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Permanent Water Commission

The Republic of Namibia  
The Republic of South Africa



**Pre-Feasibility Study into  
Measures to improve the  
Management of the  
Lower Orange River and to  
provide for future developments  
along the Border  
between Namibia and South Africa**

**VIOOLSDRIFT NOORDOEWER JOINT  
IRRIGATION SCHEME:  
ASSESSMENT OF VIABILITY**

**FINAL**

**October 2004**

**Burmeister & Partners, Ninham Shand (Pty) Ltd,  
Windhoek Consulting Engineers and WRP (Pty) Ltd  
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**COVER PAGE**

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## **VIOOLSDRIFT AND NOORDOEWER JOINT IRRIGATION SCHEME (JIA)**

### **ASSESSMENT OF VIABILITY WITH PARTICULAR REFERENCE TO JIA REQUEST FOR FURTHER INVESTMENT**

#### **EXECUTIVE SUMMARY**

##### **BACKGROUND**

*Vioolsdrift and Noordoewer are small towns on opposite banks of the Lower Orange River (LOR), some 350 km from the river mouth. Vioolsdrift is in South Africa and Noordoewer is in Namibia. The South African Government constructed a canal system serving the two settlements in 1933. The canal is fed from a weir upstream of the river crossing. The canal infrastructure has supported agriculture on the southern and northern banks of the LOR for some 70 years.*

*At Namibian independence, an international boundary was established along the LOR. This development required new management arrangements for the irrigation scheme. A Joint Irrigation Authority (JIA) was established at the end of 1993, based on an agreement between the Governments of Namibia and South Africa.*

*The South African Department of Water Affairs and Forestry (DWAF) had embarked on a renovation and upgrading programme just prior to the establishment of the JIA, but this work was stopped when the JIA was formed. In the view of the farmers, the support formerly provided by DWAF, has not been adequately replaced since the establishment of the JIA.*

*In the past decade, the JIA and the farming community have experienced financial difficulties, and the JIA requested financial assistance from the Namibia / South Africa Permanent Water Commission (PWC), mainly to repair and upgrade the deteriorating canals.*

*This study is a strategic assessment of the JIA, the farmers and their role in the communities to assist PWC decision-making on whether or not to support the JIA and under what conditions.*

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## THE STUDY

*The objectives of this study are:*

- *To determine (at a strategic level) the financial viability of the Vioolsdrift and Noordoewer Irrigation Scheme, including possible further investment, and the socio-economic benefits that the scheme holds for the area.*
- *To achieve the above through a strategic investigation and assessment of the irrigation development and the farming community.*
- *To make recommendations, including the institutional, managerial and agricultural changes that may be necessary to improve the financial and socio-economic situation of the scheme and the agricultural community.*

*These recommendations will inform decisions by the PWC regarding the role of the JIA and in particular its request for financial assistance.*

*The Scope of Work (SoW) to meet the objectives comprises an evaluation and assessment of the following:*

- *Irrigation demand, including high water table drainage requirements, crop types and cropping patterns, soil potential and water demand management.*
- *Irrigation efficiency, including the institutional and management capacity of the JIA, limiting production factors, the extent and utilization of irrigable areas below present and future flood lines, and farm management practices.*
- *The socio-economic situation of Vioolsdrift and Noordoewer, including demographic and employment circumstances, institutional arrangements and support bases, and opportunities for horticultural development.*
- *Estimates of the costs of urgent repair work, upgrading, future operations, and debt repayment for various loan / subsidy alternatives.*

*The project components can be broadly subdivided into three disciplines, or categories, namely:*

- *Agricultural and civil engineering;*
- *Agricultural economy; and*
- *Socio-economic and institutional.*

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## **SITUATION ASSESSMENT**

### **Scheme Infrastructure and Irrigation Development at Noordoewer/Vioolsdrift**

The system comprises 42 km of canals of different shapes and sizes, which can serve a total scheduled (enlisted) irrigation area of 883.7 ha. The Vioolsdrift canal starts on the South African side at a weir in the Orange River, approximately 13 km upstream of the N7 road bridge across the river. Siphons are used to transport the water across the river at 5 locations along the extent of the scheme.

A wide range of crops is cultivated on the 69 units, which make up the 883.7 hectares (ha) of land scheduled for irrigation on both sides of the river. Seventeen of these units, on 283.2 ha, are at Noordoewer and the balance of 600.5 at Vioolsdrift. Irrigation is done mainly by means of flood irrigation; 573 ha of the area currently irrigated are flood irrigated, while the balance of 155 ha is under sprinkler, micro and drip irrigation systems.

Information on the existing development was collected through questionnaires.

### **Future Irrigation Development at Noordoewer/Vioolsdrift**

The information obtained through the questionnaires shows that the area actually under irrigation is expected to increase from the existing 728 ha to 864 ha over the next five years. There will be a move towards permanent crops, as well as to more efficient irrigation systems.

Four types of irrigation system are used at Noordoewer and Vioolsdrift.

Most of the irrigation applied in the study area is presently done by means of flood irrigation. The efficiency of these systems is in the order of 75% or below. With improved irrigation systems (upgraded flood systems, mechanized systems and micro systems), it is possible to improve the overall efficiency to 85%.

General problems experienced by irrigators were identified, as well as suggestions on the removal / solving of these problems. For 31 of the 69 units, it was indicated that problems were experienced. These units are mainly located along those sections where most of the rehabilitation work on the canals is required.



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### **Previous Findings with regards to the Conveyance System**

*For the evaluation of the conveyance scheme, use was made of existing recent reports.*

*A report by Engels, Peters and Manus investigated all canals in the system with regards to urgent rehabilitation needed "before it will deteriorate to be non-existent". This was performed as a joint venture between DWAF (RSA) and the Department of Agriculture (DOA) (Namibia) during November 2001.*

*This study did not address the possible upgrading required for Modderdrift South, Duine and Naupoort canals. It likewise did not address the need for and cost of repair work to certain sections of the scheme.*

*The estimated cost varied from R 1 026 589 (SA estimate) to N\$ 1 403 844 (Namibian estimate). The SA estimate, however, did not provide for rehabilitation work to the Namibian side of the scheme. Rehabilitation work not included in any of the above estimates, is the repair of 16 damaged panels in the Noordoewer canal.*

### **Project Team's Findings and Cost Estimate for Rehabilitation of the Scheme (Engineering)**

*For the evaluation of the scheme, the findings of the above-mentioned previous studies were used. Further analyses were carried out on irrigation requirements and the farming practices based on the Project Team's exposure to the scheme, interviews and questionnaires.*

#### **Irrigation Requirement**

*Analyses show that the annual requirement exceeds the allocation of 15 000 m<sup>3</sup> per ha (the allocation as used in the LORMS Report). The estimated future difference between allocation and requirement will be even bigger, mainly due to expansion of crops with larger water requirements, e.g., grapes and lucerne.*

*A further analysis was done on a scenario where efficiency of the flood irrigation systems was improved from 65 to 80% for fodder crops and to 90% for vegetable crops. This is achievable with laser levelled flood systems, sprinkler systems and drip systems, provided the systems are not exposed to the risk of flooding.*



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*Under these improved efficiency conditions, the requirement will be below the allocation of 15000 m<sup>3</sup>, both for the present and the future situation.*

*In the Lower Orange River Management Study (LORMS), a significant area of land with potential for irrigation in the Noordoewer/Vioolsdrift region was identified.*

*The location of this potential land on the Vioolsdrift side is such that it cannot be supplied with the existing canal system. On the Noordoewer side, there is also no significant spare capacity in the canals if the original canal design norms are applied. However, if operating rules are changed, and more efficient irrigation systems are used, the canal may be adequate to supply water to additional land. All this land is above the canal, and pumps will be needed to supply the water from the canal to the irrigation areas.*

### **Conveyance System Capacity**

*The Africon Study showed that, with the additional pumping into the canals, the capacity of the conveyance system is adequate for the design requirement. This is in strong contrast to the experience of the farmers, especially if the requirement of the crops and area irrigated at present are taken into account.*

*The peak flow rate required in the main canal is 1.02 m<sup>3</sup>/s at present, whereas the canal is designed for 1.85 m<sup>3</sup>/s.*

*It is important to establish why there is this discrepancy. Although this will not make a difference to the need to rehabilitate the system, it may provide opportunities to irrigate a larger area with the present infrastructure. It may also reduce the need for additional pumping into the system.*

*Possible reasons for the apparent inability of the conveyance system to supply in the requirement are listed. Although there are serious technical problems in the system, the management of the system also plays a significant role in the shortages, which are experienced. The current application of the turn system should be evaluated against the background of the design of the system.*

### **Rehabilitation of the Scheme**

*In view of the age of the canals, it is the opinion of the Project Team that rehabilitation by means of continual replacement of damaged panels and the relining of certain sections is, in the long-term, not cost effective.*

*A cost estimate was made to replace the older canal sections, which are in a poor condition, as well as to rehabilitate the damaged sections in the rest of the system. For the purpose of this study, a rectangular section was assumed. It is assumed that during the design of the works, the optimum design will be determined.*

*The total cost of the rehabilitation work and upgrading of the system is estimated at R 8.6 million.*

### **Water Demand Management**

*The recommendations made in the report on Water Conservation in the LORMS with regards to Water User Associations (WUAs) and management of farms, are applicable to the Noordoewer/Vioolsdrift Scheme, provided that the technical problems of the system are sorted out.*

*The practicality of installing removable, more efficient irrigation systems, e.g., sprinkler and drip, on the large area of existing development which lies below the flood lines must be evaluated.*

*The practicality and feasibility of incorporating lined retention dams into the system must be investigated.*

### **Agriculture**

*A summary of the present cropping patterns, as well as the anticipated cropping patterns in five years time was prepared.*

*A dramatic increase is projected for permanent crops from 15.1 to 25.0% of the total production area within a 5-year period.*

*The projection is that the area under lucerne will remain the same, approximately 43%.*

*Areas currently planted with cotton will be phased out over time.*

*Farmers also envisage that no grain crops will be planted 5 years from now.*

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*It is envisaged that vegetable production will decline in terms of percentage of total production area (25,3 to 22.9%), but the area planted will stay approximately the same.*

*The Gross Margins and Gross Margin per cubic metre of water required to grow some of the crops grown or intended to be grown at the Vioolsdrift/Noordoewer Irrigation Scheme was assessed.*

### **Economics of Agriculture Activities and Tendencies in the Area**

*An attempt was made to reflect the possible financial growth or decline of the scheme based on the average Gross Margin expectations for the different crop groups. The total expected Gross Margin will increase from **R/N\$ 9 748 965** to **R/N\$ 15 733 865**, which reflects a growth of 61% for the Vioolsdrift/Noordoewer Irrigation Scheme over a 5-year period.*

### **Barriers/Incentives to Change**

*The Vioolsdrift/Noordoewer Irrigation Scheme is slowly but surely being transformed into a more progressive production area where the average income per hectare will increase progressively over the next few years. From interviews conducted, it became clear that the progressive farmers are dictating development trends and that change will take place at a gradual pace.*

### **Financial Situation of JIA**

*Audited statements of the Vioolsdrift/Noordoewer Joint Irrigation Scheme were requested for scrutiny. The last three years posted growing deficits. The net deficit for the previous 5-year period is N\$ 91,492.90. It is expected that Operation and Maintenance (O&M) cost will further increase its proportional contribution to the expense structure of the JIA budget over the next few years.*

### **Financial Situation of the Farmers**

*The financial position of the individual farmers in general is not very healthy. The banks, however, indicated that there are a few of these farmers who are outperforming others. These farmers are without exception to those who have and are in the process of adopting more advanced farming practices and higher value crop profiles.*

### **Institutional**

*The **JIA** appears to be relatively effective within its limited mandate. It has managed to accumulate a small Reserve Fund, which has grown from less than R 60 000 to more than R 160 000 in the five years from 1998/99. However, there is evidence that the JIA, in its present form, is not equipped to deal with the array of threats and challenges that face the Vioolsdrift and Noordoewer Joint Irrigation Authority.*

*On a **local authority** level, the settlement of Noordoewer is served by a Village Council responsible for social services such as water, electricity and the development of the settlement. Vioolsdrift is part of the NamaKhoi Local Municipality, which has its administrative seat in Springbok.*

### **Regional Economics and Planning**

*On a **National and Regional level**, it seems that Noordoewer and its environs are prominent in Namibian national and regional planning. By contrast, Vioolsdrift and its surrounding communities seem to be in a regional planning backwater, victim to other priorities and associated resource allocations.*

*The local economies of Vioolsdrift and Noordoewer depend on farming enterprises, the border post, other public service offices and tourism-based enterprises. Secondary local economic activities (approximately 10) include shops, petrol stations and motels, as well as some informal businesses in both communities.*

### **Social**

*The Vioolsdrift and Noordoewer Irrigation Scheme directly supports 45 irrigation farmers and their households, 200+ permanent farm workers and their households / families and 300+ seasonal workers and their households / families.*

*The communities of Vioolsdrift and Noordoewer are fragmented and divided by national boundaries, as well as other aspects such as different types of water users and different farming practices.*

*This strategic investigation found no formal figures for unemployment or poverty in the two towns. A detailed analysis of incomes was also not possible within the scope of this study, but it is reasonable to conclude that the majority of the population in both Noordoewer and Vioolsdrift are close to poverty thresholds.*

### **Support Infrastructure**

*A common theme from the key informant interviews is that Noordoewer is better served than Vioolsdrift in terms of Government-provided services. Housing and water are a case in point, and the two clinics are often compared in this context, as is the road infrastructure.*

## **CONCLUSIONS**

### **Institutional Framework**

*The Vioolsdrift and Noordoewer JIA is too narrowly constituted to deal with the management challenges that confront the irrigation scheme and the communities that depend on it for their livelihoods.*

*Local Government is relatively pro-active and supportive on the Namibian side of the river, and less so on the South African side.*

*National and Regional Government in Namibia appear to have provided a strategic and operational framework for the economic development of the LOR, including Noordoewer. A similar framework is not evident in South Africa.*

### **Agricultural Economics**

*The importance of Noordoewer/Vioolsdrift must not be underestimated as it is a growth point with considerable expansion possibilities that will improve the viability of the irrigation scheme.*

## **Social Fabric**

*The local economies and the associated social fabrics of the communities are very fragile. In deciding whether to invest in the irrigation scheme or not, the two Governments need to weigh the investment and its potential returns against the cost of providing welfare support to growing numbers of poor and unemployed people.*

## **Impact of Scheme Failure**

*The failure or serious financial deterioration of agricultural enterprises in Vioolsdrift and Noordoewer will have a number of local impacts. These are outlined under headings of severe, serious and moderate. Severe impacts relate to substantial primary loss of employment and livelihoods, serious impacts relate mostly to secondary job loss and the deterioration of physical and social infrastructure, and moderate impacts refer to a scaling down of public service activities.*

## **Potential Viability of the Scheme**

*Evidence suggests that the Vioolsdrift and Noordoewer Joint Irrigation Scheme is currently marginal. The outlook is that the scheme will remain marginal unless support matches funding with the facilitation of business and organizational reforms.*

*Obstacles to the viability of the Vioolsdrift and Noordoewer Joint Irrigation Scheme have been identified. Most of the obstacles are critical, but it is encouraging that many can be addressed locally. The obstacles are:*

- *Institutional arrangements for managing the water resource and the integrated development of agribusiness are weak.*
- *Small economic units and conservative farming and marketing practices.*
- *The lack of a cohesive and strategic approach to the development of agribusiness.*
- *Competition in the chosen markets and poor market selection.*
- *A lack of attractiveness to investors.*
- *The peripheral status of the joint irrigation scheme in National and Regional development planning, particularly in South Africa.*

## **INTERVENTION OPTIONS**

### **Identification and Definition of Options**

*The identified different options are:*

- *No direct Financial Support by Governments;*
- *Unqualified Government Financial Support; and*
- *Conditional Direct Financial Support.*

### **Discussion and Analysis of Options**

*The first option of maintaining the status quo and expecting the JIA and the individual farmers to find a solution would pose certain possible positive and negative consequences to a number of stakeholders. The most extreme outcome would be the total eventual failure of the scheme. Another possible outcome could be that the weaker farmers will be forced to sell their plots to more successful and resourceful farmers. This could also see new and more entrepreneurial farmers from outside buying land at the scheme.*

*Option two is most probably the easy way out, but not desirable. An unconditional rescue package would only delay a natural shake-out process, which is busy taking place. It will just conceal certain economic inefficiencies in the current operations of the scheme. This option will not present a sustainable solution to the problem at hand.*

*The third option of offering conditional assistance would see both parties having to commit themselves to find a sustainable and realistic solution to the obvious and deeper rooted problems experienced at the scheme.*

*On the part of the two Governments, a commitment in terms of a substantial financial contribution towards the rehabilitation of the scheme could be made, as well as funding a capacity building programme. The Governments could also provide financial guarantees which could be used to raise other commercial funds to finance the scheme's rehabilitation.*

*It is clear that Alternatives 1 and 2 will not lead to the desirable result, which is a lasting and sustainable solution that will contribute towards stability and economic progress in*



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the area. The recommended option is Alternative 3 that aims at creating a partnership in solving the problem.

## **RECOMMENDATIONS**

### **Short Term Actions and Responsibilities**

*It is recommended that for the immediate and short-term, the PWC makes sufficient funds available to repair those sections of the canal where the need is the most urgent. This would, however, be conditional on the JIA embarking on a programme to evaluate its own options and also that a long-term management plan be drafted and implemented.*

### **Medium- and Long-Term Interventions**

*For the medium and longer term it is recommended that the PWC makes available funding to:*

- *Appoint professional facilitators to assist the JIA and its members to draft a long-term management plan for the entire scheme, including the larger Noordoewer/Vioolsdrift community.*
- *Evaluate the role that the scheme could play in broader Regional and National development programmes and initiatives.*
- *Identify other funding partners who might provide grants or soft loans, which could be applied to the rehabilitation of the scheme, as well as launching additional capacity building programmes in the communities.*

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## 1 BACKGROUND

### 1.1 History

Violsdrift and Noordoewer are small towns on opposite banks of the Lower Orange River (LOR), some 350 km from the river mouth. Violsdrift is in South Africa and Noordoewer in Namibia. The South African Government constructed a canal system serving the two settlements in 1933. The canal is fed from a weir upstream of the river crossing. The canal infrastructure has supported agriculture on the southern and northern banks of the LOR for some 70 years.

Between 1933 and the independence of Namibia in 1990, the Violsdrift/Noordoewer Irrigation Scheme was under South African jurisdiction. An Irrigation Board was responsible for the local management of the scheme, with support from the South African Department of Water Affairs.

At Namibian independence, an international boundary was established along the LOR, and a border post was constructed between the two towns. This development required new management arrangements for the irrigation scheme. A Joint Irrigation Authority (JIA) was established at the end of 1993, based on an agreement between the Governments of Namibia and South Africa.

The South African Department of Water Affairs and Forestry (DWAF) had embarked on a renovation and upgrading programme just prior to the establishment of the JIA, but this work was stopped when the JIA was formed. In the view of the farmers, the support formerly provided by DWAF has not been adequately replaced since the establishment of the JIA.

### 1.2 The Current Situation

Some farmers on both sides of the river have been involved in the irrigation scheme for decades. However, attrition of this group has led to a mix of established and new farmers, and to some extent to a range of agricultural visions and methods.

A total of 883.7 ha is scheduled for irrigation of which 283.2 ha are at Noordoewer and 600.5 ha at Violsdrif.

The combined area currently under irrigation is 728 ha of the possible 883.7 ha.

**Table 1.1** summarizes the enlisted – and irrigated areas.

**Table 1.1 Enlisted and Irrigated Areas**

	VIOLSDRIFT	NOORDOEWER	TOTAL
Enlisted area (ha)	600.5	283.2	883.7
Area served by canal (ha)	524	283	807
Present area irrigated (ha)	475	253	728

In the past decade, the JIA and the farming community have experienced financial difficulties, apparent from the following:

- Low levels of JIA financial reserves.
- Low income of the JIA.
- High levels of debt among the farmers.
- A perceived higher incidence of bankruptcies and vacant farms compared to surrounding areas.
- The apparent inability of the JIA to maintain some parts of the infrastructure without external finance.
- Poor condition of some of the infrastructure, and hence poor performance of the scheme.

Against this background, the JIA requested financial assistance from the Namibia / South Africa Permanent Water Commission (PWC), mainly to repair and upgrade the deteriorating canals.

This study is a strategic assessment of the JIA, the farmers and their role in the communities which purpose is to assist PWC decision-making on whether or not to support the JIA and under what conditions.

### 1.3 The JIA

The Agreement establishing the Vioolsdrift and Noordoewer JIA was signed in 1992. The JIA Board was established in 1993, in terms of Article 6 of the Agreement. The international Vioolsdrift and Noordoewer JIA is the only one of its kind on the Orange River, and is perhaps a pioneer for further cooperative ventures of this kind.

Under the establishment agreement, the JIA has a limited brief. Its key function is to manage and control water supply through the irrigation scheme to the farmers. Representation on the JIA Board and in the JIA itself reflects the restricted brief. The members of the JIA are land-owning irrigators. The Board comprises land-owning

representatives of the two farming communities and representatives of the South African Department of Water Affairs and the Namibian Department of Agriculture (DOA).

#### **1.4 Socio-Economic**

Little information regarding the population in the area is available. On the Namibian side, estimates of the population of Noordoewer and environs range between 2 000 and 6 000. On the South African side, the local municipality does not have population figures for Vioolsdrift. It seems likely, however, that the population will be of the same order as Noordoewer. The economies of both communities are dependent on agricultural activity. Government services (border control, Local Government, police, education, health) and tourism are other elements of the local economies on both sides of the border.

An investigation that was conducted during January/February 1999 estimates that there were about 400 families with a family size of five per family living at the informal settlement at Noordoewer. The total population was thus estimated to be about two thousand people in the settlement. A considerable influx of people to Noordoewer has occurred over the last few years and it is estimated that the number of people in the informal settlement has since increased considerably.

A high level of unemployment in Namibia contributes towards migration of people to areas where possibilities of work exist and it is expected that more people will move to Noordoewer. People also tend to move between Noordoewer and Aussenkehr as seasonal labourers.

The Noordoewer and Vioolsdrift communities are divided by an international boundary, but there are also internal divisions. These relate to employment, income, access to social services, and involvement in the management of the water resource. Levels of poverty are significant in both communities. Failure of the irrigation scheme is likely to result in greatly increased numbers of poor and unemployed people, resulting in a welfare liability for both Namibia and South Africa.



## **2 THE STUDY**

### **2.1 Objectives**

The objectives of this study are:

- To determine (at a strategic level) the financial viability of the Vioolsdrift and Noordoewer Irrigation Scheme, including possible further investment, and the socio-economic benefits of the scheme to the area.
- To achieve the above through a strategic investigation and assessment of the irrigation development and the farming community.
- To make recommendations, including the institutional, managerial and agricultural changes that may be necessary to improve the financial and socio-economic situation of the scheme and the agricultural community.
- These recommendations will inform decisions by the PWC regarding the role of the JIA and in particular its request for financial assistance.

### **2.2 Scope of Work**

The Scope of Work to meet the objectives comprises an evaluation and assessment of the following:

- Irrigation demand, including high water table drainage requirements, crop types and cropping patterns, soil potential and water demand management.
- Irrigation efficiency, including the institutional and management capacity of the JIA, limiting production factors, the extent and utilization of irrigable areas below present and future flood lines, and farm management practices.
- The socio-economic situation of Vioolsdrift and Noordoewer, including demographic and employment circumstances, institutional arrangements and support bases, and opportunities for horticultural development.
- Estimates of the costs of urgent repair work, upgrading, future operations, and debt repayment for various loan / subsidy alternatives.
- A strategic assessment of the costs, benefits and social impacts of various scenarios for the future of the scheme, which could include; no change, scheme closure, limited re-organization and restructuring of the scheme, or more significant restructuring.

## 2.3 Methodology

The project components can be broadly sub-divided into three disciplines, or categories, namely:

- Agricultural and civil engineering;
- Agricultural economy; and
- Socio-economic and institutional.

### 2.3.1 Agricultural and Civil Engineering

Existing documentation of previous studies done on the irrigation scheme served as an important source of background information.

A three-day field visit by the Agricultural Engineer was arranged, together with the agricultural economic team to carry out an initial assessment and data collection. This was done through interviews with farmers, the JIA, the officials of the two departments of Water Affairs, and observations of the relevant scheme features.

On the technical side, it was important to establish the following:

- The extent of the farming activities.
- The general condition of the scheme infrastructure.
- The problems experienced by farmers with regards to the water supply from the scheme.

An earlier field visit to the LOR, as part of the LORMS project in September 2002, also provided useful information for this extension to the project.

Use was also made of questionnaires to gain further knowledge of the activities in the area and the problems that are being experienced. During the field visit, it became obvious that questionnaires would be necessary to fill important gaps not satisfactorily answered during the visit. The Team decided to handle the technical, economic and social issues separately, and therefore the technical questionnaire focused only on the farming activities of the farmers and the problems, which they experience with the scheme.

An example of the technical questionnaires is presented in **Appendix A**. These questionnaires were distributed among the farmers, and with the assistance of the JIA office personnel the forms were completed and returned to the Project Team.

The following steps were followed in order to achieve the project objectives:

- Determine the irrigation requirement of the members of the JIA.
- Evaluate the capacity of the scheme.
- Identify bottlenecks in the supply system.
- Evaluate identified capital works required to repair the system.
- Estimate the cost to supply irrigation water for the present and future needs of the members of the JIA, taking into account the location of existing and future potential development areas.

### 2.3.2 *Agricultural Economy*

Existing knowledge and the results of previous studies served as baseline information to assist the investigation team with the study. The Agricultural Economic team members were Messrs P de Wet and F Oosthuizen.

A field visit was arranged and interviews were conducted with farmers, JIA Board members and officials. Valuable information was also acquired through the questionnaires regarding production activities and tendencies.

Financial information was also gathered from other agriculture development initiatives within similar environmental conditions.

### 2.3.3 *Socio Economy and Institutional*

The approach for the socio-economic and institutional components of the assignment was that of face-to-face interaction with key stakeholders in the Vioolsdrift/Noordoewer Irrigation Scheme and communities, together with a review of relevant documentation. Telephonic contact with selected stakeholders was made in preparation for a field visit. The visit took place in the week 2-6 June 2003. A full list of contacts is presented in **Appendix B**.

The socio-economic and institutional Study Team comprised:

- Tim Hart – RDC Prescient Consulting (Leader)
- Milicent Solomons – Ninham Shand
- Alfons Mosimane – University of Namibia.

The interviewees included:

- Vioolsdrift and Noordoewer farmers.
- Local Government (Noordoewer and NamaKhoi (South Africa)).
- Businesses (including eco-tourism).
- Non-Government Organisations (NGOs) and community representatives.
- Managers of other irrigation projects (e.g., Aussenkehr, Grape Valley, (Namibia)).
- Department of Labour (Noordoewer).

### 3 SITUATION ASSESSMENT

#### 3.1 Scheme Infrastructure and Irrigation Development at Noordoewer/Vioolsdrift

##### 3.1.1 Scheme Infrastructure

The layout of the scheme is shown in **Figure 3.1**. The system comprises 42 km of canals of different shapes and sizes. The scheme starts with the Vioolsdrift canal on the South African side at a weir in the Orange River, approximately 13 km upstream of the N7 road bridge across the river. The Naupoort siphon is used to transfer water across the border into the Naupoort branch canal, which runs for a distance of 1.5 km on the Namibian side.

The main canal crosses the river at the bridge with the Vioolsdrift siphon and from there it remains on the Namibian side for 7.9 km (Noordoewer canal).

Where this canal ends, part of the flow continues on the Namibian side as the Duifieloop canal (4 km), while the balance of the water is discharged into the Rooiwal siphon. This siphon then transfers the water across the border, back into South Africa, into the Rooiwal canal. The length of this canal is 1.7 km before it divides into two canals - the Swartbas and the Duineloop canals. The latter is a branch canal, while the Swartbas discharges its water into the Swartbas siphon, which then crosses the river to Namibia. The lengths of the Swartbas and Duine canals are 3.7 and 2.5 km, respectively.

At the bifurcation of the Swartbas and Duine canals, the Swartbas pump station discharges its water into the system.

Downstream of the Swartbas siphon (on the Namibian side), the Modderdrift main canal feeds the water over a distance of 2.3 km. At the start of this canal, the Modderdrift pump station's water is discharged into the canal. This canal discharges part of its water into the 2.3 km Modderdrift North branch canal that remains on the Namibian side, while the balance of the water is discharged into the Modderdrift siphon back across the border into the Modderdrift South canal. The length of this last section of canal is 3.1 km.

Farmers withdraw water all along the canal system by means of sluice gates according to the size of their land enlisted with the JIA. In a few cases, farmers have their own pump stations on the river from where they abstract their own irrigation water.

**Figure 3.1: Layout of the Noordoewer/Vioolsdrift Scheme**

### 3.1.2 Existing Irrigation Development at Noordoewer/Vioolsdrift

A wide range of crops is cultivated on 69 the land units, which make up the 883.7 ha of land scheduled for irrigation on both sides of the river. Seventeen of these units on 283.2 ha are at Noordoewer and the balance of 600.5 at Vioolsdrift. At present, 728 ha is under irrigation.

Irrigation is done mainly by means of flood irrigation; 573 ha of the total area of 728 ha currently under irrigation are flood irrigated, while the balance of 155 ha is under sprinkler, micro and drip irrigation.

Information on the existing development, as obtained from the questionnaires, is summarized in **Table 3.1**.



**Table 3.1: Existing Irrigation Development on Noordoewer and Vioolsdrift**

Page	Owner	Plot	Canal	Current Crops																							
				Lucerne	Mango	Citrus	Paw paw	Vineyards	Dates	Fruit	Mielies	Sugar mielies	Corn	Oats	Tomatoes	Peppers	Chillies	Sweet melon	Pumpkin	Watermelon	Cucumber	Vegetables	Brinjals	Beans	Cashcrops	Cotton	TOTAL
1	M M van der Hoven	176, 178, 180, 182, 184, 186, 188	Modderdrif Noord	6	0	0	35	0	0	0	0	0	0	0	4	0	0	8	0	0	0	0	0	0	0	13	34.5
2	H.J. Coetzee en Seun	167, 111,114,160,166,172	Modderdrif Noord	1 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	3 0	
3	B Beets	46, 231	Swartbas - kanaal	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	
4	Piet Mostert (P J)	20	Rooiwal	7 . 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7.5	
5	J Le Roux	67	Modderdrif Suid	0	0	0	0	0	0	0	0	0	0	2.5	1	3	0	0	0	0	0	0	1	1	0	8.5	
6	NM van den Heever	26	Rooiwal	2 . 5	0	0	0	0	0	0	0	0	0	0	0	0	0	3.5	0	0	0	0	0	0.5	0	6.5	
7	Good Hope Granite CC	12	Vioolsdrift	9	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 1	
8	W Mostert	155	Vioolsdrift	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	
9	EJ Agenbach	189	Noordoewer	6 . 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.3	
10	JA Jansen	7, 8	Vioolsdrift	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	8	0	1 2		
11	JA Jansen	9, 10, 11	Vioolsdrift	0	0	0	0	0	0	0	0	0	0	8	1 0	0.5	0	0	0	0	0	1	0	0	0	19.5	
12	Orange River Farmig (Pty) Ltd	222 EA	Noordoewer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	1 0	
13	BJ van den Hoven	244, 243, 322, 321, EA	Noordoewer	0	6	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	2 4
14	A May	13	Vioolsdrift	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	5	
15	A May	34	Rooiwal	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	
16	A May	57	Duin	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	7	
17	Alban Nelson	3, 4, 145, 146, 149	Vioolsdrift	6 . 4	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	9.4	
18	GJ Coetzee	5, 6, 141, 142	Vioolsdrift	12.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12.7	
19	DC Mostert	355	Duifieloop	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
20	NJ van der Merwe	437	Noordoewer	0	0	0	0	8.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	48.5	
21	Makalani Grapes (Pty) Ltd	205	Noordoewer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
22	Burger Boerdery	238	Noordoewer	1 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1 4	
23	Jordaan	208, 430, 235	Noordoewer	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	
24	Sarel Beets	295	Rooiwal	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 4	
25	Sarel Beets	52	Rooiwal	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	
26	Sarel Beets	19	Rooiwal	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	
27	Sarel Beets	15	Rooiwal	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	
28	Manandi Boerdery	308	Duin	1 . 7	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	4.7	
29	Manandi Boerdery	170, 308	Duin Kanaal	1 . 7	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	4.7	
30	GJ Gagiano	37, 39, 41, 43, 289, 53, 55	Duin	2 8	0	0	0	0	0	4	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	4 4	
31	GJ Gagiano	64, 65	Swartbas	8	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	1 2	
32	HAP van Zyl	165	Swartbas	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	
33	Western Investment Co.	38	Duin Kanaal	0	0	0	0	1 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 0	
34	Western Investment Co.	33, 35, 36, 40, 42, 44	Swartbas	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	
35	FI van Rooyen	241, 150, 246	RSA	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	
36	CH Sutherland	16	Rooiwal	1.45	0	0	0	0	0	0	1.5	0	0	0	0	0	0	0	0	0	0	0	1.37	1.7	0	6.02	
37	CH Sutherland	22	Rooiwal	0	0	0	0	0	0	0	0	0	0	0	1.45	0	0	0	2.2	0	0	0	0	0	0	3.65	
38	CH Sutherland	32	Rooiwal	0	0	0	0	2.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.6	
39	CH Sutherland	50	Rooiwal	0	0	0	0	0	0	0	0	0	0	2 . 4	0	0	0	0	0	1	0	0	0	0	0	3.4	

Page	Owner	Plot	Canal	Current Crops																				TOTAL			
				Lucerne	Mango	Citrus	Paw paw	Vineyards	Dates	Fruit	Mielies	Sugar mielies	Corn	Oats	Tomatoes	Peppers	Chillies	Sweet melon	Pumpkin	Watermelon	Cucumber	Vegetables	Brinjals		Beans	Cashcrops	Cotton
40	CH Sutherland	59	Rooiwal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0.67	0	1.8	0	0	0	3.47
41	HJ Mulder	23	Rooiwal	6.2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7.2
42	HJ Mulder	24	Rooiwal	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
43	HJ Mulder	25	Rooiwal	3.5	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.5
44	HJ Mulder	21	Rooiwal	7.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7.2
45	Deon Nolte	157, 214, 159, 177	Modderdrif Suid	2.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.6
46	HJ Weyers	48	Rooiwal	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
47	Andrew van den Heever	30, 63	Swartbas/Rooiwal	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
48	Danie Grobler	191	Rooiwal	0	1.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3
49	Danie Grobler	267	Rooiwal	0	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8
50	MM van Rooyen	174	Duifje	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.7	0	6
51	MM van Rooyen	192	Duifje	4.1	1.7	0	0	0	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	6.2
52	MM van Rooyen	190	Duifje	4.6	2.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7.3
53	Theronshoop Boerdery	66	Swartbas	0	5	1.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.9
54	Theronshoop Boerdery	116, 117, 216, 265, 264	Rooiwal	0	2.2	1.72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.92
55	Mias Theron	1, 2	Violsdrift	8	0	0	0	0	0	0	0	0	0	0	2.66	2.66	0	0	0	0	0	0	0	2.66	0	0	15.98
56	JA Olivier (Omega Boerdery)	216, 210	Modderdrif Noord/Duifje	6	0	0	0	0	0	0	0	0	0	0	2.4	0	0	3	3.5	0	0	0	0	0	0	0	19.9
57	JA Olivier (Tropica Boerdery)	161	Noordoewer/Modderdrif Noord	0	0	0	0	1.4	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	2.1
58	JA Olivier (Elim)	163	Duifje/Modderdrif Noord	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	6
59	JA Olivier (Grass Ridge)	393	Duifje/Modderdrif Noord	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	6	0	0	0	1	0	0	0	9
60	CJ van Dyk	17, 18	Rooiwal	15.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15.4
61	J Ruppig	27, 29	Rooiwal	14.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14.7
62	CH Sutherland	28, 118, 299	Rooiwal	0	0	1.8	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	7.8
63	WHJ Mosterd	31	Rooiwal	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	2	0	0	0	0	6
64	AJ Beukes	49, 294	Rooiwal	1.4	0	0	0	0	0	0	3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.5
65	JA Meyer	58	Rooiwal	1.9	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	6.9
66	MM Meyer	60, 168, 217	Rooiwal	5	0	0	0	0	0	0	0	0	0	0	8	4	0	0	0	0	0	2	0	0	0	0	1.9
67	Romia	68, 69, 152, 153, 215	Swartbas	2.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.6
68	AJ Maas	169	Rooiwal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	Verste Stuiwer	225, 290	Rooiwal	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
<b>Total</b>				<b>316.85</b>	<b>45</b>	<b>7.42</b>	<b>35</b>	<b>54.1</b>	<b>0</b>	<b>0</b>	<b>2.2</b>	<b>1</b>	<b>0.4</b>	<b>2.5</b>	<b>49.46</b>	<b>23.11</b>	<b>0.5</b>	<b>11</b>	<b>50</b>	<b>2.2</b>	<b>1.67</b>	<b>4</b>	<b>6.17</b>	<b>34.88</b>	<b>7.7</b>	<b>85</b>	<b>728.44</b>

### 3.1.3 Future Irrigation Development at Noordoewer/Vioolsdrift

The questionnaire also made provision for each member's view on how he/she envisages his farming in five years time.

The general expectation, from the information gathered in the questionnaire, is that the irrigated area will increase from the existing 728.4 to 864.35 ha in five years time (which is still less than the total scheme enlistment of 883.7 ha). There will be a move towards permanent crops, as well as to more efficient irrigation systems.

A summary of this information, in the same format as shown for the existing development, appears in **Table 3.2**.

**Table 3.2: Future Irrigation Development on Noordoewer and Vioolsdrift**

Page	Owner	Plot	Canal	Current Crops																							
				Lucerne	Mango	Citrus	Paw paw	Vineyards	Dates	Fruit	Mielies	Sugar mielies	Corn	Oats	Tomatoes	Peppers	Chillies	Sweet melon	Pumpkin	Wtaremelon	Cucumber	Vegetables	Brinjals	Beans	Cashcrops	Cotton	TOTAL
1	M M van der Hoven	176, 178, 180, 182, 184, 186, 188	Modderdrif Noord	1 0	0	0	15	0	0	0	0	0	0	0	0	0	1 0	0	0	0	0	0	0	0	0	3 5	
2	H.J. Coetzee en Seun	167, 111,114,160,166,172	Modderdrif Noord	1 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 8	0	3 0	
3	B Beets	46, 231	Swartbas - kanaal	7 . 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7 . 2	
4	Piet Mostert (P J)	20	Rooiwal	7 . 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7 . 5	
5	J Le Roux	67	Modderdrift Suid	1 5	0	0	0	0	0	0	0	0	0	2.5	1	0	0	0	0	0	0	0	1	1	0	0	20.5
6	NM van den Heever	26	Rooiwal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7 . 5	0	0	0	0	7 . 5
7	Good Hope Granite CC	12	Vioolsdrift	1 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 1	
8	W Mostert	155	Vioolsdrift	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	
9	EJ Agenbach	189	Noordoewer	6 . 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6 . 3	
10	JA Jansen	7, 8	Vioolsdrift	0	0	0	0	1 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 2	
11	JA Jansen	9, 10, 11	Vioolsdrift	0	0	0	0	0	0	0	0	0	0	0	0	5	1 0	0	0	0	0	0	0	1 0	0	0	2 5
12	Orange River Farmig (Pty) Ltd	222 EA	Noordoewer	1 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 0	
13	BJ van den Hoven	244, 243, 322, 321, EA	Noordoewer	8	6	0	0	1 0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	3 3
14	A May	13	Vioolsdrift	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	5	
15	A May	34	Rooiwal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	7	
16	A May	57	Duin	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	
17	Alban Nelson	3, 4, 145, 146, 149	Vioolsdrift	1 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	6	0	0	0	0	0	2 1	
18	GJ Coetzee	5, 6, 141, 142	Vioolsdrift	12.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12.7	
19	DC Mostert	355	Duifeloop	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
20	NJ van der Merwe	437	Noordoewer	0	0	0	0	1 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2 8	0	4 0	
21	Makalani Grapes (Pty) Ltd	205	Noordoewer	0	0	0	0	3 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3 0	
22	Burger Boerdery	238	Noordoewer	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 4	
23	JORDAAN	208, 430, 235	Noordoewer	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	
24	Sarel Beets	295	Rooiwal	1 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 4	
25	Sarel Beets	52	Rooiwal	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	
26	Sarel Beets	19	Rooiwal	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	
27	Sarel Beets	15	Rooiwal	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	
28	Manandi Boerdery	308	Duin	0	0	0	0	5.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5 . 5	
29	Manandi Boerdery	170, 308	Duin Kanaal	0	0	0	0	5.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5 . 5	
30	GJ Gagiano	37, 39, 41, 43, 289, 53, 55	Duin	40.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	44.9	
31	GJ Gagiano	64, 65	Swartbas	1 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 2	
32	HAP van Zyl	165	Swartbas	3 . 5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 . 5	0	6	
33	Western Investment Co.	38	Duin Kanaal	0	0	0	0	1 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 7	
34	Western Investment Co.	33, 35, 36, 40, 42, 44	Swartbas	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	
35	Fl van Rooyen	241, 150, 246	RSA	9	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 6	
36	CH Sutherland	16	Rooiwal	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	6	
37	CH Sutherland	22	Rooiwal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.65	0	0	0	3.65	
38	CH Sutherland	32	Rooiwal	0	0	0	0	2.6	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	6 . 6	
39	CH Sutherland	50	Rooiwal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	7	



### 3.1.4 Irrigation Requirements at Noordoewer/Vioolsdrift

Four types of irrigation system are used at Noordoewer and Vioolsdrift. The different areas irrigated with each system are shown in **Table 3.3**. The table also shows the expected situation in five years time, as well as irrigation efficiencies as suggested by the South African Irrigation Institute (SAII).

**Table 3.3: Irrigation Systems used at Noordoewer and Vioolsdrift**

Irrigation System	Design Efficiency	Area Under Irrigation (ha)	
		Present	Future
Flood	65 %	573	549
Sprinkler	75 %	7	8
Micro	90 %	81	188
Drip	95 %	68	119
<b>Total</b>		<b>728</b>	<b>864</b>

The table shows that most of the irrigation applied in the study area is presently done by means of flood irrigation. The efficiencies of these systems are below, or in the order of 75%. With improved irrigation systems (upgraded flood systems, mechanized systems and micro systems), it is possible to improve the overall efficiency to 85%. It is therefore reasonable to assume that the efficiency of the irrigation systems at any stage will be between these two values.

The SAPWAT program was used to calculate the gross irrigation requirement for a number of alternative crops grown in the study area. Irrigation requirements were calculated for irrigation application efficiencies of 75 and 85%, respectively. Climate data from the Richtersveld weather station was used for these analyses. **Table 3.4** shows the results of these calculations.

**Table 3.4: Gross Irrigation Requirements for a Number of Crops at Noordoewer/Vioolsdrift (Irrigation Efficiencies of 75 and 85%)**

Crop	Current (ha)	Future (ha) (5 years)	Irrigation Requirement at 75% efficiency (mm)												Tot	Max	Max/day
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
<b>Permanent Crops</b>																	
Table Grapes	54.10	138.60	266	215	163	104	2	38	50	66	95	196	227	259	1 681	266	8.58
Mangoes	45.00	40.80	304	243	210	159	98	70	87	145	188	257	283	310	2 354	310	10.00
Dates	0.00	14.00	226	190	173	137	80	46	57	82	119	175	194	220	1 700	226	7.28
Citrus	7.42	7.42	219	183	165	85	80	55	70	97	123	169	185	213	1 644	219	7.06
Paw paw (papaya)	3.50	15.00	304	243	210	159	98	70	87	145	188	257	283	310	2 354	310	10.00
<b>Subtotal</b>	<b>110.02</b>	<b>215.82</b>															
			396	334	303	241	141	80	100	144	209	307	340	386			
<b>Fodder Crops</b>																	
Lucerne	316.85	372.40	282	237	214	155	79	46	59	86	128	203	241	274	2 004	282	9.10
Oats	2.50	2.50						57	93	168	206	113			637	206	6.65
<b>Subtotal</b>	<b>319.35</b>	<b>374.90</b>															
<b>Cash Crop</b>																	
Cotton	85.00	0.00	360	302	123							104	170	312	1 371	360	11.61
<b>Subtotal</b>	<b>85.00</b>	<b>0.00</b>															
<b>Grain</b>																	
Maize	22.00	7.50	276	35								68	213	334	926	334	10.77
Wheat	0.40	0.00						57	89	161	214	120			641	214	7.13
<b>Subtotal</b>	<b>22.40</b>	<b>7.50</b>															
<b>Vegetables</b>																	
Sweet Corn	1.00	0.00	171	231	233												
Tomatoes	49.46	23.66						72	103	153	204	279	21		832	279	9.00
Peppers	23.11	18.66						72	103	153	204	279	21		832	279	9.00
Chillies	0.50	0.00						72	103	153	204	279	21		832	279	9.00
Sweet melons	11.00	10.00									122	242	271	113	748	271	9.03
Pumpkin	50.00	3.00		155	189	178	110	7								189	6.10
Watermelon	2.20	6.00									122	242	271	113	748	271	9.03
Cucumber	1.67	0.00		155	189	178	110	7								189	6.10
Brinjal	6.17	1.00						72	103	153	204	279	21		832	279	9.00
Beans	34.86	13.66	155	305	277										737	305	10.89
Vegetables (unspecified)	4.00	121.95	32.6	84.6	88.8	35.6	22	30.2	41.2	61.2	106	160	62.6	22.6	747.4	160	5.71
<b>Subtotal</b>	<b>183.97</b>	<b>197.93</b>															
<b>Other</b>																	
Fallow	7.70	68.20	157.3	160.8	151.4	95.3	50.5	38.1	50.1	73.6	117	181.5	151.8	148.3	1 375.7	181.5	6.48
<b>Subtotal</b>	<b>7.70</b>	<b>68.20</b>															
<b>TOTAL</b>	<b>728.44</b>	<b>864.35</b>															

Crop	Current (ha)	Future (ha) (5 years)	Irrigation Requirement at 85% efficiency (mm)														Tot	Max	Max/day
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
<b>Permanent Crops</b>																			
Table Grapes	54.10	138.60	232	188	141	89	1	37	48	63	89	172	198	226	1 484	232	7.48		
Mangoes	45.00	40.80	268	215	185	140	87	70	76	128	166	227	250	273	2 085	273	8.81		
Dates	0.00	14.00	201	170	154	122	69	38	47	69	104	156	173	196	1 500	201	6.50		
Citrus	7.42	7.42	191	160	144	114	71	47	59	77	98	140	158	186	1 445	191	6.16		
Pawpaw (papaya)	3.50	15.00	268	215	185	140	87	70	76	128	166	227	250	273	2085	273	8.81		
Subtotal	<b>110.02</b>	<b>215.82</b>																	
			349	294	267	212	120	65	81	120	181	271	300	340					
<b>Fodder Crops</b>																			
Lucerne	316.85	372.40	248	209	189	137	69	41	52	76	113	179	213	242	1 768	248	8.00		
Oats	2.50	2.50						50	82	148	182	100			562	182	5.87		
Subtotal	<b>319.35</b>	<b>374.90</b>																	
<b>Cash Crop</b>																			
Cotton	85.00	0.00	318	267	108							91	150	275	1 209	318	10.26		
Subtotal	85.00	0.00																	
<b>Grain</b>																			
Maize	22.00	7.50	244	31								60	188	295	818	295	9.52		
Wheat	0.40	0.00						50	79	142	188	106			565	188	6.27		
Subtotal	<b>22.40</b>	<b>7.50</b>																	
<b>Vegetables</b>																			
Sweet Corn	1.00	0.00	151	204	205														
Tomatoes	49.46	23.66						63	91	135	180	246	18		733	246	7.94		
Peppers	23.11	18.66						63	91	135	180	246	18		733	246	7.94		
Chillies	0.50	0.00						63	91	135	180	246	18		733	246	7.94		
Sweet melons	11.00	10.00									108	214	239	100	661	239	7.97		
Pumpkin	50.00	3.00		137	167	157	97	6								167	5.39		
Watermelon	2.20	6.00									108	214	239	100	661	239	7.97		
Cucumber	1.67	0.00		137	167	157	97	6								167	5.39		
Brinjal	6.17	1.00						63	91	135	180	246	18		733	246	7.94		
Beans	34.86	13.66	136	269	244										649	269	9.61		
Vegetables (unspecified)	4.00	121.95	28.7	74.7	78.3	31.4	19.4	26.4	36.4	54	93.6	141.2	55	20	659.1	141.2	5.04		
Subtotal	<b>183.97</b>	<b>197.93</b>																	
<b>Other</b>																			
Fallow	7.70	68.20	138.35	141.85	133.65	84.2	44.2	33.7	44.2	65	103.3	160.1	134	131	1213.55	160.1	5.72		
Subtotal	<b>7.70</b>	<b>68.20</b>																	
<b>TOTAL</b>	<b>728.44</b>	<b>864.35</b>																	



These values of gross irrigation requirements were applied to existing crops in the study area. An analysis was done to determine what an improvement in the irrigation efficiency from 75 to 85% would mean in terms of the total irrigation water requirement. The results of this analysis are summarized in **Table 3.5**.

**Table 3.5: Gross Irrigation Requirements for Present Farming at Noordoewer/Vioolsdrift at Irrigation Efficiencies of 75and 85%**

Crop	Current (ha)	Future (ha) (5 years)	Irrigation Requirement at 75% efficiency (mm)														Tot	Max	Max/d ay
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
<b>Permanent Crops</b>																			
Table Grapes	54.10	138.60	143906	116315	88183	56264	1082	20558	27050	35706	51395	106036	122807	140119	909421	143906	4642		
Mangoes	45.00	40.80	136800	109350	94500	71550	44100	31500	39150	65250	84600	115650	127350	139500	1059300	139500	4500		
Dates	0.00	14.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Citrus	7.42	7.42	16250	13579	12243	6307	5936	4081	5194	7197	9127	12540	13727	15805	121985	16250	524		
Paw paw (papaya)	3.50	15.00	10640	8505	7350	5565	3430	2450	3045	5075	6580	8995	9905	10850	82390	10850	350		
<b>Subtotal</b>	<b>110.02</b>	<b>215.82</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>		
<b>Fodder Crops</b>																			
Lucerne	316.85	372.40	893517	750935	678059	491118	250312	145751	186942	272491	405568	643206	763609	868169	6349674	893517	28823		
Oats	2.50	2.50	0	0	0	0	0	1425	2325	4200	5150	2825	0	0	15925	5150	166		
<b>Subtotal</b>	<b>319.35</b>	<b>374.90</b>																	
<b>Cash Crop</b>																			
Cotton	85.00	0.00	306000	256700	104550	0	0	0	0	0	0	88400	144500	265200	1165350	306000	9871		
<b>Subtotal</b>	<b>85.00</b>	<b>0.00</b>																	
<b>Grain</b>																			
Maize	22.00	7.50	60720	7700	0	0	0	0	0	0	0	14960	46860	73480	203720	73480	2370		
Wheat	0.40	0.00	0	0	0	0	0	228	356	644	856	480	0	0	2564	856	28		
<b>Subtotal</b>	<b>22.40</b>	<b>7.50</b>																	
<b>Vegetables</b>																			
Sweet Corn	1.00	0.00																	
Tomatoes	49.46	23.66	0	0	0	0	0	35611	50944	75674	100898	137993	10387	0	411507	137993	4451		
Peppers	23.11	18.66	0	0	0	0	0	16639	23803	35358	47144	64477	4853	0	192275	64477	2080		
Chillies	0.50	0.00	0	0	0	0	0	360	515	765	1020	1395	105	0	4160	1395	45		
Sweet melons	11.00	10.00	0	0	0	0	0	0	0	0	13420	26620	29810	12430	82280	29810	962		
Pumpkin	50.00	3.00	0	77500	94500	89000	55000	3500	0	0	0	0	0	0	319500	94500	3048		
Watermelon	2.20	6.00	0	0	0	0	0	0	0	0	2684	5324	5962	2486	16456	5962	192		
Cucumber	1.67	0.00	0	2589	3156	2973	1837	117	0	0	0	0	0	0	10671	3156	102		
Brinjal	6.17	1.00	0	0	0	0	0	4442	6355	9440	12587	17214	1296	0	51334	17214	555		
Beans	34.86	13.66	54033	106323	96562	0	0	0	0	0	0	0	0	0	256918	106323	3430		
Vegetables (unspecified)	4.00	121.95	1304	3384	3552	1424	880	1208	1648	2448	4240	6400	2504	904	29896	6400	206		
<b>Subtotal</b>	<b>183.97</b>	<b>197.93</b>																	
<b>Other</b>																			
Fallow	7.70	68.20	12112	12382	11658	7338	3889	2934	3858	5667	9009	13976	11689	11419	105929	13976	451		
<b>Subtotal</b>	<b>7.70</b>	<b>68.20</b>																	
<b>TOTAL</b>	<b>728.44</b>	<b>864.35</b>	<b>1635282</b>	<b>1465260</b>	<b>1194313</b>	<b>731538</b>	<b>366465</b>	<b>270804</b>	<b>351184</b>	<b>519916</b>	<b>754278</b>	<b>1266490</b>	<b>1295363</b>	<b>1540362</b>	<b>11391256</b>				
@Kanaal effektiwiteit van 80% en 20 uur per dag is die benodigde vloei tempo (m³/s)																			
			0.92	0.91	0.67	0.42	0.21	0.16	0.20	0.29	0.44	0.71	0.75	0.86		0.92			
Average daily irrigation requirement (mm)																			
			7.2	7.2	5.3	3.3	1.6	1.2	1.6	2.3	3.5	5.6	5.9	6.8		7.2			

Crop	Current (ha)	Future (ha) (5 years)	Irrigation Requirement at 85% efficiency (mm)														Max	Max/day
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot			
<b>Permanent Crops</b>																		
Table Grapes	54.10	138.60	125512	101708	76281	48149	541	20017	25968	34083	48149	93052	107118	122266	802844	125512	4049	
Mangoes	45.00	40.80	120600	96750	83250	63000	39150	31500	34200	57600	74700	102150	112500	122850	938250	122850	3963	
Dates	0.00	14.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Citrus	7.42	7.42	14172	11872	10685	8459	5268	3487	4378	5713	7272	10388	11724	13801	107219	14172	457	
Pawpaw (papaya)	3.50	15.00	9380	7525	6475	4900	3045	2450	2660	4480	5810	7945	8750	9555	72975	9555	308	
Subtotal	<b>110.02</b>	<b>215.82</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<b>Fodder Crops</b>																		
Lucerne	316.85	372.40	785788	662217	598847	434085	218627	129909	164762	240806	358041	567162	674891	766777	5601908	785788	25348	
Oats	2.50	2.50	0	0	0	0	0	1250	2050	3700	4550	2500	0	0	14050	4550	147	
Subtotal	<b>319.35</b>	<b>374.90</b>																
<b>Cash Crop</b>																		
Cotton	85.00	0.00	270300	226950	91800	0	0	0	0	0	0	77350	127500	233750	1027650	270300	8719	
Subtotal	85.00	0.00																
<b>Grain</b>																		
Maize	22.00	7.50	53680	6820	0	0	0	0	0	0	0	13200	41360	64900	179960	64900	2094	
Wheat	0.40	0.00	0	0	0	0	0	200	316	568	752	424	0	0	2260	752	24	
Subtotal	<b>22.40</b>	<b>7.50</b>																
<b>Vegetables</b>																		
Sweet Corn	1.00	0.00																
Tomatoes	49.46	23.66	0	0	0	0	0	31160	45009	66771	89028	121672	8903	0	362542	121672	3925	
Peppers	23.11	18.66	0	0	0	0	0	14559	21030	31199	41598	56851	4160	0	169396	56851	1834	
Chillies	0.50	0.00	0	0	0	0	0	315	455	675	900	1230	90	0	3665	1230	40	
Sweet melons	11.00	10.00	0	0	0	0	0	0	0	0	11880	23540	26290	11000	72710	26290	848	
Pumpkin	50.00	3.00	0	68500	83500	78500	48500	3000	0	0	0	0	0	0	282000	83500	2694	
Watermelon	2.20	6.00	0	0	0	0	0	0	0	0	2376	4708	5258	2200	14542	5258	170	
Cucumber	1.67	0.00	0	2288	2789	2622	1620	100	0	0	0	0	0	0	9419	2789	90	
Brinjal	6.17	1.00	0	0	0	0	0	3887	5615	8330	11106	15178	1111	0	45226	15178	490	
Beans	34.86	13.66	47410	93773	85058	0	0	0	0	0	0	0	0	0	226241	93773	3025	
Vegetables (unspecified)	4.00	121.95	1148	2988	3132	1256	776	1056	1456	2160	3744	5648	2200	800	26364	5648	182	
Subtotal	<b>183.97</b>	<b>197.93</b>																
<b>Other</b>																		
Fallow	7.70	68.20	10653	10922	10291	6483	3403	2595	3403	5005	7954	12328	10318	10087	93443	12328	398	
Subtotal	7.70	68.20																
<b>TOTAL</b>	<b>728.44</b>	<b>864.35</b>	<b>1438643</b>	<b>1292313</b>	<b>1052108</b>	<b>647454</b>	<b>320930</b>	<b>245485</b>	<b>311302</b>	<b>461089</b>	<b>667859</b>	<b>1115325</b>	<b>1142171</b>	<b>1357986</b>	<b>10052665</b>			
@ Kanaal effektiwiteit van 80% en 20 uur per dag is die benodigde vloei tempo (m³/s)																		
	<b>0.81</b>	<b>0.80</b>	<b>0.59</b>	<b>0.37</b>	<b>0.18</b>	<b>0.14</b>	<b>0.17</b>	<b>0.26</b>	<b>0.39</b>	<b>0.62</b>	<b>0.66</b>	<b>0.76</b>				<b>0.81</b>		

Similar analyses were done for the expected future situation, again for irrigation efficiencies of 75 and 85%. The results of these analyses are summarized in **Table 3.6**.

**Table 3.6: Gross Irrigation Requirements for Future Farming at Noordoewer/Vioolsdrift at Irrigation Efficiencies of 75 and 85%**

Crop	Current (ha)	Future (ha) (5 years)	Future Irrigation Requirement at 75% efficiency (m <sup>3</sup> )												Tot	Max	Max / day
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
<b>Permanent Crops</b>																	
Table Grapes	54.10	138.60	368676	297990	225918	144144	2772	52668	69300	91476	131670	271656	314622	358974	2329866	368676	11893
Mangoes	45.00	40.80	124032	99144	85680	64872	39984	28560	35496	59160	76704	104856	115464	126480	960432	126480	4080
Dates	0.00	14.00	31616	26666	24191	19241	11257	6387	7984	11497	16686	24511	27145	30818	238000	31616	1020
Citrus	7.42	7.42	16250	13579	12243	6307	5936	4081	5194	7197	9127	12540	13727	15805	121985	16250	524
Paw paw (papaya)	3.50	15.00	45600	36450	31500	23850	14700	10500	13050	21750	28200	38550	42450	46500	353100	46500	1500
Subtotal	<b>110.02</b>	<b>215.82</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Fodder Crops</b>																	
Lucerne	316.85	372.40	1050168	882588	796936	577220	294196	171304	219716	320264	476672	755972	897484	1020376	7462896	1050168	33876
Oats	2.50	2.50	0	0	0	0	0	1425	2325	4200	5150	2825	0	0	15925	5150	166
Subtotal	<b>319.35</b>	<b>374.90</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Cash Crop</b>																	
Cotton	85.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	85.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Grain</b>																	
Maize	22.00	7.50	20700	2625	0	0	0	0	0	0	0	5100	15975	25050	69450	25050	808
Wheat	0.40	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	<b>22.40</b>	<b>7.50</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Vegetables</b>																	
Sweet Corn	1.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tomatoes	49.46	23.66	0	0	0	0	0	17035	24370	36200	48266	66011	4969	0	196851	66011	2129
Peppers	23.11	18.66	0	0	0	0	0	13435	19220	28550	38066	52061	3919	0	155251	52061	1679
Chillies	0.50	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sweet melons	11.00	10.00	0	0	0	0	0	0	0	0	12200	24200	27100	11300	74800	27100	874
Pumpkin	50.00	3.00	0	4650	5670	5340	3300	210	0	0	0	0	0	0	19170	5670	183
Watermelon	2.20	6.00	0	0	0	0	0	0	0	0	7320	14520	16260	6780	44880	16260	525
Cucumber	1.67	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brinjal	6.17	1.00	0	0	0	0	0	720	1030	1530	2040	2790	210	0	8320	2790	90
Beans	34.86	13.66	21173	41663	37838	0	0	0	0	0	0	0	0	0	100674	41663	1344
Vegetables (unspecified)	4.00	121.95	39756	103170	108292	43414	26829	36829	50243	74633	129267	195120	76341	27561	911454	195120	6294
Subtotal	<b>183.97</b>	<b>197.93</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Other</b>																	
Fallow	7.70	68.20	107279	109666	103255	64995	34441	25984	34168	50195	79794	123783	103528	101141	938227	123783	3993
Subtotal	<b>7.70</b>	<b>68.20</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>TOTAL</b>	<b>728.44</b>	<b>864.35</b>	1825249	1618190	1431523	949383	433415	369139	482096	706652	1061163	1694495	1659193	1770784	14001282		
@ Canal efficiency of 80% and 20 hours per day is the necessary flowing tempo (m <sup>3</sup> /s)																	
			1.02	1.00	0.80	0.55	0.24	0.21	0.27	0.40	0.61	0.95	0.96	0.99			1.02
Average daily irrigation requirement (mm)																	
			6.8	6.7	5.3	3.7	1.6	1.4	1.8	2.6	4.1	6.3	6.4	6.6			6.8

Crop	Current (ha)	Future (ha) (5 years)	Future Irrigation Requirement at 85% efficiency (m <sup>3</sup> )														Max	Max/day
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot			
<b>Permanent Crops</b>																		
Table Grapes	54.10	138.60	321552	260568	195426	123354	1386	51282	66528	87318	123354	238392	274428	313236	2056824	321552	10373	
Mangoes	45.00	40.80	109344	87720	75480	57120	35496	28560	31008	52224	67728	92616	102000	111384	850680	111384	3593	
Dates	0.00	14.00	28188	23746	21565	17123	9692	5250	6542	9692	14619	21888	24231	27462	210000	28188	909	
Citrus	7.42	7.42	14172	11872	10685	8459	5268	3487	4378	5713	7272	10388	11724	13801	107219	14172	457	
Paw paw (papaya)	3.50	15.00	40200	32250	27750	21000	13050	10500	11400	19200	24900	34050	37500	40950	312750	40950	1321	
Subtotal	<b>110.02</b>	<b>215.82</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<b>Fodder Crops</b>																		
Lucerne	316.85	372.40	923552	778316	703836	510188	256956	152684	193648	283024	420812	666596	793212	901208	6584032	923552	29792	
Oats	2.50	2.50	0	0	0	0	0	1250	2050	3700	4550	2500	0	0	14050	4550	147	
Subtotal	<b>319.35</b>	<b>374.90</b>																
<b>Cash Crop</b>																		
Cotton	85.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Subtotal	85.00	0.00																
<b>Grain</b>																		
Maize	22.00	7.50	18300	2325	0	0	0	0	0	0	0	4500	14100	22125	61350	22125	714	
Wheat	0.40	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Subtotal	<b>22.40</b>	<b>7.50</b>																
<b>Vegetables</b>																		
Sweet Corn	1.00	0.00																
Tomatoes	49.46	23.66	0	0	0	0	0	14906	21531	31941	42588	58204	4259	0	173428	58204	1878	
Peppers	23.11	18.66	0	0	0	0	0	11756	16981	25191	33588	45904	3359	0	136778	45904	1481	
Chillies	0.50	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Sweet melons	11.00	10.00	0	0	0	0	0	0	0	0	10800	21400	23900	10000	66100	23900	771	
Pumpkin	50.00	3.00	0	4110	5010	4710	2910	180	0	0	0	0	0	0	16920	5010	162	
Watermelon	2.20	6.00	0	0	0	0	0	0	0	0	6480	12840	14340	6000	39660	14340	463	
Cucumber	1.67	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Brinjal	6.17	1.00	0	0	0	0	0	630	910	1350	1800	2460	180	0	7330	2460	79	
Beans	34.86	13.66	18578	36745	33330	0	0	0	0	0	0	0	0	0	88653	36745	1185	
Vegetables (unspecified)	4.00	121.95	35000	91097	95487	38292	23658	32195	44390	65853	114145	172193	67073	24390	803772	172193	5555	
Subtotal	<b>183.97</b>	<b>197.93</b>																
<b>Other</b>																		
Fallow	7.70	68.20	94355	96742	91149	57424	30144	22983	30144	44330	70451	109188	91388	89342	827641	109188	3522	
Subtotal	<b>7.70</b>	<b>68.20</b>																
<b>TOTAL</b>	<b>728.44</b>	<b>864.35</b>	1603241	1425491	1259719	837671	378561	335663	429510	629537	943087	1493119	1461692	1559898	12357188			
			@ Canal efficiency of 80% and 20 hours per day is the necessary flowing tempo (m <sup>3</sup> /s)															
			0.90	0.88	0.71	0.48	0.21	0.19	0.24	0.35	0.55	0.84	0.85	0.87		0.90		

### 3.1.5 Flood Levels and Drainage Requirements

In the questionnaires the farmers were asked to give an indication of the cultivation area relative to the flood levels. Three categories were used, namely the areas:

- Below the dangerous flood level;
- Between canal and dangerous flood level; and
- Above the canal.

They were also asked to give information about drainage systems, namely what the area equipped with drainage is, and what additional areas require drainage.

**Table 3.7** shows a summary of the answers to these questions.

**Table 3.7: Information about Flood Levels and Drainage Systems**

Area Irrigated Relative to Flood Levels (ha)		
Flood Level Category	Present	Future
Below dangerous flood level	161	174
Between canal and dangerous flood level	502	534
Above canal	71	157
Total	734	865
Area Equipped with Drainage Systems (ha)		
Area equipped with drainage systems	24.7	
Additional area that needs drainage systems	26.0	
Total area	50.7	

Flood peaks for the regions with a probability of occurrence of 2 and 1% were determined using an empirical method (TR 137 : Kovacs 1988). These floods were namely 9 500 and 10 900 m<sup>3</sup>/s, which will cause flood depths of 10.6 and 11.0 m, respectively, at a position 13.5 km downstream of the bridge.

The report on flood levels appears in **Appendix D**.

### 3.1.6 Problems Experienced by the Irrigators

The questionnaires provided for the listing of general problems experienced by irrigators, as well as suggestions on the removal / solving of these problems. **Table 3.8** summarizes the list of problems raised by farmers. For 31 of the 69 units, it was indicated that problems were experienced. These units are mainly located along those sections where most of the rehabilitation work on the canals is required.

**Table 3.8: Summary of Problems Experienced by Scheme Members (taken from questionnaires)**

Canal section	Problems experienced	Proposed solution for problem
Vioolsdrif	Fencing	Repair of fencing
	Sluice that is leaking	Repair floodgate
	Canal leaking	Repair leak in canal
	None	
	Canal in poor condition	Rebuild canal
	Canal in poor condition	Rebuild canal
	Too little water in canal. Canal needs a lot of repairing.	Raise sides of canal
	Canal top level too low	A budget for the raising of the canal has been before the board
	Farm too low	
	Irrigation of unscheduled land	Identify and confront owner
Noordoewer	Sand from canals which lands in leivore	Sheet already installed in canal. Definitely helping.
	Tax of pump grounds costly	
	None	
		<i>Did not fill in</i>
		<i>Did not fill in</i>
	Floodgates that are leaking	Must be repaired
	None	
	None	
	None	
	None	
Noordoewer/Modderdrif North		<i>Did not fill in</i>
Modderdrif North	Level of canal sometimes low during peak times	Apply turn system
Duiffe		<i>Did not fill in</i>
Duiffe		<i>Did not fill in</i>
Duiffe		<i>Did not fill in</i>
Duiffe	Too little water	Modderdrifkanaal has pumps from river. Duifeloopkanaal does not have.
Duiffe/Modderdrif North		<i>Did not fill in</i>
Duiffe/Modderdrif North		<i>Did not fill in</i>
Modderdrif North	No control over <i>waterbuert</i>	Supervision to apply turn system strictly
Modderdrif North/Duiffe	Poor infrastructure as a result of age	Replace old section to limit water loss, and to improve flow.
Modderdrif North/Duiffe	Defective sections in canal that obstruct the flow	Repair
Modderdrif North/Duiffe	Seasonal "slyk" problem which coincides with peak demand. Flow is	No actual solution
Modderdrif North/Duiffe	desturbed	
Modderdrif North/Duiffe	Poor cooperation among farmers with regards to turns, especially	Put more pressure on trespassers or appoint water bailiff
Modderdrif North/Duiffe	during peak times	
Rooiwal	None	
Rooiwal	None	
Rooiwal		<i>Did not fill in</i>
Rooiwal	Canal too small	
Rooiwal	Poor	Rebuild
Rooiwal	None	
Rooiwal	None	
Rooiwal		<i>Did not fill in</i>
Rooiwal		<i>Did not fill in</i>
Rooiwal		<i>Did not fill in</i>
Rooiwal		<i>Did not fill in</i>
Rooiwal		<i>Did not fill in</i>
Rooiwal		<i>Did not fill in</i>
Rooiwal		<i>Did not fill in</i>
Rooiwal		<i>Did not fill in</i>
Rooiwal		<i>Did not fill in</i>
Rooiwal	Shortage of water	Repair canal
Rooiwal		<i>Did not fill in</i>
Rooiwal		<i>Did not fill in</i>
Rooiwal		<i>Did not fill in</i>
Swartbas	Very poor condition	Rebuild canal
Swartbas	Too little water	Rebuild canal.
Swartbas		<i>Did not fill in</i>
Swartbas		<i>Did not fill in</i>
Swartbas - canal	None	
Swartbas/Rooiwal	A lot of sand at floodgates	Move floodgates
Swartbas/Rooiwal	Water too little	Repair canal and siphons
Duin	Water insufficient in summer. Last farm on canal	Better control over water turns
Duin	Struggle with water that is not enough in summer.	
Duin		<i>Did not fill in</i>
Duin Canal	Struggle to get enough water in summer	Enlarge siphon from Noordoewer
Duin Canal		<i>Did not fill in</i>
Modderdrif South	Shortage of water	Repair canal
Modderdrif South	Canal too small	Enlarge canal
Modderdrif South	Canal is in a very poor condition	
Modderdrif South	New canal or repair	New canal / leivoor / or repair
Modderdrif South	Sluice that is leaking	New floodgate / or repair
Modderdrif South	Flow to low due to water turns not applied	Better control / water bailiff
Modderdrif South		



### 3.1.7 Previous Findings with regards to the Conveyance System

For the evaluation of the conveyance scheme, use was made of existing recent reports. Relevant reports, which were used for this study, are the following:

- a) Report by A S Engels, Ryan Peters & Leonardo Manus, November 2001: Report on technical inspection of Noordoewer/Vioolsdrift Irrigation Scheme
- b) Report by Africon Namibia Inc, October 1998: Rehabilitation of the Noordoewer/Vioolsdrift Irrigation Scheme – Report on the Capacity of the System and Upgrading Proposals.

The objective of the Africon investigation was to prepare a planning report in which the present system capacity, the required upgrading for an increased irrigation demand and associated costs were to be addressed. The findings of the study were reduced to two alternatives, namely:

- Alternative 1: Upgrading without pumping.
- Alternative 2: Upgrading with pumping.

These recommendations appear in **Table 3.9** and **Table 3.10**.

Alternative 1 would be capital intensive, whereas Alternative 2 would require a relatively low capital investment, but would have an additional pumping cost and maintenance component. It was decided to proceed with Alternative 2, and the recommendations marked as such in **Table 3.10** have already been carried out.

The irrigation, which takes place directly from the river, was taken into account in the Africon system analyses. This is namely an area of 95.6 ha. The canal capacity is therefore based on 821.8 ha. The canals were designed for a demand of 13 mm/day over a 20-hour period, at a conveyance efficiency of 80%. Per enlisted hectare, this gives a demand of 2.3 l/s/ha, and a scheme demand of 1.85 m<sup>3</sup>/s. (This compares to a total system demand of 1.92 m<sup>3</sup>/s used by Africon in their analyses.)

**Table 3.9: Alternative 1: Scope of Upgrading without Pumping**

Description (Canal / Siphon)	Current Capacity (m <sup>3</sup> /s)	Required Capacity (m <sup>3</sup> /s)	Recommendations	Net Present Values
Main canal	1.96	1.92	Raise level of Spillway 1. Raising of the canal sides not envisaged. Reduce freeboard of 120 mm in downstream section of the canal, might require remedial work in future.	Included under Vioolsdrift siphon
Vioolsdrift canal	<1.50	1.79	Raise canal sides by an average of 150 mm over a distance of 275 m. Provide additional 1 000 mm dia. pipelines in parallel with in-line siphons 2 & 3. Raise the levels of Spillway 2, 3 and 4.	N\$ 427,739
Vioolsdrift siphon	1.125	1.57	Provide additional 1 000 mm dia. pipeline in parallel with the existing siphon.	N\$ 3,292,462
Noordoewer canal	1.52	1.57	No upgrading required. Reduce freeboard of 175 mm only at upstream end.	
Duifieloop canal	0.13	0.12	No upgrading required. Reduce freeboard of 100 mm only at in-line siphon 7.	
Rooiwal siphon	0.88	1.17	Provide additional 775 mm dia. pipeline in parallel with the existing siphon.	N\$ 3,609,862
Rooiwal canal	0.98	1.17	Downstream spillway to be raised by 100 mm. Raise the canal sides by between 0 mm and 100 mm along the entire length (if additional Swartbas Siphon is provided).	Included under Swartbos siphon
Swartbas canal	0.39	0.61	Raise canal sides by between 0 and 150 mm over a distance of approximately 2 250 m (if additional Swartbas Siphon is provided).	Included under Swartbas siphon
Swartbas siphon	0.20	0.29	Provide additional 310 mm dia. pipeline in parallel with the existing siphon.	N\$ 3,090,510
Modderdrift Main canal	0.22	0.29	Raising of the canal sides not envisaged as reduced freeboard of 85 mm may be improved through careful operation of downstream sluice gates.	
Modderdrift North canal	0.15	0.11	Can convey the required flow rate at a reduced freeboard of 100 mm. No upgrading envisaged.	

**Table 3.10: Alternative 2: Scope of Upgrading with Pumping**

Description (Canal / Siphon)	Current Capacity (m <sup>3</sup> /s)	Required Capacity (m <sup>3</sup> /s)	Recommendations	Net Present Values
Main canal	1.96	1.655	No upgrading required.	
Vioolsdrift canal	<1.50	1.525	Raise the levels of spillway 2 and 3.	Included under Vioolsdrift siphon
Vioolsdrift siphon	1.125	1.305	Provide additional 1 000 mm dia. pipeline in parallel with the existing siphon.	N\$ 3,292,462
Noordoewer canal	1.52	1.31	No upgrading required.	
Duifeloop canal	0.13	0.12	No upgrading required. Reduce freeboard of 100 mm only at in-line siphon 7.	
Rooiwal siphon	0.88	0.905	No upgrading required. Capacity of existing siphon is only 3% below required flow.	
Rooiwal canal	0.98	0.905	No upgrading required.	
Swartbas canal	0.39	0.51	Raise canal sides by between 40 and 60 mm over a distance of 2 250m.	N\$ 571,635
Swartbas siphon	0.20	0.19	No upgrading required.	
Modderdrift Main canal	0.22	0.29	Raising of the canal sides not envisaged as reduced freeboard of 85 mm may be improved through careful operation of downstream sluice gates.	
Modderdrift North canal	0.15	0.11	Can convey the required flow rate at a reduced freeboard of 100 mm. No upgrading envisaged.	

These recommendations have already been adhered to.

This study did not address the possible upgrading required for Modderdrift South, Duine and Naupoort canals. It likewise did not address the need for and cost of repair work to certain sections of the scheme.

The purpose of the Engels, Peters and Manus Study was to investigate all canals in the system with regards to urgent rehabilitation needed "before it will deteriorate to be non-existent". This was performed as a joint venture between DWAF (RSA) and DOA (Namibia) during November 2001.

The whole system was inspected, and all defects were identified and listed. A cost estimate was then made of the rehabilitation work required. Suggested rehabilitation consisted mainly of replacing damaged / broken panels and re-lining other parts of the canal system. The estimated cost, as made by the joint venture, varied from R 1 026 589 (SA estimate) to N\$ 1 403 844 (Namibian estimate). The SA estimate, however, did not provide for rehabilitation work to the Namibian side of the scheme.

Rehabilitation work not included in any of the above estimates is 16 damaged panels in the Noordoewer canal. These were pointed out to the project team during their site visit in February 2003.

### *3.1.8 Project Team's Findings and Cost Estimate for Rehabilitation of the Scheme (Engineering)*

For the evaluation of the scheme, the findings of the above mentioned previous studies were used. Further analyses were carried out on irrigation requirements and the farming practices based on the project team's exposure to the scheme, interviews and questionnaires.

In the following paragraphs these findings are discussed.

#### *3.1.8.1 Irrigation Requirement*

The most significant differences between the present situation and the anticipated future farming development are the following:

- There will be an increase in the present area under irrigation of approximately 130 ha, or 18%.
- The percentage permanent crops will increase from the present 15% to 25% of the total irrigated area.

- The percentage area irrigated with flood irrigation systems will drop from the present 79 to 64% in favour of more efficient irrigation systems.

In order to establish whether the conveyance system is capable of supplying the demand, the total annual irrigation requirement and peak irrigation requirement are of importance, for both the present and the future situation.

**Table 3.11** summarizes these requirements, based on the estimated infield irrigation system efficiencies. From the questionnaires, it was established that it is mainly the permanent crops which are irrigated with micro - and drip systems, while the balance of the area is flood irrigated. This is also the approximate situation envisaged for the future. For the purposes of determining the requirements, the efficiency of micro - and drip systems was accepted as 90%, and that of the flood irrigation systems as 65%.

**Table 3.11: Present Gross Irrigation Requirement at Noordoewer/Vioolsdrift**

Description	System Requirement		
	Present	Future	Original Design
Area irrigated (ha)	728	864	821.8
Annual requirement (m <sup>3</sup> )	12,441,627	14,665,116	12,327,000
Peak month requirement (m <sup>3</sup> )	1,815,314	1,933,885	4,218,792
Average annual requirement (m <sup>3</sup> /ha)	17,080	16,967	15,000
Peak flow requirement in canal (m <sup>3</sup> /s)	1,02	1,08	1.85

The table shows that the annual requirement exceeds the allocation of 15 000 m<sup>3</sup> per ha (the allocation as used in the LORMS Report). The estimated future difference between allocation and requirement will be even bigger, mainly due to expansion of crops with larger water requirements, e.g. grapes and lucerne.

For the calculation of the present and future peak flow rate requirement in the canal, it was accepted that the irrigation water for 821.8 ha is supplied through the canal.

If the existing efficiency of the flood irrigation systems are dropped to 55%, the present irrigation requirement will be 14.389 million m<sup>3</sup>, the average annual requirement 18754 m<sup>3</sup>, and the peak flow requirement 1.16 m<sup>3</sup>/s.

A further analysis was done on a scenario whereby efficiencies of the flood irrigation systems are improved from 65 to 80% for fodder crops and to 90% for vegetables. This is achievable with laser levelled flood systems, sprinkler systems and drip systems, provided the systems are not exposed to the risk of flooding. The results of this analysis appear in **Table 3.12**.

**Table 3.12: Gross Irrigation Requirement at Noordoewer/Vioolsdrift with Improved Efficiencies**

Description	System Requirement		
	Present	Future	Original Design
Area irrigated (ha)	728	864	821.8
Annual requirement (m <sup>3</sup> )	10,313,452	12,498,490	12,327,000
Peak month requirement (m <sup>3</sup> )	1,518,879	1,653,051	4,218,792
Average annual requirement (m <sup>3</sup> /ha)	14,158	14,460	15,000
Peak flow requirement in canal (m <sup>3</sup> /s)	0.85	0.93	1.85

Under these improved efficiency conditions the requirement will be below the allocation of 15 000 m<sup>3</sup>/ha, both for the present and the future situation. This aspect is discussed further in **paragraph 3.1.8** (Water Demand Management).

### 3.1.8.2 Potential Additional Irrigable Soils at Noordoewer/Vioolsdrift

Soils that can possibly be cultivated at Noordoewer/Vioolsdrift are products of alluvium deposits of the Orange River, as well as materials resulting from weathering of the mountains surrounding the area, mainly shale and sandstone. The soil in general has a coarse texture with a relatively high pH. The soil does thus have a high infiltration rate with a low water holding capacity.

The soil reconnaissance survey carried out for the Tandjieskoppe Project conducted a detail investigation of soil that can be developed adjacent to the current Noordoewer area.

Soil in general is described as comprising deep dark greyish brown alluvial gritty coarse sandy soils. The consistency is hard to very hard when dry but pliable when moist and more sticky and more plastic when wet. The soil pH is relatively high, yet the electrical conductivity (EC) is low indicating non saline conditions.

Crops identified for the area can be cultivated on the soil without problems if properly managed.

The Tandjieskoppe investigation identified three areas adjacent to Noordoewer that can still be developed. The identified areas are on State land with a gross area of 868 ha with a provisional irrigation area of 720 ha.

The Cabinet of Namibia has approved the “Green Scheme” development proposal and it is envisaged that future large scale irrigation development will be based on this model. The basic principles to of the “Green Scheme” are the following:

- Government aims to create a conducive environment for development.
- Optimal utilisation of resources.
- Stimulation of socio-economic development initiatives.
- Joint Venture development between Government and Private Sector.
- Combination of approximately 50% large scale and 50% small scale development.
- Capacity building and skills transfer.
- Provision of agricultural support services to small scale irrigation farmers on a cost recovery basis.
- Land usage rights could be based on Freehold title owners, if already in possession of private sector entrepreneurs, or a long-term leasehold right on Government land.

Development at Noordoewer will definitely be beneficial as it will enlarge the economy of scale that will stimulate supportive service development in the region. The basic steps of development will comprise the following:

- Principle decision from the Namibian Government to make the land available for development.
- Detail planning of project development.
- Secure financing of development of “off land” infrastructure.
- Construction of transportation and water supply systems.
- Phase I “on land” development (320 ha).
- Phase II “on land” development (160 ha).
- Phase III “on land” development (240 ha).

In the LORMS, the potential land for irrigation in the Noordoewer/Vioolsdrift region was determined. These findings are summarized in **Table 3.13**.

**Table 3.13: Potential Additional Irrigable Soils at Noordoewer/Vioolsdrift**

Description	Area of Land	
	Noordoewer	Vioolsdrift
Land below 60 m above river	405	448
Land between 60 and 140 m above river	470	406
Total potential area below 140 m above river	875	854

The location of this potential land on the Vioolsdrift side is such that it cannot be supplied with the existing canal system. On the Noordoewer side, there is also no significant spare capacity in the canals if the original canal design norms are applied. However, if operating rules are changed, and more efficient irrigation systems are used, the canal may be adequate to supply water to additional land. All this land is above the canal, and pumps will be needed to supply the water from the canal to the land.

### 3.1.8.3 Conveyance System Capacity

The Africon Study showed that, with the additional pumping into the canals, the capacity of the conveyance system is adequate for the irrigation design requirement. This is in strong contrast to the experience of the farmers, especially if the requirement of the crops and area irrigated at present are taken into account.

**Table 3.11** shows that the peak flow rate required in the main canal is 1.02 m<sup>3</sup>/s at present, whereas the canal is designed for 1.85 m<sup>3</sup>/s. The requirement is therefore approximately 55% of the capacity of the canal. Though this analysis was not done for each section of the canal, approximately the same tendency is expected.

It is important to establish why there is this discrepancy. Although this will not make a difference to the need to rehabilitate the system, it may provide opportunities to irrigate a larger area with the present infrastructure. It may also reduce the need for additional pumping into the system.

Possible reasons for the apparent inability of the conveyance system to supply in the requirement are listed below. Some of these were taken from the list of reasons provided by the farmers on the questionnaires.

- Lifted panels in the canals which may seriously obstruct the flow.
- Previous maintenance work done to the canals which causes obstructions.
- Stones, sand and other objects in the canal.



- Leaking floodgates.
- Leaking canals.
- Operating rules not applied, or ignored (users take water when it is not their turn).
- Poor efficiencies of irrigation systems.
- Poor scheduling techniques applied at farm level.

Although there are serious technical problems in the system, the management of the system also plays a significant role in the shortages, which are experienced. The current application of the turn system should be evaluated against the background of the design of the system. Useful information in this regard can be obtained by measuring the total back flow to the river of unused water in the canal system.

#### 3.1.8.4 Rehabilitation of the Scheme

In view of the age of the canals, it is the opinion of the project team that rehabilitation by means of continual replacement of damaged panels and the relining of certain sections is, in the long-term, not cost effective. Here specific reference is made to the Modderdrift Main, North and South canals, as well as the Swartbas canal. These canal linings are more than 35 years old. From the visual inspections, it appears that the reinforcing steel has been damaged over the years due to water penetration into the concrete that was made from relatively coarse sand. To invest on relining and sealing in a system with a doubtful foundation and poor structure is not advisable.

In view of this opinion, a cost estimate was made to replace the mentioned canal sections, as well as to rehabilitate the damaged sections in the rest of the system. For the purpose of the cost estimate, it was decided that the parabolic canal sections be replaced by rectangular sections. The quality control (mainly the compaction of the concrete) is much more effective when shutters are used, although significantly more expensive. It is assumed that during the design of the works, the optimum design will be determined. For the purpose of this study, a rectangular section was assumed.

The total cost of the rehabilitation work and upgrading of the system is estimated at R 8.6 million. The costs for the different canal sections are summarized in **Table 3.14**.

The rebuilding of the Naupoort canal was not considered in the Engels, Peters and Manus Study. Reasons for this might have been that the present canal (almost no concrete lining exists any more) still functions well, and leakages return back to the river.

**Table 3.14: Cost Estimate for Rehabilitation and Upgrading of the Canal System**

Section		Present canal			Reconstructed rectangular canal				Cost estimate for rehabilitation				
	Length	Shape	Top	Av.	Width	Depth	Water	Freeboard	Construction	Unforeseen	P& G's	Engineering	Total
Canal name			Width	Depth			Depth		Cost	Cost (10%)	Cost (15%)	Cost (7.5%)	Cost
	(km)		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	( R )	( R )	( R )	( R )	( R )
Modderdrift South	2.7	Parabolic	1100	400	820	400	250	150	1,176,086	117,609	194,054	111,581	1,599,330
Modderdrift North	2.33	Parabolic	1200	486	650	486	336	150	941,977	94,198	155,426	89,370	1,280,971
Modderdrift Main	0.24	Parabolic	1600	920	950	625	475	150	142,441	14,244	23,503	13,514	193,701
Modderdrift Main	2.07	Rect.	940	675	940	675	525	150	1,160,076	116,008	191,412	110,062	1,577,558
Swartbas	3.66	Parabolic	1560	980	1560	980	780	200	2,257,083	225,708	372,419	214,141	3,069,351
Duin	2.5	Parabolic	1870	900	Repair siphon and reline first section of canal				36,000	3,600	5,940	3,416	48,956
Rooiwal		Parabolic	2300	990	Replace 40 panels of 2.5 metres each				61,940	6,194	10,220	5,877	84,231
Noordoewer		Parabolic	2700	1500	Replace 16 panels of 2.5 metres each				45,602	4,560	7,524	4,326	62,013
Naupoort	1.5	Parabolic	900	450	500	400	250	150	504,706	50,471	83,277	47,884	686,338
Violsdrift									9,000	900	1,485	854	12,239
<b>Total</b>	<b>15</b>								<b>6,334,911</b>	<b>633,491</b>	<b>1,045,260</b>	<b>601,025</b>	<b>8,614,687</b>

### 3.1.8.5 Water Demand Management

In the report on Water Conservation in the LORMS a number of conclusions and recommendations were made for Water Demand Management (WDM).

The recommendations made with regards to WUAs and management of farms are applicable to the Noordoewer/Vioolsdrift Scheme, provided the technical problems of the system are sorted out.

The large area of existing development which lies below the flood lines will, however, require special attention. The practicality of installing removable, more efficient irrigation systems, e.g., sprinkler and drip, must be evaluated. This is already applied on some farms and, with the advantage of early flood warning, it appears to be a practical and feasible procedure.

The incorporation of lined retention dams which can hold water for a day or two on each farm will greatly improve the conveyance system efficiency. The practicality and feasibility of this addition to the system must be investigated.

## 3.2 Agriculture

### 3.2.1 Physical Situation

#### 3.2.1.1 Farms

During March 2003, a survey was done where the following information was obtained from the farmers:

- Crops and area currently planted.
- Crops and area projection for 5 years (2008) into the future.

A summary of the results is given in **Table 3.15** and **Table 3.16**.

The total area under production will increase from 728.44 to 864.35 Ha. The increased area is land that is situated mainly above the existing water supply canal. This land was previously regarded as not suitable for cash crops traditionally planted at Vioolsdrift/Noordoewer, but is highly suitable for the establishment of permanent crops. The intention of the farmers is thus to establish permanent crops in these areas as they are not subject to flood risk.

**Table 3.15: Vioolsdrift/Noordoewer: Cropping Pattern (Farmers' perspective)**

Crop	Current (ha)	Future (ha) (5 years)
<i>PERMANENT CROPS</i>	54,10	138,60
Table Grapes	45,00	40,80
Mangoes	0,00	14,00
Dates	7,42	7,42
Citrus	3,50	15,00
Papaya		
<b>Subtotal</b>	<b>110,02</b>	<b>215,82</b>
<i>FODDER CROPS</i>		
Lucerne	316,85	372,40
Oats	2,50	2,50
<b>Subtotal</b>	<b>319,35</b>	<b>374,90</b>
<i>CASH CROP</i>	85,00	0,00
Cotton		
<b>Subtotal</b>	<b>85,00</b>	<b>0,00</b>
<i>GRAIN</i>	22,00	7,50
Maize	0,40	0,00
Wheat		
<b>Subtotal</b>	<b>22,40</b>	<b>7,50</b>
<i>VEGETABLES</i>	1,00	0,00
Sweet corn	49,46	23,66
Tomatoes	23,11	18,66
Peppers	0,50	0,00
Chillies	11,00	10,00
Sweet melons	50,00	3,00
Pumpkin family	2,20	6,00
Watermelon	1,67	0,00
Cucumber	6,17	1,00
Brinjal	34,86	13,66
Beans	4,00	121,95
Vegetables (unspecified)		
<b>Subtotal</b>	<b>183,97</b>	<b>197,93</b>
<i>OTHER</i>	7,70	68,20
Fallow		
<b>Subtotal</b>	<b>7,70</b>	<b>68,20</b>
<b>TOTAL</b>	<b>728,44</b>	<b>864,35</b>

**Table 3.16: Vioolsdrift/Noordoewer: Cropping pattern (Farmers' perspective)**

Group	Current Production (ha)	% Current Production	Future Production (ha)	% Future Production	Hectare Change (Current to Future)
Permanent	110,00	15,1%	215,8	25,0%	105,8
Fodder	319,4	43,8%	374,9	43,4%	55,6
Cash	85,00	11,7%	0,0	0,0%	-85,0
Grain	22,40	3,1%	7,5	0,9%	-14,9
Vegetable	184,00	25,3%	197,9	22,9%	14,0
Fallow	7,70	1,1%	68,2	7,9%	60,5
<b>Total</b>	<b>728,40</b>	<b>100%</b>	<b>864,4</b>	<b>100%</b>	<b>135,9</b>

### 3.2.2 Crops

#### 3.2.2.1 Permanent Crops

A dramatic increase is projected for permanent crops from 15.1 to 25.0% of the total production area within a 5-year period. This tendency is generally experienced along the LOR area and it can be assumed that the area under permanent crops will increase even further thereafter.

#### 3.2.2.2 Fodder Crops

The projection is that the area under lucerne will remain the same, approximately 43%. Farmers tend to regard lucerne as an easy crop to produce that will also ensure a regular cash flow to the farm. Areas that are subjected to floods, where permanent crops cannot be planted, are envisaged for lucerne production.

#### 3.2.2.3 Cash Crop

Areas currently planted with cotton will be phased out over time. The cotton price can, however, result in a different scenario in future.

#### 3.2.2.4 Grain Crops

Farmers also envisage that almost no grain crops will be planted 5 years from now. The apparent perception is that farmers doubt the viability of the crops based on the

trend where increased production costs are experienced and income expectations are not that promising.

#### 3.2.2.5 Vegetables

It is envisaged that vegetable production will decline in terms of percentage of total production area (25.3 to 22.9%), but the area planted will stay approximately the same. Vegetable producers have a competitive advantage in that they can produce during off-season periods and can thus supply markets during periods of relatively low supply, and thus realize a seasonal high commodity price. The results of the survey indicate that farmers decide on the type of vegetable to plant at the beginning of the season.

#### 3.2.2.6 Fallow

The survey results indicated that 7.9% of the land will not be planted 5 years from now. The detail analysis indicates that it is actually land currently under cash and grain crops that will be fallow. Farmers are thus currently uncertain what to plant in these areas and it is highly unlikely that the area will not be utilised at all, and it can be expected that the land will either be utilised for lucerne or vegetables.

#### 3.2.2.7 JIA Farmers' Crops and Returns

It is worthwhile comparing some crops grown in the area to determine their viability. Direct comparison of the Gross Margins of crops can give a wrong impression as it does not compare all the cost and benefit aspects such as capital development cost, waiting period until full production as well as other forward and backward economic linkages of specific crops. **Table 3.17** and **Table 3.18** give a reflection of a comparison of Gross Margins and Gross Margin per cubic meter of water required to grow certain crops in the Violsdrift/Noordoewer Irrigation Scheme.

**Table 3.17: Gross Margin Comparison of Crops**

Crop	Yield (ton)	Price/Ton	Gross Income/ha	Production Cost/ha	Gross Margin/ha
Table Grapes	15	8 300	124 500	79 901	44 598
Dates (Barhee)	9	20 000	180 000	103 104	76 896
Dates (Medjool)	7,2	25 000	180 000	84 152	95 848
Lucerne	18	500	9 000	5 652	3 347
Wheat	5	1 400	7 000	4 363	2 636
Maize	7	1 300	9 100	5 380	3 720
Oats	5	1 300	6 500	3 062	2 437
Cotton	3	2 800	8 400	5 674	2 725

**Note:** Income and cost projection for Dates are based on a very conservative scenario and the Gross Margins should be higher in reality.  
Information contained in this table is partly obtained from a report of Dr.Daan Louw : *Development Potential Along the Lower Orange River.*

Gross Margins of permanent crops, table grapes and dates, are much higher per hectare when in full production. Development cost requirement and waiting period until full production will be restrictive factors that will probably necessitate a gradual shift towards permanent crops.

**Table 3.18: Gross Margins per m<sup>3</sup> Water**

Crop	Gross Margin/ha	Annual Water Requirement (m <sup>3</sup> / ha)	Gross Margin per m <sup>3</sup> Water
Table Grapes	44 598	13 500	3,30
Dates (Barhee)	76 896	14 342*	5,36
Dates (Medjool)	95 848	14 342*	6,68
Lucerne	3 347	22 000#	0,15
Wheat	2 636	5 270	0,50
Maize	3 720	8 800	0,42
Oats	2 437	8 800	0,28
Cotton	2 725	11 250	0,24

\* Water requirements as calculated and implemented at the Naute Date plantation close to Keetmanshoop: Namibia.  
# Minimum water demand for lucerne as calculated by the Division Agriculture Engineering of the Ministry of Agriculture, Water and Rural Development of Namibia

Gross margin per m<sup>3</sup> water for table grapes and dates are considerably higher than that of other crops. As water is regarded as a scarce commodity it is advisable to encourage the development towards crops where the highest income per m<sup>3</sup> could be achieved.

### 3.2.3 Economics of Agriculture Activities and Tendencies in the Area

The financial impact of the development tendency in the area will affect the income prospects and it is important that a positive tendency must be experienced to ensure the long-term viability of the Irrigation Scheme.

The changes in the crop scenario as reflected in **Table 3.19** indicates the hectares planted with specific crops, but it does not give an indication of possible changes that could be expected in the financial status of the Vioolsdrift/Noordoewer Irrigation Scheme. An attempt was made to reflect the possible financial growth or decline of the scheme based on the average Gross Margin expectations for the different crop groups.

**Table 3.19: Gross Margin Reflection of Development Tendencies**

Crop	Current (ha)	Average Gross Margin for Crop Groups (per ha)	Total Gross Margin for the Crop Groups	Future (ha) (5 years)	Average Gross Margin for Crop Groups (per ha)	Total Gross Margin for the Crop Groups
Permanent Crops	110,0	44 598	4 905 780	215,8	49 725	10 730 655
Fodder Crops	319,4	3 347	1 069 032	374,9	3 347	1 254 790
Cash Crop	85,0	2 725	231 625	0,00	2 725	0
Grain	22,4	3 720	83 328	7,5	3 720	27 900
Vegetables	184,0	18 800	3 459 200	197,9	18 800	3 720 520
Other (Fallow)	7,7	0	0	68,2	0	0
<b>TOTAL</b>	<b>728,4</b>		<b>9 748 965</b>	<b>864,4</b>		<b>15 733 865</b>

NOTES: Average Gross Margin is based on the composition of the crops at the specific period. The Average Gross Margin for vegetables was calculated based on Tomatoes and Pumpkin (76% of current vegetable cultivation) using cost and income figures obtained from farmers at the Irrigation Scheme.

The total expected Gross Margin increase from **R/N\$ 9 748 965** to **R/N\$ 15 733 865** reflects a growth of 61% for the Vioolsdrift/Noordoewer Irrigation Scheme over a 5- year period.



The average income scenario for areas subjected to possible floods looks different as permanent crops cannot be planted due to high development cost and risk factors. The detail analysis indicates that farmers predominantly cultivate lucerne and vegetables in areas that are subjected to possible floods. The composition consists of approximately 60% lucerne and 40% vegetables. These figures are shown in **Table 3.20**.

**Table 3.20: Gross Margin Reflection for Farming Units Subjected to Floods Based on the Average Farm Size for Namibia and South Africa**

	Gross Margin/ ha	South African Farms		Namibian Farms	
		Average farm size (ha)	Total Gross Margin (R/N\$)	Average farm size (ha)	Total Gross Margin (R/N\$)
Lucerne	3 347	12,6	42 217	10,8	26 147
Vegetables	18 800	8,4	157 920	7,2	135 360
<b>Total</b>		<b>21</b>	<b>200 092</b>	<b>18</b>	<b>171 507</b>

The average Gross Margin for farming units is thus N\$200 092 for South African farms and R171 507 for Namibian farms. (The Gross Margin for a scenario of 60% Lucerne and 40% vegetable is R/N\$9 528.20 per hectare.)

Income levels for farming units are relatively low if overhead cost elements, as well as income expectations of the farmers are taken into consideration. The viability of average units under the flood line is not good and will be subjected to further pressure as cost elements increase over time. The viability of a farming unit of 30 to 35 ha will relieve the financial pressure considerably from the farmer.

### 3.2.3.1 Barriers/Incentives to Change

The Vioolsdrift/Noordoewer Irrigation Scheme is slowly but surely being transformed into a more progressive production area where the average income per hectare will increase progressively over the next few years. Farmer profiles and their orientation have changed considerably during the last few years and are more progressive and business oriented.

It can be expected that the medium- to long-term operational activities will be more market orientated and that the sustainability of the scheme will improve over time.

A few selective interviews were conducted to gather further information on the reasons why farmers either change or do not change at the Vioolsdrift/Noordoewer Irrigation Scheme. Answers differed considerably, but it became clear that the progressive farmers are dictating development trends and that change will take place at a gradual pace. The main points raised as possible barriers/incentives to change are summarised below.

### 3.2.3.2 Financial Considerations

The income/cost aspect remains the main factor that determines change.

- Initial establishment cost required for a specific crop.
- Waiting period until first income can be expected.
- Annual operational cost requirements for a specific crop.
- Financial position of individual farmers and access to credit facilities.
- Pricing structures/tendencies at traditional and export markets.
- Marketing price risk perception for a specific crop.

### 3.2.3.3 Crop Diversification

Risk management through diversification of crops, as well as stabilising labour requirements throughout the year are factors that influence farmers in their decisions on what crops to plant. Farmers strive to reduce their risk through the planting of different crops that will lessen the risk of total production failures if one specific crop fails to produce during a specific year. Another advantage of crop diversification is that it leads to more stable labour requirements throughout the year if production planning is carefully done.

### 3.2.3.4 Natural Phenomena

Large areas currently under production are situated below flood lines and are thus subject to possible flood damage from time to time. Farmers cannot risk the establishment of permanent crops, which require very high development costs in areas

where they can be damaged by floods. Lucerne and vegetables will probably be planted in these areas in future.

### 3.3 Financial Situation

#### 3.3.1 JIA

Audited statements of the Vioolsdrift/Noordoewer Joint Irrigation Scheme were requested for scrutiny. The income statements of the last five years are reflected in the **Table 3.21**.

**Table 3.21: Income Statement for Vioolsdrift/Noordoewer Irrigation Scheme (Last Five Financial Years)**

YEAR	2003	%	2002	%	2001	%	2000	%	1999
<b>INCOME</b>	<b>445,586.88</b>		<b>358 926.27</b>		<b>337 329.16</b>		<b>346 894.64</b>		<b>301 456.92</b>
RSA water levies	283,611.39	64	228 575.80	64	200 153.57	59	305 957.30	88	263 336.88
Namibia water levies	113,374.00	25	108 488.95	30	92 115.60	27	-		-
Other income – interest	42,593.53	10	20 788.03	6	45 059.99	14	40 937.34	12	38 120.04
Telephone cost recovered	-		-		-		-		-
Insurance policy received	3,376.38		1 073.49		-		-		-
Rent received - equipment	2,631.58		-		-		-		-
<b>EXPENDITURE</b>	<b>491,737.63</b>		<b>391 253.79</b>		<b>344 761.08</b>		<b>333 379.83</b>		<b>320 554.44</b>
<b>Water levy DWAF – RSA</b>	<b>116,752.06</b>	<b>23</b>	<b>70 252.58</b>	<b>18</b>	<b>28 148.30</b>	<b>8</b>	<b>32 049.84</b>	<b>9</b>	<b>29 612.16</b>
<b>Personal expenditure</b>	<b>124,226.88</b>	<b>25</b>	<b>110 545.72</b>	<b>28</b>	<b>103 383.80</b>	<b>30</b>	<b>110 249.94</b>	<b>33</b>	<b>87 015.42</b>
Salaries and wages	122,026.11		108 253.86		102 905.00		108 355.94		86 107.56
Social security (NAM)	1,038.37		1196.56		478.80		1 023.80		632.66
Social security	1,162.40		1 113.30		-		870.20		275.20
<b>Administration costs</b>	<b>96,880.37</b>	<b>20</b>	<b>103 874.78</b>	<b>27</b>	<b>89 692.10</b>	<b>26</b>	<b>67 806.97</b>	<b>20</b>	<b>46 248.92</b>
Accounting fees	29,767.64		29 801.35		24 551.18		18 041.99		8 375.00
Bank charges	6,938.39		4 705.23		4 193.49		3 663.91		2 853.92
Computer expenses	2,800.42		3 399.95		2 711.01		2 300.37		6 761.88
Debt Recovery costs	1,431.95		16 241.70		9 010.39		1 513.79		-
Insurance	5,551.92		1 988.65		102.39		-		-
Legal fees	1,566.00		576.43		-		-		-
Licenses	183.00		315.00		-		282.00		-
Losses – Theft	566.72		-		2 090.92		-		-
Interest Paid – Bank	266.64		-		-		-		-
Office expenses	2,150.00		1 400.00		950.00		2 191.37		190.00
Rent – movable fixed assets	7,990.84		2 410.62		1 782.69		-		-

YEAR	2003	%	2002	%	2001	%	2000	%	1999
Rent paid – fixed property	10,225.00		15 543.64		11 740.00		8 600.00		8 400.00
Stationery and printing	2,989.85		1 536.62		1 673.51		1 618.56		1 007.82
Telephone and postage	14,655.65		11 561.19		22 027.52		20 640.67		12 472.80
Transport	-		1 119.65		91.00		-		-
Travelling expenses	9,796.35		13 274.75		8 768.00		6 886.00		5 737.50
<b>Stores</b>	<b>719.22</b>	<b>0</b>	<b>2 479.86</b>	<b>1</b>	<b>5 697.44</b>	<b>2</b>	<b>1 449.78</b>	<b>0</b>	<b>563.28</b>
Protective clothing	719.22		1 036.35		234.73		309.43		200.00
Consumables – toxic	-		-		3 491.23		-		-
Consumables	-		1 443.51		1 971.48		1 140.35		363.28
<b>Operations and maintenance</b>	<b>143,929.10</b>	<b>29</b>	<b>69 339.13</b>	<b>18</b>	<b>83 422.44</b>	<b>24</b>	<b>87 408.30</b>	<b>26</b>	<b>121 977.66</b>
Fuel and maintenance	16,617.93		15 386.01		14 535.07		15 715.06		12 882.08
Electricity	35,684.83		37 481.41		33 920.71		32 311.65		43 410.55
Repairs – equipment	3,433.04		2 870.88		13 645.85		23.90		1 914.00
Maintenance – water structures	84,127.60		13 600.83		16 669.24		39 357.69		58 822.61
Maintenance – buildings	4,065.70		-		4 651.57		-		-
Transport	-		-		-		-		3 510.00
<b>Loss due to sale of equipment</b>	<b>-</b>		<b>-</b>		<b>-</b>		<b>-</b>		<b>1 438.42</b>
<b>Depreciation</b>	<b>9,230.00</b>	<b>3</b>	<b>34 761.72</b>	<b>8</b>	<b>34 417.00</b>	<b>10</b>	<b>34 415.00</b>	<b>10</b>	<b>35 137.00</b>
Vehicles	4,404.00		4 400.00		4 400.00		4 400.00		2 954.00
Equipment	4,826.00		30 361.72		30 017.00		30 015.00		30 015.00
Computers	-		-		-		-		2 168.00
<b>NET SURPLUS (DEFICIT) for the YEAR</b>	<b>(46,150.75)</b>		<b>(32 327.52)</b>		<b>(7 431.92)</b>		<b>13 514.81</b>		<b>(19 097.52)</b>
<b>Accumulated Surplus</b>	<b>485,690.56</b>		<b>530,841.31</b>		<b>563,168.83</b>		<b>570,600.75</b>		<b>557,085.94</b>

Water tariffs form the basis of the income of the Vioolsdrift/Noordoewer JIA. It is also clear that the tariff amount is currently established at a level to meet the basic financial requirements of the JIA. The last three years posted growing deficits. The net deficit for the five year period accumulates to N\$91,492.90.

The three largest cost components for the last financial year are:

- Personnel expenditure 25%
- Operations and Maintenance 29%
- Administration cost 20%.

It is expected that O&M cost will further increase its proportional contribution to the expense structure of the JIA budget over the next few years due the following reasons:

- a) Electricity costs will increase, as additional pumps will have to be installed to supply water for the planned expansion.
- b) Indications are that the electricity unit cost will increase.
- c) The condition of the canal system deteriorates at an increased rate and maintenance cost will definitely increase every year.

Water tariffs paid by the farmers to the Vioolsdrift/Noordoewer JIA are reflected in **Table 3.22**.

**Table 3.22: Water Cost per hectare per Year**

	2000/01 R/N\$	2001/02 R/N\$	2002/03 R/N\$	2003/04 R/N\$
<b>RSA Farmers</b>				
Government water levy	82.70	123.25	167.00	214.50
Government Research levy	2.72	2.94	2.71	3.24
JIA operational & maintenance levy	280.00	285.00	315.00	506.00
Reserve fund levy	35.00	0.00	0.00	35.00
VAT	28.59	29.36	67.86	106.22
<b>TOTAL</b>	<b>429.01</b>	<b>440.55</b>	<b>552.57</b>	<b>864.96</b>
<b>% Increase / (Decrease)</b>		<b>3%</b>	<b>25%</b>	<b>57%</b>
<b>Namibian farmers</b>				
JIA operational & maintenance levy	280.00	285.00	315.00	506.00
Reserve fund levy	35.00	0.00	0.00	35.00
River levy	10.00	10.00	10.00	10.00
<b>TOTAL</b>	<b>325.00</b>	<b>295.00</b>	<b>325.00</b>	<b>551.00</b>
<b>% Increase / (Decrease)</b>		<b>(9%)</b>	<b>10%</b>	<b>70%</b>

Records show that the cost of water to the irrigation farmers increased considerably over the last four years. Provision for the Reserve Fund Levy was not charged for two years due to an appeal from the farmers, based on their financial situation during the particular years. The Levy was, however, again reinstated for the 2003/04 financial year.

It is envisaged that it will be expected of the JIA to at least take full responsibility in future for the maintenance of the scheme and it is thus a reality that its income will have to be increased. As the JIA income is generated mainly from the JIA O&M levy, it is expected that this levy will have to be increased considerably. (It is estimated that the maintenance cost will increase from the current cost of less than R/N\$ 100 000-00 to approximately R/N\$ 300 000-00 per year).

### 3.3.2 *Farmers*

During discussions with various commercial banks servicing the scheme members, it transpired that the financial position of the individual farmers in general is not very healthy. Many of the farmers are in arrears with the repayment of their production loans, as well as other credit facilities extended to them. The financial institutions are very concerned about the future of these farmers.

The banks, however, indicated that there are a few of these farmers who are outperforming others. These farmers are without exception those who have and are in the process of adopting more advanced farming practices and higher value crop profiles.

## 3.4 Institutional

### 3.4.1 *Joint Irrigation Authority*

The JIA serves 29 irrigators on 600.5 ha of scheduled irrigation land in South Africa (average of 21 ha per irrigator), and 16 irrigators on 283.2 ha in Namibia (average of 18 ha per irrigator). The JIA Board oversees and directs JIA activities. The Board comprises three irrigators from each of Vioolsdrift and Noordoewer, one representative of DWAF South Africa and one representative of the DOA in Namibia. The irrigator Board members are explicitly *land owners*. Current Board membership and staff establishment are shown in **Table 2.3** below.

**Table 3.23: JIA Board and Staff**

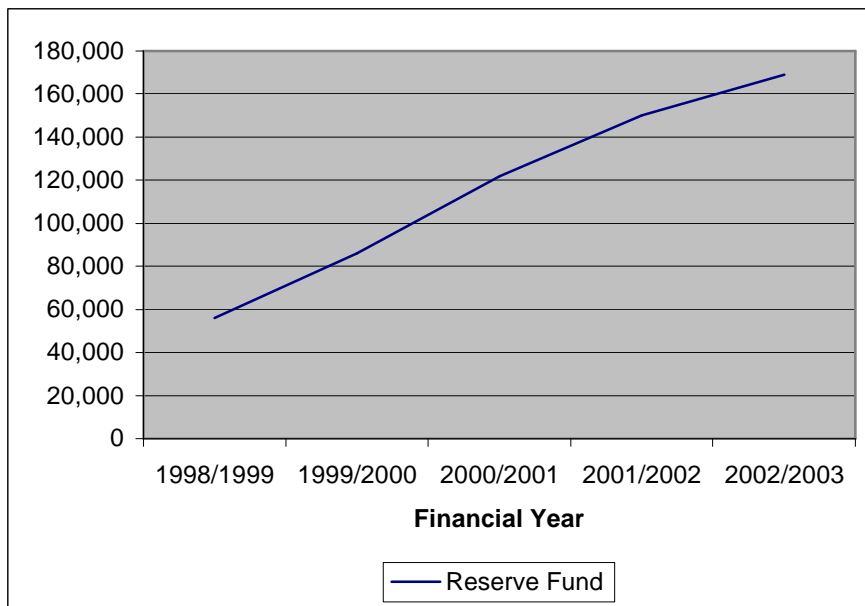
<b>Namibia</b>	
Mr A Olivier	Chairperson – land owner
Mr N van der Merwe	Land owner
Mr B J van der Hoven	Land owner
Mr L Hugo/ P Liebenberg	Representative for the Department of Agriculture and Rural Development
<b>South Africa</b>	
Mr G Gagliano	Vice Chairperson – land owner
Mr J A Jansen	Land owner
Mr M M Meyer	Land owner
Mr L Snyders	Representative for the Department of Water Affairs and Forestry
<b>Staff Establishment</b>	
Mrs W Beets	Secretary
Mr D Beets	General Supervisor
	2 pump operators and 12 labourers

In its current form, the JIA explicitly excludes membership by non-irrigation water users and by non-landowners. This is seen as a problem by stakeholders seeking more inclusive and strategic management of the water resource.

The narrow JIA membership may not be ideal from a broader Integrated Water Resource Management (IWRM) perspective, but it is arguably appropriate in the context of the restricted brief of the organization. This brief is to simply control and supply water to the Vioolsdrift and Noordoewer Joint Irrigation Scheme. Functions within the brief include budgeting and financial planning, the management of the small staff establishment, seeking and securing finance, operations and maintenance, management of income from water tariffs and other levies, and financial reporting.

The JIA appears to be relatively effective within its limited mandate. It inherited infrastructure that was deteriorating and has managed both routine maintenance and emergency repairs. It does not have reserves for the required permanent canal repair and upgrading, but in general it has kept the scheme running with very limited resources. The JIA has, however, managed to accumulate a small Reserve Fund, which has grown from less than R60 000 to more than R160 000 in the five years since 1998/99. The fund is clearly inadequate for investment in infrastructure, but it does suggest a responsible approach to the provision of a fund for contingencies.

**Figure 3.2** illustrates the growth of the Fund.



**Figure 3.2: Growth of the JIA Reserve Fund (Rands)**

The JIA seems to have secured the trust of most of the irrigation farmers through its efforts to keep the infrastructure working. It would be threatened, however, if the system fails consistently to deliver water to some farmers. There is evidence of some discontent in this regard, and some of the farmers most affected by breakdowns and repair activities have raised questions regarding the value of their JIA membership. This potential threat to the cohesiveness of the JIA has serious implications for the ongoing financial and managerial viability of the body. Clearly the implementation of a comprehensive canal repair and upgrading process would assist the JIA to command the ongoing loyalty of its members.

Despite its relative effectiveness within a narrow mandate and with limited resources, there is a great deal of evidence that the JIA, in its present form, is not equipped to deal with the array of threats and challenges that face the Vioolsdrift and Noordoewer JIA. From an institutional and managerial perspective these threats and challenges include the following:



#### 3.4.1.1 Locally

- Farms too small to be economic, coupled with somewhat individualistic approaches to farming (thereby limiting potential economies of scale).
- Conservative farming and marketing practices (in some cases), coupled with a slow response to market changes.
- Slow adoption of technological change (in some cases).
- Flood plain farming is high risk, especially since there is limited land to act as a buffer in the event of flooding. Against this background there is a reluctance to invest in crops with a high establishment cost, exacerbated by low financial reserves.
- Risk of JIA liability in the event of canal failure and of costs to affected farmers.
- Border restrictions on the movement of labour, especially on the South African side.
- Poor local road infrastructure and the problem of dust.
- Poor local domestic water supply, especially on the South African side.

#### 3.4.1.2 Regionally

- Aggressive marketing by new vegetable market competitors in Gauteng and Mpumalanga. An oversupply in the vegetable market, reportedly improving of late.
- The low investor and market profile of Vioolsdrift and Noordoewer due to limited collective management and marketing. Some investor interest from table grape growers and exporters is reported.
- Limited infrastructural, strategic, managerial and technical support (see **Section 3.7** below), and limited collective use of support.
- Opportunities to move into locally viable export crops (such as table grapes and dates) not actively pursued (with exceptions), and opportunities to share packing and marketing infrastructure (for example with Aussenkehr) largely unexplored.
- Agricultural development at Vioolsdrift seems to be a relatively low priority for the South African Government (see **Sections 3.4.2** and **3.4.3** below). By contrast, the development of Noordoewer and surrounds is a high priority in Namibian National and Regional Planning (see **Sections 3.4.3** and **3.4.4** below).

Against the background of the threats and challenges, it is clear that the Vioolsdrift and Noordoewer Irrigation Scheme needs a level of coordinated and collective strategy, including planning, financing, technical support, interaction with Local and Regional Government, marketing, IWRM and community / worker relations. The JIA is not formally constituted to fulfil these roles, nor has it actively pursued them. In this context, there are presently no firm links between the JIA and other water users (Community and Local Government), or with Government planning and development processes that might impact the future of the settlements and the scheme.

### 3.4.2 Local Authorities

The Namibian constitution makes provision for Local Authorities. Local Authorities include Municipalities, Communities and Village Councils. The settlement of Noordoewer is served by a Village Council responsible for social services such as water, electricity and the development of the settlement. The Village Council appears to be relatively active in these contexts (see **Section 3.6**). A key characteristic of the Noordoewer Village Council is that it is based in the settlement. This contrasts with the Local Government situation at Vioolsdrift, discussed below.

Vioolsdrift is part of the NamaKhoi Local Municipality, which has its administrative seat in Springbok. The downstream settlement of Rooiwal is in the Local Municipality of Richtersveld, where Port Nolloth is the administrative hub. These administrative centres are distant from Vioolsdrift, and appear to provide limited attention to the planning and administrative systems of the two municipalities (see **Section 3.5** for planning priorities, and **Section 3.7** for a review of infrastructure provision).

### 3.4.3 Regional Governments

In Namibia, second tier government is the responsibility of Regional Councils. There is evidence of regional-level planning in Noordoewer (see **Section 3.5**), and of inter-governmental cooperation between the regional and local tiers.

Provinces are the second sphere of Government in South Africa. The strategic survey reported in this document did not address the relationship between the province and local development at Vioolsdrift. The more relevant connection is at municipal level, through the IDP (Integrated Development Plan) process. The IDP relevant to Vioolsdrift is discussed in **Section 3.5**.

#### 3.4.4 National Governments

Prior to 1990, the South African Government administered Namibia. South African jurisdiction was contested internationally from the mid-1900s, and Namibia gained independence in 1990. South Africa and Namibia have signed several agreements covering bilateral and regional relationships. In the water resources management arena, the bi-lateral Namibia – South Africa PWC deals with matters of common interest along the LOR. A multi-lateral commission (ORASECOM) has been established for the entire Orange-Senqu Basin, with Namibia, South Africa, Botswana and Lesotho as members. At present, it is likely that the bilateral PWC will remain the major national-level connection with the Vioolsdrift-Noordoewer Irrigation Scheme.

### 3.5 Regional Economics and Planning

#### 3.5.1 National, Regional

The Namibian National Development Plan (Phase II) and Vision 2030 aim to make Namibia food self sufficient, with a key focus on development along the major rivers (Kavango, Kunene, Zambezi and Orange). Striking evidence of the roll-out of the plan along the Orange is the irrigation project at Aussenkehr, some 40 km downstream of Noordoewer. The Aussenkehr development integrates irrigated agriculture with a sophisticated packing and international marketing enterprise. The major products are table grapes and dates. Mangoes and citrus were also planted but their long term prospects have not been proven beyond doubt at this stage. Over 1 000 ha is already under irrigation, growing to a planned 3 500 ha in ten years.

Significant international investment has flowed into the Aussenkehr development. The Namibian Government appears to accord it a high priority, and the President has visited the scheme. It is reported that he has shared a vision of similar developments elsewhere on the LOR. The link between the National Development Plan and Regional / Local Planning is not clear at present. However, there is evidence that national priorities are filtering down to the regional and local levels.

In this context, the Regional Council responsible for Noordoewer has extensive development plans for the settlement, including the extension of irrigated agriculture, and the development of table grape farms. Pockets of land have reportedly been

demarcated for phased development. The Regional Council estimates that some 2 500 ha of land in and around Noordoewer is suitable for grape production. Business Plans have been developed and investors have been invited for discussions.

Opportunities for empowerment, on the Namibian side are being implemented at Aussenkehr and are investigated by the Ministry of Agriculture and the Namibian Development Corporation. The Regional Council official interviewed reported that Noordoewer farmers had not accepted empowerment proposals, and said that the Government intended to press ahead with this initiative. The Regional Council is investigating the purchase of a farm for a youth development scheme.

In the South African case, there is no equivalent national prioritization of the development of the LOR. The Provincial Department of Agriculture is promoting the development of a paprika project at Goodhouse, upstream of Vioolsdrift, but the relevant IDP (NamaKhoi) appears in general to address development issues elsewhere in the very extensive municipality. Plans relevant to Vioolsdrift include a community tomato drying project (reportedly a failure due to limited management capacity), and limited support to housing, sanitation and electrification.

Overall, it seems that Noordoewer and its environs are prominent in the Namibian National and Regional Planning. By contrast, Vioolsdrift and its surrounding communities seem to be in a regional planning backwater, victim to other priorities and associated resource allocations.

### 3.5.2 *Farming Enterprises*

The local economies of Vioolsdrift and Noordoewer depend on:

- Farming enterprises;
- The border post and other public service offices; and
- Tourism-based enterprises.

These are discussed here, and in **Sections 3.5.3, 3.5.4 and 3.5.5** below.

The farming enterprises share the canal infrastructure. Dominant crops are lucerne, tomatoes, green peppers, green melons and melons.

Some farmers on both sides of the river have been farming for decades. New farmers are taking over some of the farms, sometimes with new visions and farming methods.

The farms directly support the farming community itself, as well as hundreds of farm workers. The numbers are unclear at present. The Namibian Department of Labour records 100 permanent farm workers and 143 seasonal workers in Noordoewer. An informal source in the farming community estimates these numbers at 500 and 300 respectively.

No official figures were obtained on the South African side. Based on Namibian official figures and the relative number of farms, a conservative estimate is 180 permanent and 260 seasonal workers. The informal source cited above, estimates 800 and 1200, respectively. In South Africa, seasonal workers travel to Vioolsdrift from as far afield as Kuruman, Upington and Steinkopf. Seasonal workers on both sides of the river also work on other farms (for example at Aussenkehr on the Namibian side).

### 3.5.3 *Government Services*

Government services are a prominent element of the local economies of Vioolsdrift and Noordoewer. Some are associated with the border post, while others serve the communities on both sides of the river. Among these services are the following:

- Customs;
- Immigration;
- Police;
- Local Government (especially on the Namibian side);
- Regional Government (on the Namibian side);
- Health services (clinics); and
- Education (schools).

The strategic evaluation did not attempt to quantify public sector employment, or the spending of public employees in the two towns, but after farming, government services may well be the most important contributor to the local economy.

### 3.5.4 *Tourism-Based Enterprises*

A small tourism sector is based in Vioolsdrift and Noordoewer. The attractions are the rugged environment, the river, and the seasonal flush of wild flowers. The main tourism enterprises cater for overland touring and river rafting, and many provide accommodation for both. Employment was not assessed in detail, but it is likely to be small in comparison with government services and agriculture.

### 3.5.5 Secondary Enterprises

A secondary local economy is linked to the activities described above, including shops, petrol stations and motels. A business census was not undertaken, but the two communities have a total of around 10 formal shops. Informal businesses exist in both communities, providing convenience goods and in some cases alcoholic beverages.

## 3.6 Social

### 3.6.1 Demography

Very little demographic information was found for the settlements of Vioolsdrift and Noordoewer. IDP documentation from the NamaKhoi Local Municipality in South Africa has population estimates for the major towns in the municipality, but no figures are given for Vioolsdrift. The Noordoewer Village Council estimates the current population of the town at 2000. Other informants cite figures of between 3000 and 6000. Vioolsdrift and its surrounds are likely to have a population in the same broad range. Gender and age distributions were not investigated.

In overview, the Vioolsdrift and Noordoewer irrigation scheme directly supports:

- 45 irrigation farmers and their households (see **Section 3.5.2**).
- 200+ permanent farm workers and their households/ families (see **Section 3.5.2**).
- 300+ seasonal workers and their households / families (see **Section 3.5.2**).

### 3.6.2 Community Dynamics

The communities of Vioolsdrift and Noordoewer are fragmented and divided in a number of ways:

- The national boundary separates two elements of the joint irrigation scheme. This divide impacts the communities in many ways, including the different levels of support discussed in **Section 3.7** below. The boundary also restricts the movement of farmers and workers, and delays the movement of goods. It was reported that farmers and workers wishing to move through the border post have encountered serious problems, especially on the South African side of the border.

- The divide (in South Africa) between the Vioolsdrift community and the local governments (NamaKhoi and Richtersveld) serving them (see **Sections 3.4.2, 3.5.1 and 3.7.1**).
- The divide between agricultural and other water users. As discussed in **Section 3.4.1**, the current mandate of the JIA does not promote the participation of non-agricultural water users. Some community informants expressed unhappiness with this situation, and in general it runs counter to the spirit of IWRM. It also tends to draw a clear line between the white farming community and the predominantly black worker communities. There is encouraging dialogue around these issues, but the agreement founding the JIA limits constructive action.
- The fragmentation of farming practices, and the tension between conservative and evolutionary visions of the future of agricultural enterprise in Vioolsdrift and Noordoewer.

### 3.6.3 Social Welfare and Poverty

This strategic investigation found no formal figures for unemployment or poverty in the two towns. In broad terms, the two populations may be classified into the following socio-economic groups:

- Employed people (including commercial farmers, public servants and business people).
- Full-time farm workers.
- Temporary and contract farm workers.
- People in informal employment.
- Unemployed people.

A detailed analysis of incomes was not possible within the scope of this study, but in general full-time farm workers on both sides of the river appear to earn around R 300 (N\$300) per month. A daily wage of between R15 and R20 seems to be common among temporary and contract farm workers. Those fortunate to find temporary work at Aussenkehr earn around 30-36 Namibian Dollars. Some farmers provide other benefits, such as access to vegetables that are unmarketable, but the scope and extent of these practices is unknown. In Vioolsdrift, many farmers are unhappy about South African minimum wage legislation (minimum wages are higher than the present average rate),

with some arguing that they will not be in a position to provide both the minimum wage and other benefits.

Overall, it is possible that employment levels are higher in Vioolsdrift and Noordoewer than in some surrounding areas. However, the incomes of a significant proportion of the employed population (farm workers) are low, and many are only seasonally employed. Given these income levels, and the evident, but unquantified presence of informally employed and unemployed people in both settlements, it is reasonable to conclude that the majority of the population in both Noordoewer and Vioolsdrift are close to poverty thresholds.

### **3.7 Support Infrastructure**

#### *3.7.1 Housing and Social Services*

In Noordoewer, community housing is a mix of formal and informal (reed) structures. Formal brick houses are mainly found in the old town, whilst people occupying newly demarcated plots often live in reed houses. The Village Council has allocated 400 formally demarcated plots and 200 more await occupation. Loans are available to people wanting to build formal structures. Most households in Noordoewer (including those on the new plots) have access to water and electricity. Some poor households collect water from the canal for household consumption. Many households do their washing in the canal. Community housing in Vioolsdrift is mostly informal. Phase 1 of a water supply project has begun, and the NamaKhoi Municipality has set funds aside for housing and sanitation development.

The Noordoewer community is served by two primary schools and a clinic. There are also three churches in the town. Following completion of primary school, many children attend high school in Karasburg, some 140 km from Noordoewer. It is reported that some children do not complete secondary education due to lack of funds for fees and transport. The clinic is well equipped and staffed, and provides a service to both Noordoewer and nearby farming areas. Similar social services are available in Vioolsdrift. Primary education is available in the town, but many of the farmers and business people send their children to school in Springbok. Some Noordoewer children also attend school in Springbok. A modern clinic facility is available in Vioolsdrift, but it is reportedly understaffed.



### 3.7.2 Differences between Noordoewer and Vioolsdrift

A common theme from the key informant interviews is that Noordoewer is better served than Vioolsdrift in terms of government-provided services. Housing and water are a case in point (discussed in **Section 3.7.1** above). The two clinics are often compared in this context, as is the road infrastructure.

The roads in Noordoewer are reportedly relatively well maintained, while those in Vioolsdrift are poor. The poor roads impact on farming enterprises (dust and vehicle maintenance) and on riverside tourist facilities.

The reasons for the relative neglect of Vioolsdrift have not been fully investigated, but they may be related to the priorities of a newly established municipality and the distance between Vioolsdrift and the administrative centre of Springbok. On the other hand, Noordoewer may be relatively advantaged, because of its location in a recognized development area (with clear planning for the development of the town and its farms (see **Section 3.5.1**)), and because of the presence of many Government departments in the town itself.

## 4 CONCLUSIONS

### 4.1 Institutional Framework

The Vioolsdrift and Noordoewer Joint Irrigation Scheme is a test case for local-level international cooperation in economic development and water resource management. Its position astride an international boundary brings many challenges, however, not least because two institutional systems are involved. One of the keys to the sustainability and viability of the scheme is to secure an appropriate level of integrated management at local level, whilst securing the maximum benefit available through the institutional networks of both Namibia and South Africa.

Against this background, the conclusions listed below move from the local to the national scale, with particular emphasis on the local level. The conclusions are as follows:

- The Vioolsdrift and Noordoewer JIA is too narrowly constituted to deal with the management challenges that confront the irrigation scheme and the communities that depend on it for their livelihoods. There are essentially two sets of challenges: the first is to manage the water resource in an integrated and inclusive way for the benefit of all users; and the second is to manage the collective agricultural enterprise in a manner that will make it regionally competitive and sustainably profitable. The latter challenge encompasses issues such as strategy, planning, and innovation, economies of scale, finance, investment and marketing.
- It appears that at least two organizations are needed to fulfil these integrative roles: one charged with local development and IWRM; and the other with agri-business development. A version of the South African WUA model may be considered in the first instance. It is difficult to prescribe a model in the second case, with many public and private sector options to be considered.
- The potential transformation of the JIA to fulfil either of these roles is a matter for further consideration.
- Local Government is relatively pro-active and supportive on the Namibian side of the river, and less so on the South African side. One of the options to re-dress the balance is to raise the profile of Vioolsdrift in the planning processes of both the NamaKhoi and Richtersveld Municipalities. This can be done through National or Provincial Government, or through local initiative. The integrative structures

envisaged above might be well placed to interact meaningfully with these municipalities.

- National and Regional Government in Namibia appear to have provided a strategic and operational framework for the economic development of the LOR, including Noordoewer. A similar framework is not evident in South Africa, possibly reflecting different national and regional priorities. It is ambitious to imagine that national and regional level planning in South Africa can be changed to serve the needs of Vioolsdrift, but focused interventions on key issues might be appropriate. An issue in point is the reduction or elimination of obstacles to cross-border movement between the two communities.

#### **4.2 Agricultural Economics**

The importance of Noordoewer/Vioolsdrift must not be underestimated as it is a growth point with considerable expansion possibilities that will improve the viability of the irrigation scheme. Development tendencies as discussed previously in the report did indicate a gradual movement towards high value crops that will contribute positively towards financial as well as social economic aspects in the region. It is advisable that due attention is given towards the following aspects that will enhance the viability of the irrigation scheme:

- Encourage the cultivation of high value crops through marketing support incentives to the farmers.
- Encourage the use of more efficient irrigation systems (Volume of water allocation can stay the same to a farmer, but he/she can cultivate a larger area with the same amount of water.)
- Initiate the development of the undeveloped area adjacent to the current Noordoewer Irrigation Scheme.

### **4.3 Social Fabric**

Violsdrift and Noordoewer constitute a small node of employment and modest economic opportunity in a region where options are very limited. In this context, the communities are divided by an international boundary, and by internal schisms related to income, access to social services and support, and to involvement in the management of the water resource that is crucial to both communities. There is also an overlay of poverty within both communities.

The local economies and the associated social fabrics of the communities are very fragile. The impacts of possible scheme failure are discussed in more detail below, but in broad terms the only alternative to sustainable economic development is a welfare liability for both countries. In deciding whether to invest in the irrigation scheme or not, the two governments need to weigh the investment and its potential returns against the cost of providing welfare support to growing numbers of poor and unemployed people.

### **4.4 Impact of Scheme Failure**

The failure or serious financial deterioration of agricultural enterprises in Violsdrift and Noordoewer will have a number of local impacts. These are outlined under headings of severe, serious and moderate below. Severe impacts relate to substantial primary loss of employment and livelihoods, serious impacts relate mostly to secondary job loss and the deterioration of physical and social infrastructure, and moderate impacts refer to a scaling down of public service activities.

#### **4.4.1 Severe Local Impacts**

Likely severe impacts include:

- The loss of livelihoods for 45 irrigation farmers and their households, and the deterioration of farms and infrastructure managed by these farmers. The costs of rehabilitation, following such deterioration, are likely to be high.
- The loss of 200+ permanent farm worker jobs and 300+ seasonal jobs, with associated hardship for the households and extended families of the newly unemployed. With few economic opportunities in the region, unemployed farm workers will struggle to secure alternative employment. In this context poverty is likely to increase dramatically. A likely outcome is an increased welfare liability for both Namibia and South Africa.

- Breakdown of the JIA and rapid deterioration of irrigation infrastructure. As with the deterioration of privately-owned farm infrastructure, rehabilitation of severely degraded irrigation infrastructure will be very costly.

#### 4.4.2 *Serious Local Impacts*

Possible serious impacts are:

- Loss of business for enterprises serving farms and farm-employed people, with possible bankruptcies and job loss. These impacts will be less immediate than the loss of jobs on farms, but over time the implications for those involved will be no less severe.
- Deterioration of the infrastructure supporting communities and businesses (water supply, roads), with associated damage to eco-tourism employment. Even without such deterioration, local tour operators feel that sub-standard infrastructure is a threat in a very competitive industry.
- Overstretched social support and welfare infrastructure, including clinics and private and public institutions providing aid. Pressure on social support will be increased by unemployment and poverty, possibly compounded by limited government funds.

#### 4.4.3 *Moderate Local Impacts*

Moderate impacts are likely to include:

- A scaled down public service presence, with an emphasis on essential services and border control activities.

#### 4.4.4 *National and Regional Impacts*

Apart from the local impacts of scheme failure or deterioration listed above, there are also impacts at regional and national level. These include the following:

- Failure of an international cooperation initiative, with possible negative sentiment for other projects of this kind. The Vioolsdrift/Noordoewer Joint Irrigation Scheme is potentially a model for similar developments on the Orange and along other

international watercourses. The failure of the scheme might discourage riparian states from exploring similar cooperative ventures.

- Questions regarding the role and effectiveness of international water resource management institutions, and especially the PWC. If the PWC is unable to intervene effectively to avert failure or to mitigate deterioration, partners and stakeholders in such international bodies might begin to see them more as forums than as operational institutions.
- A setback to national and regional development strategy in Namibia. The Namibian Government is clearly committed to the development of the LOR. Based on feedback from the Noordoewer Local Government, and from Regional Government, Noordoewer has a place in this development initiative. Scheme failure will clearly constitute a setback in this context.
- Opportunities for investors to obtain cheap land and cheap irrigation infrastructure. Failure of the irrigation scheme might have the effect of putting cheap land and infrastructure on the market. From one perspective it might be argued that this is a quick route to the required agricultural reforms. However, the costs in terms of short-term severe impacts must be considered.
- Less competition in markets served by Vioolsdrift and Noordoewer, and possible shortage of specific products. Some local farmers emphasized the issue of shortage, but in competitive markets the shortages might be short lived.

## **4.5 Potential Viability of the Scheme**

### *4.5.1 Criteria / Preconditions for Viability*

The viability of the Vioolsdrift and Noordoewer Joint Irrigation Scheme depends on many interrelated preconditions. These have to be considered in the context of any turnaround strategy, and comprise a viability checklist against which to test turnaround plans. The preconditions include:

- The resources (management, organization and money) to maintain and improve the irrigation infrastructure. The JIA request for assistance addresses the money aspect, but does not explore the issues of management and organization.
- Sufficient Local Government institutional and financial capacity (and willingness) to maintain and improve local civic infrastructure and social services. This is likely to

be a particular challenge in South Africa, where Local Government appears to have other priorities.

- Empowered local communities with sufficient income to sustain quality of life, and with effective involvement in structures planning and distributing water and other developmental resources.
- The institutional, managerial and financial capacity in the collective agribusiness enterprise to plan and implement strategies to ensure competitiveness and sustainable profitability. This is a critical gap in the present context.
- The willingness of the farming community to take measures to be competitive, and the courage to move on if they are not so.
- The prevalence of opportunities and an enabling legal and institutional environment which will attract investors and financiers.
- Removal of obstacles to the movement of goods and people. High on the list of such obstacles is bureaucracy at the border post.
- Clear links to national and regional development plans and initiatives, with support from Governments through these initiatives.

#### 4.5.2 *Current Viability*

Evidence suggests that the Vioolsdrift and Noordoewer Joint Irrigation Scheme is currently marginal. The clearest indicator is the JIA request for assistance from Namibia and South Africa through the PWC. Even with an injection of funds, the scheme does not have the appropriate institutions and support to manage the necessary transformation of agricultural business practices. Without these the outlook is that the scheme will remain marginal unless support matches funding with the facilitation of business and organizational reforms.

#### 4.5.3 *Obstacles to Viability*

Obstacles to the viability of the Vioolsdrift and Noordoewer Joint Irrigation Scheme have been identified in various chapters of this report. The key obstacles are listed below. Most of the obstacles are critical, but it is encouraging that many can be addressed

locally. This suggests that turnaround strategies must be largely local in focus, with regional and national elements. The obstacles are:

- Institutional arrangements for managing the water resource and the integrated development of agribusiness are weak. This is particularly so in the latter case, where no overarching development-oriented body exists.
- Small economic units and conservative farming and marketing practices.
- The lack of a cohesive and strategic approach to the development of agribusiness.
- Competition in the chosen markets and poor market selection.
- A lack of attractiveness to investors. Elements of this lack of attractiveness include small farming units, a history of low returns among farming enterprises and the risks associated with flood plain farming.
- The peripheral status of the joint irrigation scheme in national and regional development planning, particularly in South Africa.

Along with the preconditions for viability, the obstacles will have to be considered in proposed strategies to rehabilitate and revive the Vioolsdrift/Noordoewer Joint Irrigation Scheme.



## **5 INTERVENTION OPTIONS**

### **5.1 Identification and Definition of Options**

#### *5.1.1 No Direct Financial Support by Governments*

This option will mean that no material or financial support is given to the JIA in order to assist the farmers to rehabilitate the irrigation scheme infrastructure. It will be expected that the JIA will have to apply their reserve fund to fund repairs and maintenance, as well as the replacement of certain portions of the canal system or to install pumps at various strategic sections to augment the water volumes in the canal.

#### *5.1.2 Unqualified Government Financial Support*

In the other extreme, the two Governments can decide to provide all the material and financial resources required to rehabilitate the scheme and canal system to a level where it is again fully operational at design level. This will further mean that the JIA will not make any meaningful contribution towards the repairs.

#### *5.1.3 Conditional Direct Financial Support*

The third option consists of an entire array or continuum of alternatives where the two Governments would come to the assistance of the JIA, but on a conditional basis where contributions from the JIA would be required. The contribution from Government side could be in the form of financial assistance, technical assistance or capacity building. The JIA and farmers on the other hand could make a counter financial contribution or re-organize their collective or individual management systems and approaches or consider changes in their farming practices that could make their enterprises more profitable and sustainable.

### **5.2 Discussion and Analysis of Options**

The first alternative of maintaining the status quo and expect the JIA and the individual farmers to find a solution would pose certain possible positive and negative consequences to a number of stakeholders. The most extreme outcome would be the total eventual failure of the scheme. This would theoretically mean 45 farmers ceasing farming operations and having to find alternative means of sustaining themselves. Equally 200 permanent employment opportunities will be lost and an approximate equal number of seasonal job opportunities. The chance of a total system failure is, however,

not very likely. There are already a number of farmers who have invested in additional irrigation infrastructure to augment water quotas from the canal system. This will probably be the norm in the event of further deterioration of the canal system especially for the more progressive farmers who have adopted a higher value crop profile. Another possible outcome could be that the weaker farmers will be forced to sell their plots to more successful and resourceful farmers. This could also see new and more entrepreneurial farmers from outside buying land at the scheme.

A do-nothing approach could also have negative effects of which the certain shock on the local economy and the economic instability and uncertainties of a deteriorating situation would be the most negative and unwanted effects. The traumatic effects of a restructuring process of the farmer profile of the scheme on the society should be avoided as far as possible.

Option two is most probably the easy way out, but as in the case of the first option, not desirable. The situational analysis made it very clear that the current condition of the canal system is not the contributing factor to the poor financial performance of the scheme, but rather is the result of it. The primary contributing factors rather lie in the farming practices and cropping profiles prevalent at the scheme, as well as the socio-economic dynamics of the scheme. An unconditional rescue package would only delay a natural shake-out process, which is busy taking place. It will just conceal certain economic inefficiencies in the current operations of the scheme. This option will not present a sustainable solution to the problem at hand.

The option of offering conditional assistance would see both parties having to commit themselves to find a sustainable and realistic solution to the obvious and deeper rooted problems experienced at the scheme. The PWC could request the JIA to evaluate their own situation in terms of a problem analysis and to find a long-term vision for the scheme and to identify possible solutions, based on the problem analysis and working towards clear long-term objectives and goals. Farmers could, on an individual, as well as collective level, set targets for improved operational efficiencies and changed crop profiles from low value crops to higher value crops. The JIA could for instance investigate possible value adding opportunities that may exist, not only generating additional financial returns for the members, but also creating additional employment opportunities in the two towns.

On the part of the two Governments a commitment in terms of a substantial financial contribution towards the rehabilitation of the scheme could be made. In addition, the Governments could further pledge financial resources to fund a capacity-building programme as proposed above. The Governments could also provide financial guarantees, which could be used to raise other commercial funds to finance the scheme's rehabilitation.

### **5.3 Recommended Option**

Based on the discussion above, it is clear that Alternatives 1 and 2 will not lead to the desirable result, which is a lasting and sustainable solution that will contribute towards stability and economic progress in the area.

The recommended option is Alternative 3 that aims at creating a partnership in solving the problem.

## **6 RECOMMENDATIONS**

### **6.1 Short-Term Actions and Responsibilities**

It is recommended that for the immediate and short-term, the PWC makes sufficient funds available to repair those sections of the canal where the need is the most urgent. This would, however, be on the condition that the JIA would embark on a programme to evaluate its own options and that a long-term management plan is drafted and implemented.

### **6.2 Medium- and Long-Term Interventions**

For the medium- and longer term it is recommended that the PWC make available funding to:

- Appoint professional facilitators to assist the JIA and its members to draft a long-term management plan for the entire scheme, including the larger Noordoewer/Vioolsdrift community.
- Evaluate the role that the scheme could play in broader regional and national development programmes and initiatives.
- Identify other possible funding partners that might provide grants or soft loans, which could be applied for the rehabilitation of the scheme, as well as additional capacity-building programmes in the communities.

## REFERENCES

- DWAF, DIRECTORATE: Guide for the Advisory Committee for Water Resources  
WATER RESOURCES Modelling, Edition 1 (Draft 4)  
PLANNING (November 2001 –  
DWAF, 2001a)
- DWAF, DIRECTORATE: Guidelines for Water Resources Modelling Procedures to  
WATER RESOURCES Support Water Management Institutions, Edition 1  
PLANNING (November 2001- (Draft 4)  
DWAF, 2001b)
- DEPARTMENT OF WATER Regional Maximum Flood Peaks in Southern Africa.  
AFFAIRS AND FORESTRY, PRETORIA.  
Technical Report TR 137.  
Kovacs, ZPSJ (1988).
- DEPARTMENT OF WATER Boegoeberg Dam: Estimation of flood peaks for required  
AFFAIRS AND FORESTRY, probabilities.  
PRETORIA.  
Report No. D700/R001/2003.02.  
Rademeyer, P, Linström, C &  
van der Spuy, D (2003).

## **Appendix A**

### **Example of Questionnaire used**

Eienaar / Boer: .....

Perseel nommer: .....

Blad no:

Kanaalseksie:

**Huidige boerdery**

	Gewas	Area (ha)	Maand geplant	Maand ge-oes		Besproeiingsmetode					Posisie m.b.t. vloedvlak		
				Van Maand	Tot Maand	Vloed	Sprinkel	Mikro	Drup	Ander	Onder gevaarlike vlak	Tussen kanaal en gevaarlike vloedvlak	Bo Kanaal
1													
2													
3													
4													
5													
6													

**Verwagte boerdery 5 jaar in die toekoms**

	Gewas	Area (ha)	Maand geplant	Maand ge-oes		Besproeiingsmetode					Posisie m.b.t. vloedvlak		
				Van Maand	Tot Maand	Vloed	Sprinkel	Mikro	Drup	Ander	Onder gevaarlike vlak	Tussen kanaal en gevaarlike vloedvlak	Bo Kanaal
1													
2													
3													
4													
5													
6													

**Aantal sluise op perseel**

1		
2		

**Hoë Watertafel**

1		
2		

**Belangrike probleme way ondervind word met die skema se watervoorsiening (tot rand van land)**

	Probleem	Voorstel om probleem uit te skakel
1		
2		
3		
4		

## **Appendix B**

### **Socio Economy and Institutional List of Contacts**



<b>MEETING WITH THE IRRIGATION AUTHORITY</b>		
<b>~ 3 JUNE 2003 ~</b>		
<b>ATTENDEES</b>		
	Mr J A Olivier Mr D H Beets Mr G Gagiano Mrs W Beets Mr T Hart Mr A Mosimane Mrs M Solomons	Joint Irrigation Authority Joint Irrigation Authority Joint Irrigation Authority Joint Irrigation Authority RDC University of Namibia Ninham Shand
<b>MEETING WITH THE GENERAL MANAGER AT AUSSENKEHR</b>		
<b>~ 4 JUNE 2003 ~</b>		
	Mr A Vermaak Mr T Hart Mr A Mosimane Mrs M Solomons	General Manager Aussenkehr RDC University of Namibia Ninham Shand
<b>MEETING WITH THE VIOOLSDRIFT/ NOOROEWER COMMUNITY MEMBERS</b>		
<b>~ 4 JUNE 2003 ~</b>		
	Mrs W Beets Mr D Beets Mr D Goussard Mr L Burger Mr A Nelson Mr J A Jansen Mr A May Mr R Theron Mr Paulus Mr Naested Mr J Le Roux Mr M Meyer Mr G Gagiano Mr H Malan Mrs Maudie Bleach Mrs N van den Heever Mr J A Olivier Mr M Moeketsi Mr A J Janson Mr CH Sutherland T Hart Mr A Mosimane Mrs M Solomons	Joint Irrigation Authority Joint Irrigation Authority Gariep Motors Noordoewer B/S Albaine Farm Klipwerf Farm May's Farm Fiddlers Inn Kiosk Hikewal SA Border Police Jacandel Farm Water Board Water Board Farmer Bushwacked Plot 26 Joint Irrigation Board Tourism Org Farmer Farmer RDC University of Namibia Ninham Shand
<b>MEETING WITH THE VIOOLSDRIFT COMMUNITY MEMBERS</b>		
<b>~ 4 JUNE 2003 ~</b>		
	Ms R Links Ms J van den Heever Mr L Pieters Mr M Moeketsi Mr T Hart Mr A Mosimane Mrs M Solomons	Advice Office Nama-Khoi Municipality Nama-Khoi Municipality Tourism Org. RDC University of Namibia Ninham Shand

## **Appendix C**

### **Flood Levels at Noordoewer/Vioolsdrift**

## FLOOD LEVELS AT NOORDOEWER/VIOLSDRIFT

### 1. OBJECTIVE

The objective of this task is to determine the extent of the inundation of the irrigation area immediately downstream of Vioolsdrift Weir during floods with probabilities of occurrence of 1% and 2% respectively (1 in 100 and 1 in 50 year floods).

### 2. METHODOLOGY

The following methodology was used to achieve the objective:

- As a first step the flood peaks with probabilities of occurrence of 1% and 2% respectively were determined; and
- Using these flood peaks in a steady state hydraulic analysis the extent of the inundation of the irrigation area of concern was determined.

### 3. HYDROLOGY

The peaks of the floods were determined using only an empirical method (TR 137: Kovacs 1988). The results are given in **Table 1**.

**Table 1: Flood Peaks at Vioolsdrift Weir**

	Probability of Occurrence	
	1%	2%
Flood peak (m <sup>3</sup> /s)	10 900	9 500

Although Boegoeberg Dam is a long way upstream, the remainder of the catchment between Boegoeberg Dam and Vioolsdrift Weir does not contribute significantly to flood peaks (in fact flood peaks with a certain probability of occurrence are smaller at Vioolsdrift Weir due to damping and losses). The results at Vioolsdrift Weir were therefore validated using the results of the latest hydrological flood peak analysis done for Boegoeberg Dam (Rademeyer et al: 2003) given in **Table 2**.

**Table 2: Flood Peaks at Boegoeberg Dam**

		Probability of Occurrence	
		1%	2%
Flood peak (m <sup>3</sup> /s)	Deterministic	15 350	13 190
	Statistical	12 560	10 700

#### 4. HYDRAULICS

The sectional data used for the hydraulic modelling in the Orange River (Task 8.2) were also used for this task. The flood peaks determined in the previous section were used as input. The water heights at specific points were determined running a steady state analysis of the area of concern. The results are given in **Tables 3** and **4** for flood peaks with a 2% and 1% probability of occurrence respectively.

**Table 3: Inundation Information for Flood Peak with 2% Probability**

Description	Distance from Vioolsdrift Weir (km)	Flood Peak (m <sup>3</sup> /s)	Minimum Chainage Elevation (m amsl)	Water Surface Elevation (m amsl)
Vioolsdrift Weir	-	9 500.00	165.20	177.44
Vioolsdrift Bridge	12.6	9 500.00	161.10	172.23
	13.5	9 500.00	161.10	171.74
	25.2	9 500.00	155.60	166.33
Start of gorge	33.6	9 500.00	151.60	161.43
	42.1	9 500.00	143.50	155.00

**Table 4: Inundation Information for Flood Peak with 1% Probability**

Description	Distance from Vioolsdrift Weir (km)	Flood Peak (m <sup>3</sup> /s)	Minimum Chainage Elevation (m amsl)	Water Surface Elevation (m amsl)
Vioolsdrift Weir	-	10 900.00	165.20	178.18
Vioolsdrift Bridge	12.6	10 900.00	161.10	172.66
	13.5	10 900.00	161.10	172.13
	25.2	10 900.00	155.60	166.81
Start of gorge	33.6	10 900.00	151.60	162.22
	42.1	10 900.00	143.50	155.00

## REFERENCES

Kovacs, ZPSJ (1988).

***Regional Maximum Flood Peaks in Southern Africa.***

Technical Report TR 137.

Department of Water Affairs and Forestry, Pretoria.

Rademeyer, P, Linström, C & van der Spuy, D (2003).

***Boegoeberg Dam: Estimation of flood peaks for required probabilities.***

Report No. D700/R001/2003.02.

Department of Water Affairs and Forestry, Pretoria.