

Conceptualizing Sustainability: the Case of Johannesburg and Water

Brian Charles Boshoff

**Dissertation submitted to the faculty of the Virginia Polytechnic Institute
and
State University in partial fulfillment of the requirements for the degree of**

**Doctor of Philosophy
In
Environmental Design and Planning**

Max O. Stephenson (Chair)

Bruce E. Goldstein

Sonia A. Hirt

Kris F. Wernstedt

**September 10 2010
Blacksburg, Virginia**

**Keywords: Sustainability, Sustainable Development, Conceptualization,
Water, Johannesburg.**

Copyright

Conceptualizing Sustainability: The Case of Johannesburg and Water

Brian Charles Boshoff

ABSTRACT

Johannesburg, South Africa has stated ambitions of becoming a “sustainable city” and a “world-class African city.” Many factors may contribute to the realization of these aims. One is a “sustainable” water supply, since water is fundamental to life and to economic activity. But South Africa (SA) is a “water-stressed” country, indeed, globally, it is one of the twenty most water-deficient countries and Gauteng province (where Johannesburg is located) may run out of water by 2015.

Many demand and supply factors conspire to affect adversely the “sustainability” of water and any “sustainable development” trajectory in SA. Accordingly, I survey the literature on “sustainability” and “sustainable development” (S/SD) to see if it might offer some way out of SA’s water dilemma. This is a vast, complex and contested body of literature, but overall, S/SD appears to be “common cause.” But this does not necessarily mean that S/SD concepts are either well understood or integrated, especially as applied to the water sector in SA. I suggest that a comprehensive understanding of what might be contemplated by S/SD concepts as regards the water sector is lacking, so I seek to determine how the concepts of S/SD “play out”, how they can be translated and understood, and what import selected S/SD concepts may have in terms of the water sector in Johannesburg.

This is accomplished by means of a broad literature review and by conducting interviews with mostly senior personnel in Johannesburg who are responsible for water and sustainability public policy and issues in Johannesburg and in SA.

This research describes several major ramifications of water and sustainability in Johannesburg and contributes empirically, by examining the intersection of S/SD, water and Johannesburg and theoretically, by developing a heuristic model (HM), so that understanding of S/SD (especially as it relates to water in SA) can be crystallized and provide a platform for further debate, contestation, interpretation and implementation. The lexicon emerging from the HM will help leaders to balance the competing claims and tensions during conception and implementation of relevant water policies. The model depicts the interplay of sustainability premises with actual conditions in an important developing nation.

Acknowledgements

I would like to thank my parents and my long-suffering family: Paula, Emma, Virginia and Peter. Also, thanks to my wider family, friends, fellow musicians and to colleagues and support staff at the University of the Witwatersrand, Johannesburg and at Virginia Tech, (especially Krystal Wright, Rhonda Carner, Karen Boone and Gwen Ewing), for all their support in various ways. Special thanks to the Eyestone family for their friendship and Blacksburg hospitality. I am also most grateful to Paul Sulter for editorial assistance, to the Fulbright program, to my committee members: Bruce Goldstein, Sonia Hirt and Kris Wernstedt. Special thanks to my supervisor, Max Stephenson – the match that hopefully wasn't actually consumed kindling whatever flame has finally flickered...

Table of Contents

Acknowledgements.....	iii
Chapter one. Introduction	1
Chapter two. Methods.....	12
Chapter three. Literature Review; S/SD – Axiology, Principles, Themes and Metaphors.....	19
Chapter four. Water in SA and Johannesburg	51
Chapter five. SA and Johannesburg – Case Study Description.....	65
Chapter six. Water, Sustainability and Johannesburg (WSJ) – Case Discussion and Analysis.....	111
Chapter seven. Conclusions	133
Bibliography	138
Appendix A. Interview questionnaire	174
Appendix B. Johannesburg by the numbers	187

List of figures

Figure 1. Water scarcity in southern African countries	2
Map 1. Mean annual precipitation in the southern African region	3
Figure 2. Predicted changes in precipitation in Africa by the end of the 21st century	4
Figure 3. Sustainability depicted in terms of intersecting circles	9
Figure 4. City of Johannesburg Governance model.....	88
Figure 5. Inter-basin transfer schemes into the Vaal River Basin	98
Figure 6. Heuristic model relating the S/SD Principles, Themes and Metaphors and the “5 Es”	128

List of Tables

Table 1. Interviewees and their institutions	14
Table 2. Sectoral contributions to Johannesburg’s economy.....	84
Table 3. Johannesburg’s population composition and growth rate.....	85
Table 4. Johannesburg’s sustainable development targets	91
Table 5. Johannesburg’s environmental targets.....	92
Table 6. Johannesburg’s financial targets	93

List of abbreviations and acronyms

ANC	African National Congress
COSATU	Congress of SA Trade Unions
CSD	Commission on Sustainable Development
CSIR	Council for Scientific and Industrial Research
DEAT	Department of Environment Affairs and Tourism
DWAF	Department of Water Affairs and Forestry
EF	Ecological footprint
GEAR	Growth, Employment and Redistribution Program
GEM	Group for Environmental Monitoring
GJMC	Greater Johannesburg Metropolitan Council
IEM	Integrated Environmental Management
Joburg	Johannesburg
MIC	Microbially Influenced/Induced Corrosion
NEDLAC	National Economic, Development and Labor Council
PTM	Principles, themes and metaphors wrt sustainability / sustainable development
RDP	Reconstruction and Development Program
SA	South Africa
SACN	South African Cities Network
SANCPR	South Africa's National Country Profile Report
S/SD	Sustainability/ Sustainable Development
UFW	Unaccounted for water
UM	Urban metabolism
WSJ	Water, sustainability and Johannesburg

Chapter One.

Introduction.

(In terms of) “Sustainability, over the past few decades we have increasingly come to understand the interdependence between humankind and ecosystems, and that our activities often affect the quality and quantity of available water. We have also increasingly recognized our obligation to protect the natural environment, while at the same time promoting development that will meet the needs of not only current generations, but of future generations as well... perhaps the most important challenge facing our water managers ... is the need to introduce equity in resource distribution. Too many of our people are poor. The goals of sustainability and efficiency cannot be divorced from this. ...” (South Africa: Department of Water Affairs and Forestry 2004 National Water Resources Strategy. Introduction by Buyelwa Sonjica, Minister of Water Affairs and Forestry (2004).

Johannesburg, South Africa has ambitions of becoming a “sustainable city” and a “world-class African city” (Joburg 2030). Many factors may shape the realization of these aims, such as good governance and increased development, but the ramifications of a “sustainable” water supply is likely to underpin all of them. Besides the obvious need for water in terms of physical survival and development (in its widest sense), water also symbolises relationships, and the natural cycles of birth, death and rebirth (Croxon 2003: 299) and it is “the earth’s blood” (Lanz et al. 2006). In fact, the earth¹ is often termed the “blue planet,” since it consists mostly of water—the oceans make up about 97 percent of all water; ice caps and glaciers 2 percent; groundwater about 0.5 percent; lakes, biota, rivers, soil moisture and atmospheric water vapour 0,001 percent. Freshwater constitutes only about 3 percent of total water, but much of this is locked up in ice caps, glaciers or deep underground. Only about 0.003 percent of total water is readily available freshwater. Water is a vital resource and has no substitutes, but despite its importance, “water is one of our most poorly managed resources” (Miller 2004: 314). Indeed, as Gorbachev (cited in Turton 2002: 7) has stated, “water is life is a chorus that echoes around the world ... (it) is a symbol in many religions

¹ According to Scriber (2010: 29), “space travellers might one day drink melted moon ice and convert it to oxygen for fuel for a trip to Mars.”

and cultures for purification and replenishment, and is regarded as something to rejoice over. But water is also a nightmare of untold proportions for millions of people.”

The grim arithmetic of water reveals that globally, over a billion people’s water supplies are “under threat from increasing populations, expanding cities, industrialisation, climate change, and the rising demand for food” (Water Research Commission 2009: 13). SA presents a similar “grim arithmetic.” According to Ashton and Haasbroek (2001: 2), “based on present population trends and patterns of change in water use, SA will reach the limit of its economically usable land-based water resources sometime between the years 2020 and 2030. SA is one of the twenty most water-deficient countries in the world.” In addition, the specter of climate change might result in rainfall in the growing season decreasing by 5-15 percent in SA by 2050 (Joubert 2006: 50).

Figure 1 depicts the southern African water scarcity situation. It suggests clearly that SA is amongst the countries with the worst “water-scarcity index” in the world today.

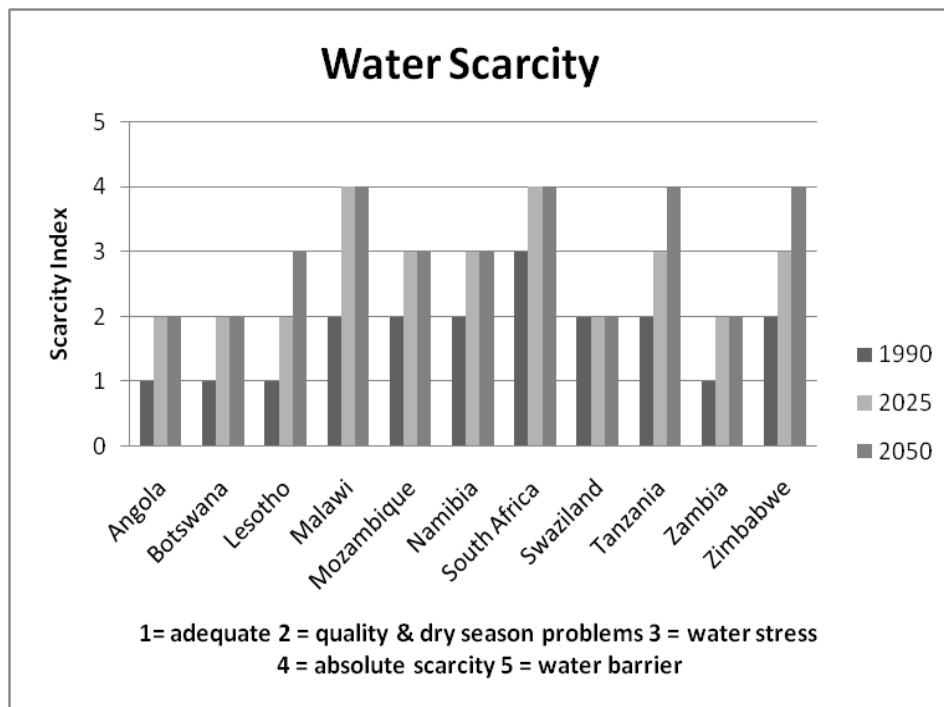
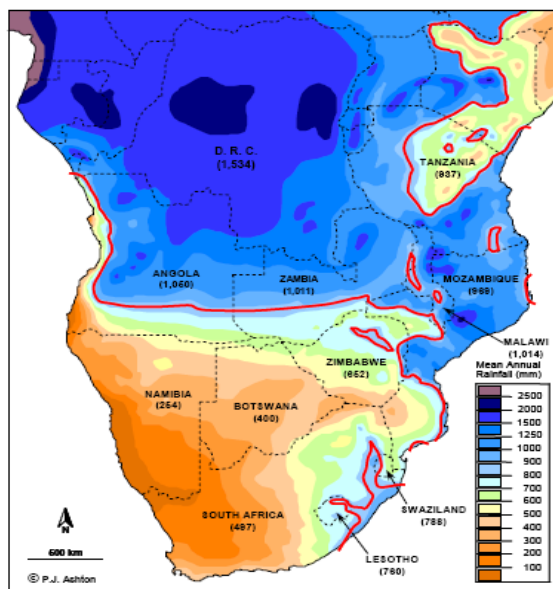


Figure 1. Water scarcity in southern African countries

Source: Olsson (1995), cited in Weakley (2009: 6).

A number of factors conspire to make this so: from the supply side, there are low and erratic rainfall, high temperatures and evaporation rates, seasonal and unevenly distributed rainfall,

the ramifications of global warming (SA becoming hotter and drier) and ever more depleted and polluted water resources (de Vallier 1997; Stein 2002). Furthermore, most of the suitable dam sites in SA have already been fully developed and any new resource development will be considerably more expensive per unit of stored water than previous schemes. Non-conventional sources of water, such as desalination, are available, but at a high price (de Vallier 1997). The map below illustrates SA's dire situation in terms of mean annual precipitation.



Map 1. Mean Annual Precipitation (MAP) in the Southern African region (courtesy of Prof. Peter Ashton).

Source: Turton (2008: 2). Used with permission of Peter Ashton, 2010.

This scenario is expected to worsen— precipitation is expected to drop by about 10 percent in most of SA during the present century, as indicated in the figure below.

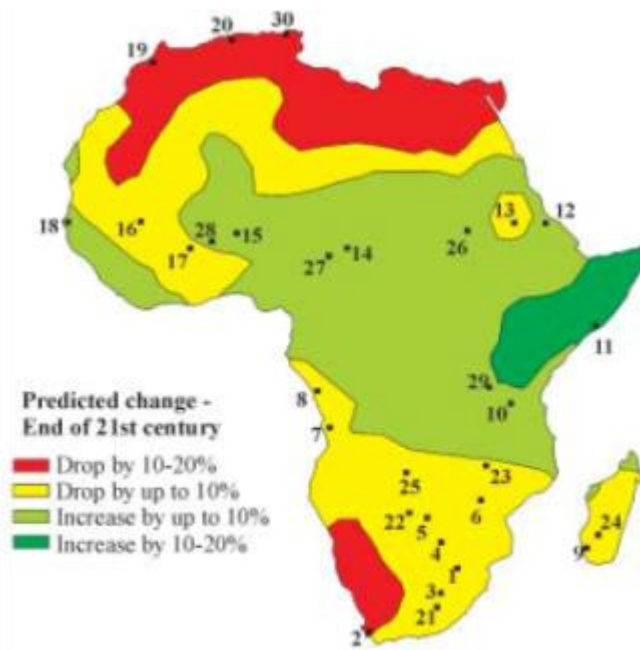


Figure 2. Predicted changes in precipitation in Africa by the end of the 21st century.

Source: de Wit and Stankiewicz (2006), cited in Weakley (2009: 5).

On the demand side of the water equation, SA faces a possible water deficit due to a burgeoning population (notwithstanding an HIV/AIDS incidence of 22.6 percent), coupled with rapid industrialization, mechanization and urbanization (Ashton and Haasbroek 2001:2). Furthermore, “the expanding agriculture, mining, energy, industry and urban sectors of SA are developing in areas that are poorly supplied by surface water resources” (Huntley et al. 1989; Ashton and Haasbroek 2001: 2). In other words, there is a significant mismatch of demand and supply of water resources in SA, alongside an emergent issue of supply problems more generally (Middleton 1998). Also, “seasonal river flows, combined with limited supplies of ground water and growing demands for water in areas located relatively far from suitable water sources led water resource managers to concentrate on developing large storage reservoirs and water transfer schemes” (Ashton and Haasbroek 2001: 2).

Goldblatt et al. (2002: 40) have argued that “current water requirements are equivalent to about 60 percent of the maximum available yield in the country ... and unless proactive strategic measures are taken to address this potential water shortage, the macroeconomic impacts of water scarcity may have a crippling effect on South Africa’s ability to meet the

developmental requirements of its people.” To add to these woes, SA is currently in the unenviable position of having 98 percent of the national water resource allocated at a high assurance of supply (Turton 2008: 2) and levels of urbanization are increasing, from 54 percent in 1996 to 55.9 percent in 2001 and 57.2 percent in 2007 (SAIRR 2008: 25). In the Gauteng province (containing the city of Johannesburg), urbanization levels are already at 96 percent (SACN 2006: 2-17). Urbanization brings with it many problems, as it places huge demands not only on water, but also on land, housing, transport and employment in limited geographical areas.

Clearly, SA faces a major challenge in terms of managing its scarce water resources. Water is and has always been a contentious socio-political issue in the country; indeed, a Drought Investigation Commission was established as far back as 1923 (Davenport 1987) and in 1986, the Department of Water Affairs and Forestry [DWAF] (DWAF 1986: 10.3) argued “... water is becoming *an increasingly scarce strategic resource, requiring optimal management and allocation in the national interest*” (my own emphasis).

The apartheid Nationalist government recognized SA is a water-scarce country and in order to address supply constraints, it built dams with some vigor. However, much of this was really about electioneering in order to garner electoral support, especially from the primarily Afrikaans farmers who were National Party (apartheid) supporters (Middleton 1998). Accordingly, many dams were built to meet agricultural needs (primarily supporting irrigation schemes) and the water and other needs of the nation’s disenfranchised black population were largely not addressed (Middleton 1998).

But what is the *post*-apartheid government doing about this developing crisis? Is there at least some rhetoric concerning water, “sustainability” and “sustainable development” (S/SD)? Indeed, what does “sustainability” mean in a general sense, and more specifically, what does it mean in the context of the SA water sector? I seek to ascertain how S/SD might be translated and understood and what import selected S/SD concepts have for the SA water sector. By this I do not imply a focus on S/SD indicators, around which a large volume of literature is developing. Instead, I examine the issue of Water and Sustainability/ Sustainable Development in SA and in Johannesburg (WSJ), in order to illustrate not so much how the concepts of S/SD might be implemented, but instead how they might, and are being

conceptualised by those dealing with S/SD in SA, particularly by those dealing with water and sustainability in Johannesburg.

I thus investigate the case of Johannesburg, the primary city in one of the African continent's leading nations and try to determine how that city is addressing the notion of sustainability, particularly as regards water resources. This is an enormously complex undertaking and I seek ultimately to crystallize my findings in a heuristic model of sustainability so that understanding of the concept (especially as it relates to water in South Africa) might be enhanced and provide a lexicon which will enable decision-makers to come to grips with a dialectical sustainability framework at an urban scale that allows them to be self-conscious about the difficult trade-offs which need to be made regarding WSJ.

The current SA government has taken steps to address the S/SD imbroglio and the following quotations point to some initial pieces of the "sustainability puzzle" falling into place in the nation. For example, in an introductory letter canvassing public input² into the draft National Water Conservation and Demand Management Strategy (1999), Professor Kader Asmal, a previous African National Congress (ANC) Minister of Water Affairs and Forestry, suggested:

One of the key thrusts of the *new approach in which we are managing water in South Africa* is the entrenchment of and insistence on *efficient water management and use*. We have been able to give strong emphasis to this concept, both in our *legislation as well as through key demonstration water conservation and demand management projects*. The Department of Water Affairs and Forestry's draft framework is the first step in that process ... (my emphases).

The post-apartheid government employed an extensive process of public participation as it developed new water resource management policies and legislation. In fact, the SA National Water Act (Republic of SA, 1998) "ranks with the best in the world in terms of its scope and intent, as well as the democratic and participative manner in which it was developed" (Ashton and Haasbroek 2001: 5). So, there are indeed moves afoot in South Africa to address

²Public participation *per se* represents a radical departure from the previous regime's distinct lack of consultation and collaborative planning.

sustainable development, one dimension of which is to secure more efficient water management and use. SA is moving away from a previous approach to water management that concentrated on the supply side and on only a small segment of the country's total population, towards a guiding conception that seeks to assist all segments of the populace while considering both supply and demand factors and their interplay.

But "S" and "SD" are topical, debatable and, one might say, liquefied concepts. As Holden and Linnerud (2007: 176) have observed, "attempts at defining sustainable development have been unsuccessful for two decades." Also, the concepts of S/SD have many proponents and opponents. Detractors of these notions point to, *inter alia*, the vagueness of the terms, their oxymoronic nature and even the need for these approaches to be replaced by a technocratic paradigm, bowing to what they see as the power of the market mechanism and the saving graces of technology (Tate and Mulugetta 1998; Giddings et al. 2002; Hopwood et al. 2005; Quenta et al. 2009).

Notwithstanding criticisms of the notions of S/SD, they seem to be durable globally and in SA. Indeed, they have found their way into major SA legislation and policy. For example, S/SD is referred to in the nation's Bill of Rights, it is contained in numerous sections of the Development and Facilitation Act 67 of 1995, and (echoing the 1987 Brundtland Commission's Report), it is defined in SA's National Environmental Management Act 107 of 1998 as "the integration of social, economic and environmental factors into planning, implementation and decision-making, so as to ensure that development serves present and future generations" (van Wyk 1999: 243).

In addition, new water-related legislation presages implications for S/SD. For example, the SA Department of Environment Affairs and Tourism (DEAT) and major cities such as Johannesburg, Cape Town and Durban, have embraced initiatives such as "Local Agenda 21" and have joined the International Council for Local Environmental Initiatives (ICLEI). SA legislation requires that S/SD must be considered, but the law does not *prescribe* what form S/SD should take, nor does it guarantee effective or equitable implementation of S/SD.

The argument developed so far suggests the following:

- S/SD constitutes a meta-narrative (at least in terms of its being measured by a voluminous and burgeoning literature and policy rhetoric) for development and for resource development particularly;
- SA legislation dictates that S/SD be considered (although legislation is more or less silent on the ramifications of S/SD);
- Water is an important issue (from a purely survival point of view, but also as a fundamental necessity for socioeconomic development) in SA;
- There is added impetus in SA for water to be considered in terms of S/SD, since the nation is water-stressed and that situation is expected to worsen.

But recognizing S/SD as common cause does not necessarily mean that these concepts are either particularly well understood or integrated in a holistic fashion, especially as regards S/SD and the water sector specifically. Many people in SA have written about sustainability, (see, for example, Murray and Tredoux 1998; Whitehead and Audouin 1998; Havemann 2006; Todes et al. 2009 and Pieterse 2010), but I maintain this has occurred in rather a piecemeal fashion and no comprehensive understanding of what might be contemplated by these concepts concerning the nation's water sector has yet emerged.

The general S/SD literature is immense and parts of that scholarship have coalesced around considering the “three Es” of sustainability, viz., the Economy, the Environment and Equity, in terms of three concentric or overlapping circles, as illustrated below and sometimes referred to as a “three-ring circus” (Levett 1998: 295).

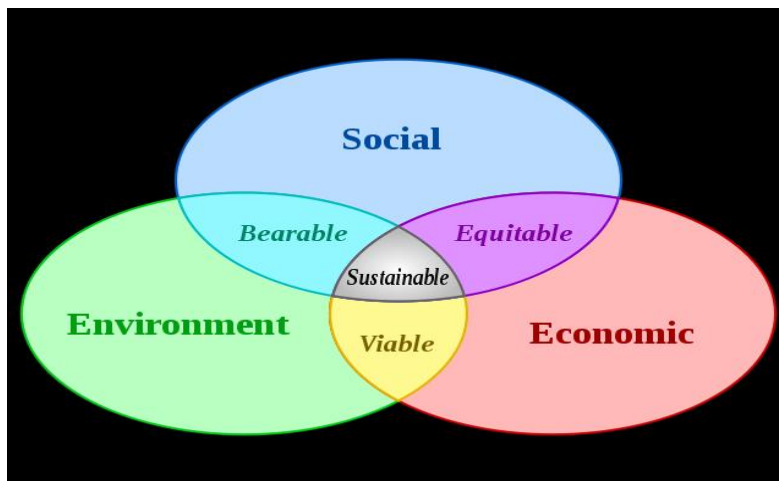


Figure 3. Sustainability depicted in terms of intersecting circles.

Source: Adams (2006), cited in Weakley (2009:11).

My contribution to the literature and to planning practitioners is to describe some of the ramifications of water and sustainability in Johannesburg (and to a lesser extent, South Africa as a whole). I seek to contribute to S/SD knowledge by highlighting and synthesizing the substantive issues, including what I term S/SD “principles, themes and metaphors”. In addition, I seek to increase understanding of what might be contemplated by the three or perhaps more “Es” in Johannesburg, the primary city of SA.

Moreover, I examine how these “Es” interrelate and provide a conceptual framework to describe that interaction in SA using Geertz’s concept of “thick description” (Geertz ,1973, cited in Stake 1995: 42, 43). This is accomplished by means of a review of relevant literature and documents, as well as by conducting personal interviews with mostly senior personnel (primarily in Johannesburg) responsible for water and sustainability, and related public policy and issues in the city and in SA. The HM I propose, further to my findings from these sources, is intended to serve as a “knowledge repository” for anyone dealing with SA sustainability, especially sustainability in relation to the water sector. I contend that the “Es” outlined in the model will help leaders balance the competing claims and tensions during conceptualization and implementation of relevant water policies. The conceptual frame I outline depicts the interplay of sustainability premises with actual conditions in an important developing nation.

Chapter Outline.

Chapter One. Introduction.

Chapter Two. Methods.

This chapter discusses the methodology employed, i.e., an extensive literature review and semi-structured interviews with pertinent people who could shed light on water resources (in SA and especially Johannesburg) through the SD lens. It also suggests a rationale for examining Johannesburg for this study.

Chapter Three. Literature Review; S/SD Axiology, Principles, Themes and Metaphors.

This chapter reviews a strong measure of the literature on sustainable development without claiming to be comprehensive. S/SD theory is vast, the more so because it is multidisciplinary and embraces methodological and axiological concerns. The chapter also briefly reviews the related notions of the sustainable city, the healthy city and the ecocity. Some sustainable development principles and what I term “themes” or the “three Es” are established in order to provide an analytical framework for a case study of the water sector and SD in Johannesburg. Finally, the chapter introduces metaphorical devices such as urban metabolism and the ecological footprint.

Chapter Four. Water in SA and Johannesburg.

This chapter highlights SA water supply and demand issues, and to a much lesser extent, water quality concerns, as well as important legislative initiatives and how these relate to this research. I address the issue of sustainable development and water with reference to SA at large, and to Johannesburg in particular. I outline the overall situation regarding water demand and supply, and the social/political and economic factors governing water in SA and Johannesburg.

Chapter Five. SA and Johannesburg – Case Study Description.

The chapter commences with a brief overview of SA, but its main focus is Johannesburg and its position in the global economy. I also provide information concerning urban sustainable development in SA at large, and on the sustainable development initiatives being undertaken in Johannesburg more particularly.

Chapter Six. Water, Sustainability and Johannesburg (WSJ) – Case Discussion and Analysis.

This chapter provides a detailed examination of relevant initiatives undertaken or proposed in Johannesburg in order to engender sustainable development in terms of water. It pays particular attention to the metaphors contemplated in the earlier theory chapter and to key institutional and other factors that influence WSJ.

Chapter Seven. Conclusions.

This chapter explores the nexus of Water-Sustainability-Johannesburg and illustrates and offers those findings in a heuristic model.

Chapter Two.

Methods.

In order to develop an overall approach to this study, I took a cue from Boyer (1990:18-19), who posited a “scholarship of integration,” which means “making connections across the disciplines, placing the specialties in larger context, illuminating data in a revealing way (and), often educating non-specialists, too. ... [S]uch efforts are increasingly essential, since specialization, without broader perspective, risks pedantry.” This study employed qualitative methods to uncover and analyze themes that have emerged from alternate interpretations of sustainability, in order to explore their portent for water use and development in SA and Johannesburg. It did so primarily by means of an extensive survey of the literature and then via interviews with key personnel in Johannesburg.

This research was “cross-disciplinary” and includes descriptive empirical data. I adhered to Yin’s (1989: 95) injunction to use multiple sources of evidence, an important advantage of which is the “development of converging lines of inquiry, a process of triangulation” (Yin 1989: 97). Yin (1989: 84) notes that evidence may emanate from six sources: documents, archival records, interviews, direct observation, participant observation and physical artifacts. I discuss these sources in turn as they apply to this study (the last three listed were not employed in this research).

Sources of evidence

Documents and archival records

I conducted an extensive literature survey with regard to:

- sustainability and sustainable development in general, and also the “sustainable city, healthy city and ecocity”;
- water resources in South Africa. (As outlined in other sections, this addressed legislative, political and socio-economic and ecological aspects encapsulated in the “three Es” viz. Economy, Equity and Environment).

- published literature, official documents and websites of the City of Johannesburg. I focused on Johannesburg as a city and the water-related sustainability challenges it faces to develop a case analysis of that community's evolving water situation.

Literature and data were gathered from the following sources:

- Academic literature at large, via university libraries and from faculty members in a variety of departments
- University dissertations and discourses
- The Internet
- Institutions visited
- Government documents
- The press, especially Johannesburg's news dailies and weeklies
- Seminars, institutional and societal meetings
- Publications by apposite institutions, e.g., the Johannesburg Metro Council, City of Johannesburg, Johannesburg Water and the Water Research Commission.

Interviews

I conducted semi-structured, in-depth interviews with key informants. After Yin (1989: 89), I asked respondents for facts and judgments and generally to offer their insights. I employed a combination of etic, or "imposed frame of reference" (my introduction and interpretations of S\SD and WSJ), and emic analysis (Stake 1995), allowing participants to interpret S/SD and WSJ as they wished. The interviews helped me to construct an interpretation of how S/SD theory could apply to WSJ and also assist in schema-building. Indeed, these key informants were very helpful in the development of the case study of Johannesburg's water needs and its sustainability.

I interviewed primarily *senior* personnel, which significantly reduced the sample size and also meant that it was often difficult to schedule interviews, given interviewees' busy schedules. As a result, I conducted the 15 interviews over a seven-month time span. Interviewees were drawn primarily from relevant officials of the City of Johannesburg, the Johannesburg Water Utility, and Gauteng province, but also from private consultants

employed in state or other water-related institutions. Almost all the interviews were conducted face-to-face, but in a few cases, completed responses to questions were returned by email and followed-up telephonically. I undertook to ensure the confidentiality of key informants by alluding to them only by category in the text when discussing their responses and by limiting identifying detail about their employment positions.

Table 1. Interviewees and their institutions (anonymity was guaranteed, hence neither names nor specific job titles are given).

Organization Represented	Date Interviewed
Environmental consultant	5 April 2009
City of Johannesburg	1 October 2008
Johannesburg	1 October 2008
Water (Pty) Ltd	
City of Johannesburg	5 September 2008
Wits University	13 October 2008
Gauteng Department of Agriculture, Conservation and Environment	6 October 2009
Johannesburg	23 September 2008
Water (Pty) Ltd	
Johannesburg	1 October 2008
Water (Pty) Ltd	
Johannesburg	1 October 2008
Water (Pty) Ltd	
City Of Johannesburg	15 September 2008
Johannesburg	26 September 2008
Water (Pty) Ltd	
City of Johannesburg	22 September 2008
Own consultancy (Water-Related)	31 March 2009

Ex-City of Johannesburg

Own consultancy (Water-Related 1 April 2009
and Ex- Council For Scientific And
Industrial Research employees

City of Johannesburg

9 December 2008

The face-to-face interviews generally lasted 60-75 minutes, although some interviews were much longer—two hours or more. My modus operandi was to take copious notes during the interview, and also to tape record it to ensure accuracy of notated material and for keeping an additional record of the interviews. It should be noted English is not the first or home language of some of the respondents and several of them are relatively new appointees. Whilst these factors did not present problems in communication or interpretation, they resulted in a few grammatical or other errors in terms of transcriptions or quotations and responses.

I reviewed each interview for common claims and themes concerning this study's central questions. I then delimited those and went through each interview again to determine if each offered clarification or alternate elements or conceptualization of those ideas. Each of these was then examined afresh to inquire into their differences and commonalities, and implications for this study are organizing ideas. As anticipated, I used snowballing to acquire data, clarify follow-up questions, and obtain the names of additional potential interviewees. More than one respondent corroborated most information, but I found some degree of divergence of viewpoint concerning whether and when SA will run out of water, as well as what factors are contributing to the uneven distribution of water amongst the populace and how that issue is now manifest. Regarding the former, responses varied from doomsday scenarios to longer-term optimism.

The Case Study: An Overview

According to Yin (1989: 16), the case study is one of the major research strategies in the social sciences, taking its place alongside experiments, surveys, archival analysis and historical research. The case study is an “empirical inquiry that investigates a contemporary phenomenon within its real life context, especially when the boundaries between context and phenomenon are not clearly evident. The case study is not just a method for data collection, not just a design feature, it is a comprehensive research strategy which connects empirical data with research questions and to its conclusions” (Yin 1993: 59). The case study “also allows us to move away from dogmatic certitude ... and the dogmatic, simplified problem free version [of logical empiricism] that has come down on social scientists” (Diesing 1992: x).

The case study can “contribute uniquely to our knowledge of individual, organizational, social and political phenomena and it allows an investigation to retain the holistic and meaningful characteristics of real life events” (Yin 1989: 145). It captures the complexity of a single case (Stake 1995: xi) and its “unique strength is its ability to deal with a full variety of evidence – documents, artifacts, items, and observations” (Yin 1989: 14).

Case study researchers can adopt many roles, such as that of biographer, interpreter or advocate (Stake 1995), and similarly, there are many nuances of case study research, whether or not the study is primarily evaluative.³ This analysis seeks to understand the peculiarity and complexity of a single case, i.e. Water and Sustainability in Johannesburg (WSJ) (Stake 1995). It is not necessarily the task of the case study researcher to understand the universe, but to come to grips with the particular instance (here, the question of sustainability and its relationship to water supply and demand in a major city in South Africa) and interpret it in light of theoretical and experiential considerations. This does not preclude other researchers utilizing the case study to develop “lessons from experience” for other cities, and indeed, many of the propositions offered here may be tested elsewhere.

³Much of case study methodology has been developed around evaluations for educational and health and nutrition programs.

Types of case study

Case studies can be explanatory, exploratory, descriptive or pluralistic (Yin 1989: 15). This case study is pluralistic, since I seek:

- a) to describe some of the ramifications of WSJ;
- b) explain WSJ in the light of S/SD theory and initiatives; and
- c) explore S/SD and WSJ and interpret all of this in terms of a conceptual schema.

Before discussing the specific design and other aspects of this case study, it is important to deal with some of the criticisms associated with such efforts more generally.

Criticisms of case study research

The case study is considered by some to be a poor relation in the suite of available qualitative methods, but Yin (1989) and Stake (1995) argue this is a misguided criticism. The case study method is sometimes considered a weak sibling in research due to its alleged insufficient rigor, lack of precision and objectivity, lack of generalizability and sometimes, excessive length. But I agree with Yin's (1989: 21) response to these charges. Regarding the supposed lack of rigor, "the 'stronger research siblings' also have weaknesses in research design, including bias, there is bias in experiments, in designing questionnaires, and in conducting historical research. And any study can be considered too lengthy—this deficiency is often a function of poor research design."

Selecting and designing the case study

Johannesburg provides a microcosm of water and sustainability issues in SA and is by far the largest and most important city in the nation. The ramifications of its sustainability efforts will be an important exemplar for the rest of SA, notwithstanding the importance of considering other locales' specific contexts. Johannesburg is also a suitable candidate for a case study because it has established a water utility, it has articulated many policies and other responses to its developmental challenges, and has better sources of data than most other SA locales. Johannesburg is also appropriate to study in terms of logistical considerations and my professional and personal familiarity with the city.

This research employs a single-case design, a design that has the potential to represent a contribution to knowledge and theory building (Yin 1989: 47). As stated, the case study's strength as a form of analysis is its unique ability to deal with a variety of evidence—documents, artifacts, interviews and observations. The literature survey helped to develop “sharper and more insightful questions about the topic” (Yin 1989:20), while interviews constituted a vital source of information. My experience with this research echoes Yin's contention that “key informants are often critical to the success of a case study. Such persons not only provide the case study investigator with insights into a matter, but can also suggest sources of corroboratory evidence – and initiate the access to such sources” (Yin 1989:89).

In conclusion, I sought to develop what Yin (1989:146) considered an “exemplary case study.” In order to “qualify” as exemplary:

- The case must be significant and of unusual and general public interest;
- The underlying issues must be nationally important, either in theoretical or practical terms;
- The case must be complete and have boundaries;
- The case analyst must expend exhaustive effort in collection of evidence;
- The researcher must consider alternative perspectives and value statements and display sufficient evidence

More successful case studies develop explanations or descriptions that reflect theoretically significant propositions (Yin 1989: 115) and I have endeavored to do likewise by thoroughly examining and critiquing the literature on S/SD and applying it to the SA/Johannesburg context.

Chapter Three.

Literature Review; S/SD Axiology, Principles, Themes and Metaphors.

“To think that their present circumstances and their present societal arrangements might be sustained – that is an unsustainable thought for the majority of the world’s people” (Marcuse 2006: 55).

Crises and conferences

Over the last few decades, the world’s political leaders have held numerous conferences to devise responses to crises. To mention but a few⁴, these meetings have ranged from the UN Conference on the Human Environment in 1972, through the World Population Conference in 1974, to the UN Conference on Human Settlements (HABITAT) in 1976, and the UN Conference on Science and Technology for Development in 1979 (Johnston and Taylor 1992). In more recent decades conferences addressing crises included the World Commission on Environment and Development (1987) and the World Summit on Sustainable Development or “Rio Summit” (1992). Subsequent to the latter were International Conferences on Human Rights, Population and Development, the World Summit on Social Development, the fourth World Conference on Women, and Habitat II, and the second UN Conference on Human Settlements (1996). Closer to home, in 2000, Johannesburg hosted an international conference entitled “Johannesburg: Urban Futures” and then, of course, “the World Summit on Sustainable Development” or “Rio + 10” took place in Johannesburg in 2002.

Water supply and water quality are receiving increased attention from policymakers, as analysts suggest the need is increasingly urgent. Indeed, some commentators are raising the specter of water wars between nations or communities (Miller 1998; de Villiers 1999; Turton and Henwood 2002). Concomitant with calls for responses to these looming crises has been

⁴See d’Auria et al. (2010) for a comprehensive discussion of “formulations and calibrations” regarding human settlements.

the rise of a vast body of literature on S/SD. This chapter aims to lay bare S/SD and examine how these concepts might be applied to water issues in Johannesburg.

Crises and cities

Many of the effects of the above concerns or crises are manifested in cities, giving rise to urban pathologies, which can be categorized in terms of social and physical blight. As Harvey (1989: 229, cited in White 1994:65) has observed:

Once the city was the high point of human achievement, objectifying the most sophisticated knowledge in a physical landscape of extraordinary complexity, power, and splendor at the same time as it brings together social forces capable of the most amazing social technical and political innovation. But it is also the site of squalid human failure, the lightning (sic) rod of the profoundest human discontents and the arena of social and political conflict⁵ (Harvey 1989: 229, cited in White 1994: 65).

But cities will also be important in that as this is written, for the first time ever, more than half (50.6%) of the world's population will be urban-based (UN HABITAT 2009: 228). In the 1800s, only 3 percent of the world's population lived in urban areas; in 1950, it was 29 percent and by the year 2015 there will be 27 cities with over 10 million inhabitants. Twenty-two of those cities will be in developing countries (Barnett and Lulofs 1996: 1). UN HABITAT (2009: 226) estimates the total world population will reach 6.9 billion in 2010 and 7.6 billion by 2020.

Dealing with growing populations is just one contemporary urban challenge. UN HABITAT (2009: 4-8) also cites as key concerns, the environment, the economy, institutional change and changes in civil society, whereby urban residents "will have to find a way in which to engage with the state if their service needs are to be met" (UN HABITAT (2009: 7). Indeed, in SA, the lack of service delivery, such as water services, is a major issue and, one might argue, a threat to the sustainability of the ANC as the ruling party.

Perلمان (cited in Barnett and Lulofs 1996: 22) has called solutions to urban problems the best-kept secrets in the world! One is also mindful of Henry Ford's statement that "we have solved the problems of the city by leaving it" (Peirce, in Barnett and Lulofs 1996: 26).

In addition, there are the impacts associated with the sheer scale of human activity and the increased size of cities and the demands they place on the environment (Girardet 1992; Miller 1998). For example, a typical US city of 1 million people requires a daily input of 625,000 tons of water and has to deal with 500,000 tons of sewage daily (Miller 1998: 318). This, in part, has led to increased attention to making cities “sustainable”, which of course demands at least a renewable and potable water supply. To compound the problems urban areas and (urban) planners confront, there is no general agreement on the definition of sustainability, or on what makes a city sustainable. There is also increasing recognition that urban problems can have significant and broad spatial and temporal effects and that the causes and linkages among problems and effects are highly complex.

In an effort to assist planners as they seek to negotiate a sustainable development path through some of these challenges and crises, particularly those pertaining to the water issue, I undertake a review of some of the dimensions of urban sustainability, including some of the inherent conflicts embedded in it and the need to consider its axiological and operational dimensions.

This chapter provides a theoretical base for a subsequent case study of the city of Johannesburg and its water sector. I argue that despite the construct’s numerous interpretations and what some see as the enervation of S/SD, these ideas have much to offer, but they will not necessarily simplify planners’ tasks. In fact, coming to grips with S/SD will increase the complexity of their challenges.

Sustainability

The durability of the mantra of sustainability seems set to outstrip even that of globalization. The former concept “has been one of the great advances in recent years ... (it) represents one of the most important development paradigms of the late twentieth century “(Engel and Engel, in Barrow 1995). Without entering a debate into the differences between paradigms and philosophies, Giddings et al. (2002: 188) have suggested “it is clear from all the debates about sustainable development that there is no common philosophy. There are so many interpretations of sustainable development that it is safe to say that there is no such thing as sustainable development-ism, in contrast to the schools of neo-liberalism, feminism, deep

ecology or socialism. Rather, the existing worldviews of people and organizations flow into their conception of sustainable development.”

Nevertheless, the terms sustainability and sustainable development are pervasive. According to Kates et al. (2005:1), “the concept of sustainable development is now enshrined on the masthead of *Environment* magazine, featured on 8,720,000 Web pages and enmeshed in the aspirations of countless programs, places, and institutions. ...” And Worldwatch (2009) calls for a global cultural transformation from consumerism to sustainability. I will take it as axiomatic that sustainability is a desirable goal. It must be noted, however, there are numerous perspectives on sustainability and not all of them represent apologists’ views. And as Campbell (1996: 296) notes, “the current concept of sustainability, though a laudable holistic vision, is vulnerable to the same criticism of vague idealism made thirty years ago against comprehensive planning.” For Krueger and Agyeman (2005: 416), “sustainability ... is a social process with the resultant tensions emerging from enormous differences in social, institutional, and discursive practices that often seem irrational at best and schizophrenic at worst.”

Seen pessimistically, “sustainable development has been stripped of its transformative power and reduced to its lowest common denominator ... it is so malleable as to mean many things to many people, without requiring commitment to any specific policies” (Campbell 1996: 301). Or, as a senior Johannesburg official remarked in an interview: “sustainability becomes everything and nothing” (Interviewee G, 2008).

Also, the concept is “ambiguous” (Keiner 2006) and is especially attractive to politicians seeking to embrace its appealing goals. In fact, “in the manner of *Alice in Wonderland*, and without regard for accuracy or consistency, ‘sustainability’ seems to have been redefined flexibly to suit a variety of wishes and conveniences” (Bartlett 2006: 17).

S/SD detractors, such as Tate and Mulugetta (1998: 69), maintain that adoption of technology and the workings of the free market represent a challenging alternative to sustainability. These authors also cite Beckerman (1994: 195), who has argued sustainability cannot be operationalized in any meaningful way and ... “from the economist’s perspective the concept is basically flawed. This is because it mixes up together the technical characteristics of a particular development path with a moral injunction to pursue it...many economic activities

that are unsustainable may be perfectly optimal and many that are sustainable may not even be desirable, let alone optimal.”

Beckerman (cited 1999: 192), in turn has quoted Dasgupta and Maler (1994, unpaginated) in summarizing the overall position: “... most writings on sustainable development start from scratch and then proceed to get things hopelessly wrong. It would be difficult to find another field of research endeavor in the social sciences that has displayed such intellectual regress.” These advocates have in turn been accused of being Pollyannas in terms of their trust in markets (Mazmanian 2008).

A comprehensive response to these positions would occupy volumes, but Daly’s thoughts provide a swift riposte to the concept’s principal critics:

Today’s standard neo-Classical (N-C) theory begins with non-physical parameters (technology, preferences, and distribution of income are all taken as given) and inquires how the physical variables of quantities of goods are produced and resources used must be adjusted to fit an equilibrium (or an equilibrium rate of growth) determined by these nonphysical parameters. The nonphysical qualitative conditions are given and the physical, quantitative magnitudes must adjust. In N-C theory this “adjustment” always involves growth. Neoclassical economics, with its subjective theory of value, shifted attention away from resources and labor and onto utility, exchange and efficiency. Thus, one of the questions facing us becomes what is the proper scale of the macroeconomy relative to the ecosystem? (Daly 1996: 4).

As Daly (1996: 49) has also observed, “the point is that the evolution of the human economy has passed from an era in which man-made capital was the limiting factor in economic development, to an era in which remaining natural capital is the limiting factor ... the market does only one thing – it solves the allocation problem by providing the necessary information and incentive. What it does not do is solve the challenges of optimal scale and equitable distribution (Daly 1996: 59).

There are at least three values at play in discussions of sustainability: allocation (efficiency), distribution (justice) and scale. Scale, in fact, has a “maximum limit defined by either regenerative or absorptive capacity of the ecosystem, whichever is less. We can now talk of

an anthropocentric and a biocentric optimum” (Daly 1996: 51). Expansion could defy the ecological capacity of the earth to support life in future, because liquidation can be optimal in the economists’ models. The dominant economic model excludes ecological costs altogether. Moreover, even those models that recognize ecological costs, if they are based on present value maximization, can also lead to “optimal” liquidation. The neo-Classicist’s usual assumption is “additional man made capital substitutes for liquidated⁶ natural resources” (Daly 1996: 5).

In contrast to the N-C view, the sustainable development / steady state economy paradigm begins with physical parameters (a finite world, complex ecological interactions, and the laws of thermodynamics) and inquires how the “nonphysical variables of technology, preferences, distribution and lifestyles can be brought into feasible and just equilibrium with the complex biophysical system of which we are a part. The physical quantitative variables are what is given, and the nonphysical qualitative patterns of life become variables” (Daly 1996: 4).

And so “the power of the concept of sustainable development is that it both reflects and evokes a shift in our vision of how the economic activities of human beings relate to the natural world and ecosystem which is finite, non-growing and materially closed. Wastes and inputs must therefore be kept at ecologically sustainable levels. This change of vision involves replacing the economic norm of quantitative expansion (growth) with that of qualitative improvement (development) as the path of future progress. Today the classical ghost of the steady state economy has returned to the ball, uninvited, in the costume of sustainable development” (Daly 1996: 4).

This argument has important implications for water resource development, and, as will be shown, water could easily become a major limiting (natural capital) factor in SA’s development trajectory. In narrow terms, this might refer to notions of “sustainability” of a resource and constitute part of Daly’s concern with scale. But the canvas is much wider and we need to take cognizance of the scale of water in terms of supply and demand, and also the other values mentioned by Daly: those of allocation and distribution. Here man-made capital

⁶⁶ And if the pun be excused, firstly water as a resource cannot be substituted by any man-made capital. Secondly, water resources can be “liquidated” by any number of means, e.g., failing to control evaporation, having tariffs not represent true costs of procurement and distribution, and not least, simple wastage via leaks in reticulation systems. Some of these issues will be addressed in subsequent chapters. This is the stuff of any number of water conservation/sustainability programs.

and the prevailing political⁷ and social economy can be limiting factors. We need to ask: how is water distributed; to whom is it distributed (individually and sectorally); and who gets it, and at what price? I argue addressing successfully the interrelationships among these values of scale, allocation and distribution is what “sustainable development” is all about. It is the obverse of “sustainability.” (For this reason, I will continually refer to S/SD and not one or the other concept).

To grasp sustainability fully, one needs to consider a host of other concerns, such as the issue of scale (from local to global impacts); the economic, social and political circumstances which have led the world to its current condition; and the ramifications of economic growth, a central concern of the Brundtland Commission in 1987. Underpinning all such debates are axiological issues.

Axiology

The field of environmental ethics emerged in the 1970s and the globalization of environmental problems has contributed to the formulation of an ethics that is interdisciplinary and multicultural. Environmental ethics is a rapidly expanding field that addresses a host of issues: ecology, gender, human/nature relationships (including our duties to fauna and flora), and so on (Armstrong and Botzler 1994).

To employ a cliché, this ethical domain deals with a range of development/environment perspectives and various “shades of green.” At the dark green extreme, “Deep Ecologists” or “Ecocentrists” (O’Riordan 1981: 1) see incompatibility between continued high levels of economic growth and sustainable development, as the one systematically undermines the other. (Opponents charge them with “ecofascism” and “eco-imperialism”). At the lighter green side of this spectrum are the Cornucopians or “Technocentrists” (O’Riordan 1981: 1), who believe salvation lies in a combination of the abundance of nature, the ingenuity of the human race and an unbridled faith in technological advance (O’ Riordan et al. 1983; Armstrong and Botzler 1993; Haughton and Hunter 1994).

⁷Consider apartheid as the ultimate in man-made placing of limits, (short of slavery!), in terms of no voting rights, limited access to resources, restrictions on movement and residence and so on.

In between these two extremes are a range of views, most of which involve a “sustained critique of the failings of conventional economics, of the capitalist mode of production and of the former centrally planned economies of Eastern Europe and the Soviet Union” (Haughton and Hunter 1994: 20). As Haughton and Hunter (1994) counsel, one way through this maze of arguments is to interpret sustainable development as not so much the limits of growth, but more the growth of limits. These concerns are at the center of the formulation of the “precautionary principle” in sustainable development – if in doubt about an activity’s likely environmental consequences, simply do not take the activity further, or at least attend to measures aimed at mitigating its impacts.

Another fundamental dilemma when considering sustainability is how the environment should be valued. Do we use financial values, moral and ethical values, quality of life considerations, or other assessment mechanisms? Some of these values are necessarily qualitative, so whose values do we accept as primary? Should values be ecocentric or anthropocentric? Modifying ecosystems is often contrary to long-term human interests and clearly there is no shared or common standard for decision-making.

Brown (1993) provides recommendations for tackling these issues.⁸

- Environmental decision-makers must understand values questions;
- Ethical positions must be disclosed;
- Solutions to environmental problems must consider social alternatives;
- Economic analyses must expose their value assumptions and environmental decisions must be viewed primarily as ethical choices (Brown 1993:29).

This brief review illustrates that conceptions of S/SD are underlain and informed by a range of environmental (and other) beliefs, ethics and values. Related concerns involve contentious epistemological issues. Are environmental challenges indeed problems? And if they are, how should they be addressed?⁹ (Baarschers 1996).

⁸ Although Brown [1993] is not explicit about the nature of these recommendations, they are presumably considered in terms of choice processes and their outcomes.

⁹ Consider, for example, Dixy Lee Ray’s rather Cornucopian book on “Environmental Overkill” which argued that environmental problems are “amenable to solution when we use the knowledge that science can provide” (Ray 1993: ix). The book also rails against Al Gore and his book “Earth in the Balance.” Ray (1993: 188) sees Gore as “an extremist on environmental issues... he came to his positions through narrow prejudice and partisan enthusiasm and completely ignored scientific impartiality...” (Rush Limbaugh argued “a way must be found to get this [her] book into the hands of as many Americans as possible”). There are a host of epistemological, political, values and ethics

Sustaining the notion of S/SD

Adoption of some of the above perspectives, especially the econocentric view of Beckerman et al., readily leads to easy dismissal of S/SD concepts. As Purvis and Grainger (2004) have noted, S/SD has “become an ambiguous compromise between an environmentalist ideal and a developmentalist ideal.” Amongst other relevant definitional views in the intellectual marketplace are those of Campbell (1996: 301), who offers useful interpretations of the “bandwagon for sustainable development.” In the optimistic view assumed here, “the idea has become hegemonic, a meta-narrative, a given. It has shifted from being a variable to being the parameter of the debate, almost certain to be integrated into any future scenario of development” (ibid: 301). If this is so, then what does sustainability mean? This section delves more deeply into notions of sustainability and sustainable development and it critiques pessimistic views of the concepts, especially in the urban setting. Following Campbell (1996), some of the inherent contradictions of sustainability and urban development are elucidated.

Sustainability is not a conceptual island and is considered by most to be a holistic and multi-disciplinary concept. This is compounded by similar problems, such as how to define “development” and “environment” and the numerous theoretical approaches one can take to address such issues (Purvis and Grainger 2004). There is a wide spectrum of beliefs and approaches regarding sustainability – some even hold the view that in the absence of a clear definition, it is not possible to pursue appropriate planning strategies. In response to the dismissal by some of the value of S/SD, I agree with the counterviews of Campbell (1996: 297) and Alberti and Susskind (1996: 214). For the former, sustainability, “if redefined and incorporated into a broader understanding of political conflicts in industrial society, can become a useful organizing principle for planning ... the more it stirs up conflict and sharpens the debate, the more effective the idea of sustainability will be in the long run.”

The latter authors suggest four general propositions regarding sustainability:

- Sustainability requires invention, not just discovery;

issues here, but this example at least serves to illustrate divergences of viewpoint in terms of environmental and (by extension), sustainability issues.

- Sustainability is an opportunity rather than a constraint;
- Sustainability is a process, not an outcome;
- Sustainability involves a self-conscious *choice*, it does not simply happen.

In light of the last listed requirement, self-consciousness, Meadows et al. (1992), who were responsible for the much-debated “Limits to Growth” report to the Club of Rome have argued their book was not a prediction of doom or a preordained future, but about *a choice* (my emphasis). That initial challenge remains “how to bring about a society that is materially sufficient, socially equitable and ecologically sustainable, and one that is more satisfying in human terms than the growth-obsessed society of today” (Meadows et al. 1992: xiv).

Examination of sustainability or sustainable development is complicated by the fact that at least 100 definitions of S/SD exist (Global Research Development Center: undated).

According to the International Institute for Sustainable Development (IISD)(2010:1), the most frequently cited definition of SD is that first offered by the Brundtland Commission, also known as the “World Commission on Environment and Development” (WCED). The WCED (1987: 8) defined SD as that which seeks to “meet the needs and aspirations of the present without compromising the ability to meet those of the future.” Accordingly, the Brundtland Commission widened the sustainability calculus by pointing to the need to bring environmental, social, economic and political choices into conceptualization and decision-making.

This view constituted a “shift from the traditional, conservation-based usage of the concept as developed by the 1980 World Conservation Strategy (IUCN, 1980), to a framework that emphasized the social, economic and political context of development” (Krueger and Agyeman 2005: 411). The Brundtland Report called for a new “holistic ethic in which economic growth and environmental protection go hand-in-hand” (Barrow, 1995: 370).

The Brundtland Report stressed that both “First” and “Third World” countries had to develop and implement policies to protect their environment and reduce poverty, and that obtaining these objectives did not have to place a burden on development (Brundtland Report 1987). On the face of it, this provides planners with little guidance beyond an indication of temporal concerns on a generational scale and concern for people’s needs and aspirations, of whatever

stripe. Perhaps the Brundtland Commission could be credited with having achieved the most widespread dissemination of the concept of sustainability. However, sustainability, in terms of its use as a *concept* (and not in the everyday English language sense of the word), can be traced back at least to the economist Faustmann's use of the concept in 1849, when discussing "sustainable forest management" (Kula, 1994). In this sense, sustainability, in the narrow sense of the term, is a concept with rather a long pedigree!

Pearce et al. (1990: 3), cited in Kula (1994: 33) have offered a more apt definition for countries whose major problem is not over-consumption, by suggesting sustainable development is "a vector of desirable social objectives such as an increase in real income per capita; an improvement in health and nutrition; educational achievement; access to resources a fair distribution of income; and increase in basic freedoms." Barnett and Lulofs (1996: 1) have provided another definition: "Sustainability is an ethic, a set of principles, and a vision for the future. It is a powerful global concept that is expressed locally."

The concept also comes in different "strengths," namely "strong/hard" sustainability and "weak/soft" sustainability.

Hard or strong sustainability implies that renewable resources must not be drawn down faster than they can be renewed, i.e. that (critical) natural capital must not be spent – we must live off the income produced by the capital. Soft or weak sustainability accepts that certain resources can be depleted as long as others can substitute for them over time. Natural capital can be used up as long as it is converted into manufactured capital of equal value. The problem with weak sustainability is that it can be very difficult to assign a monetary value to natural materials and services, and it does not take into account the fact that some natural materials cannot be replaced by manufactured goods and services. Strong sustainability thus maintains that there are certain functions or ecosystem services that the environment provides that cannot be replaced by techno fixes (Krueger and Agyeman 2005: 412).

In addition to the various strengths within the notion of sustainability, many authors also perceive differences between the terms sustainability and sustainable development. The differences between the two *can* be seen as being largely semantic, but one can also view them as having slightly different nuances, and being two sides of the same coin. I conceive of sustainability as related to carrying capacity, i.e. a sustainable resource is that which is not

used up over time. Sustainable development here, on the other hand, refers to development, which utilizes sustainable resources, which can be sustained over time (generations) and which explicitly incorporates the “three Es,”¹⁰ discussed in more detail below. Randolph (2004) has suggested another “E” might refer to “Eternity” to express the need to be able to sustain such initiatives over time.

For this study, these concerns led to questions related to how key informants in Johannesburg interpret S/SD and whether S and SD are indeed conceived as interchangeable concepts. Furthermore, in tandem with the literature, key informants’ views can help to construct a heuristic model of S/SD that might help to guide decision makers as they address the many challenges that have been outlined.

Interviewees were asked a mix of discrete and open-ended questions regarding how they and their organizations interpret and operationalize S/SD (please see annexure containing the questions). In terms of interviewees’ familiarity with the literature, it is clear that on one level, the WCED of 1987 has indeed demonstrated that it was a major influence in terms of popularizing (but not originating) the concept of SD. Many interviewees “recycled” the WCED’s well-worn definition of SD and referred to intergenerational (and equity) concerns and the need to adopt a long-term perspective (Interviewees T, MA, MN and H: 2008). For example, Interviewee E (2009) stated that sustainability implies “access, equity, affordability, growth and development and managing risks. It is about “some for all forever and we need to tackle poverty in order to tackle sustainability—inequity implies unsustainability.”

Interviewee M (2009) also echoed the literature, in terms of the Hicksian conception of capital and interest (as highlighted by Daly (1996) in the literature review): “The problem is that we have to rely on external sources for our water—this is a limiting factor—we treat it like a bank overdraft—we will pay back with more interest, we mustn’t eat into capital.”

To illustrate how the terms of S/SD are contested, Interviewee E (2009) argued: “SD is a cliché, based on dodgy assumptions; it’s just a buzzword ... the Statist approach is naive regarding its understanding of sustainability ... the technocist approach ignores relationships,

¹⁰From a more architectural and urban design perspective, “four T’s might be added: “talent, technology, tolerance and territory assets” (Leite 2008). For reasons of brevity, these will not be discussed here, but this serves to illustrate allied professions are also developing maxims for sustainability. Hirt (2010: pers.comm.) suggests 3 Ss: “science, society and space”).

ethics and wholeness – in the end it’s all very contextual.” This perspective may be juxtaposed with the view of Interviewee T (2009) who declared “sustainability is not just airy-fairy, but is absolutely fundamental to survival. We need to develop a new social contract. We need to do things differently. Sustainability is no longer a luxury. We are at the threshold and need new thinking and paradigms, but the term is widely thrown around and so is devoid of meaning.” Nonetheless, Interviewee T also observed that “sustainability is not entrenched and is hard to operationalize— for this we need charismatic, credible leadership” (Interviewee T: 2009).

The accusation of vagueness regarding S/SD, prevalent in the literature, also came up in interviews with senior Johannesburg officials. “The conceptual framework of sustainability can be destroyed by appending to it the whole issue of HIV/AIDS ... sustainability thus becomes everything and nothing. Sustainability is part of an ethos—whether you understand the term properly is another question, like the term ‘conservation.’ What we practice and interpret regarding sustainability is antithetical—we actually can’t have SD, because SD is development that won’t adversely affect the environment (Interviewee G: 2008).

It appears for some interviewees, there is a generalized, vague and/or Brundtlandian “future generations” notion of sustainability, a conception that has not been extensively explored: “Sustainability is the process of affording services to all. There has to be sustainability in order to ensure that future generations receive the [water] service.” (Interviewee H: 2008). “Sustainability is what you must do to be able to continue going forward, so that there is no poor legacy left environmentally. Sustainability requires investment and institutional change ... from reactive to proactive teams that provide services” (Interviewee R: 2008).

Sustainable development is also seen as “what happens when we convert natural capital into social and financial capital” (Interviewee T: 2009) and it is “the ability to provide urban services to residents, in a manner that does not burden the environment, now and in the future. It is development that provides a balance between the economic benefits of our interventions while at the same time mitigating negative impacts on our environment” (Interviewee MA: 2008).

In terms of the relationship between S and SD, some interviewees’ responses are presented below:

The terms “are different, but can be used interchangeably, but S is narrower. The issue is how to configure built environment sustainability within the envelope of the natural environment that it needs to sustain it. This means we need to ask “out of the box” questions re: sustainability. The Johannesburg mayor has said for environment and sustainability we can’t have poverty and excessive consumption of resources (a la the WCED). Thus, economic development and poverty are yoked with the green agenda (Interviewee G: 2008).

Furthermore, Interviewee M (2008) observed:

Sustainability suggests reducing our collective use of resources, most of which are over-used already. This will require changes in consumption patterns and expectations, as well as development of environmentally-friendly technologies. Sustainable development implies controlling population growth and a move away from Capitalism (not necessarily to Communism). We just need to use resources at a different place, govt. versus individuals. The solution is much bigger than the effort we put into it, we need more people doing little things. The human psyche is not geared to deal with things in advance (recall the events of Easter Island). We don’t have sustainable methods of production, only when we run out of water will we act” (Interviewee M: 2008).

For Interviewee MA (2008), “Sustainable development is the consideration of composite factors in approaching matters of development. It takes into consideration issues of society/social, economic and political concerns, amongst many. It is developments that weight the risk factors and positive aspects prior to implementation in order to maximize the benefits of the development while minimizing any negative impacts on the environment and society. Similarly, sustainability is about the specific focus on a particular subject. The degree of sustainability can be measured as the tenacity of interventions/programs to survive with as little use of man-made energy as possible. Sustainable development however is a means to sustainability.”

Interviewee B: 2008 argued: “sustainability is to maintain certain processes or resources indefinitely. SD is that which doesn’t contribute to the depletion of natural resources. Water

and sustainability are highly linked to economic transformation and empowerment.” For Interviewee M 2008, “S is about the activities engaged in to get to SD.”

This backdrop discussion of the literature and of interviewee responses concerning differences between sustainability and sustainable development is helpful in understanding the context of “Water, Sustainability and Johannesburg” (WSJ). (There is also a large body of related literature dealing with “sustainable urban water management” (SUWM) and the “co-evolution of... socio-institutional and technical systems” van de Meene and Brown (2009: 1448)). But for the purposes of this study, water, in terms of sustainability, refers to an amount of water being available over time, whereas “sustainable development” refers not only to a sustained supply of this resource, but also to issues of how much it costs in terms of demand and supply, who gets the resource at what cost and in what amount, and water-related environmental assessment concerns (impacts on the broader biophysical and socio-economic environment). Sustainable development therefore represents part of a paradigm shift from reductionist analysis and the exploitative use of natural and human resources to an acceptance that humanity must work with nature. In order to delve yet deeper into the nature of S/SD, the principles that underpin these concepts are discussed below.

Principles of S/SD

According to Haughton and Hunter (1994: 17) there are three basic principles of sustainable development. These are outlined below along with statements aimed at suggesting their portent for WSJ.

The Principle of Intergenerational Equity. In considering any human activity, the effects on the ability of future generations to meet their needs and aspirations must be considered. This is sometimes also referred to as the *principle of futurity*.

In other words, is there enough water in SA for present and future generations and what is the quality of this water?

The Principle of Social Justice. This principle is concerned with current generations, where poverty is seen as a prime cause of degradation. Sustainability requires that control over distribution of resources be more evenly exercised, taking account of basic needs and

common aspirations. Wider participation in environmental strategies and policies is an integral element of achieving this aim, sometimes also known as intra-generational equity.

In other words, who gets what amount and quality of water and at what price in SA?

The Principle of Transfrontier Responsibility. “At the broad level, stewardship of the global environment is required. More specifically, transfrontier pollution needs to be recognized and controlled. Where feasible, the impacts of human activity should not involve an uncompensated geographical displacement of environmental problems. Rich nations should not overexploit the resources of other areas, distorting regional economies and ecosystems. Similarly, the environmental costs of urban activities should not be displaced across metropolitan boundaries, in effect subsidizing urban growth” (Haughton and Hunter, 1994: 17).

In other words, what happens to areas that supply Johannesburg’s water and areas that receive its wastewater? What are the ramifications of water pollution and eutrophication?

Sustainability is also generally taken to embody the “precautionary principle” (Haughton and Hunter 1994), which suggests in cases of uncertainty regarding sustainability mandates, societies should err on the side of prudence. Because survival of practically all of the global life-support systems is uncertain, we should be “very conservative in our estimate of various input and output capacities, and particularly the role of unstudied, apparently ‘useless’ species” (Goodland 1995:70) and of course water is fundamental to the survival of any species. To narrow the discussion further, I now address other themes and inherent tensions permeating the discussion on S/SD; especially the “three Es.”

Conceptual Aids, Conflicts, the “Three Es” or Themes of S/SD, and the Metaphors of “Urban Metabolism” and the “Ecological Footprint”

After Campbell (1996), it can be argued that planners have to deal with property, resource and development conflicts and try to balance Economic Growth, Equity and Environment, or “the three Es,” in their pursuit of sustainability. The property and development tension pits environmental protection against the need for social justice, economic opportunity and reduction of income inequalities, while the resource conflict aligns environmental protection against social justice, economic opportunity and reduction of income inequalities.

These conflicts and the three Es are discussed later in more detail. At this stage, I consider some broader S/SD concerns (Barrow 1995). Barrow has described sustainable development as addressing the following aims:

- The maintenance of ecological integrity;
- The integration of environmental care and development;
- The adoption of an international (north-south interdependence) stance;
- The satisfaction of at least the basic human needs for all;
- A stress on normative planning (“utilitarian conservation”);
- Calls for inter-generational, intra-generational and inter-species concern;
- A stress on the application of science to development problems;
- The acceptance of some economic growth (within limits);
- Attaching a proper value to the natural and cultural environment;
- The adoption of a long-term view of development. (Barrow 1995: 373).

Three fundamental systems can be identified in this list of concerns, economic, biological and social. The goals represented for each system need to be integrated in order for sustainable development to be achieved. “Central aims associated with the biological system include the maintenance of biodiversity and the maximization of productivity. Social justice and sustainable institutions are associated with the social system, while economic aspirations include the satisfaction of basic needs, equity and high quality goods and services” (Barrow 1995: 373). Barnett and Lulofs (1996) expand on these systems and point to the community’s economic component being based on the preservation of its productive capital stock, which its environment and natural resources; people–human resources; and productive facilities and infrastructure. They maintain that “a society can realize sustainable economic development, if it maximizes income generation while maintaining or increasing the stock of assets that yields such benefits. A viable economic system generates surpluses and technical knowledge. It explicitly considers natural capital as part of its assets and a key to its productivity. Therefore, a sustainable economic system incorporates externalities into market prices so as to reflect the full costs of goods and services. In other words, it concentrates on development (qualitative) rather than on growth (quantitative)” (Barnett and Lulofs 1996: 12).

In turn, environmental management “demands ecosystems be maintained for their essential natural functions, their beauty and their livability as a landscape. This also relates to the capacity of natural resources and their waste assimilation capacity for human use. The global ecosystem can reach stability only if subsystems, such as species and biotic components, are viable. Biological diversity maintains the life support systems for all species” (Barnett and Lulofs 1996: 12). And social equity implies that “diverse social and cultural systems are preserved. A viable social system is one able to address a variety of societal tensions such as the ramifications of inequality, by distributing costs and benefits equitably. Social sustainability implies intra-generational equity (e.g., elimination of poverty, viable levels of welfare, protection of public health, provision of education) and intergenerational equity (leaving the world in a better condition). In order to achieve some semblance of sustainability and also balance within and between the economic, environmental and social systems, a new process of urban management called engagement is required” (Barnett and Lulofs 1996: 12).

Furthermore, Barnett and Lulofs (1996: 12) state that “engagement is a participatory approach to managing a region to foster its sustainability. It blends the concepts of good governance, participation, consensus-building, and participatory strategic planning. It allows cities to link goals, assess trade-offs and identify leverage points for action. Participation implies cooperative problem-solving. It is the involvement of citizens and groups in the community’s decision-making process and in the implementation and evaluation of policies and programs. It indicates that citizens are willing to accept joint responsibility for the sustainability of their city.”

To elucidate S/SD further, Goodland’s (1995:3) suggestion that sustainability can be categorized in terms of (interlinked) “social, economic, and environmental” concerns helps to clarify further the “three Es.” In essence, social sustainability refers to moral capital, which can be achieved only by systematic community participation and a strong civil society. “It requires maintenance and replenishment by shared values and equal rights, and by community, religious and cultural interactions. Economic sustainability seeks to add the criterion of scale to those traditionally addressed in economics: allocation and efficiency” (Goodland 1995:3)

Furthermore, “natural capital must be maintained (according to the Hicksian notion of income, i.e. ‘the amount one can consume during a period and still be as well off at the end of a period).’ Environmental sustainability seeks to improve human welfare by protecting the sources of raw materials used for human needs and ensuring that the sinks for human wastes are not exceeded, in order to prevent harm to humans” (Goodland 1995:3).

Qunental et al. (2009: 12) have proposed a “new set of six main pillars to substitute for this traditional three pillar approach...

- Sustaining natural capital
- Sustaining life-support systems
- Minimizing human impacts
- Developing human capital
- Developing social capital
- Developing economy
- Developing institutions.”

However, I would argue that this argument and distinction are largely semantic and the above are in fact embodied in the notion of the “three Es.” as described in terms of apexes of a triangle, or indeed corresponding to the “economic,” equity” and “environment” pillars, or legs of a stool. In sum, as Berke (2008: 401) has observed, “planners (need) to reframe their work to anticipate and accommodate the needs of current and future generations in ways that balance the three Es and link local actions to global concerns.” Knight-Lenihan have offered another useful summation:

Whether and how sustainable development is addressed is influenced by existing ecosystem resilience (a system’s ability to cope with perturbations, including development), the ability of human society to influence resilience (society’s adaptability), and the capacity to create a fundamentally new system when economic, ecological or social conditions require it (transformability) (Knight-Lenihan (2007: i).

In order to enhance understanding of S/SD, it is useful to complement the notion of the three Es, by turning to the metaphors of Urban Metabolism (UM) and the Ecological Footprint

(EF). These metaphors help to, *inter alia*, introduce the dynamic notion of flow (especially important when discussing the flow of water) and resource use and water (to mention just one resource).

The Metaphors of “Urban Metabolism” and the “Ecological Footprint”

Urban metabolism (UM)

In 1965, Wolman coined the term “urban metabolism” to serve as a metaphorical comparison of an urban system with a living organism. Although it cannot really be used to identify a life-cycle for a city, the concept is very useful for describing the major daily material inflows and outflows of a city, such as water, food and fuel flowing in and waste heat, sewage, solid waste and air pollutants flowing out (White 1994).¹¹ It is also a useful metaphor for addressing the (sustainable) flow of water and wastewater in a given area, such as Johannesburg and obviously, in order to be sustainable, Johannesburg requires clean water and the city also needs to manage its wastewater effectively. The UM metaphor thus makes one cognizant of the need to consider the dimensions of input, conversion and output¹² in relation to a given resource¹³ and that notions of sustainability require moving from a linear system to one of closing the loop. As Wolman (1965) has argued:

The metabolic requirements of a city can be defined as all the materials and commodities needed to sustain the city’s inhabitants at home, at work and at play. Over a period of time, these requirements include even the construction materials needed to build and rebuild the city itself. The metabolic cycle is not completed until wastes and residues of daily life have been removed and disposed of with a minimum of nuisance and hazard—man has come to appreciate that the earth is a closed ecological system and the usual methods that once appeared satisfactory for the disposal of wastes no longer seem acceptable. He has the daily evidence of his eyes

¹¹The urban metabolism approach evolved alongside the materials balance (or residuals and environmental quality movement [REQM]) approach (White 1994: 48).

¹²In terms of water utilization in any given industrial or domestic process—where and how is it obtained (input), how is it used/processed? (conversion) and what happens to it as it exits this process and becomes wastewater (output). This gives rise to the commonly used “sustainability injunction” to “reduce, reuse and recycle” (See Miller 2004).

¹³This is readily applicable to energy resources as well as water resources, for example.

and nose to tell him that the planet cannot assimilate without limit the untreated wastes of his (sic) civilization (Wolman 1965, cited in White 1994: 42).

Interestingly, Wolman, even in 1965, focused on “three metabolic problems that have become more acute as cities have become larger and whose solution rests almost entirely in the hands of the local administrator” (Wolman 1965, in White 1994). The main problems were water supply, sewage disposal, and control of air pollution. He noted that water quality was a more critical factor than air quality, at least in terms of meeting health objectives. Again, rather ahead of his time, Wolman suggested that water was wastefully used in cities because the visible cost to the user reflected, at best, only the costs of delivery, and excluded the costs of production and restoration¹⁴ (Wolman 1965, cited in White 1994: 45, 47).

What Wolman’s metabolism approach demonstrated was the “need to see urban water as part of the hydrological cycle, not just a commodity that was produced, used and discarded. We can apply the metabolism concept to a new view of cities, which sees them as not simply ‘throughput,’ or a linear metabolism, but a circular metabolism in which the waste products must be re-used as far as possible” (White 1994: 43).

Lyle (1994: 4) has emphasized this point: “... Humans have replaced nature’s endless cycling and recycling of materials, processes at the core of the earth’s operating system, with an encompassing system of *one way flows*, moving the materials that support life in vast quantities from source, through consumption, to sink. Eventually a one-way system destroys the landscapes on which it depends...” (my emphasis).

This discussion suggests S/SD should, in accordance with the UM metaphor, at least attempt to limit wastage and move from a linear to a circular metabolism. Accordingly, the phenomenon of “unaccounted for water” will be discussed later in the chapter on WSJ.

The Metaphor of the “Ecological Footprint”

Wackernagel and Rees (1996) are the prime protagonists of the Ecological Footprint (EF) metaphor. They defined the concept as follows: “The ecological footprint is an accounting

¹⁴ This is the stuff of latter day resource and environmental economics (or ecological economics) and its precedents. See Pearce, Costanza, Tietenberg, Callan and Thomas et al. (various dates).

tool that enables us to estimate the resource consumption and water assimilation requirements of a defined human population or economy in terms of a corresponding productive land economy” (Wackernagel and Rees 1996: 9).

Rees (1996 <http://dieoff.org/page110.htm>. Accessed 7.7.2009) avers that in terms of the EF,

Cities necessarily appropriate the ecological output and life support functions of distant regions all over the world through commercial trade and the natural biogeochemical cycles of energy and material. Indeed, the annual flows of natural income required by any defined population can be called its appropriated carrying capacity. Since for every material flow there must be a corresponding land/ecosystem source or sink, the total area of land/water required to sustain these flows on a continuous basis is the true ecological footprint¹⁵ of the referent population on the Earth.

Much of SA’s and especially Johannesburg’s water supply must be obtained from somewhere else. At the “city-state level”, Johannesburg does not fulfill any of its own water needs; it imports water from the Vaal River and from the neighboring state of Lesotho. This has a bearing on S/SD. Major engineering works (with associated fiscal and environmental impacts) are required to supply cities and enable them to import water. This is not a new phenomenon: “Many cities import water from a considerable distance, and this often involves the construction of large reservoirs, (with the attendant flooding of large areas of countryside) aqueducts, pipelines, smaller storage reservoirs, groundwater pumping stations and the re-routing or alteration of existing courses to facilitate water supply” (Haughton and Hunter 1994: 168). Other examples of cities reliant on water importation include New York, which acquires only 5 percent of its water locally; San Francisco and Oakland, which get water from the Hetch Hetchy aqueduct which is approximately 100 miles northeast of these

¹⁵ Rees’s ecological footprint analysis of Vancouver, Canada, indicated the city appropriates the productive output of a land area nearly 174 times larger than its political area to support its present consumer lifestyle. Other researchers found the aggregate consumption of wood, paper, fiber and food by the inhabitants of 29 cities in the Baltic Sea drainage basin appropriates an area 200 times larger than the cities themselves. “Advanced” economies are running massive, unaccounted ecological deficits with the rest of the planet... Even if their land area were twice as productive as world averages, many European countries would still run a deficit more than three times larger than domestic natural income. These data emphasize that (most) developed countries are over-populated in ecological terms – they could not maintain themselves at current material standards if forced by changing circumstances to live on their remaining endowments of domestic natural capital. This is hardly a good model for the rest of the world to follow!” (Rees 1996 <http://dieoff.org/page110.htm>. Accessed 7.7.2009)

cities (Bourne 2010) and Los Angeles and environs, which receive water from the Colorado River (Nicholas 1982, cited in Haughton and Hunter 1994: 168). And in terms of what Bourne (2010: 143) terms the “replumbing” of California, the state has “2,000 miles of pipelines, canals, and aqueducts, with the California aqueduct delivering 2.6 million acre feet of water to Southern California and stretching for 444 miles” (Bourne 2010: 143). Similarly, much of Dakar’s water supply has to be brought from a lake 200 km away, due to overuse and pollution of local groundwater supplies (Hardoy et al. 1992, cited in Haughton and Hunter 1994: 169). Clearly then, many cities or countries can not lay claim to “sustainable” local water resources, given that these areas are not self-sufficient in water and so water effectively has to be “imported” from further afield. Furthermore, the vast expense and often negative environmental impacts associated with such actions can be said to compromise notions of economic and environmental sustainability.

The EF metaphor will later be translated to the case of WSJ. In the meantime, I consider some of the conflicts inherent in S/SD outlined earlier.

Some conflicts in striving for urban sustainability

In addition to the above dimensions of sustainability, it is instructive to consider Campbell’s (1996) notion of the “planner’s triangle and sustainability.” He uses a simple triangular model to understand divergent priorities for planning. Campbell (1996), contends the elusive goal of sustainability might be reached if planners could mitigate the three conflicts presented in this triangle: those of the property conflict (for example the tension between private sector interests and the public good); the resource conflict (economic or instrumental value and utility versus the ecological value¹⁶ of resources) and the development conflict, which, for Campbell (1996: 309), “... is where the real action for planners will be: seeking to resolve both environmental and economic equity issues at once. Here is where the profession can best make its unique contribution.”

The planner must thus reconcile the conflicting interests of “growing the economy, distributing growth fairly and in the process not degrading the ecosystem” (Campbell 1996: 298). And as Daly (1996: 299) avers: “this could be the most challenging conundrum of

¹⁶Resource and/or environmental economists describe various dimensions of the notion of “value”, such as option, existence and bequest value. (See the work of David Pearce, for example – various dates).

sustainable development: how to increase social equity and protect the environment simultaneously, whether in a steady state economy or not ... how could those at the bottom of society find greater economic opportunity if environmental protection mandates diminished economic growth?" Theoretically, this has interesting antecedents, in terms of the traditional economic growth vs. environment conflict. In particular, as regards the latter, Daly maintains that to "sort out conflicts and harmonies we must distinguish growth (quantitative increase by assimilation or accretion of materials), from development (qualitative improvement, realization of potential). This also requires a shift in terms of seeing the economy as a subset or subsystem of the environment and not vice versa" (1996:13).

Daly states that "unless one has a vision of the economy as a subsystem, the whole idea of sustainable development—of a subsystem being sustained by a larger system whose limits and capacities it must respect—makes no sense whatsoever" (Daly 1996: 7). In particular, he calls for a reduction in throughput, in terms of economic input and output, and a steady-state economy (SSE). In a SSE, the aggregate throughput is constant, though its allocation among competing uses is free to vary in response to the market... throughput is really a process in which low entropy materials are transformed into commodities and then eventually into high-entropy wastes" (Daly 1996: 31).

These issues are particularly apposite in contemporary SA, where the above conflicts are often thrown into sharp relief and need to be debated. Daly's thesis, while holding much intuitive appeal, needs to be tested in SA circumstances, where arguably the trade-offs are much more difficult and sustainability an even more elusive goal. Would a SSE retard or prevent environmental degradation and our depletion of natural capital, but also do little to relieve poverty?

As Campbell (1996: 304) has observed,

(T)he advocates of sustainable development rightly reject as flawed the premise of conventional economics that only a growth economy can achieve social redistribution. And growth economics has indeed exacerbated the environment's degradation. However, it is wishful thinking to assume that a sustainable economy will automatically ensure a socially just distribution of resources. The vision of no growth (commonly, though not universally assumed to characterize sustainable development)

raises powerful fears, and planners should be savvy to such fears. Otherwise, they will understand neither the potential dangers of steady-state economics nor the nature of the opposition to sustainable development (Campbell 1996: 304).

Armed with an exploration of conflicts and PTM in the S/SD polemic, I now address a possible spatial manifestation of the above, and consider urban S/SD in general, before focusing on S/SD as regards Johannesburg.

Urban sustainability, Again.

Emerging from the thicket of environmental crises and problems associated with urban areas and human settlements are the notions of the “sustainable city” or “the ecocity” and “healthy city.” The definitions of the environmental planning lexicon remain opaque, however: it is not clear whether these terms are interchangeable or complementary, or whether the concepts and practices espoused by their proponents have been adequately integrated and implemented. Indeed, d’Auria et al. (2010: 9) have highlighted the “fluctuating notion of human settlements” and the nebulosity of this field.

A useful starting point for a discussion on the slippery notion of sustainability, is to try to determine what some of its goals might be. The World Health Organization (WHO) (1992:102), cited in Haughton and Hunter (1994: 25), has suggested sustainable urban development should have as its goal that cities’ urban systems continue to support more productive stable and innovative economies, yet do so with much lower levels of resource use. Breheny (1990) has posited that urban sustainability involves “the achievement of urban development aspirations, subject to the condition that the natural and man-made stocks of resources are not so depleted that the long-term future is jeopardized” (Cited in Haughton and Hunter 1994: 25). In practice, the objective of moving towards becoming a more sustainable city “needs to be set in the context of a broader sustainable society, and related to its contribution to global sustainable development” (Haughton and Hunter 1994: 26).

At an overall level, there are also different interpretations of cities as far as S/SD is concerned: on one level, cities are seen as generators; on another, as parasites (Girardet 1992; White 1994). According to Alberti and Susskind (1996: 213),

The impact of cities on the environment increasingly dominates the debate on sustainability. Most global and regional environmental problems originate in cities. Cities concentrate increasing numbers of people and human activities; thus, they import increasing amounts of natural resources and export vast quantities of emissions and waste. Urbanization also entails major changes in the way people use natural resources. While it accelerates the transition from traditional to modern fuels, it also intensifies the use of energy and its environmental impacts... on the other hand, cities provide major opportunities to achieve economies of scale and use natural resources more efficiently ... thus the way cities are designed and managed can be crucial to sustainability ... what makes urban settings especially interesting is that cities are organized systems of many interacting biophysical and socioeconomic components and that the way they are organized and managed affects the level of environmental pressure that individuals exert (Alberti and Susskind 1996: 213).

Girardet (1992: 90) has suggested cities must be viewed as parasites because at present they have little concern for the health of their host organism, “Gaia,” the living planet earth. Cities, particularly those of the developed countries, require vast quantities of water. Worldwide, North American citizens use the most water, with an average daily use of nearly 6,400 liters per person.¹⁷ (However some cities, such as Albuquerque, NM have employed a number of sustainability measures, such as offering rebates for installing low-flow fixtures and harvesting rainwater, such that per capita domestic consumption is only 80 gallons or approximately 304 liters per person per day (Royte 2010)). Traditionally, most early cities drew on water from nearby rivers and lakes, but modern cities (like Johannesburg) are often built in less suitable locations, with limited local water augmented by supplies from remote sources. As such, “current cities are parasites that, unlike successful parasites in nature, have not evolved mutual aid relationships with their life-support host landscape that prevent the parasite from killing off its host and thereby itself” (Odum 1993, cited in Lyle 1994: 5).

As will be shown to apply to WSJ, Barnett and Lulofs (1996) maintain:

Soaring urban growth rates are straining urban services at the same time that mandates for environmental protection, job creation, social services and financial self-

¹⁷ Includes domestic, irrigation and industrial use.

sufficiency are being passed to localities. Cities and regions are growing in power as countries all over the world decentralize to the local level. Metropolitan regions are becoming the key unit in the global economy. Cities are not just cities anymore. What we call a city is actually a metropolitan region made up of cities, suburbs, and other governmental jurisdictions. The boundaries of the city-state vary with the dynamics of its social, economic, and environmental systems. Our ability to govern these new city-states and address issues of the economy, the environment, social equity, and civic engagement is in question. Since more and more people live in metropolitan areas, effective governance of these cities is even more important (1996:1).

The Sustainable City

For purposes of this study, I will use Barnett and Lulofs' (1996: 1) definition of a sustainable city state: "A sustainable city state is a metropolitan region that competes successfully in the global economy and maintains its cultural and environmental vitality ... a sustainable city has a strong economy, a clean environment, social equity, and civic engagement."¹⁸ Later, I will translate this in terms of the implications of how sustainable management of the water sector in Greater Johannesburg can assist in the achievement of this sustainability vision.

The Healthy City

The WHO's "Healthy Cities Program" (HCP) aims to improve environmental and health conditions through a developmental strategy that uses raised awareness, mobilization of community participation in partnerships with local (municipal) agencies and institutions, and city networking. The central objective is to develop the role of local governments in public health and to encourage them to implement a "Health for All" policy at the city level (Soll et al. 1995).

Several authors discussing the Healthy City recognize that an environmentally or ecologically unsustainable city will ultimately prove to be both socially and economically unsustainable

¹⁸Without engagement it would be difficult to attain equity and also engage in the inherent economic, ecological and social tradeoffs as regards sustainability, which require quite some discourse...

and as a result very unhealthy. (Hancock 1996). A WHO Expert Committee on Environmental Health in Urban Development (WHO 1991) has identified broad categories of health effects resulting from the impact of urban development: communicable diseases that flourish when the environment fails to provide barriers against pathogens (overcrowding increases these risks), the importation of pathogens and increases in vector populations; diseases and injuries associated with exposures to toxins and hazards that are often intensified by the living conditions in urban environments; and psychosocial health problems resulting from the stresses of urban life.

The WHO Expert Committee (1991) also summarized the major forces affecting health and the environment in the urban areas of developing countries experiencing rapid and massive population growth: settlements built in hazardous areas; overcrowding and congestion; extreme poverty; pollution arising from industrialization and improper waste disposal and the inability of cities to summon the financial and administrative resources to ensure potable water supply, sanitation, housing, waste management, environmental controls and to provide health and social services (Hancock 1996). And Satterthwaite (1993) has suggested that low-income groups, especially women and children, bear most of the health burden of environmental hazards in urban environments. This includes the lack, or poor quality, of water.

The Ecocity

Ecocities have taken important steps to reduce their parasitic role in the planet's ecology toward a stance which can "endure and can provide its inhabitants with a meaningful existence without destroying the ecological base on which it stands" (White 1994:144). The key ingredients in creating a green city are seen to be the need to look at the city in its bioregional context, and to bring about fundamental changes in the ways in which people treat nature and each other.

Greening the city in the context of the urban explosion of Third World cities implies a development process that goes beyond anti-pollution measures, conservation of green areas, and reforestation of the surrounding environment of the city. It also includes better

transportation systems, public services and waste recycling technologies to rationalize the use of resources and energy with the urban ecosystem (Haughton and Hunter 1994).

In ecocity terms, urban sustainability may be viewed in two alternate ways (Platt et al. 1994: 11). The first concerns the protection and restoration of the remaining biological phenomena and processes within the urban community, or the “the greening of the city,” in the phrase of Nicholson-Lord (1987, cited). This sense reflects Sears’ observation (1956:471) that

ecological communities insure an orderly cycle of material land-energy transformations [and] regulate the moisture economy, cushion the earth’s surface against violent physiographic change, and make the formation of soil possible. All but the last of these functions apply to the urban context more intensely than to the rural. To these may be added the aesthetic, educational, recreational, and psychological benefits of natural areas within cities. ... In the second sense, urban sustainability refers to the impact of cities upon the larger terrestrial, aquatic, and atmospheric resources of the biosphere from which they draw sustenance and upon which they inflict harmful effects. Sustainability in this sense would involve issues of transportation, energy conservation, air and water pollution abatement, material and nutrient recycling, and so forth¹⁹. (Sears 1956:471, cited in Platt et al. (1994: 11)).

Towards achieving urban sustainability: sustainability and the urban dimension in particular

The United Nations Center for Human Settlements (UN-HABITAT “Global Report on Human Settlements” 1996) posits that as urban authorities progress from a commitment to environmental quality to one oriented to sustainable development, two further tasks must be addressed. The first concerns minimizing the negative impacts of city-based production and consumption on all people, not just those within a city’s jurisdiction. The second concerns implementing urban development and management strategies based on an understanding of

¹⁹Van der Ryn and Calthorpe (1986: 55) outline some basic principles of an ecologically planned community:

- greater residential densities
- locating services so as to make them easily reachable
- building in local employment
- devising information-efficient and energy-efficient building strategies
- creating design-encouraging networks of local people to carry social responsibilities
- providing local energy and food production
- recycling water and wastes
- integrating community design with a transportation system that provides balanced options

the finite nature of many resources (or ecosystems from which they are drawn) and of the capacities of ecosystems in the wider regional, national and international context to absorb or break down wastes.

The institutional dimension, whether implicitly or explicitly, as will be shown later in the discussion on Johannesburg, is important to securing sustainability. For example, some of the suggested initiatives for sustainable urban management from Agenda 21 (Earth Summit 1992) include the following: institutionalizing a participatory approach to promoting social organization and environmental awareness, strengthening the capacity of local bodies to deal with environmental challenges and establishing mechanisms to mobilize resources for local initiatives to improve environmental quality. A proxy for all of this then could be an additional “E,” that of “Engagement.”

Similarly, Speth (1992) has argued the shift to a sustainable society requires a number of transitions: demographic, technological, economic, social equity and institutional. The latter transition is crucial to achieving any of the others and involves conceiving and implementing different arrangements among governments, businesses and peoples.

Duhl (1993) has likewise bemoaned cities’ inability to develop systems of governance that can respond effectively to the diversity and complexity of their populations and challenges. He has proposed:

We must collect the skills that bring diverse heterogeneous people and populations together. It is important to cultivate systemic, ecological understandings of particular issues, to see them within family, neighborhood, community, city, region, national or international context. Since the issue of health in a city constitutes more than medical care we must create both an understanding of the health territory and a set of processes which bring the diverse people and groups with their varied values together, to create something more than a set of specialties (Duhl 1993: 123).

UN-HABITAT has argued that good governance in cities is fundamental to their capacity to attain sustainability. Cities have great potential to combine healthy and safe living conditions, cultural riches and environmental advantages. The UN entity has outlined two routes to enabling cities to prosper: one strategy is to enable the role of governments and

another is to engender sustainable human settlements development. This requires “hard-headed choices about production and consumption patterns in urban areas—between the demands of regions and the demands of cities; between balanced use of resources and misuse of resources; between consideration of the finite nature of ecosystems or willful indifference to them; between wasteful living standards and carefully managed ones. In addition, it calls for social equity through improved governance and adequate habitation” (UNCHS 1996: xxii).

Conclusions

This chapter has sketched some of the dimensions and alternate conceptualizations of sustainability and pointed out several dilemmas inherent in its pursuit. This discussion has suggested not simplicity, but added complexity. The experiences of Johannesburg, South Africa, provide a context in which to root the concerns treated here. This city’s leadership has shown it is cognizant of resources, development and growth tradeoffs and of the need to devote attention to participation and community perceptions of the environment and development, à la Campbell’s (1996) description of the inherent conflicts in the pursuit of sustainability. The theoretical arguments that may be applied to a discussion of WSJ can be summarized as follows:

The concepts analyzed above may constitute a meta-narrative with considerable merit. Largely because they are comprehensive and holistic in nature, they bring together otherwise competing thrusts that are inter- and multi-disciplinary in character. It will also become apparent that especially as water is concerned, the city-state cannot be seen in isolation and a wider regional canvas needs to be considered, an idea espoused by Geddes as long ago as 1915 (cited in Haughton and Hunter 1994: 228): “some resources are naturally better managed at the regional level, *most notably water supply* and disposal, which should be related to natural watershed areas” (My emphasis).

In terms of urban planning and the implementation of S/SD, it seems that “nothing inherent in the profession guides planners toward economic development, environmental protection or social equity. In an effort to achieve sustainable development, planners are forced to work within the tensions created amongst these aims in trying to satisfy all of them” (Campbell:

1996: 296). Campbell (1996: 296), discussed above, refers to the tension as the “planners’ triangle,” with sustainable development located at its center, a center which cannot be reached directly. Instead, SD planners must seek approximately and indirectly to do so by repeatedly confronting and addressing the various conflicts at play among the claims necessary to achieve it.

If sustainable development is to represent the new framework for planning in SA, national and local officials and planners must seek ways to balance the three competing domains. Especially in the aftermath of apartheid, they need to develop the economy effectively and distribute the proceeds of its growth fairly, all the while preventing the degradation of the environment. Campbell’s triangle, which informs the conceptual model presented later, not only illustrates these conflicts, but also highlights the potential complementarity of interests implicit in them. Conflicts are inevitable and as such are unavoidable, requiring planners to act as mediators, alongside their role as midwives of S/SD. Emphasizing the complementarity of interests, however, requires different skills. Planners can be instrumental in building coalitions among interested stakeholders, such as labor and environmentalists, or community groups and business. To this end, Campbell has suggested “planners need to combine both their procedural and their substantive skills and thus become central players in the battle over growth, the environment, and social justice” (1996: 297). Notwithstanding the numerous perspectives on sustainability per se, and on its relationship to urban development, (Campbell 1996: 301) offers a useful summary: sustainability “defines a set of social priorities and articulates how society values the economy, the environment and equity.”

The next chapter explores the issue of water in SA, with a view to linking that analysis to S/SD in Johannesburg and the nation thereafter.

Chapter Four.

Water in SA and Johannesburg.

“South Africa is the first country in the world that has adopted national water law in which water is seen as a tool in the transformation of society toward social and environmental justice” (Schreiner et al. 2002: 127).

This chapter frames subsequent discussion by examining the water situation and pertinent legislation shaping water policy and usage in SA. It outlines how these factors are shaping “WSJ.” As Segal (2009: 2) has observed:

The political transition of the 1990s introduced fresh thinking and new energy into water management. Water was defined as an “indivisible natural resource,” managed by the national government for the benefit of all South Africans. As a consequence, the system of riparian rights was abolished and citizens’ rights to water were changed to the status of temporary use rights from having been, where applicable, permanent property rights. The policy emphasis shifted from large-scale infrastructure development to issues of access, with a strong component of social equity, of ecological sustainability, of water conservation and demand management, and of decentralization in service delivery (Segal 2009: 2).

Such thinking is also reflected in the literature relating to “sustainable urban water management” which argues “provision of urban water services is an example of socio-technical systems... (which) comprise the production and use of technology and the management regime – the associated individuals and organizations that come together to innovate, develop, produce, market, distribute, and use the technologies, together with the cultural meaning that is attached to these technologies” (van de Meene and Brown, 2009: 1449).

Interviewees (2008, 2009) also noted the importance of considering water quality and quantity and relevant institutions and legislation in any discussion of sustainability.

Meanwhile, leading SA legal academics have noted

The National Water Act reflects the most far-reaching environmental law reform made by the new government ... (it) illustrates how social equity, economic needs and natural resource management can be accommodated in a composite Act of Parliament. The challenge is going to be for administrators, implementers and others to ensure that ideals and aspirations are converted into reality (Glazewski 2000: 541).

According to Webber Wentzel²⁰ (2008), overall environmental legislation in SA encompasses²¹ the following:

- The Constitution
- The National Environmental Management Act (NEMA)
- Sustainable development
- The Polluter Pays principle
- Administration and enforcement
- Integrated environmental management
- The National Water Act
- Water use licensing
- Pollution of water resources

Salient features of the most applicable of these items to SA water concerns are discussed below.

The Constitution

Section 24 of the South African Constitution states everyone has the right to an environment that is not harmful to their health or well-being, and to have the environment protected for the

²⁰One of SA's leading law firms.

²¹The other major pieces of environmental legislation, not *directly* related to water, are: [Air Pollution statutes](#); [The Environment Conservation Act](#); [Waste Management](#); "[Other important environment legislation](#)"; [Heritage Resources](#); [Hazardous Substances](#); [Public Nuisance](#) provisions; [Nuclear Energy](#); [Protected Areas](#); Pesticides and Fertilizers regulation; and [Marine management](#)

benefit of present and future generations through reasonable legislative and other measures that

- prevent pollution and ecological degradation;
- promote conservation; and
- secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Section 38 of the Constitution allows certain persons to approach a competent court when Section 24 has been infringed or threatened. The right (legal standing) to bring such claims forward is broadly defined to include, among others, anyone acting in the public interest.

The National Environmental Management Act

The National Environmental Management Act, No. 107 of 1998 (NEMA), took effect in January 1999 as the flagship environmental statute of SA. NEMA's primary purpose is to provide for co-operative environmental governance by establishing principles for decision-making on all matters affecting the environment. NEMA also established procedures and institutions aimed at promoting public participation in environmental management.

The principles enshrined in NEMA guide the interpretation, administration and implementation of the Act and all other laws concerned with the protection or management of the environment in SA. These concepts serve as a framework within which the nation's environmental management must take place. They include, among others, sustainable development and the "polluter pays" principle.

Sustainable development

Sustainable development is required to ensure the integration of social, economic and environmental factors in decision-making so that development serves present and future generations. Furthermore, sustainable development requires a risk-averse and cautious approach be applied to decision-making (hence the well-known "precautionary principle" in S/SD)²².

²² See Haughton and Hunter (1994), for example.

The Polluter Pays principle

This states “the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimizing further pollution, environmental damage or adverse health effects must be paid by those responsible for harming the environment” (Webber Wentzel

2008http://www.wwb.co.za/wwb/view/wwb/en/page1874?categorylisting=cl_results&category_id=134&additionalcategories=&ccs_no_cache=1. Accessed various dates 2008, 2009.)

NEMA also imposes a duty of care on every person who causes, has caused or may cause significant pollution or degradation of the environment to take reasonable measures to prevent pollution or degradation from occurring, continuing or reoccurring. Insofar as such harm to the environment is authorized by law or cannot reasonably be avoided, NEMA requires the pollution or degradation be minimized and rectified.

The State may direct any person who fails to take these reasonable measures not to commence, continue or complete such efforts. Should a person fail to comply with a directive, the government may itself take reasonable measures to remedy the situation and recover all the costs of remediation from the specified persons to include the person who failed to take the reasonable measures. Liability may be apportioned according to the degree to which each person was responsible for the harm to the environment.

NEMA makes provision for damages to be awarded by the courts where loss or damage has occurred as a result of a contravention of certain environmental statutes. In addition, some offenses under specified environmental statutes (for example, the National Water Act, No. 36 of 1998 and the Environment Conservation Act No. 73 of 1989) may result in the imposition of penalties, such as a fine and/or imprisonment. Importantly, NEMA holds employees, managers, agents and directors liable for any offenses resulting from failure to take all reasonable steps necessary to prevent the commission of an offense.

Administration and enforcement

NEMA further provides for enforcement of provisions of certain environmental Acts and enables the director general or the provincial head of department to designate environmental management inspectors to ensure that result.

Integrated environmental management

NEMA also outlined a system of environmental impact assessments and related management tools, which took effect in 2006. The resulting assessment regime requires that the environmental impacts of listed activities be considered, assessed and reported to the competent authority. The law contains two lists of activities. One offers actions required for a full environmental impact assessment while the second sets out activities that necessitate only a basic environmental review.

The National Water Act

The National Water Act No. 36 of 1998 recognizes that water is a natural resource that belongs to all of SA's people. The Act regulates the manner in which people obtain the right to use water and provides for just and equitable utilization of water resources. Sustainability and equity are identified as central guiding principles in the protection, use and management of water resources including consideration of the following:

- the basic human needs of present and future generations;
- the need to protect water resources;
- the need to share some water resources with other countries; and
- the need to promote social and economic development through water use.

The national government, acting through the Department of Water Affairs and Forestry is responsible for acting on these fundamental principles.

Water Use Licensing

Water use requires a license or other form of regulatory authorization under the National Water Act. For the purposes of the Act, "water use" includes, among other things, taking water from a water resource; storing water; impeding or diverting the flow of water in a watercourse; disposing of waste in a manner that may detrimentally affect a water resource; and altering the bed, banks, course or characteristics of a watercourse. The exceptions to this rule are water use identified under schedule 1 of the National Water Act: water use that is a continuation of a lawful water use which took place during a period of two years before the

commencement of the National Water Act; and water use that is permissible in terms of a general authorization or waiver from the responsible authority.

Water Resource Pollution

The National Water Act addresses situations where the pollution of a water resource occurs as a result of activities on land. The person who owns, controls, occupies or uses the land in question is responsible for taking all reasonable measures to prevent any pollution of a water resource from occurring, continuing or recurring. In recovering these costs, the catchment management agency may also claim damages from any person who would have benefited from the measures taken by it. If these steps are not taken, the catchment management agency concerned may do whatever is necessary to prevent the pollution or remedy its effects. The agency may then recover from this person all the costs incurred as a result of its so acting. In recovering these costs, the catchment management agency may also claim damages from any person who would have benefited from the measures taken by it.

The National Water Act lists the acts and omissions that constitute offenses, including associated penalties. These include unlawfully, intentionally or negligently committing any act or omission that pollutes or detrimentally affects a water resource. In addition to possible criminal proceedings, the Act also provides for an enquiry into the harm, loss or damage suffered as a result of an act or omission constituting an offense. The court may award damages for the loss or harm a person suffered. The court may also order that remedial measures be undertaken either by the accused or the relevant water management institution.

As noted above, the Department of Water Affairs and Forestry is responsible for administering and enforcing (the relevant) environmental laws in SA. I will discuss this department and its importance for this study later. Having outlined the relevant legal framework, I next provide an overview of water requirements and resource capabilities in SA, drawing extensively on Basson et al. (1997). This discussion of supply and demand has obvious implications for sustainability in terms of available water quantity.

Water Supply in SA

Unlike many other countries on the continent, SA has no major rivers. The Democratic Republic of Congo (DRC), for example, has annual renewable water resources of

1019 km³/yr, while SA has only 50 km³/yr (Hirj et al. 2002: 7). The largest river in SA, the Orange, has less than 10 percent of the water flow of the Zambezi River, the closest major river to SA. In fact, the total surface runoff of all SA rivers combined is less than half that of the Zambezi river.

Furthermore, most of the larger rivers draining the country are shared by one or more neighboring states. Water resources management and utilization in SA is thus strongly dependent on the needs and activities of these countries (Basson et al. 1997: 11). About 350 million m³/yr is already utilized (at 1996 development levels). Basson et al. have estimated that an additional 13 250 million m³/yr (26 percent) could be available for use, mainly through the provision of further regulated storage by the construction of large dams.²³ These same analysts also estimate that should current growth trends and usage patterns continue, the total requirements for water will approximately double over the next 30 years, or will grow at roughly 3 percent per year (Basson et al. 1997: 10). Further evidence of the dire water supply and demand situation is provided by Chiuta et al. (2002: 26), who note that per capita water availability, which was 1 266 m³ in 1995, may decline to only 997 m³ per person in 2025.

Due to the highly variable nature of river flow in SA and the infrequent occurrence of large floods, greater regulation to limit spillage is not regarded as economically viable since much of the floodwater that may be stored is also lost to evaporation. A pronounced imbalance exists with respect to resource potential and the utilization of surface water in the country. Most of the water occurs in the eastern and southeastern parts of the nation, while the greatest needs for water occur in the central region and adjoining areas.

The importance of the inter-basin transfer of water to the national economy of SA is illustrated by the fact that Gauteng province's Gross Geographic Product (GGP)²⁴ is 100 percent dependent on external water sources, i.e. a source remote from where production takes place. Gauteng, meanwhile, contributes about 40 percent of the nation's Gross National Product (GNP) (Basson et al. 1997: 55). An inherent benefit of linking the resources of the country together over a large geographic area, however, is that it facilitates the support of water supplies to areas which may be under severe drought conditions from areas where the

²³ Large dams have a storage capacity of about 55 per cent of SA's total annual runoff, approximately 90 percent of economically exploitable surface water. These dams command virtually all the runoff from the interior of the country. The inter-basin water transfer schemes have the capacity to move about 3 600 million cubic metres or 8 percent of the total available surface water from areas of relative abundance to areas of low availability and/or high water demand (SANCP 1998: 16).

²⁴ Also referred to as "Gross Value Added." (GVA).

prevailing conditions are less critical. This not only contributes to buffering SA against disaster, but also offers the opportunity of deploying the resources in a systems context, thereby achieving an overall yield greater than the sum of the component parts (Basson et al. 1997: 56).

The re-use of water forms an integral part of managing water resources in a systems context, and is extensively practiced in the inland parts of the country. Return flows typically occur as point discharges of treated effluent into a watercourse or as diffuse seepage such as may occur from irrigated areas close to a river (Basson et al. 1997: 56). Of specific interest is the highly seasonal occurrence of rainfall over virtually all of the country as well as the high variability of rainfall, a consequence of the topography. Rainfall is unevenly distributed, with more than 60 percent of the river flow arising from only 20 percent of the land area. SA is also poorly endowed with groundwater as it is mainly underlain by hard rock formations, which, although rich in minerals, do not contain any major groundwater aquifers, which could be utilized on a national scale. Nevertheless, groundwater played a pivotal role in the settlement and initial development of the country, and continues to do so, especially in rural parts of the nation (Basson et al. 1997: 8).

Most of the main metropolitan and industrial growth centers, which have developed around mineral deposits and harbor sites, are remote from major river courses. Some of the irrigation developments in the country are also located in sub-optimal regions with respect to water use efficiency, having been established during times when water was still relatively abundant. These factors aggravate the current situation of use and availability imbalance, with the result that in several river catchments the water requirements already far exceed the natural availability of water. Supply and needs have thus had to be balanced by large water resource development projects and the extensive inter-basin transfer of both raw and potable water from areas of surplus to areas of deficit. Total storage capacity of about 1 000 million m³ has been created by the construction of large dams, holding more than half of the mean annual runoff for the country (Basson et al. 1997: 9).

The Central drainage region serves Johannesburg. This area comprises the total Vaal river catchment with its tributaries. It drains part of the provinces of Mpumalanga, Free State, Gauteng, North West and Northern Cape. The basin is mainly covered by Highveld savannah

vegetation. The Vaal River is the most developed and regulated watercourse in the country, with the Vaal River system supporting roughly half of the economic activity in SA.

Water requirements and utilization

Irrigation employs the most water in the Vaal basin, followed by mining and industrial use, with a similar proportion going to urban and domestic use. In terms of surface water resources, of the total runoff, only 46 percent can be harnessed as usable yield. This has already been achieved through the construction of a number of dams that virtually fully regulate the river.

Although dolomite aquifers provide a reliable base flow to rivers in the region, groundwater pumping, together with mine dewatering, has resulted in new equilibria being reached. Generally, surface and ground water in the region are interactively balanced and any large increase in groundwater pumping, especially from dolomitic sources, will result in a corresponding reduction in spring flow and surface water.

Water quality

SA applies “General and Special Effluent Standards”, which are concentration-based standards for the quality of effluent returned to surface water bodies, to regulate waste production. These values set limits for the concentrations in discharged effluent of various major ions, nutrients, metals and microbiological constituents, and they have not been adequate to protect water resources. Thus, a new policy for protection of water resource quality, “Receiving Water Quality Objectives,”²⁵ was formulated a decade ago by the DWAF and is now enforced by that same agency (SANCPR 1998:15).

Water quality along the Vaal River downstream of the Vaal Dam is highly influenced by the effluent return flows from the large urban centers as well as through high salinity mine

²⁵“In order to ensure fitness for use of the country's water resources, the users' requirements had to be brought into consideration. This principle resulted in the Receiving Water Quality Objectives (RWQO) approach, which essentially dictates the nature and extent of Source Directed Controls (SDCs) that are required within a catchment context. The Receiving Water Quality Objectives approach for non-hazardous substances accepts that the receiving water environment has a certain, usually quantifiable, capacity to assimilate waste without serious detriment to the quality requirements of its recognised users. However, if applied without the necessary precaution, the Receiving Water Quality Objectives approach for non-hazardous substances will inevitably lead to the deterioration of water resources to the point where they will be less fit for use by the recognised water user sectors. To counter the limitations of this approach, a precautionary approach was accepted to avert danger and minimise uncertainty and potential risk of undesirable impacts on the environment” (DWAF: undated. http://www.dwaf.gov.za/Dir_WQM/wqmFrame.htm). Accessed 11.11.2009.

pumpage. About 60 percent of the water abstracted by Rand Water is returned as treated effluent to the Vaal and Crocodile rivers, and the Vaal is carefully managed so as not to exceed selected water quality (salinity) thresholds, while spillage to the Orange River is also limited during flood events (Basson et al. 1997: 50).

Two fundamental principles linked to the utilization of groundwater are the sustainability or recharge of the resource and its interrelationship with surface water. Groundwater can be abstracted on a sustainable basis only at a rate less than, or equal to, the long-term average recharge of the source through infiltration from rainfall. Should more water be abstracted over prolonged periods of time, groundwater levels will drop, and springs and boreholes will run dry. In this respect it is well known that many of the streams that existed when people first started to develop the country have since dried out, while groundwater failure commonly occurs in some of the more densely populated areas. Basson et al. (1997: 63) have argued there are “potentially disastrous consequences facing the country, should serious changes with respect to water utilization not be made, as well as the importance and urgency for the timely introduction of appropriate strategic measures to prevent the stagnation of South Africa’s development due to a lack of sufficient water, a few decades from now [fail to be recognized.]” It is therefore appropriate to examine future options for water supply and use. The following discussion draws on Basson et al. (1997: 65), who present numerous mechanisms to address this issue.

Besides conservation, other options include re-allocation of water, greater re-use of water, the concept of virtual or embedded water, importation of water, desalination of seawater, weather modification, shipping of fresh water, and the possible towing of icebergs. Each of these is briefly discussed below.

Water conservation involves all water-use sectors and broadly refers to voluntary and induced changes to water use, with the purpose of gaining greater efficiency. Trial assessments indicate that additional savings of about 10-15 per cent can be achieved in urban areas, such as those served by the Vaal River system, while estimates for the agricultural sector suggest that irrigation efficiencies may be improved by up to 30 percent for some schemes (Basson et al. 1997). Other savings may also be effected through better management approaches, such as the removal of alien vegetation in catchment areas and along watercourses. Leak detection programs similarly reduce losses in municipal (and other) reticulation systems. The

successful implementation of water conservation measures is thus very important and can extend the capability and utility of the country's water resources. It can also significantly delay the implementation of new water resource developments, but cannot replace the need for supplementary measures in the long-term.

Typical household water-saving devices in inland areas do not generally contribute to an improvement in water balance viewed from a resource perspective—the water saved would in any case have returned to the system as treated effluent for later re-use. But any savings in water use will result in lesser infrastructure requirements, which contribute to the economic efficiency of water supply. It is also of significantly greater benefit to save on the consumption of good quality water higher up in the system than on high-salinity water originating from urban and irrigation return flows lower down the system. A further consideration is that small effluent streams in general do not lend themselves to very efficient re-use (Basson et al. 1997: 66).

Re-allocation of water

Irrigation use has the lowest economic return, on average, of all productive user sectors. It is therefore imperative that priority consideration be given to more efficient utilization of irrigation water, be it for the production of higher value crops under irrigation or for the possible allocation of some irrigation water to alternative use, provided that such usage would also be socially acceptable and beneficial. This does not mean that all the water should immediately be re-allocated from irrigation to urban use, but certainly that priority should be given to urban use above irrigation where in competition. Also, should industrial growth be stifled by a future lack of water, it would clearly be more advantageous to decommission irrigation in favor of the urban use of water (Basson et al. 1997: 66).

Greater use of existing water

Re-use of water holds great benefits and already takes place extensively in the Vaal River system as well as for most other non-consumptive inland users of water where effluent is returned to the rivers (Basson et al. 1997: 66). The extent to which water can be re-used is generally a function of the inherent characteristics of the water systems, especially the relationship between consumptive and non-consumptive use as well as water quality

requirements. In certain areas, a greater degree of re-use will eventually require some desalination of return flows before they re-enter the system.

Direct re-use of water in a closed system is generally a highly sophisticated operation and has therefore been mostly limited to the re-use of water within industries. The direct reclamation of domestic use effluent has generally been applied only on a small scale and under unique conditions of water scarcity (such as in Windhoek, Namibia). It is, however, a proven technology that has become less costly in recent years, thus offering the opportunity for possible larger scale application in coastal cities.

Virtual or embedded water supply

The concept of virtual or embedded water is associated with the principles of water conservation and the re-allocation of water (Basson et al. 1997: 67). This refers to “replacing the production of an item (which is not water-efficient) with its importation from elsewhere and thereby freeing the resource (water in this case) for a more beneficial use. A typical example would be the importation of grain from elsewhere in southern Africa where agricultural conditions are more favorable than in SA, thereby making the water currently used for the irrigation of such crops available for industrial purposes and domestic supplies.” Virtual water is also defined as “the amount of water used to create a product” (Basson et al. 1997: 67). For example, the production of a pound of beef requires 1,857 gallons of water (for drinking water, waste cleaning purposes and the growing of food for feed) (McNaughton 2010).

Water importation

Water importation from large under-utilized rivers within reasonable proximity to SA could be a viable and sustainable option for the augmentation of local water resources (Basson et al. 1997: 67). Because of its size and northern location, the Vaal River system would probably be the logical recipient basin. The Zambezi is the only river reasonably close and of sufficient size to serve as a source of water. To date, the technical feasibility of conveying water from the Zambezi to SA has been established in broad terms, but its practical feasibility remains to be demonstrated.

Desalination of water

Sea water desalination, although currently at least double the cost of developing the most expensive surface resources in SA, is technically feasible and is practiced on a large scale in many Middle Eastern countries (Basson et al. 1997: 69). Technological developments in this field as well the affordability and relative cost of other options will largely dictate when some of SA's coastal cities will resort to this option (Basson et al. 1997: 69).

Weather modification

Augmentation of rainfall by seeding of clouds has been the subject of intensive research for more than 15 years in SA – with promising results. Basson et al. (1997: 69) estimate that the yield of the Vaal dam could be increased at a competitive cost by means of cloud-seeding; the estimated additional yield of about 150m³/a is relatively small when considering the annual growth in water demand of about 200m³/a in the Vaal river system. While some practical and logistical problems do remain to be addressed, the complex legal consequences that could result from weather modification may be more important and may eventually limit its application.

Shipping fresh water

Shipping water from the mouth of the Zambezi or Zaire rivers may also hold promise, especially for augmenting supplies to coastal areas (Basson et al. 1997: 69). This option appears economically competitive with the desalination of seawater and it is technically feasible to float large, specially adapted tanker ships into the freshwater wedge discharged by these rivers into the ocean, and then simply open gates to fill the ship with fresh water for transportation to coastal cities. The major advantage of such shipping of fresh water would be the reduced environmental impact of the operation compared with extraction from a river, or the energy requirements and waste products associated with desalination.

Icebergs

Tapping of icebergs for freshwater has captured the imagination of innovators for many years (Basson et al. 1997: 69). Many unresolved technical details remain, and these have a direct bearing on the cost and feasibility of this option. The indications are that it may be an alternative to the desalination of seawater.

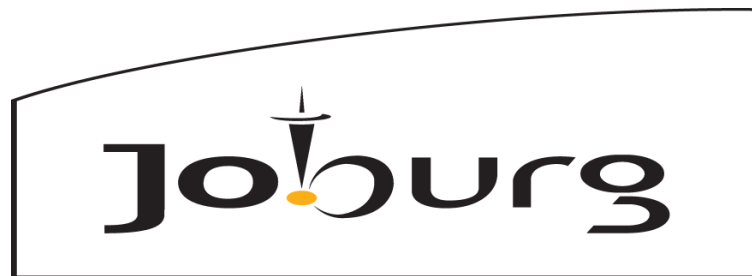
Suppression of evaporation

High evaporation losses occur from the surface of reservoirs due to the generally dry climate of SA (Basson et al. 1997: 69). Attempts in the past to suppress evaporation by covering the water surface with floating material or a protective layer proved unfeasible.

This brief survey has provided an overview of the increasingly pressing water supply (and to a lesser extent, the challenging water quality) situation obtaining in SA. As stated in the introduction to this study, there are a number of factors that render SA vulnerable, at least in terms of its water resources. On the supply side, SA experiences low and erratic rainfall, high temperatures and evaporation rates, seasonal and unevenly distributed rainfall, the ramifications of global warming (the country becoming hotter and drier) and ever more depleted and polluted water resources (Stein 2002; de Vallier 1997). Demand for water is steadily increasing and virtually all the most suitable dam sites in SA have already been fully developed and any new resource development will be considerably more expensive, per unit of stored water, than were previous schemes. This is clearly a worrying state of affairs, which demands a “sustainability” response by the SA state and its citizens. Accordingly, this chapter addressed some of the (often very progressive) legal ramifications regarding water in SA. It also examined the large variety of (often creative) options contemplated in terms of overcoming these problems, such as towing icebergs to SA or modifying the weather so as to induce rainfall. Against this sobering, but also potentially corrective and sustainability-inducing backdrop, the next chapter provides more detail and a discussion of the case study area, Johannesburg.

Chapter Five.

SA and Johannesburg²⁶ – Case Study Description.



a world class African city

(Official Johannesburg logo)

Introduction

This chapter provides background and descriptive information on the City of Johannesburg (CoJ) case study area as well as the wider political, economic and environmental factors that influence the city. More importantly, the discussion suggests how the notions of S/SD “course through the veins” of the City’s policies, plans and strategies, particularly the “three Es” of Equity, Environment and Economy.

It is not possible to understand Johannesburg in isolation and the city cannot be separated from the broader political, spatial and socio-economic system in which it is located. Johannesburg is inevitably linked to factors and influences at the regional, national and global level. I discuss the latter briefly and then discuss the city in more detail.

²⁶Variously abbreviated as “Joburg”, “Jhb.” and more colloquially: “Jozi.”

A development snapshot of SA as a whole.

The UNDP's (2007/2008) Human Development Index (HDI) ²⁷ for South Africa is 0.674, which gives SA a rank of 121st out of 177 countries with data. SA has always exhibited large income inequalities and its Gini co-efficient of 0.67 is one of the world's highest (SAIRR 2008: 235). Access to basic services is also a perennial problem. At the time SA's new constitution was formulated in 1996, the Department of Water Affairs and Forestry (DWAFF) estimated that 18 million people (out of a total SA population of approximately 40 million) were without basic²⁸ water supply while 27 million people had no basic sanitation. Estimates of the capital cost of remedying these deficiencies have varied from R4.4 billion to R13 billion over the last ten years (SAIRR 1998: 327). In the most recent national household survey, Statistics South Africa (2010: 5) found "the percentage of households who receive piped water supplies from their local municipalities increased from 78.2% in 2004 to 83.3% in 2009." Furthermore, "there has been an increase in the percentage of households who used safe off-site water sources (neighbor's tap [faucet], communal tap or off-site borehole) over time. The use of safe water sources increased from 16.9% in 2002 to 21.0% in 2009. Even though these sources are not yet on-site, they mirror the reduction... in the use of unsafe sources such as streams, rivers, dams, pools, etc." (Statistics South Africa 2010: 26).

The SA government has made many attempts to rectify service backlogs and encourage S/SD, but, given the multi-dimensional nature of S/SD, increasing the extent of supply of water services does not necessarily mean that that S/SD will be achieved. To wit, in terms of the financial/economic dimension of sustainability for municipalities, "of those who received piped water from a municipality, [only] 49.6% said in 2009 they paid for the water as opposed to 67.0% in 2002 (Statistics South Africa 2010: 27). Clearly, this trend has negative implications for the sustainability of the municipal fiscus. And in terms of another dimension of S/SD, equity, "there are still significant differences between the different population groups in terms of households who have to use off-site safe water sources, with 26.5% of the

²⁷The HDI provides a much more complete picture of a country's development status than other indicators, such as GDP per capita.

²⁸Basic water and sanitation can have many meanings in SA, but is usually taken to be a rudimentary form of water supply (such as communal standpipes or water delivery via tankers) and a "bucket system" latrine or so-called "long drop."

black African population still using these sources compared to only 2% of other population groups” (Statistics South Africa 2010: 26).

To understand WSJ and the developmental context and needs of South Africans better, one must recognize SA’s history and the legacy and costs of apartheid.

A brief history of apartheid and its implications for this study.

Until the advent of the new government in 1994, SA had repeatedly seemed to be on the verge of civil war and the cause is generally agreed to have been apartheid, the “strange disease that has affected the South African body politic” (Lapping 1989: xiii). This “apartness” or segregation had been practiced in SA for almost 300 years, but gained most political attention under the Malan government of 1948. Under that regime, “petty apartheid” was initially instituted: segregating transport, barring interracial sexual relationships and so on.

As Roberts (2003: 191) has noted, “apartheid produced one of the most extreme examples of environmental injustice and unsustainable development ever known.” Apartheid was “management by objectives”, where the primary objective was racial segregation and blacks’ exercising their political rights in their “homelands” (also termed “reserves” and “Bantustans”).²⁹ This then was the ultimate in “top down” development management, in terms of deciding what race group people belonged to (via the Population Registration Act), where people could live and how and where they would conduct their lives.

Under the policy of industrial decentralization (justified theoretically by growth pole theory), industries were to be lured into the peripheral areas of SA’s geography by means of incentives and subsidies. Here it was hoped that blacks would find employment, thus keeping them out of the largely white population group “core”, and enabling them to exercise their political rights in their “homelands” in the “periphery”, rather than in the rest of SA (Boshoff 1989).

²⁹The government insisted on calling their creations “national and independent states”; these were then deemed to be outside “white South Africa.”

Industrial decentralization also meant that theoretically each homeland would have an industrial economic base and would have its own local government, which would enable it to “form a confederation with their great protector and friend, white South Africa” (Lapping 1991:108). The government would attempt to modernize and co-opt tribal chiefs: chiefs and headmen were taught the techniques of modern administration as well as procedures to ensure that the Department of Native Affairs officials kept ultimate control of them. More often than not, such areas had few natural and other resources, and were more or less left to fend for themselves. Water, for example, was obtained from non-perennial, frequently polluted rivers or springs and this is still the case, to a considerable extent, as noted above.

In the apartheid era, water was not considered a resource problem as far as black South Africans were concerned (Davenport 1987). Allocation of water favored white landowners and led to skewed water distributions among economic sectors and inefficient water use in a country experiencing water stress (Goldblatt et al. 2002). Despite deficiencies in terms of availability and quality, water was nevertheless a “free environmental good,” at least for many rural dwellers. Migrating to urban areas and having to pay for water, even for rudimentary services, was clearly problematic for (black) rural dwellers and this in part led to a culture of non-payment for services in urban areas. This attitude is still pervasive today and results in major political and other problems. For example, there is often violent opposition to the installation of pre-paid water meters in Johannesburg and also much “sewer abuse,” a practice whereby people place foreign objects into unsophisticated sewer systems thereby blocking them (Interviewee Joburg Water 2008).

Furthermore, apartheid resulted in major water quality problems. As described by Moyo and Mteta (2002), for example, “Alexandra township³⁰ (in the Johannesburg area alongside the Jukskei river) had a population density of 600-700 people per hectare, yet until the mid-1980s there was no sewer system in the area. Even after this was partially rectified and after cleanup and restoration operations were undertaken, the problem has remained” (Moyo and Mteta 2002: 153). For example, E. Coli. counts in the Jukskei River now average 20,000 colony forming units, far above standards which require a complete absence of E. Coli for drinking water and less than 1.3 colony forming units for recreational usage (Matowanyika 2010).

³⁰Nelson Mandela once lived in a Alexandra, a township which plays an important part in SA’s struggle history. Many ANC leaders moved there in the 1940s (Harrison 2004: 50).

Water also had some overtly sinister connotations during the reign of the apartheid regime. The post-apartheid SA Truth and Reconciliation Commission (TRC), chaired by Archbishop Desmond Tutu, revealed that water served as an instrument of oppression and indeed torture under the apartheid regime. For example, the SA Police's counter-insurgency³¹ unit Koevoet³², which became "notorious for its human rights abuses during its pursuit operations" (TRC 1998: 64), poured boiling water over the heads of captured "terrorists" (TRC 1998: 72), while others were deprived of food and water³³ and sanitation facilities (ibid: 75) and submerged in water (ibid: 75). Water supplies were also poisoned (ibid: 85) and attacked (ibid: 154).

Overall, the apartheid regime's development management and public administration were geared towards social engineering, controlled from Pretoria by an enormous bureaucracy of Afrikaners, intent on sustaining white hegemony in SA. Modernization, in these terms, meant separate (and supposedly equal) development. The job of the Nationalist (Afrikaner) state was to lead black South Africans to a modern, Western form of development. But in the end, it was (the Afrikaner) President F. W. de Klerk who in 1990 greatly accelerated progression towards democracy when he removed bans³⁴ on liberation movements such as the African National Congress (ANC) and the Pan African Congress (PAC), as well as on a number of internal pressure groups and their leaders. As De Klerk (2010:1) recently observed, on the occasion of the 20th anniversary of the unbanning of the ANC, "... 'separate development' (was) the idea that we could somehow unscramble the South African omelet and create a commonwealth of southern African states, all working happily in harmony and co-prosperity."

Clearly that stance was unrealistic and in 1991, the principal apartheid laws were repealed—the Group Areas Act, which separated residential areas by race; two Land Acts, which prevented blacks from owning land in the 87 percent of SA land reserved for whites, and the

³¹ At the height of the war against the South West African People's Organisation (SWAPO), (in what is now Namibia), in the early to mid-1980s, *Koevoet* alone claimed a kill rate of around 300 to 500 people a year, for which its members were paid a bounty per corpse (TRC 1998: 69).

³² An Afrikaans term for a crowbar. The apartheid Minister of Law and Order, one Louis le Grange, described Koevoet as "the crowbar which prises terrorists out of the bushveld like nails from rotten wood." (TRC 1998: 73).

³³ A woman detainee told the TRC that for "the first month of my detention, I didn't get a drop of water to wash myself" (TRC 1998: 193).

³⁴ Some bans had been in existence for 30 years.

Population Registration Act, which classified people according to their race (The Economist Intelligence Unit 1991).

The reform initiatives were the result of a number of factors, including demands by the black majority for reform backed by the externally organized armed struggle of the ANC; internal pressures through boycotts and civil unrest, unsuccessful attacks by anti-apartheid activists on what they saw as the system of co-opted local black rule in the townships, and international sanctions against SA. In essence, a combination of moral repugnance (internally and abroad), the inherent unworkability of apartheid, disinvestment by overseas companies, overseas banks' loan refusals, the sagging economy and mounting and increasingly violent black opposition to apartheid eventually spelled its demise. As Schlemmer (1991: 15) has observed, it would be "naive to isolate a single factor that triggered apartheid reform." Other factors he adds were, "the seepage effects of low-key civil disobedience, the Namibian settlement, the collapse of Eastern Europe, informal dialogue with the African National Congress (ANC), changes in the National Party constituency, new kinds of Afrikaner intellectuals, aspects of SA's political culture, and the nature of F.W. de Klerk as a leader."³⁵

³⁶ The first free and fair elections in SA occurred in 1994, as did the installation of President Nelson Mandela in a non-racial democracy. That year, SA was also accorded international status, after having been effectively expelled in 1974 from the UN General Assembly and barred from participating in UN agency activities.³⁷

Despite these monumental changes and, inter alia, the avoidance of civil war, the adoption of a very progressive Bill of Rights and the labeling of a multi-ethnic SA as the "Rainbow Nation", many of the structural challenges and problems caused by apartheid remain, with many people living well below acceptable minimum standards of living (whatever poverty indices are used). Addressing the lack of development is seen in its own right as a moral responsibility for the government and all members of the community.

³⁵ De Klerk "was a traditional politician who did not believe in the past role played by bureaucrats in decision-making. Consequently, it was not bureaucrats who played a major role in the reform initiatives of the late 1980s and early 1990s, it was the politicians themselves who handled it. The top-down management style of the past was replaced by "the explicit recognition that further change must be negotiated with legitimate leaders of all communities" (Cloete 1991:36).

³⁶ On the other hand, Nelson Mandela, who shared the Nobel peace prize with De Klerk, states in his autobiography that De Klerk was by no means the great emancipator. "He was a gradualist, a careful pragmatist... He had the courage to admit that a terrible wrong had been done to our country and people through the imposition of the system of apartheid. He had the foresight to understand and accept that all the people of SA must, through negotiations, and as equal participants in the process, together determine what they want to make of their future" (Mandela 1994: 503,533). On the 20th anniversary of the unbanning of the ANC, De Klerk himself admitted that "February 2, 1990, was not an epiphany or Damascene conversion, it was the culmination of a long and tortuous search for a solution to the vexatious questions that had divided South Africans for generations" (De Klerk 2010: 4).

³⁷ In 1991, Malawi was the only black African state to have full diplomatic relations with Pretoria.

The public sector in SA had in the past not been sufficiently attuned to the needs of those on the ground. It was also insufficiently equipped in terms of skills and resources and lacked political will. Especially in rural areas, institutions were not well developed, beyond a few localized NGOs. In urban areas, racial segregation increased the cost of urban development for the poor. Separate black local authorities lacked the political tradition, functional ability and financial capacity to administer their areas. Their lack of funds was compounded by rent and service boycotts³⁸. Even today, in the new SA, low earnings and high unemployment mean that the tax bases of many towns are small and adequate services are not provided.

But, as many environmental and resource economists³⁹ and others have suggested, economic and other activity (and indeed sustainability) and the development trajectory of any nation does not occur in an environmental vacuum. After all, it is the environment that provides life support, resources for development (including, of course, water) and a sink for wastes. As Interviewee G (2008) observed: “This all occurs within the ‘envelope’ of the natural environment.” Accordingly, it is necessary to consider briefly SA’s physical, social and political environment and the ramifications of environmental management in SA, especially since “environment” is one of the “three Es.”

SA and the environmental “rules of the game.”⁴⁰

It is important to discuss the environmental “rules of the game” in South Africa, because the environment is one of the “three Es” contemplated in the discussion on sustainability and these rules or conditions have a major influence and bearing on (sustainable) development. They include a natural ecological diversity and richness; variability in climate and weather patterns; a first /third world dichotomy; mass urbanization; agriculture divided between prosperity and poverty; a mismatch of industrial growth locations and water availability; coal, energy and atmospheric pollution; and restricted access to domestic energy and water (Huntley et al. 1989). This, then, is the “environmental stage” or some of the initial

³⁸ Ironically, especially at the time of writing, the current ANC government is facing violent community strikes and disruptions against poor service delivery and corruption, especially at the local government level.

³⁹ See for example, Daly, Pearce, Costanza, Tietenberg, Callan and Thomas et al. (all various dates).

⁴⁰ Although these “rules” might more accurately be seen as conditions that shape context, the terminology is reflective of apartheid era SA. Especially the 1980s was seen as an era of both “reform and repression” in SA and scenario planning was much in vogue – socio-economic and political commentators would outline “rules of the game” and put forth various “high” or “low” road scenarios, (or “trajectories”), which SA might follow. (The “low road” of course would involve failure to overcome apartheid and could result in civil war). See especially the work of Clem Sunter, in terms of scenario planning in SA.

conditions upon which (sustainable) development is predicated, but it is equally important to take cognizance of how these have been addressed. How the environment is managed will have a major bearing on achieving any semblance of sustainable development. Accordingly I briefly examine some of the ramifications of environmental management in SA.

Environmental management in SA

Glazewski (2000) argues that in a sense, environmental management, at least in terms of conservation laws, has been evident in SA since the days of the Dutch settlers in the 1650s. Historically though, legislation and rulemaking was top-down in character in South Africa. However, the development of an Integrated Environmental Management (IEM) approach (hitherto voluntary), has led to the incorporation of environmental concerns in development proposals. But protest and negotiation have been successfully used in SA as instruments to attain a number of social objectives, including an improved urban environment. Beyond their political objectives, the rent boycotts during and after the anti-apartheid struggle sought to secure or improve long-term access to key services such as water supply, sanitation and solid waste management, while sacrificing environmental quality in the short run. Community organizations also lobbied to preserve architectural, historic and cultural heritage, to establish tree-planting campaigns, and to oppose establishment of toxic waste dumps in nearby communities (Leitman 1995).

Until fairly recently, there were few explicit considerations of notions of urban sustainability at all scales, beyond some mention of this in the “Green Paper for an Environmental Policy for South Africa” (Department of Environmental Affairs and Tourism Green Paper 1996:1), which stated that “sustainable development requires that there is participation, equity and sustainable use of resources.” The Green Paper noted too there are many areas the government needs to address in its environmental policy including improved pollution and waste control, focusing on people and their participation in decision-making, developing an improved system of governance, and ensuring that environmental decision-making employs an integrated and macroeconomic perspective. Also, the government considered it important that management of development conform to recommended principles outlined in Agenda 21, the UN program for global sustainable development (Department of Environmental Affairs and Tourism Green Paper 1996).

The “old South Africa” (i.e., that which obtained prior to the 1994 democratic elections), saw “an absence of general environmental policy, political will and awareness of the need to consider environmental issues, an authoritarian system of government⁴¹; a lack of accountability by political decision makers to the populace; inadequate public participation; inefficient administrative structures; legislative inadequacies and a lack of environmental expertise and financial resources” (Van Wyk 1998: 2). But post-1994, increasing attention has been devoted to environmental and sustainability concerns in SA by a wide variety of actors.

The Green Paper was followed by a Draft White Paper on Environmental Management Policy for SA in 1997, which in turn led to a fresh White Paper on Environmental Management Policy for the nation in 1998. The 1998 White Paper identified seven strategic goals for achieving environmental sustainability and integrated environmental management.

The national strategy for Integrated Environmental Management in SA was published in April 1998. It was followed by the draft National Environmental Management Bill in July 1998. The bill addressed, among other concerns, a National Environmental Policy, a National Environmental Forum, a Commission for Sustainable Development, and IEM. The purpose of IEM is to promote the application of appropriate environmental management tools in order to ensure integrated environmental management of policies, programs, plans and projects.

Despite these advances, there is still much duplication regarding environmental and planning legislation and structures (Todes 2009; MacCarron 2009). As Todes (2009: 429) has contended, the key problems in this regard are “the poor implementation of *sustainability thinking*, and hence *unsustainable decision-making and development*; the neglect of social concerns; perpetuation of unevenness and inequalities; duplication; tardy decision-making; and pressure on capacity and resources.” (My emphases).

This sketch of apartheid and post-apartheid SA illustrates the difficulties the country faces and the need for S/SD now and in the future, given that problems are likely to intensify and that sustainability is inherently concerned with present and future generations. The post-

⁴¹As the doyen of SA environmental journalists, James Clarke (1991) reported: in 1986, the Transvaal (now called Gauteng) Province’s Chamber of Industries attacked environmentally aware people, accusing them of hysteria and trial by rhetoric!

apartheid ANC government does not represent a panacea for all the country's problems, as will be briefly demonstrated in due course. This is a lengthy issue to address, but suffice it to say for now, that for some political commentators anyway, "the ANC is no longer the morally or politically dominant organization that it was five years ago. Its popular support may be much the same as it was then, but it is internally divided and uncertain of itself. This has opened up space for opposition, and civil society more generally, to be far more assertive. The transformation processes set in motion during the Mandela era have produced a corrupt and dysfunctional state, unable to deliver services efficiently (if at all.). This is not a state capable of delivering a 'better life for all' or 'transforming' the lives of the poor" (Myburgh 2010:1;

<http://www.politicsweb.co.za/politicsweb/view/politicsweb/en/page71619?oid=176561&sn=Detail>. Accessed 18.5.2010.). By extension of course, a dysfunctional and corrupt state will severely compromise the debates pertaining to SD and the operationalization and implementation of SD in South Africa.

Spatially and substantively, I now focus on SA urban areas in general and the City of Johannesburg and the province in which it is located.

SA urban areas in general

Urbanization in SA has been rapid, due to blacks' exclusion from formerly white-owned farming land, the overt "forced removals"⁴² of people from ex -White SA and people (including ecological refugees), escaping from overcrowded, under-serviced and degraded rural environments. Metropolitan areas occupy six percent of the land and at current rates of urbanization, almost 30,000 ha of agricultural land is lost to urban settlement each year. Urban areas also use vast quantities of water, energy, foodstuffs and raw materials and generate much waste and pollution (Department of Environmental Affairs and Tourism Green Paper 1996: 22).

Urban areas produce more than 15 million tons of solid waste a year, yet only a tenth of waste disposal sites are licensed and there is little control over illegal waste dumping (Department of Environmental Affairs and Tourism Green Paper 1996: 15). The 1996 Green

⁴²One of the most lamentable aspects of apartheid. Blacks were forcibly removed from so-called "White SA" and often literally dumped in the veld [field] and /or virgin areas of open land with no infrastructure or employment prospects— this was arguably one of the cruellest dimensions of spatial and racial separation. This was known as "Forced Removals."

Paper also recognized that towns and cities generate and accumulate wealth and are centers of education, economic opportunity, employment, innovation and culture, but are also immense consumers of natural resources (White 1994).

Metropolitan areas now contain almost half the country's population. The nine largest cities in SA (including Johannesburg) are home to 16.5 m people and this represents 37 percent of SA's total population (South African Cities Network [SACN] 2004: 26). But towns and cities display the greatest disparities in wealth and are characterized by overcrowding, poverty and unemployment, poor services, inadequate facilities, collapsing infrastructure and general decay.

Greater Johannesburg in global context

Johannesburg's leaders have proudly proclaimed the city's desire to become a world-class African city. In terms of the global city pecking order, Johannesburg is regarded as a "secondary world city" (Knox and Agnew 1989). Beaverstock and Taylor (1999) have offered a roster of world cities, with an inventory of "world cityness" based on cities' levels of advanced producer services (i.e. accounting, advertising, banking and legal). Their resultant hierarchy is that of

- Alpha world cities, e.g. London and New York;
- Beta world cities, e.g. San Francisco and Sydney; and
- Gamma world cities, e.g. Amsterdam and Boston.

These authors dubbed Johannesburg a Gamma world city, since it is a "major accountancy service center", a "minor advertising center", and a "major global banking service center" (Beaverstock and Taylor 1999). Beaverstock and Taylor (1999) did not regard Johannesburg as showing evidence of "world city formation," although it is the only African city to appear on their list. Some urban theorists, such as Robinson (2006), are moving away from such terminology and prefer to be attentive to the "diverse spatialities of ordinary cities", an approach which emphasizes the importance of local spaces (SACN 2006: 2-7).

Latter-day Johannesburg is devoting much attention to this approach, especially given its desire to become a world-class African city. Thus, Johannesburg no longer reflects an apartheid SA laager⁴³ mentality. In fact, it is now decidedly outward-looking – according to the City of Johannesburg Integrated Development Plan Revision (IDPR 2008/09: 42), it is a “mayoral priority to ensure that the city shares best practices and learns from other local government institutions abroad, and locally.” Consequently, the city has entered into agreements with Addis Ababa, Windhoek, New York City, Birmingham (UK), Rio de Janeiro and Salvador da Bahia, and has also identified Shanghai, Mumbai, Lusaka, Bogota, Matola and Kinshasa as candidates for possible partnership.

Johannesburg in provincial context

Johannesburg is located in Gauteng province, one of nine in SA. Gauteng is the smallest province at 16,927 km², which is 1.4 percent of the total area of the country, but the province is home to about 9.68 million people (20.9 percent of the total SA population) and is the most densely populated province in SA, with 572.3 persons per square kilometer, compared with the national average of 33.8 (SAIRR 2008: 20). The South African Cities Network (SACN) (2004: 2-9) predicts the Gauteng polycentric urban region, which includes Johannesburg, will be home to about 14.6 million people by 2015, placing it above cities such as Los Angeles and Shanghai in terms of population and making it the 14th largest urban region in the world. Gauteng’s Gross Geographic Product (GGP) at 2008 prices was R585 billion or 33.6 percent of the total SA Gross Domestic product (GDP) (SAIRR 2008: 98). Gauteng is overwhelmingly dominant in these terms – the next highest GDP per province is that of KwaZulu-Natal at R324 billion (SAIRR 2008: 91). Gauteng also has the highest real growth rate in the country at 6 percent (SAIRR 2008: 98).

Clearly these factors will dramatically increase the quantitative and qualitative demand for water and indeed the City of Johannesburg’s Integrated Development Plan Revision (2008/09: 190) also stresses that “if the current consumer habits persist, the country will become water-stressed by 2025. Gauteng Province will, however, experience a water

⁴³Just as the early American Pioneers drew their wagons into a circle for protection, so did the Boer Voortrekkers (pioneers). The laager was a temporary refuge against marauders. Later in SA’s history, a “laager mentality” would prevail. The apartheid state metaphorically formed a circle of wagons in defense against hostile global anti-apartheid sentiment and sanctions. This also gave rise to the establishment of import-substituting strategic industries, such as the arms manufacturing industry (“ARMSCOR”) and the oil-from-coal (“SASOL”) industry.

shortage by 2015.” This certainly serves to focus the mind on the ramifications of water and S/SD, but first, some additional background regarding Johannesburg is necessary.

The City of Johannesburg

Johannesburg was founded in 1886 after the discovery of gold and was for over a century the center of South Africa’s gold-mining industry. Many of the gold mines in the city ceased operation in the 1970s, but in its day, the Witwatersrand gold industry accounted for more than 40 percent of the world’s annual gold production. It is ironic that the mining industry that once represented the economic base of the city is now a major contributor to water and general pollution problems in Johannesburg and its environs (Beater 2009). Johannesburg is one of the youngest major cities in the world and in the space of 100 years, has been rebuilt four times. First it was a tented camp; then a town of tin shanties; then of four-storey Edwardian brick buildings; and finally, a city of modern skyscrapers (Johannesburg website <http://www.joburg.org.za/> Accessed 15.1.2002).

Johannesburg was also influenced by apartheid, and the legacy of the apartheid system is still evident in the city in a number of ways. For example, the urban form varies greatly across the metropolitan area, especially in areas such as the Soweto and Alexandra townships⁴⁴.

Alex., as Alexandra Township is known, has always been an important entry point into the city for migrants, many of whom migrated from SA’s impoverished rural areas or from then war-torn Mozambique (Davenport 1987; Wisner 1995). The township is a 20-square-block enclave carved out of Johannesburg’s white northern suburbs, and houses a population of nearly half a million, whilst about 1.5 million people live in Soweto,⁴⁵ a sprawling urban complex 16 km southwest of the city. Johannesburg’s small Colored (people of mixed race) population clusters in townships west of the city, while the bulk of its Indian population lives in Lenasia, a special Asiatic township built in the 1950s to accommodate Indians forcibly removed from the city center (Johannesburg website <http://www.joburg.org.za/> Accessed various dates).

⁴⁴“Township” in SA generally meant an area occupied by (segregated) black South Africans.

⁴⁵An acronym for **South-Western Townships**.

Services (including various forms of water provision such as standpipes and full water services to each household) and houses are now being upgraded in the disadvantaged areas to enable a unified, integrated metropolitan area, but Johannesburg still retains a high degree of racial segregation, due to urban form being difficult to transform. Black Johannesburgers, no longer subject to draconian apartheid legislation, are free to live where they choose. However, many still cluster in the inner city, which suffers from chronic urban decay and poor services, or in townships on the urban periphery, which were essentially dormitory cities for blacks working in the city under apartheid.

Besides having been physically rebuilt four times, Johannesburg has also undergone significant institutional and financial rebuilding, (with implications for the S/SD “Es” of economics and equity). During the apartheid era, the greater Johannesburg region was divided into 11 local separate authorities, seven white and four black. The white authorities were 90 percent self-sufficient, spending R600 per capita; the black authorities were only 10 percent self-sufficient, spending R100 per capita. After the demise of apartheid, the city council became responsible for a population seven times greater than before apartheid, and about two-thirds of those people were poor (Johannesburg website <http://www.joburg.org.za/> Accessed 2.2.2002).

Johannesburg’s council, like many others in SA, has experienced severe financial strain (or unsustainability) Indeed, in 1997, the SA Department of Constitutional Development (DCD) noted that at least 93 councils across SA were effectively unable to pay their staff their next month’s salary and defaults to the electricity utility (Eskom), increased from R147 million in December 1993 to almost R850m in January 1996. By 1997, “banks refused loans to the City and overdrafts carried exorbitant charges ... the Johannesburg metro had failed to pay its creditors for three months, its actual capital expenditure (capex) had peaked at R1 280m in 1996/7 and stood at R 592m in 1997/8. Its budget deficit stood at R314 m and it had issued call bonds for R405m at very high interest rates, to cope with its budget shortfall.” (Allan et al. 2001: x).

As reported in *IGOLI NEWS* (a newsletter produced by the Johannesburg City Council), Johannesburg lived off a R300 million overdraft, residents and consumers of services owed

the council almost R2.1 billion, and the arrears bill grew by R33 million each month.⁴⁶ In perhaps the most extreme case of nonpayment and financial mismanagement to date, the municipality of Mohlakeng, less than 10 km from Johannesburg, went into liquidation in September 1994. Residents had not paid rent or service levies and the municipality had neither met its external commitments nor paid its staff. By the time the sheriff attached the 28 council vehicles, sewage was spilling into the streets and refuse had not been collected for more than a month.

In an effort to remedy such situations, and help usher in a sustainable, democratic, so-called “New South Africa,” or “Rainbow Nation,” the Johannesburg Council exhorted inhabitants to “imagine⁴⁷ a city council that provides the first 161 kl of water and the first 60kw of electricity used free of charge, without increasing any other costs ... and to imagine a situation where street lights are fixed on the same day⁴⁸ they are reported broken. ...” (IGOLI News 1999/2000:1). The Council thus embarked on the IGOLI 2000 initiative. The plan (undated, but probably 1999) had two components: (a) a three-year IGOLI 2002 plan for getting the basics right, and (b) an IGOLI 2010 plan, which was to define and create a world-class city by this date.

The plan was aimed at improving existing service delivery and also extending services to the poorest of the poor, all without losing jobs. This plan sought to create efficient entities that would be able to attract the managerial and technical skills required for running municipal functions better and providing good quality services. Amongst others, these “corporatized units” included electricity, waste management and a water and sanitation utility. The City was “confident that within two years these units will collectively save the City R2 billion thus enabling it to, for example, install an additional 20,000 water connections, provide 40,000

⁴⁶Non-payment became so bad that the government instituted a campaign called “*Masakhane*” – “Let us build together.” This initiative was originally intimately bound up with the government’s mass housing program and was led by President Mandela himself. The campaign aimed to break mortgage, rent and service boycotts adopted by communities as an act of protest against the apartheid regime. “Now people must be persuaded to pay, although this is a complicated endeavor, since some 45 per cent of the population is unemployed or employed in the informal sector. Of those 79 per cent are illiterate; 50 per cent live in conditions without electricity or sanitation; and 25 per cent have no direct access to water. Furthermore, out of last year’s budget amount of \$0.9 billion equivalent, only 878 houses were built, the rest of the money evaporating in talk shops, national and regional housing forums, salaries and perks of bureaucrats and politicians and the production of plans that look good on paper and still have to be tested on building sites. The SA Housing Minister declared that the boycotts should be history now...they were part of the strategy to liberate our people. Only when a new attitude of responsibility has taken root will that liberation be a reality” (1999 <http://www.southafrica.net/news/tales.html>)

⁴⁷One imagines that this prevailing state of affairs would not catapult Johannesburg into “Alpha” status on Beaverstock and Taylor’s roster of world cities!

⁴⁸A decade later, Johannesburg residents are up in arms about the Council’s seeming inability or unwillingness to fix the numerous potholes in the city’s “unsustainable” roads. The Johannesburg Roads Agency initially declared that it did not have enough money to fix the potholes, but it has since emerged that they have actually spent less than 2 percent of their budget in this regard. As is usually the case, there are “gainers and losers” in any given scenario – tire retailers and fitters estimate that 60 percent of motorists’ tire replacements are actually due to damage caused by the potholes in Johannesburg’s roads. This vignette again illustrates the importance of accountability, responsibility, efficiency and effectiveness in terms of engendering sustainability.

improved housing subsidies, construct 400 km of paved roads etc.” (IGOLI News 1999/2000:1). The City also tried to engage with stakeholders and conducted more than 500 meetings with businesses, civics, labor and community organizations and ratepayers, in an effort to engender better efficiencies and delivery of services (IGOLI, News 1999/2000:1).

In terms of engendering institutional sustainability, Johannesburg would make a single company responsible for water and sanitation and for setting standards, policies and tariffs. Then City Manager Ketso Gordhan promised that by employing one of the best water management teams in the world, the R176 million lost annually in unpaid water bills would be saved. He observed that “we cannot bill for 80 percent of that because we don’t know who is using it and there are 150,000 unaccounted for and unmetered water outlets in Joburg. We want to separate the council from service providers so we can hold them accountable and get rid of unnecessary bureaucracy by running services on a professional commercial basis. The move is expected to cause an uproar among union leaders, who have actively tried to prevent privatization programs by local authorities (Gordhan, cited in IGOLI News 1999/2000:1).

According to Gordhan (cited in IGOLI News 1999/2000:1), the council would retain ownership of Johannesburg’s water storage and supply infrastructure, but private companies would be able to tender for management of the operations for a period of up to three years. “The major challenge for the management of water supplies and sanitation was controlling the extensive levels of bad debts owed to the council by errant and defaulting ratepayers. Moreover, Johannesburg was believed to be losing between 35 percent and 40 percent of its water because of poor management and damaged infrastructure... and effective management of water and sanitation could lead to savings of as much as R160 million a year for the council” (Gordhan, cited in IGOLI News 1999/2000:1).

The IGOLI 2002 documents strengthened the case for changes regarding the institutional problems confronting the city.⁴⁹ The document reported the delivery of water and sanitation was managed through an unnecessarily complex arrangement that resulted in considerable

⁴⁹There was no distinction between commercial and other activities of the council (e.g., electricity and libraries). The structures were uniform (strategic executives, executive officers, managers), and so were the rules and tender procedures. Five administrations brought about duplication and lack of coordination. Fragmentation occurred because of the gap between policy decisions and implementation. The absence of a performance management system resulted in staff not being rewarded appropriately for performing well, or underperforming, as the case might be. Bureaucratic procedures were slow and led to waste and low productivity (IGOLI 2002: 7).

inefficiency. Functions were split among the various levels, with some focusing on bulk supply and others on reticulation. Different departments provided a range of auxiliary services including fleet management, corporate services, finance and human resources and customer services. This created especially complex lines of accountability and reduced operational efficiency. The need to manage this complexity on a daily basis resulted in an inward-looking bureaucracy, which was unable to maintain a focus on its core responsibility of delivering a service. IGOLI 2002 also argued that the establishment of a wholly council-owned utility for water and sanitation would offer substantial benefits for the city management and its citizens alike.

IGOLI 2002 also noted that this would allow for clear lines of accountability to be established, improve operational efficiency and enable a focus on core services. It would enable the introduction of new management skills and new technology, which would contribute to improved efficiency. This in turn would result in increased revenue, which could be used to pay for improved service delivery. Perhaps most importantly, the utility's ability to raise capital would be a critical factor in meeting backlogs and extending service coverage. The strategy also highlighted numerous indirect benefits of enhanced water and sanitation supply, such as improved quality of life and health for residents and increased attractiveness to investors. Notwithstanding those bold initiatives, the council experienced internal problems.⁵⁰ In the end, as Allan et al. (2001: ix) reported, "what was needed was a full institutional overhaul and in the words of one senior [unnamed] official: Joburg was sick to the core of its own dysfunctionality, neurosis, and power plays."

IGOLI 2002 was followed by another strategy, "Joburg 2030." As Hossack has suggested (2002, <http://www.joburg.org.za/> Accessed various dates), Joburg 2030 seeks to boost investment in the city, raising economic growth to provide Johannesburg residents with a sustainable increase in wealth and quality of life and the council with increased revenues for service and delivery. Joburg 2030's lofty vision for utilities companies in 2030 is that "the

⁵⁰The following vignette, reported in the national *Business Day* daily, provides an example of intrigue within the council and the accusations, counter-accusations, and party and interpersonal politics that bedevil any institution. As reported by Xundu (2000: 4), tension between Johannesburg's executive committee chairman, Collin Matjila and his deputy, Kenny Fihla, over the executive mayor position, led to the former's resignation... sources said that Fihla was not in the ANC national executive committee's good books because he disobeyed instructions not to appoint current Johannesburg city manager Ketso Gordhan... a source said that Kenny did not have either the right national and international connections that Matjila had. He was also immature and if the ANC decided to keep him, it would be as executive deputy mayor... Fihla said there was no substance to claims of tension between him and Matjila... the ANC provincial spokesman said: "We are aware that this is an election year and people will do anything to tarnish the image of ANC leaders in the eyes of the voters..." and so on! But not much has changed – the ANC is currently (2009, 2010) experiencing extremely bitter internal wrangling and tensions between its various factions.

electricity, water, sanitation and waste services they offer to industry will comply with international standards of service and reliability. These services will be cost-effective and price competitive on a world scale” (Joburg2030, <http://www.joburg.org.za/content/view/123/58/1/2/> Accessed various dates).

“Joburg 2030” also aims to help the city grow into an export-oriented hub, closely integrated into the global economy, with the emphasis on trade, transport, financial and business services, information and communication technology and business tourism. But the city has also cast its sustainability net wider, specifically regarding urban sustainability initiatives. Johannesburg, along with Durban and Cape Town, joined the International Council for Local Environmental Initiatives (ICLEI) Model Communities Program. Durban was the first city in SA to respond to the Local Agenda 21, an important by-product of the 1992 Rio Summit on Sustainable Development. Thus, the Local Agenda 21 program and the “Model Communities Programs” were to be “mechanisms for the implementation of environmental management strategies that aim to facilitate the transition to a more democratic process and decision making in the metropolitan area” (Whitehead and Audouin 1998: 2).

Also in pursuit of sustainability, the city has attempted to avoid top-down planning; the Johannesburg Metro’s participatory planning process garnered six priority focus areas for attention for the next five years. These emphases are pollution, poverty, waste management, health, public open spaces and parks, and conservation and protection of the built environment. Although Johannesburg has a diversified economy and is the industrial, mining and financial center of SA, it owes its initial existence to gold mining. Yet, that history has created environmental and social costs, as stated earlier. Mining activity and resultant mine dumps and slimes dams⁵¹ led to significant air and water pollution in the city. In order to avoid future problems, urban sustainable development in Johannesburg is focused on the “proactive, integrated and participatory management of social, ecological and economic resources, as opposed to top-down reactive strategies for control” (Whitehead and Audouin 1998:1).

⁵¹Dams containing waste and/or tailings from mining activity.

There is further evidence of the impacts of apartheid: Johannesburg is a deeply polarized⁵² city. Although its 791,367 households together earn more than R28 billion, 18,12 percent of them survive on less than R500 per month and almost half of those have no income whatsoever—unsurprising in a city with an unemployment rate of about 29 percent. A further 32.4 percent of households earn between R500 and R2,500 per month; 20 percent earn between R2,500 and R8,000 per month. Only 11.76 percent of the city’s households earn between R8,000 and R30,000 per month and the top 1.1 percent of households earn more than R 30,000 per month. About a quarter of households do not have formal shelter and the household Gini-coefficient for 2005 in Johannesburg was 0.75, again illustrating the high level of inequality obtaining in the metro area (SACN 2006: Annexure tables). Rates collection and expenditure are equally skewed: 65 percent of the population lives in Soweto township, but that area contributes less than 2 percent to the metropolitan rates base (Allan et al. 2001: 5).

Contemporary Johannesburg

Today, the Greater Johannesburg Metropolitan area generates 12 percent of the country’s GDP and 38 percent of Gauteng province’s GDP. In fact, Johannesburg generates 10 percent of the GDP of the entire African continent (Lundqvist et al. 2005: 267). Some 74 percent of SA companies situate their headquarters in Johannesburg. All the mining houses’ headquarters are located in the city, as is the Chamber of Mines, which regulates the industry. Local factories in Johannesburg and on the East Rand produce a variety of goods ranging from textiles to specialty steels. A substantial engineering sector serves the needs of the mining industry. Virtually all the country’s banks, insurance companies and building societies have their head offices in the inner city of Johannesburg, which houses over 2.2 million m² of offices. This constitutes the largest accumulation of office space in Africa. Johannesburg website: <http://www.joburg.org.za/> Accessed various dates).

⁵²In the political watershed year of 1994, the average annual p.c. income in the *relatively* wealthy suburb of Randburg was R53,927 (US \$7,500), whereas the figure in Soweto, perhaps SA’s wealthiest black township, was R8,358 (Allan et al. 2001:8). The US\$/R exchange rate fluctuates constantly and occasionally rather wildly. In 1994, the rate was approximately R6/\$ and reached a high of over R13 /\$ in 2001. As of October 2009, the rate was about R7.50/US\$. Another example of these disparities is “in the wealthy Sandton area, 12,201 accounts were in arrears, representing R197m in unpaid bills. In the black township of Alexandra, by contrast, 15,018 similar accounts represented an uncollected amount of a mere R15m” Allan et al. (2001: 8).

As regards Johannesburg’s economy, the Integrated Development Plan Revision (2008/09: 128) notes the city’s solid economic growth has been related to the sectoral composition of its economy: “Specifically, Johannesburg’s share of two of the fastest-growing sectors (financial and business services, and trade) in the economy is proportionately greater than its share in the national economy. The most volatile of the sectors, agriculture, has a far smaller share of the Johannesburg economy than the national economy. The share of the usually slow-growing community and personal services sector is lower in Johannesburg than in the national economy. Approximately 62 percent of all economic growth in Johannesburg arose from the following sectors: finance and insurance, other business services, construction, retail trade and wholesale trade,” as shown in Table 2.

Table 2. Sectoral contributions to Johannesburg’s economy

Source: Johannesburg Integrated Development Plan Revision (2008/09) (sic for “notes” section).

The table below illustrates the contribution of sectors to the City’s economy

Sector	2000	2007
Fin services, Insur, real estate and business services	25%	29.2%
Wholesale and Retail Trade, Hotels and Restaurants	17.7%	18.1%
Construction (Residential and non-residential)	3%	4.8%
Transport, Storage and Communication	8.1%	8.7%
Manufacturing (Food and Non-Food items)	20%	17.8%
Mining and Quarrying	2.0%	1.3%
Agric, Hunting, Forestry and Fishing	0.4%	0.2%
Community, Social Services (include govt services)	21%	17.6%

Notes

- From sectors contribution perspective, the first four sectors are clearly growing sectors.
- The last four sectors can be regarded as declining sectors.
- Growing sectors are skills intensive and mainly non-tradable.
- While declining sectors require less skilled labour and are tradable.
- Johannesburg is skilled constrained.
- The economy’s growth pattern exacerbate the shortage of skills and this makes our firms less competitive in the world market.

Demographics

Johannesburg has a polyglot population. There are 11 official languages in SA, of which four are predominantly used in Greater Johannesburg, namely English, Afrikaans, Sotho and Zulu. The city's demographics are summarized in Table 3 below.

Table 3. Johannesburg's population composition and growth rate

Population group			
Persons	1996	2001	percent change
African	1,853,220	2,370,288	27.9 percent
Colored ⁵³	171,614	206,166	20.1 percent
Indian	96,835	134,097	38.5 percent
White	492,303	515,176	4.6 percent
Total population	2,639,110	3,225,608	22.2 percent
Persons per household	3.77	3.07	

Source: Johannesburg website, derived from the official SA census.
(<http://www.joburg.org.za/>)

The City of Johannesburg's Integrated Development Plan Revision (2008/09: 26) ascribes continued high population growth rates to rural-to-urban, as well as cross-border, migration and notes that many in-migrants still wind up settling in intensifying pockets of poverty, either in informal settlements, in and around hostels, or in "bad buildings" in and near to the inner city. In-migration accounted for 4.8 percent of Johannesburg's total population in 2006 (SACN 2006: 2-18). Johannesburg has the fourth highest net in-migration (of over 120,000 people) amongst SA's municipalities, leading to increasing demand for water (SACN 2006: 2-18).

⁵³Of mixed race.

(Sustainable?) living conditions in Johannesburg

Many residential buildings suffer breakages in water and power, which remain unreported for fear of attracting the attention of building control and public health officials. Low payment levels for rates and services exacerbate the situation. Johannesburg municipal by-laws prohibit the complete cut-off of water to blocks of flats (apartments) because of the danger of fire. Often, “non-paying residents faced with cut-offs in their individual apartments simply vandalize fire hydrants to gain access to water. Pollution levels are high in the inner city due to unbalanced pH and copper levels in industrial effluent. High bacterial content is also found in the water due to blocked sewers in informal settlements and in the city, especially in the north” (Allan et al. 2001:125).

Settlements, especially those in and around Alexandra township, produce huge quantities of trash, which, combined with poor sanitation, sewage and refuse services, cause significant land pollution. Alexandra township is the most densely populated low-rise informal settlement in SA, with about 1 person per 29m². Most of Alexandra’s inhabitants do not have access to formal housing or employment, which leads to further impacts on environmental quality. The limited availability of space for expansion aggravates the problems in the area. Due to more pressing problems caused by the large, dense population and poverty, open space and conservation issues are relatively low government priorities. A combination of diarrhea and other gastro-intestinal and ophthalmological diseases is high in these communities due to bad water quality “Johannesburg faces enormous challenges in addressing the various dimensions of sustainability. Even though it is over 15 years since the advent of democracy in SA, there are at present 180 informal settlements in the city, and their populations are growing faster than the average rate across the city at 7 percent per year” (City of Johannesburg, 2009: 9).

Irregular services lead to solid waste and wastewater problems. This combines with conditions of poverty among the local communities of the area and forms a vicious cycle of environmental degradation and poor environmental and human health quality. Accordingly, the SA Cities Network has found that only 28 percent of Johannesburgers were satisfied with the provision of free basic services and only 58 percent of its residents were satisfied with their “quality of life in general” (SACN 2006: Annexure tables). Johannesburg had to admit

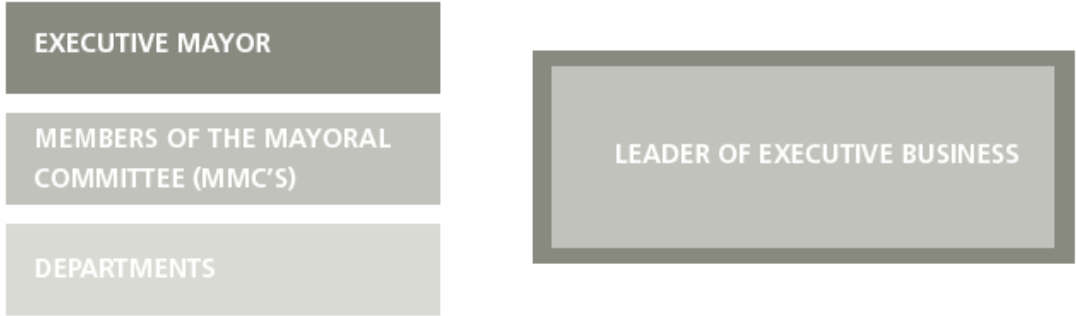
the evidence is mixed on whether the City is adequately addressing the basic needs of this poor population. On the positive side, the data suggest progress in meeting the population's requirements for access to piped water, decent sanitation, regular waste removal and electricity. Access refers to both physical proximity and availability of network infrastructure, and to affordability of the service. In 2007/08, the City increased the allocation of free basic water to 10 kl for some 110,000 households registered on its indigency database. It has also introduced further allocations of 4 kl free emergency water for those households on pre-payment meters, and provision for households to represent themselves to the City for more free water beyond this if they meet certain criteria. (City of Johannesburg Integrated Development Plan Revision 2008/09: 26).

The city faces major sustainable development challenges and in order to address these, Johannesburg sees its responsibility to plan, facilitate, maintain and enhance sustainable natural environments and facilities that contribute to the quality of life and meet the needs of the present and future.

Thus, the following sections examine how this sustainability aim is intended to be achieved, by outlining some of the major thrusts of important policy initiatives of the City of Johannesburg (CoJ) that illustrate the intended direction and vision for the city. While the institutional dimension is ultimately essential in effecting implementation and engaging with stakeholders regarding any S/SD initiatives, it is still true to say that without a (sustainable development) vision, the city could perish.

The City of Johannesburg's Integrated Development Plan Revision (IDPR)(2008/09: 76) shows the latest Institutional Framework and, as will be shown in due course, notions of sustainability are implicitly and explicitly mentioned in the IDPR. The City's political governance structure currently comprises the Council, the Executive Mayor, and the Mayoral Committee, as illustrated in Figure 4.

EXECUTIVE



LEGISLATURE

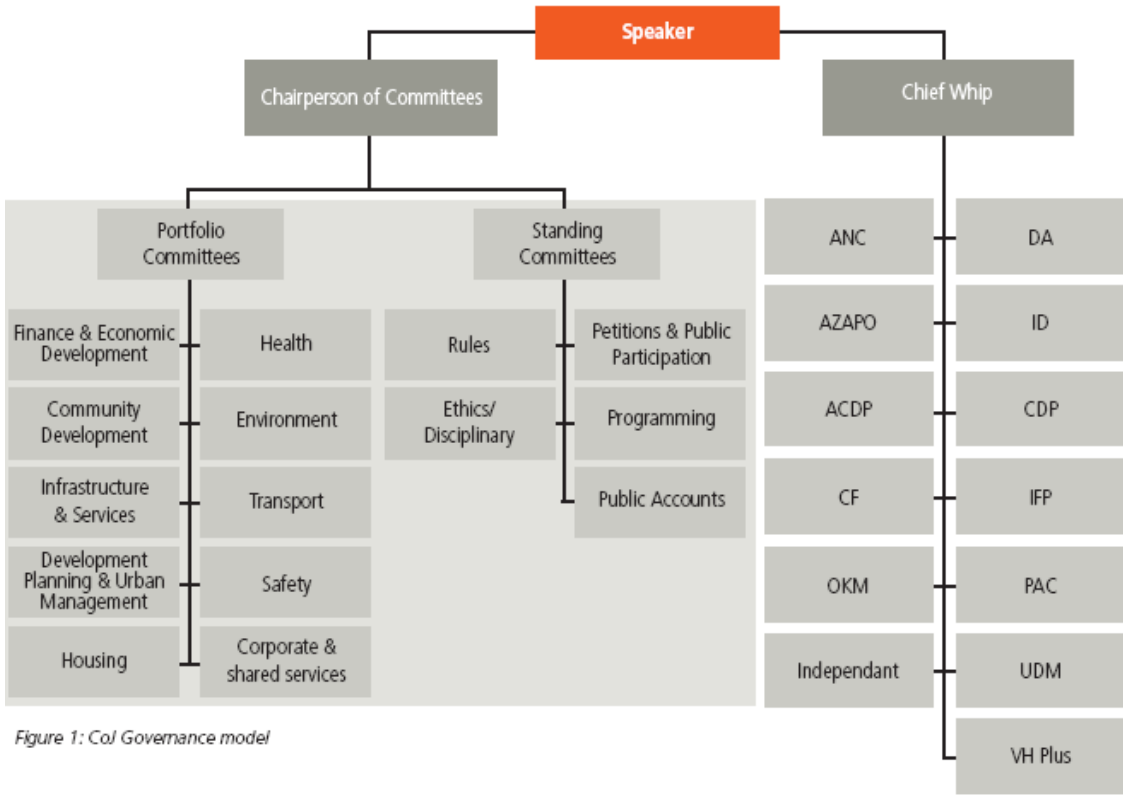


Figure 1: CoJ Governance model

Figure 4. City of Johannesburg governance model.

Source: City of Johannesburg’s Integrated Development Plan Revision (IDPR)(2008/09: 76).

The Council consists of 217 elected Councillors, made up of 109 Ward Councillors and 108 Proportional Representation (PR) Councillors.

There are two major components as regards planning in the CoJ: the Growth and Development Strategy (GDS) and the Integrated Development Plan (IDP).

The GDS charts the long-term strategic course and makes some of the bigger, overarching decisions about what should be prioritised to accelerate growth, reduce poverty, build sustainable settlements, and empower communities. It is made up of four sections: a long-term strategic perspective, a development paradigm, a vision statement, and statements of strategic choices.

The IDP defines the medium term path. The IDP spells out where the City wants to be after five years and how it intends to get there. The Integrated Development Plan Revision (IDPR) shows that “the IDP is the key mechanism for vertical and horizontal alignment. It strives to achieve vertical integration between the municipality and other spheres of government, and works towards horizontal integration between adjacent municipalities. The IDP weaves together the discrete activities within the municipality by providing a strategic overview; detailing the processes of intergovernmental alignment; showing the outreach and consultation process; setting out a summary of the Spatial Development Framework (SDF) and Capital Investment Framework (CIF); and framing the Performance Management System (PMS). The IDP also contains sector plans that define the delivery agenda, an overview of the City’s key projects at an area-based level, and the key urban management issues and interventions” (2008/09: 76).

Six core development principles cut across and underpin the strategic choices made in the GDS and IDP (Interviewee G 2008). These are proactive absorption of the poor, balanced and shared growth, facilitated social mobility and reduced inequality, settlement restructuring, innovative governance solutions and sustainability and environmental justice. As regards the latter, it is worth paraphrasing the City’s intentions in this regard, so as to continue to build a “thick description” of water, sustainability and Johannesburg (WSJ). As the IDPR 2008/09: 15) notes: “cities ignore the risk of global environmental trends at their peril, and the worst affected, whenever cities fail to manage these risks, are always the poor. Johannesburg must become a more ‘sustainable city’ by anticipating and managing the effects of environmental change. It also means promoting ‘environmental justice’ by ensuring that poorer communities do not routinely suffer most the effects of urban-environmental risks and disasters.”

The IDPR (2008/2009) also shows that the City is discussing the potential future environmental shocks and risks in areas of water supply and fuel costs. Also being discussed

are ways to calculate precisely the benefits versus risks of different investments that could be made in response to natural resource crises. The City further states that it is contemplating ways not simply to advocate for reduced consumption and more sustainable resource use, but also to regulate demand strongly. Regulatory mechanisms being discussed include new building codes, price penalties built into tariffs, and new smart meters. Monitoring of air and water pollution shows that while there has been improvement in some areas, other high-risk locations are worsening.

Thirteen “Sector Plans” bridge the GDS and IDP, and again, it is clear, on paper anyway, that the City is evolving in terms of institutional reform and S/SD and that it is consciously attempting to address sustainability issues. The tables below show the specific developmental /sustainability targets established by the City. One can readily detect the import of the “three Es” in what follows. This information, along with the interviews, helps to inform the heuristic model presented later.

- Community development
- Corporate and shared services
- Economic development
- Environment
- Financial sustainability
- Governance
- Health
- Housing
- Legislature
- Public safety
- Spatial form and urban management
- Transportation
- Infrastructure and services
 - Water management and planning
 - Energy management and planning
 - Waste management
 - Management, regulatory and support services
 - Bulk infrastructure and coordination

Some of the city’s SD targets are indicated below in Table 4.

Table 4. Johannesburg sustainable development targets.

Source: City of Johannesburg Integrated Development Plan Revision (2008/09: 49)

Indicator	Five year target (2006/11)
• Percentage coverage of basic level ¹ of service to all households	Water 100% Sanitation 100%
• Percentage service connections ² of electricity to all formalised households	95 % by 2011
• Percentage provision of street lighting to all formal and proclaimed informal settlements	95%
• Percentage provision of street lighting in high crime areas, in both formal and informal settlements	60%
• Percentage reduction in electricity usage	10%
• Percentage reduction of electricity outages (bulk, medium and low voltage)	30% by 2010
• Percentage reduction of electricity losses	From 3% to 1% (non-technical losses)
• Percentage improvement of cleanliness levels ³ in the Inner City	Inner City Regeneration Charter Plan 100%
• Percentage reduction of unaccounted for water	25% (physical and commercial losses)
• Percentage reduction of waste to landfill sites	15%
• Percentage collection of waste in all areas (formal and non-formal areas) once a week	100%

¹ Level of service 1 (LOS 1) water include water standpipes and water tankers located within a 200 metre radius LOS 1 sanitation include VIP for each household, chemical toilets and any other dry onsite sanitation

² Service connection completed before or after the construction of housing structure

³ Based on prescribed Service Level Agreements

Environmental sustainability

The environmental indicators are informed by the five-year IDP strategic objectives of ensuring sustainable development and environmental justice, and providing recreational facilities (developing parks) especially in previously disadvantaged areas of the South.

Table 5. Johannesburg environmental targets.

Source: City of Johannesburg Integrated Development Plan Revision 2008/09: 100).

Indicator	Five year target (2006/11)
• Number of trees planted on sidewalks, in parks and in private properties	200 000 trees planted
• Percentage reduction in waste disposal to landfill, and sorting at source in the City	15% reduction of waste to landfill (based on the 2006 baseline)
• Percentage reduction in air pollution levels	5% reduction based on 2005 baselines
• Percentage improvement in integrity of water courses and river health	10km of water courses rehabilitated 10% improvement in river health
• Number of water bodies rehabilitated for ecological and recreational purposes	Two water bodies Five wetlands
• Number of wetlands rehabilitated for aquatic habitats and watercourse	5% of the city's total area by 2011
• Percentage increase the total land area proclaimed as conserved area	2% reduction
• Percentage reduction in greenhouse gas emissions through flagship projects	5 flagship projects
• Percentage compliance of City (capital) projects to the EIA Regulations	100% compliance
• Percentage of compliance of key City (capital) projects to EIA specific conditions	100% compliance

Economic/Financial sustainability

Economic/Financial sustainability (FS) sector indicators are important to address as well, since they are part of the economic dimension of sustainability, and many sustainability and other initiatives cannot be implemented in a pecuniary vacuum. FS in Johannesburg is informed by the IDP objective of ensuring sustainability, accountability and responsiveness to the needs of the city and the communities of which it is comprised. Responsiveness and accountability are important, even if indirect, aspects of sustainability; without these it is unlikely any sustainability initiatives would be conceptualised or operationalized and financed. To wit, many local government and other officials are highly corrupt⁵⁴ and/or lacking in skills, so much so that “the financial records of many of South Africa’s municipalities are in

⁵⁴The famous anti-apartheid activist and poet Breyten Breytenbach, in a recent radio interview on “Radio 702”, referred to contemporary SA under the ANC as a “kleptocracy.”

such a poor state that the [SA] Auditor General’s Office is unable to express an opinion on them.” (Politicsweb2008 <http://www.politicsweb.co.za/politicsweb/view/politicsweb/en/page72308?oid=92334&sn=Marketingweb+detail>. Accessed 3.2.2010).

The City maintains that the Financial Sustainability Sector (FSS) is “the engine that provides strategic leadership in co-ordinating the City’s efforts through formulation and enforcement of policies, rules and regulations to facilitate its financial sustainability. This sector also provides good governance and appropriate, equitable and affordable service to the City’s citizens” (City of Johannesburg Integrated Development Plan Revision 2008/09: 103).

Financial targets are indicated below:

Table 6. Johannesburg’s financial targets.

Source: City of Johannesburg Integrated Development Plan Revision (2008/09: 138).

Maximise Revenue Collection and Billing	
<ul style="list-style-type: none"> • Enforcement of credit control throughout the customer base • Completion of Revenue • Unresolved queries dating back years • Increase in the interest rate putting pressure on customer finances 	<ul style="list-style-type: none"> • Started with reduction of deemed areas, with over 21,4% current success rate • Fostering completeness of revenue partnering with property value chain • Complying with the NCA and anticipating more queries with pressures of interest rates, and preparing to set the systems accordingly
Financial Control and Reporting	
<ul style="list-style-type: none"> • Power outages due to load shedding will influence income and increase customer queries • Compliance with the NCA • Inaccurate and interim meter readings • Turnaround times and dependencies on MEs 	<ul style="list-style-type: none"> • Partnering with MEs to resolve meter challenges and interim readings • Developing SLAs to strengthen the improvement of turnaround times with MEs • Staff trained to respond to the NCA, closely monitoring its effect on income

The setting of targets and goals is all very well, and it is clear that aspects such as improved revenue collection and billing and financial controls and reporting, have major implications

for the economic aspects of sustainability. However, I suggest there is a notorious slip 'twixt the policy/strategy lip and the implementation cup. As Brown (2008: 221) has contended:

The inertia associated with administrative systems is possibly the most significant obstacle to advancing sustainable urban water management ... implementation impediments ... include institutional fragmentation, undefined organizational responsibilities, limited political incentives and disincentives, poor organizational commitment, technological dependency, poor community capacity to meaningfully participate and an overall lack of experiential knowledge with facilitating more sustainable urban water management approaches.

Institutional sustainability –another “E”–Engagement

In an attempt to overcome many of these problems, an important institutional innovation in Johannesburg has been the establishment of the Joburg Water utility, which is intended to foster sustainability. Johannesburg Water (JW) was established in January 2001 as an independent company, with the City of Johannesburg as the sole shareholder. As indicated earlier, JW was the product of months of effort initiated by the City Council as part of its IGOLI 2002 transformation plan. This was aimed at the establishment of different business units for the various service delivery functions of the Council. JW is the amalgamation of more than 12 different Council operating Departments and numerous support clusters.

According to the Johannesburg Water (JW) website (2010)

<http://www.Joburgorg.za/content/view/35/66/1/1/#ixzz0cg4ozZsl> Accessed 12.4.10

the vision, mission and objectives of JW are the following:

Vision

Johannesburg Water's vision is to become the leading water utility in South Africa.

Mission

To provide all of Johannesburg's people with access to quality water and sanitation services.

To achieve this Johannesburg Water will:

- Deliver a sustainable, affordable and cost effective service;
- Upgrade services in low income areas;
- Create a customer-focused culture;
- Build capacity through the development of our employees with emphasis on those who were previously disadvantaged; and
- Improve protection of the environment

Objectives

To deal with water and sanitation backlogs in informal settlements; update the Water Services Development Plan and to review the metering policy and unaccounted-for water and energy.

In terms of one of the “three E” considerations, equity, since 2001, JW and the City of Joburg have provided all households within the city of Johannesburg with 6,000 (later 10,000) liters of free essential water per month, as part of an overall poverty alleviation campaign. Also in terms of sustainability initiatives, consumption over and above the 6,000 liter/month threshold will be charged for, according to a stepped tariff band. Those who consume more water will thus be charged progressively higher rates, according to their levels of consumption. Water saving, as part of sustainability initiatives, is particularly important in Johannesburg, given its reliance on external sources for water. Accordingly, I examine the supply of water to Johannesburg in more detail and the ramifications of that situation for SD.

Water supply to Joburg

Besides an inherent paucity of lack of rainfall in SA, as discussed earlier, the combination of ever-increasing demand and insufficient water supply over the years has meant that Johannesburg has to appropriate water from external sources, including from distant rivers and dams within SA (for example, the Tugela-Vaal scheme), but also from the neighboring state of Lesotho, via the Lesotho Highlands Water Project (LHWP). The LHWP is a massive scheme, involving a phased series of 6 dams and 240km of transfer and delivery tunnels,

enabling water to reach SA from Lesotho (van Robbroeck 1986: 6). The LHWP obviously assists in alleviating SA's insatiable thirst for water and engendering a sustainable water supply. However, the LHWP is also vitally important to Lesotho in terms of it being a "source of employment, spending, and extra Customs Union revenue on imports during construction, a means of energy independence (via the associated hydroelectric scheme)" (Cobbe 1988: 80) and of course revenue from water sales to SA.

But besides these benefits accruing to both countries, there were also vast costs, not all of which were pecuniary - the main "social and environmental impacts were expected to be the displacement and resettlement of over 1,300 people, and the loss of some 400ha of arable land and 18700 ha of grazing in Lesotho" (van Robbroeck 1986: 11).

Furthermore, after completion of the first phase of the LHWP, the Chief Executive (CE) of the Lesotho Highlands Development Authority (LHDA) was indicted on fraud and bribery charges of US\$6m, along with many of the construction companies involved in the project that were allegedly engaged in bribery and corruption. This inflated the project costs of the LHWP (thus dealing a blow to the financial sustainability of the program) and in 1999 the CE was convicted and sentenced to 18 years in prison (Institute for Security Studies 2010) http://www.ipocafrika.org/index.php?option=com_content&view=article&id=71&Itemid=66. Accessed 3.2.2010.

There were also interesting geopolitical ramifications associated with the LHWP: in 1985 there was a SA National Defense force incursion into Lesotho and an engagement with Lesotho troops, which resulted in loss of life.⁵⁵ Ostensibly this action was taken to stabilize a deteriorating political situation in Lesotho, but many commentators believe it was SA ensuring there was no disruption in water supply to SA via the LHWP (Copland⁵⁶ pers. comm. 1999). This also serves to illustrate the externalities associated with conditions of "unsustainability" – Johannesburg's dependence on external water sources can provide major

⁵⁵This was not the first time there had been incursions from SA into Lesotho. Lesotho's persistent refusal to sign a joint non-aggression act led South Africa to impound consignments of arms destined for Lesotho, and again, in August 1984, to threaten economic sanctions. In December 1985 commando troops- believed by the Lesotho Government to be from South Africa- killed nine people (including several ANC members) in a raid in Maseru (Lesotho's capital). On 1 January 1986 South Africa imposed a blockade of the border with Lesotho, impeding access to vital supplies food and fuel (Europa World Year Book 1996: 1955). Similarly, the sudden change in regime in January 1986 was widely viewed as a direct result of Pretoria's actions. (Cobbe 1988: 71).

⁵⁶Prof. Copland was head of the Dept of Social Anthropology at the University of the Witwatersrand, He is married to a Lesotho national and by virtue of this and his research interests and numerous contacts within Lesotho, he has a good information network, especially as regards Lesotho socio-political "undercurrents."

economic and other benefits to another country, but at the same time this very dependence could result in disputes and even the specter of “water wars” between SA and Lesotho.

The Rand Water Board (RWB, or Rand Water) supplies Joburg (and also some neighboring towns and provinces) with water. The RWB was established in 1903 and is now the largest bulk water utility in Africa, pumping about 3.5 billion liters of water daily to customers over an area that stretches over 18,000 km² (Rand Water Board Annual Report 2006: 7). This sharing of water amongst many geographically diverse users compromises the sustainability of water supply for Joburg, in terms of the city competing for water with other cities and provinces. Indeed, as Interviewee G 2008 pointed out, rampant and unplanned development in these neighboring areas, with concomitant demand for more water, effectively places ever growing pressures on the supply of water to Joburg. The transfer of water to Joburg is illustrated in figure 5.

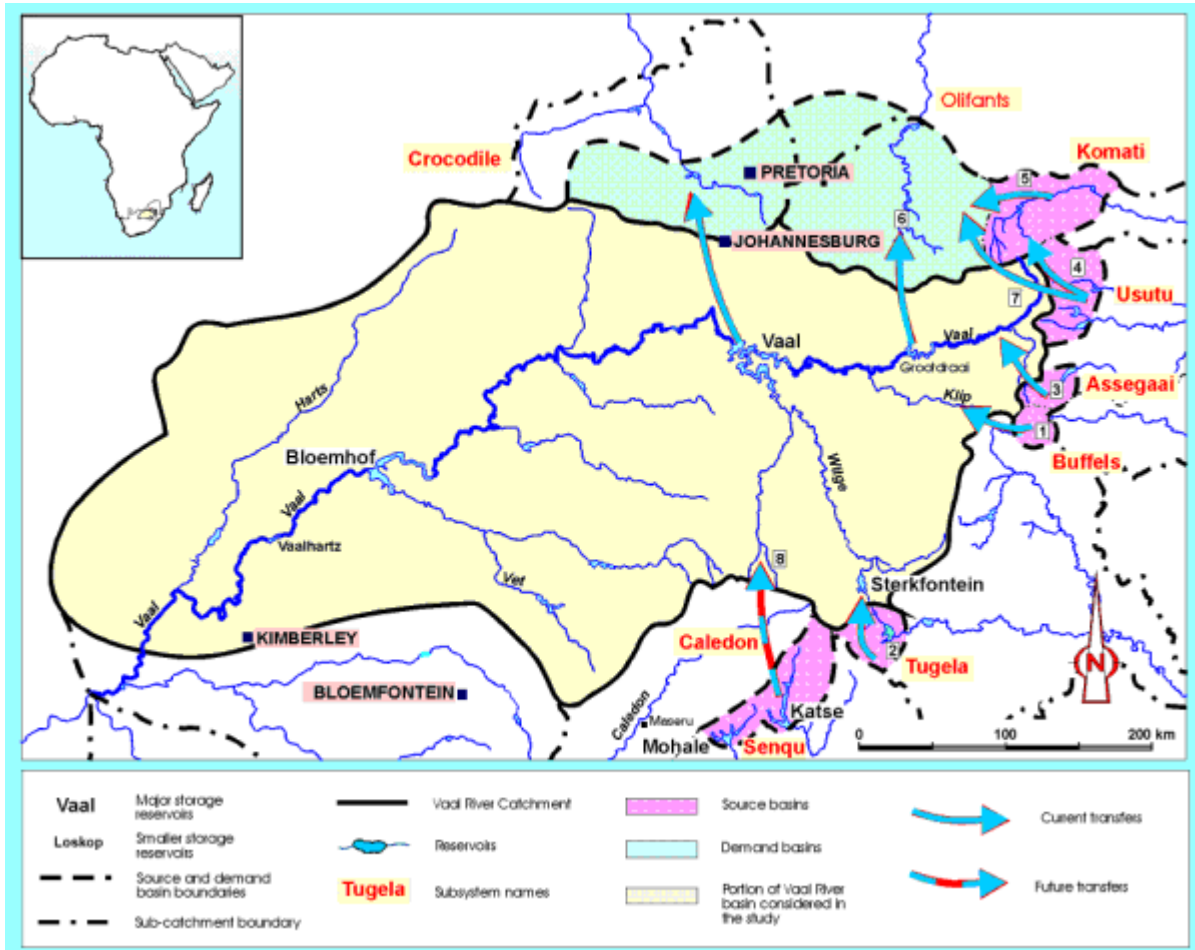


Figure 5. Inter-basin transfer schemes into the Vaal River Basin

Source: DWAf, 2004, cited in Weakley (2009:10)

The RWB obtains most of its raw water from the agricultural catchment of the Vaal Dam, (completed in 1938), and the industrialized Vaal River Barrage reservoir, (completed in 1923) and covering a catchment area in excess of 50,210 km². Three inter-basin transfers have been developed to supplement Rand Water’s available raw water resources as a result of increased demand. (Heath and Geldenhuys: mimeo, undated). A further impediment to achieving sustainability in Joburg is the city’s location on a ridge, hence potable water for the region has to be pumped up about 50 km from the region of the Vaal River, as well as from other catchments, as demonstrated in the figure above. (The need for energy to pump water

also has implications for notions of sustainable energy, especially in light of the crisis in Eskom, SA's monopolistic and chaotic electricity utility.⁵⁷

The quality of raw water from the sources drawn upon by water in the upper Vaal, upper Tugela (in SA) and Malibamatsu (in Lesotho, part of the LHWP) catchments has been excellent. This has enabled Rand Water to supply potable water to consumers that meets the quality requirements of most of the world's leading developed nations. The RWB has stated that it supplies the third best drinking water quality in the world,⁵⁸ but also that there is a vast gap between the quality of tap water available to Rand Water consumers and the poor quality of river water in the streams draining the Witwatersrand⁵⁹ (Rand Water Board Annual Report 2006).

Several interviewees were concerned about the RWB, especially in terms of social and institutional sustainability. As Interviewee G stated, "older white engineers have left or been forced out, resulting in too many people there without experience, engineering skills and any sense of organizational vision and who are running the RWB into the ground. We are heading

⁵⁷Eskom is SA's electricity utility, with a virtual monopoly over electricity supply. SA's electricity price has hitherto been amongst the lowest in the world and electricity supply was generally uninterrupted. However, in recent years supply has been erratic, resulting in blackouts and brownouts (or as Eskom euphemistically puts it: "load shedding"). This has caused considerable damage to the economy (estimates are losses of R2 billion per day) and also widespread accusations of bad planning, mismanagement and of the perceived perils of the ANC government's policy of "Black Economic Empowerment" (Affirmative Action), which saw the departure of many skilled and experienced personnel from Eskom. Severe power shortages are looming for SA and so Eskom has to embark on considerable maintenance and especially capital expenditure in order to build more (coal-fired) power stations. Electricity consumers will thus see their electricity bills rising by about 45 percent p.a. for the next three years, with considerable inflationary and other ramifications. The above is customarily referred to in SA as "the Eskom debacle." What is more, the envisaged power stations will be major consumers of already scarce water.

⁵⁸"Every month throughout Johannesburg about 500 samples are taken and analysed to ensure compliance with the SANS 241 standard. Between 42 and 46 determinants are checked and more than 4 000 analyses carried out each month. These include aesthetic, mineral, chemical and microbiological parameters. The results show excellent compliance with the highest category (Class 1) in this standard, which confirms that the drinking water in Johannesburg is some of the best in the world. This water monitoring has increased since Johannesburg Water took over – previously only 150 samples were tested a month. In addition, the number of parameters tested has increased. In one litre of Joburg water, there is typically 18 milligrams of calcium; eight milligrams magnesium; 10 milligrams of sodium; three milligrams of potassium; 11 milligrams of chloride; 12 milligrams of sulphate; 0,5 milligrams of nitrate; and 0,2 milligrams of fluoride; with a total alkalinity of 77; total dissolved solids 150; and 7.7 pH (pH units). This complies fully with SANS 241 Ed 6.1, Class 1 Drinking Water." (www. Eco-h2o_co_za.mht 2010. unpaginated).

⁵⁹ In effect, the RWB has to "go to a lot of expense and trouble" in order to treat water to a high standard. As noted, service delivery is neither universal, nor acceptable everywhere in SA and Johannesburg -- not everyone has RWB water piped into their homes and many people have to "forage" for water from streams or dams or communal standpipes. Such water is often polluted and water supply and potability is compromised by the unfortunate intersection of skills deficiencies, poor management and maintenance and corruption in SA. The upshot is that "RWB delivered" water *output* is of high quality, but water *inputs* are frequently polluted and difficult and expensive to treat.

for an Eskom situation ... and there is evidence of underinvestment in bulk water infrastructure” (See also footnote 47). Interviewee G and Interviewee T, both Joburg Water personnel, thus lament being at the mercy of RW, which is financially and institutionally stressed (Weakley 2009). This reflects a wider and serious institutional and technical/engineering malaise in SA as a whole and demonstrates the importance of considering other “Es” of Engineering and institutional Engagement in conceptions of S/SD. Indeed, Cokayne (2010:1) has cited SA’s institution of Consulting Engineers South Africa (CESA), which recently complained,

the lack of technical management capacity, particularly in municipal and provincial government, was likely to be the single biggest stumbling block to sustainable development and growth in South Africa... the number of professionally registered engineers employed by all tiers of government had declined from 5 100 serving 14 million people outside the “homelands” in 2005, to an estimated 1 800 serving about 47 million people in the entire country this year. The percentage of professional engineers working in the public sector had also dropped from 40 percent in 1980 to 15 percent in 2005 and has probably shrunk further to 10 percent today (Cokayne 2010:1, citing CESA).

Furthermore, CESA’s deputy-president has said “historically the municipal engineer was a very highly regarded and respected member of the government who had a lifetime career and a 20 to 30 year outlook. However, most municipal engineers were now given only a five-year contract... and the way the government had structured senior positions in local government and the respect given to these positions meant no matter how much you pay them, nobody wants to do the job” (Cokayne 2010:1).

An Internet blogger, identified only as “Moseka,” responded to Cokayne’s article and this response, although anecdotal, illustrates the intersection of race, affirmative action/ “black economic empowerment,” corruption, macropolitics, cronyism, skills and capacity deficits involved with the legacy of apartheid and the difficulties of engendering S/SD in contemporary SA:

CESA seem to be making a very simplistic analysis of this whole issue. I must first indicate that I am an engineer of 15 years in the private sector and black. Only

recently have I started looking at doing work for some municipality as a contractor. From my observation there are a number of factors to this problem and they need to be addressed together. Contrary to CESA's observations I have actually found that former municipal engineers (almost all white) have left the municipalities when the black administration came in (not sure why, but suspect an opportunity to make more dough⁶⁰) and they are actually now consulting for the self same municipalities milking it while making shoddy jobs. On the other side you also have a former white technician, who would have previously been only a foreman, now holding the technical manager position and actually pushing the work to their former bosses who are now running the consulting firms. I was actually horrified to find on one occasion the "consulting engineer" charging a municipality upwards of R6 million for an upgrade on a conventional off the shelf water treatment plant design. Compounding this problem are the deploees of the ANC, who have no clue about engineering, wanting to have too much to say on the projects. Even worse is that these "consulting engineers" know their politicians very well and an envelope here and there, phony partnerships etc to make sure the work keeps rolling in. In the Free State [a province adjoining Gauteng province], where actually there is a massive water quality and water treatment problem, I am still to see the AA [Affirmative Action] candidates ... running the technical departments. What everyone (black or green or white) is concentrating on is outwards, to identify the next partner for a fat kickback, not the operation and maintenance of the assets that they are running. So please stop making this a black/white issue. This is a greed and lack of professionalism issue (Cokayne 2010: 1).

These comments point up not only the multi-dimensional nature of sustainability, but also the concrete aspects of S/SD, where, for example, wastewater simply needs to be treated, no matter one's conceptions of S/SD. Here again, Johannesburg is compromised, in that it cannot discharge and dilute its liquid wastes into large rivers or the sea (JW website, various dates; Weakley 2009). The result is that the city's wastewater is discharged into catchments that are classed as sensitive to the discharge of waterborne pollutants. However, Johannesburg has developed and refined a biological wastewater treatment process, which removes organic pollutants, as well as nitrogen and phosphorus. The system is recognized

⁶⁰Money

internationally as the “Johannesburg Process.” Nevertheless, surface water quality is deteriorating in Johannesburg, mainly due to blocked sewers, ageing infrastructure and litter carried via the stormwater drains into Johannesburg’s small rivers and streams (<http://www.Joburgorg.za/content/view/35/66/1/1/#ixzz0cg4ozZsl>. Accessed various dates).

Approximately 99 percent of the water pumped into the city is purchased from Rand Water while 0.9 percent is provided by Johannesburg’s eastern neighbor, the Ekurhuleni Metropolitan Municipality. Approximately 0.1 percent is pumped from Tshwane (Pretoria) Metropolitan Municipality (Weakley 2009: 9). Interviewees (see later) perceived this reliance on one basically monopolistic water supplier as inefficient and “unsustainable.” (Weakley 2009).

In order to engender sustainability, JW and the City of Johannesburg have embarked on a number of campaigns and strategies, one of which has been “Operation Gcin’Amanzi”, which was launched in 2003 in Soweto in response to the fact that at the time, 83 percent of water losses in deemed consumption areas occurred in Soweto.

This operation developed four interventions to promote Water Demand Management (WDM):

- The repair and upgrade of networks
- Once-off leak repair and retrofitting in private properties;
- The installation of prepayment water meters, tied to debt write-off;
- The promotion of efficient water use (CoJ, 2009:61), cited in Weakley (2009: 53).

Operation Gcin’Amanzi has resulted in a savings of 101 billion litres of water, R299 million saved through reduced bulk water purchases, and a 42 percent return on investment (CoJ, 2009: 62), cited in Weakley (2009: 61).

Johannesburg and JW have also undertaken education and awareness campaigns, and further attempts to reduce water losses through the installation of pre-paid meters and infrastructure refurbishment (City of Johannesburg Integrated Development Plan Revision 2008/09: 190). In addition, a tariff and metering framework has been established to ensure equity and

affordability in service charges. A number of water demand-side management strategies have also been instigated, including dual distribution systems; rainwater harvesting; regulation of effluent discharges; enforcement of waste charge-discharge systems; retrofitting of food waste processors to more restaurants and households to reduce food waste loads; return flow management into the sewer to minimise stormwater infiltration; providing sanitation services for dense settlements to reduce pollution; and enforcing the retrofitting of a dual flush system in toilets (City of Johannesburg Integrated Development Plan Revision 2008/09: 273). The City also in June 2009 released a Water Services Development Plan that includes a Conservation and Demand Management Strategy for Johannesburg, but it is being rewritten and will become available officially late in 2010 (Weakley 2009: 14).

Water quality, though not the primary focus of this study, is an important factor to consider in WSJ. Water emanating from the Vaal Dam catchment is, as stated above, of good chemical and microbiological quality, taste and odor, but problems have been experienced in the drinking supply because of copious growths of certain algal species in the dam. These do not generally pose a health threat, but can be aesthetically undesirable. Water quality is also affected by institutional / social sustainability problems in that the presence of harmful amounts of *E. coli*, for example, is seen as a health problem, not an environmental problem (Interviewee M: 2009). Sustainability can also be compromised by poor problem definition, institutional fragmentation, possible duplication and skills limitations.

Quality problems are, however, frequent in the Vaal River barrage catchment (i.e. streams draining the Witwatersrand) as a result of overstressed wastewater treatment facilities resulting in the discharge of sub-standard effluent. Sewage spills from blocked sewers and the inability of these systems to keep pace with the rapid rate of urbanization remain a threat (Rand Water Board Annual Report 1998: 20). Indeed, interviewees R and T (2008) argued sewers represented a major area of sustainability concern and maintaining the quality of sewers is seen as an important part of sustainability, but one which must be a social and environmental responsibility on the part of users, not just officials. One interviewee saw this as a function of users' history, culture and affordability levels (Interviewee R: 2008). For example, sewer abuse includes sewers being used as an alternative waste disposal system – items disposed of in sewers include fetuses, tires, cars and car parts, cutlery lost whilst washing, electric cabling and soiled diapers (Interviewee R: 2008).

Problems with sewer sustainability are so important they have become part of the city's Key Performance Indicators (KPIs). Sewer blockages have to be cleared as soon as possible and response times improved. Programs to step up previous sewer maintenance are in place and the aim is to reduce problems by a third before they occur, with the aid of a telemetry system, which enables quick responses. In addition, sewer pump stations are now inspected every day and 17 percent of the total network of 10,000 km of sewers are swept. Every sewer is cleared every 7 years and by 2011 every sewer will be cleared every second year (Interviewee R: 2008).

According to Heath and Geldenhuys (undated mimeo: 2), there are at least 25 major water works in the Vaal river barrage catchment, many of which have insufficient capacity to cope with the increased loads⁶¹ placed on them due to rapid urbanization and lack of finances⁶². Capacity is not just a physical problem, however. Interviewees' responses and the literature point to vast problems with institutional capacity as well: As Segal has suggested, poor water treatment and ensuing water quality problems are also the result of "the lack of managerial and technical capacity to manage waste water treatment works to the required standard, itself due to over-hasty affirmative action policies, the departure from local government of experienced white males and the politicization of what should be a professional and technical services environment. The problems have been exacerbated by the very large number of players in the sector across the three tiers of government, with some confusion among them as to who is accountable for what" (2009: 8).

The issue of unaccounted-for water (UFW) serves to illustrate these technical and other deficiencies, as elucidated by de Vallier and Broadhurst (1997) and de Vallier (1997). Since UFW is such a clear and concrete manifestation of wastage and unsustainability, it is discussed in some detail.

⁶¹The major problems are nutrients (phosphorous and nitrogen) and microbiological pollution (which originates from treated and untreated sewage—faecal coliform counts have reached several million/100ml, thus threatening recreational water use (Heath and Geldenhuys p5 undated mimeo).

⁶²The loss of filter backwash water results in Rand Water losing some R50 000/day of revenue (2 percent of water lost is lost through filter backwash). If algal problems (taste and odor) persist for two months a year, the potential increase in unit treatment costs is 0.8c/Kl. If this occurs for six months, there would be a 2.6c/kl cost increase (Heath and Geldenhuys p5 undated mimeo.). As an example, water quality testing costs R200 000 p.a. in (what was) the Southern Metro Local Council alone (Ras 2000 pers. comm.). (This was one of four local councils in Johannesburg before Johannesburg became a unicity.)

Unaccounted-for water

The UFW phenomenon demonstrates both the wastage of a resource by society and what might be termed unsustainable behavior. UFW is, of course, not solely a SA phenomenon, but the SA situation certainly displays some primarily apartheid-induced idiosyncrasies. But first, after de Vallier and Broadhurst (1997: 7), UFW is defined simply as “the difference between the measured volume of potable water having entered a distribution system and the measured amount of water leaving the system.”

The numerous components of UFW can be grouped as follows:

- Leakage from the reticulation system
- Flushing of mains
- Reservoir leaks, overflows and flushing
- Fire fighting usage when not metered
- Meter inaccuracies
- Unmetered connections
- Theft and unauthorized usage
- Reading, data capture and processing errors

Whilst some UFW components are attributable to administrative errors,⁶³ & ⁶⁴ many are attributable to physical losses.

Few local authorities have comprehensive structures in place to deal with the control and reduction of UFW. Most local authorities are reactive rather than pre-emptive in terms of instituting procedures for leakage control, replacement of consumer meters etc. Furthermore, because of the relatively low cost of water, most local authorities compensate for revenue

⁶³ Errors in meter reading, whether accidental or deliberate; errors in transferring meter reading data to the accounting system; errors in the consumer database; delays and errors in invoicing consumers and registering new consumers; and bad debts.

⁶⁴ A practical and very effective method of reducing meter reading and data capture errors is through the use of handheld electronic terminals (HHET. i) LC conducted a study on behalf of the Johannesburg City Council in 1992 entitled “Pilot Project to Evaluate Electronic Meter Reading Systems”. The study found that time-savings of 15 percent in meter reading, in supervision and 50 percent in data capture could be achieved through use of HHET. The occurrence of meter reading errors was dramatically reduced while errors in transferring readings from the HHET to the consumer database were virtually eliminated. Local authorities such as the Durban Corporation and the Johannesburg City Council, who have introduced HHET, report dramatic improvements in the efficiency of meter reading and data processing (de Vallier and Broadhurst 1997: 7).

losses by increasing tariffs rather than implementing procedures for the control and reduction of all components of UFW.

Rapid urbanization experienced in SA since the late 1980s has significantly increased the number of unmetered consumers. Unauthorized connections installed by consumers without the permission and knowledge of the local authority occur mainly in informal settlements and areas of land invasion.

The urgent implementation of comprehensive management procedures on a national basis is essential to “safeguard the availability of this strategic resource in the interest of future generations of South Africans. Furthermore, international experience has shown that each new water source costs four times as much as its predecessor to develop. From an economic point of view it is therefore essential that all existing water sources are utilized to their utmost efficiency, thereby reducing or delaying the need to develop new sources (de Vallier and Broadhurst 1997: 4).

De Vallier and Broadhurst (1997) also determined that the status quo of UFW management in SA varies considerably from one local authority to another. In some instances, such as the Durban Corporation and Johannesburg City Council, there are comprehensive and active UFW management structures in place. This is largely due to senior management officials who are committed and dedicated to the principles of UFW management. In other instances, especially the smaller local authorities, there is little or no attempt at UFW management. These local authorities generally use reactive means of leakage control and compensate for any loss of revenue by adjusting water tariffs on a regular basis.

Generally, the status quo of UFW management and knowledge is alarmingly low, given the water-stressed conditions prevailing in SA. In most cases, the local authorities do not have the resources to meter and monitor all new consumers.

De Vallier and Broadhurst have reported the results of a nationwide survey that showed that UFW ranged from 2.8 percent to 34.8 percent of the average daily volume of water supplied to the system (1997: 24). Estimates of national UFW given in various publications range from 12.8 percent to 40 percent of the total production of water. As far as Johannesburg is concerned, Ras (2000. Pers. comm.) estimates that UFW is 38 percent by volume (where a

figure of 12 percent is acceptable for SA conditions). De Vallier and Broadhurst found the UFW figure for Soweto is 68 percent and that water is literally going down the drain: people are paying for fixed consumption of 20 kl per month (which is only 40 percent of what they should be paying) and are in fact consuming between 40 and 60kl per month (1997: 24). This also means there is little incentive for reducing consumption and attending to maintenance, and taps [faucets] and pipes thus leak continually, especially in areas (such as Soweto and other townships) where metering is deficient, inaccurate or non-existent. In wealthier areas with functioning meter systems, it is much easier for authorities to measure and control UFW.

In addition, mostly due to apartheid, but also due to seemingly endemic corruption in SA, there is historically a culture of non-payment, and the Johannesburg Council is not (politically) strong enough to implement new procedures to ensure payment for services rendered (Ras 2000, pers. comm.). Township dwellers are in fact paying a rate based on deemed consumption rather than on average metered consumption. According to Ras (2000 pers. comm.), the council's mandate precludes it from operations and maintenance off the road reserve. i.e., the council may operate only in the public space (the road and sidewalk) and not in private houses or commercial enterprises. However, it would make good economic and sustainability sense if the council could itself repair leaks on properties and at the same time engage in training programs so that small private contractors could then engage in such activities. Ras (2000 pers. comm.) estimates that this expense could be recovered within three months.

The cost of UFW in Johannesburg was estimated at R180m p.a. and could be reduced by R150m p.a. if a holistic approach were to be adopted. Holistic here means that the causes of UFW are not entirely technical in nature. Approximately 20 percent is due to technical reasons: leaking mains, reservoir overflows, defects and malfunctions in infrastructure causing water wastage, such as air release valves, isolating valves, or broken or missing seals. The balance is due to billing losses, where consumers are not on the billing system, are on the system but are not paying, or are indigents. Dealing with UFW and defining "sales, billing, metering" is a "very political decision" (Interviewee Mn: 2008). This is due to myriad factors, including the legacy of apartheid where services were non-existent, deficient or rudimentary and/or free; or there was a protest culture of non-payment for services. It is also due to current high levels of unemployment and consequently low levels of willingness and /or the ability to pay for services.

The path to sustainability also requires relatively difficult political maneuvering and behavioral change (on the part of officials being more diligent in performance of their duties, for example, and in terms of consumers acting sustainably by using less water and actually paying their utility bills and paying them in a timely manner). Also, attention needs to be devoted to administrative issues, such as accuracy in billing systems and actual meter reading and the use of various technologies (for example, better fixtures and different metering systems, such as hand-held meters).

Price of course is an important stimulus to engender behavioral change and a stepped tariff may go some way to water saving. According to de Vallier (1997: 5), the achievement of effective water conservation requires “better efficiency of both water delivery systems and water usage, i.e. it requires the implementation of an effective water conservation management policy that can be implemented in two main areas”.

Supply management is to be effected primarily through technical measures⁶⁵, whilst demand-side measures⁶⁶ include both the harder technical, but also softer socio-economic tools and approaches. All in all, this can be considered as a two-prong approach to engendering S/SD, which is a welcome departure from measures in SA that have traditionally focused on supply management, rather than demand management. Demand management relates to the reduction of non-essential water use by all categories of consumers.

The existence of UFW and leakages means that the metabolic system becomes linear, and there is little hope of closing the cycles and reusing/retreating the lost water. Ideally, there should be no leakages and where possible, water should be recycled, or find its way into rivers, so that it can be part of the “ecological reserve,” i.e. the water flow required in a river to maintain its ecological integrity.

⁶⁵ Active leak detection and repair, reactive leak repair, pressure management, distribution system maintenance, meter maintenance, data base management and conducting water balances and audits.

⁶⁶ Education and public awareness, water regulations, water pricing and tariff structure policy, universal metering, consumer plumbing system maintenance, retrofitting water-saving devices, garden watering regulations, recreational water usage, water restrictions and creative and innovative presentation of utility bills.

Local and other authorities have attempted to address the closing of this loop, but the work has not been easy, as Wolfaardt and Archibald (1992) have shown.

One of the prime issues facing major water-using industries in SA is the problem of utilizing water more efficiently in order to reduce water consumption and the cost of effluent treatment. Many industries practice water recirculation as a means to effect such reductions. While this strategy has advantages, it may create further problems. One of these is biofouling⁶⁷ and the consequences of this phenomenon. The most serious implication of this phenomenon is microbially influenced or induced biocorrosion that can result in an increase in the corrosion of metals, in turn compromising water quality.

For example, SA, as the world's largest producer of several minerals, depends financially on their export. Since cooling by water is essential in many mining (and power generation) operations, most mines are highly dependent on the availability of good quality water. The SA gold mining industry consumes more than 3,000 Ml of water annually for basic mining operations and for cooling purposes. The Chamber of Mines Organization (1985) estimates financial losses due to poor quality service water to be in the order of R200 million/year. One can see the effects of the interplay of at least the “three Es” here—poor quality water can have economic impacts, impacts on ecosystems, and, due to the costs incurred, impacts on gold mining companies' profitability, subsequently influencing workers' working conditions and remuneration packages.⁶⁸

In fact, as far as the sustainability of Johannesburg is concerned, it is ironic that the city's history and economic base is explicitly founded on gold mining, yet mining activities are causing major water and environmental problems, especially in terms of Acid Mine Drainage (AMD) (Interviewee T: 2009).

According to Africa Water News (2010: unpaginated), AMD refers to a “deadly cocktail of toxic chemicals, including heavy metals and radioactive uranium, as well as high levels of sulfates, leaking from disused mine workings into dolomitic areas underground, infiltrating ground water and overflowing to the surface water sources. This acid drainage lowers water

⁶⁷Such an accumulation of microorganisms or their excretory products in water systems is generally referred to as biofouling. Biofouling in industrial water systems is usually characterized by the colonization of surfaces in contact with water by microorganisms (Wolfaardt and Archibald 1992).

⁶⁸One could continue this form of chain-reaction thinking, à la the environmental assessment literature.

quality, poisons food crops and poses several health risks, including increased rates of cancer, decreased brain function and skin lesions.”

Furthermore, Africa Water News (2010: unpaginated) reports “globally, AMD has been cited as posing environmental risks second only to climate change” and that SA’s Minister of Environmental Affairs called AMD “a ticking time bomb.” Indeed, “environmentalists are worried that the acid is eating away at the underground dolomite, and that it is consistently filtering into aquifers used for drinking and irrigation ... and experts have warned that in less than three years, acid mine water will begin to flow uncontrollably out of the Central Basin, below Johannesburg, and in 18 months polluted water in that basin will reach critical levels, affecting the structural integrity of the Johannesburg CBD” (Africa Water News 2010: unpaginated).

Wolfaardt and Archibald (1992) have argued that the cost of corrosion in SA amounted to 5.2 percent of GNP in 1983. This means a total of R6.8 billion per annum. The importance of MIC in this figure is unknown, although it has been held responsible for up to 50 percent of total corrosion in systems in other countries^{69 70}

Having discussed the case study area and described some of the challenges linked to water, sustainability and the steps Johannesburg is taking to address them, I now turn to further sustainability analysis of Johannesburg.

⁶⁹A few examples taken from Wolfaardt and Archibald (1992: 2) are:

It is estimated that at least 50 percent of all pipeline failures in Great Britain were due to the activity of sulfate reducing bacteria (SRB); Other reports indicated that sulfate reducing bacteria resulted in the corrosion of 70 percent of all the seriously corroded water mains examined in the UK;

Nearly one-half of the corrosion of steel culvert pipes in Wisconsin, USA, is due to the activities of SRB;

MIC was claimed to be responsible for damage to metals costing 1.5 billion Francs in France in 1967;

1969 MIC cost Australia \$2.5 million and New Zealand \$5 million. Wolfaardt and Archibald (1992: 3) cite Hassan et al., who, in 1990 referred to estimates made in 1954, which suggested that detrimental activities of the SRB were responsible for damages worth 2.0x10⁹ dollars in the USA.

⁷⁰ A preliminary feasibility study in Gauteng indicates that up to 240-million liters of contaminated water in mines could be cleaned and supplied to Gauteng residents. A plant to clean the mine water will cost about R1-billion to build and commission. The first phase of the Gauteng water project will cost about R250-million (iafrica.com: 1999).

Chapter Six.

Water, Sustainability and Johannesburg (WSJ).

Case Discussion and Analysis.

Previous chapters highlighted the complexities associated with water and with S/SD (as well as with the nebulosity of human settlements), including those pertaining to the sustainable city. Now, to assist in furthering understanding of the ramifications of S/SD, the questions regarding WSJ become:

- Where does the water come from? (upstream of Johannesburg – input and supply)
- What happens to it? (Johannesburg in situ – conversion and demand)
- Where does it go? (downstream from Johannesburg – output, environmental impacts and wastage⁷¹)
- What import does this have in terms of WSJ and the principles, themes and metaphors discussed earlier, especially in terms of their usefulness for an expanded heuristic model of sustainability? ⁷²).

Although, for the sake of clarity and brevity, the metaphors are discussed separately in what follows, in practice these overlap considerably. The easiest way to conceive of these applications is to consider water as a flow variable, and to keep in mind the systems approach and the environmental assessment literature (in order to take cognizance of the total environmental impacts associated with water, which would encompass cognitions of the “three (at least) Es” of environment, equity and economics).

The spatial dimension is the organizing principle for this section. In other words, I commence upstream and deal with issues surrounding water supply from the LHWP and then, closer to Johannesburg, the Rand Water Board. I then address the flow of water

⁷¹This is not to suggest that there will not be a host of environmental impacts and wastage within Johannesburg as well.

⁷² Obviously, to investigate fully the concept as it applies to and is manifest in, Johannesburg is a mammoth undertaking, but I will handle just one dimension, so as to again illustrate the value of S/SD theory – one of the major tasks of this research. What becomes clear, though, is that one needs to be concerned with systems, flows and externalities across time and space. (And if one employs the “Es”, one should also be concerned about how these costs and benefits are distributed in society and in ecosystems).

through Johannesburg, paying particular attention to (unsustainable) wastage of water via so-called unaccounted for water. Finally, I turn to some of the downstream effects water has as it flows out of Johannesburg, by examining the fate of Alexandra township and the Hartbeespoort Dam. Thus, with the background information and sustainability detail pertaining to Johannesburg in the previous chapter, this chapter casts the sustainability net somewhat wider. As indicated earlier, the metaphors of the Ecological Footprint and of Urban Metabolism are ideally suited to such efforts and again, they help literally and figuratively to develop a dynamic/flow perspective of sustainability and water.

As regards the metaphor of the ecological footprint (EF) and its bearing on WSJ, the city and its hinterland are not nearly able to supply their combined water needs. As a result of SA's water deficit, the augmentation of its water supply has long occupied many hydrological and other minds in SA. This has necessitated a sustainable source of supply from, among other sources, the Lesotho Highlands Water Project (LHWP), since Lesotho has a steady supply of water from its mountainous regions.

While much of EF analysis is about overall resources and much of the empirical work relates to agricultural needs, I will adapt these and restrict the metaphoric interpretation to that of water. This importation of water may have clear benefits to water users in SA (and, of course, to the Lesotho fiscus), but in terms of the EF metaphor, it can also be dangerous in that it can lead to a certain "parasitism" by the city (to borrow Girardet's 1992 term), with negative externalities attendant upon the "host." It also has the potential to lull Johannesburg society into Cornucopian thinking, whereby it could be felt that technology has solved the problem of deficient water supply and thus negate the need for conservation or sustainability measures, for example.⁷³

The Ecological Footprint metaphor and the Lesotho Highlands Water Project.

One of the distinguishing features of Lesotho is its enormous dependency on SA, and consequent vulnerability. For example, migrant worker earnings, primarily from SA's gold mines, account for half of Lesotho's GNP and these workers' jobs are at stake in light of the vagaries of the economy and the gold price, the Rand exchange rate and the high cost

⁷³(Notwithstanding the initiatives regarding demand and supply management in SA, this LHWP water importation could reflect the "extra/reserve earth thinking" – if SA does not have enough water it can simply be appropriated from somewhere else).

structure of gold SA mines. Also, Lesotho is highly dependent on imports from SA for the day-to-day needs of its urban population (Cobbe 1988: 77) and more than 90 percent of Lesotho's energy requirements are imported from SA (Europa World Year Book 1996: 1958).

The Lesotho agreement and experience illustrates to an extent the fact that SA, via its demand for water, places an ecological, socio-economic and political footprint on another nation. This actually suggests a number of points and reinforces the interconnectedness and the ecological and systems views of this study. It also reinforces the need to adopt an inter- and trans-disciplinary perspective to consider the nature of stocks and flows, geopolitics, and the “three Es.”

This is also a classic example of the sustainability principle of “transfrontier responsibility”, as espoused by Haughton and Hunter (1994). Another typical example of this is acid rain, with one country, such as the United States, exporting contaminants across a frontier or border, to another country, such as Canada. The parallel here is that SA's voracious demand for water results in environmental and geopolitical impacts in Lesotho, although these impacts are of course not necessarily all negative in nature. Notwithstanding the importance of Lesotho water for SA, Lesotho is highly dependent⁷⁴ on SA. Nonetheless, SA is increasingly becoming dependent on the supply of water from Lesotho. This relationship is supposed to be symbiotic: Simply put, SA gets water; Lesotho gets electric power and royalty payments for water. But this relationship could quickly sour if supplies are threatened, raising the specter of water wars in the sub-region.

Urban metabolism and water

The second metaphor to be explored, in terms of the flow of water through Johannesburg, is that of the “urban metabolism.” As indicated earlier, this metaphor holds that a (partial) state of sustainability may be said to obtain if an input (such as water) is firstly available and, secondly, if it can be reused, recycled or reduced. The latter actions serve to “close the loop” or have conditions of a circular metabolism, instead of the resource proceeding through a given system (such as a city) in a linear fashion and becoming waste. Thus, on the face of it,

⁷⁴This would make for an interesting case study in terms of Dependency theory, as contemplated in “Development Studies” programs, for example.

some might argue that Johannesburg is unsustainable in terms of the city not being able to meet its own water needs. Others may conceive that this problem has been overcome and conditions of sustainability obtain, by importing water from other areas of SA and from other countries, viz. Lesotho.

However, this water can still be wasted, with sustainable development ramifications. For example, as was demonstrated, wastage through unaccounted-for water may result in physical losses, which in turn may necessitate water restrictions, imposition of quotas, increases in tariffs, possible health hazards and so on.

After considering where Johannesburg receives its water and what happens as it moves through the city, I now consider the output/environmental impact, and water wastage⁷⁵ issues as the water flows downstream. The notions of the footprint and the city as parasite [externalities] become apposite again, in terms of showing how water emanating from Johannesburg can threaten the sustainability of other areas, i.e. Alexandra township, within the Johannesburg area, and Hartbeespoort Dam, near Pretoria.

The Ecological Footprint revisited: the cases of Alexandra township and the Hartbeespoort dam

The Jukskei River passes first through Johannesburg and then Alexandra and finally to the Hartbeespoort Dam near Pretoria. It is highly polluted, with litter, overflowing chemical toilets, oil, kitchen waste and detergents discharged directly into the river. Worse, this polluted water is used for drinking and washing in Alexandra (Matowanyika 2010).

Furthermore, many people here live in informal housing, where they are exposed to a variety of threats, including health hazards, fires and flooding. Wisner (1995: 272) noted that a 1:50 year flood could destroy nearly 900 shacks, thus endangering 4,400-10,500 people.

Similarly, Wisner (1995: 272) found that 1,235 shacks were located below the 1:50 year flood line⁷⁶, thus exposing up to 7,410 people to this risk. In addition to the hydrology of the area, illegal garbage dumping has narrowed the channel of the Jukskei river, thereby increasing the risk of floods. Many shack dwellers live precariously near the edge of a 15-20m (60 feet) river escarpment, which is highly erodible and undercut by floods. As Wisner

⁷⁵This is not to suggest that there will not be environmental impacts and wastage within Johannesburg as well.

⁷⁶The probability that flooding will occur in a certain area once in a 50-yr period.

(1995) has argued this is a clear violation of “environmental rights” in urban SA, and in terms of the Principles, Themes Metaphors (PTM) framework presented here, is a situation that is not sustainable⁷⁷. This in stark contrast to the role that sustainable (urban) rivers and other natural capital such as parks can play in improving the psychological well-being of people, in terms of stress reduction and enhancing air quality by releasing moisture and removing dust and pollutants from the atmosphere (Maas *et al.* 2006 in Matowanyika 2010).

The impact on the Hartbeespoort Dam

Hartbeespoort Dam is a warm monomictic impoundment 40km north of Johannesburg. The dam is fed by two main river systems: the Crocodile (into which the Jukskei drains) and Magalies rivers. The Crocodile River, draining the natural runoff and effluent streams from the urbanized and industrialized northern slopes of Johannesburg, contributes approximately 90 percent of the inflowing water and over 95 percent of the nutrient load (Pearce 1987: 118). As a result, the dam is highly eutrophic, and has inevitably gained notoriety and been the focus of much limnological research (Chutter and Rossouw 1991).

Pearce (1987: 1) has noted the occurrence of high concentrations of algae, normally associated with excessive eutrophication at Hartbeespoort dam, was dramatically reduced when water hyacinth (*Eichhornia crassipes*) became dominant in the dam. If the *Eichhornia* were to be permitted to increase to cover this impoundment completely, the recreational value of the impoundment would diminish as full *Eichhornia* cover precludes boating and fishing and decreases the aesthetic appeal of the impoundment. Nonetheless, algal-related water problems would lessen sharply because of shading and nutrient removal. However, full cover results in the development of conditions whereby “manganese water” might occur (manganese water is more expensive to treat than algal-laden water).

In addition, the high cost of treating “manganese” water, the cost of controlling the *Eichhornia* and the loss in recreational value of the lake must be considered, indicating that the use of full *Eichhornia* cover to improve water quality does not appear to be an

⁷⁷This does not imply that water in and of itself is the cause of human malaise along the Jukskei river. It is human agency, by virtue of pollution, and the fact that the poor are forced to use polluted water and live in hazardous areas, that is the cause. The PTM of S/SD help to illustrate this point.

economically viable prospect. “One could, however, use a partial cover of *Eichhornia* to improve water quality. This has the advantages of permitting boating and fishing on the uncovered area of the impoundment and the population can be maintained at a size which will not adversely affect oxygen exchange and thus water quality” (Pearce 1987: 155).

It has to be noted, however, that *Eichhornia crassipes* is a proclaimed noxious weed throughout SA. It has the potential for very rapid growth, particularly in eutrophic conditions, and may cover vast areas of standing water and disrupt water flow in irrigation channels and blocks sluices. It also creates ideal conditions for malaria mosquitoes and bilharzia (schistosomiasis) snails to breed and may increase the loss of water from the surface of a lake by its transpiration (Pearce 1987: 159).

The next section discusses WSJ in more detail.

WSJ: Preliminary conclusions

S/SD is a social construction and indeed a societal choice. SA and Johannesburg are making some conceptual and operational strides towards achieving S/SD, in terms of water resources development. The need to address S/SD is given some impetus by the limited supply of water in SA, the degraded state of water resources, and the “developmental state of play,” i.e. the enormous social, economic and infrastructural backlogs which are largely a result of apartheid and which require rectification, not least in terms of access to essential water resources.

It has been shown that in practice, the expression of S/SD is a function of a host of factors, including societal values, beliefs, ethics and political and institutional arrangements. However, lack of skills and capacity and, to a lesser extent, financial shortages compromise such efforts.

SA's and Johannesburg's drive towards sustainability is expressed in a number of forms: the Constitution, water resources [and other] legislation which is fundamentally different from that which obtained in the apartheid era, “sustainability statements” at all levels of government, and a scientific and planning community directing efforts towards a host of demand and supply issues. As demonstrated earlier, a voluminous literature and some of the

results of interviews serve to map a contested and ever-expanding S/SD terrain. It is thus instructive to examine interviewees' responses, specifically as regards S/SD and Johannesburg, against the backdrop of the three and perhaps more "Es."

Interviewees G, MA, MN (2008) drew attention to the fact that S/SD *is* specifically mentioned in Johannesburg's GDS and IDPs (as was shown in earlier chapters). Interviewee MA (2008) provided an insider's perspective:

The vision for the City of Johannesburg (CoJ), contained in the GDS, states explicitly the need for the creation of sustainable urban spaces. Sustainability also runs as a central theme in a range of interventions undertaken by all sector departments. The departments therefore all have a mandate to exercise sustainability in their respective operational guidelines. Sustainability for the CoJ is the ability to afford an efficient and convenient urban system for its residents, which will thrive for years to come. This is purely as a need to change the inherited, unjust spatial form of the city, which is cumbersome on the residents of the city and service delivery. An efficient and convenient urban system is not only about the people, but also about the environment and how our actions interact and impact on the environment (Interviewee MA 2008).

However, it is not only the fashion and currency/common cause of S/SD, but also local conditions and challenges, such as a sprawling, water-deficient city, which prompt the City to pay attention to S/SD. In fact, the ramifications of "Peak Oil", Hurricane Katrina and Climate Change (CC) have also served as catalysts to focus the S/SD minds of those in the city. As Interviewee G (2008) noted, the consequences of CC for SA are serious and include soil drying, with consequences for marginal agriculture, and possibly leading to ecological refugees migrating to Johannesburg, bringing about the spread of viral diseases and denser urban settlements. As it is, "the quantity and quality of water are insufficient to meet future demand. Supply is more or less static relative to demand and this yoked with declining water quality and we will have to especially focus on the poor" (Interviewee G: 2008).

One can also surmise that some conceptions of S/SD reflect the instrumentalist and/or technocratic imperative "to deliver" for both the interviewees' superiors and for citizens. Interviewee R (2008) observed "services must be provided which are affordable to customers and charged for so that you can effect your operations, which must be efficient.

Technological options must be chosen which do not cause undue harm to the environment and are acceptable, yet affordable and won't be vandalized. They must also reflect political ideals and objectives.”

The complexity of these tasks is exacerbated by the fact that such “objectives” can be complicated and multifarious. According to the “sustainable urban water management” (SUWM) approach, sustainable urban water systems need to “dynamically and simultaneously provide for supply security, public health, flood protection, waterway health, biodiversity, social amenity and recreation, water conservation and efficiency, carbon neutrality, and urban heat island amelioration” (Chocat et al., 2007; Brown et al., 2009, cited in van de Meene and Brown 2009: 1449).

The need also to look at technologies that are accessible, affordable and appropriate was echoed by several interviewees (Interviewees E; H; J 2008). S/SD implies a “continued supply of water to the community, keeping existing infrastructure running and replacing aged pipes etc., so as to provide for new development in the city” (Interviewee T 2008). S/SD also involves demand-side management and actions such as those undertaken in Soweto, which has the most water losses, and so Johannesburg Water replaced mains, fittings and installed pre-paid meters (Interviewee M: 2008). Every new development in Johannesburg must have a pre-paid meter, irrespective of people's income levels. This is part of the bigger picture of demand management. (Interviewee J: 2009). To further illustrate the complexities of S/SD: the latter demand management initiative of using pre-paid meters (PPM), may at first blush appear to be a potent weapon in the technical and economic sustainable development armory.

However, in terms of social sustainability/equity concerns, this measure has proved highly unpopular with lower income water users, so much so that (sometimes violent) protests have ensued and the legality of using PPMs was taken to the SA Constitutional Court, the highest court in SA (van Rooyen et al. 2009).

On a wider level, Interviewee G noted that actions such as “audits of wetlands, (so as to understand ecological services as part of the environmental “E”) and stormwater management systems and catchment management in general is required ... some parts of the city are massively under-serviced and are prone to flooding and solid waste disposal problems” (2008).

As emphasized previously, S/SD does not occur in an institutional vacuum, and in this arena, much frustration was evident from interviewees—conceptualizing S/SD is tricky enough, but operationalizing it in an institutional framework with attendant inefficiencies and macro- and micro-politics is arguably trickier.

In pre-S/SD days institutions could get away by focusing almost exclusively on the economic development dimension. With the advent of S/SD, “all projects now have to be approved and have to focus on the three pillars [economic, environmental and equity/social] – it is a painfully slow process (Interviewee H: 2008). Clearly, for all its good intentions, giving expression to S/SD imposes burdens on those tasked with doing so. The interplay between the above “E” dimensions and the inherent difficulties in making requisite trade-offs is clearly illustrated by the comments of interviewee H: “The City would like to have everyone with waterborne sewerage and a water connection by 2014 ... moving to a progressive realization of rights for all, but without demand management, the city won’t be able to maintain growth” (Interviewee H: 2008). This is another good example of the inherent trade-offs and conflicts among the various “Es.”

In addition, the economic/financial dimensions will necessarily come into play too: “There are different elasticities in terms of tariffs and costs; a 1 percent increase in price for the affluent will not result in a concomitant 10 percent reduction in demand, and vice versa” (Interviewee G: 2008). It is thus necessary to employ a variety of strategies to engender sustainable resource use—“the City has to come up with other programs to manage demand, e.g. rainwater harvesting, besides using only economic instruments like tariffs, for example” (Interviewee H: 2008). The city will also try to show its softer side with efforts such as trying to understand consumers and their consumption patterns as opposed to just issuing bills (Interviewee H: 2008). The city thus has to engage in a rather delicate political and S/SD balancing act, again reminiscent of the conflicts elucidated by Campbell (1996). As Interviewee G (2008) noted:

The challenge of the city is that the finances are affected by the previous regime. With over 90 percent of revenue coming from selling services, it is very difficult to think of having demand management. Providing more water and more electricity means more revenue. So, if people save water (which is encouraged through the

block tariff system), then city finances take a knock. There is a similar situation with electricity – ripple control and switching to solar water heating will reduce revenue, thus we have a sustainability dilemma. Similarly, with respect to the rates base, the municipality will get higher rates from settlement patterns which are more lucrative (larger and less dense settlement patterns), but which are not necessarily more sustainable. The typical municipality is not incentivized to engage in demand management. In fact, structurally, cities are incentivized to get people to consume more. So one needs to separate the harder sustainability issues from broader sustainability issues (Interviewee G 2008).

Again, this plainly illustrates some of the inherent complexities and contradictions embodied in S/SD. On the one hand, in order to remain solvent (or financially/economically sustainable), the Joburg municipality needs to generate income by selling a resource (such as water and energy, for example). On the other hand though, S/SD would require that as little of that resource is used as possible in the SA context.

But as indicated earlier in terms of discussions on the institutional dimension of sustainability, or by proxy, the “E” of engagement, pecuniary issues can be less important than capacity issues. Indeed, van de Meene and Brown (2009: 1461) argue for policy interventions to require urban water governance capacity building programs. As Interviewee E (2009) noted “The Municipal Infrastructure Grant attempts to address many of the issues, but in an un-coordinated way—there is more money than skills—the biggest challenge is the newer and poorer municipalities and the lack of participation.”

Similarly, it is important “for Joburg Water’s forward planning, to be proactive and conduct service delivery audits via a Service Delivery Forum, but this initiative is not well understood in the organization, according to Interviewee J (2008). It thus appears that there is some institutional inertia in terms of maintaining the status quo and not adopting (more of) a sustainability approach in JW, and/or that innovations are difficult to implement. As Interviewee MAT (2008), noted: “Project Managers can have fanciful ideas, but they are too expensive and irrelevant—i.e. they are not sustainable.”

The legacy of apartheid also rears its ugly head. For example, the issue of supply of and charging for water, is a highly emotive one in SA and given the country’s historical trajectory

and also its current challenges, this alone deserves substantial further inquiry. As Interviewee G (2008) lamented: “But now what does it mean to deliver water to people who are used to obtaining it for free—how, at what price etc.?” In terms of apartheid institutions, “Joburg Water was formed from 11 separate local authorities and so we have inherited an enormous variation in terms of infrastructure fittings, valves etc.”

Indeed, Interviewee T (2008) reported “the previous regime used asbestos pipes, which, besides posing health risks, are very brittle, so technicians may have to deal with technological unsustainability, in terms of fixing up to five pipe bursts in the same street in a week” (Interviewee T: 2008).

Besides such technical and technological deficiencies, there were also planning and administrative shortcomings, as elucidated by Interviewee T (2008): “To compound this, there was abysmal apartheid era record-keeping, and the previous Johannesburg Planning Department went on a rampant development free-for-all, with no thought of where (a) land and (b) services were available ... nowadays, JW can’t provide all the necessary services and we are only now starting to align costs and complexities” (Interviewee T: 2008).

Relief for this situation is not immediately at hand either. Interviewee R (2008) noted that “the JW turnaround strategy will take another 2-3 years because of the lack of financial sustainability and UFW and pipe bursts.” Clearly, contemporary officials are hamstrung in their S/SD efforts and this also means that additional expenditure is required, placing burdens on financial sustainability. For example, Johannesburg has to undertake a “R500m water and sewer pipe replacement program” (Interviewee T: 2008). To add to (especially technical) officials’ frustrations, the City’s noble intentions of engendering sustainability (by measures such as ‘compacting’ the city, for example) can result in negative externalities and conflicts. The following, when juxtaposed with the densification quote below, illustrates some of the classic S/SD conflicts: Those at the more strategic level ask: “How must we configure settlement better to so as to reduce its ecological footprint (EF)? The sprawling city means that development should occur along transport corridors and more water will be supplied in the city. ...” (Interviewee G: 2008).

But for those at the more technical coalface (or the proxy of another “E” – “Engineering”), reduction of the EF has its own problems: “Environmental approvals can take forever and the

use of a certain (larger) diameter pipe (necessary when settlements are densified, for example), triggers the need for an Environmental Impact Assessment (EIA), which can take 12-18 months to complete. This makes planning a nightmare and causes budgets to be exceeded” (Interviewee T: 2008). Then again, many of the city institutions are “trying to operate as businesses, but are sometimes interested in the bottom line (only), but they have made strides and have to push the city’s agenda – they are trying to commit to complying to environmental sustainability, by complying with ISO 14000, for example” (Interviewee MAT: 2008).

And what might S/SD mean when applied specifically to the water sector in SA? Interviewee MA (2008) noted:

This particular issue is about the need to address the needs of many communities who are affected by structural poverty. At the same time, we have to consider the extent and nature of our interventions in assisting these communities. These groups need water as a basic service and some cannot afford the cost of the resource. So, in developing a system of free water provision, for instance, there needs to be a determination of how much is enough. Sustainability also refers to the availability of this resource in that it is charged purely because it is a resource that has increasingly become scarce. Gauteng, as an example, is reported to have a short supply of water and so the interventions within the province must look at systems to save water and also curb the wasteful/unaccounted loss of the resource (Interviewee MA 2008).

In the end, then, “we have the best policy and legislation in the world—the problem is implementation, especially in terms of the lack of skills and the complexities of linkages between actors (inter-government, civil society etc.). Skilled people can’t cope with the dysfunctionalities at local level, so they leave and we need to reinvent wheels that didn’t work” (Interviewee E: 2009).

Part of the dysfunctionality (and at least the “Es” of Engagement/governance and Equity) that interviewees and other officials and indeed all South Africans have to contend with, is the vexatious issue of politics and corruption in South Africa.

The SAIRR (2009: 661,662) citing the World Bank's "Governance Indicators Report" (2009 <http://info.worldbank.org/governance/wgi/index.asp> Accessed 20.5.2010), observes that SA scored the following in 2006, where 100 is a high score and the USA score is in parentheses for comparative purposes:

Voice and accountability	67.3 (83.7)
Political stability	44.2 (57.7)
Government effectiveness	76.8 (92.9)
Regulatory quality	70.2 (93.7)
Rule of law	58.6 (91.9)
Control of corruption	70.9 (89.3).

Paton (2010: 30-34) provides a more detailed and instructive backdrop to the bald statistics above:

On township streets protestors burn libraries and clinics [and frequently break or abuse water-related infrastructure as well] because 'those who are our mayors took money for themselves.' In political quarters, corruption busters fear exposing fraud for fear of losing their lives to hit men. In boardrooms too, concern is deepening over the insidiousness of corruption in SA... the black hole left by corruption is R30 billion per annum ... there is hardly a transaction in a municipality, province or government department that shouldn't be treated with suspicion... the key decision makers who decided on contract were politically appointed (Paton 2010: 30-34).

The issue of corruption and party politics and how this compromises S/SD could occupy volumes, but suffice it to say "it is corruption linked to political elites, taking place with impunity, which is threatening to turn SA into a crony state. This corruption is tied into self-perpetuating networks of patronage and power: those who are in power control access to resources, which help them stay in power" (Paton 2010: 34). Again, this is well recognized by those at the coal-face: "Policy needs checks and balances, otherwise it just serves narrow interest groups. For the first ten years of the new SA, it was about targets, but now it is more about basic services and how to use water as an enabler, a tool to create jobs-initially in terms

of infrastructure, then institutions, but now both. The key problem is governance and how policy might be held to balance by a vibrant civil society” (Interviewee E: 2009).

Interviewee G, who operates at a more strategic level in the city, summed up the situation: “Sustainability means harnessing the energy of citizens as well in order to meet development objectives. The theory behind this is that the municipality is a machine of service provision, to provide predefined products and services. The input for this is city finances, paid for by revenue paid for those services. Municipalities in SA have to raise 90 percent of their revenue required, thus challenging the machine” (2008). Echoing what is arguably a universal sentiment, Interviewee G said that “Governments are under pressure to do more with less, be more effective and efficient, but people want to pay less. Thus governments have to do more with less and ask hard questions about who it wants in the city in order to generate revenue and what it can actually provide with this revenue—more parks or more revenue from services, such as electricity? The latter will of course bring in more revenue” (2008).

In addition to these difficult issues pertaining to the opportunity costs associated with such choices, there is also the spatial dimension to consider—where should development occur in Johannesburg? Should Johannesburg be a compact city and how should the City address the vexed question of “informal settlements? Should the latter be formalized and have services installed? If so, how will this affect the provision of (sustainable) infrastructure, including that pertaining to water? As Interviewee G (2008) noted: “then there is the marginal cost and marginal benefits associated with providing infrastructure at the edges of the city ... should water infrastructure be provided in certain settlement contexts? Does the municipality provide more standpipes or yard taps [faucets], which are unmetered? This means that the service cannot be charged for and will result in a loss of income for the City. The municipality needs to get smarter about understanding the political economy of constraints and how choices bend and how this goes with sustainability.”

These interviewees’ comments views regarding capacity and institutional problems are corroborated by a recent report to Business Leadership SA on SA’s water crisis, in which the author noted, that “not one of the numerous institutional proposals [emanating from a variety of water legislation] has been taken through to fruition. For instance, although several Catchment Management Agencies have been established and one even has a board and an executive, none is yet fully functional – this 11 years after the legislation. No less tellingly, at

the recent rate of issuing new [water] licenses, it will take at least five years to eliminate the current list of applications “ (Segal 2009: 2).

But it is on the ground where such problems and poor delivery of services (e.g., of water) are most keenly felt, especially by SA’s impoverished majority. Thus, President Zuma (2010, <http://www.politicsweb.co.za/politicsweb/view/politicsweb/en/page71656?oid=172808&sn=Detail> Accessed 18.5.2010) has suggested:

There is something seriously wrong in the manner in which government works at the frontline service level. The experience of government for most people is a frustrating one. They spend more time in government offices waiting for services they are not even sure they will receive. They meet employees across the counters who are sometimes disrespectful and unwilling to serve them. This experience of government is even worse for the poor. They spend hours in lines waiting for services, only to be told to come back the following day or the following week. Other than frontline departments, the public is also frustrated by the slow turning wheels generally. It takes too long for undertakings to be honored and for simple services to be provided. Potholes stay unfilled for months if not years, schools remain without windows, hospitals without medicines (Zuma 2010).

Engagement

Regarding the additional “E” of engagement, an interviewee said “engagement is not just about consulting people, but drawing a line in the sand – we can’t provide people with whatever service they want. Engagement is a very complicated issue and is no guarantee of sustainability—think of the culture of political intolerance [in many parts of SA] and political capital and service delivery are big election issues (Interviewee G: 2008).

I suggest that engagement has a much wider meaning than consultation or participation though. It also pertains to a broad engagement with a variety of issues and challenges, disciplines, practitioners and institutions. In terms of the HM, engagement is multi-dimensional and requires that all the other Es contemplated in the HM are *engaged* with, such that the dialectics and trade-offs inherent in the model can be addressed. After all, one of the tenets of S/SD is that all its (often competing) dimensions are contemplated simultaneously --

the notion of engagement thus courses through the entire HM. Another more concrete dimension of engagement relates to staff complements and capacity in other words, those who will be engaging with S/SD issues and attendant institutions. . For example, Segal (2009: 4) reports the SA water sector is in some disarray and that the system is unable to achieve the laudable water policy reforms of the 1990s. A prime example of this pertains to inadequately treated effluent from sewage treatment works, as discussed earlier. Although this state of affairs is partly due to under-investment in physical infrastructure, it is also a reflection of a lack of engagement and institutional and other malaise.

To add to this situation of unsustainability, amongst local authorities in SA, Segal (2009: 9) has contended difficulties in the SA Department of Water Affairs and Forestry, as reported above, “were compounded by allowing, if not encouraging the retirement or premature departure of highly experienced officials, including many with specialized skills. The resulting loss of institutional memory is significant and, given that the age profile of the Department spikes roughly in the age ranges 25-35 and 50-60 with a wide ‘valley’ in between. ...”

Also, the DWAF has “up to now chosen not to take legal action against under-performing authorities and has only recently adopted a ‘name and shame’ approach by making public its findings on the quality of management of drinking water and of wastewater treatment achieved by the country’s local authorities. In the first survey of water quality management, published earlier this year, only 22 local authorities were awarded so-called ‘Blue Drop’ status, meaning they achieved a score of above 95 percent in complying with the required quality standard (Segal 2009: 7).

Environment

Conceptions of the “environment” have become more holistic and have shifted from narrow views encompassing only biophysical or “flora” and “fauna” issues, to an all-encompassing perspective that includes, but is not be limited to, the “built” and “socio-cultural” environment as well. As interviewee R said: “environment cuts through and influences all the rest, so have environment as the bedrock—it is the foundation” (Interviewee M: 2009). Another interviewee noted, “The environmental leg is about sufficiency of the resource, and the ecological reserve” (Interviewee R: 2008).

Equity

A missing aspect in terms of this discussion of sustainability and sustainable development for Johannesburg is a depiction of the role of government and legislation—this may be incorporated in the social/equity “E” of the prevailing understanding of sustainability. Interviewee B (2008) offered some thoughts on this concern: “We have been raised in a competitive environment where everyone wants to be better off than your neighbor. This unnatural existence needs serious interventions through laws, policies and regulation if sustainability is to be achieved. A good example is the recent financial crisis the US and the world faces at present. This greed and lack of sustainability could only have been quelled by government. The implementation of renewable energy in SA will only be realized through mechanisms such as feed-in tariffs and other policies. (Interviewee B: 2008). Interviewee R said, “Equity is about level of service and political aspirations, fairness, affordability of service” (Interviewee R: 2008).

Economics

“The economic leg is about service level minimums – cross-subsidization is not wrong, but needs to be balanced against affordability” (Interviewee R: 2008)

Engineering

“Add the technological/engineering dimension” (Interviewee T: 2008). This is particularly interesting in light of Brown’s (2008: 221) assertion that “for the urban water sector to transition to sustainable urban water management, shifts from the linear, ‘technocratic’ approach, to an adaptive, participatory and integrated approach is required.” I would argue that in fact, comparatively more attention has been paid to the latter superstructural elements and that the “E” of engineering and the technical dimension needs to be explicitly brought into play as well. Although “engineering” and the technological dimension is essential to consider in terms of the HM, it should be considered in the widest sense of the term. In other words, “engineering” and “technology” cannot be divorced from their attendant political, institutional, socio-cultural and spatial milieus. For example, what might appear to be a “simple and elegant” technological solution to water conservation and fiscal responsibility

via user charging (as was the case where pre-paid water meters were installed in SA), turns out to be fraught with violent user discontent and users’ legal challenges to the imposition of such technology!).

Accordingly, on the basis of the extensive discussion above as well as on interviews with key personnel involved with water and water supply and sustainability in Johannesburg, a qualified heuristic model augmenting the existing three “E’s” view of sustainability is presented below in Figure 6.

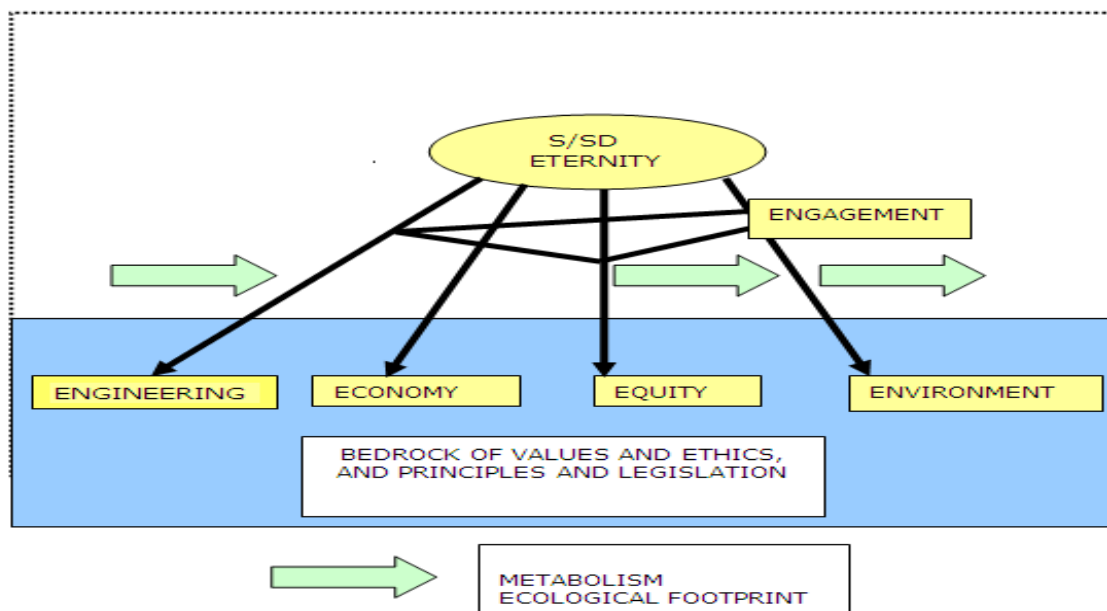


Figure 6. Heuristic model relating the S/SD Principles, Themes and Metaphors and the “5 Es”.

As demonstrated, many principles permeate the discussion of sustainable development in SA and Johannesburg. These overlap with the aforementioned themes here, especially with regard to inter-and intra-generational equity. As has been demonstrated, these principles do appear to inform latter-day water resource management initiatives in SA, from the budget rhetoric, through water-related legislation, through the most important supplier to Johannesburg viz., the RWB and the policy thrust for Johannesburg via IGOLI 2002 and 2030. The principle of transfrontier responsibility was demonstrated in the discussion of the spatial flow of water, from Lesotho through and past Johannesburg.

In sum, and on the basis of the literature and interview responses, I propose five Es of sustainable development:

“**Equity**” could be construed in a number of ways, and again reflects society’s values, its political systems, economic order and so on. (Equity in terms of water supply could mean anything from “a guaranteed and free supply of water to all” to universal access, but with differential tariffs according to a means test or based on consumption). Indeed, the state has devoted some attention to this in that all South Africans are now entitled to 10,000 liters of free water per month, and beyond that amount, consumers pay differential rates according to how much water they consume. That is, there is a stepped tariff and it could be argued that equity demands that it is fair and just (and sustainable) that those who consume more water will pay more for it.

“**Economy**” similarly reflects economic schools of thought/paradigms, political economy, financial arrangements and mechanisms for the allocation of scarce resources. For example, will Johannesburg be able to afford to deliver the services it proposes? (And as interviewees pointed out, there is an innate perversity in trading off economic/fiscal sustainability and environmental notions of sustainability. In environmental sustainability terms, the scarce resource of water needs to be conserved and used as little as possible, yet in terms of the Johannesburg treasury, the city needs to maximize revenue from the sale of this same scarce resource. In addition, there is much debate concerning the ramifications of the “commodification” of water and of having a distinct water utility. (See Bond 2001; Smith 2003 and Smith and Hanson 2003).

“**Environment**” can represent how society regards the environment as a source of resources for development, a life-support system and a sink for wastes. It also embodies notions of how society deals with the impact of its actions on the environment and whether it will engage in any form of environmental assessment. The “Work for Water” program and legislation pertaining to Integrated Environmental Management are clear indications of moves in SA to bring about S/SD. The former provides a good example of the inter-relationship of the various sustainability themes. Catchments are protected and alien vegetation is removed (environment); this increases water supply (which will have economic ramifications – fewer storage and/or treatment facilities may need to be built), and the program provides

employment for people, many of whom were previously unemployed (this addresses economic and equity concerns).⁷⁸

“**Engineering**” could be seen as an end in itself (by employing “sustainable technology” for example), or as a *means* to a more “sustainable” planning end. Here, it is a proxy term for the technical/technological dimension of sustainability and it will ultimately find expression in physical forms as well as in the articulation of ideas that become part of public consciousness about how life will unfold in a community. These might include bulk and associated infrastructure and the numerous technical issues highlighted by interviewees with the provision of water and sewerage services. Recall too that the ticking time bomb of Acid Mine Drainage, if not (holistically, but certainly technically) addressed, has the potential to affect and literally undermine the very structural integrity of the Joburg CBD.

“**Engagement**,” in keeping with the injunction to adopt an ecological view of the system, these “separate” themes need to be related and this is achieved via “engagement.” This could include inter-and trans-disciplinary engagement and everything relating to what is variously termed “governance”, community/public participation, the involvement of “interested and affected parties” and so on. Engagement might also mean that governance becomes more interactive and participatory and adopts a network-based adaptive approach to environmental policy implementation (van de Meene and Brown 2009). Thus, importantly, engagement also attends to institutional arrangements that are to give expression to any of society’s S/SD intentions. I demonstrated this in terms of the discussion of institutional changes that have occurred in Johannesburg and in terms of the planning arrangements and (sustainability) targets that the city has set itself. Also, bear in mind that at least in the opinion of CESA, the lack of technical management capacity (and engagement), particularly in municipal and provincial government, is likely to be the single biggest stumbling block to sustainable development and growth in South Africa.

It is clear if the three traditional sustainability thematic legs are not held together by the cross piece of engagement, it will be easy for the stool legs to splay. Theoretically, this represents the practical purport of a lack of holism and an integrated/ecological view, à la Capra (1997). In practice as well as in principle, splaying legs could lead to initially disparate and piecemeal

⁷⁸ Poor (or unsustainable) environmental management can also result in a host of negative environmental, economic and social impacts, as was demonstrated in the discussion on the Hartbeespoort Dam, with eutrophication imposing many environmental and socio-economic costs.

initiatives, and ultimately, the downfall of the S/SD stool. As pointed out by many interviewees, the engagement support crosspiece is essential if communities are successfully to address explicitly issues of the legal environment and the vexatious issue of securing effective governance.

The top of the stool represents the elusive notion of S/SD (this is similar to S/SD at the centre of Campbell's (1996) triangle). Again, although there is no objective evaluative criterion for S/SD, a stable stool will lead to a well-seated S/SD. The dimensions of the seat, and how comfortable it is, might represent the degree to which a given society has embarked on and achieved its vision of S/SD, and how this is measured in terms of the S/SD indicators which that society has generated according to its ethics and values, hence these notions are shown as the bedrock of the model.

One might argue that no city will in practice become unsustainable in terms of actually disappearing; it may simply decline. This is really a question of degree. Would one call the rust-belt cities unsustainable? Are some of the highly polluted Eastern European cities such as Baia Mare⁷⁹ unsustainable, or just highly hazardous and unpleasant to live in? After all, these cities still exist, even if only for an indeterminate period. What does this say about societal notions of equity? Costs associated with pollution are being externalized onto the populace of a particular mining town and not the populace of the country, for example.

Similarly, some might argue that there is an opportunity cost of *not* embarking on S/SD. Again, note what can happen if any of the legs is deficient—the stool becomes lopsided and in danger of tipping. If any of the legs becomes too short relative to the others, this danger increases. For example, if environmental assessment concerns are not addressed, pollution and/or toxicity may result. This in turn may impose a burden on the economic leg in terms of pecuniary costs (e.g., cleanup costs). Furthermore, non-financial costs will also manifest themselves, e.g., health and other social costs, such as birth defects etc. (and which will ultimately be reflected in the government's health budget anyway). The most extreme example of this is probably that of the Easter Islanders, who clearly did not embrace S/SD and allowed the forest resources on which they depended to dwindle (Diamond 2005).

⁷⁹A mining town in NW Romania. It made headlines when a lake full of cyanide burst its banks and poisoned 2 000 km of the Danube. Worse still, dust (containing zinc, copper, manganese, cadmium, mercury and arsenic) from mining tailings was so fine that it passed through the lining of the lungs and into the bloodstream. Inhabitants' blood lead levels contained more than 6.5 times the concentration known to cause mental impairment (Monbiot 2000).

Furthermore, they could not escape their situation by appropriating resources from elsewhere. A curtailment in the economic leg can lead to less social sustainability, for example, areas that are undergoing economic distress (rustbelt), a declining economic base etc.

If the equity leg, a proxy for social sustainability, is deficient, there could be similar decline. A country that is in political turmoil, or failed states such as Somalia and Zimbabwe, are unlikely to devote much political and fiscal attention to S/SD concerns. Authors such as Goodland (1995) suggest that social sustainability is the most important dimension of S/SD. Whilst this is debatable, one could ask with respect to WSJ and Johannesburg: What would have happened to SA if the bloodless revolution to democracy in 1994 had not occurred? Civil war could have resulted. By the same token, relative shortages of water services could instill riots and civil disobedience. Absolute shortages would, of course, have ramifications for survival and most economic activity in the city and country.

If inadequate attention is given to any of the four legs and their supporting cross-piece, the stool will be short, representing a development trajectory that has not been fully achieved. Note that this is not to suggest any growth mania, but is more in keeping with Daly's notion of a steady state economy, one that minimizes throughput. It could be argued that "the steady state" allows for a "steady stool."

The metaphors have been implicitly discussed above. Note that part of their value in the model and S/SD cognitions is that they embody notions of flows across space, as well as consideration of externalities and environmental impacts such as those in practice affecting Lesotho and the Hartbeespoort dam. Thus they can embrace cognitions of upstream/input; conversion/throughput; and downstream/output.⁸⁰

⁸⁰The model could apply to the energy sector as well, for example. One could consider "upstream effects" (e.g., pollution associated with fossil fuel power stations, the consumption of energy at a given locale, and the downstream impacts such as acid rain). The important point is that there is a flow and associated impacts across time and space, and that environmental impacts associated with this are distributed within and across society and ecosystems.

Chapter Seven.

Conclusions.

At one level, water can be considered as a purely physical resource—one that is fundamental to our survival and economic life. In this respect, both quantity and quality of water are critical. As such, this resource is framed by and subject to all manner of value judgments (Ball 1990). The manner in which society chooses to deal with water is a function of its ethics, values and political economy and these are generally expressed formally in a given society's constitution and legislation. Societies can also choose both initially to conceptualize and subsequently interpret and operationalize the notions of S/SD and also those of the sustainable, healthy and ecocity. These are all, of course, social constructions that have many apologists and often, as many detractors. As has been shown, S and SD are subject to a plethora of definitions, interpretations, axiologies and even different strengths, ranging from “weak” to “absurdly strong.” Concerning the latter, I have argued it is apposite to adopt a strong sustainability approach when it comes to WSJ, given that water is simply such a fundamental and also non-substitutable resource.

Added to the inherent complexity of the notions of S/SD and the sustainable city per se, is the complexity of the water issue. As Segal has observed:

Prima facie, water policy is a deceptively simple topic. The reality is different. The profound importance of water to human survival; the number and diversity of interests; the competition for access to water, locally and nationally as well as internationally; the technological choices for supply and treatment of waste water; ensuring reliable delivery of water of the appropriate quality to different classes of users and managing treatment of the resultant outflows; the use of price, licensing and other mechanisms for allocating water; the sheer size of the industry, with fixed assets of several hundred billion rands; ... these and other factors make water a sector of exceptional, and increasing, complexity (Segal 2009: 1).

It is also important to contextualise S/SD and water. For example, the issues will be vastly different between areas where there is sufficient water and those regions with conditions of water scarcity, such as obtain in SA. By the same token, the overall developmental state of the nation and its political economy as well as the efficacy and indeed corruptability of its institutions, have a major bearing on S/SD.

SA at large, and Johannesburg more particularly as a world city in waiting, have made enormous strides in addressing sustainable development and sustainability. This is especially true given the history of apartheid and its legacy of, inter alia, racial, spatial and class distortions and service delivery backlogs. As the SA Cities Network puts it: “The history of urban development under apartheid created specific conditions which mitigate against sustainable cities” (SACN 2006: 4-17). Thus, SA’s multitudes of poor, needy and uneducated can hardly be expected to be cognizant of, or adhere to, the theoretical or other demands of S/SD, when they unavoidably have a short-term, survivalist perspective. These conditions, as well as increasing water scarcity, certainly increase the S/SD challenge in SA. Added to this are the inherent contradictions and conflicts embodied in S/SD—again, recall the instance where Johannesburg needs to sell water (and other resources) in order to garner revenue for the city’s treasury. This is at odds with the sustainability imperative to use as little of this scarce resource as possible and institute demand and supply management measures pertaining to the use of water.

As stated earlier, S/SD is not confined to political-economic discourse. The technical/engineering dimension is just as important, or as argued here, should be so considered. Consider a water or sewer pipe, for example: its diameter, the material used, microbially induced corrodibility and construction can all have major S/SD implications, in terms of service delivery, or in terms of supply interruptions, capital and maintenance costs, and wastage of a scarce resource via water bursts or leaks. This calls to mind the well-known proverb:

*For want of a nail the shoe was lost,
for want of a shoe the horse was lost;
and for want of a horse the rider was lost;
being overtaken and slain by the enemy,
all for want of care about a horse-shoe nail.*

Benjamin Franklin (adapted version)
Poor Richard's Almanac

As shown above, SA has contemplated S/SD in its Constitution and in legislation pertaining to the environment and the economy, and this has met with some international acclaim. Nonetheless, the Johannesburg region's operationalization and enforcement of legislation and implementation of policy necessary to realize those noble aims is demonstrably flagging. The critically important Johannesburg region may now be compromising its own S/SD aspirations. Getting beyond Brundtland and the successive World Summits on Sustainable Development, and considering the substance of and interplay between the "Es" and S/SD principles, themes and metaphors, has revealed the inherent complexity of S/SD. The Heuristic Model sketched here attempts to crystallize this complexity conceptually and will hopefully allow leaders to balance the competing claims and tensions during conception and implementation of relevant water policies.

To be sure, this is only a model and it reflects the extraordinary complexity of the S/SD challenge. After all, an interrogation of any of the Es on their own (in an absolute sense) is an undertaking of considerable intricacy. That task is dramatically amplified when holistically considering all the Es together and the undergirding influence of the axiological dimension. And to revisit the views of Alberti and Susskind (1996: 214): "... sustainability, if redefined and incorporated into a broader understanding of political conflicts in industrial society, can become a useful organizing principle for planning ... the more it stirs up conflict and sharpens the debate, the more effective the idea of sustainability will be in the long run."

It seems then, that despite detractors, the concepts of sustainability and sustainable development have much to offer planners, but using them requires holistic and multifarious enquiry, with due cognizance being taken of inherent conflicts and trade-offs which need to be made. The thick description of WSJ provided here has sought to demonstrate the inherent and also revealed complexity of S/SD. Echoing Stake (1995: 43), "the function of research is not to map and conquer the world, but to sophisticate the understanding of it." The

ramifications of S/SD thus require far more investigation than this study has been able to undertake. Nevertheless, I have, partly by means of the Heuristic Model derived from discussion of Johannesburg and SA conditions and challenges in the water sector, sought to illuminate the challenges that emerging nations confront at various scales of and of various stripes. Enacting laws and constitutional provisions, however elegant and farseeing vis-à-vis S/SD is hardly sufficient to realize those elusive aims. One also needs appropriate resources (at least in terms of quantity and quality) and the nation (at various scales) needs the skills, capacity and strategies to install and maintain (sustainable) infrastructure (understood broadly to include political, social, economic and technical wherewithal).

This research then has sought to make a contribution by gathering, interrogating and importantly, integrating “highly entropic” sets of literature pertaining to S/SD in general, the sustainable, healthy and ecocity and also the literature dealing with sustainable water resources. Developing this lexicon might be viewed as an end in itself, but I have also sought to consider these tradeoffs in the empirical case of Johannesburg. Thus, I have elucidated the difficulties of dealing with WSJ and have shown that a multitude of issues need to be concretized and brought into the WSJ calculus and that difficult trade-offs need to be made, some of which may appear to be intractable. (Recall the need for Johannesburg to engender S/SD by simultaneously trying to conserve water in a water stressed environment, but also trying to maximize revenue for the city fiscus by selling as much water as possible to a variety of consumers).

Considering further research avenues, I suggest that research into S/SD should continue in absolute and in relative/relational terms. That means delving deeper into what might be contemplated in terms of the substantive dimensions of each leg of the S/SD stool. For example, just the “E” of economy as it concerns just water as a resource, is fraught with tensions, dilemmas and difficult policy choices. Should water be commodified? What is the interplay between public and private ownership of water? How and to what extent should water be charged for? SA has attempted to engender S/SD in this regard by substantially changing legislation pertaining to water (such that there is now state ownership of water and private riparian rights have been severely curtailed) and by providing limited free water to all, whilst at the same time instituting a stepped tariff which is designed to reduce consumption of water and engender S/SD.

Naturally, these dilemmas do not occur in an institutional, political, socio-economic, ideological and ethical vacuum in the context of a given society. This resonates with McConnell's (1985)⁸¹ framework of planning theories, where these can be considered in terms of theories for, in and of planning. In other words, S/SD must also address the substantive, procedural and societal dimensions, in concert.

The next, more difficult S/SD challenge is to relate these now proposed four stool legs and their allied cross-piece comprehensively and holistically to each other and to address the multi-faceted trade-offs that necessarily present themselves as a result. Just taking the above example of the economy "E", it is obvious that this inevitably incorporates cognitions of the other "Es" (engagement with various institutions, lawmakers, policy makers, consumers; equity in terms of providing free water; economics in terms of charging for water; engineering how is this water procured and distributed?; eternity (the seat of the stool in the model)—will future generations have enough potable water?

Whether one considers S/SD in terms of any number of "Es", or one wishes to add the trio of the "Ps" of planet, prosperity and people, it remains a many-headed Hydra, full of "plasticities, protruberances and pendulosities" as Grayling (2005:67) might put it. S/SD will always be conceptually and operationally contested, but "rather than discarding the concept of sustainable development, it provides a useful framework in which to debate the choices for humanity" (Hopwood et al. 2005: 49). In the end, in attempting to further our knowledge of S/SD, we may not wish to be "so open-minded that our brains fall out ...", but "honor the man⁸² who seeks [S/SD] truth, but despise the man who claims to have found it. ..."

(Grayling 2005: 124, 125), citing Voltaire. Or as O'Riordan (1993: 37), cited in Holden and Linnerud (2007: 176), had it: "Like it or not, 'sustainable development' is with us for all time."

And "in the beginning was, and always is, water" (Lanz et al. 2006).

⁸¹ An old reference, but in my view, a classic work.

⁸² Sic.

Bibliography

- Aberley, D. 1993. *Boundaries Of Home. Mapping For Local Empowerment.* Gabriola Island: New Society Publishers.
- Aberley, D. 1994. *Futures By Design.* Gabriola Island: New Society Publishers.
- Africa Water News. 2010. South Africa's Poisoned Water and Possible Police Action. <http://africancleanwater.com/>
- Accessed 18.5.2010
- Agyeman, J. Et Al. 2003. *Just Sustainabilities.* London: Earthscan.
- Alberti, M. And Susskind, L. 1996. Managing Urban Sustainability: An Introduction To The Special Issue. *Environmental Impact Assessment Review.* Vol. 19 Pp. 211-221.
- Alexander, E. R. 1992. *Approaches To Planning.* New York: Gordon And Breach.
- Allan, K., Gotz, G. and Joseph, C. 2001. *Johannesburg. An African City In Change.* Johannesburg: Zebra Press.
- Ambert, C. Et Al. 1998. *Water And Sanitation: Technical Questions.* Mimeo. Department Of Town And Regional Planning. University Of The Witwatersrand.
- Andruss, V.; Plant, C.; Plant, J. And Wright, E. 1990. *Home! A Bioregional Reader.* Gabriola Island: New Society Publishers.
- Archibugi, F. And Nijkamp, P. 1989. *Economy And Ecology: Towards Sustainable Development.* Boston: Kluwer.
- Armstrong, S. J. And. Botzler, R. G. 1993. *Environmental Ethics. Divergence And Convergence.* New York: McGraw Hill.
- Ashton, P. J. Et Al. 1985. Limnology of Hartbeespoort. National Scientific Programmes Unit: CSIR, SANSP Report 110.

- Ashton, P. J. and Haasbroek, B. 2001. Water Demand Management and Social Adaptive Capacity: A South African Case Study. CSIR Mimeo.
- Atkinson, D. 2001. Indigent Policies And The Use Of Equitable Share. *Journal For The Institute Of Municipal Finance Officers*. 1(4). Pp 1-2.
- Attfield, R. And Belsey. A. 1994. *Philosophy And The Natural Environment*. New York: Cambridge University Press.
- Auerbach R. 1997. *People And South African Integrated Catchment Management*. WRC Report No 684/1/97. Farmer Support Group, University Of Natal.
- Ausubel, H. And Herman, R. 1988. *Cities And Their Vital Systems Infrastructure Past, Present, And Future*. Washington, D.C.: National Academy Of Engineering, National Academy Press,
- Baarschers, W.H. 1996. *Eco-Facts And Eco-Fiction*. New York: Routledge.
- Babbie, E. 1986. *The Practice Of Social Research*. Belmont: Wadsworth.
- Ball, P. 1999. *H₂O: A Biography Of Water*. Orion: Phoenix Press.
- Bamberger, M. And Hewitt, E. 1986. *Monitoring And Evaluating Urban Development Programs*. Washington D.C.: The World Bank.
- Barbour, I. G. 1980. *Technology, Environment And Human Values*. New York: Praeger.
- Barnett, C. And Lulofs, F. 1996 *Sustainable Cities*. Research Triangle Institute: Research Triangle Park:
- Bartelmus, P. 1994. *Environment, Growth, And Development: The Concepts And Strategies Of Sustainability*. New York: Routledge.
- Bartlett, A. A. 2006. Reflections In Sustainability, Population Growth, And They Environment -2006. In Keiner, *Op. Cit*.
- Bartuska, T. J. Et Al. 1994. *The Built Environment*. Menlo Park: Crisp.

Bartuska, T. J. 1994. *Cities Today: The Imprint Of Human Needs In Urban Patterns And Form*. In Bartuska, T.J. Et Al. 1994. Op.Cit.

Basson, M., Van Niekerk, P. And Van Rooyen, J. 1997. *Overview Of Water Resources Availability And Utilisation In South Africa*. Pretoria: Dept. Of Water Affairs And Forestry.

Beaverstock and Taylor 1999. A Roster of World Cities. *Cities*, 16(6), Pp. 445–458.

Behrens, R. And Watson, V. 1992. *Spread City! Evaluation Of The Costs Of Urban Growth In Metropolitan Cape Town*. Working Paper No. 46, July. Urban Problems Research Unit: University Of Cape Town.

Behrens, R. 1993. *Higher Density Development: A Review Of Policy Measures, Restrictive Regulations And Residential Trends In Greater Cape Town*. Working Paper No. 49, May. Urban Problems Research Unit: Development Action Group. University Of Cape Town.

Bekker, S. And Robinson, P. 1996. Development Planning In The Provinces: A Methodology During Transition. *Development Southern Africa*. Vol 13. No.4 Pp. 539-554. August.

Bellamy, I. 1997. *The Environment In World Politics: Exploring The Limits*. Edward Elgar, USA.

Bethlehem, R. 1988. *Economics In A Revolutionary Society: Sanctions And The Transformation Of SA*. Craighall: A.D. Donker.

Berke, P. R. 2008. The Evolution Of Green Community Planning, Scholarship And Practice: An Introduction To The Special Issue. *JAPA* VI. 74, No. 4, PP. 393- 407. Autumn.

Birley, M. And Peralta, G. L. 1995. Health Impact Assessment Of Development Projects. In Vanclay, F. And Bronstein, D.A. (Eds.) *Environmental And Social Impact Assessment*. Chichester: John Wiley And Sons.

Bond, P. 2001. *Valuing Water Beyond “Just Price It” Costs And Benefits Of Water For Basic Human Environmental Needs*. Paper Presented To The Council Of Canadians Conference Water For People And Nature. Vancouver: University Of British Colombia.

Booth, D. E. 1998 *The Environmental Consequences Of Growth: Steady-State Economics As An Alternative To Ecological Decline*. London: Routledge.

Boshoff, B.C. 1989. Industrial Decentralization and Regional Development in South Africa. Unpublished M.Sc. (TRP) Dissertation. School Of Architecture And Planning, University Of The Witwatersrand, Johannesburg.

Boulding , K. E. 1991. What Do We Want To Sustain? In Costanza, R. (Ed.) 1991. *Ecological Economics*. New York: Columbia University Press.

Bourne, J. K. Jnr. 2010. California's Pipe Dream. National Geographic Op. Cit.

Bourne, L. T., Bourne, D. E, Watermeyer, G. S. And Klopper, J. M. L. 1987. *A Liquid Consumption Survey Of Individuals In Greater Cape Town*. University Of Cape Town, Cape Town: Water Research Commission.

Boyer, E. L. 1990. *Scholarship Reconsidered: Priorities Of The Professoriate*. Princeton: Carnegie Foundation.

Braat, L.C. And Steetskamp, I. 1991. Ecological-Economic Analysis For Regional Sustainable Development. In Costanza, R. (Ed.) 1991. *Ecological Economics*. New York: Columbia University Press.

Breheny, M. J. (Ed.). 1992. *Sustainable Development And Urban Form*. London: Pion.

Brown, R. R. 2008. Local Institutional Development And Organizational Change For Advancing Sustainable Water Futures. *Environmental Management*. 41 P 221- 233.

Briassoulis, H. 1989. Theoretical Orientations In Environmental Planning: An Inquiry Into Alternative Approaches. *Environmental Management*. Vol.13 No.4. Pp 381-392.

Bridgman, H. Et Al. 1995. *Urban Biophysical Environments*. New York: Oxford University Press.

- Brits, A. G., Geldenhuys, J.C., Kok, A. M And Baxter, D.A. 1998. *The Effects Of Water Quality And Chemical Composition On The Corrosion Of Mild Steel Pipelines*. Water Research Commission. 259(1). Pretoria: Water Research Commission.
- Brown, D.A. 1993. Ethics, Science And Environmental Regulation. In Armstrong And Botzler *Op.Cit*.
- Brummer, S. 1995. Corruption Probe Into SANCO 'Donations.' *Mail And Guardian* Sept. 1-7, P.7.
- Brussard, P. F., Reed, J. M. And Tracy, R. 1998. Ecosystem Management - What Is It Really? *Landscape And Urban Planning*. Vol 40. Pp 4-20.
- Buhlungu, S. Et Al (Eds.). 2006. *State Of The Nation. South Africa 2005-2006*. Cape Town: HSRC Press.
- Business Day 1999. *Agencies Concerned About The Cost Of Services*. February 23.P2.
- Cadman, D. And Payne, G. (Eds.). *The Living City: Towards A Sustainable Future*. London: Routledge.
- Cahn, R. 1978. *Footprints On The Planet*. New York: Universe Books.
- Cairns, J. Jr. 1996. *Facilitating Paradigm Shifts*. Annals Of Earth. Falmouth: Ocean Arks International.
- Callan, J. S. And Thomas, J. M. 2000. *Environmental Economics And Management: Theory, Policy, And Application*. New York: The Dryden Press.
- Calland, R. 2006. *Anatomy of South Africa: Who Holds the Power?* Cape Town: Zebra Press.
- Calthorpe, P. And Poticha, S. 1993. *The Next American Metropolis: Ecology, Community, And The American Dream*. New York: Princeton Architectural Press.
- Camhis, M. 2006. *Sustainable Development And Urbanization*. In Keiner, *Op. Cit*.
- Campbell, S. 1996. Green Cities, Growing Cities, Just Cities?. *APA Journal*. Summer. Pp. 296-312.

- Canfield, C. 1990. *Ecocity Conference*. Berkeley: Urban Ecology.
- Capra, F. 1997. *The Web Of Life: A New Synthesis Of Mind And Matter*. London: Harpercollins.
- Carley, M. And Christie, I. 1994 *Managing Sustainable Development*. London: Earthscan.
- Carroll, T. F. 1992. *Intermediary NGOs*. Connecticut: Kumarian Press.
- Castle Brass Holdings (Pty) Ltd. 1989. *Water Loss Analysis On Municipal Distribution Systems*. Water Research Commission Final Report, CSIR Division Of Water Technology. 157(1)89. Pretoria: Water Research Commission.
- Chiuta, T. M., Johnson, P. and Hirji, R. 2002. Water and the Economy. In Hirji et al. op. cit.
- Chutter, F. M. and Heath, R. G. M. 1993. Relationships Between Low Flows And The River Fauna In The Letaba River. Pretoria: WRC report No. 293/1/93.
- CIA Fact File (2009). The World Factbook. Lesotho.
<https://www.cia.gov/library/publications/the-world-factbook/geos/lt.html>
 Accessed 11.11. 2009.
- City Of Johannesburg. 1999. *IGOLI 2002*. Johannesburg.
- City Of Johannesburg. 1999. *IGOLI News*. Johannesburg.
- City Of Johannesburg: Corporate Planning Unit. 2002. *Joburg 2030 Full Report*. Johannesburg.
- City Of Johannesburg. 2005. *Joburg Human Development Strategy: Joburg's Commitment To The Poor*. Johannesburg: Office Of The City Manager.
- Cobb, J.B. 1995. *Is It Too Late?: A Theology Of Ecology*. Texas: Denton.
- Cousens, D. W. H. 1988. *Surface Water Resources Of South Africa: Research Needs*. Pretoria: Water Research Commission.
- Creamer, M. 2005. Water Voltage. *Engineering News*. 25(14). Pp. 22-23.

Cromberge, P. 2005. Sink Or Swim. *Engineering News*. 11(35). Pp. 8-9.

CDE (Centre For Development And Enterprise) 1996. *Cities And The Global Economy. New Challenges For South Africa*. CDE: Johannesburg.

Christopher, A. J. 1982. *South Africa*. Essex: Longman.

Clarke, J. 1991. *Back To Earth*. Johannesburg: Southern.

Cloete, F. 1991 The State Policy Machine. In Lee And Schlemmer *Op.Cit*.

Cobb, J. 1993. *Ecology, Ethics And Theology*. In Daly And Townsend, *Op. Cit*.

Cock, J. And Koch. E. 1991. *Going Green: People, Politics And The Environment In South Africa*. Cape Town: Oxford University Press.

Cokayne, R. 2010. Public Sector's Outflow Of Engineers Hinders Development. Business Report. 5 February 2010.

http://www.busrep.co.za/index.php?from=rss_&fArticleId=3631162.

Accessed 5.2.2010.

Colby, M. E. 1989. Environmental Management In Development: The Evolution Of Paradigms, Policy Research Working Paper Series 313. Washington D. C.: The World Bank.

Common, Michael S. 1995. *Sustainability And Policy: Limits To Economics*. New York: Cambridge University Press.

Colby, M. E. 1991. Environmental Management In Development: The Evolution Of Paradigms. *Ecological Economics* 3:193-213.

Conn, W. D. 1986. *Review Of Techniques For Weighing Or Valuing The Benefits Associated With Environmental Quality Improvements*. Report Prepared For Joint Commission Great Lakes Scientific Advisory Board Social And Economic Considerations Committee.

Coombs, H. C. 1990. *The Return Of Scarcity*. New York: Cambridge University Press.

- Corbett, M. N. 1981. *A Better Place To Live: New Designs For Tomorrow's Communities*. Emmaus: Rodale Press.
- Corrigan, T. 1998. Beyond The Boycotts: Financing Local Government In The Era Of Apartheid, Spotlight Series, *South African Race Relations*, No. 2/98, October 1998.
- Corson, W. H. 1996 .Measuring Sustainability: Indicators, Trends And Performance. In: Pirages, *Op. Cit.*
- Costanza, R. 1991. *Ecological Economics*. New York: Columbia University Press.
- Costanza, R. Et Al. 1992. *Ecosystem Health*. Washington D.C.: Island Press.
- Croall, S. And Rankin, W. 1981. *Ecology For Beginners*. New York:
- Croxon, P. B. 2003. *The Piatkus Dictionary Of Mind, Body And Spirit*. London: Piatkus.
- Dalal-Clayton, B. Et Al. 1994. *National Sustainable Development Strategies: Experience And Dilemmas*. IIED Environmental Planning Group. London: IIED.
- D'Auria, V., De Meulder, B. and Shannon, K. (eds.). 2010. *Human Settlements. Formulations and Calibrations*. Amsterdam: SUN.
- Daly, H. E. 1991. *Steady State Economics*. Washington D.C.: Island Press.
- Daly, H. E. 1996. *Beyond Growth: The Economics Of Sustainable Development*. Boston: Beacon Press.
- Daly, H. E. And Cobb, J. B. Jnr. 1989. *For The Common Good*. Boston: Beacon Press.
- Daly, H. E. And Townsend K. N. 1993 *Valuing The Earth*. Cambridge: MIT Press.
- Dangerfield, B. J. 1983. *Water Supply And Sanitation In Developing Countries*. The Institution Of Water Engineers And Scientists. London: England.
- Davenport, T. R. H. 1987. *South Africa: A Modern History*. Johannesburg: Macmillan.
- Davis, G. 1995. Welcome To The House Of Chaos. *Mail And Guardian* Sept. 1-7, P8.

Davis, R. J. (Ed.). 1996. *Contemporary City Structuring: International Geographical Insights*. International Geographical Union: Commission On Urban Development And Urban Life, Society For Geographers, Pp62-73.

Davies, B. R., O’Keeffe, J. H. And Snaddon, C. D. 1993. *A Synthesis Of The Ecological Functioning, Conservation And Management Of South African River Ecosystems*. Water Research Commission. TT 62/93. University Of Cape Town, Rondebosch: Water Research Commission.

De La Court, T. 1990. *Beyond Brundtland*. New York: New Horizons Press.

Deloitte And Touche Consortium. 1995. *A Possible Model For The Use Of Economic Instruments In Environmental Management In South Africa*. South Africa: Department Of Environmental Affairs And Tourism.

Dendrinis, D. 1992. *The Dynamics Of Cities*. New York: Routledge.

de Klerk, F.W. 2010. The Game Changers. http://www.iol.co.za/index.php?setid=1&click_id=13&art_id=vn20100202072418628C453269&newslett=1&page_number=2 .

Accessed 2.2.2010

de Vallier, W. 1997. *Unaccounted-For Water: Guidelines For The Formulation Of Policy And Implementation Of Practical Methods For The Control Thereof*. Water Research Commission. Braamfontein: Water Research Commission.

de Villiers, M. 2001. *Water Wars: Is The World’s Water Running Out?* London: Phoenix Press.

Diesing, P. 1992. *How Does Social Science Work? Reflections On Practice*. Pittsburgh: University Of Pittsburgh Press.

Dyson, L.L. And Van Heerden, J. 2002. A Model For The Identification Of Tropical Weather Systems Over South Africa. *Water SA*. 28(3). Pp 249-258.

Du Pisani, J.E (Undated). *Solids-Free Sewer Systems In South Africa: A Community Leader’s Guide*. Pretoria: CSIR Division Of Building Technology.

Dunstan, B And Associates. 1998. *Handbook To Guide Communities In The Choice Of Sanitation Systems*. Pretoria: Water Research Commission Report No TT 104/98

Dunstan, B. And Associates. 1998. *Evaluation Of Onsite Sanitation From A Socio-Economic Perspective*. Pretoria: Report To The Water Research Commission No KV 114/98.

Development Bank Of Southern Africa (DBSA). 1998. *South African Water Briefing Paper*. Midrand: DBSA.

Diamond, J. 2005. *Collapse: How Societies Choose To Fail Or Survive*. London: Penguin.

Douglas, I. 1983. *The Urban Environment*. London: Edward Arnold.

Dreyer, L. 1998 *The Dynamics Of The Community Non-Compliance With Basic Water Supply Projects*, WRC Report, No Tt 93/98.

Dryzek, J. 1992 *Rational Ecology*. Oxford: Blackwell

Duhl, L. J. 1993 Conditions For Healthy Cities. *Environment And Urbanization*. Vol. 5 No.2 October. Pp. 112-124.

Dyck, R.G. 1996. *Integrating Planning And Sustainability Theory: A Conceptual Framework For Post-Modern Professional Education And Practice*. Mimeo. Blacksburg: Virginia Polytechnic Institute And State University.

Earth Summit 1992. *The Rio Declaration On Environment And Development*. London: Regency Press.

Eco-h2o. 2010. Johannesburg's Water Cycle. www.Eco-h2o.co.za.mht. Accessed 20.5.2010.

Economist Intelligence Unit 1991-1992 *South Africa: Country Profile*. London: The Economist

Emoto, M. 2005. *The Secret Life Of Water*. London: Beyond Words Publishing.

Europa World Online. Lesotho.

<http://www.europaworld.com/welcome?authstatuscode=200>

Accessed various dates.

Everatt, D., Jennings, R., Davies, S. And Isserow, M. 1998. *Investigating Water And Sanitation In Informal Settlements In Gauteng*. Johannesburg: The Community Agency For Social Enquiry.

Esman, M. J. 1991 *Management Dimensions Of Development*. Connecticut: Kumarian Press.

Feyerabend, P. K. 1978. *Against Method: Outline Of An Anarchistic Theory Of Knowledge*. London: Verso.

Foddy, W. 1993. *Constructing Questions For Interviews And Questionnaires. Theory And Practice In Social Research*. New York: Cambridge University Press.

Fin Week Survey. 2008. Johannesburg: Gearing For The Future. *Fin Week Survey*. Pp 40-51.

Financial Mail. 2005. Municipal Management: Rusting Republics. *Financial Mail*. 20-23.

Fourie, A.B. And Van Reyneveld, M.B. 1993. *Environmental Impact Of On-Site Sanitation A Literature Review With Particular Application To South Africa*. Water Research Commission. 57(94). University Of The Witwatersrand, Johannesburg: Water Research Commission.

Folke, C. 1991. *Linking The Natural Environment And The Economy*. Boston: Kluwer.

Forsey, H. 1993. *Circles Of Strength*. Gabriola Island: New Society Publishers.

Friedman, S. And Reitzes, M. 1995. *Democratic Selections? Civil Society And Development In SA's New Democracy*. Development Paper No. 75. Midrand: Development Bank Of Southern Africa.

Friedmann, J. 1987. *Planning In The Public Domain: From Knowledge To Action*. Princeton: Princeton University Press.

Friedmann, J. 1992. *Empowerment: The Politics Of Alternative Development*. Cambridge: Blackwell.

Fuggle, R .F. And Rabie, A. 1992. *Environmental Management In South Africa*. Cape Town: Juta.

Garcia, D. 2008. The Climate Security Divide: Bridging Human And National Security In Africa 2. *African Security Review*. Pretoria: Institute For Security Studies. 17: 3 Pp2-17. September.

Georgiou, S., Whittington, D., Pearce, D. And Moran, D. 1997. *Economic Values And The Environment In The Developing World*. Edward Elgar,Us.

Giddings, B., Hopwood, B. And O'Brien, G. 2002. Environment, Economy And Society: Fitting Them Together Into Sustainable Development. *Sustainable Development* 10, P 187-196.

Girardet, H. 1992. *The Gaia Atlas Of Cities*. New York: Anchor Books Doubleday.

Glaeser, B. (Ed.). 1984. *Ecodevelopment: Concepts, Projects, Strategies*. New York: Pergamon.

Global Development Research Center. SD Features. Definitions.

<http://www.gdrc.org/sustdev/definitions.html>

Accessed 7.5.2010.

Goerner, S J. 1994. *Chaos And The Evolving Ecological Universe*. Pennsylvania: Gordon And Breach.

Goldblatt, M., Gelb. And Davies, G. 2002. *Microeconomics And Sustainable Development In Southern Africa. Synthesis Report Of South Africa Study: Water, Energy And Sustainable Development*. Midrand: DBSA.

Goldin, I. And Winters, L. A. 1995. *The Economics Of Sustainable Development*. New York: Cambridge University Press.

- Goodland, R., Et Al. 1991. *Environmentally Sustainable Economic Development: Building On Brundtland*. Paris: UNESCO.
- Goodland, R. Et Al. 1992. *Population, Technology And Lifestyle*. Washington D.C.: Island Press.
- Goodland, R. 1995. The Concept Of Environmental Sustainability. *Annual Review Of Ecological_Systems* 26:1-24.
- Goodland, R., Mercier, J-R, Muntemba, S. 1995. *Environmental Assessment In Africa*. World Bank: Proceedings Of The Durban World Bank Workshop June 25 1999.
- Gordon, R. 1992. *Basic Interviewing Skills*. Itasca: F. F. Peacock Publishers.
- Gorgens A.H.M. And Rooseboom A. 1990. *Potential Impacts Of Rainfall Stimulation In South Africa*. A Research Planning Study. NSI Report No 1665/ 5028.
- Goudie, A. 1986. *The Human Impact On The Natural Environment*. Cambridge: MIT Press.
- Goudie, A. 1993. *The Nature Of The Environment*. Oxford: Blackwell.
- Grayling, A. C. 2005. *The Heart Of Things. Applying Philosophy To The 21st Century*. London: Phoenix.
- Greater Johannesburg Metropolitan Council 2000. *Igoli News*. December 1999 January 2000. Johannesburg.
- Hammond, A. Et Al. 1995. *Environmental Indicators*. Washington D.C.: World Resources Institute. May.
- Hamdi, N. And Goethert, R. 1997. *Action Planning For Cities*. Chichester: Wiley.
- Hanna, K. S. 2005. Planning For Sustainability: Experiences In Two Contrasting Communities. *Journal Of The American Planning Association*. 71(1). Pp 27-40.

Hardoy, J., Mitlin, D. And Satterthwaite, 1994. *The Future City*. In Holmberg, J.(Ed), Op.Cit.

Harrison, P. And Heese, S. 2006. *South Africa's Top Sites. Families*. Kenilworth: Spearhead.

Hart, S. L. Et Al. 1984. *Improving Impact Assessment*. Boulder: Westview Press.

Houghton, G. And Hunter, C. 1994. *Sustainable Cities*. London: Kingsley.

Havemann, G. 2006. *A DBSA Perspective On Sustainable Development: Towards Responsible Investment In Infrastructure*. Midrand: Development Bank Of Southern Africa.

Helm, D. 1991. *Economic Policy Towards The Environment*. Oxford: Blackwell.

Henderson, H. 1980. *Creating Alternative Futures*. New York: Perigee.

Henderson, H. 1995. *Paradigms In Progress: Life Beyond Economics*. San Francisco: Berrett-Koehler Publishers.

Henderson, H. 1996. *Cultural DNA*. *Annals Of Earth*. Falmouth: Ocean Arks International. Pp. 10-12.

Hester, R. T. 2006. *Design For Ecological Democracy*. Cambridge: MIT Press.

Hilton-Barber, M. 2000. Bringing Water To The Poor. *The Star*. Tuesday February 29. P7

Hindson, D. Et Al. 1996. *Durban's Tomorrow Today*. Durban: Indicator Press.

Hirji, R., Johnson, P., Maro, P. And Matiza C. T. 2002. *Defining And Mainstreaming Environmental Sustainability In Water Resources Management In Southern Africa*. SADC, IUCN, SARDC, World Bank: Maseru.

Holden, E. And Linnerud, K. 2007. The Sustainable Development Area: Satisfying Basic Needs And Safeguarding Ecological Sustainability. *Sustainable Development*. 15. Pp. 174-187. Online 10.1002/Sd.416

Accessed 5.9.2008

Holland, A. S. 2005. *The Water Business: Corporations Versus People*. Bangladesh: The University Press.

Holmberg, J. (Ed) *Policies For A Small Planet*. 1994. IIED. London: Earthscan.

Hopwood, B., Mellor, M. And O'Brien, G. 2005. Sustainable Development: Mapping Different Approaches. *Sustainable Development* 13, P 38-52.

Hossack, C. 2002. Joburg 2030 -the high road to growth
http://www.Joburgorg.za/feb_2002/30year_plan2.stm. February 19.

Accessed 3.3.2005

Huntley, B. Et Al. 1989. *South Africa's Environments Into The 21st Century*. Tafelberg: Human And Rousseau.

International Fund For Agricultural Development (IFAD). (2007). Rural Poverty In Lesotho.
<Http://Operations.Ifad.Org/Web/Guest/Country/Home/Tags/Lesotho>.

Accessed 28.8.2009.

Institute for Security Studies. 2010. Lesotho Highlands Water Project.
http://www.ipocafrika.org/index.php?option=com_content&view=article&id=71&Itemid=66.

Accessed 3.2.2010.

International Institute for Sustainable Development (IISD). 2010. What is Sustainable Development?

<http://www.iisd.org/sd/>

Accessed 7.5.2010.

Jackson. B. 1997. *Designing For Cost Recovery*. Mimeo. Midrand: DBSA.

Johannesburg City official website.

<http://www.joburg.org.za/>

Accessed various dates.

Johannesburg Water. Website.

[Http://Www.Johannesburgwater.Co.Za/](http://Www.Johannesburgwater.Co.Za/)

Accessed various dates.

Johannesburg Water 2009. Proposed Tariffs for the 2009/10 Financial Year. Johannesburg Water website.

<http://www.johannesburgwater.co.za/uploads/documents/Tariffspercent20200910.doc>

Accessed 20.11.09

Johannesburg Water 2010. Vision, Mission and Objectives

<http://www.Joburgorg.za/content/view/35/66/1/1/#ixzz0cg4ozZsl>

Accessed 12.4.10

Johnson, H.D. 1995. Green Plans: The Netherlands Leads The Way. *Earth Island Journal*. Summer. Pp.30-32

Johnson, E. H. 2001. Optimal Water Meter Selection System. *Water SA*, 27(4). Pp 481-550.

Johnston, R. J. 1986. *Philosophy And Human Geography*. Maryland: Edward Arnold.

Johnston, R. J. And Taylor, P. J. 1992. *A World In Crisis?* Cambridge: Blackwell.

Jones, J. P. Et Al. 1993. *Postmodern Contentions*. New York: Guildford Press.

Jooste, S. And Claassen, M. 2001. Rationale For An Ecological Risk Approach For South Africa Water Resource Management. *Water SA*. 27(3). Pp 283-292.

Jorgenson. S.E. 1992. *Integration Of Ecosystem Theories: A Pattern*. Boston: Kluwer.

- Joubert, L.S. 2006. *Scorched. South Africa's Changing Climate*. Johannesburg: Wits University Press.
- Kasrils, R. 2002. An Assured Water Supply for South Africa. Water Dome. World Summit on Sustainable Development.
- Kates, R. Et Al. 2005. What Is Sustainable Development? Goals, Indicators, Values And Practice. *Environment* 43(3) P9-21.
- Keiner, M. 2006. *The Future Of Sustainability*. Springer. Netherlands
- Kelly, M., Selman, P. And Gilg, A. 2004. Taking Sustainability Forward: Relating Practice To Policy In Changing Legislative Environment. *TRP*, 75(3). Pp 309-335.
- Krueger, R. And Agyeman, J. 2005. Sustainability Schizophrenia Or Actually Existing Sustainabilities? Toward A Broader Understanding Of The Politics And Promise Of Local Sustainability In The US. *Geoforum* Volume 36, Issue 4, July, Pages 410-417
- Kirk, J. And Miller, M. L. 1986. *Reliability And Validity In Qualitative Research*. Newbury Park: Sage.
- Kirkby, J. Et Al. (Eds.). 1995. *The Earthscan Reader In Sustainable Development*. London: Earthscan.
- Koch, E. 1991. "Rainbow Alliances: Community Struggles Around Ecological Problems", In Cock, J. And Koch. E. (Eds.) *Op.Cit.*
- Knight, R. V. And Gappert, G. 1989. *Cities In A Global Society*. London: Sage
- Knox, P. L. And Agnew,J. 1989. *The Geography Of The World Economy*. London: Edward Arnold.
- Knox, P. L. 1994. *Urbanization*. New Jersey: Prentice Hall.
- Knox, P. L. 1995. *Urban Social Geography*. Essex: Longman.
- Koch, E. 1991. Rainbow Alliances: Community Struggles Around Ecological Problems, In Cock And Koch *Op.Cit.*

- Korten, D.C. 1995. *When Corporations Rule The World*. Connecticut: Kumarian Press.
- Kreimer, A. T. 1993. *Towards A Sustainable Urban Environment*. The Rio De Janeiro Study. Washington D.C.: World Bank.
- Krost, P. Igoli 2002 – What It Means For You. *Saturday Star* 5.2.2000 P5
- Kula, E. 1992. *Economics Of Natural Resources, The Environment And Policies*. London: Chapman And Hall.
- Lans, K. Et Al. 2006. *Who Owns The Water?* Baden: Lars Muller Publishers.
- Lapping, B. 1991. *Apartheid: A History*. New York: George Braziller.
- Lazarus, P. 1997. *Towards A Regulatory Framework For The Management Of Groundwater In South Africa*. Report To The Water Research Commission And The Department Of Water Affairs And Forestry.
- Lawrence, D. P. 1993. Quantitative Versus Qualitative Evaluation: A False Dichotomy? *Environmental Impact Assessment Review*. 13:3-11.
- Lawson, L. 1991. The Ghetto And The Greenbelt. The Environmental Crisis In The Urban Areas. In Cock And Koch. *Op.Cit*.
- Lee, R. Et Al. 1991. Speaking Or Listening? Observers Or Agents Of Change? Business And Public Policy:1989/90 In Lee And Schlemmer. *Op.Cit*.
- Lee, R. And Schlemmer, L. 1991. *Transition To Democracy*. Cape Town: Oxford University Press.
- Lee, J. A. 1985. *The Environment, Public Health And Human Ecology*. Baltimore: Johns Hopkins University Press.
- Leitman, J. 1995. SA: *The Institutional Setting For Urban Environmental Management*._Mimeo.
- Leite, C. 2008. *Reinventing Sao Paulo At The Urban Sustainability Age*. P O R T A L E D U C A T O R I U M Sustentabilidade Cidade Arquitetura Design [Www.Educatorium.Com/Leite](http://www.Educatorium.Com/Leite).

Accessed 2.2.2009

Lemon, A. (Ed.) 1991. *Homes Apart: South Africa's Segregated Cities*.
Bloomington: Indiana University Press.

Lemon, A. 1996. Post-Apartheid Cities: Planning For A New Society, In Davis, R. J.(Ed) op.
cit.

Lesotho Highlands Development Authority, 1996. *Resettlement And Development
Study*. Task 4 Report, Executive Summary. Hunting-Consult 4 Joint Venture.

Lesotho Highlands Development Authority, 1997. *Resettlement And Development
Study*. A Synopsis Of Studies And Proposed Programs. Hunting-Consult 4 Joint
Venture.

Lesotho Highlands Development Authority, 1997, *Resettlement And Development
Study*, Volume 3. Social Impact Assessment And People's Involvement Programme.
Hunting-Consult 4 Joint Venture.

Levitt, R. 1998. Sustainability Indicators – Integrating Quality of Life and
Environmental Protection. *Journal of the Royal Statistical Society*. 161, Part 3, pp.
291-302.

Levy, J. M. 1991. *Contemporary Urban Planning*. New Jersey: Prentice Hall.

Lohnert, B. 1996 The Identification Of Urban Vulnerable Groups. In Davies, R.J. (Ed)
op.cit.

Ligero, P., Vega, A. And Soto, M. 2001. Pretreatment Of Urban Wastewaters In Hydrolytic
Upflow Digester. *Water SA*. 27(3). Pp 399-404.

Luccarelli, M. 1995. *Lewis Mumford And The Ecological Region: The Politics Of Planning*.
New York: The Guilford Press.

Lundqvist. J. et al. 2005. Water Management in Megacities. *Ambio* Vol. 34, No. 3, May. Pp.
267-268.

Lyle, J. T. 1994. *Regenerative Design For Sustainable Development*. New York: John Wiley.

MacCarron, G. M. 2009. *The Relationship Between Planning And Environmental Management In Gauteng*. A Masters Research Report Submitted To The Faculty Of Engineering And The Built Environment, University Of The Witwatersrand, Johannesburg.

Mackay, H. M. And Johnson, P. J. 2004. Towards Co-Operative Governance In The Development And Implementation Of Cross-Sectoral Policy: Water Policy As An Example. *Water SA*. 30(1). Pp. 1-8.

Mail And Guardian. 1996. *Preparing For The 21st Century*. Insert. Johannesburg.

Majavu, M. 2002. Alexandra Renewal Takes Off.

<http://www.Joburgorg.za/content/view/892/192/>.

Accessed 5.2.2010.

Malan, G. J. 1988. Water Consumption And Possible Water Savings In Apartment Buildings. Water Research Commission Final Report, CSIR Division Of Water Technology. 177(1)88 Pretoria: Water Research Commission.

Mandela, N. R. 1994. *Long Walk To Freedom*. Boston: Little, Brown And Company.

Marcuse, P. 2006. Sustainability Is Not Enough. In Keiner, *Op. Cit*.

Matowanyika, W. 2010. The Impact Of Alexandra Township on The Water Quality of the Jukskei River. Masters Research Report Submitted To The Faculty Of Science, University Of The Witwatersrand, Johannesburg.

Mazamanian, M. 2008. Book Review Of *Green Cities* By M. E Kahn. *Urban Affairs Review*. Vol. 44, No. 1 P 144-146. September.

Masundire, H. And Mackay, H. 2002. The Role And Importance Of Aquatic Ecosystems In Water Resources Management. In Hirji Et Al. *Op.Cit*.

- Mawhinney, M. 2002. *Sustainable Development. Understanding The Green Debates*. Blackwell Science: Oxford.
- Mazvimavi, D. 2002. Watershed Degradation And Management. In Hirji Et Al. Op.Cit.
- Mayo, D. G. And. Hollander, R. D. 1991. *Acceptable Evidence: Science And Values In Risk Management*. New York: Oxford University Press.
- McAllister, D. M. 1981. *Evaluation In Environmental Planning*. Cambridge: MIT Press.
- McConnell, S. 1981. *Theories For Planning*. Heinemann: London.
- McDonald, D. A And Smith, L. 2004. Privatizing Cape Town: From Apartheid To Neo-Liberalism In The Mother City. *Urban Studies*. 41(8). Pp 1461-1484.
- McGlashan, J, E. 1992. *Guide For The Marine Disposal Of Effluents Through Pipelines*. Report Prepared For The Water Research Commission. South Africa
- McKenzie, R. And Lambert, A. 2001. Development Of A Simple And Pragmatic Approach To Benchmark Real Losses In *Potable Water Distribution Systems In South Africa*. Water Research Commission. 159(01). Pretoria: Water Research Commission.
- McKenzie, R. And Lambert, A. 2002. Development Of A Windows Based Package For Assessing Appropriate Levels Of Active Leakage Control In *Potable Water Distribution Systems*. Water Research Commission. 169(02). Pretoria: Water Research Commission.
- McNaughton, S. 2010. Hidden Water. National Geographic. Op.Cit. (insert).
- Meadows, D. L. 2006. Tools For The Transition To Sustainability. In Keiner, *Op. Cit*.
- Meadows, D. Et Al. 1992. *Beyond The Limits*. Vermont: Chelsea Green.
- Meadows, M. E. 1985. *Biogeography And Ecosystems Of South Africa*. Cape Town: Juta.

- Mellos, K. 1988. *Perspectives On Ecology*. New York: St Martin's Press.
- Middleton, B. 1998. *Water Audit, The Future, Some Solutions*. Mimeo.
- Miller, A. 1993. The Role Of Analytic Science In Natural Resource Decision Making. *Environmental Management*. Vol. 17. No.5 Pp.563-574.
- Miller, G. T. 1993. *Environmental Science*. Belmont: Wadsworth.
- Miller, G. T. 2004. *Living In The Environment*. Belmont: Wadsworth.
- Millsap, W. (Ed.). 1984. *Applied Social Science For Environmental Planning*. Boulder: Westview.
- Mindtools.com. 2010. Heuristic Methods.
http://www.mindtools.com/pages/article/newTMC_79.htm.
 Accessed 2.2.2010.
- Molden, D. 2007. *Water For Food, Water For Life: A Comprehensive Assessment Of Water Management In Agriculture*. London, UK: Earthscan; Colombo, Sri Lanka: IWMI.
- Molupe, M. 2000. *Planning For Water Provisional In Informal Settlement*. Research Report, MSc Development Planning, University Of The Witwatersrand: Johannesburg.
- Morehouse, Ward. 1989. *Building Sustainable Communities : Tools And Concepts For Self-Reliant Economic Change* New York : Bootstrap Press.
- Morgan, D. L. 1988. *Focus Groups As Qualitative Research*. Newbury Park: Sage.
- Morris, P. 1995. Democracy, Governance And Partnerships With Institutions Of Civil Society And The Private Sector. *Development Southern Africa* Vol. 12, No. 3 June Pp. 423-434.
- Morrison, G. Et Al. 2001. Sustainable Development Indicators For Urban Water Systems: A Case Study Evaluation Of King William's Town, South Africa And The Applied Indicators. *Water SA*. 27(2). Pp. 219-232.

Mtetwa, S. And Schutte, C.F. 2002. An Interactive And Participative Approach To Water Quality Management In Agro-Rural Watersheds. *Water SA*. 28(3). Pp 337-344.

Murray, E. C. And Tredoux, G. 1998. *A Technology For Sustainable Water Resources Development*. Report To The Water Research Commission. WRC Report No 842/1/98. Cape Water Programme, Division Of Water Environment And Forestry Technology, CSIR.

Moffat, M. 1992. Ethnographic Writing About American Culture. *Annual Review Of Anthropology* 21-205-229.

Moffatt, I. 1995. *Sustainable Development: Principles, Analysis And Policies*. New York: Parthenon.

Muller, J. G. 1998. Paradigms And Planning Practice: Conceptual And Contextual Considerations. *International Planning Studies*. Vol. 3 No. 3 Pp.287-302.

Mwangi, O. G. 2008. The Role Of The Lesotho Highlands Water Project In Environmental Degradation. *African Security Review*. Pretoria: Institute For Security Studies. Vol. 17 No 3. September.

Myburgh, J. 2010. The ANC's Destructive Itch. Politicsweb. 18 May 2010.

<http://www.politicsweb.co.za/politicsweb/view/politicsweb/en/page71619?oid=176561&sn=Detail>

Accessed 18.5.2010.

Nagpal, T. And Foltz, C. 1995. *Choosing Our Future: Visions Of A Sustainable World*. Washington, D.C.: World Resources Institute.

National Geographic. 2010. Water. Our Thirsty World. Special Issue. Washington D. C.: *National Geographic*. Vol. 217. No. 4. April.

Nationmaster. Undated. Statistics On Lesotho.

<Http://Www.Nationmaster.Com/Country/Lt-Lesotho>

Accessed 6.7.2009.

Norgaard, R. B. 1994. *Development Betrayed: The End Of Progress And A* O'Connor, M. (Ed.). 1994. *Is Capitalism Sustainable?* New York: The Guilford Press.

Njobeni, S. 2005. Cape May Desalinate Sea Water 'As A Last Resort.' *Business Day*, 24 March.

O'Neill, J. 1993. *Ecology, Policy And Politics*. New York: Routledge.

OECD. 1978. *Urban Environmental Indicators*. Paris: OECD.

Ophuls, W. 1992. *Ecology And The Politics Of Scarcity*. New York: W. H. Freeman.

O'Riordan, T. 1981. *Environmentalism*. London: Pion.

O'Riordan, T. And Turner, R. K. 1983. *An Annotated Reader In Environmental Planning And Management*. Oxford: Pergamon Press.

Ophuls, W. 1992. *Ecology And The Politics Of Scarcity*. New York: W.H. Freeman.

Page, T. 1991. "Sustainability And The Problem Of Valuation." In Costanza, R. (Ed.) 1991. *Ecological Economics*. New York: Columbia University Press.

Palmer I. 1993. *Water And Sanitation In Urban Areas: Financial And Institutional Review*. WRC Report No 571/1/94. Palmer Development Group, Kenilworth.

Palmer I. 1994. *Water And Sanitation In Urban Areas: Financial And Institutional Review*. WRC Report No 571/5/94. Palmer Development Group, Kenilworth.

Palmer, S. E. 1996. *Integrating Restoration Of Natural Habitat In Urban Areas*. *Annals Of Earth*. Falmouth: Ocean Arks International. Pp. 23-27.

Palmer, I. H. And Ramaema, T.L. 1999. *The Water Services Development Plan: A Requirement Under The New Water Services Act*. Pretoria

Parsons, R And Tredoux, G. 1993. *The Development Of A Strategy To Monitor Groundwater Quality On A National Scale*. Report Prepared For Water Research Commission. Stellenbosch

Pearce, D. And Warford, J. J. 1993. *World Without End*. New York: Oxford University Press.

Pearce, D. Et Al 1993 *Blueprint: Measuring Sustainable Development*. Earthscan. London.

Pearce, D. W., Markandya, A. And Barbier, E. B. 1989. *Blueprint For A Green Economy*. London: Earthscan.

Pearce, J. 1987. A Preliminary Investigation Into The Effects Of Water Hyacinth On Algal Growth and Water Quality. *Water Research Commission*. 142/1/87. Pretoria: Water Research Commission.

Pepper, D. 1984. *The Roots Of Modern Environmentalism*. London: Croom Helm.

Pieterse, A. J. H. And Vuuren. J. 1997. *An Investigation Into Phytoplankton Blooms In The Vaal River And The Environmental Variables Responsible For Their Development And Decline*. Report To The Water Research Commission By The Department Of Plant And Soil Sciences. Potchefstroom University.

Pieterse, E. (ed.). 2010. *Counter Currents: Experiments in Sustainability in the Cape Town Region*. Auckland Park: Jacana Media.

Pirages, D. C. 1996. *Building Sustainable Societies : A Blueprint For A Post-Industrial World*. Armonk, N.Y.: M.E. Sharpe.

Platt, R.; Rowntree, R.A.; Muick, P.C. 1994. *The Ecological City*. Amherst: The University Of Massachusetts Press.

Politicsweb. 2008. SA's Municipal accounts In a Mess.

<http://www.politicsweb.co.za/politicsweb/view/politicsweb/en/page72308?oid=92334&sn=Marketingweb+detail>.

Accessed 3.2.2010.

Postel, S. 1996. *Dividing The Waters: Food Security, Ecosystem Health And The New Politics Of Scarcity*.

- Potter, R. B. And Salu, A.T. 1990. *Cities And Development In The Third World*. London: Mansell.
- Purvis, M. And Grainger, A. (Eds.). 2004. *Exploring Sustainable Development. Geographical Perspectives*. London: Earthscan.
- Pye-Smith, C. Et Al. 1994. *The Wealth Of Communities*. Connecticut: Kumarian Press.
- Quental, N., Lourenco, J. M. And Da Silva, F.N. 2009. Sustainable Development Policy: Goals, Targets And Political Cycles. *Sustainable Development*. Online 10.1002/Sd.416.
- Rand Water (Various). [Http://Www.Randwater.Co.Za](http://Www.Randwater.Co.Za)
Accessed on various dates.
- Rand Water (Undated) *Water Origination: Where Does Water Come From?*
[Http://Www.Randwater.Co.Za/Corporateresponsibility/WWE/Pages/Water Origination.aspx](http://Www.Randwater.Co.Za/Corporateresponsibility/WWE/Pages/Water%20Origination.aspx).
Accessed on various dates.
- Randolph, J. 2004. *Environmental Land Use Planning and Management*. Washington: Island Press.
- Ray, D. L. And Guzzo, L.R. 1993. *Environmental Overkill: Whatever Happened To Common Sense?* Washington D.C.: Regnery Gateway.
- Redclift, M. 1984. *Development And The Environmental Crisis*. London: Methuen.
- Redclift, M. 1987. *Sustainable Development*. New York: Methuen.
- Rees, W. E. 1996. Revisiting Carrying Capacity: Area-Based Indicators of Sustainability
<http://dieoff.org/page110.htm>
Accessed 7.7.2009.
- Rich, B. 1994 *Mortgaging The Earth*. Boston: Beacon Press.
- Riddell, R. 1981. *Ecodevelopment*. New York: St. Martin's Press.

- Riddell, R. 2004. *Sustainable Urban Planning*. Blackwell: Oxford.
- Robertson, J. 1990. Alternative Futures For Cities. In Cadman, D. And Payne, G.(Eds) *Op. Cit.*
- Roberts, D. 2003. Sustainability And Equity: Reflections Of A Local Government Practitioner In South Africa. In Agyeman Et Al. (Eds.) *Op Cit.*
- Rogerson, C. M. 1993. *Managing Urban Growth: The International Experience. Development Strategy And Policy Unit. Urban Foundation Research.* Johannesburg: Urban Foundation.
- Rosenbaum, Walter A., 1991. *Environmental Politics And Policy.* Washington, D.C.: CQ Press.
- Rosenthal And Walton 1996. *Second Draft Proposal Concerning A Non-Profit Organizations Bill.* Johannesburg: Development Resources Center.
- Rudestam, K. J. And Newton, R .R. 1992. *Surviving Your Dissertation.* London: Sage.
- Sale, K. 1985. Dwellers In The Land: *The Bioregional Vision.* San Francisco: Sierra Books.
- Satterthwaite, D. 1993. The Impact On Health Of Urban Environments. *Environment And Urbanization*, Vol. 5 No. 2 October. Pp.86-111.
- Schlemmer, L. 1991 The Turn In The Road: Emerging Conditions In 1990. In Lee And Schlemmer. *Op. Cit.*
- Schiller E. J. And Droste R. L. 1992. *Water Supply And Sanitation In Developing Countries.* Michigan: Ann Arbor Science Publishers.
- Schoeman, G. 1997. The Development Of Programmes To Combat Diffuse Sources Of Water Pollution In Residential Areas Of Developing Communities. *Water Research Commission.* 519(1). Pretoria: Water Research Commission.
- Schreiner, B. Et Al. 2002. From Bucket To Basin: New Paradigms For Water Management, Poverty Eradication And Gender Equity. In Turton And Henwood (Eds.) *Op. Cit.*

Schrire, R. (Ed.) 1990. *Critical Choices For South Africa*. Cape Town: Oxford University Press.

Scribner, B. 2010. Water's Out There. National Geographic. Op. Cit.

Segal, N. 2009. *Does South Africa Face A Water Crisis?* A Report To Business Leadership South Africa. Mimeo.

Shrader-Frechette, K. S. And McCoy, E. D. 1993. *Method In Ecology*. New York: Cambridge University Press.

Singh, V. P. 2000. The Entropy Theory As A Tool For Modeling And Decision-Making In Environmental And Water Resources. *Water SA*. 26(1). Pp. 1-12.

Smith, L. And Hanson, S. 2003. Access To Water For The Urban Poor In Cape Town: Where Equity Meets Cost Recovery. *Urban Studies*. 40(8). Pp 1517-1548.

Smith, L. 2003. *The Corporatization Of Urban Water Supply: Cape Town's Institutional Transformation In Post-Apartheid South Africa*. Geography Ph.D. Dissertation. Clark University: Massachusetts.

Smith, L. 2004. *The Murky Waters Of The Second Wave Of Neoliberalism: Corporatization As A Service Delivery Model In Cape Town*. *Geoforum*. 25. Pp 375-393.

Smith, L. Undated. *Neither Public Nor Private: Unpacking The Johannesburg Water Corporatization Model*. Mimeo.

Smits, S, Pollard, S, Du Toit, D, Butterworth, J And Patrick Moriarty. 2004. *Modeling Scenarios For Water Resources Management In The Sand River Catchments, South Africa*. Water Households And Rural Livelihoods (WHIRL) Project Working Paper 8.

Soll, M. Et Al. 1995. *Creating Sustainable Cities: The Healthy Cities Program Of The WHO*. Paper Presented At The International Association For Impact Assessment 15th Annual Meeting Durban, South Africa.

Solsona, F. And Pearson, I. 1995. *Non-Conventional Disinfections Technologies For Small Water Systems*. Water Research Commission. 449(1). Pretoria: Water Research Commission.

South Africa. *Central Statistical Service's Provincial Statistics 1995, (Report Number 00-90-07). Provincial Statistics (Part 7) – Gauteng.*

[Http://Www.Statssa.Gov.Za/Publications/Report-00-90-07/Report-00-90-071995.Pdf](http://www.statssa.gov.za/publications/report-00-90-07/report-00-90-071995.pdf)

Accessed 5.5.2009.

South Africa. Department Of Environmental Affairs And Tourism. (DEAT). 1992 *The Integrated Environmental Management (IEM) Procedure. Guideline Document 1: IEM.* South Africa.

South Africa. Department Of Environmental Affairs And Tourism. 1993. *The Use Of Economic Instruments To Control The Discharge Of Effluent From Sappi's Ngodwana Paper Mill To The Elands River:A Case Study.* Pretoria: Environmental Project Evaluation.

South Africa. Department Of Environmental Affairs And Tourism. 1999. *White Paper On Environmental Management Policy.* Pretoria: DEAT.

South Africa. Department Of Water Affairs And Forestry. (DWAF). National Water Resource Strategy.

[Http://Www.Dwaf.Gov.Za/Documents/Policies/NWRS/Default.Htm](http://www.dwaf.gov.za/Documents/Policies/NWRS/Default.htm)

Accessed 29.7.2005

South Africa. Department Of Water Affairs And Forestry (DWAF). 1991. *Water Quality Management Policies And Strategies In The RSA.* Pretoria: DWAF.

South Africa. Department Of Water Affairs And Forestry. 1998. *Proposal For A National Strategy For Managing The Water Quality Effects From Dense Settlements.* Pretoria: DWAF.

South Africa. Department Of Water Affairs And Forestry. 1999. *Water Conservation And Demand Management :National Strategy Framework.* Pretoria: DWAF.

South Africa. Department Of Water Affairs And Forestry. 2002. *Waterdome: Display And Information At The World Summit On Sustainable Development.*

South Africa. Department Of Water Affairs And Forestry. Undated. Water Quality Management in South Africa.

http://www.dwaf.gov.za/Dir_WQM/wqmFrame.htm.

Accessed 31.1.2010.

South Africa. Dept. Of Environmental Affairs And Tourism. 1996. Green Paper: *An Environmental Policy For South Africa*. October.

South Africa Water Law Review. 1996. *Fundamental Principles And Objectives For A New Water Law In South Africa*.

<http://www.hst.org.za/pphc/Phila/summary/natwaterpol.htm>

Accessed 8.06.1997.

South Africa. 1998. *Background Information On Local Agenda 21*. Pretoria: Dept. Of Environmental Affairs And Tourism. Mimeo. October.

South Africa. 1998. The Report Of The Truth and Reconciliation Commission. Volume 2.

<http://www.justice.gov.za/trc/report/finalreport/Volumepercent202.pdf>

Accessed 4.11.2009.

South Africa. Statistics South Africa. 2010. *General Household Survey 2009, July*. Pretoria: Statistics South Africa.

http://us-cdn.creamermedia.co.za/assets/articles/attachments/27436_p0318june2009.pdf

Accessed 8.5.2010.

South African Institute Of Race Relations (SAIRR). 2008. *South Africa Survey 2007/8*. Johannesburg: SAIRR.

Stake, R. E. 1995. *The Art Of Case Study Research*. London: Sage.

Starke, L. 2008. *State Of The World: Ideas And Opportunities For Sustainable Economies*. Worldwatch Institute: Earthscan.

- Stein, R. 2002. Water Sector Reforms In SA: Some Case Studies. In Turton And Henwood (Eds.) *Op.Cit.*
- Stephenson, D., Green, I. R. A . And Lambourne, J. J. 1986. Research In Urban Hydrology And Drainage. Water Research Commission, *Water Research Programme*. 115(1)86. Johannesburg: Water Research Commission.
- Stephenson, D. 1993. Effects Of Urbanization On Catchment Water Balance. *Water Research Commission*, 183(11). University Of The Witwatersrand, Johannesburg: Water Research Commission.
- Stewart, T. J., Scott, L. And Itoni, K. 1993. Scenario Based Multicriteria Policy Planning For Water Management In South Africa. *Water Research Commission*. 296(1). Pretoria: Water Research Commission.
- Speth J. G. 1992. The Transition To A Sustainable Society. *Proceedings Of The National Academy Of Science. USA*. Vol. 89. Pp. 870-872. February
- Stassen, G. And Boshoff, B. C. 1992. Towards Environmentally Sustainable Energy Development In South Africa. *Journal Of Energy R And D In Southern Africa*. February. Vol.3, No.1. Pp.15-18.
- Suzenet, G., Tal, A. And Boymanns, D. 2001. Sustainable Water Management For The City: Technologies For Improving Domestic Water Supply. *Built Environment*. 28(2). Pp. 138-163.
- Tate, J. And Mulugetta, Y. 1998. Sustainability: The Technocratic Challenge. *Town Planning Review*. 69 (1) Pp. 65-86.
- Terblanche, A. P. 1994. The Potential Health Impact Of Global Climate Change. Mimeo. Council For Scientific And Industrial Research: Environmental Services. South Africa.
- The Weekly Mail. 1991. *The Green Pages*. Johannesburg: WM Publications.
- Tietenberg, T. 1992. *Environmental And Natural Resource Economics*. New York: Harpercollins.

- Timberlake, L. 1985. *Africa In Crisis*. London: Earthscan.
- Timberlake, M. 1985. *Urbanization In The World Economy*. Orlando: Academic Press.
- Timberlake, L. 1987. *Only One Earth*. New York: Sterling.
- Todes, A., Sim, V. and Sutherland, C. 2009. The Relationship Between Planning and Environmental Management in South Africa. *Planning Practice and Research*. Vol. 24. No. 4 November. Pp. 411-433.
- Tomlinson, R. H. 1990. *Urbanization In Post Apartheid South Africa*. London: Unwin Hyman.
- Tomlinson, R. H. 1994 *Urban Development Planning: Lessons For The Economic Reconstruction Of South Africa's Cities*. Johannesburg: Witwatersrand University Press.
- Trzyna, T. C. 1995. *A Sustainable World: Defining And Measuring Sustainable Development*. Sacramento: International Centre For The Environment And Public Policy. California Institute Of Public Affairs.
- Turner K. N., Fowler T. G., Manson N. J. And Stephenson D. 1997 *Optimisation Of Rand Water's Distribution System*. Report To The Water Research Commission. Water Systems Research Group, University Of The Witwatersrand.
- Turton, A. And Henwood, R. 2002. *Hydropolitics In The Developing World*. Pretoria: African Water Research Unit.
- Turton, A, Ashton, P. And Cloete, E. 2003. Transboundary Rivers, Sovereignty And Development: Hydropolitical Drivers In The Okavango River Basin. Pretoria: African Water Issues Research Unit (AWIRU) And Green Cross International.
- Turton, A. 2008. Three Strategic Water Quality Challenges That Decision-Makers Need To Know About And How The CSIR Should Respond. Pretoria: CSIR.
- Taigbenu, A. E. 2005. *Proceedings Of The Special Colloquium: Water Research Showcase*. Johannesburg: University Of The Witwatersrand.

United Nations Centre for Human Settlements (HABITAT). 1996. *An Urbanizing World*. New York: Oxford.

UN-HABITAT. 2003. *Water And Sanitation In The World's Cities: Location For Global Goals*. London: Earthscan.

UN-HABITAT. 2009. *Planning Sustainable Cities: Policy Directions*. London: Earthscan.

Vanclay, F. And Bronstein, D.A. (Eds.). 1998. *Environmental And Social Impact Assessment*. Chichester: John Wiley And Sons.

van de Meene, S. J. And Brown, R. R. 2009. Delving Into The “Institutional Black Box”: Revealing The Attributes Of Sustainable Urban Water Management Regimes. *Journal Of The American Water Association*. Vol. 45. No. 6. December. Pp. 1448-1464

van Der Ryn, S. 1995. *The Toilet Papers: Recycling Waste And Conserving Water*. Sausalito: Ecological Design Press.

van Der Ryn, S. And Cowan, S. 1996. *Ecological Design*. Washington D.C.: Island Press.

van Der Ryn, S. And Calthorpe, P. 1986 *Sustainable Communities : A New Design Synthesis For Cities, Suburbs, And Towns*. San Francisco : Sierra Club Books.

van Wyk, J. 1998. *Environmental Law. Mimeo*. University Of The Witwatersrand.

van Riet W. F. And Slabbert S.A. 1996 *The Ability Of Catchment Basins To Supply The Water Demands Of Rural And Urban Areas*. WRC Report No 680/1/96. Report To The Water Research Commission. Pretoria: GIS LAB, University Of Pretoria.

van Rooyen, C. et al. (eds.). 2009. *Johannesburg Case Study*. Durban: The Water Dialogues South Africa.

van Ryneveld, M. B. 1999. *An Introduction To The Provision Of Physical Infrastructure*. Department Of Civil Engineering, University Of Witwatersrand. Mimeo.

van Schalkwyk, A. 2001. Institutional Arrangements And Support Services Required For Sustainable Community Water Supply. *Water Research Commission*. Pietersburg: Water Research Commission.

Vegter, J. R. 2001. Groundwater Development In South Africa And An Introduction To The Hydrogeology Of Groundwater Regions.. *Water Research Commission*, 134(00). Pretoria: Water Research Commission.

Versveld, D. B., Le Maitre, D. C. And Chapman, R. A. 1998. "Alien Invading Plants And Water Resources In South Africa: A Preliminary Assessment". *Water Research Commission*. 99(98). Pretoria: Water Research Commission.

Vojnovic, I. 1994. *The Pathway Towards Sustainable Development And Sustainable Urban Forms*. Research Paper 188. University Of Toronto: Department Of Geography.

Wackernagel, M. And Rees, W. 1996. *Our Ecological Footprint*. Gabriola Island: New Society Publishers.

Wall, K. Undated. *Water And Waste In South Africa*. Mimeo.

Water Research Commission. 1996. *The Philosophy And Practice Of Integrated Catchment Management: Implications For Water Resource Management In South Africa*. Pretoria: Department Of Water Affairs And Forestry.

Water Research Commission. 2008a. Water Wheel. September/October. Vol.7. No. 5.

Water Research Commission. 2008b. Water Wheel. November/December. Vol.7. No. 6.

Water Research Commission. 2009a. Water Wheel. March /April 2009. Vol. 8. No. 2.

Water Research Commission. 2009b Water Wheel. May/June 2009. Vol. 8. No. 3.

Watson, V. 1992. *The Promotion And Regulation Of Multifunctional Land Use: International Trends And Practices*. Working Paper No. 47, November. Urban Problems Research Unit: University Of Cape Town.

Weakley, D. J. 2009. *Water Demand Management In The City Of Johannesburg*. Unpublished B.Sc (URP) Research Report. School Of Architecture And Planning, University Of The Witwatersrand, Johannesburg.

Webber Wentzel Law Firm, South Africa. Environmental Legislation.

http://www.wwb.co.za/wwb/view/wwb/en/page1874?categorylisting=cl_results&category_id=134&additionalcategories=&ccs_no_cache=1

Accessed various dates.

Weimer, D. L. And Vining, A. R. 1992. *Policy Analysis*. New Jersey: Prentice Hall.

Whipple, W. 1978. *Water Problems Of Urbanizing Areas*. New England College Henniker, New Hampshire.

White, R. R. 1994. *Urban Environmental Management*. New York: John Wiley And Sons.

Whitehead, M. And Audouin, M. 1998 *Local Agenda 21 And The Pathway To Democracy*. Johannesburg: Greater Johannesburg Metropolitan Council.

WHO. *World Health Report 1995*. Geneva: WHO.

Wood, A. And Pybus, P. 1992. *Artificial Wetland Use For Wastewater Treatment Theory, Practice And Economic Review*. Pretoria: Water Research Commission Final Report, CSIR Division Of Water Technology Health Programme.

World Bank's "Governance Indicators Report" (2009

<http://info.worldbank.org/governance/wgi/index.asp>)

Accessed 20.5.2010,

World Commission On Environment And Development (Brundtland Commission) 1987. *Our Common Future*. New York: Oxford University Press.

Worldwatch. 2010. *State of the World 2010: Transforming Cultures—From Consumerism to Sustainability*. Washington D.C.: Worldwatch Institute.

Worster, D. 1993. The Ecology Of Order And Chaos. In Armstrong And Botzler, *Op. Cit.*

Wright, A. M. 2002. *Water And Sustainable Development In Africa: An African Position Paper*. Pretoria: International Water Management Institute.

Xundu, X. 2000. President Pledges Free Services To Poor. *Business Day*. P 10.

Xundu, X. 2000. Implementation Of Free Basic Water Programme Set For July. *Business Day*. P 18.

Yin, R. K. 1989. *Case Study Research*. Newbury Park: Sage.

Yin, R. K. 1993. *Applications Of Case Study Research*. Newbury Park: Sage.

Yin, R. K. 1994. *Case Study Research. Design And Methods*. Newbury Park: Sage.

Zuma, J. G. 2010. "Changing The Way Government Works." Presidential Address To A Meeting With Directors-General And Deputy Directors-General Of National And Provincial Government Departments, April 23.

<http://www.politicsweb.co.za/politicsweb/view/politicsweb/en/page71656?oid=172808&sn=Detail>

Accessed 18.5.2010.

Appendix A. Interview questionnaire.

**Brian Boshoff: Wits University Dept. of Urban and Regional Planning: Questionnaire –
Water and Sustainable Development**

Thank you for agreeing to participate in this interview. I am undertaking it as part of my requirements to obtain a Ph.D. degree from Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA. The research aims to deepen understanding of the concept of sustainability, particularly as regards the water sector in Johannesburg and South(ern) Africa.

The questionnaire may be completed electronically* or by means of a face-to-face interview. If we have scheduled an interview, but you would prefer to complete the questionnaire electronically, please let me know as soon as possible. (My contact details are provided below).

The interview should take approximately 45-60 minutes and may be a bit shorter (or longer) depending on the character of your responses. In order not to miss or misrepresent any information, I will tape record your interview. To ensure anonymity/confidentiality, your responses will be assigned a code or a pseudonym. If, in addition to this effort to assure confidentiality, you desire that any parts of our conversation be “off the record”, your wish will be respected and the tape recorder switched off when you share those observations. The tape recordings obtained for this research will be destroyed one year after its completion and meanwhile will be stored in a secure and locked location.

There are no expected or “correct” answers to the issues we shall discuss. We will begin with a few questions that help me understand better your professional position, role and responsibilities. Thereafter, I shall be asking you several open-ended questions. Throughout, please feel free to share your comments and insights and provide your views as you believe appropriate. Please bear in mind too, that this research seeks to enrich the understanding of

“sustainability.” There are many possible perspectives and interpretations of this term, so please be as candid and comprehensive in your responses as possible. Finally, this research is not only about “sustainability” *theory*, but also about *learning more about how you employ the concept in practice as well as your practical and experiential knowledge regarding it*. I very much want to learn what you think and believe concerning these matters and how you have experienced these concepts in your daily work.

Thank you very much for your assistance.

I hereby consent to the interview

Name

Signature.....

Date.....

*Please email completed questionnaires to me as soon as possible at

brian.boshoff@wits.ac.za

(011) 717 7708 (Wits)

Cell: 073 267 7176

Fax: (011) 646 9861

Thank you very much!

INTERVIEW QUESTIONS: Re. Water and Sustainability (WS) in Johannesburg and South(ern) Africa

- Date -----
- Time -----
- Location -----

A Interviewee details

A1 Name of interviewee (will be coded or given a pseudonym).....

A2 Institution where currently employed.....

A3 Years of service at institution.....

A4 Professional title at institution.....

A5 Brief job description.....

.....

.....

.....

A6 Academic or other qualifications.....

.....

A7 In what ways do the above relate, if at all, to Water and Sustainability?

.....

.....

.....

.....

.....

.....

.....

.....

B: Water and Sustainability

B1 Does your organization explicitly mention the concept of sustainability in its mission, vision, objectives or other guiding policy documents?

.....

.....

.....

.....
.....

If so,

B1.1 in what specific context does it do so? (vision/mission statement / operational guidelines / policy statements etc.)

.....
.....
.....
.....
.....

B 1.2 how do you believe your institution interprets “sustainability” ? Why, in your view, has it adopted this formal position?

.....
.....
.....
.....
.....

B1.3 how do you interpret/define/paraphrase the idea of sustainability / sustainable development?

.....

.....

.....

.....

.....

B 1.4 can you identify specific ways in which your organization has sought to realize its formal conception of sustainability?

.....

.....

.....

.....

.....

B2 Do you understand the terms “sustainability” and “sustainable development” to have the same or different meanings? Please explain.

.....

.....

.....

.....

.....

B3 What do you think S/SD means when applied *specifically to the water sector* in Sn. Africa?

.....

.....

.....

.....

.....

.....

B4 How do you think water law and policy in SA (or anywhere else) might (have) contribute(d) to sustainability?

.....

.....

.....

.....

.....

B5 What do you think should be done, when and by whom, in order to bring about sustainability in SA in general, and more importantly, with respect to the water sector?

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

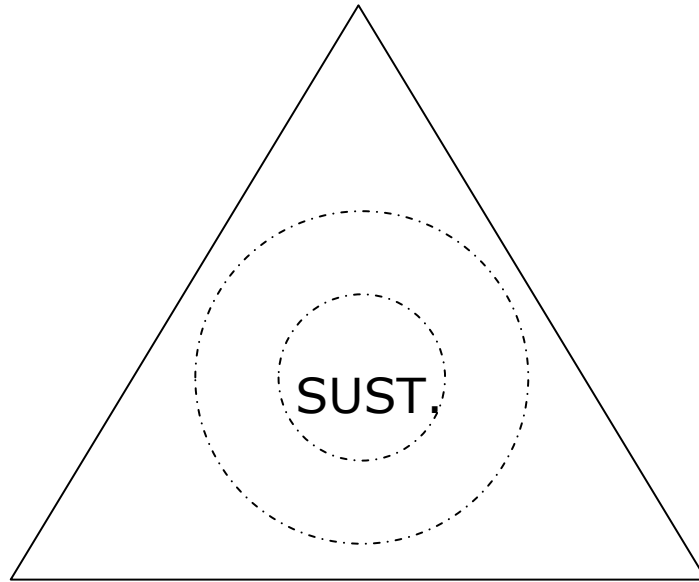
.....

.....

B6 Open-ended discussion and insights

Please refer to the 3 “Es” model of sustainability below

Environment



**Equity
/Social
Justice**

Economy

What might be contemplated in terms of each “E” at each corner of the triangle, in terms of equity/environment/economics - the “3 Es.” and how do these “Es” interrelate?

.....

.....

.....

.....

.....

.....

.....

.....

.....

Does this capture the most significant dimensions of sustainability as you might have encountered these in your work responsibilities? Is anything missing?

.....

.....

.....

.....

.....

How conceptually useful is this model for your work, as it stands?

.....

.....

.....

.....

.....

Do you have any further comments on the model (does it help to crystallize understanding of sustainability as you have worked to realize the idea in your professional role)?

.....

.....

.....

.....

.....

Are there any other dimensions of sustainability in terms of how you have come to understand the term), that we have not dealt with? Or, are there any other concerns that you wish to share on this topic?

Thank you very much for your assistance.

Appendix B. Johannesburg by the numbers.

The altitude is 2,000 m above sea level. The air is thinner, and eggs take an extra minute to boil

There are six million trees in Johannesburg (1.2 million in parks and pavements, and 4.8 million located near private homes)

Johannesburg's residents earn between them a total income of R28 billion per annum.

The city enjoys an average of twelve hours of sunlight a day

Forty percent of the population is under the age of 24

There are 100 water towers and reservoirs

There are 8,000 km of water pipes

There are 8,149 km of sewerage pipes

The city has two active power stations, capable of generating 600 kW

The average travel time for commuters is 72 minutes

There are 17 nature reserves in the city

There are 12 river systems that run throughout the city

Forty percent of all the world's human ancestor fossils have been found in areas adjoining the city

Johannesburg has about 150 heritage sites, half of which are national monuments

Johannesburg houses the only two polar bears in Africa, at the Johannesburg Zoo

There are 4 443 ha of open veld

There are 63 ha of bird sanctuaries

There are 87 ha of nature trails

There are 80 ha of botanical gardens

There are 106 dams

There are 394 public sports facilities

There are 98 public recreation centers

There are 59 public swimming pools

There are 126 community health clinics and 10 environmental health clinics

The city collects 1.8 million tons of garbage each year

Of this, 244,200 is in the form of illegal dumping, and 1,779 tons is litter from the streets

Thirteen percent of the city's waste is recycled

Ninety percent of the city's people have to walk less than 1km to access their modes of transport

Traffic congestion has increased by 26 percent since 1999

Some 35 000 people buy fruit and vegetables each day at the Fresh Produce Market, some from as far away as Botswana and Angola, arriving in 5 500 vehicles each day.

Source: JOBURG OFFICIAL WEBSITE

http://www.Joburgorg.za/facts/index_numbers.stm

Accessed various dates.