from the table that the estimated costs given in DWS (2016b) are significantly higher than those indicated in LORWUA (2004). An explanation for this is that the LORWUA (2004) costs have not yet been escalated; as well as likely further deterioration of the

conveyance infrastructure during the 12 year period between the two condition assessments, and possibly a more comprehensive assessment.

This current study will formulate a possible Implementation Action Plan for the conveyance infrastructure, which will be discussed further in the main '*Existing Conveyance Infrastructure and Irrigated Land*' Report. The implementation action plan will provide details of proposed short-, medium- and long-term interventions to maintain and improve the condition of conveyance infrastructure, which is critical to supply an essential element (water) for the continued prosperity of the area.

### 3.6 Ebenhaezer

The ORGWS also provides water to the Ebenhaezer community irrigation project. In 1926, the Ebenhaezer families were moved from Lutzville to their current location, further down the Olifants River near the estuary, at the end of the canal system. An area of 257 hectares of irrigable land was split among the then-150 families. These plots of land are too small for commercial agriculture and over time farming activities have reduced to mainly small subsistence farming activities.

In 2005, the Ebenhaezer community, comprising a total population of approximately 3500 people, predominantly Afrikaans speaking descendants of the original Ebenhaezer farmers won a breakthrough land settlement claim to the value of R100 million. However, this settlement was not implemented, and it was renegotiated to R350 million in 2014. This amount includes money to buy about 50 privately owned vineyard farms, and the area includes 1566 ha of privately owned commercial land along the Olifants River and 1919 ha of state-owned land (IOL, 2014). It is hoped that this land claim would enable the community to return to some of the more fertile land along the Olifants River from which they were previously removed.

The LORWUA operates and maintains the canal system up to the Ebenhaezer balancing dam. From there on, there is a canal to the Ebenhaezer community, which is operated and maintained by the community itself. Roux and Keuck (2009) provide a comprehensive description of the Ebenhaezer scheme.

The Ebenhaezer balancing dam was constructed in 2003 as an earth fill dam with a storage capacity of 140 000 m<sup>3</sup> and a full supply depth of 6 m. It is lined with a 1.5 mm HDPE waterproofing geomembrane, of which the top portion is covered with a rock lining. The dam functions as a balancing dam, as the top 2 m water depth is utilised for approximately 80% of the time. The liner is thus covered with a rock lining to protect the exposed section against sunlight, wave action, wear-and-tear and vandalism, etc.



A long-weir and adjustable sluice gates (**Figure 3.12**) are used to control the water level in the canal according to allocated water demand, and the surplus water is diverted to the balancing



dam. When the water level in the canal is less than required, the canal water flow is stabilised by pumping water from the balancing dam to the canal.

### **Figure 3.12 | Sluice gates installed near the Ebenhaezer balancing dam**

A pump station, which has four variable speed pumps in parallel, is automatically controlled by an ultrasonic water level recorder in the Parshall measuring flume in the canal. The maximum pumping capacity of the pumps is 600 m<sup>3</sup>/h. Raw water is also pumped from the balancing dam for domestic use to a water purification plant, via a 200 mm diameter, 1.3 km long uPVC rising main. The pump capacity is 170 m<sup>3</sup>/h. The domestic and irrigation water pumps use the same suction pipe from the balancing dam and are pre-primed by the vacuum pump system.

Additional infrastructure in the form of a high-pressure irrigation scheme is expected to be provided to the Ebenhaezer farmers. This scheme was advertised in a tender by the Department of Rural Development and Land Reform (DRDLR) in 2014. In this scheme, water will be pumped from the canal to a balancing dam on the hill, from where water will gravitate to clusters of farmers as per a predetermined schedule of releases. The balancing dam will also provide drinking water to Papendorp and upstream commercial farmers could also benefit from the scheme. The tender was awarded, but an appeal process followed, and the latest information is that the matter has been referred back to the DRDLR.

The LORWUA supplies water to Ebenhaezer at the Parshall measuring gauge at the start of the Ebenhaezer channel. The water supplied is subject to the water allocation Ebenhaezer is entitled to, as well as to any restrictions applicable to the entire LORWUA distribution system. Flow measurements are continuously and automatically monitored by the measuring gauge.

At a public meeting on 12 February 2018, the Ebenhaezer farmers claimed that they are not receiving their scheduled water allocations due to operational mismanagement by the LORWUA, i.e. no policing and monitoring of water abstraction along the canal is implemented. Several of the farmers criticised the LORWUA for its perceived lack of control over the water allocations. However, these views are in contrast to those of some DWS and WCDoA staff who have commented that there is some internal mismanagement by the Ebenhaezer farmers themselves.

A breakdown of the Ebenhaezer annual water tariffs is provided in **Table 3.10**.

**Table 3.10 | Ebenhaezer annual water tariffs**

<b>Ebenhaezer</b>	<b>2017/2018 (per hectare)</b>
Water Research Fund (DWS)	R 5.89
Infrastructure Charge (DWS)	R 361.12
WMA (DWS)	R 244.00
<b>Subtotal</b>	<b>R 611.01</b>
VAT (14%)	R 85.54
<b>Total</b>	<b>R 696.55</b>

# 4 Existing Agricultural Areas

## 4.1 Locality and Extent of the Agricultural Areas

The existing agricultural areas located within the study area, as shown in **Figure 4.1**, were split into the three regions mentioned in **Section 1.3** of this report. Currently, the agricultural areas are divided into three categories, namely:

1. Cultivated irrigated areas;
2. Cultivated dry-land areas;
3. Uncultivated or dry/arid area.

The existing agricultural land use areas, obtained from the National Department of Environmental Affairs (2013-2014) and updated with Bing Imagery (2016-2017) are summarised in **Table 4.1** below. Refer to **Figure 4.1** below for the location of the existing agricultural areas.

**Table 4.1 | Existing agricultural areas per region**

Study Area Region	Cultivated Irrigated (ha)	Cultivated Dryland (ha)	Uncultivated, Dry/Arid (ha)	Total (ha)
Region 1: Upstream of Clanwilliam Dam	12 000	16 000	225 000	253 000
Region 2: Clanwilliam Dam to Bulshoek Dam	2 900	22 000	45 200	70 100
Region 3: Bulshoek Dam to Olifants Estuary	15 800	31 200	218 700	265 700
<b>Total</b>	<b>30 700</b>	<b>69 200</b>	<b>488 900</b>	<b>588 800</b>

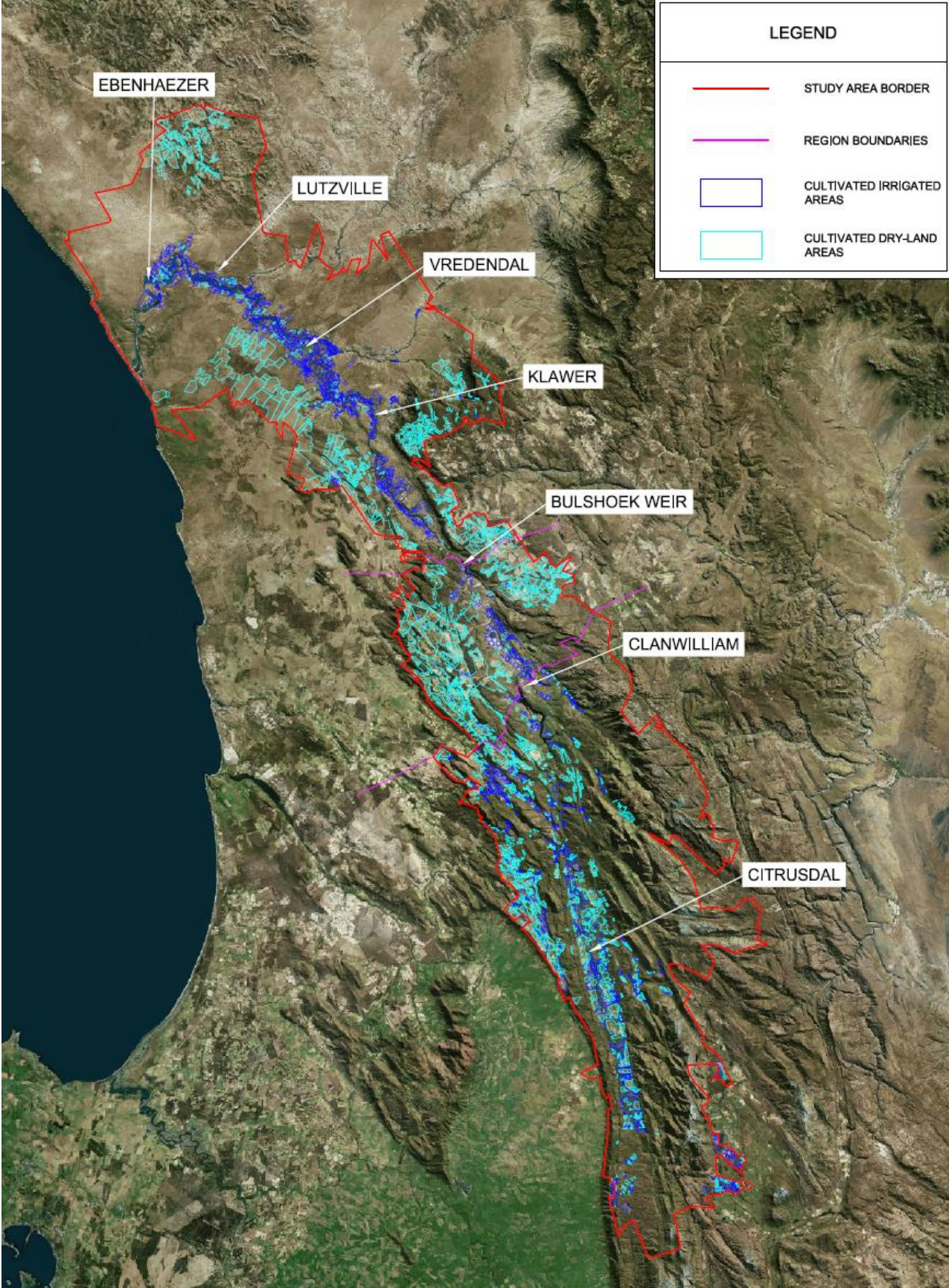


Figure 4.1 | Existing agricultural land use

## 4.2 Existing Agricultural Areas and Water Requirements

The agricultural water requirements, calculated in Task 3(b), will be reconciled with the Cape Farm Mapper Crop Census (2013) data, to calculate the total area of each crop type in the study area and applying the general irrigation quota to the area. Crop irrigation quotas can be obtained from the WUAs and/or CMAs. The water requirements will be reported on in the 'Existing Conveyance Infrastructure and Irrigated Land' Report.

## 4.3 Potential for Further Agricultural Development

### 4.3.1 Locality and Extent of the Agricultural Areas

In this section, land (properties) owned by government and privately-owned land were identified (**Figure 4.2**). The land ownership details (name, address, contact details, etc.) have also been recorded for each property in the study area. **Table 4.2** summarises the property ownership for each region in the study area. The study area boundary and regions are as previously defined in the 'Feasibility Study for the Raising of Clanwilliam Dam' (DWAf, 2008). The government owned properties do not include the urban/town areas such as Citrusdal, Vredendal, Klawer and Ebenhaezer, but only properties with possible development potential up to the above-mentioned town borders.

**Table 4.2 | Property ownership per region**

Study Area Region	Government (ha)	Private (ha)
Region 1: Upstream of Clanwilliam Dam (inclusive of the properties around the dam)	82 600	170 500
Region 2: Clanwilliam Dam to Bulshoek Weir (inclusive of the properties around the weir)	900	69 100
Region 3: Bulshoek Weir to Olifants Estuary	43 000	222 700
<b>Total</b>	<b>126 500</b>	<b>462 300</b>

From the table above, it is evident that only a small fraction of the study area is government-owned. Depending on the suitability of the government-owned land, the approach should be to first consider the development of new farms on these properties. For the expansion of existing farms, privately-owned land will likely be considered.

The locality of the government-owned properties in Region 1, in relation to existing irrigated agriculture and surface water sources, is another factor that must be considered. The majority of the 82 600 ha of government-owned properties are located in the upper regions of the

Cederberg Mountains consisting of steep slopes and possible Critical Biodiversity Areas. Thus, only a small area could be considered for the development of any new agricultural areas.

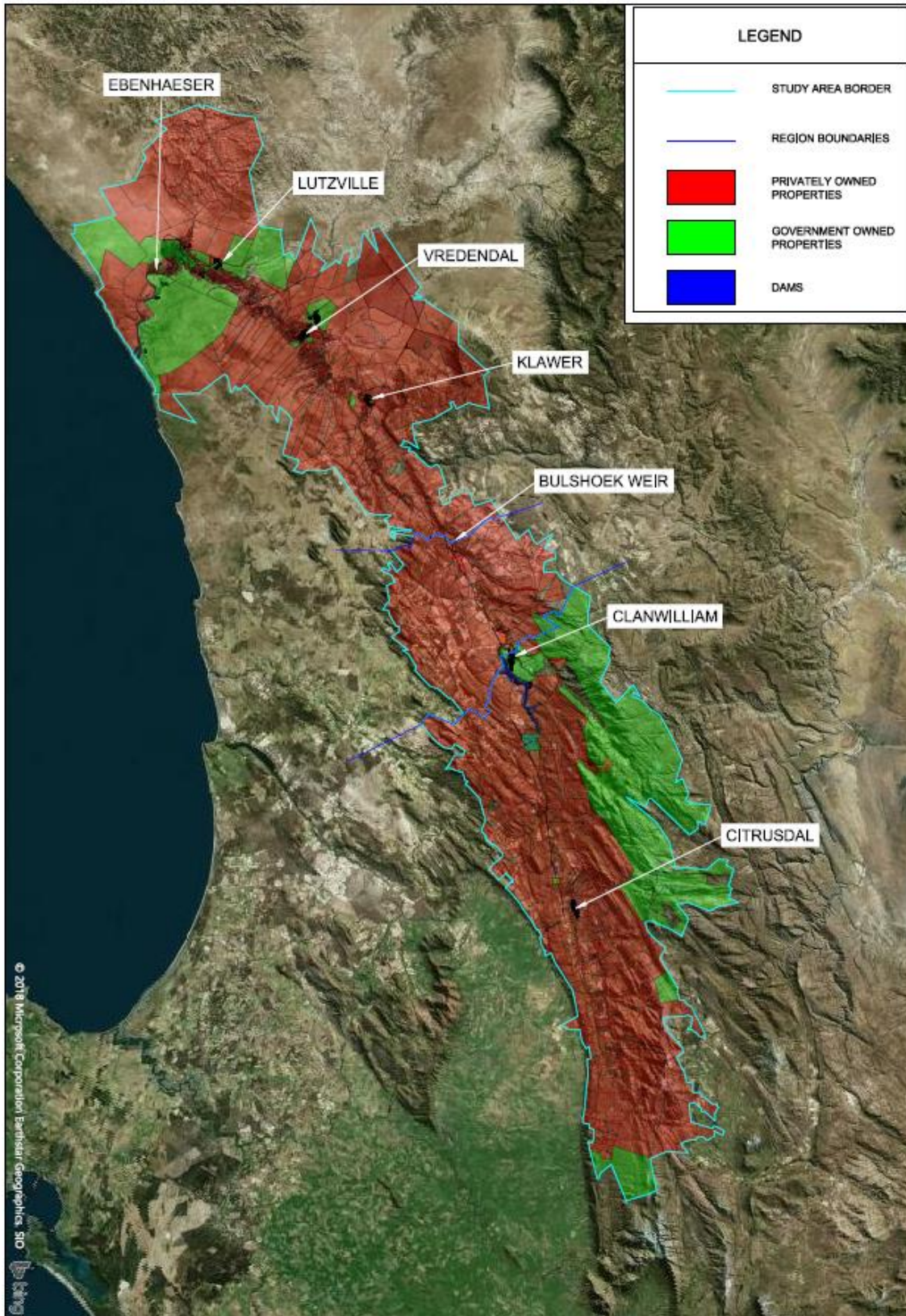


Figure 4.2 | Land ownership of study area

### 4.3.2 Soil Suitability

The 'Soils, Water Requirements and Crops' Report (DWAF, 2004), prepared as part of the Feasibility Study for the Raising of Clanwilliam Dam, included mapping of soils upstream of Bulshoek Weir to a lateral extent of about 60 m above the level of the river or existing canals. **Figure 4.3 to Figure 4.5** show the potential rating of soils for the production of annual tuberous crops, **Figure 4.6 to Figure 4.8** show the potential rating of soils for the production of annual non-tuberous crops, and **Figure 4.9 to Figure 4.11** show the potential rating of soils for the production of perennial crops.

The potential irrigable areas previously identified will be reviewed, taking influencing factors into account. The findings from a soil survey and expert interpretation should be available before the future irrigation water requirements and associated infrastructure requirements are addressed. Due to advanced farming technology and management skills that exist in the developed sections of the study area, the inherent soil limitations do not pose any serious constraints on the irrigation development. It is rather factors such as relative position to water sources and environmental impacts that dictate further development.

#### *Region 1 and 2 Soil Suitability*

Based on these evaluations, about 2 000 ha are recommended for perennial crops (e.g. citrus and wine grapes) in the southern section of the basin from Keerom to Bulshoek Weir. Another 19 000 ha are marginally and conditionally recommended provided that subsoil limitations are properly ameliorated. About 8 600 ha of this class has a potential rating that is near the upper limit of the conditionally recommended class. The main limitations in this class are wetness and shallow underlying weathering rock combined with low clay content. These limitations are relatively easy to ameliorate and with judicious irrigation practices approximately 10 000 ha can be used for economically viable production of citrus and wine grapes. Within the lateral extent of the survey approximately 10 000 ha is available in the Keerom to Bulshoek section for any combination of irrigated annual (tuberous and non-tuberous) and perennial (citrus, wine grapes, mangos) production.

#### *Region 3 Soil Suitability*

The soils in the surveyed area from Bulshoek to the coast differ greatly from those in the southern section in terms of the dominant limitation(s). Deep, well-drained red sandy soils can be highly recommended for irrigated tuberous and non-tuberous crops without any subsoil

amelioration measures. However, these soils are only conditionally recommended for perennial crops due to the very sandy nature and risk of sandblasting of crops. Non-tuberous crops are conditionally recommended, while perennial crops are recommended on these soils after amelioration of subsoil limitation. In this section there is approximately 105 000 ha that can be recommended to produce perennial crops after amelioration of subsoil limitations, in particular hardpans, and if provision is made for leaching and drainage to remove soluble salts from saline environments. Most of the areas recommended for perennial crops can also be used for irrigated non-tuberous annual crop production.

### **4.3.3 Other Information**

The abovementioned information from the Feasibility Study for the Raising of the Clanwilliam Dam (DWAF, 2008) will be updated with the 2013 Crop Census data and 2016 – 2017 Bing imagery. Uncultivated potential irrigation areas will be screened out by overlaying Critical Biodiversity Areas (CBAs), land ownership and distance of areas in relation to canals, rivers and dams.



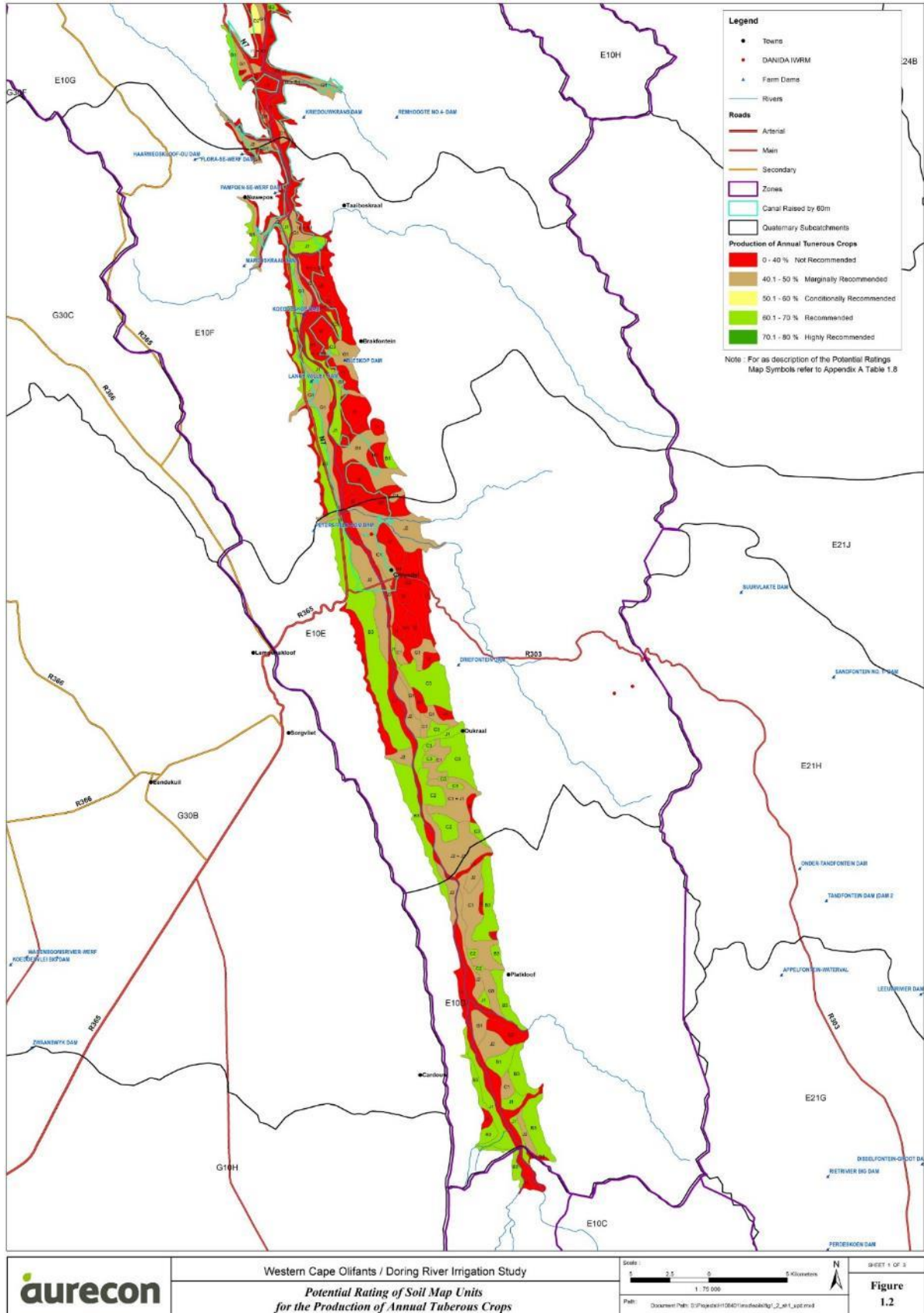
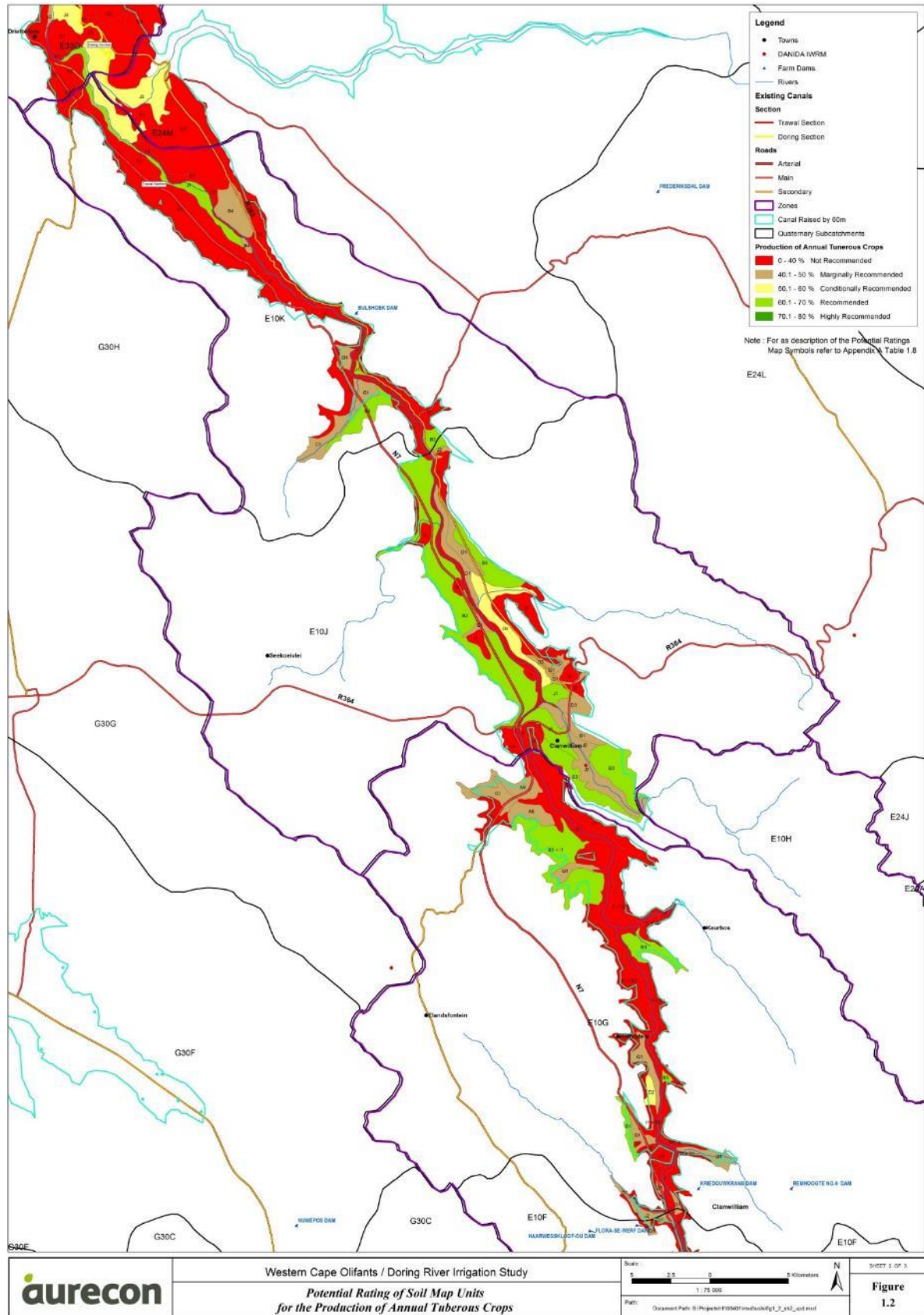
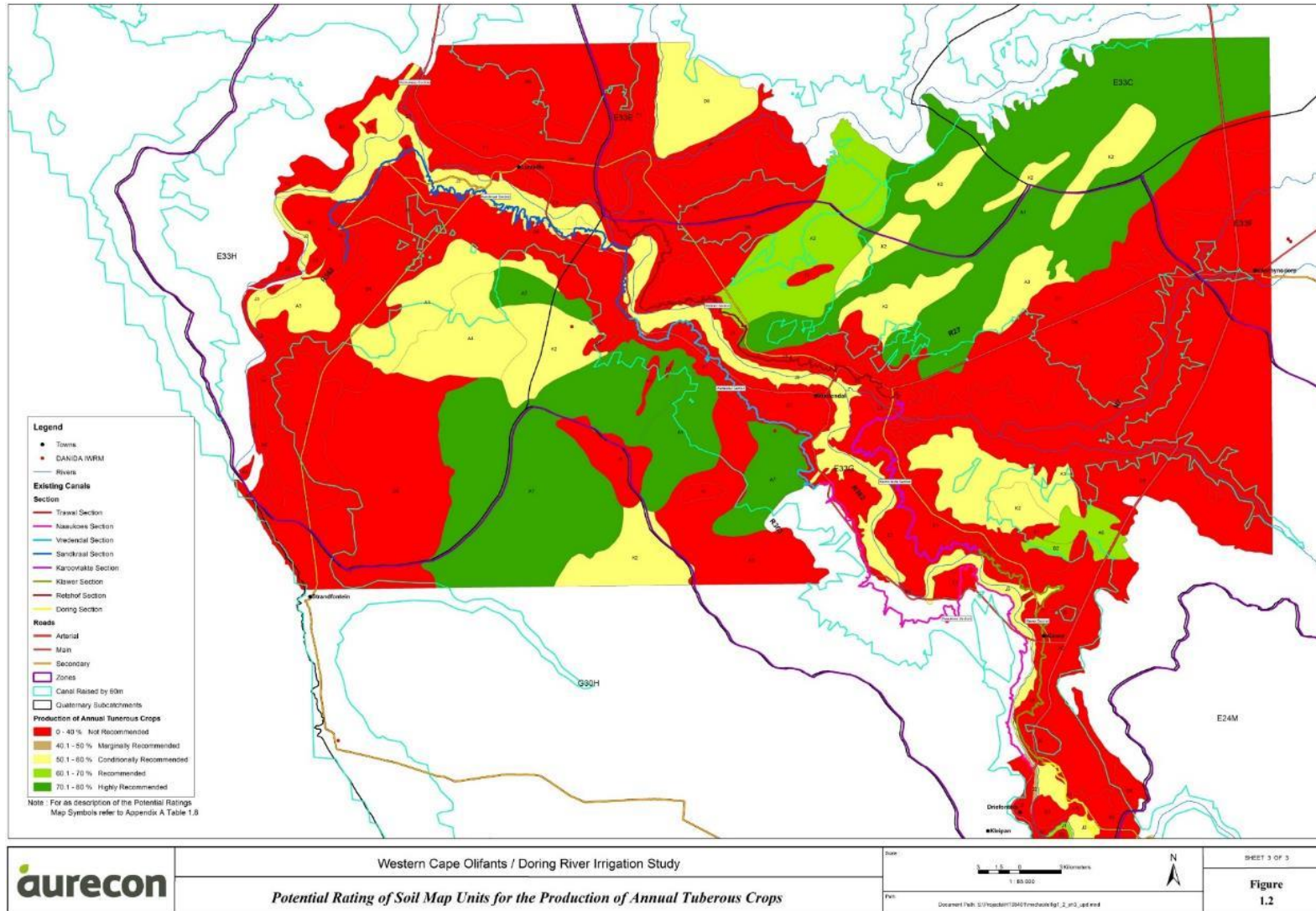


Figure 4.3 | Potential rating of soils for the production of annual tuberous crops, Sheet 1 of 3 (Feasibility Study for the Raising of the Clanwilliam Dam, 2008)



**Figure 4.4 | Potential rating of soils for the production of annual tuberous crops, Sheet 2 of 3 (Feasibility Study for the Raising of the Clanwilliam Dam, 2008)**



**Figure 4.5 | Potential rating of soils for the production of annual tuberous crops, Sheet 3 of 3 (Feasibility Study for the Raising of the Clanwilliam Dam, 2008)**

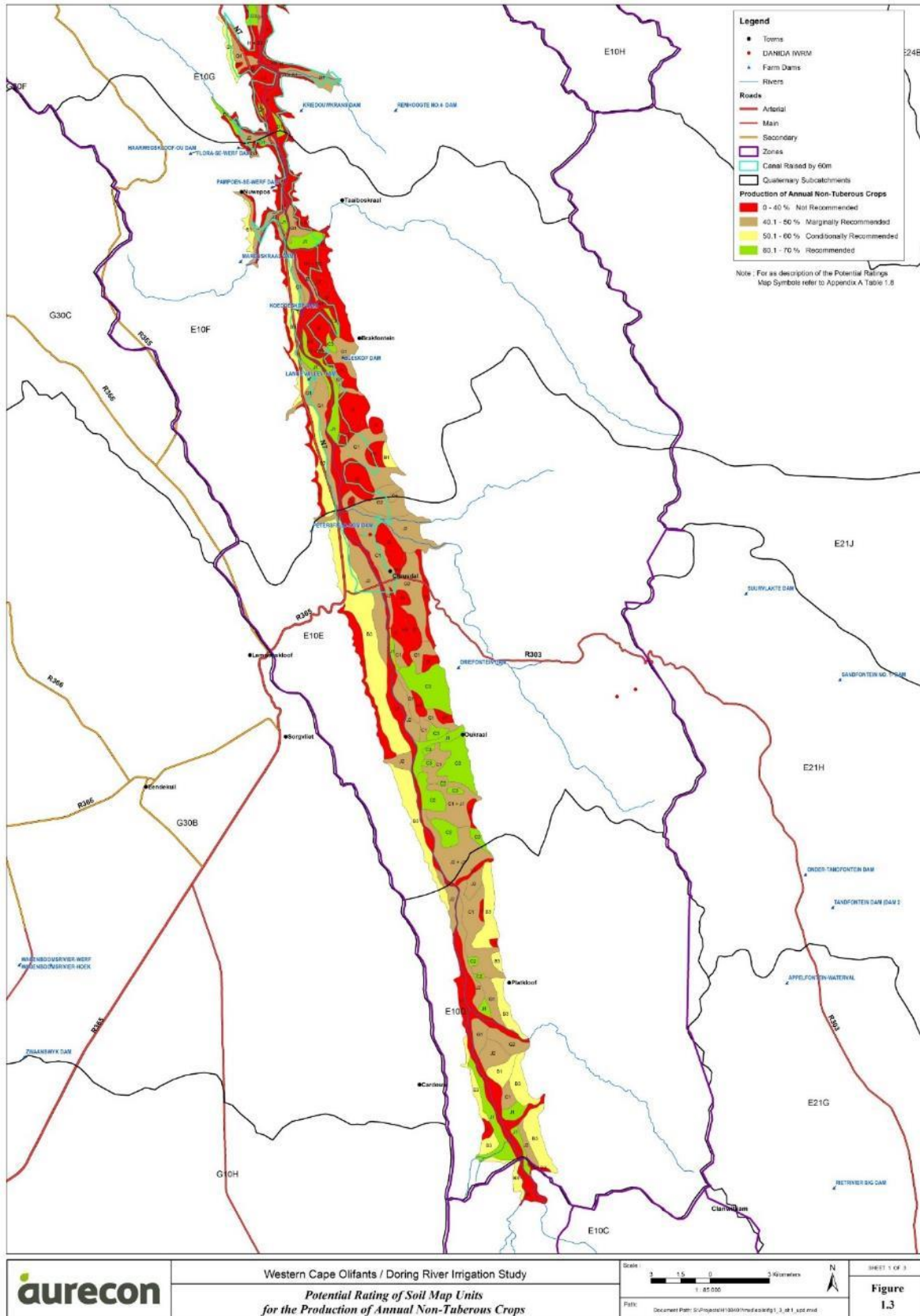
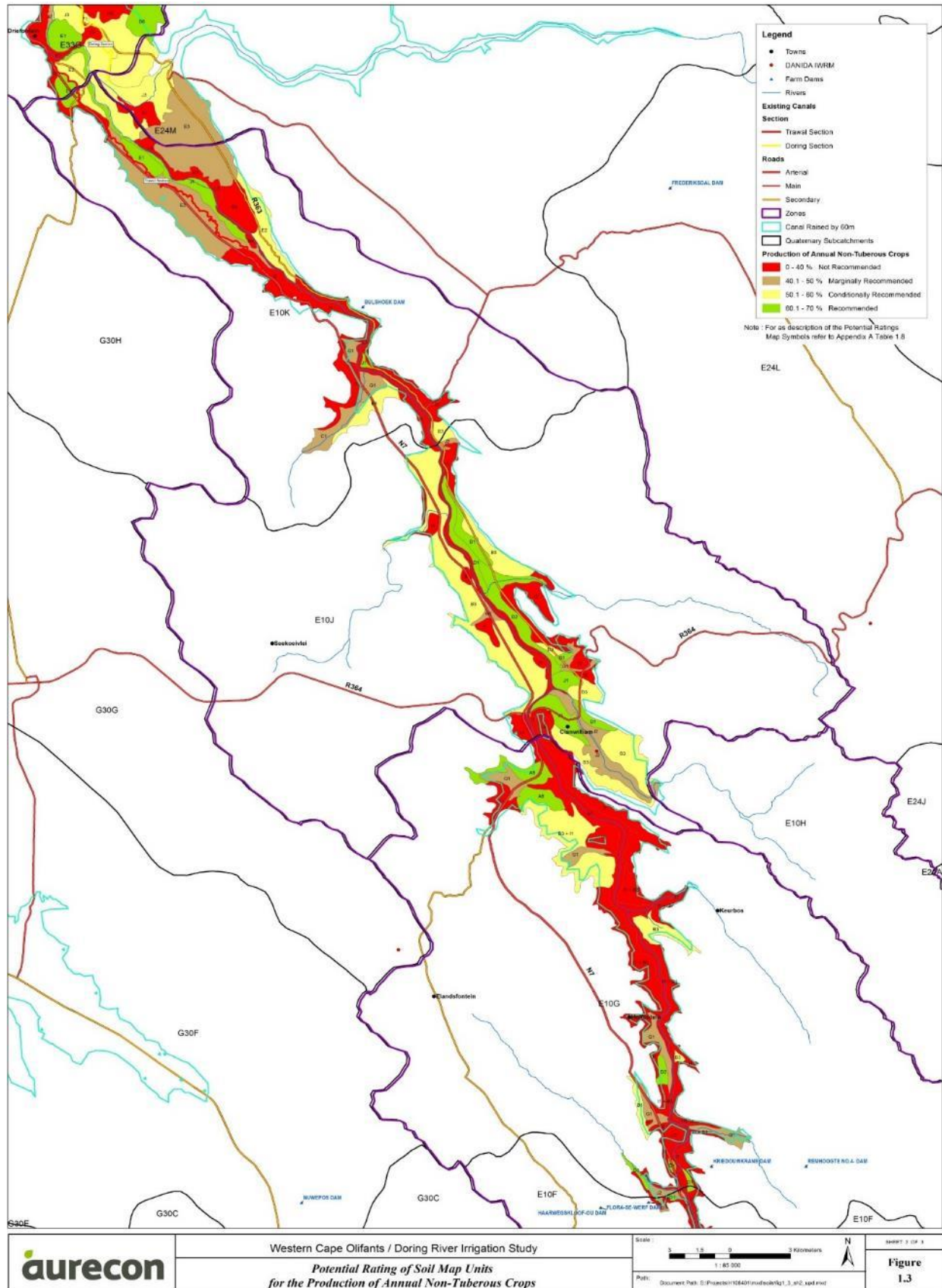


Figure 4.6 | Potential rating of soils for the production of annual non-tuberosous crops, Sheet 1 of 3 (Feasibility Study for the Raising of the Clanwilliam Dam, 2008)



**Figure 4.7 | Potential rating of soils for the production of annual non-tuberos crops, Sheet 2 of 3 (Feasibility Study for the Raising of the Clanwilliam Dam, 2008)**





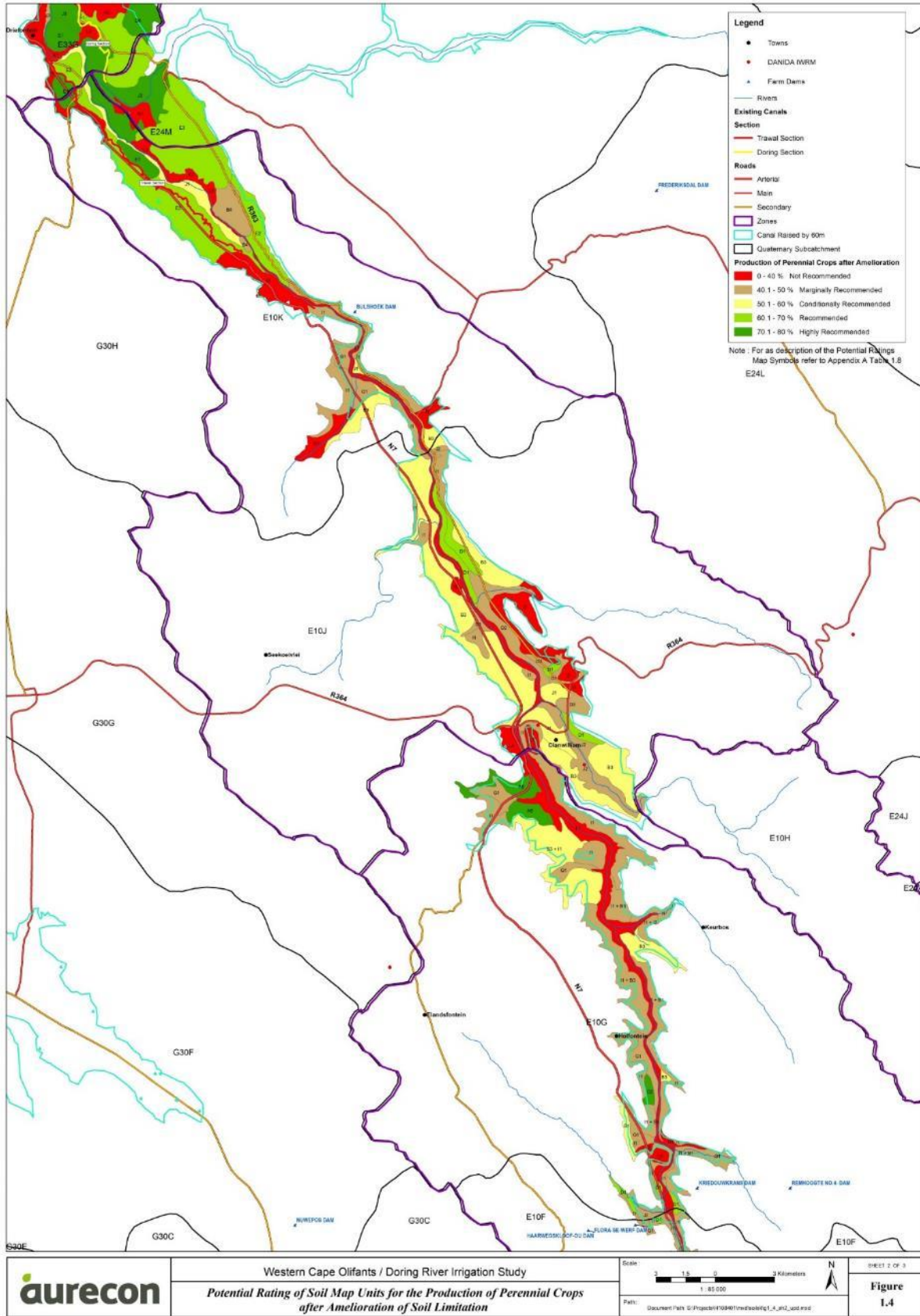


Figure 4.10 | Potential rating of soils for the production of perennial crops, Sheet 2 of 3 (Feasibility Study for the Raising of the Clanwilliam Dam, 2008)



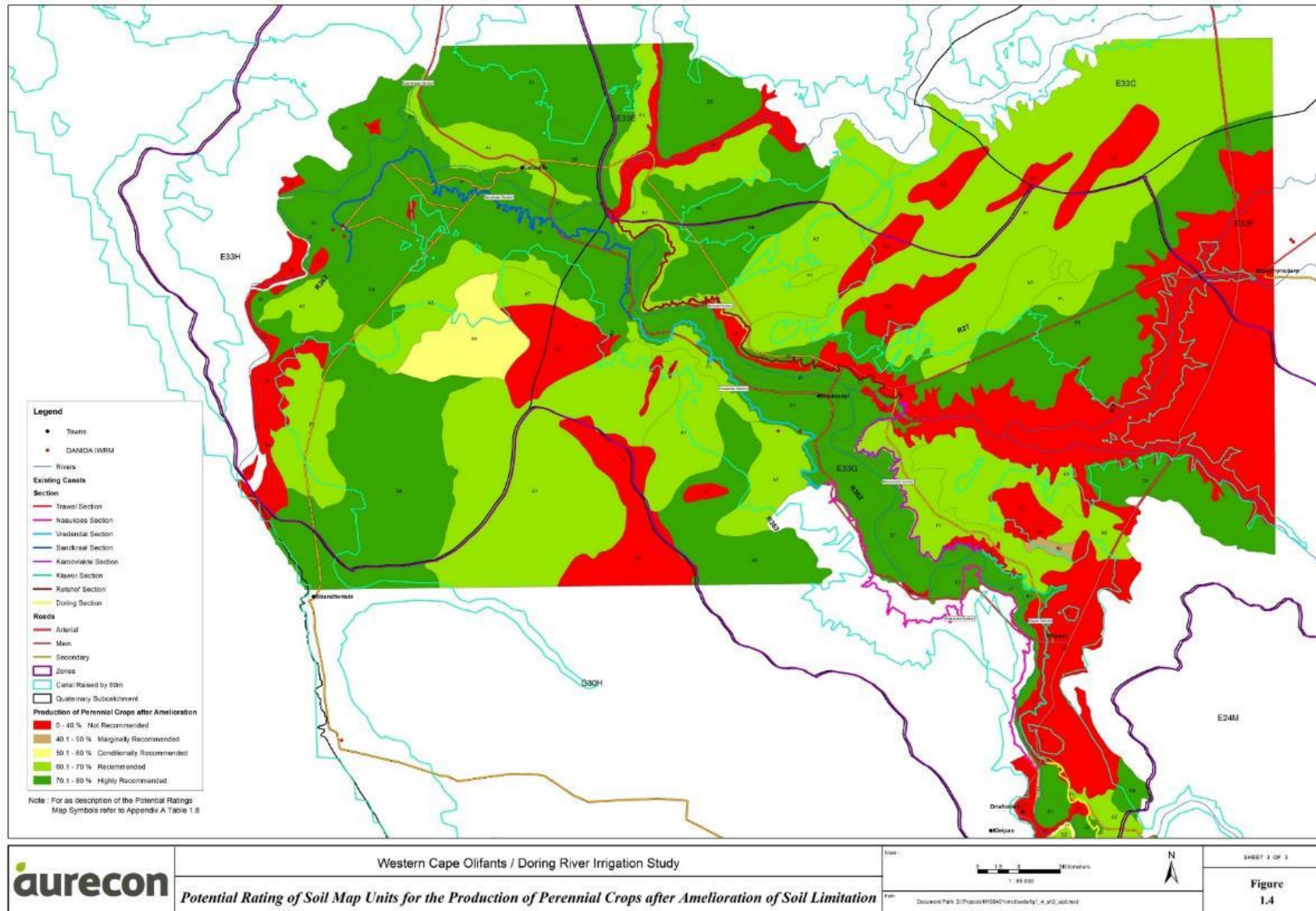


Figure 4.11 | Potential rating of soils for the production of perennial crops, Sheet 3 of 3 (Feasibility Study for the Raising of the Clanwilliam Dam, 2008)

## 5 Conclusions

In this report, the extent and condition of the existing infrastructure in the study area was discussed, following a literature review of available information from previous studies, a field trip and public meetings held in the study area, and communication with various stakeholders. It was found that most of the conveyance infrastructure is over 80 years old and requires urgent rehabilitation, maintenance and repair. An Implementation Action Plan will be prepared as part of the *'Existing Conveyance Infrastructure and Irrigated Land'* Report.

This report also investigated the current agricultural development in the study area. It was found that the existing irrigated areas total 30 700 ha, i.e. 12 000 ha in Region 1, 2 900 in Region 2 and 15 800 ha in Region 3. The *'Existing Conveyance Infrastructure and Irrigated Land'* Report will determine the current agricultural water requirements following an evaluation of the current crop types.

# References

Creamer Media. 2017. *Western Cape: Multi-million rand maintenance plan underway to stem agriculture losses in Clanwilliam*. <http://www.polity.org.za/article/western-cape-multi-million-rand-maintenance-plan-underway-to-stem-agriculture-losses-in-clanwilliam-2017-01-20>.

Accessed: 29 January 2018.

Department of Agriculture: Western Cape, South Africa. 2018. *CapeFarmMapper ver 2.0.6.7*. <https://gis.elsenburg.com/apps/cfm/>. Accessed: 26 March 2018.

Department of Water Affairs and Forestry, South Africa and Department for International Development, United Kingdom. 2007. *Inception Report*. Prepared by E van der Berg of Ninham Shand (Pty) Ltd, in association with Pegasys (Pty) Ltd and Informage, as part of the Support to Compulsory Licensing in the Jan Dissels river Catchment, Western Cape.

Department of Water Affairs and Forestry, South Africa and Department for International Development, United Kingdom. 2007. *Rapid II Reserve Determination Report*. Prepared by C Brown and R Magoba of Southern Waters Ecological Research and Consulting cc, as part of the Support to Compulsory Licensing in the Jan Dissels River Catchment, Western Cape.

Department of Water Affairs and Forestry, South Africa and Department for International Development, United Kingdom. 2007. *Groundwater Report*. Prepared by R Parsons of Parsons & Associates cc, as part of the Support to Compulsory Licensing in the Jan Dissels River Catchment, Western Cape.

Department of Water Affairs and Forestry, South Africa and Department for International Development, United Kingdom. 2007. *Opportunities for productive water use by emerging farmers Report*. Prepared by K von der Heyden and A Selby of Pegasys (Pty) Ltd, in association with Ninham Shand (Pty) Ltd and Informage, as part of the Support to Compulsory Licensing in the Jan Dissels River Catchment, Western Cape.

Department of Water Affairs and Forestry, South Africa and Department for International Development, United Kingdom. 2008. *A Framework for Water Allocation in the Jan Dissels*

*River Catchment*. Prepared by A Selby of Pegasys, in association with Ninham Shand (Pty) Ltd and Informage, as part of the Support to Compulsory Licensing in the Jan Dissels River Catchment, Western Cape.

Department of Water and Sanitation, South Africa. (2016a). *Condition assessment audit of irrigation scheme infrastructure*. Prepared by LTE Consulting and PULA Strategic Resource Management. Document ID: WP0485WTE-Southern- Clanwilliam GWS.

Department of Water and Sanitation, South Africa. (2016b). *Condition assessment audit of irrigation scheme infrastructure*. Prepared by LTE Consulting and PULA Strategic Resource Management. Document ID: WP0485WTE-Southern- Olifants River van Rhynsdorp GWS.

IOL. 2015. *Relief for Clanwilliam farmers*. <https://www.iol.co.za/news/south-africa/western-cape/relief-for-clanwilliam-farmers-1810878>. Accessed: 16 May 2018.

Kriel, G. 2017. *Olifants River Valley farmers' irrigation woes*. <https://www.farmersweekly.co.za/crops/field-crops/olifants-river-valley-farmers-irrigation-woes/>. Accessed: 26 January 2018.

LORWUA. (2004). *Investigation into the rehabilitation of the canal downstream of Bulshoek Dam*. Prepared by Element Consulting Engineers. Project No. 03046.

Ndlendle, S. 2017. *Canal emergency repair saves water levels*. <https://www.iol.co.za/news/south-africa/western-cape/canal-emergency-repair-saves-water-levels-7509419>. Accessed: 26 January 2018.

Oosthuizen, C. and Brink, J. A. 2015. *Bulshoek Dam: Failure in slow motion or time bomb?* SANCOLD Conference, 1-3 September 2015, Cape Town, South Africa.

Roux, A. S. and Keuck, P. G. 2009. *Applying modern technology to solve water supply problems at Ebenhaeser in the Western Cape Province of South Africa*. 60<sup>th</sup> International Executive Council Meeting & 5<sup>th</sup> Asian Regional Conference, 6-11 December 2009, New Delhi, India.

Western Cape Government. 2017. *R4 million maintenance plan at Clanwilliam Dam canals stem water losses*. <https://www.westerncape.gov.za/news/r-4-million-maintenance-plan-clanwilliam-dam-canals-stem-water-losses-1>. Accessed: 26 January 2018.



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