Regional water supply to ensure basic services in rural areas of South Africa – what is required, what works, what are the challenges?

Type: Short Paper (up to 2,000 words)

Author *Monja Esterhuizen, Development Planner, UWP Consulting (Pty) Ltd. monjae@uwp.co.za.*
Tel: +27 (0) 12 424 9709

Abstract/Summary

Access to basic (at least 200m from homestead) water supply is still a challenge in rural and developing areas of South Africa. A study was commissioned to investigate the backlog in supplying water to all areas of the KwaZulu-Natal Province. The study aimed to determine the current levels of water services, the consumers' current (2015) and future (2035) water requirements (based on demographics, growth and progressively higher service levels) and how both could be met if not provided for already according to national standards. Available water sources and other factors were taken into account to determine conceptual (potential) supply areas. Spatial and geographic analysis played an important role in the visualisation of supply areas, the conceptual planning of water supply infrastructure, in determining inputs for high level costing, and for estimating a timeframe for programme implementation. The results of the study are proposed water supply scheme areas that ensure access to basic supply to all consumers. The potential costs and timeframes for implementation are presented to assist the responsible authority in financial planning and phasing of projects.

Introduction

South Africa has made tremendous strides in ensuring access to basic water, sanitation, and electricity services to all its citizens--currently estimated as 54 million people living in 15 million households. There remains, however, a small portion of the population, less than 10%, that require access to safe, reliable and adequate water supply – defined as the backlog. Households falling in the backlog category reside in rural areas, in dispersed villages and households. Road access to these areas is difficult and the topography poses an even greater challenge in planning and construction of affordable and appropriate services. Furthermore, the situation is exacerbated due to the limited and accessible water resources available in South Africa and the low economic status of unserved areas.

This paper aims to assist in conceptualising planning approaches to ensure water supply to communities and households in deep rural areas, considering 1) information required comparted to what is currently available, 2) the methodology to determine water requirements and 3) developing scheme areas suitable for these consumers.

Context

The study area (**Figure 1**) comprises of the uThukela District Municipality (UDM) in the KwaZulu-Natal (KZN) Province of South Africa. The municipality is designated as a Water Services Authority (WSA) and therefore responsible for water and sanitation services for its area of jurisdiction. From the 2011 Census the UDM had a total population of 668 847 people and 147 217 households. It covers an area of 11 326km² (similar to Abidjan and Tiassele combined) and is divided administratively into five Local Municipalities (LM) namely Emnambithi/Ladysmith, Imbabazane, Indaka; Okhahlamba and Umtshezi.

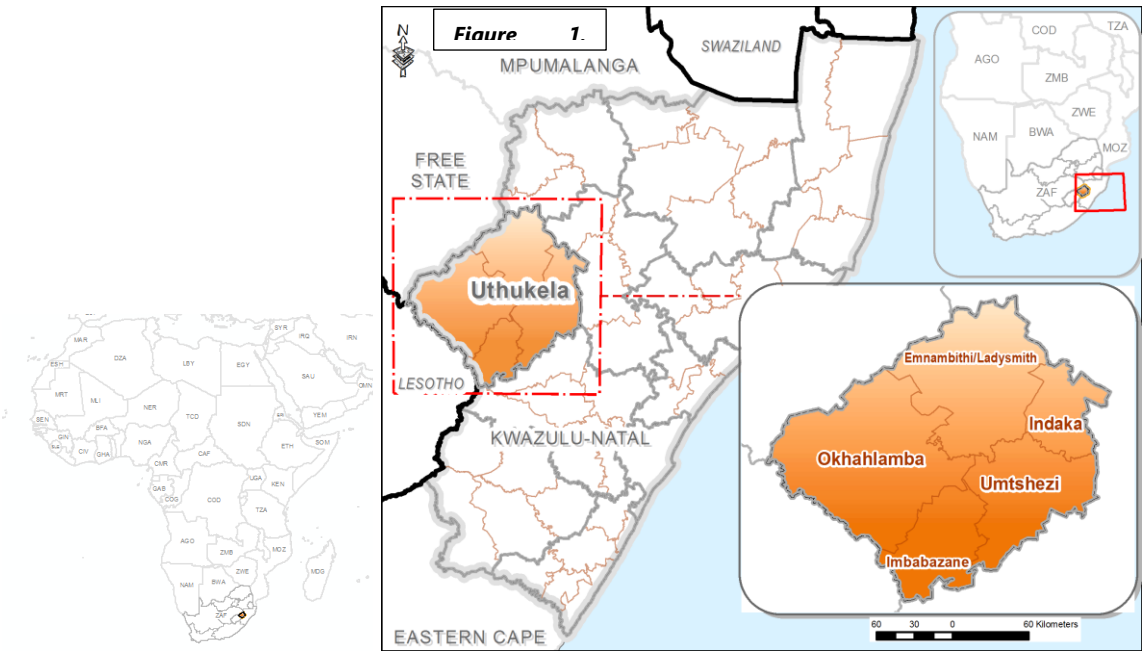

Figure 1: Study Area

The UDM is 38% urbanised (people living in urban and peri-urban areas), with the remainder of households living in traditional, tribal or farm areas. There are three larger well-developed urban nodes (total households 54 621) where the predominant economic activities are industrial, business services and manufacturing. The smaller towns and rural areas rely on agriculture (commercial and communal), mining and tourism as main economic contributors. Only the households in urban areas are billed for municipal services, of which the rate of payment is only 55% (reducing the potential income for re-investment by the District in municipal infrastructure).

Water resources consist of the Thukela River with its major tributaries: Little Thukela, Klip, Sundays and Bushmans Rivers. The main dams applicable to the UDM are the Woodstock Dam, Spioenkop Dam, Wagendrift Dam and the Driel Dam. Rivers drain towards the east coast of the KZN Province and discharge into the Indian Ocean.

According to the Uthukela Water Management Area Internal Strategic Perspective, surplus water is available downstream of the Driel Dam – at the Spioenkop Dam and downstream thereof, from the Thukela River. Surplus water is also available from the sub-catchment of the Bushmans River. The Little Thukela and Sundays sub-catchments however are already stressed in terms of water allocations. In the case of the Little Thukela, only water for basic human needs can still be allocated for abstraction (DWAF, 2004).

Most water supply schemes utilise surface water as source, but there are also many consumers in rural areas reliant on groundwater sources as well as springs. Groundwater quality in the northern parts of the UDM is affected by the coal mining activities and coal deposits found in those areas.

The 2011 Census indicated that there were 46 668 households (31.8%) from a total of 146 621 households in the UDM having water services below basic[1] levels. Most of these households (12 439) reside in the Okhahlamba LM – a predominantly rural area.

The 2020 water requirements per LM are presented in **Figure 2**. Water requirements were calculated

[1] Basic levels of water supply service, as defined in the White Paper for Water Supply and Sanitation Policy (Department of Water Affairs and Forestry, 1994) are Distance: Water supply within 200 meters walking distance; Quantity: 25 litres per capita per day; Quality: Water of acceptable quality; Availability: Water available 98% of the time and Flow/Assurance: Sustainable flow of 10 litres per minute.

based on existing service levels and projected, progressively higher levels of service and considering population growth.

The Emnambithi / Ladysmith LM has the largest water requirements, requiring 46.1% (22.794 million m³/a) of all water due to urban and industrial development.

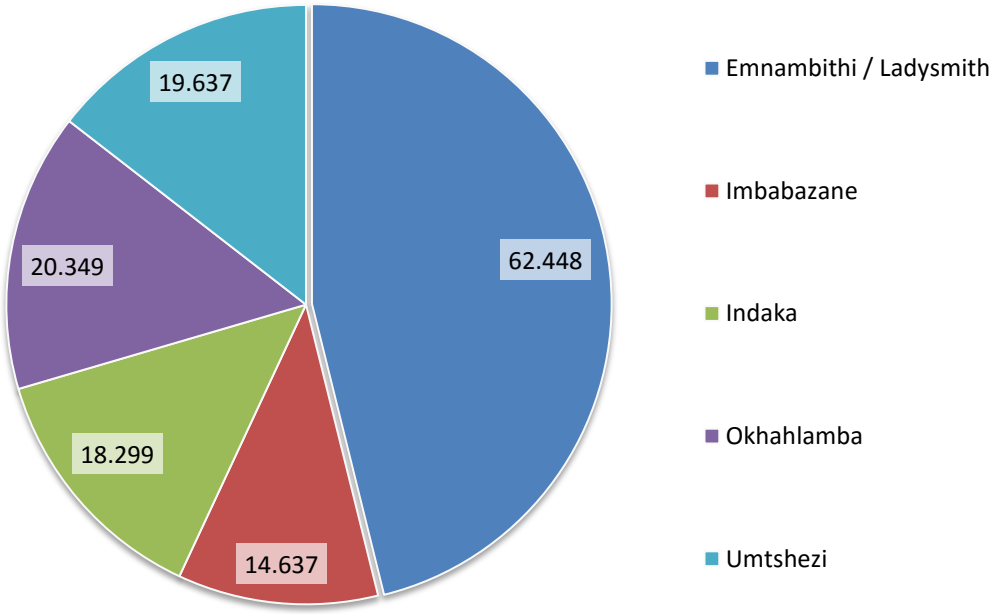

Figure 2. UDM 2020 Water Requirements (Ml/d)

Aims

The aim of this study was to inform decision-makers on the current situation of water services and the required potential infrastructure and associated costs to address the backlog and to provide for water supply up to 2035. It included conceptualising new water supply schemes or propose upgrading or augmentation of existing water supply infrastructure.
Consideration was given to existing schemes, projects that are being implemented, available water resources, the institutional arrangements of the UDM and financial resources.

Activities Undertaken

The first step (Status Quo) was to collect information on the **current water supply services infrastructure** (bulk and reticulation; supply areas) and confirm **water service levels** (ranging from house connections, yard connections, community stand pipes, to no formal service) and water sources in the UDM. The Department of Water and Sanitation (DWS) has an existing geodatabase with information on settlement areas and water supply infrastructure. Where possible, this information was updated from as-built drawings and input from municipal officials so that a Geographic Information System (**GIS**) could be utilised for spatial planning and mapping of the study area. Very little information was available in the form of as-builts of pre-2015 constructed infrastructure – whether as electronic or paper drawings – that could be verified against already-captured features in the GIS (this was mostly due to changes in institutional arrangements and relocation of electronic and paper media, getting lost in the process).

Parallel to the Status Quo investigation, a **water requirements model** was developed utilising 2011 Census population and supporting information (e.g., service levels, income, urban / rural character). Population growth rates were established and following an approach to provide progressively higher levels of service, the water requirements for 2011, 2015, 2020, 2025, 2030 and 2035 were calculated. Provision was made for acceptable water losses, water conservation and water demand management

(WC/WDM), current water consumption and settlement character (well-developed urban node versus rural settlement).

Various local and regional study reports were consulted to gain an understanding of the current and potential **water sources** available – for allocation for domestic consumption. A large component of existing water sources (114 million m^3/a) utilised in the UDM – falling in the Upper Thukela Water Catchment, is for irrigation (87 million m^3/a) with urban use in the main centres being an estimated 17 million m^3/a. The other water catchments applicable to the UDM are the Little Thukela, Bushmans and Sundays River areas.
Groundwater is utilised in many of the rural settlements for water supply, but since almost no metering takes place, the quantities supplied is very difficult to determine. This summer's (2015/2016) drought resulted in a number of boreholes running dry, compelling the UDM to drill and develop additional boreholes or to provide water in the form of water tankers (the latter being a very expensive option).

Analysing the information, proposed supply areas were developed for consumers not yet supplied with basic services, taking into consideration the existing water supply infrastructure, available water sources, water requirements and further factors such as topography, township layout and institutional arrangements for water supply. These proposed supply areas were developed for settlements and not for individual farmsteads and their farmworkers as the farm owner is responsible for services (i.e. self-supply). The proposed supply areas were ring-fenced and initial sketches were made to represent the potential proposed infrastructure components (bulk pipes and components and reticulation pipes). The GIS was also used to estimate the number of community stand pipes to provide for and ensure they are within 200m of households.

Using the information captured in the GIS and cost parameters provided based on constructed infrastructure, preliminary costs were calculated for the proposed scheme areas. The costs included professional fees, costs for surveys, environmental investigations and stakeholder engagements.

The result was a report documenting how to reach universal coverage of all towns and settlements' water supply to fulfil current and future water requirements, taking available water sources, water service levels and costing into account.

Main results and challenges

The UDM was demarcated into 34 water supply schemes (WSS) of which 21 were existing supply areas. Therefore, there were 13 future WSS areas proposed to ensure universal access of at least basic water supply to all (**Figure 3**).

The costs (all inclusive of construction, environmental, studies and fees) for implementation of the proposed schemes ranged from R28 162 (USD 1 976) per household, up to R256 316 (USD 17 987) per household and totalling R2 052 million (USD 144 million) for the UDM. The two largest future scheme areas would cost R564.2 million (USD 39.6 million) and R985.3 million (USD 69.1 million) respectively. These costs however are indicative as standard cost parameters were applied for non-capital expenditure (site investigations, community consultations, contingencies) and further refinement will be beneficial. The estimated costs however provide a very good indication of the financial investment requirements for the District.

The spatial distribution of households (generally a low population density of 568 persons / km^2 or 139 households / km^2), access to existing services and water sources, affordability (for the UDM and consumer) all play a role in water services planning, especially ensuring access to water supply for the poor.

The main challenges encountered during the study were:

- Having access to accurate, up-to-date information with coverage of the full study area:
  - Demographic information for all populated areas;

- spatial information to represent water supply infrastructure;
- metered water supply to calibrate (and validate) water use volumes (and current and projected water requirements);
- confirmation of existing and planned water service levels;
- establishment of population growth rates; and
- access to planning documents or water supply planning conducted on behalf of the UDM, by other appointed consultants. (Very little information could be obtained from the UDM itself, except for the confirmation of water service levels and estimates of volumes of water supplied, from scheme operators and managers).

- Agreeing on parameters for the water requirements model (water consumption categories or indicators – litres per capita per day – per water use type or settlement type; rate of service level upgrades); and
- To what level of detail planning should be conducted for this study (it was not a detailed feasibility-level study where in-depth investigations were conducted to compare options between water sources and infrastructure sizing and capacities).

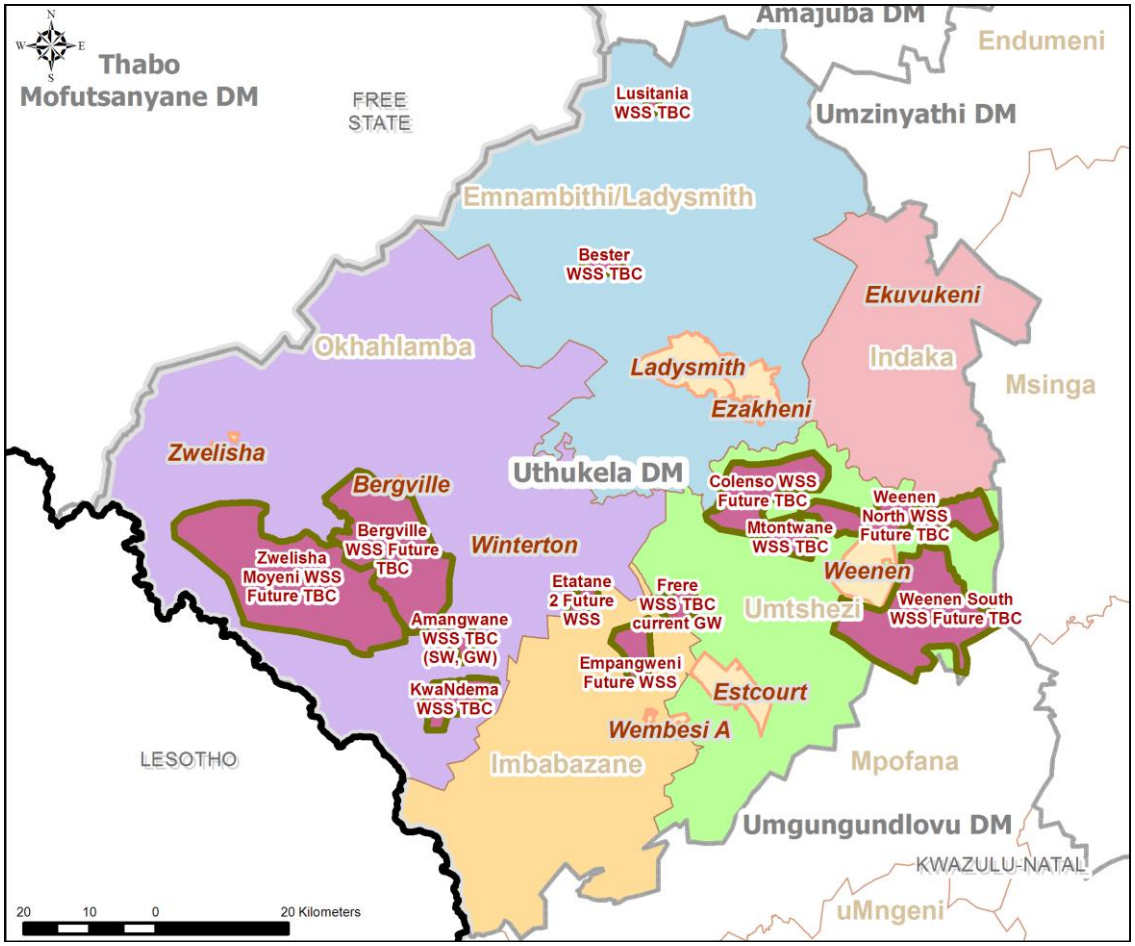

Figure 3. Proposed Water Supply Scheme Areas

Conclusions and Recommendations

There are thirteen areas in a water supply deficit or not having access to at least basic RDP standards of water supply and no existing project to fund new infrastructure. The water supply areas requiring development of regional bulk (>2Ml/d) services are:

- Bergville WSS Future (proposed supply area);
- Ekuvukeni Lime Hill WSS (existing supply area); and
- Zwelisha Moyeni WSS Future (proposed supply area).

It is recommended that detail feasibility studies be conducted for the above three areas to investigate options regarding the water source (existing and development thereof) and water supply infrastructure (cost versus service level and implementation programme). The costs for implementation as well as for operation and maintenance can then be determined within a high level of confidence.

If the planning commences in July 2016, these schemes could potentially only be commissioned during 2022 – 2023.
Detail feasibility studies can be used to develop Implementation Ready Reports that are required to meet funding application criteria (as managed by the Department of Water & Sanitation).

Smaller areas (<2Ml/d requirement) can likely be served through the development of local sources (most often groundwater schemes supplied from boreholes. There are eight such potential cases in the UDM).

Lessons learnt, what works and what is required:

- It is critical to have access to uniform (such as a national census) **primary datasets** to represent **demographics / households**, **water service levels** and settlement type (urban / rural character). If possible, such datasets should include existing water supply areas and **infrastructure** components (bulk and reticulation footprint, sizing and capacities where possible) as well as **water resources** (spatial features).
- Develop a study-specific **GIS** to spatially capture, query, analyse and represent information not only for the visualisation and planning of future scheme areas, but also in **discussion with officials** from the UDM (**developing media to facilitate discussions in the form of maps, data tables, and presentations**).
- The DWS, as custodian of South Africa's water resources, has conducted several **water resource studies** – these were also vital in **reconciling water requirements, with available water sources** to propose new scheme developments. In South Africa, a process is under way to license all water use (except for abstractions for individual household use) by all sectors. This is to assist in determining the water balance for our resources and the volume of water that should be reserved for the environment and basic human needs, the volume of water in use and the volume of water that can still be allocated to new water users.
- To agree on a set of **design parameters** – guided by policy and engineering principles where possible – to determine current and future water requirements.
- Make use of **standard costing parameters** (for infrastructure components such as bulk pipelines, concrete reservoirs, etc.) to estimate the proposed schemes' development costs (ideally calculated from recently constructed infrastructure).
- **Stakeholder input** plays in important role during the planning process – to **obtain information**, **verify** existing services and in discussion of the study results. This fosters **acceptance of the study outcome and recommendations for implementation** by the UDM. It further assists the UDM to evaluate options for funding of infrastructure (management, operation, maintenance, upgrading and new) and consider affordability for the service provider or implementer (in this case the UDM) and consumer (consideration to be given to the poor and the overall consumer profile of the service provider – how much can be invested and how much can be expected financially in return).

Acknowledgements
Department of Water and Sanitation, KwaZulu-Natal Regional Office, Department of Cooperative Governance and Traditional Affairs, KwaZulu-Natal Province, Umgeni Water, uThukela District Municipality Officials, Ziyanda Consulting

References

Department of Water Affairs and Forestry. 2004. Internal Strategic Perspective: Thukela Water Management Area: Prepared by Tlou & Matji (Pty) Ltd, WRP (Pty) Ltd, and DMM cc on behalf of the Directorate: National Water Resource Planning (East). DWAF Report No. P WMA 07/000/00/0304.

Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: Amajuba

District Municipality. First Stage Reconciliation Strategy for Newcastle Water Supply Scheme Area – Newcastle Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: Gert Sibande District Municipality. First Order Reconciliation Strategy for Greater Volksrust Water Supply Scheme Area – Pixley Ka Seme Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: uMzinyathi District Municipality. First Stage Reconciliation Strategy for Dundee Glencoe Water Supply Scheme Area –eNdumeni Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: uMzinyathi District Municipality. First Stage Reconciliation Strategy for Glencoe Water Supply Scheme Area – eNdumeni Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: uMzinyathi District Municipality. First Stage Reconciliation Strategy for Tugela Ferry Water Supply Scheme Area – Masinga Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: uThukela District Municipality. First Stage Reconciliation Strategy for Bergville Water Supply Scheme Area – Okhahlamba Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: uThukela District Municipality. First Stage Reconciliation Strategy for Colenso Water Supply Scheme Area – eMnambithi / Ladysmith Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: uThukela District Municipality. First Stage Reconciliation Strategy for Ekuvukeni Water Supply Scheme Area – Indaka Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: uThukela District Municipality. First Stage Reconciliation Strategy for Estcourt Water Supply Scheme Area – uMtshezi Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: uThukela District Municipality. First Stage Reconciliation Strategy for Ezakheni Water Supply Scheme Area – eMnambithi / Ladysmith Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: uThukela District Municipality. First Stage Reconciliation Strategy for Ladysmith Water Supply Scheme Area – eMnambithi / Ladysmith Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: uThukela District Municipality. First Stage Reconciliation Strategy for Loskop Water Supply Scheme Area – Imbabazane Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: uThukela District Municipality. First Stage Reconciliation Strategy for Weenen Water Supply Scheme Area – uMtshezi Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: uThukela District Municipality. First Stage Reconciliation Strategy for Winterton Water Supply Scheme Area – Okhahlamba Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: uThukela District Municipality. First Stage Reconciliation Strategy for Zwelisha Moyeni Water Supply Scheme Area – Okhahlamba Local Municipality.
Department of Water and Sanitation (2011). Development of a Reconciliation Strategy for all towns in the Eastern Region: uThukela District Municipality. First Stage Reconciliation Strategy for Ezakheni Water Supply Scheme Area – eMnambithi / Ladysmith Local Municipality.
Department of Water and Sanitation (2015). Reference Framework geodatabase. Directorate: Macro Planning and Information Management, Department of Water and Sanitation.
Department of Water and Sanitation (2015). Quarterly Performance Evaluation Report of the Driefontein Complex Bulk Water Supply Project. KwaZulu-Natal Chief Directorate: Bulk Infrastructure Programme. RBIG KNR020. Period 01 July 2015 to 30 September 2015.
IWR Water Resources (2015). Off-channel Dams in the Injasuthi River Catchment. Surface Water Assessment. October, 2015.
Statistics South Africa (2013). 2011 Census Data Package (Small Area Layer level).
Sukuma Consulting Engineers (Pty) Ltd (July, 2010). Uthukela District Municipality Bhekuzulu / Epangweni Community Water Supply Feasibility Study / Technical Report.
uThukela District Municipality (2015). Geographic Information System (GIS) geodatabase and shapefiles.
Uthukela Water (2003). Geographic Information System (GIS) shapefiles.
UWP Consulting Engineers. (Pty) Ltd (March, 2015). Development and Implementation of Water Conservation / Water Demand Management in uThukela District Municipality. Bulk Water Meter Audit Report.
Willcocks Reed & Kotze (June, 2006). Proposed Driefontein Complex Bulk Water Supply and Community Reticulation Project. Feasibility Report. March 2006. Amendment No. 1.

Contact Details

Name of Lead Author:
Monja Esterhuizen Email: monjae@uwp.co.za