

Effects of dewatering and sinkholes on people and environment – an analysis of the Carletonville area in Gauteng, South Africa

*ELIZE S. VAN EEDEN, BRAAM DE VILLIERS, HERMAN STRYDOM AND
LESLIE STOCH**

Introduction.

To older generations the sinkholes that formed in the Carletonville municipal area¹ (Oberholzer Compartment) of the Gauteng Province of South Africa, especially during the sixties and seventies, are well-known. During 1964 permits were granted to the gold mines to drain three dolomitic compartments. The 1964 dewatering permits served to legitimise the illegal dewatering of the dolomitic compartments which had commenced in the fifties. Since then dewatering has had a serious impact on the ecology of the area and its environs. Amongst others, the Mooi River downstream was seriously contaminated. This ultimate decision by Government was clouded

* Elize S. van Eeden of *Historical Dimensions CC* (Box 8962, Centurion, 0046: historicaldimensions@mweb.co.za) is a part-time extraordinary associate professor at the Potchefstroom University. Her most recent publication (in conjunction with Dr Otto Terblanché of the University of Port Elizabeth) is *The Kohler Story, 1871-2002*, published in January 2002. Prof. A.B. de Villiers of the geography subject group at Potchefstroom University has recently retired; Prof. H. Strydom is head of the social work subject group; Dr E.J. Stoch is a geologist and former resident of Carletonville. Valuable direct and indirect contributions of other experts are also acknowledged: the late Dr F.J. Wolmarans (formerly a private consultant in Geology and also a former resident of Carletonville); N. J. Jacobs (Environmental Historian of the Brown University) and empirical research input from Ph.D. geography students Sarah Currie and Marthie Coetzee (PUCHE). This article is based on an oral and poster presentation at the nineteenth International Congress of Historical Sciences, 6-13 August 2000, Oslo, Norway, oral and poster presentation, 9 August 2000.

1 . The area known as Carletonville was proclaimed in 1948. In 1959 it became a municipal area. Before 1948, and for a long period during the nineteenth century, the area was part of the Gatsrand Ward of the Potchefstroom District. For discussion purposes this area will be referred to as Carletonville (named after an engineer, Guy Carleton Jones, of Consolidated Goldfields). See E.S. van Eeden, *Carletonville van pionierstreek tot goudspens*, Pretoria, 1995, p. 66.

by the most seductive of economic laws, namely greater profit and increased tax.

From a national point of view, the question of ethics and the human rights of those affected became insignificant issues. It appears that the State elected not to be accountable for the serious psychological and economic setbacks suffered by inhabitants of the area. The substantial cost that resulted from the exercise required to reverse the damage runs into millions of rands. With regard to these events the financial drawbacks suffered by well-known gold mines specifically, as a result of damage caused to the mining infrastructure and property, as well as loss of lives of employees and their families, aroused concern. Farmers and some businessmen from time to time raised serious objections to the dewatering of compartments, and to the consequences of polluted water due to mining activity.

On the contrary, the approach of central government was apparently two-pronged: firstly, it had what it regarded as a duty to remain on good terms with the mining industry as a major source of income in the form of tax. Secondly, and stemming from the first, it saw as its task to pacify the Carletonville community with promises of future compensation for losses suffered. A number of investigations by a variety of committees and commissions followed, all serving to fulfil the government's goal of pacifying the community. None of these were based on acceptable democratic principles. Recollection and 'oral mining history' bear testimony to falsified signatures on confidential reports that were never made public, and to authors who never saw nor approved the final product.² Against this background a multi-faceted perspective will be presented on the effects of dewatering in the Carletonville municipal area.

A topographic and historical background to the existence of water in the Carletonville Municipal area and environs, 1838-1963.

Topographic background. (See Figure 1.)

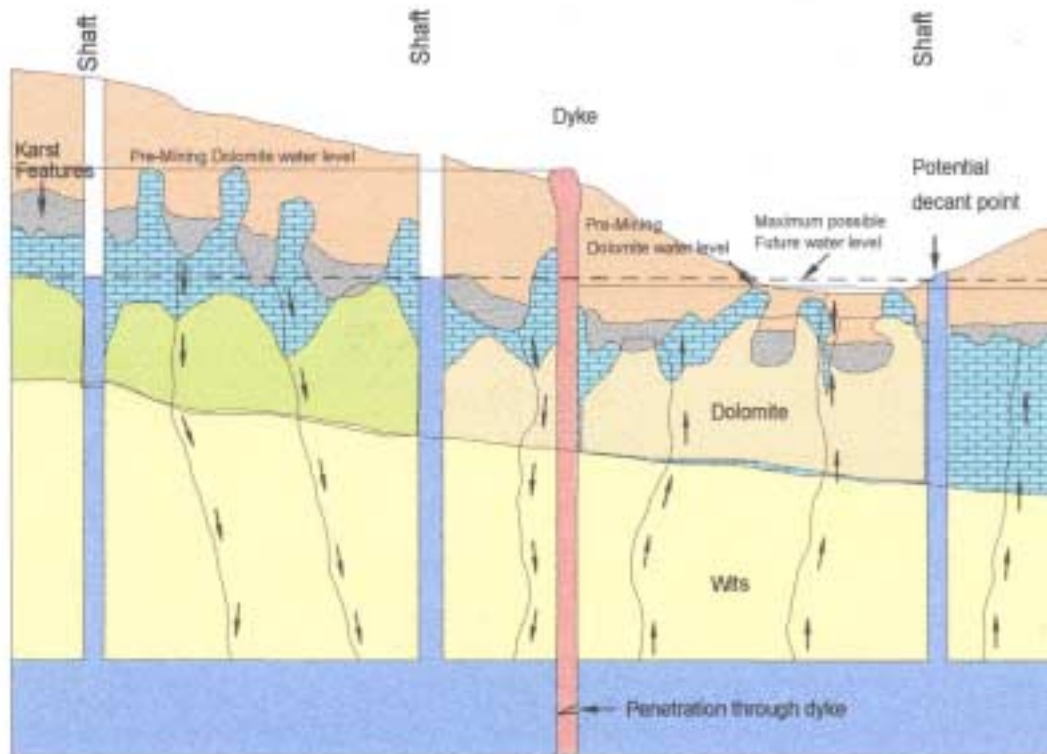
Physical characteristics and geology of the Wonderfontein catchment. The tributary of the Mooi River draining the Carletonville area is the Wonderfontein Spruit. This area will be referred to as the Wonderfontein Catchment for the purpose of this discussion. This drainage system is located to the west of Johannesburg in the Gauteng Province and is also known as the Far West Rand area. The geology of the area has been extensively researched

2 . PUCHE, Carletonville Project, Interview Dr E.J. Stoch, 19 April 1989; Union of South Africa, Dept. of Water Affairs, Report on certain Irrigation Board findings on the distribution system, 1958-1959. 1958. W.P. Series 1958(9)/1958. Pretoria: Government Printers.

and documented, primarily owing to the presence of rich gold reserves.³ The gold deposits of the Carletonville area, as part of the Far West Rand area, were regarded as some of the richest gold reserves in the world. The Carletonville gold mines are located in the Witwatersrand Supergroup dated at 2800 – 2700 million years BP (Before Present).⁴

Figure 1

A SCHEMATIC DIAGRAM ILLUSTRATING THE HISTORIC, CURRENT AND FUTURE SITUATIONS OF WATER LEVELS IN THE STUDY AREA.



The region is geologically also notable for its complex system of dolomite compartments (the dolomite being part of the Chuniespoort group of approximately 2300 million years BP)⁵ of the Transvaal Supergroup and dykes. The dolomite at one time comprised the main source of the potable

-
3. R.A. PELLETIER, “Contributions to the Geology of the Far West Rand”, *Transactions of the Geological Society of South Africa*, XL, July 1937, pp. 130, 139; W.M. WALKER, “The West Wits Line”, *South African Journal for Economics*, 18(1), March 1950, pp. 16-17.
 4. “Before Present” is a well-known concept in the discipline of geography. Also see L.E. KENT (comp.) for the South African Committee for Stratigraphy (SACS), “Stratigraphy of South Africa” in *Republic of South Africa, Department of Mineral and Energy Affairs, Geological Survey South Africa*, 8, 1980.
 5. See L.E. KENT (comp.) and SACS, “Stratigraphy of South Africa “...8, 1980, fig. 1.3.1.

water for the city of Johannesburg and surrounding areas.⁶ The dykes were responsible for the formation of the underground water compartments. They are composed mainly of nepheline syenite and are of Pilanesberg age (1330 to 1290 million years BP). Many of the dykes cut through the Chuniespoort dolomite have the effect of creating watertight compartments within the dolomite. These compartments act as potential conduits for groundwater flow in the underlying formations. Each compartment, therefore, has the ability to hold vast quantities of water and tends to be completely watertight in relation to adjacent compartments. Compartments within the Wonderfontein Spruit include the Gemsbokfontein, Zuurbekom, Venterspost, Bank, Oberholzer and Boskop/Turffontein compartments.⁷

Topography. The topography of the Wonderfontein Catchment is strongly influenced by the various geological phenomena located both outside and inside the Catchment Area boundaries. The terrain of the area is relatively flat with elevations ranging from 1750 m above mean sea level in the southeast to 1400 m at the confluence with the Mooi River. The topography of the area is dominated by the Gatsrante, a series of east to west trending cuestas with an average height of approximately 100 m above the footslopes. The Wonderfontein has an outflow parallel with and to the north of this range of hills in a very broad open valley, which descends from the footslopes to the Spruit approximately 100 m lower down.⁸

Due to extensive gold mining in the Carletonville area since 1937, the topography of the Wonderfontein Spruit has been drastically altered in its upper reaches. The main impact on the topography has been the physical presence of tailings dams, rock dumps and surface infrastructure. Rock dumps and tailings dams in excess of 20 m in height created a noticeable change in the otherwise generally flat to undulating topography. The formation and presence of sinkholes also altered the natural topography of the Catchment. Although occurring as a natural process, the numerous new sinkholes in the study area have been attributed to the dewatering of the dolomite compartments by the gold mines in the area.⁹ (*See figures 1-2.*)

6 . See Section 2.1 and J.R. SHORTEN, *The story of Johannesburg*, Johannesburg, 1970, pp. 53, 167, 168, 359.

7 . See L.E. Kent (comp.) and SACS, "Stratigraphy of South Africa "...8, 1980, fig. 1.3.1.; J.F. WOLMARANS, *Die ontwatering van die dolomietgebied aan die Verre Wes-Rand: Gebeure in perspektief*, (Ph.D. University of Pretoria, 1984).

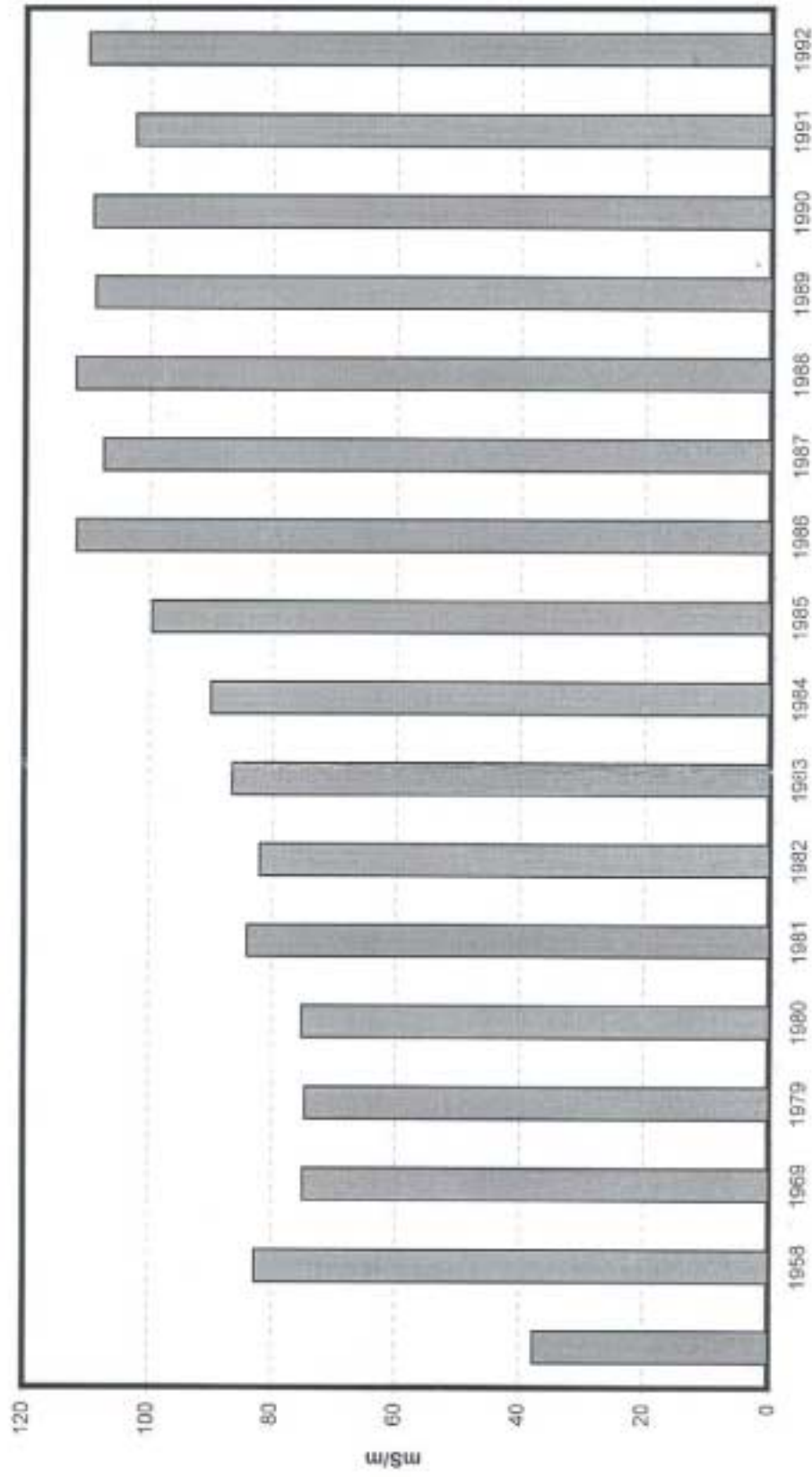
8 . See the topographical map RSA, 1:50 000, Carletonville 2627 AD.

9 . See J.F. WOLMARANS, *Die ontwatering van die dolomietgebied aan die Verre Wes-Rand: Gebeure in perspektief*, p. 104; W.M. WALKER, "The West Wits Line", *South African Journal for Economics*, 18(1), March 1950, pp. 16-20; R. MACNAB, *Gold, their touchstone: Gold Fields South Africa, 1887-1987, a centenary story*, Bergvlei, 1987, pp. 144-145; 214-222.

Figure 2

Impact of Mine Tailings on a dolomitic Spring

Conductivity: Annual Averages



copy of this report
from the file

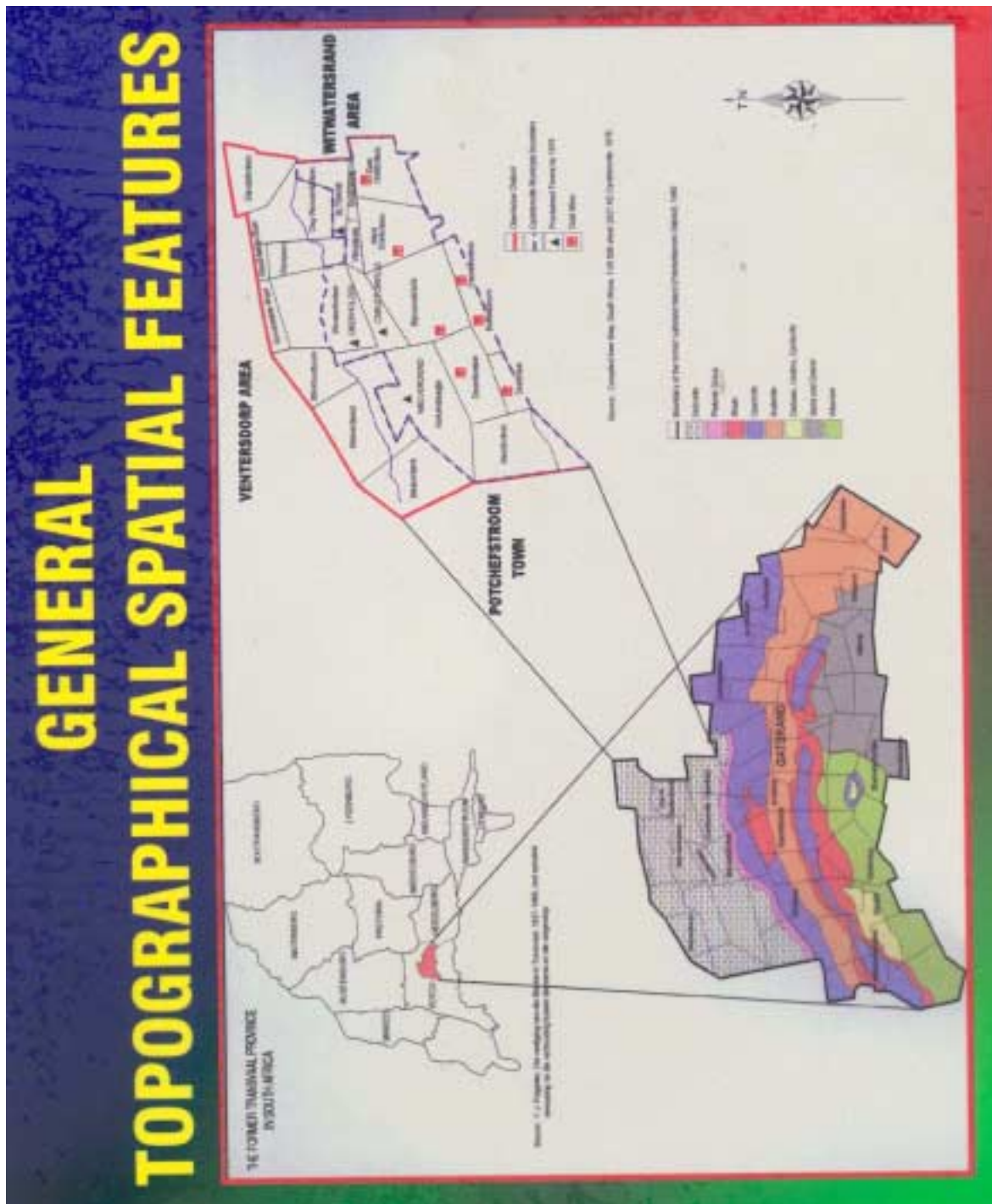
Historical background.

The water position in the Gatsrand Ward. According to documented reports and the memories of travellers in the early nineteenth century, plenty of water existed in the present-day Carletonville and its surrounds.¹⁰ From a geographical point of view, this area is also characterised by a number of prehistoric sinkholes already visible before extensive human presence in this area during the twentieth century. (See Map 1.) Before that time these subsidences¹¹ were largely the result of floods caused by heavy rains.¹² The first evidence of human intervention and control of water dates back to 1851. The establishment of white governance and the occupation of farming land led to the land being divided up among Voortrekker emigrants.¹³ Underground water in the study area that appeared on the surface became known as natural springs or ‘eyes’. One was known as the Eye of Wonderfontein (on the farm Bank) and the other as Wonderfontein Eye (on the farm Wonderfontein). Both these natural springs contributed water to the Mooi River west of Carletonville, where it connected with the Boskop area as an important source of water for the city of Potchefstroom.¹⁴

Since the nineteenth century and well through the early period of the twentieth century, governments of the former Transvaal area were periodically compelled to become involved in quarrels between local owners,¹⁵ and even between owners and surrounding cities, about the water use and division of this area’s underground water.¹⁶ Therefore, for about the first 50 years of the twentieth century, underground water resources of the

-
- 10 . National Archive, Pretoria, Witwatersrand Supply Commission, 1901-1902, File W. 50, Wonderfontein Water Supply Float Survey of springs, sources and main arms of river below Wonderfontein springs, August 1901, map 3/1868; J.R. SHORTEN, *Die verhaal van Johannesburg/The story of Johannesburg*, Johannesburg, 1970, pp. 53, 167, 168, 359.
 - 11 . J.F. WOLMARANS, *Ontwatering van die dolomietgebied aan die Verre Wes-Rand...*, p. 13.
 - 12 . For a more detailed view on the topography see section 2.2. Also compare J.F. WOLMARANS, *Ontwatering van die dolomietgebied aan die Verre Wes-Rand...*
 - 13 . Compare State Secretary, TRANSVAAL ARCHIVE (TA) in the National Archive, Pretoria, Ref. R930/55: *Nieuwe wetten voor de maatschappij der Hollandsche Afrikanen benoorden de Vaalrivier*, 1855; DEPARTMENT OF JUSTICE (TA), Ref. LD1268 nr. AG 223/07: Deed of Agreement no. 194, 28 October 1876.
 - 14 . Compare Office of the Secretary, Administration of Pretoria, Minutes of a meeting of the Executive Council, 31 July 1901, p. 70.
 - 15 . NATIONAL ARCHIVE (NAB), TKP, Executive Committee Minutes, Minutes, 31 July 1901, p.70; NAB, Witwatersrand Water Supply Commission, 1901-1902, File W. 50, August 1901, maps 3/1868; 1/379 and 1/380; Department of Justice (TA), Ref. LD1268, no. AG 223/07: Rooth en Wessels/Minister of Lands, 5 June 1907.
 - 16 . NAB, TKP, Executive Committee Minutes, Minutes, 31 July 1901, p. 70; NAB, Witwatersrand Water Supply Commission, 1901-1902, File W. 50, August 1901, maps 3/1868; 1/379 and 1/380; Department of Justice (TA), Ref. LD1268 nr. AG 223/07: Rooth en Wessels/Minister of Lands, 5 June 1907.

Carletonville area served mainly the agricultural sector of the small number of inhabitants on surrounding farms.¹⁷ By 1957 these water resources produced about 54 million litres per day. Gold mining in the area has since affected the water and ground stability in the Carletonville area.¹⁸



17. E.S. VAN EEDEN, *Ekonomiese ontwikkeling en die invloed daarvan op Carletonville, 1948-1988: 'n Historiese studie* (Ph.D. PUCHE, 1992), pp. 118-119.
18. E.S. VAN EEDEN, *Die geskiedenis van die Gatsrand vanaf die vestiging van die Trekkergemeenskap omstreeks 1839 tot die proklamering van Carletonville in 1948*, (MA, PUCHE, 1988), pp. 21-24.

Prospecting for gold – water resources at stake. Early prospecting for gold in the Carletonville area got under way between 1899 and 1911. Three gold mining companies were unsuccessful in their prospecting efforts, mainly because of constraints the underground water-bearing dolomite formation caused in identifying gold ores.¹⁹ Three decades of prospecting commenced when Consolidated Gold Fields Limited made use of the most advanced technology of the time. Gold was discovered by means of the so-called geomagnetic method of prospecting. To mine the gold in these water-bearing compartments, an underground cementation process was developed in order to secure the sealing of dolomite fissures through which water could penetrate. The involvement of West Witwatersrand Area Limited, since 1932, led to the opening of four gold mines by different gold mining groups in the Carletonville area from 1937 to 1962.²⁰ They were Barlow Rand Limited Corporation (Blyvooruitzicht gold mine), Gold Fields of South Africa (with two mines, namely West Driefontein and Doornfontein) and Anglo American Corporation (Western Deep Levels gold mine).²¹ From 1937 to 1948 several towns were also proclaimed, namely West Wits (1937), Oberholzer (1939), Bank (1940), Welverdiend (1942), Blybank (1947) and Carletonville (1948).²² Apart from these towns mining communities were also accommodated on mine property.²³ From July 1959 the Carletonville Municipal area was proclaimed, which included all the mining areas and towns mentioned above. (See below a discussion on the effects of dewatering in some of these areas in Carletonville.)²⁴ Venterspost, a mining area just beyond the eastern borders of the Carletonville area, was the first to experience difficulty with dewatering by the cementation process. By 1949

-
- 19 . R.A. PELLETIER, “Contributions to the Geology of the Far West Rand”, *Transactions of the Geological Society of South Africa*, XL, July 1937, pp. 130, 139; W.M. WALKER, “The West Wits Line”, *South African Journal for Economics*, 18(1), March 1950, pp.16-17.
- 20 . A.P. CARTWRIGHT, *Gold paved the way*, pp. 145; 150-151; 160-172; H.F. OPPENHEIMER, “The Anglo American Corporation’s role in South Africa’s gold mining industry”, *Optima*, 34(2), June 1986, p. 63.
- 21 . P.J. MALAN, “50 Jare van saamwerking in die mynbou”, Vereniging van Ondergrondse Amptenare, 1969, pp. 67-69; S.R. POTTER (ed.), *South African Mining and Engineering Year Book, 1950-1951*, p. 67.
- 22 . E.S. VAN EEDEN, *Ekonomiese ontwikkeling en die invloed daarvan op Carletonville, 1948-1988...*, pp. 23; 24-30.
- 23 . *Rand Daily Mail*, 2 July 1959, p. 6; W. HAGAN-WATSON, “Down memory lane: Blyvoor's first 20 years”, pp. 1-10.
- 24 . UNION OF SOUTH AFRICA, Transvaal Province, *Official Newspaper*, CLXIX, 24 June 1959, columns 11-14; Carletonville (Munisipaliteit), LAC, Minutes: Minutes, 18 June 1959, pp. 6-7; E.S. VAN EEDEN, *Ekonomiese ontwikkeling en die invloed daarvan op Carletonville, 1948-1988...*, p. 31.

water in the Venterspost Dolomitic Compartment had been drawn down to such a low level that the spring in that area ceased to flow.²⁵

Farmers in the vicinity of the Oberholzer Compartment, on which the mining activities of the Carletonville area began, faced a threat similar to that at Venterspost. The Water Act of the day²⁶ decreed that the industrial activity was taking place in a subterranean water control area. This meant that the Ministry of Water Affairs had adequate authority over what was happening, but it was not applied in the cause of the environment. It appears as if the Ministries of Economic Affairs and of Mines were also probably well-informed about these events.²⁷ A new *Water Act* was promulgated in 1956,²⁸ ostensibly to strengthen the hands of the government in terms of the over-extraction of water. But by September 1959 the Wonderfontein Eye had dried up. An Interdepartmental Committee regarding dolomitic mine water was appointed at the time by the government, and it tabled its final report in 1960.²⁹ This Committee proposed that the Oberholzer Compartment be completely dewatered because of the problems that might arise within the mining activities underground. The then three mines were regarded as a valuable source of income for the South African government. Ironically enough, gold mines had already started to extract underground water freely before the Interdepartmental Committee's proposals were made public.³⁰ *Controversy regarding water extraction in the Carletonville Area: decision-making on national level continues.* Apart from the Interdepartmental Committee, a few other committees were also assigned to assist the government in coming to the most convenient conclusion about the future of underground water in Carletonville.³¹ A small number of residents of the area

-
- 25 . Compare J.F. WOLMARANS, *Die ontwatering van die dolomietgebied aan die Verre Wes-Rand*, p. 170; R. MACNAB, *Gold their touchstone: Gold Fields of South Africa, 1887-1987 - a centenary story*, Bergvlei, 1987, pp. 124; 212-213.
 - 26 . Information supplied by Dr E.J. Stoch and based on documents in his possession regarding dewatering in the Carletonville area.
 - 27 . Compare the activities and responses by the authorities referred to in E.S. VAN EEDEN, *Ekonomiese ontwikkeling en die invloed daarvan op Carletonville...*, pp. 34; 86-87; 89.
 - 28 . Information supplied by Dr E.J. Stoch and based on documents in his possession regarding dewatering in the Carletonville area.
 - 29 . UNION OF SOUTH AFRICA, "Final Report, Interdepartmental Committee on Dolomitic Mine Water Far West Rand", November 1960, pp. 5, 9, 22; J.F. WOLMARANS, *Die ontwatering van die dolomietgebied aan die Verre Wes-Rand ...*, p. 22.
 - 30 . Compare J.F. WOLMARANS, *Die ontwatering van die dolomietgebied aan die Verre Wes-Rand ...*, p.13; Memorandum, Oberholzer Irrigation Board submitted to the Select Committee Water Bill, 1960.
 - 31 . The Oberholzer Irrigation Board and the Joint Committee on Dewatering were fully aware of the proposals and approach with regard to the dewatering of the Oberholzer Compartment. See E.S. VAN EEDEN, *Ekonomiese ontwikkeling en die invloed daarvan op Carletonville, 1948-1988 ...*, pp. 84-86.

were invited to make inputs or contributions to committees, but according to some of them, always in a reserved fashion. Some were kept totally in the dark concerning government's decisions.³²

Meanwhile a group, called the Joint Committee on Dewatering of Mines in the Far West Rand, indicated support, in its 1963 report, for the views of the Interdepartmental Committee on dewatering. The Joint Committee, ironically, only accommodated members and expertise from four mining groups and two government departments³³ who had an interest in the area. Locals, especially local government, farmers and businessmen, conveniently escaped the thoughts of the decision makers. Not even the then notorious member of parliament, J.C. Greyling, was invited. The Joint Committee proposed guidelines for compensating residents and replacing borehole water that had dried up as a result of dewatering. Gold mines (especially the mines in the Gold Fields Group where work was seriously affected by the existence of underground water) were tasked to return a large percentage of the underground water to the compartment after dewatering. The founding of a dolomitic water association was also suggested.

By December 1963 nothing definite in this regard was in operation. Nor had the government lawfully allowed anyone to dewater the underground compartments in the Carletonville area by permanent permits.³⁴ But government probably knew about activities of the gold mines operating with temporary permits. On this a well-known former businessman of the Carletonville area in the sixties, J. van Rooyen, said:

The fact that West Drie [one of the gold mines of the then Gold Fields group] had failed to return at least 80% of the water to the compartment, was one of the best kept secrets of the mining industry and of the previous government. The Claimant discovered that West Drie had transgressed the parameters of their temporary permits ...³⁵

After dewatering had become a frequent activity of the mines, apparently with or without even temporary permits, the appearance of new sinkholes caused a chaotic and nerve-racking situation for the people of Carletonville. This lasted at least up to 1972. To understand fully high-level human

32 . Memories, Dr E.J. Stoch (former farmer and resident of the Carletonville area), 1992; Letter J. van Rooyen/E.S. van Eeden, 27 January 1999.

33 . Compare the outline of members supplied in the Report of 1963: Personal Documents, Dr E.J. Stoch, Report of the Joint Committee on Dewatering of Mines: Far West Rand, 4 June 1963.

34 . Compare memories Dr E.J. Stoch, 1992, and the Stoch documents.

35 . J. VAN ROOYEN, "Claim for damages as a result of dewatering of the Oberholzer Compartment during the period 1957 to 1964," Claim, 11 November 1997 (document in the possession of Van Rooyen), p. 7.

intervention in local water resources such as the case in the Carletonville area, the following section is presented.

The influence of water extraction on the physical environment, 1964-2000.

Underground water. Water is transferred between compartments via the series of ‘eyes’ or natural springs mentioned in the previous section. These eyes are located on the surface at the lowest point in the landscape where a dyke intersects the surface of the land. Due to the influx of large quantities of water into the underground workings of the mines, these were granted permission during the fifties and sixties to dewater some of the compartments (see previous section) and to pierce dykes forming different compartments.³⁶ Due to the cavernous nature of the dolomite, continuous subsurface erosion from water percolating through the covering soil eventually results in sinkholes or surface subsidence. Excessive artificial raising or lowering of the groundwater table within a compartment then disturbs equilibrium and results in renewed subsurface erosion, or with a raising of the water table, a change in the cohesive strength of the soil bridging sub-surface cavities. Additional sinkholes and dolines usually occur and continue to form until a new state of equilibrium has been reached. Many scientific records exist on how natural factors lead to the formation of sinkholes.³⁷ The situation in the Carletonville area, however, appears to be unique since water extraction in a potential sinkhole area was lawfully approved.³⁸

Groundwater quality. Natural groundwater quality from dolomite in the Far West Rand (part of the study area – *See Map 1.*) is generally good as far as the total dissolved salt values (TDS) are concerned. These values appear to be less than 200 mg/ .³⁹ However, these waters can easily become polluted due to open joints, faults and solution channels along which surface water has easy access to groundwater. Surface subsidence such as sinkholes provides direct conduits for polluted rain, storm water and the unauthorised dumping of refuse and waste. Other sources of pollution include extensive

36 . Information supplied by Dr E.J. Stoch and based on documents in his possession regarding dewatering in the Carletonville area.

37 . See e.g. D. BRIGGS AND P. STRATTON, *Fundamentals of physical geography*, Hutchinson: London, 1985; J.N. JENNINGS, *Karst & Geomorphology*, (Oxford, 1985).

38 . Compare J.N. JENNINGS, *Karst geomorphology*, pp. 19-32.

39 . VAN WYK AND LOUW, “Statistics undocumented,” 1993. It is assumed that the salt content prior to the development of mining activities in the Carletonville area was good because there were no other influences prior to mining activities that could have affected the water quality negatively. However, due to a lack of more detailed historical information for the period discussed, it is assumed that the quality of the groundwater indeed was better than in the nineties of the twentieth century.

urbanisation, in particular low cost housing projects that use pit latrines,⁴⁰ or aqua-privies type sewage disposal systems.

The gold mines and agricultural activities in the Carletonville area brought about a further source of pollution of the dolomite. Gold mining has the potential to pollute groundwater by means of:

- Ø Acid mine drainage whereby pyrite from rock dumps and slime dams oxidise to form sulphuric acid and iron in solution. The result is water with a low *pH* and high dissolved iron content. All dumps located above dolomite have their acid mine drainage neutralised as the water passes through the dolomite; thus the low *pH* rapidly rises. Many of the heavy metals will precipitate from this high *pH* solution but sulphate, calcium and magnesium will contribute to high salinity of characteristic composition; and
- Ø Radioactive contamination of soil, water and air (since the ores in the mining area contain significant amounts of uranium wastes that are disposed of without uranium recovery) have the potential to generate a radiogenic hazard. Uranium is a radioactive metal which includes compounds dependent on oxidation or reduction and the *pH* conditions of the environment.⁴¹

As a result of urbanisation, pollution from domestic and industrial waste disposal is difficult to control properly, due to the frequently bad location of waste sites, the dumping of toxic (often liquid) waste and the scavenging and squatting of jobless and homeless people. Leaches generated at a waste site are often rapidly introduced to groundwater through the removal of topsoil; outcrop mining and exploration trenches; and open pit quarries that are dug in the area and later converted into licensed waste disposal sites.⁴² These also concern the area under study.⁴³

40 . Palmer Development Group, (in association with Maketha Development Consultants), "Review of rural sanitation in South Africa," executive summary and main report to Mvula Trust and the Water Research Commission, April 1995.

41 . G. WENDEL, "Radioactivity in mines and mine water – sources and mechanisms," *South African Institute for Mining and Metallurgy*, March/April 1998; M.A. Ford, "Uranium in South Africa," *South African Institute for Mining and Metallurgy*, February 1993; P.L. KEMPSTER, H.R. VAN VLIET, U. LOOSER, I. PARKER, M.J.SIEBERBAUER AND P. DU TOIT, "Overview of radioactivity in water resources: uranium, radium and thorium," *IWQS* Pretoria, 1996.

42 . C.A.R. BAIN, H.J. SCHOONBEE, L.P.D. DE WET, J.J. HANCKE, "Investigations into the concentration of ratios of selected radionuclides in aquatic ecosystems affected by mine drainage effluents with reference to the study of potential pathways to man," W.R.C. report no. 313/1/94 1994.

43 . Based on personal observations since the mid-nineties by the writer of this section, A.B. deVilliers.

Spruit water and irrigation. The Wonderfontein Spruit originates south of Krugersdorp. The gradient of the Wonderfontein Spruit in this area is low. Before dewatering in the sixties, the stream used to flow in a westerly direction past the gold mining towns of Westonaria, Carletonville and Wilverdiend, but the gold mines and the redirection of water into a series of canals and pipelines drastically altered the natural drainage of the stream. Mine water is pumped to the surface and channelled into a series of canals and pipelines to prevent the water from percolating back into the underlying dolomite compartments. As a result of this dewatering, the land surface has become very unstable and sinkholes and dolines have formed, thereby resulting in extensive geomorphological changes to the river course. Due to the low gradient and flat nature of the area, wetland systems are common. These wetlands are important ecological systems that need to be protected and preserved.

Dams in the drainage basin, as recorded by 1999, included the Tudor, Lancaster, JCI Attenuation, Donaldson, Harry's and Padda dams. The Tudor and Lancaster Dams both contain slime which is partially concealed by reed beds. The water in these dams is pumped from the mines as part of their dewatering programmes. At the time of this study (2001) the water was used for irrigating crops and for domestic and industrial use in the Carletonville region.⁴⁴ The natural drainage of the Wonderfontein Catchment has been considerably altered by the presence of canals, furrows and pipelines developed by the gold mines at the request of power structures at the time (See section 2). The surface runoff from Bekkersdal is drained via a storm water canal to join the overflow from the Donaldson Dam. The water flows into a 700 mm pipeline, which is then connected to a 1 m pipeline. This pipeline stretches over a distance of 26 km. Subterranean water from the Ventersdorp Gold Mine and the Hannes van Niekerk waste water treatment works are conveyed to the 1 m pipeline via a series of smaller (600 m) pipelines.⁴⁵

The Oberholzer canal system, which since the sixties supplied the Oberholzer Irrigation Board with fissure water, was discontinued in 1998. This water was pumped from the West Driefontein Gold Mine to supply farmers of the Oberholzer Irrigation Board (*See Visuals 1-3*). As previously stated, it is the quality of this water that was questioned.

44 . A.B. de Villiers, course notes, Environmental Geography, PUCHE, (1998).

45 . A.B. de Villiers, Mapping project, 1998-1999.

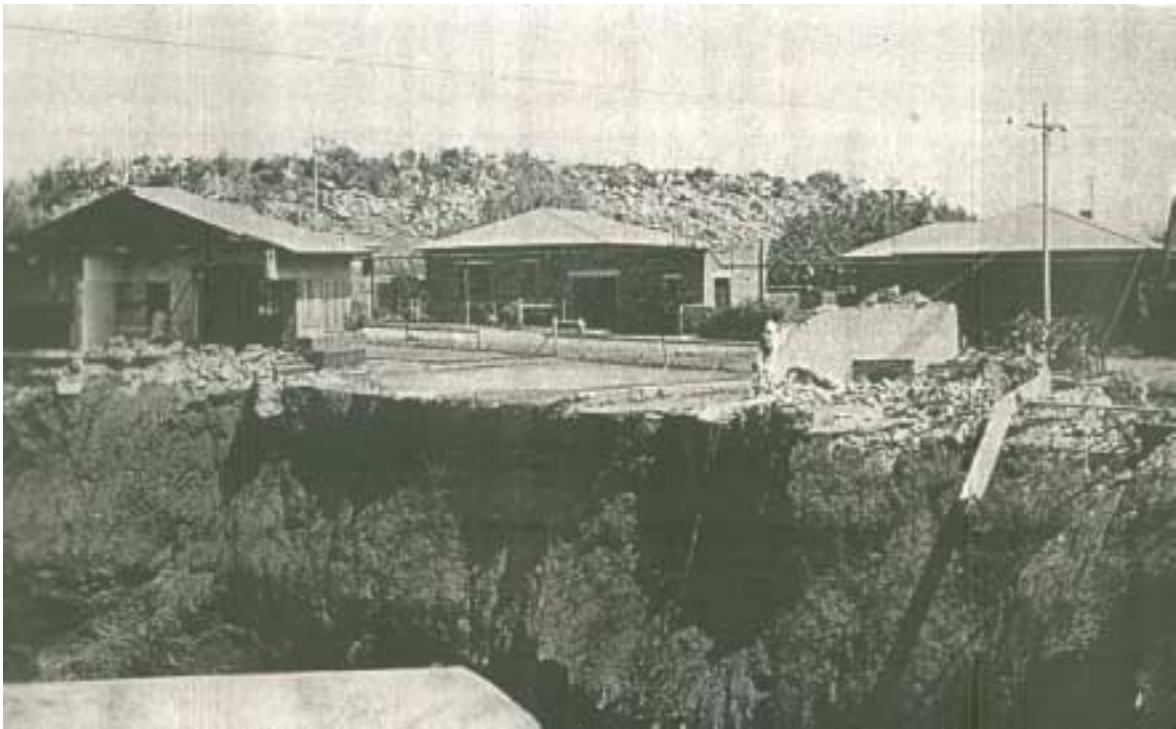


Visual 1: Water is piped across dewatered compartments to prevent pollution

Natural vegetation. Cultivation and mining have dramatically altered the natural vegetation of the Mooi River Catchment. The conservation status of the vegetation is very poor. Although originally an excellent cattle and sheep farming area, many parts have been ploughed for the cultivation of maize (approximately 65 per cent has been transformed).⁴⁶ By 2000 the natural vegetation was represented by only a few small remnants, which were often degraded as a result of overgrazing. Cattle were being grazed on the vegetation, but the dominance of sour grass species often result in a low nutrient status of the grass during winter. The natural vegetation is highly threatened by urbanisation, industrialisation and mining, though to a lesser degree by agriculture, where the maize production is limited in many places by shallow, rocky soils.⁴⁷

46 . Compare E.S. VAN EEDEN, *Ekonomiese ontwikkeling en die invloed daarvan op Carletonville, 1948-1988...*, On the agricultural development of the Carletonville area, Chapter 3; E.S. VAN EEDEN, *Die geskiedenis van die Gatsrand...*, pp. 21-34.

47 . Information from Sarah Currie, Ph.D. student in geography who is working on groundwater quality of the study area.



Visual 2: The sinkhole at Blijvooruitzicht on 3 August 1964 Source: B. Jacobs

Dewatering and its impact on people's lives, 1964-2000, an overview.

Awareness of the impact of sinkholes and water issues on people's lives started to become a reality for the Carletonville community when West Driefontein's crushing plant disappeared into a huge sinkhole on 12 December 1962. Thereafter more changes followed. How sinkholes have affected, and still affect, people's lives since 1964 will be broadly reviewed.

Infrastructural changes. The period 1959 to 1972 is accentuated because it is during that time which dewatering took place and sinkholes developed. Although sinkholes appeared to have become regular occurrences,⁴⁸ discussions on water pollution as being a result of dewatering causes concern and raises continuous debate.

Farming activities obstructed. Orderly arrangements started in 1964 for the use of water originating from dewatering for local irrigation purposes. This was done by the gold mining authorities through the construction of cement

48 . This statement is made because all activities in town continued regardless of sinkholes that appeared on almost a weekly basis. It may be that the locals' attitude was more a matter that they had to cope because of the difficulty of getting work elsewhere. Compare E.S. VAN EEDEN, *Ekonomiese ontwikkeling en die invloed daarvan op die Carletonville gemeenskap*, Chapters Two to Four.

channels and drainage pipes.⁴⁹ However, the consequences of these decisions and the use of water by farmers were more complex. The Interdepartmental Committee report, as referred to in section 2.1.3, predicted two ways in which dewatering could have an effect on the farming community. Firstly, dewatering provided an opportunity to expand the irrigation area, but it also raised questions about the period for which the water would last. This was because the mines themselves, as well as the mining communities needed water. Secondly, the dewatering process could lead to the drying up of boreholes.⁵⁰ This eventually happened before the Committee's report was made public.⁵¹ The futures of approximately 200 irrigation farmers, especially dairy farmers, were at stake.⁵²

By 1964 a Dolomitic Water Association was in operation, managed mainly by mining personnel. Carletonville farmers and other locals affected were advised by the Dolomitic Water Association to claim for losses where water shortages occurred. In the same year a State Technical Committee started to function. It operated in an advisory capacity to the Dolomitic Water Association.⁵³ On the farm Bank, and parts of other farms in surrounding areas, a series of sinkholes appeared during 1966. This led to questions with regard to compensation as the farmers had to leave their property.⁵⁴ Irrigation farmers started complaining because of a lack of compensation. They questioned the principles of compensation as devised by the Water Association, as well as the Association's competence.⁵⁵ The Transvaal Agricultural Union (TAU) Advisory Committee was invited, in February 1966, to represent the Carletonville area farmers in the Oberholzer district.

-
- 49 . E.S. VAN EEDEN, *Ekonomiese ontwikkeling en die invloed daarvan op die Carletonville gemeenskap*, Chapters Three and Four; N.J. VAN WYK, "Natural farming regions of Transvaal", *Farmers Weekly*, 77, 6 April 1949, p.52; J.J. STEYN, "Agtergrond tot departementele landbouvoorligting in Potchefstroom substreek," 1985, p. 1.
- 50 . J.F. WOLMARANS, *Die ontwatering van die dolomietgebied aan die Verre Wes-Rand*, p. 13; Carletonville (PU vir CHO), Ref. 1: Memorandum, Oberholzer Irrigation Board submitted to the Select Committee Water Bill, 1960.
- 51 . PUCHE, Carletonville Project, Interview, Dr E.J. Stoch/E.S. van Eeden, January 1995.
- 52 . Compare interview with Stoch and J.F. WOLMARANS, *Die ontwatering van die dolomietgebied aan die Verre Wes-Rand*, pp. 20-23; PUCHE Carletonville Project, Reference1: Minutes, Oberholzer Irrigation Board, ca. 1962-63.
- 53 . Documents, DR E.J. STOCH, Final Report, Interdepartmental Committee on Dolomitic Mine Water, Far West Rand, November 1960, pp. 5, 9, 22; J.F. WOLMARANS, *Die ontwatering van die dolomietgebied...*,p. 22.
- 54 . Compare newspaper impressions on the process of removal: *Carletonville Herald*, 30 January 1970; *The Star*, 24 March 1970; *Die Transvaler*, 29 April 1970; RSA, *Debates of the House of Assembly*, 24 May 1973, column 7633.
- 55 . Compare documents E.J. STOCH, Memorandum, Randfontein District Agricultural Union, and the Oberholzer Farmers' Union, 17 February 1966.

The Committee's purpose was to assist farmers in the negotiating process and the drafting of their land compensation claims.⁵⁶



Visual 3: The salts from slime dams was conducive to water pollution

While the process of compensation of farmers for losses incurred due to the formation of sinkholes was taking place, a water shortage also occurred. This caused further frustration among the farmers. Depleted water resources also affected the Oberholzer Irrigation Board to such an extent that the Ministry of Water Affairs decided to discharge some of its employees.⁵⁷ In the mean time the gold mining authorities arranged with the Rand Water Board (Johannesburg area) to supply water to 30 farmers in the Carletonville area for household use and irrigation.⁵⁸ With this gesture the Chamber of Mines may have hoped to avoid claims from farmers due to droughts. The farmers

56 . Documents, E.J. STOCH, Transvaal Agricultural Union Advisory Committee for the Far West Rand Dolomitic Area, Minutes, 19 April 1966; 20 April 1966 [a notice to farmers that the TAU will assist them]; 5 September 1966; “Boere na minister oor myne se water”, *Carleton Nuus/News*, 9 November 1967, p. 1.

57 . Documents E.J. STOCH, Memorandum, Randfontein District Agricultural Union, and the Oberholzer Farmers’ Union, 17 February 1966.

58 . Compare *Carletonville Herald*, 18 February 1966, p. 5; PUCHE, Carletonville Project, interview, G. Hommes (wife of Oberholzer township founder J.E. Hommes)/E.S. van Eeden, 29 November 1988.

themselves viewed compensation for their land, based on their valuations, as the most important issue.⁵⁹ Another very serious accusation by farmers against the West Driefontein gold mine specifically was with regard to the quality of water received through channels and drainage pipes the mines had installed over hectares of land. The presence of boron and aluminium, as well as a high phosphate content, had been investigated by some of the farmers. This investigation proved that water quality had deteriorated.⁶⁰ The results caused wide reaction.⁶¹ The high salt content of water aroused concern because of the effects it could have on crops and livestock. The lack of seed from bokwiet, maize and corn was also noticed, as well as the abnormal pigmentation of grass and clover. Deaths and deformities recorded in fish, goats and pigs were also ascribed to the water quality.⁶² While investigations commenced, the TAU Advisory Committee sent a deputation to the Ministry of Mining and Planning. This led to the appointment of a Commission of Enquiry. This Commission identified only a low calcium percentage in the water which was thought to be the reason for the animals' abnormalities.⁶³

The TAU Committee questioned these findings and urged the Commission to inform the public. This did not happen, and for years after 1971 silence prevailed. In the late eighties and nineties, so-called water pollution once again became an issue when researchers from various disciplines re-investigated some concerns. The main issue investigated was the possibility that water from the mines also negatively affected water consumers in the Mooi River-Boskop area (further west of Carletonville). The possible effects on fauna and flora in this area were also considered.

Dewatering gradually led to a forced removal of the affected farmers in the Carletonville area. By 1968 the Eye of Wonderfontein in the Bank Compartment had virtually run dry.

59 . Interview, Dr E.J. Stoch/E.S. van Eeden, June 1990.

60 . Based on results recorded by geologists and geographers up to 1996. It is believed that the presence of high quantities of sulphate might have been the main reason for concern in the late sixties, rather than boron or any other mineral mentioned. See chart outline in poster display on the Mooi River quality, 9 May 1997.

61 . Documents, E.J. STOCH, Transvaal Agricultural Union Advisory Committee for the Far West Rand Dolomitic Area, Minutes, 17 November 1967; 3 November 1968; M. VORSTER, "Report on the geohydrology of the Wonderfontein area," as telephonically discussed with a Dr Bredenkamp, Dept. of Geohydrology, Pretoria, 10 August 1989.

62 . Compare Documents E.J. STOCH, Letter, Lever's Stock Feeds Pty. Ltd./J.E. Hommes, 1 November 1968; Interview E.J. Stoch/E.S. van Eeden, 19 April 1989; *Herald vir die Goue Weste*, 29 November 1968; *Rand Daily Mail*, 8 December 1969.

63 . Documents, E.J. STOCH, Transvaal Agricultural Union Advisory Committee for the Far West Rand Dolomitic Area, Commission of Enquiry, 17 November 1967; 3 November 1968.



Visual 4: The dry river bed of the former Wonderfontein ‘eye’.

A total 54 sinkholes had formed during 1970, when the dewatering process of the Bank farming area approached completion.⁶⁴ Several farmers appeared to be reluctant to enter the fierce debate that developed among other farmers and the mines on the alleged issues of pollution and the scarcity of water. Crop failures, loss of livestock and apparent difficulty in obtaining sufficient compensation from the Dolomitic Water Association led to dismay among members of the farming community. It should be mentioned that some farmers were reasonably satisfied with their compensation, especially when more than one valuator became involved. Government also requested farmer involvement in the revision of the water acts because extant regulations did not make provision for ordinary citizen's rights to underground water. No amendments in this regard were recorded during the seventies. An improvement in compensation led the TAU Advisory Committee to discontinue their work.⁶⁵

With many ‘old’ faces in the farming community near Carletonville having gone out of business since 1972, new ones appeared on the scene after the Dolomitic Water Association made land available only for rent. By 2001 this was the prevailing situation, with the memory of sinkholes remaining

64 . J.F. WOLMARANS, Die ontwatering van die dolomietgebied aan die Verre Wes-Rand...,p.170.

65 . Documents, E.J. STOCH, Transvaal Agricultural Union Advisory Committee for the Far West Rand Dolomitic Area, Commission of Enquiry, May 1968; *Die Landbouweekblad*, 21 May 1968; interview Dr E.J. Stoch, 27 June 1990; 9 July 1990.

something of the past.⁶⁶ Yet with rumours of indirect water⁶⁷ pollution by the gold mines were still being debated.

The business sector of the Carletonville Township enters the sinkhole debate.

In contrast with the water problems experienced by farmers in the Carletonville area, the business sector of Carletonville experienced a loss of trade due to the sinkhole problem. On the one hand, businesses since the early fifties were geared to provide service to the mining industry, while on the other hand, general dealers served the community. The sinkhole problem that had developed since 1962 (*See Visual 4.*) contributed to a slackening in industrial growth experienced during the next two decades.



Visual 4: Sinkhole at the West Driefontein reduction plant in 1962

66 . PUCHE, Carletonville Project, interviews (residents of area), V. van Aswegen, 3 March 1989; G.G. Toxopeus, 3 March 1989; G. Hommes, 28 November 1988.

67 . Compare the Greater Carletonville Municipality, Council minutes, June 1996. An example of radioactivity analysis of Welverdiend's Borehole Water is referred to.

From 1965, when there were sixteen light industries, the number had declined to eleven in 1972.⁶⁸

In contrast with the industrial sector, the general dealers' trade was better able to survive in the disastrous sixties. The local Carletonville Chamber of Commerce acted as a conduit between the local government and the business sector. This was done to ensure transparency and to help retain business people still loyal to the area. Their actions included publicity ventures launched in co-operation with the Carletonville Town Council in 1963⁶⁹ and 1966.⁷⁰ A fear had arisen that the area's purchasing power and residents' property values might decline after the first sinkholes had appeared.⁷¹ The premises of approximately eighty-six trading dealers were affected. Some business people also experienced a serious labour shortage due to the unwillingness of those from outside the town to live and work within the area.⁷²

The lack of sufficient variety in goods offered, partially as a consequence of the sinkhole period, had led consumers to take their business to nearby towns such as Randfontein and Krugersdorp. Although the business sector indicated some growth between 1965 and 1969 (from 245 to 289 businesses)⁷³ their commercial future remained gloomy.

-
- 68 . CENTRAL ARCHIVE DEPOSITORY (CAD), Box 224, File 15/11/8(2), Carletonville township, letter, Townclerk Carletonville/Council for the Development of Natural Resources, 19 November 1964. According to this Council thirty-three industrial buildings in Carletonville were affected by sinkholes. This finding is different from the Municipal Year Book of 1964-65 which referred to sixteen light industries affected. See South African Association for Municipal Employees, *South African Municipal Yearbook*, 1964-65, p. 321; *South African Municipal Yearbook* 1971-72, p. 350.
- 69 . K. STEYTLER, "Transvaalse dorp trek windskeef", *Die Huisgenoot*, 22 February 1963, p. 8; *Carletonville Herald*, 24 February 1964, p. 1; 9 October 1964, p. 1; *Potchefstroom Herald*, 3 July 1964, p. 1; 21 February 1964, pp. 1-11 (Appendix: Streekskongres van die Afrikaanse Handelsinstituut) en TBP, Munisipaliteit Carletonville (MCV), lêer 93/1/27, "Streeksontwikkeling vir Wes-Transvaal en aangrensende gebiede: brosjure, terugblik oor tien jaar, 1964-1974", 31 October 1974.
- 70 . NAB, Municipality of Carletonville (MCV), Box 5, File 2/2/(3), Amptelike onthale en funksies: onthaal van finansiële instellings, 17 Augustus 1966, pp. 1-4.
- 71 . PUCHE, Carletonville Project, Reference Minutes Carletonville/Oberholzer Chamber of Commerce and Industries, minute, 4 June 1964; Reference 3, Interview A.E. Grundlingh/E.S. van Eeden, 19 October 1988; *Carletonville Herald*, 24 January 1964, p. 1.
- 72 . National Archive, Pretoria, CAD, Box 224, File 15/11/8(2), Carletonville Township: Letter, Town Clerk Carletonville/Council for the Development of Natural Resources, 19 November 1964.
- 73 . Municipal Year Book of 1964-65 that referred to sixteen light industries affected. See South African Association for Municipal Employees, *South African Municipal Yearbook*, 1964-65, p. 321; *South African Municipal Yearbook* 1968-69, p. 322.

Yet another debate commenced when it became known that the Dolomitic Water Association was not prepared to compensate traders for the financial loss they experienced as a result of provincial and local road closures. Two well-known businessmen then present, B. Lumley and J. van Rooyen, indicated their dissatisfaction with the attitude of the gold mines by appealing to the Dolomitic Board. This unhappiness resulted in the founding of the Carletonville Advisory Committee in 1966, following negotiations at government level (the Ministry of Mines). This Committee spoke for the Ministry with regard to the local situation in Carletonville. The Committee also requested the formation of an economic commission to assess the damage at Carletonville with the aim of restoring trust.⁷⁴ It is uncertain if results in this regard were ever published.

Government's involvement in the 'survival' of Carletonville did not immediately result in improvement. A number of businessmen, amongst them Lumley and Van Rooyen, had left Carletonville by June 1966. It was felt that neither the government, nor the mining authorities were sincere in their actions of compensation. According to Van Rooyen the weakness of the Dolomitic Water Association was due to the Association's being dominated by the representatives of the mines. He maintained:

[T]he most important other party – the victims of dewatering – were neither parties to this agreement, nor consulted; nor were they afforded their democratic right of representation on the Management Committee of the Association.⁷⁵

The mining authorities had in fact spent about R11 million in compensation by 1973. This did not include compensation for financial losses incurred as far as local infrastructure was concerned. In 1966 the expense in this regard was claimed to be R18 million.⁷⁶ Eventually trust in the town and its commerce was restored, due largely to the almost uninterrupted activity of the mines and the full support of the government.⁷⁷ In the town of Bank, however, drastic changes occurred when the Bank compartment was dewatered and the

74 . PUCHE, Carletonville Project, Reference 1, minutes, Carletonville/Oberholzer Chamber of Commerce and Industries, Minute, 6 February 1966; *Herald vir die Goue Weste*, 11 February 1966, p. 1.

75 . Compare Document, Claim, 11 November 1997, Claim for damages as a result of dewatering of the Oberholzer Water Compartment during the period 1957-1964 against the Far West Rand Dolomitic Water Association, West Driefontein Mining Company, J. van Rooyen, 1999, p. 10; *Herald vir die Goue Weste*, 24 June 1966, p. 1.

76 . Compare G. OLIVER, "Parliament given details of safety measures. Toll of the sinkholes", *The Star*, 29 January 1966.

77 . Compare Republic of South Africa, *Debates of the National Assembly*, 24 May 1973, columns, 7632-7634; E.S. VAN EEDEN, *Ekonomiese Ontwikkeling en die invloed daarvan op Carletonville, 1948-1988: n Historiese studie*, Chapters Two to Six.

appearance of sinkholes made inhabitation too dangerous. Some residents believed that the gold that had brought them to the area would eventually chased them away.⁷⁸ The local newspaper applauded those traders in and around Carletonville town who had not been frightened away by the difficult decade between 1962 and 1972. A newspaper divided the business community in Carletonville into two groups, namely the so-called “vasbyters” [determined ones] and the “ongewenstes” [undesirables].⁷⁹ Van Rooyen, as mentioned earlier, and who moved away from the area, objected strongly to these names. According to him:

[T]he truth is that [I] was a victim of the economic injustices committed by the Mines and the previous Apartheid government during the dewatering of the Oberholzer Compartment. During the apartheid era all information relating to dewatering was considered as confidential and was not made available to businessmen like myself who suffered serious financial losses as a result of the act of dewatering. We were in fact led to believe that the Mines enjoyed statutory immunity, which prevented us from taking legal action....⁸⁰

Not all businesses were affected. In fact, by 1973 the number of business in Carletonville rose to 390 and the value of building plans increased from R2 790 056 in 1972 to R4 320 269 in 1973.⁸¹ These developments, as well as the continued support of the local government, helped prevent an exodus of local people to other towns.⁸²

Despite the fact that confidence in Carletonville’s commercial capabilities was fully restored by the early eighties while more expansions were witnessed,⁸³ bitterness prevailed amongst some who had been seriously

78 . *Carletonville Herald*, 30 January 1970, pp. 10-11; *The Star*, 8 January 1970, pp. 2, 24, and March 1970, p. 5.

79 . See *Die Vaderland*, 16 October 1980, pp. 16-17.

80 . Letter that accompanied the document, Claim, 11 November 1997, Claim for damages as a result of dewatering of the Oberholzer Water Compartment during the period 1957-1964 against the Far West Rand Dolomitic Water Association, West Driefontein Mining Company, J. van Rooyen, 1999. Letter J. van Rooyen/E.S. van Eeden, 27 January 1999.

81 . ID, MCV, Reference 73/5, Publicity, vol. 9, 15 November, 1972-5, November 1976.

82 . Compare PUCHE, Carletonville Project, Reference 1, Report, Number of trade licences issued for the period Jan. 1973-Dec. 1988.

83 . E.S. VAN EEDEN, *Ekonomiese Ontwikkeling en die invloed daarvan op Carletonville, 1948-1988: ‘n Historiese studie*, Chapter Five.

affected. At the time of this research (2001), claims and hearings continued involving the former process of compensation.⁸⁴

Communication routes at stake, with economic pressures and debates between sectors and governments on local and national level.

Railways. The former southwest railway route between Pretoria and Cape Town (via Kimberley), which passed through Carletonville, was also affected by the tragic sinkhole period. The route served mainly three local stations, namely Welverdiend, which was not affected, as well as Oberholzer and Bank, both more central to the sinkhole-affected area. The first signs of ground movement were recorded during July 1962, between the Bank and Oberholzer stations. Soon thereafter the future of the route was at stake. Investigations into the financial implications of rerouting of the line, or safeguarding the present line, were undertaken to ensure the livelihood and safety of farmers, travellers and traders. Eventually, however, the intensity of sinkhole development in the Bank compartment led to the consideration of a new rail route.⁸⁵ Even the imposition of strict speed limits on the line could not prevent this move.

Conflict between the town councils of Carletonville and Fochville soon developed because of newspaper speculations on the possibility that the Fochville line could become the alternate stop for the Pretoria-Cape rail route. National and Provincial Departments became involved in local affairs in order to try to calm the situation. They also tried to find ways by which the safety of the general public could be ensured without seriously affecting the town of Carletonville. An example of official action was the decision to allow the famous Blue Train, the Trans Karoo and the 22:00 train from Johannesburg to bypass Carletonville through Fochville.⁸⁶ After 1968 the railway facilities at the Bank station deteriorated further due to continuous sinkhole formation and subsidence. This state of affairs contributed to the total collapse of Bank's economic structure. This in turn brought to the fore the question of continued use of the railway line through sinkhole areas. Attention was devoted to finding an alternate route. It was suggested that the

84 . As an example, see Document, Claim 11, November 1997, Claim for damages as a result of dewatering of the Oberholzer Water Compartment during the period 1957-1964 against The Far West Rand Dolomitic Water Association, West Driefontein Mining Company, J. van Rooyen, 1999,

85 . South African Transport Services, *The least unsafe route*, I (compiled by J.F. Wolmarans), pp. 34-38; Intermediate Depot (ID), Pretoria, Carletonville Municipality, File 88/1, Railway facilities, Letter, Acting Town Clerk/Carletonville/SAR and Harbours, 28 May 1963.

86 . ID, Pretoria, Carletonville Municipality, File 88/1, Railway facilities, Letter, Manager, SAR and Harbours/J.C. Greyling (Member of Parliament for Carletonville), 28 December, 1966.

Bank line should be used only for goods trains that could move slowly through the area. During 1970 approximately 1029 goods trains per month still used this route. Thereafter, and until 1972, the goods trains service for the mines and the agricultural sector was temporarily disrupted as a result of the unstable environment. The effect that this, and the discontinuation of passenger services, had on the stations at Welverdiend and Oberholzer was felt deeply. Passenger services used by commuters to and from the mining area for general and working purposes were also disrupted for a certain period.⁸⁷

After the goods train service had been reopened in 1973, and the passenger services in 1975, it was estimated that at least R30 million had been saved by not developing the alternate route. The key input of the farming community in pressing government to re-open the goods train services should be mentioned. The lack of such services, in addition to losses caused by the water situation, was more than many of them could bear.⁸⁸

Roads. Roads in the Carletonville area were affected much earlier than railways. During the early fifties and sixties two main roads were affected by sinkholes and subsidences. A portion of the P89/1 route to Pretoria in the Bank vicinity was diverted at the expense of road authorities, the local authorities and the mines. Danger signals were also put on the P111/1 route to Johannesburg. In 1957 this route was diverted by approximately four kilometres at a cost of R30 000. By 1963 parts of both roads, as well as several district roads, were temporarily closed.⁸⁹

Fears of economic isolation and competition by neighbouring towns resulted in local business applying pressure on the authorities.⁹⁰ At least some of the main roads, ironically enough, were opened in 1969, at a stage when the safety of the railway line came into dispute (see previous section). However, road P89/11, in the vicinity of Bank, was permanently rerouted at a cost of R500 000.⁹¹

87 . South African Railway Services, *The least unsafe route, I*, (compiled by J.F. Wolmarans), pp. 57,70-75; *Die Transvaler*, 10 May 1968; *Die Vaderland*, 3 September 1970; *Die Beeld*, 8 November 1970.

88 . ID, MCV, File 88/1, Railway facilities, Minute Executive Committee, 8 May 1973, art. 7.2; Letter, SAR/Mr. C. Greyling, 30 March 1973; City Clerk Carletonville/C. Greyling, 28 February 1974; File 93/6/5(3), Council, Annual Reports, Report of the Mayor, 19 April 1975.

89 . Compare ID, MCV, File 70/1/8(1), Provinsiale en genommerde paaie: memorandum oor die veiligheid van paaie in die Carletonville-omgewing, 2 Mei 1963; Minutes Executive Committee, minute, 12 September 1962, p. 12, 26 September 1963.

90 E.S. VAN EEDEN, *Ekonomiese ontwikkeling en die invloed daarvan op Carletonville...*, Chapters Three to Six.

91 . Compare *Rand Daily Mail*, 31 July 1971.

As pointed out in previous sections, dewatering, followed by sinkholes, totally disrupted communities near mining areas of Carletonville. The effect it also had on towns and their infrastructure, apart from that which had been dealt with in section 4.1 (e.g. schools, houses, churches, etc.), unfortunately can not be covered in the span of one article, although much can be said in each case as far as effects on such structures/institutions are concerned. Effects on the psychological well-being of the local community are briefly covered in the next section as an indication of the trauma experienced by some people of the area at the time of the dewatering period, as orally transmitted in 2000.

The psycho-social effect of sinkholes.

Disasters such as sinkholes have psycho-social consequences for the living circumstances of inhabitants in the area.⁹² As already mentioned in previous sections, the area affected by sinkholes as a result of dewatering received intense public attention. In the following paragraphs some demographic data of the respondents who participated in an interview and the completion of a questionnaire on what they recall of Carletonville during the sinkhole period will be discussed briefly in the sections that follow.

Demographic data and questionnaire. So as to collect information, 43 respondents⁹³ took part in interviews and completed questionnaires in January 2000. Apart from a Minister, who acted as a liaison between the researcher⁹⁴ and some respondents, this number of respondents included fifteen professional people in the area and twenty-eight elderly of the local service centre for the aged, from several church denominations, who witnessed events in the Carletonville area thirty-five to forty years ago, being then at an average of 25 to 40 years of age. Of the fourth-three respondents, 11 (25,6%) were male, and thirty-two (74,4%) female. The youngest respondent was 62 years of age, whilst the eldest was 84 years of age. Personal interviews were conducted according to a schedule. The questionnaire consisted mainly of qualitative questions, while only a few quantitative

92 . Compare S.K. SCHNEIDER, *Flirting with disaster: public management in crisis situations*, London, 1995.

93 . Only white respondents participated. The town of Carletonville and surrounding towns were mainly populated by whites during the sinkhole period. This does not mean that no black people on mining area property and outside the area of municipal jurisdiction suffered any loss or experienced any fear. The West Driefontein and Westdene disasters are typical examples of incidents during which inhabitants lost property or/and lived in fear of their lives. To find people recalling those events in 2000 was more difficult than the researcher had anticipated. However, it would be valuable, from a socio-psychological perspective, to commence in future such an undertaking among inhabitants of the Khutsong Township, if finances permit.

94 . Prof. H. Strydom, Head of the social work subject group, PUCHE.

questions were put to respondents (a total of 15 questions). The quantitative questions were on demographic data. The schedule of questions consisted mainly of a) memories of the sinkhole trauma, b) the effect of the trauma on relationships, and c) the effects of the trauma on general and future perspectives.

Memories and the overall effects of the trauma. The 43 respondents were requested to remark on whether they could still remember what had happened, and what the most serious effects of the trauma on daily functioning had been. The majority of respondents had no difficulty in recalling the sinkhole events. Some recalled becoming *blasé* (eight), while three claimed to have overcome the agony, stating that the events had become deeply buried in their memories. Some of the respondents stated that the events would forever be part of their memories (eight). To some the events still cause nightmares (three), and another three claimed that talking about the sinkholes still conjured up feelings of unease. They remembered frightening things such as doors that would not open, and flights into the night were still vivid memories.

Other memories such as those of spooky ruins of abandoned buildings, the sounds of a sinkhole event (described as being like that of distant drums, or trains approaching, and/or milk cans on a wagon travelling over a bumpy road), and the silence thereafter, are but a few of the traumatic recollections. Other memories of sinkholes occurring within view of the respondents are still more traumatic. People described events such as trees, houses and appliances disappearing into sinkholes; persons saved in the nick of time after a warning shout; the disappearance of a tennis clubhouse with someone in it. One of the most dreadful occurrences is the description of a family unable to leave their house through the door. This occurred after they had watched a neighbouring house disappearing into a sinkhole. (*See Visual 6 for tragic events on, for example, the Blyvoortzicht mining property.*)

Besides lost property and the death of loved ones, respondents had abandoned faith in the belief that life has a certainty, consistency or predictability. People who survived such an ordeal usually try to answer a number of questions that have to do with basic things in life. Typical examples are: Why did I survive this ordeal and others not? What terrible wrong have I done to deserve this? What am I going to do to transform this experience into something positive?⁹⁵

According to some respondents, they suffered from stress, anxiety and sleeping disorders. The reliving or re-experiencing of the event in the form of nightmares, flashbacks or even panic attacks is associated with survival of

95 . P.E. HODGKINSON AND M. STEWART, *Coping with catastrophe: a handbook of disaster management*, (London, 1991).

traumatic events.⁹⁶ It is, however, notable that three respondents indicated that they experienced a negative growth in their relationships because friends and family from other towns avoided visiting them, especially at night:

Friends and family would not spend the night in Carletonville – before dark they would leave, as if sinkholes can only appear during night time!

Three other respondents indirectly blamed the government and the gold mines for allowing underground activities in the area to develop whilst knowing that topographic features did not favour such a venture: *People should never have been allowed to live in this area.*

From these rather simplistic and general remarks and the seriously valuable oral memories of what the respondents could recall, it appears as though some families and friends had grown closer, while others were subject to various forms of family disorganisation. Literature also explores the issue of why some families cope better with a disaster than others,⁹⁷ which will not be discussed as part of the range of this paper. Never the less, mutual care, support, community homogeneity and social involvement⁹⁸ can be inferred from some of these comments, while other views focused on instability, disruption, blame, anger and trauma.⁹⁹ It is interesting to note that a minority of respondents were prepared to blame the mining authorities, while others applauded their assistance during those uncertain times. No respondents reflected any bitterness against government, perhaps because they respected it and/or were not informed of the extent to which it had backed the mining authorities in their economic venture. Literature supports the idea that recovery structures need to remain invested in the local community, with assistance from external resources.¹⁰⁰ According to available statistics, 35 people had been killed by 1966, not to mention the 29 mine workers that died in the West Driefontein flooding in 1969.¹⁰¹ The indirect influence of dewatering on the living, as far as the use of polluted water is concerned and

96 . G.A. TOBIN AND B.E. MONTZ, *Natural hazards: explanation and integration*, (London, 1997); T. NEWBURN, *Disaster and after: social work in the aftermath of disaster*, (London, 1993).

97 Compare T. NEWBURN, *Disaster and after: social work in the aftermath of disaster*.

98 . Compare G.A. TOBIN AND B.E. MONTZ, *Natural hazards: explanation and integration*, (London 1997).

99 . Compare P.E. HODGKINSON AND M. STEWART, *Coping with catastrophe: a handbook of disaster management*; T. NEWBURN, *Disaster and after: social work in the aftermath of disaster*.

100 . E. JAGO, "Flood disaster experience: a six-months perspective," *Australian Social Work*, 44(4), December 1991, pp. 43-52.

101 . E.S. VAN EEDEN, *Ekonomiese ontwikkeling en die invloed daarvan op Carletonville...*Chapter four.

as discussed in previous sections, is not clear or open, and probably never will be. Silence and perhaps even secrecy remain. Literature also reports on benefits that usually occur during disasters, like purposeful changes in life structure, changes in views of others and the world, and the search for meaning in adversity.¹⁰² Evidence that the people of Carletonville lived in a traumatised community certainly exists. However, it is remarkable that many respondents feel that Carletonville is their community and that they prefer to stay on in that area.¹⁰³ Perhaps in 2000 they felt more so than they had during the sixties, seventies and eighties.

An analysis of the effects and ‘silence’ in the case of Carletonville’s dewatering and sinkhole crisis.

The presence and visibility of ‘silence’ on the national level, as far as the dewatering and sinkhole crisis of Carletonville is concerned, can be a very complicated issue. As outlined in the previous sections, government and mining authorities were visible in their sympathy, assistance and financial promises when critical situations developed. Direct answers as to why the development of a situation, such as the Carletonville case, was allowed by government and decision makers of the time are not forthcoming. It is also difficult, from a 2003 position, to gain a balanced perspective of the past. Government and mining authorities had, in fact, making decisions that gave an impression that they regarded themselves as being above the law. The economic advantages of exploring for gold in a very vulnerable geological environment far outweighed the well-being of the local people, many of whom had settled in the area because of possibilities offered by the gold mining activities. No ethical code was followed before and during the process of dewatering. The only tenet that was strictly observed was that of secrecy. This also concerns rumours of polluted water since the sixties, and still an ongoing debate which should not be ignored. Because of the secrecy regarding the extent to which dewatering and the use of water from dewatering operations affected the environment and the living, a situation developed where many could speculate, while those in the know are silent.

102 . J.C. MCMILLEN, “Better for it: how people benefit from adversity,” *Social Work*, 44(5), September 1999, pp. 455-468; S. BRANDLER, “Practice issues: understanding aged holocaust survivors”, *Families in Society*, 81(1), January-February 2000, pp. 66-75.

103 . Impressions and remarks made by respondents to the researcher, H. Strydom, in January 2000.

Therefore, after 100 years,¹⁰⁴ the water issue has not yet settled down. It is no more a matter of the once beautiful natural springs – they are no longer there. What it is about is secrecy on an important issue that concerns both man and the environment: healthy water. Past secrecy resulted in a human and environmental disaster. In the case of both, the past is forgotten when one looks at things from the ‘outside’ i.e., the environment (*See figures 1 and 2*). The ‘inside’ decisions are more complicated, as seen in the previous sections. Much has been done to rectify one-sided decision-making. Minister Haak told the newspapers in 1966 that 1 393 039 tons of cement had already been pumped into boreholes alone. If the 1962 and 1969 West Driefontein Mining disasters are recalled, and one considers what was done merely in terms of cement to assure the survival of this rich gold mine, it would add up to millions and millions of tons. The environment has been permanently affected because of dewatering, whereas most dissatisfied people were able to move away, and/or recover financially or overcome trauma. On the statistical side, as seen above, the period of economic setback due to dewatering and sinkholes had been less than a decade. Time healed these wounds, though the general economic status of Carletonville is still highly dependent on the presence of gold mines¹⁰⁵ whose productive time is slowly running out.

In 2000 water was still pumped from the dewatered compartments of Venterspost, Bank and Oberholzer, and it was estimated to consist of the natural groundwater recharge and water imported from Rand Water. With the exception of minor quantities, the mine reused the water and also supplied certain irrigation boards and individuals on a contractual basis. Surplus water was discharged into the Wonderfontein Spruit below the Oberholzer compartment. This has the effect of partially recharging the Boskop/Turffontein compartment to maintain a constant water table in the area and prevent formation of sinkholes and surface subsidence, as well as the drying up of boreholes of private users. These areas are to be studied so as to determine the extent of groundwater pollution caused by materials from gold mines upstream. Recklessness and a lack of sensitivity in this regard may, as in the past, end up cloaked in secrecy, to the detriment of environmental and human health.

104 . Difficulty in ensuring that farmers in the area benefited from the eye to water their crops in the late 1890’s are known. Compare J. SHORTEN, *Die verhaal van Johannesburg*, (Voortrekkerpers; Johannesburg), pp. 53; 167-168; Also see the Rand Water Board’s first minute book in 1903 covering the Wonderfontein water issue.

105 . E.S. VAN EEDEN, “So long gold mines – long live industries. Carletonville’s battle for economic survival,” *South African Economic History Journal*, November 1997.

Opsomming

Die gevolge van ontwatering en sinkgatvorming op die mens en omgewing – ‘n analise van die Carletonville-gebied in die Gauteng-provinsie, Suid-Afrika.

Ouer generasies sal die reeks sinkgate wat gedurende veral die vyftiger- tot sewentigerjare in die Carletonville munisipale gebied gevorm het, goed onthou. In die besonder is dit die permitte wat in 1964 deur die regering aan goudmyne in hierdie gebied uitgereik is om die drie geologiese dolomitiese kompartemente te ontwater wat kontroversieel was. Sedertdien het ontwatering ‘n ernstige impak op die ekologie van die omgewing en streek gehad. Onder meer is die Mooirivier stroomaf erg besoedel. Hierdie deurslaggewende besluit deur die regering is benewel deur die mees verleidelike ekonomiese beginsels, naamlik groter wins en ‘n hoër belastingwingsgrens.

Uit ‘n nasionale perspektief het vrae soos die etiese beginsel daaragter en die kwessie van menseregteskendings teenoor diegene wat ernstig deur die besluitneming geraak is, bloot eenvoudig betekenislose aangeleenthede geword. Dit kom voor asof die destydse regering ook nie verantwoordelik gehou is vir die ernstige sielkundige en ekonomiese terugslae van veral die Carletonville-bewoners nie. Eventueel het die proses om ‘n ommekeer van die “ontwateringsoefening” te bewerkstellig tot skade van miljoene rand gelei. Te midde van hierdie gebeure was daar ook kommer rakende die finansiële verliese van welbekende goudmyne as gevolg van die skade aan myninfrastrukture, -eiendom en -werknemers sowel as ‘n verlies van familie deur sommige werknemers. Boere en sommige sakelui het van tyd tot tyd hierdie omstrede prosesse van ontwatering en die gevolge daarvan onsuksesvol bevraagteken. Die wyse waarop die proses verloop het, sowel as die uitwerking wat dit op die mens en omgewing gehad het, word in hierdie artikel bespreek. Skrywers uit ‘n verskeidenheid van dissiplines het waardevolle navorsingsinsette gelewer met die doel om oor hierdie aangeleentheid, waaroor die laaste woord waarskynlik nog nie gespreek is nie, ‘n wyer en meer opgedateerde perspektief te bied.