11 EVALUATION OF THE WATER SUPPLY SITUATION IN THE WESTERN HIGHVELD AREA, SOUTH AFRICA

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Summary

The Western Highveld area is located some 100 km north east of Pretoria and supports a population of approximately 1.1 million, most of whom live in peri-urban areas. Water is currently supplied to the area from two main sources namely the Weltevreden and Bronkhorstspruit water purification plants which supply 60Ml/day and 40 Ml/day respectively.

The water supply to the area appears to be sufficient for most of the year except during the months of September until March when severe water shortages occur annually. The problem has been the subject of numerous studies over a period of many years and, to date, relatively little progress has been made in addressing the problems.

The Department of Water Affairs and Forestry has undertaken several studies to investigate the possibility of supplying additional water resources to the area by commissioning a new water transfer scheme. Although such a scheme is possible and could be completed within a few years, it is prohibitively expensive. Before investing several hundred million rand on a new pipeline it was decided to investigate the true magnitude of the problem and assess whether there may be any scope for utilising the current resources more efficiently in line with the latest government guidelines on all new water-related developments.

A study was recently commissioned by the Department of Water Affairs and Forestry and undertaken by a group of water conservation specialists comprising WSS, WRP and BIGEN. The aim of this study was to assess the water supply situation in the Western Highveld area and to evaluate the water demands for each area based on the level of service and population served. The preliminary findings from the study were very interesting and clearly indicated that the current water supply of approximately 100 Ml/day should be sufficient to supply the total population without further augmentation. Through further investigation it became apparent that the water shortages during the summer period are caused by excessive water use and losses in certain areas including irrigation for gardens and small-scale agriculture. The high water use in certain areas results in water shortages in other areas which in turn have to be supplied using water tankers. In effect the garden water is costing the taxpayers in the order of R50 per kl or approximately 20 times the price of a normal water supply.

The situation in the Western Highveld area is extremely sensitive for a number of reasons and the residents are becoming weary of studies which do not address their immediate needs. As a result, the Department has already initiated a Short Term Regional Implementation Plan (STRIP) to reduce wastage and try to provide a continuous water supply to all residents, some of whom have never had the benefit of a piped water supply although they are serviced by the water reticulation system.

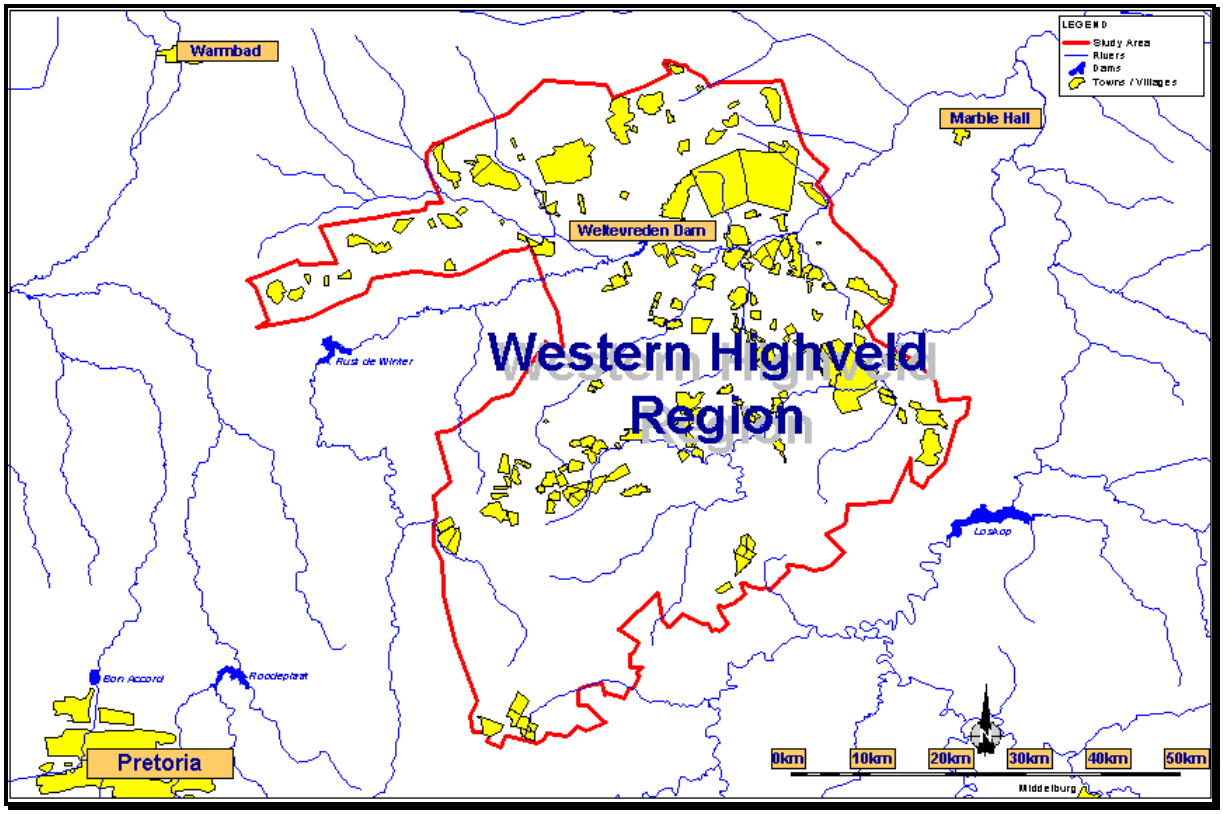
The paper provides details of the current water supply situation and highlights the main sources of wastage in the study area. It concludes with a summary of the key problems experienced in the area and some recommendations on what can be done to alleviate the suffering of the residents.

11.1 Introduction

According to the available information, the Western Highveld area (Figure 1) supports a population of just over 1.05 million of which 95,000 currently rely on boreholes for their water. The remaining 950, 000 consumers receive water at varying levels of reliability from the Weltevreden and Bronkhorstspruit water treatment works (WTW).

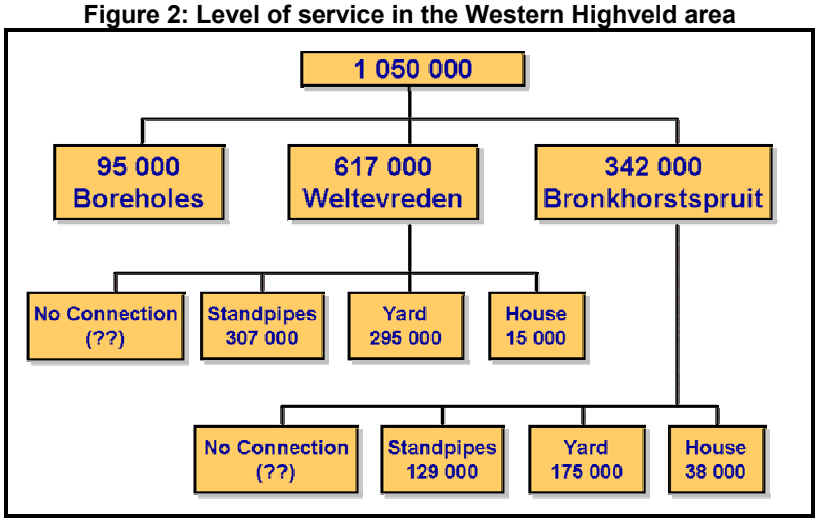
The breakdown of residents served according to the different supply systems and levels of service is provided in Figure 2.

Figure 1: Map of the Western Highveld Area



As can be seen from Figure 2, the majority of residents receiving formal water supplies (over 90%) are either supplied from yard connections or standpipes. Only 5% of the population served receive water through formal internal house connections,

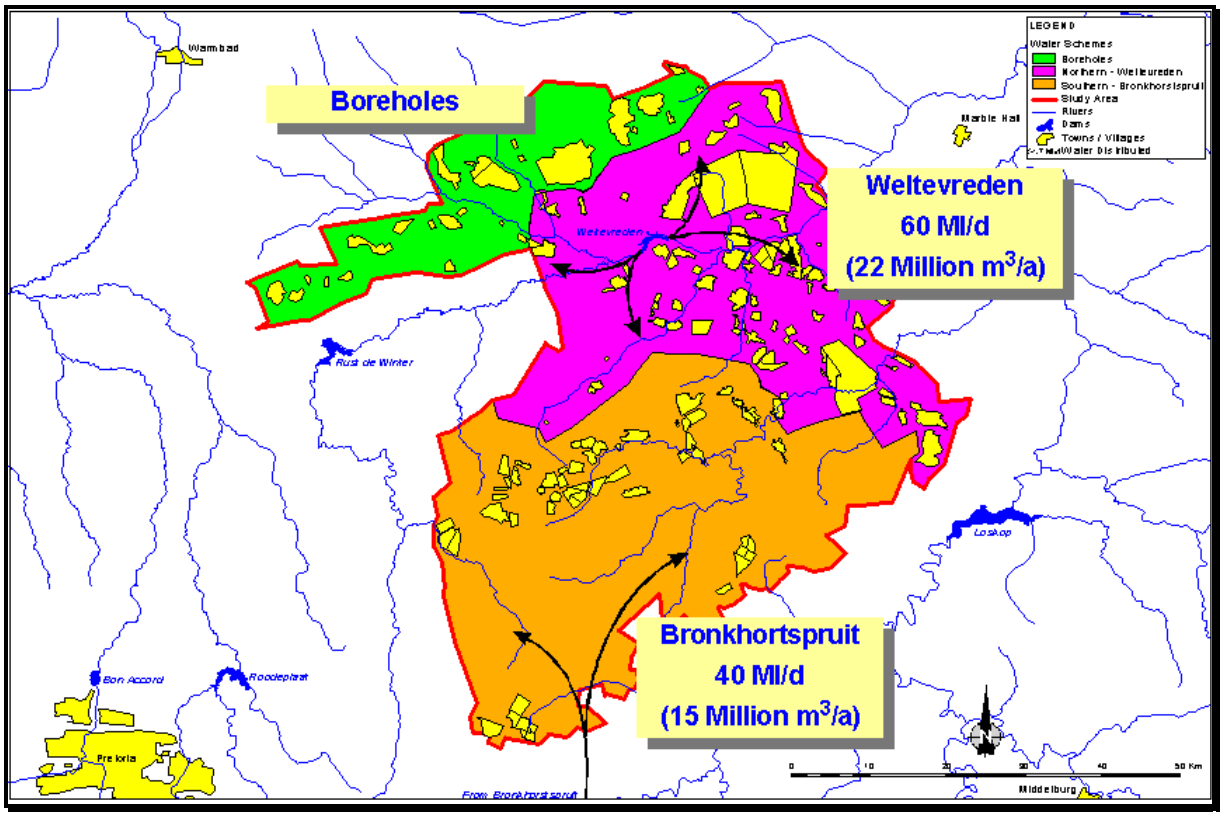
Figure 2: Level of service in the Western Highveld area



11.2 The Problem

The water supply to the Western Highveld area is limited by various constraints including the treatment capacity of the two Water Treatment Works as well as the yield limitations from the two main supplying reservoirs, namely Bronkhorstspruit and Weltevreden. These two water treatment works are capable of supplying a total of 100 Ml/day with the split as shown in Figure 3.

Figure 3: Western Highveld – supply zones



Each year, during the hot summer months, there is a severe water shortage which results in many residents being cut off for days and even weeks at a time. In order to address this problem, numerous studies have been undertaken by the Department of Water Affairs and Forestry to investigate the viability of increasing the water supply to the area. Before any new water resources are developed, however, the Department of Water Affairs and Forestry has made it clear that the existing resources must be used effectively and efficiently. In this regard, the Department commissioned a new study to assess the efficiency of water use in the area and to determine whether or not the available water supplied to the area is sufficient to meet the needs of the residents. The remainder of this paper presents a summary of the preliminary findings from the study and concludes with an outline of the situation and some broad recommendations for addressing the water shortages.

11.3 Estimation of water demands

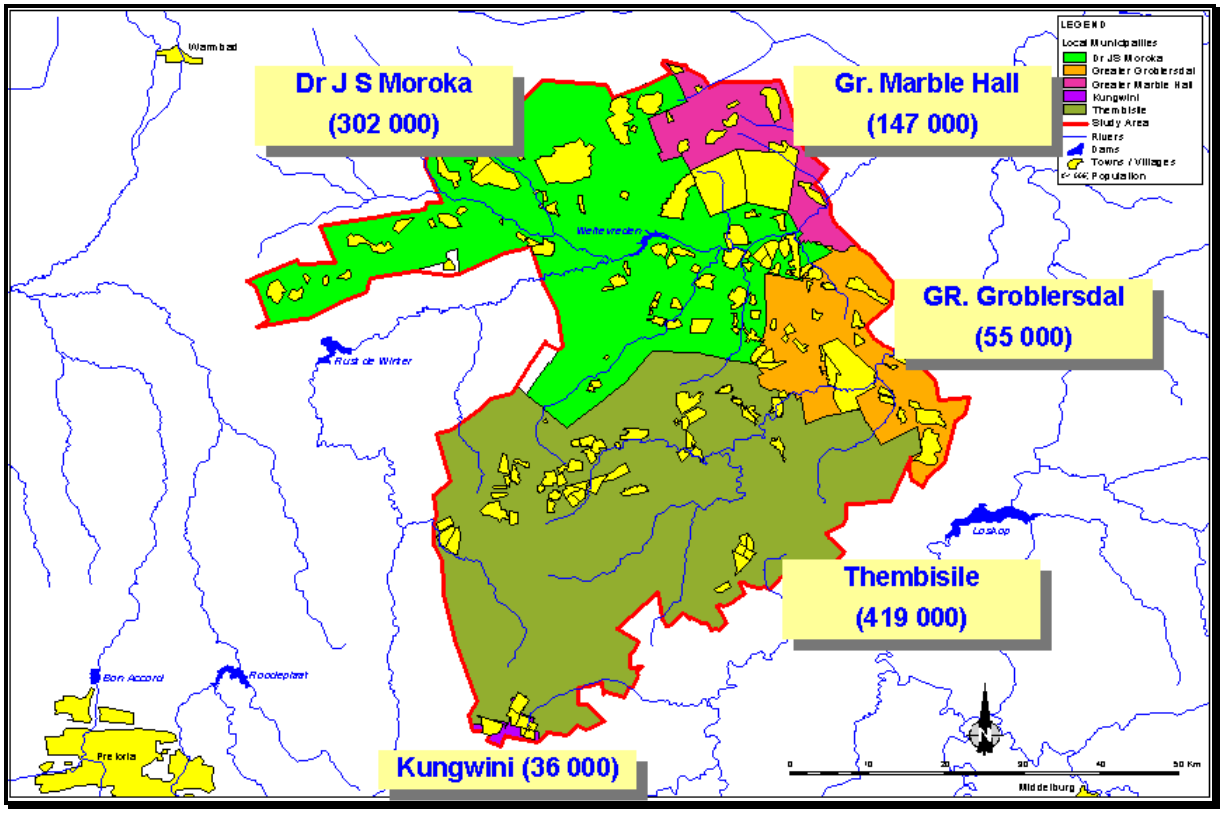
One of the first issues addressed in the study concerned the assessment of the water demands in the area. Considerable work in this regard has been undertaken in many previous studies and, based on the results of such work, it is possible to estimate the average water use per person per day for the various different levels of service.

The first step in the analysis was to identify the number of residents served in each area and to confirm the figures through discussions with community leaders and representatives from the Ikangala Water Board. Various anomalies were identified and were eventually resolved, after which it was agreed that the total population served from the water reticulation system is in the order of 960,000. The distribution of the residents and the various urban and peri-urban areas are shown in Figure 4.

The initial results from the demand assessment are shown in Figure 5. From this figure it can be seen that the total water demand for the area is estimated to be in the order of 56 Ml/day which is based on realistic per-capita consumptions as suggested by the Department and based on their considerable experience in other similar areas . An allowance of 20% for leakage was also incorporated into the calculation, which is considered to be a realistic in such peri-urban areas. It should be noted that most of the pipe-work in the area is relatively new, in which case the leakage from the system should be relatively small. This initial water demand assessment suggests that there is ample water being supplied to the

area (100 Ml/day) and that there should in theory be no supply problems. In reality, however, the situation is very different and many thousands of residents experience problems on a regular basis during the summer months.

Figure 4: Map showing population figures as well as urban and peri-urban areas



11.4 Identification of the problem

In the previous section it was shown that the water supplied to the Western Highveld area is theoretically sufficient to supply the total population, with considerable excess for further development. In the summer months, however, severe water shortages occur in certain areas resulting in the need to use water tankers to carry water to many outlying and high areas, which do not receive even the basic constitutional allowance. Clearly the actual water use in the area is not being reflected properly in the various tables and figures. In order to identify the discrepancies, the project team undertook a series of flow measurements at selected points in the system to assess the actual water use, which could then be compared to the theoretical water use. Some of the results are shown in Figures 6 and 7 for two of the areas investigated where very high leakage or night-time use was observed.

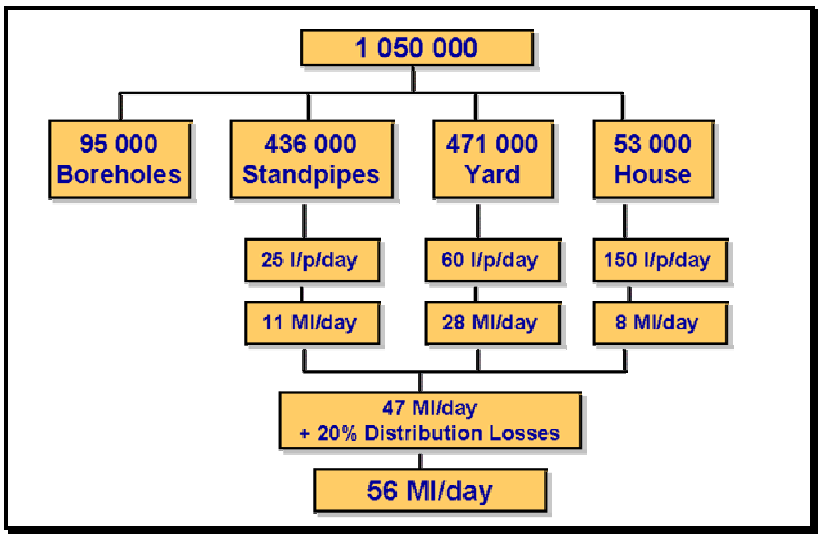
These two figures show the flows entering the areas over a period of several days. It is important to identify and analyse the minimum night flow (MNF) which represents the minimum flow entering each area during the period of minimum demand which is normally between 12 midnight and 4 am. The magnitude of the MNF is a very useful indicator of leakage and/or illegal use and in the case of the areas presented, a MNF value of 20 to 30 m^3/hr would be expected.

From the analyses of the figures, it is clear that the MNFs are significantly greater than the expected value, suggesting abnormally high night-use and/or leakage. Having identified certain areas of exceptionally high water use, the next step in the investigation was to identify the cause of the high MNFs.

11.5 Preliminary analysis of minimum night flows

The water supplied to an area during the period of lowest demand is termed the minimum night flow (MNF) and typically occurs at approximately 2am when most consumers are asleep. The magnitude of the MnF is one of the most useful indicators of leakage and wastage in a water supply system. A typical well-managed system will experience a MNF value in the order of 10% to 15% of the average daily demand.

Figure 5: Estimated water demands for the Western Highveld Area



The areas investigated initially all have internal plumbing and it was therefore decided to visit each area as well as monitor the sewage returning to the sewer system. The visual inspection is very useful and can identify many key problems, while the assessment of the sewer flows will identify whether tap and toilet leakage is a major issue without having to disturb the residents, with an internal household survey. In some parts of South Africa, the tap and toilet leakage can account for more than 80% of the total night flow (Mckenzie, 2002)

Figure 6 shows a night flow of 500 m^3/hr which is extremely high and represents 12 Ml/day or 12% of the total water supplied to the whole of the Western Highveld area (not just the Siyabuswa area). Such leakage/wastage is unacceptable in any area and particularly in areas where some consumers receive no water. Figure 7 also shows a very high night flow which is lower than that shown in the previous figure but remains extremely high and indicates high leakage or wastage.

In the case of the Western Highveld area, it was difficult to measure the sewage return flows, however, preliminary measurements in Siyabuswa suggest that the sewage return flows are in the order of 30% of the MNF which indicates that internal plumbing leakage is significant but is not the only problem suggesting significant levels of reticulation system leakage.

From the visual inspections of the area, several other problem issues were identified including, excessive garden irrigation as well as unattended visible leaks at standpipes, water mains and air valves. In many instances the fittings have been damaged or have simply broken through constant use or vandalism. Unless this type of problem is repaired quickly and effectively, there will always be water shortages in the area.

Garden irrigation, which occurs in certain parts of the Western Highveld area, is common practice in areas near to the supply points in the water distribution system. Further along the same pipeline, the residents often receive no water from the distribution system and rely on water tankers to supply them. The cost of the tanker water is estimated to be in excess of R50/m^3 compared to a cost of approximately R3/m^3 for the normal reticulated water. It should also be noted that the payment levels for the water in most areas could be considered to be zero with the result that Ikangala Water is effectively carrying the full cost of both the reticulated water as well as the water supplied by a fleet of water tankers.

Figure 6: Flow measurements in Siyabuswa Flow (m^3/hr)

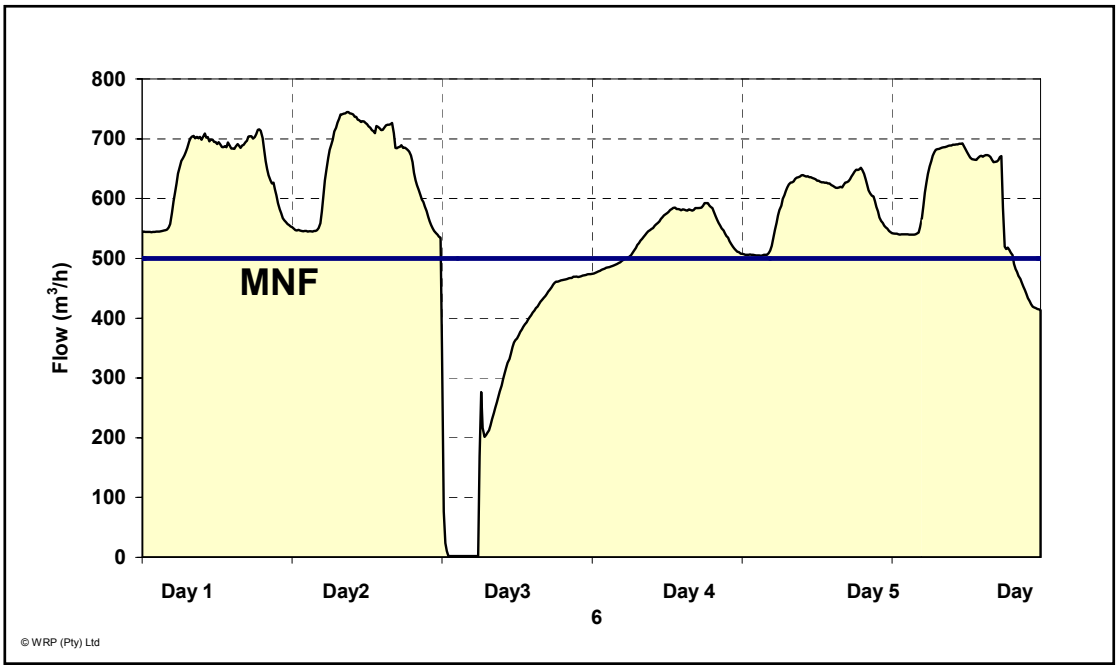
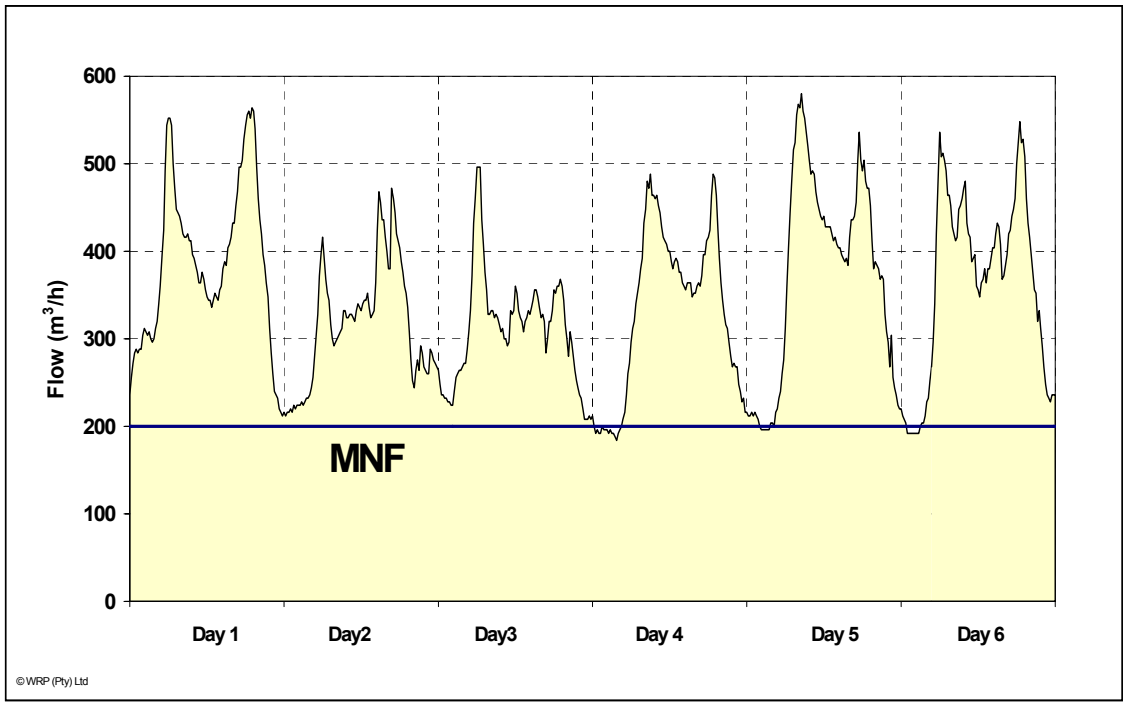


Figure 7: Flow measurements in Ekangala Flow (m^3/hr)



11.6 Summary and recommendations

It is difficult to summarise the full water supply situation of the Western Highveld area in a few pages, due to the complexity of the situation and the many factors that influence the water demand patterns. Based on the available population figures, the water supplied to the area should be sufficient to me*et al*l existing demands and be able to accommodate future improvements to the levels of service in the area.

The use of the potable water for gardening purposes is clearly a serious and key issue in the supply area.To highlight this problem it should be noted that irrigation of 1 ha will use as much water as 500 normal residents, on the assumption that it is applied efficiently. In the case of the study area, it is likely that each hectare irrigated is using enough water to support between 500 and 1000 people at a per capita use of 100 l per day. There is currently no information on the extent of such irrigation, although the extent of the green lawns in certain areas is a clear indication of the extent of the problem. This paper does not necessarily condemn irrigation for gardens or small scale agriculture. It simply highlights certain water use practices that have resulted in severe water shortages in the area. The decision regarding what is acceptable and what should be provided to the residents is a very complicated and often controversial issue. Before any decision can be taken, a detailed investigation of the social benefits of such irrigation must be undertaken and this is already underway as part of the DWAF project.

In addition to the problem of garden watering, the extent of the visible leaks is a major problem, which must also be addressed before the residents can be expected to try and save water. There is little incentive or motivation for residents to save water when standpipes leak continuously for months at a time without being repaired. This type of problem requires careful technical and social intervention, where the leaks are repaired quickly and effectively and the residents are educated on how they can also help to reduce their water consumption. Once again, this issue is currently being investigated as part of the social component of the ongoing DWAF project.

In summary, the problems faced in the Western Highveld area are numerous and complex, requiring a comprehensive water conservation initiative that addresses both the technical as well as the social issues. Whether or not such interventions will be successful in changing the perceptions and behaviour of the residents can only be judged from the results which, in turn, will only be available in a year or two. The Department has already initiated a major water conservation project in the area in an attempt to alleviate the water shortages and ensure that all residents have access to clean potable water.

While this paper may not present the solution to the problem, it does highlight certain very important issues concerning the use of potable water for irrigation and/or garden watering. Many of the residents in such areas rely for survival on some form of small scale irrigation to provide food and, in particular, maize. By using potable water for irrigating their gardens, they often manage to provide food for their families, but at the same time cause water shortages in other areas. Various papers have been presented on the subject and in most cases the conclusion is that such irrigation should be promoted as a means of providing food for the poor. This paper does not attempt to pre-judge the situation but rather to highlight the problem and the knock-on effects that such irrigation can have on the water supply in an area.

It is important for the Department to investigate the extent of this problem and provide guidance on how best to address the water shortages, without causing further hardship to those who currently rely on such water for their survival.

11.7 References

Mckenzie, R. S. (2002). ‘Khayelitsha: Leakage Reduction through Advanced Pressure Control’ In *Journal of the Institution of Municipal Engineering of Southern Africa*, vol. 27, no. 8, August 2002

11.8 Acknowledgements

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