



Relevance of groundwater quality assessment in the Lusaka aquifer

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LUSAKA WAS INAUGURATED as the new capital of Zambia (then Northern Rhodesia) on 31 May 1935. At independence in 1964, the city had a population of only about 195,700. During this period, the city had the capacity to adequately cope with the provision of basic needs and services. However, when the country's economic standing began to dwindle in the middle of the 1970s, the capacity to provide these services also began to be affected. The situation worsened from the mid 1980s, particularly with a heightened rural-urban migration in search of a better life. Because of financial constraints, the local authority began to experience problems with fulfilling most of its social obligations to city residents. This paper examines whether current socio-economic and financial scenarios and a regulatory framework favour the supply of good quality groundwater in quantities that can facilitate development of the city.

From the earliest days of settlement in the early 1900s, the suitability of Lusaka's location has been a source of great controversy. Many reasons have been advanced for this controversy, among which has been the geology that underlies the city. Lusaka's geology comprises mainly karstified marbles inter-bedded with thin sub-horizons of schists and quartzites. Differential dissolution of the marbles has developed a system of conduits and solution channels, whose presence has transformed these rocks into a favourable and comparatively cheap source of water supply to the city.

However, rapid growth of population, which currently averages about 4.5% per annum, has caused rapid rates of urbanization. With completion of the privatization exercise, there has been an even increasing migration of retired and retrenched people into Lusaka. Proportionate to this growth in population has been a heightening of anthropogenic activities, such as the increased generation of waste exacerbated by inadequate methods of its disposal. With no master plan for municipal solid waste management, the city population may face great difficulties with sources of its water supplies in terms of quality. Of particular interest are the long-term impacts of the *now abandoned* official dumpsite at Libala, which may heighten risks of groundwater contamination in the Lusaka aquifer.

Sources of water supply to Lusaka

Lusaka Water and Sewerage Company (LWSC) is the sole authority charged with exploration, exploitation, conveyance, and distribution of good quality water and in sufficient quantities to sustain city development. Current sources of supply comprise about 50% each from Kafue

River, which is located about 50 km south of the city and from 52 boreholes tapping the Lusaka aquifer (Figure 1). Prospects for extra sources of supply to Lusaka in the future other than from these two appear very remote. By virtue of its comparatively low capital investment, increased exploitation of groundwater resources from the city aquifer may offer the only exploitable alternative to satisfy the ever-increasing water demand in Lusaka.

However, a rise in anthropogenic activities over the aquifer recharge area, initiated by rapid population growth, pose great risks to the quality of groundwater resources. This results mainly from increased use of the ground to dispose of various forms of liquid and solid waste such as:

- Sewage through use of pit latrines and septic tanks;
- Industrial effluents;
- Domestic and industrial wastes; and
- Clinical and other forms of hazardous/toxic wastes.

Management of ground-water resources

Water supply and sanitation systems must always exist within a set of legal regimes, water rights, and social and civil institutions. However, current practices of liquid and solid waste disposal are not regulated and pose great threats to the sustainable exploitation of good quality water from the Lusaka aquifer.

Liquid waste disposal

Currently there is no policy framework governing the suitability and/or restriction in use of different types of sanitary systems in different parts of the city. The Environmental Protection and Pollution Control Act (EPPCA) N^o 12 of 1990 and Public Health Act Cap 295 of 1994, are not explicit on the requirements for adequate sanitation. In some cases, the *conflict* in mandates among regulatory institutions has made it difficult to implement programmes and set pollutant priorities to reduce pollution of groundwater.

Solid waste disposal

The Environmental Council of Zambia (ECZ) is empowered, under section 48 of the EPPCA, to issue general and specific directions to the Lusaka City Council (LCC) and all other District Councils on the collection and disposal of waste. Among other things, this Act empowers the ECZ to:

- Formulate and provide standards on the classification and analysis of wastes and advise on the best methods of its disposal;

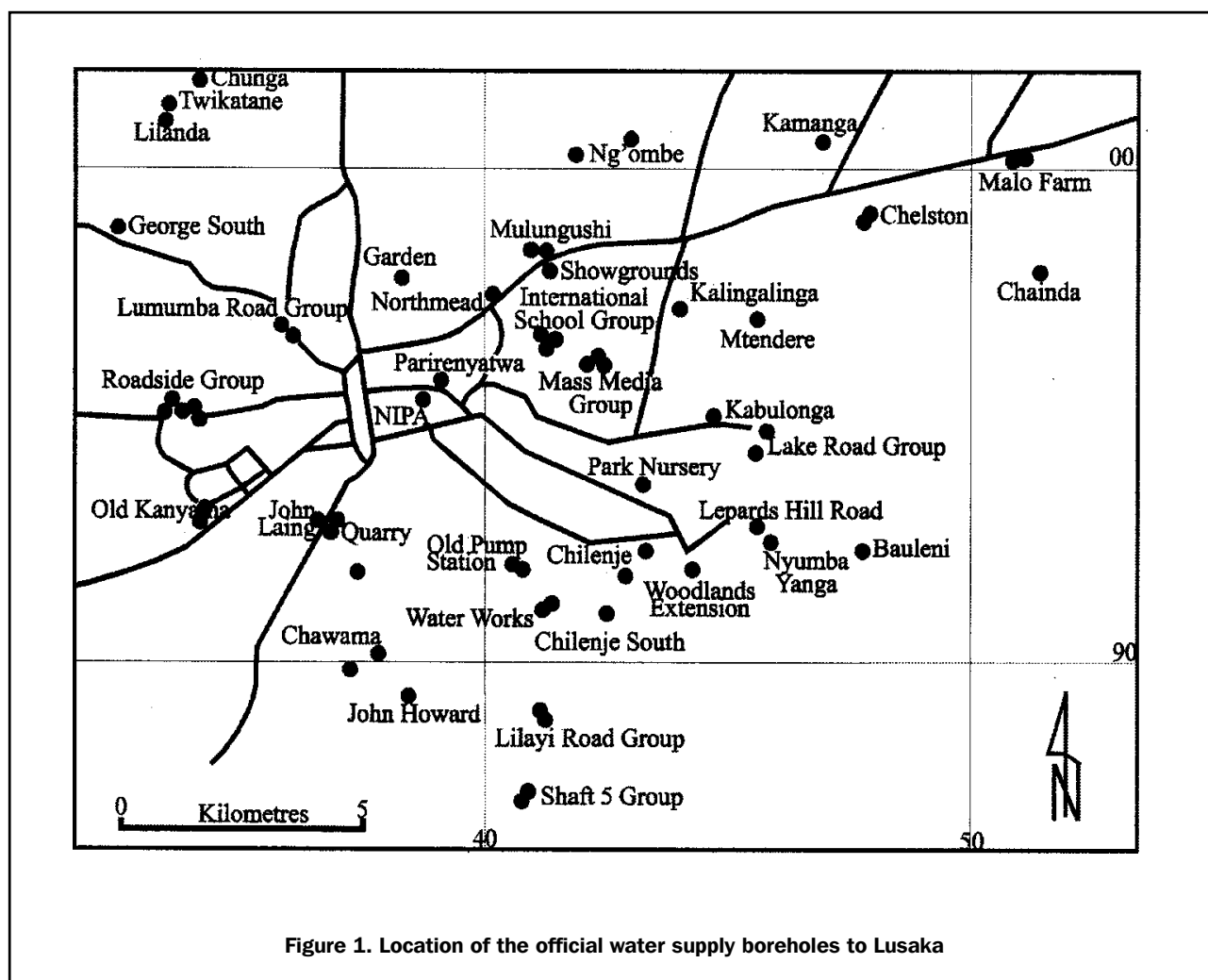


Figure 1. Location of the official water supply boreholes to Lusaka

- Provide for monitoring and regulation of any waste disposal sites; and
- Licence the transportation of solid waste and control activities at disposal sites such as ensuring that:
 - i) Collected waste is transported to licensed sites only;
 - ii) A waste disposal site is enclosed and secure from scavenging activities; and
 - iii) Landfill operations do not pose any contamination threats to surface and groundwater.

None of these statutes appears to be enforced, probably because of lack of capacity in the Council to do so. For instance:

- Authorisation was given to use the abandoned, unlined quarries on karstified terrain at Libala, in spite of the practice being environmentally damaging to the quality of groundwater; and
- In spite of their impact on the environment, hazardous and clinical wastes have hitherto been inadequately managed in that they all end up in the open, unlined quarries at the city dumpsite.

Groundwater quality monitoring

The situation in Lusaka is such that there has been an unregulated disposal of liquid and solid waste over most of the aquifer recharge areas in Lusaka, a practice that has become a potentially serious source of groundwater contamination. Because groundwater systems take long periods to respond to environmental factors, such a monitoring process will provide an early warning system for such problems as over-abstraction and contamination of the aquifer.

Currently, aquifer data is collected mostly under specific projects to investigate quality and quantity aspects. The collection of this data is neither co-ordinated nor harmonized, as each institution collects data for its own purpose and agenda.

As such, despite the availability of sizeable amounts of data, the aquifer is still not well understood. In addition, the effects of anthropogenic activities on the aquifer recharge area and the subsequent degradation of groundwater quality in the Lusaka aquifer are still not well known. As Lusaka is so heavily dependent upon groundwater resources for its water supply, it is critically important that a monitoring

network and an early warning system are put in place to detect impending areas of water quality deterioration (*hot spots*). This will assist stakeholder-institutions such as Lusaka Water and Sewerage Company, the Public Health Department of the Lusaka City Council, ECZ, and the Department of Water Affairs to implement activities that will provide early signs of water quality degradation and provide a sustainable and adequate supply of potable water to Lusaka.

Conclusion

Generally, groundwater aquifers take long periods to respond to environmental factors and equally as long to recover from both natural and anthropogenic degradation. Currently however, the unsatisfactory status of groundwater management in Lusaka arising mostly from indiscriminate disposal of liquid and solid wastes, poses a great threat to groundwater contamination in the Lusaka aquifer.

Recommendation

Faced with current shortfalls in the enforcement of environmental statutes regarding waste disposal, and an increase in the use of groundwater as a source of potable water in/by the city, it is imperative that an aquifer-monitoring network and an early warning system are established, in order to assess contamination hazards to groundwater arising from a rise in anthropogenic activities over the aquifer recharge areas. When- and wherever possible, existing monitoring boreholes, for instance those drilled by the ECZ, should be incorporated in the aquifer-wide network, from which the author intends to adopt a

few. In places, additional boreholes may need to be completed in strategic locations, after existing hydrogeologic data has been evaluated.

References

- GOVERNMENT of the Republic of Zambia (GRZ) / Water Sector Development Group (1993): *Strategy and Institutional Framework for the Water Supply and Sanitation Sector, Lusaka*.
- GOVERNMENT of the Republic of Zambia (GRZ) / Water Sector Development Group (1999): *Outline of Implementation Plan – Demonstration project for the city of Lusaka*.
- LUSAKA CITY COUNCIL (1999): *Water Supply and Sanitation situation analysis – Issues, Constraints, and Possible Options. Water Supply and Sanitation Issue Specific Working Group (IWG)*.
- NKHUWA, D.C.W. (1996): Hydrogeological and Engineering Geological problems of urban development over karstified marble in Lusaka. *Mitt.Ing –u. Hydrogeol., Heft 63, 251S, Aachen*.

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