CHAPTER 5 – YIELD BALANCE AND RECONCILIATION STRATEGIES

NEED FOR YIELD BALANCE AND RECONCILIATION STRATEGIES

The various sectors within the ISP area have different overall water requirements and these requirements are generally at different levels of assurance of supply. Assurance of supply is mainly determined by whether an area receives transferred Orange River water or not. The yield balance situation and the current and future management perspectives and reconciliation options are discussed in *Chapter 4: Water resources perspective of the ISP area*.

Yield balance and reconciliation strategies address the need to:

- ⇨ Clarify uncertainties and information gaps regarding the availability of surface water and groundwater;
- ⇨ Undertake detailed water requirement investigations;
- ⇨ Determine and implement water reconciliation strategies for specific systems, geographical areas or water sectors;
- ⇨ Address the requirements for compulsory licensing.

Adequate amounts of water at acceptable assurances of supply are required, especially for irrigation, but also for towns.

RELEVANT IDENTIFIED STRATEGIES

The following specific strategies have been developed further:

5.1 Reliability of the yield balance;
5.2 Groundwater;
5.3 Compulsory licensing;
5.4 Supply to local authorities;
5.5 Reconciliation.

It was considered unnecessary to develop strategies for specific water use sectors. There is no specific "water requirement" strategy, as this is adequately covered in the other strategies.

5.1 RELIABILITY OF THE YIELD BALANCE

Management objective:

To address the uncertainties, assumptions and gaps as identified in the estimates of water availability and requirements for especially the Fish-Sundays system, to obtain a higher confidence water balance, thus creating opportunities for improved water management and curtailing of wastage.

Situation assessment:

Available yield

Available yields are tabulated in Chapter 3 **Table 3.4**. The total yield is estimated at 757 million m^3/a, with a local yield of 160 million m^3/a and impacts of transfers in on yield of 575 million m^3/a. A calculation of the maximum Orange River water requirements of the ISP area however indicates a quantity of 658 million m^3/a. The implications of this difference of 83 million m^3/a at 1:50 year assurance of supply, is that farmers could potentially use more water than have been allocated for transfer from the Upper Orange WMA.

The rivers are generally adequately gauged for current large-scale yield modelling requirements, with the following qualifications. An additional flow gauge on the Bushmans River, closer to the estuary, would improve estimates. The Sundays River should also be gauged below Darlington Dam (and possibly also closer to the estuary), but no good sites are available. None of the estuaries have installed water level recorders. The numbers of evaporation stations are diminishing and there are not enough rainfall gauging stations. Water balances have not been undertaken for Commando Drift Dam and Lake Arthur.

As elsewhere, information on groundwater availability is very poor. Information on surface water availability is generally reasonable, except for information on required Reserves, which is either at low confidence levels for rivers or non-existent for most estuaries, wetlands and aquifers (refer to the *Reserve and Resource Quality Objectives Strategy*, Strategy 6.1).

Current water requirements

Volumes required by users are tabulated in Chapter 3 **Table 3.7**. The total requirement is estimated at 759 million m^3/a. The accuracy of available information related to irrigation water use is poor and it is important that it be improved. There is significant uncertainty regarding water use allocations which do not form part of existing government water schemes (GWSs). No up-to-date information on actual irrigation water use is available, either from GWSs or for the substantial irrigation outside GWSs. Farmers often do not inform system operators when they do not use their allocated water. No reliable observed data on the quantity of irrigation return flows are available. Irrigation return flows are best estimates by DWAF staff of percentages of use and are of low confidence. An improved operational model (refer to the *Orange-Fish-Sundays Water Supply System Management Strategy*, Strategy 12.1) could significantly improve estimates of river losses, which have a significant impact on water availability, as well as of irrigation return flows. Irrigation farmers in the Lower Sundays River Scheme notably use much less than their allocations.

Information about the volume of the available groundwater resources, depth, the distance between a suitable source and its intended use, quality, and its reliability (assuming proactive, appropriate aquifer management) is not conveniently available to planners and engineers in a readily understandable format. The existing available graphic information sources are too generalised and at too small a scale to be practically useful for aquifer exploration, development and management. The major hindrance to the optimal development of groundwater resources is the lack of and/or inaccessibility of area and aquifer-specific data at the scale of a quaternary catchment, or group of related quaternary catchments.

Water balance

The mass water balance of large portions of the ISP area was updated, as part of the Orange River Replanning Study (ORRS), and the requirements for annual transfer of Orange River water was refined in the Orange River Continuous Study. Both studies covered the hydrological period 1920 to 1987 for the Eastern Cape Rivers. The entire ISP area is approximately in balance, with most shortfalls in demand being met by transferred Orange River water.

Strategic approach:

With irrigation using 94% of all available water it is obvious that the focus should be on improving the reliability of irrigation water allocations, uses and return flows, to attain a reliable water balance. Specific attention should be paid to increasing the confidence in the accuracy of irrigation water allocations and use outside GWSs. The difference of 83 million m^3/a between the allocation of Orange River water to this ISP area and the maximum quantity that may be used will be urgently addressed. Adequate keeping of records is a major gap which requires attention.

The operational knowledge of the Orange-Fish-Sundays Water Supply System urgently needs improving and this can be achieved by promoting the installation of gauging stations, rain gauges at selected points in the catchment and water level recorders in identified estuaries to supply specific information needs that will support and improve effective management decisions. The paucity of groundwater information should be addressed by initiating focussed studies on regional aquifers where the demand warrants it and by installing systems that improve knowledge about groundwater availability. Little benefit will be gained by updating local hydrology (because local yield is such a small component of the total yield and because significant floods or droughts should have recently occurred to have an influence). Only undertake updates of a specific system or river when there is a specific need, such as a significant licence application in a tributary, or when there is good reason to believe that the hydrology will change after an update.

Management actions:

1. Ensure proper record keeping of actual water use in GWSs;
2. Compare scheduled quota amounts with actual use once actual use values are available;
3. Improve the confidence in irrigation use outside GWSs by verification of WARMS as a first step;

4. Urgently address the difference of 83 million m^3/a between the allocation of Orange River water to this ISP area and the maximum quantity that may be used;
5. Improve knowledge on river loss estimates when an improved operational model has been implemented;
6. Address gauging requirements. See the *Monitoring Networks and Data Capturing Strategy*, Strategy 13.1;
7. Determine the need to undertake water balances for Commando Drift Dam and Lake Arthur.

Responsibility:

RO.

Priority:

1 – Very high, due to the influence that improvements in the reliability of information may have on the water balance and hence on licensing decisions.

5.2 GROUNDWATER

Management Objective:

The management objective is to ensure the sustainable use of groundwater and the appropriate exploration, development and monitoring of the unexplored aquifers.

Situation Assessment:

Regional scale groundwater resource assessment and usage figures are available from studies such as the Fish to Tsitsikamma Water Resources Situation Assessment Study, based on the 1:500 000 DWAF map series and the NWRS evaluation. A spatially-weighted, aquifer-specific GIS-based estimation of groundwater potential is available from this study. These numbers are summarised in tabular form in **Appendix 2**.

Overviews of the patterns and controls of groundwater occurrence, anticipated yields, water quality variations and aquifer classification (scale 1:3 000 000), aquifer vulnerability (1:6 000 000) *inter alia* are summarised and illustrated. The regional maps are available from DWAF (hydrogeology map series at 1: 500 000) and the Water Research Commission.

Regionally there are four strategic aquifer systems in this ISP area. These are:

- The Katberg Sandstones (fractured rock aquifer);
- The Witteberg Quartzites (fractured rock aquifer);
- The Intergranular Coastal Aquifers (primary aquifer(s) of marine, fluvial and Aeolian origin);
- The Dolerite Dyke system (fractured rock aquifer), which can be considered as a strategic resource since it delivers reliable yields and acceptable water quality in the sub-areas otherwise dominated by regolith aquifers of very poor water quality and yield.

It is appreciated that groundwater is an affordable and flexible supply in the socio-economic and demographic conditions prevalent in this area. In some cases, e.g. for small Karoo towns and rural settlements (see the *Supply to local authorities strategy*, Strategy 5.4, which addresses current and potential future supply to towns), groundwater offers the only feasible option, either as sole supply or as an augmentation option. Many towns are fully or partially dependent upon groundwater (Nieu-Bethesda, Aberdeen, Jansenville, Paterson, Kenton-on-Sea, Alexandria and Kleinemonde for example). In Graaff-Reinet, Bedford and Pearston for example the water supply is one of combined surface and groundwater. Supply from springs is considered as groundwater supply because aquifer management would impact upon it. Throughout the ISP area groundwater is used seasonally for irrigation or stock watering.

This dependence means that economic and social costs can be high in the event of failure in respect of either quantity or quality of supply. At present it is unknown exactly how many boreholes are in operation throughout the WMA. A total of 7 535 boreholes are recorded on the NGDB and on the basis of a 30% national average success rate this suggests that approximately 2 260 boreholes are in operation. There is no information on illegal drilling and the number of boreholes which might not be recorded.

Aquifers under stress (which may also be the result of inadequate management) include the Albany Coast primary aquifers and the fractured dolerite and Karoo aquifers in the Middelburg, Graaff-Reinet, Tarkastad, Hofmeyr and Paterson areas. Recently there have been reports that the groundwater supply to Middelburg and Kenton-on-Sea has failed and R2 million has been allocated to Middleburg in terms of drought relief, as a response to supply failure.

It is of concern that *ad hoc* investment in groundwater supply schemes during droughts, while much needed at the time, do not thereafter insist on, or provide, the necessary investment to ensure that the root cause of the problem of perceived unreliability of groundwater – viz. lack of suitably designed and implemented monitoring networks and programmes, lack of understanding of appropriate groundwater management amongst persons tasked with this responsibility and timely expansion of wellfields as demand increases or as monitoring information indicates that it is needed, is addressed.

Determination of groundwater Reserves has been done at preliminary or rapid levels of determination (see the *Reserve and resource quality objectives strategy*, Strategy 6.1) in the P10B, P10E, and P20A catchments. Based on the present levels of data distribution, data accessibility, data validation, the frequency of monitoring and the uncertainty as regards resource quantification, any determination of the groundwater Reserve at intermediate or comprehensive levels for the various aquifers would be of a low confidence.

Current documentation, protection, monitoring and management of springs are inadequate. There is limited quantitative understanding of variations in spring discharge with climatic variability. So too there is little knowledge of natural impacts on base flow versus influences of anthropogenic factors. Current understanding of the relationship of different aquifers to spring flow and baseflow and to each other is not documented. This is of particular importance in evaluating the groundwater Reserves for estuaries, undammed rivers and in the protection of aquifers, both from a RQOs or a source-directed measures perspective.

Appreciation of the movement of contaminants in fractured rock aquifers is poor in this WMA and little attention is given to protection of the groundwater resource. With very little industry and mining this is not a major issue in this ISP area.

Strategic Approach:

Summarise the current understanding of availability/potential and possible use of groundwater for the whole ISP area into a Management Plan, and then improve on it by implementing the following actions in terms of the Management Plan:

1. Establish an immediate and urgent monitoring programme;
2. Initiate the planning of a GIS-based data and information base that will be web served and useful to local government, the Department of Economic Affairs, Environment and Tourism, The Department of Agriculture and Land Affairs, other DWAF Directorates, aid organisations, non-Government organisations and the private sector at WMA or larger scale. Any GIS-based system must provide data as well as information and best practice and/or planning guidelines relevant to any particular area and should be regularly updated;

3. Educate users and other professionals in the water industry in the risk and adaptive management approach most suited to groundwater management as well as the application of operations and maintenance rules;
4. Re-evaluate aquifer protection measures to distinguish ambient from anthropogenic influences impacting on the groundwater resource. The results of physical and chemical monitoring must be brought to bear in the planning, implementation and regulatory decisions;
5. A comprehensive audit of groundwater usage and current exploration is urgently required;
6. Include a strong groundwater management component as part of a future Integrated Water Resource Management team in the CMA;
7. Develop a trans-disciplinary strategy to address the extreme poverty in the area, since water supply and sanitation are key inputs.

Management Actions:

Human Resources

1. Establish scientific posts for personnel that would be responsible for the interpretation of data, dissemination of information and development of the GIS-based data, information and knowledge management;
2. Establish a mentorship programme that supports ongoing field and scientific training. This will promote confidence, competence and vision;

Groundwater Monitoring

3. Design, implement and expand the monitoring network with immediate effect. Upgrade as data, insight and information become available. Evaluate and interpret monitoring data and information and integrate the outcome into groundwater management actions;
4. Co-ordinate the groundwater and water quality monitoring and regular information exchange, particularly with respect to the management and monitoring of effluent from WWTWs and siting and construction of ventilated improved pit latrines;
5. Select preliminary sites based on the Working-for-Water and Working-for-Wetlands programmes to prioritise monitoring. Integrate the insights and results with other monitoring results;

Groundwater Management, Reserve and Resource Protection

6. Prioritise aquifers which are most stressed with respect to over-abstraction, poor management and threat of contamination, for purposeful intervention to improve groundwater management and resource protection. Align this initiative with disaster and drought management initiatives, particularly in Middelburg, Graaff-Reinet and Kenton-on-Sea;
7. Consider the implications and develop a strategy to address the possibility that DWAF will maintain the responsibility to authorise aquifer-specific management plans on a catchment and a wellfield scale. Similarly the Department could be required to support municipal and larger groundwater users to implement the operating rules of wellfield(s) and to adapt these as monitoring results become available;
8. Identify the rivers that are most dependent upon spring flow. Initiate a spring flow and water quality monitoring programme in order to obtain ground-truthing data about baseflow and/or groundwater contribution to surface water;

Impact on Ecosystems

9. Ensure that the impacts of the Working-for-Water and Working-for-Wetlands programmes on the groundwater regime are monitored;

Knowledge Management

10. Establish an effective and efficient GIS-based data, information and knowledge management system accessible to government and private sector. It is imperative that any GIS-based work has a sound physical process and theoretical basis;

Socio Economic Responsibility

11. Develop and implement a strategy to integrate the socio-economic factors and poverty eradication in groundwater resource evaluation, planning, implementation, management and maintenance of infrastructure. The factors must be addressed in terms of references for groundwater studies at all stages, i.e. planning, exploration, implementation, wellfield and aquifer management;
12. Rural supply and small town schemes should include a food garden allocation over and above the Human Reserve. Good nutrition and health is important given the social circumstance and the Aids epidemic;
13. Develop and implement a strategy for interfacing with existing education initiatives in order to support sustainable groundwater supply. Develop a concept document for groundwater education at various levels of government, community and schools.

Responsibility:

RO and water resources managers, assisted by Chief Directorate: Information Management.

Priority:

1 - Very high.

5.3 COMPULSORY LICENSING

Management objective:

To identify the need for compulsory licensing in stressed areas, prioritise such requirements and provide guidance regarding the initiation, implementation and management of the required process.

Situation assessment:

Compulsory licensing is the process of getting all water users in a catchment licensed. In the long-term everybody in the country will be licensed. Compulsory licensing will therefore over time be implemented in all catchments – stressed or not. It is firstly a tool for redressing imbalances and inequities and in these cases curtailments may well ensue. It is not necessarily, however, a threatening process.

The Tarka catchment is in stress as a result of over-allocation and over-utilisation of irrigation water, and diminished dam yields due to siltation. All other catchments in the ISP area are currently in a balanced situation. Deteriorating water quality towards the bottom ends of the major rivers are pushing sections of these rivers towards a stressed situation. Compulsory licensing may become necessary to reduce this trend.

There is significant uncertainty regarding the water use situation in the Kat River catchment, especially among the ex-Ciskei irrigators, which could potentially require compulsory licensing to correct the situation. DWAF's view is that the catchment is in balance, but that there are many unutilised water allocations, while unlicensed users make use of the allocated water not taken up.

Compulsory licensing is not seen as a priority in the remainder of the area.

Strategic approach:

The need to curtail water allocations through compulsory licensing will be avoided where possible (except perhaps to recover unused water). Other ways of bringing the required water back into the system must first be tackled, for example the clearing of invasive alien plants; verifying, recalculating and determining available water and water use; ensuring the implementation of water conservation and demand management etc. If a balanced situation cannot be achieved by these intervention measures, compulsory licensing will proceed in a phased, integrated manner as a step-wise process. If the situation is resolved following the implementation of any of the above approaches, the compulsory licensing may be delayed.

Management actions:

Implement the compulsory licensing process, according to national priorities, as follows:

- Do verification of existing registered use and the lawfulness of such use in:
  - The Tarka River to determine how much water has been over-allocated and is being used in the catchment;

- The Kat River to find out how much spare capacity actually exists in the system and how much water is illegally used;
- The Kamdeboo River area (N14C quaternary), where there is high water use, to sort out the perceived/alleged unlawful use of canals/dams, as a matter of urgency;

- Reconsider the need to implement the process further. Consider what other intervention measures, such as revisiting the Reserve, clearing invasive alien plants, water trading, water conservation and demand management etc. might do to achieve a balanced water situation and implement those interventions that will lead to a balanced situation.

If a balanced situation has not yet been achieved, implement the following steps, which will eventually also be implemented in all remaining catchments:

- Update the hydrology and set up water resources models as required by compulsory licensing to update the yields of these catchments;
- Revisit and refine the water requirements;
- Assess the social dynamics of the identified catchments and the potential economic impacts of allocation decisions;
- Revisit the current yield balance and potential yield balance scenarios in the identified catchments once the Reserve and detailed modelling studies are complete, and the social and economic issues are understood;
- Undertake scenario and operational assessments and the development of a set of water allocation rules, following the required participative stakeholder processes, ensuring that water for poverty eradication receives adequate priority;
- Publish water allocation schedules, following the quantification of multi-criteria decision-making recommendations and the required public, legal and administrative processes.

Responsibility:

The RO in consultation with D: WA, D: RDM and D: NWRP.

Priority:

2 – High, for the Verification component.
3 – Medium for the remainder of the process.

5.4 SUPPLY TO LOCAL AUTHORITIES

Management objective:

Through this strategy local authorities will know and understand the limitations to their water supply. IDPs, WSDPs and Water Sector Plans should reflect both the constraints as well as the opportunities pertaining to the availability of water. Local authorities will work together with the Department to access potential resources and to optimise the use of that water which is already available.

Situation assessment:

Appendix 3 contains a table of all municipalities in the ISP area and **Appendix 4** provides a table of towns per quaternary.

Table 5.1 presents detailed information on the water supply situation of the towns in the ISP area. There is continued urbanisation in many towns in the ISP area. Urban water requirements tend to grow, even though populations have become stagnant or are even slightly declining in some areas. Twelve towns receive transferred water from the Orange River, with most other towns being reliant on groundwater, some with poor quality. Many towns in this area occasionally run short of water and the DWAF perception is that this is often the consequence of poor water management. There is an identified need for augmentation at thirteen towns and services are being upgraded in many towns.

The Albany Coast Situation Assessment Study [21] is underway to review the water augmentation options of several coastal towns in the Albany Coast sub-area (Alexandria, Boknes, Canon Rocks, Kenton-on-Sea, Port Alfred, Kleinemonde and Bathurst). Current problems relate to high growth rates in coastal areas, high holiday peak water usage, inadequate sources in terms of quality and quantity and limited infrastructure capacity. The situation in Port Alfred is critical during peak demand and available sources are only adequate until 2005.

The town of Graaff-Reinet is vigorously campaigning for an additional water allocation, i.e. additional Orange River water through the Wapadsberg Scheme for both irrigation and primary use, although numerous previous investigations have shown that any such scheme would be far too expensive. The supply of primary water only via the proposed Bruintjieshoogte Scheme is less costly, yet still disproportionately expensive in relation to local sources, in particular groundwater. Since the yield of the Orange River is currently fully allocated in terms of the current level of development, these proposed schemes would have to buy out current water rights or obtain water from further resource development in the Orange River. The town should implement good water management practices and adequate water conservation measures, which should make the current supply adequate to 2032, after which other sources should be considered.

Strategic approach:

The approach will be to work with and to inform local authorities. Promote up-front liaison and agreement between DWAF and municipalities regarding proposed water resource developments as

mentioned in the WSDPs. Promote awareness at municipalities of the need to inform government of their water resource development plans and to consult with DWAF staff before making recommendations.

Encourage municipalities at any available forum, committee or other venues jointly attended by DWAF and local authorities to first pursue alternative augmentations options, such as improved management of water supply infrastructure, water demand management, groundwater abstraction, effluent re-use, water trading or the eradication of invasive alien plants in water stressed areas, before applying for additional surface water use. Further encourage municipalities to develop local schemes or to identify potential local schemes for augmentation. Where potential future supply cannot be identified in the WSDPs, further investigations must be identified and implemented by the local authorities. IDPs and WSDPs must become the documents that reflect the total municipal water strategies.

Address poor management through liaison and capacity building efforts. Plan and implement a programme to build capacity at district and local municipalities.

Aquifer management plans, inclusive of the monitoring of borehole levels, are essential for aquifers supplying the coastal towns, to avoid over-abstraction and saline intrusion. Such plans must be strictly adhered to.

Future planning should consider applicable social, environmental and economic impacts and costs, also at local authority planning level in the IDPs, WSDPs and water sector plans.

Management actions:

Water planning:

1. Urgently engage with municipalities that need augmentation now;
2. Clearly communicate to municipalities the need for Water Services Development Plans to:
    - More closely conform to the NWRS, ISP and catchment plans;
    - Highlight the current sources of supply and future anticipated sources of supply of the local authorities;
    - Refer to each other where applicable;
    - Address water demand management in sufficient detail and effluent re-use measures where appropriate;
3. Identify outstanding WSDPs and provide pressure to ensure that they are submitted. Review IDPs, WSDPs and water sector plans where necessary and propose feedback to the relevant municipalities to ensure that requirements are realistic;
4. Use the Regional Working Groups for WSDPs to ensure that WSDPs are in line with other planning documents;

Other actions:

5. Prepare to implement the anticipated recommendations of the Albany Coast Situation Assessment Study following its completion;
6. Implement recommendations of the Norwegian Agency for Development Cooperation (Norad) Groundwater Project (refer to the *Groundwater Strategy*, Strategy 5.2). Provide

available regional planning information and aquifer specific modelling information to local government as input to water planning. Engage the Water Research Commission (WRC0 to support the initiative;

7. Improve local water management by informing municipal employees at local and district level on what can and can't be done and inform them of their options;
8. Request D: WUE at DWAF head office and the regional Water Conservation division to prioritise assistance to municipalities regarding the development and implementation of WDM strategies, to overcome the technological barriers that many of the local municipalities in the area face;
9. Through co-operative governance, under the *Groundwater Strategy*, aim to improve monitoring of aquifers, especially the coastal aquifers, and have water management plans compiled.

Responsibility:

The RO must review the WSDPs and follow up with local authorities in cases where submissions are incomplete or have not been submitted. The RO must guide the local authorities with regard to development of local schemes, implementation of water demand management and implementing investigations where future sources of supply are uncertain.

Directorate Information Programmes and RO Sub-Directorate Hydrological information must investigate the need for coastal aquifer management plans and compile a strategy to deal with the situation.

Priority:

1 – Very high

Table 5.1 : Local authorities water supply situation assessment

Town/s	Water use	Assurance of water supply/reliability of the water source	Current supply source	Problems with current supply	Need to augment existing supply	Comment on WDM initiatives and success	Planned water schemes/studies
Aberdeen	0.281 Mm^3/a	Good	Borehole supply		Yes	- Implement a WC&DM strategy - Telemetry for water supply system is required	- Additional boreholes required; - Investigate and establish safe yield of boreholes/aquifer; - Refurbish and upgrade bulk water supply infrastructure
Addo	0.1 Mm^3/a from ORP Water Supplied (rural) = 0.396 Mm^3/a	Good	Orange River Project	Occasional pollution problems at Caesar's Dam near Addo, from informal settlement	No		No further schemes planned
Adelaide		Unacceptable	Koonap River off-channel storage: scheme was recently upgraded using El Nínõ funds	Suffered serious water shortages in dry years	Yes		- Proposed: Extension of Bedford Scheme; - Koonap River is a suitable source for further augmentation; - Additional storage needed in water supply system; - Possible supply from proposed Foxwood Dam; - Groundwater is an option to be investigated.
Alexandria	0.6 Mm^3/a	Adequate	Borehole supply - coastal dunes. Existing source (Fish Kraal) and conveyance adequate until 2007	Moderate growth in water use. Situation is not yet critical. Conveyance system needs to be upgraded	No		- Surface Water (SW) scheme not required; - Can be supplied with GW from additional sources at Cape Pardone, Fish Kraals and Apies River: Ecological sensitivity is an issue, EIA report prepared; - Conveyance system needs to be upgraded

Town/s	Water use	Assurance of water supply/reliability of the water source	Current supply source	Problems with current supply	Need to augment existing supply	Comment on WDM initiatives and success	Planned water schemes/studies
includes Shamwari Game Reserve	Water supplied (urban) = 0.178 Mm^3/a	Should meet water requirements to beyond 2020	Borehole supply and New Year's Dam		No	Unaccounted for water (UAW) is high, possibly leaking from the old KwaNonzwakazi Reservoir	The WTW needs refurbishment
Bathurst	0.30 Mm^3/a	Augmentation may be required	Mansfield, Sarel Hayward and Golden Ridge Dams, and the remainder from boreholes and rainwater tanks. Existing sources: Golden Ridge (a private dam) will be adequate until 2006	TDS of borehole water is high. It is not known if these boreholes have been abandoned. Moderate growth is expected. Portions of town rely on private sources - not reticulated	Yes		- Carry out Reserve determination study for Golden Ridge Dam. Supply from this source can continue; - Commence GW investigation to identify GW augmentation options
Bedford	Dam firm yield = 0.27 Mm^3/a Boreholes = 0.126 Mm^3/a Orange River Project = 0.48 Mm^3/a capacity Treatment works = 0.6 Mm^3/a		Orange River Project has been linked. Small dam and emergency boreholes for periods of drought		No		
Boknes, Cannon Rocks	0.24 Mm^3/a	Inadequate	Borehole supply. High growth in water use is expected	Poor quality water and failure of boreholes. Situation critical during peak. Concern regarding development of the Alexandria wellfield.	Yes		- Additional boreholes can be developed as required: sufficient GW resources at the Apies River mouth and Fish Kraal, but environmental constraints to be resolved with Sanparks; - SW resources not favourable.

Town/s	Water use	Assurance of water supply/reliability of the water source	Current supply source	Problems with current supply	Need to augment existing supply	Comment on WDM initiatives and success	Planned water schemes/studies
							- New conveyance system to be built. - Can be supplied with GW from additional sources at Cape Padrone, Fish Kraals and Apies River: Ecological sensitivity is an issue, EIA report prepared
Bontrug		Good	Orange River Project		No		
Cannonvale		Good	Orange River Project, supplied by NMMM		No		
Cookhouse	0.4 Mm^3/a from ORP	Adequate	Orange River Project		No		
Cradock	3.5 Mm^3/a from ORP Allocation of ORP water = 6.6 Mm^3/a	Adequate to 2012	Orange River Project		No		
Enon	0.1 Mm^3/a from ORP	Good	Orange River Project		No		No further schemes planned
Fish River Mouth		Good	Receives water from Bira		No		
Fort Beaufort	2.6 Mm^3/a allocation from Kat River	Yield of Kat River fully allocated	Kat River Dam	Shares dam with irrigators and Seymour. Water services scheme falling into disrepair.	No	WDM needs investigation	Groundwater Several possible dam sites investigated in Kat River Basin Study
Graaff-Reinet	Water use = 2.23 Mm^3/a Nqweba Dam allocation = 3.3 Mm^3/a Mimosadale wellfield yield = 0.3 Mm^3/a	Adequate to 2032 on condition that system is: - Well managed; - Well maintained; - WC&DM is implemented	Nqweba Dam, Mimosadale Wellfield	Salinity is a problem. Nqweba Dam was almost empty when bought in 2001, and has not filled much since then.	No	- Telemetry for water supply system required. - A WDM plan was devised and Graaff-Reinet was requested to	- A site-specific hydrological/hydro-geological study and undertaking of metering/monitoring is required; - Upgrading of WTW required.

Town/s	Water use	Assurance of water supply/reliability of the water source	Current supply source	Problems with current supply	Need to augment existing supply	Comment on WDM initiatives and success	Planned water schemes/studies
						implement, but they are slow in doing so.	- Construct booster pump station, rising main (Nqweba-Kroonvale) and water reticulation; - Upgrade Skuinsdak Reservoir; - Upgrade Tweededrif gravity mains pump station and rising main; - Replace Adendorp-Wolwas rising main; - Upgrade rising main from emergency wellfield to WTW.
Grahamstown	8.6 Mm^3/a	Adequate for foreseeable future	Orange River Project: Hermanuskraal Weir-tunnel-Glen Melville Dam. Water is also obtained from Howiesonspoort, Settlers, Jameson and Milner Dams. Supply setup is complex due to source and user level differences	Dense settlement problems e.g. night soil could potentially impact on groundwater quality	No	No structured meter maintenance in place. No leak detection surveys conducted.	Future sources when required: - Jan Kleynhans scheme; - Increased allocation from Glen Melville Dam; - Groundwater development.
Hofmeyr	0.09 Mm^3/a	Needs augmentation	Borehole supply	Boreholes unable to meet water demand	Yes		Expand the wellfield
Hogsback			Run-of-river and Plaatjies Dam		No		
Jansenville		Poor	Borehole supply	Poor water quality is a problem	Yes	- Investigate re-use of outfall water WC&DM - Plan prepared	- Additional boreholes can be developed to supplement southern field supply. - Upgrade water reticulation - Looking to possible abstraction from Darlington Dam (ORP water) in long term

Town/s	Water use	Assurance of water supply/reliability of the water source	Current supply source	Problems with current supply	Need to augment existing supply	Comment on WDM initiatives and success	Planned water schemes/studies
Kenton-on-Sea, Bushmans River Mouth	0.58 Mm^3/a	Desalination plant was commissioned as a result of peak holiday season demand	Borehole supply at dunes and Diaz Cross. Reverse osmosis seawater desalination plant. Supply adequate to 2005	High growth in water use is expected. Situation critical even during low demand. A problem with the position of the RO plant is being experienced.	Yes		- Produce EIA report and develop Kwaaihoek wellfield; - Upgrade supporting infrastructure for the existing RO plant: electrical, intake, disposal. EIA required for disposal of brine from desalination plant; - Develop GW sources at Merweville and Bushfontein together with conveyance system; - Further studies to confirm the anticipated yields of the GW sources are recommended, but implementation can commence; - Alternatively expansion of the reverse osmosis plant or supply from SW can be considered.
Kirkwood	Water supplied = 0.624 Mm^3/a	Good	Orange River Project		No		No further schemes planned
Kleinemonde	0.11 Mm^3/a	Good	Supplied from Port Alfred and Wellington Dam	High growth in water use expected. Situation not critical yet. Supply from Wellington Dam has poor water quality (TDS), up to 2 500 mg/l at times. Source has sufficient capacity until 2007.	Yes		Identify suitable GW resources for future augmentation

Town/s	Water use	Assurance of water supply/reliability of the water source	Current supply source	Problems with current supply	Need to augment existing supply	Comment on WDM initiatives and success	Planned water schemes/studies
Middelburg	0.75 Mm^3/a	Good if managed properly. Adequate to 2010	Borehole supply	Failure of boreholes due to poor management of system	No	Need to implement WC&DM urgently	Further borehole development
Middleton: Private Town			Orange River Project		Unknown		
Nieu Bethesda	0.01 Mm^3/a	Good	Borehole supply		Yes		- Additional boreholes required; - Augment bulk water supply and infrastructure as per current report. - Investigate and establish safe yield of boreholes/aquifer; - Construct pumping distribution water supply to commonage camps; - Water reticulation to 55 erven being installed at present
Paterson	Water supply (urban) = 0.120 Mm^3/a	Inadequate	Borehole supply	Inadequate yield	Yes		- Develop new boreholes. A successful borehole was drilled on a farmer's land without his permission. This issue must be resolved. - Possible use of ORP water from Addo WTW is a long-term option, but is expensive.
Pearston		Inadequate	Borehole supply	Inadequate yield	Yes		Groundwater development
Peddie	Dam, treatment works and pipeline have capacity of 0.11 Mm^3/a	Adequate for town	Supply from Keiskamma River		No		

Town/s	Water use	Assurance of water supply/reliability of the water source	Current supply source	Problems with current supply	Need to augment existing supply	Comment on WDM initiatives and success	Planned water schemes/studies
Port Alfred	1.73 Mm^3/a	Inadequate	Mansfield and Sarel Hayward Dams and boreholes in coastal dunes	Situation is critical during peak demand. Available sources are adequate until 2005. Water in Sarel Hayward Dam becomes saline. Current source: poor water quality (TDS) of 1700 mg/l. GW resources not sufficient to supply full future requirement, but can postpone development until 2011.	Yes		- Develop GW resources at Sunshine Coast and Glendour to postpone SW scheme; - Undertake further studies to determine best surface water scheme: Glen Melville, Settlers and Sarel Hayward; - Undertake further GW studies to firm up on GW development potential of the Witteberg
Riebeeck-East	0.0285 Mm^3/a	Good	Borehole supply		No	Current water loss less than 10% of water consumption	- Additional boreholes can be developed as required; - An additional 300 kl of storage capacity is required to ensure 72 hr storage; - Reservoir required to serve Kwanomzamo
Riet River Mouth					Unknown		
Rosmead railway station					Unknown		
Seymour	Treatment plant capacity = 0.22 Mm^3/a	Yield of Kat River fully allocated	Kat River Dam and boreholes	May be conflict with Fort Beaufort and requirements of irrigators. Water services scheme falling into disrepair	No	WDM needs investigation	

Town/s	Water use	Assurance of water supply/reliability of the water source	Current supply source	Problems with current supply	Need to augment existing supply	Comment on WDM initiatives and success	Planned water schemes/studies
Somerset East	0.8 Mm^3/a from ORP Capacity of water supply scheme = 1.5 Mm^3/a	Adequate to 2005	Orange River Project, three small dams, boreholes and springs	Adequate	No		Further Orange River water supply
Steynsburg	Water availability is 0.6 Mm^3/a	Inadequate in summer	Borehole supply	Inadequate in summer. Problems with borehole water quality and quantity. One borehole abandoned.	Yes		- Possibility to link to Orange River Project – approved in principle; - Part funding is available; - Proposed abstraction point is an existing airshaft in ORP tunnel
Tarkastad	0.1 Mm^3/a Yield supply is 83.61 l/s = 2.6 Mm^3/a	Good	Supply from 3 boreholes		No		Additional boreholes can be developed as required; No plans have been made to increase the supply
Uitkeer		Good	Orange River Project		No		

5.5 RECONCILIATION

Management objective:

The strategy provides a guideline on how best to balance water requirements with existing resources to obtain a sustainable, balanced water situation, through recommended intervention measures and development guidelines. Adequate volumes of water at an appropriate quality should be made available when required to meet requirements at an acceptable assurance of supply and cost, whilst limiting negative environmental and social impacts.

Situation assessment:

Available yield:

The available surface water yield of the ISP area (with current developed water infrastructure) is 160 million m^3/a, groundwater use is 24 million m^3/a and usable return flows (mainly from irrigation with Orange River water) amount to 110 million m^3/a, totaling 294 million m^3/a of "local" resources. The 1:50 year impact of the large amounts of Orange River water transferred in from the Upper Orange WMA to meet requirements for irrigation and local towns, urban needs of the NMMM and freshening releases, is 575 million m^3/a. Total available yield is 757 million m^3/a, taking river channel losses of 112 million m^3/a (all ascribed to transfer of Orange River water) into account.

Current water requirements:

Irrigation accounts for 629 million m^3/a, at 1:50 year assurance of supply, of the total local requirements of 668 million m^3/a. The total ISP area requirement is 759 million m^3/a. A calculation of the maximum possible Orange River water requirements of the ISP area indicates a quantity of 83 million m^3/a in excess of the allocation of 575 million m^3/a at 1:50 year assurance of supply. The annual transfer to the NMMM amounts to 11 million m^3/a. Freshening transfers from the Orange River is allowed to flush through the system to flow to the sea, together with any natural runoff, in order to ensure a reasonable quality of water for abstraction.

Current water balance:

Table 5.2 shows the reconciliation of water requirements and availability for the year 2000 at 1:50 year assurance, in million m^3/a.

The ISP area and sub-areas are in balance, with the shortfall in local yield being fully met by transferred Orange River water. Significant amounts of freshening flows are transferred for blending purposes to make poor quality water usable.

Table 5.2: Reconciliation of water requirements and availability for the year 2000 at 1:50 year assurance (million m³/a)

Sub-area	Available yield				Water requirements			Balance (1)
	Local yield	Transfers in (2)	River Losses (3)	Total	Local require-ments	Transfers out (2)	Total	
Fish	179	575	-94	**660**	467	193 (4)	660	**0**
Albany Coast	21	1	0	**22**	22	0	22	**0**
Sundays	94	123	-18	**199**	182	18 (4)	200	**-1**
Total for ISP area	**294**	**575**	**-112**	**757**	**671**	**88** (4)	**759**	**-2**

1) Surpluses are shown in the most upstream sub-area where they first become available.
2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. Addition of the transfers per sub-area therefore does not necessarily correspond to the total transfers into and out of the WMA.
3) The river losses resulting from evaporation and seepage for the transferred volumes have been included here. This was a best estimate from the ORRS modeling (16).
4) 70 Million m³/a flows to sea from the Fish River and 7 million m³/a from the Sundays River, while 11 million m³/a is transferred on from the Sundays sub-area to NMMM.

Current and future water demands:

Irrigation: There is a demand in the Fish River, Lower Sundays River and Kat River for further expansion of irrigation and for resource-poor farmers' irrigation development. Between Middleton and Hermanuskraal in the Fish River catchment some low quality water is still available for scheduling and applications have been received for such water use. This can be considered if irrigators accept the quality and if downstream impacts do not present a problem. An updated water balance is however needed before any decision can be reached.

A total of 4 000 ha (38 million m³) of identified future Orange River allocations have been reserved for new irrigation by resource-poor farmers in the ISP area. Of this, 180 ha have already been approved near Addo. If the proposed 860 ha of new irrigation (for Phases 3 and 4) at Tyhefu were developed, it would form part of the 4 000 ha new development. Other applications have also been received for new resource-poor farmers' schemes.

Rural use: Large dispersed communities in the ex-Ciskei region are in need of water (quaternary Q93C near Peddie). This would be allocated under water for Basic Human Needs, but should also include some additional water to allow for food gardening and other livelihood strategies.

Urban use: Limited growth is expected for local towns that use transferred Orange River water. The Algoa Pre-Feasibility Study recommended that the NMMM would not require significantly increased transfers before 2020. The NMMM can use 13.5 million m³/a from the Sundays River at the lower (Kouga) tariff, due to the exchange of water from the

Kouga system. Refer to the *Tsitsikamma to Coega ISP* for corresponding similar water use values of the NMMM.

Forestry: Applications have been received to establish small areas of new forestry in the Kat River catchment.

Future available Orange River water:

44 Million m^3/a remains in the Upper Orange WMA, after 12 000 ha has been allocated for resource-poor farmer irrigation development. This water is "reserved" for urban and industrial growth in the Orange River and Fish to Tsitsikamma WMA. Future water transfers of 38 million m^3/a (4 000 ha of the 12 000 ha) for resource-poor farmers in this ISP area have been reserved, as part of the current water balance. A further transfer of 28 million m^3/a from Gariep Dam, likely 26 million m^3/a for urban use by NMMM and 2 million m^3/a for small towns, has been used to determine the Upper Orange ISP's yield balance for 2025. Further transfers from the Orange River would likely require operational improvements or infrastructure development to increase the yield of the Orange River System.

Strategic approach:

Undertake an updated water balance of the area, with a focus on pin-pointing actual/current lawful requirements, before any decisions on future allocations are reached, apart from the reserved water for future Orange River transfers. The actual situation of scheduled vs. actual irrigation use needs to be established, especially for the Kat River catchment. Maximum possible use of Orange River water in the ISP area must be brought in line with the allocation for transfer from the Upper Orange WMA.

For supply to meet the forecast future requirements, the following reconciliation interventions appear to be favourable and are listed in order of current understanding of priority:

- **Further transfers from the Upper Orange WMA** will:
  - Meet the needs of new resource-poor farmers, up to 38 million m^3/a;
  - Partially meet growth in urban demands of towns in the ISP area as set out in the *Supply to Local Authorities Strategy*, Strategy 5.4, following the implementation of other measures such as water conservation and demand management, increased operational efficiency, sustainable development of groundwater or trading of water use authorisations;
  - Meet growth in urban and industrial use of the NMMM/Coega, through transfers via the Fish and Sundays River catchments, although further development in the Orange River may be needed (to be made available at the cost of augmentation) and if there are not higher priority competing uses;

- **Urban water demand management.** (Refer to the *Urban and industrial water conservation and demand management strategy, Strategy 8.1*). Water demand management is the most viable way to reduce the urban water demand, and must be vigorously pursued. The savings as a result of demand management are expected to be obtained by the reduction of site leaks, reservoir overflows, unmetered connections and behavioral change of consumers;

- **Agricultural water demand management. (**Refer to the *Agricultural water conservation and demand management strategy, Strategy 8.2*). Through conversion to higher value crops, more efficient irrigation methods and reduced distribution losses, water could become available for opportunistic or longer-term irrigation development or possibly for increased freshening releases;

- **Improved system operation.** (Refer to the *Orange-Fish-Sundays WSS management strategy, Strategy 12.1*). Implement an improved operational model, to reduce river losses, limit unused scheduled releases and spills, attain more effective freshening releases and test development scenarios;

- **Make full use of existing infrastructure.** Clarify the position of Kat River irrigators (allocated/unused water or illegal use of water) and rectify the situation to ensure that wastage does not occur;

- **Removal of invasive alien plants** holds potential especially in the coastal catchments, both for augmenting yield by clearing upstream of existing storage facilities or to make provision for the Reserve. A total of 4 million m^3/a could theoretically be released if complete eradication could be achieved. Working-for-Water projects should continue;

- **Water trading / buying out of irrigation rights.** The trading of existing licences can bring about a better use of available water without further impacting on the yield. By further trading of unused or under-utilised allocations more water could become available for use;

- Through registration and verification of lawful use, the extent of **unused allocations** will be determined. **Illegal users** will also be identified and such use put to an end, bringing water back into the system for use. (See the *Trading of water use allocations* and *Licensing strategies*);

- Ensure implementation of **sustainable management of stressed aquifers** such as the primary coastal aquifers and the fractured dolerite and Karoo aquifers (refer to the *Groundwater strategy, Strategy 5.2*);

- **New groundwater development.** (Refer to the *Groundwater strategy, Strategy 5.2*). Groundwater holds possibilities for development, in particular to augment the supply of towns;

- **New surface water schemes.** The proposed Foxwood Dam in the Koonap River will be costly. The proposed Baddaford off-channel dam in a Kat River tributary is being evaluated to supply a potential resource-poor farmer scheme. The potential Wapadsberg Scheme for Graaff-Reinet would be very costly and would likely be unaffordable for local consumers, even if additional Orange River water were available, which it is not.

The DWAF will not give consideration to licence applications for new schemes unless all other reconciliation options, such as water demand management and water re-use have been properly

explored and implemented, and if there are no options other than new development. Local development of groundwater schemes will be favoured over new surface water development, but financial viability will influence such decisions.

Off-channel storage is preferable to in-channel storage, particularly where river flow dynamics are important in sustaining the health of ecologically sensitive rivers and estuaries.

Consider all social, environmental and economic impacts and costs in the comparison and selection of future augmentation options.

Management actions:

1. Undertake an updated water balance;
2. Considered the dune fields in the Albany Coast area as an emergency supply option during peak requirement periods rather than as a primary or augmentation source of supply in the area. The Witteberg Quartzites are the appropriate source for regional aquifer development;
3. Actively promote the establishment of feasible and sustainable resource-poor farmer schemes, through the *Poverty eradication and land reform strategy, Strategy 11.1*;

Responsibility:

The D: NWRP is responsible for general planning pertaining to this strategy and D: Options Analysis is responsible for feasibility analyses of identified development or intervention options. They will be supported by the RO, D: RDM and the Environment and Recreation Sub-Directorate, Directorate Water Utilisation.

Priority:

1 – Very high.