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SUCCESS FACTORS FOR URBAN BROWNFIELD REDEVELOPMENTS IN SOUTH AFRICA

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A research report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Engineering.

Johannesburg 2017

DECLARATION

I declare that this research report is my own unaided work. It is being submitted to the Degree of Master of Science in Engineering to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University.

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ABSTRACT:

This research sought to identify the key success factors associated with industrial brownfields site redevelopment projects in urban areas of South Africa. Nine such success factors were identified from international and local literature.

Through documentary research, three brownfield case studies in Johannesburg were investigated. These included the Newtown Cultural Precinct, the Egoli Gas site and the AECI Modderfontein site. Commonalities includes location within the urban edge, original industrial land use, and the redevelopment intent of the landowners. Aspects differing among the sites include distance from the inner city, size, the certainty of contamination and redevelopment success. Based on the findings of the three case studies, the nine success factors were refined.

The factors are no or low contamination, brownfields policy maturity, certainty regarding liability for remediation, risk-based land use options, favourable market conditions, quick funding access with rapid statutory approvals, readily available municipal services and transport infrastructure, and strong political and community support. The case study findings provide indications towards generalisation for success factors that may apply to future brownfields projects.

Further research required includes a larger database of brownfields redevelopment case studies to be developed for South African, in order to further test associated success factors.

Dedicated to my wife and kids

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LIST OF ACRONYMS

BRT	Bus Rapid Transit
CABERNET	Concerted Action on Brownfields and Economic Regeneration Network
CARACAS	Concerted Action on Risk Assessment for Contaminated Sites in the European Union
CBD	Central Business District
CCTV	Closed Circuit Television
CERCLA	Comprehensive Environmental Response and Liabilities Act of in 1980
CEO	Chief Executive Officer
CoJ	City of Johannesburg
DEA	Department of Environmental Affairs
DWS	Department of Water and Sanitation (previously the Department of Water Affairs)
EIA	Environmental Impact Assessment
EU	European Union
GAPP	GAPP Architects and Urban Designers
GDARD	Gauteng Department of Rural Development
ICO	Inner City Office
IDP	Integrated Development Plan
JDA	Johannesburg Development Agency
NEMA	National Environmental Management Act (1998)
NEMWA	National Environmental Management: Waste Act (2008)
NICOLE	Network for Industrially Contaminated Land in Europe
NID	Newtown City Improvement District
SARS	South African Revenue Service
SDF	Spatial Development Framework
SPV	Special Purpose Vehicle
UDZ	Urban Development Zone

UK	United Kingdom
US	United States
USEPA	United States Environmental Protection Agency
WULA	Water Use License Application

GLOSSARY

Superfund site	The remediation of the worst hazardous waste sites in the US require central government intervention. The Comprehensive Environmental Response and Liabilities Act (CERCLA) in 1980, made provision for such funding, which became known as the Superfund.

1. Introduction

A brownfield site is a property that has previously been developed, as opposed to a greenfield, or undeveloped site. Most brownfield definitions agree on the inclusion of old or derelict industrial or commercial sites, its location inside the urban edge, and the possibility of contamination (USEPA 2015; CABERNET 2006; Adams et al. 2010).

The uncertainty regarding contamination and stigma attached to brownfield sites often cause them to lie fallow, taking up valuable space within urban areas. This wasted space contributes to urban sprawl as primary negative impact (Adelaja et al. 2010; Amekudzi & Fomunung 2004; Rall & Haase 2011; Schadler et al. 2011). Other effects include a reduction in public health (Berman & Forrester 2013; Litt et al. 2002), an increase in crime, and a general decline in community vitality and property values (Accordino & Johnson 2002; Leigh & Coffin 2005).

The realisation of brownfields as a problem started in the 1980s, followed by the practice of remediation in the 1990s, and the redevelopment of these sites since the early 2000s. In both the urban planning and environmental science/engineering areas, important aspects include land-use, policy development, risk, liability, decision analysis and sustainability.

The United States (US), the United Kingdom (UK) and Europe are leading thinkers in the realm of contaminated land remediation and brownfields redevelopment. Significant industrial activity and space constraints in these countries have resulted in high property values in the major urban centres. This has, in turn, encouraged progressive brownfields legislation and policies and in these countries.

These laws and policies allow for the redevelopment of brownfields by mainly the private sector, despite barriers like uncertainty regarding liability, lack of funding, or limited second land use options (De Sousa 2001; Vanheusden 2007; Ren et al. 2015). There are thus many international examples of successful redevelopment projects from which can be learnt.

In South Africa, the legal framework for contaminated land changed in May 2014, when Section 8 of the National Environmental Management: Waste Act (2008)

"NEMWA" came into effect. This section deals with identification and remediation of contaminated land (Kvalsig 2014). According to the Adams model (2010) the policy framework in South Africa is still focused on the identification and remediation of contaminated land. It lacks policies that enables brownfields redevelopment, especially relief from liability for second-use property developers. Authorities have allowed property developers greenfield development on urban fringes, and green-buildings ratings, without sufficient pressure to redevelop brownfields (Seeliger & Turok 2015).

The international body of knowledge may, therefore, provide some guidance for South Africa's newly defined contaminated land management system and the potential development of a brownfields regime. This research report identifies the common success factors for brownfields redevelopment projects in an urban context, and tests their application against three case studies in South Africa.

1.1. Negative effects of undeveloped brownfields

1.1.1. Urban sprawl

The negative effects of urban sprawl include loss of natural land, air quality, increased energy usage and cost of infrastructure provision, and social impacts (Johnson 2001; European Environment Agency 2006). In terms of land, natural habitat and related biodiversity on urban fringes is rapidly lost and fragmented. This takes place through urbanisation and its secondary edge effect impacts (Laurance et al. 2007; Porensky & Young 2013). Brownfields that remain undeveloped contribute to this loss of natural land outside urban areas.

Social impacts of urban sprawl include increased distance from job opportunities, lacking social infrastructure and increased social segregation (European Environment Agency 2006, Fitchett 2014).

1.1.2. Neighbourhood decline

Brownfields areas are often associated with overall neighbourhood decline. Proven ancillary impacts include a decrease in property values and an escalation of crime (Carroll & Eger 2006; Mihaescu & Vom Hofe 2012). After the successful redevelopment of brownfields, property ownership and value have been shown to improve and crime reduced (Bacot & O'Dell 2006; Berman & Forrester 2013).

1.1.3. Public health and environmental justice

The health impacts of highly contaminated Superfund[1] sites (the worst hazardous waste sites in the US requiring central government intervention) are well documented (Lybarger et al. 1998; Austin et al. 2011; Gensburg et al. 2009; Chatham-Stephens et al. 2013; Kielb et al. 2010). Sites with known contamination may affect public health. There are statistical and spatial links between increased mortality caused by respiratory illness and cancers in communities affected by concentrated groupings of historic brownfields. It calls for a coordinated approach between the urban planning and public health aspects of brownfields redevelopment (Litt et al. 2002).

Increased incidence of illness close to contaminated sites is one of the origins of the environmental justice movement (Pellow 2004; Schlosberg 2007; Bullard & Johnson 2000). This movement, started in Warren County in 1982, highlights the fact that low-income citizens in many countries are exposed to unsafe polluting industries and sites, active and closed, that their more affluent counterparts are not (Bullard & Johnson 2000; Pastor et al. 2001; Eckerd & Keeler 2012a; Litt et al. 2002).

Sufficient evidence suggest that by the end of the 1990s, low-income communities had had to face greater health and safety risks in their workplace and communities than high-income communities (Bullard & Johnson 2000; Eckerd & Keeler 2012b). According to one estimate, contaminated sites were the source of disease burden in 20% of cases in developing nations (Blacksmith Institute n.d.; Chatham-Stephens et al. 2013).

1.2. Redevelopment of brownfields

Remediating and redeveloping brownfields helps to combat the negative impacts described above. This includes consolidation of the built urban form, preservation of natural habitat and open spaces, community revitalisation and improvement in

[1]In the US, contamination cases such as Love Canal and Valley of the Drums in the late 1970s caused the central government to promulgate the Comprehensive Environmental Response and Liabilities Act (CERCLA) in 1980, which became known as the Superfund (De Souza 2001).

property value and crime rates (Dorsey 2003; Lange & McNeil 2004; Wedding & Crawford-Brown 2007; Steiner 2014; Bacot & O'Dell 2006; Berman & Forrester 2013). Understanding the redevelopment of brownfields is therefore an important part of a sustainable urban future as originally envisaged in 1987 when "Our Common Future" was published by the United Nations World Commission for Environment and Development (Brundtland 1987).

A correlation can be drawn in the UK between environmental concern for the scale of greenfields development and government interest in brownfield redevelopment. As a result, by 2000, a policy target was set to provide 60% of new housing on previously developed land. By 2004, 50 - 70% of new housing projects were already being undertaken on previously developed land in urban areas (Adams et al. 2010, pp.96–97).

Brownfields development is one of the few initiatives that benefit both public health and environment both in the core and the edge of the city, as it reduced environmental pressure on the urban edge, and betters unused city centre industrial areas (Greenberg et al. 2001).

1.2.1. Current knowledge on brownfields remediation and redevelopment

Policy and knowledge development

At the onset of brownfields redevelopment in the late 1990s, the original focus was on identifying investment decisions and barriers to redevelopment (Yount & Meyer 1999; McCarthy 2002; Accordino & Johnson 2002; De Sousa 2001).

Some of these barriers included variability and complexity of legal procedures/regulation, uncertainty regarding liability for clean-up, and a lack of balanced funding sources (Yount & Meyer 1999; De Sousa 2001; Howland 2003a; Noonan & Vidich 1992; Nijkamp et al. 2002; Alberini et al. 2005).

With regard to environmental risk assessment of brownfield sites, the "elimination of risk" method was previously used, meaning that no health risks should remain after remediation, which made the cost of clean-up very high. More recently, the "minimisation of risk" method to ameliorate and redevelop sites is currently being implemented, where remediation is done according to the end land use (typically

classed in industrial, commercial or residential) (Noonan & Vidich 1992; CARACAS & LQM 1998; Agostini et al. 2012; Zabeo et al. 2011; Luo et al. 2009).

The implementation of the ‘minimisation of risk” methodology results in the high-risk areas of a site being intensively remediated and monitored, and other lower risk areas left as is. This decreases clean-up costs, and allows redevelopment according to risk zones on the property.

Through decision analysis methods, and tools informing planning and implementation of clean-up efforts, risk assessments are conducted on a regional and site level prior to redevelopment. This reduces the time and cost spent prior to clean-up measures being implemented (Pizzol et al. 2011; Schädler et al. 2012; Chen & Ma 2013; Bello-Dambatta et al. 2009; Luo et al. 2009). For example, site attributes such as zoning, land value, contamination risk, clean-up cost, ownership structure, and proximity to infrastructure will be gathered. These attributes are then statistically analysed according to multi-criteria. This improves decision-making before the implementation of the measures needed for redevelopment.

Since the early 2000s, redevelopment activity and the number of completed projects worldwide has increased significantly. It has therefore become possible to study the outcome of the many projects executed in various countries in order to understand whether these have been successful or not (Wedding & Crawford-Brown 2007; Tonin 2014; Frantal et al. 2013; De Sousa 2006).

The three stage policy maturity model proposed by Adams et al. (2010) provides a framework within which most policy development and research regarding brownfields can be grouped. These include:

> Stage 1 - understanding brownfields by definition and mapping; stage 2 - recognising potential and securing commitment; and stage 3 - generating engagement with the private sector (Adams et al 2010: 76).

Knowledge of the different stages of policy maturity to facilitate clean-up, redevelopment and involvement of the private sector has improved significantly (Adams et al. 2010; Luo et al. 2009; Spínola & Philippi 2011; Pediaditi et al. 2010; Hollander 2010).

Measuring redevelopment outcomes

Success factors for brownfields redevelopment is a constant theme of research in international literature (De Sousa 2001; Nijkamp et al. 2002; Lange & McNeil 2004; Bacot & O'Dell 2006; Osman et al. 2015). Some of the key factors influencing brownfields redevelopment are level of contamination, legal compliance, uncertainty regarding liability, second land-use options, economy of scale of developments, distance from city centres and infrastructure, and funding (De Sousa 2001; Nijkamp et al. 2002; Yount & Meyer 1999; Lange & McNeil 2004; Amekudzi & Fomunung 2004). Social factors such as public health and public pressure are also relevant (Osman et al. 2015; Litt et al. 2002).

In order to hasten the path towards mature brownfields policies and more redevelopment projects in South Africa and other developing nations, it is necessary to appreciate and apply international lessons from developed countries.

With the growth of sustainable development as practice (Dorsey 2003), sustainable remediation has become an underlying principle of brownfields remediation (Nijkamp et al. 2002; Vamerali et al. 2009; Brecheisen & Theis 2013; Holland 2011; Holland et al. 2011; USEPA 2008). The United States Environmental Protection Agency (USEPA) defines green remediation as:

> The practice of considering all environmental effects of remedy implementation and incorporating options to maximise net environmental benefit of clean-up actions (USEPA 2008: 1).

Sustainable remediation considers aspects such as the energy usage and related carbon emissions of clean-up (USEPA 2008; Hou et al. 2014). Related topics include passive instead of active treatment of contaminants through bioremediation (Vandenhove 2013; Shah & Braun 2004), brownfields "greening" (open space and related second uses) (Pediaditi et al. 2010; Siikamäki & Wernstedt 2008), and using contaminated sites for renewable energy projects (Jensen 2010; Adelaja et al. 2010).

1.3. Research problem

Common contributing factors to the success or failure of brownfield site redevelopment projects in South Africa are not well understood or documented (Potts & Cloete 2012; Theron 2010; Kadas et al. 2008; Spínola & Philippi 2011).

There is a lack of research output from South Africa on brownfields, when compared to the international body of knowledge. South Africa has a short history of managing contaminated land. The first Act to address contaminated land (NEMWA) was published in South Africa in 2008, and the associated framework document[2] on contaminated land assessment was published in 2010. The contaminated land section of NEMWA was enacted in 2014 with specific regulations attached.

Sites such as Iscor Pretoria and the erstwhile Iscor Vanderbijl (now Arcellor Mittal), various Transnet sites, and inner city industrial land parcels remain in need of remediation and redevelopment. However, there is a lack of incentives to attract the private sector to such redevelopments opportunities.

1.4. Research question

What are the factors that contribute to the implementation success of projects where industrial brownfield sites are remediated and subsequently redeveloped?

For the purpose of this study, “brownfields redevelopment” refers to the change of use of a site from its original industrial purpose to a new non-industrial use. Some form of development is usually associated with the new use. Derelict commercial properties that are unused due to economic or urban planning drivers, and mining land use, are excluded. Brownfields outside urban areas are also excluded.

This research aims to identify the most important factors determining the implementation success rate of brownfields redevelopment. It then tests the success factors against three local case studies, in order to improve South Africa’s understanding in the field.

1.5. Structure of this research

The literature review in this study considers the international and local body of knowledge regarding brownfield sites and their redevelopment. From this, key

[2]Framework for the Management of Contaminated Land, 2010 (Department of Environmental Affairs)

success factors of brownfields redevelopment projects are identified and discussed according to the research question as stated above. The research method, namely documentary research, is then described.

The data analysis chapter presents three South African case study sites, selected because of certain shared features, whilst providing a representative cross-section of urban brownfields in South Africa. Shared features include their location within the urban edge of Johannesburg, original industrial land use, and the intent of the landowners to redevelop brownfields land. Aspects differing among the sites include distance from the inner city, size, the certainty of contamination and redevelopment success. The case studies are:

- The 25 hectare Newtown Precinct in the city centre of Johannesburg has been redeveloped numerous times since the start of Johannesburg. The presence of contamination was not clearly established.
- The 14 hectare Egoli Gas site is located in Cottesloe between the Universities of Witwatersrand and Johannesburg. The owners began conceptualising its redevelopment plan only in 2001, but the project has not yet been implemented. The presence of contamination was clearly established.
- The 1 600 hectare AECI Modderfontein site is about 18 km away from the city centre of Johannesburg. Heartland Properties started the redevelopment activities on unused Explosive Act buffer land in 2000. A significant portion of the property was recently sold to the Hong-Kong based property developer Zendai, currently in the process of redeveloping the land. The presence of contamination was likely but not clearly established.

Each case is contextualised, followed by a description of its data sources, and the presentation and analysis of data. Possible associated success factors are highlighted, and a preliminary analysis of each case study provided.

The cases are then evaluated against the identified redevelopment success factors from the literature in the discussion chapter. The conclusion highlights features of each success factor, and potential generalisation for future brownfield redevelopments. Future research opportunities are lastly identified.

2. Literature review

The structure and purpose of this literature review is threefold.

Firstly, the international body of knowledge regarding contaminated sites and their redevelopment is broadly reviewed. This includes the various definitions, assessment methodologies and redevelopment of brownfield sites. Publications in the field of brownfields predominate in developed economies such as Europe, the UK and the US. The associated research output can be considered “best practice”.

Secondly, brownfields redevelopment in South Africa and other developing nations is reviewed. Policy development in especially South America is explored as a parallel to South Africa. Brownfields practice in these economies is not well-developed, with limited available publications, apart from legislative regimes of contaminated land. South Africa’s research output in the field is also discussed.

Thirdly, key factors that contribute to the implementation success of brownfields redevelopment projects are identified and discussed according to the research question.

2.1. Definitions of brownfields

The USEPA defined brownfields as:

> Real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant (USEPA 2015).

Contaminated brownfield sites are generally distinguished from Superfund sites (see glossary), in that they have low levels of pollution and can therefore often be redeveloped (Local Government Environmental Assistance Network 2016).

In the UK, greater emphasis has been placed on “derelict land” or “previously developed land.” Brownfields was a much later addition to the vocabulary (de Souza 2010). The term “brownfield” was originally used simply as the opposite of “greenfield” (Alker et al. 2000). A “greenfield” is a previously undeveloped property often on the outskirts of urban areas (Dorsey 2003). There is no strong connection

in the UK between “brownfields” and “contamination” as is the case in the US and Canada (Adams et al. 2010).

CABERNET’s definition of brownfields, representing a European perspective, reads:

> Sites that have been affected by the former uses of the sites and surrounding land; are derelict and underused; many have real or perceived contamination problems; are mainly in developed urban areas; and require intervention to bring them back to beneficial use (CABERNET 2006).

This is still the most commonly used definition in Europe today. The term brownfield is not consistently used in Europe, but the region faces similar challenges to the US regarding contaminated sites, brownfields, and urban sprawl (Vanheusden 2007; European Environment Agency 2006; Erdem & Nassauer 2013; CARACAS & LQM 1998).

Potts & Cloete (2012) propose the following definition for brownfields for South Africa:

> A brownfield site is infill land or premises where remedial action is required prior to redevelopment. It may also be vacant, derelict or contaminated. No specific land use is attributed (Potts & Cloete 2012, p.395).

The authors proposed to add *infill* to the general international definition, thereby referring to land within the urban edge.

Most brownfield definitions agree on the inclusion of derelict industrial or commercial sites, their location inside the urban edge, the possibility of contamination, and some level of intervention required prior to development (USEPA 2015; CABERNET 2006; Adams et al. 2010; NICOLE Brownfield Working Group 2011).

2.2. Aspects of brownfields

2.2.1. Risk assessment

Remedial action according to predefined standards are typically the outcome of site or risk assessments, which attempt to determine the risk of pollution/contamination

to human health and the environment. A phase one, or preliminary site assessment should only make use of interviews and cursory investigation; whereas phase two, or detailed assessments require intrusive sampling of various media, testing and pollution plume determination (Noonan & Vidich 1992; Ferguson et al. 1999).

Formerly, regulators drove the *elimination of risk*, which often made clean-up very expensive. Thinking has evolved towards minimisation or management of risk - focussing on high-risk areas on a site for dedicated clean-up, or encapsulation to prevent the spread of contamination (Ferguson et al. 1999; Hollander et al. 2010). Lower risk areas are then often fully redeveloped.

Hamilton and Viscusi (1999) conducted research on the financial efficacy of the conservative approach of the Superfund clean-ups and the measured health benefits thereof. The requirement in 1986 was that the on-site risk assessment consider the hypothetical risk to future individual residents. This study found that in the majority of 150 sample sites, a high population risk of cancer occurred in a small percentage of cases, and was otherwise mostly low. It was proposed that cost of remediation should rather be linked to explicit benefits. The authors also showed that blanket "elimination of risk" with fixed standards is perhaps not cost-effective, and that minimisation/management of risk methods should rather be applied.

CARACAS conducted research regarding contaminated land risk assessment in 16 European nations between 1996 and 1998. Ferguson (1999) summarised the findings of the CARACAS research. The findings identify the seminal contamination cases in various countries. Clean-up requirements imposed by these governments commonly included full remediation to pre-contamination conditions.

Ferguson (1999) further wrote that the *elimination of risk* standards applied in the two decades before the research was widely regarded as technically and economically unfeasible, and policies moved towards *fitness for use.* The timing, application and standards from country to country varied. For example, the Dutch soil screening values were first to be developed, and widely referenced internationally. These were reduced in 1997 to less stringent *fitness for use* standards. *Fitness for use* is also termed *minimisation of risk* by other authors.

Certain fundamental principles were common in the analysis of the 16 countries. These included the intention to limit future pollution, application of the polluter pays principle with assistance to innocent land owners, the precautionary principle, and the risk-based approach informing remediation activities (Ferguson 1999).

CARACAS identified the differences between countries. These included the use of generic guideline values for various media, decision-support procedures for remediation and integration of risk assessment thinking into site designs. Common issues faced were reducing the cost of addressing contamination against public health and business confidence parameters.

There is alignment between Hamilton and Viscusi (1999) and Ferguson (1999) on the change from elimination of risk to fitness for use thinking in risk assessment and management around 1999. It has since been engrained into numerous countries' risk assessment standards (Luo et al. 2009).

Conceptual site models – source-pathway-receptor

One of the critical drivers for the degree of remediation to be undertaken is the risk that the contaminants pose to the surrounding environmental or human receptors. The *conceptual site model* illustrates a hypothesis of how the pollution source, the pathway (the environmental media in which the contaminant is transported) and the receptor (the environmental habitat, animal or human community at risk of being impacted) is linked.

This method of risk assessment for contaminated sites was first documented in the late 1970s and is still applicable (Luo et al. 2009; Thomsen et al. 2016). Conceptual site models are commonly applied in groundwater modelling practice.

Fields such as ecotoxicology (Hoffman et al. 2003) and bioavailability (Latawiec et al. 2010) have recently been added to the many complex variables affecting this pollutant linkage concept.

2.2.2. Decision analysis and brownfields

Decision analysis methods are widely used to assist decision makers with the uncertainties, complexities and risks associated with contaminated land (Bello-Dambatta et al. 2009).

Noonan and Vidich (1992) described the concern in real estate purchase of the possibility of contamination. If the site was known to be contaminated, a hazardous waste risk assessment could be undertaken as part of the land sale agreement. The cost of assessment was often greater than the property purchase price, and in such cases guidance on the need of contamination testing for purchases was required. The authors set out a decision tree model for deciding which level of site assessments should be used, based on original land use. This is an example of site-level decision analysis with a useful decision-making matrix.

Pollard et al. (2004) critically reviewed the evolution of decision making for contaminated land, from cost-focus in the 1970s to technology-centeredness in the 1980s, risk-based decisions of the 1990s and sustainability drivers of post-2000. Decision-making in the new millennium was described as increasingly complex. Aspects such as liability, funding, community acceptance, expected success of various clean-ups and land use all have to be considered. The question was posed whether the various decision-making processes did in fact support integrated decision-making.

The authors found that potential pitfalls come into play as decision tools are applied to brownfields. On the one hand, decision-makers can overestimate these methods' ability to improve integration. On the other hand, where some pragmatists believe they can conclude decisions without tools, the structured analysis that tools provide do increase consistency and provides transparency to stakeholders. Pollard et al. (2004) further referred to quick screening techniques such as the *rapid appraisal technique,* often suitable for simpler projects, and *technical appraisal* being required for more complex projects with more parameters

The study concludes that decision-analysis adds value by making the roadmap to decisions transparent. Further, decisions made on a purely technical basis without consideration of other aspects, is unacceptable to stakeholders. A broader suite of

decision tools is required when moving from contaminated land into brownfields redevelopment, as additional parameters come into play. Pollard's study provided a framework for decision-making for the redevelopment of brownfield sites (Pollard et al. 2004).

A study by Bello-Dambatta et al. (2009) reviewed various decision analysis methods for contaminated land. The Multi-Criteria Decision Analysis (MCDA) was accepted as the overarching method that assists with complex decisions, uncertainty and many conflicting criteria that requires trade-offs and various alternatives. MCDA is then further divided into *Multi-Attribute Decision Analysis (MADA)* and *Multi-Objective Decision Analysis (MODA)*. *MADA* is commonly used for problems with simple, well defined alternatives. It is commonly used for contaminated land. More complex tools used include *Multi-Attribute Value Theories* (MAVT), *outranking techniques* and *Analytical Hierarchy Process* (AHP).

The authors focused on the *Analytical Hierarchy Process* (AHP) as widely used and growing methodology. AHP is a decision method that has been applied in thousands of projects for other fields, but not yet to brownfields. AHP is put forward as a decision making tool that is inclusive (understood by lay-people), rational, consistent and defensible, by simplifying complex problems and also measure inconsistency in decision making. More case studies are required in order to prove the statement that AHP is superior as decision analysis tool, but it has obvious advantages (Bello-Dambatta et al. 2009).

Schädler et al. (2012) wrote that the conflicting goals of maximising land value, minimising clean-up costs and adding to sustainable development were not easily brought together, and therefore large "mega" brownfields sites remain derelict. The paper described the compilation of an integrated assessment model that considers redevelopment alternatives of "mega" contaminated sites through a spatial decision support system (SDSS).

This spatial decision support system is a form of MCDA. The paper evaluated all the required criteria to determine the best (land use, economical and sustainable) redevelopment options in a comprehensive decision model. The model does not require significant base data and statistical analysis. It is a good example of a

complex modern MCDA exercise and address the aspects required as noted by Pollard et al. (2004).

Decision support and analysis tools are important for brownfields regeneration because of the complex multi-faceted nature of these projects, in not only cost, method and feasibility but more recently the need to measure which options are more sustainable and acceptable to stakeholders. Many of these parameters are hard to measure and weight. Greater transparency is required to show due process to stakeholders and regulators alike.

2.3. South African context and body of knowledge

2.3.1. Relevant legislation

The discussion below focuses on the legislation with regard to the most pertinent environmental media for contaminated land/brownfield sites. These include soil, surface and groundwater.

In the Constitution of the Republic of South Africa of 1996, the right to a clean and protected environment is provided for in section 24. The prevention of pollution and ecological degradation through legislation and related measures are included (Republic of South Africa 1996).

This principle was incorporated in Chapter 2 sustainability principles of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) which indicates that pollution and environmental degradation should be avoided, and where this is not possible should be minimised and remedied. These sustainability principles address waste as well, including the avoidance, minimisation, re-use, recycling and disposal in a responsible manner (Republic of South Africa 1998a). The National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) was only promulgated in 2008.

The Department of Environmental Affairs (DEA) published a framework document for the management of contaminated land in 2010 (DEA 2010). This was followed by the publication of the “norms and standards” in 2014.

Section 8 of NEMWA came into effect in May 2014, when *Government Notice No. 331*, the *National Norms and Standards for the Remediation of Contaminated Land*

and Soil Quality was promulgated on 2 May 2014. It deals with identification and remediation of contaminated land. The *norms and standards* aimed to provide a uniform national approach to determining contamination status, provide clarity on the method and criteria for assessment, and the provision of minimum standards for assessment (DEA 2014).

Soil screening values were also provided for specific land uses ranging from industrial to residential use. After the outcome of a site assessment report, a landowner may be ordered to remediate immediately, within a specific timeframe, or only monitor contamination, depending on the human health and environmental risk (Kvalsig 2014).

Herselmann et al. (2013) conducted research to show that the methodology of using a single set of soil screening values for the entire South Africa was not correct. Different soils were shown to react differently to contaminants, and a host of other factors such as pH and temperature affect contamination of soils. The findings place a great responsibility on practitioners to conduct the correct method for soil, surface water and groundwater analysis, with due consideration for the local conditions of a site.

Apart from the norms and standards for contaminated land, there are numerous other regulations in the waste management sector, including aspects such as the classification, disposal and design of containment barriers for waste.

Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) in South Africa identifies a number of water uses which need to be licensed by the Department of Water and Sanitation (DWS). One of these are:

> 21 (g) disposing of waste in a manner which may detrimentally impact on a water resource …" (Republic of South Africa 1998b)

This places an onus on site owners to prevent pollution of water resources via leachate from waste and contaminated soil bodies, and monitoring of surface and groundwater resources to prove such prevention.

2.3.2. Urban planning policies

In order to prevent urban sprawl, most of the metropolitan areas in South Africa's planning policies promote the redevelopment of brownfield sites as part of infill development (Turok 2015). These policies do not address the aspect of contamination or pollution, as this falls within the ambit of the DEA, the provincial environmental authorities and the Department of Water and Sanitation (DWS).

2.3.3. Research output

The knowledge and expertise from the mining sector is invaluable to brownfield sites in South Africa and may assist to provide remediation solutions for many contaminated properties. It is often focused on the issue of mine closure, such as the Rehabilitation Prioritisation Index (RPI) for asbestos mines in 2008 (Van Rensburg et al. 2009).

Research output regarding brownfields regeneration is very limited in South Africa. Research is still exploratory (Potts & Cloete 2012) and the redevelopment of brownfields still a novelty (Theron 2010; Seeliger & Turok 2015). The questioning of the correctness of Soil Screening Values in the recently promulgated Norms and Standards for Contaminated Land by Herselmann et al. (2013) confirms the lack of knowledge and understanding.

Theron (2010) provided an overview of the concepts of brownfields redevelopment from the writer's international experience. This was then used to critique the South African context, including two local case studies. The article indicated that South Africa was at the beginning of its brownfields redevelopment era, that innovation and experience from the private sector will be required for successful projects, that professional project teams must be diverse, well experienced and adaptable to improve chances of success. Lastly, uncertainty regarding liability from the private sector as well as a low interest of government to redevelop contaminated sites were noted as obstacles to success.

Potts & Cloete (2012) sent questionnaires and held interviews with various stakeholder groups, towards developing brownfield guidelines for South Africa. Findings were that there was little understanding among stakeholders regarding

brownfields, but that private sector groups were interested in the redevelopment of brownfields.

Seeliger & Turok (2015) conducted interviews with well-known developers in Cape Town, Johannesburg and Durban. Most developers active in these metropolitan areas were of the opinion that brownfields redevelopment projects are too risky, and preferred to work in greenfield environments, or take part in the selective green building movement (Seeliger & Turok 2015). Despite this, there was a niche of developers who have been successful. The authors also noted that some banks were starting to provide loans for brownfield developments.

2.3.4. Successful projects

Despite the low maturity of the sector in South Africa, there have been some successful (privately driven) brownfield site redevelopments.

Van Zyl (2005) provided a brief history and review of the success of the Victoria and Albert Waterfront in Cape Town, which was converted from a shipyard to a mixed-use development. The area became isolated and derelict by the 1970s. A steering committee was set up in 1984, and the South African Cabinet accepted the redevelopment proposal in 1988. Some harbour functions were retained, but entertainment, retail and residential uses added. The development was found to be successful. This view is re-iterated by other authors (Ferreira & Visser 2007). Apart from the town planning approvals required, no environmental legislation was yet in place at the time, as the Environmental Impact Assessment (EIA) regulations in terms of the Environment Conservation Act (1989) were only promulgated in April 1998. This may have simplified the approvals process.

Theron (2010) describes the Thesen Island redevelopment in the Knysna River estuary. The island was originally used as a timber-processing plant. Barloworld purchased the island and its timber plant. With growing community concern regarding contamination and pollution, and its location in an ecologically sensitive estuary, plans for redevelopment were the only feasible way forward. Contaminated soil at the timber lay-down area and pressure tanks were excavated and removed to the Vissershok hazardous landfill site in Cape Town. The redevelopment planning process was initiated in 1991 by Dr. Chris Mulder. A voluntary EIA process was

undertaken. Due to the sensitive lagoon system, extensive planning and regulatory approvals were only approved in 1998.

The Ebotse Golf Estate development on an old sand quarry in Benoni in 2007 was documented by Le Roux (2007). The site included a large excavated area and a slimes dam with 975 000 m^3 of clayey material. Town planning and EIA processes had to be undertaken and were both approved. Clay quarries have successfully been redeveloped in many cases, due to their non-polluting nature (Pearman 2009).

2.4. Redevelopment of brownfields

2.4.1. Barriers to redevelopment

De Souza (2001) considered the obstacles faced by private developers in Canada, Europe and the US when engaging in brownfields. These barriers identified include legal inconsistency, poor inventories of location and condition of these sites, the absence of standard implementable clean-up guidelines, remediation liability uncertainty, and poor funding options.

De Souza's paper (2001) found that variability in particularly the US and Europe were decreasing. Governments were further setting up brownfields databases more often, assisting with funding for remediation and simplifying liabilities and regulations. This stemmed from a realisation in governments that it is impossible for them alone to remediate and redevelop the many sites. Authorities in all three contexts were thus seeking policies that reduced cost and risk for the private sector to attract its investment. Instead of requiring clean-up outcomes to achieve pre-development conditions, the US, European and Canadian governments were moving towards less stringent, flexible, site-specific risk assessments. These risk assessments should be linked to future land use, to lower costs.

Nijkamp et al. (2002) used a systemic approach to analyse soil remediation policy in the Dutch context based on 18 case studies. Legal regulations, balanced financing and accountability of the current owner were found to be causes of stagnation in brownfields redevelopment.

The De Souza (2001) and Nijkamp et al. (2002) papers both highlight various stagnation factors to the successful redevelopment of brownfields sites; namely cumbersome legal requirements, lack of funding options, and remediation liability.

McQueen (2011) analysed some of the key variables in the brownfields development process in a Canadian context. With regard to redevelopment barriers, it was found that tax incentives are often too late in the redevelopment process, and that private developers need grant and funding options at the onset of a redevelopment project.

The Urban Development Zone (UDZ) scheme in South Africa was initiated in 2004, and offers tax-deduction incentives for development in the urban core of cities. It is described in greater detail in section 2.5 below.

Other barriers identified in South Africa were inflexibility of zoning and development options by local government regarding, for example, interim use or industrial-residential combination (Potts & Cloete 2012).

Dixon et al. (2011) found that urban regeneration policies based on the redevelopment of brownfield sites came under threat due to economic recession. More marginal sites, often smaller, longer in disuse, and often with known contamination, were often left unused. This was due to their high remediation cost, and lowering property values (Dixon et al. 2011a, p.96). Marginal brownfield sites therefore appear to be more vulnerable to poor market conditions than larger, better-located and low-contamination brownfield sites.

Frantal et al. (2013) investigated brownfield redevelopment projects in the Czech Republic. The greatest proportion of redeveloped sites had simple ownership structures. These findings reconfirmed those of Adams et al. (2001) where complex, multiple ownership of brownfield sites was found to be a barrier to redevelopment.

2.4.2. Analysis of redevelopment outcomes

Concerning the outcomes of brownfield redevelopment, aspects such as sustainability, environmental justice, and determining success or failure factors have been studied intensively. This contributes to understanding for future projects and the needs of each stakeholder involved. Section 2.5 below focuses on the identification of factors that contribute to redevelopment success.

2.5. Key contributing factors influencing brownfields redevelopment success

Factors influencing the outcome of brownfield redevelopment initiatives have been studied widely (Noonan & Vidich 1992; De Sousa 2001; Nijkamp et al. 2002; Lange & McNeil 2004; Amekudzi & Fomunung 2004; Bacot & O'Dell 2006; McQueen 2011; Dixon et al. 2011b; Osman et al. 2015). Some key factors emerge which influence the success of brownfields redevelopment from a range of studies undertaken. These factors are each discussed and analysed below.

2.5.1. Factor one: Sites with little or no contamination are more readily redeveloped

Howland (2003) investigated three case studies in Baltimore, all originally industrial sites, to investigate the boundary between government and privately funded brownfields redevelopments.

Camden Crossing was a government-funded site with a complex clean-up plan, and earmarked for residential development. This redevelopment failed due to poor market demand, a heavily contaminated site, proposals for residential use, which required more intensive remediation, and the inexperience of the developers. The project was also delayed, resulting in local and state government administrative changes, and changes to remediation standards. The residential end use was because of lobbying by adjacent community groups with the city, instead of pure market analysis, which might have suggested other uses also.

Two other sites, with low levels of contamination, were successfully redeveloped for industrial use by the private sector. The end-user market for these sites, namely port-related warehousing, was consistent at the time, when compared to the fragile residential market of Camden Crossing. Redevelopment to the same industrial land use meant much cheaper remediation, and quicker acceptance and approvals from city officials. The developers also had strong experience in the industrial market.

Howland (2003) concluded that sites with strong market demand and low levels of contamination would more likely be initiated and funded solely by the private sector alone. More complex clean-ups were found to require more government funding.

Bacot & O'Dell (2006) determined useful economic and environmental criteria for measuring local government brownfields programs. Where increases in property

values, levels of private sector investment, interest in grant funding and effective remediation of hazardous contamination took place, the brownfields programme was deemed to be working.

The authors found a positive correlation between hazardous contamination scores and private investment, in that the remediation of highly polluted sites was not possible without dedicated private sector participation.

An inverse relationship was shown between the level of groundwater and soil contamination and property valuation. Sites with less contamination had a higher commercial value than sites with a high degree of contamination.

Osman et al. 2015 used two national datasets (in the Czech Republic) to determine factors that have a significant influence on successful brownfields regeneration. These were the CzechInvest listing existing brownfields, and the authors' own database of successfully regenerated sites (including both contaminated and uncontaminated brownfields. The authors found that factors such as human and environmental health were drivers towards the public pressure placed on landowners to remediate especially contaminated brownfields for redevelopment. In the study, the redevelopment (linked with remediation) rate of contaminated sites was more than 50 %, as opposed to one-third for uncontaminated sites (Osman et al. 2015, p.314). Therefore, public pressure was found to be less for uncontaminated brownfields.

Lange & McNeil (2004) statistically analysed data collected from two national surveys in the US. They concluded that factors other than environmental aspects like contamination and remediation have an impact on the success rates of brownfield redevelopment. The more successful sites appear to have adopted a risk-based clean-up approach (by determining clean-up criteria on the second use).

Another example of the risk-based approach is documented by Winson-Geideman et al. (2004). In this study of 169 sites, about one-third of redevelopments made use of encapsulation (an engineered barrier between the contamination source and receptors), thus following the risk-based approach. In both these cases, this reduced the impact of contamination level as a success factor.

Critique

Howland (2003) and Bacot & O'Dell (2006) appear to have opposing findings with regard to private sector investment in highly contaminated sites. However, this contradiction merely emphasises that sites earmarked for redevelopment with high complexity regarding clean-up are best served by a wide range of stakeholders (private, state and communities). This varied input reduces risk, improves decision-making, and gains buy-in from all stakeholders.

Howland (2003) further proves that local government does not necessarily possess the technical, business knowledge or mobility of the private sector. The strong local market knowledge and experience of private developers are required for redevelopment project.

Although the study does not address the level of contamination, Osman (2015) proved that public pressure due to environmental health is a driver for brownfields with known contamination to be redeveloped.

Findings of Lange & McNeil (2004) and (Winson-Geideman et al. 2004) namely that a risk-based approach, including encapsulation can reduce the impact of contamination level as a deciding factor, has long term implications. Although this appears to be a logical option to save cost, it would in a South African context require regular monitoring. Surface and groundwater up- and downstream of such an area would have to be monitored to ensure the pollution plume remains stable. These monitoring costs should be considered as long-term operational costs to redevelopment.

2.5.2. Factor two: Mature brownfields management policies facilitate development

As nations become aware of the impact of pollution, contaminated land and the need for remediation/redevelopment, the need arises to devise strategies and regulate associated activities in the brownfields redevelopment sector (Adams et al. 2010). In both developed and developing nations, the contaminated land and subsequent brownfields policy and clean-up requirements are a widely studied topic. Authors have investigated which policies work best, and compare different states or country

models to one another (De Sousa 2001; Kadas et al. 2008; Spínola & Philippi 2011; Vanheusden 2007; Luo et al. 2009).

The three-stage policy maturity model (Adams et al. 2010) as described in section one above provides a framework within which most policy development and related research can be grouped.

These are as follows:

- Stage 1 - understanding brownfields
    - (1a) definition, and
    - (1b) mapping;
- Stage 2 - recognising potential and securing commitment; and
- Stage 3 - generating engagement with the private sector.

Policy development in developed nations

For developed nations, the brownfields regime is more than 25 years old (Hollander et al. 2010) and first used in the US in the early 1990s. These countries have grappled with compliance, standards and evaluation of sites and matured in thinking to where brownfields redevelopment is encouraged through many incentives, funding options and knowledge in its applications. The US, UK and Europe are the most prominent among these. The USEPA clean-up guidelines remain the standard to which all states must comply as a minimum (De Souza 2001).

De Souza (2001) studied the Canadian context of contaminated land policy and compared it to US and European policy at the time. De Souza found that, contrary to the US, Canada has a lack of standardised and practical clean-up criteria, due to each state approaching brownfields in a different manner. This created complexity, uncertainty and variability among the different states in the character and application of regulations. This is so because these states have the right to adopt and amend the national clean-up values and guidelines generated by the Canadian Council of Ministers of the Environment.

Nijkamp (2002) investigated the Dutch brownfields regime, and conducted 18 case studies to determine success factors for sustainable urban brownfield development.

It was found that onerous, impractical legal procedures may cause stagnation in the planning process.

Vanheusden (2007) considered the brownfields legal regimes of the European Union and member country situation and compares it to that of the US. Belgium was used as a case study, and it was found that the US was ahead of the EU in progressive policy development and consistency in many aspects.

In the European Union, each country has its own standards and laws, creating similar confusion to the Canadian case (De Souza, 2001). Each member state of the EU still has its own laws, regulations and policies, often at different stages of maturity based on its political history and context. As definitions and application regarding contaminated sites and brownfields differ among member states, a unified policy and approach is unlikely (Erdem & Nassauer 2013).

Lange & McNeill (2004) analysed data from a nationwide US survey and found that the minimisation of risk approach, as described above reduced the time to occupancy when compared to the elimination of risk approach.

McQueen (2011) analysed key variables in the development process of brownfields in Canada and found that stringent clean-up regulations can slow the progression of projects. Whereas developers preferred risk-based clean-ups (instead of complete clean-ups), monitoring periods still take time. McQueen proposed that policies regarding development approvals should be shortened to offset time lost for remediation.

A risk-based approach, similar to the US approach, has been adopted in the UK (Ren et al. 2015). Risk management, as opposed to risk elimination, was considered to be the more mature approach.

Brownfields policy in the UK was found to be closely linked to sustainable development for the prevention of urban sprawl (Adams et al. 2010; Dixon et al. 2011b). Government has contributed significantly to brownfields housing projects, thus making it more attractive for the private sector to invest in these redevelopments. These initiatives were strongly linked to the unwillingness of the public to simply allow urban sprawl and concern for the little space left for development in the UK as a whole. De Souza (2001) found that the authorities in

Canada were slower to change policy than comparable countries such as the UK, due in part to a lack of the threat of urban sprawl.

Policy development in developing nations

The contaminated land regime of developing nations such as Brazil and South Africa are still new (Kadas et al. 2008; Kvalsig 2014). Brownfields redevelopment is a novelty, as noted by Seeliger & Turok (2015). Research and issues relevant to the developed nations in the early 2000s are relevant for these developing countries now, and may provide applicable “lessons learnt” as they follow a similar trend of thinking, policy development and practice (Spínola & Philippi 2011; Kadas et al. 2008; Mabahwi et al. 2012; Potts & Cloete 2012).

Potts & Cloete (2012) investigated brownfields policy development in South Africa. On the question to respondents of what aspects should be included in a brownfields policy, it was indicated that tax incentives were considered an important aspect. In the conclusion, the writers indicated that private sector respondents interviewed did not prefer tax breaks as funding method.

When considering the large amount of investment in the Johannesburg Urban Development Zone (UDZ), namely R9 billion (City of Johannesburg 2012), the provision of a tax incentive is an obvious aspect to include in brownfields policy. Public-private partnerships are also proposed, but this is a highly regulated and cumbersome method, and known to slow down progression.

Potts & Cloete (2012) found no evidence of a brownfields inventory or policy for South Africa. These authors suggest potential aspects to be included in such an inventory. These include community profiling, public participation and special brownfields units. It considers brownfields in a holistic manner, not only looking at contaminated land.

Kadas et al. (2008) provided an overview of legislative regimes for contaminated land in Argentina, Brazil, Chile, Colombia, Ecuador, Mexico and Peru. The authors established that the levels of policy development and the regulation of contaminated land vary greatly in these countries. The region was improving with regard to regulation of contaminated land management and liability. As a first step, the “polluter pays” principle was already broadly implemented.

Spínola & Philippi (2011) discuss contaminated land and related policies in the state of São Paulo, Brazil in recent years. The Environmental Company of the State of São Paulo started managing contaminated sites in the 1990s, and published a yearly inventory of these sites for the state in 2002.

The authors indicated that Brazil did not yet have an approved national policy regarding contaminated sites management or brownfields in 2011. Site closure requirements were captured in “deactivation plans”, and the creation of a “fund” for orphaned sites was also allowed for. The “fitness for use” approach as described by Ferguson (1999) was adopted in related legislation of 2009.

It further requires involvement in contaminated sites management by municipalities through master plans and land use plans – thereby acknowledging the need and participation of municipalities in the matter. Although it appears that only the city of São Paulo was actively involved in planning for such sites, it highlights the importance of urban planning involvement of local government in brownfields redevelopment. This is one of the necessary principles put forward by Hollander et al. (2010). The concept of brownfields redevelopment is not mentioned by Spinola & Phillipi (2011), indicating a similar maturity level to that of South Africa, where contamination is still the focus.

Luo et al. (2009) described the Chinese contaminated land regime and sought to find solutions from the risk-based approach used in the UK. The Chinese government first recognised contaminated land as a problem in 2006. Issues with policy mentioned were a lack of a clear policy framework; limited supply of administrators and organisations dealing with the matter, little technical expertise, and no financial incentives for clean-up processes.

Teng et al. (2014) documented the history of soil quality monitoring in China, and confirmed that the Chinese Environmental Protection Administration was in process of setting up a comprehensive soil monitoring network. Contaminated land management has thus became a priority for China, and appeared to be driven by environmental health concerns, due to the country’s extensive pollution problems of the last few decades.

Ren et al. (2015) investigated a residential brownfields redevelopment in China's Tiexi industrial zone in Shenyang. The study found that despite the remediation and clean-up undertaken, some contaminants (including lead and arsenic) still remain in the soil as a human health and environmental risk. It was further confirmed that the Chinese government has not yet promulgated a regulation on brownfields management.

Critique

The literature considered from both developing and developed nations is in line with the model of Adams (2010) for policy maturity, and further with the concept of the risk-based clean-up approach. The inclusion of known or potential contamination in brownfield definitions is not universal, with the US and Canada pertinently including, and the UK and Scotland excluding contamination (Adams et al. 2010, p.99). The definition of brownfields therefore determines the contents of brownfields policy.

Vanheusden (2007) seems to be missing the key difference between the EU and the US, namely that the latter is one country, and policy-making on a national scale is a much simpler affair than in the case of the EU with its many layers of bureaucracy. This is perhaps the reason the US is more advanced than the EU in terms of policy and implementation thereof. Bureaucracy is thus a detractor to brownfields policy development due to slow decision-making.

Legal regimes seem to follow a trend of first implementing the Polluter Pays Principle, requiring remediation as contaminated land management laws are introduced (Kadas et al. 2008; Department of Environmental Affairs 2014). As time progresses and regulators realise the key role of private developers, the concept of brownfields redevelopment is then embraced (Seeliger & Turok 2015). When considering South Africa, and other Latin American case studies (Spínola & Philippi 2011), where contaminated land/brownfield redevelopment is in its infancy, it will likely take at least a decade for "developer friendly" brownfields policies to be developed.

Progressive policy must therefore be simple, practical, and consistent over various states of a country. It must also be easy to apply, and support rapid decision-making for a shorter planning approvals process. Strong policy to prevent urban sprawl,

coupled with willingness of government to invest in brownfields, creates a conducive environment for private sector investment.

South Africa has the advantage that law and policy-making is centralised on a national level, as opposed to Europe (Erdem & Nassauer 2013) or Canada (De Sousa 2001). South Africa has only defined “contaminated land”, and has not started the mapping of these sites. The country is therefore at Stage (1a) of policy development in terms of the Adams (2010) model. This is similar to other developing countries, with the exception of China, which is more organised and targeted in their approach to deal with contaminated land and brownfields development (Teng et al. 2014).

The research of Potts & Cloete (2012) is a useful starting point for South Africa and provides relevant guidance on first steps to be taken, including definitions, dedicated policy and guidelines.

Developed vs. developing country brownfields policy maturity

Some of the differences between developing and developed nation context regarding contaminated sites redevelopment are presented in Table 1.

Table 1: Expected differences between South Africa / developing countries and developed countries regarding contaminated land / brownfields redevelopment

South Africa / developing nations	UK, US and Europe
Industrialisation is still in progress	Industrialisation is largely achieved
New to the problem of contaminated sites (although mining sector in South Africa is well studied) and related human health and environmental (HHE) impacts.	Governments are familiar with the problem of contaminated sites and its impacts.
Cheap land and resulting wastage of urban space – low emphasis on urban regeneration.	Expensive land and high focus on urban regeneration.
Vast open space – receptors can often move away from perceived pollution sources.	Limited open space (UK / Europe) with receptors in close contact to polluted sites, and resulting public pressure for remediation.

South Africa / developing nations	UK, US and Europe
High rate of poverty and related exposure to pollution – low levels of community empowerment to lobby against pollution.	Lower rates of poverty – higher levels of community empowerment to lobby against pollution.
Lacking guidelines regarding contaminated sites remediation, and no policy for brownfields redevelopment.	Well-developed guidelines regarding contaminated sites and brownfield redevelopment.
Weak understanding / low capacity in regulatory / approval authorities regarding brownfields.	Strong knowledge / high capacity in regulatory / approval authorities regarding brownfields.

Sources: (Potts & Cloete 2012; Blacksmith Institute n.d.; Chatham-Stephens et al. 2013; Kadas et al. 2008; De Sousa 2006; Ren et al. 2015).

2.5.3. Factor three: Sites with certainty regarding apportionment of liability for clean-up and perception of few latent risks are more likely to be redeveloped

"Polluter Pays" Principle and related liability

The "Polluter Pays" Principle is a well-established concept; however there are opposing views on its effectiveness and best application (Ambec & Ehlers 2014; Luppi et al., 2012). Environmental liabilities can be transferred with property ownership, depending on the country of jurisdiction (Latawiec et al. 2010; Practical Law Company 2012).

There is sufficient evidence to suggest that private land owners fear liability and further regulation, which in turn prevents them from participating in redevelopment projects (Hollander 2010). Liability is perceived to increase with residential end use, as there are more users and potentially more claimants (Adams et al. 2010). Liability issues may therefore cause stagnation in the redevelopment planning process (Nijkamp et al., 2002).

Conservative assumptions regarding human health and environmental risk of contamination and permanent remediation for elimination of risk related to Superfund sites was effected at great cost. It was estimated that between 30-70% of the cost of clean-up programmes up until 1996 in the US was spent on litigation (De Souza 2001).

Avenues other than the “polluter pays” principle must considered under certain circumstances. Legal costs can exceed actual remediation costs causing the polluter to become insolvent (De Souza 2001). Historic contamination could have been considered within legal limits at the time (McGuigan 2000). Lastly, properties may have been abandoned (Accordino & Johnson 2002). These other avenues include tax incentives, voluntary clean-up programmes, and redevelopment.

Uncertainty regarding liability has therefore been established as one of the important barriers to brownfields redevelopment (Sigman 2010; McGuigan 2000; Alberini et al. 2005; De Sousa, 2001; Nijkamp et al. 2002).

The European Parliament promulgated the Environmental Liability Directive (35 of 2004), which has since then been amended three times (European Commission 2016). This directive provides the framework for preventing and remedying environmental damage through the Polluter Pays Principle (European Commission 2016). Member states still have the discretion to apply negligence as a softening tool to strict compliance (Van ’t Veld & Shogren 2012). The directive is equivalent to the Superfund in compliance, but does not make provision for central funding.

Relief from liability in the US

Only in the mid-1990s, about 15 years after the promulgation of the Superfund, did governments start experimenting with policies to stimulate both clean-up and redevelopment (Bacot & O’Dell 2006). The USEPA subsequently implemented the Brownfields Initiative in 1995 (De Sousa 2001). State governments started implementing voluntary clean-up, which provided any party willing to clean up a site with protection from further legal action once a voluntary clean-up agreement was signed. This protected redevelopers from liability (De Sousa 2001).

These more investor friendly options culminated in the Small Business Liability Relief and Brownfields Redevelopment Act (Public Law 107-118, H.R. 2869 – the “Brownfields Law”) in 2002, more than 20 years after the original CERCLA was promulgated (De Sousa 2006). As discussed above, both the Noonan and Vidich (1992) and De Souza (2001) studies referred to the aversion of private sector investment in brownfields redevelopment until the passing of the Brownfields Law.

Most importantly, the Brownfields Law provides protection from Superfund liability (which was based only on ownership of property) for prospective buyers, contiguous property owners or innocent landowners (Bacot & O'Dell 2006).

It is possible in the US to take insurance against long-term costs related to unknown issues, by any of the various parties involved in brownfields redevelopment. Such insurance provides some assurance to regulators and protection for developers (Hollander 2010).

Today many states and organisations in the US have Brownfields redevelopment toolkits and guidelines for communities to use (Council for Development Finance Agencies, 2015; British Columbia Ministry of Environment, n.d.; Massachusetts State Energy and Environmental Affairs, n.d.).

Relief from liability in Europe

De Souza (2001) recorded the generalisation of incentives across European Union (EU) member states in order to incentivise redevelopment. Some states have exempted polluters from actions considered legal at the time, or place time or value limits on retrospective liabilities (De Souza 2001). Once clean-up was approved, future liability was transferred to governmental agencies. A "fault-based allocation" system was being used as opposed to the joint and several system in the US. Europe therefore had a system of shared responsibility that reduced the uncertainty for developers (De Souza 2001).

Only France and Spain managed to successfully transfer liability to government agencies routinely, with most other countries partially or rarely achieving such transfers (NICOLE Working Group 2011).

Options for reducing liability uncertainty

When considering brownfields policy maturity, the model proposed by Adams (2010) shows that beginners in policy development tend to require elimination of risk, or compliance at all costs. The more realistic approach seeks to manage such risk, referred to as the risk-based approach (Ferguson 1999).

McQueen (2011) found that at the onset of a project, all stakeholders, namely first and second owner, and the regulator, should map out and address all liability and

risk issues, to prevent projects from suffering. Dedicating a city employee specialising in brownfields projects assisted greatly in reducing uncertainty among developers, and ensured stable process for all involved, and self-inflicted faults were also avoided in many cases (Bacot & O' Dell 2006).

Critique

Through the key change via the Brownfields Law, the US has addressed the liability issues from CERCLA satisfactorily enough that private developers have become willing players in the redevelopment process without undue fear of attracting liability (De Sousa 2001). The reduction in liability, as well as various voluntary clean-up programmes, has produced positive outcomes. Of the 46 states with such programs, less than 1% of environmental cases have been re-opened, and two thirds of these states have programs providing assistance in the form of tax incentives, direct funding, technical assistance or program support (Adams et al. 2010).

It appears that the European attempts have been less clear, due to individual member states each retaining their own legislative framework, with only France and Spain successful at transferring liability to the state once remediation was completed (NICOLE Brownfield Working Group 2011; Vanheusden 2007).

Dedicated legislation such as the Brownfields Law in the US, implemented countrywide as a minimum standard, has shown success in providing legal certainty for the many potential actors in brownfields redevelopment. Similar to the US, it is possible that RSA's brownfields redevelopment regime will benefit from dedicated policy and legislation addressing liability (Potts & Cloete 2012).

2.5.4. Factor four: Redevelopment land use options based on a risk minimisation approach improve the feasibility of brownfields projects

Due to the difficulty of determining exact human health and environmental risk, there is an ongoing debate regarding what activities/land uses should be permitted after the clean-up of a brownfields site. Whereas industrial land use has low sensitivity to risk, land use such as residential and schools are examples of land uses with high sensitivity to risk.

Activity Use Limitation, as described by Hollander et al (2010), limits risk to the new owner by the zoning of the new land uses, according to the risk assessment undertaken at the time of clean-up. It should be written into the title deed of the relevant property. It follows the minimisation of risk approach as documented by Ferguson (1999). McQueen (2011) reiterates the view that second land use should be determined by a risk-based approach.

Where end land use remains the same, e.g. industrial to industrial, it is more likely that the private sector will fund redevelopment themselves (Howland 2003a). However, industrial land use yields low returns (Winson-Geideman et al. 2004).

For residential land use, the remediation standards and human health risk is high (with unrestricted future use). Winson-Geideman et al. (2004) found that in Illinois, Cook County, properties cleaned for re-use to residential standard were half the number of those cleaned to commercial standard.

In the Czech Republic, commercial land use was a common second use choice (Frantal et al. 2013). This was reiterated by Osman et al. (2015), where it was found that second uses were mostly public facilities (service and retail), with a typical change from production to consumer activities. Given the good returns and moderate clean-up costs of commercial and retail redevelopment, investors favoured these land uses.

Inflexibility of zoning and development options by local government, such as interim use and industrial/residential combination options can be a detractor for brownfields redevelopment (McQueen 2011). Rall and Haase (2011) describe the interim use strategy adopted by Leipzig city, in which property owners in low growth and derelict areas, which showed positive results, waive rates on vacant plots in return for regular maintenance.

Lange & McNeil (2004) found that the proposed land use of more successful brownfields projects is normally consistent with the master plan for the community.

Dixon et al. (2011) indicate that the “end-product” of a redevelopment should have a sustainable long-term market demand to transcend property/economic “booms” and slumps.

Brownfields to green space

It is a well-known practice in the US and Germany to redevelop domestic landfill sites into park landscapes; and there is extensive knowledge regarding the practice and monitoring over time (Misgav et al. 2001; Laner et al. 2012).

Many examples exist of clay or stone/clay quarries that are redeveloped for open space or residential purposes due to their low pollution potential and health risk, such as the Eden Project in the UK (Whitbread-Abrutat 2003).

Whereas these brownfields to public open space redevelopment projects have many benefits in terms of quality of life (De Sousa 2006), their continual long term funding requirements have to be borne by local government.

Through the drive towards sustainable remediation, the EU (and the associated national policies) put green space creation from brownfield sites forward as incentive towards sustainability principles (Hou & Al-Tabbaa 2014). Brownfield site greening is generally regarded to be in line with sustainable development, but evidence suggests there are many flaws (Doick et al. 2009).

Pediaditi et al. (2010) investigated green spaces now being reconsidered due to their funding requirements and proven un-sustainability in the UK context. The authors find a lack of mandatory institutional procedures to monitor and evaluate the sustainability of these brownfield site greening projects.

Research by Doick et al. (2009) find similar results to Pediaditi et al. (2010). Brownfield site greening success factors were investigated on six UK projects. This research supports the notion that capital funding programmes for land regeneration should include management, monitoring and maintenance budgets.

Critique

There is good consensus in literature that land use options for redevelopment should be based on the risk as determined in the clean-up phase of the project (i.e. the land use of the development as a whole) (Ferguson et al. 1999; Hollander et al. 2010; Luo et al. 2009) . Furthermore the placement of activities within a site should follow the same pattern, with industrial use being the least sensitive, commercial and retail at

moderate risk and residential use as the most sensitive land use (Hollander et al. 2010; Winson-Geideman et al. 2004).

Commercial or retail land use seems to be a reasonable hybrid of limiting risk and generating income from a redevelopment project (Frantal et al. 2013; Bacot & O'Dell 2006). Knowledge and flexibility of the local government is also an important aspect, as brownfield site redevelopment projects often have unique circumstances (McQueen 2011; Rall & Haase 2011).

Public open space as end land use, or brownfield site greening, has recently become popular as part of the sustainable remediation movement due to the enhancement of the quality of life of surrounding communities (De Souza 2006). However, the long-term financial feasibility is poor (Doick et al. 2009).

2.5.5. Factor five: Favourable market conditions attract private sector investment

National and local property market conditions will both influence brownfields redevelopment projects. This may be in the form of the recession conditions of 2009, which were regarded by some developers as an opportunity (Dixon 2011), or local market conditions as a key determinant for brownfield redevelopment project success (Bacot & O'Dell 2006). Through incentive schemes (either national, such as the USEPA Brownfields Programme, or local, such as urban development zones with tax breaks), government can improve the business case for investors when compared to other areas (Bacot & O'Dell 2006).

From around 2001, the US and European Governments no longer make the clean-up of low risk sites mandatory, until redevelopment is complete, or when the property is sold (De Souza 2001).

Competitiveness vs. population density

Oliver et al. (2005), in association with the CABERNET working group (2006), provide a useful analysis of competitiveness and population density in 15 European countries (including the UK and Ireland) (see Figure 1). This analysis placed the countries in three distinct groups as indicated below. Denmark, Austria, France and Spain could not be placed.

The analysis does acknowledge that issues such as industrial history, politics and various aspects of the property market are excluded. Furthermore, redevelopment demand and population demand can vary significantly within each country, as well as in various stages of economic cycle.

The analysis makes three conclusions. Firstly, in countries where competitiveness is high and population density low, abatement of contamination is the focus. Secondly, where population density is high and availability of greenfields for development is scarce, regeneration projects are a priority.

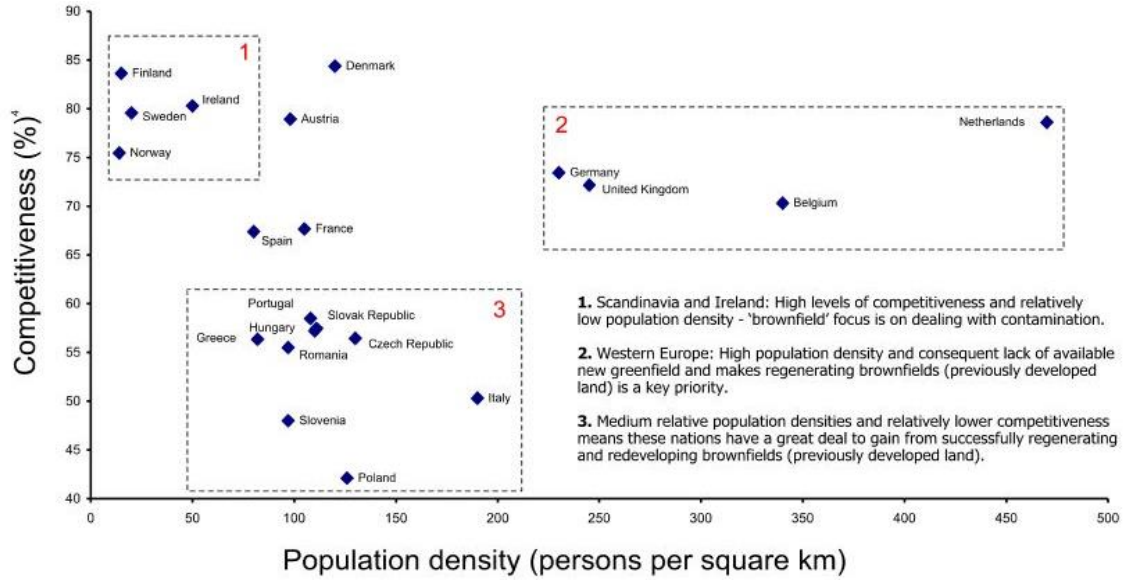


Figure 1: "Population density and competiveness of selected European nations" (NICOLE Brownfield Working Group 2011, p.16)

Thirdly, countries with medium population density and lower competitiveness were earmarked as having to benefit from redevelopment of brownfields/previously developed land. No reasons are provided for the last-mentioned statement regarding medium-density countries.

Market conditions in high-income areas

According to Adams et al (2010), market conditions tend to be stronger in higher income areas. In the UK, the more prosperous south-east areas are considered better potential redevelopment areas when compared to the north west, where de-industrialisation has had significant impacts since the 1970s (Adams et al. 2010).

Frantal et al. (2013) found that prosperous areas are more likely to be redeveloped; and municipalities with higher development potential will contain more redeveloped sites. This study concluded that development potential can be measured by certain indicators, most importantly local business activity, proximity to urban centres and transport infrastructure, and quality of local infrastructure.

The stronger these local market conditions, the more likely private sector will fund redevelopment themselves, making a return on investment in a shorter timeframe (Howland 2003).

Incentivised areas and public investment

It has been proven that property values of an incentivised area can outpace that of the city in a US context, proving the impact of schemes such as grant funding and public investment (Bacot & O'Dell 2006; Amirtahmasebi et al. 2016). Private sector investment attracted by public investment can be significant (Shand 2010).

Critique

Brownfields redevelopment will probably follow the trend of conventional property development in cyclic boom and slump periods from a macro-economic perspective (Dixon et al. 2011a). However, this will be influenced by sustainable development and urban regeneration policies incentivising brownfields redevelopment over greenfields development (Dorsey 2003).

Local (micro) conditions can overcome the macro-conditions in unique circumstances only (Bacot & O'Dell 2006). This is proven in the case of the Ebotse Golf Estate in South Africa in 2007, where the remediation cost of an old sand quarry was well below the market value of the developed estate (Le Roux 2007).

It appears that brownfields surrounded by urban decay will generally require more public funding as catalyst before private investment will follow (Howland 2004; Bethlehem 2013). Higher income areas tend to attract redevelopment projects more often, due to quicker and improved return on investment (Frantal et al. 2013; Osman et al. 2015).

The brownfields policies of the US and European governments show cognisance of market conditions and a risk-based approach. This is proven in that sites with low

contamination levels are not required to undertake remediation until the redevelopment is complete or the sites are being sold (De Souza 2001).

2.5.6. Factor six: Quick access to a variety of funding options, coupled with clear and rapid approvals process encourages redevelopment

CABERNET's A-B-C funding model

In 2006, CABERNET developed the A-B-C model for redevelopment projects, which provides an understanding of clean-up vs. redevelopment potential, as well as private vs. public funding. Figure 2 shows the model as re-visited by the 2011 NICOLE Working Group. The 2011 revision of the model adds the "who pays" dimension, which deals with the apportionment of risk (NICOLE Brownfield Working Group 2011, p.18).

Sites with low levels of contamination and high land value after remediation were proposed to be suitable to be redeveloped by the private sector alone. Heavily contaminated (often Superfund) sites, with a low land value after remediation were proposed to be suited the public sector and funded by the government only. Moderately complex sites were found to present an opportunity for public-private partnerships (NICOLE Brownfield Working Group 2011).

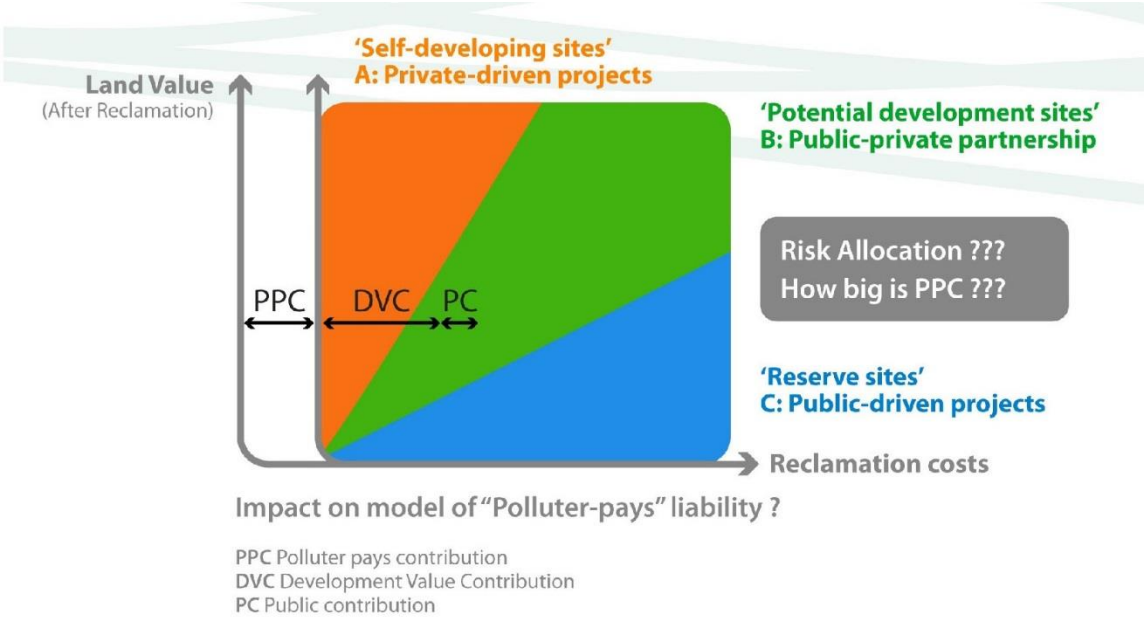


Figure 2: Developed CABERNET A-B-C Model, as developed in 2006 by CABERNET and re-visited in 2011 by the NICOLE working group (NICOLE Brownfield Working Group 2011, p.18)

Other authors support the findings of the NICOLE working group. Howland (2003) found sites with low contamination suitable for private sector funding. Dixon et al. (2011) concluded that strong public-private partnerships allow the risk of more heavily contaminated sites to be shared, and improve the chances of success. Brownfield sites with significant contamination not being suitable for the private sector were also confirmed by other authors (De Sousa 2001; Lange & McNeil 2004; Adams et al. 2010).

Access to funding

Yount & Meyer (1999) found that smaller developers could not readily access funding, obtain grants, and lacked information regarding remediation. Larger development companies could more often gain the support of other stakeholders for developments, and were more commonly part of public funding schemes. This finding was before the promulgation of the "Brownfields Law" in 2002. After its promulgation, small businesses could more readily access the brownfields redevelopment sector when the USEPA's funding was expanded from Superfund sites only, to include brownfields (Adams et al. 2010).

Limited funding resources were available for investigation, remediation and redevelopment in the late 1990s in Canada. US and European governments were found to offer more direct funding and incentives to "share" funding and risk with the private sector (De Souza 2001). By 2005, the Canadian government committed funding for redevelopment for the first time, but 95% of this was focused on federal projects (Adams et al. 2010).

By 2010, provincial and local government were mostly responsible for regulation of smaller brownfields in Canada, holding the private sector fully responsible for clean-up and redevelopment funding. The country's poor funding initiatives did not deter the private sector in strong markets such as Toronto, but weaker markets, such as Quebec, required more government assistance (Adams et al. 2010, p.92). This is aligned with the findings of Dixon (2011) that marginal sites were likely to remain undeveloped in tough economic times.

Adams et al. (2010) found that the UK saw an improvement in development on brownfield lands only when legal powers and funding resources for intervention were

added to brownfields policy. These changes assisted to improve private sector interest.

Funding incentives

Funding incentives include tax incentives based on area (e.g. urban development zones) (Yount & Meyer 1999), lowering of liabilities for voluntary clean-up (De Sousa 2001), and more flexible risk-management schemes (NICOLE Brownfield Working Group 2011; Chen & Ma 2013).

McQueen (2011) found that the availability of tax incentives are often too late in the redevelopment process - with private developers requiring grant and funding options in the initial stages of the redevelopment process. The author further found that upfront grants and reductions in development charges were more successful funding instruments (McQueen 2011, p.59).

Urban Development Zone in South Africa

The Urban Development Zone (UDZ) scheme in South Africa was initiated in 2004 and offers tax-deduction incentives for development in the urban core of cities. It provides a 20% tax deduction of the investment value for improvements made, excluding purchase price of property, within the first year of investment. The same percentage is applicable for four years after that (City of Johannesburg 2006; South African Revenue Service 2004).

The private sector in South Africa was found to be averse to the tax breaks as an incentive for brownfields redevelopment. It was however noted as a necessary part of a potential brownfields policy (Potts & Cloete 2012).

R 9 billion of the investments made in the Johannesburg UDZ made use of the tax incentive since the inception between 2004 and up to 2012 (City of Johannesburg 2012). The Cape Town UDZ has facilitated tax breaks for an amount of R 2,9 billion between 2005 and 2010 (City of Cape Town 2011). Despite its apparent aversion, the private sector did therefore make use of this tax-incentive.

The UDZ tax incentive only assists to reduce taxable income and improve profits. In the first years when a redevelopment project is still making a loss, it does not assist. Developers cited this as a shortcoming of the UDZ incentive (Mwangala 2010). This

finding agrees with that of McQueen (2011). Developers indicated that the UDZ was not a primary funding or investment attraction tool. Market demand and potential rental growth were indicated as primary attracting factors to the Inner City (Mwangala 2010; Rhizome Management Services 2009).

Rapid approvals and knowledge of city employees

The Italian government's quicker approval of remediation times and voluntary agreement between government and stakeholders were identified as success factors by Tonin (2014). This finding was corroborated by McQueen (2011), who found that the quicker processing of redevelopment applications by authorities assisted the redevelopment process.

Tonin (2014) concluded that the capacity in government to assess remediation plans and projects was also important to success. Bacot & O'Dell (2006) found that that flexibility and knowledge of city employees is crucial to make projects work and increase private sector trust.

Critique

It appears that, due to their maturity and good understanding of brownfields, the US and Europe have numerous public funding and support options available for brownfields redevelopment projects (Hollander 2010; Ferguson 1999). These mechanisms are available to private developers.

South Africa does not have many direct funding options. The private sector bears most of the risk/cost. Theron (2010) indicates that financial institutions do not have the in-house expertise to evaluate brownfields proposals. Lenders often require extensive documentation before engaging brownfields projects, and remain conservative. Seeliger and Turok (2015) noted a greater willingness by the banks in recent times to fund brownfields projects.

Developers need to shorten the timeframe of the development cycle due to the cost of lending (McQueen 2011; Tonin 2014). Some of the incentive schemes offered provide indirect assistance, but often too late in the process (McQueen 2011). The long-term commitment required making brownfield projects succeed, as noted by

Hollander (2010) and Dixon et al. (2011) appears to be in conflict with the need of developers to shorten the development timeframe.

Brownfield funding assistance schemes limited to target areas in the urban core are effective in providing assistance for redevelopment. These schemes allow for the strategic intervention of combatting urban decay (Bacot & O' Dell 2006). The UDZ initiative in South Africa is a successful secondary initiative to support redevelopment where market demand is already high (Mwangala 2010).

2.5.7. Factor seven: Larger sites with economy of scale are more often redeveloped than small sites

Yount & Meyer (1999) compared large and small-scale redevelopment projects to identity the key factors affecting investment decisions. Environmental risk assessments represented a larger portion of total costs on small sites, reducing the return on investment of these smaller sites. Investigation costs did rise somewhat with site size, but larger project sites could better dilute this cost due to their greater investment value and expected return (Yount & Meyer 1999).

Dixon et al. (2011) found that combining a number of small sites appeared to improve chances of success of brownfields redevelopment. This was corroborated by Osman et al. (2015). These authors undertook an analysis of their database, and found that that larger brownfields sites (i.e. 30 hectares and larger) were more often redeveloped when compared to small sites (<15 hectares). Frantal et al. (2013) also conducted a database analysis, and found that the average size of redeveloped sites was approximately eight hectares, with the total range being between one and 30 hectares.

In the South End area of the Charlotte case study, average sizes of brownfield redevelopment sites were less than one hectare (Bacot & O'Dell 2006). It appears that this finding is thus not aligned with other literature (Dixon et al. 2011b; Osman et al. 2015). However, many of the South End sites received grant assistance of up to 50% of their contamination assessments (Bacot & O' Dell 2006). These sites were therefore assisted to overcome the challenge noted by Yount & Meyer (1999).

Critique

There is sufficient literary evidence to suggest that small individual brownfields redevelopment sites, of a few hectares in size, are less often redeveloped. Larger sites of at least eight hectares, or combining smaller sites to approximately 15 hectares, are more often redeveloped (Dixon et al. 2011b; Osman et al. 2015; Frantal et al. 2013). This phenomenon is due in part the economy of scale diluting the fixed cost of site assessment and remediation (Yount & Meyer 1999; Bacot & O'Dell 2006).

2.5.8. Factor eight: Readily available municipal services and close proximity to transport corridors are incentives to redevelopment

Various authors has found that brownfield sites in close proximity to airports, rail infrastructure or city centres were redeveloped more frequently when compared with sites with poorer locations (Lange & McNeil, 2004; Hollander et al. 2010).

Lange & McNeil (2004) collected data for 75 sites through the survey method, and compared successful redevelopments with less successful projects. More than 50% of successful sites benefited from infrastructure in close proximity as compared to less than 30% of less successful sites (Lange & McNeil 2004, p.105).

These findings were corroborated by Osman et al. (2015), where close proximity to rail, city centres and motorways were found to be important regeneration factors for brownfields. This analysis was done from a database of 101 successfully regenerated sites.

Frantal et al. (2013) determined that close proximity to infrastructure could assist to overcome other detracting factors, such as previous industrial use and the presence of contamination. Factors deemed part of infrastructure proximity were distance to regional centres, proximity to main road network, and quality of local infrastructure.

Critique

Redevelopment sites closer to regional centres and major transport infrastructure such as roads, rail and airports, are typically developed sooner than sites located further away (Lange & McNeil 2004; Osman et al. 2015; Frantal et al. 2013). The

findings across the studies are aligned, and include various types of transport infrastructure and municipal centres.

2.5.9. Factor nine: Strong political and community support encourage redevelopment

Socio-political “approval” or “license to operate” is well documented in literature (Demuijnck & Fasterling 2016). The concept is relevant for brownfields redevelopments, due to the potential negative history of these sites (Dillon 2014; Hollander et al. 2010; Frantal et al. 2013).

In the UK, brownfields redevelopment was found to be driven by a long-standing desire to protect greenfields sites (Dorsey 2003). Non-governmental organisations’ and general public opposition to the development of rural areas has led to more than 50% of developments in the UK in recent years to include brownfield redevelopments (Adams et al. 2010).

Hollander (2010) indicated that short term “quick wins” are not common in successful projects, but rather strong long-term vision of various stakeholders. This theory is corroborated by Dixon et al. (2011), who also found that successful projects have a strong “brand” i.e. creating “flagship” projects. Long-term job creation will likely assist community support and success (Lange & McNeil 2004).

The support of local government can assist to fill final funding gaps, and to lower property taxes (Hollander et al. 2010). Frantal et al. (2013) found that “soft” factors such as political leadership, strong stakeholder and community support can allow negative factors to be overcome.

Critique

Literature indicates that community and political support are required for brownfield redevelopment projects to succeed (Demuijnck & Fasterling 2016; Hollander et al. 2010; Lange & McNeil 2004; Frantal et al. 2013).

Drivers for achieving community support for brownfields redevelopment will vary, based on the socio-economic situation of the surrounding area. As a factor, high unemployment rate was found to impact more significantly on the redevelopment of less expensive brownfield sites, and was present in 52% of cases investigated

(Osman et al. 2015). This was due to the short-term employment opportunities as part of the redevelopment process.

2.6. Synthesis and conclusions

This literature review has demonstrated that there is a substantial body of knowledge pertaining to contaminated land remediation and brownfields redevelopment internationally. Developed economies such as the US and Europe's policy thinking, tools (funding and advice) and assistance are well developed for attracting brownfields redevelopment projects (Adams et al. 2010). There are further two main driving forces for brownfields redevelopment, namely containing urban sprawl and addressing contamination related to public and environmental health.

Key factors influencing the success of brownfields redevelopment identified from international literature include:

- Sites with little or no contamination are more readily redeveloped;
- Mature brownfields management policies facilitate development;
- Sites with certainty regarding apportionment of liability for clean-up and perception of few latent risks are more likely to be redeveloped;
- Redevelopment land use options based on a risk minimisation approach improve the feasibility of brownfields projects;
- Favourable market conditions attract private sector investment;
- Quick access to a variety of funding options, coupled with clear and rapid approvals process encourages redevelopment;
- Larger sites with economy of scale are more often redeveloped than small sites;
- Readily available municipal services and close proximity to transport corridors are incentives to redevelopment; and
- Strong political and community support encourage redevelopment.

These factors may be relevant for the development of this sector in South Africa.

Developing nations are still primarily concerned with enforcing compliance, with little emphasis placed on creating a positive environment for investment from the private sector (Kadas et al. 2008; Spínola & Philippi 2011). Compliance is varied, and successful brownfields redevelopment projects are comparatively few. There are strong similarities between South Africa and Latin America in terms of approach and maturity to brownfields (Kadas et al. 2008; Spínola & Philippi 2011; Potts & Cloete 2012; Seeliger & Turok 2015).

South Africa has a strong knowledge base from the mining sector and mine closure regulations (Limpitlaw et al. 2005; Hattingh & Bothma 2013). This country's contaminated land management and brownfield redevelopment sector is only starting, and may gain much from the international knowledge, research base and mature policies attracting private investment. Testing some case studies in South Africa against the success factors identified internationally will provide assistance towards the development of the brownfields revitalisation regime.

3. Research method

In chapter 2, the techniques and approaches regarding brownfields redevelopment suggested by the literature were first explored. From this literature review, key success factors were drawn out. The South African situation regarding brownfields redevelopment was also investigated. Certain differences were identified between developing countries and developed countries with regard to brownfields redevelopments. This approach created the theoretical knowledge basis for application to the case studies.

This chapter focuses on the research methods used, and the motivation for selection of case study sites. Internationally, case study research on brownfields of either a few, or hundreds of sites, appear to be prevalent (Howland 2003), depending on the availability of data. Documentary research as primary method of investigation have been successfully used by researchers where only a few cases were studied (Jensen 2010; Erdem & Nassauer 2013). The case study sites in this study were selected because of certain shared features, whilst providing a representative cross-section of urban brownfields in Johannesburg.

In chapter 4, three South African case studies are analysed using documentary or archival research, against the theoretical background of international literature. Chapter 5 evaluates the case study findings against literature.

3.1. Multiple case study method

Multiple case study research is preferred to single case studies by Rowley (2002). In analytical generalisation, every case study is seen as an experiment. Multiple case studies are regarded as similar to multiple experiments. Where an increased number of case studies shows replication of a theory, observations are expected to be more robust (Rowley 2002).

Data was collected to explore three sites over the long term, from which to make comparisons with the literature. The data collected represents each case as a sequence of events over a period of years. This data was used to describe change over time, or time-series analysis (Yin 2003). Due to the varied site selection, contrasting results were expected, to test the validity in the South African context of

the success factors of the success factors drawn out of the literature review (Rowley 2002).

3.2. Documentary analysis method

Documentary research has many advantages, including public availability, cost-effectiveness and covering a long span of time (Bowen 2009). It is a valid method for qualitative case studies, providing in-depth descriptions of cases and tracking change over time (Yin 1994; Stake 1995).

The documentary research was based on the consultation of various types of documents drawn from different sources over the history of each of the case studies, thereby providing triangulation. Important time-based events applicable to this study are mostly historic and not ongoing, confirming the applicability of the documentary research method. Each data source was evaluated for origin, reliability, objectivity and applicability to the case study or research question, after Bowen (2009).

3.2.1. Limitations of documentary research

Due to the research method employed for this research, no contamination measurements for any environmental media were carried out. Moreover, no interviews with site owners or professionals involved in any of the sites were held, nor were any questionnaires sent out. The potential limitations in documentary research include insufficient detail, some documents not being retrievable, and bias in the selection of documents (Bowen 2009).

As documentary research was followed, understanding of the three case study sites was limited to documents publicly available. The data gathered was silent on a number of issues. A deeper understanding of each case study may have been gained through interviews with site owners and personnel, professionals and access to private records.

This study was qualitative. Weightings were not attached to the associated success factors identified for each site.

3.3. International research methods for brownfields

Howland (2003) indicates that case study research is the most prevalent methodology in brownfields literature. This approach is confirmed by the literature review of this study (Lange & McNeil 2004; Dixon et al. 2011a; Hollander et al. 2010; Nijkamp et al. 2002).

There are also studies where only two or three case studies were described in depth and compared (Howland 2003a; Jensen 2010; Erdem & Nassauer 2013). Howland (2003) analysed three case studies in the same city, to understand the interface between publicly and privately driven brownfields redevelopment projects. Howland used mostly documentary research, with only two interviews conducted.

Jensen (2010) used archival research to obtain data for four case studies of brownfields to renewable energy projects, apart from conducting many interviews. Erdem & Nassauer (2013) studied three public parks developed on brownfield sites designed at varying times in European and US contexts, using only documentary research.

Hollander (2010) first surveyed USEPA officials, then made use of three case studies to develop hypotheses to identify key variables. The sites selected were of varying sizes and complexity and in different cities. Apart from the interviews conducted, documentary research was done on public records and newspaper articles (Hollander 2010).

3.4. Identification of case study sites

Three case study sites were selected which represented certain shared features and provided a representative cross-section. Shared features included their location within the urban edge of Johannesburg, original industrial land use as part of the origins of Johannesburg, and the intent of the landowners to redevelop brownfields land. Aspects considered in the choice of sites include distance from the inner city, size, the certainty of contamination and redevelopment success. The size of the study sites was chosen to vary, as well as each site's proximity to the city centre of Johannesburg. The Egoli Gas site and AECI Modderfontein were clearly

documented as contaminated. Contamination of the Newtown site was not clearly established.

The status of each case study was documented. One site's redevelopment was successful, one site's redevelopment was not yet implemented, and the last site was in the process of being redeveloped. These projects were studied to obtain a better understanding of the respective success factors for redeveloping brownfields.

Newtown

Newtown is a precinct of approximately 25 hectares in the inner city of Johannesburg. Its original land use was industrial, with activities such as power generation, rail yards, maintenance workshops and the fresh produce market of the city. Urban decay increased significantly in the 1980s and 1990s. With substantial public and private sector investment and redevelopment since this time, this mixed use precinct is regarded as a highly successful initiative in the inner city (Shand 2010; Rhizome Management Services 2009; Bethlehem 2013). Most of the property in the area is government-owned.

Egoli Gas site

The Egoli Gas site is the smallest of the case studies, approximately 14,85 hectares in extent, and is located west of the University of Witwatersrand and east of the University of Johannesburg in the "institutional belt" along the south of Empire Road. The site is thus on opposite side of Wits from the centre of Johannesburg. It has an industrial land use history of producing gas from coal (from 1927 to 1992). A portion of this site is used as distribution site for gas produced by SASOL. The old gasworks factory itself is derelict, as the intended redevelopment initiative of 2010 did not go ahead.

Modderfontein

The AECI explosives factory was established in the Modderfontein area, approximately 18 km from the Johannesburg city centre, as part of the start of mining in the Witwatersrand in 1896. It grew with the mining industry to circa 2000, in the manufacturing of explosives and fertiliser from nitrogen and ammonia related processes. The site, therefore, has an industrial history.

At the height of production, the operational part of the site was approximately 200 hectares in size, and the buffer zone required by the Explosives Act more than 2 000 hectares. In 1999, parts of the area became available for development due to improved safety standards and release of land from the buffer zone. Heartland Properties was established as the property development arm of AECI. It successfully undertook redevelopment projects on the buffer land until 2013. Approximately 1 600 ha of the former buffer zone was sold to the property developer Zendai in 2013, who has embarked on a multi-decade development process of the area.

3.5. Sources of data

Valid sources of data for each of the case studies and their locations include various document forms, as identified by the methodology of Bowen (2009). Official documents and government publications studied include administrative documents representing agencies and organizations, such as progress reports, business plans, brochures, position papers, and minutes of meetings.

Institutional policy documentation reviewed include spatial development frameworks, integrated development plans, urban development frameworks, and area-based economic development plans. Public documents such as published and publicly presented documents including books, newspaper articles, and magazines were also reviewed.

Site-based documents studied include regulatory applications made such as town planning or environmental impact assessments and related specialist studies, media releases by site owners, notices sent to shareholders and transaction documentation for land sale agreements.

3.5.1. Analysis of document sources

The approach used to analyse data sources was to list all the documents in tabular format; determine for each document a category, original purpose, extract key data points, and note the degree of relevancy to the study (Bowen 2009). Aspects such as authenticity, credibility, and accuracy had to be determined.

3.5.2. Data sources for Newtown

A wide variety of sources as described was available for the Newtown case study. These included official documents, institutional policy documents developed for the area specifically. Regarding site-based documents of the private sector, fewer of these were available. The identified sources showed a high level of corroboration of facts. Evaluation reports commissioned by the JDA and consultant's documents appeared the most objective, whereas marketing and media releases by the City of Johannesburg (CoJ) and newspapers were found to be less objective.

3.5.3. Data sources for Egoli Gas site

Document sources for this site were limited mostly to site-based documents related to the redevelopment process, with fewer public plans and policies. These site-based data sources showed a high level of accuracy and validation from source to source. Most of these sources were either specialist site investigations or actual letters or minutes of meetings, providing insight to the various stakeholders' viewpoints. The sources investigated did not clearly provide information on why the development did not go ahead.

3.5.4. Data sources for Modderfontein

Documentation because of AECI being a public company was a dependable source of accurate data. These included sources on the activities of Heartland Properties and the land sale and activities of Zendai. Numerous site-based data sources such as specialist reports, environmental impact assessments (EIAs) and minutes of stakeholder meetings were also used. Institutional policies of the City of Johannesburg and media reports provided background confirmation of site-based information. The sources identified showed a high level of validation of facts. The site-based and company reporting documents were found to be objective.

3.6. Document analysis and evaluation of data

3.6.1. Analysis of data

The method of analysing documents was modelled according to Bowen's methodology. This involved perusal, then reading, and lastly interpretation of important and pertinent passages of text identified. Document analysis produced

data, which was then arranged in themes and classes through content analysis (Labuschagne 2003).

The data analysis regarding each case was exploratory, seeking to present an accurate unfolding of events over time, and placed into themes where appropriate. After the presentation of the data regarding each case study, observed reasons as to why each redevelopment case was successful or not, were documented. These reasons were derived from the data itself.

3.6.2. Determination of factors to analyse and evaluate case studies

An exploratory literature survey was firstly undertaken to obtain a high-level understanding of the international body of knowledge regarding contaminated sites and brownfields.

Then, the survey was narrowed to the redevelopment of brownfields. This included firstly the barriers to redevelopment, and secondly approaches and methods to overcome these barriers. Lastly, the survey sought to identify case studies where success or failure of brownfields were documented.

From this understanding, a literature review was undertaken to identify success factors, which were documented by various authors, thereby seeking replication of principles among authors.

3.6.3. Evaluation of data

In Chapter 5, data for the three case studies was evaluated against the success factors as identified from the literature. Success factors identified from the literature were reconsidered based on the key factors that emerged from case study findings, to derive a final set of success factors for brownfields redevelopment, based on the South African context.

4. Analysis of case studies

As indicated in the previous chapter, three case study sites were selected (Figure 3). Each of the cases is presented in this chapter. The three selected properties have all been in use for more than a century and linked to the establishment of Johannesburg in the late 1800s.

The Newtown area in central Johannesburg represents a precinct rather than an individual site – with various initiatives and developments having taken place in the last decades. Since the development of Brickfields around 1890 and the President Street Power Station at the turn of the 20th century, the area has been redeveloped numerous times. Between 1970 and 2000, business locations to the north and east of the city centre became more favourable, and many private and public entities moved away from the city centre, with increasing dormancy in especially the Newtown area (Beavon 1997). This Newtown precinct was chosen as a case study due to its industrial origins, numerous changes of land use, and private and public ownership.

The Cottesloe Gas Works was established in 1927, and was one of the key early sources of energy for the city through a coal-to-gas process. The gas production plant was closed in 1992. Since then it has only been used for the import, storage and distribution of gas to central Johannesburg (Tsica Heritage Consultants 2010). The unused historic part of Egoli Gas has been dormant since 1992. The property was proposed for remediation and redevelopment in 2009, yet the project was not implemented.

AECI's Modderfontein property, where explosives were first manufactured for the gold mining industry in 1896, was about 18 km outside the city at the time of its establishment. It has since been incorporated in the urban edge of Johannesburg. In 1999 and 2000, with improved safety standards, the Explosives Act buffer requirement fell away. As a result, the land surrounding the Modderfontein site became available (AECI 2000; Engineering News 2000).

Apart from the development activities of Heartland Properties, the larger land portions to the north, have been dormant since then (eProperty News 2005). Approximately 1 600 hectares of AECI property was sold in 2014 to Hong Kong

based property group Zendai, and the redevelopment planning process is currently underway (Republic of South Africa 2014; Zendai Holdings Limited 2013). Smaller land parcels not sold to Zendai at Modderfontein are managed by AECI's Acacia Real Estate, which includes some land still available for redevelopment (http://www.aeci.co.za/bs_acacia_estate.php)

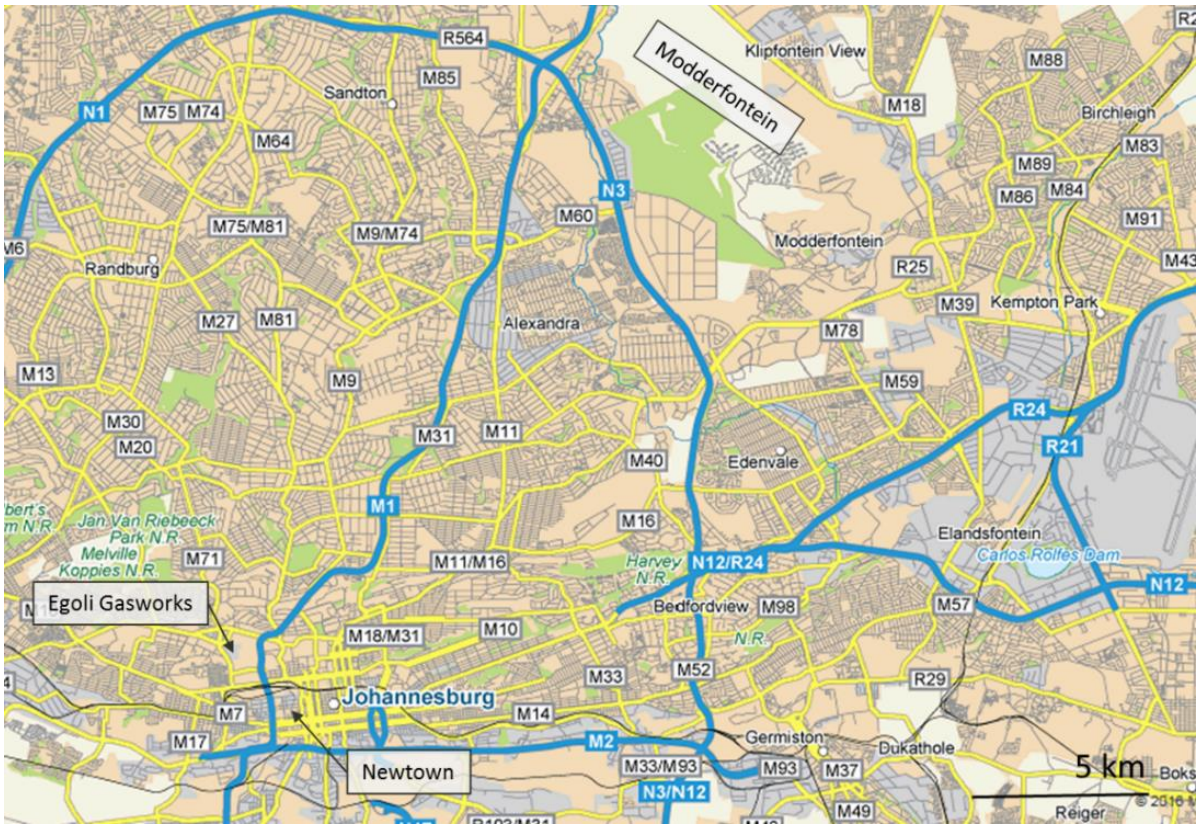


Figure 3: Regional context of the three case study sites selected (source: Map Studio 2016)

4.1. Newtown

4.1.1. Introduction and context

Newtown is a precinct comprising approximately 25 hectares in the inner city of Johannesburg. It is located directly south of the Transnet marshalling yard between the M1/Carr Street off-ramp and the Nelson Mandela Bridge (See Figure 4). It is in Ward 60 of Planning Region F of the city. Most of the land in Newtown is owned by the City of Johannesburg.



Figure 4: Regional context of Newtown (source: Google, AfriGIS 2016)

Early History

An extract of Pritchard's commercial map of Johannesburg of 1896 shows the Brickfields area, where Newtown is now located (Figure 5). The British governing authority identified Brickfields, Burgersdorp and a part of Fordsburg for demolition and redevelopment in the early 1900s. After forced removals and burning of the area in 1904, 70 hectares was earmarked and became known as "Newtown" (Brodie 2014).

For the next 90 years, Newtown was the main industrial area of the city. By 1915, Newtown's industrial uses included the rail marshalling yard and related infrastructure, the fresh produce market and livestock yard (including an abattoir). Power generation activities included the Jeppe Street Power Station (including its turbine hall and cooling towers), as well as the tram shed and the electric workshop (housing the turbines for the tram system) (Brodie 2014). There was also a migrant worker's compound located in this precinct (Gaule 2005).



Figure 5: An extract of the map 1896 of Johannesburg (Pritchard 1896) with the approximate position of the current Newtown indicated (Source: Vintage Maps, [online] Available at: http://www.vintage-maps-prints.com/products/old-map-johannesburg-california-1896)

Decline and urban decay

By the early 1980s, the city council had reneged on maintaining the Inner City infrastructure, and as a result there was a decline in the Newtown area which led to a state of urban decay. The adjacent Central Business District had already started its gradual migration to Sandton. During the late 1990s, vacancy rates increased, large institutions closed their offices in the city centre, and investment further declined. (City of Johannesburg 2011a).

Urban renewal and redevelopment

The city started various urban renewal initiatives from 1992 onwards, which provided the necessary impetus for a change in the Inner City. The Greater Johannesburg Metropolitan Council was established in 2000, and the Johannesburg Development Agency (JDA) in 2001. The JDA's mandate was to implement urban regeneration capital projects within the city (City of Johannesburg 2011a).

Significant political support was behind the urban renewal of Newtown; the President of South Africa supported the vision in 1997. Major funding initiatives that provided support for Newtown were the Urban Renewal Programme and the Gauteng Blue IQ

project, both initiated in 2001. The Blue IQ was a multi-billion rand initiative to develop specific major infrastructure projects in the province (http://www.blueiq.co.za). The Urban Renewal Programme was a national initiative focussing on investment in eight urban nodes of poverty.

The JDA acted as an implementing agent for public investment, fast-tracking development approvals, infrastructure investment, and active urban management. These activities created conducive market conditions. The private sector responded well to this urban renewal, contributing numerous privately funded developments in the last 20 years. Newtown is currently one of the sought-after investment areas on Johannesburg's Inner City.



Figure 6: Aerial image of Newtown in 2000 (GAPP Architects and Urban Designers & Urban Solutions Architects 2001, p.7)

4.1.2. Description of data sources

Each data source is described here to confirm its nature, origin, reliability, objectivity and its relation to the study topic.

Newtown Urban Design Framework

Origin, reliability, objectivity

The ICO appointed GAPP Architects and Urban Designers (GAPP) to compile the Newtown Urban Design Framework (UDF) in 1999. The Newtown Urban Design Framework was a design implementation document, showing a physical interpretation of CoJ's Inner City policies. It assisted with the prioritisation of public investment, and guided decision-making. This document has a high level of reliability, but its objectivity is not certain. Most of its recommendations were implemented.

Relation to the study topic

The objectives of the afore-mentioned document included the coordination of the various initiatives in Newtown, (creating a commonly shared vision), and providing a strategy for implementation of the main actions required to stimulate investment (GAPP 1999). It was also aimed at improving investor confidence. Most of the conclusions and recommendations proposed were later implemented. It points to the consultant's understanding of urban decay, renewal of brownfields and property development. The document is therefore highly relevant to the research question.

Newtown Cultural Precinct Urban Design Plan

Origin, reliability, objectivity

This precinct plan was a more detailed explanation of design principles and policies proposed in the 1999 Newtown UDF; and the foundation for agreement of site development plans and building plan approvals in the Newtown Precinct. It was completed in 2001.

Alignment and advice were incorporated from parallel studies undertaken at the time, such as the Newtown Cultural Precinct Plan – Town Planning Aspects and Incentives, the Urban Cost Modelling for Newtown, and the Infrastructure Analysis

for the Newtown area (GAPP Architects and Urban Designers & Urban Solutions Architects 2001). This document has a high level of reliability and objectivity; most of its recommendations were implemented.

Relation to the study topic

Particular proposals made, that assisted rapid redevelopment, included a proposed design review panel and procedure, blanket rezoning to accommodate all proposed land uses according to the Precinct Plan, and town planning procedures to tailor development parcel sites according to the Precinct Plan (GAPP Architects and Urban Designers & Urban Solutions Architects 2001).

This document also addresses the aspect of specialised council functions to support redevelopment, land use, transport and municipal infrastructure, funding, marketing and political support for redevelopment. The document is therefore relevant to the research question.

Inner City Position Paper

Origin, reliability, objectivity

The position paper was a planning report for the JDA as implementing agency in 2001, and was drafted by the City of Johannesburg. Its specific author is not mentioned in the paper. It summarised the status quo, challenges and opportunities for the Inner City, thereby giving direction to the activities of the JDA. It further prioritised public investments over the short term and clarified institutional arrangements.

The style of the document appears to be concise and pragmatic, with little jargon and marketing. Its description of the status quo, as well as the problems plaguing the Inner City, is a valuable summary. Many proposals made in the document were implemented (City of Johannesburg 2001).

Relation to the study topic

This document identifies regeneration for the inner city. Aspects such as market conditions, availability of municipal services, funding and political support are all

addressed in this strategy. The document is therefore relevant to the research question.

Newtown Cultural Precinct Design and Development Manual

Origin, reliability, objectivity

This manual, compiled by GAPP was commissioned by the JDA in 2003, to guide and control development of the precinct. It is considered reliable and objective.

Relation to the study topic

This document confirms the presence of the design review panel, as proposed by the 2001 Urban Design Framework, whose role was to assist with expediting the redevelopment of "bad buildings" (as it was referred to by the City of Johannesburg). A pilot City Improvement District (CID) is referred to as already in existence for a small area, to be extended to the whole precinct. The objectives of the CID are also described, including numerous urban management, marketing and major events (GAPP Architects and Urban Designers 2003b). The document is therefore relevant to the research question.

2003 City of Johannesburg Spatial Development Framework

Origin, reliability, objectivity

A Spatial Development Framework (SDF) seeks to give spatial guidance for development as envisaged in the Integrated Development Plan (IDP) of a local or metropolitan municipal area. As SDFs are policy documents, which are subject to public comment and council approval (which gives them legal standing), their reliability is high – as many other public and private investment decisions are based thereon. It is therefore expected to be objective. In 2003, with growing development, containing sprawl was an important aspect to address.

Relation to the study topic

In the "New Opportunity Areas Programme," mentioned in the SDF, the city sought to identify unique areas that comply with its planning principles. One of these areas was "Redevelopment, Densification and Infill." Redevelopment and brownfield sites were therefore addressed in the document, which relates to brownfields policy as

part of the research question (City of Johannesburg 2003). The document is therefore relevant to the research question.

Urban Development Zone Tax Incentive

Origin, reliability, objectivity

The Urban Development Zone (UDZ) tax incentive is a national government policy which was initiated in 2003 in order to address urban decay in South Africa's largest cities, through an accelerated depreciation allowance. The South African Revenue Service (SARS) drafted this document. The City of Johannesburg submitted an application for the establishment of an Urban Development Zone (UDZ) for the Johannesburg Inner City to National Treasury in 2004 (City of Johannesburg 2004). This application included Newtown.

The UDZs were subsequently implemented in most of the metros, with billions of rand worth of private sector investment benefitting from the incentive. The document is expected to be reliable. It has been estimated that, since its inception in 2004, the UDZ tax incentive used by the private sector accounts for R9 billion in developments in the Johannesburg zone, including large banks, mining houses, hotels and residential developers (City of Johannesburg 2012).

Relation to the study topic

This tax incentive policy addressed the funding of urban renewal in 13 inner city areas of the major centres of South Africa, which includes brownfields sites.

Activities listed in the incentive are construction and improvement of commercial, residential buildings, and low-cost housing units, situated within the UDZs. Further, the policy seeks to encourage investment in highly populated areas, Central Business Districts (CBDs), inner city environments, and areas with existing urban transport infrastructure for trains, buses or taxis. Only "costs incurred in relation to the erection, extension, addition or improvement of the building" are applicable to this tax incentive. Therefore, land purchase cost is excluded. Specific allowance was made for low-cost residential housing, where the unit cost was below R350 000 and rent below 1% of the unit value per month.

The depreciation values for the various types of development are mostly around 20-25% in the first year of assessment, and taper off with smaller percentages in following years. All the depreciation values add up to 100% depreciation of investment over between seven and ten years (SARS 2003). This policy document is highly relevant to the funding aspect of the research question.

Greater Newtown Cultural Quarter Development Strategy

Origin, reliability, objectivity

The JDA undertook the compilation of this business plan for Newtown as a cultural precinct in 2004, in order to encourage the attraction of private sector investment. This took place after the initial phase of public sector development was almost complete. Various strategic objectives were identified, each with a number of projects to support it. As with other JDA documents, it appears to be a reliable objective document.

Relation to the study topic

Applicable strategies in the document included a land development and release strategy, reinforcing linkages to the surrounding areas and city and a whole, institutional arrangements and residential development (JDA 2004).

Maximum investment from the private sector was sought. Identified projects, related to the research question, included the improvement of public transport, light industrial and office space conversion to loft-type housing, branding, provision of safe public space, review of urban frameworks, the creation of development parcels, and ensuring related infrastructure requirements were met. This document addresses funding, redevelopment, infrastructure provision, transportation access and political support, and is thus relevant to the research question.

Newtown North Urban Design Framework

Origin, reliability, objectivity

The JDA appointed GAPP and Urban Solutions in 2005 this urban design study to advise the development of Newtown to the north of Carr Street, where the Old Park Station is located, mostly on Transnet-owned land, which was the other large

property owner in Newtown, apart from the City of Johannesburg. It is considered reliable and objective.

Relation to the study topic

This document addresses various aspects of redevelopment, namely land ownership, land use, the lack of engineering services, attraction of private sector investment, and statutory approvals.

Newtown Redevelopment incorporating Newtown North – Engineering Services Investigation and Assessment Report

Origin, reliability, objectivity

This assessment of engineering services for Newtown was commissioned by the JDA in 2006, to assess the need for infrastructure upgrades as part of future development (PD Naidoo and Associates & Themba Consulting Engineers 2006).

PD Naidoo and Associates (PDNA) is well-known consulting engineering firm, and its report, compiled in associated with Themba Consulting Engineers, is expected to be reliable and objective.

Relation to the study topic

Municipal engineering services are one of the aspects to address as part of redevelopment of brownfield sites. Redevelopment cannot take place without sufficient municipal services capacity. Services investigated were bulk water, sewage, storm water, roads, gas, electricity and telecommunications.

This report concludes that bulk services in Newtown are sufficient overall, but that minor supply services, especially around No. 1 Central Place, require significant upgrading and re-alignment. The total cost of upgrades, at the time, was estimated to be R16 million. This cost was escalated by 10% per annum, to a cost of approximately R30 million in 2015 (PDNA & Themba Consulting Engineers 2006).

Analysis of the Impact of the JDA's Area-Based Regeneration Projects on Private Sector Investment

Origin, reliability, objectivity

The JDA appointed Rhizome Management Services in 2009 to analyse and confirm private sector investment that came about as a result of the JDA's regeneration projects.

The authors interviewed 30 relevant role-players, and studied a wide variety of document sources, including cadastral plans as part of their research. The data on project expenditure was extracted from the JDA's Development Information Management System (DIMS), including capital and professional fees.

Limitations include the sole focus on the JDA's activities, and the assumption that there is a 1:1 ratio, noted as conservative, of property transfers to further investments made, due to the insufficient feedback from private sector developers on their investments after property purchase (RMS 2009). The document did not reference the 2005 Newtown North Urban Framework conducted by GAPP. The approach of the study is professional, and the content is expected to be reliable and objective.

Relation to the study topic

The assignment sought to quantify private sector investment, analyse property market trends, identify factors influencing investor interest, and determine the key factors for investor decisions and motivations. This report is relevant to the funding, market conditions, infrastructure availability aspects of brownfields redevelopment, and directly related to the research question.

Joburg Inner City Urban Design Implementation Plan

Origin, reliability, objectivity

A consortium of consultants was appointed jointly by the JDA and the CoJ in 2009 to compile this plan from existing documents. The purpose of this implementation plan was to establish common objectives for all the players in the Inner City. Priority areas for intervention and coordination of actions were identified at a high-level and

in detail for the numerous precincts. These common objectives and coordinated actions were then used to identify investment priorities for the Inner City budget allocation over the next three financial years (2009-2011). As the document was drafted by external consultants under the auspices of the JDA, its reliability and objectivity is expected to be high (JDA & City of Johannesburg 2009).

Relation to the study topic

Newtown's state in 2009 is described, including completed interventions and challenges/opportunities for future action. Development interventions proposed mostly relate to the further redevelopment of particularly bad buildings, and an increase in residential and mixed use. (JDA & City of Johannesburg 2009).

The remaining content of the report focuses on less intensive management improvements related to public spaces. The document therefore has limited relevance to the research question.

2010 Region F Spatial Development Framework

Origin, reliability, objectivity

A discussion on these aspects of the regional SDFs was provided in on page 73 for the overall SDF for the city. Regional SDFs were instituted from 2006 onwards as part of division of the city in administrative regions.

Relation to the study topic

The 2010 Region F SDF refers to the Inner City area, which includes Newtown, Ferreirasdorp and Westgate - all as part of sub-area 12. The sub-area 12 was identified as a high-priority area due to the Bus Rapid Transit (BRT) running through it, which requires the prioritisation of infrastructure investment along the identified corridor. One of the development objectives set out was to support private sector redevelopment initiatives, particularly of the "bad buildings" initiative the city had initiated.

The redevelopment of the Potato Sheds, Central Place and Majestic Building, all in Newtown, were indicated as especially important mixed use developments. There were no new industrial uses proposed for Newtown. Other aspects pertaining to

redevelopment included changing road hierarchies, improving access and mobility, and supporting the business core through public space upgrading (City of Johannesburg 2010).

This document addressed municipal infrastructure, land use, transport corridors, redevelopment and catalytic public spending to attract private sector investment. This policy document is relevant to the research question.

Newtown: a Cultural Precinct – Real or Imagined (Master of Arts Research Report)

Origin, reliability, objectivity

Urban Genesis, a company specialising in urban management, and active in the Inner City since 2002, employed the author of this research report. From 2007, onwards she worked for the Newtown Improvement District. It is for this reason she had first-hand experience of the case study area for an extended period in the early 2000s. Shand's research includes interviews with many of the important players in the regeneration process of Newtown, including Barry Senior of GAPP, and Graham Reid, the Chief Executive Officer (CEO) of the JDA from 2001 to 2005. The report is thus expected to be reliable, but rather subjective due to the author's personal involvement (Shand 2010).

Relation to the study topic

The report provides useful insight to many aspects of the case study area's urban regeneration and management, (including funding, infrastructure, and political support) through the involvement of the author in Newtown and interviews with key people. The report is thus relevant to the research question.

Johannesburg Inner City End of Term Report

Origin, reliability, objectivity

This report appears to have been commissioned by the JDA. It seeks to provide understanding and clarification regarding the urban renewal of the Inner City, with a focus on two aspects: Firstly, the Inner City policies and programmes led by the city; Secondly, to summarise important public and private sector projects undertaken in the decade from 2001 to 2011 (City of Johannesburg 2012).

The facts in this report are sourced from the City of Johannesburg and the JDA, amongst others. In terms of the impact of public funding on the private sector, its main source is the report by Rhizome Management Services of 2009 (one of the data sources described above).

This document is expected to be a reliable source of information. However, the document serves a marketing purpose for Johannesburg as a "World-class African City" – and this limits the objectivity of the document.

Relation to the study topic

The document has many references to Newtown and provides a valuable source of information regarding the case study and the relevant policies of the City of Johannesburg. It further particularly addresses the funding and policy aspects of urban regeneration of which brownfields sites are part of. The document is relevant to the case study of Newtown and the research question.

Urban Regeneration in the Joburg CBD

Origin, reliability, objectivity

Lael Bethlehem was the CEO of the JDA from 2005 to 2010, and therefore has first-hand experience of the activities and drivers for regeneration of Newtown. However, this journal article (written in 2013) cannot be considered to be an academic paper owing to that fact that no references are provided. It therefore simply relies on the author's experience and knowledge. The article is reliable, but perhaps subjective, as the author was personally involved.

Relation to the study topic

The article provides a summary of urban regeneration in the Joburg CBD from the perspective of Bethlehem, who had particular insight into the matter. The article's relevance to the study topic relates to key factors the author cites for urban regeneration, which includes industrial brownfields properties. These factors are:

"Public investment in urban renewal and infrastructure, City Improvement Districts, Institution and corporate investment, and entrepreneurial private investment in the residential sector." (Bethlehem 2013, p.19) The article is thus relevant to the research question.

"What's the Plan?" The changing approaches to regeneration and spatial planning in the Inner City of Johannesburg (2000 to 2015) Inner City Booklet

Origin, reliability, objectivity

The booklet investigates the evolving approach of government on a local level towards urban renewal in Johannesburg. This booklet was used for a public exhibition/open day to engage Inner City stakeholders hosted at the end of 2015. It considers the numerous planning documents for the Inner City. Although the exhibition and booklet were both commissioned by the City of Johannesburg and JDA and notes certain achievements, it also notes some of the shortcomings/alternatives of the approaches followed (City of Johannesburg & JDA 2015). The objectivity and reliability of the document appear to be high.

Relation to the study topic

This booklet may provide insight into the local government approach towards redevelopment of Newtown, which is relevant as a success factor for the redevelopment of brownfields. The contents of the booklet is thus relevant to the research question.

Inner City Transformation and Investment Trends: 2009-2014

Origin, reliability, objectivity

This presentation-style document was compiled by the JDA. It seeks to provide an understanding and clarification regarding the urban renewal of the Inner City in the

period from 2009 to 2014. Its main headings are the context, property market trends, public and private sector investment, and lastly a way forward (JDA 2015). It is expected to be a reliable and objective source of information.

Relation to the study topic

The document provides limited information regarding the case study site between 2009 and 2014. It indicates the value of public and private investments made. Challenges include the continuous funding of the City Improvement District. The document is relevant to the case study of Newtown and the research question.

Newtown Urban Design Framework Review (GAPP 2015)

Origin, reliability, objectivity

The assignment was likely commissioned by the JDA. It provided a high-level review of the original plan and vision, the revision of spatial and legal frameworks, the revision of institutional arrangements, and an implementation programme for identified projects. This document is considered to be reliable and objective.

Relation to the study topic

The commissioning of this review confirms the long-term commitment of the city pertaining to effective brownfields regeneration. Additional projects such as Site 8, Site 6 (recently awarded to Crowie Projects), the Old Park Station and other opportunities north of Carr Street are described in the document. The land release strategy described in the 1999 framework is planned by creating various redevelopment parcels, each to be sold off and separately developed. Refinements to the precinct are also proposed.

News Archive, City of Johannesburg website (http://www.joburg.gov.za)

Origin, reliability, objectivity

The articles reviewed from the City of Johannesburg's website have an obvious promotional style, with jargon often being used, and unsubstantiated statements made. They contain few references to data sources, and it is assumed that most of these data sources would be from within the City of Johannesburg itself. Where

specific amounts or numbers are mentioned, these appear to be correct and verified by other sources. Their objectivity is thus low, and reliability moderate.

Relation to the study topic

The archive provides a news source over time, for verification of events regarding the case study. It is therefore relevant to the case study, and the research topic in relation to local government involvement.

Johannesburg Development Agency website (http://www.jda.co.za)

This website is the repository for the activities and documents of the JDA. Although not objective, dates and information provided are expected to be accurate.

As a special purpose company of the city, the JDA was instrumental in the redevelopment of Newtown. Its activities, annual reports and planning documents provide arguably the best record of events of the case study site.

Newtown Improvement District website (http://www.newtown.co.za)

This website is the repository for the activities of the Newtown City Improvement District (NID). Although not objective, dates and information provided are expected to be accurate.

Rea Vaya website (http://www.Reavaya.co.za)

This website is the repository for the future planning, routes and schedules of the Rea Vaya Bus Rapid Transit system, which commenced in 2009. Although not objective, dates, route maps and information provided are expected to be accurate.

Gautrain website (http://www.gautrain.co.za)

This website is the repository for the future planning, routes and schedules of the Gautrain system, which includes its bus routes at every station. Although not objective, dates, route maps and information provided are expected to be accurate.

4.1.3. Presentation and analysis of data

The description of the case study over time is presented here. This section represents the data where information provided in data sources are consistent with each other.

Aspects where no data could be found

Despite Newtown's past industrial land uses (such as power generation, workshops, abattoirs, and railway yards), no document sources could be identified that confirm contamination, or environmental and human health effects as a result thereof.

Some possible reasons for this are natural assimilation over time in the case of hydrocarbons, waste such as ash being removed to other locations, and the encapsulation of soil layers by the periodic redevelopments over time.

Urban decline of the 1980s and 1990s

By the early 1980s, the Worker's Compound and Cooling Towers were used only as a storage depot, because of urban decay and the migration out of the city. The Turbine Hall was occupied in the late 1990s by squatters, and crime levels were high (City of Johannesburg 2011a; City of Johannesburg 2003a).

The city council divided the Johannesburg CBD into four metropolitan substructures after the 1994 elections, which added to the decline of the Inner City. The City of Johannesburg was practically bankrupt by 1997/1998. After intervention and restructuring assistance from National Treasury, the Greater Johannesburg Metropolitan Council was established in 2000 (Bethlehem 2013; Shand 2010).

Therefore, it can be deduced that some areas of Newtown could by 1999 have been categorised as "brownfield."

Early city initiatives in the 1990s

The Cooling Towers were demolished in 1985. GAPP compiled the first Urban Design for Newtown in 1987 (Shand 2010). The city started various urban renewal initiatives from 1992 onwards. The Central Johannesburg Partnership (CJP) was initiated in 1992 to combat urban decay. In turn, the CJP started numerous other organisations and initiatives, such as the Inner City Housing Upgrading Trust in 1993

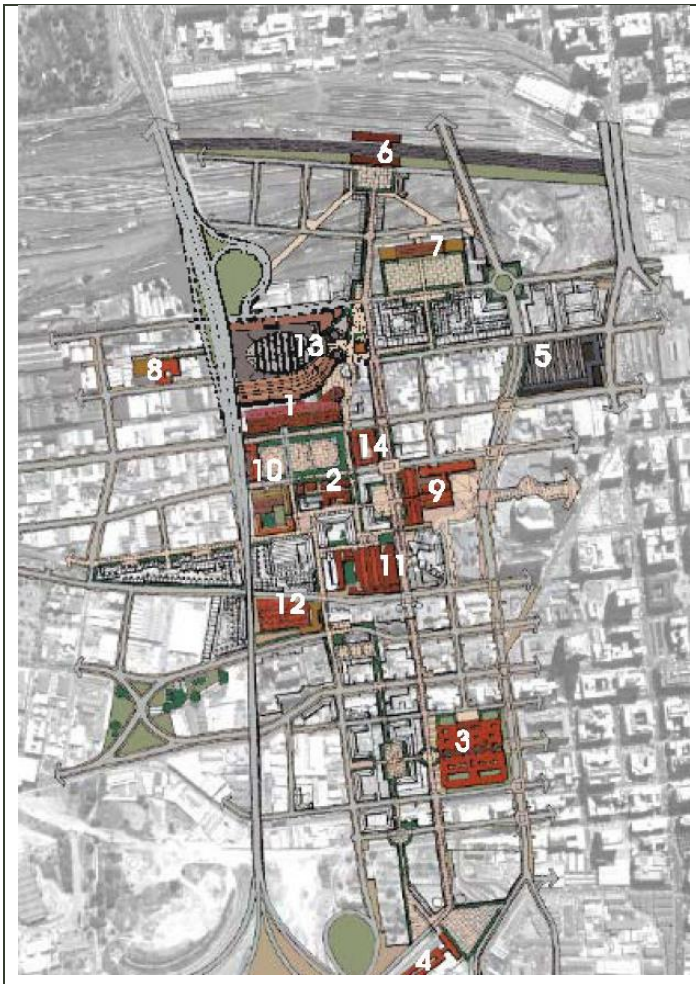
and the Johannesburg Trust for the Homeless in 1995. Some of the developments undertaken in Newtown at the time were Museum Africa (1994), SABMiller's "World of Beer (1995), the Workers Library and Museum (1995), and the Reserve Bank (1996).

The urban renewal of Newtown had the necessary policy and political support, when considering the many initiatives and investments from the national, provincial and local government. It started with the new vision for the Inner City, "The Golden Heartbeat of Africa" as launched in 1997 by Thabo Mbeki (City of Johannesburg 2007). Some of the political support stemmed from the tainted history of the area in the early 1900s (Gaule 2005; Johannesburg Development Agency 2004).

The Inner City Office (ICO) was established to align contradictory planning and policies in 1998. This office oversaw the drafting of the Inner City Spatial Framework and Inner City Economic Development Strategy, both in 1999. These documents identified various urban renewal programmes, which included Newtown and Braamfontein.

The Gauteng Province invested in the ICO (which eventually became the JDA) during 1999 through Blue IQ. The Blue IQ (now the Gauteng Growth and Development Agency) is an investment holding company funded by the Gauteng provincial government. It provided funding to the JDA as implementing agent for various projects, including Newtown. The Gauteng Economic Department also funded a building maintenance project in Newtown (Shand 2010).

The 1999 GAPP Urban Design Framework (UDF) was one of the seminal planning documents for Newtown. Figure 7 shows its key existing and proposed installations. The framework proposed a series of goals for Newtown. These included creating a safe and secure environment, improving accessibility, developing the Turbine Hall, creating a critical mass and a 24 hour city, and establishing a coherent development framework for the area. The establishment of a focused special purpose vehicle to drive the development and land release process was also a goal of this urban design framework. The JDA became the special purpose vehicle that was envisaged.



Existing installations (1999)

1. The Market Theatre & Museum Africa
2. Worker's Library & Museum
3. The Magistrates Court s
4. Westgate Station
5. MetroMall Taxi Rank

Proposed installations (1999)

6. Proposed Newtown Station
7. Transport Museum
8. Cybersite & Interactive Media Centre
9. AngloGold Corporate Headquarters and Museum
10. National African Art Gallery
11. Science and Technology Centre
12. Craft & Design Centre
13. Hall of Fame
14. Interactive Entertainment Centre

Figure 7: Plan of Newtown with existing and proposed redevelopment interventions in the Urban Design Framework of 1999 (GAPP 1999, p. 25)

Bethlehem (2013) described the JDA's interventions in the Inner City, including Newtown, in two phases. The first phase, from 2000 to 2005, focused on iconic interventions designed to attract attention, thereby acting as catalysts for future development. The Nelson Mandela Bridge and Mary Fitzgerald Square were the interventions undertaken in this phase.

The second phase, from 2005/2006 onwards, included smaller sustained activities to support private sector investment. It included the Newtown Improvement District and its active urban management such as adequate lighting, cleaning, service provision and management of public spaces. These initiatives are still ongoing. The Rea Vaya public transport system was one of the larger interventions of this stage.

Establishment and first activities of the JDA (2001 – 2005)

The Inner City Position Paper, generated by the JDA in 2001, documented strategies, guiding principles and first priorities. The guiding principles of this paper proved to remain intact throughout the tenure of the JDA. These included focusing on improving the management of the public environment, working collaboratively with other stakeholder in the Inner City, creating a favourable investment environment, and maintaining and increasing momentum (Johannesburg Development Agency 2001). Specific interventions identified in this document and affected in Newtown include Newtown as a Special Activity Precinct, Closed Circuit Television (CCTV) camera installation for public safety, MetroMall intermodal facility development, the Newtown City Improvement District and creation of middle-income housing opportunities.

The unique situation that most of Newtown Precinct was government-owned, meant that urban renewal and redevelopment could be done on a large scale in a short time-span (Johannesburg Development Agency 2015). The JDA committed 37% of its budget in the first few years to Greater Newtown. Its investment in the case study area was the highest between 2001 and 2006, with gradual exit of the JDA since 2005.

Investment in infrastructure

The precinct plan update, compiled by GAPP in 2001, proposed various measures to improve access to transport corridors and municipal services (Figure 8). These measures included urban design, traffic and engineering studies. The Nelson Mandela Bridge connection to Braamfontein and the M1/Carr Street Interchange were both completed in 2003. In the same year, the MetroMall transport interchange and trading facility was completed in an effort to address taxi management and public transport. These projects were catalytic early investments for improving access to Newtown. These projects were all implemented through the JDA.

Two assessments of civil engineering infrastructure were undertaken: in 2001 by Themba Consultants, and 2006, with Themba Consultants in association with PDNA. Services investigated included bulk water, sewage, storm water, roads, gas, electricity and telecommunications.

The 2006 study concluded that bulk services were sufficient overall, but that minor supply services, especially around No. 1 Central Place, required significant upgrading and re-alignment. The total cost of upgrades at the time was estimated to be R16 million. As No. 1 Central Place and Newtown North were not developed at the time, such upgrades were not required. Escalated by 10% per annum, this cost had risen to about R30 million in 2015 (PDNA & Themba Consultants 2006). Such service upgrades will now have to be effected, as the redevelopment of sites at Central Place and Newtown North is imminent.

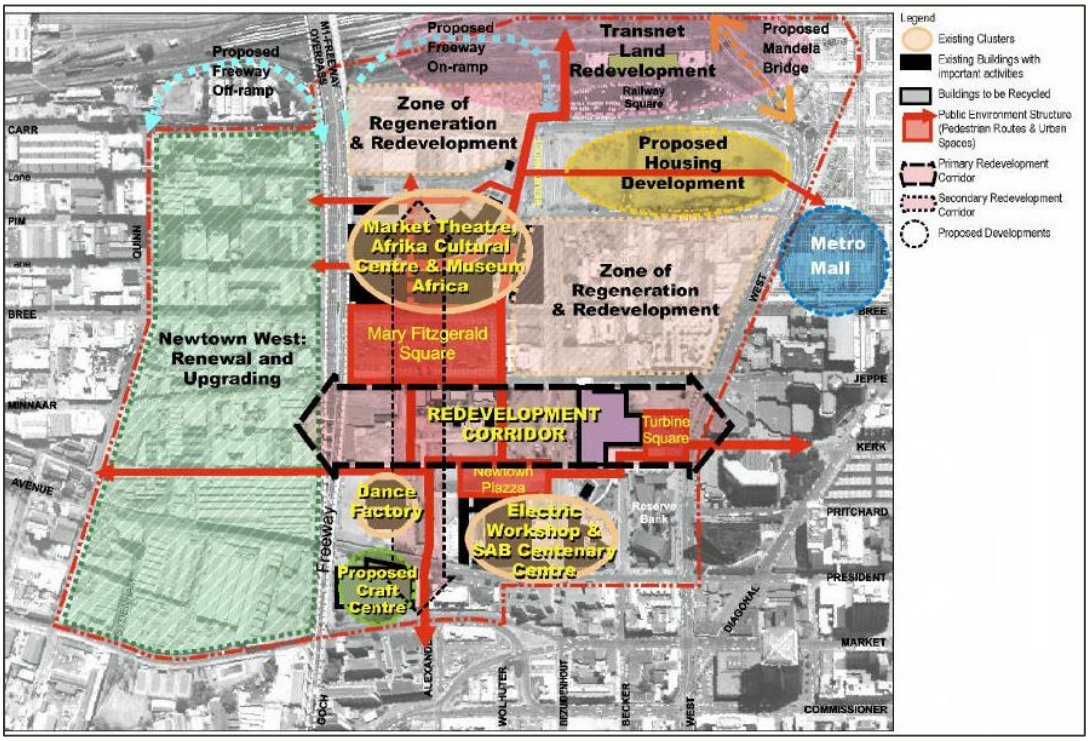


Figure 8: Precinct Plan Concept (GAPP Architects and Urban Designers & Urban Solutions Architects 2001, p.13)

Early planning and policy development

In the 2003 citywide SDF, the concepts of redevelopment, densification and infill of brownfields, was supported by the City of Johannesburg (City of Johannesburg 2003a; City of Johannesburg 2010b).

Planning and guideline documents drawn up for Newtown specifically included the Urban Design Framework in 1999, the Cultural Precinct Urban Design Plan in 2001, the Central Place Precinct Plan in 2003, the Cultural Precinct Design and

Development Manual in 2003, and the Newtown North Urban Design Framework in 2005. All of these documents were compiled by GAPP.

Particular proposals made to assist with rapid redevelopment included a design review panel, a procedure for quicker building plan approvals in the precinct, blanket rezoning to accommodate all proposed land uses according to the Precinct Plan, and town planning procedures to tailor development parcel sites according to Precinct Plan (GAPP Architects and Urban Designers & Urban Solutions Architects 2001).

The Greater Newtown Development Business Plan was completed in 2004, and many of its projects and plans implemented. This document addresses funding, redevelopment, infrastructure provision, transportation access and political support, and is thus relevant to the research question.

Identified projects that came to fruition included the improvement of public transport (through Rea Vaya and the Gautrain), light industrial and office space conversion to loft type housing (Grain Silo housing project), branding and provision of safe public space (through the NID), review of urban frameworks, the creation of development parcels, and ensuring infrastructure requirements (through NID) were met.

These planning documents gave clear direction and assisted good decision making for the redevelopment of Newtown. The JDA generally implemented the proposals in the documents soon after. The documents were consistent with each other in that they all identified problems and provided implementable solutions. These studies were likely associated success factors towards the redevelopment of the area.

Public and private property development

Mary Fitzgerald Square was completed in 2004 as first improvement to the public realm. The No 1. Central Place redevelopment, looking over Mary Fitzgerald Square was completed in 2005 by the JDA (GAPP 2005). The Science & Technology Centre (SCIBONO) was finished in 2004 in the defunct Electric Workshop.

The Turbine Hall redevelopment for AngloGold Ashanti's head office was completed in 2007 ((City of Johannesburg 2011a)). Due the squatter problem in and around the Turbine Hall, its development was seen as one of the anchor projects.

The attraction effect of the Urban Development Zone tax incentive

The City of Johannesburg indicates in an article that R9-billion worth of UDZ-related private investment was invested in Newtown between 2004 and the end of 2011 (City of Johannesburg 2012). For Newtown, these investments include the Turbine Hall AngloGold Ashanti Head Office development (City of Johannesburg 2004). For the Inner City overall, commercial banks, mining house headquarters, the Africa Housing Company (AFHCO) and City Property are among the beneficiaries of the UDZ tax incentive. This investment value was recorded somewhat less in 2010 at R8.2 billion, as reported by the Region F IDP of 2010 (City of Johannesburg 2010b).

RMS (2009) indicates that the "Department of Economic Development" tracking of UDZ related information did not contain any detail, or process to track whether developments took place or not. RMS, therefore, did not make use of the Department of Economic Development's data.

Although the City of Johannesburg article indicates that the UDZ "attracted" the investment amounts, interviews with private property developers indicate otherwise. RMS (2009) and Mwangala (2010) both conducted interviews with property developers in the Inner City, and the findings are similar. The UDZ Tax Incentive was viewed by investors as improving profits, but not a primary attraction for development in the Inner City. Primary attractions to development were deemed to be growing market demand and tangible improvements in urban management. This view was confirmed and re-iterated by the JDA (Johannesburg Development Agency 2015).

Private sector investment (2005 to present state)

Crime reduction in the Inner City

Fifteen CCTV cameras were originally installed as a pilot programme in the Inner City in 2001 in order to reduce crime, (Johannesug Development Agency 2001; City of Johannesburg 2011a). The Johannesburg Metro Police Service started its operations in 2005, enforcing the Inner City by-laws. The number of cameras in the Inner City was increased gradually to a total of 240 cameras in 2008, leading to significantly reduced crime. The CID officers have also contributed to significant crime reduction by their visibility and surveillance (Johannesug Development Agency 2001; City of Johannesburg 2011a).

Newtown Improvement District

Between 2005 and 2010, few infrastructure upgrades or development projects took place for Newtown in particular; major infrastructure and public spending were complete (Shand 2010). However, the Newtown Improvement District was established in 2006. Its focus was active urban management, which included marketing, events and services management, and the provision of cleaners and public safety ambassadors. These ambassadors were trained to direct and assist visitors to the area. Tenants pay a levy for these operational aspects (http://www.newtown.co.za).

The NID was funded by the JDA from 2006 to 2010, with the intention that the sale of 1 Central Place would provide sufficient funding so that the JDA/Blue IQ could withdraw from the area. This did not take place, and the JDA has continued to fund the NID's activities. Shand (2010) describes the exit of funding from the JDA, and handover of the NID to the City of Johannesburg's Directorate of Arts, Culture and Heritage (COJACHS) in 2010. This ongoing funding was listed as a challenge in 2015 (Johannesburg Development Agency 2015).

Bus-Rapid Transit and the Gautrain (2009)

The Rea Vaya Bus Rapid Transit (BRT) system started by the city in 2009, and has recently added Newtown to its destinations (www.Reavaya.co.za). The Gautrain, completed in 2012, included a bus service for Park Station. The Park Station bus route runs along Sauer Street, assisting to improve the accessibility to Newtown (www.gautrain.co.za).

Newtown Junction and other recent private sector developments

Although the first steps of planning of the Potato Sheds redevelopment was already in progress in 2010, construction only started in 2012, and the project was completed in 2014. Its total value was R1.4 billion, which was the largest investment in the Inner City in many years (Shand 2010; Bethlehem 2013).

Around the same time, between 2014 and 2015, the Majestic Development opposite the Market Theatre, redevelopment of the Grain Silos and the City Lodge were all completed for a combined value of more than R200 million.

The tender for the Site 6 mixed-use development has recently been awarded to Crowie Projects. Atterbury Properties is also busy with the Joburg Auto City Franchise at the Carr Street off-ramp. These two projects will add R450 million to private investment in Newtown.

The Newtown North (as per the Urban Design Framework completed in 2005) redevelopment plans did not progress according to the 2005 planning. This slowing of development in the north, on Transnet land, was noted by the JDA in 2015 (Johannesburg Development Agency 2015). This was due in part to the squatter problem that developed at Park Station (Shand 2010).

The review of the 1999 Newtown Urban Design Framework by GAPP in 2015 refined and amended some of the development proposals. Further sites were indicated for land release (such as Site 6 referred to above), as a result of this document. The review confirms the City of Johannesburg and JDA's long-term vision and commitment in the area.

4.1.4. Preliminary analysis of the Newtown case study

The City of Johannesburg and JDA identified the following common normative planning principles (applied by the City and its companies over 15 years of Inner City regeneration) in its 2015 analysis of spatial planning and regeneration in the Inner City:

- Investment attraction through iconic projects;
- Institutional arrangements for Inner City Regeneration;
- Coalition formation and partnerships for regeneration;
- Spatial planning approach;
- Urban design;
- Focus on urban management and enforcement; and
- People focussed - pro-poor, livelihoods and community needs focus (McGurk 2015, p.7).

Bethlehem (2013) is of the opinion that the four most important factors for improvement and investments within the Inner City were the following:

- public investment in urban renewal and infrastructure;
- City Improvement Districts
- Institutional and corporate investment; and
- Private, entrepreneurial investments, especially in the residential sector (Bethlehem 2013, p.19)

These aspects are confirmed by the findings of the RMS report of 2009, discussed below.

The JDA's public funding and its attraction for private sector investment was investigated by Rhizome Management Services in 2009. It was estimated that the government investment made via the JDA in the Newtown Precinct between 2001 and 2008 was R188 million (Johannesburg Development Agency 2009; Rhizome Management Services 2009). This figure only included investments by the JDA. Shand (2010) cites a higher figure of R300 million, but does not provide any detail on what is included in this figure. As a result of the catalytic investment, private investment in the same time period was estimated at R 2.7 billion.

Overall property rental rates rose in Newtown from R25/m^2 in 2003 to about R55/m^2 in 2008 (City of Johannesburg 2011a). The occupancy rate for rental office space in Newtown increased from 58% in 2003 to 84% in 2008. The property transactions in Newtown were quiet until 2005, with significant increase since then (Rhizome Management Services 2009).

The RMS report of 2009 made some conclusions relevant to the Newtown case study. These include:

- Many new property developer interviewees indicated that the JDA's investment in particularly Braamfontein and Newtown encouraged them to invest.
- General consensus among investors showed Braamfontein and Newtown to be the best interventions in the Inner City, due to the large-scale and long-term

negotiated capital investments, coupled with professional planning, urban management, and social programmes.

- Ongoing interest and active management of regenerated areas were found to be as important to Newtown's success as its initial investments, emphasising the importance of the Newtown Improvement District. Social infrastructure investment, including programmes, education and awareness were among the important factors.
- Primary attractors to development were deemed to be growing market demand and tangible improvements in urban management.
- Smaller capital-focussed interventions were seen to be less effective.
- A quick rise in the number of deeds transfers was evident in areas where the JDA intervened.

The common factors from the data sources analysed appear to be the following:

- Political support for the Newtown Precinct meant that significant public funds were allocated to the precinct, both for planning and execution of the redevelopment project. Government ownership of most of the precinct increased the scale and shortened the implementation timeframe of regeneration.
- The continual spatial planning and urban design approach guided decision-making according to sound principles. This allowed evaluation and adjustment as development took place. Spatial planning documents were undertaken in 1999, then reviewed in 2001. Design guidelines were developed in 2003, together with further plans. The UDF of Newtown North was completed in 2005. In 2015, these plans were re-evaluated and built upon in preparation for future redevelopments.
- The JDA, as special purpose vehicle for both planning and execution of regeneration activities, was an important institutional arrangement. Throughout its tenure, this institution appears to have been pragmatic, professional and objective in its conduct. Its conduct built trust and confidence in the private sector.

- Early large-scale interventions such as the Nelson Mandela Bridge, MetroMall, Mary Fitzgerald Square and the M1/Carr Street interchange attracted investment to the Newtown Precinct.

- Dedicated urban management, including consistent municipal services, marketing, public space management and safety through the Newtown Improvement District improved investor confidence.

- Large-scale corporate and private sector investment as a result of the public investments created further confidence for smaller private investors. Examples such as the Turbine Hall redevelopment for AngloGold Ashanti in 2005 and the Newtown Junction redevelopment of the Potato Sheds by Atterbury Properties in 2014 are examples of these. The upper limit of public investment as stated by Shand (2010) which possibly include the NID's management, was R300 million. Private sector investment from 2001 to 2015 is more than R4 billion.

Whereas these improvements and investments of the early 2000s are substantial, this particular time coincided with the property boom in South Africa over the same period (2002 – 2007). This boom is an external influence which improved the return on investment made in the area (Rhizome Management Services 2009).

4.2. Egoli Gas

4.2.1. Introduction and context

The Egoli Gas site is the smallest of the case studies, approximately 14,85 hectares in extent, and located between the Universities of Witwatersrand (Wits) and Johannesburg in the “institutional belt” along the south of Empire Road. Adjacent land uses include the John Orr School to the east, the Milpark commercial node and Milpark Hospital to the north, and the SABC to the west (see Figure 9). It falls in Ward 60 of Planning Region F of Johannesburg.



Figure 9: Context of the Egoli Gas site within the "institutional belt" (source: Google, AfriGIS 2017)

The southern border of the Braamfontein Spruit watershed runs along Enoch Sontonga Avenue, with the Sturrock Park and the Wits Campus draining northwards. Sturrock Park and the Egoli Gas site represents the headwaters of the Braamfontein Spruit, which is the main drainage feature of this area.

The Spruit was modified to a closed storm water culvert on the Egoli Gas property. The groundwater flow on site follows its topography, which slopes from south to north.

The site has an industrial land use history of producing gas from coal, established in 1927. This production ceased in 1992. A portion of the site is currently used as distribution site for gas produced by SASOL. The site is zoned “Industrial 2” on the western side of the original Braamfontein Spruit tributary and “Municipal” on the eastern side thereof.

The old gasworks factory itself is derelict, as the intended redevelopment initiative of 2010 did not go ahead.

History

With the closing of the President Street Gas Works in 1928, a new site was sought for gas production from coal. The Cottesloe site (Egoli Gas site) was selected because it was hidden from the residential areas of town by topography, yet close enough to the edge of the city. Its slope was further suitable for gravity flow of various liquids of the gas-making process (Tsica Heritage Consultants 2010). The Gasworks was established in 1927, and first managed by the Department of Water and Gas in Johannesburg’s City Council.

Gas production from coal

Between 1928 and 1991 hydrogen-rich coal-based gas was produced at the Cottesloe Gas Works. This manufacturing process was highly polluting; and by-products of the coal-to-gas process included coke, coal tar, ammonia, and sulphur. Tar, ammonia and other impurities were gravity fed to the “tar and liquor well.” Coke was used by the works itself for heating purposes, and sold to other industries for the same purpose. Approximately 25 000 tons of coke were produced as a by-product annually. Tar could be used for laying roads, pathways, protective coating. Tar oil and black varnish were also sold (Tsica Heritage Consultants 2010).

Closing of coal to gas plant in 1992

From the 1960s, a decline was seen in gas production due to the decision to start supplementing gas supply with that of Sasol. In 1988 the decision was taken to close the plant, and in 1992 the then-called Metro Gas ceased production of coal-based gas on site. From then onwards Egoli Gas purchased its entire requirement from Sasol Gas.

During this time, the public also began to raise concerns regarding the yellow smoke from the retort stacks and apparent contamination of the Braamfontein Spruit by the Gasworks. It could not clearly be ascertained from the data sources if these claims were substantiated (Tsica Heritage Consultants 2010).

Gas supply and activities from 1992 to present

The city council intended to demolish certain parts of the buildings and machinery after the closure of the coal-to-gas plant. However, a prolonged negotiation ensued with the National Monuments Council (NMC). This Council required a Heritage Conservation Management Plan to be undertaken due to the heritage value of the buildings and infrastructure (Tsica Heritage Consultants 2010).

Nevertheless, certain portions of the site were leased out. Prior to selling the site, thieves stripped many of the machines and valuable metal parts. The old unused buildings have been steadily deteriorating ever since, and remain in a dilapidated and structurally dangerous state (Tsica Heritage Consultants 2010).

Privatisation was realised in 2000 when the Egoli Gas Consortium bought the works and established Egoli Gas (Pty) Ltd (http://www.egoligas.co.za). The gas distribution function of the site has increased, gas pipelines to customers improved, and the business has become more efficient and profitable. The high-pressure gas storage site of SASOL is at Langlaagte, with the low-pressure storage and distribution on site, to approximately 12 000 end-users.

Further upgrades and extensions are planned as part of a R300 million expansion plan (Egoli Gas 2014). The owners of the site have been considering the redevelopment of the derelict portion of the site since the early 2000s. This initiative reached a high point in 2011, but was never implemented (Davie 2011).

4.2.2. Description of data sources

Each data source is described here to confirm its nature, origin, reliability, objectivity and its relation to the study topic.

City of Johannesburg Spatial Development Framework (CoJ 2003)

This document as data source is discussed in section 4.1.2

2010 Region F Spatial Development Framework

Origin, reliability, objectivity

Section 4.1.2 (page 78) above contains a discussion on the origin, reliability and objectivity of the equivalent regional SDF.

Relation to the study topic

The Region F SDF refers to the Inner City area, which includes the Egoli Gas site as part of sub-area 1. This area comprises mostly of institutional uses. One of the development objectives set out was to support land uses complimentary to institutional land use, including high-density residential uses, but excluding large scale retail and industrial uses (City of Johannesburg 2010b).

The document addressed municipal infrastructure, land use, and transport corridors close to the case study site. This policy document is relevant to the research question.

Draft NEMA Basic Assessment Report

Origin, reliability, objectivity

This Environmental Impact Assessment (EIA) Report was compiled by Velcich & Louw in 2011 as part of the EIA process undertaken for the proposed redevelopment, under the 2010 NEMA EIA Regulations. These regulations require the relevant Environmental Assessment Practitioner (EAP) to remain objective and independent in their reporting and assessment. The report was written by reputable environmental consultants.

Most of the information used for the EIA report is sourced from specialist investigations as part of the EIA process. Such studies include geotechnical, storm water design, soil vapour survey, civil engineering services, electrical services, ecology, and archaeology (Van der Westhuizen 2011). Due to these reasons, the report is expected to be reliable and objective.

Relation to the study topic

The report, and particularly its public participation annexure, provides insight to contamination, land use options, municipal services, provincial/local government, and stakeholder engagement (public and government) for the proposed redevelopment of the Egoli Gas site. It is highly relevant to the case study and research question.

Egoli Gas Site Remediation Plan

Origin, reliability, objectivity

Georem was appointed by the site owner in 2006 to advise them on the management and remediation of contamination on site as part of the redevelopment process. The company is well known in the mining industry for its environmental sampling, as well as remediation work for soil and groundwater media. The report served as a specialist study for the EIA process, and summarised most of the previous soil and groundwater investigations undertaken by various other consultants.

The objectivity of the site remediation plan may be questioned, as the company would have been contracted to undertake the work should authorities have accepted the plan. However, as the company works regularly with environmental consultants and authorities, it appears professional and objective.

Relation to the study topic

The report provides insight to the level of contamination on the site, and the management of risk as a result thereof. The report also suggests suitable land uses based on the level of risk across the site and makes reference to certain contaminated land policies that needed to be adhered to. The report is highly relevant to the case study and the research question.

Health-based risk assessment

Origin, reliability, objectivity

Georem appointed Infotox in 2011 to undertake a phase one review of available information and a health-risk assessment of contamination levels on site. The

assignment was based on Georem's site work and remediation plan. Infotox was to identify further work required to implement the remediation plan (van Niekerk 2011).

Relation to the study topic

The report considered the same information as the site remediation plan, but its focus was the human health risk of contamination and related land uses. The report is highly relevant to the case study and the research question.

Egoli Gas Precinct Plan for a Mixed Use Development

Origin, reliability, objectivity

GAPP was appointed by Egoli Gas to develop the development's precinct plan. As the plan was drafted for the redevelopment in 2010, the information is primary and reliable. In a similar fashion to the EIA document, the precinct plan considered many specialist studies, including civil engineering studies, a traffic assessment, a site remediation plan, town planning and the EIA (GAPP Architects and Urban Designers 2010). GAPP is a well-known consultant in private and public sector assignments, and the proposals made appear to be objective.

Relation to the study topic

This plan considers contamination risk and related proposed land use, various City of Johannesburg planning policies, municipal services availability, stakeholder comments and support. The report is highly relevant to the case study and the research question.

Egoli Gas Works Heritage Report

Origin, reliability, objectivity

A heritage assessment had to be completed in terms of National Heritage Act (1998) prior to the development due to the fact that the Gasworks is more than 60 years old. The report was completed by Tsica Heritage Consultants in 2010. The relevant approvals were obtained from the various heritage authorities at local, provincial and national levels.

Relation to the study topic

This document provides a detailed history of the case study site and its operations, which is relevant for understanding the location of the various activities on site. It also provides details of the ownership changes, which in turn relates to apportionment of liability and responsibility for remediation. The report is highly relevant to the case study and the research question.

Annual Report of the Competition Commission of South Africa

Origin, reliability, objectivity

The 2001 annual report of the Competition Commission provides an overview of the cases it considered during the time period. The sale of the city's Metro Gas to the Egoli consortium is summarised in the report. The Department of Trade and Industry was the author of the report. As it is an annual report with full financial and other information related to its operations, it has to comply with audit rules and regulations. The report appears to be reliable and objective.

Relation to the study topic

This document confirms the transfer of ownership of the property, which is an important aspect of the redevelopment of this brownfields site, as it relates to the legal entity responsible for contamination and the liability for remediation.

News Archive, City of Johannesburg website (http://www.joburg.gov.za)

Origin, reliability, objectivity

Section 4.1.2 (page 82) above contains a discussion on the origin, reliability and objectivity of the equivalent regional SDF.

One particular article published on 11 November 2011 describes the proposed redevelopment, and contains verbatim statements by the CEO, Mr Quintus Joubert as well as Barry Senior from GAPP. The article has the same verbatim quotes and broad content as the article published in the Mail & Guardian of the same date, 11 November 2011. It appears that these articles had a similar source, probably a media briefing or statement from Egoli Gas.

Relation to the study topic

The Gas Works specific article provides insight to the case study in terms of chronology of events and details of the redevelopment process and various applications made.

Mail and Guardian Newspaper (http://www.mg.co.za/)

Origin, reliability, objectivity

An article published on 11 November 2011 by L. Davie, describes the proposed redevelopment, and verbatim statements by the CEO, Mr Quintus Joubert as well as Barry Senior from GAPP. The article has the same verbatim quotes and broad content as the article published on the City of Johannesburg's website of the same date, 11 November 2016. It appears that these articles had a similar source, probably a media briefing or statement from Egoli Gas. Its objectivity and reliability is expected to be moderate.

Relation to the study topic

The specific article provides insight to the case study in terms of chronology of events and details of the redevelopment process. Aspects discussed include the various applications made, indications on how contamination has hampered private investment previously, remediation activities on site, value of investment and proposed land uses.

4.2.3. Presentation and analysis of data

The description of the case study over time is presented here. This section represents the data provided where information provided in data sources are consistent with each other.

Aspects where no data could be found

Various data, related to this case study, could not be obtained:

- Apportionment of liability between City of Johannesburg and Metro Gas at the time of the land sale could not be determined.
- It could not be determined if the statutory applications, namely the town planning and EIA applications were approved.

- It is not clear from the data if the tender document was issued to tenderers or not. The newspaper articles of November 2011 were the latest data in the public domain regarding the development.
- No data could be obtained indicating whether the tenderers would have assumed any liability for contamination and remediation should they have been successful in the bid.
- It is not known if any of the remediation actions were undertaken.
- The data did not provide a clear indication of why the Egoli Gas redevelopment did not take place.

Sale of Metro gas to the Egoli Gas Consortium (2000)

The Competition Commission approved the sale (including the property) between Metro Gas and the Egoli Gas Consortium, focusing on the privatisation of gas sales to consumers, employment issues, and noting that Metro Gas was a failing company (Competition Commission 2001). No mention is made in the annual report of the aspect of contamination or related liability.

Newspaper interviews of 2004 with the CEO at the time, Quintus Joubert, confirm that Egoli Gas had been considering redeveloping part of the site since 2001 (City of Johannesburg 2011b; Kloppers 2004). Many developers have been interested in undertaking the redevelopment, but contamination of the site has always been a challenge preventing this (Davie 2011).

This intent to redevelop the site was in line with city policy at the time. The overall city SDF, compiled in 2003, was entitled “A Growth Management Approach.” The document made reference to vacant land and brownfield sites that should be developed in order to support densification and infill development. It further proposed an upgrade and regeneration programme, primarily focused on the Inner City (City of Johannesburg 2003a). This city-wide SDF does not make any specific reference to the site itself, nor the area surrounding the site.

Determination of soil and groundwater contamination

SRK, Groundwater Consulting Services and Metago Environmental Engineers have undertaken various phases of contamination assessments, groundwater

assessments and monitoring on site between 1996 and 2000. Metago then continued with groundwater monitoring for the next decade (Georem International 2011). It appears from Georem's report that groundwater monitoring was ongoing.

Georem International has done significant work since the mid-2000s in determining the location, depth, distribution and levels of contamination on site as a result of the coal to gas process. The company considered all previous studies and reports during its investigations. Georem conducted a soil vapour survey of more than 200 points across the site, which largely confirmed findings of previous studies (GAPP Architects and Urban Designers 2010).

Georem's understanding of the studies and status of contamination on the site is summarised below.

It was initially found that the top two metres, and in isolated areas up to six metres, of soil and fill material in the eastern section of the site were contaminated with various Poly-aromatic Hydrocarbons (PAH) and some inorganic pollutants. This area of the site was referred to as the "valley-fill area". A shallow weathered aquifer within the fill material was found to be contaminated, and causing cross-contamination of the deeper shale aquifer.

Similar PAH contaminants were present in mostly the upper three metres of the soil of the decommissioned plant area. On-site boreholes down-slope from the plant area all contained organic and inorganic contamination, with the highest levels around the plant area.

Early indications were that the contaminants had not yet migrated off-site. Concentrations of contaminants decreased markedly towards the north of the site, indicating that the contaminants were not very mobile or soluble (Georem International 2011).

The Braamfontein Spruit was also formalised into a pipe on site, preventing to some extent the migration of contaminants northwards from site via surface drainage (Van der Westhuizen 2011).

Upstream off-site sources of contamination

Water quality from the direction of Sturrock Park contained inorganic contamination, which was thought to be from the old landfill located beneath Sturrock Park. However, after the installation of a monitoring well on the Sturrock Park property, it was confirmed that Sturrock Park's contribution was not significant (Georem International 2011).



Figure 10: Area of Contamination (GAPP 2010: 31)

Continuous monitoring

Metago's wider monitoring programme included monitoring of up- and downstream water has also been continuous since 1996. Monitoring was conducted at

seventeen on- and off-site wells on a quarterly basis. Findings from this wider monitoring programme show that the pumping of off-site boreholes at the University of Johannesburg and John Orr School may be creating preferential flow paths towards these boreholes, necessitating more eastern/western perimeter monitoring holes (Georem International 2011). It appears from Georem's report that monitoring is ongoing.

The redevelopment proposal

Appointment of professional team

It is evident from the appointment and completion dates of specialist reports as part of the EIA that the first appointment of consultants for the redevelopment was in 2008. The planning stage of the redevelopment was at its peak between 2009 and 2011.

Specialist studies conducted to support the environmental and town planning applications included a geotechnical investigation, an "engineering services outline scheme report," a health-based site risk assessment, a contamination remediation plan, an ecological study, an archaeology, and a traffic impact assessment (Van der Westhuizen 2011).

The two most important statutory applications made were a land use planning application (in terms of the Town Planning Ordinance of 1985) by Steve Jaspan and Associates (2011), and an environmental authorisation (in terms of the NEMA 2010 EIA Regulations) by Velcich & Louw (2011).

The Heritage Conservation Management Plan, compiled by Tsica Heritage Consultants (2010), was part of the development proposals for the site, specifying the significance of each building and structure and how these can be preserved. These were incorporated into the development proposal by GAPP (2010).

Suitability of the site for the proposed redevelopment

Alignment with local government planning policies

The 2010/2011 version of the Region F Spatial Development Framework was compiled on a detailed level per area. Region F includes the site, as part of sub-area 1.

Infrastructure investment was prioritised along the Empire Road corridor to support mixed development uses due to the proximity of the Rea Vaya along Empire Road. Such mixed-use should have included inclusionary and gap market housing. Land use changes complementary to the institutional belt, including high density residential uses, were supported by the city (City of Johannesburg 2010b).

Apart from the large retail component, the redevelopment proposal was aligned to the 2010 Region F Spatial Development Framework.

Limitation: The town planning memorandum by Steven Jaspan and Associates could not be obtained as a data source. This memorandum would have described and motivated how the development proposal aligned with the latest spatial development framework for the area.

Surrounding land use

Atlas film studio, 44 Stanley Avenue, Garden Court Hotel and Johannesburg Chamber of Commerce are in the precinct between Empire, Owl, and Barry Hertzog Roads, where numerous old industrial buildings were refurbished and re-used. Institutional, residential and commercial development thus surrounded the site (GAPP Architects and Urban Designers 2010).

Despite the 2008 recession, there were some major developments in the immediate area around the site prior to 2010. These were residential, office, and institutional developments; and included niche apartments and professional offices, film studios and advertising firms (GAPP Architects and Urban Designers 2010).

Transportation access and municipal services

Empire Road is a major east-west route to the north of the site. The Rea Vaya system also runs along this road. Enoch Sontonga to the south of the site is also an east-west road, linking Braamfontein with Vrededorp. Annet Road on the western boundary of the site connects these larger arterials and provides access to the site. Frost Avenue offers an extra entry point to the site. Empire Road offers an on- and off-ramp to the M1 Highway less than 3 km from the site. The site, therefore, has excellent local and regional transportation access.

Apart from electricity provision, which would require the developer to fund a new substation, other existing municipal services could accommodate the development. These services included bulk water, storm water, and sewage (GAPP Architects and Urban Designers 2010).

Georem's Site Remediation Plan

As part of the redevelopment planning, Georem compiled a site remediation plan in 2011, which was an updated version of work originally conducted in 2006. The integrated approach included systematic planning of activities, dynamic work strategies, and real-time measurement technologies. The systematic planning of remediation was to be incorporated into the final development proposal, so that excavation and soil movement costs could be limited. A combination of methods was proposed, depending on contamination levels and health risk.

Excavation of soil was only to be undertaken in hotspot areas where on-site treatment was not possible. Between 1,500 and 2,000 m^3 of heavily contaminated soils were to be excavated and removed to a registered hazardous waste disposal site.

The pumping of oxygen-saturated water via subsurface wells (referred to as bio-venting) was proposed to assist the natural process of breakdown of hydrocarbons by microorganisms of remaining areas with lower levels of contamination. The injection of chemical oxidants was also suggested as an additional measure to break down PAH structures to more degradable compounds. This injection method was proposed for the valley fill area as well as the plant area.

The pumping and treatment of contaminated groundwater was proposed from concentrated contamination points. A range of on-surface treatments was considered, including chemical additions remediate pH, air stripping, carbon absorption, biological treatment, and UV oxidation. The purpose of the pump-and-treat method was not the removal of all contaminants, but rather those that are high in concentration and solubility. The effluent from the treatment process would be directed to the sewer system.

The valley-fill area was to be capped with clean soil after initial excavation and in-situ treatment. Clean soil would be placed over the contaminated soil to prevent volatile

organic compounds being released into the atmosphere (as bio-organisms break these down). Healthy soil, with seeding, would assist with natural assimilation.

Impermeable capping was proposed for the old plant area. If elevated VOC release was still measured in the plant area after remediation, an impermeable capping with bentonite clay or high-density polyethylene would be installed. This method would ensure good indoor air quality for future building users and include ongoing monitoring.

The migration of contaminants via groundwater northwards was not an identified issue, and the above remediation measures were to be implemented as part of the redevelopment. For these reasons, the proposal for a cut-off trench with a permeable reactive barrier was disregarded.

As there was no pertinent legislation on remediation standards at the time in South Africa, international standards would have been used, and finer detailed work plans and remediation outcomes agreed between the Department of Water Affairs (DWA), site owner and stakeholders (Van der Westhuizen 2011). The costs of the various remediation initiatives above were not discussed nor available (Georem International 2011).

Health-based risk assessment

The risk assessment undertaken by Infotox in 2011 identified the absence of a conceptual groundwater model for the site as a shortcoming of the work undertaken to date. Infotox further concluded that site safety for human use could only be achieved after the remediation plan proposed by Georem was completed, further tests conducted and a land release document compiled, as was the practice in the US (van Niekerk 2011).

The proposed redevelopment proposal

A comprehensive urban design precinct plan for mixed-use development was compiled in 2010 (GAPP Architects and Urban Designers 2010). Land uses included retaining the Egoli Gas offices and distribution centre, the conversion of the old retort houses into a hotel, retail and lifestyle area, the development of mixed-use office and residential use east and south of the old retort houses, student accommodation on

the uncontaminated area in the south, and a park area on the contaminated valley fill area.

The total bulk building surface was estimated to be approximately 100 000 m^2 (GAPP Architects and Urban Designers 2010; Van der Westhuizen 2011). The development cost was estimated at R1 billion in 2011 (City of Johannesburg, 2011).

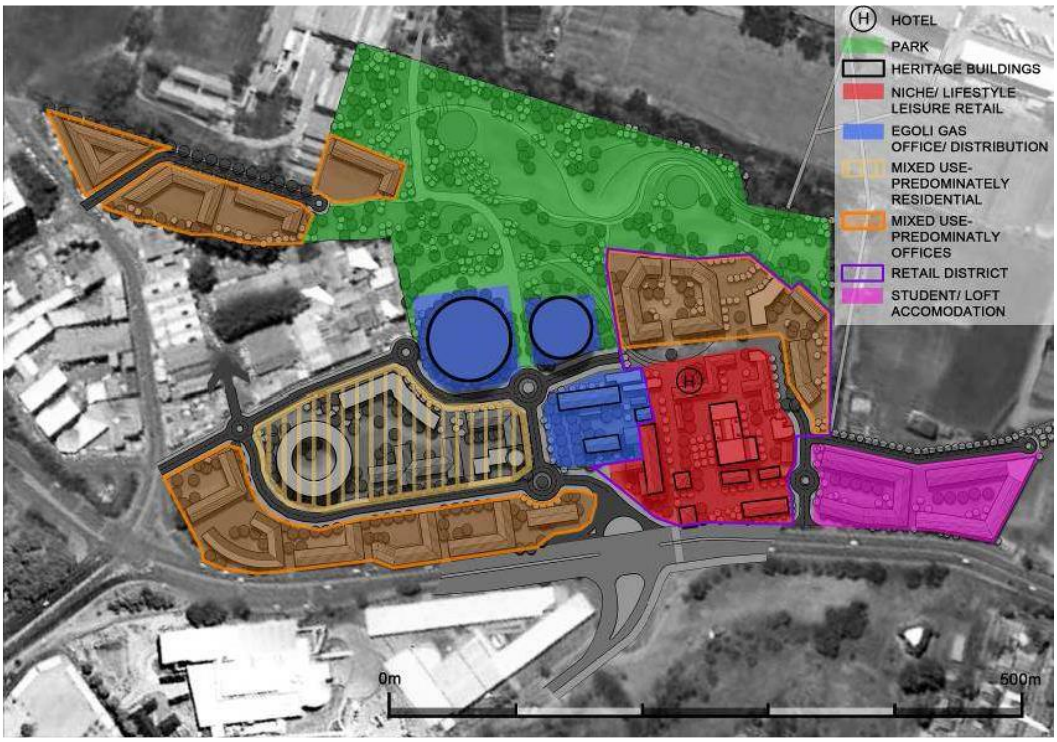


Figure 11: Redevelopment Plan for Egoli Gas site (GAPP 2010, p. 40)

Apart from the ongoing operations of Egoli Gas, no new industrial land uses were proposed for the site. Of the proposed 100 000 m^2 of development (excluding open space), the percentages of each land use were 10% for retail, 40% for offices, 4% for hotel and 46% for residential (including combined upper income and student accommodation).

Civil engineering proposals included the construction of a storm water attenuation dam at the downstream (northern) side of the site on top of the Braamfontein Spruit channel. This dam was to comply with the city council's requirement for storm water attenuation (Van der Westhuizen 2011).

Development phasing proposed at the time

The strategic first phase of the project would have been a retail development in the gasworks buildings, supported by offices, a hotel, and residential use. The first phase would have served as catalyst for further investment (GAPP Architects and Urban Designers 2010).

Stakeholder engagement outcome on the redevelopment proposal

It is clear that extensive public consultation was undertaken, as is evident from public participation annexure of the Draft Basic Assessment (BA) Report (Van der Westhuizen 2011). The Environmental Assessment Practitioner (EAP) consulted with a broad range of stakeholders, including universities, resident associations, students, developers, individuals and a range of Non-Governmental Organisations (NGOs). Meetings, letters, emails and telephone calls were recorded in the comments and response report - a standard procedure when conducting EIAs.

It is clear from the comments and responses received from stakeholders, that there is general support for the development, but with a number of stakeholder issues, such as heritage, land use, and links to adjacent sites. There was also a clear attempt by the various consultants appointed to take into consideration and update the development proposals, based on these stakeholder concerns (Van der Westhuizen 2011).

Comments from the City of Johannesburg on applications for the redevelopment

It is clear from an internal memorandum from the Environmental Management Section of the City (5 August 2010) regarding the town planning application, that no objection was raised, nor was any mention made of contamination on the site.

The same environmental management section of the City commented on the Draft BA report with its specialist studies to the GDARD in August 2010. These comments indicate an understanding of the pertinent issues of the site, and refer to the need to comply with the regulations of the National Water Act (1998). The memorandum further notes that the land use alternative of open space for the entire site was not duly considered in the report, especially considering the contaminated nature of the site. The BA report was believed to be biased due to the Braamfontein Spruit already

being modified into a channel, proposing that rehabilitation of the stream should be considered (Van der Westhuizen 2011).

Preliminary comments from GDARD

At the time of the applications, it was standard practice for the competent authority for the environmental application to comment on the draft EIA report before submission of the final version. In this case, the only comment received from GDARD at the time was that a contamination remediation plan for the contaminated soil and ground water should be included in the application (Van der Westhuizen 2011).

Absence of comments from Department of Water Affairs

Despite numerous attempts, the appointed environmental consultant was not able to solicit comments from the then Department of Water Affairs during its comment period. The report with all its annexures was submitted to the Department. The relevant specialist at National Office to which it was allocated, never submitted comments on the Draft BA report, and the consultant opted to submit the Final BA Report to GDARD, indicating DWA comments would be presented if received from the Department (Van der Westhuizen 2011).

Receiving comments or approval from DWA would have been vital for the GDARD to make a decision on the environmental application.

Tenders for redevelopment

Based on interviews with GAPP Architects and the same company CEO as in 2004, Mr. Quintus Joubert, the Mail and Guardian reported in November 2011 that Egoli Gas would issue a tender in early 2012 for the intended redevelopment (Davie 2011). From these interviews, it appears that the plans for redevelopment were still on track at the time. The rezoning application to the City had reportedly also been made by this time, with approvals expected in 2012. Construction was to commence in the fourth quarter of 2012 (City of Johannesburg 2011b).

It is not clear from the data if the tender document was in fact issued to tenderers. The newspaper articles of November 2011 are the latest data in the public domain regarding the development.

Macro-economic conditions at the time of the tenders

The GDP growth rate was negative in 2009, but grew to 3.1% in 2010 due to development and infrastructure investment associated with the Soccer World Cup in 2010. The finance minister at the time estimated an increase of 0.4% in GDP for the year 2010 (Steyn 2015). It appears from Table 2 below that 2011 and 2012 were years with poor economic growth.

Table 2: Residential property growth and GDP growth for South Africa between 2007 and 2015

Year	Property Growth %	GDP Growth %
2007	22.4	5.5
2008	-0.5	3.6
2009	0.4	-1.5
2010	2.4	3.1
2011	1.1	3.6
2012	2.3	2.5
2013	4	2.2
2014	7.4	1.6
2015	5.8	1.3

(Sources: ABSA, Reserve Bank South Africa 2016)

4.2.4. Preliminary analysis of the Egoli Gas case study

Based on the data investigated, the following aspects, derived from the review of the literature, suggest reasons for the failure in implementing the development.

Remediation was probably not part of the responsibilities of the developer or main contractor in the tender document envisaged at the end of 2011. If this was the case, such developers would have experienced difficulty in obtaining support from commercial banks, due to the related cost and liability uncertainty, as noted by Theron (2010), potentially leading to redevelopment failure.

Given the speciality of remediation required, it is likely that only Georem would have been considered for the remediation contract. No estimate could be found in the data for the cost of implementing the remediation plan. The uncertainty of the remediation costs could have led to difficulty in obtaining funding.

By the end of 2011, consultation with authorities was still underway, and therefore approvals had not yet been obtained. Agreement with stakeholders such as DWA

and City of Johannesburg was still to be undertaken. If agreement on the remediation standards could not be reached with competent and commenting authorities, it could have resulted in a delay in obtaining statutory approvals. Such delays could have contributed to redevelopment failure.

As the site was not in the UDZ area where tax incentives were available, this could have lowered the medium-term return on investment of the proposed redevelopment, but not likely to have influenced the decision from developers to tender, as the UDZ was not a primary attractor for investment even in the Inner City (Mwangala 2010; Johannesburg Development Agency 2015).

From the findings of Seeliger & Turok (2015) that only a few niche developers were interested in the risk of inner city and brownfield redevelopment projects, it can be deduced that developer interest in tenders for the Egoli Gas site with known contamination may have been limited.

4.3. AECI Modderfontein

4.3.1. Introduction and context

The Modderfontein area of Johannesburg is to the east and southeast of the Buccleuch N1/N3 Highway interchange. The site borders Linbro Park agricultural holdings to the east, Tembisa and its various extensions to the northwest along Allandale Road, and the R25 to Bapsfontein on its southern boundary Figure 12. The site is located in Ward 32, Sub-area 19 of Planning Region E of Johannesburg.

This case study site includes all the AECI land that became available for sale or redevelopment after the deregulation of the Explosives Act buffer circa 1999, around the remaining operational area (see Figure 12).

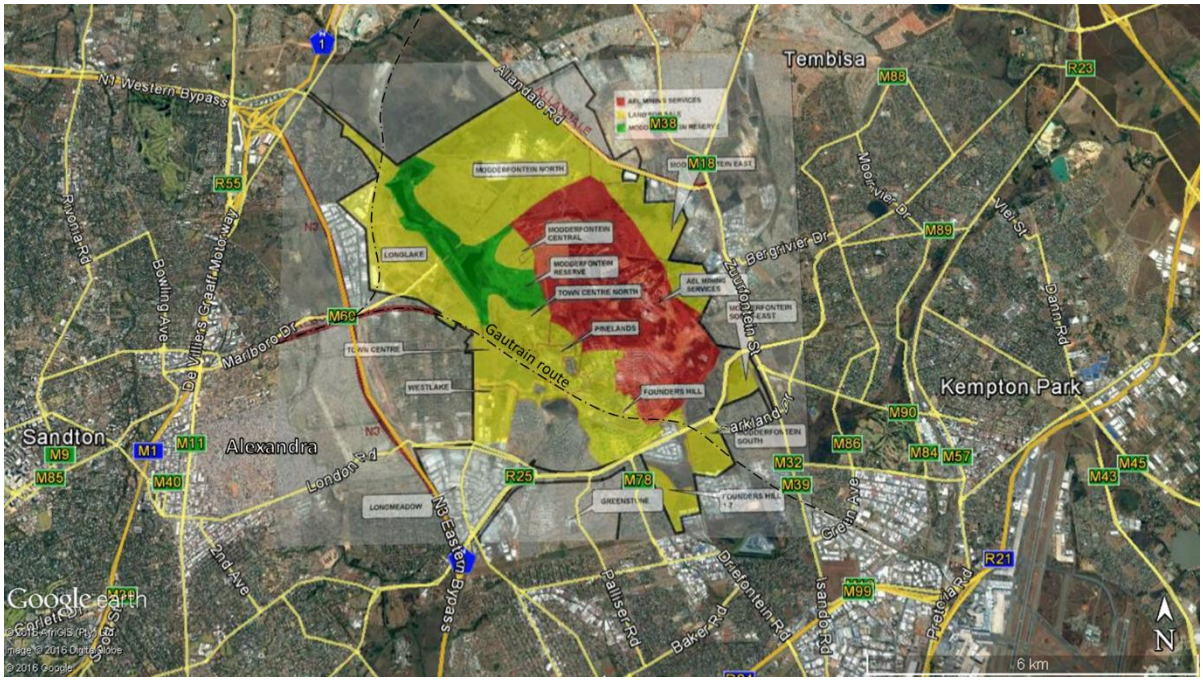
The case study site is in a tertiary catchment area of the Modderfontein Spruit, which drains in a north-westerly direction into the Jukskei River (see Figure 13).

Surrounding current land use

The land uses surrounding the site vary. A cemetery and the Gautrain Depot are the only forms of development on the remaining vacant area to the northwest of the site, where the Modderfontein Spruit has its confluence with the Jukskei River. Low-density residential areas include Linbro Park agricultural holdings (A.H.) and Glen Austin A.H. further north. High density residential areas such as Alexandra and Tembisa, and the western suburbs of Kempton Park are adjoined with industrial areas like Kelvin, Isando and Chloorkop around the study site. The newly developed mixed land use estates of Heartland Properties are also situated around the site.

Transportation access and municipal services

Transportation access includes main feeder routes such as Allandale Road, the N3 Highway, and the R25. The Gautrain's Marlboro Station is located approximately one kilometre west of the site. Its route between Pretoria and OR Tambo Airport runs along the western boundary and through the southern area of the site. The Modderfontein Station is proposed on the site itself.



(Black border indicates AECI land holdings in 2013, Yellow indicates developable and saleable land, Red indicates AEL operational area)

Figure 12: Local context of AECI's land holdings and disposable buffer land around the AEL operational area (source: Google, AfriGIS 2016, Zendai 2014)

Manufacturing and pollution history

The Modderfontein Dynamite Factory started in 1896 to manufacture explosives for the mining industry in South Africa, which grew tremendously in the following century (Brodie 2014). The Kynoch factory and the Cape-based company Cape Explosives Works merged with the Nobel Industries in 1923, to become African Explosives and Chemical Industries (AECI) as it is known today (Booth 2011).

With the ammonia synthesis process introduced in 1932, the nitrate load into natural waters increased. Various extensions to these manufacturing plants ensued in the following decades. From 1977, the making of nitro-glycerine was undertaken by a semi-automated process in the interests of safety. By 1983 the Modderfontein Factory was the largest diversified commercial explosives factory in the world (Breier-Menke & Moffat 1987).

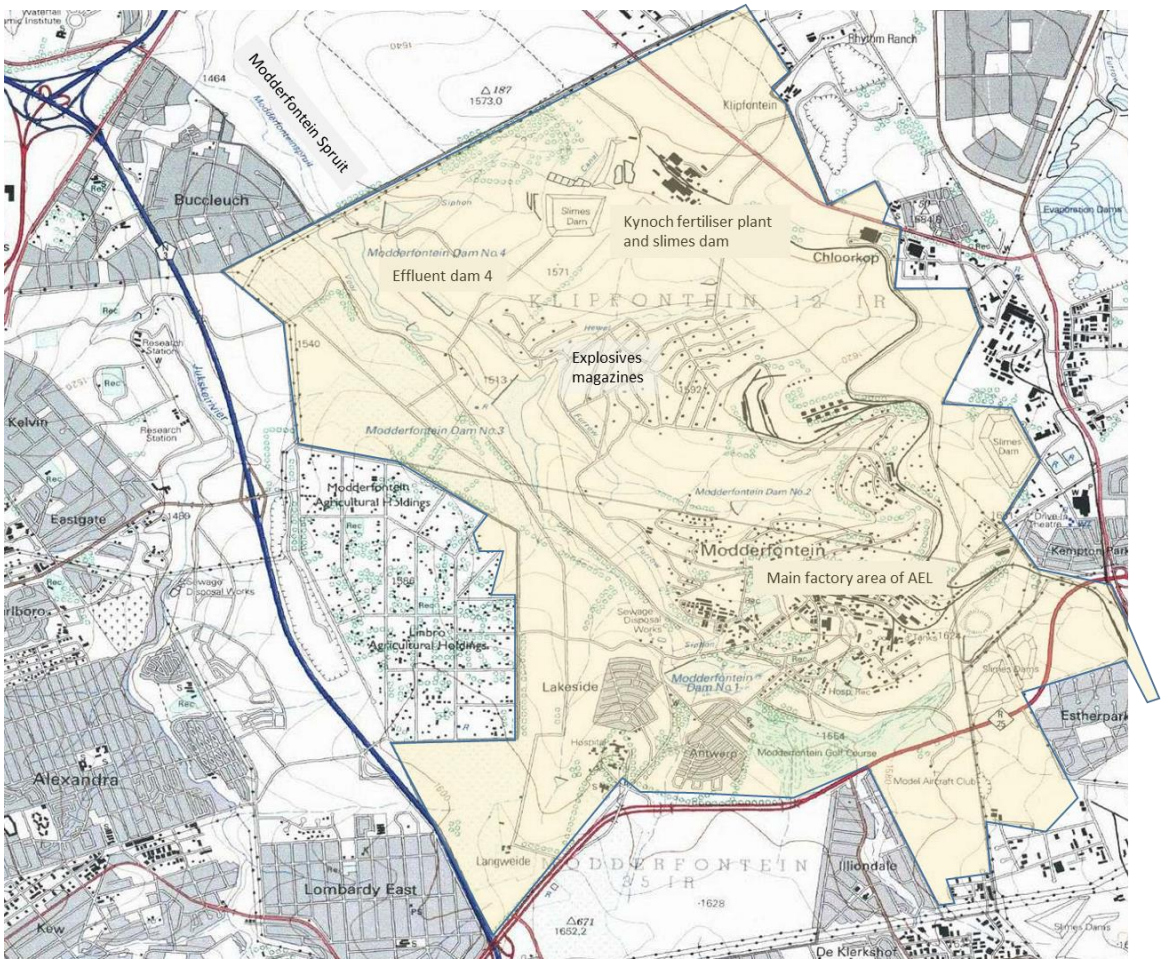


Figure 13: Site context of Modderfontein site (source: Surveyor General 2016)

Explosives Act buffer zone

Approximately 3 000 hectares was largely undeveloped around the perimeter around the factory to comply with the requirements of the Explosives Act of 1956, thereby providing a safe buffer zone (Breier-Menke & Moffat 1987). AECI retained the ownership of these undeveloped properties.

Nitrogen waste and effluent from manufacturing

1956 Water Act and its implications

Pollution of the Modderfontein Spruit by AECI was probably at a peak in the late 1950s. This pollution was caused due to the ongoing expansions of the explosives manufacturing process that resulted in an increased pollutant load in effluent water. This increased pollutant load therefore had an impact on natural waters downstream of the facility.

AECI started collecting data in 1962 in order to monitor its activities in an effort to meet the standards of the 1956 Water Act discharge standards to public streams. Wastewater was classified as “weak” or “strong" based on the nitrogen concentrations (Breier-Menke & Moffat 1987).

Application of the “strong” effluent, in the form of liquid fertiliser, on adjacent pastures was begun on initially 1 500 hectares surrounding the facilities, with the addition of another 600 ha at a later stage. These fields were used as feed for rearing cattle, under the supervision of AECI’s dedicated team of agricultural scientists (Altona et al. 1983). After implementing a range of solutions in the early 1960s to reduce nitrogen loads, effluent with high nitrogen loads to Dam Four reduced by more than 70% (Altona et al. 1983).

Construction of denitrification ponds in 1976

Due to the increasing nitrogen loads being released into natural waters, two new denitrification ponds were constructed in 1976. The efficiency of nitrogen use and fixing after the completion of the denitrification ponds was estimated at 99.9% in 1983. From this data, it can be deduced that nitrogen levels were managed within acceptable levels from this date onwards (Altona et al. 1983).

Nitrate loads in AECI’s No. 4 Effluent Dam

Elevated levels of nitrates in the Jukskei system could likely be linked to the Modderfontein Spruit and mining activities in the Central Rand area (Van Veelen & Van Zyl 1995). Van Veelen and Van Zyl argued that these loads were generated by the AECI operations, which is no longer active. These elevated nitrate levels are supported by reports dating back to 1955 of downstream users complaining about

water quality in the Modderfontein Spruit, due to the ever-increasing loads of wastewater from the factory (Breier-Menke & Moffat 1987).

Water quality of the Modderfontein Spruit

An analysis was done by Huizenga & Harmse in 2005 on the historic water quality of the Jukskei River. The monitoring data for this study was only available for the years of 1994 – 1997. The assessment focused on whether it was geological or human-made pollution sources that were responsible for the low PH, high sulphate concentrations and elevated levels of other inorganic constituents such as phosphate, nitrate, and chloride in the early 1980s.

The Modderfontein Spruit was found to be one of the contributors to pollution of the Jukskei (Huizenga & Harmse 2005). Possible sources of pollution identified included AECI and the Kelvin Power Station (KPS), as these were the largest industries along the Modderfontein Spruit, as well as the Isando industrial area, which is upstream of these facilities. No liability was apportioned. The levels of nitrates in the Modderfontein and Jukskei were very similar, indicating that AECI did not contribute abnormal nitrate loads to the Modderfontein Spruit. The potential source of low pH and high sulphates in the Jukskei River was possibly related to gold mining activities, known to cause these effects (Huizenga & Harmse 2005). This was determined by comparative water chemistry analysis between water from the Klein-Jukskei and the Central Rand area, but the process of how the contaminated groundwater entered the Jukskei remains unclear (Huizenga & Harmse 2005, p.444)

<u>Stakeholder engagement</u>

AECI established a Community Awareness and Emergency Response Committee (CAER) in 1995 as a forum for reporting on complaints and incidents at the factory. The committee meets every two months and minutes of meetings are made available to the public on AEL's website (http://www.aelminingservices.com/operations/other-operations/caer-charter).

It therefore appears that the company has some form of commitment to stakeholder engagement on a regular basis.

Redevelopment activities since 2000

In 1999, Heartland Properties was established as a subsidiary of AECI in order to develop or sell off undeveloped land that became available as a result of the Explosives Act buffer zone no longer being a requirement. In the following 14 years, the company successfully developed numerous estates with residential, commercial and office use, thus fulfilling its mandate (AECI 2000; Heartland Properties 2008; Heartland Properties 2012; AECI Limited 1999).

In 2013, the remaining 1 600 hectares of the buffer zone was sold to the Hong Kong based property developer Zendai. The sale included all the assets and transfer of staff of Heartland Properties (Republic of South Africa 2014). Zendai has been in process of planning and developing the first stages of "Modderfontein City" since the purchase (Zendai et al. 2015).

4.3.2. Description of data sources

Each data source is described here to confirm its nature, origin, reliability, objectivity and its relation to the study topic.

Disposal of wastewater from Modderfontein Factory: review of the biological nitrogen removal systems

Origin, reliability, objectivity

Employees of AECI authored this published academic article in 1983. This increases credibility, since they would have privileged information regarding the operations.

Relation to the study topic

The article provides history of the case study site regarding contaminants and its management as well as activities on the Explosives Act buffer zone.

Industrial Water Management: Changing Perspectives 1937

Origin, reliability, objectivity

Employees of AECI authored this published academic article in 1987. This increases credibility, since they would have privileged information regarding the operations.

Relation to the study topic

The article provides history of the case study site regarding contaminants and its management as well as activities on the Explosives Act buffer zone.

1999 AECI Limited Annual Report

Origin, reliability, objectivity

The 1999 annual report to shareholders is governed by certain auditing regulations and scrutinised by a wide range of stakeholders. An annual report is a legal requirement of a listed company. It is therefore expected to be a reliable data source with correct facts.

Relation to the study topic

The report confirms the intent to dispose the non-operational assets, including land through the establishment of Heartland Properties in 1999. Reference is made to limited areas of contamination that would have to be remediated prior to such land development or sale activities. The intent to redevelop brownfield sites owned by the company is confirmed.

South Africa to import urea

Origin, reliability, objectivity

This magazine article from 2000 was also published on the Engineering News website. It can be expected that the information would be objective and fairly reliable.

Relation to the study topic

The article confirms the decommissioning of AEL's number four ammonia plant, and the sale of a controlling stake in Kynoch Fertilisers to an international company.

2003 City of Johannesburg Spatial Development Framework

This document as data source is discussed in section 4.1.2.

Environmental Impact Report for Isidleke Development, Modderfontein

Origin, reliability, objectivity

This EIA Report was compiled by an independent environmental consultant in 2005, and is therefore expected to be objective and reliable. Oryx Environmental also has a strong track record in the environmental industry. The company was commissioned by Heartland Properties for one of the ongoing redevelopment projects on AECI land.

Relation to the study topic

The report confirms contamination of nitrogen and manganese at selected sites, and particularly at effluent Dam No. 4. It is therefore relevant to the study topic.

Scoping Report & Plan of study for EIA Relocation of the Detonator Destructor Facility

Origin, reliability, objectivity

This EIA Report was compiled by an independent environmental consultant in 2007, and therefore expected to be objective and reliable. Willchem cc has a proven track record in the environmental industry, specifically in the industrial and mining sector. The company was commissioned by Heartland Properties to compile the EIA for the relocation the detonator destructor facility on AECI land.

Relation to the study topic

The report provides insight into the planning of Heartland/AECI regarding future operations and new land uses. AECI's duty of care with regards to environmental management, specifically decontamination, is notable at a time when formal soil screening regulations were not yet available in South Africa. This duty of care and forward planning approach may have been an associated success factor for brownfields redevelopment on the case study site.

2007 AECI Corporate Citizenship Report: Case Study - Rehabilitation of Modderfontein's Dam No. 4

Origin, reliability, objectivity

As part of its corporate citizenship report in 2007, AECI discussed the rehabilitation effluent dam No. 4. The reporting style appears to be scientific and reliable. As AECI's 2007 annual report includes the case study site, it adds to reliability, as stakeholders and shareholders would have scrutinised the report.

Relation to the study topic

This case study description confirms contamination of Dam No. 4, and the need for remediation, which is part of the case study description.

AECI and Heartland Properties Presentations to Investors

Origin, reliability, objectivity

Heartland/AECI likely compiled these presentations internally for its investors in 2008, 2012 and 2013. Information is expected to be reliable, as investors would have scrutinised the presentation. It is expected to be reliable and objective.

Relation to the study topic of Heartland's 2008 presentation

This presentation provides insight to the planning activities of Heartland at the time of economic downturn. The status of redevelopment and land ownership is also indicated. The significant cost of required infrastructure investments for future redevelopment and development is also shown.

Relation to the study topic of Heartland's 2012 presentation

This presentation provides insight to the planning activities of Heartland prior to the land sale to Zendai. The status of redevelopment and land ownership prior to the land sale is also indicated.

Relation to the study topic of AECI's 2013 presentation

This presentation provides insight to the planning activities of Heartland at the time prior to the land sale to Zendai. The status of redevelopment and land ownership prior to the land sale is also indicated.

Minutes of Modderfontein Community Liaison Meeting (Heartland Properties 2009)

Origin, reliability, objectivity

Mr. Diepenbroek, the CEO of Heartland, chaired this meeting and was further the author of the minutes. Various internal and community stakeholders attended the meeting on 5 March 2009. As it was an open meeting, and vetted by the attendees, it is expected to be a reliable and objective data source.

Relation to the study topic

This document confirms some of the redevelopment activities of Heartland Properties. It also confirms the rehabilitation of pollution attenuation Dam No. 4, as listed in other data sources.

Heritage Impact Assessment for Modderfontein Village Development

Origin, reliability, objectivity

This heritage assessment was undertaken by an independent heritage consultant (R. Bosman) in 2010, and can be expected to be reliable and objective.

Relation to the study topic

This document provides a summary of the history of the case study site and its operations, which is relevant for understanding the location of the various activities on site. It further provides an independent account of the site's activities since 2000. The document is not used for heritage purposes, but rather a general data source. This report is relevant to the case study and the research question.

2010 Region E Spatial Development Framework

Origin, reliability, objectivity

The origin, objectivity and reliability of this report has been discussed in section 4.2.2

Relation to the study topic

The Region E SDF refers to the Alexandra/Sandton area, which includes the site as part of sub-area 19, which includes AECI Modderfontein and the surrounding suburbs.

The 2011 Spatial Development Framework of Region E, the Alexandra / Sandton area, included the site as part of sub-area 19, AECI Modderfontein and the surrounding suburbs. Sub-area 19 area comprised mostly institutional uses. The main development objective was to "develop a high quality, sustainable human settlement" on the remaining vacant land (City of Johannesburg 2010a, p.154). The SDF earmarked the sub-area for redevelopment, infill, and densification of the city. It indicated the following: "redevelopment and consolidation of the existing AECI factory and associated industrial areas" (City of Johannesburg 2010a, p.155).

This document addressed municipal infrastructure, land use, and transport corridors of the case study site. This policy document is relevant to the research question.

Presentation on AECI, Heartland, Zendai Transaction

Origin, reliability, objectivity

This presentation appears to have been jointly compiled between the two companies as part of the land sale agreement in 2013. It is expected to be reliable and objective, and contains a summary of the structure, conditions, valuations, and maps relative to the commercial agreement.

Relation to the study topic

This document provides insight into the land sale agreement, and is relevant to the case study.

Shareholder Circular - major transaction in respect of the acquisition of property assets in Modderfontein, South Africa (Shanghai Zendai Property Limited, 2013)

Origin, reliability, objectivity

Zendai sent a circular to all its shareholders prior to a special general meeting, with information regarding the intended land sale, as part of the condition of sale. The document is expected to be reliable but perhaps not objective, as Zendai was directly involved.

Relation to the study topic

One of the aspects in the circular was that no detailed site investigations with regards to contamination, heritage or other such aspects, was done prior to the sale; and it was assumed that information provided by AECI was correct.

This document provides insight into the land sale agreement, and is relevant to the case study.

Proceedings of the Competition Commission on the land sale between AECI and Zendai

Origin, reliability, objectivity

In 2014, the Competition Commission of South Africa had to consider to purchase as part of the conditions of the land sale agreement. The proceedings of the Competition Commission are expected to be and objective and reliable data source.

Relation to the study topic

The document confirms the land sale, and it may provide other information and confirm facts from an independent source regarding the case study. It is not otherwise related to the study topic.

The further evolution of South African environmental legal practice

Origin, reliability, objectivity

The environmental department of Edward Nathan Sonnenberg (ENSafrica) wrote the article in the normal course of its business in 2014, providing comment and insight to environmental law in South Africa. It is one of the well-known law firms in the country, therefore expected to be reliable and objective.

Relation to the study topic

ENSafrica was the legal advisor for the land sale agreement between Zendai and AECI, and would therefore have had particular insight to the negotiations. This article indicates that environmental legacy issues were a key aspect of the transaction, due to the intended redevelopment including residential land use. This suggests the presence of contamination, liability and requirements for remediation as part of the redevelopment.

Modderfontein Regeneration: Final Workshop Report

Origin, reliability, objectivity

This document was drafted by Atkins and ARUP as main consultants to Zendai after its public workshop in July 2015. It contains records from all the stakeholder consultations and planning undertaken for the proposed Modderfontein City, mainly in visual format. This document is comprehensive. As it was subject to public scrutiny, it is expected to be reliable and objective.

Relation to the study topic

This document covers all development aspects, including contamination and related land use zoning proposals, comments and inputs from society and government. It is probably the most relevant data source regarding the redevelopment proposals made for the case study site.

4.3.3. Presentation and analysis of data

The description of the case study over time is presented here. This section represents the data where information provided in data sources are consistent with each other.

Aspects where no data could be found

Various data, related to this case study, could not be obtained:

- It is not clear if Zendai has made any formal statutory applications (EIA and town planning) after the land purchase.
- Heartland's funding source is not certain.

Limitations

The operations of African Explosives Limited (AEL) are ongoing (City of Johannesburg 2010a; AECI 2013). AEL's activities from 2000 onwards on the remaining 1 300 ha, excluded from the Zendai transaction in 2014, is not part of this case study. This area includes the explosives magazines.

Remaining areas of contamination in the buffer zone

AECI detailed in its 1999 Annual Report that each of the properties to be developed has "pockets of contamination that are the legacy of up to 100 years of industrial operation". It further states that each of these areas was defined and characterised, and programmes put in place to remediate these affected areas (AECI Limited 1999).

Contamination at Kynoch Fertilisers

Kynoch fertiliser terminated the manufacture of nitric acid and ammonia around 2000, due to an agreement reached with SASOL for the supply of nitrogen needs of AECI, thus closing down the no. 4 ammonia plant (Engineering News 2000). The site operations at the time of termination included two tailings facilities, presumed to be for gypsum. In 2000, AECI sold its remaining stake in Kynoch but the property remained in AECI's possession (AECI Limited 1999).

The Kynoch Fertiliser factory and its tailings facility were listed as contaminated land in the environmental sensitivity map as presented in the workshop report of 2015 (Zendai et al. 2015, p.83). The plant area was included in the land sale agreement to Zendai.

Contamination at No.4 Effluent Dam

An EIA report dated 2005 for the Isidleke development at Modderfontein by Oryx Environmental confirms the presence of contamination as follows:

> The water quality data provided by AECI suggests high levels of contamination of nutrients such as ammonia (NH_3N) and manganese (Mn) at some sites (Oryx Environmental 2005, p.55).

This aforementioned report states that the confirmation of *Mn* suggests that other similar metals could be present, but are not indicated or accounted for. The contaminated areas are further indicated to be directly east of Dam No. 4, as well as westward.

The No. 4 Effluent Dam was no longer required after the scaling down of nitrogen production in 2007. Inspection and analysis showed that the sediment did contain elements similar to that of first effluent but not in levels justifying complete removal. Recent sampling proved that contaminants caught in sediment were not readily released into the water. The dam was rehabilitated, and monitoring downstream is continuous to ensure none of the contaminants mobilise again (AECI 2007; Diepenbroek 2009).

This dam has subsequently been incorporated in the Modderfontein Nature Reserve, and was therefore excluded from the land sale to Zendai.

As part of AECIs ongoing plans for development on buffer areas, an EIA process was undertaken in 2007 to relocate the Detonator Destruction Facility to the future core explosives area. Soil sampling of nitrates, lead and aluminium was to be undertaken and appropriate action taken if necessary (Willchem cc 2007). It is not clear what the outcome of this sampling was, as the EIA report was not found in the public domain.

The core explosives area described in the Scoping Report corresponds with the area that was retained by AEL in 2013.

Activities of Heartland Properties and AECI from 1999 to 2013

Heartland Properties, a fully owned subsidiary of AECI, was established in 1999 to realise value from the surplus land around the various operations, and the buffer areas earlier required in terms of the Explosives Act. All the land was originally zoned for heavy industrial uses, to allow for AECI's expansion (AECI Limited 1999; Oryx Environmental 2005). At the onset of Heartland Properties, there were about 3 000 hectares available for conventional development to the open market.

Light industrial, retail, and commercial options were developed in Longmeadow Business Estate, while Thornhill and Lakeside were the first residential estates. The Greenstone Hill and Park development was established in 2001 between Modderfontein and Edenvale (Heartland Properties 2008; Oryx Environmental 2005). In 2010, Heartland only had about 2 300 ha left, having sold off 1 000 Ha in the preceding ten years (Bosman 2010).

Future developments such as Westlake, Pinelands, Highlands and the Historic Precinct were still to be realised (Heartland Properties 2012). These areas were all included in the land sale to Zendai, and incorporated into the development framework (AECI 2013).

By 2013, the site and surrounds had limited municipal services capacity, and significant contributions and investment from private developers were required for further urban development (AECI 2013).

<u>Planning</u>

It appears that master planning for AECI's properties has been ongoing since the establishment of Heartland Properties, with various iterations. GAPP undertook the first vision for the site in 2005 (Oryx Environmental 2005), whilst the City of Johannesburg undertook its own version in 2009, the Modderfontein Contextual Framework, according to which it wanted development to proceed (City of Johannesburg 2010a).

Alignment with municipal planning policies

Development of AECI's buffer area was aligned with both the 2003 and 2010 SDF policy documents.

Stakeholder engagement

Evidence suggests that Heartland has adhered to legal requirements regarding public participation during the numerous EIA processes since the establishment of Heartland (Oryx Environmental 2005; Willchem cc 2007).

In addition, there is proof that since its establishment in 2009, the Modderfontein Environmental Community Initiative (MECI) has met on a regular basis with Heartland Properties regarding a range of aspects including new developments, rehabilitation initiatives and environmental management (http://meci.co.za/minutes.html).

Zendai land sale and development initiative (2013 onwards)

The Chinese property developer Zendai purchased 1 600 ha from AECI in 2013 at just more than R1 billion for what is to become an R 84 billion regeneration project (Muller 2015). The Heartland Property Company was included in the sale. The Modderfontein Reserve of 275 ha and the AEL factory land of 1300 ha were retained by AECI (see Figure 14).

Concerns were raised in 2013 of potential liability in terms of contaminated land, prior to the enactment of the contaminated land regulations in NEMWA in 2014, due to the inclusion of residential land use of the land to be sold (Edward Nathan Sonnenberg 2014). None of these concerns were clarified or tested. Zendai did, however, in their clarification to shareholders, mention that the company had not undertaken its own due diligence. They relied on the studying of documentation and history as provided by AECI (Zendai Holdings Limited 2013).

With regard to brownfields policy, National Norms and Standards for the Remediation of Contaminated Land and Soil Quality published in 2014, will apply for the remediation of the Kynoch tailings dams, indicated as area 3A on Figure 14. The 2015 masterplan is shown in Figure 15.

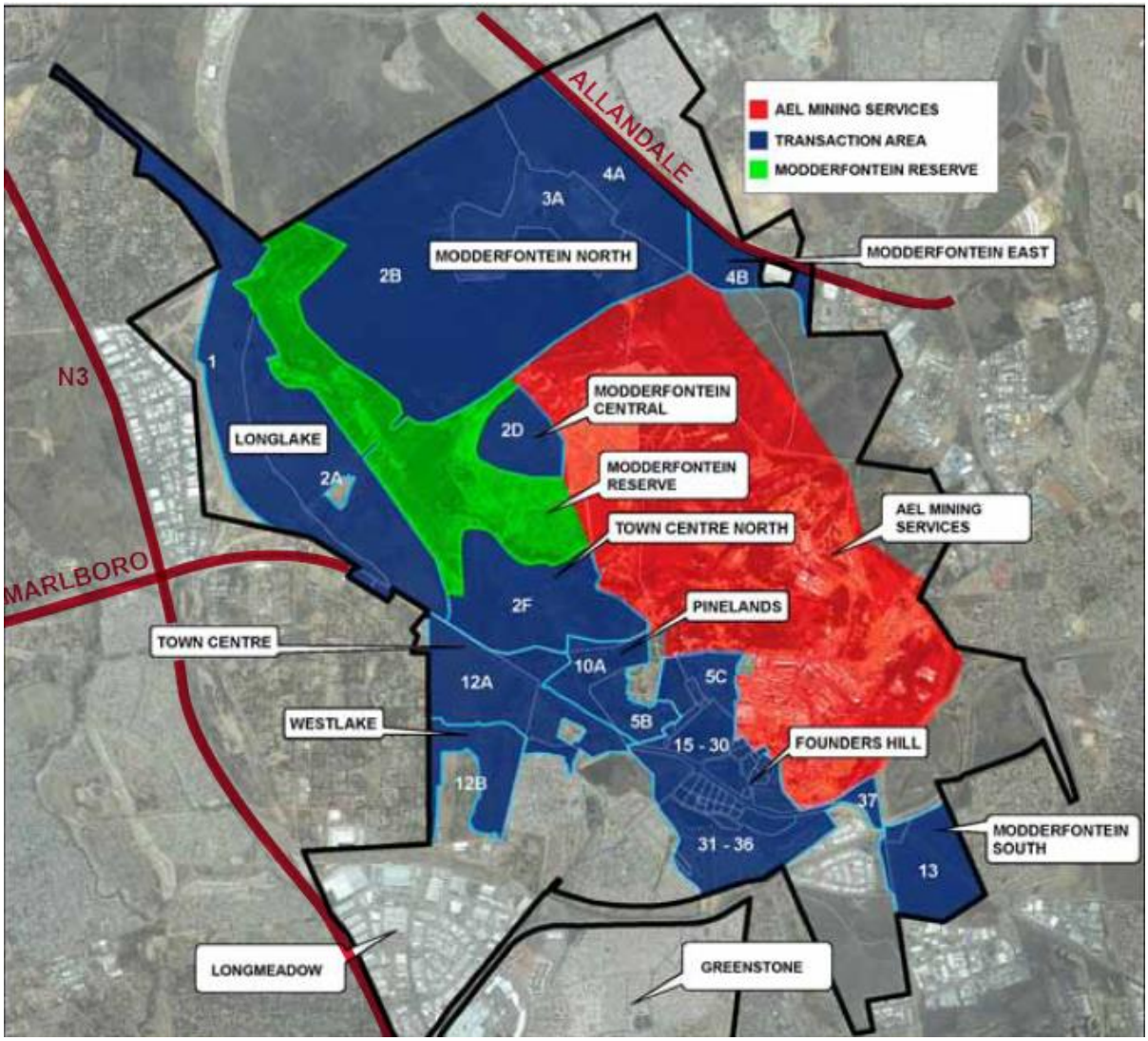


Figure 14: Land sold to Zendai (marked Transaction Area in blue) in 2013 in context of AECI property and the remaining AEL operational area (Source: Zendai 2013)

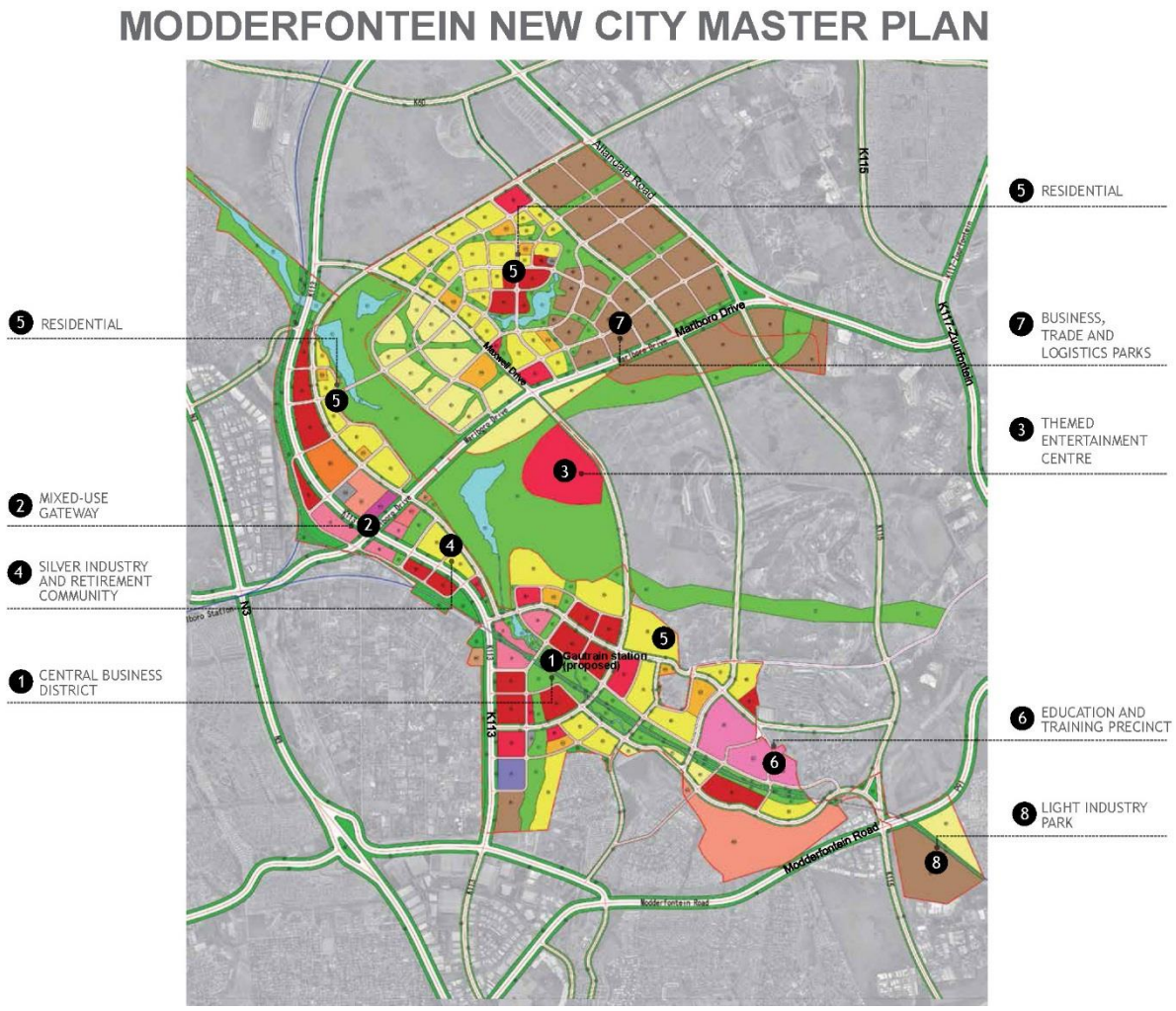


Figure 15: Zendai's master plan for Modderfontein City (source: Zendai 2015: 65)

Transportation access and municipal services

Since purchasing the land, Zendai has invested a further R400 million in municipal infrastructure, undertaken an extensive master planning exercise, and engaged a broad range of stakeholders regarding the development framework. Transfer of the last land portion was only taken two years after the initial sale agreement, in 2015 (Muller 2015).

From Zendai's stakeholder engagement workshop report, detailing the proposed development over the next two decades, it is clear that comprehensive thinking and planning on all aspects of new "city" is being undertaken. Once agreed with relevant key stakeholders, such as the City of Johannesburg, detailed precinct plans, related approvals and development will proceed as per market demand (Zendai et al. 2015).

The Gautrain's Modderfontein Station will likely be located on the site, intended to be commissioned by early 2019 (Muller 2015), improving the development's public transport access.

4.3.4. Preliminary analysis of the Modderfontein case study

Heartland's development activities were on excess land used as buffer area. The buffer area had few industrial activities, other than some effluent dams, the Kynoch operations with its tailings dam, and explosives magazines. The 1 600 ha not yet developed and sold to Zendai was also from the buffer area.

These buffer areas had low levels of contamination and in isolated areas only. This factor, low overall contamination in isolated areas only, can be associated with Heartland's redevelopment success. Further, Zendai's future redevelopment activities will likely be positively affected by the low levels of contamination.

The evidence suggests that AECI has approached effluent water management scientifically since the 1960s, with proven duty of care with regard to rehabilitation of problematic areas of their operations. This approach arguably made it easier to redevelop (through Heartland) and sell off land to Zendai, as rehabilitation was already completed. AECIs commitment to rehabilitation may be associated with the redevelopment success of Heartland Properties. For example, if No. 4 Effluent Dam was not rehabilitated, it could not have been included in the Modderfontein Reserve. The company spent R34 million on land remediation between 1996 and 1999, and its annual reports prove its spending on remediation and rehabilitation (AECI Limited 1999).

It can be expected that site assessments will have to be undertaken at the old Kynoch plant area to determine the extent and level of contamination prior to development.

The property boom between 2002 and 2006 probably assisted development activities from a macro-economic perspective at the onset of Heartland's land development initiatives. In terms of redevelopment cost, land purchase was discounted due to AECI's ownership – this more than likely improved the business case of these developments when compared to developers that had to still purchase land.

Over 14 years, Heartland Properties developed valuable knowledge and expertise regarding land development of AECI's excess property around its operations. Heartland's institutional knowledge and understanding of the Modderfontein area's property market is likely to be associated with redevelopment success of Zendai.

From Zendai's R400 million investment in infrastructure in the first two years after the land sale, and its bank guarantees with Hong Kong Bank's South African branch, it appears that the developer has quick access to private funding. This quick access to funding options can be expected to be related to redevelopment success in the future.

Due to the strong trade relations between South Africa and China, it can also be assumed that provincial and local government will support Zendai's development activities. Political support for redevelopment of the case study site may also be associated with potential success.

5. Discussion

In this chapter, each of the three case studies is evaluated against the nine contributing success factors to brownfields redevelopment identified in the literature review.

5.1. Evaluation of case study findings against literature

5.1.1. Newtown

The precinct-level intervention is regarded as one of the more successful interventions in the Johannesburg inner city. Large-scale interventions requiring significant funding attracted the attention of private investors.

Factor one: Sites with little or no contamination are more readily redeveloped

From the data analysed, no contamination was documented for the area of Newtown. When redevelopment activities started in earnest, from 1999 onwards, contamination was not evident in Newtown.

The presence of no proven contamination as a success factor probably lead to the redevelopment success of Newtown as a brownfields precinct (De Sousa 2001; Howland 2003b; Bacot & O'Dell 2006; Hollander et al. 2010).

Factor two: Mature brownfields management policies facilitate development

Momentum for redevelopment started in the late 1990s. The establishment of the Inner City Office in 1999 and the JDA in 2001 were particular turning points.

Redevelopment policy and planning documents were compiled and implemented in quick succession between 1999 and 2003. The City of Johannesburg has continued to update these as required. For example, four urban design frameworks and precinct plans have been compiled for Newtown in 1999, 2000, 2005, and 2015.

These planning frameworks and plans were mature policies; and assisted in shortening the development approvals process; and showed a high degree of integration between different aspects of development and role-players. As contamination was not an issue affecting redevelopment, the policies and plans did not have to address environmental risk.

The SARS UDZ Tax Incentive, implemented in 2004, was an effective secondary incentive policy to improve profit margins, but not a primary attraction for private investment to the area (Rhizome Management Services 2009; Mwangala 2010). The investment in the Inner City would have taken place without the SARS Urban Development Zone tax incentive (Johannesburg Development Agency 2015).

The urban renewal strategies and incentives for the Inner City and Newtown have contributed to facilitate redevelopment in Newtown over the last two decades. Therefore, the presence of brownfields policy maturity as a success factor (Lange & McNeil 2004; McQueen 2011; Adams et al. 2010) was arguably associated with the redevelopment success of Newtown. As the Newtown did not have contamination, the silence of policies on the issue was not relevant to the case study.

Factor three: Sites with certainty regarding apportionment of liability for clean-up and perception of few latent risks are more likely to be redeveloped

Most of the properties and associated buildings in the history of Newtown were originally owned by the City of Johannesburg, its subsidiary companies, or similar large public entities (GAPP Architects and Urban Designers 2003a).

As contamination could not be identified as an issue from the data analysed, related liability for remediation of such contamination was not applicable. No latent risks were therefore expected for redevelopment in Newtown.

The perception of few latent risks in Newtown was probably associated with the redevelopment success (Sigman 2010; McGuigan 2000; Alberini et al. 2005; De Sousa, 2001; Nijkamp et al. 2002).

Factor four: Redevelopment land use options based on a risk minimisation approach improve the feasibility of brownfields projects

No evidence could be found in the data that the new land uses proposed and implemented in Newtown were influenced by contamination risk to human health or the environment.

The current land uses in Newtown vary greatly - they include retail, commercial, office, entertainment, hard and soft open space, education, institutional and residential uses. No new industrial land use has been implemented in Newtown.

This shows consistency with findings in the literature, which indicates that most brownfield sites have industrial land use origins, but redevelopment tends to be commercial, retail or residential (Frantal et al. 2013; Winson-Geideman et al. 2004).

No land use restrictions were necessary, as there was no evidence for contamination. This success factor is not applicable to the Newtown case study.

Factor five: Favourable market conditions attract private sector investment

2001 to 2008-time period

South Africa experienced a property development "boom" between 2002 and 2007 on a macro-economic level. Private investors expected strong returns according to the property boom at that time (Funke et al. 2006).

Most of the investment in the early 2000s in Newtown was in public infrastructure, and funded by public institutions. These investments were not highly dependent on favourable market conditions, but the institutions would still have benefitted from good interest rates and favourable lending terms.

The JDA, through its area-based intervention, spent R188 million in Newtown between 2001 and 2008, thereby assisting to create favourable micro-economic conditions for private investment. Significant investments were made in municipal services and transport infrastructure. Over the period of 2001 to 2008, R 2.7 billion was spent in Newtown by the private sector (Johannesburg Development Agency 2009).

According to the evidence of this study, the development of AngloGold Ashanti's Turbine Hall in 2005 was the most significant early private investment in Newtown. The JDA's analysis confirms that private sector investment was flat until 2005. A significant increase occurred in 2007 and 2008, with more than 60% of private sector investment (as measured from 2001) occurring in those two years. The JDA's analysis also makes reference to the context of the 2002-2007 property boom assisting the positive impact of the JDA's investments (Rhizome Management Services 2009).

The active urban management of the NID has had a positive impact on the case study site since its inception in 2006, which may have assisted in the success of Newtown's redevelopment.

2009 to 2016-time period

Brownfields redevelopment is more difficult in poor property markets (Adams et al. 2010). With the financial crisis and recession in 2008, the property boom in South Africa ended. Residential property growth, as an indication of the overall property market, was poor in the years following the 2008 recession (Global Property Guide 2016; Steyn 2015). The increased growth figure in 2010 before the Soccer World Cup was an exception.

According to the JDA, private sector investment in Newtown between 2009 and 2016 was in excess of R 1.6 billion, excluding another R450 million in planning or under construction (Johannesburg Development Agency 2015).

Private development interest in Newtown has increased since 2013. The most recent of these developments is the Newtown Junction retail and commercial development at the Potato Sheds in 2014, a R 1.4 billion investment. This was despite very little public investment (R16 million) made in Newtown after 2008.

The strong macro-economic market conditions between 2002 and 2007 likely contributed to the private sector investment in Newtown's redevelopment.

The investment in the Inner City would have taken place without the SARS Urban Development Zone tax incentive. Despite the fluctuating macro-economic growth periods, other factors such as growing market demand and tangible improvements in urban management seems to have stimulated redevelopment in Newtown (Rhizome Management Services 2009; Mwangala 2010; Johannesburg Development Agency 2015).

Most importantly, the JDA, as special purpose vehicle and implementing agent of the City, was effective in the funding and execution of public investment identified in the planning documents. This created long-term favourable micro-economic conditions.

The favourable area-based market conditions created by local government likely had a significant impact on private sector investment and redevelopment success in Newtown, similar to the case study of Charlotte presented by Bacot & O'Dell (2006).

Factor six: Quick access to a variety of funding options, coupled with clear and rapid approvals process encourages redevelopment

Most of the properties and buildings in Newtown belong to government. The fact that the JDA and other public entities undertook many of the developments, prevented long approvals processes, due to co-operative governance and political will. Funded by the various spheres of government, the JDA as special purpose company focused towards the regeneration of the Inner City, was an associated success factor in Newtown's redevelopment success.

As government owned most of the land and buildings, investment in Newtown was assisted by various government-related funding initiatives (Rhizome Management Services 2009; Shand 2010; City of Johannesburg 2011a).

In addition, a blanket rezoning application was undertaken for Newtown, and a Design Review Panel was established, according to the Urban Precinct Plan of Newtown (GAPP 2003). This replaced the need for individual rezoning applications, thereby speeding up the approvals process (City of Johannesburg 2003b; GAPP Architects and Urban Designers 2003a).

The funding of the first phase of redevelopment projects in Newtown, in the late 1990s and early 2000s, was therefore principally from public sources within all three tiers of government. These included the City of Johannesburg, the Johannesburg Development Agency (JDA) in partnership with Gauteng Blue IQ, the Gauteng Department of Education, and the Johannesburg Property Company. For example, the public private partnership of R198 million for the Brickfields social housing project was the largest yet for South Africa at the time (Johannesburg Housing Company 2005).

The private sector responded well to these catalytic publicly funded projects and fast-tracked approvals process, with examples of the larger developments including the World of Beer (SABMiller 1995), Turbine Hall (AngloGold Ashanti 2005), and

more recently Newtown Junction (2014) and City Lodge Hotel (2014) by Atterbury Properties.

The presence of quick access to funding options and rapid development approvals processes as a success factor arguably lead to the redevelopment success of Newtown, as documented in literature (McQueen 2011; Tonin 2014).

Factor seven: Larger sites with economy of scale are more often redeveloped than small sites

The Newtown Cultural Precinct between Carr and Dolly Rathebe, the M1 overpass and Mtemi Piliso is approximately 25 hectares in extent. This is larger than the average 15 hectares indicated in the literature review as critical size to leverage economy of scale (Meyer & Lyons 2000; Dixon et al. 2011a; Frantal et al. 2013; Osman et al. 2015).

The sufficient size of the Newtown Precinct is consistent with the literature in terms of size. The presence of sufficient size as success factor in the regeneration of Newtown probably lead to success.

Factor eight: Readily available municipal services and close proximity to transport corridors are incentives to redevelopment

Newtown is part of Johannesburg's city centre, and was therefore well located to bulk services, major road networks, and rail infrastructure at Park Station. However, due to the lack of upgrading and maintenance through the 1980s and 1990s, the services fell into disrepair and transport access had become problematic (GAPP Architects and Urban Designers 1999).

The early planning frameworks compiled since 1999, included numerous transport-related projects for implementation (GAPP 1999, 2000, 2003). Specific transportation projects undertaken by the City as part of redevelopment, include the Nelson Mandela Bridge and the M1/Carr Street interchange north of Newtown, both completed in 2003. By 2003, R400 million had already been invested in municipal services in the area (City of Johannesburg 2003b). These projects had a catalytic effect on access between Newtown and the adjacent areas.

The Rea Vaya Bus Rapid Transit (BRT) system was started by the City in 2009, and has recently added Newtown to its destinations. The Gautrain, completed in 2012, included a bus service for Park station. The Park Station bus route runs along Sauer Street, improving the accessibility of Newtown. The implementation of these two public transport systems probably assisted in the success of Newtown's redevelopment, improving public transportation access to the area.

The planning and continued improvement of public transport since 2000, as well as the investment in municipal services, is a likely success factor in Newtown's redevelopment. This is aligned with literature (Lange & McNeil 2004; Frantal et al. 2013).

Factor nine: Strong political and community support encourage redevelopment

As government owned most of the land and buildings, investment in Newtown was assisted by various government-related funding initiatives (Rhizome Management Services 2009; Shand 2010; City of Johannesburg 2011a). The urban renewal of Newtown had the necessary policy and political support on a national, provincial and local government level, with funding spent through mainly the JDA (City of Johannesburg 2007; Johannesburg Development Agency 2004).

The requirements of the Municipal Systems Act of 2000 and public participation approach of IDPs normally followed provided an opportunity for public inputs to the renewal process. Ward-related and broader meetings would have played an equivalent role. However, no evidence could be found in the data of participatory activities conducted for any of the redevelopment initiatives in Newtown.

Shand (2010) argues that Newtown has indeed became a community through inter alia its public and private sector investment, cultural activities, and growing residential land use (Johannesburg Development Agency 2015). The long-term vision of this community was a secondary contributing factor to the success of the precinct (Dixon et al. 2011b; Hollander et al. 2010).

The presence of political and community support as success factor in the Newtown Precinct redevelopment probably lead to its redevelopment success. This is in alignment with literature (Hollander et al. 2010; Frantal et al. 2013).

5.1.2. Egoli Gas site

Despite many positive factors, many specialist studies and an ideal locality, this single-owner site was not redeveloped successfully. Exact reasons remain unclear.

Factor one: Sites with little or no contamination are more readily redeveloped

The Egoli Gas site works site was moderately contaminated at a site level, but pollutants were not proven to migrate off-site to downstream properties.

Between 1 500 m^3 and 2 000 m^3 of highly contaminated soil would have had to be removed for offsite disposal or treatment. This was the most costly part of remediation. On-site treatment was to be conducted for the remaining material. The cost of site remediation activities was not known with any level of accuracy, and therefore the risk of cost overrun was listed as a risk in the site remediation plan (Georem International 2011).

In line with the findings of Nijkamp (2002), the site owner delayed the remediation and was aiming to combine it with the redevelopment, in order to save costs.

Egoli Gas had been considering redeveloping part of the site since 2001, and over time many developers had been interested in undertaking the redevelopment. Contamination of the site was always a challenge preventing redevelopment (City of Johannesburg 2011b; Kloppers 2004; Davie 2011). This reiterates the lack of private developer interest where contamination is known and the cost is undetermined (De Sousa 2001; Meyer & Lyons 2000).

The absence of little or no contamination as success factor was arguably associated with the redevelopment not going ahead, as identified in literature (Howland 2003).

Factor two: Mature brownfields management policies facilitate development

<u>Policies regarding brownfields redevelopment</u>

The 2003 and 2008 Spatial Development Frameworks of the planning area supported the notion of densification, infill and strategic brownfields site redevelopment (City of Johannesburg 2003a; City of Johannesburg 2010b). The Egoli Gas redevelopment was aligned with these policy documents. The SDFs were mature in its support for brownfields to be redeveloped.

The “Framework for the management of contaminated land” (DEA 2010) was referenced by Georem at the time in 2011. This policy document provided some guidance on soil screening values depending on end land use (industrial, commercial or residential).

No comprehensive, integrated policy addressing brownfields redevelopment was in place at the time of the redevelopment process (Potts & Cloete 2012). As the Egoli Gas site had known contamination, a brownfields policy to assist redevelopment would have had to address this issue.

The policies mentioned above did assist to facilitate the redevelopment, but were silent on overcoming the barriers to redevelopment associated with contamination. An overarching policy mechanism (considering various pieces of legislation) such as the Brownfields Law in the US was not in place solve the problem of liability apportionment for prospective property developers. This could have in turn assisted funding from commercial banks. The various approvals processes and the role of each authority was further unclear and slow.

Maturity in “generating engagement with the private sector” as per stage 3 of the model of Adams (2010) was therefore still lacking.

As found in literature (Adams 2010), the absence of brownfields policy maturity as success factor probably lead to redevelopment not going ahead.

Factor three: Sites with certainty regarding apportionment of liability for clean-up and perception of few latent risks are more likely to be redeveloped

The gas plant had already been decommissioned at the time of purchase. Following the polluter pays principle, liability for pollution rested with the City of Johannesburg, the original owner. It is uncertain if the purchase agreement between Egoli Gas and the City addressed the aspect of pollution and related liability, as those details were not included in the review of the acquisition (Competition Commission 2001).

It is probable that Egoli Gas accepted the liability of pollution. This is inferred from the fact that numerous specialists were appointed to determine the extent (and associated remedial cost) of the contamination on site as part of the redevelopment proposal (Georem International 2011; van Niekerk 2011). Whereas the exact cost for

remediation was not confirmed, these studies greatly assisted to reduce uncertainty regarding latent risks.

Although there was significant interest by developers for the decade from 2001 to 2011, the contamination of the site was always a constraint (Davie 2011). This confirms the uncertainty of private investors regarding liability of the site, as documented in literature (Sigman 2010; Jensen 2010; McCarthy 2002).

According to media reports, a tender would have been issued to private developers for the plan (Davie 2011). One would assume that the liability for pollution would vest with Egoli Gas and not be transferred to the developer. However, the data is silent on whether latent risks were clarified in the eventual tender document that Egoli Gas issued to developers, and what the exact ownership arrangement were going to be. It is likely that developers intending to submit tenders may have struggled to obtain funding/bank guarantees from financial institutions due to the presence of contamination and uncertainty regarding liability, as indicated by Theron (2010).

The absence of certainty regarding liability and few latent risks for private developers was probably a contributing factor to the redevelopment not going ahead.

Factor four: Redevelopment land use options based on a risk minimisation approach improve the feasibility of brownfields projects

The redevelopment plan design by GAPP appeared to be a sensible plan with the correct principles, densities, land use variety and the result of a thorough understanding of the site and its surroundings (GAPP Architects and Urban Designers 2010). The development was phased, with the development of the hotel, retail space and some office uses in the old gas works comprising the first stage.

The valley-fill area on site (highest levels of contamination) was earmarked for open space use after rehabilitation with soil capping. Less contaminated areas were planned for retail use. The clean area to the south was earmarked for student accommodation. Land use planning for the development was thus according to contamination risk. This is aligned with the risk-based approach currently being used in brownfields management (Ferguson 1999; Hollander et al. 2010; Luo et al. 2009).

The presence of redevelopment land use options based on a risk management approach as success factor should have contributed to redevelopment success. It appears that other factors were greater determinants in this particular case study.

Factor five: Favourable market conditions attract private sector investment

The property boom in South Africa (Funke et al. 2006) ended in 2008. Apart from the increased growth figure in 2010 (due to increased activity before the World Cup), residential property growth, as an indication of the overall property market, was poor at the time of the proposed redevelopment between 2009 and 2012 (Global Property Guide 2016). Brownfields redevelopment is more difficult in poor property markets (Adams et al. 2010).

Due to the Egoli Gas site's location outside the Inner City UDZ, favourable area-based conditions could also not be capitalised upon, as was the case for Newtown, and other cases in the UK and the US (Bacot & O'Dell 2006; Dixon et al. 2011b; City of Johannesburg 2006).

The absence of favourable market conditions as success factor was arguably associated with the redevelopment not going ahead.

Factor six: Quick access to a variety of funding options, with clear and rapid approvals process encourages redevelopment

Given the low appetite for risk from public banks (Theron 2010), and as the property was confirmed to be contaminated, it is likely that the project would have had to be largely privately funded, as property redevelopment with known contamination was not a well-understood concept at the time in South Africa. The willingness of banks to loan money for brownfields referred to by Seeliger & Turok (2015) refers to inner city scenarios, but contamination is not mentioned in the particular paper.

A portion of the development costs may have been carried by the landowner, Egoli Gas. These would include aspects such as the cost of land, remediation, and power generation from gas. The cost of construction, and other development costs, was likely to be for the developer. In addition to this, no tax incentives were available for the redevelopment due to the property being located outside the UDZ jurisdiction. A tax incentive would have improved the profit margin of the redevelopment process.

The EIA was compiled according to the 2010 NEMA EIA Regulations, which meant the approvals process was clear: the competent authority would only have 30 days to issue a record of decision, although this timeframe was often not adhered to. Township establishment applications in terms of the Town Planning Ordinance of 1985 follow a clearly understood application process. Applications often takes longer than a year, especially if objections are raised (City of Johannesburg 2016a). The chairperson of the South African Affordable Residential Developers Association (SAARDA) indicated that approvals previously taking 12 to 18 months, now often takes 3 years (Slabbert 2016).

If water containing a waste was to be released into the environment, it would require a water use license application (WULA) in terms of Section 21 (g) of the National Water Act (1998). However, this was not the case, as contaminated water of the remediation activities was planned to be released into the sewage system.

No clear process was available at the time for the various soil remediation activities intended. If the DWA would require a WULA, this was likely also to slow down the process, as there was no legislated review timeframe for such applications at the time. At the time of this development, the typical timeframe for WULA approvals of mining activities was three and a half years. Government has recently, in 2015, implemented a shorter process of 300 days (Munnik 2015).

The absence of quick access to funding options and rapid approvals processes were likely associated factors in the redevelopment not going ahead, as documented in literature (McQueen 2011; Tonin 2014).

Factor seven: Larger sites with economy of scale are more often redeveloped than small sites

The Egoli Gas site is 14.85 hectares in extent. This parcel size is in line with the literature finding that larger sites are required to leverage economy of scale (Meyer & Lyons 2000; Dixon et al. 2011b; Frantal et al. 2013).

According to the literature (Meyer & Lyons 2000; Dixon et al. 2011a; Frantal et al. 2013; Osman et al. 2015) the site had a large enough size and economy of scale. This aspect was therefore not associated with the redevelopment not going ahead.

Factor eight: Readily available municipal services and close proximity to transport corridors are incentives to redevelopment

The Egoli Gas site was well serviced with regard to municipal services, and capacity was confirmed with the city council. However, electrical capacity was not available and a new substation would be required. The option of using gas to generate electricity on site to overcome this constraint was investigated (GAPP Architects and Urban Designers 2010). Major road networks such as Empire Road, the M1 and the then-planned Rea Vaya bus system were in close proximity to the site.

As the Rea Vaya's routes run along Empire Road in close proximity to the site, it may have assisted in the success of the Gas Work's redevelopment with regard to access and public transportation to the redevelopment.

Municipal services and transport corridors were readily available for the Egoli Gas site, which is one of the required aspects of successful redevelopment in literature (Lange & McNeil 2004; Osman et al. 2015; Frantal et al. 2013).

Access to transport corridors and municipal services was present as a success factor (Lange & McNeil 2004; Frantal et al. 2013), but did not contribute to the redevelopment not going ahead.

Factor nine: Strong political and community support encourage redevelopment

The derelict nature of some areas of the site and related issues such as crime were a concern of the surrounding community. Therefore, the prospect of urban regeneration of the site was regarded by the media as positive (Davie 2011; City of Johannesburg 2011b). Feedback from public participation as part of the EIA process was generally positive, as long as each stakeholder's key issues were addressed (Van der Westhuizen 2011).

Although certain comments on the statutory applications needed to be addressed, the City of Johannesburg was welcoming of the proposal due to its alignment with the City's densification, infill, urban regeneration and transport planning policies (Van der Westhuizen 2011).

Support for statutory applications

It is not known if the formal approvals (environmental or town planning) were obtained from the City Council and GDARD before the redevelopment process came to a standstill in 2012. Preliminary comments from these authorities did not indicate any fatal flaws related to the redevelopment. Furthermore, GDARD's studies commissioned in 2010 and 2012 to investigate the possible use of mine residue areas for urban development, and their approval of the Ebotse Golf Estate on an old quarry site, showed their intent to support brownfields development (GDARD 2012; Le Roux 2007).

The redevelopment project had sufficient political and social support. This factor has been documented as assisting in success of redevelopments (Hollander et al. 2010; Adams et al. 2010; Meyer & Lyons 2000). The presence of social/political support as a success factor (Hollander et al. 2010; Frantal et al. 2013) did not contribute to the redevelopment not going ahead.

5.1.3. Modderfontein

The redevelopments undertaken by Heartland Properties from 2000 to 2013 can be regarded as successful. Its original Longmeadow Business Estate was sold out by 2004, and the Greenstone Hill mixed use development was sold out by 2007. By 2010, it had developed and sold off approximately 1000 ha of land. These events provide a historic view, from which certain observations can be made.

One cannot yet determine with certainty whether the proposed Modderfontein City redevelopment will be successful, as it is still in its early stages. Decades of redevelopment are still to follow.

Factor one: Sites with little or no contamination are more readily redeveloped

The land which Heartland Properties started developing incrementally since 2001, and which Zendai purchased from AECI, comprises mainly buffer surrounding the remaining AEL factory.

Remediation on known contaminated areas was completed by AECI itself. The rehabilitation of Effluent Dam No. 4, two million tons of carbon-rich ash at the AEL

plant, and the ongoing Kynoch tailings dam removal are some examples (Coetzee 2004; AECI 2007).

The Kynoch Fertiliser factory and tailings facility were listed as contaminated land in the environmental sensitivity map as presented in the workshop report of 2015 (Zendai et al. 2015, p.83). It can be expected that site assessments will be undertaken to determine the extent and level of contamination prior to development.

The overall site therefore has almost no remaining contamination, apart from known hotspots such as Kynoch (AECI Limited 1999). This was due, in part, to AECI's proven duty of care with regard to land remediation.

The presence of low levels of contamination as an associated success factor for redevelopment will arguably contribute to redevelopment success. The private sector is more willing to invest in these cases than with heavily contaminated sites (De Sousa 2001; Howland 2003b; Hollander et al. 2010).

Factor two: Mature brownfields management policies facilitate development

The 2003 and 2010 SDF spatial planning documents of the City supported the brownfields redevelopment of the AECI Modderfontein land and is considered as mature policy (Hollander et al. 2010; McQueen 2011).

It is expected that this maturity regarding planning documents relating to brownfields will be associated with the successful redevelopment of the property.

With regard to brownfields policy as it relates to contamination, the 2014 norms and standards for contaminated land will apply for the remediation of the Kynoch tailings dams, when it takes place. The South African norms and standards for contaminated land are still immature, as found by Herselmann (2013). Nevertheless, it is likely that AECI followed international standards when conducting soil assessments of old explosives areas (Willchem cc 2007).

The maturity of brownfields policy where it relates to redevelopment as an associated success factor is expected to contribute to successful redevelopment.

As the Modderfontein has very low levels of contamination, the silence of brownfield policies to overcome barriers with regard to contamination was not important for this case study.

Factor three: Sites with certainty regarding apportionment of liability for clean-up and perception of few latent risks are more likely to be redeveloped

Zendai did not conduct their own due diligence or investigations regarding the land and potential liabilities attached (Zendai Holdings Limited 2013). As the development proposals include a range of land uses from residential to light industrial, it allows Zendai to adapt the land use in future according to environmental risks, if discovered.

From its circular to shareholders, and with AECI's reputable operational record, it appears that Zendai has certainty regarding apportionment of liability, and expects few latent risks. Certainty regarding liability risk is an important requirement for brownfields redevelopment success (De Sousa 2001; Nijkamp et al. 2002; McCarthy 2002).

The presence of certainty regarding liability as a success factor will arguably lead to successful redevelopment.

Factor four: Land use options based on a risk minimisation approach improve the feasibility of brownfields redevelopment projects

Low levels of contamination are present on the land to be redeveloped. Therefore, land use according to human health and environmental risk is not a major determining factor that must be considered in the land use framework plans currently being compiled.

With regards to the Kynoch plant and old operations, this area was recognised as being contaminated in planning documents of Zendai. It was further indicated that the final land use of this area would have to be considered carefully, depending on determined health risk (Zendai 2015, p.58).

Redevelopment land use options are being approached according to the risk management approach (Ferguson et al. 1999; Hollander et al. 2010; Hamilton &

Viscusi 1999). The presence of this success factor should lead to the successful redevelopment of the Modderfontein site.

Factor five: Favourable market conditions attract private sector investment

The property boom between 2002 and 2006 probably assisted development activities from a macro-economic perspective at the onset of Heartland's land development initiatives (Funke et al. 2006). The presence of favourable market conditions as a success factor probably lead to the redevelopment success of Heartland Properties.

Whereas the market has improved since the 2008 economic crisis, the country's economic outlook, based on low GDP growth, has been mediocre since then (see Table 2). It appears that Zendai had a longer-term view when purchasing the land. Their development framework stretches to 2060, thus going beyond the short and medium term conditions. Its South African CEO indicated that development would be guided by "market demand" (Muller 2015). Zendai paid for the land in full in March 2014, indicating a strong financial position (AECI 2013). Literature indicates that "long-term vision" is required to realise redevelopment projects (Hollander et al. 2010), which is being applied in this case.

Zendai's investment in South Africa was probably assisted by the extensive trade agreements between the South Africa and China. Twenty-six new trade agreements between the two countries, to the value of R 94 billion, were signed by December 2015 (Republic of South Africa 2015). These multi-lateral trade agreements probably assisted in creating a favourable business environment for the redevelopment project by a Chinese-based company.

Zendai possibly saw the current depressed market conditions as an opportunity for purchasing of land at a reduced price, similar to examples in the UK (Dixon et al. 2011a).

The depressed property market conditions favoured Zendai at the time of the land sale in 2014, as opposed to the overvalued market prior to 2007. Coupled with favourable trade conditions between South Africa and China, favourable market conditions will therefore be a probable success factor for redevelopment activities of Zendai.

Factor six: Quick access to a variety of funding options, with clear and rapid approvals process encourages redevelopment

Funding options

With regard to Heartland Properties, land purchase was discounted, due to AECI's ownership - this likely improved the business case of these developments when compared to developers that had to still purchase land. Further, financial support for its activities from its holding company AECI, was a likely funding source (Venter 2008). The company therefore had quick access to at least partial funding.

With AECI's strong financial position, it is likely that commercial banks would have more easily lent money to Heartland, when compared to a conventional developer with no larger holding company.

Zendai manages over 5 billion dollars of assets globally. The payment guarantee for the land sale was provided by the South African branch of the Bank of China Limited (Zendai Holdings Limited 2013). The strong trade agreements between South Africa and China may have provided additional funding options to Zendai, not available to other developers.

The exact funding mechanisms to be used are not known, but the R400 million spent in the first two years after the land sale, proves funding is not a challenge for Zendai.

Approvals processes

Due to AECI's proven commitment to remediation, these activities were removed from the development approvals processes, thereby simplifying and speeding up these processes.

GDARD will be the relevant competent authority for precinct-level EIAs to be undertaken, and have shown flexibility based on site-specific scientific evidence by environmental practitioners (as previously described).

The EIA processes will have to be conducted according to the 2014 NEMA EIA Regulations, which means the approvals process of this legal requirement is clear. With the promulgation of these regulations, shorter timeframes have been specified for the entire process. Apart from some upfront specialist studies of approximately

three months, the full Scoping/EIA process takes 258 calendar days under normal circumstances, including competent authority review. The process can therefore be completed in approximately a year.

Township establishment applications in terms of the Town Planning Ordinance of 1985 are a clearly understood process. Delays in this process appear not to have influenced the redevelopment activities of Heartland Properties adversely, given the many developments already implemented since 2000.

With the promulgation of the Spatial Planning and Land Use Management Act (2013), each municipality has to draft by-laws in terms of which town planning applications are made. The City of Johannesburg promulgated its by-laws in July 2016 (City of Johannesburg 2016b). These are more efficient and streamlined than the old legislation, and are expected to shorten the approvals time frame. Zendai will therefore benefit from this streamlined process.

The latest planning and environmental approvals processes in South Africa are fairly efficient, which will likely contribute the success of the redevelopment, in alignment with literature (McQueen 2011; Tonin 2014).

The presence of available funding options for Zendai as a success factor is expected to be associated with the Modderfontein City redevelopment's success (Bendor et al. 2011; McCarthy 2002).

Factor seven: Larger sites with economy of scale are more often redeveloped than small sites

The development size of the proposed Modderfontein City is more than 100 times larger than the 15 hectares figure derived from the literature as the minimum viable size for a redevelopment site. The development can generate sufficient economy of scale to improve chances of success, in comparison to redevelopments such as Egoli Gas, which is one development on one site.

The presence of a property size larger than 15 hectares as a success factor in the Modderfontein redevelopment is arguably a contributing factor to potential redevelopment success. This is supported by literature (Meyer & Lyons 2000; Dixon et al. 2011b; Frantal et al. 2013).

Factor eight: Readily available municipal services and close proximity to transport corridors are incentives to redevelopment

Prior to 2013, Heartland successfully invested in the servicing and rezoning of land to prepare it for redevelopment, in accordance with agreements with local government. However, from 2008 to 2013, Heartland Properties reported on the challenging situation regarding further availability of services. Significant upfront expenditure on new infrastructure would have been required to speed up its realisation of land assets, which was not part of AECI's core business (AECI 2013). This lack of infrastructure availability was thus a detractor for further redevelopment.

In 2008 its CEO indicated that the company wished to exit the property development market in the next five years (Venter 2008). The sale of excess land and Heartland Properties was thus an opportunity to avoid such municipal infrastructure spending.

The extensive capital spent on infrastructure in the first two years after the land sale, but prior to development, is an indication of the willingness of the Zendai to assist in providing access to services access for its future developments. The company and other large developers, such as Atterbury Properties north of the Buccleuch Interchange, are investing in infrastructure to support their developments.

The Modderfontein site has always been well located for transport corridors, including regional routes and highways directly passing the site. The proposed Gautrain Modderfontein Station at the development provides an additional mode of transport.

The close proximity to transport infrastructure, as well as a developer investing in infrastructure prior to redevelopment is present as a success factor. It will probably lead to the potential success of the redevelopment of the Modderfontein site (Lange & McNeil 2004; Amekudzi & Fomunung 2004; Frantal et al. 2013).

Factor nine: Strong political and community support encourage redevelopment

AECI has engaged the community surrounding its operational and safety issues since 1996, through its Community Awareness and Emergency Response forum.

Heartland Properties further appears to have followed the required legal requirements for its EIA processes since 2000. No evidence could be found for particular political support of the company's redevelopment plans, apart from alignment with the relevant spatial frameworks of the area.

With regard to community support, comments in the EIA processes investigated are typical of such processes. Stakeholders were generally accepting of redevelopment as long as their concerns were considered (Oryx Environmental 2005; Willchem cc 2007). No evidence could be found of formal appeals lodged against development approvals, which would have been a proven sign of objection.

Thorough and continual stakeholder engagement, rather than outright support, was present as associated success factor. It probably led to the redevelopment success of Heartland Properties.

Since purchasing the land, Zendai has taken extensive steps to engage the stakeholders on a wide basis for its urban design framework (Zendai et al. 2015). This consultation includes public workshops and open days with the general public and community groups, and interactions with City and provincial government stakeholders. Before formal applications are made, these engagements provide context for the various stakeholders before receiving formal applications of development to comment on.

The important trade agreements between South Africa and China provide additional political support for the Modderfontein City development (Muller 2015; Republic of South Africa 2015).

The presence of social and political support as success factor will arguably be associated with the successful redevelopment of Zendai. This is in alignment with literature (Hollander et al. 2010; Meyer & Lyons 2000; Lange & McNeil 2004).

5.1.4. Comparison of the case studies

It is necessary to note certain contextual similarities and differences between the findings of the three case studies, which informs observations and conclusions made. These are presented in Table 3.

Table 3: Contextual similarities and differences between the three case studies

Aspect	Newtown	Egoli Gas	AECI Modderfontein
Contamination	• No proven contamination	• Moderate level of contamination by City of Johannesburg (first owner)	• Low, isolated levels of contamination by first owner, AECI.
Ownership	• The majority of Newtown is owned by government • Numerous small land parcels	• Privately owned by a single owner • Single land parcel	• Privately owned by a single owner • Several large land parcels
Funding	• R300 million public catalyst funding • UDZ Tax incentive offered improved returns on investment	• No public funding • UDZ Tax incentive was not applicable	• No public funding, • UDZ Tax incentive was not applicable
Timeline of redevelopment	• Incremental redevelopment in process for more than 15 years	• Once-off combined attempt at redevelopment	• Incremental redevelopment in process for more than 15 years
Redevelopment approvals process	• Special purpose vehicle was established for redevelopment. • Numerous iterations of urban development plans, periodically revisited • Adoption of masterplans by government prior to site-scale applications • No EIA approvals were required	• One iteration of urban development plan • EIA approvals were required	• Special purpose vehicle was established for redevelopment. • Numerous iterations of urban development plans, periodically revisited • Adoption of masterplans by government prior to site-scale applications • EIA approvals were required
Infrastructure/ transport	• Municipal services access largely available • Significant government funding required to achieve improved transport access	• Municipal and transport access largely available	• Municipal and transport access largely available for Heartland Properties • R400 million private infrastructure funding required in 2014
Political and community support	• Strong political support in place. • No proven community support	• No proven political support • Mixed reaction from community	• Political support in place for Zendai activities, no proven support for Heartland.

5.2. Research findings

5.2.1. Findings regarding factors not previously identified from literature

Catalytic public investment in inner city brownfields areas can attract private investment

The Newtown case study confirmed previous findings (Adair et al. 1994; Kemmerling & Stephan 2002) that significant government investment in infrastructure and urban management over a long period of time creates favourable market conditions in the intervention area. These favourable conditions can attract private investment of a much greater magnitude.

Spatial planning approach

The spatial planning approach followed by the JDA in Newtown was successful. This approach has also been implemented elsewhere (Nadin 2007). The urban design plans and guidelines developed were followed, reviewed and updated periodically. It included quicker development approvals processes due to blanket rezoning undertaken. Importantly, the CoJ and JDA implemented most of the interventions proposed.

The value of special purpose vehicles

In the case studies of Newtown and Modderfontein, the JDA and Heartland Properties were respective special purpose vehicles (SPVs) created within greater property holding entities (namely the City of Johannesburg and AECI). These special purpose vehicles were in both cases associated with redevelopment success.

The SPVs probably had staff with strong experience in the property development sector, and were given special decision-making powers, making it more agile than the greater organisations it was part of.

The presence of special purpose vehicles for brownfield site redevelopments may be associated with redevelopment success where such sites is owned by large companies or institutions, as identified in literature (Amirtahmasebi et al. 2016).

5.2.2. Findings regarding pre-identified success factors from literature

Regarding the nine success factors identified from the literature, the following discussion summarises how the findings from the case studies support or contradict the "factors" that were derived from the literature.

Factor one: contamination

Concerning contamination levels, the case study findings regarding redevelopment were aligned with literature. Two of the sites with little or no contamination (Newtown and Modderfontein) were redeveloped. The Egoli Gas site has a moderate level of contamination and has not yet been redeveloped. This appears to be the most significant factor. Other factors such as risk and liability stem from contamination.

Factor two: policy maturity

Regarding the maturity of brownfields management policies facilitating development as a success factor, spatial planning policies supported brownfields redevelopment as a principle in the case studies, thereby confirming maturity. Pertaining to the redevelopment aspect of brownfield management policy, the case study findings support the literature-derived factor. Regarding overcoming the contamination aspect of brownfield management policy, it remains lacking (immature); the case study findings also support the literature-derived factor.

Factor three: liability

The aspect of liability for remediation and related latent risks was not applicable to Newtown. Clarity was not obtained in the Modderfontein case on the apportionment of liability. However, due to the proven record of AECI in remediation of its land before redevelopment or sale, Zendai probably had high confidence that no latent risks would arise at a later stage.

For the Egoli Gas site, it appears that the owners accepted the liability for clean-up of contamination, although they did not cause it. Due to extensive investigations, latent risks were therefore not expected between the first and second owner. Regarding confidence of developers responding to the tender documents from Egoli Gas, the data is silent, but latent risks were possibly expected, due to the history of the site. The case study findings all supports the literature-based factor.

Factor four: land use options

The factor of redevelopment land-use options based on a risk minimisation approach for brownfields projects was most applicable for the Egoli Gas case study, with its moderate levels of contamination. Although the Egoli Gas redevelopment planning proposals were aligned with this principle, it was not successfully redeveloped, and case study support for the literature-derived factor cannot be proven.

Zendai will follow the risk-based land use planning approach for the old Kynoch factory at the Modderfontein site, supporting the identified success factor from literature. The factor was not applicable to the Newtown site.

Factor five: market conditions

The property boom in South Africa in the early 2000s assisted the Newtown and Heartland Properties' redevelopment processes with strong growth conditions. The poorer property market conditions after 2008 could not be overcome in the case of the Egoli Gas case study, and slowed the development tempo of Heartland Properties in the same period. The active trade agreements between South Africa and China, coupled with depressed market conditions, probably assisted with the investment decision for Zendai at Modderfontein.

Through public infrastructure investment in targeted areas such as Newtown (and tax incentives to a lesser degree), the private sector was attracted successfully. The findings of the three case studies therefore support the factor of favourable market conditions on redevelopment as derived from literature.

Factor six: funding and approvals

The Newtown redevelopment case study findings support the literature-derived factor of quick access to funding, and clear rapid approvals processes. The Gasworks case study supports the factor, but conversely proven by the absence of financing and quick approvals.

Quicker approvals processes were not found in the Heartland and Zendai case studies. However, quick access of these companies to funding contributed to their success, thereby supporting the literature-derived factor.

Factor seven: economy of scale

Over the three case studies, larger sites with an economy of scale were found to more often be redeveloped than small sites. The scale factor identified from literature was thus supported by the case study findings.

Factor eight: services and transport

The factor of readily available municipal services and proximity to transport corridors is a pre-requisite for redevelopment. From the findings of the Newtown and Modderfontein case studies, the factor derived from literature was supported.

The Egoli Gas site findings confirms that the presence of services and transport access is a requirement, but not always a success factor.

Factor nine: stakeholder support

Political support as success factor was supported by the findings from the Newtown case study, where it preceded decision-making and funding support for the regeneration of the area. In the Modderfontein City case redevelopment as planned by Zendai, similar political support was created by the strong trade agreements between South Africa and China.

Other than nominal policy support, no political support could be identified for the Egoli Gas site. The factor identified from literature was thus supported by the findings from two of the case studies.

Community support for the redevelopment of the Egoli Gas site developed over time with the statutory planning processes, as the site owner and consultants considered comments from stakeholders, and amended the development proposals accordingly. The approvals processes for Heartland Properties all required stakeholder engagement as part of legal requirements. Hence, community support was also present. For Zendai, community support is expected based on the extensive public meetings and engagements arranged by the developers.

For Newtown, community support is deemed to have been gained through the stakeholder engagement requirements of local government, but was less pertinent, as no data could be obtained of specific public inputs obtained.

Community support as identified success factor from literature is confirmed by two of the case studies' findings, and implied by the third.

6. Conclusions

The research question set out in Chapter 1 of this report was:

> What are the factors that contribute to the implementation success of projects where industrial brownfield sites are remediated and subsequently redeveloped?

In the literature review, the international body of knowledge regarding contaminated sites and their redevelopment was broadly reviewed. This included the various definitions, assessment methodologies and redevelopment of brownfield sites. Brownfields redevelopment in South Africa and other developing nations were also reviewed. Policy development in especially South America was explored as a parallel to South Africa. South Africa's research output in the field was discussed. Nine factors that contribute to redevelopment success of brownfield sites within the urban context were derived from literature.

Three South African case studies were then analysed using documentary or archival research, against the theoretical background of international literature. These projects were studied to obtain a better understanding of the respective success factors for redeveloping brownfields.

The case study sites represented certain shared features, and provided a representative cross-section. Shared features included their location within the urban edge of Johannesburg, original industrial land use as part of the origins of Johannesburg, and the intent of the land owners to redevelop brownfields land.

Cross section aspects include distance from the inner city, size, certainty of contamination and redevelopment success. The size of the study sites were chosen to vary, as well as each site's proximity to the city centre of Johannesburg. The Egoli Gas site and AECI Modderfontein were clearly documented as contaminated. Contamination on the Newtown site was not clearly established as fact.

The status of each case study was documented: Newtown's redevelopment was successful, the Egoli Gas redevelopment was not yet implemented, and the AECI Modderfontein site is in the process of being redeveloped.

6.1. Brownfields redevelopment success factors for South Africa

Important success factors that emerge from this study for brownfields sites redevelopment projects in South Africa are discussed here.

Factor one: Sites with little or no contamination are more readily redeveloped

Both the Newtown (zero contamination) and the Modderfontein (very low level isolated contamination) case studies were not burdened by contamination, thereby simplifying the redevelopment process.

Higher levels of contamination increases redevelopment cost and timeframe

Higher contamination levels on a brownfields site will probably increase remediation cost, eventual development cost, and certainty regarding development cost. AECI itself undertook the remediation in the Modderfontein case study, thus not transferring these costs to the (re)development companies. This approach (of early remediation by the polluter) reduced the eventual redevelopment cost, and the certainty thereof.

The moderate level of contamination (and related remediation cost) in the Egoli Gas case study was not paid for by the polluter (the City). When the second owner (Egoli Gas) then considered redevelopment, the remediation cost had to be combined with the redevelopment cost. Moreover, the cost of clean-up was not certain.

Higher contamination and related remediation may also increase the construction timeframe of a redevelopment project. At Modderfontein, remediation was undertaken separately and before redevelopment, thereby not adding time to redevelopment. The Egoli Gas remediation plan would have been executed as part of the redevelopment process, potentially slowing the project down.

This phenomenon was not applicable to the Newtown case study as no contamination was present.

Generalisation

As this literature-derived factor was confirmed by all three case studies, generalisation for future brownfields is possible.

Factor two: Mature brownfields management policies facilitate development

As noted by Adams (2010), the definition of brownfields will inform policy maturity, as countries place emphasis on different aspects of the definition, driven by unique contexts. These include the availability of greenfields land on the outskirts of cities and the prevalence of contaminated sites.

Spatial planning support is sufficient for brownfields redevelopment where little or no contamination is present

Spatial planning support for brownfields was present for all the case studies. For the Newtown and Modderfontein sites with little or no contamination, this proved sufficient to support redevelopment. Spatial planning support alone was not sufficient to support the redevelopment of the Egoli Gas site, due to its contamination.

This principle was replicated in two of the three cases; therefore generalisation is possible for future brownfields projects.

Addressing barriers to redevelopment caused by known contamination must be included in brownfield policies where brownfield sites are contaminated

Although a framework regarding guideline values for remediation based on land use was available, an integrated brownfields management policy did not address contamination sufficiently in the Egoli Gas case study. Brownfields policy was therefore immature in that respect, and this contributed to the site not being redeveloped. As the other two case study sites (Newtown and Modderfontein) had little or no known contamination, this feature was not applicable.

This principle occurred in only one of the three cases, therefore generalisation is not yet possible for future brownfields projects.

Factor three: Sites with certainty regarding apportionment of liability for clean-up and perception of few latent risks are more likely to be redeveloped

The lower the contamination on a brownfields site, the less pertinent the issue of liability for clean-up is expected to be.

The issue of liability for remediation and related latent risks did not affect Newtown, as contamination was not present.

The data did not provide clarity in the Modderfontein case on the transfer of liability. However, AECI had a proven record regarding remediation of its land before redevelopment or sale. This probably reduced the importance of liability transfer for Zendai.

Egoli Gas probably accepted full liability for the clean-up of the site purchased from the City of Johannesburg, but wanted to fund the remediation from redevelopment. The data did not provide clarity on the probable liability transfer between Egoli Gas and tenderers for the redevelopment. In order to attract investors, one might expect that Egoli Gas would have protected such tenderers from liability.

This principle was replicated in two of the three cases, therefore generalisation is possible for future brownfields projects.

Perception of few latent risks improves investor confidence

Government and later private redevelopers in the Newtown case study did not expect any latent risks due to contamination, which assisted to improve investor confidence. For Modderfontein, Zendai probably also had good confidence that few latent risks would arise.

Notwithstanding the possible protection from liability in the tender documents issued by Egoli Gas, the history of the site and future property (land or building) ownership arguably affected investor confidence for the project.

This principle was replicated in all three cases, therefore generalisation is probable for future brownfields projects.

Factor four: Redevelopment land use options based on a risk minimisation approach improve the feasibility of brownfields projects

Commercial/retail use is an especially well-suited land use for brownfields redevelopments.

As described in the literature review, commercial land use provides better income than industrial land use, but lower health risk than residential land use. It is therefore a commonly selected land use option for regeneration projects where contamination is known. For the Egoli Gas case study's mixed use proposal, commercially related land uses represented more than 50% of the proposed development. This principle

was not applicable to the Modderfontein and Newtown case studies as contamination was not known or significant.

Risk-based arrangement of activities on a site level improve redevelopment feasibility

If site-level activities are planned according to the health risk of original contamination locations, remediation costs are reduced, making the overall development more feasible.

Although this factor was used in the planning of the Modderfontein and Egoli Gas as cases, these projects were not yet implemented. Therefore, the case studies do not show sufficient replication to suppose generalisation.

This principle was not applicable to the Newtown case study.

Factor five: Favourable market conditions attract private sector investment;

Attracting private sector investment through favourable market conditions can occur on different levels. Macro-economic conditions influence redevelopment, as confirmed by all three case studies. These included property market conditions in all three cases, and international trade agreements, applicable only to the Modderfontein case study.

Dedicated government intervention on a large scale can also create favourable market conditions, as proven by the Newtown case study. Coupled with long-term commitment (such as City Improvement Districts), these interventions create investor confidence regarding the longevity of its intended investment. Both of these are required for private sector participation. No generalisations can therefore be made for future brownfields projects.

Based on the occurrence of this success factor in all three case studies, on more than one level, generalisation for future brownfields is applicable.

Factor six: Quick access to a variety of funding options, coupled with clear and rapid approvals process encourages redevelopment;

Funding

In areas where many of the properties are government-owned, large-scale public intervention with public funds over a short time-span is possible. In turn, this can attract significant private investment. In the Newtown case study, this large-scale intervention was executed through the JDA as special-purpose vehicle, which assisted with improving the turnaround time of projects.

For Heartland Properties and Zendai in the Modderfontein case study, quick access to funding contributed to their success. Both of these companies were part of larger entities, which could provide funds and access loans quicker than first-time developers.

Developers interested in the Egoli Gas site redevelopment tender in 2012 were likely smaller developers, lacking support from commercial banks. Due to the history of the site and its known contamination, and the property market decline since 2008, quick access to funding was not likely for these smaller developers.

The applicability of quick availability of funding as success factor is probable for future brownfield regeneration projects, based on replication in all three case studies.

Rapid and clear approvals processes assist redevelopment

The contamination burden at the Gasworks Site case study created a prolonged approvals process, specifically regarding remediation. If a dedicated policy integrating the approvals process of brownfields with contamination is not created, it can be expected that this situation will continue occurring.

The Newtown precinct was the only case study where a special approval zone was created by blanket rezoning. The design review committee set up to rapidly review site development plans was also unique. This method of speeding up approvals may be replicated in future brownfields with large-scale government intervention and the use of a special purpose vehicle such as the JDA.

The tactic by AECI (the polluter) to complete remediation separately and before redevelopment initiatives, probably simplified and shortened the redevelopment process for Heartland and Zendai.

With only one case study for each of these unique situations, no generalisation can be made for future brownfields projects.

Factor eight: Readily available municipal services and close proximity to transport corridors are required for redevelopment

Significant investment had to be made in transport infrastructure to “unlock” the Newtown Precinct. Similarly, Heartland Properties noted the lack of municipal services as a detractor to its investors in 2012. After the land sale in 2013, Zendai had to spend hundreds of millions of rands on infrastructure upgrades around the Modderfontein site. As confirmed in two case studies, this requirement of services and good transport access will remain a requirement for future brownfields.

However, as found in the Egoli Gas case study, its presence may not always be a determining factor.

Factor nine: Strong political and community support encourage redevelopment.

Political support influences policy, planning, and decisions regarding funding for redevelopment projects. It may be due to the particular history of a place (such as Newtown), or due to bilateral trade agreements (as with Zendai’s investment in Modderfontein). Although not always applicable on an individual site level, the political context within which brownfield regeneration takes place is expected to remain an important consideration for similar future projects. Some sites (such as the Egoli Gas site) may not be affected adversely or positively by the political context.

The Egoli Gas and Modderfontein (Zendai) case studies provide examples of the importance of obtaining (often through numerous interactions and amending redevelopment proposals) community buy-in for a project. This factor was not clearly visible in the Newtown study.

From the findings of two from three case studies for each aspect, political and community support is expected to remain a relevant success factor for future brownfields projects.

6.2. Contribution of this research

This research provides additional insight into the current situation of brownfields redevelopment in South Africa, furthering the understanding provided by Potts & Cloete (2012) and Seeliger & Turok (2015). The case study findings provide indications towards generalisation for success factors that may apply to future brownfields projects.

6.3. Recommendations for future research

The lack of well-documented brownfields redevelopment case studies in South Africa deserves attention. A database of redeveloped brownfields in South Africa should be addressed. In cases where data sources are silent regarding such case studies, interviews may be useful to provide insight into particular aspects of these case studies. It links to the need for definition, policy and an inventory of contaminated / brownfields sites as noted by Potts & Cloete (2012).

The expected success factors identified in this study may then be tested against the broader case study database in order to achieve generalisation and improve the robustness of these factors. With a greater database of brownfields redevelopments, statistical analysis can be added. This will in turn inform brownfields redevelopment policy-making.

It appears from the case studies that certain factors carry greater weight as determinants for whether redevelopment is successful or not. In further research, with more data, it will be necessary to determine the weighting of factors in each case study.

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Appendix A: Data sources

Data sources for Newtown

- Newtown Urban Design Framework (GAPP 1999);
- Inner City Position Paper (JDA 2001);
- Newtown Cultural Precinct Urban Design Plan (GAPP 2001);
- Newtown Cultural Precinct Design and Development Manual (GAPP 2003);
- Johannesburg Spatial Development Framework (2003);
- Urban Development Zone (UDZ) Tax Incentive (SARS 2003);
- Greater Newtown Cultural Quarter Development Strategy (JDA 2004);
- Analysis of the impact of the JDA's area-based regeneration projects on private sector investments (Rhizome Management Services 2009);
- Joburg Inner City Urban Design Implementation Plan (JDA & CoJ 2009);
- Regional Spatial Development Framework, Region F (2010);
- Newtown: a Cultural Precinct – Real or Imagined (Master of Arts Thesis, Shand 2010);
- Johannesburg Inner City End of Term Report (CoJ 2011);
- Urban Regeneration in the Joburg CBD (Journal Article, Bethlehem 2013);
- Inner City Transformation & Investment Trends, 2009 – 2014 (JDA 2015);
- “What’s the Plan?” Inner City Booklet (JDA 2015);
- Newtown North Urban Design Framework (GAPP & Urban Solutions 2005);
- Newtown Redevelopment incorporating Newtown North – Engineering Services Investigation and Assessment Report (PDNA & Themba Consulting Engineers 2006);
- Review of Newtown Urban Design Framework (GAPP 2015);
- News Archive, City of Johannesburg Website (http://www.joburg.org.za/);
- Johannesburg Development Agency website (http://www.jda.co.za);
- Newtown Improvement District website (http://www.newtown.co.za/);
- Rea Vaya website (http://www.Reavaya.co.za); and
- Gautrain website (http://www.gautrain.co.za).

Data sources that could not be obtained:

- Inner City Spatial Framework (1999);
- Inner City Economic Development Strategy (1999);
- “Newtown Cultural Precinct Plan – Town Planning Aspects and Incentives” (Steve Jaspan and Associates 2001);
- Urban Cost Modelling for Newtown (Walker Maré Quantity Surveyors 2001); and
- Infrastructure analysis for the Newtown area ((Themba Consulting Civil and Structural Engineers 2001).

Data sources for Egoli Gas site

- Johannesburg Spatial Development Framework (2003);
- Regional Spatial Development Framework, Region F, 2010-2011;
- Draft NEMA Basic Assessment Report (V&L 2011), with relevant specialist studies including:
    - Site Remediation Plan (Georem International 2011);
    - Risk-based Site Assessment (Infotox);
    - Draft Precinct Plan for a Mixed Use Development (GAPP); and
    - Egoli Gas Works Heritage Report (Tsica Heritage Consultants).
- Annual Report of the Competition Commission of South Africa (2001);
- Mail & Guardian newspaper;
- Rea Vaya (http://www.Reavaya.co.za);
- News Archive, City of Johannesburg Website (http://www.joburg.org.za/);
- Egoli Gas (http://www.egoligas.co.za); and
- The Citizen newspaper.

Data sources that could not be obtained:

- Township establishment application (Steve Jaspan and Associates, 2010).

Data sources for Modderfontein

- “Disposal of wastewater from Modderfontein Factory: review of the biological nitrogen removal systems” – academic article published by four AECI employees (1983);
- “Industrial Water Management – Changing Perspectives” – academic article published by two AECI employees (1987);
- Annual Report AECI Limited (1999);
- “South Africa to import urea” – (Engineering News 2000);
- Johannesburg Spatial Development Framework (2003);
- Environmental Impact Report for Isidleke Development, Modderfontein (Oryx Environmental, 2005);
- AECI – Corporate Citizenship Case Study: Rehabilitation of Modderfontein’s Dam 4 (2007);
- Scoping Report & Plan of study for EIA Relocation of the Detonator Destructor Facility (Willchem cc 2007);
- Heartland Properties – Investors Presentation (2008);
- Minutes of Modderfontein Community Liaison Meeting (2009);
- Heritage Impact Assessment for Modderfontein Village Development (Bosman 2010);
- 2010-2011 Regional Spatial Development Framework, Region E (CoJ 2011);
- Heartland Properties – Investors Presentation (2012);
- Integrated Report - Operational review - Property (AECI 2013);
- Shareholder Circular - major transaction in respect of the acquisition of property assets in Modderfontein, South Africa (Shanghai Zendai Property Limited, 2013);
- AECI, Heartland, Zendai Transaction, Presentation (2013);
- Proceedings of the Competition Commission on the land sale between AECI and Zendai (2014);
- Article by Edward Nathan Sonnenberg on the AECI / Zendai agreement and the question of pollution (2014);
- Modderfontein Regeneration: Final Workshop Report, 28-29 July 2015 (Zendai, ARUP, Atkins);
- “Modderfontein’s R84bn city on track” (www.financialmail.co.za 2015);

- Modderfontein Environmental Community Initiative (http://meci.co.za/minutes.html);
- Press release regarding the signing on 26 trade agreements between China and South Africa (Republic of South Africa 2015);
- Municipal Planning By-law in terms of SPLUMA (CoJ 2016); and
- News Archive, City of Johannesburg Website (http://www.joburg.org.za/ 2016); and
- Archaeological Investigation Of A Historical Ash Dump Associated With The Modderfontein Explosives Factory (Pelser 2013).