5. SITUATION ASSESSMENT FOR THE UPPER KEI SUB- AREA

5.1 General Overview

5.1.1 Topography and Rivers

The Upper Kei sub-area comprises the upper portion of the Great Kei catchment down to the confluence of the Black and White Kei Rivers. It consists of the S10, S20, S31 and S32 quaternary catchments. The main rivers are :

- The White Kei River (S10)
- The Indwe River (S20)
- The Klaas Smits and Heuningklip Rivers (S31)
- The Black Kei and Klipplaat Rivers (S32)

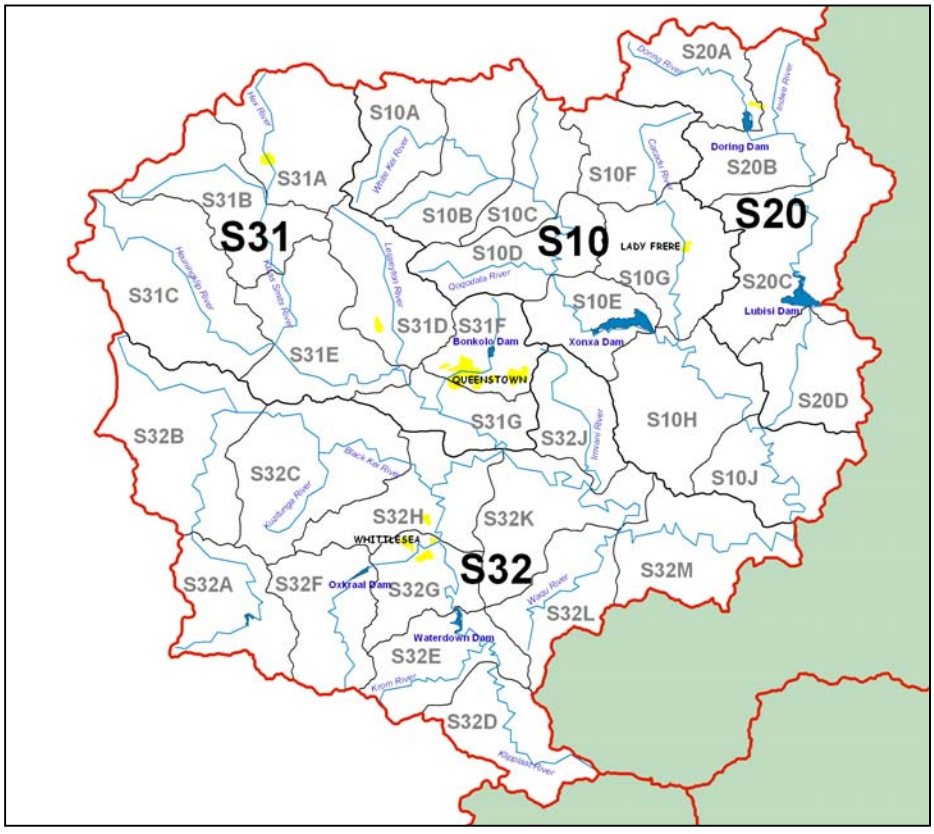

Figure 5.1 The Upper Kei Sub-area

The Upper Kei catchment is approximately 11 500 km^2 in extent. This is 55,8% of the total Great Kei catchment area of 20 699 km^2. The area falls within the inland plateau topographical zone and occupies a broad undulating plateau with river valleys. The catchment area, which is almost circular in shape is contained by the Amatola mountain range in the south, the Winterberg in the east and the Stormberg in the north with the outlet of the catchment in the southeast. The altitude of the plateau lies between 1100 and 1400 masl with the surrounding mountains varying from 1900 masl in the south to 2100 masl in the north.

5.1.2 Climate and Rainfall

The climate in the catchment is very harsh, varying from hot and dry in the summer months (> 40^0 C) to very cold in the winter months (-10^0 C minima). Widespread frost and snowfalls on the high lying ground are experienced in winter.

There is a high temporal and spatial variation in rainfall over the catchment. The Mean Annual Precipitation (MAP) varies from approximately 400 mm in the west of the catchment to 900 mm in the east to a maximum of 1200 mm in the Amatola mountains in the south. Rain falls predominantly in the summer months (70% - 80%), generally in the form of high intensity thunderstorms often accompanied by hail. Variability of rainfall from season to season is high with frequent dry spells and droughts occurring. Mean Annual Evaporation (MAE) rates vary from 2000mm in the west to 1700mm in the east and 1400mm in the south.

5.1.3 Geology, Soils and Vegetation

The area is underlain by horizontal to very gently dipping rocks of the Karoo Supergroup (shale, mudstones and sandstones) with dolerite intrusions often in the form of ring structures. Soils are poorly developed, being shallow and rocky and mostly not suitable for crop production. In general shallow residual soils and rock occur on hilltops with talus on the slopes and slightly deeper residual soils in the valleys.

The plateau area is predominantly covered by grassveld and savanna with varying degrees of invasion by Acacia Karoo (thornveld). Valley thicket is located in the lower reaches of the Black Kei River valley. There are no significant indigenous forests in the catchment with only some 800ha of commercial forestry in the headwaters of the Klipplaat River. Although there are some invasive alien plants (black and silver wattle) mainly around the Queenstown area, these are not yet a significant problem.

5.1.4 Land Use and Settlement Patterns

Land use patterns have been influenced by the fact that the sub-area was until 1994 divided into the former Ciskei and Transkei as well as South Africa. The area is characterised by dispersed rural village settlements (although often urban and dense in nature) and communal subsistence farming and grazing in the former Ciskei and Transkei areas. The former RSA component of the area (mainly in the S31 and S32D, E, L catchments) comprises largely privately owned commercial stock and game farms. Queenstown within the Lukhanji Municipality is the main town reflecting the only large urban node where most services and higher order infrastructure are to be found.

Natural pasture covers over 93% of the sub-area with communal and private stock farming being the main activity.

It is estimated that some 17 000ha of land in the sub-area is irrigated of which only 8 600 ha have assured water supplies from dams as part of formal irrigation schemes. The remaining irrigated areas rely on run-of-river schemes or opportunistic irrigation mainly in the upper Klipplaat, Heuningklip and Klaas Smits catchments. The largest scheduled irrigation schemes include the Klipplaat Government Water Scheme (1905ha) from Waterdown Dam, Oxkraal (541 ha) from Oxkraal Dam, Nthabethemba

(1200 ha) from five small dams, Xonxa (1643 ha) from Xonxa Dam and Qamata (3050ha) from Lubisi Dam. Most of these schemes are located in the former Ciskei and Transkei and have either not been developed or have been developed but are now either defunct or only partially used. The actual irrigation areas and water use is thus substantially less than the scheduled irrigation areas mentioned above. Rehabilitation of some of the schemes and establishment of Water User Associations are in various stages of implementation, which is proving to be a slow process.

Other smaller irrigation schemes include the Doornrivier scheme with its raw water source from the Doringrivier Dam near Indwe and the Zweledinga scheme in the upper Oxkraal River with water from the Bushmanskrantz Dam.

The predominant irrigation practice in the S31 catchment is “opportunistic”, occurring on a large scale when water is available in the Klaas Smits and Heuningklip Rivers. Groundwater normally extracted from “wellpoints” alongside the rivers is also used for irrigation in this catchment. There is also irrigation development along the upper Klipplaat River, which relies on run-of-river flow.

Severe erosion has occurred in the upper reaches of the White Kei and its tributaries, and in the Upper Black Kei (Hewu and Nthabathemba Districts) due to settlement patterns and poor land use practices resulting in degradation of the land. This has resulted in an increase in the turbidity of the rivers and sedimentation of dams.

5.1.5 Demography

The residential pattern in the former Ciskei and Transkei areas is mainly rural with many large rural villages (populations often greater than 10,000 people). Although the so-called rural population comprises over 70% of the population, most of these people reside in what are essentially urbanised villages. A characteristic of these areas is the density of population of approximately 55 persons per km^2 compared to approximately 4 persons per km^2 in the former South African component of the sub-area.

The main urban centre is Queenstown with a population approaching some 80,000 in the year 2000. The second largest urban area is Sada/Whittlesea in the former Ciskei. Other small formal towns include Sterkstroom, Indwe and Lady Frere. The total population of the sub-area was estimated based on 1995 data (**Ref. 24**) and Census 2001 data (**Ref. 6**) at approximately 408,000 people in the year 2000. This population is not expected to increase substantially in the future due mainly to the lack of employment opportunities and the resultant outward migration of people from the sub-area.

Table 5.1 Population Estimates of the Upper Kei Sub-area (Year 2000)

Quaternary Catchment	Population
S10	140,000
S20	75,000
S31	64,000
S32	129,000
Totals	**408,000**

It should be noted that more recent data (**Ref. 7**) indicate that there is likely to be a slight decline in overall population numbers in the area from the year 2005 to the year 2015 due to many factors including the effect of HIV/AIDS, outward migration etc.

5.1.6 Economic Development

The former Ciskei and Transkei areas have minimal commercial development and the population in these areas generally rely on income from migrant workers and state social grant benefits. Unemployment rates in these areas exceed 60%. The only industrial complex is located at Ezibeleni outside Queenstown, which was established as a border industrial area for the former Transkei. Since 1994 many of the industries have moved away and there has been a general decline in economic opportunities in the area.

The Chris Hani WSDP (**Ref. 7**) gives GGP figures for sectoral contribution for the whole Chris Hani District, but which would be very similar for this sub-area. These figures show that the Community Service sector is by far the largest contributor at 49%, followed by Trade at 15%. Agriculture, Finance and Manufacturing contribute approximately only 7 – 9% each.

“With agriculture being regarded as the only sector within the district economy with the potential for future development, the small contribution of 8,97% to the district GGP is evidence of the current under performance of this sector” (**Ref. 7**). The CHDM have prioritised agriculture and irrigation development, which is important when considering DWAF support to irrigation schemes and poverty alleviation programmes.

There are a number of private and public game farms and nature reserves in the catchment covering an area of approximately 34,000 ha.

There is very little significant mining activity in the area other than quarry mining for construction aggregate. Whilst coal deposits do occur fairly widely in the catchment, the only marginally viable deposit is located near Indwe. Although coal is not commercially mined at present there has been renewed interest and limited mining activity may recommence in the future.

Small but important wetlands occurring in the upper Klipplaat, Oxkraal and White Kei catchments give rise to the sources of these rivers.

5.2 Water Resources Overview

5.2.1 Surface Water

(a) Raw Water Resources and Supply Systems

A considerable amount of bulk raw water supply infrastructure (dams, pipelines and canals) has been developed in the sub-area, aimed at meeting urban needs and to supply water for irrigation especially in the former Ciskei and Transkei. All the main rivers are regulated by dams.

Table 5.2 Main Rivers and Dams in the Upper Kei Sub-area

Catchments	Rivers	Main Dams	Owner
S10	White Kei Cacadu	Xonxa Macubeni	DWAF DWAF
S20	Indwe	Doring River Lubisi	DWAF DWAF
S31	Heuningklip Klaas Smits Lesseyton Bonkolo	- - - Bongolo	- - - Lukhanji LM
S32A - C	Black Kei	Glenbrock Mitford Tentergate Limietskloof Thrift	DWAF DWAF DWAF DWAF DWAF
S32D - H	Klipplaat Oxkraal	Waterdown Bushmanskrantz Oxkraal Shiloh	DWAF DWAF DWAF DWAF

Due to the high sedimentation rates in the sub-area, the original yields of the dams may be substantially reduced. Furthermore, accurate flow gauging data is not available for many of the rivers in the former Ciskei and Transkei, resulting in hydrological calculations with a low degree of confidence.

The total surface water resource available from the Upper Kei catchment before specific allocations for the ecological Reserve or afforestation is estimated at 151 million m^3/a. Groundwater availability is estimated at 12 million m^3/a. Return flows from this catchment are estimated at 10 million m^3/a. The impact of the ecological Reserve based on a desktop analysis undertaken as part of the NWRS is estimated at 16 million m^3/a. Return flows from Queenstown are used extensively by irrigators in the Lower Klaas Smits River area. There is a reasonable amount of groundwater use especially in the Hewu District in the Black Kei catchment. The groundwater resource availability is discussed in **Section 5.2.2**.

Table 5.3 Available Water in the Upper Kei Sub-area (Year 2000)

Type of Water Resource	Amount (million m^3/a)
Total surface water resource yield	151
Subtract:	
- Ecological Reserve	10
- Invasive alien plants	4
Net surface water yield available for use	137
Available groundwater resource	12
Usable return flows	10
Total Local Yield	**159**

Due to the important role that Queenstown plays in the sub-area, it is imperative that sufficient raw water is always available to meet the town's requirements. Bulk raw water supply for Queenstown is currently supplied from the small Bongolo Dam just outside the town and from Waterdown Dam some 40 km away on the Klipplaat River. A number of studies have been undertaken to investigate possible future raw water supplies for the town (**Ref. 19 and 20**). These studies indicated that additional raw water would be required by the year 2000, but were based on the assumption that the full water allocation for irrigation was being used, which is not presently the case. Water restrictions were introduced in December 2003 in Queenstown due mainly to the fact that the main supply pipeline from Waterdown Dam could not deliver the peak water requirements and that there was very little water available from the Bongola Dam.

(b) Water Supply Infrastructure

The Klipplaat River Government Water Supply Scheme serves Queenstown and the Sada/Whittlesea complex, and irrigation along the Klipplaat River downstream of the Waterdown Dam to the confluence with the White Kei River. Water is supplied from Waterdown Dam to Queenstown through 46 km of pipeline(s). A booster pumpstation some 16 km from Queenstown increases the flow in the pipeline. An off-take supplies Sada. The capacity of this scheme to augment supplies to Queenstown is limited. Queenstown is also served by the small Bongolo Dam.

Cacadu RWSS is the largest regional rural surface water supply scheme. The scheme obtains water from the Macubeni Dam and supplies approximately 70,000 people living in Lady Frere and surrounding villages. Expansion of this RWSS and possible sedimentation of Macubeni Dam has placed a question mark over the assurance of supply for this scheme. The town of Indwe is supplied from the Doring River Dam.

Other domestic water supply schemes are based mainly on groundwater schemes. The largest of these include borehole supplies to Sterkstroom, Ilinge and the Hewu groundwater scheme. Under the DWAF BoTT programme numerous small village water supply schemes have been installed based largely on groundwater.

(c) Institutional Arrangements

The majority of bulk water infrastructure in this sub-area has been developed, and operated and maintained by DWAF. The process of transferring assets and the responsibility for operation and maintenance to the Chris Hani District Municipality (CHDM) was initiated in July 2003 and is scheduled to be complete by June 2005. As with other sub-areas in this ISP area, the lack of financial and skilled manpower resources will be a major constraint on successfully achieving this goal.

5.2.2 Groundwater

There is believed to be a considerable amount of good quality groundwater available for use in the catchment with estimates ranging up to 200 million m^3/a, which is far in excess of current demand. Based on technology used to date, this groundwater has usually only been found in small quantities with low yielding boreholes. It has been estimated that under good conditions up to 40 successful boreholes spread over an area of about 50 km^2 are required for a supply of 1 million m^3/a. Groundwater has therefore been difficult to exploit in any meaningful quantities for large schemes but has normally been considered for small individual village schemes. Due to the lack of adequate groundwater monitoring, the groundwater resources have often been over exploited with resultant failure and loss of confidence in this type of water supply. In addition, the quality of groundwater has sometimes been impacted due to polluted run-off.

New siting methods for boreholes based on satellite imagery and specialist geological knowledge of the characteristic dolerite ring structures in the sub-area are showing promise, with experimental boreholes delivering up to 30 l/s. Notwithstanding the surplus of surface water resources in this sub-area, DWAF support for the development of this groundwater resource especially for small village water supply schemes will continue.

5.2.3 Current Water Requirements

By far the largest water allocation within this area is for irrigation, making up over 80% of the total requirement. The water resources are mostly not being fully utilised due to the state of disrepair of irrigation schemes in the former Ciskei and Transkei areas. Within the former South African areas irrigation is mainly opportunistic based on run-of-river flows or alluvial groundwater.

The main urban use of water is for the Queenstown and Sada/Whittlesea areas with a number of regional rural water supply schemes throughout the sub-area supplying basic levels of service.

Table 5.4 Local Water Requirements* in the Upper Kei Sub-area (Year 2000)

Sector	Amount (million m^3/a)
Irrigation	69
Urban**	10
Rural***	5
Afforestation	0
Total Local Requirement	**84**

*At a 1 in 50 year assurance.

**Industrial demand has been included in the urban demand.

*** Stockwatering has been included in the rural water requirements.

Existing water allocations have been used as the water use in most of the irrigation schemes in this sub-area is not well known due to the lack of information on areas under production. Actual water use is currently much less.

While irrigation is the largest user based on allocations from existing dams, the actual use of water for this purpose is only a fraction of the allocation. Water allocations from dams are mainly for irrigation in the sub-area and only the Waterdown Dam has a significant allocation for domestic use. While the dams are in place to supply irrigation water in the former Ciskei and Transkei areas, much of the downstream infrastructure has fallen into a state of disrepair. As this sector has been identified as the top priority for growth in the area by the CHDM, efforts are already underway to rehabilitate the former schemes and make use of these valuable water resources. DWAF and the Provincial Department of Agriculture (PDoA) can play a major role in assisting the DM to undertake this expensive task and ensure that development is based on sustainable practices. Assistance will also be required from DWAF in establishing WUAs as most of the schemes will be communally based.

5.2.4 Yield Balance

The water balance in the year 2000 for the Upper Kei catchment sub-area is as follows:

Table 5.5 Reconciliation of the Upper Kei Sub-area in Year 2000

Description	Amount (million m^3/a)
Local yield	159
Transfer in	0
Total yield	159
Local requirement	84
Transfer out	0
Total requirement	84
Water Balance	**75**

This large surplus is located mainly in the former Transkei area below the Xonxa and Lubisi Dams. Within the Black Kei catchment, local catchment deficits are experienced in the Klipplaat and Klaas Smits catchments due to run-of-river abstractions and an over-allocation of available water from the Waterdown Dam.

The present allocation for urban use from Waterdown Dam for Queenstown and Sada/Whittlesea is 8,25 and 4,2 million m^3/a respectively with a further allocation of 14,8 million m^3/a for irrigation. The actual yield of the dam (17,5 million m^3/a) is less than these allocations. Due to the fact that some of the allocation for irrigation is not currently used, no major water shortages have been experienced. This may change as the irrigation rights are taken up or alternatively converted to domestic allocations. Proposals for further studies into the future raw water supply scenario to the Lukhanji Municipality (Queenstown) are presently being addressed by DWAF and the CHDM. These studies will obtain more up to date information with respect to actual and future water supply requirements and use from Waterdown, Shiloh and Oxkraal Dams and other available raw water resources in the region such as Xonxa Dam. The studies will also investigate the optimal operation of the dams in the Oxkraal – Klipplaat system in order to maximise the available yield. The studies should also address the question of water conservation and demand management in Queenstown where it is estimated that unaccounted for water is anything between 10 and 30% (**Ref. 7**).

5.2.5 Future Water Requirements

Based on the above, there is a large amount of water available in the sub-area as a whole for further development. It is noted (**Ref. 7**) that "*an accurate assessment on the extent of the surplus water resources can only be made once the uncertainty regarding actual water use patterns and allocations is resolved*". The water sector plans and WSDP prepared for the area do not contain accurate or detailed information on this aspect. Other than water use for revitalised and expanded irrigation schemes, future growth in water use is mainly expected in the Queenstown and Sada/Whittlesea complex. Addressing this very important issue is further developed in Strategy No. 1.4.

5.2.6 Water Quality

(a) Surface Water Quality

Water quality of the rivers is generally suitable for domestic and agricultural use (**Ref. 19**). No major problems with respect to the water quality aspects of the rivers in the area have been detected although the number of monitoring points in the sub-area is small. No monitoring occurs downstream of Queenstown which is the largest potential source of pollution.

Large water supply schemes to Queenstown and Sada in turn generate waste water effluent. The adequacy of treatment and return flow to the rivers is controlled by the local authorities and no ongoing problems have been reported. Treated waste water from Queenstown is used to irrigate pasture lands in the lower Klaas Smits River.

Rehabilitation of irrigation projects and the use of fertilizers and poisons may result in the pollution of rivers and groundwater sources. RQOs should be considered for the rivers and a water quality monitoring programme instituted in the near future.

In general, due to the expansion of water supply to the rural areas it can be expected that the quality of the rivers and groundwater may deteriorate without the implementation of appropriate sanitation to these areas. Recent outbreaks of cholera in the nearby Engcobo area highlight the importance of providing safe drinking water and adequate sanitation. DWAF have recognised the importance of the latter and have embarked on a widespread sanitation implementation programme in the rural areas.

Leachate from unlicensed solid waste sites may be a cause of pollution of water resources. While the main towns have recently embarked on upgrading and licensing of their solid waste sites, unlicensed sites especially in the rural areas should be identified and corrective measures taken to prevent pollution.

A comprehensive soil conservation programme should also be implemented by the PDoA to reduce the loss of topsoil and the amount of sediment reaching the rivers and dams. The situation is particularly serious in parts of the former Ciskei and Transkei.

(b) Groundwater Quality

Groundwater quality in the area is generally good as is evidenced by its wide scale use. Refer to the above section on sanitation and groundwater pollution for additional comments.

5.3 Key Issues

Based on a detailed situation assessment of the Upper Kei catchment sub-area, the following key issues have been identified.

5.3.1 Water Balance and Reconciliation

Issue : Future water supply to Queenstown and Sada/Whittlesea. Refer Strategy No. 1.4.

5.3.2 Water Resources Protection

Issue : Water quality monitoring of surface and groundwater resources is insufficient.

Issue : Soil erosion due to poor land use management practices is leading to an increase in the turbidity of the rivers and high dam sedimentation rates.

5.3.3 Water Use Management

Issue : Large water resource developments (dams and canals) for irrigation purposes are in place but most of the available/allocated water is not used. The economic development of this region is linked to utilisation of this water and the development of agriculture.

5.3.4 Water Conservation and Demand Management

Issue : No WCDM programmes are in place in the sub-area either for urban or irrigation use. These are required especially in Queenstown and Sada/Whittlesea.

5.3.5 Institutional Development and Support

Issue : Rehabilitation of former irrigation schemes in the Ciskei and Transkei areas is very slow and requires assistance from DWAF. This assistance also includes help with the establishment of WUAs.