



INTECEPTING CONTAMINATION

IMPROVING THE QUALITY OF THE VAAL RIVER
NETWORK THROUGH SELF-REPLENISHING
NATURAL SYSTEMS

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PROJECT INFORMATION

Research Field
Environmental Potential

Programme
Water Treatment and Research Facility
with Community Interface

Site Description
North western quadrant of the intersection
of the R42 and R57, on the peripheral edges
of Bophelong Township and Vanderbijlpark

Site Location
Old Sewer Pump Station, 550-IQ
Zuurfontein, Outspan Servitude A.24/62
and A.376, Vanderbijlpark

Coordinates
26 °42'30.51" S, 27°48'49.21" E, elevation
1478m

Client
Industrial Companies



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ABSTRACT

This dissertation's urban vision looks at the environmental issues of land, water and the health of the people of Vanderbijlpark, all of which have been affected by heavy industry. The study sets out to address the deteriorating quality of the Vaal River's water and how this is affected by the tributaries feeding into it. This dissertation will focus on the remediation and monitoring of the contaminated water through an ecosystemic approach.

The programme involves the removal of heavy metals from the industrial effluent from the surrounding heavy industry that flows into the Rietspruit Canal. The potential of micro-organisms, plants and insects will be explored as elements of a natural treatment system of the contaminated water. The site identified for the remediation processes is an abandoned parcel of land - a remnant of the natural landscape after urban sprawl.

The algae and wetland treatment system will run through the facility, becoming the spine for the remediation process and movement through the facility. The production of silk, its uses and by-products will be integrated to support the overall system which treats the contaminated water. The facility aims to address the community's need to express their voice on environmental and health issues by integrating a community auditorium and exhibition space. The construction and materiality is grounded in the premise that the local companies will remain supportive and collaborative in the environmental intervention in the Rietspruit Canal system, into which they contribute considerable effluent. It will also be proposed that the local companies will fund and supply various steel products for the construction of the intervention. This will form part of the company's corporate social responsibility and a way of giving back to fringe communities affected by industry.

Keywords_ regenerative thinking, resilience, urban-rural land, remediation, contamination, phytoremediation, corporate responsibility, fenceline community

EKSERP

Die stedelike visie vir hierdie verhandeling fokus op die omgewingskwessies van grond, water en die gesondheid van die mense van Vanderbijlpark wie almal geraak word deur swaar nywerhede. Die studie spreek die verswakkende kwaliteit van die Vaalrivier se water aan en hoe dit geraak word deur sytakke wat daarin vloei. Die verhandeling sal fokus op wyses waarop besoedelde water deur middel van 'n ekosistemiese benadering herstel en gemonitor kan word.

Die program behels die verwydering van swaar metale uit die industriële uitvloeisel van die omliggende swaar nywerhede wat in die Rietspruit-kanaal vloei. Die potensiaal van mikro-organismes, plante en insekte as elemente van 'n natuurlike stelsel vir die behandeling van die besoedelde water, word ondersoek. Die terrein wat geïdentifiseer is vir die herstelprosesse is 'n verlate stuk grond, 'n oorblyfsel van die natuurlike landskap na stadspreiding.

Die stelsel vir die behandeling van alge en vleilandhabitate sal deur die fasiliteit loop en die ruggraat van die herstelproses vorm. Die produksie van sy en die gebruike en neweprodukte daarvan sal geïntegreer word om die totale sisteem wat die besoedelde water behandel, te ondersteun. Die fasiliteit het ten doel om die behoefte van die gemeenskap om hul stemme oor omgewings- en gesondheidskwessies te verhef, aan te spreek deur die gemeenskapsamfiteater en uitstalruimte te integreer. Die konstruksie en materialiteit is gegrond op die veronderstelling dat die grootste staalnywerheid, ArcelorMittal, ondersteunend en samewerkend sal wees ten opsigte van die omgewingsingryping in die Rietspruit-kanaalsisteem, waartoe hul aansienlike uitvloeisel bydra. Daar sal ook voorgestel word dat die swaar nywerhede die befondsing asook verskeie staalprodukte vir die oprigting van die fasiliteit sal verskaf. Dit sal deel uitmaak van die maatskappy se korporatiewe sosiale verantwoordelikheid en is 'n manier om aan gemeenskappe wat deur die industrie geïmpak word, terug te gee.

Trefwoorde_ vernuwend denke, veerkragtigheid, stedelik-plattelandse grond, herstel, besoedeling, fitoherstel, korporatiewe verantwoordelikheid, grenslyngemeenskap

UMQUONDO WOMBHALO

Intloso yalombalo wukubuka izikhalo ezimayelana nomhlaba, amanzi nokuphila kwabantu ababuya endaweni yase Vanderbijlpark. Izimpila zalabahlali balendwawo nomhlaba wabo ucindezekile kakhulu imboni yezintsimbi. Siyobesibuka ukuwohla komfula wase Vaal noku thinteka kwalowomfula ngenxa yemi mfundlane engenayo. Lombala uzogxila ekususeni kwesikhunta nokugada kwamanzi angcolile noku sebenzisa ihlelo lomphakathi wezilwane nendawo yazo zokuphila.

Loluhelelu luhilela ukususwa kokungcola, kwezintsimbi ezisindayo, okubuya ezimbonini eziseduze, okungena eRietspruit Canal. Kuzobe kuhlolwa amandla eszilwanyana esincane, izitshalo nezinambuzana, okususa ukungcola emanzini. Indawo esikhonjelwe inqubo yokususwa kwaleso sikhunta, yindawo elahliwe – yindawo ebeseyisetshenziselwe ukuwandisa izindawo.

Uhlelo lokwelashwalezilwelwekanya noxhaphozi, luzobawumgogodlo wenquba yokulungisa, kanya nekunyakaza ngokusebenzisa isikhungo. Ukhukhiqzwa kasilika, ukusetshenziswa kwayo futhi nemikhiqizo yawo izobe ihlanganiswe ukusekela uhlelo jikelele lapho aphatha ngayo amanzi anqolile. Isikhungo sihlose ukubekana nesidingo somphakathi ukuba baveze izwi labo ngezemvelo Kanye nempilo ngokuhlanganisa isiteji somdlalo somphakathi Kanye nesikhala sokubukisa. Ukwakhiwa Kanye nokubaluleka kuhlala phezu kwesisekelo sokuthi ukuvulwa kenkampani enkulu kunazonke yezintsimbi, ArcelorMittal, izohlala isekela ekubambisaneni kokungenela kwezemvelo ohlelweni. Rietspruit Canal, lapho bathuthukisa ukungcola okuningi. Kuhlangozwe ukuthi isokhokhela, futhi inikeze imikhiqizo ehlukehlukehene yezintsimbi zokwakha izindlela zokuyenza isimo sibengcono. Lokhu kuzoba yingxenywe yenkampani yokuba ibenesibopho nomphakathi, Kanye iqhamuke nezindlela zokunikela emphakathini, upheto ohlaselwe umkhakha.

Amagama abalulekile – ukucabanga okuzivuselela, khono eliphawulekayo, umhlaba wase dolobeni nasemakhaya, ukususwa kwesikhunta, ukungcola, ukusebenzisa izitshalo ukususa ukungcola, umthwalo, wemfanelo wenhlangano, Umphakathi ohlukanisiwe.

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A NOTE FROM THE AUTHOR

As a child I grew up on the farmlands just beyond the site selected for this dissertation. My grandmother, Irene Grala, who stayed on the farm with our family, would always tell me the water is dirty and that we should boil it before drinking it, yet I never understood why. This very same water will form the base of inspiration for my dissertation. I return home to explore the convoluted relationship of opportunity brought by industry and the effect that industry has on the environment and the immediate community.

Time spent in Vanderbijlpark left me wondering why a large majority of the community are so poor and sickly. Even though all the generations of men in my family had worked for ArcelorMittal at some point in their lives, I never understood the underlying history of the place or the complexity that the industry posed for the people. After completing my degree in Architecture, I left Gauteng to work for a small architectural practice in Kalk Bay, Western Cape. Stuart Thompson, one of the partners gave me a book to read called Toxic Futures which focuses on towns disadvantaged by mega industry. An entire chapter was dedicated to Vanderbijlpark and for the first time I understood how spatial planning and economic growth affected the area of my upbringing, Vanderbijlpark. There was no hesitation when the time came for me to choose a topic for my dissertation - I decided to go back to my hometown.



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01

CHAPTER ONE

INTRODUCTION

1.1

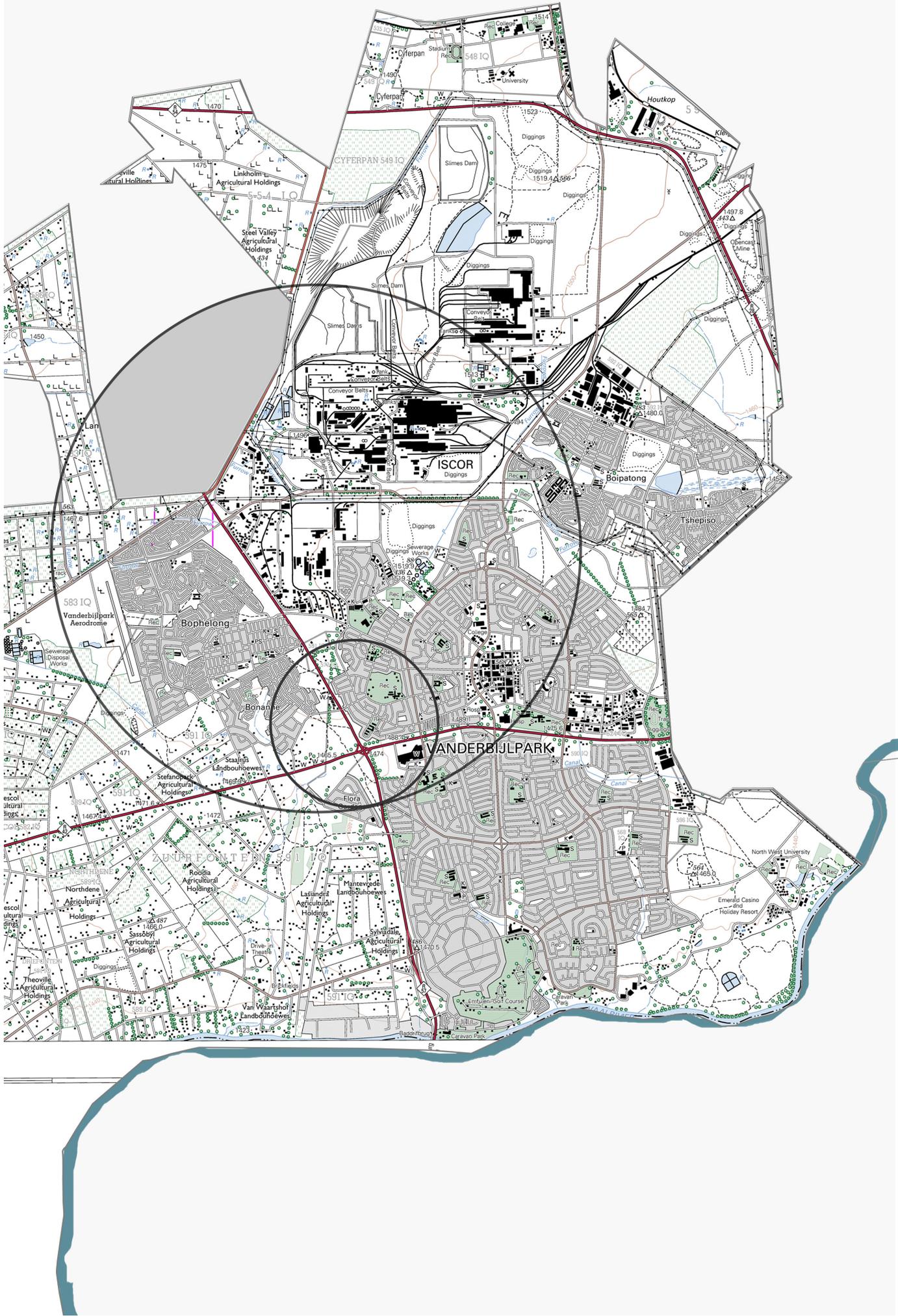
THE STORY OF A PLACE [HISTORICAL BACKGROUND]

Vanderbijlpark is one of the earliest examples of an industry centric town developed in South Africa. A large part of South Africa's history is rooted in the discovery of minerals and the location of settlements and towns were a result of the migration of people to meet the large work force required by the developing mining industry. New towns were developed by companies serving the state, which meant that the new towns were also company towns. These new towns have been influenced by the International New Town Movement which had a distinct lay-out and social vision. (Brockett, 1996:161)

Chronologically, the Vaal Triangle's development began in Vereeniging directed by Sammy Marks who had the vision to establish the steel industry in South Africa. The Vaal Triangle includes the towns of Vanderbijlpark, Vereeniging and Sasolburg. The entire Vaal area has large amounts of coal deposited beneath its surface which made it the ideal location for the mining venture in 1897. The South African Iron and Steel Corporation (ISCOR), now ArcelorMittal, developed the new town of Vanderbijlpark near these coal deposits which were crucial for the production of steel. The industry was expected to deliver cheap inputs for a great profit – exploiting the cheap labour of the area. ISCOR was established in the 1920's in response to the large scale industries required for the growth of the engineering and automotive sector in South Africa crucial for World War 2. (Brockett, 1996:161)

Developed in 1943 to house ISCOR workers, Vanderbijlpark is one of the earliest examples of the New Town Movement in South Africa. The New Town idea evolved from social principles of lifestyle and equality, but this was inappropriate due to South Africa's apartheid policy which was in full force. The black population were excluded from the town's vision of better living and working conditions. (Brockett, 1996:14) Vanderbijlpark's estimated population was 90,000 whites and 120,000 blacks who were housed in separate zones over an area of 10,900 acres. The majority of the black communities were and still are housed within 5km of ISCOR. Bophelong, established in 1955, was Vanderbijlpark's original township for the black Iscor workers. This segregation through racial zoning and class stratification made a mockery of the social principles of the New Town Movement.

Today South Africa is sub-Saharan Africa's primary steel making producer - 1 of 65 countries in the world which have primary steelmaking production. The Vaal Triangle is the heart of South Africa's mineral and energy complex and continues to play a role as one of Gauteng's top economic value contributors. In South Africa, the top five steel companies together contribute approximately R600 billion to the nation's Gross Domestic Product (GDP) (15% of the total GDP) and employ more than 8 million people. The mineral and energy workers of the Vaal Triangle industrial sector add value to South Africa's economy, yet these people are some of the poorest and most disadvantaged people of the entire country. In Vanderbijlpark, two thirds of the households are dependent on the steel industry for their livelihood. (O'Flaherty, 2015: online) The persistent state of poverty and daily environmental battle is an accepted norm in the lives of the industrial working class.



1.2

THE INDUSTRIAL LANDSCAPE'S GROWTH LIMIT

One thing is certain, as humans take more of the primary productivity of the earth for themselves and the life forms of their choice (such as corn and cows), they leave less for other life forms. The result is a loss of economic value: game, fish, chemicals, medicines, foods may be disappearing with species that no one has even identified. There is also a spiritual and aesthetic loss; a loss of colorful companions in creation. There may be, for all anyone knows, a loss of critical pieces that hold together ecosystems. There is certainly a loss of genetic information that has taken billions of years to evolve – and that humanity is just beginning to learn how to read and use. (Meadow et al. 1992:66)

Growth is seen as the answer to poverty and creates an illusion of a more prosperous future. It is measured and compared in financial terms of GDP rather than looking at characteristics such as health, education and the well-being of the communities which support the ability to produce the final goods or services which are eventually converted into monetary value. Growth is seen as economic development rather than its more important social-ecological value. (Meadows et al. 2004:19)

The current growth model, also visible in Vanderbijlpark, is rooted in separation. It is a story of self and a story of the natural world. This worldview has separated human and other living systems, and the natural world is shrinking as humans turn the natural into materials, energy, title deeds and money. Economists believe in endless growth, yet economic growth requires consumption of natural resources. (Meadows et al. 2004:19)

Natural resources can be renewable, like the soil and its ability to yield crops year after year by implementing crop rotation to avoid exhausting the soil. On the other hand, most of the materials and energy extracted from our environment are limited and non-renewable.

The earth provides a steady flow of resources into the economic system only to end up with waste sinks and brownfields. These waste sinks/ brownfield sites accumulate large quantities of hazardous substances and contaminants which are rarely treated. Although the earth's processes of regeneration attempts to protect the remaining natural world and the people, this regenerative ability is limited. Earth only has a limited capacity to deal with the pollutants generated by the materials and energy used for economic growth. When the growth exceeds the earth's ability to recover the world will reach a point of complete exploitation. Endless growth is impossible without a balance between nature and man. (Meadows et al. 2004:19)

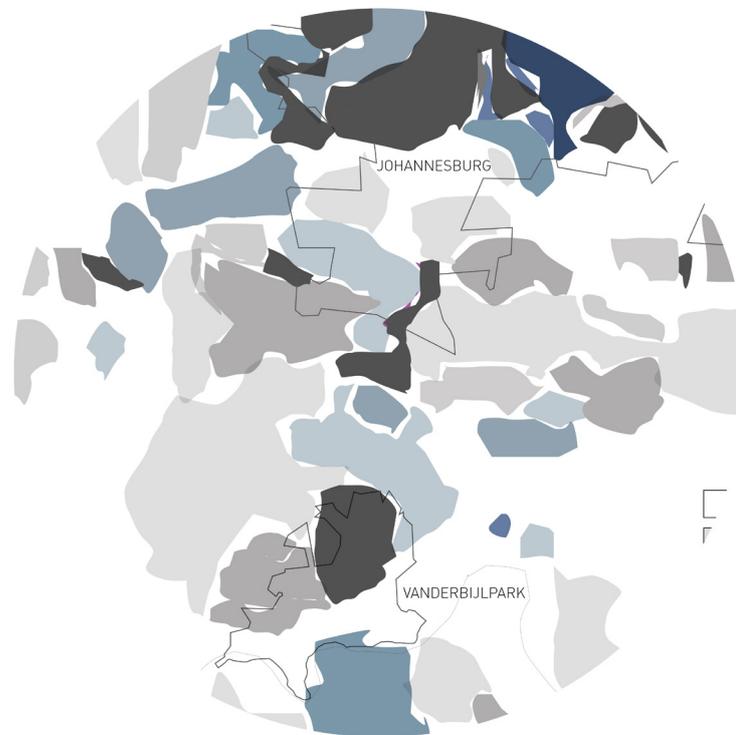


Figure 1.2: Author's Mapping of GDP. (South Africa Data Portal, 2016)



A CONTAMINATED LANDSCAPE

THE GENERAL ISSUE
OF EXPLOITATION

The steel works in Vanderbijlpark is one of the largest in the world, yet the mega industry's success has had an adverse effect on the community and environment. The environmental concerns caused by the industry are deeper, more complex issues of groundwater, land contamination and pollution of the air quality.



Figure 1.3: Industrial landscape. (Author, 2016)

1.3

THE GENERAL ISSUE

Continual growth in pollution and consumption could severely damage the ecosystems and social systems that support life on earth. The drive for limitless economic growth could eventually disrupt many local, regional, and global ecosystems.

The steelworks in Vanderbijlpark is one of the largest inland steel works in the world, yet the mega industry's success has had an adverse effect on the community and environment. Issues of exploitation of resources and people, and flouting environmental laws are the top issues of injustice. The environmental concerns caused by the industry however, are even deeper, more complex issues of ground water, land contamination and pollution of the air quality.

The Vaal Environmental Justice Alliance (VEJA) is an active player which focuses on monitoring the main polluters in the Vaal Triangle. The Vaal Triangle is the first area in South Africa to be declared an Airshed Priority Area in terms of the National Environmental Management Act (39/2004). An Airshed Priority Area is regarded as a polluted area which is detrimental to human health and the environment.

Fenceline communities are the people directly affected by the operations of the industry. The Bophelong Township in Vanderbijlpark is classified as a fenceline community as it falls within a 5km radius of the high risk zone of the Airshed Priority Area. (Environmental Affairs and Tourism, 2007:27) A survey by The Benchmarks Foundation recorded that 49% of the Bophelong residents and workers suffer from respiratory problems, loss of eyesight and hearing. Other cases involve kidney failure, cancer, tuberculosis, manganese and cadmium poisoning and chronic bronchitis. (The Benchmarks Foundation, 2013: online)

The general issues of contaminated land, water and health are part of a complex problem not only limited to Vanderbijlpark, but a major concern globally. This dissertation will focus on one of the major, more visible issue of the quality of the water of the Vaal River. Mega industries have been identified as point sources as they contributed to the contamination of the water network.(Groenewald, 2000:122)



THE MAPPING OF PLACE

REMNANTS OF A NEW TOWN
 PLANNING SCHEME

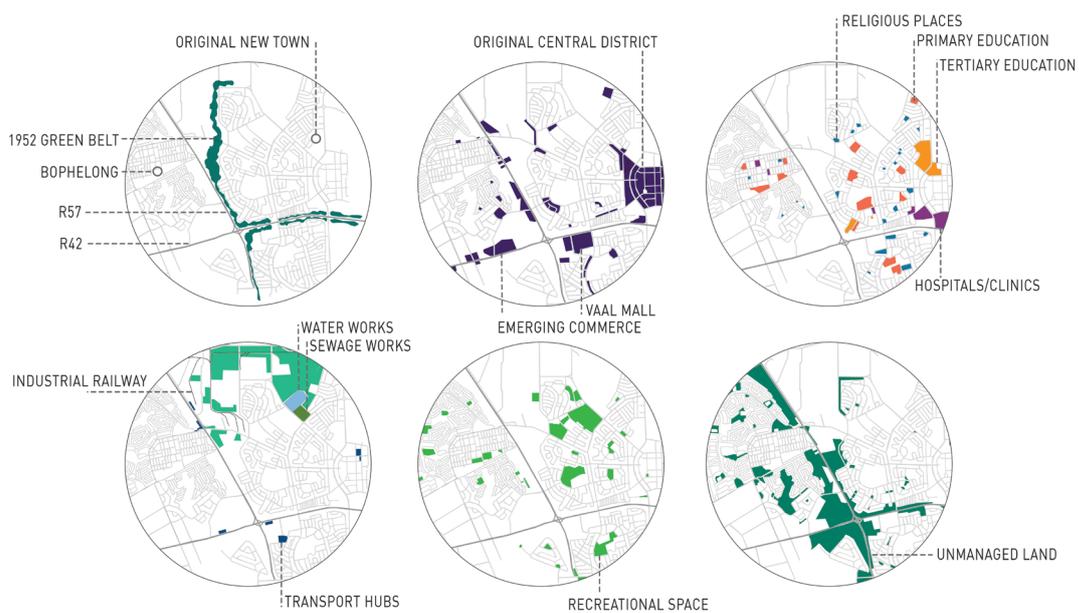


Figure 1.5: Context Mapping. (Author, 2016)

1.4

THE URBAN ISSUE

Cities and towns are dynamic human artifacts which will experience structural change, development and growth. This dynamic change will occur in the relationships of the urban with the surrounding territory. Change is most visible on the outskirts, the transitional zone between rural and urban areas. (Fazal, S.2012:1)

The town planning layout of Vanderbijlpark is one of the most deliberate examples of apartheid planning in South Africa. Bophelong is located on the outskirts of the town that has been segregated from the central district/heart of the town by the large regional road (R57) and industrial areas. This forced segregation has resulted in the fenceline township of Bophelong being located on the perimeter of the steelworks, resulting in the community being largely affected by the heavy industry. (Brockett, 1996:165)

ISCOR's intention for Vanderbijlpark was for it to be surrounded by a continuous greenbelt which would serve as a recreational space and buffer outward development. The greenbelt was a large part of the town's strategy, but ISCOR never managed to procure the surrounding land and hence was unable to control development. The greenbelt consequently failed to control expansion and limit urban sprawl. (Brockett, L. 1996:166) Figure 1.4 shows the demographic data of the dissertation's focus area at the intersection of the R42 and R57. The blue indicates white afrikaans speaking people and the the sesotho people.

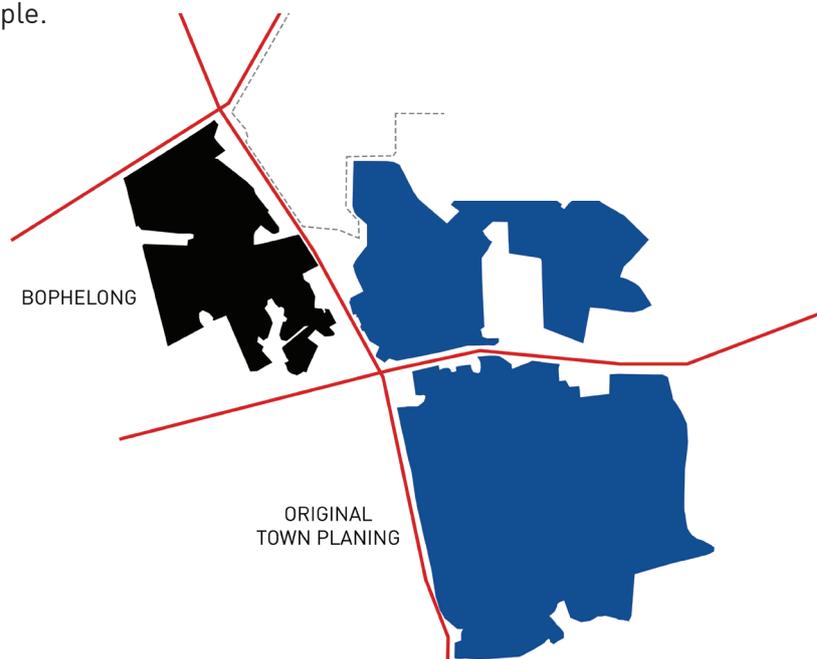


Figure 1.5: Dot mapping showing the focus area with bophelong and the original town. (DotMap, 2016)



FRAGMENTED TERRITORY

URBAN SPRAWL AND
SHIFTING RURAL LAND



URBAN SPRAWL

ORIGINAL
NEW TOWN

FOCUS AREA
FARMLANDS



Figure 1.7 Urban development pushes back rural land (Author, 2016)

The development of 65,000sqm Vaal Mall in 2007 marks the moment of critical urban change. The Vaal Mall was a response to the demands of a growing town. The concentrated civic energy at the original Central District was dwindling and shifting to a new emerging district at the intersection of the R42 and R57 near the Vaal Mall development. The new emerging node has been declared an official node by the Emfuleni Municipality since 2014 (Emfuleni Local Municipality. 2014:34). The emerging node has had a positive impact on the urban issue of the apartheid planning in Vanderbijlpark. It acts as a mitigation device to lessen the severity of the deliberate segregation of the New Town planning.

The declared node is situated between urban and rural land, outside the perimeter of the original town and green belt buffer. When unplanned urbanization occurs the rural land often disappears piece by piece. In Vanderbijlpark, the expanding town is slowly pushing the rural area back as development progresses, leaving unresolved parcels of land which are neither rural nor urban in the battlefield of the environmental and socioeconomic change. Historically, rural and urban land has been viewed as two separate social and economic systems with few interactions. The term urban-rural has been used to define this open, and often neglected land, and attempts to recognize the link between urban and rural.

Urban-rural land parcels are seen as places with potential for dynamic landscape and social change. This land has the potential to provide for the people who have been pushed to the edge of town either due to their economic status, race or livelihood. The urban-rural fringe phenomenon can be identified in Vanderbijlpark and traced back to the ineffectiveness of the green belt concept of the New Town Movement and the segregation of communities under apartheid town planning.

1.5

THE ENVIRONMENTAL ISSUES OF THE STEEL INDUSTRY

The industrial activities of steelmaking disturb and destroy the natural ecosystems. The processes use large amounts of water during the processing and separating of the minerals from ore. The primary waste produced in metal processes includes untreated water, oil, grease and mill scale (microscopic steel shavings) which are deposited into tailing dams. The leakage of waste liquid from the tailing dams causes serious environmental damage and affects the health of those who live within close proximity (fenceline communities). Contaminated sediment and heavy metals are a major hazard when damaged dams/deliberate actions release them to enter the downstream water course. These heavy metals are transported into the river network as surface run-off or directly enter the groundwater. Even the repairing of a tailing dam requires the dam to be emptied and toxic water is released as surface run-off.

The Rietspruit Canal in Vanderbijlpark is an example of a downstream water canal which transports surface run-off contaminated with heavy metals and chemicals into the Vaal River network. There is currently no infrastructure or water reclamation systems in place to deal with the daily industrial effluent flowing into the Vaal River network.

1.6

THE ARCHITECTURAL ISSUE

The industrial sector is a vital part of our economy, yet the industrial landscape is associated with exploitation of resources to construct the new development required. An alternative approach to infrastructure development will be proposed through this intervention. The approach aims for the reinterpretation of production and manufacturing by natural mechanisms which can regenerate and improve the environment instead of exploit and pollute it. The approach aims to reunite man and the natural environment. Infrastructure is traditionally perceived as a solitary object in the landscape; this intervention proposes an alternative, dynamic infrastructure that uses a construct of natural, regenerative systems. The intervention proposes intercepting the polluted condition of the site by implementing natural systems to form a restorative architecture which sustains a healthy thriving social-ecological system.

The insertion of an alternative infrastructure requires an approach which integrates complex systems and local people into a single balanced system.

1.7

MAIN OBSERVATION

The current state of the industrial landscape requires reworking of existing infrastructure as well as introducing new infrastructure which will protect the environment. In this instance the alternative infrastructure should intercept the contaminated water and improve the quality of the water before entering the Vaal River Network. The urban-rural site identified for the insertion of the new infrastructure can be used as a habitat for the processes and production methods needed to improve the quality of the water currently passing through. The processes and production methods require an understanding of the natural mechanisms as parts of the constructed, holistic treatment system.

1.8

PROBLEM STATEMENT

The theoretical point of departure of this dissertation argues that neglected parcels of land suspended between a rural and urban setting can assist the contaminated/disrupted industrial landscape by providing a balanced habitat in which natural healing mechanisms can thrive, eventually becoming an alternative regenerative, healing infrastructure.

1.9

RESEARCH QUESTION

How can architecture be constructed to intercept and create a condition which sustains the healing of a contaminated environment and its people?

1.10

DELIMITATIONS

The main environmental concerns caused by the industrial sector are deeper, more complex issues of polluted ground water, land contamination and unsuitable air quality. These more complex issues are not addressed in the chapters to follow, but primarily serve as an introduction/background to the severity of the industrial pollution in the Vaal Triangle and are included in the Urban Framework. Therefore, this dissertation does not attempt to solve the general problem of industrial pollution, but instead the project focuses on a facet of the greater water issue which is that of untreated industrial effluent. The industrial effluent referred to in this study is currently flowing via the open Rietspruit canal into the Vaal river network. The research will focus on the removal of heavy metals to ensure that they are permanently removed from the environment and not disposed of as hazardous waste.

1.11

INTENTION

The intention of this dissertation and the processes developed can be seen as a mechanism of systems which collectively create architecture to treat a contaminated condition. This will be referred to as the interception.

This dissertation's contextual and conceptual response is that of intercepting and treating the surface water travelling from the industrial area before it enters the Vaal River network. The understanding of the rural-urban condition has been introduced to set the scene to discuss importance and role of rural-urban sites. The potential of the site allows the interception to be submerged and processes flourish in the natural environment, close to the ground. The removal/treatment processes are supported by the natural environment of plants, insects and micro-organisms.

The intention is founded in understanding the requirements of a new self-replenishing infrastructure which relies on the natural potential of the site to facilitate healing/treatment of the contaminated water. Research of alternative removal/treatment processes will be interpreted to create a holistic system which will inform the design development and facilitate the treatment of the water.

The project sets out to include the fenceline communities by introducing a community development interface which will provide an integrated platform for meeting and sharing of information within the community or by VEJA, as well as a space where the client, ArcelorMittal can have face to face contact with the community and share an awareness of the continuum of mining activities and improvements can be displayed and discussed in the exhibition hall.

1.12

METHODOLOGY

“The dynamics of place begin to reveal themselves as tangible data that is used to generate information which informs the architecture.”
(Littman, 2009:10)

Experimental methodology applies a scientific approach to research which requires an understanding of data which can be recorded to evaluate the value of the exploration.(Lucas, 2016:45)

In this dissertation the identification of an appropriate site becomes critical for the foundation of the research. The informants influencing the design will include contextual data, technical calculations, water treatment methods and the functional requirements for each process. An understanding of the research and site will transform the proposal through a series of iterations.

1.13

STRUCTURE OF DISSERTATION

The dissertation’s investigation will be divided into sections to understand the complexity of the processes and translation of the research into reality.

Chapter 3 – Client and Urban Considerations

Chapter 4 - Contextual Understanding

Chapter 5 – Regenerative Thinking and Replenishable Systems

Chapter 6 – Programme

Chapter 7 – Design Development

Chapter 8 – System Data & Technical Exploration



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