

## Exploring aspects of the water history of the Potchefstroom region and the local management of it

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### Abstract

It is by now common knowledge that South Africa is a water scarce country and that the correct public management of its potable water sources such as the transportation of it as well as the purification of the used water is of utmost importance. In the history of South Africa, the supply of potable water and basic sanitation services to all the inhabitants has never been higher on the national, provincial and especially the local government sphere agendas than since the end of April 1994.<sup>1</sup>

Even though the Mooi River valley area has always been described as water rich, it might in the near future be described as “water, water everywhere, but not a drop to drink”! The city of Potchefstroom gathers its potable water from surface- and groundwater in the Mooi River Catchment. The water is collected, stored and released from the Boskop Dam from where it is transported in a 12km long open-on-top cement canal to the water purification works of the City. In an ad hoc field visit by the authors, it was discovered that the water canal is broken and being polluted in a variety of ways before it reaches the purification works. Improvement of this inefficient management situation is also currently quite impossible seeing that the Department of Water Affairs’ workforce has declined to a mere 20 people to maintain the whole of the Mooi River valley.<sup>2</sup>

The article starts off with a historical water related background of Potchefstroom identifying some historical happenings and developments of importance with reference to the development related to Potchefstroom and especially the source and transport of its potable water. Thereafter the

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- 1 JWN Tempelhoff, *African water histories: Transdisciplinary discourses* (Vanderbijlpark, Corals Publishers, 2005), p. 111.
  - 2 Interview, Mr W Liebenberg (Retired Regional Manager, DWA Regional Office, Potchefstroom)/Prof EJ Nealer, 16 March 2011.

article highlights some important water resources related legislation, which is obviously not being adhered to. Important role-players involved with the public management of the potable water supply for the city residents of Potchefstroom are furthermore identified. Lastly the way forward is addressed and some recommendations on the improvement of the transport of the City's potable water through the dolomite underlain area are given.

**Keywords:** Water history; Dolomite; Municipal water supply; Department of Water Affairs (DWA); Water-transporting cement canal; Co-operative governance; Water resource management.

## Introduction

South Africa finds itself in an arid to semi-arid region, with an average rainfall of approximately 500mm per annum, compared with a world average of 860mm. Furthermore, this below-average rainfall is unevenly distributed in that 65% of the country receives less than 500mm of rain annually, which is usually regarded as the minimum for successful dry-land farming, while 20% of the country receives less than 200mm.<sup>3</sup>

The aforementioned hydrological state is not true for the Mooi River valley area on the Far West Rand upstream of the city of Potchefstroom, which has over the years been described as 'water rich' and scenically beautiful<sup>4</sup> – but due to, amongst others, gold mining activities, urbanisation, informal settlements and the geologically underlying dolomite with resulting complex geo-hydrology of the landscape, the quest to provide effective management of the physical environment deserves attention. The city of Potchefstroom falls in the municipal jurisdiction of the Tlokwe Local Municipality and has a population of approximately 250000 people.<sup>5</sup> The area is situated downstream of the current environmental crises on the West Rand and Far West Rand regarding aspects such as acid mine drainage (AMD)<sup>6</sup>, closure of mines, and naturally rewatered gold mines which have negative effects on the Wonderfontein Spruit (upstream tributary of the Mooi River), as well as the underground located groundwater aquifers and springs in the karst

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3 Department of Water Affairs and Forestry (DWAF), *Management of the water resources of the Republic of South Africa* (Cape Town, CTP Book Printers, 1986), p. 1.3.

4 WJ Badenhorst, *Die geskiedenis van Potchefstroom* (Johannesburg, Afrikaanse Pers Bpk., 1938), p. 15.

5 Tlokwe City Council, "IDP REVIEW 2009-2010", 2010 (available at <http://www.potch.co.za/pdf2010/TLOKWE%20IDP%202009.pdf>), as accessed on 9 February 2011).

6 Times Live, 'Acid mine drainage needs urgent action', 2011 (available at <http://www.timeslive.co.za/local/article896257.ece/DA--Acid-mine-drainage-needs-urgent-action>), as accessed on 8 February 2011).

(dolomite) landscape.<sup>7</sup>

In this research venture the primary objective has been to determine and report on the nature and extent of the public management and specifically the transport of Potchefstroom's raw water (to be used and consumed by households of the city) through a geologically sensitive karst (dolomite) area. The research methodology included a thorough and comprehensive literature review of the typical basic geo-hydrology of the terrain, place and role of the National Department of Water Affairs Regional Office situated in Potchefstroom, the history of the transport of water in soil-dug and built canals in the area, field-visits to the area, and personal interviews with municipality practitioners and North-West University (NWU) researchers in the field of municipal- and water services management as well as disaster risk reduction. The outcomes of this research are considered of utmost significance for the current and future municipal managers and officials who are tasked with the more effective, efficient and economic public management and delivery of potable water services within the demarcated municipal area of the Tlokwe Local Municipality.

To follow in the discussion is a brief contextualising of the water history of the Potchefstroom region. The nature and extent of the transport of the city's raw water from Boskop Dam to the Tlokwe Local Municipality's water purification works will be reported on after which some recommendations will be made to possibly contribute to the improvement of sustainable potable water collection, storage, transport, treatment and reticulation in the whole geographical responsibility area of the Municipality.

## **A water history of Potchefstroom**

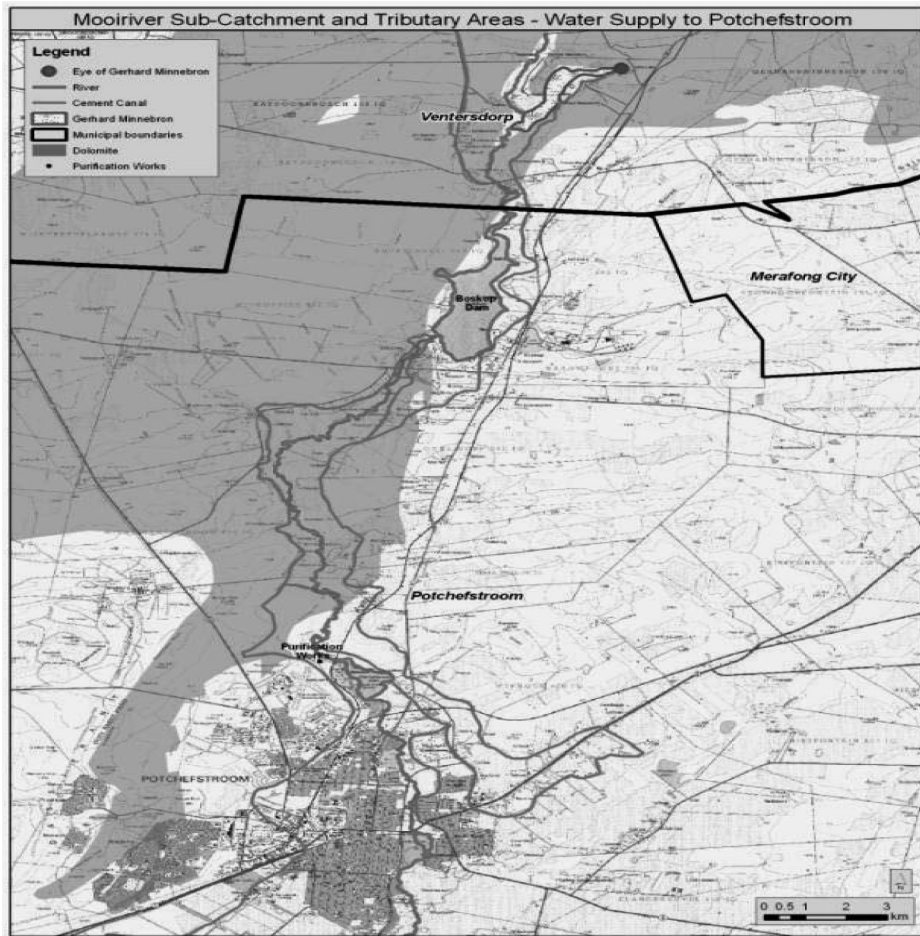
The Mooi River area in the vicinity of Potchefstroom was said to be founded by Andries Hendrik Potgieter during 1835 and the first little town in the area (called Mooiriviersdorp) was established during 1838 on the western bank of the Mooi River on several farms in the neighbourhood of Oude Dorp.<sup>8</sup> The area was located on a triangular flat wetland (vlei) with "shallow soil on top of lime- and oukclip rock formations and with "black elephant rock

<sup>7</sup> Interview, Mr F Le Roux, (Control Technician, Directorate Hydrology, DWA, Boskop Dam)/Prof EJ Nealer (Researcher), 8 April 2010.

<sup>8</sup> GA Jenkins, *A century of History: The story of Potchefstroom* (Potchefstroom, The Potchefstroom Herald, 1939), p. 7.

(dolomite) scattered on the sides.”<sup>9</sup> Water was collected with soil-dug furrows from nearby located springs in the area. See Image 1 for a geographical map on which the location of Oude Dorp can be seen in the area immediately alongside the southwest side of Boskop Dam:

Image 1: Locality map of the Potchefstroom area



Source: J Potgieter, Map of Gerhard Minnebron in Mooi River Sub-Catchment Area (Potchefstroom, AGES, 2010).

Due to heavy rainfall during 1840 as well as the unplanned, too small and wetland-type physical terrain (geologically underlain by dolomite), the Oude Dorp area became heavily flooded and impassable for the settling town folk

<sup>9</sup> WJ Badenhorst, *Die geskiedenis van Potchefstroom* (Potchefstroom, Afrikaanse Pers Bpk., 1938), p. 11.

and animals. A decision was taken to move the town approximately 10km downstream (1 hour travelling by horse) in an attempt to get off the muddy soil (weathered after dolomite [wad]) and underlying dolomite bedrock.<sup>10</sup> This new and current location was established in 1841 and named Potchefstroom.<sup>11</sup> See Image 1 for a geographical map indicating the locality of the city.

The new location of the town was much more user-friendly and the property stands of it could be measured out prior to the resettlement of the inhabitants. Alongside the streets of Potchefstroom were dug furrows which transported water from a canal built to transport water from the Mooi River to each and every house of the town. The “scenically beautiful” described town however in 1866 was reported in the *De Argus* newspaper as being “...in a shameful state we cannot deny, witness our water furrows and streets, which make it dangerous to anyone to be out after sunset and this leads us to the subject we have in view, viz. the establishment of a municipality to correct these and other evils”.<sup>12</sup> The fact that sanitation comprised of shallow pit latrines and “french drains” dug in the ground must have added to the negative state of affairs.

Potchefstroom Dam (earlier known as Lakeside Dam) was built to meet the town residents’ water needs and also to act as recreation resort. In 1924 the Town Council decided to build the first water purifying system (3.4 Mℓ/day) and by 1926 the town had its first piped water.<sup>13</sup> This potable water purification system has continuously been upgraded to currently produce 33.6 Mℓ/day.<sup>14</sup>

The need to build a bigger dam was addressed by the building of Boskop Dam and water-transporting canals with cement on both sides (banks) of the Mooi River by 1959. The essence of having the canals cemented was because the nature of the soil and underlying dolomite rock with its cracks, ponors and sinkholes caused major water losses along the previously ground-dug furrows in which the transported water merely disappeared into the underground.<sup>15</sup> In order to manage the surface water in the Mooi River valley

10 HM van Coller, “Die burgerlike lewe in Potchefstroom ten tye van die Eerste Vryheidsoorlog” (MA, NWU, 1983), p. 11; Interview, Mr JJ Smit, Senior Geologist (AGES)/Prof EJ Nealer (Researcher), 16 September 2010.

11 WJ Badenhorst, *Die geskiedenis van Potchefstroom.*, p. 15.

12 WJ Badenhorst, *Die geskiedenis van Potchefstroom.*, p. 102.

13 JF Kleinhans, “Die koste van watervoorsiening te Potchefstroom” (PU for CHE, MBA Dissertation, 1985), p. 7.

14 Interview, Mr JF Kleinhans, Manager, Engineering Services, Tlokwe Local Municipality/Prof EJ Nealer (Researcher), 27 October 2010.

15 Anon., “Kanale uit Boskop se dam nou reeds naby Potchefstroom”, *Potchefstroom Herald*, 18 Desember 1958.

more effectively, the upstream located Klerkskraal Dam and its western and eastern banks' cement canals were completed in 1971.<sup>16</sup>

Before one can turn to the empirical findings of the research's focus, the foundational and especially the transformative legislation regarding potable water supply management by a municipality within its demarcated municipal area will now be identified.

The Water Act 54 of 1956 contained mechanisms to determine and obtain entitlements to public and private water within the borders of South Africa.<sup>17</sup> In addition, the Environment Conservation Act 73 of 1989 facilitated the Government's quest towards effective protection and controlled utilisation of the physical- as well as the human-changed environment.<sup>18</sup> In 1995 a White Paper on National Sanitation was promulgated by identifying the fact that all citizens of the country have equal rights to a safe and healthy environment.

During this time the final Constitution (Act 108 of 1996) was compiled and together with some preparatory work at the then Department of Water Affairs and Forestry on a set of basic principles in water resources management, the Water Services Act 108 of 1997 was promulgated. This Act set the transformed foundation for the National Water Act 36 of 1998 which now recognises that water in South Africa is a scarce and unevenly distributed national resource which belongs to all its inhabitants, does away with the distinction between public- and private water, and that the National Government is responsible for the nation's water resources and their use. This should be attained in a sustainable manner by means of, among other things, integrated water catchment management of all aspects of water resources and, where appropriate, the delegation of management functions to a regional or catchment level so as to enable everyone to participate. It furthermore legislates the way in which the water resource should be protected, used, developed, conserved, managed and controlled. It also governs how a municipality may return effluent and other wastewater back to the water resource.<sup>19</sup> Consequently, the National Environmental Management Act 107 (NEMA) was promulgated in 1998.

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16 Department of Environmental Affairs (DEAT), 'Report of Interdepartmental Committee on Irrigation: Verslag oor die bestaanbaarheid van besproeiingseenhede op die Mooirivier-staatswaterskema'. (Unpublished), (Pretoria, DEAT, 1983).

17 Union of South Africa, Water Act 54 (Pretoria, Government Printer, 1956).

18 RSA, Environment Conservation Act 73 (Pretoria, Government Printer, 1989).

19 RSA, National Water Act 36 (Pretoria, Government Printer, 1998).

In order to ensure the practical manifestation of government for the people by the people, the local government sphere of the developing South Africa has been reconstructed and legislated with the Local Government Municipal Structures (Act 117 of 1998) and Systems (Act 32 of 2000) acts. For the purpose of this article's focus the subsequent Disaster Management Act 57 of 2002 can also be mentioned as a vehicle to prevent or reduce risk of disasters, mitigating the severity of disasters, emergency preparedness, rapid and effective responses to disasters and post-disaster recovery, and establishment of national, provincial and municipal disaster management centres all over the country.<sup>20</sup>

In the next section the nature and extent of the transport of Potchefstroom's potable water from Boskop Dam via the western bank (of the Mooi River) cement canal to the City's purification works will be looked at in more detail.

### **Nature and extent of the transport of Potchefstroom's potable water from Boskop Dam**

With reference to the Potchefstroom area in the Mooi River catchment, the area's drinking water originates from surface water collected in the Mooi River surface water catchment consisting of the Wonderfontein Spruit from the northeast and the Mooi River from the north as well as groundwater from springs in the dolomite (karst) landscape. The three biggest surface water dams in the area in which the water is collected and stored are the Klerkskraal Dam (full capacity of 8 million m<sup>3</sup>), Boskop Dam (21 million m<sup>3</sup>), and Potchefstroom Dam (2 million m<sup>3</sup>).

In a report on the safety inspection done at the Boskop Dam<sup>21</sup> it is stated that the "dam is founded on fairly complex geology consisting of a quartzite ridge, shale, lava, dolomitic limestone, a number of faults and a diabase dyke." This report also states that dolomite exists across approximately 75% of the catchment area that can, due to the high permeability of the area, have a very big effect on the size of a flood.

According to research that has been done by the Africa Geo-Environmental Services (AGES), the canal stretches through areas underlain by dolomite

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<sup>20</sup> RSA, Disaster Management Act 57 (Pretoria, Government Printer, 2002).

<sup>21</sup> Department of Water Affairs and Forestry (DWAF), 'Mooirivier Staatswaterskema, Boskopdam, Damveiligheidsinspeksie', (Pretoria, DWAF, 1999).

rock. Water can seep through the cracks in the canal and subsequently lead to the formation of sinkholes.<sup>22</sup> This state of affairs is of crucial importance in that the underlying geology of the area, through weathering, determines the resulting very clayey topsoil and ground surface gradients which in their turn affect the typical geo-hydrology of the area (i.e. creation of open or confined underground located groundwater aquifers). See Image 1 for the occurrence of dolomite in the area (indicated in grey shading).

From Boskop Dam the water destined for use by Potchefstroom's residents as well as downstream farmers up to the Vaal River, is transported through natural gravitation in uncovered (open-on-top) cement canals through and past the city. The Tlokwe Local Municipality's water purification works is situated immediately northwest of the Mooi River inflow into the Potchefstroom Dam.

These two canals were built by the National Department of Water Affairs (DWA) around 1959 in proclaimed water servitudes under the ownership and maintenance of the Department. See Image 1 for the locality of the canal on the western side of the Mooi River as well as Image 2 for a picture of a section of this canal and servitude stretching from the overflow of the Boskop Dam's wall through the city of Potchefstroom down to the Vaal River on the farm Kromdraai:

Image 2: A section of the canal and servitude 500 metres downstream of the Boskop Dam wall



Source: EJ Nealer, 16 March 2010.

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22 Interview, Mr JJ Smit Senior Geologist (AGES)/Prof EJ Nealer (Researcher), 16 September 2010.

The two types of cement canals found in the vicinity of the Boskop and Klerkskraal dams are the western bank canal that has a water carrying capacity of 7000 m<sup>3</sup>/hour (1 m<sup>3</sup> = 1000 litres) and the eastern bank canal that has a water carrying capacity of 4500 m<sup>3</sup>/h. During an interview, the DWA said that it constantly allows 2000 m<sup>3</sup>/hour raw water to be released from the western bank canal opposite the water purification works for treatment by the Tlokwe Local Municipality before usage by the residents of Potchefstroom.<sup>23</sup> Water can also be taken directly from the Potchefstroom Dam in Potchefstroom.<sup>24</sup>

The cement canal flows in an officially declared DWA fenced-off servitude which varies in width according to circumstances. The servitude is the area through which the canal itself as well as the piece of land next to the canal passes and which the DWA may use to inspect and maintain the canal with. Only the officials from the DWA and the respective owners of the land through which the servitude passes are allowed to obtain access to the servitude.<sup>25</sup>

During ad hoc field visits by the researchers to the Boskop Dam area and the open-on-top cement western bank canal in the DWA servitude during 2010, they observed that the canal stretches through an area which geologically is underlain by dolomite rock. At various places, the canal is visibly cracked and broken with clear seepage of water into the surrounding weathered soil of the underlying dolomite.

The service road in the DWA servitude is also fully overgrown with bushes and shrubs and has not been maintained and can even barely be driven along in a 4x4 vehicle. Furthermore, no safety and security features are being built in and maintained along the servitude of the canal; especially where it crosses roads and passes close to farm houses. Informal squatting is also taking place at various places along the canal system and the Mooi River banks. See Image 3 for a photo indicating the nature of the ill-maintained DWA cement canal and servitude:

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23 Interview, Mr L Caldwell (Regional Manager, DWA, Potchefstroom)/Prof EJ Nealer (Researcher), 16 April 2010.

24 Interview, Mr B Nell (Chief Scientist, Tlokwe City Council)/Prof EJ Nealer (Researcher), 28 January 2011.

25 Interview, Mr L Caldwell (Regional Manager, DWA, Potchefstroom)/Prof EJ Nealer (Researcher), 5 May 2010.

Image 3: Nature and extent of the overgrown canal and its ill-maintained servitude



Source: EJ Nealer, 16 March 2010.

Higher up in the catchment at Rysmierbult, from the blood stains visible on the cement sides of the canal, it is clear that some squatters slaughter live stock right next to the water transporting canal and then merely wash the blood and waste material off into the water. Rumour also has it that livestock poachers have on occasion actually chased an animal into the water canal where it then got stuck due to the slippery algae on the cement walls of the canal and where the poachers then killed and slaughtered it in the canal. At two places along the canal the farmers have even built cattle kraals on top of and across the canal and do not try to prevent the cattle waste and urine from entering the water-transporting canal. According to Ben Nell this is against the law because the water purifying process cannot remove all the nitrates present in urine.<sup>26</sup> See Image 4 for a photo of the exact spot where slaughtering and informal squatting is taking place:

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<sup>26</sup> Interview, Mr B Nell (Chief Scientist, Tlokwe City Council)/Prof EJ Nealer (Researcher), 14 February 2011.

Image 4: Unlawful theft of water from the canal as well as some visible slaughtering of live stock on the cement overhang



Source: EJ Nealer, 16 March 2010.

At this moment in time the downstream located city of Potchefstroom's water is managed by the Regional Office of the Department of Water Affairs (DWA) which collects, stores, manages and controls the surface water from the Mooi River catchment and groundwater flowing from the natural springs, into the Boskop Dam (12km north of the city). One of these springs is the Gerhard Minnebron which, as the largest natural spring in the Southern hemisphere and situated 5km north of Boskop Dam, yields water at a flow rate of 60 - 80 Mℓ (mega litres) per day.<sup>27</sup> See Image 5 for a photo of the spring:

Image 5: Gerhard Minnebron



Source: EJ Nealer, 29 September 2010.

<sup>31</sup> F Winde, "Challenges for Sustainable Water Use in Dolomitic Mining Regions of South Africa – a Case Study of Uranium Pollution. Part 1: Sources and Pathways", *Progress in Physical Geography* 27, 2006, pp. 333-347.

The regional Office of DWA situated in Potchefstroom is responsible for inter alia, the maintenance of all the cement canals in the Mooi River Catchment region. Nevertheless, the DWA office stated that under the previous government dispensation it had 100 personnel members to manage all its responsibilities. Today this office has to cope with a workforce of only 20 personnel members and consequently it acknowledges that the canals are in a bad state.<sup>28</sup>

The North West Province's Department of Environmental Affairs in Mahikeng also does not play any role in the collection, storage and treatment of Potchefstroom's potable water. The onus lies on Tlokwe Local Municipality to see to the quality of water that reaches the residents' homes. The DWA in Potchefstroom is only in contact with the Tlokwe Local Municipality in the sense of providing raw water to the Municipality's water purification works and giving co-operation if needed. The Municipality, in the final instance, is responsible for the treatment of the canal-transported water before reticulation. The Municipality is not concerned with the management of the surface water catchment area (dams, canals, land-use and rivers) because it considers this the primary function of the Regional Office of DWA.

From the review and discussion thus far, it is alarming and almost unbelievable that DWA and the Municipality, now (170 years since the establishment of Potchefstroom), still see it fit to transport the city's raw water destined for drinking, in an open-on-top and uncovered cement canal. This could explain why a municipal resident of Potchefstroom who, for example, uses 37Kℓ of water, only pays R4-54/Kℓ<sup>29</sup> whereas a residential water user in Klerksdorp (whose water originates from the Vaal River) has to pay R11-16/Kℓ<sup>30</sup> and one in Carletonville (where water originates from the Lesotho Highlands Water Scheme) R10-35/Kℓ.<sup>31</sup>

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28 Interview, Mr L Caldwell (Regional Manager, DWA, Potchefstroom)/Prof EJ Nealer (Researcher), 16 April 2010.

29 Interview, Ms R Meyer (Accounts Section, Tlokwe City Council)/Ms E Annandale (Researcher), 23 November 2010.

30 Interview, Mr T Diseko (Accounts Section, Matlosana Local Municipality)/Ms E Annandale (Researcher), 23 November 2010.

31 Interview, Ms R Pretorius (Accounts Section, Merafong Local Municipality)/Ms E Annandale (Researcher), 23 November 2010.

## **Conclusion and the way forward**

It can be concluded that the founding and establishment of the city of Potchefstroom has a long history of orderly planned and peaceful development in a 'scenically beautiful' physical environment, albeit that its surface water catchment area resides in a geologically highly sensitive dolomite rock underlain area. This fact calls for a more sensitive and scientific approach and protocol to be followed regarding town development in general.

The current state of the water-transporting canal from Boskop Dam to the water purification works of Tlokwe Local Municipality leaves much to be desired and that the possible water losses into the underlying dolomite (karst) landscape and pollution of the canal cannot be resolved immediately. This unsatisfactory state of water resources management unfortunately can lead to the outbreak of water-related diseases that might cause severe epidemics. The fact that the raw-water transporting canal of DWA is built on dolomite rock also causes the risk of sinkholes forming when water spillages or cracks in the cement canal occur.

One can also deduce that the effective management of a city's potable water has now become a very complex activity due to a high level of diversity encompassed in the different integrated actions needed for it. This emphasises the fact that one public service provider cannot do it alone any longer and that the vehicle of effective co-operative governance should be utilised to identify all involved, interested and committed role-players and stakeholders and to continuously coordinate their actions in a highly integrated attempt to achieve improved water resources management in the local government sphere of the developing South Africa.

From the aforementioned conclusions the following recommendations can be made to try and improve the transport of the raw water in the open-on-top cement canal from Boskop Dam to the water purification works of Tlokwe Local Municipality:

- The Regional Office of DWA located in Potchefstroom must be allocated the necessary exposure and even publicity opportunities to strengthen the public institution's capacity and quest to improved water resources management in a more integrated manner for the Mooi River catchment as a holistic whole.
- Other strategically important role-players and stakeholders like the School for Social and Government Studies, Environmental Sciences and Management

Unit, African Centre for Disaster Studies at NWU's Potchefstroom Campus, CudyWat Niche at the Vaaltriangle Campus of the University, AGES etc. must become more visible, accessible and volunteer to join forces in very much needed Public-Private-Partnerships (PPPs) and effective co-operative governance with the respective offices of DWA and the Tlokwe Local Municipality. The necessary legislation has been promulgated to support this quest for improved municipal service delivery. The responsible government officials and involved role-players must just start to implement, monitor and review it more effectively.

- An “Informing the community members project” about the status of the City’s potable water with reference to, for example, good news on the existence of the Gerhard Minnebron natural spring, the very low water tariffs which residents have to pay, the obtaining of DWA’s Blue Drop status over the past two years, and the origin of the potable water as well as the destiny of the used water should be established through the use of modern communication media.<sup>32</sup>
- From a Disaster Risk Management point of view, it is crucial for the public management of the Mooi River Catchment Area to be improved to facilitate more sustainable environmental health by means of, inter alia, improved public management and administration, disaster risk management, and development in general over the long run.

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32 ES Van Eeden and EJ Nealer, ‘Interdisciplinary reflections on the challenge of environmental management in dolomitic areas of South Africa – The case of Delmas and Merafong City local municipalities’, *Administratio Publica*, Vol. 19, No. 3, September 2011, p. 130.