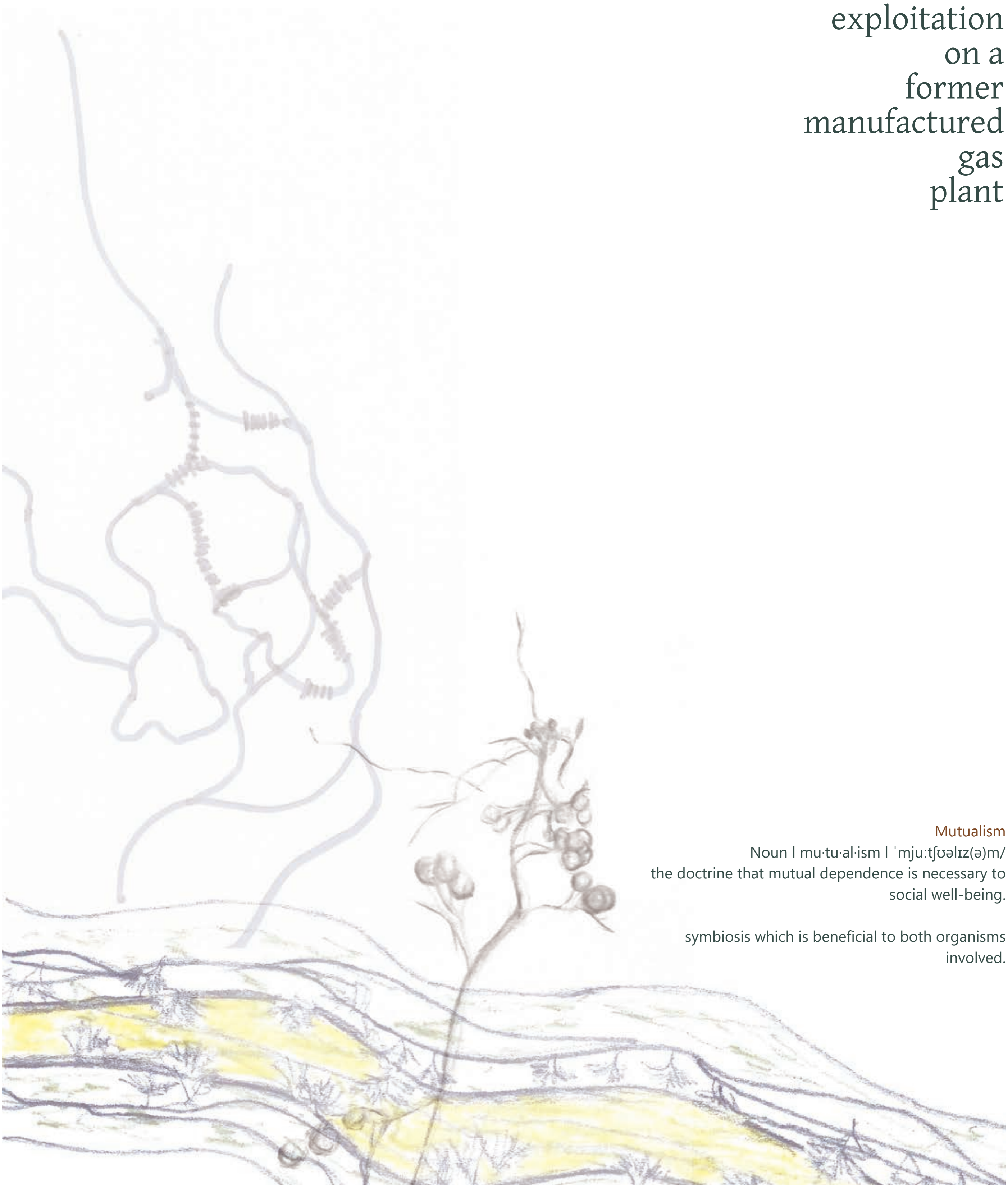
MUTUALISM

The antidote to exploitation on a former manufactured gas plant



Mutualism

Noun I mu·tu·al·ism I ˈmjuːtʃʊəlɪz(ə)m/

the doctrine that mutual dependence is necessary to social well-being.

symbiosis which is beneficial to both organisms involved.

Dissertation title: Mutualism: The antidote to exploitation on a former manufactured gas plant

Site description: The Cottesloe Gas Works

Project address: 1 Annet Rd, Cottesloe, Johannesburg

26º11'23.31"S 28º01'10.00"E

Gauteng

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Clients: Private-Public Partnerships between:
Governmental: City of Johannesburg (Power, City Parks, Sport and Recreation, JDA and Working for Wetlands.
NGO - Earth Keeper
Private institutions - Banks
Community organisations – Uthando Centre and Church @44

Research field: Heritage- and Cultural Landscapes/ Environmental Potential

Submitted in fulfillment of the partial requirements for the degree of Masters in Landscape Architecture (Professional) in the Department of Architecture, Faculty of Engineering, Built Environment and Information Technology, University of Pretoria.

In accordance with Regulation 4(e) of the General Regulations (G.57) for dissertations and thesis, I declare that this dissertation, which I hereby submit for the degree Master of Landscape Architecture (Professional) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution. I further state that no part of my dissertation has already been, or is currently being, submitted for any such degree, diploma or other qualification. I further declare that this dissertation is substantially my own work. Where reference is made to the works of others, the extent to which that work has been used is indicated and acknowledged in the text and list of references.

University of Pretoria

2017

Abstract

The Johannesburg, Cottesloe, Gas Works is located within the Witwatersrand zone of integration, between the University of Johannesburg and Witwatersrand. According to the Johannesburg Metropolitan Open Space System (JMOSS), there is a high priority to link secondary open spaces such as the educational premises. The Johannesburg Gas Works forms part of Jozi's cityscape and the three remaining 45meter high gas cylinders represents a visual iconic landmark in the city. The site is currently inaccessible.

The aim of this dissertation will be to determine the manner in which a user experience can be created as a palimpsest of meaning between the tangible and intangible elements on site. This implies a dialogue between the polluted areas of industrial waste, the layers of historical significance and the remnants of nature. The dissertation specifically focuses on awareness creation through the landscape experience on a post-industrial site of the associated social exploitation and environmental contamination. The Open Narrative approach will be used as part of the methodology which implies multiple interpretations by users and recognizes the presence of embedded narratives inscribed by past and future cultural practices and natural processes.

A new narrative is inscribed onto the site and provides multiple experiences with each visit to the site through a phased intervention that opens up areas and processes for experience as they become decontaminated. To facilitate the palimpsest of tangible and intangible meaning, the user experience is proposed to consist of three realities: a lower, in-between and upper reality with increasing elements of transience. **The essence of the design and its programme becomes mutualistic (as opposed to exploitative), based on the principles outlined by Klein** (2014) namely, "*interdependence, reciprocity and cooperation*". The goal of the design intervention is to foster a renewed community identity and social and environmental health through the range of active and passive activities proposed but also through the particular experiences that open up the site for renewed interpretation to all users. The dissertation demonstrates that new meanings can be applied to spaces that once posed a cultural limitation. A mutualistic relationship between the site and the people can and should co-exist.

Table of Contents

Preamble

Industrialist Capitalism was the main reason for the Coal to Gas conversion site to be built in Johannesburg in 1928. It served various functions to the City of Johannesburg – such as providing Gas for household cooking and the streetlights. The by-products produced included the tar that was used on all the streets in Johannesburg at the time. Liquid ammonium was used for gardening. However, during and after the operation of the plant, 1928 -1992, the site was heavily polluted with organic, carcinogenic Polycyclic Aromatic Hydrocarbons (PAH's) and inorganic contaminants (heavy metals). Tests performed by SRK Consulting and Metago Engineers during 1996 – 2000, compiled by Georem International, indicated very high levels of contamination in the soil and groundwater that may be detrimental to human health. If the groundwater will not be treated and the migrating leachate plume not stopped, it will contaminate other groundwater users.

The industrial buildings encapsulated within this site holds mostly mixed perceptions as a result of the environmental and social exploitation narrative up to date. The fuel gases generated during operation had detrimental effects to workers' health. Today, gas and other soil vapour contaminants create a noticeable odour surrounding the site. For some, the Johannesburg Gas Works, may be visually unappealing and others are romanced by these grotesque buildings.

This dissertation investigates the awareness creation of the associated social exploitation and environmental contamination through the landscape experience on a post-industrial site, whilst a renewed community identity and social and environmental health are fostered.

CHAPTER ONE

Introduction

Chapter overview

This chapter will discuss the introduction to the site and problem, research question, hypothesis, sub-questions, delimitations and assumptions of the study.

1.1 Introduction to the problem

The Johannesburg Gasworks typology was a "mono-functional factory-type" built across the British Empire (Läuferts & Mavunganidze 2015:86) in the era of industrialization. Thousands of black workers worked from 1928 -1992, within the Johannesburg Gas Works to extract gas for the smaller white minority to use (Läuferts & Mavunganidze 2015:87). Nikolaus Pevsner, a twentieth century architectural historian describes these "mono-functional factory-type" industrial buildings to possibly assume many different uses whilst it communicates the formal and material debts owed to history and narrating the fraught stories of workers (Opper in Läuferts & Mavunganidze 2015:87). This dissertation proposes that the landscape that carries the stains of pollution and former industrial use can be re-appropriated so that the post-industrial landscape can convey significance of social, economic and environmental concerns. There exists a pertinent need to address the damage caused by abandoned industrial sites and the accompanied pollution in the urban setting (Kirkwood 2011: xiv).

The Gas Works plant was established in a worldwide period of industrialisation, imperialism and capitalism. An observation was made by D.H Aldorft that: "Over the whole period (1919-1939), the South African economy was one of the most buoyant in the world, largely due to the massive arise towards industrialization." (Läuferts & Mavunganidze 2015:19). Nine years after this resilient period, the Apartheid law was enacted (South Africa Profile – BBC News, 2017). One year later the gold price soared with 44% on 19 September 1949 (Johannesburg Timeline 1800-1991. South African History. Online 2017). During Modern Capitalism, the global financial system was directly linked to the gold standard. Vladimir Lenin also wrote the essay: "Imperialism, The highest stage of Capitalism" during 1921 (Bordo, Eischengreen & Irwin 1999:).

There were only two coal to gas conversion plants built in South Africa: The Johannesburg Gasworks and the Cape Town Gasworks. The City of Johannesburg originated as a result of findings of Gold during the mid-1800's in the Transvaal (South Africa Profile – BBC News, 2017). The Gasworks in Johannesburg started on a different parcel of land than the current Cottesloe site and was named the President Street Gasworks in Newtown. It operated from 23 June 1892 to 23 Dec 1928 (Läuferts & Mavunganidze 2015:17).

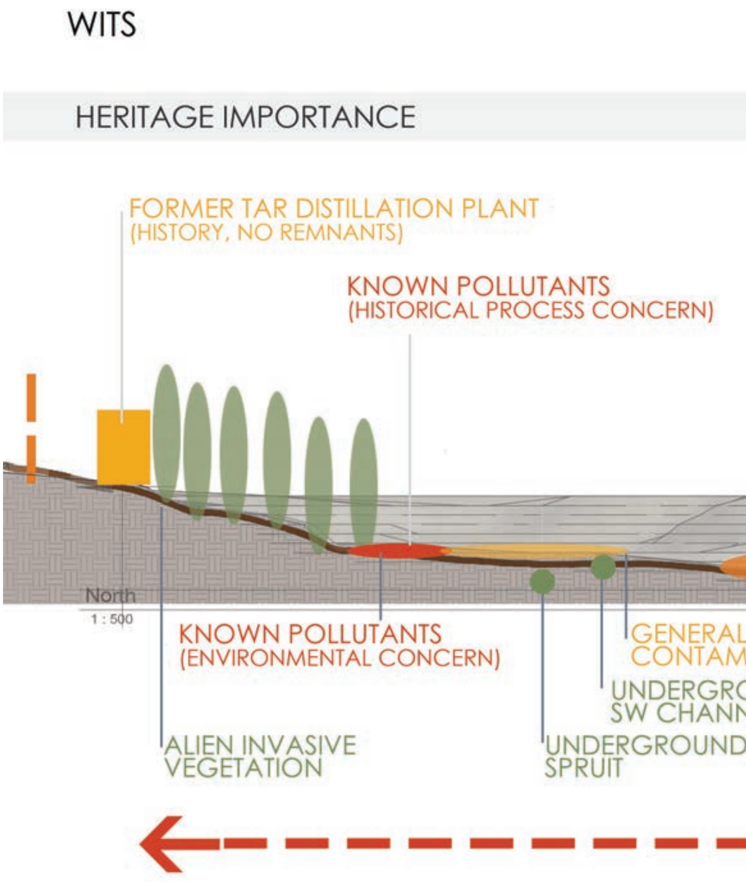
When considering this history and the site today, one is left with several questions: to whom does the heritage of the Johannesburg Gas Works belong to? The site carries the burden of exploitation of black workers. Why does it need to be preserved and not be broken down? Besides the fact that the buildings are older than 60 years, it signifies an important stage during South African history. This dissertation argues that the exploitation of human health and the environment is evident and the place can be re-inscribed with a new all-inclusive narrative of natural restoration, human health and community cohesion. The site is situated within an important Institutional node and the space is unused and polluted. It will be detrimental to human health on a broader scale if there is no action to transform the pollution. The site also conveys heritage significance with regards to industrial buildings and coal to gas conversion that occurred on-site.

1.2 Site location

The Johannesburg Gasworks is situated within the Witwatersrand belt of integration between the University of Johannesburg and the University of Witwatersrand.

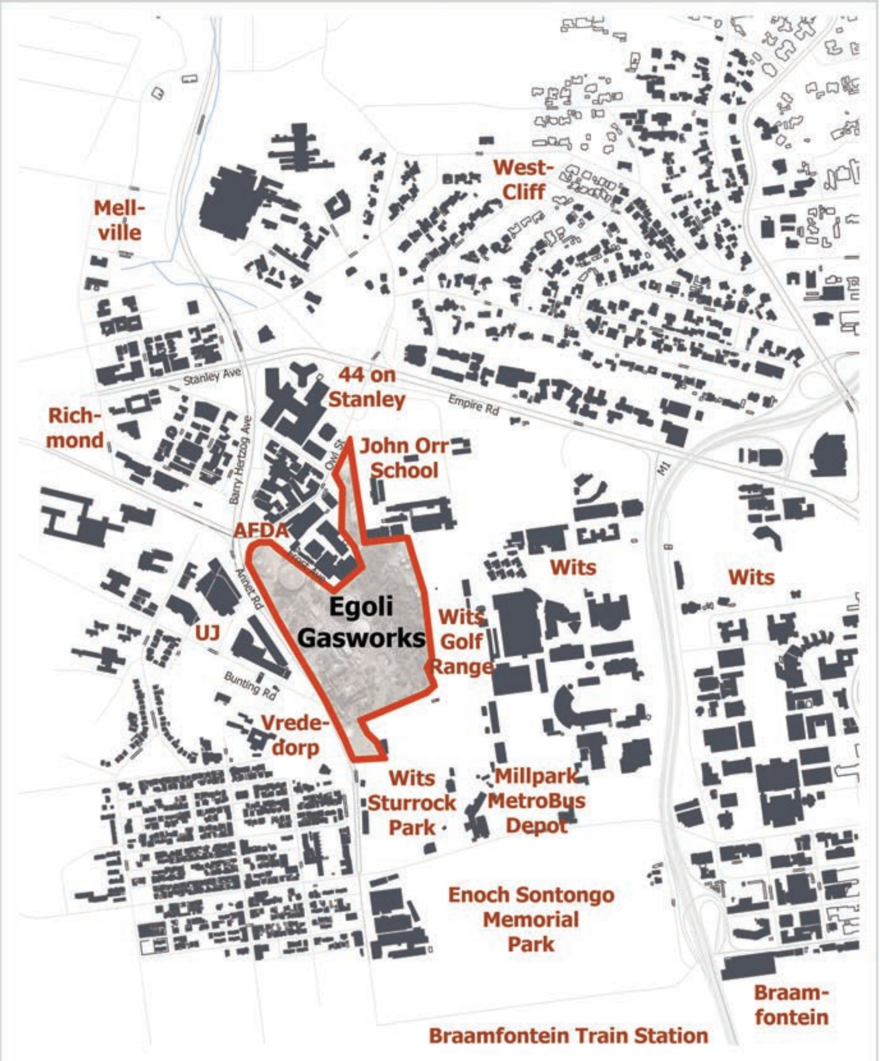
The site is surrounded by research institutions, film and medical industries. The residential areas consist of upper-, upper to middle-, middle- and low income groups. The site falls within the Millpark Knowledge Precinct as stated by the Empire-Perth Corridors of Freedom, City of Johannesburg and has the potential to become a future mixed-use regional node. The redevelopment of the Gas Works should be considered as a "strategic catalytic project" to the Milpark Precinct (JDA n.d: 87).

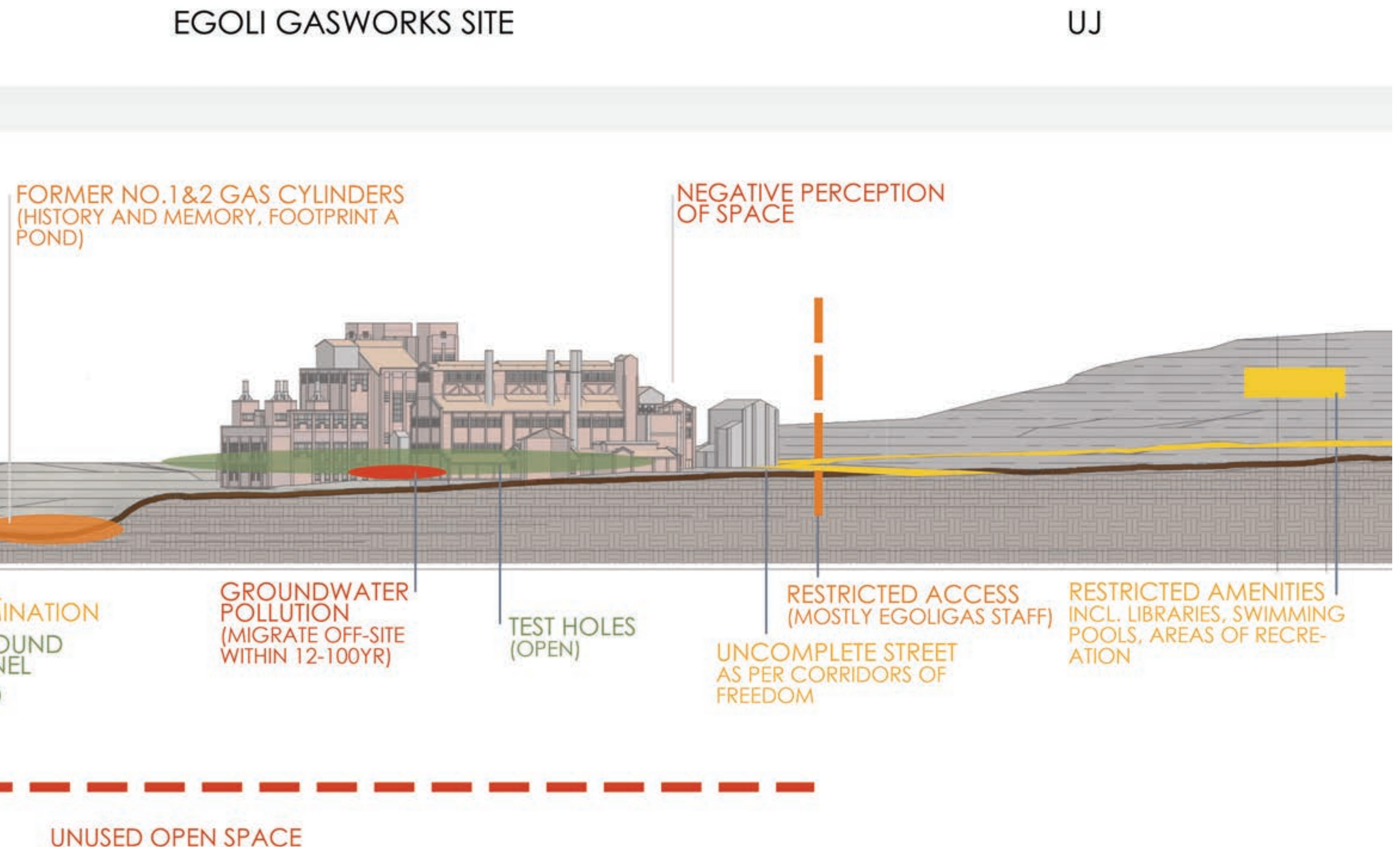
The site issues are summarised below in Figure 2. The groundwater pollution, soil pollution, unused open space and the negative perception to this space are among the most important considerations.



To the right, Figure 1.1: Locality of Johannesburg Gasworks (Author, 2017)

Below, Figure 1.2: Site issues (Author, 2017)





1.3 Research Question

How can the **experience** of a post-industrial landscape create awareness of the associated **social exploitation and environmental contamination** while fostering a **renewed community identity and social- environmental health**?

1.4 Thesis statement/ Hypothesis

Community Identity is the antidote to **individualist consumerism** and this intangible value can become part of an **open narrative** in an abandoned **post-industrial landscape** healed through the process of natural **restoration**.

1.5 Sub-Questions

- What is the heritage **value** of the selected post-industrial site within the SA context?
- What is an **open narrative approach** in design and how does it allow the tangible and intangible to be experienced?
- How can **community identity** (intangible) as opposed to **individualistic consumerism** be established as a “new” narrative through the **landscape experience**?
- In what manner can the **exploitation of human health and the environment** (tangible and intangible) be experienced as part of an open narrative?
- What is **natural restoration (tangible)** and how is it achieved?
  - o How can soil and water pollution be resolved?
  - o How can natural restoration create a new experience for human health and the environment as part of an open narrative?
- How can **community identity and cohesion** be strengthened through landscape design on an abandoned **post-industrial landscape**?

1.6 Aims of the study

- Proposed implementation of remediation strategies, in a manner that the user can relate to the past but also create his/her own experience through the Open Narrative approach.
- Proposing a connection of the site with its surroundings, perforate it for pedestrian movement.
- Identification of inorganic groundwater pollution remediation strategies.
- Identification of organic soil pollution remediation strategies.
- Research the transient quality of memory evoked through Landscape Architecture as design informant.
- Create an area/ landscape that can foster community identity, cohesion and human well-being.

1.7 Limitations

Access to the site is controlled and only a few site visits were granted due to the high pollution factor of the site. The revegetated area against the steep slope was densely covered and access to the Tar Distillation Plant remnants were not possible.

1.8 Delimitations

For the importance of this study, the remediation will be focused on pollutants that occurs on-site.

The boundaries of the site are:
Annette Rd to the West of the site where UJ is located, with Owl Str to the North – AFDA, Atlas Studios and residential complex slices in between Owl and Frost Ave. John Orr School forms the North-Eastern boundary of the site and the Eastern boundary is depicted by the Wits Golfing range. The site cuts in at the far Southern side of the site from what might look like a part of Wits sports fields.

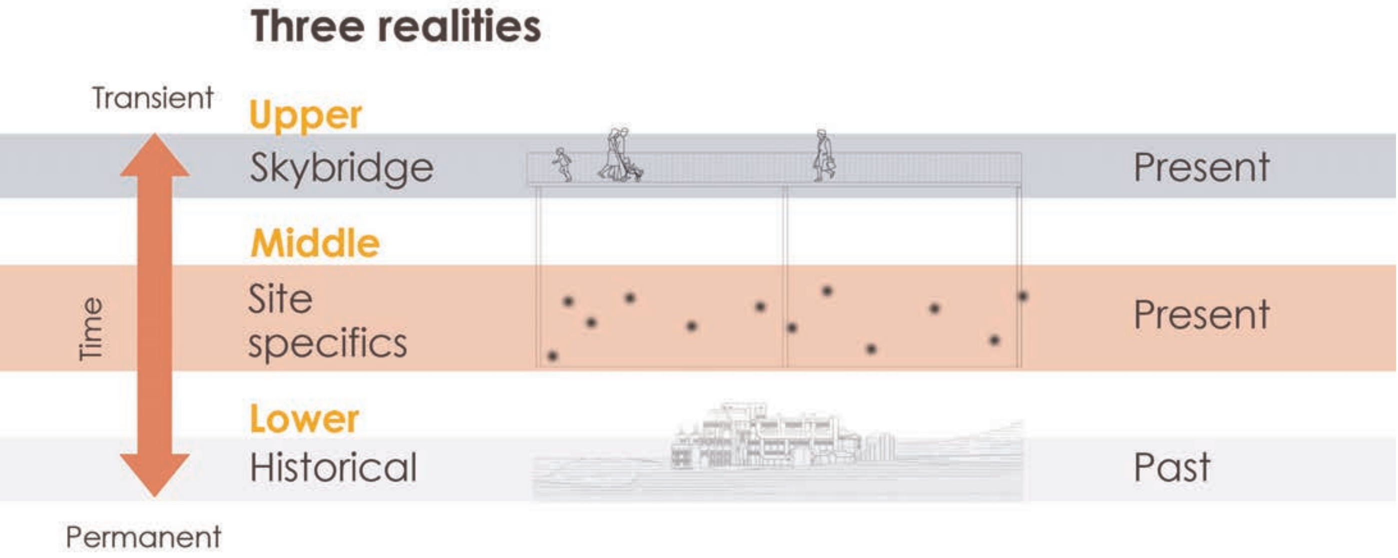


Figure 1.3: Three realities (Author, 2017)

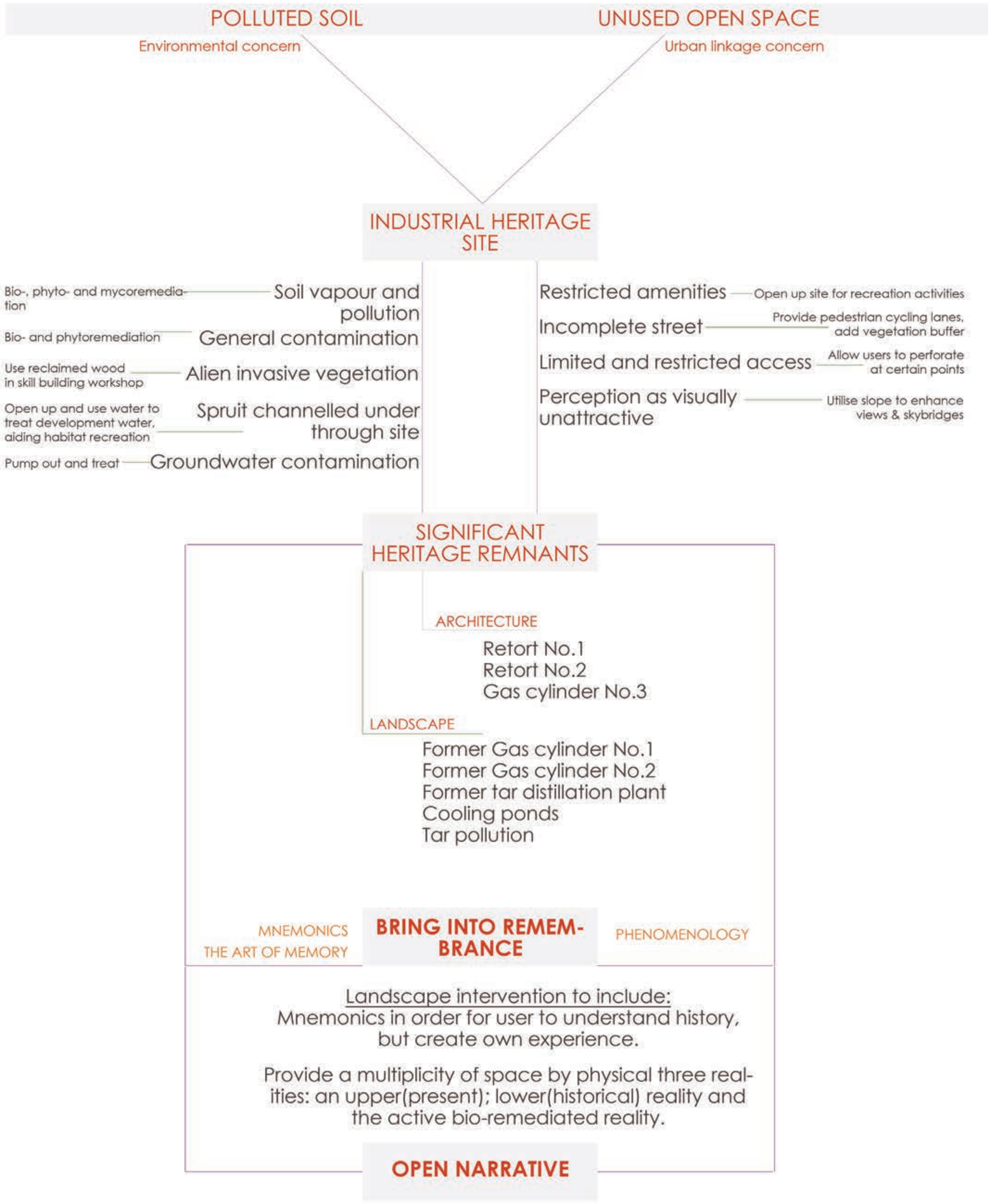


Figure 1.4: Site issues, site informants that feed into/ inform the theoretical approach (Author, 2017)

1.9 Assumptions

The assimilation of soil pollution areas compiled by GAPP architects and urban designers from the Georem report were used to inform design decisions and are assumed to be accurate and complete.

1.10 Methodology

As part of the research the spatial data was compiled by means of mapping, spatial analysis and visualizations. Along with the Literature Review (Desktop study); Field studies (Site visits and observation) and Case studies (Comparative precedents) methods were employed.

The Open Narrative Approach overlaps with principles of Phenomenology and these approaches will be used in the design of the Johannesburg Gas Works landscape.

The study will investigate in what manner an Industrial setting can act as a palimpsest for the specific user experience. It will be mainly enacted through suggesting three realities (see Figure 3, page 10): An upper reality through which the user experiences the space – creating own memories whilst experiencing what happened in the historical context of the site which is the lower reality. The in-between space becomes the transient zone wherein bio-remediation takes places and the processes can be valued and understood.

Figure 4, page 11 indicates how the site issues and informants fed unto the proposed theoretical approach to lead to a proposed landscape intervention.

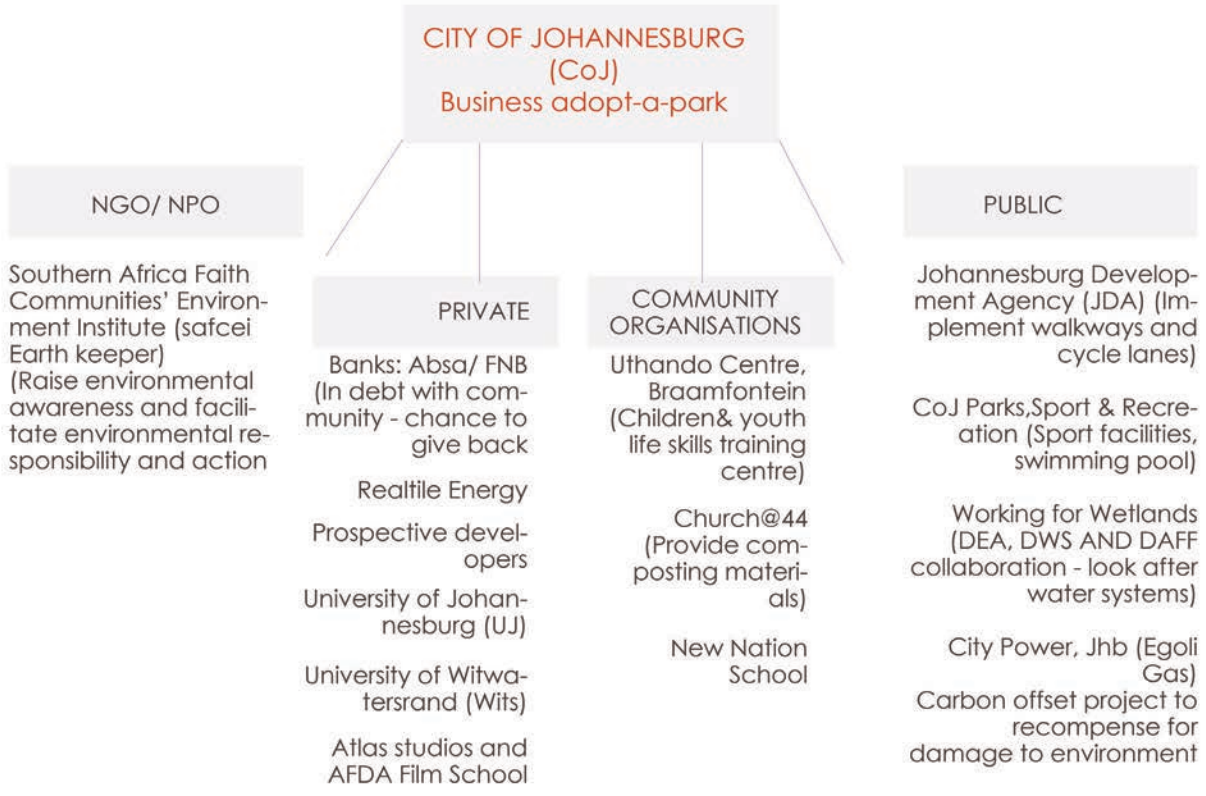
1.11 Client

This project need to be driven by Private-Public Partnerships between Governmental Institutions, proposed NGO, Private investors as well as the community. By involving all affected parties, the project will become a reality. Please refer to Figure 5, page 12 that indicates the public, community and private stakeholders that were identified within the project area that could result in a successful partnership for the proposal.

The project can mainly be **overseen** by Business-adopt-a-Park, which is a strategic partnership arrangement between CoJ Parks and Zoo (JCPZ) and Crebus (Pty) Ltd. This initiative envisions to establish the community value that relates to SA Parks in residential areas. The community benefits from parks by enjoying: a safe place for relaxation, children's play area, walking trials, sports facilities and also heritage and historical significant related activities for families.

NGO - Earth Keeper will assist with the facilitation of environmental action and responsibility support environmental training and learning.

Private institutions will include the educational focused neighbours:. The University of Witwatersrand (Department of Microbiology and Bio-Technology) and the University of Johannesburg (Department of Botany and Plant Biotechnology).
Mycelium research projects in order to sway Government bodies, such as the Department of Health. The students are assumed to produce the spawn for mycoremediation processes on the site, as well as the production of inexpensive compost tea. The students



Above, Figure 1.5: Outline of Private, Public Partnership with community involvement as Client (Author, 2017) may also train community members the grassroots of phyto- and mycoremediation at the horticultural therapy skills centre.

Financial institutions such as Banks.
There are a lot of pressure on the Banks to give back to the community, as they take a lot from the people without giving back.

Community organisations: Surrounding communities provides initial composting materials. Materials provision can be instigated by Church@44. Saw dust can be obtained from the Wits woodworkers association.

Uthando Centre, Braamfontein.
The Uthando Centre of Excellence was opened by the for-profit social enterprise, Afrika Tikkun. It is a humanitarian non-government organisation providing social, educational and health services to children, youth and young adults. The aim is to provide cradle to career interventions, helping children with homework and providing outdoor activities and to equip the youth with values and skills. This open space can become a place where these children and youth can come after school to exercise and do sports and homework outdoors or develop skills at the biological skills centre/ horticultural therapy. As this park becomes a key park to the supporting activities of the initiative, Afrika Tikkun might contribute to the maintenance of the sporting facilities and other associated activities of the new park.
Also, the activities that the Braamfontein Conference and Recreation Centre might not be able to host can be held at the new park.

Public/ relevant state-owned Departments
Working for Wetlands
This programme is a joint venture between the Department of Environmental Affairs, Department of Water and Sanitation and the Department of Agriculture Forestry and Fisheries. They focus on the rehabilitation, protection and wise use of wetlands in a manner that provides employment opportunities. Working for Wetlands may look after the ponds health and provide the investment.

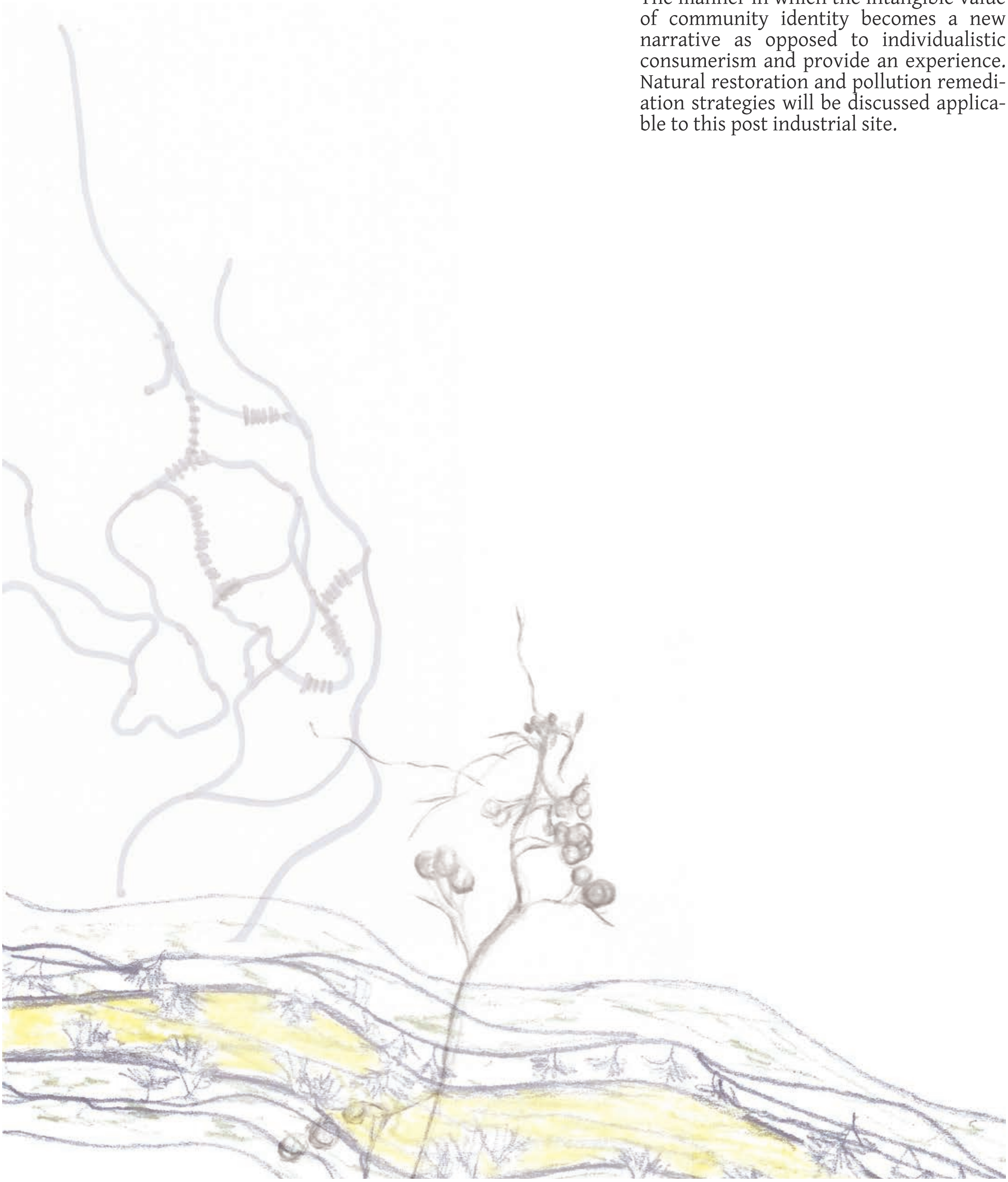
Corridors of Freedom, Group Communication and Tourism Department, CoJ.
The walkways and cycling lanes surrounding the site, as well as transecting the site to form the connections as per Empire-Perth Corridors of Freedom should be implemented by the Johannesburg Development Agency (JDA) and the City Council.

Egoli Gas,City Power.
This can be part of their carbon offset project to recompense for damage to the environment.

CHAPTER TWO

Theory and Research

Chapter overview
In this chapter, the heritage value of the selected post industrial site will be discussed. The Open Narrative approach will also be discussed and how it allows the tangible and intangible to be experienced. The manner in which the intangible value of community identity becomes a new narrative as opposed to individualistic consumerism and provide an experience. Natural restoration and pollution remediation strategies will be discussed applicable to this post industrial site.



2.1 What is the heritage value of the selected post-industrial site within the SA context?

The ICOMOS Australia Burra Charter states that "Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects". The National Heritage Resources Act (NHRA) categorises heritage value (in general all sites) according to aesthetic, architectural, historical, social and technological values. It is clear from the NHRA and Burra Charter that heritage consists of tangible and intangible values. The author made use of the five values proposed by NHRA to discuss the value of Johannesburg Gas Works

Firstly, the architectural and aesthetic values will be discussed, then the historical timeline and technological value and lastly the social value of the Johannesburg (Cottesloe) Gas Works.

Aesthetic and Architectural values:

The **prominence** of the Johannesburg Gas Works in the cityscape serves as a landmark and therefore **contributes to the aesthetic value of the city**. The Retorts and Gas cylinders have been in the peripheral views of many students, the surrounding community and CBD and can be said that it has gained intangible value as a result of the visual characteristics of the place. According to Alfrey and Putnam (1992:9-10), a factory has industrial heritage value when people are interested in the aesthetic value of functional, technical or historic elements of a place.

The rise of industrialisation has brought on major ecological and social impacts in history (Chan 2009: 22). Capitalist industrialisation changed the dynamics in our society and geopolitics. The Johannesburg Gasworks typology was a "mono-functional factory-type" built across the British Empire (Läuferts & Mavunganidze 2015:87) in the era of industrialization. It was built in the Dickensian, Neo-Gothic architectural style very contrary to the 'Johannesburg veld-land' (Läuferts & Mavunganidze 2015: 79), but occupies civic qualities such as those designed by German romantic architect, Karl Fredrich Schinkel. It is the only remaining factory of its type in South Africa, as the other Gas Works in Cape Town, built in 1988 has already been demolished.

The National Heritage Resources Act 25 of 1999, states under point 34(1) Structures, that: No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority." As building on Cottesloe site commenced from 1927, many buildings are more than 60 years old and should be retained. Under the Heritage assessment criteria and grading in the NHRA s(7), a 3-tier system is differentiated: Grade 1 is defined as resources with qualities that is exceptional and special on a national level, Grade 2 is based on resources which is significant to a province and Grade 3 is significance and relevance to a specific community.
It can be argued that the Johannesburg Gas Works has unique national significance, as this is the only coal to gas conversion plant in SA that still exists and should be graded under Grade 1.

Historical and Technological Value

Plans were drawn up in 1927 when the demand for gas could not be met anymore and the Cottesloe site was the ideal site as it was hidden from residential areas. Operations commenced from 23 June 1928 (Läuferts & Mavunganidze 2015:19).

The oldest bench in Retort House No. 1, which was fabricated in England in the 1920's was selected by Peter Finsen as one of the oldest pieces of machinery to be retained. It is a remnant of the Glover-West system to produce gas. This forms one of the most important elements of industrial technology in Johannesburg (Läuferts & Mavunganidze 2015:69).

Steel construction material was imported from Britain until January 1946 when Iscor provided 1800 tons of SA Steel for the largest circular gas holder. It can therefore be concluded that 'the Gasworks served an accurate barometer of major economic change in SA" as stated by Monica Läuferts (Läuferts & Mavunganidze 2015:6). Other additions were made to the Gasworks such as the Retort House No. 2 and the Gasification Building during post war 1950s (Läuferts & Mavunganidze 2015:6). Once the Tully Plant was added to Retort House No. 2 in 1959 the Gasworks became a fully operational industrial site (Läuferts & Mavunganidze 2015:33). In 1988 it was decided to close the plant down and was effected in 1992 (Läuferts & Mavunganidze 2015:59). From 2001 to 2013 the Johannesburg Gasworks exchanged several owners and is the property of Realtile Energy currently.

Furthermore, the site has the potential to **contribute to the cultural heritage of SA** (Grade 1) and demonstrates a **high degree of technical achievement during the 20th Century** as per Section 3 of the NHRA. Future development of the site must thus preserve historical aspects and the technological value.

Social value:

In the pluralistic society of SA, the question is always inevitably, to whom does this heritage belong? The Gas Works carry the burden of mass exploitation of black labour for the white minority (Läuferts & Mavunganidze 2015:86). It is the case with the many other extractive infrastructures found on the Rand. With this in mind, it can be argued that the Gas Works might also just be demolished (Opper in Läuferts & Mavunganidze 2015:86). The possibility exists to re-inscribe the place with new and inclusive memories from a diversity of users. The term *contact zone* is used by the historian and anthropologist James Clifford (Opper in Läuferts & Mavunganidze 2015:87), to marry socially and spatially segregated areas in a city. The reliving of spaces in Johannesburg can be accomplished by Clifford's 'co-presence, interaction, interlocking understandings and practices', thereby creating new meaning to spaces that once posed a cultural limitation (Opper in Läuferts & Mavunganidze 2015:87). Co-presence implies – the mutualistic living of people together regardless of demographics; Interaction implies – activities and spaces to enhance community engagement and the Interlocking of understandings and practices – to integrate a wide variety of social groups. The social value should therefore be graded under 1 for national significance and 3 for significance related to a specific community.

The UNESCO Historic Urban Landscape Approach (HUL) relates to the tangible and intangible heritage. It states that the tangible and intangible values are “sources of social cohesion, factors of diversity and drivers of creativity, innovation and urban regeneration.” (UNESCO:2017). The intangible values can also relate to the social-political values such as capitalism which is an ideology. This ideology formed the driver for the development of a coal to gas factory and justified the exploitation of human health and the environment. Various layers of the city are considered to increase sustainability of design interventions and planning such as: the existing, diversity in culture, community values, intangible values, environmental and socio-economic factors (UNESCO:2017). To commemorate the tangible and intangible values, it becomes an opportunity for urban regeneration and social cohesion.

Design application
Due to the fact that the author perceives the social value of the Johannesburg Gas Works to be most significant of all, it was decided that the design application will focus on the social value through urban regeneration and social cohesion.

2.2 What is an open narrative approach in design and how does it allow the tangible and intangible to be experienced?

Tangible can be defined as physical things that can be sensed through touch. Intangible can be defined as unseen things that may structure or influence people or society.

According to Santiago (2015: 47), an open narrative strategy can be described as the synthesis of multiplicity, temporality and flexibility exluding definitive form-giving.

Multiplicity relates to a large number or variety of uses and people and are interchangeably used as multireferentiality which relays as alluding to several aspects. It most importantly relates to unity that is multiple in itself, such as a mutualistic relationship. Multiplicity provides choice and recombination. It is also known as a typology in Landscape Architecture which lends itself to a multilateral and interdisciplinary input across Landscape Architecture, Architecture and sculpture. The intentions of these projects are commemoration, experience and meaning with functional issues second (Folkerts 2015:68,71).

Temporality refers to that which is subject to change, transient and fleeting. It also refers to a fixed reference on the geology and landscape which is subject to change and this becomes a dynamic reality (Folkerts 2015:76).

Figure 2.1. Built-structure timeline. (Groupwork 2017).

Flexibility can be described as the ability to be easily modified. Flexibility is the equivalent in meaning to resilience and adaptability. Flexibility relates to a design where not all things are permanent (Heyde 2015:194; Gallier 2015:46). It 'enables social, cultural and economic processes to be further unfolded in the future' (Heyde 2015:191).

The **exclusion of definitive form-giving** relates to not dictating forms to provide a controlled experience. The form-making should be more transparent, not imposing certain values onto the user, but the user can choose to be engaged in the valu-action and experience. Multiple experiences for a designed space can allow this to happen. The core form-giving can relate to the intangible aspects such as the production of memory which is necessary such as in Remembrance Park 14-18, West Flanders designed by Jeroen Geurst and Lodewijk Baljon. The visitor is necessary to move through the spaces to remember and imagine what might have happened during the Great War. Reading keys/ stones aid in this memory. Therefore, the visitor enables the choreography of memory. The Park is a score that is open and would be incomplete without the reader (visitor) (Gallier 2015:44)

Usually, an open narrative project is incomplete, as it should allow the project to go through the different stages to create new stories as to be seen in the projects of Catherine Mosbach (Louvre-Lens Museum) and Michel Desvigne (Nord-pas-de-Calais region). The site is transformed rather than preserved (Santiago 2015: 47). According to Raxworthy (2013:64), these two challenges arise: The recuperation of site specifics as well as the inclusion of a 'performative agenda', a sequence of movements in time that causes the landscape to change.

Figure 2.2: Louvre-Lens Museum Park (Tempsreel, 2012)

Catherine Mosbach – Louvre Lens, Paris

Surfaces as a pattern language and indicates mutation – nature took over in past and continues with that same idea.
An open narrative strategy has been used as departure point for this case study. It is not fully completed; it will go through different stages to create new stories. It suggests multiplicity, temporality and flexibility that occurs on site, but is not too definitive in form-giving. Hidden site specifics are exposed (Santiago 2015: 47).

Client: Cultural tourists.

Figure 2.3: GASP (Coxall 2017)

Aim: Instigation of economic growth in the old mining site of Nord-Pas-de-Calais through cultural tourism (Santiago 2015: 44).

McGregor Coxall – Glenorchy Art Sculpture Park (GASP), Tasmania

Understanding the past looking through a specific lens, to aid in remembering what the site have been and how it is transformed. Views are framed. Two main areas are designed: one that is open and exposed and the other being sheltered and protected. The areas respond to wind, shadow, light and seasons.

Client: The blue collar community.

Aim: Regeneration of industrial area through cultural tourism (McGregor Coxall: 2017).

As per Matthew Potteiger and Jamie Purinton (1998), a discursive realm is representative of the landscape narrative, which promotes negotiation, value structuring, ideologies and beliefs (Potteiger & Purinton in Swaffield 2002: 141).

Three realms are differentiated in narratives: The story realm; The contextual/ intertextual realm and the discourse realm. The first is described as 'cultural systems of signification, as language', the second is linked to text and intertextual associations and the discursive realm implies 'meanings and interpretations are both enabled and constrained within social discourses' (Swaffield 2002: 137).

The discourse realm is further different to the other realms as it 'requires attention to whose story is told and to what ideologies or world views are implicit in the telling.' (Potteiger & Purinton in Swaffield 2002: 137).

Three examples where the open narrative approach has been used includes the Splice Garden designed by Martha Schwartz,see Figure 4, Page 19. Negotiation, value structuring, ideologies and beliefs are opened in this rooftop garden. At the Whitehead Institute in the USA, the technology of splicing is utilised in the creation of new life forms. Schwartz used different cultures to create a spliced garden. A combination of Japanese Zen and French Renaissance garden design were used. A feeling of lifelessness is provoked with the artificial contemporary materials used.

In the project, De-code/ Re-code, Atlanta designed by Conway and Schulte, language is used as infrastructure, see Figure 5, Page 19. Written regulations and government processes determined the form of the public spaces.

Beliefs are materialised to seem natural (Potteiger & Purinton in Swaffield 2002: 143). An incomplete narrative is visible at the Crosby Arboretum in Mississippi showcasing ecological indeterminacy, see Figure 6, below (Potteiger & Purinton in Swaffield 2002: 143). The seven vegetation types found in the region are planted in this area to enhance biodiversity and aims for preservation and research purposes. The changes between these exhibits are both subtle and drastic. Plants that are applied to industrial, aesthetic, scientific and agricultural uses are showcased (Crosbyarboretum 2017). It was implemented by the Crosby Arboretum Foundation.

Theme parks and gated communities are exemplary of closed narratives. In an open approach, **multiple stories or sequences with complexity** are activated with opportunity for **choice or recombination.** Others can appropriate a place with their own stories when a space is left unprogrammed as applied at the Vietnam Memorial designed by Maya Lin in New York. A rhetorical silence is experienced which ‘evokes a multitude responses from others’ (Potteiger & Purinton in Swaffield 2002:143).

An **intertextual creation** should be the aim, with stories that are not smoothly resolved. An active encounter of the various readers provokes different readings and new life. The ideology of Capitalism can be opened and therefore the ideology becomes ‘denaturalized’ (Swaffield 2002: 143). It is not necessary that the narrative should be planned or controlled, open narrative invites the users by this ongoing process of narrative production to ***“make place and stories form part of a constitutive process of the own user experience, interpretation and memory”*** (Potteiger & Purinton in Swaffield 2002: 144).

An open narrative is *‘open to interpretation, multiple authorship, competing discourses and change, making landscape such a phenomenon.’* (Potteiger & Purinton in Swaffield 2002: 137).

Design application to Cottesloe Gas Works

In terms of open narrative, the design will make use of the principles of **multiplicity, temporality, recuperation of site specifics, value structuring, experience and a sequence of movement.**

By means of applying three realities where narratives happened, happen and still will happen onto the site – it offers three different experiential layers through time. The past is represented by the lower, historical layer, the present is represented by the transient (interbeing and intermezzo) factors in the form of a pattern and involves: water purification (organic

Figure 2.4: Splice garden (MarthaSchwartz, 2017)

Figure 2.5: De-code/ Re-code (Atlantapublicart, 2008)

Figure 2.6: Crosby Arboretum (Crosby Arboretum 2017)

and inorganic contaminants, oil and colourants); soil rehabilitation and vegetation patterns changing across seasons. The upper reality provides a holistic view of the site and of all its transient qualities. This reality is experienced through another transient mechanism, namely movement as recommended by Raxworthy (2013). The skybridge/ elevated walkways allow one to propel yourself forward at some points to appreciate certain views of the site. Multiple stories can happen in these in-between spaces.

The flow of gas (tangible) can be experienced through lifting the stages of gas flow to the soil level and narrating something that would else have stayed hidden. Making something tangible but hidden to the eye, tangible and visible.

Except for the housekeeping issues on-site, the pollution is hidden below and within the soil surface. Illumination will be shed on this problem by means of landscape interventions and be exposed. The condition of the soil will also be improved to enhance ecology and community identity.

Phenomenology

The integration of Phenomenology and open narrative approach was investigated and was found to overlap in the areas of **multiplicity, mental signification, temporality, movement, value structuring, experience and cycles and rhythms of natural processes and human life,** see Figure 9, Page 21.

Phenomenology is described by Elizabeth K. Meyer as works that are “set in motion by the cycles and rhythms of human life and natural processes. Bodily experience, movement in space, fluctuating characters, and temporal considerations defined this type of landscape architectural practice” (Meyer 2000: 243). She also accentuates the importance of designers to design to the citizen’s experience and rhythms of collective public life.

Prof. Cristophe Girot, Chair of Landscape Architecture at the Swiss Federal Institute of Technology argues that a typology (variety of uses) applied onto a landscape should be assessed in terms of the ‘*deeper cultural values, beliefs and habits*’ as this forms an elemental part of a place. The ‘particular societal organization and local culture’ are very important (Girot 2012). This further substantiates the importance of the deeper beliefs that led to the existence of the Johannesburg Gas Works and to expose the negative effects it had on human health and the environment. Also, he reveals an important key to accomplish this: through the local community.

In the late 1970’s, Dieter Kienast, Swiss Phenomenological Landscape Architect and holder of a doctorate in phytosociology, pursued a new type of planning based on science. He performed a study where plants settled in certain areas – this gives information on its use. Revegetation will happen in an abandoned parking lot in contrast to a plant’s growth that are curtailed on a surface that is stepped on often. Various environments can now be read and interpreted based on the existence of particular plants. Different types of plant communities can be seen in certain land uses or different social structure of various neighbourhoods. This study revealed the roots of the landscape profession – the study of plants and the interaction thereof with people (Freytag in Girot 2016 :231). The spontaneous growth of vegetation in certain habitats can be seen in Figure 8, Page 21.

Kienast designed a ‘phytosociological’ garden as part of the Grun 80 Swiss exhibition. The didactic approach shows the dynamics of plants and the competitiveness that exist among them in order to gain sun, water and soil. Furthermore, he wanted to show the stages of succession which would express how Switzerland would appear without intervention. He also aimed in exposing the ‘image of nature’ held by Switzerland as alpine meadows – which are in fact intervened landscapes of production. It was opposing the rest of the aesthetical pleasing landscapes in the exhibition (Freytag in Girot 2016:232). In effect, Kienast revealed through his Phenomenological approach an ideology that plants always live in harmony – it is not always the case. The plants are in competition for the most sunlight, soil and water. By completely admonishing the tendency to design manicured gardens at the time, he revealed the truth about plants, but also the beauty in a natural landscape that is dependent on rain and snow and no irrigation.

Design application for the Cottesloe Gas Works

Mutualism is the symbiosis between things, indicating interconnectedness and interdependence rather than hierarchy.

In the area chosen for the sketchplan, details will be shown certain plant species thrive in specific habitats e.g. the junction between bricks on concrete edge and mycelium bricks allows for a shallow soil bed – only certain pioneer groundcovers will sprout. The mycelium bricks will degrade as the nature of the brick is to do and produce mushrooms which absorbs the soil vapor of old tar remnants and bricks. The shade from trees and mist from the water courses provides a microclimate for the mushrooms on the mounds to flourish whilst performing mycoremediation of contaminated soil. The mushrooms absorb the petroleum and heavy metals found within the soil.

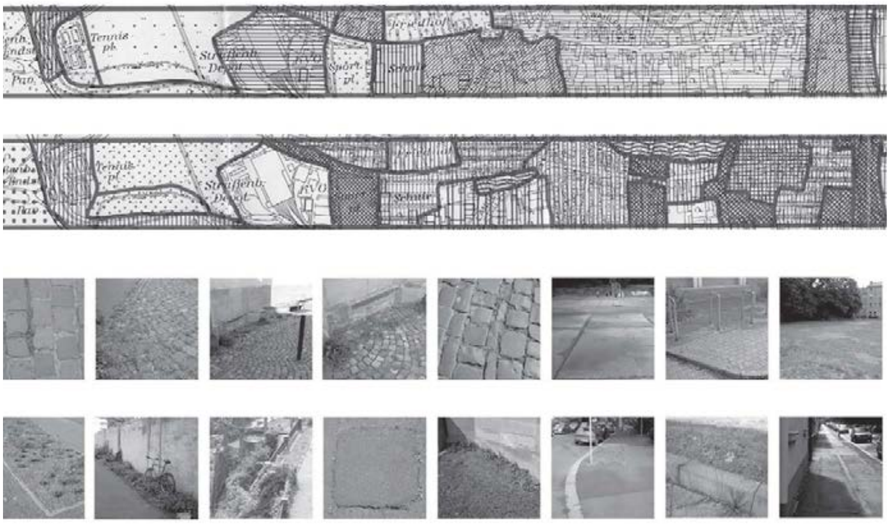
2.3 How can community identity (intangible) as (opposed to individualistic consumerism) be established as a “new” narrative through the landscape experience?

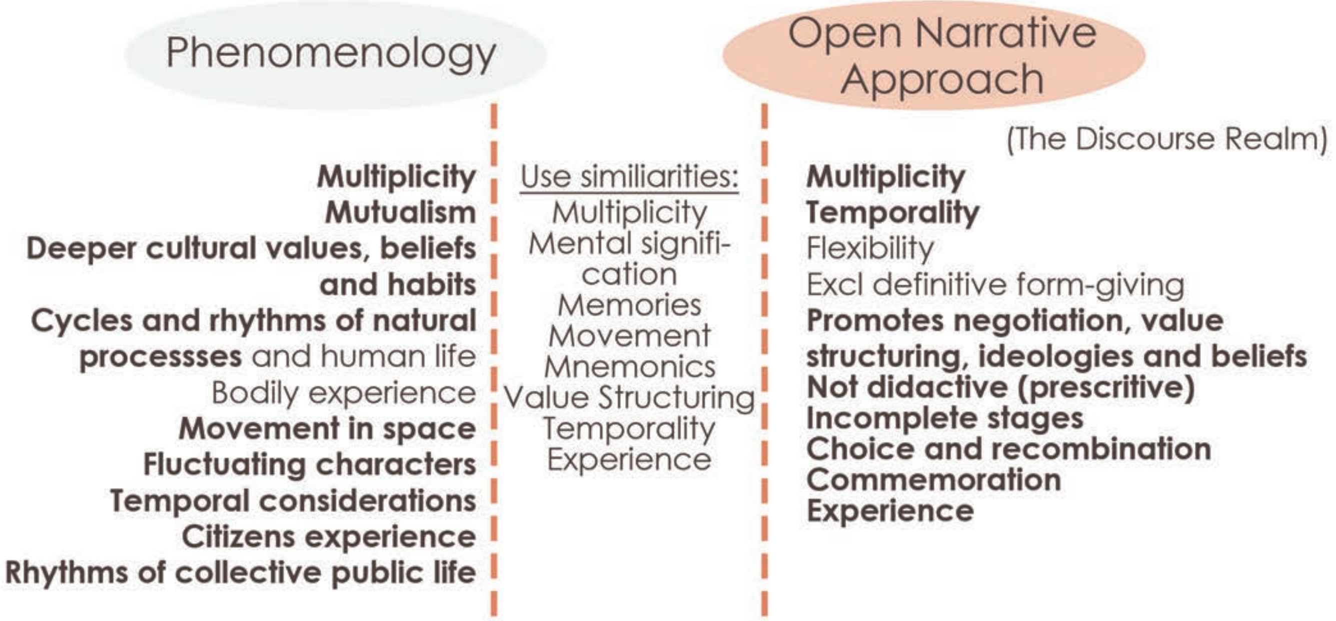
Consumerism (materialism) is the lifestyle depicted by acquiring goods and services. Individualism is an attribute to Western civilizations and is the antithesis to Eastern civilizations’ collectivism. Collectivism relates to the group as priority. With consumerism, the individual is placed at the centre instead of a community (Eckersley, Dixon, Douglas 2001: 57). Therefore, individualistic consumerism values the acquisition of goods and service to assure self-reliance and independence. This is mostly associated with the capitalistic system.

To the right, Figure 2.7. Stages of succession without intervention at Grun 80 (Freytag in Girot 2017: 233)

To the right in the middle, Figure 2.8. Habitat influencing plant species and growth (Freytag in Girot 2017: 232)

Bottom of page, Figure 2.9. Phenomenology and Open Narrative Principles overlap. (Author 2017)





Phenomenology

Multiplicity
Mutualism
Deeper cultural values, beliefs and habits
Cycles and rhythms of natural processses and human life
Bodily experience
Movement in space
Fluctuating characters
Temporal considerations
Citizens experience
Rhythms of collective public life

Use similiarities:
Multiplicity
Mental signification
Memories
Movement
Mnemonics
Value Structuring
Temporality
Experience

Open Narrative Approach
(The Discourse Realm)

Multiplicity
Temporality
Flexibility
Excl definitive form-giving
Promotes negotiation, value structuring, ideologies and beliefs
Not didactive (prescritive)
Incomplete stages
Choice and recombination
Commemoration
Experience

What is capitalism?

As per the Oxford Dictionary (2017), Capitalism is defined as: "An economic and political system in which a country's trade and industry are controlled by private owners for profit, rather than by the state."

The consequences of Capitalism are set out by Ecuadorian ecologist Esperanza Martinez (2013:12), which stated that: *"It has become clear over the last century that fossil fuels, the energy sources of capitalism, destroy life – from the territories where they are extracted to the oceans and the atmosphere that absorb the waste."*

It can be argued that Capitalism destroys life and the environment where the waste of fossil fuels is disposed. Coal is like a natural sponge; carbon is sequestered from plants and absorbs heavy metals and other substances in groundwater. When burned, winds carry it towards the ocean, from where we consume the fish which absorbed these substances, according to the Australian-born Environmentalist Tim Flannery (2010: 185).

It is claimed by Naomi Klein that an alternative worldview to Capitalism as well as different policy strategies should be in place to overcome our ecological crisis, it can be achieved through the following: ***"...interdependency rather than hyper-individualism, reciprocity rather than dominance, and cooperation rather than hierarchy'*** (Klein 2014: 462).

What values should be part of the landscape?

A people-centered way of visualizing public places entails the involvement of the local in planning and design which emphasise their collective, cultural and social importance to communities (PPS, 2015). Collective implies to favour the group over the individual and therefore collective memory will be dependent on identity and local culture. Commemorative sites are linked to collective memory (Dietze-Schirdewahn 2017:18)

Value could be given to the in-between spaces such as Berger (2006) explains "Industrial ruins/ waste landscapes (drosscape)" which are "an indicator of healthy urban growth" (Berger 2006: 1). These values are aimed at a broader cultural community and Rubió's 'terrain vague' theory - void spaces but filled with possibilities (Rubió 1995: 120). The 'terrain vague' theory states that abandoned industrial sites are artefacts of evolution and growth. Industrial ruins become relics that stems from urban evolution and change. Industrial ruins are part of "an open system whose planned complexity always entails unplanned dross" (Berger 2006: 44).

Interdependence
The dependence of two or more people or things on each other. (Dictionary.com)

Reciprocity
The practice of exchanging things with others for mutual benefit. (Dictionary.com)

Cooperation
The action or process of working together to the same end. (Dictionary.com)

What is community identity?

Gina Christie stated that "Community identity can be described as a sense of belonging and companionship where a group of people share a common interest or belief "(Christie 2009: 108). It is argued in her dissertation, that this identity is strengthened through relationships between individuals and further through events and the landscape is the channel.

Design application of community identity being the antidote to capitalist exploitation.

The ecological landscape of the Johannesburg Gas Works will have value in itself and treated in such way. It should not be overprogrammed but enhance community cohesion whilst serving an ecological function of water and soil purification.

Characteristics of a landscape built through anti-exploitation endeavours:

1. Spaces are planned to contain large green spaces for the mental and social well-being of humans.
2. Open and accessible spaces and amenities provided to the public.
3. Activities not primarily aimed to generate revenue; only for sustainability aimed primarily at the welfare and well-being of people.
4. Apply alternative water and soil purification strategies to remediate pollution in-situ. This treatment provides a precedent to pollution treatment which poses detrimental health impacts to the residents of Gauteng.
5. Parks are implemented for social and mental well-being.
6. To atone a once mutualistic relationship between nature and people.
7. Seating options for all.
8. Nature has intrinsic value in and for itself, not only for human use or well-being.

Where there is companionship a group shares a common interest or belief a unique space can be created where lower-, middle- and upper-class people can gather with a shared interest. By providing in the basic needs of the people a landscape can be created which forms a link toward reciprocity.

Community identity will be established on this polluted site, becoming another layer on top of a palimpsest industrial site which current narrative is individualistic consumerism. Community identity will become the glue between different income social groups. The re-use of the site will develop, serve and house different people. It is aimed at bringing cohesion where social divides exist toward interdependence and cooperation.

Activities proposed for this Park:

- **Leisure and recreation:** Open-air theatre; Picnic areas; seating areas; Open-air gym and children's play area.
- **Sports:** Swimming pools; Soccer field; Cricket pitches; Jogging trails; Cycling trails
- **Work opportunities:** Local jobs created at eco-textile plantations, Fresh produce markets (fish and oil) and Stitching workshops. Benches will be arranged in a manner that students or scholars can have a study area/ groupwork space.

In a park people have the opportunity to sit and read a book, arrange a birthday party or meet up with

Figure 2.10: Kokerei swimming pool (Pinterest 2017)

friends. Reliance and dependence on others are characteristic of communities that function well. Community identity can be enhanced through the expression of form-making in the landscape and certain programmes initiating participation as well as the expression of certain values.

Kokerei Zollverein, Essen, Germany.

OMA

Original use – former largest coal mine in Europe
Current use – Cultural landscape and other activities

Diverse programmes happens on the site such as: space for arts and entertainment; water basins that run along the ovens' batteries freeze that becomes an ice-skating facility; jogging and cycling trails and an open air swimming pool built from a container between the rustling ruins. During the winter months (Vollmer & Berke, 2010:96). As part of the master plan, a central axis is maintained along the railway between the coal mine and coking plant. Pedestrian walkways, cycling tracks and playgrounds are intertwined with this axis. Vegetation started to grow spontaneously between buildings and the serenity is interrupted by movement such as joggers (Merin 2014)

Users: Local people of Essen and international tourists

Aim: Sensible preservation and repurposing for new uses.

Value for project: The adaptability of post-industrial landscapes to be repurposed and new layers of memory to be created on it through community activities such as swimming, jogging, cycling etc.

Figure 2.11: Westergasfabriek aerial (Westergasfabriek, 2017

Cultuurpark Westergasfabriek, Amsterdam, The Netherlands.

Gustafson Porter

Original use – Gas Works
Current use – Cultural venue and city park

In 1967, the site was polluted after 82 years of coal to gas conversion on the site. In1992, the buildings were used temporarily for creative and cultural activities and since then entrepreneurs and artists have flocked to the site. The site was so suitable for the hosting of cultural events that it was later designated as a cultural zone. In 2003 the park opened hosting different amenities including: and the historic buildings used by creative entrepreneurs as work space, events, musical performances, markets and festivals. (Westergasfabriek 2016). The soil pollution is dealt with through cut and fill. It is done in such a way that the legacy that the gasworks left in the landscape is no longer evident (Margolis & Robinson 2007:118)
People can also take part in activities such as fencing, yoga, jogging and cycling.

Users: City of Amsterdam and International tourists

Aim: Activities for the community for everyday living and also a prominent cultural venue.

Value for project: Strategic soil placement. The events held at post-industrial landscapes serves to improve community cohesion. Pollution should not be dealt in a way too seamless that the legacy left by the industry on the site is lost.

Community identity and cohesion are further strengthened through:

- Amenities in close relation to each other allowing surplus time not spent on traveling.
- Programmes that allow knowledge and skills transfer - users engage in work that benefit themselves and their community such as stitching workshops.
- Educational information such as outdoor library.
- Opportunity for social network building (Amenities and enough seating options)
- Create different plazas and spaces for recreation and events to happen.

The site will not be put in place through exploitative endeavours but through Private- Public partnerships. Such state departments that value the environment are Johannesburg City Parks, Johannesburg Development Agency (JDA), Department of Environment (DEA), Department of Water and Sanitation (DWS). Earth Keeper which is a Non-Governmental Organisation that raises environmental awareness and facilitate environmental responsibility and action. The former owners of the site: Johannesburg City Power (Egoli Gas), could also contribute to the measures put in place to remediate the environmental damage.

It will not be possible to build the park without money/capital but not all capital derives from exploitation. The project has the potential to show how this can be overcome. The open narrative approach will be used so that the anti-exploitation narrative can be opened up in order to question exploitation and raise awareness of the detrimental effects it may pose on human health and the environment.

2.4 What is natural restoration (tangible) and how is it achieved?

a. How can soil and water pollution be resolved?

Natural or ecological restoration can be defined as the *"process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed"* (SER Primer 2004:3).

The nine attributes of restored ecosystems according to the Society of Ecological Restoration are the following: 1. Characteristic grouping of the naturally occurring species; 2. Mostly indigenous species with allowance for some invasive species; 3. All functional group species should be present; 4. Physical environment should be able to sustain the species; 5. The eco-system functions according to developmental stage; 6. Should be integrated into larger landscape; 7. Potential threats to systems integrity should be reduced; 8. System is resilient to adapt to periodic stress; 9. Functioning, structure and biodiversity may fluctuate as natural systems do. (SER Primer 2004:3).

Multiple interpretations of what nature is, should co-exist when the restoration is applied (Clemmensen 2014:55). The past should be imagined to recall the future (Clemmensen 2014:58).
According to Descombes (2012), Hunt's theory also classifies "the garden" as a vital place of reflection, questioning, and uncertainty concerning the relationship between the world-given and the world-transformed, a place that signifies, simulates, and exposes what we are doing to the world-given. This can be part of the Open Narrative.

a. Design application how soil and water pollution will be resolved.

Soil pollution at the site can be differentiated in terms of highly contaminated zones and general contamination. The highly contaminated zones contain the following organic PAH contaminants amongst others: Benzo(a)pyrene; Benzo fluoranthene; Chrysene; Benz(a)anthecene, Naphthalene and Pyrene (Georem 2011:12). General contamination can be classified as tar residues in the soil and housekeeping issues and can be treated by applying Phytotechnologies. It is proposed that the soil of the highly-contaminated zones up to 3m deep will be excavated and form a steeply graded mount. The soil stabilisation mat phytotechnology will be applied to stabilise the soil until the microclimate has been established for mycoremediation. The landscape will be shaped to assist in ecological functions. These zones can be re-purposed by filling it with building rubble and incorporating remnants of the holes as part of the design as places to experience the amount of contamination. The (former) highly contaminated and less contaminated areas should be treated by addition of compost, saw dust, sewage sludge and important it needs to be aerated and watered (Way 2013: 35). Biomass, leaf litter and fly ash can be added to raise the pH level as done at the Seattle Gas Works designed by Richard Haag Associates (Way 2013: 35). The less contaminated zones will require 12-15 years of plant succession before the pollutants will have decomposed entirely.

According to the GeoRem Report (2006), the groundwater is polluted with organic and inorganic contaminants. The valences and the concentrations of the heavy metals are unknown and therefore it is proposed that the system will be designed to remove a general level of inorganic contaminants (which are usually found in drinking water – it can become hazardous when certain concentrations are exceeded). Inorganic contaminants found during the borehole tests are the following: chloride, sulphate, manganese, magnesium and sodium with metals including

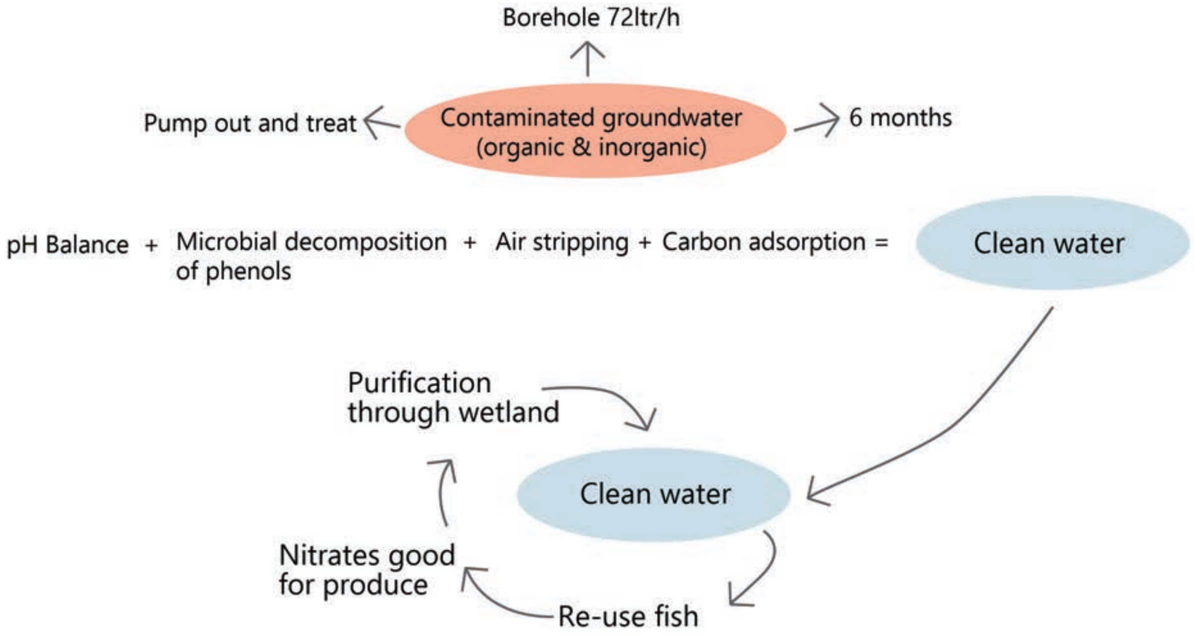


Figure 2.12. Contaminated water purification process (Author, 2017)

iron, chrome, copper and nickel (Georem 2006: 4). The organic contaminants: phenols have become mobile and moved into the water (Infotox 2011: 6). The other semi-volatile substances have a higher molecular mass and therefore are rather found in the soil than in the water (Infotox 2011: 9). As part of the purification system it is proposed that there will be made for provision for other semi-volatile substances which may have become mobile. The stages the water proposed to go through are as follows: pH adjustment (limestone to higher the pH level for heavy metals to oxidise); Microbial decomposition of phenols through fungi; Air stripping (fountain to aerate water); biological treatment (terraces and plants to remove the residue or organic components); carbon adsorption (activated carbon woven cloth to remove the rest of the phenols and other possible organic components), see Figure 13, Page 25. It is imperative to divert rainwater to not overflow the system according to Vlok (2017).

The design application is discussed in detail in Chapter 6.

2.5 Conclusion

The Cottesloe Gas Works holds aesthetic, architectural, historical, social and technological value and is the only remaining Gas Works in South Africa. It is unique and should be integrated into the surrounding community to become a place with a new inclusive narrative by the applying the principles of co-presence, interaction, interlocking understandings and practices.

As part of the Open Narrative approach the following principles will be applied in the design: multiplicity, temporality, recuperation of site specifics, value structuring, experience, incomplete stages and a sequence of movement, see Figure 9, Page 21. Three realities/ narratives will be used from where the tangible and intangible can be experienced: a lower, in-between and upper reality with increasing transience, see Figure 3, Page 10.

In collectivism cultures interdependence, reciprocity and cooperation were harbored, but during the industrial capitalism era these values changed to individual consumerism which lead to exploitation where one species benefits over the other. It is proposed that this design will be characteristic of anti-exploitation endeavours. It will be open and accessible to the public with large green recreational spaces that promotes mental, social and environmental well-being. Community and identity and cohesion will be strengthened through proposed activities/programmes. Natural restoration will involve the public and will be experienced in incomplete stages by the visitor.

With the application of natural restoration, multiple interpretations of what nature is will co-exist. There will be three different planting strategies applied in the Master Plan area, suited to te specific conditions and habitats. The landscape will be a place of reflection between the world-given and the world-transformed, exposing what we are doing in the world-given by lifting the highly contaminated soil (mainly to prevent the soil from leaching further) and stockpiling it into mounds which will form part of the remediation process. The user will be aware of these mounds and the effect that exploitation may have. The process of natural restoration will also form part of the experience and a new inscribed narrative.

CHAPTER THREE

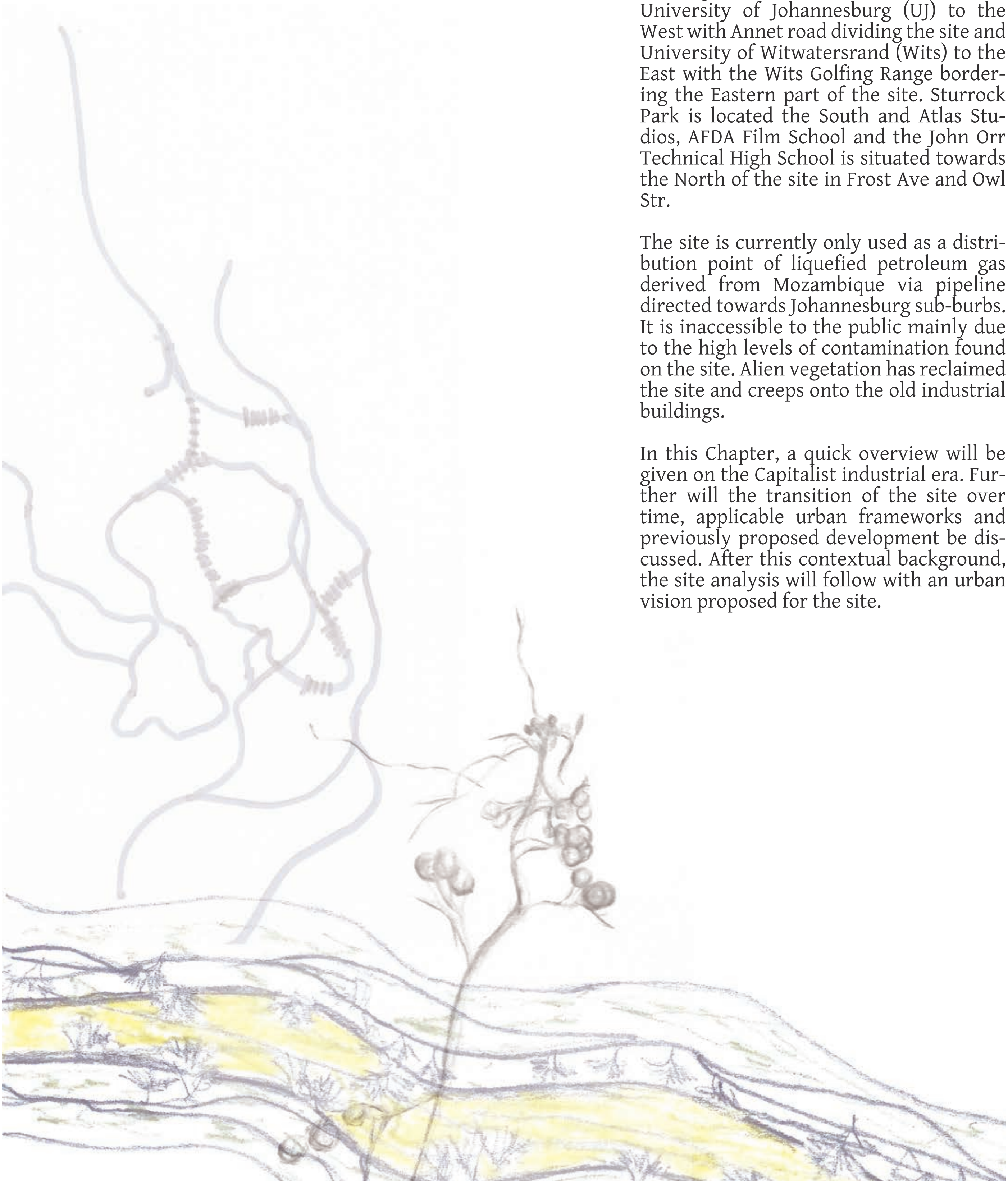
Context, history, site analysis and urban vision

Chapter overview

The study area is located in Cottesloe which is found within the CBD of Johannesburg. The site is situated between the University of Johannesburg (UJ) to the West with Annet road dividing the site and University of Witwatersrand (Wits) to the East with the Wits Golfing Range bordering the Eastern part of the site. Sturrock Park is located the South and Atlas Studios, AFDA Film School and the John Orr Technical High School is situated towards the North of the site in Frost Ave and Owl Str.

The site is currently only used as a distribution point of liquefied petroleum gas derived from Mozambique via pipeline directed towards Johannesburg sub-burbs. It is inaccessible to the public mainly due to the high levels of contamination found on the site. Alien vegetation has reclaimed the site and creeps onto the old industrial buildings.

In this Chapter, a quick overview will be given on the Capitalist industrial era. Further will the transition of the site over time, applicable urban frameworks and previously proposed development be discussed. After this contextual background, the site analysis will follow with an urban vision proposed for the site.



3.1 Urban analysis

3.1.1Context

The Johannesburg Gasworks is situated in Johannesburg within the Witwatersrand belt of integration between the University of Johannesburg and the University of Witwatersrand.

The site is surrounded by research institutions, film and medical industries. The residential areas also consist of varying income groups. The site falls within the Millpark Knowledge Precinct and has the potential to become a future regional node as stated by the Empire-Perth Corridors of Freedom.

3.1.2 Historical

Capitalist industrialisation changed the dynamics in our society and geopolitics. This Gasworks typology was a “mono-functional factory-type” built across the British Empire in this era.
Operations commenced from 1928 to closure in 1992. As a result of the coal to gas conversion plant, a legacy is left in the landscape in the form of soil and water pollution. This includes undissolved tar-like liquids are also known as a dense non-aqueous phase liquid (DNAPL).

The additions to the Cottesloe Gas Works can be seen since its inception in 1929 to the current state. In Figure 3, the delineation of the underground Braamfontein Spruit running South to North can be seen as well as the railway tracks entering the site from the Southern side that brought the coal to Retort no. 1. The railway tracks has been removed after the functionality for it did not exist anymore. The Tar Distillation Plant addition to the Gas Works can be seen in Figure 4. The tar was heaped into mounds as seen in Figure 11, Page 30.

The existing and demolished buildings on-site are depicted in Figure 12 (Tarushin). After the closing of the plant, some structures were removed and the valuable structures of heritage significance were retained. The existing site with creeping vegetation predominantly from the Eastern side of the site can be seen in Figure 13. The building lines that are dashed in this figure are buildings that do not contain heritage significance and therefore has been demolished as part of the urban vision, which is discussed in more detail under 3.2 in this Chapter.

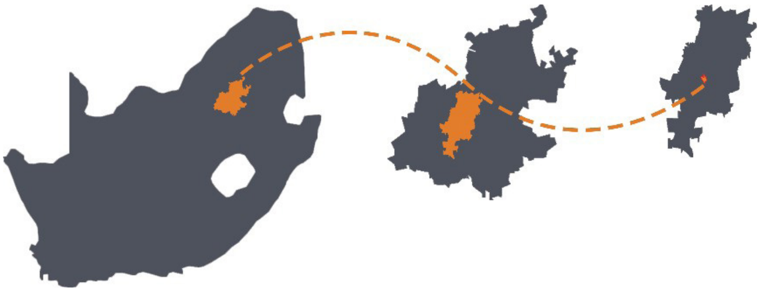


Figure 3.1. Macro context (Author, 2017)

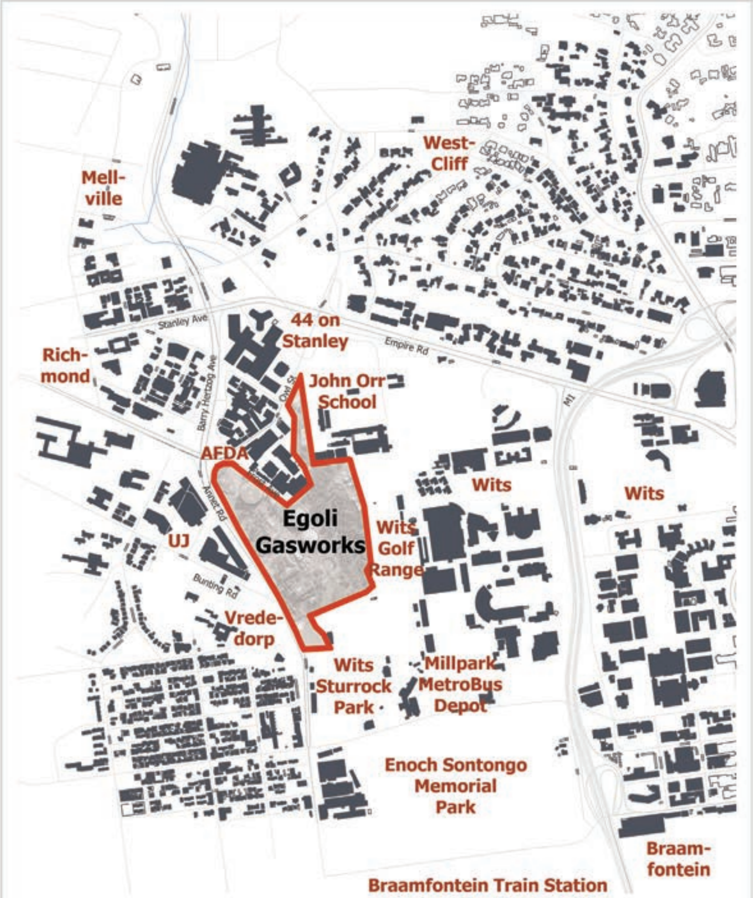
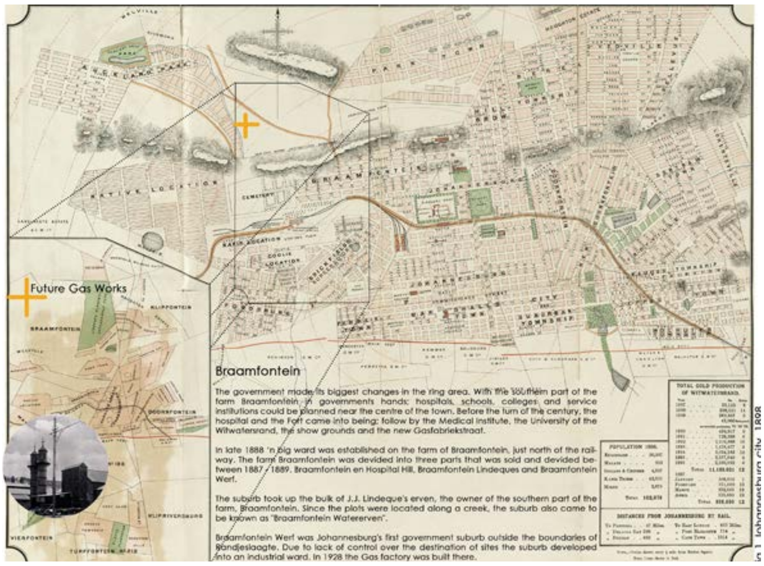


Figure 3.2. Site locality (Author, 2017)



Braamfontein

The government made its biggest changes in the ring area. With the southern part of the farm Braamfontein in governments hands: hospitals, schools, colleges and service institutions could be planned near the centre of the town. Before the turn of the century, the hospital and the Fort came into being: follow by the Medical Institute, the University of the Witwatersrand, the show grounds and the new Gasfabriekstraat.

In late 1888 'n big ward was established on the farm of Braamfontein, just north of the railway. The farm Braamfontein was devided into three parts that was sold and devided between 1887 / 1889. Braamfontein en Hospital Hill, Braamfontein Lindeques and Braamfontein Werf.

The suburb took up the bulk of J.J. Lindeque's erven, the owner of the southern part of the farm, Braamfontein. Since the plots were located along a creek, the suburb also came to be known as "Braamfontein Watererven".

Braamfontein Werf was Johannesburg's first government suburb outside the boundaries of Randjeslaagte. Due to lack of control over the destination of sites the suburb developed into an industrial ward. In 1928 the Gas factory was built there.

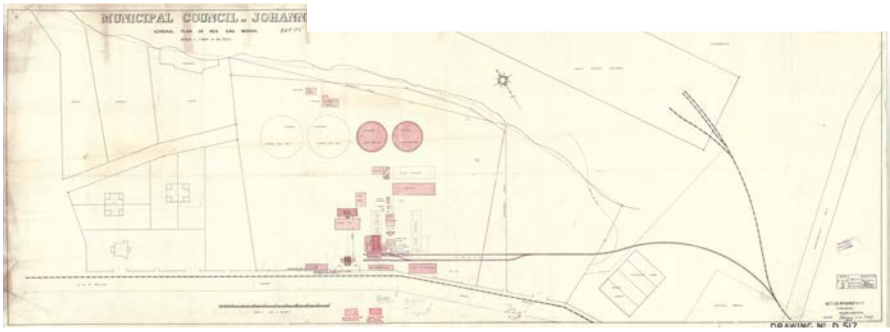
Figure 3.3. Origins of Johannesburg city and Braamfontein, 1898

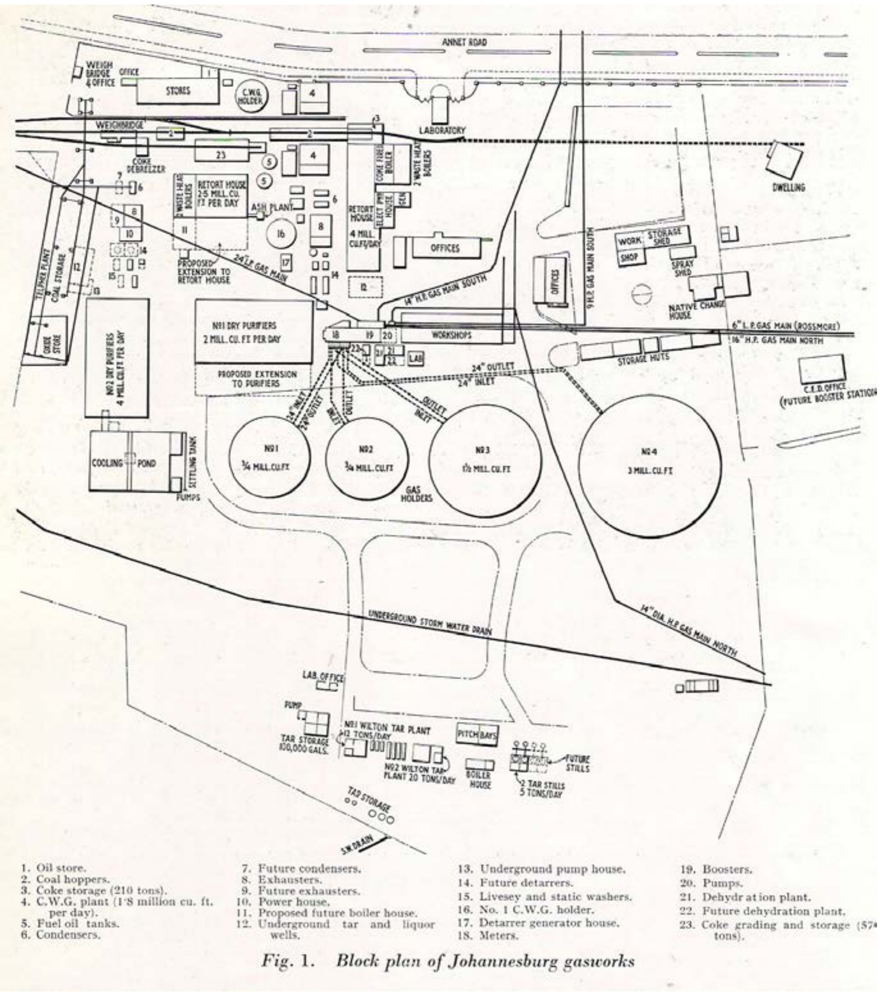
Cottesloe Gas Works transition over time

Figure 3.4. General site plan D517 of the Gas Works, 1927

Figure 3.5. Gas Works site plan, 1954 (Coke and Gas Reprint, 1953-4)

Figure 3.6. Built structure timeline (Groupwork 2017)





Aerial photographs

Figure 3.7. Aerial view on Gas Works, 1953 (Finsen 1953)

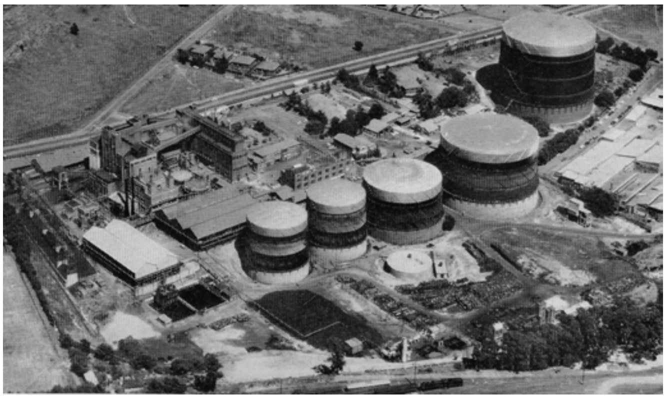


Figure 3.8. Aerial view on Gas Works, 1959 (Finsen 1959)

Figure 3.9. Aerial view on Gas Works, 1990s (Finsen 1990s)

Figure 3.10. Aerial view on Gas Works, 2009 (Finsen 2009)

Figure 3.11. View on tar distillation Plant, 1950 (Finsen 1950)

Demolished and existing structures

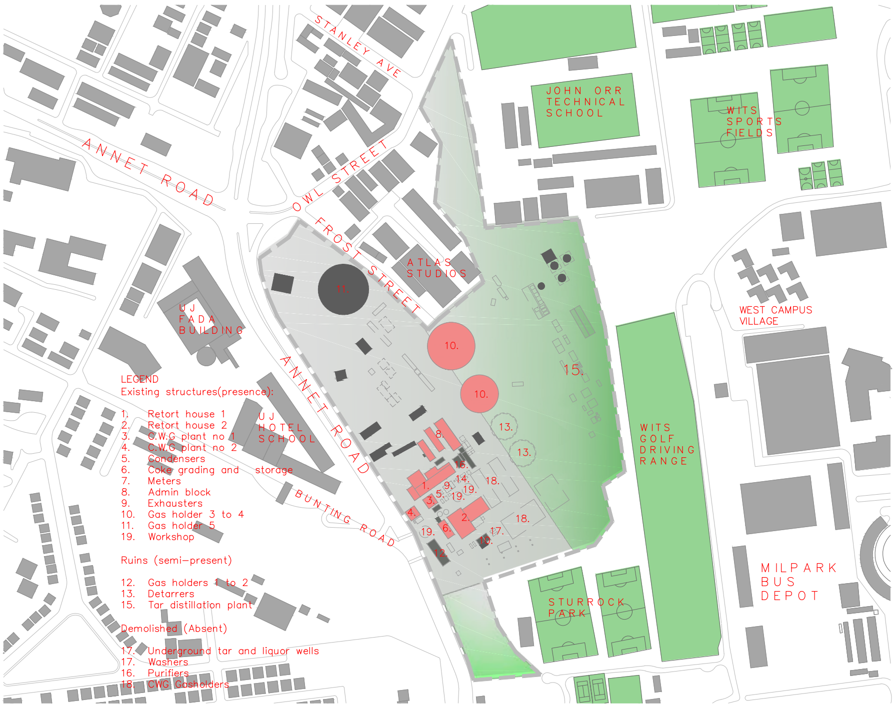


Figure 3.12. Existing and demolished buildings (Tarushin, 2010)

Figure 3.13. Existing site (Groupwork, 2017)

3.1.3 Physical

The open spaces surrounding the site are mostly privatised and is inaccessible to the public. See Figure 15. Public access should be provided for the proposed public park. Annet Str is categorised under the same class as Empire Rd, which is a high order Class 2 Rd according to the City of Johannesburg Complete Streets Design Guideline. Pedestrian walkways and cycling lanes should be accommodated with variable standards and the public transport should be of a high standard for Class 2 roads. Pedestrian crossings are very dangerous over the busy Annette Rd, therefore a pedestrian bridge is proposed from the University of Johannesburg's side. A Traffic light with a pedestrian crossing should also be provided. The road reserve proposed in Figure 17 for Anett Rd, has been adapted from the Complete Streets Design Guideline mentioned above.

The Old Johannesburg Gas Works has been a producer of gas and other useful by-products such as liquid ammonium for gardens, coke and tar, but is derelict and polluted now. It is time to bring energy back onto the site.

3.1.4 Political: Frameworks

The site is a tertiary open space (heritage and prospective open space) and should link the surrounding secondary institutional open spaces. JMOSS prioritizes this as high priority. GAPP Architects and Urban Designers proposed a mixed-use node in 2010 which is still pending.

Johannesburg Spatial Development Framework (SDF)

The vision of the SDF 2040 is to address spatial inequality and steer future development. By doing this a more liveable, productive and equitable city is created (City of Johannesburg: Department of Development & Planning, 2016:8).

"Therefore, the spatial vision envisaged by the SDF 2040 for Johannesburg is a compact polycentric city with a dense urban core linked by efficient public transport networks to dense, mixed use, complimentary sub-centres, situated within a protected and integrated natural environment." (City of Johannesburg: Department of Development Planning, 2016:18). The city of Johannesburg has the potential to

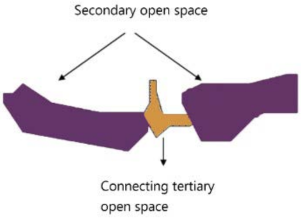


Figure 3.17. Connecting tertiary open space (Author 2017).

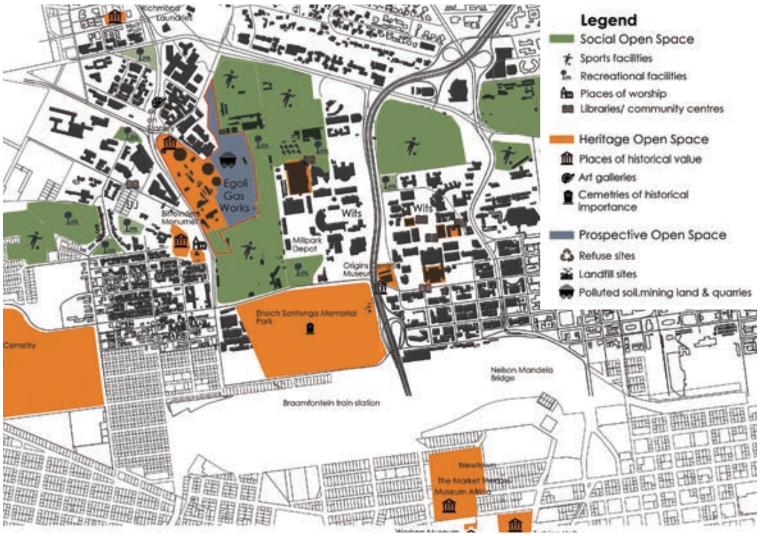


Figure 3.14. Social, heritage and prospective Open spaces (Author, 2017).

Figure 3.15. Public transportation routes and stops (Groupwork 2017).

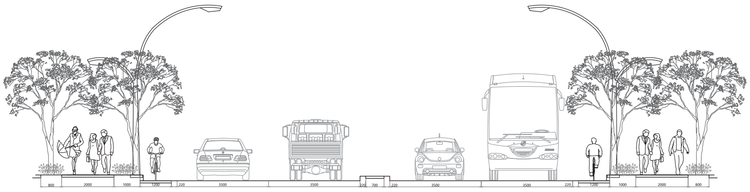


Figure 3.16. Proposed road reserve (Author, 2017).

Figure 3.18. Polycentric, inverted polycentric and compact polycentric city model (Groupwork, 2017).

Figure 3.19. Height Zones proposed for the Milpark Precinct (JDA n.d:87).

Figure 3.20. Concept Framework (JDA n.d:87).

Figure 3.21. Strategic Area Framework for the Empire-Perth Development Corridor (JDA n.d:88).

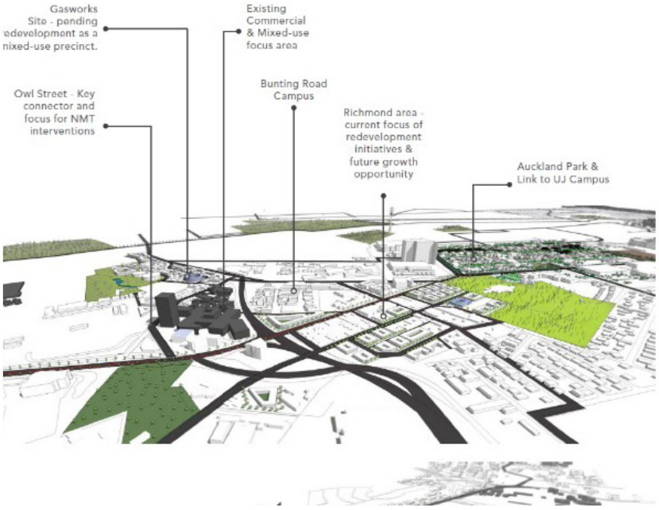
transform from an inverted polycentric model to a compact polycentric city. The Johannesburg Gas Works situated within a medical and institutional belt, is seen to potentially become a complimentary sub-centre/ mixed-use node with effective public transport links. In this model people stay closer to work opportunities, not spending time on commuting which implies more time for the people. Activities and programmes to enhance this multiplicity should be promoted, see Figure 19,Page 32.

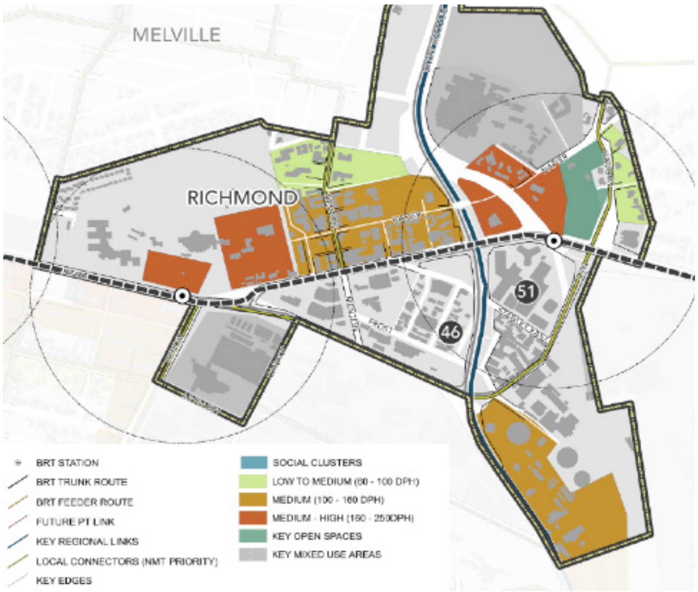
The Environmental Planning and Management Department of CoJ collaborated with Johannesburg City Parks to compile a Metropolitan Open Space System in recognition of the rapid loss of the city's open space resources. SEF was involved with this process (SEF 2002:1).

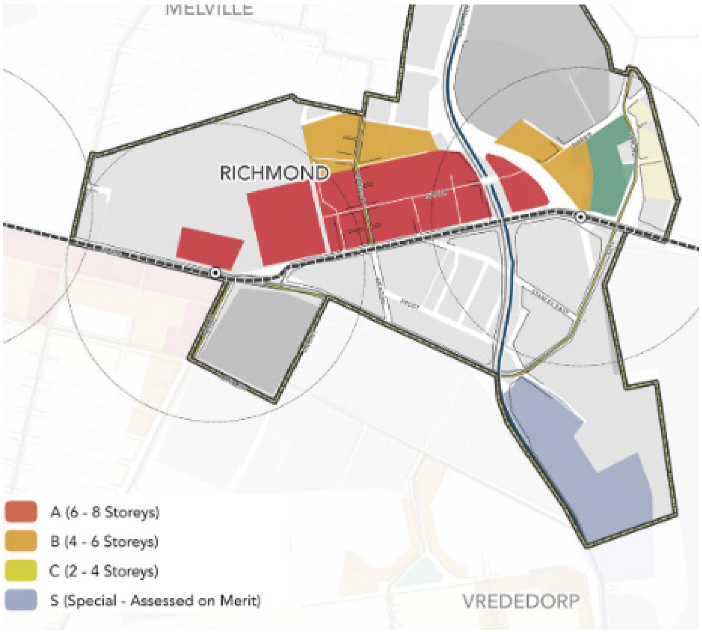
Secondary Open Space Secondary open spaces consist of heritage, institutional and agricultural spaces. a) Connecting secondary open space. The link between two secondary open spaces is performed by a connecting tertiary open spaces and JMOSS prioritizes this as high (SEF 2002:35,36). The site is situated between two institutional spaces and could therefore act as the connecting tertiary open space.

Corridors of Freedom Empire-Perth
The Corridors of Freedom is an initiative of the City of Johannesburg: group Communication and Tourism Department. It aims to re-stitch the city to link people to their jobs by means of transit-orientated development e.g. Rea Vaya enables fast and affordable mobility along corridors. The study area falls within the Millpark Precinct. "The Milpark/Richmond Local Area represents a key opportunity for the development of a major mixed use activity node." see Figure 21, Page 33 (JDA n.d: 86).

The Gasworks redevelopment should be considered as a "strategic catalytic project" to the Millpark Precinct. Implementation of pedestrian and cycling routes to link the Gasworks with 44 on Stanley to







the BRT route is a specific proposed project (JDA n.d: 87). The City of Johannesburg complete street guidelines have been followed in order to propose this around the Johannesburg Gas Works and to link the site through Owl Str. Medium density mixed-use activities are proposed for the site such as: Residential, Commercial, Start-up businesses, niche retail, Butterfly sanctuary, Aquaculture, Energy Research Laboratory which entails education and implementation of sustainable energy sources, Aromatic herb oil production and Eco-Textile mills and a public park hosting events and most importantly purification of the contaminated soil and water.

GAPP Framework (2010)

The mixed-use development is still pending. Sound urban design principles have been applied. However, the remnants in the landscape has not been retained neither the legacy that industry left in the landscape. Buildings have been placed over two of the former gas tank foundations and cooling ponds. Not many activities to enhance the community identity in the landscape can be seen on this level of planning.

Figure 3.22. View from west onto development (GAPP 2010: 36)

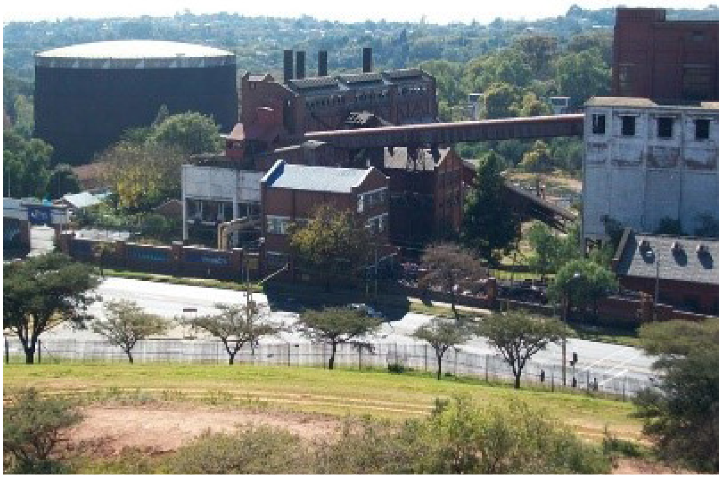
Figure 3.23. GAPP urban vision (GAPP 2010:34).

Figure 3.24. Weighbridge (Author 2017)

Figure 3.25. Site view from UJ (Lauferts, 2010).

Figure 3.26. Retort 1 (Author, 2017).

Figure 3.27. Gasholder No.4 and 5 (Author, 2017).



3.2 Site Analysis

As seen in the Figure 27, Alien invasive species revegetated the derelict site. The mutation nature created in between the hard surfaces surrounding the structuresiscan be clearly seen.

The Braamfontein Spruit runs 1.5m underneath the site with a concrete channelised storm water link and is not currently contaminated, see Figure 36, Page 39.

The heavily contaminated soil is indicated in red and general contamination in blue. The boreholes with the most organic and inorganic contamination are found at SRK 1,2 and 3 in the plant area. Boreholes GCS 2, SRK 5 and 6 also showed varying results that indicates contamination, see Figure 35, Page 38.

Various pedestrian movement is found in the areas of the Owl-, Frost- and Annet Street entrances consisting of students, scholars, public transport users and workers.

The topography of the site in the valley are allows the water to move from a Southerly to a Northerly direction. Drainage will flow from West (Annet Str) to East to the Valley and from East (Wits) to West to the valley area.

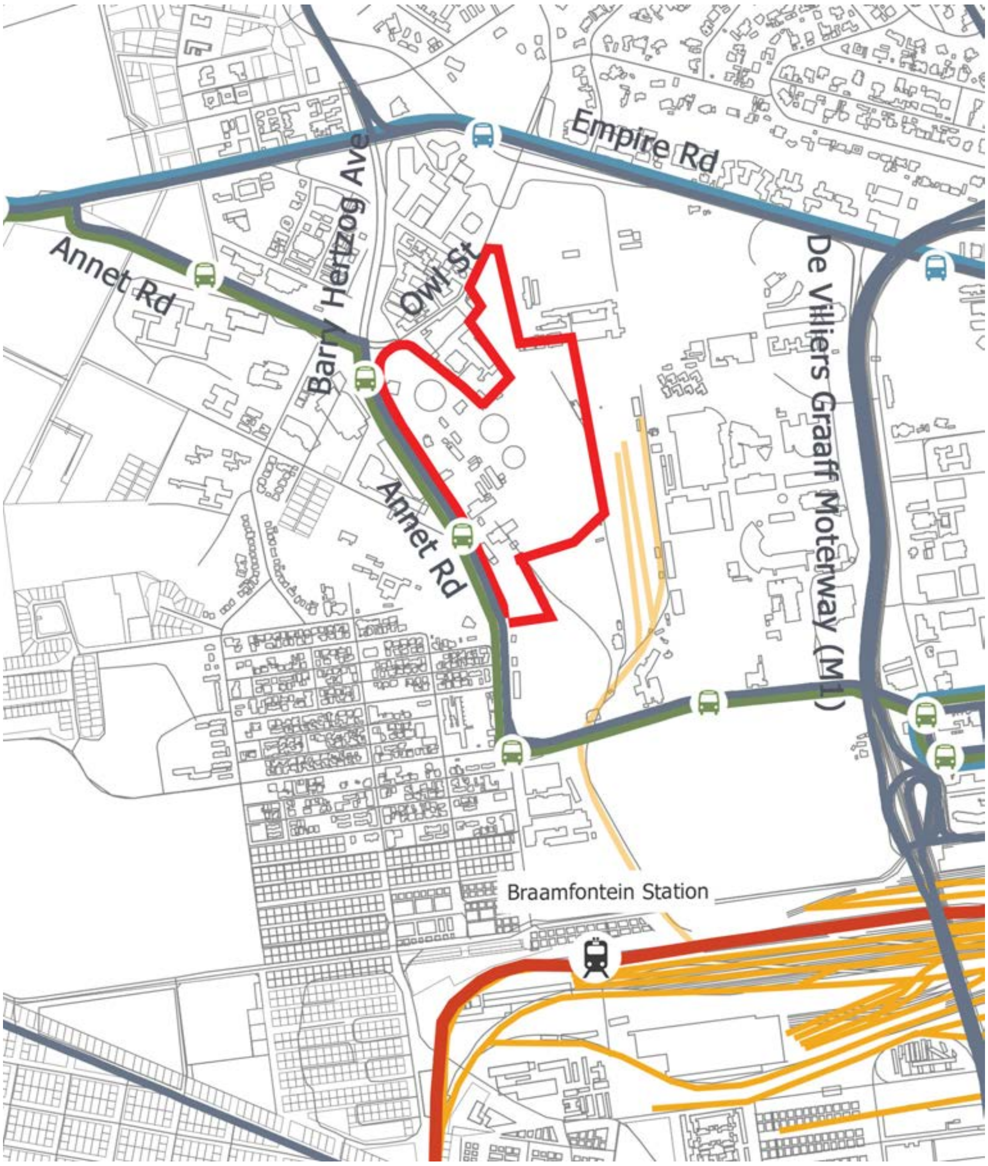


Figure 3.28. Public transport routes surrounding the site (Groupwork, 2017).

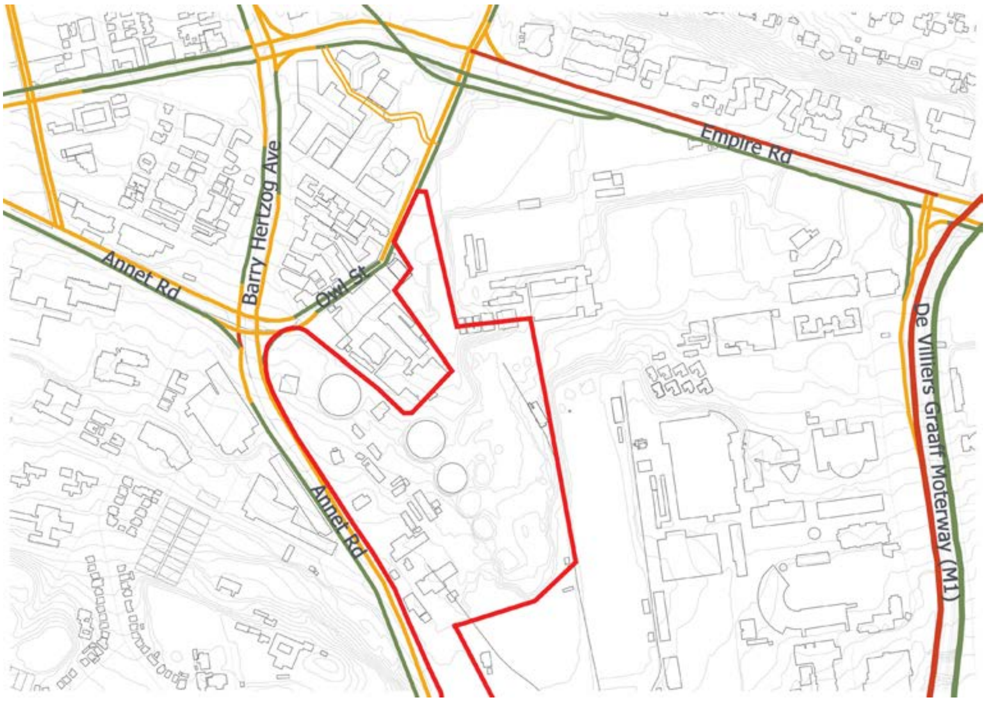


Figure 3.29. Peak hours vehicular movement (Groupwork, 2017).

Predominantly NNW wind direction

Figure 3.30. Soweto Highveld Grassland Vegetation Unit (Author, 2017).

Figure 3.31. Underlying geology: Basalt and shale (Author, 2017).

3.2.2 Photographs of detrimental impacts on human health and the environment

The detrimental impacts of human health and the environment are visible where the soil profile is infiltrated with coal tar liquid. Coal tar was buried with the decommissioning of the plant. Fuel gases were inhaled by workers and safety masks were not provided or encouraged, see Figure 32, Page 40 and Figure33, Page 41.

3.2.3 SWOT Analysis

Strengths

- The site's locality is found within the Empire-Perth Corridors of Freedom as enacted by JDA and CoJ. This aims to provide a pedestrian and cyclist linkage through the site which meets with the BRT rout on Empire Rd.
- The heritage significance of the site is very unique and can be preserved through remediation and proposed programmes to re-appropriate the structures.
- The site is situated in a very important node within the CBD of Johannesburg and surrounded with varying income group residential areas. This site can provide a link and greatly contribute to community cohesion.

Weaknesses

- Care and planning should prevent the entire site to be built upon and should still integrate with the community's recreational needs.
- The site is contaminated with carcinogenic compounds and releases soil vapours. It also produces a migrating leachate plume, which can be stopped with phytoremediation technologies. The soil quality can be enhanced engaging the public to give composting materials. Through the use of degrading mycelium bricks, the mushrooms can absorb the soil vapours released by old materials found on-site. The groundwater can be pumped and treated within the landscape.
- The site is inaccessible and has only two entrances. Better accessibility with parking areas to the North and South can be provided with occasional perforation points along with a pedestrian bridge

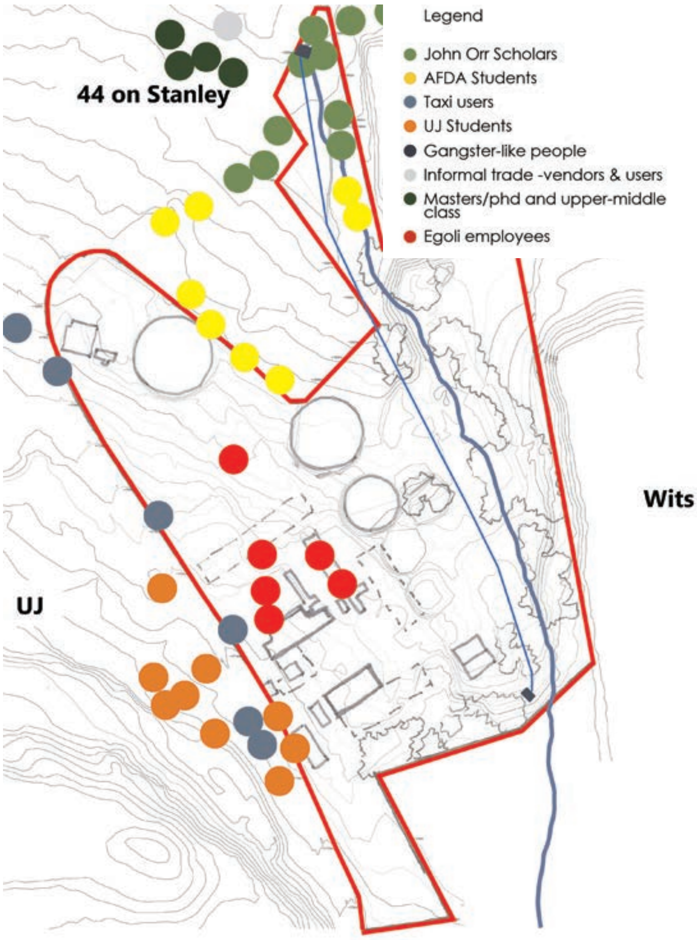


Figure 3.32. Pedestrian movement (Author, 2017).

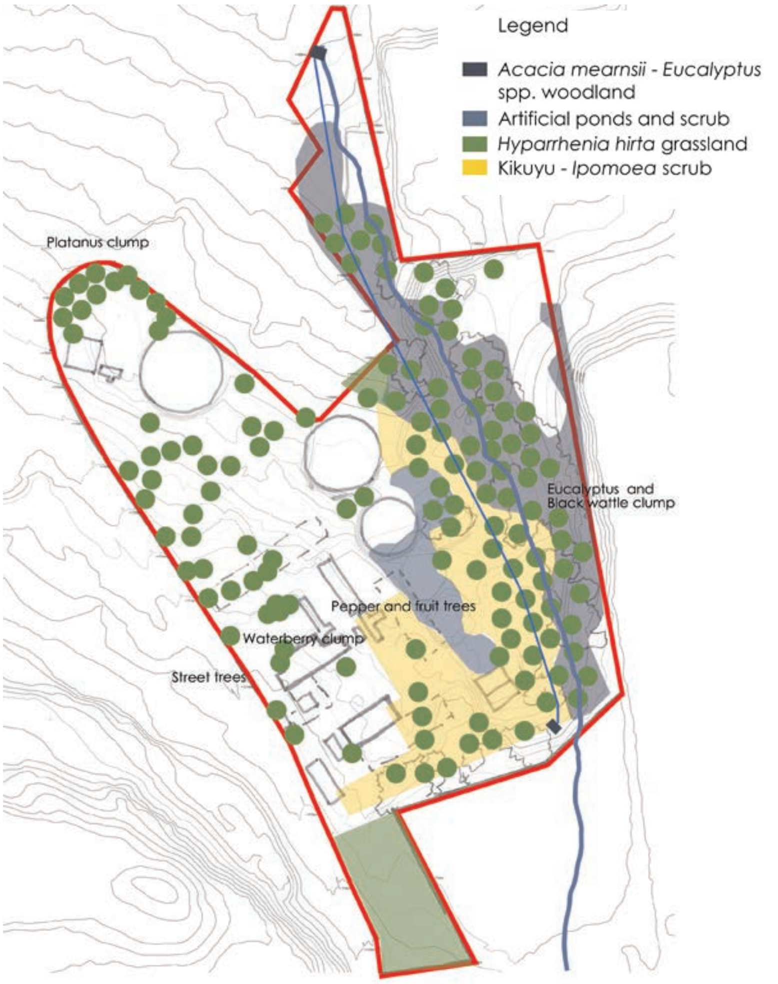


Figure 3.33. Existing site vegetation Author, 2017).

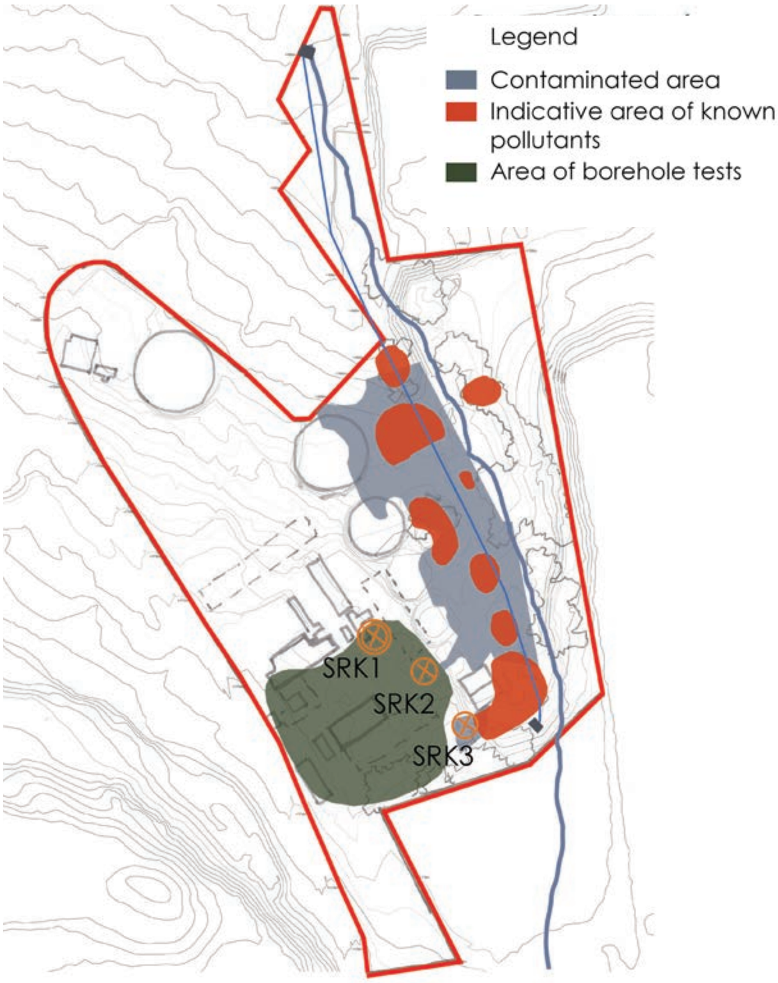


Figure 3.34. Areas of soil contamination Author, 2017).

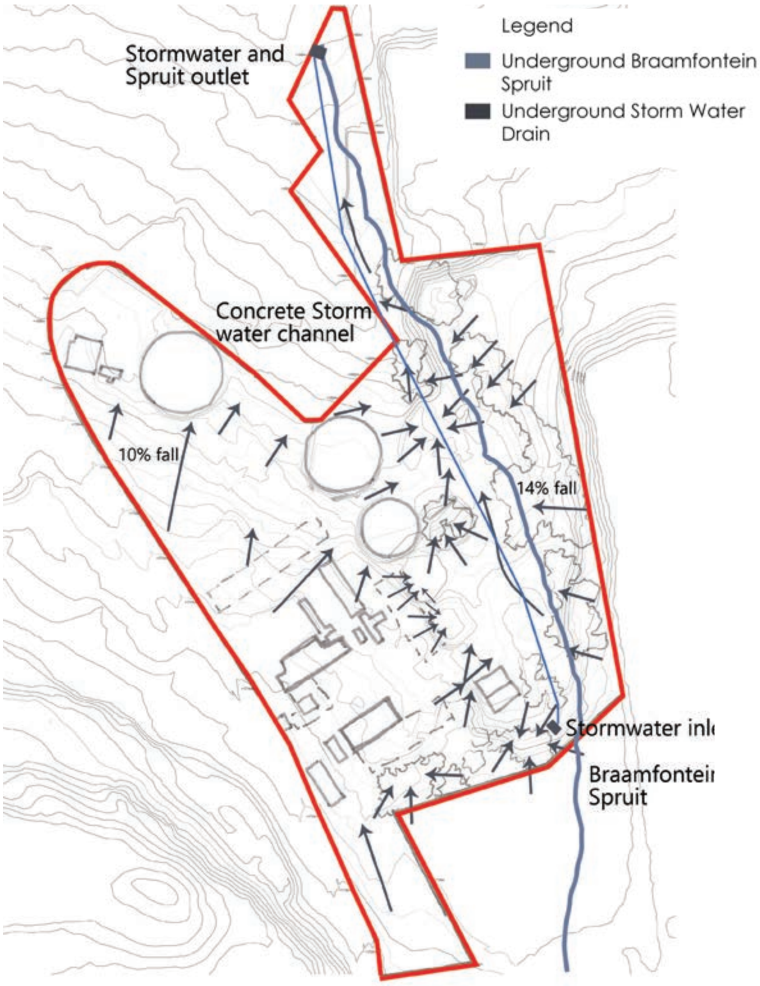
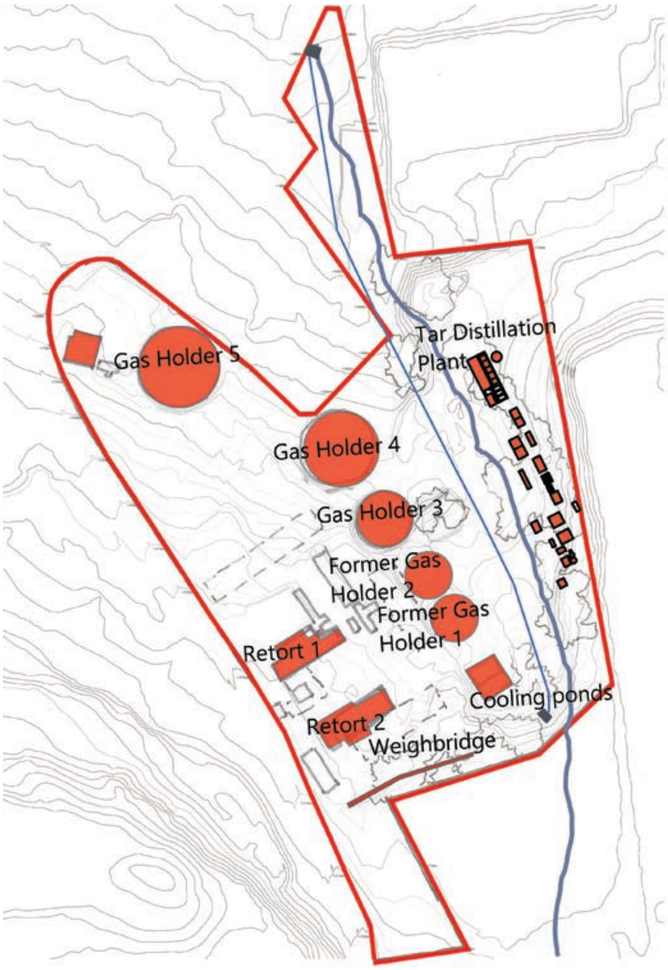


Figure 3.35. Water and drainage Author, 2017).

Figure 3.36. Heritage importance (Author, 2017).



over Annet Rd and from the Wits Golfing range to link the site to the surrounding Universities.

- The alien invasive plants should be eradicated before soil tilling starts in Phase 1 and be sent to a toxic waste facility, where the plants will be incinerated and the metals be re-sold to the metal industry.

Opportunities

- The site can showcase how pollution can be dealt with on-site and become a narrative of the effects of exploitation on the environment.
- The site is unplanned with some historical remnants which may aid in the storytelling of the past. With the re-purposing, it can become part of a new narrative.
- The view of the old industrial building and gas holders form a beautiful backdrop to the Park.
- Many studies have been performed as part of the previous proposed development to determine the soil factors on the site.
- Earth Keeper, a NGO can facilitate the process of natural restoration.

Threats

- The remediation workers should wear the applicable PPE as safety measure to prevent contamination from soil.
- Visitors may want to enter certain areas of the site in early stages. Pathways need to take people around the site and balustrades along pathways can prevent people from entering polluted areas not yet remediated.
- Rainwater falling on the polluted soil areas should be allowed to infiltrate to the groundwater and not be harvested for re-use as it may become contaminated on soil-contact. Care should be taken when planning the systems of the site to ensure healthy areas for people.
- Water bodies and courses on the site may become contaminated and needs to be outlined with the applicable sealing technologies.

The strengths and opportunities are assets to the project, however the negative aspects such as the weaknesses and threats will be addressed in a manner that it transform it into positive design possibilities.

Figure 3.37. Soil pollution (Lauferts: 2010)

Figure 3.38. Polluted contained water (Author, 2017)

Figure 3.39. Rubble and tar piled on-site (Author, 2017)

Below, Figure 3.40. Discharging coke from coke chambers (Finsen 1970's)

Figure 3.41.Positioning hopper without full PPE (FInsen, 1970's)

3.3 Urban Vision for the Cottesloe Gas Works

The urban vision for the site is a restitutive park. Giving back to the site for all the years it provided the city with gas, ammonium for gardens and tar for Johannesburg roads. Four architectural programmes are depicted by the urban vision, namely: Energy Research Laboratory, Aromatic herb oil, Eco-Textile Emporium and Aquaculture. The landscape intervention will tie in with the strengthening of community identity and water purification.

Restitution noun l res•ti•tu•tion l : an act of restoring (Merriam-Webster 2017) : act of giving

Relationships zoned on-site

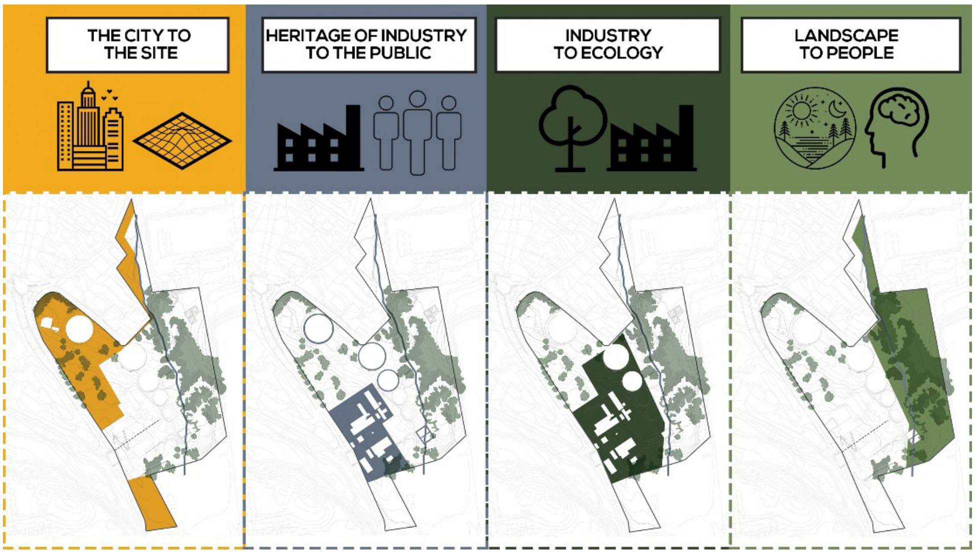
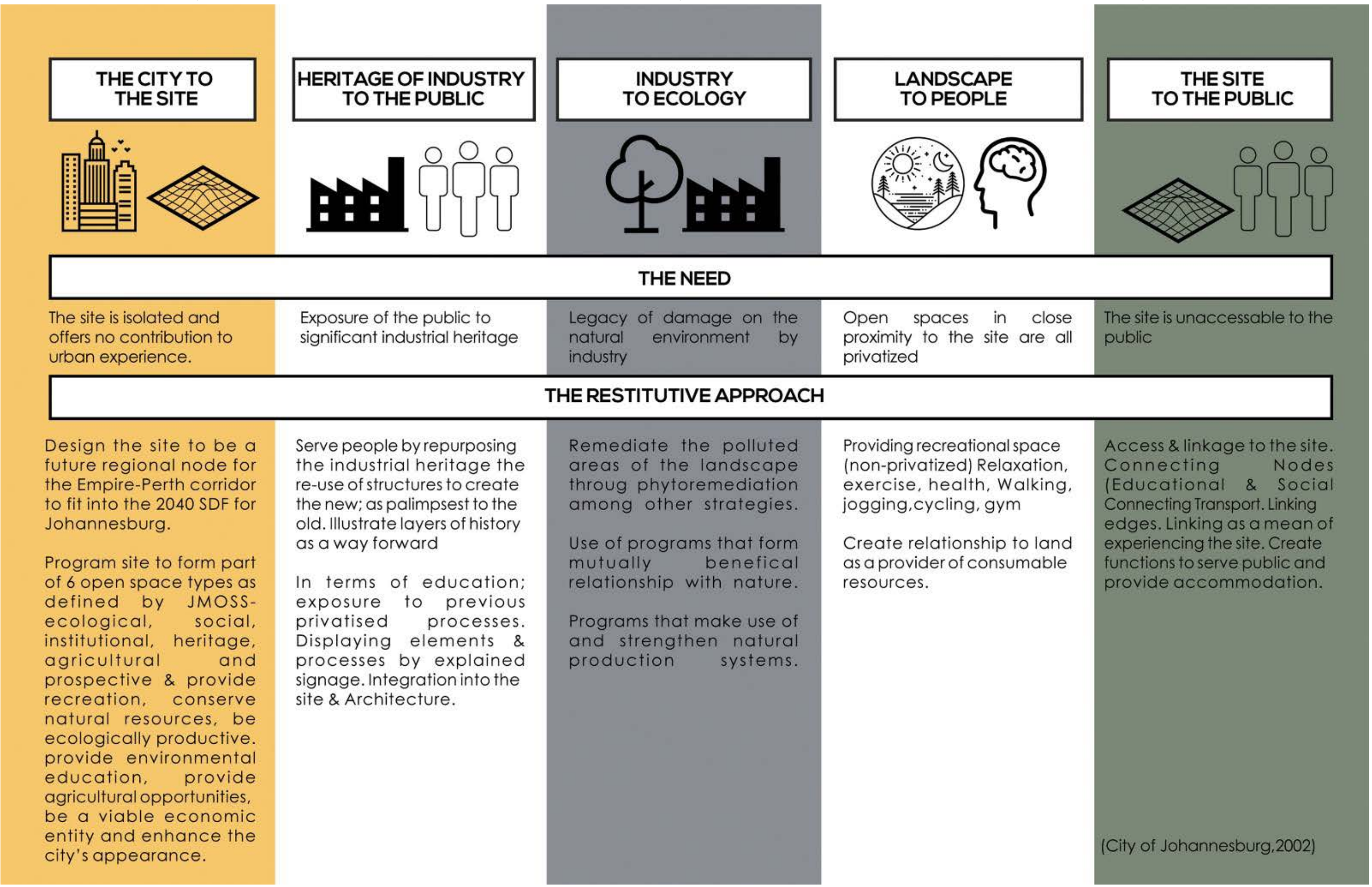


Figure 3.42, above: Relationships zoned on-site (Groupwork, 2017)

Below, Figure 3.43. Relationships requiring restitution (Groupwork 2017)

Figure 3.44, above: Relationships consolidated (Groupwork, 2017)



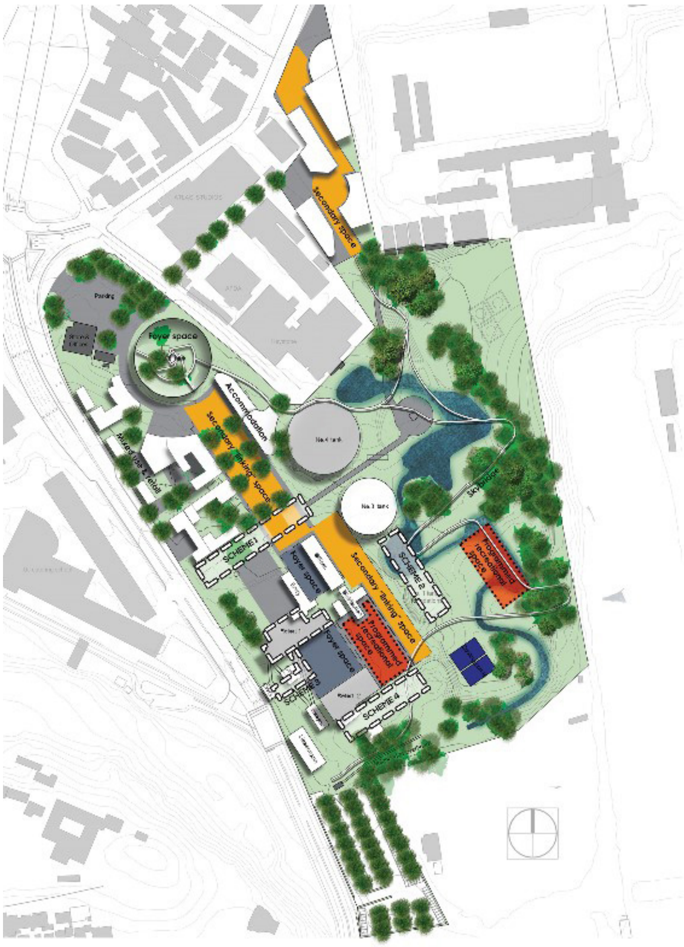
THE CITY TO THE SITE	HERITAGE OF INDUSTRY TO THE PUBLIC	INDUSTRY TO ECOLOGY	LANDSCAPE TO PEOPLE	THE SITE TO THE PUBLIC
THE NEED				
The site is isolated and offers no contribution to urban experience.	Exposure of the public to significant industrial heritage	Legacy of damage on the natural environment by industry	Open spaces in close proximity to the site are all privatized	The site is unaccessible to the public
THE RESTITUTIVE APPROACH				
Design the site to be a future regional node for the Empire-Perth corridor to fit into the 2040 SDF for Johannesburg. Program site to form part of 6 open space types as defined by JMOSS- ecological, social, institutional, heritage, agricultural and prospective & provide recreation, conserve natural resources, be ecologically productive. provide environmental education, provide agricultural opportunities, be a viable economic entity and enhance the city's appearance.	Serve people by repurposing the industrial heritage the re-use of structures to create the new; as palimpsest to the old. Illustrate layers of history as a way forward In terms of education; exposure to previous privatised processes. Displaying elements & processes by explained signage. Integration into the site & Architecture.	Remediate the polluted areas of the landscape throug phytoremediation among other strategies. Use of programs that form mutually benefical relationship with nature. Programs that make use of and strengthen natural production systems.	Providing recreational space (non-privatized) Relaxation, exercise, health, Walking, jogging,cycling, gym Create relationship to land as a provider of consumable resources.	Access & linkage to the site. Connecting Nodes (Educational & Social Connecting Transport. Linking edges. Linking as a mean of experiencing the site. Create functions to serve public and provide accommodation. (City of Johannesburg,2002)

Urban vision defined

The hazardous process of coal to gas has left remnants of its destruction on the Old Johannesburg Gas Works site in the form of tar and other harmful pollution. The site is currently isolated and the empty shells of industry are abandoned and left to be consumed by nature and the clutches of time. This creates a visual contrast between the buildings and the landscape, surrendering to that which it once oppressed. This site provides the perfect opportunity for restitution between not only industry and nature but also industrial heritage and the city dwellers. This is an attempt to reactivate the site's latent potential of being a productive and relevant site once again. Applying the principles of regenerative architecture, we are challenged by the idea of a new typology for abandoned industrial heritage sites such as the Old Johannesburg Gas Works.

The purpose of restitution is to restore, give back that which has been lost and to compensate by reverting as far as possible to a position before injury occurred. These definitions align with the principles of regenerative design and form the driver for the design and zoning of the new Restitution Park.

The relationships in need of restitution as illustrated in figure 25 are the following: The city to the site; heritage of industry to the public; industry to ecology, landscape to the people and the site to the public.



Conclusion

Considering the importance of the site's location, it is imperative to integrate the site into the city and surrounding community for the people. The environmental conditions of the site would also be improved if the proposed development is to take place. Providing accessibility to the public, it would aid in the Empire-Perth Corridors of Freedom initiative. The proposed programs includes: Energy Research Laboratory, Aromatic herb oil, Eco-Textile Emporium and Aquaculture and would all contribute to the Restitution of this park for the people.

Figure 3.45. Urban Vision for the site (Groupwork, 2017)

Figure 3.46. Parti diagram of Urban Vision informants for the site (Groupwork 2017)

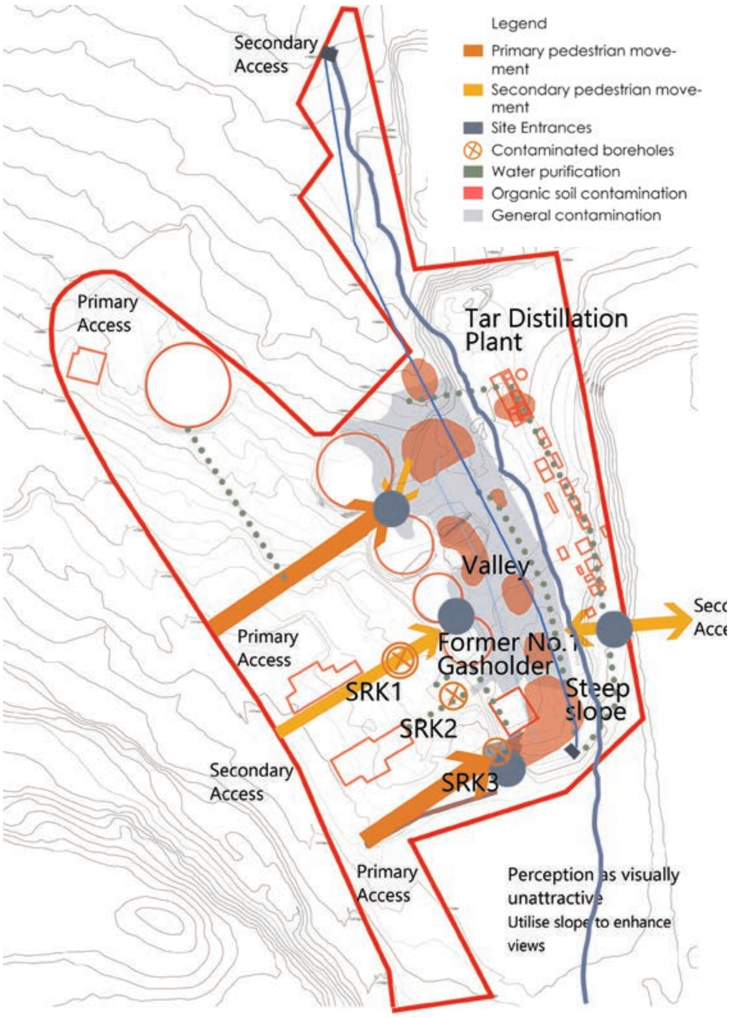


Figure 3.47 Design informants (Author, 2017)

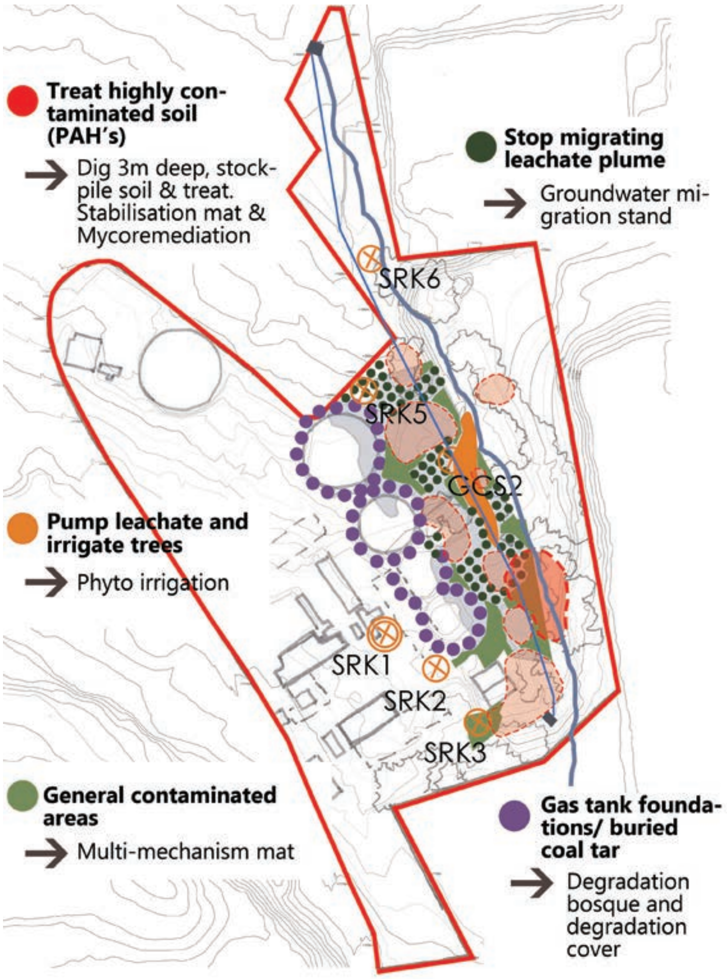


Figure 3.48. Phytotechnologies applied to the site (Author, 2017)

CHAPTER FOUR

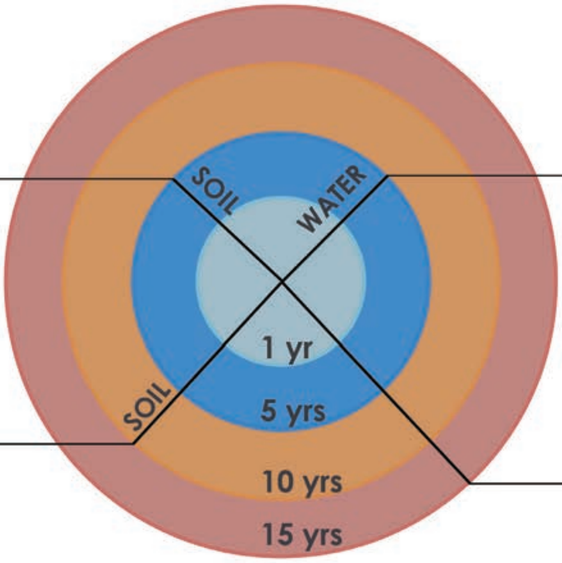
Program

Chapter overview

In this chapter, a brief overview will be discussed on the overall program which includes the phasing of the proposed development, the proposed activities for the strengthening of community identity, the improvement of the environmental health as well as the experience of the site may provide. The site programs are also discussed and indicated on a plan.

General contaminated soil areas:
- **9 mos** of treatment.
- After species succesion **(+- 3 - 5 yrs).**
- Implement hard and soft landscaping according to phasing

Highly contaminated soil excavated 3m deep, soil additions made and stockpiled, soil stabilisation mat phytotechnology applied until microclimate established for mycoremediation. It poses no threat to health - becomes **a mound.** Leachate will be treated in purification swale system **(+- 8-10 years).**



Contaminated groundwater diluted (inorganics and organics) **(6 mos - 5 yrs**). Complete removal may not be possible,but the aim is dilution. Purified water recharges groundwater.

Inorganics purified from water: Trapped (immobile in water) in soil and sediment. Removed through phytoremediation **(10-15 yrs).**

Fig. 4.1, above: Contaminants removal process (Author, 2017)

Fig. 4.2, below: Phased approach for the site (Author, 2017)

Planting strategies implemented according to phases

Time	Stage	Soft landscaping	Hard landscaping
Year 1	1: Site Prep	1. Remove alien invasive species 2. Plant bamboo on steep slope	
Year 1, month 7	2: Shift highly contaminated soil		1. Shift highly contaminated soils to create mounds. Fill some remaining holes with rubble.
Year 2-4	3: Soil Prep	1. Till soil, add compost, effective micro-organisms. Allow rainwater and oxygen into the soil (9 mos). 2. Hydroseed. 3. Plant trees (Phytotechnologies: Tree migration stand and Degradation Bosque)	1. Routes around site. 2. Access to lawn patches (non-contaminated zones) and pilates deck.
Year 4-8	4: Further remediation and bridges	1. Apply mycoremediation and multi-mechanism mat to mounds. 2. Apply other Phytotechnologies: Degradation Cover, Phyto-irrigation trees and multi-mechanism mat).	1. Implement contaminated water purification system. 2. Build bridges over contaminated mounds. 3. Implement textiles waste water purification system. 4. Build retention ponds to capture rainwater. 5. Introduce greywater to system.
Year 8-11	5: Communal areas opens	1. Layers (1m) from bio-remediated contaminated mounds are peeled and stockpiled annually which becomes new mounds. 2. Plant plantations (hemp; stinging nettle and flax. 3. Landscaped area around textiles water pond. 4. Indicator species planted for environmental monitorring.	1. Build all other pathways. 2. Opening of swimming pool area; events plaza; riverfront edge seating.
Year 12	4: New mounds opens	1. Soil-stabilisation mat phytotechnology applied to new bio-remediated mounds. These new mounds become meditation mounds/ play mounds.	
Year 20	5: Site design completed	1. Site fully bio-remediated (Inorganics in water fully remediated with phytotechnologies.	1. Skate park opens

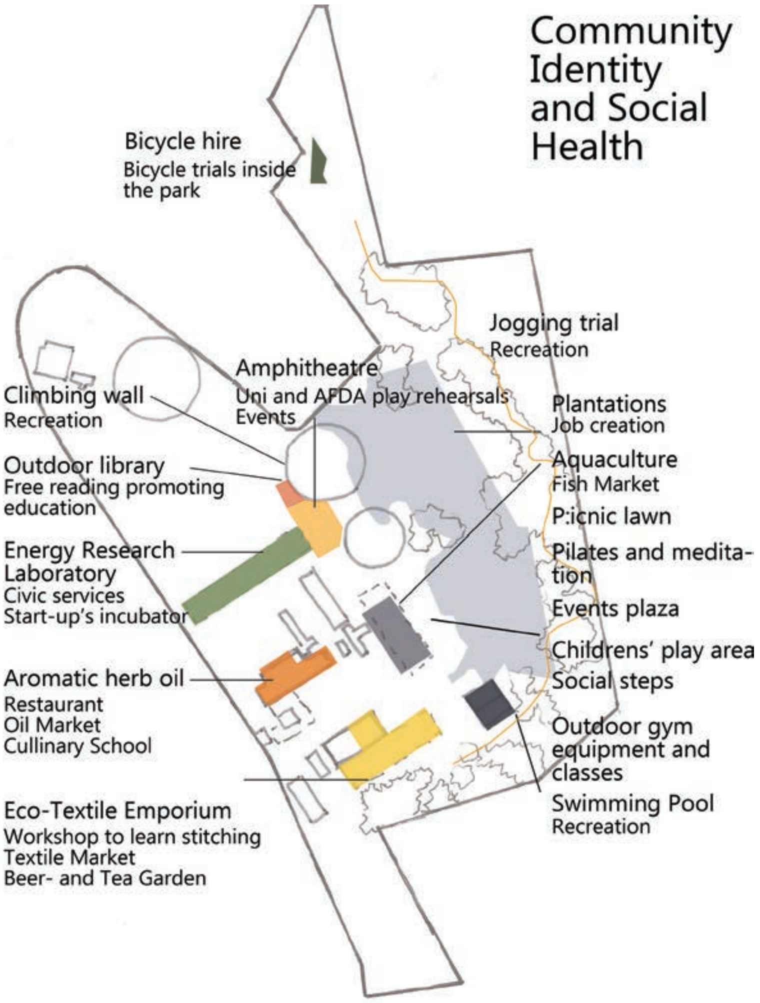
Fig. 4.3, to the right: Community Identity and Social Health on-site (Author, 2017)

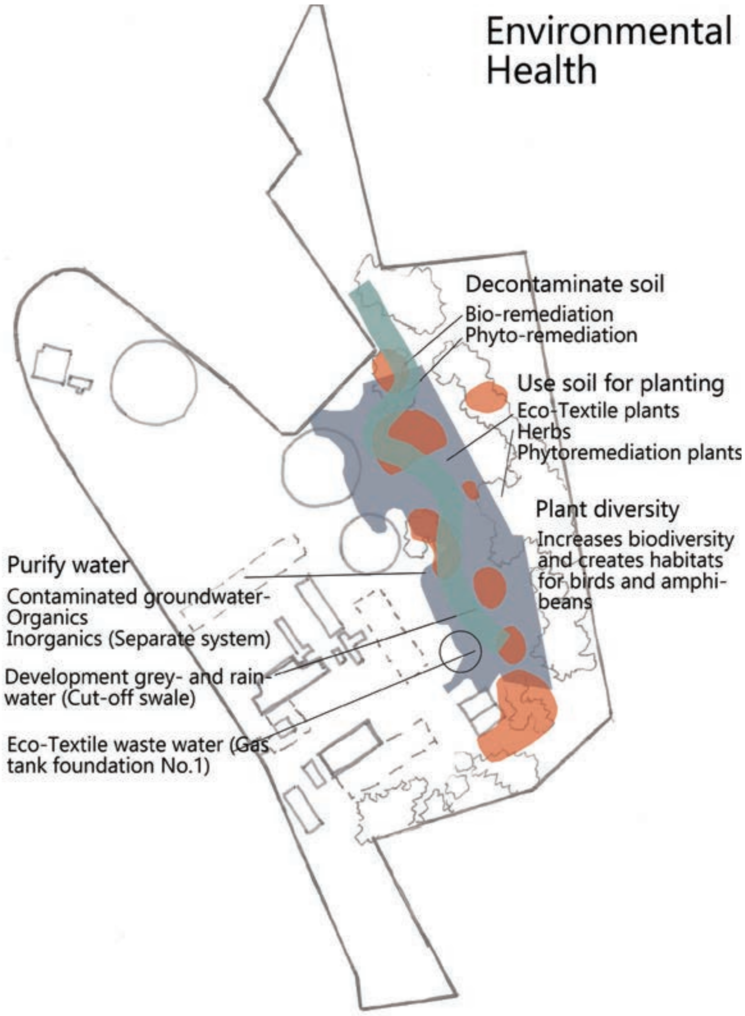
Fig. 4.4, below: Promotion of Environmental Health on-site (Author, 2017)

4.1 Overall program

The remediation measures and the time it will take to remediate certain specifics will greatly contribute to the phasing of the project, as can seen on the opposite page in Figure 1 and 2.

The overall program will entail the strengthening of community identity and the improvement of environmental health which forms part of the user experience on the post-industrial landscape.





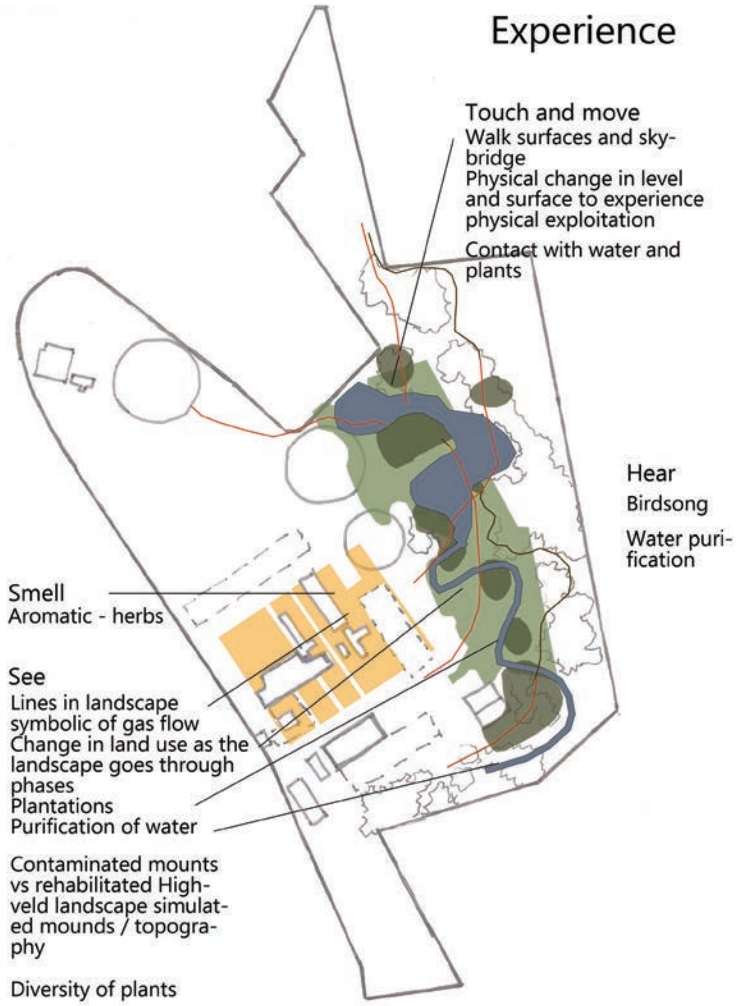


Fig. 4.5. Landscape elements enhancing the user experience (Author, 2017)

4.2 Sub programs/ functions

In order to gain a better understanding of the proposed programs on the site, this Chapter should be read in conjunction with the Theory Chapter under 3.3 where community identity and cohesion are described in more detail. Community identity will be strengthened through the following proposed activities:

Leisure and recreation
- Amphitheatre and Events Plaza: Universities, AFDA and Keystone productions hosting rehearsal plays free of charge and open to the public.
- Picnic areas: Areas are made available for people to have a picnic or host a birthday party.
- Seating areas: Various seating options are provided throughout the park.
- Open-air gym: Outdoor gym classes will allow people to maintain good physical health.
- Children's play area: Mounds will be provided in the play area.
- Outdoor library: Free reading promoting education.
- Bird watching: With the aim of natural restoration, the park will become a place of biodiversity and attract various bird species.
- Horticultural Therapy: A sensory garden has many cognitive benefits including improved memory and goal achievement. Physical benefits include an improved immune response, decreased heart-rate and stress to enhanced eye-hand coordination. People from all ages will plant seeds to provide seedlings for this development and park. Plants for other parks can also be planted here. Plants will be kept in nursery area/ greenhouse.

Sports
- Bicycle hire: Bicycle can be hired with routes provided inside the park.
- Fishing: a deck area/ jetty and area adjacent to the rainwater detention pond.
- Yoga and Pilates classes: Decks allowing people to interact with nature without being physically exposed to the pollution; lawn areas outside the generally polluted area.
- Swimming pools: The cooling ponds of heritage importance to be retained and converted into a public swimming pool.
- Soccer field: A Public-Private partnership are proposed to allow one of the less used soccer fields to be used by the public.
- Cricket pitches: Cricket nets are adjacent to the soccer field and are also proposed to be part of the Public-Private partnership.
- Jogging trails: Multiple routes in the park allows for joggers to exercise, some routes will only become available once all the phases are implemented.

Work opportunities

- Local jobs created at eco-textile plantations.
- Fresh produce markets (fish, oil and textiles).
- Stitching workshops.
- Benches will be arranged in a manner that students or scholars can have a study area/ groupwork space.
- Overseer at outdoor library.
- Life saver at swimming pools, fencing and ablution facilities.
- Event's organizer at the events plaza and soccer field.

The proposed activities for the park are arranged on the Eastern part of the Johannesburg Gas Works site – mainly in the valley fill area as per Figure 15. The various activities provide for variation and the multiplicity of activities will allow people to revisit the park on different occasions and improves the use of the park. It is important to note that as the project goes through the rehabilitation stages, so will different areas of the park be opened as described in Figure 19.

Fig. 4.8. Children playing along stream edged with rocks Author, 2017)

Fig. 4.10. Rubber matted mounds becoming a playtrack (Pinterest.com, 2017)

Fig. 4.6. Bicycle-hire in Maboneng (Author, 2017)

Fig. 4.7. Events for public at low cost in Maboneng (Author, 2017)

Fig. 4.9. Horticultural Therapy (CCI, 2017)

Fig. 4.11. Pilates in a Park (The Community YMCA, 2017)

Fig. 4.12. Children playing along stream edged with rocks Author, 2017)

Fig. 4.13. Public outdoor library in Tel Aviv, Israel (Archdaily, 2011)

Fig. 4.14. Toddlers play area (Ages 1-6) (City of Cape Town, 2017).

Fig. 4.15. Adventure play area (Ages 7-16) (City of Cape Town, 2017).

Fig. 4.16. Social steps at Robson Square, Vancouver (2017)

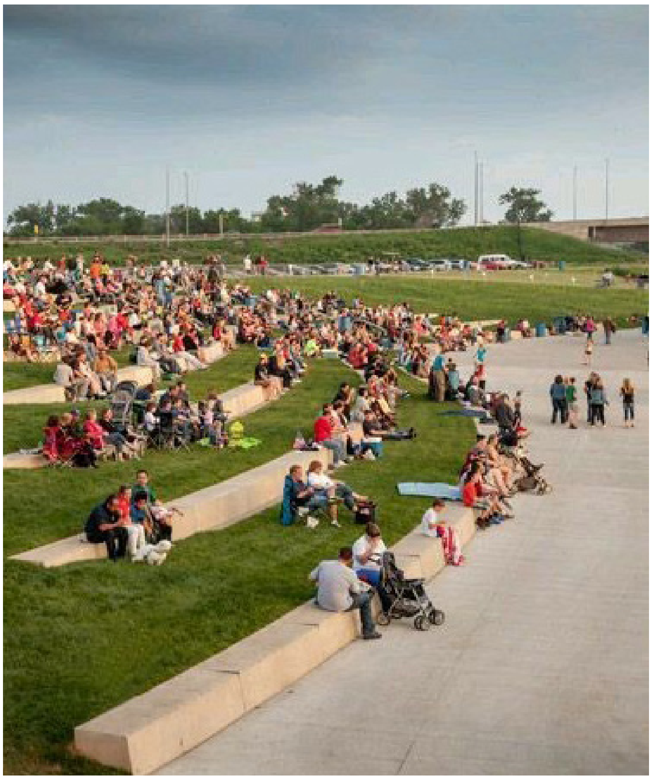


Fig. 4.17. Example of lawned events plaza (Pinterest, 2017)

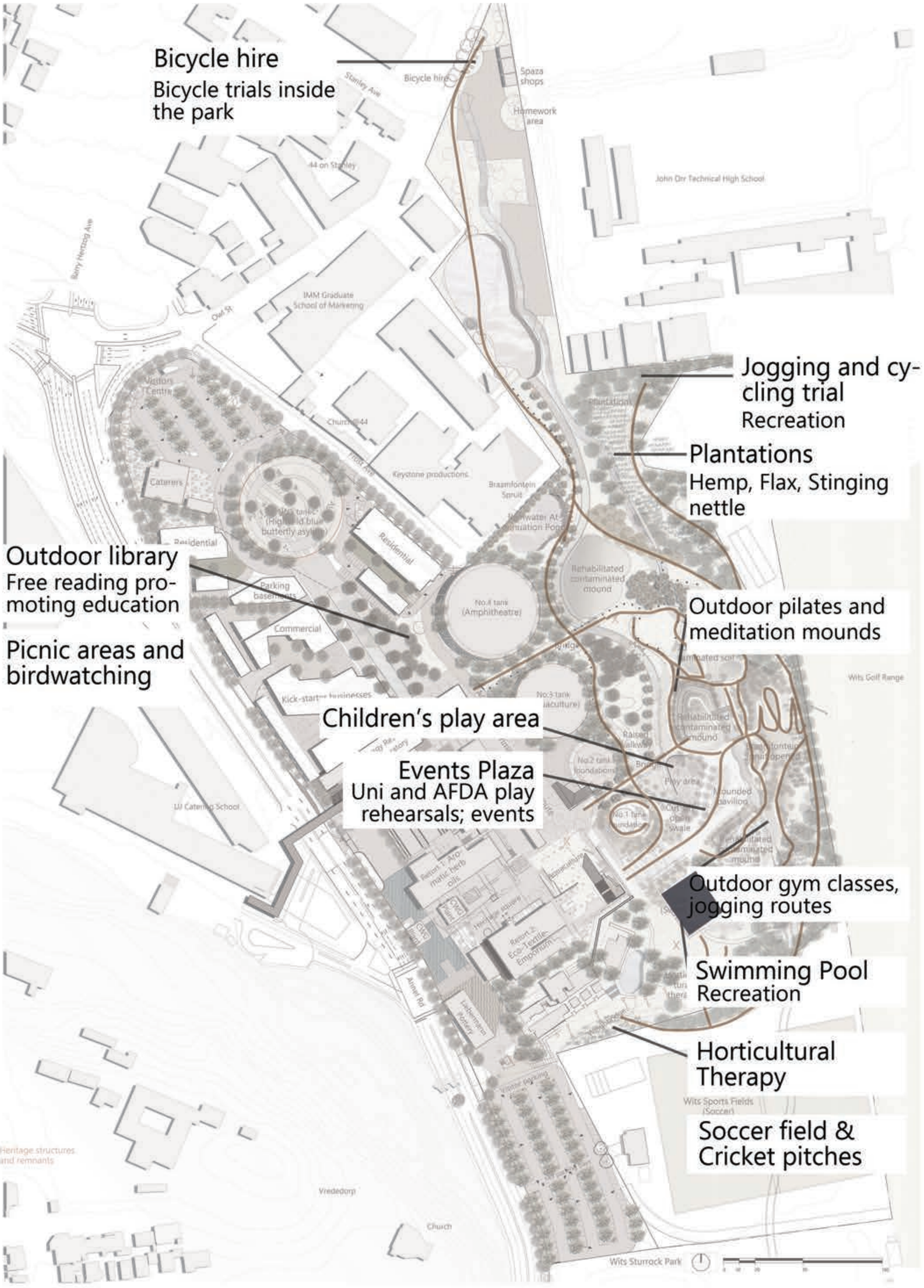


Fig. 4.18. Proposed activities in the landscape (Author, 2017)

CHAPTER FIVE

Concept

Chapter overview

In this Chapter, the conceptual triggers from the applied theory will be discussed briefly. The conceptual generators will be discussed in more detail along with the conceptual approach. It will conclude with the final landscape architectural concept. A concept is comprised from the site, idea and programme. The conceptual generators encapsulates all of these aspects.

5. 1 Theory and conceptual triggers

The Open Narrative inspired the concept of Mutualism through its principles. The social values as part of the heritage analysis also inspired the concept further.

The Theory consists of the overlapping principles of Phenomenology and Open Narrative which will be applied in the design. The main design principles will be: mutualism, multiplicity, movement, experience and incomplete stages. The Open Narrative are applied as three layers of experience on the site.

The Rhizome is derived from Phenomenology. The Rhizome rests on three components and manifests as Mutualism in three layers, The Rhizome is a mutualistic conceptual trigger which promotes interdependency and the intermezzo. Mutualistic organisms such as lichens and fungi aided in form-giving and is discussed under 5.2.2.

Three narratives are applied by three realities– it offers three different experiential layers through time. The past is represented by the lower, historical layer, the present is represented by the transient (interbeing and intermezzo). Lastly, the upper reality provides a holistic view of the site and of all its transient qualities (water, soil and vegetation). This reality is experienced through another transient mechanism, namely movement.

5. 2 Description of conceptual generators

The conceptual generators investigated for this project consists of five generators, namely:
5.1.1 **Movement**(object) **brought on by movement**(-subject) overlaid onto the **rhizome.**
5.1.2 **Mutualistic organism** e.g Lichen and fungi **patterns** giving rise to form-giving on the site.
5.1.3 **Mound/ mounds of polluted soil** symbolic of the tumulus, dealing with highly contaminated soil.
5.1.4 **Design informants:** Topography, polluted soil areas and systems will form part of the concept and how to overcome pollution and enhance community identity.
5.1.5 **Activities** and planning of spaces to promote **community identity** as part of programme.

5.2.1 Movement(object) brought on by movement(subject) overlaid onto the rhizome.

The rhizome according to Gilles Deleuze and Felix Guattari (1987) have many interconnections. The rhizome gathers, collect and interconnect phenomena.

An example of the rhizome is evident in the relationship between an orchid and wasp. An orchid attracts a wasp by forming an image of a wasp, the wasp then transports the pollen, reterritorializing the orchid. A cyclical mutation occurs of deterritorialization and reterritorialization. The space wherein a wasp lives also becomes the orchid's territory. This process is called a rhizome (Yada 2017).

The rhizome favours mutualism (multiplicity) over the arborescent (dualistic or binary) (Deleuze & Guattari 1987: 8). Multiplicity is the unity that is multiple in itself such as in the interaction between two heterogenic species for the benefit of both. The connections used in the rhizome are trans-species and planar whereas the arborescent favours the linear and vertical connections (Deleuze & Guattari 1987: 21).

The rhizome will assist in the ordering of the site and nodes of activity. Multiple nodes or noteworthy phenomena on-site are identified and serves as core areas from where the transient patterns will originate. That which happens between the nodes are known as the interbeing or intermezzo (Deleuze & Guattari 1987: 25). The transient patterns identified such as the movement of users, water and changes in vegetation colour will mainly happen in the intermezzo areas. The rhizome allows for various, non-hierarchical entry and exit points in landscape design.

The rhizome is a concept which favours mutualism (multiplicity) over the arborescent (dualistic or binary) (Deleuze & Guattari 1987: 8). Multiplicity is the unity that is multiple in itself such as in the interaction between two heterogenic species for the benefit of both, whereas the arborescent favours the linear and vertical connections (Deleuze & Guattari 1987: 21). The rhizome promotes the interbeing or intermezzo which may refer to being between point A and B. It is a temporal space to be in. The rhizome thrives on the interconnectedness between heterogenous elements/ species.

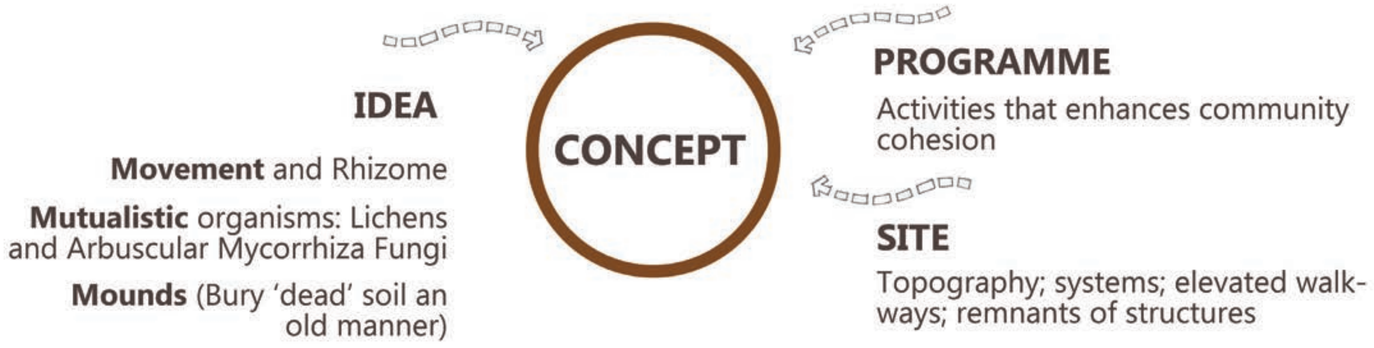


Fig. 5.1. Conceptual influences (Author, 2017)

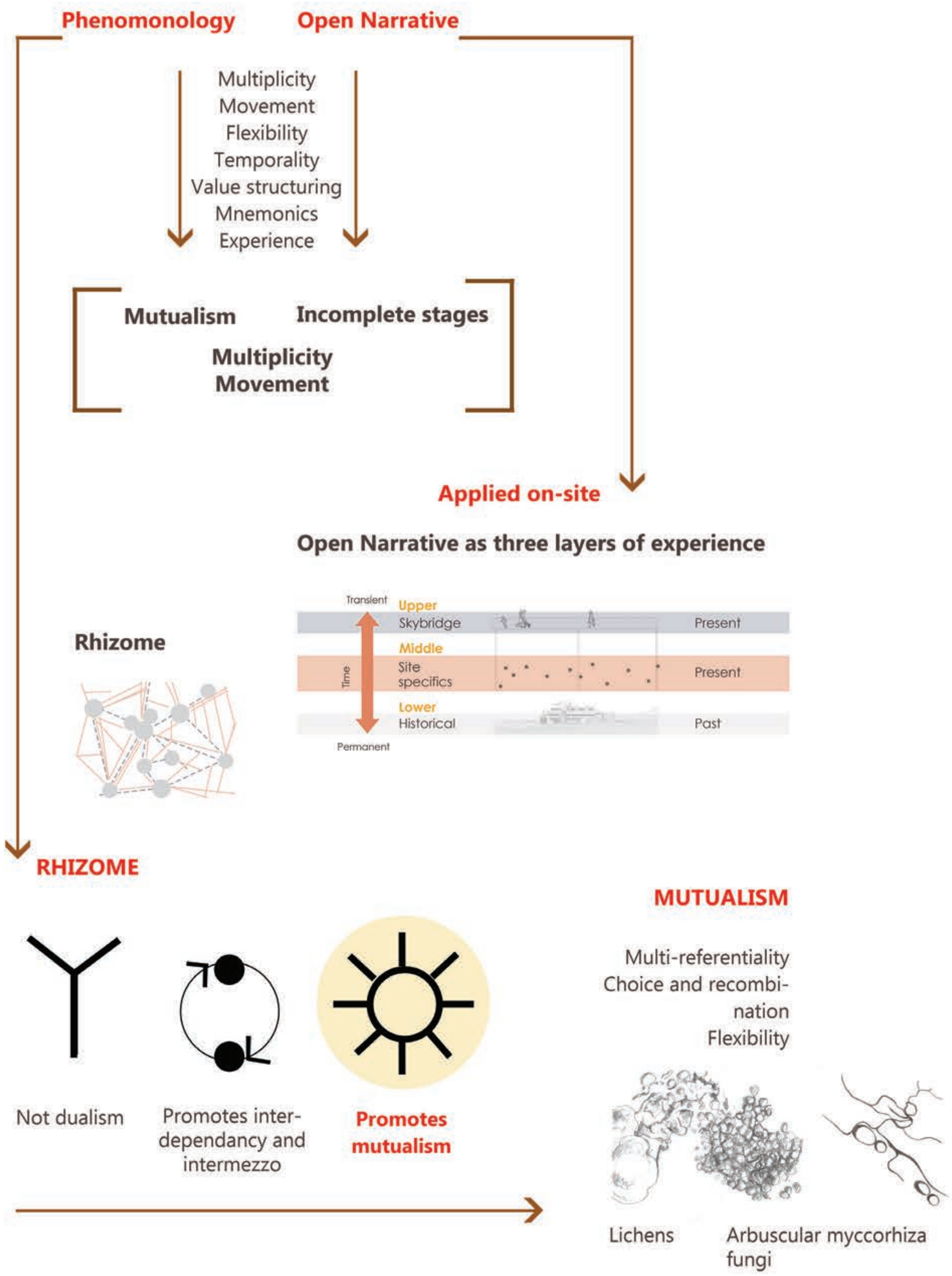


Fig. 5.2. Theory and conceptual triggers(Author, 2017)

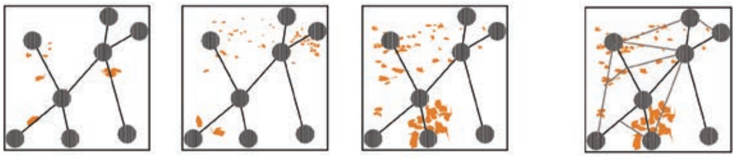
Movement by movement

Movement brought on by movement (spontaneous)

e.g wind, people interact, movement in tree colour.

That which moves is light in materiality becomes ‘transient props’.

Movement overlaid onto rhizome



Rhizome - constant (fixed environment) with movement (variables).

On-route (Main)

Fig. 5.3. Movement brought on by movement (Author, 2017)

Transient patterns overlaid onto Rhizome

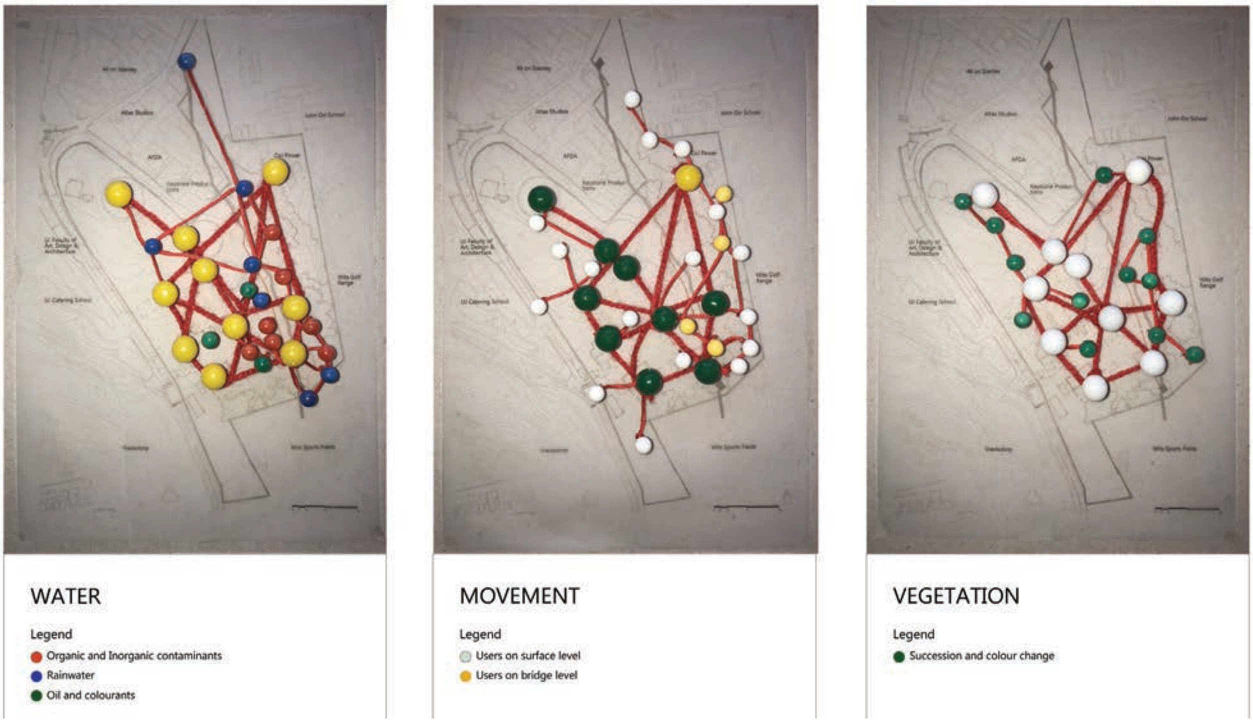


Fig. 5.4. Transient patterns overlaid onto a site rhizome model (Author, 2017)

As an experiment that explores transience, the author recorded the movement of leaves on different days as illustrated in Figure 5.3. The leaves are the object and it fell to the ground due to seasonal changes (movement). Movement (Wind or people) caused the leaves to move and form a pattern. This self-organising pattern is a phenomena which happens in any space and subsequently, this same pattern was overlaid onto the rhizome pattern. Between the nodes in the rhizome spontaneous movement is expected to happen in the fashion of changes in vegetation colour, water systems, soil purification process. People moving through these spaces will in itself form their own self-organising pattern and experience the space through movement. It can also be stated that which moves is light in materiality and becomes transient props just as the gas produced from coal on the site was light in materiality and temporal as it needed to burn to serve its function and have transpired to the air.

In the bottom part of the figure, the constant (fixed environment) are depicted with movement (variables) overlaid. The transient patterns can happen along the main routes of the rhizome (direct links between the nodes) or create a spontaneous finer grain between these main routes.

The existing remnants in the landscape becomes the nodes according to which the rhizome is organised. The transient patterns identified such as the movement of users, water and changes in vegetation colour will mainly happen in the intermezzo areas. The rhizome allows for various, non-hierarchical entry and exit points in landscape design.

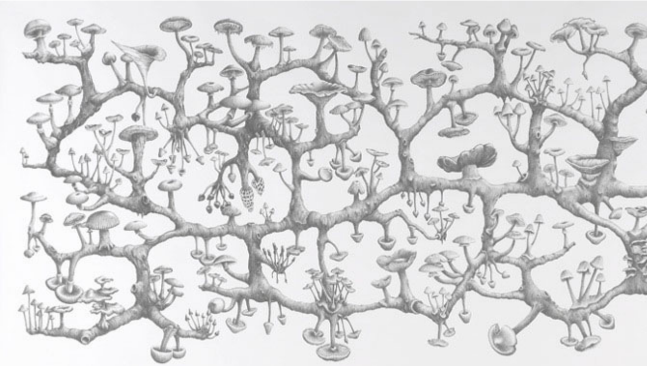


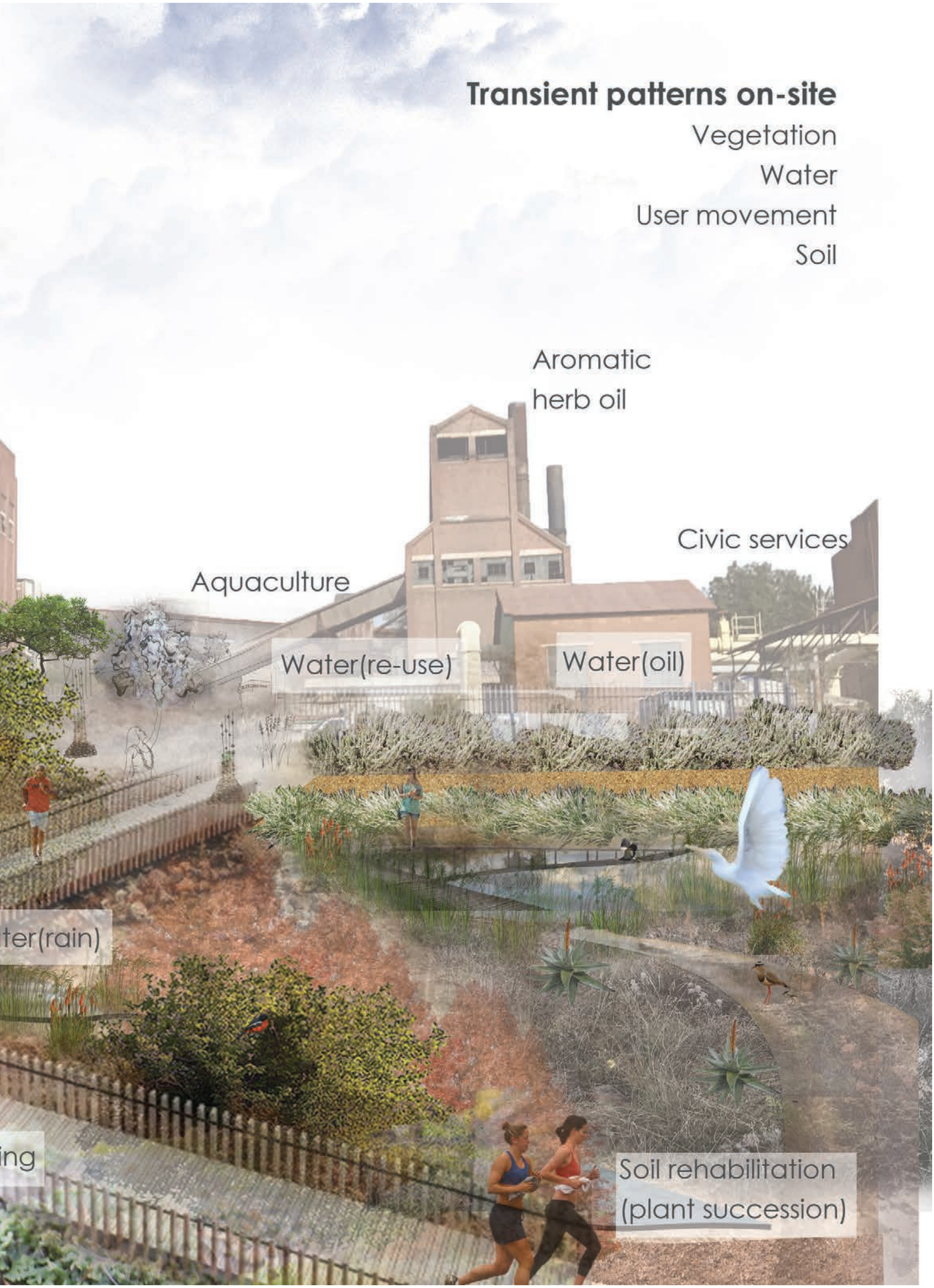
Fig. 5.5. Mycelium rhizome (Giblett, 2009)

Next two pages, Fig 5.6. Identified transient patterns on-site e.g. vegetation, water, user movement and soil. (Author, 2017)


Eco-textile emporium
Water(organic & inorganic)
Rehabilitated soil used for produce
Wa
Water (colourants)
Lichens (mutualism) define patternmaki

Transient patterns on-site

Vegetation
Water
User movement
Soil



5.2.2 Mutualistic organism e.g Lichen and fungi patterns giving rise to form-giving on the site.

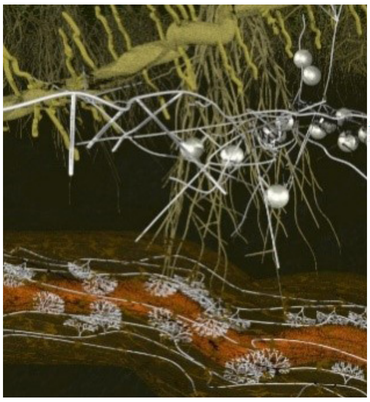
Derived from the Mutualism theory, this refers to organisms that both benefit from the relationship and not just one as in the case with capitalistic endeavours such as mining sites and gas manufacture plants where nature plays the second violin. Nature is taken from and left in a polluted state.

Lichens are a mutualistic relationship between algae and fungi. Lichens in the environment is also an indicator of clean, unpolluted air. The park will be filled with lichens as the soil vapours starts to cease.

Fungi assists with the breakdown of PAH's, particularly the mushroom genus which will also be used in the mycoremediation process. Another fungi, the arbuscular mycorrhiza is the mutualistic relationship between the roots of the plant and fungus. The hyphae enter the roots and faster nutrient transfer take place. The hypha produces glomalin which is one of the major stores of carbon in the soil. Carbon acts as a natural sponge in polluted soils. The fungus is responsible for 80% of terrestrial plants' inorganic nutrient uptake. This mutualistic relationship's pattern has a similar pattern to the rhizome. Therefore, the mutualistic organisms mentioned becomes part of the new narrative on the site.

Figure 5.8 indicates a diagrammatic cross-section through a lichen. This image can be compared with the idea of vegetation reclaiming derelict spaces such as what happened at the Cottesloe Gas Works Refer to Figure 5.6, below. Spontaneous fingers protrude from the fungi to the algae, indicative of their mutualistic relationship.

In Figure 5.7 the seasonal life of the arbuscular mycorrhiza fungi is combined. An almost serpentine language can be derived from the bottom image. At some points the linear and meandering lines meet and then go on again. It is indicative of interconnectedness, all lines joined in some way and dependent on each other, see Figure 6.26, page 90. This has assisted in the general form giving of pathways through the site.



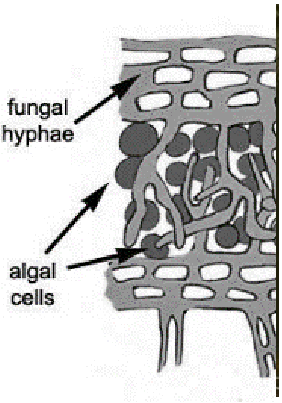
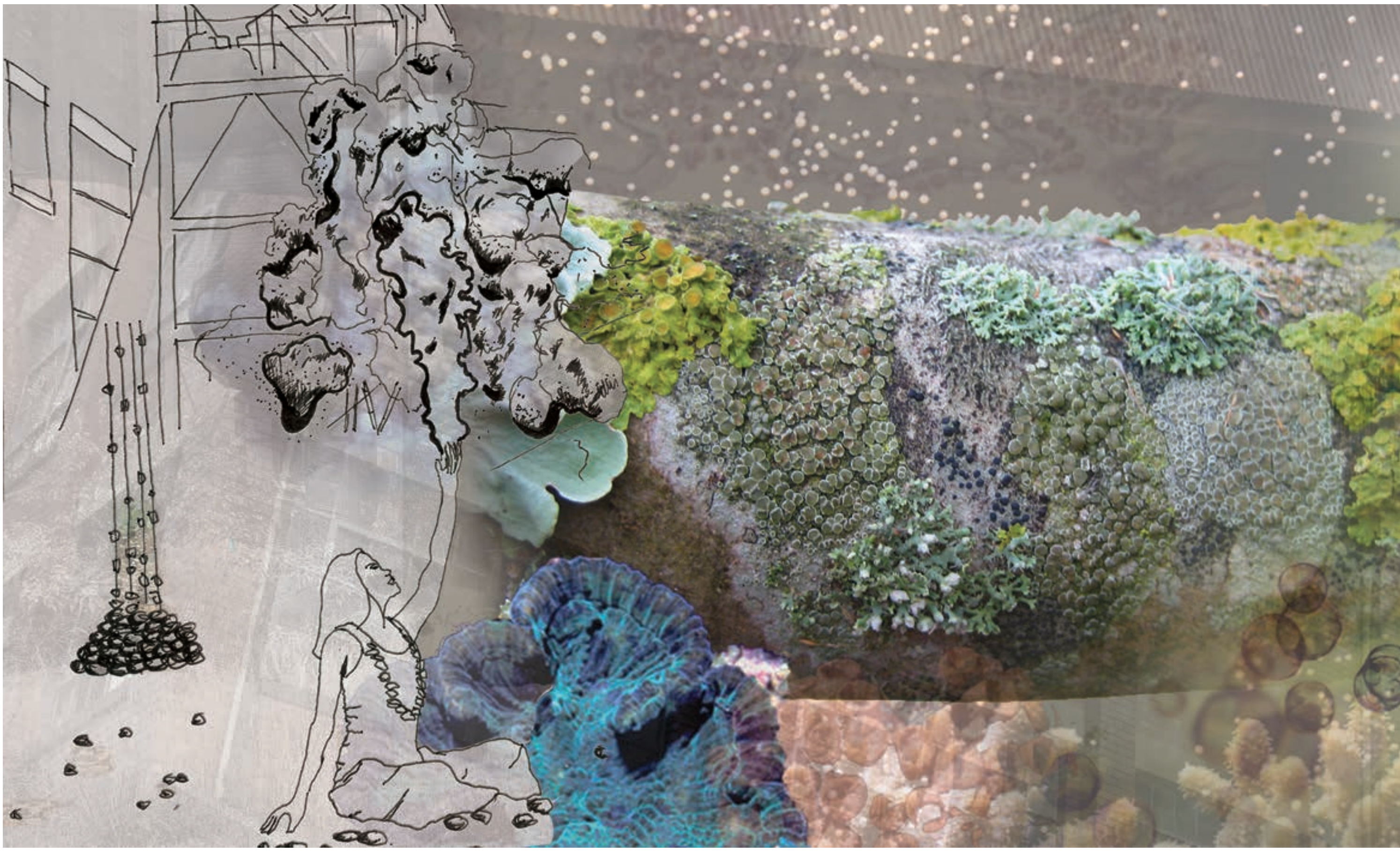


Fig 5.7. Diorama of Arbuscular Mycorrhiza seasonal life cycle (Scivit, 2010)

Fig 5.8. Leaf-like lichen cross section (Suboptimist 2013)



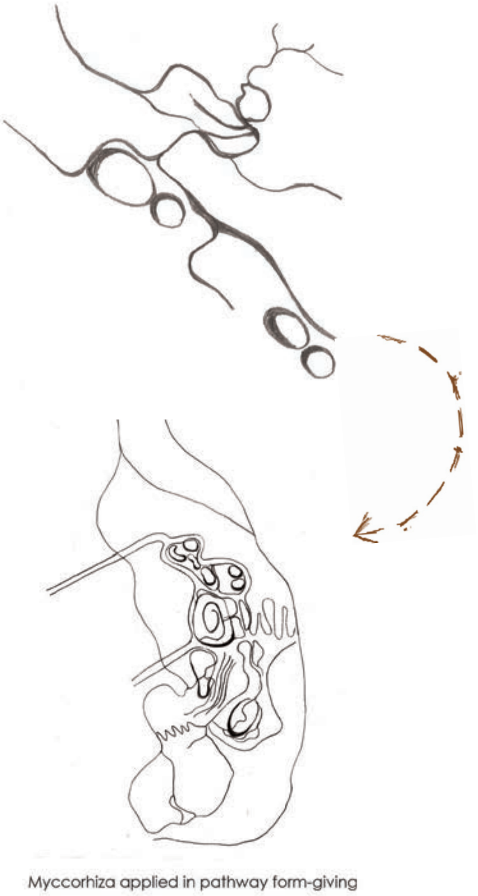


Fig 5.10. Mycorrhiza extrapolated to form-giving (Author, 2017)

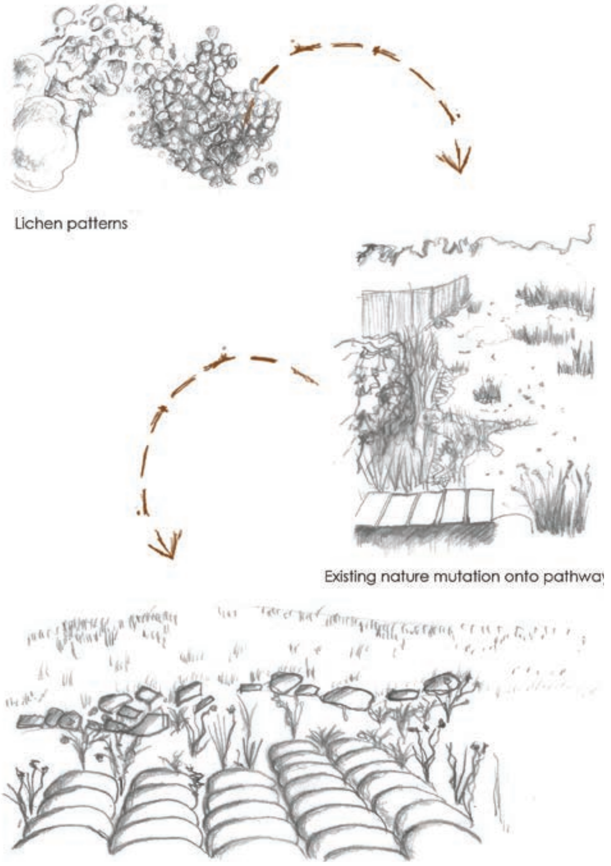


Fig 5.11.Lichen Pattern used in detailing (Author, 2017)

Fig 5.9. Mutualism the antidote to Capitalist exploitation (Author, 2017)

5.2.3 Mound/ mounds of polluted soil symbolic of the tumulus, dealing with highly contaminated soil.

The highly-contaminated soil was mounded and formed part of a public park at the Seattle Gas Works, see page 77. To cap the soil with a clay layer is a traditional method and effective as it prevents possible contact with humans and animals. The leachate can be drained and treated at the sources in swales with mycoremediation and further as part of the sub-surface water treatment system. The proposal for the Restitutive Park is to not cap the soil, but to also mound the highly contaminated soil and remediate it through phytotechnologies (soil stabilization mat and mycoremediation).

Another reason to make the mounds would be a symbolic notion of the tumuli built across the world varying over different ages and civilisations. A Tumulus was built over a grave. The symbolism of burying the ‘dead’, contaminated soil will form part of the open narrative where one could wonder what lies hidden beneath these mounds. The meaning and value becomes open to interpretation and discussion.

A further strengthening of the mound concept originated from the former use of the tar distillation plant on the site, where dry tar was stockpiled in steep high mounds as described on Chapter 3, page 30.
Cairns are also broadly used throughout the world to mark one’s progress on a journey, it becomes an aid to mental signification.

The form of the mound was investigated. To access the mound is dependent on the steepness and height. If the mounds have a fairly steep gradient but is not higher than 3m, small children would easily play on it as seen in figure 11. A series of mounds are investigated which is substantiated by multiplicity as design principles for the open narrative and phenomenology. A play area would be essential to the public park.

A series of different mound explorations are indicated on the opposite page, the design of one single great mound was explored. A sunken view deck is provided as a meeting point between the park and Wits. The great mound would have reflected the great exploitation of the environment through industrial processes. Views were considered for the great mound as shown in Figures 5.21-27, Page 61.

To design a great mound or a series of smaller mounds would both provide a user experience. Below in figures 20-22, the conceptual development is illustrated from a great mound to a series of smaller mounds. It was further investigated to mound the highly contaminates soil into 4 larger mounds of 8-meter height and as the process of mycoremediation takes place, annually a meter of remediated soil can be shaved from the top and mounded onto smaller mounds of maximum 3-meter height. These mounds become accessible to the people by allowing pathways up and down. These mounds have different characteristics and can be divided into active and passive mounds. Some mounds will be used for exercise and others for meditation and Pilates.

Burial mounds/ cairns are found throughout different civilizations across the world.

It becomes a universal symbol to the burying of the dead and old.

In the case of the site. the dead is the highly contaminated soil, seemingly worthless soil. The old, is the old exploitation value that is grounded in individualistic consumerism. By mounding the soil, a symbol, formerly used to indicate the dead and old transitions into healthy soil and mounds forming part of a new narrative upon which people can walk, play and meditate.


Fig. 5.12. Kosciuszko-mound. (Trip points, 2017)

Fig. 5.13. Cahokia Mounds. (Grkids, 2017)


Fig. 5.14. Various burial cairns and mounds (Wordpress.com, 2013)

Mound explorations

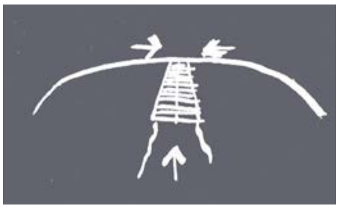


Fig 5.21. From below and over (Author, 2017)

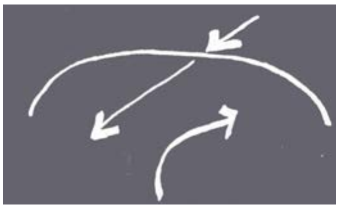


Fig 5.22. From below and from above (Author, 2017)

Fig 5.23. Pass through (Author, 2017)

Fig 5.24. Below to around and above (Author, 2017)

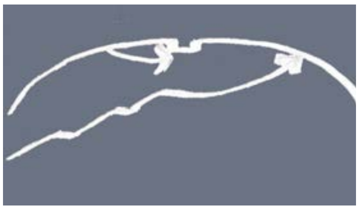


Fig 5.25. Below to around and above and pass through (Author, 2017)

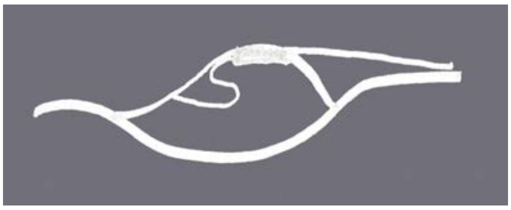


Fig 5.26 . Walk up (Author, 2017)

Fig 5.27. Bridges from both sides, look-out and water feature to side (Author, 2017)

Various burial mounds/ cairns

Fig. 5.15. Etruscan Tumuli. (Socks, 2017)

Fig. 5.16. Tumulus at Grosmugl. (Wikimedia, 2017)

Fig. 5.17. Tumuli at Sulm valley necropolis (Wikimedia, 2017)

Fig. 5.18. Wisconsin Indian mounds. (Pinterest, 2017)

Fig. 5.19. Cairns in Qa'ableh (Abdirisak, 2009)

Fig. 5.20. Cairns at re-entrant, Somalia (British Institute in Eastern Africa, 1976)

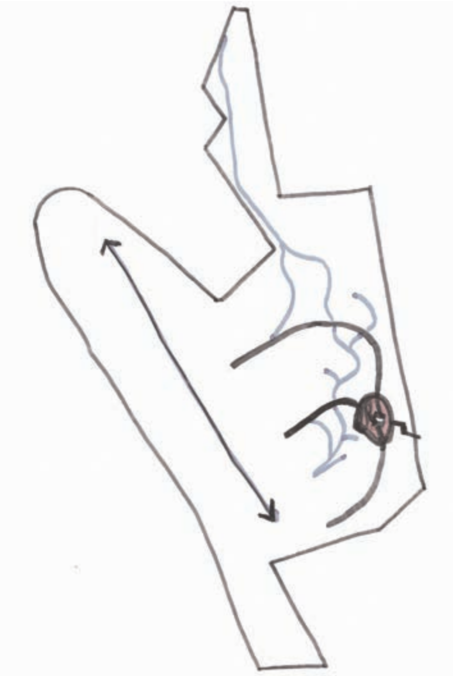


Fig 5.28 Three bridges leading to the great mound (Author, 2017)

Fig 5.29 Smaller mounds enhancing nodes (Author, 2017)

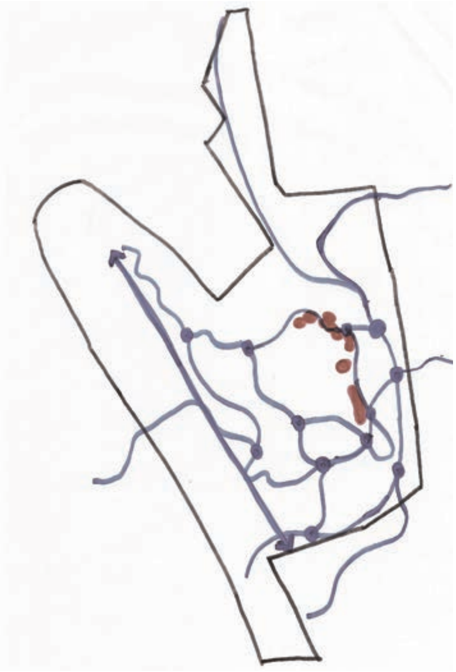


Fig 5.30 Smaller mounds forming children's play area (Author, 2017)

Fig 5.31. Conceptual image illustrating the great mound within topography of the site (Author, 2017)

Fig 5.32. Visualisation of great mound as part of an exploration (Author, 2017)

5.2.4 Design informants: Topography, polluted soil areas and systems will form part of the concept and how to overcome pollution and enhance community identity.

The design informants should be seen as a part of the conceptual generators. **The topography** (steep slope and valley fill area) will influence where the systems will be placed. The **systems** will form part of the concept and how to overcome pollution to enhance community identity, specifically phytotechnologies for soil remediation and water purification system requirements for organic and inorganic contamination. **Elevated walkways** over the general contaminated soil (low level of contamination) areas whilst bio-remediation takes place will ensure a user experience and prove to be a sound health principle. **Remnants of structures** in the landscape will also form places of interest where people can linger. The steep slope provides a micro-climate for plantations requiring more humidity. The function of the resulting holes due to excavation of the contaminated soil has been investigated, see below. The remnants in the landscape become the nodes which will be linked in the rhizome.

Process drawings

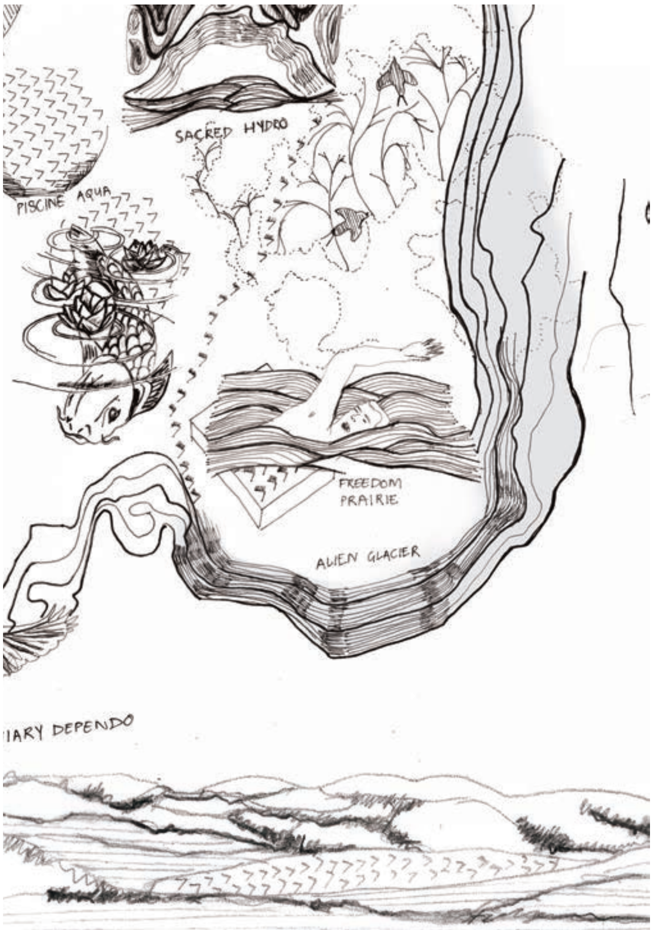


Fig. 5.33. Topography and systems informant process sketches Author, 2017)

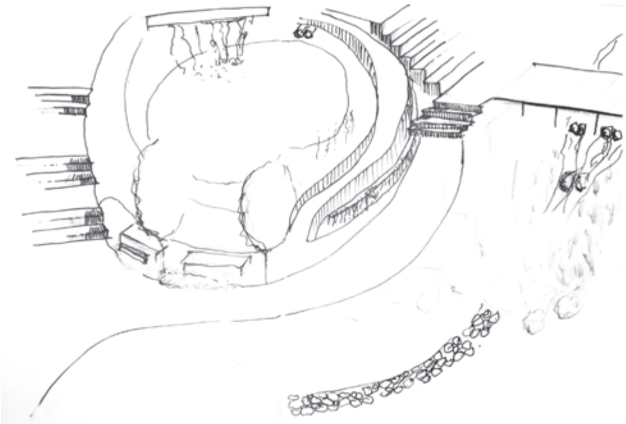


Fig. 5.34. Remnants of Gas tank foundation No.1 process drawings (Author, 2017)

Fig. 5.35. Re-appropriation of holes investigated o(Author, 2017)

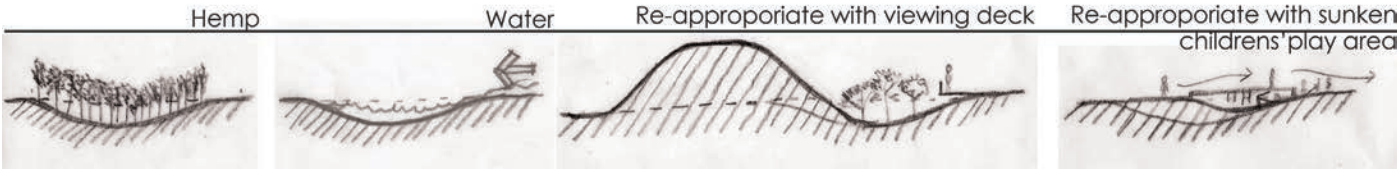
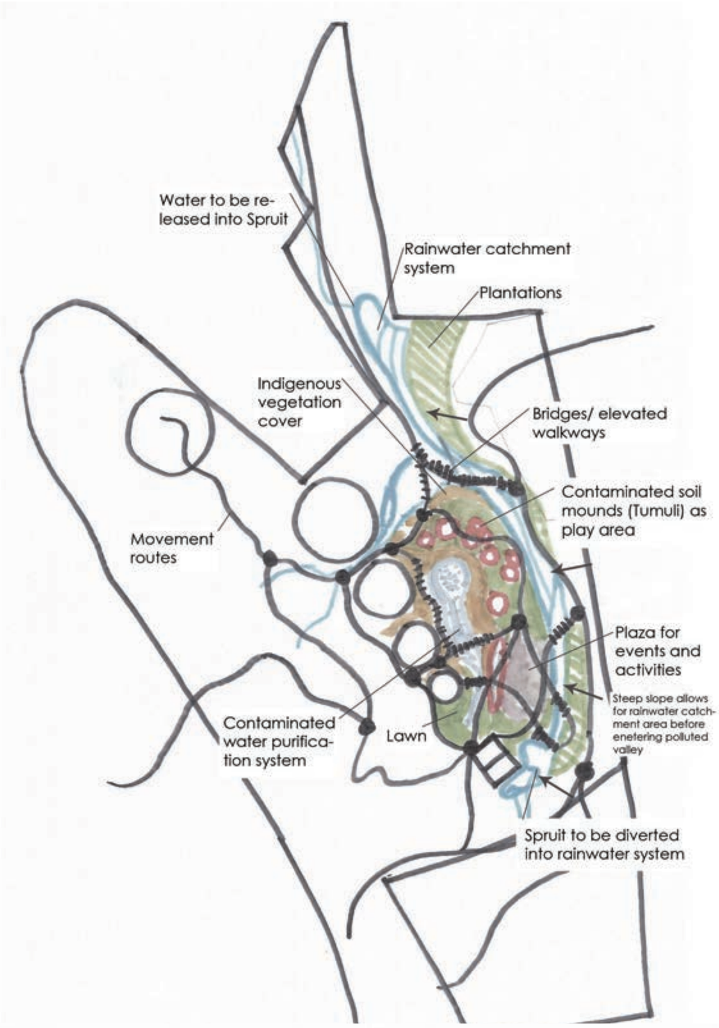
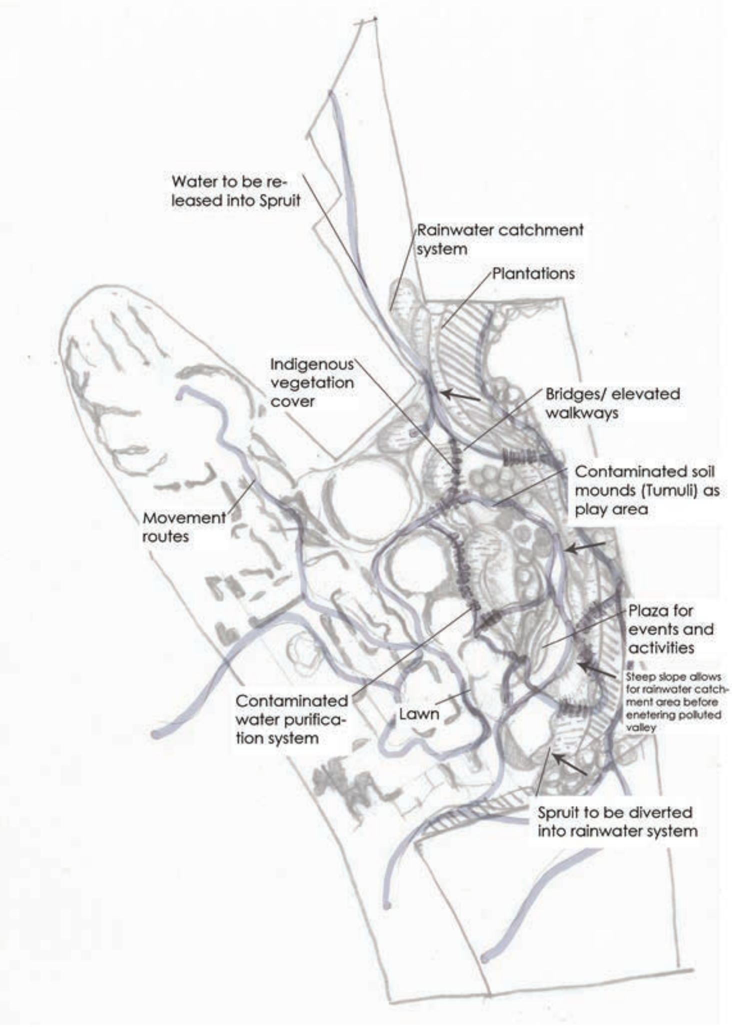


Fig 5.36, to the right: Process image to conceptual diagram (Author, 2017)

Fig 5.37, below: Process image leading to final conceptual diagram (Author, 2017)





5.2.5 Activities and planning of spaces to promote community identity as part of the programme.

The proposed activities are discussed in more detail under Chapter 2 in Programme as well as Chapter 4. The Park will aim to include different ages, genders and cultures. Various outdoor activities and seating options will be provided in the Park.
The selected activities proposed for the Sketchplan area are the following:

Leisure and recreation
- Events Plaza (Stepped pavilion) and social steps at entrance: Universities, AFDA Film School and Keystone productions hosting rehearsal plays free of charge and open to the public. More informal school plays can also be practiced here.
- Picnic areas: Areas are made available for people to have a picnic or host a birthday party.
- Seating areas: Various seating options are provided throughout the park.
- Open-air gym: Outdoor gym equipment will allow people to maintain good physical health.
- Children's play area: Mounds will be provided in the play area.
- Bird watching: With the aim of natural restoration, the park will become a place of biodiversity and attract various bird species.
- Horticultural Therapy: As part of a pergola structure, the planterbox which also offers seating options becomes a place to practice horticultural therapy.

Sports
- Jogging trails: Multiple routes in the park allows for joggers to exercise, some routes will only become available once all the phases are implemented.
- Cycling routes: Bicycle can be hired with routes provided inside the park.
- Yoga and Pilates classes: Decks allowing people to interact with nature without being physically exposed to the pollution; lawn areas outside the generally polluted area.
- Swimming pools: The cooling ponds of heritage importance to be retained and converted into a public swimming pool.

Work opportunities
- Benches will be arranged in a manner that students or scholars can have a study area/ groupwork space.
- Life saver at swimming pools.
- Event's organizer at the events plaza and soccer field.

5.3 Conclusion

The conceptual generators included movement brought on by movement overlaid onto the rhizome; the lichen and fungi patterns influenced the form and will be seen in the detailing such as the mounded pavillion and also the pathway detail; the use of mounds is firstly symbolic of the tumulus and to bury the old manner of doing things (exploitation). The mounds will act in the transition of contaminated soil to rehabilitated soil. Then secondly, the mounds are symbolic of stockpiling of dry tar on the site during its former use. When the contaminated soil mounds are scraped while being rehabilitated, the new form may be reminescent of the Highveld landscape. Another conceptual generator included the topography, polluted soil areas and systems. These areas provide certain criteria to work with such as the phytotechnologies applied on a manufactured gas plant. The activities and planning of spaces to promote community identity and cohesion as part of the programme also served as a conceptual generator.

Fig 5.38 Proposed community interaction surrounding the active and passive mounds (Author, 2017)

Site indicated as conceptual diagram

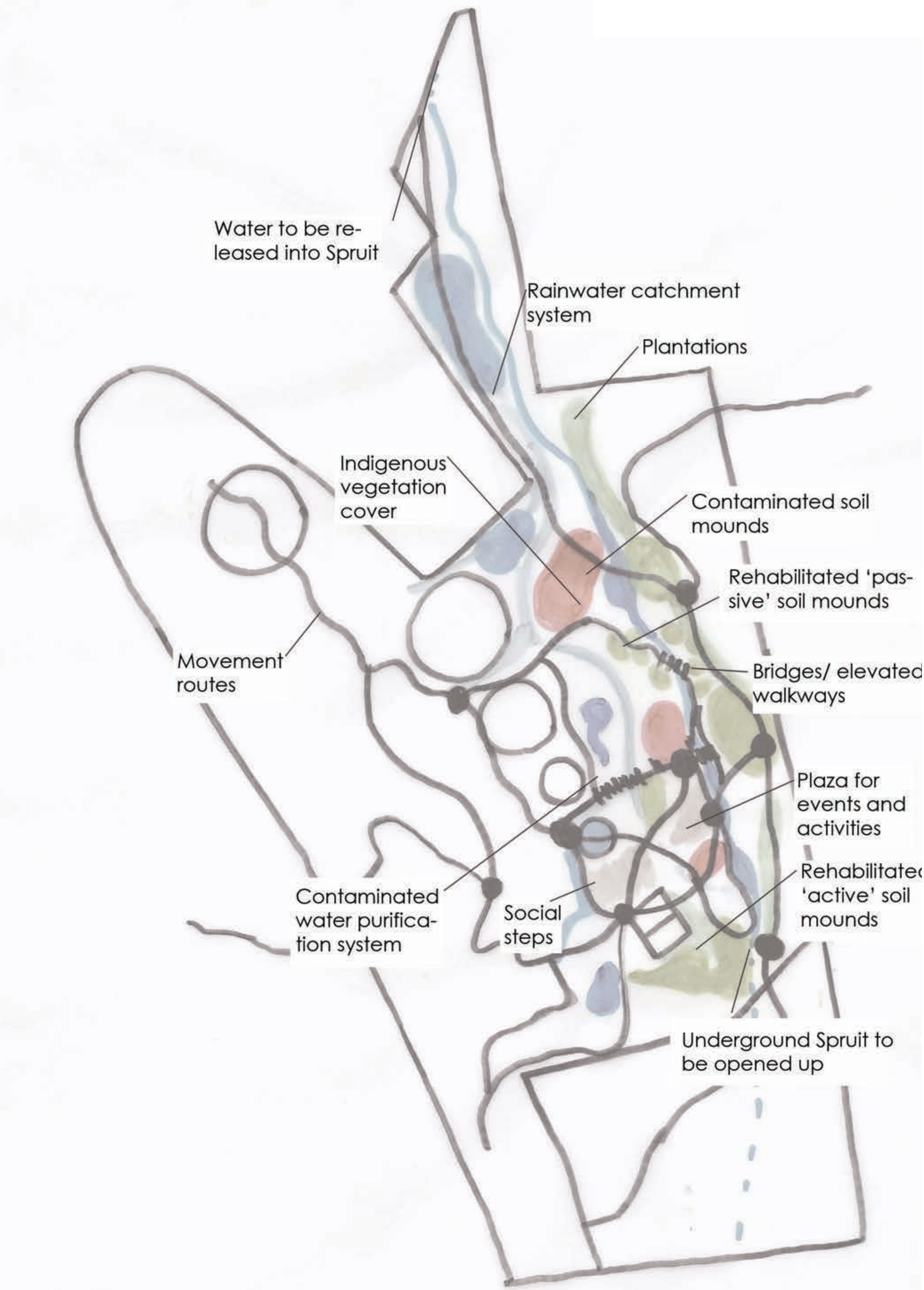


Fig 5.39. Site indicated as a conceptual diagram (Author, 2017)

CHAPTER SIX

Design development

Chapter overview

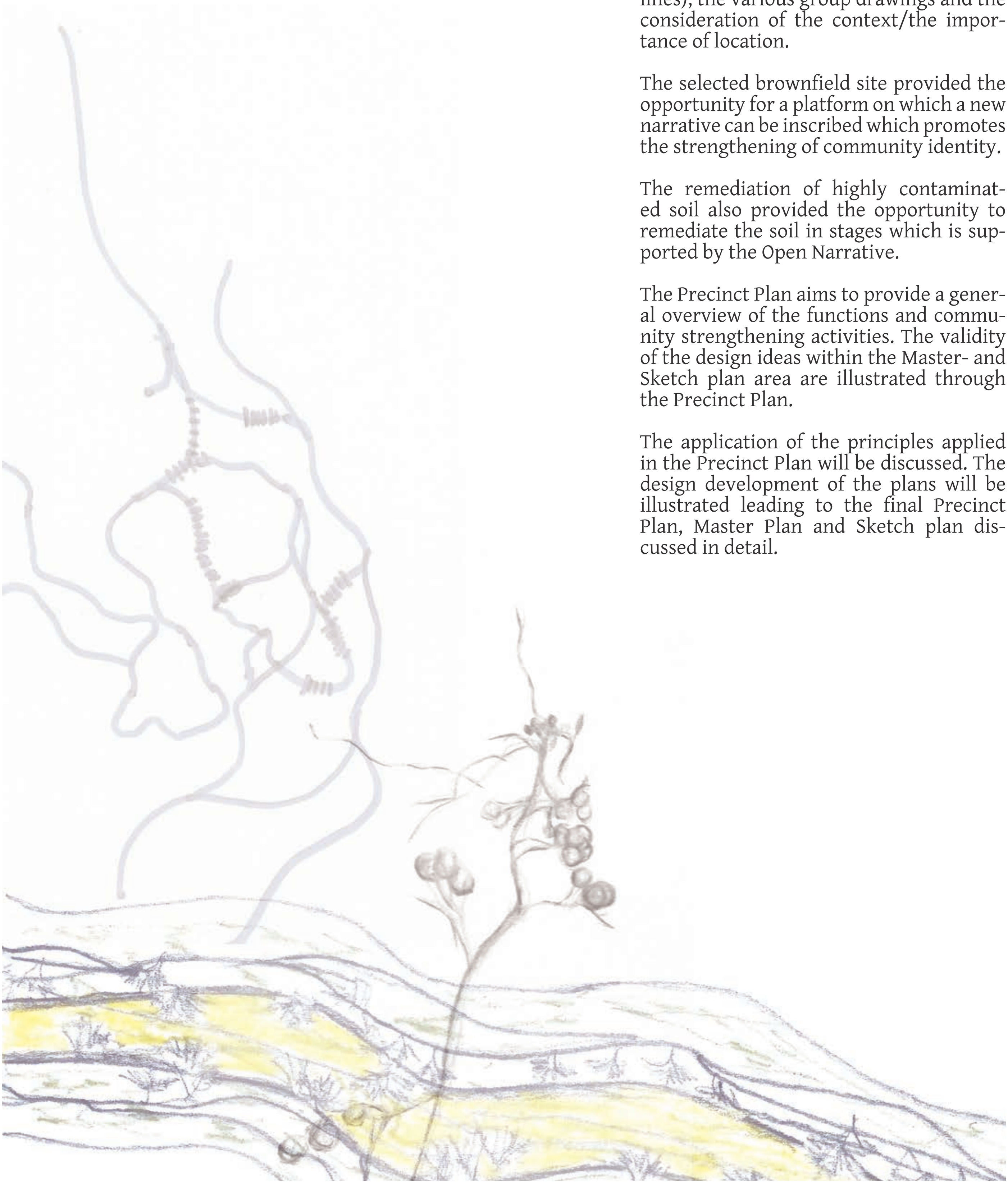
The final Precinct plan, Master plan and Sketch plan is an amalgamation of the applied theory premise (Regenerative design for the Precinct plan and Open narrative for the Master and Sketch Plan); research (precedent studies, City guidelines), the various group drawings and the consideration of the context/the importance of location.

The selected brownfield site provided the opportunity for a platform on which a new narrative can be inscribed which promotes the strengthening of community identity.

The remediation of highly contaminated soil also provided the opportunity to remediate the soil in stages which is supported by the Open Narrative.

The Precinct Plan aims to provide a general overview of the functions and community strengthening activities. The validity of the design ideas within the Master- and Sketch plan area are illustrated through the Precinct Plan.

The application of the principles applied in the Precinct Plan will be discussed. The design development of the plans will be illustrated leading to the final Precinct Plan, Master Plan and Sketch plan discussed in detail.



6.1 Development of the Restitutive Park Precinct-Plan

Overview of the Precinct Plan

The aim of the Precinct plan of the Johannesburg Gas Works is to portray restitutive principles and to be a production park. For background knowledge on the principles applied to the restitution park, please refer to 3.3 Urban Vision on page 41. The main theory applied to the Precinct Plan involved Regenerative Design. The site has been approached, as part of a group, which resulted in the following architectural programmes, see Figure 6.1 on the opposite page:

- Eco-Textile Emporium (Renee du Toit) – Regenerative design, transformative resilience, philological restoration.
- Aquaculture (Jan-Paul du Plessis) – Site as palimpsest (narrative)
- Aromatic Herb Oil Distillery (Nellis Basson) – Hybrid architecture, heritage, palimpsest and Regenerative Design
- Energy Research Laboratory (Jan Diedeleff van Aswegen) – Didacticism

It was decided to provide residential units on the site, as students require residential units in close proximity to their University or other research institutions. An area is designated for kick-starter businesses for University graduates to start a small business. Niche retail businesses such as at 44 on Stanley are also included into the Precinct Plan. In Gas Tank No.4 an amphitheater is proposed to host events. Mycelium bricks will also be manufactured on-site, it does not require any special provision except what any building provides. A Highveld butterfly asylum is proposed in Gas Tank No. 5 which will be opened up to become a point of entry into the site.

Precinct Plan Informants

Fig 6.1. Site model indicating surrounding context (Author, 2017) (Author, 2017)

As a result of the restitutive nature of the park, the binding element to these programmes will be water and the purification thereof. The grey- and rainwater harvested in the proposed development will be purified for the use of plantation irrigation and re-use within the buildings. This main element, water, will be dealt with on-site by the author. The main issues will also be addressed namely: remediation of the polluted soil and water as well as the instigation of community identity through various proposed activities by means of applying the Open Narrative approach. **Movement:** The new can be understood through the old, therefore the primary access on the Southern side of the site is gained through the railway that brought the coal to the site via train.

The landscape space between the buildings serves two sets of people: the workers and the visitors. The aim for the workers will be to provide ample opportunity to practice healthy living at the workplace e.g. places to contemplate; outdoor gym equipment, multiple spaces for seating and an outdoor library. The aim for the general public would be to provide places of gathering e.g. market spaces where Eco-textiles and fresh fish products can be acquired from as well as a tea house and restaurants etc. Students from surrounding educational institutions and the general public can be trained and learn hands-on of sustainable building methods and energy resources.

There exists a disparity between the Eastern and Western sides of the site. It can be seen through predominant hard to soft landscape. In the derelict state that the site occurs within, mutations of the natural landscape between the harder surfaces surrounding the buildings has occurred. Therefore, the planting that protrudes into the western side (park area) has ordered lines. That which mutates on the hard landscape, will have a resultant organic form which is adopted from fungi and lichen patterns.

The planting associated with production are ordered and planted within straight lines such as the flax, herbs and aromatic trees. The plants associated with remediation is planted in lines derived from more natural shapes.

Precinct Plan Informants to programmes

Programmes proposed are selected in a way to still have a productive component to it - as the former function had been. The surrounding context has also been considered. The programmes proposed need to serve the surrounding context and establish community identity on a site with an exploitation narrative up to date. The UJ Cullinary School is located opposite the site in and they will use the Aromatic Herb Oil Distillery. Fresh fish cultivated locally will be a benefit to all people surrounding the site. The site is accessible to all and residents, students and scholars will benefit from a large, green open space. The Eco-Textile Emporium fits well in with the cultural arc in the CBD area. As Energy resources are being depleted and the effects of a coal driven landscape exposed, the visitors will become more aware and interested in more environmentally friendly technologies, skills can be learned at the Energy Research Laboratory. The development water will require purification and link in with all the associated programmes.

Composite Functional relationship diagram of group programs

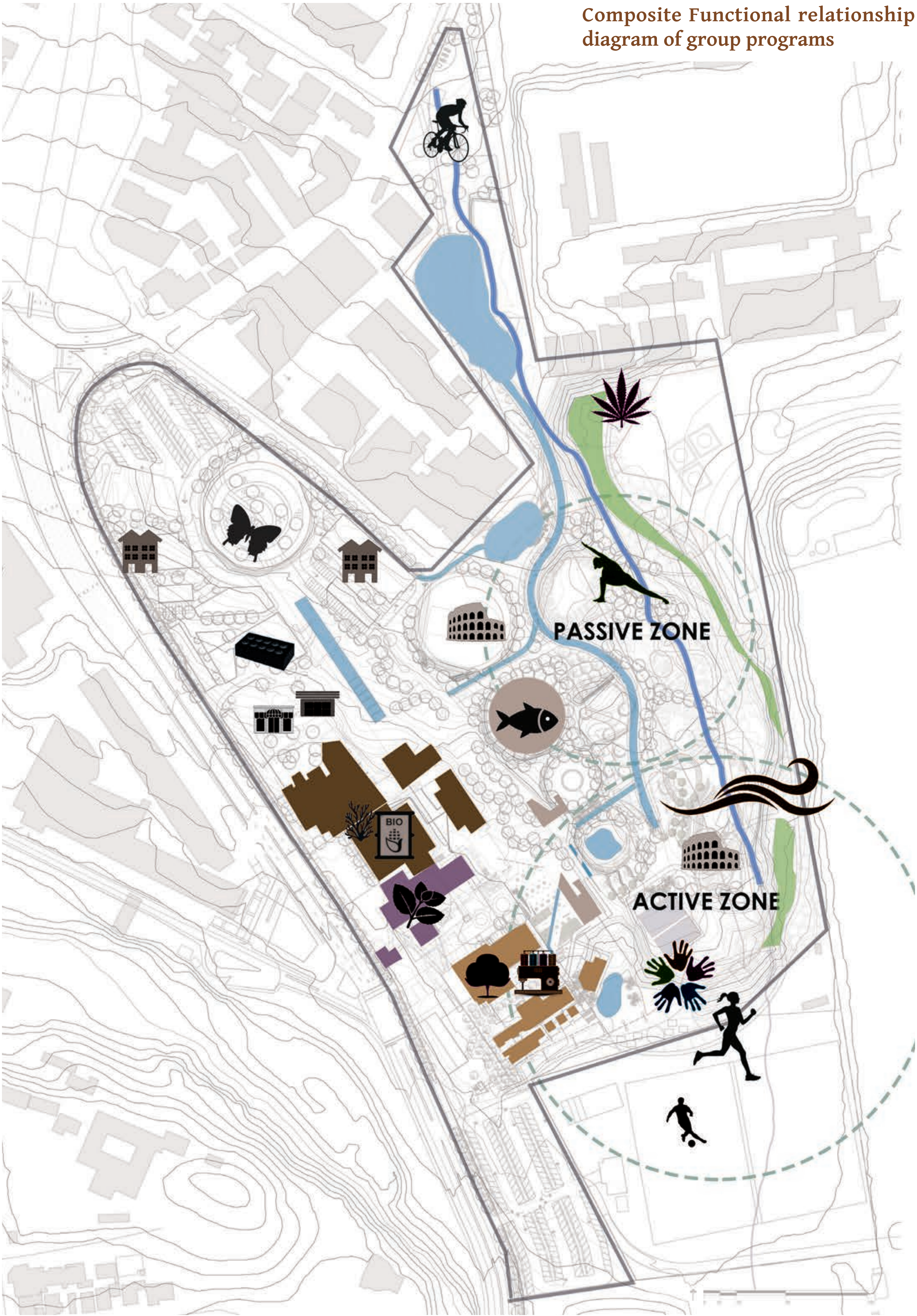


Fig 6.2. Composite Functional relationship diagram of group programs (Author, 2017)

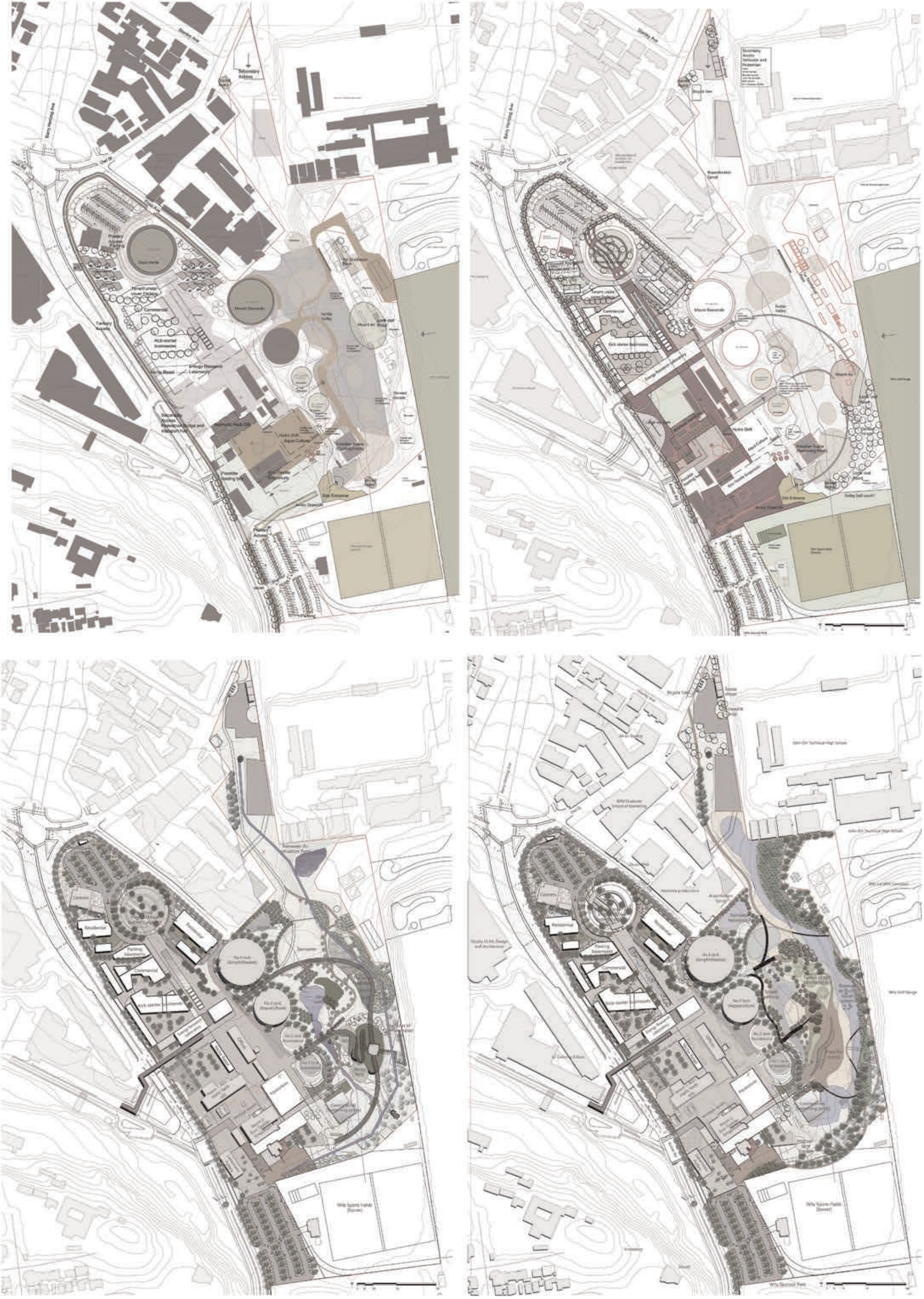


Fig 6.3. Development of Precinct Plan (Author, 2017)

Final Precinct Plan

Fig 6.4. Final Precinct Plan, 1:1000 (Author, 2017)

Spatial organisation of the Precinct Plan

Egoli Gas are currently still distributing gas (derived from Mozambique) from the site to the rest of Johannesburg, but there has been notions of relocation to another site further from residential areas in the near future. It is therefore assumed that the gas distribution process will relocate.

Vehicular/Pedestrian Access

The following parking areas are provided: to the North of the site with entrance in Frost Avenue just off Owl Avenue; to the South a parking area is also provided. These access points becomes the primary access points, see Figure 6.5.

Pedestrian access

Secondary access points will be discussed. Allowances are made to perforate the site from Annet Rd at the Kick-starter businesses, at the Energy Research Laboratory as well as the Eco-Textile Emporium.

A Pedestrian bridge from the University of Johannesburg and pedestrian crossings over the busy Annet Rd are proposed.

The steep slope on the Eastern side requires a bridge to access the site. Access can be gained from the University of Witwatersrand by this means. This bridge will later be partially broken down when the life expectancy of the applied material (bamboo) has superseded. However, the thick bamboo culms will be retained and re-used as pergola/ shading structures. As the rehabilitated soil mounds form, it will provide a more pedestrian-friendly slope for pathways from the Wits Golf range.

Access can also be gained into the site with a bridge from the Wits Sport Fields, which will be opened up for public use as part of a Public-Private Partnership. The same will happen as stated above, when the bridge life expectancy has come to a close end and the rehabilitated mounds have formed, access can be gained through walkways.

Pedestrian access is allowed from the North-Eastern part of the site In Owl Street next to the John Orr Technical High School.

Public transport

A bus lay bye are provided at the Bunting Rd/ Annet Rd intersection in Annet Rd.

Services access/ loading bays

Services entrances are required for delivery and loading at the various programmes. An entrance is provided mainly for the Aquaculture programme where Frost Avenue ends. It goes around the Gas tank No. 4 and ends between Gas tank No.3 and 4. For the Aromatic Herb Oil distillery programme a loading bay area with limited parking areas are proposed at the location which is currently the main entrance to Egoli Gas. Another loading bay is proposed from Annet Rd servicing the Eco-Textile Emporium.

Residential access

Two residential complexes are proposed. Access to the Western residential units can be gained from one of the main entrances, the entrance in Frost Ave. The residential units on the Eastern side can be gained from another entrance in Frost Ave.

Planting Strategy

As two of the programmes rely on herb fields/ plantations as a main requirement to their functionality, it is proposed to be planted on areas not contaminated. The hemp, Stinging Nettle and flax requires a damp and semi-shaded micro-climate. It will be planted on the steep slope between proposed indigenous forest as well as integrated between the buildings of the various programmes where the micro-climate allows for its growth.

The herbs will be planted as part of a hydroponic system in Retort No. 1, however more space is required, therefore the Bay Laurel trees and rosemary will be planted in a manner that allows multiple options of moving through it intertwined on the Western side of the site. These plants become a temporary physical barrier/ edge to the street, yet allows visual access and pathways at points to infiltrate the site. The smell of the aromatic rosemary and Laurel trees will add to the experience of the user, see Figure 6.7 on the opposite page.

Other plants and trees utilised as part of the phytotechnology applications as well as landscaping purposes will be planted on-site by means of horticultural therapy in the nursery area proposed to the South of the site, refer to the Technical Chapter, page 104 where planting strategies are discussed in more detail.

Systems: water and soil

A cut-off swale is proposed which receives a constant water flow from the Spruit through a drop inlet pipe. The function of the cut-oof swale is to purify development water (grey-and rainwater).The highly contaminated soil will be mounded and mycoremediation applied. As the soil is rehabilitated, it will be scraped one meter from the top annually and heaped to form new mounds forming part of a new narrative. Refer to the hydrological systems discussed on page 98.

Various users of the functions provided in the Precinct Plan

Daily use

Business people; Residents; management of restaurants; Security

Weekday use

Business people; Staff - oil distillery, aquaculture; Energy Research Laboratory, Eco-textile mill; Niche Retail; Researchers; Young professionals; harvest plantations; Utilise social steps as lunch area; homework areas; passive mounds for meditation.

Pedestrian and cycling routes (Commuting to work or recreational) **:** 44 on Stanley; Business people; John Orr Scholars; Park visitors; Film Students (AFDA); Residents; Film Students (AFDA); Marketing Students; UJ, Wits Students

Sport-related activities: Park visitors Sports enthusiasts

Weekend use: Heritage interested visitors; Church @44; Customers to the oil factory, aquaculture, restaurant, beer and tea garden, niche retail; visitors at the events plaza; Park visitors Sports enthusiasts.

Fig 6.5. Spatial organisation of Precinct Plan: Access and choice (Author, 2017)

Fig 6.6. Spatial organisation of Precinct Plan: Water and Soil (Author, 2017)

Fig 6.7. Spatial organisation of Precinct Plan: Vegetation zones (Author, 2017)

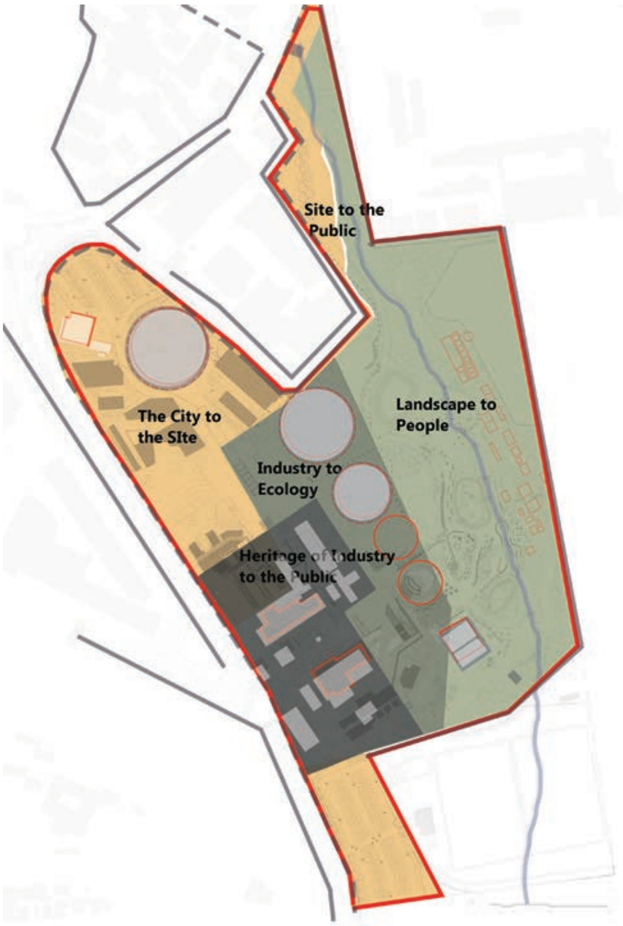


Fig 6.8. Spatial organisation of Precinct Plan: Restituted relationships (Author, 2017)

6.2 Development of the Master Plan for restoration of the site

Master Plan informants

It was considered to mound the highly contaminated soil, the apply phytoremediation as part of natural restoration. It was considered to divert the Braamfontein Spruit running underneath the site, but after careful GIS overlay, the correct delineation of the Spruit could be established.

Master Plan inspiration

From site analysis

The general- and highly contaminated soil areas provided vital information as this areas effects and determines the design.

The contaminated groundwater poses a risk to other groundwater users if left untreated. It might migrate off-site within an estimated 12 -100 years. This needs to be treated. Remediation strategies were drawn from the Georem report performed on this site as discussed under Chapter 2.

The steep gradient along the Southern and Eastern sides of the site creates a valley fill area within the centre and the topography would influence the water flow towards the lowest contours on-site. The open cut-off swale has been designed to follow the lowest points.

There are remnants of the tar distillation plant as well as purification plant foundations. The purification plant will be re-adapted as part of the Eco-textile water purification system. The cooling ponds are situated also within the Strategy plan area and will be reused as public swimming pools.

Master Plan Informants

Fig 6.9. Model of Strategy Plan, indicating slope and soil pollution (Author, 2017)

From theory

The Open Narrative approach promotes **incomplete stages**, as this will be the case with this area. As the process of phytoremediation allows for certain areas to be opened in stages as the site is being remediated.

Multiplicity is applied by providing various entry and exit points as well as the park provides opportunity for choice or recombination.

Temporality is applied by means of applying three realities where narratives happened, happen and still will happen onto the site – it offers three different experiential layers through time. This is seen through the transient qualities of vegetation, water and soil remediation. The recuperation of site specifics and a sequence of movement forms part of this process.

Value structuring is achieved by remediation of the site in incomplete stages, as the user will realise the movement in soil, water and vegetation growth. The accent is on self-actualisation, realising the impact of exploitation on the environment through witnessing the large contaminated mounds being slowly remediated. The programmes allows for community identity which becomes a new narrative inscribed onto the site.

From initial technical investigations

Highly contaminated soil is proposed to be dug out up to 3m and stockpiled into mounds. The mounds will be phytostabilised with a soil stabilisation mat until the conditions are favourable for mycoremediation.

Conceptual approach

The mounds represent a universal typology of the tumulus. This design element will be symbolic of burying the old manner of exploitation. As the remediated soil layers will be peeled off and stockpiled onto new layers, the shape of the mounds will take on the natural hills of the Highveld in riverine habitats. This can then further form a new narrative reminiscent of Highveld riverine habitat.

The arbuscular myccorhiza fungi and lichens are representative of the mutualistic relationship between organisms. The fungi produce carbon which is one of the elements that breaks down pollutants in the soil. The microscopic imagery of the fungi aided in form-generation.

Inspiration from research on mycoremediation and phytoremediation

The *Pleurotus ostreatus* (Oyster) mushroom have been proven to perform the best to break down PAH's into smaller molecules by projects performed by Mycologist, Paul Stammets. It can also take up heavy metals found in soil. Mushrooms can also absorb soil vapours. Refer to page 108 for a detailed discussion.

From precedent studies

At the Seattle Gas Works Park, the highly contaminated soil was stockpiled first and clay-capped before soil tilling and other soil additions took place. The kite hill adopted the shape of pre-development Seattle. As the planning for the park started in 1971, it was prior to the advancements in mycoremediation in the early 2000s, see Figure 6.10, opposite page.

Landschaftspark Duisberg-Nord. Phyto-technologies applied for bio-remediation and programmes on the post-industrial site invigorates community identity. The evolving stages the project needs to go through in the process of healing will also be eminent in my project, see Figure 6.12.

Cultuurpark Westergasfabriek. Strategic soil placement. The events held at post-industrial landscapes serves to improve community cohesion. Pollution should not be dealt in a way too seamless that the legacy left by the industry on the site is lost, see Figure 2.11, page 23.

Louvre Lens. Hidden site specifics are exposed. The residue of the coal tar in the soil will be revealed. The open narrative approach that crosses competing discourses will also form part of approach, see Figure 2.2, page 18.

Bioremediation Park Design, Sydney. On-site bio-remediation techniques and elevated steel walkways across the site. Reappropriation of industrial remnants in landscape, see Figure 6.13.

Fresh Kills Landfill, Natural restoration for the sake of recuperating natural habitat and for good eco-system functioning. Community – cultural and educational programming forms part of the cohesion of the site. Nature has value in itself and contributes to the well-being of people, see Figure 11.

Kokerei Zollverein, The adaptability of post-industrial landscapes to be repurposed and new layers of memory to be created on it through community activities such as swimming, jogging, cycling etc, see Figure 2.10, page 23.

Fig 6.10. Kite Hill on Seattle Gas Works Park (Pinterest :2017)

Fig 6.11. Fresh Kills Landscape (Fieldoperations 2017)
Fig 6.12. Emscher River at Duiburg-Nord (Latz 2011)

Fig 6.13. Steel platform above preserved sandstone and oil tank foundation (Coxall:2017).

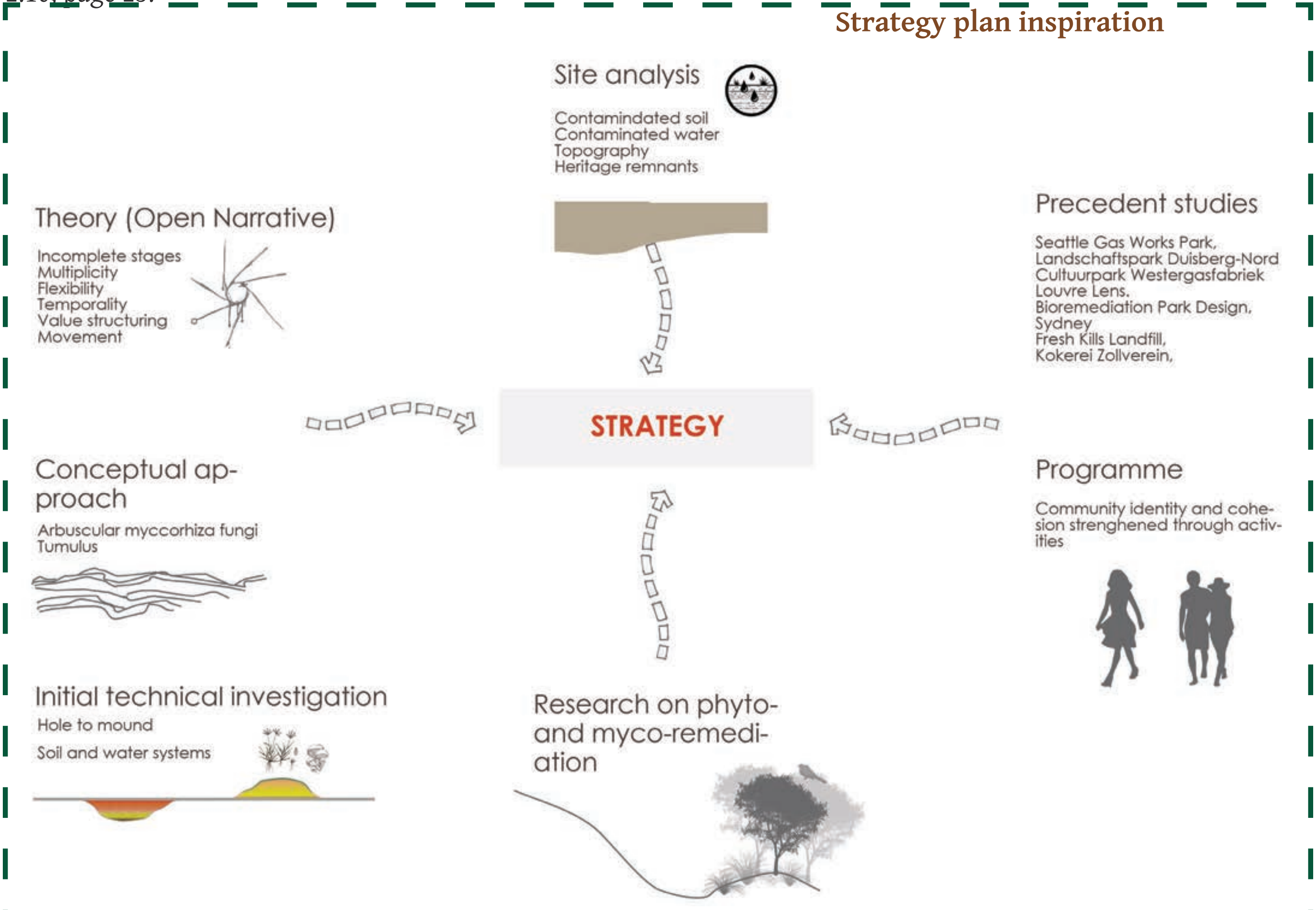
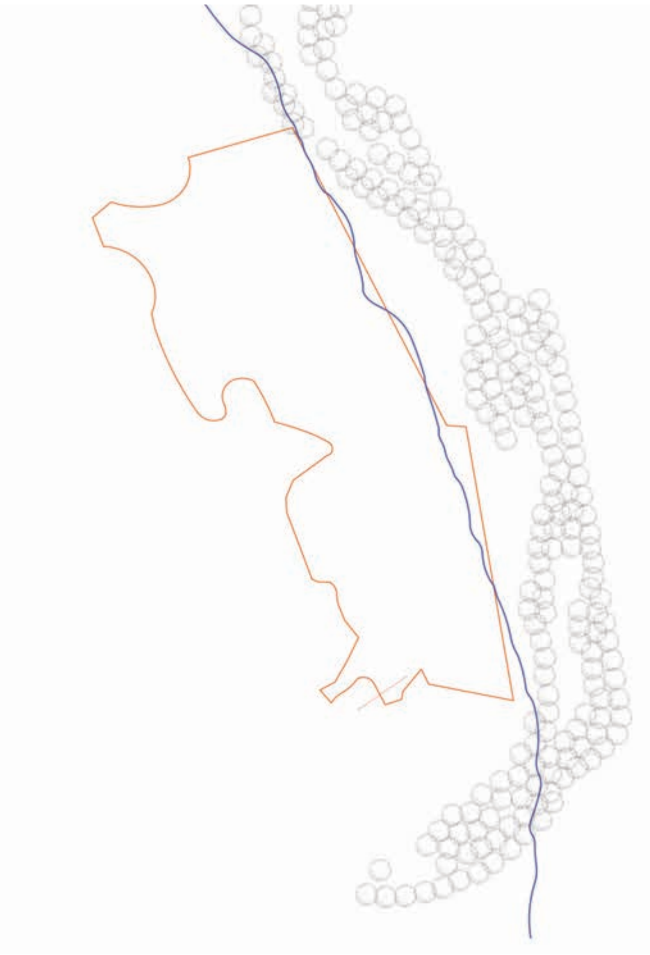


Fig 6.14. Composite Functional relationship diagram of group programs (Author, 2017)

Stage 1 (Year 1)

Remove alien invasive vegetation in contaminated area and to be sent to a toxic waste facility. Eucalyptus and black wattle to be re-used harvested from steep slope.
Plant bamboo on steep slope.

Site Preparation.



Stage 2 (Year 1, month 7)

Mound highly contaminated soil.
Apply soil stabilisation mat and fill remaining holes with building rubble.

Shift highly contaminated soil.

Fig 6.15 .Stages of implementation for the Master Plan, (Author, 2017)

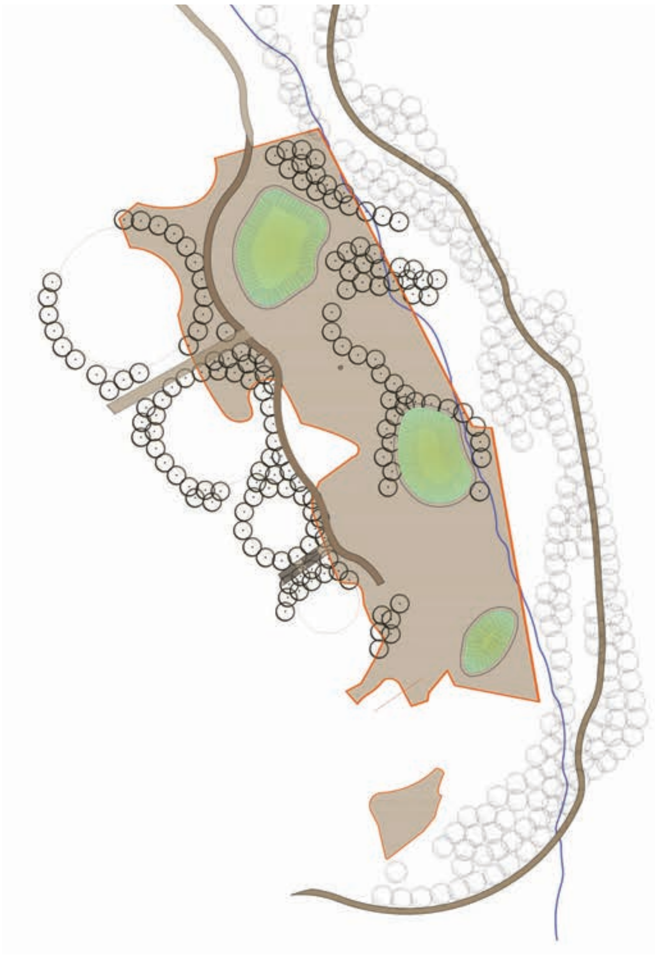
Stage 3 (Year 2-4)

Till soil, add composting materials and effective mircro-organisms.
Hydroseed.
Plant trees for phytoremediation.
Routes around site.

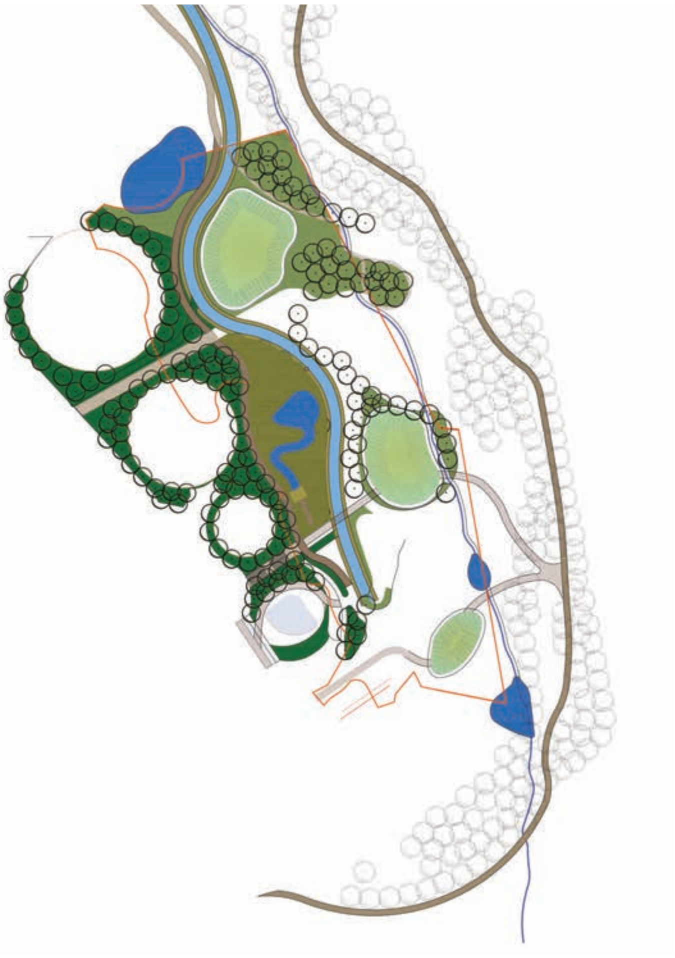
Stage 4 (Year 4-8)

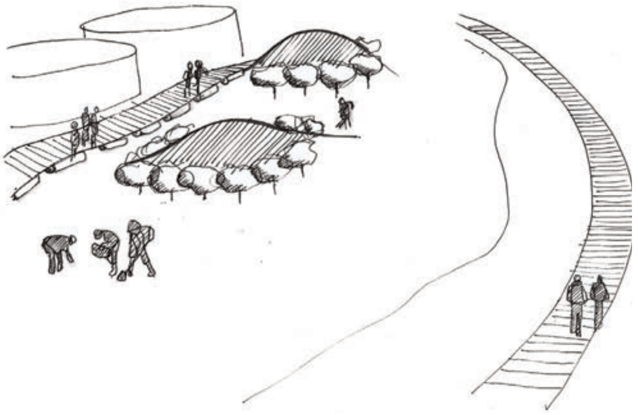
Other phytotechnologies applied.
Implement contaminated water purification system.
Build bridges over contaminated soil (irrigation attached for mycoremediation).
Implement textiles water purification system.
Implement cut-off open channel along with rain and greywater purification ponds and swales.

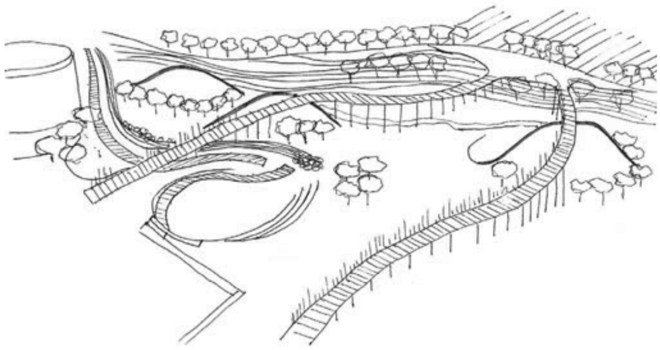
Soil preparation.



Further remediation and bridges.



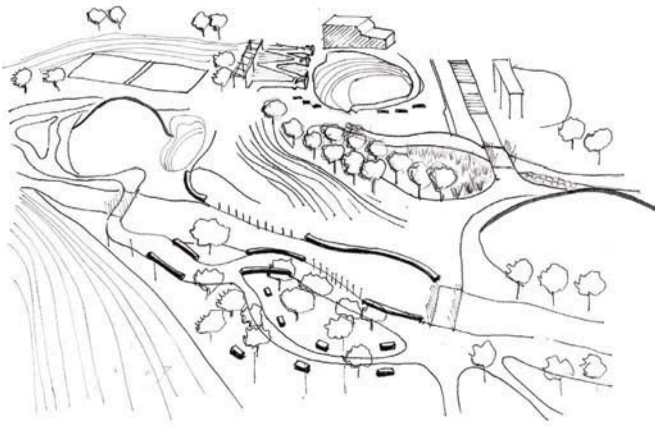




Stage 5 (Year 8-11)

Plantations to be planted.
Indicator species to be planted for environmental monitorring.
Opening of swimming pool area, events plaza, waterfront edge seating.
Landscaped area around eco-textile water purification.

Communal area opens.



Stage 6 (Year 12)

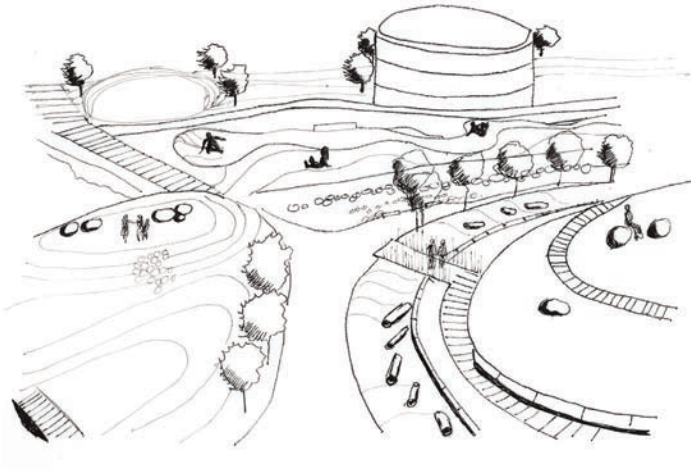
Active mounds become areas of exercise 'ladders'.
Passive mounds becomes meditation mounds and childrens' play areas. Both types will be planted to some extent.
PET tolerant indicator plant species planted.

New mounds completed.

Stage 7 (Year 20)

Site fully bio-remediated (inorganics in water fully remediated with phytotechologies.)
Skate park to be built in remnant of contaminated water purification system.

Site design completed.



Development of 1:500 Master Plan

That which derives from the developed areas are more linear and relates to the historical process of gas flow. That line is therefore extended into the landscape as entry points to the park. Bridges forms a further extension over the contaminated soil mounds. The bridges will be built in stage 4. Routes are provided for the workers around the park area to the plantations. In the final stage the bridges will be broken down with the thick bamboo culms staying intact which will be re-used as outdoor gym equipment and for a pergola structure providing shade for bicycles.
The images in Figure 6.20, page 84 all represent stage 6 of the park development.

It was decided to open up the Braamfontein Spruit to restore possible lost riverine habitats with the closure of it.

Various meandering routes allows for multiple experiences and choice or recombination, see Figure 6.16 below. The ‘active’ mounds are in close vicinity to the main entrance of the park and the ‘passive’ mounds more to the North.

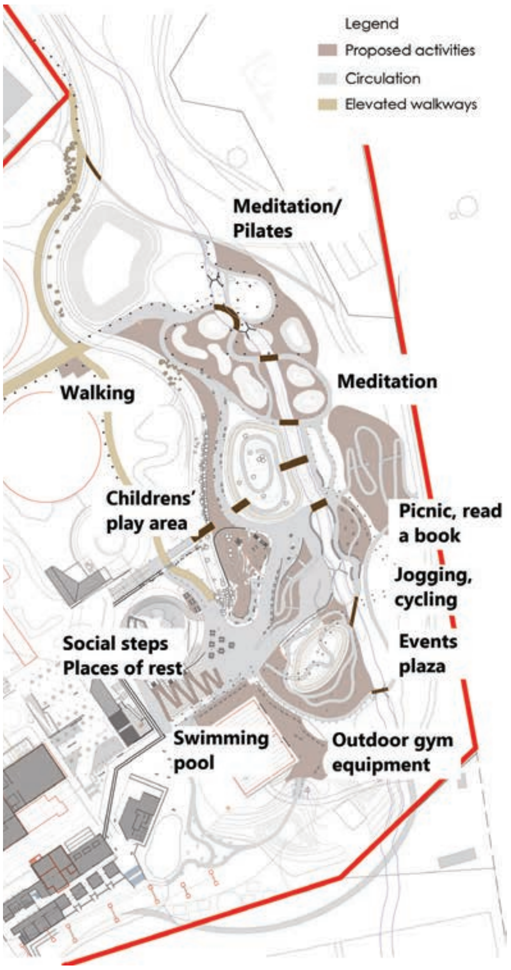
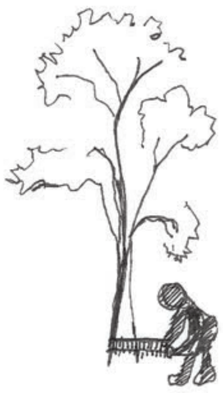
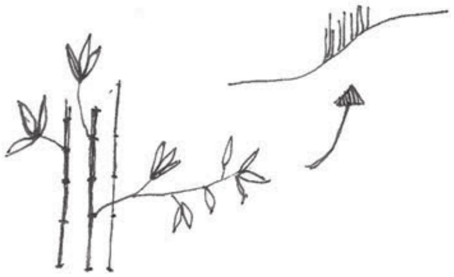


Fig 6.16. Circulation and proposed activities in the Master Plan area (Author, 2017)

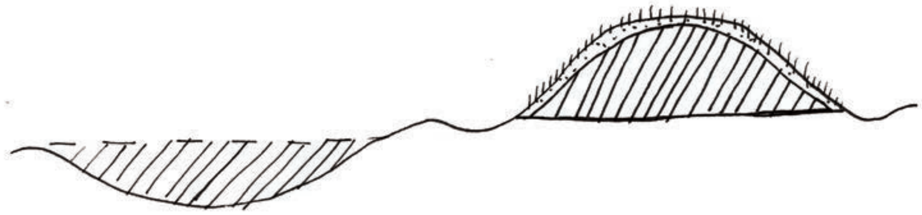
1.





Remove alien invasive species **Plant bamboo on steep slope**

2.



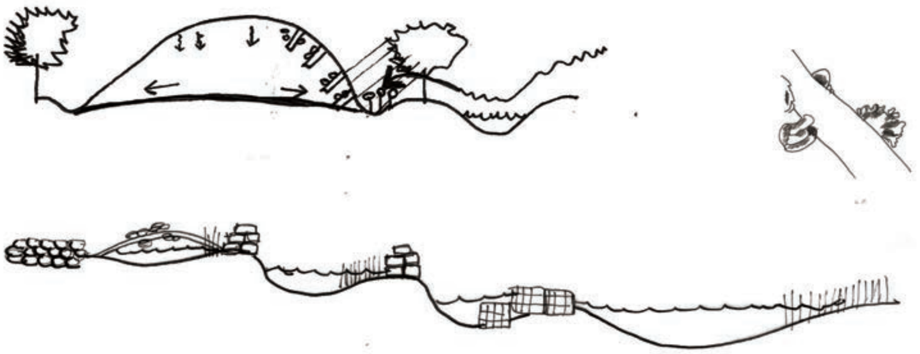
Shift highly contaminated soil

3.

Till soil, add: compost; compost tea; water and oxygen.

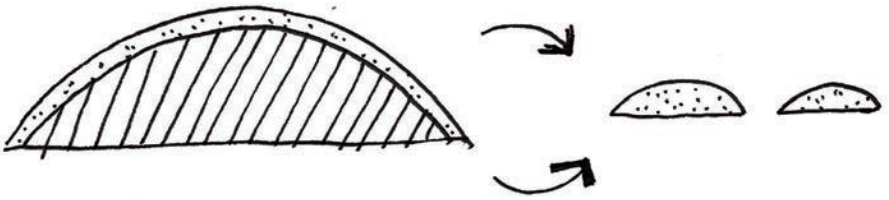
Fig 6.17. Rehabilitation process illustrated (Author, 2017)

4.



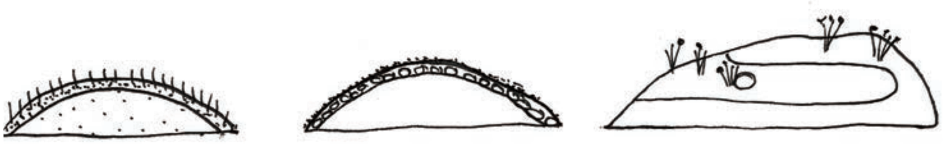
Apply mycoremediation. Implement contaminated water purification system.

5.



One metre of rehabilitated contaminated soil peeled annually and stockpiled.

6.



New mounds re-used as meditation mounds/ play area. Soil sealed with soil stabilisation mat and rubber matting.

7.

One metre of rehabilitated contaminated soil peeled annually and stockpiled.

The clay exploration models were made as part of an investigation to determine entry points into the Master Plan area. The experience from the upper reality was explored through the use of skybridges which link the entry points to a great mound of contaminated soil. Another clay model was made to show the stages that the contaminated water need to go through.

In the flour and cardboard model, the shapes of the mounds was explored. It was decided that the contaminated soil mounds would have a more unnatural 'mount' form. The form that the rehabilitated mounds take on would be more natural, reminiscent of the Highveld landscape. The use of micro-climate was also explored in order to create favourable conditions for the mycoremediation process. The waterflow of the cut-off swale were mainly determined by the lowest contour levels and points but also some inspiration were drawn from the intertwined linear shape of the arbuscular myccorhiza fungi.

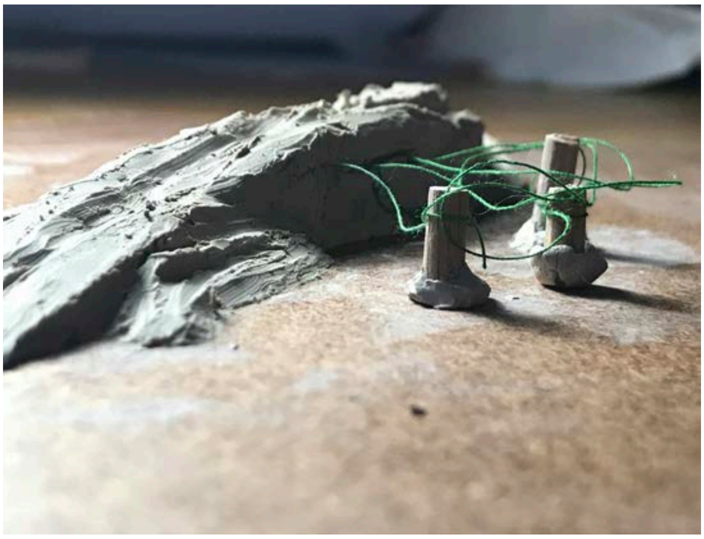
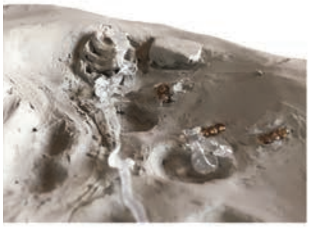


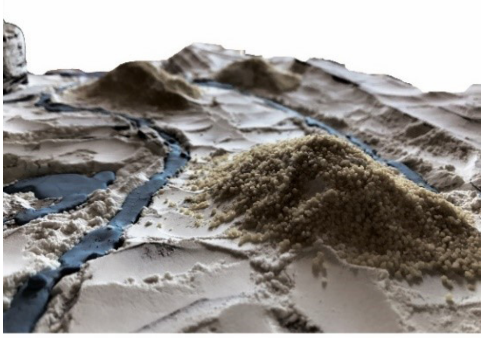
Fig 6.18. Opposite top right: Models from clay to explore transience with height and elevated walkways/ bridges Author, 2017)

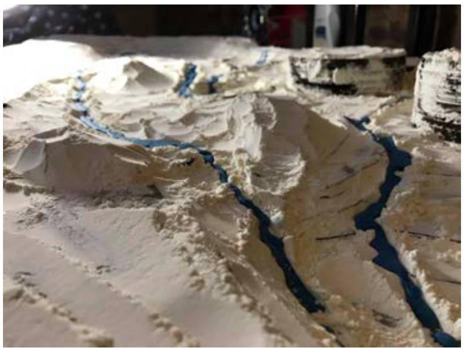
Fig 6.19. Opposite below: Models from cardboard and flour to explore micro-climate, form of mounds and cut-off swale waterflow (Author, 2017)

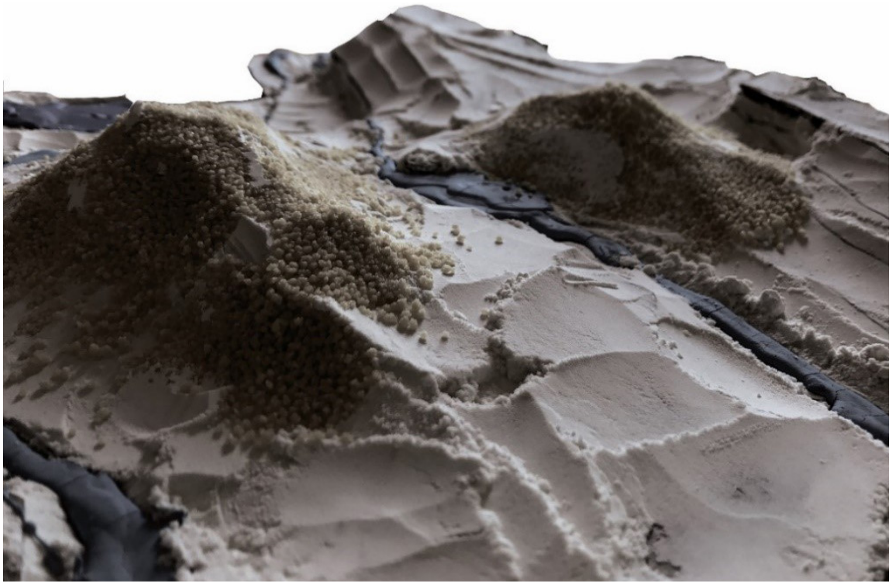
Fig 6.20. This page: Models from clay experimenting with the mounded pavilion inspired by the arbuscular myccorhiza fungi (Author, 2017)

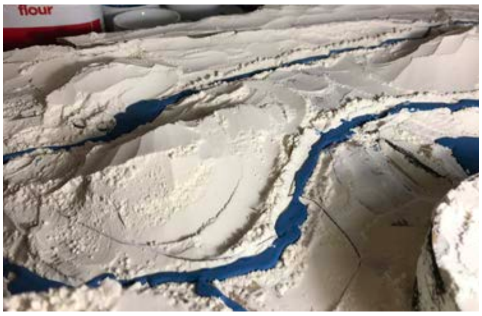
Exploration models











Development of 1:500 Master Plan

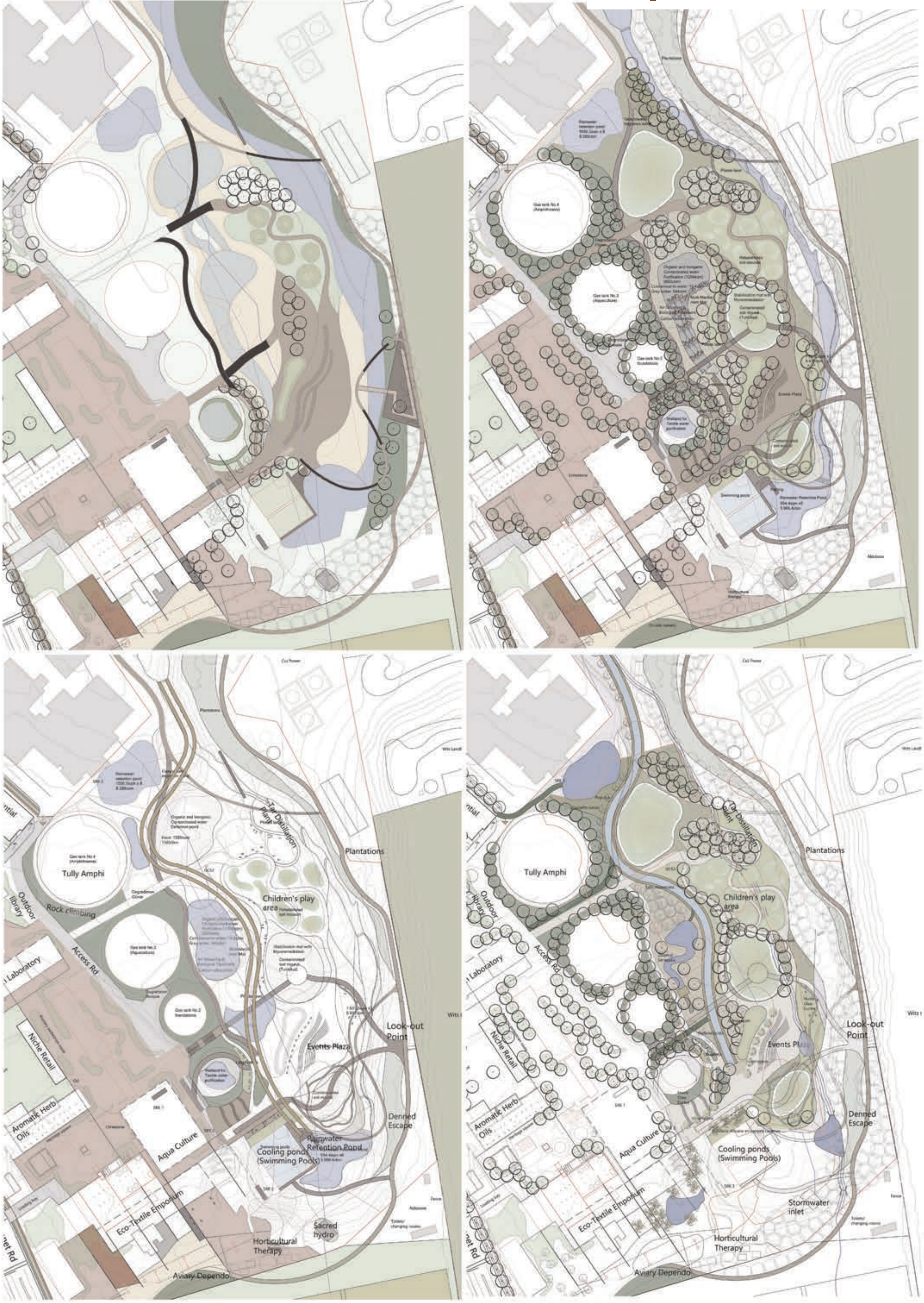


Fig 6.21. Development of 1:500 Strategy Plan (Author, 2017)

Final 1:500 Master Plan

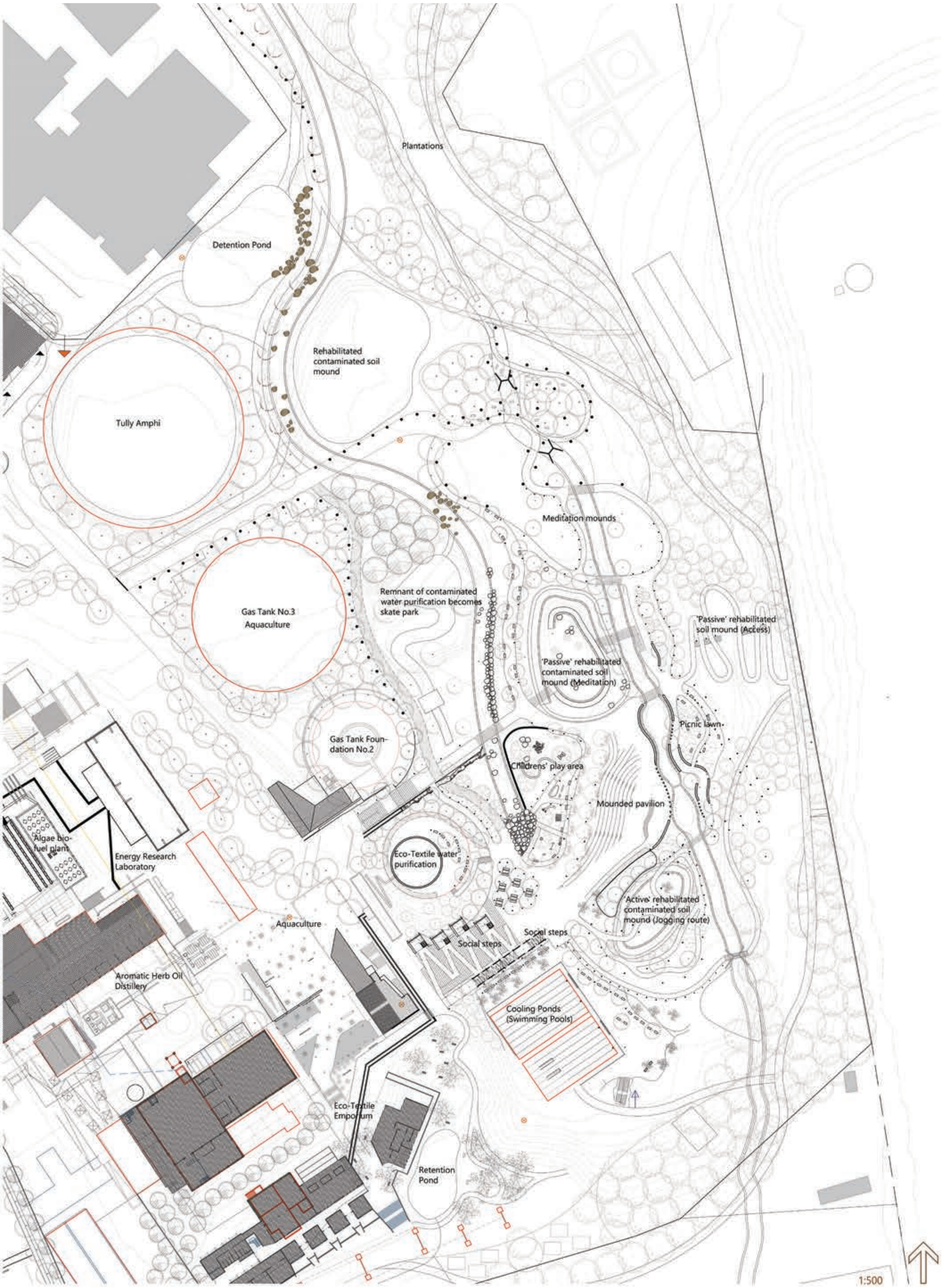


Fig 6.22. Final 1:500 Master Plan (Author, 2017)

6.3 Development of the Sketch Plan

Introduction

The area for the Sketch plan was selected for the following reasons:

- It contains remnants of the Gas Works to be re-appropriated (Cooling ponds and foundation of purification plant, the former gas tank no. 1 foundation.
- It is a main area of energy and activity where various activities will be performed to strengthen community identity. It is also the social heart for community gathering and identity.
- The area contains a placed contaminated mound that will be remediated.
- The differences in surfaces includes: paving, raised walkways and bridges portraying the three transience realities.

Sketch Plan Development

The following principles of the Open Narrative approach were applied in the design: multiplicity, temporality, recuperation of site specifics, value structuring, experience, incomplete stages and a sequence of movement. As part of the Methodology, the three realities/ narratives have been used from where the tangible and intangible can be experienced: a lower, an in-between and upper reality with increasing levels of transience.

The mounds become symbolic to the exploitation narrative by means of the association of a tumulus with burial grounds. The changing mounds becomes an aid to mental signification, as the visitor moves along a journey, it becomes a reference point. Through visiting the site on various occasions the transition is witnessed. This relates to the in-between or intermezzo where bio-remediation takes place. The upper reality

Photos of the Sketch Plan area

Fig 6.23. Photographs of Sketchplan area(Author, 2017)

Sketch Plan Focus Area

Fig 6.24. Sketchplan focus area (Author, 2017)

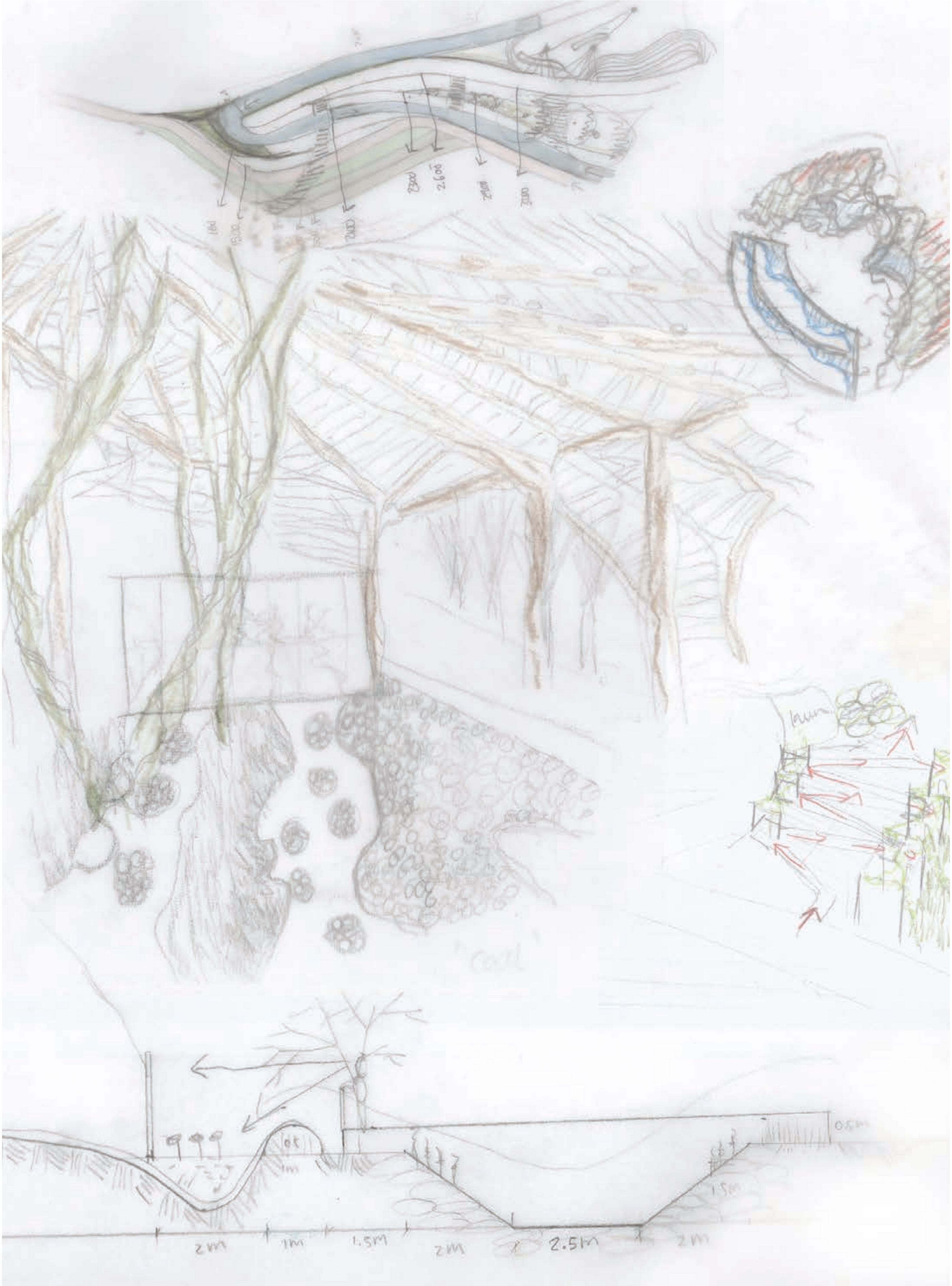
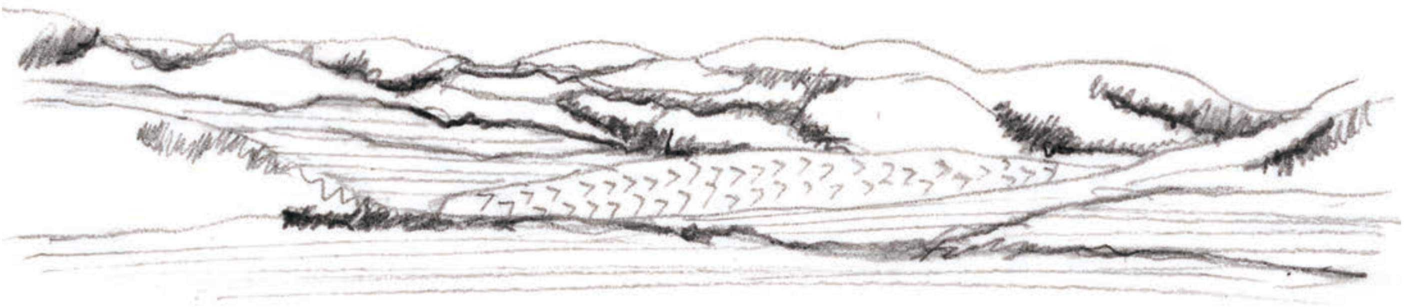


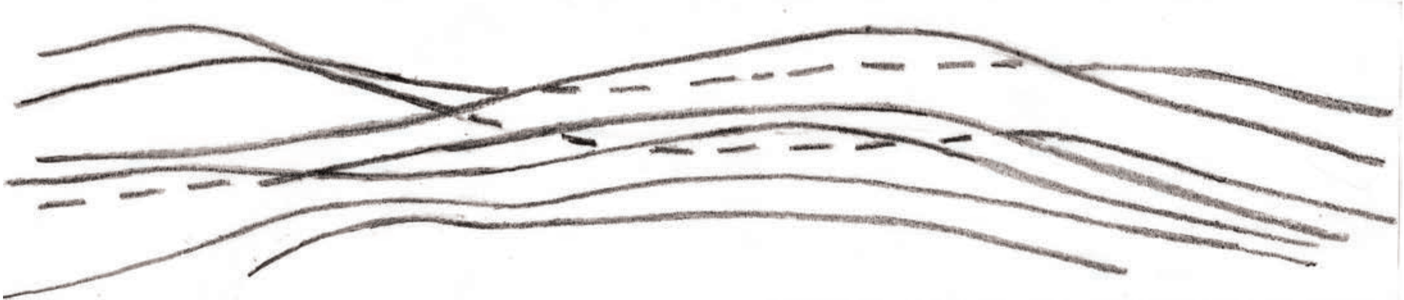
Fig 6.25. Sketchplan process sketch compilation 1 (Author, 2017)

Fig 6.26. Sketchplan process sketch compilation 2 (Author, 2017)



Hilly Highveld Landscape

Arbuscular Myccorhiza Fungi



Fungi and Highveld abstracted to form

Fig 6.27. Hilly Highveld Landscape and Arbuscular Myccorhiza abstracted to form (Author, 2017)

Sketch Plan Development: Mounded Pavilion

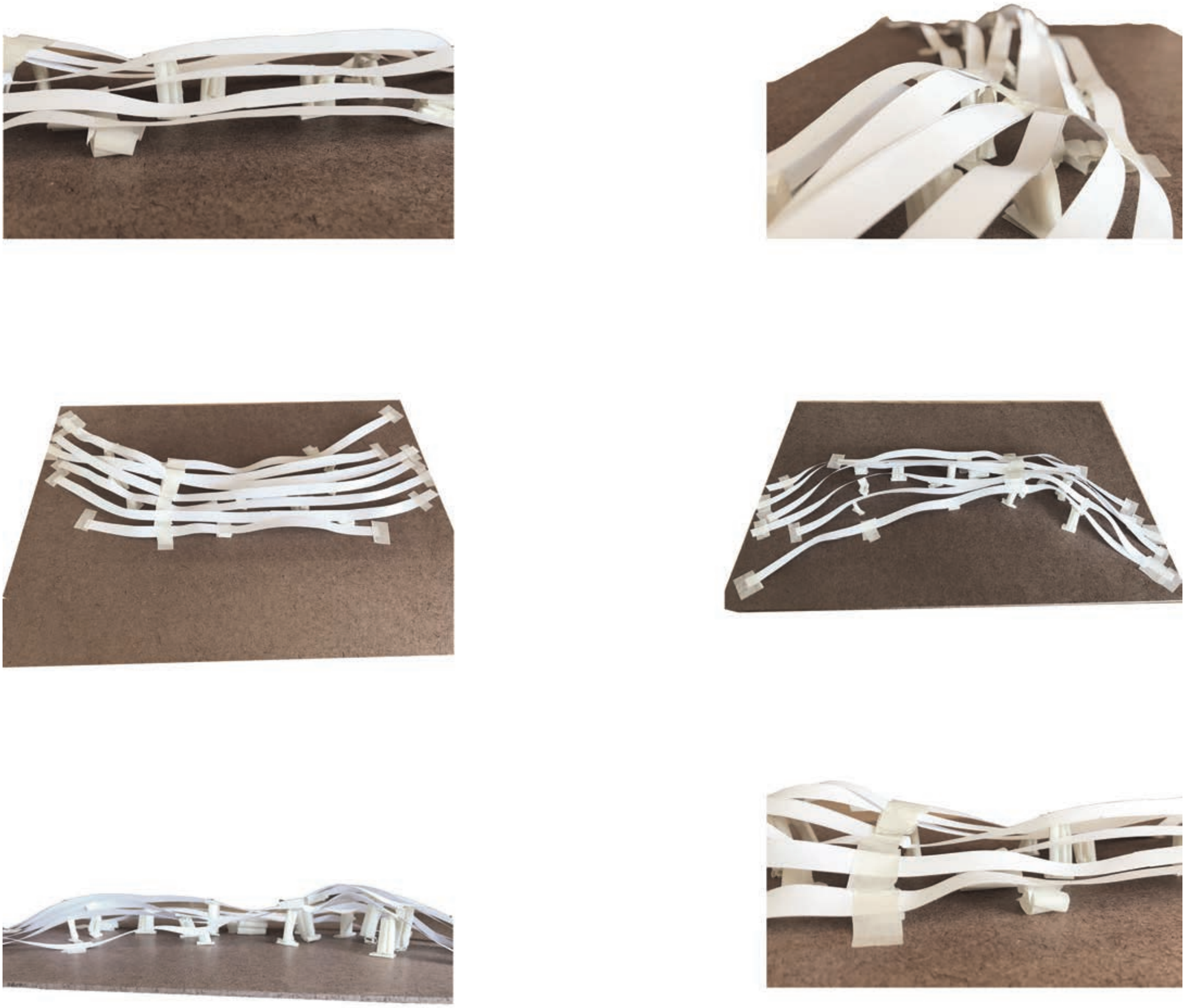


Fig 6.28. The Arbuscular myccorhiza fungi abstracted to give form to the mounded pavilion (Author, 2017)

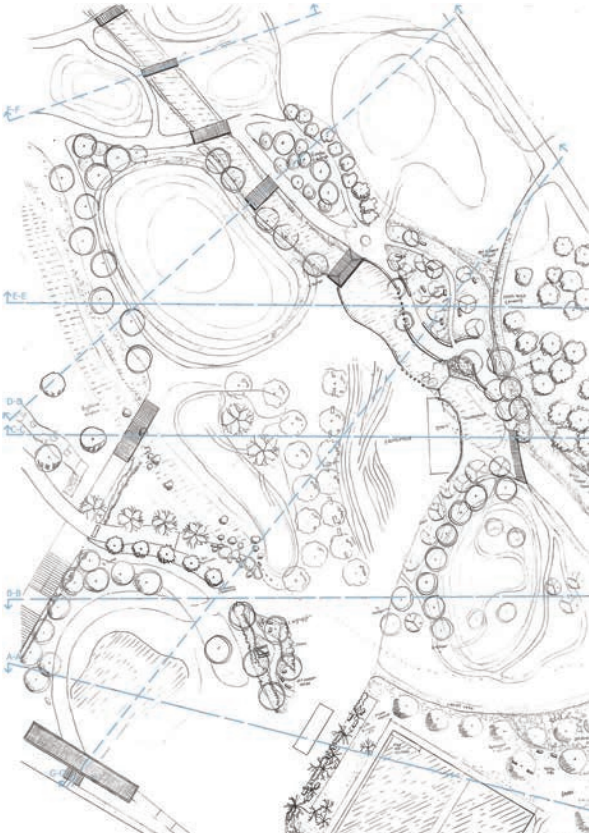


Fig 6.29. Sketchplan development through iteration (Author, 2017)

can be experienced as the visitor transcends up the mounds, per bridge or per walkway depending on the stage the project occurs within at that stage. Therefore, the landscape will be experienced from a bird's eye view seeing the natural restoration processes and the movement of water, vegetation (succession, growth and colour), soil and other users. The bridge crossings over the water are close to the upper reality and a holistic approach of mutualism can be seen through out the site. The lower reality consists of the historical layer: which consists of: The Gas tank foundation No.1, cooling ponds, the holes and the foundation remnant of the purification plant. There is a constant interplay between the upper and intermezzo reality, with some areas cordoned off until remediation has taken place, then it is opened for proposed activities, see Figure 6.15 on page 80.

The concept involved the arbuscular fungi pattern which are evident in the general form-giving of the sketchplan area. The extrapolated form from the pattern involves a language similar to snakes lying next to each other. One line becomes the next and pops out a little further, all lines effectively intertwined and part of a whole, refer to the mounded pavilion detail 2 on page 134. Not only does the fungi relate to form-giving, but also its function of mutualism is conveyed throughout the design, refer to detail 5 ,on page 143 where the transition of the new paving surface transition to old bricks mediated by mycelium bricks absorbing soil vapours from the old bricks. *Interdependence* is conveyed throughout the design.

A new inclusive narrative is realised on the site by experiencing natural restoration but also by proposed activities. Community identity and cohesion is fostered through: active and passive outdoor sporting activities (Swimming pools, jogging, cycling and urban outdoor fitness classes); play area; events plaza; social steps; meditative mounds and picnic lawn.

Multiple entry and exit points are provided into the Sketchplan area, with the main entrance being a stramp from the South-Western side. It becomes a place of arrival and seating/ shelter spaces are required for people to linger in this threshold space. This area can be compared to a glade (clearing) in a forest which is a natural meeting place. The stramp becomes 'social steps' where people may eat their lunch, meet up with friends, become a venue for small bands. It is a place where you can be both alone but also part of a group. Areas of rest are provided to the sides where people rest under a pergola in a 'pod' space or park their bicycle whilst attending other activities on the site.

The pergola structure - as mycelium bricks degrade spontaneous vegetation sprout that would find that conditions ideal. It becomes a planter box to be used in horticultural therapy. The remaining bamboo culms from the former bridge becomes a shading structure.

Play area for kids incorporates rubber-matted mounds and also a part of the 'hole' is incorporated but the surface is lifted to 1.5m instead of 3m deep for safety reasons. The bamboo stalks derived from the sky-bridges broken down in Stage 6, becomes useful in the play area as it hangs from the steel grid walkway over the hole so that children can run through it and provides sensory stimulation. The cut-off open swale is also adjacent to the play area and a part is open for the children to play in the shallow water between tightly packed rocks. This is the point where the clean Braamfontein Spruit enters into the swale and has not yet been contaminated with development water. The length is approximately 5m and cordoned off with bamboo stalks packed in a pattern.

The mounded pavilion is a place in the line of the route from the main entrance towards Wits. The visitor can enter the pavilion by various ramps, one can sit and meet up with friends or walk through. The space will also be used to host rehearsal shows to the public by AFDA Film School and the University Drama students. It can be used by the Church@ 44 and the New nation school t o host events.

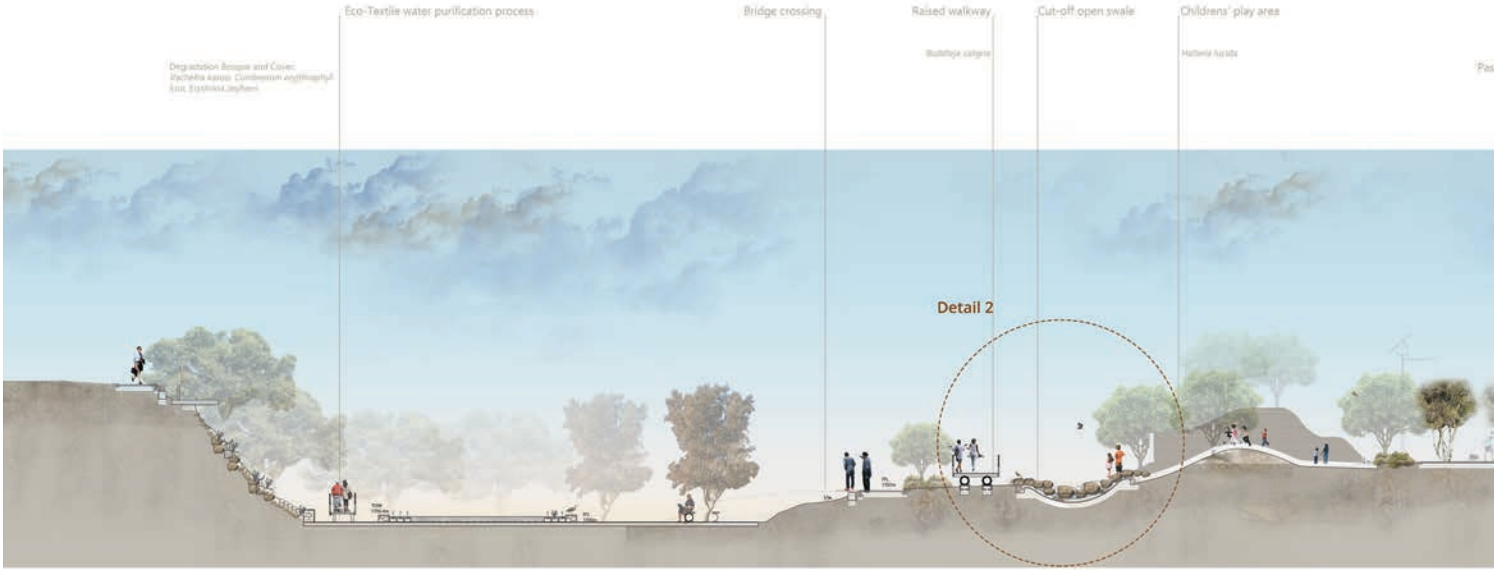
Another hole is partially preserved to accentuate the relation between hole and mound. A viewing deck is provided on the final floor level and the visitor can peek far down between the tree canopies through to the bottom of the hole. When looking up, the high mound is in contrast and compels the visitor to question the impacts of exploitation. At the same time the remediation will also be witnessed. Contaminated mound
A promenade is provided along the opened-up Braamfontein Spruit: a space for lingering and picnicking on the lawn. It also serves as a thorough route for joggers and cyclists with various walkways.

The lawned mounds to the far North can be used for passive recreation such as pilates or meditation.

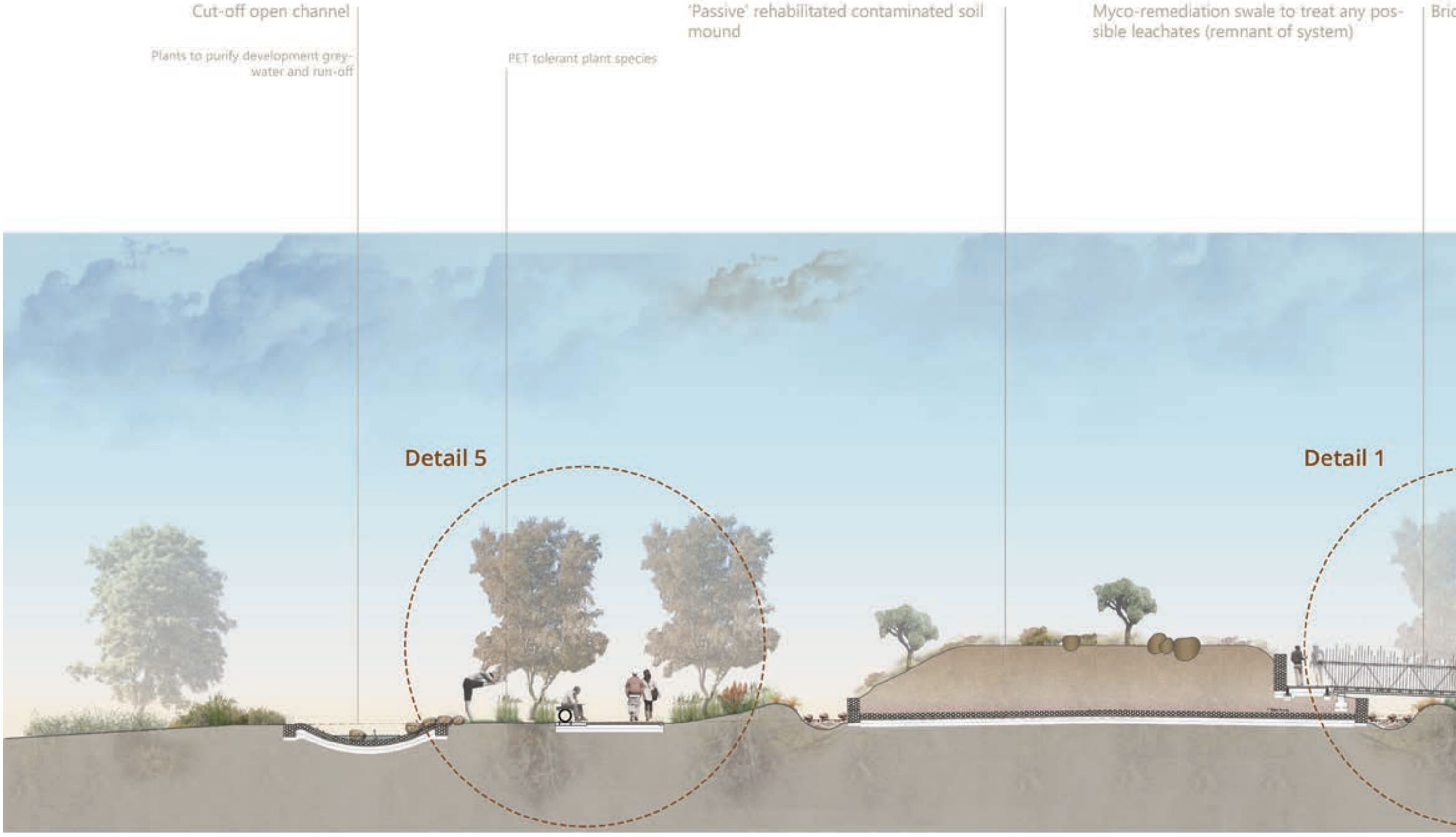
Final Sketch Plan

Fig 6.30. Final 1:200 Sketchplan (Author, 2017)

Section G-G



Section D-D



Final Sections

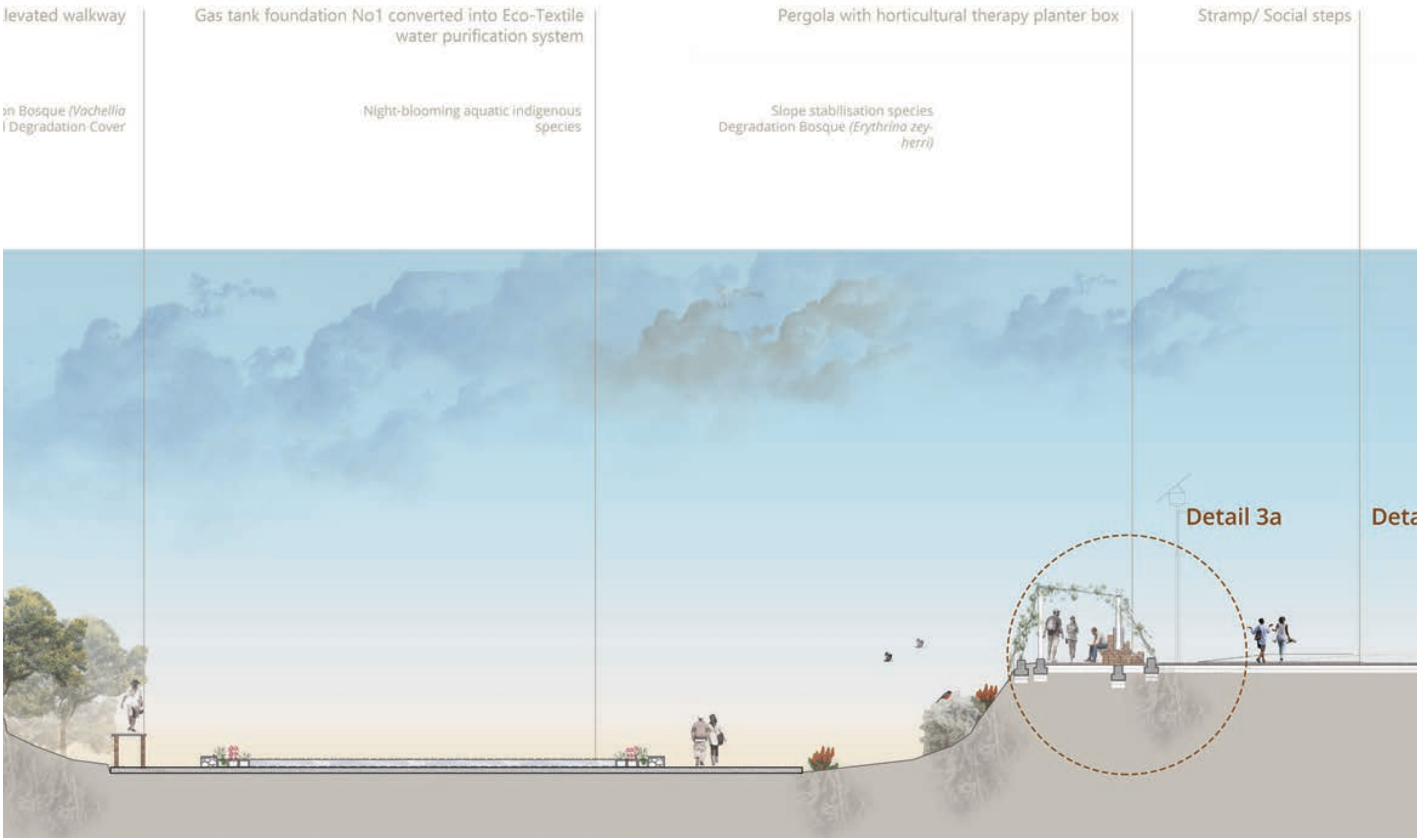
Fig 6.31. Section G-G includes the gas tank foundation no. 1, raised walkway, cut-off open swale, childrens'play area, stepped pavillion and opened up Braamfontein Spruit (Author, 2017)

Fig 6.32. Section D-D includes the cut off open swale, pilates lawn, walkway that degrades to the edges, rehabilitated 'passive' mound, bridge corssing over the opened up Braamfontein Spruit and jogging trials (Author, 2017)

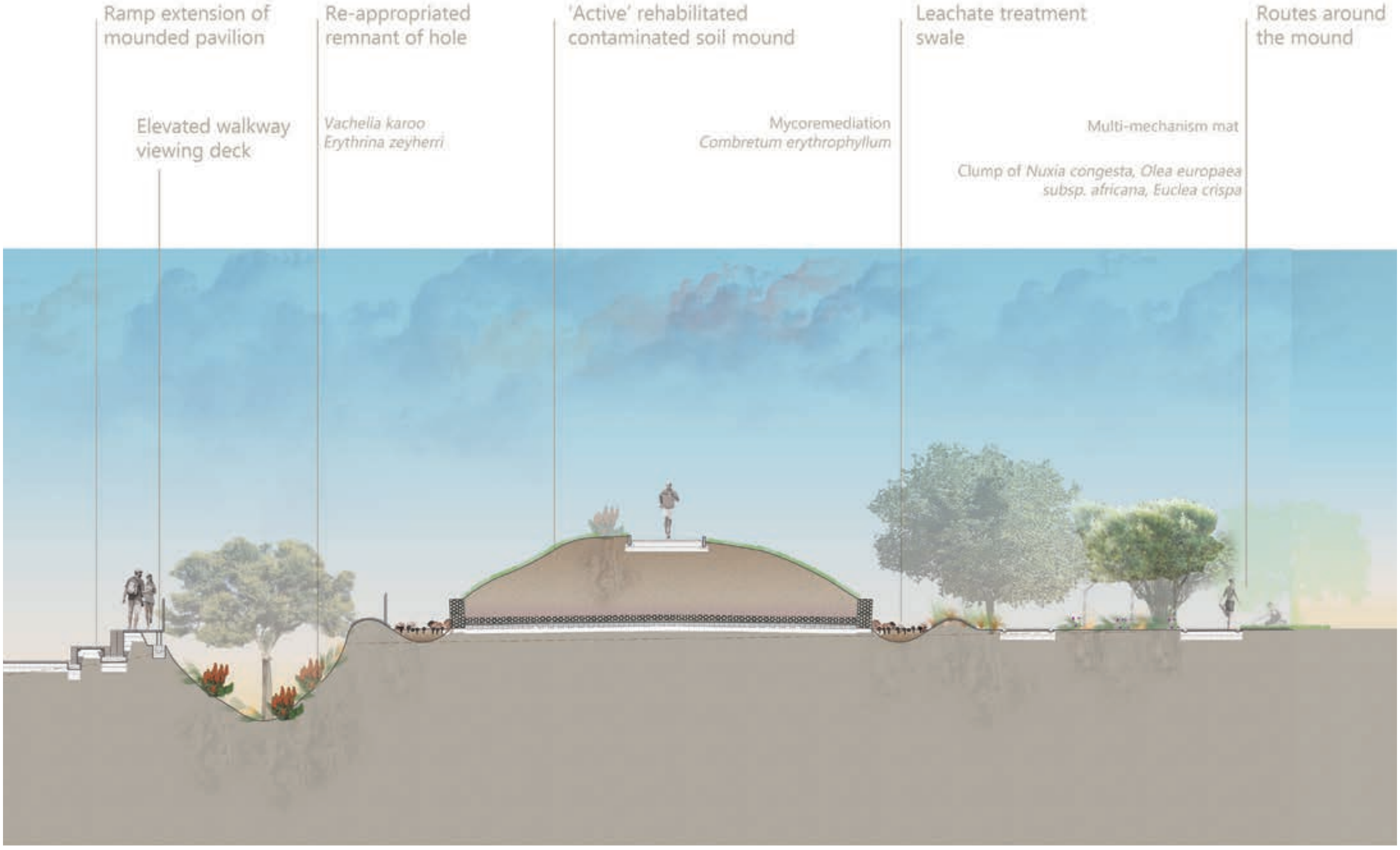
Fig 6.33, opposite page: Section B-B includes an "active" rehabilitated mound with re-appropriated bamboo bridge culms as outdoor gym equipment. (Author, 2017)

Fig 6.34. Section D-D includes a gathering place at the main entrance to the Park which becomes social steps (stramp) with places of rest to the sides under pergolas. To the sides are the Eco-textile water purification system (gas tank foundation no. 1) and swimming pool (former cooling ponds) irrespectively (Author, 2017)

Section A-A



Final Sections



Section B-B

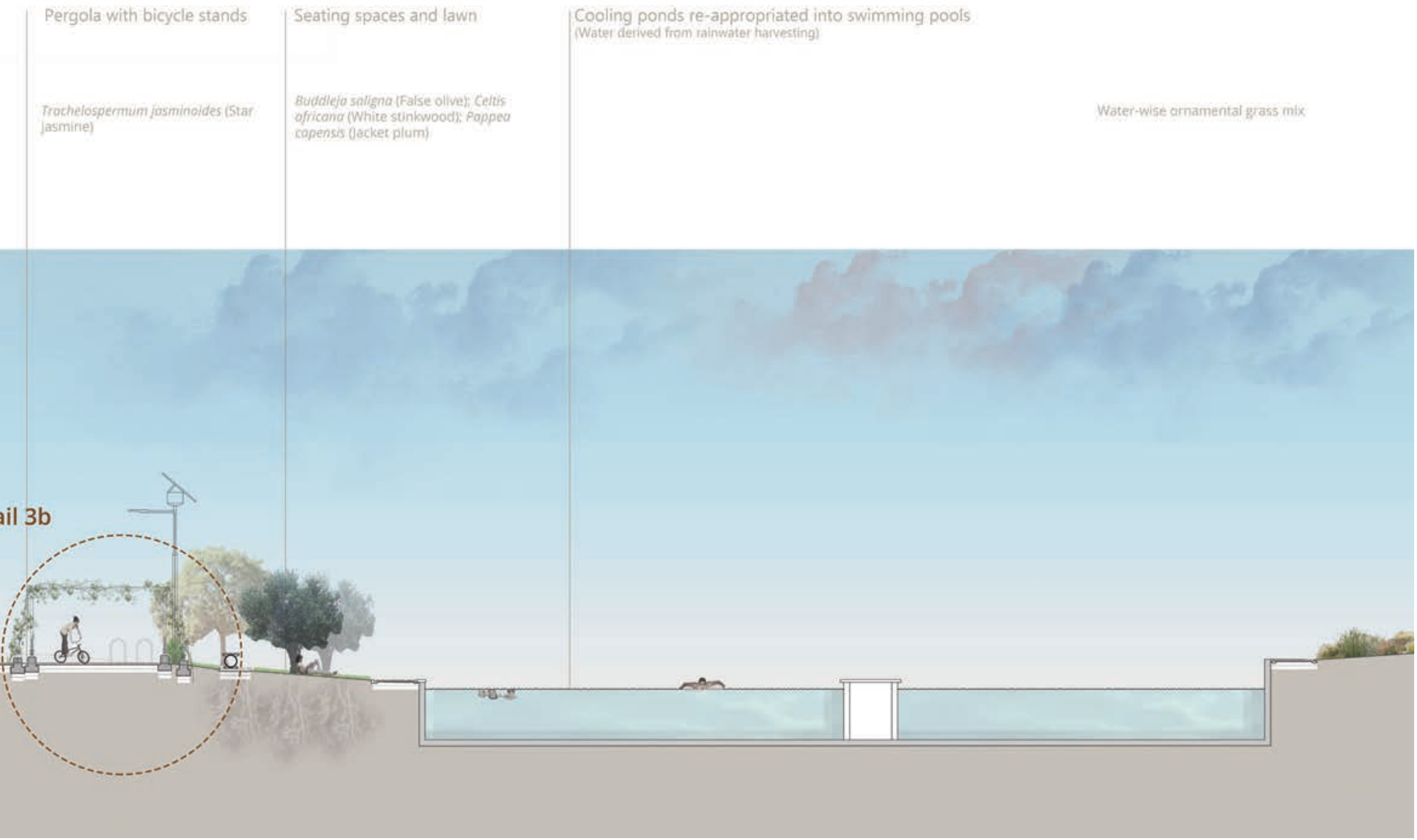


Fig 6.35, Perspective A: Gas Tank Foundation No.1 (Author, 2017)

Fig 6.36 Perspective B: Mounded pavilion (Author, 2017)

Gas Tank Foundation No. 1

Perspectives

Mounded pavilion

CHAPTER SEVEN

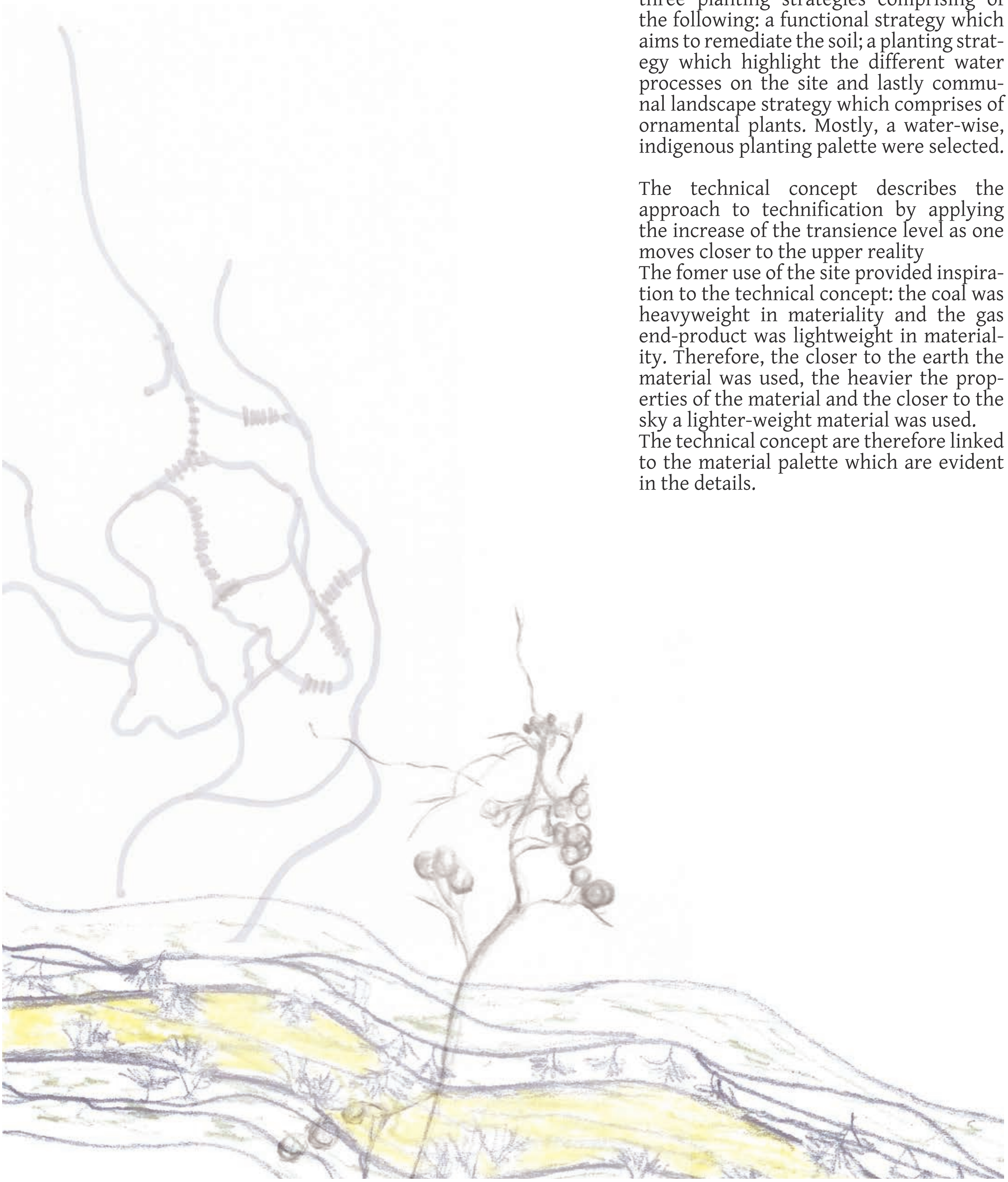
Technical resolution

Chapter overview

In this Chapter the water systems, planting strategy, technical concept, materials and details will be discussed.

The water systems consists of a sub-surface and a surface water system. There are three planting strategies comprising of the following: a functional strategy which aims to remediate the soil; a planting strategy which highlight the different water processes on the site and lastly communal landscape strategy which comprises of ornamental plants. Mostly, a water-wise, indigenous planting palette were selected.

The technical concept describes the approach to technification by applying the increase of the transience level as one moves closer to the upper reality
The fomer use of the site provided inspiration to the technical concept: the coal was heavyweight in materiality and the gas end-product was lightweight in materiality. Therefore, the closer to the earth the material was used, the heavier the properties of the material and the closer to the sky a lighter-weight material was used.
The technical concept are therefore linked to the material palette which are evident in the details.



7.1 Hydrological systems

The hydrological systems are divided into sub-surface and surface systems. The sub-surface water system describe the principles to remediate the contaminated groundwater. The surface water includes the Spruit, cut-off open swale to treat development water and eco-textile waste water purification.

The Braamfontein Spruit has its source at the Barnato School just West of the site. It is canalised underground through mainly residential areas from the source to where it daylights at the Parkview Golf Course. The Braamfontein Spruit runs South to North through the Western part and under the site at approximately 1.5 metres below the soil surface. The canalisation of the Spruit has caused a possible loss in riverine habitats and through this project it will aim to re-establish this. The Spruit's delineation is in close proximity to highly contaminated soil zones and want to prevent contamination from entering the Spruit. Therefore, the soil will be rehabilitated through phytoremediation and the highly contaminated soil will be mounded and mycoremediation will be applied. By means of an offline cut-off swale, the proposed development water will be cleansed with the Braamfontein Spruit water. The function of the cut-off swale will be primarily to capture contaminants and to establish riverine habitats.

7.1.1 Sub-surface hydrological system

The groundwater is polluted with organic and inorganic contaminants mostly at the old plant area but three other lower located boreholes have also shown variation during the monitoring process. Inorganic contaminants found during the borehole tests are the following: chloride, sulphate, manganese, magnesium and sodium with metals including iron, chrome, copper and nickel (Georem 2006: 4). The valences and the concentrations are unknown and therefore the system will be designed to remove a general level of inorganic contaminants (which are usually found in drinking water – it can become hazardous when certain concentrations exceed). The organic contaminants: phenols have become mobile and moved into the water (Infotox 2011: 6). The other semi-volatile substances have a higher molecular mass and therefore are rather found in the soil than in the water (Infotox 2011: 9).

Stages for organic and inorganic contaminated water purification:

1. Pump water from borehole
2. Ph adjustment - Limestone to higher the pH level for heavy metals to oxidise.
3. Microbial decomposition - Fungi decomposes the phenols. Mycobooms can also be used.
4. Air stripping - Fountain to aerate water for further oxidation.
5. Biological treatment - Terraces and plants to remove the residue or organic components.
6. Carbon adsorption - Activated carbon in gabions to remove the rest of the phenols and other possible organic components).
7. Release water (groundwater recharge & phytoirrigation) - Super-absorbent Polymer (Hydrogel) are used, which can hold up to 300 time its own weight. It retains water and slowly releases water to the plantations.


Fig 7.1. Stormwater channel inlet (Author 2017)


Fig 7.2. Collecting water sample from stream through gas works (Finsen pre -1940s)


Fig 7.3. Spruit as concrete channel outlet (Author 2017)

HYDROLOGICAL SYSTEM_ SUB-SURFACE WATER

AIM: DILUTION OF HEAVY METALS, PHENOLS, NOT REMOVAL

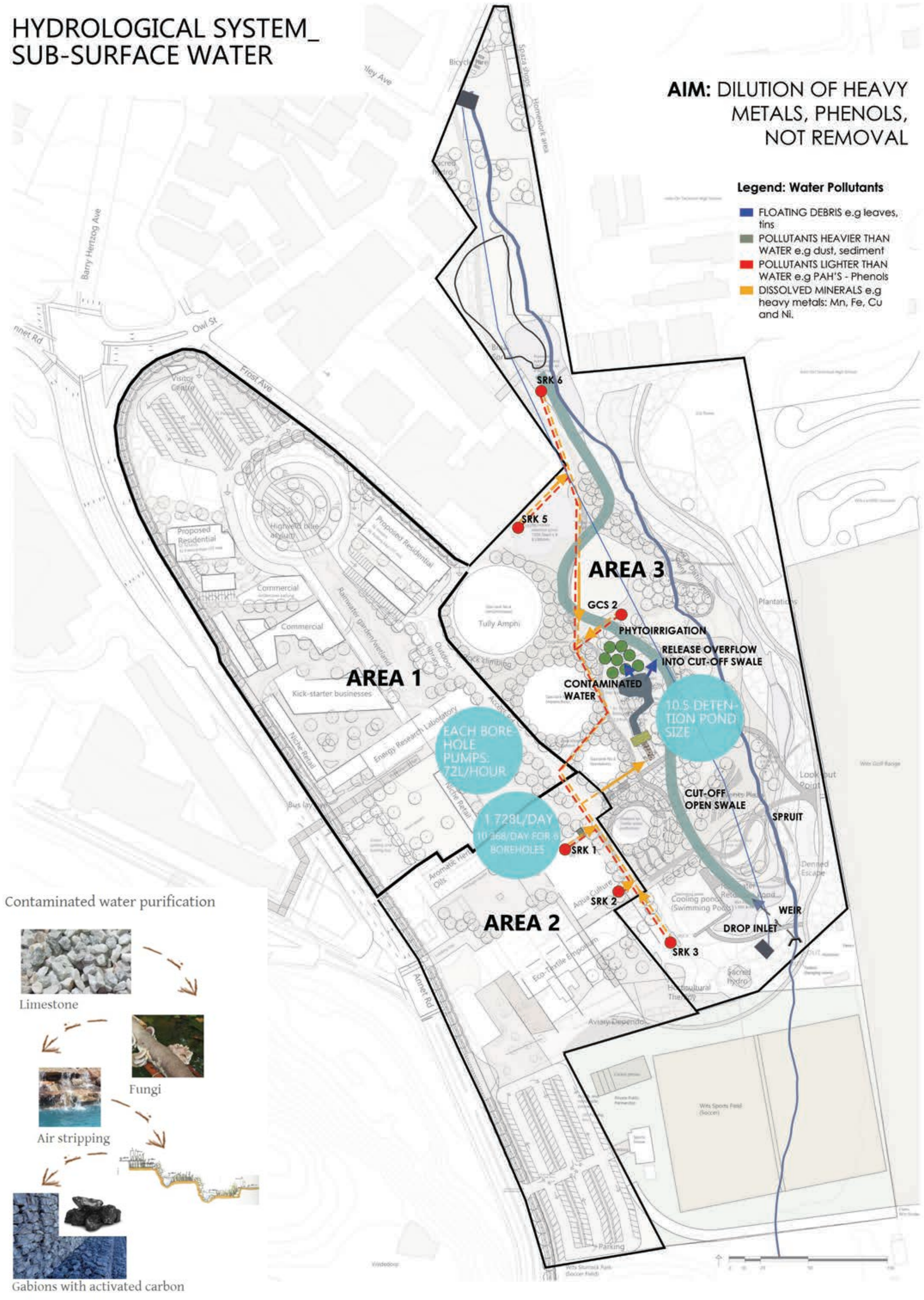


Fig 7.4. Hydrological system - sub-surface water (Author, 2017)

7.1.2 Surface hydrological system

There are five types of water pollutants, namely:
1. Floating debris e.g leaves, tins - Trash traps.
2. Pollutants heavier than water e.g dust, sediment - Settling ponds.
3. Pollutants lighter than water e.g oils. - Polysterene floaters in pond or oil trap
4. Dissolved minerals e.g salts, nutrients e.g various forms of Nitrogen, Phosphorus and Potassium - Wetland
5. Pathogens e.g harmful bacteria and viruses. - Sunlight and mycelium (mycobooms)

The development water consists of grey- and rain water and contains elements of all of the above and will be purified by means of entering into a constructed bio-swale before entering the cut-off vegetated open swale for treatment. The water derived from the parking areas will enter into a pond with polystyrene floaters before entering the cut-off open swale system.

7.1.2.1 Storm Water calculations

Sizing of retention dam: Greatest volume of water in retention dam at any time is 21 447.73 m^3(April). This is also the minimum capacity of the retention dam. Incorporating safety factor into calculation: ad 8% = 23 171 m^3 As the cut-off swale will be supplied with water from the Spruit continually and the overflow of the large dam directs back into the Spruit, the need for additional water storage is not a requirement, therefore the safety factor incorporated is reduced.

Retention dam sizes:
417m^2 x 5m = 2 085m^3
895 m^2 x 2m = 1 790 m^3
1421 m^2 x 0.5 = 710 m^3
706 m^2 x 1m= 706 m^3
2 980 m^2 x 6m= 17 880 m^3

Sizing of cut-off swale:
Swale to accommodate 10-year flood at least as the flow will not vary as the 150mm dia inlet pipe cannot deliver more water such as in a flood situation. The Rational Method was used to calculate the size for the Braamfontein Catchment which will be 4.5m x 0.5m deep. A wide surface area will allow for more contact time of the water inside the vegetated geo-mat lined cut-off swale.

Sizing of opened up spruit:
The 1.5 m deep Spruit level was retained and widened at edges to 4.5m wide, the same as above. The surface of the Spruit will also be lined with a geo-mat.

Please refer to the Appendix for calculations prepared by means of the Rational Method in order to calculte Cut-off open Swale and opened up Spruit.

Fig 7.5. (Kennen & Kirkwood, 2015)

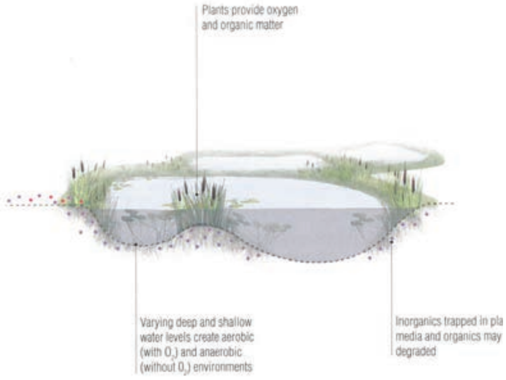


Fig 7.6. Surface-flow wetlandl (Kennen & Kirkwood, 2015)

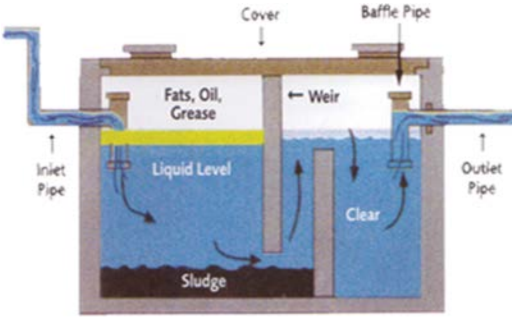


Fig 7.7. Multi-mechanism mat Kirkwood (Kennen & Kirkwood, 2015)

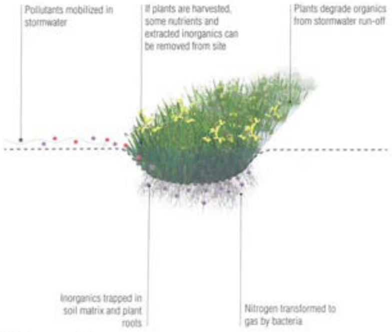
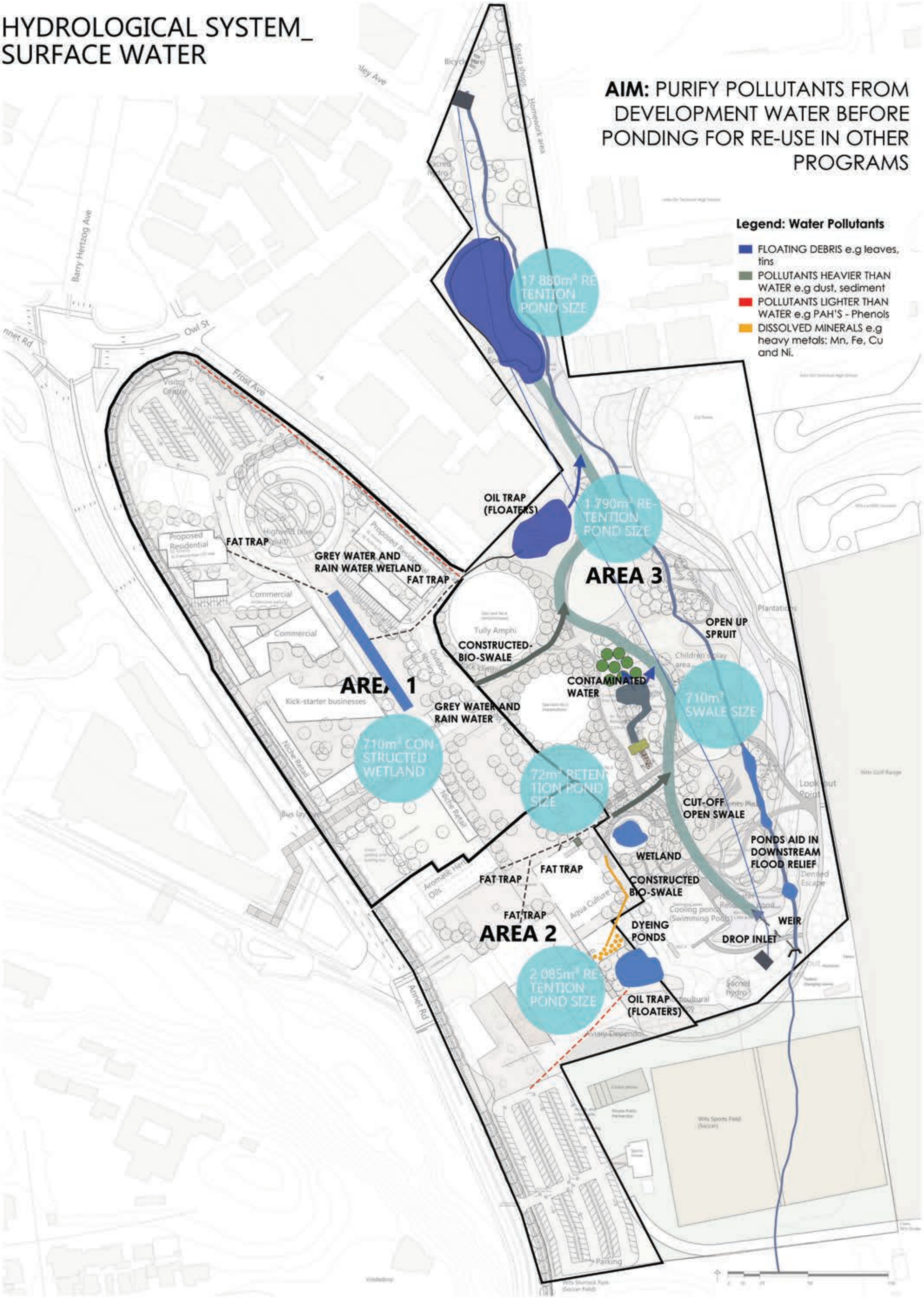


Fig 7.8. Multi-mechanism mat Kirkwood (Kennen & Kirkwood, 2015)

HYDROLOGICAL SYSTEM_ SURFACE WATER



AIM: PURIFY POLLUTANTS FROM DEVELOPMENT WATER BEFORE PONDING FOR RE-USE IN OTHER PROGRAMS

Legend: Water Pollutants

- 🟦 FLOATING DEBRIS e.g leaves, tins
- 🟩 POLLUTANTS HEAVIER THAN WATER e.g dust, sediment
- 🟥 POLLUTANTS LIGHTER THAN WATER e.g PAH'S - Phenols
- 🟧 DISSOLVED MINERALS e.g heavy metals: Mn, Fe, Cu and Ni.

Fig 7.9. Hydrological system - surface water (Author, 2017)

7.2 Planting Strategies

The planting strategies for this project were divided into three groups, namely: Functional planting; Planting to highlight different water processes and a third the communal landscape strategy. Each will be discussed in more detail below. Mostly indigenous species were selected with some other species which serves specific functions.

7.2.1 Functional planting strategy

This strategy relays the overall remediation of the soil. Brownfields are a universal problem and requires a cost-effective remediation solution. Brownfields are considered as socially and economically disintegrated and dysfunctional and requires remediation measures to become a habitable place. The basis of phytotechnologies are found on ecological principles along with natural system functioning as part of human and societal interventions (Kennen & Kirkwood 2015:5).

The necessity to remediate the associated contamination found in soil and groundwater through plants is directly in accordance with neighbourhood and community health and sustainability (Kennen & Kirkwood 2015: xvii).

According to Kennen & Kirkwood (2015), the phytotechnologies applicable to a former manufactured-gas plant, includes the following:

- Groundwater migration stand to stop migrating leachate plume.
- Degradation bosque and degradation cover at the gas tank foundations and buried coal tar spots.
- Multi-mechanism mat at the generally contaminated areas.
- Phyto irrigation where leachate is pumped and irrigated onto trees.
- Soil stabilisation mat to stabilise highly contaminated zones.

Intensive research and studies performed by Mycologist, Paul Stammets has proven that mycoremediation are very effective in cleaning soil contaminated with hydrocarbons and heavy metals. However, whilst establishing the microclimate for the mushrooms to grow, the soil-stabilisation mat phytotechnology will be applied to stabilise the highly contaminated mounded soil.

The applied phytotechnologies, mechanisms, functions, how and where applied and proposed plant species will be discussed in more detail below:

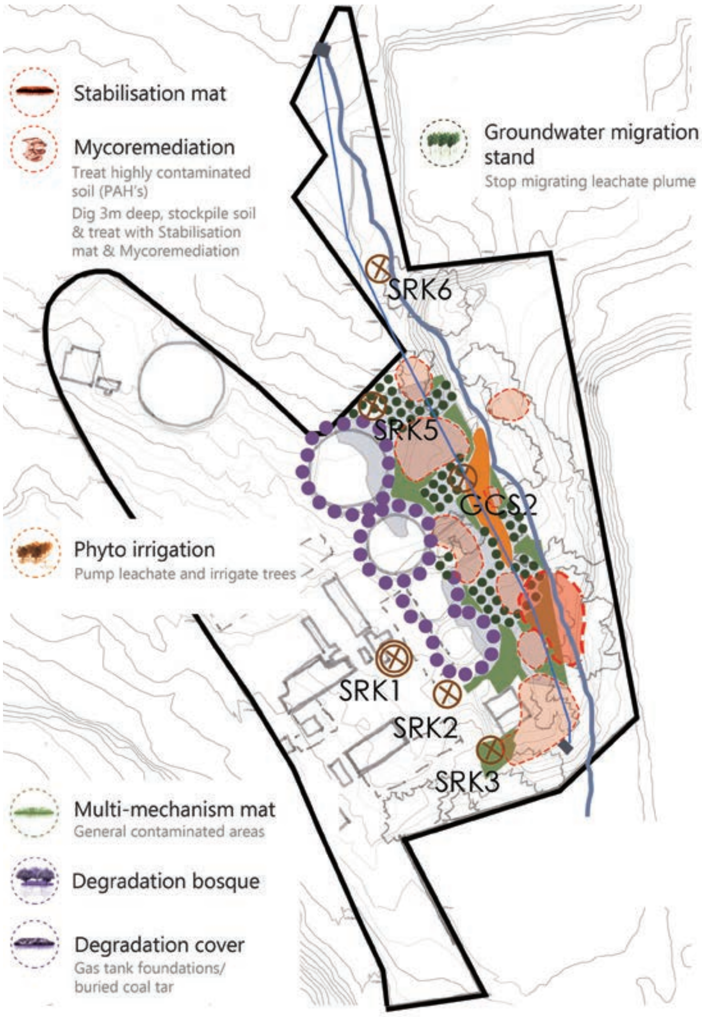


Fig 7.10. Applicable phytotechnologies to a manufactured gas plant site (Author, 2017)

Applicable Phytotechnologies

Groundwater migration stand
Mechanisms
Phytohydraulics.

Function
High evapotranspiration rate species with **deep taproots** inhibits migrating plume through the pull of transpiration. Water is transpired through the tree.

Where and how
- **Trees tap into polluted groundwater and plumes.**
- Take up water and degrade petroleum.
- **Stop migration of plume.**

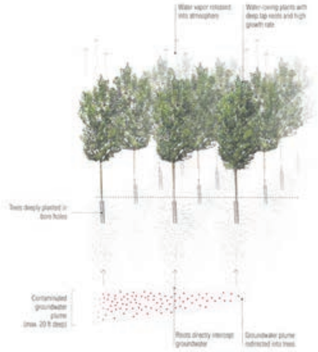


Fig 7.11. Groundwater migration stand (Kirkwood (Kennen & Kirkwood, 2015)

Fig 7.12. Combretum erythrophyllum (Saveourplant.org.za, 2012)

Fig 7.13. Vachellia karoo (SeedsforArfrica, 2017)

Plant plan with applied three strategies

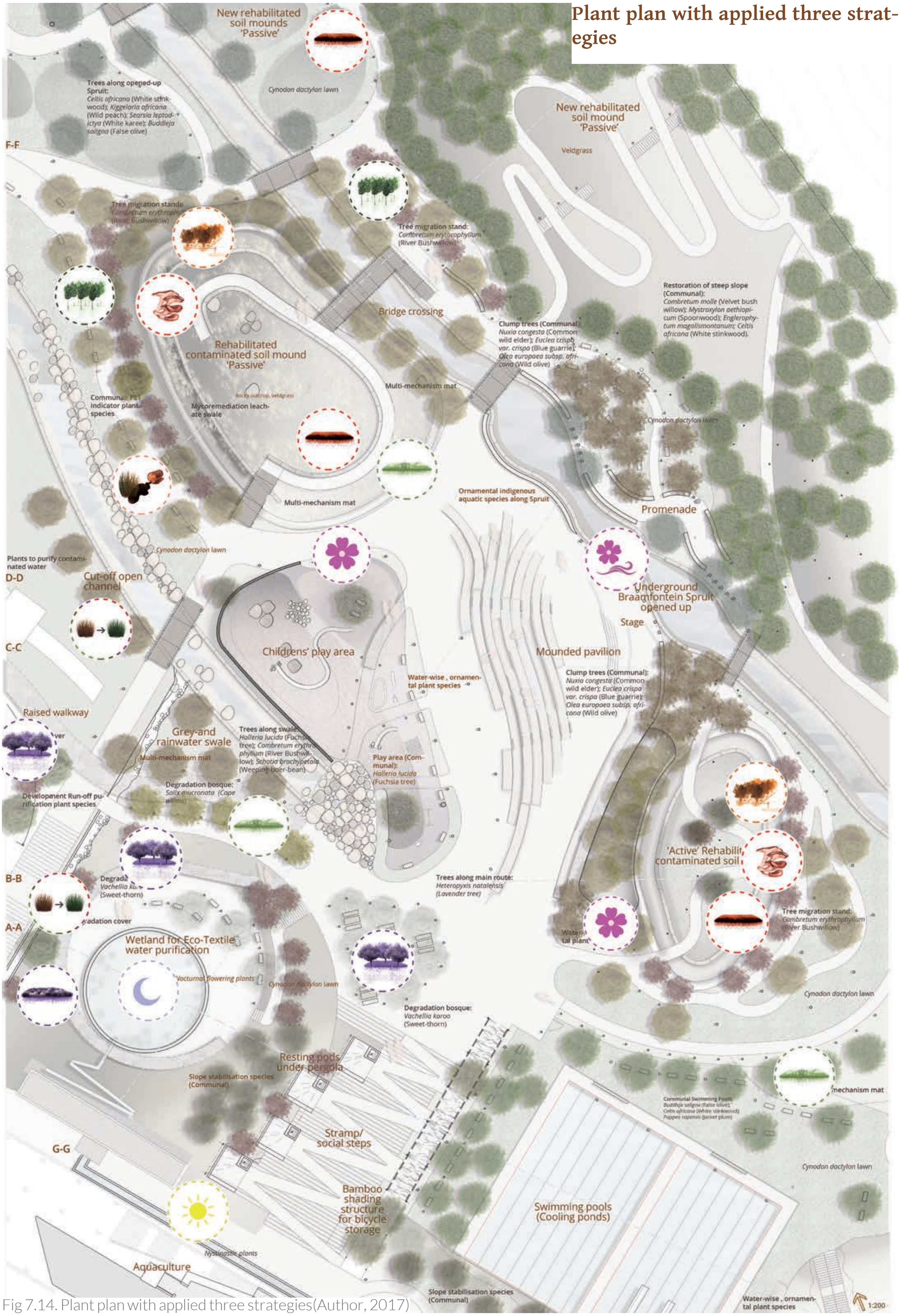


Fig 7.14. Plant plan with applied three strategies(Author, 2017)

Degradation bosque

Mechanisms

Rhizodegradation; Phytodegradation; Phytovolatilization and Phytometabolism.

Function

Degradation of contaminants within soil through **Deep-rooted tree and shrub species up to 3m deep.** Contaminants are **broken** to smaller substances in soil or **volatilized** to air.

Where and how

- Coal tar (DNAPL) is likely in **MGP foundations.** - Areas where coal tar is buried. -**Break up petroleum.**

Degradation cover

Mechanisms

Rhizodegradation; Phytodegradation; Phytovolatilization and Phytometabolism.

Function

Under bosques of trees, shorter plants to remediate petroleum found in surface soils through **plant root exudates up to 1.5m. Enhance microbial environment** for contaminant break-down in soil.

Where and how

- A mix of **low groundcover and drought-tolerant grass species** which encourages diverse microbial environment. Removes contaminants in surface soils up to 1.5m deep. - **Plants are not harvested.**

Stabilisation mat

Mechanisms

Phytostabilisation

Function

Plants hold contaminants on-site to **prevent migration off-site.** Aim is to **minimise exposure to humans and animals.**

Where and how

-Traditional **clay cap is replaced** by this method. -Prevents contaminants from moving while **water can still penetrate** through the mat.

-Treated contaminated soil will be placed in new mounds and sealed with a stabilisation mat.

Proposed plant species

Cynodon dactylon (Couch grass)

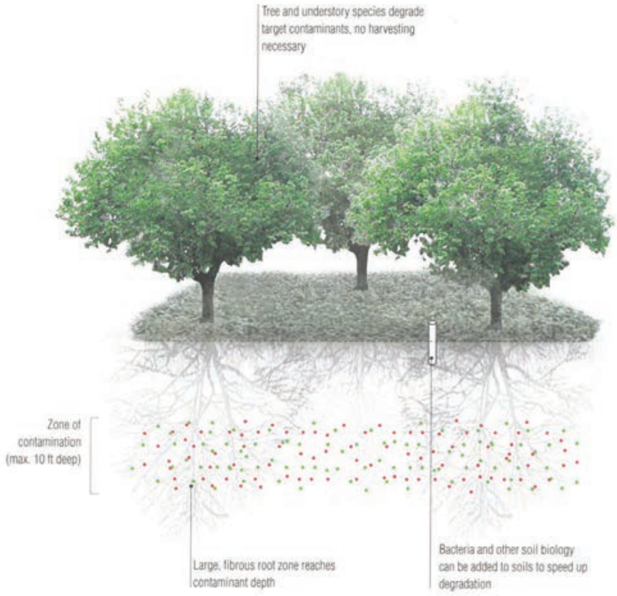


Fig 7.15. Degradation bosque (Kirkwood (Kennen & Kirkwood, 2015)

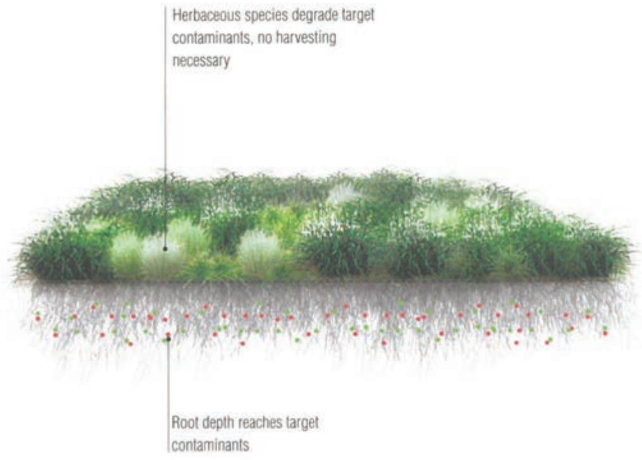


Fig 7.16. Degradation cover (Kirkwood (Kennen & Kirkwood, 2015)

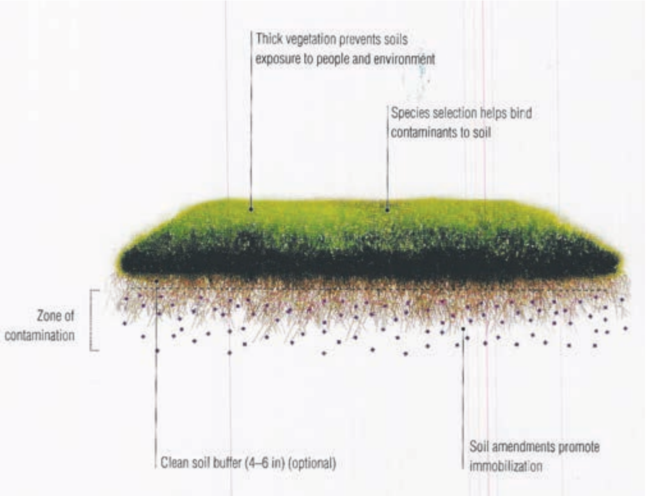


Fig 7.17.. Degradation cover (Kirkwood (Kennen & Kirkwood, 2015)

Proposed plant species

Vachellia karoo
(Sweet thorn)

Erythrina zeyherri
(Ploughbreaker)

Brachiaria mulato II (Velvet signal grass); *Festuca arundinacea* (Tall fescue); *Calamagrostis epigijos* (Bushgrass); *Chloris gayana* (Rhodes grass); *Eragrostis curvula* (Weeping lovegrass); *Eragrostis teff*

Themeda triandra (Red grass); *Setaria lindenbergiana* (Mountain bristle grass); *Sorghum x sudan* ;*Elionurus muticus* (Wire grass); *Aristida junciformis* (Ngongoni three-awn); *Cynodon dactylon* (Couch grass); *Eragrostis capensis* (Heart -seed love grass)

Cynodon dactylon
(Couch grass)

Phyto irrigation

Mechanisms

Rhizodegradation; Phytodegradation; Phytovolatilisation

Function

Leachate pumped and irrigated onto high evapotranspiration rate species / high bio-mass plant species. Contaminants are volatilized or metabolised within the plant.

Where and how

- Leachate from buried coal tar pumped and irrigated onto trees. - Prevent plume from migrating. - Denitrifying bacteria in soil converts Nitrogen in the wastewater into a gas, therefore more biomass production equals greater nitrogen levels to be removed.

Proposed plant species

Salix mucronata (Cape willow)

Multi-mechanism mat

Mechanisms

Phytoextraction; Phytometabolism; Phytodegradation;Phytostabilization, Phytovolatilization.

Function

Stabilize non-extractable metals, while **slowly degrading** tough PAH petroleum. Aim is **maximum amount of technology** utilised over a large area with **mixed contamination.**

Where and how

- Choose **metal excluder plants** (do not take up metals, but stabilises it in the soil and has nitrogen fixing roots) and a mixed herbaceous planting. Low plants reaching up to 1.5m in depth. - Planting should be **cut and harvested** to remove maximum amount of pollutants. - Plants possibly for biomass production and **"hyper-accumulator" species** are used.

Mycoremediation

Mechanisms

Rhizodegradation

Function

Mycelium produces acids and enzymes that break down woody plants into lignin and cellulose. Hydrocarbons and other pollutants are also decomposed into smaller less toxic molecules.

Where and how

Highly contaminated soil mounds. Provide suitable substrate in semi-shaded conditions consisting of wood chips, logs and stumps.

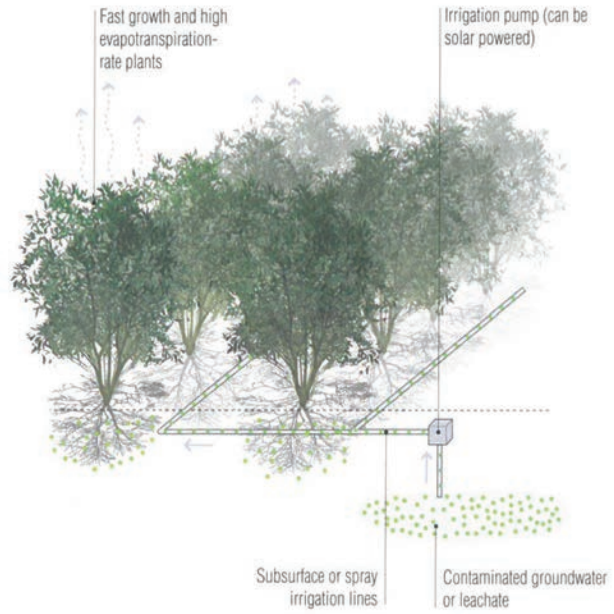


Fig 7.18. Phytoirrigation(Kirkwood (Kennen & Kirkwood, 2015)

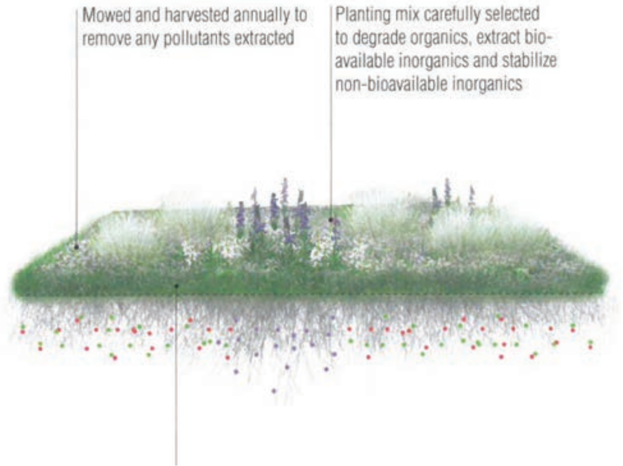


Fig 7.19. Multi-mechanism mat Kirkwood (Kennen & Kirkwood, 2015)

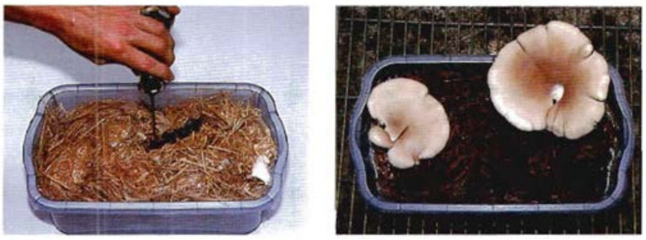


Fig 7.20. Mushrooms consuming used car oil (Stamets 2005: 87)

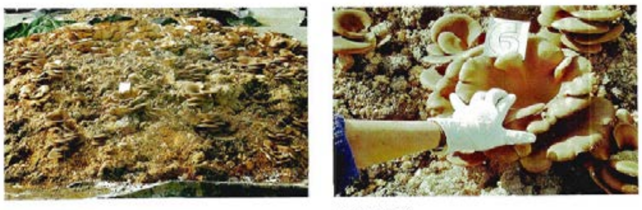


Fig 7.21. Mushrooms rehabilitating diesel contaminated soil (Stamets 2005: 93)

Proposed plant species

Fig 7.22. Salix mucronata (Royalascot.co.za, 2017)

Lolium multiflorum (Annual rye grass); Brachiarri serrato (Velvet signal grass); Cynodon dactylon (Couch grass); Festuca scabra (Munniksgras); Festuca arundinacea (Tall fescue)

Trifolium vesiculosum (Zulu Arrow leaf clover); Datura stramonium (Jimsonweed); Amaranthus spinosus (Spiny amaranth); Heteropogon contortus (Spear grass); Sphaeranthus gomphrenoides

Smell of mushroom attracts insects, which eggs attracts birds and which disperses seeds-bringing biodiversity back to the site.

Fig 7.23. Multi-mechanism mat Kirkwood (Kennen & Kirkwood, 2015)

Mycoremediation

The *Pleurotus ostreatus* (Oyster) mushroom have been studied to perform the best to break down PAH's into smaller molecules by projects performed by Paul Stammets. Lignin, which is mycelium food and PAH's contain similar hydrogen bonds – this is what enables mycelium to break down PAH's. In Figure 7.28 used car oil is used as nutrients to grow for the mycelium. As the straw's colour lighten, the petroleum content is reduced. Oyster mushrooms thrive on soil contaminated with diesel as seen in Figure 7.29. Mycelium also takes up heavy metals such as cadmium and lead that is found within the contaminated groundwater (Stamets 2005: 104).

Mycobooms – a hemp sock filled with saw dust and compost and mycelium spawn. Utilised as a floater on water containing PAH's (Darwish 2013: 179).

Mycoreactors - Cardboard tubes inserted into contaminated soil with 1 m depth. The flowing should be added to ensure the longevity of the system: mycelium spawn, microbes, wood chips, unsterilized straw, spent mushroom substrate as well as oxygen (Darwish 2013: 179).

The contaminated soil can also be sown with spawn and be covered with a polyethylene black plastic. The spawn will fuse and become a strong mycelial mat. (Stamets 2005: 92). Mycelium requires a microclimate that allows for shade and some water perspiration/irrigation. This promotes growth and the amount of exudates and acids excreted by the mycelium that breaks the PAH's down.

7.2.2 Highlight different water processes planting strategy

The following strategies discussed are applied at habitats where more water is required. Four different water process are differentiated:
Plants surrounding the edge of the Braamfontein Spruit; Plants at Eco-textile waste water; Plants to purify development grey water and run-off and Plants to purify contaminated water.

7.2.2.1 Plants surrounding the edge of the Braamfontein Spruit

The beauty of the spruit is celebrated with the use of ornamental indigenous plant species which are adapted to marginal or aquatic habitats.

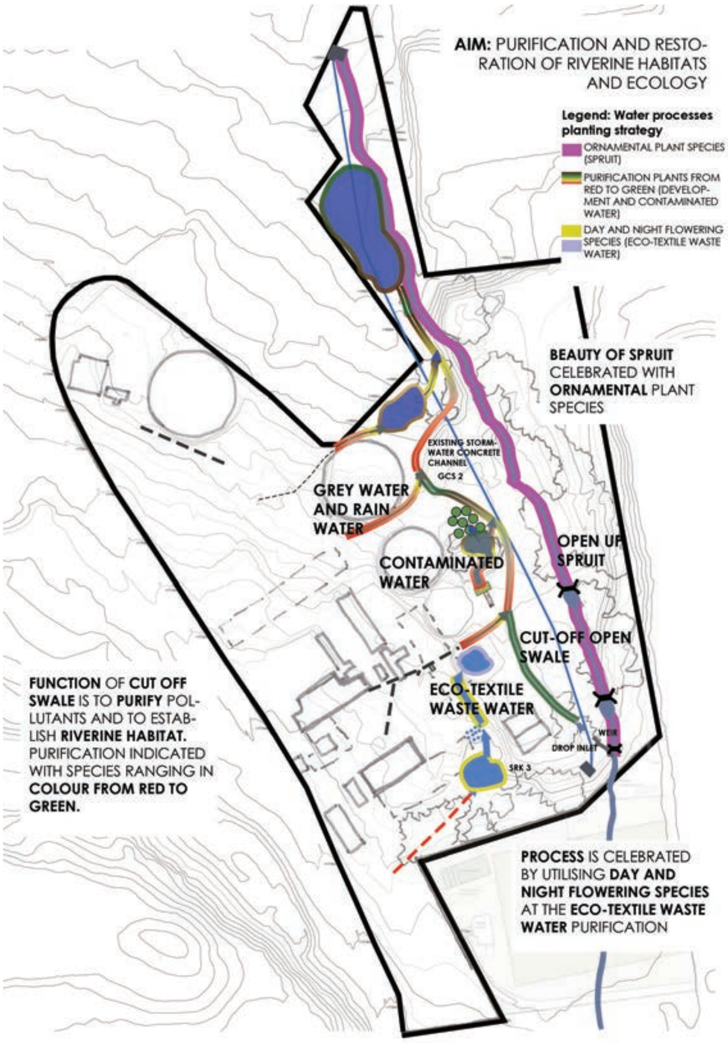


Fig 7.24. The four different water processes are indicated. (Author, 2017)

Water processes
- Edge of the Braamfontein Spruit


Dierama pendulum
(Fairy bell)


Miscanthus junceus
(Vlei grass)


Isolepis cernua
(Fibreoptic grass)


Schoenoplectus brachiseras
(Plume sedge)


Digitaria eriantha
(Finger grass)


Cyperus alternifolius


Kniphofia ensifolia
(Red hot poker)


Cyperus textilis
(Umbrella Sedge)


Euryops pectinatus
(Golden Euryops)


Zantedeschia aethiopica
(White arum lily)


Buddleja salviifolia
(Wild sage)


Gomphostigma virgatum
(Otter bush)


Dietes grandiflora
(Wild Iris)


Barleria obtusa
(Bush violet)


Juncus rigidus and oxicarpa
(Matting rush)


Nymphoides thunbergiana
(Floating hearts)

7.2.2.2 Plants at Eco-textile waste water

Process is celebrated by utilising day and night flowering species at the Eco-textile waste water purification

Function
Nastic movement of higher plants in response to the onset of darkness, e.g. the closing of flower petals at dusk and the sleep movements of legume leaves.

Mechanisms
Nyctinasty

Plants that bloom during the day
These species will be used in the bio-swale leading to the wetland - indicative of day work hours of the Textile Mill as well as the plants that 'work'. All the species mentioned on opposite page bloom during the day and the fabaceae family shows sleep movements during the night time.

Nocturnal flowering plants
These plant species will be utilised at the wetland made in Gas Tank foundation No.1. During dusk, nigh-time hours, these flowers open up, which are indicative of the second part of the day - rest time.

7.2.2.3 Plants to purify development grey water and run-off

Colour of plants range from red to green, the same as the contaminated water purification. It is indicative of the cleaning process from contaminated to clean water.

Mechanisms
Rhizofiltration.

Function
Contaminants found in stormwater are removed and trapped within plants and soil. Organic pollutants will be degraded, Nitrogen in water turns into a gas and inorganics is trapped in soil. Riverine habitat is established which may possibly have been lost with the Spruit being piped underground.

- Eco-Textile Waste water purification
Plants that bloom during the day


Oxalis purpurea
(Grand duchess sorrel)


Arctotes arctotoides
marigold


Lasiospermum bipinnatum
(Cocoonhead)


Osteospermum muricatum
(White felicia)

Water processes
- Development Run-off purification


Kniphofia ensifolia
(Red hot poker)


Themeda triandra
(Red grass)


Eragrostis racemosa
(Narrow heart love grass)


Aristea ecklonii
(Blue stars)


Fig 7.25. Change in vegetation colour from red to brown as the water is purified (Author, 2017)

Water processes

- Eco-Textile Waste water purification

Arctotis acaulis
(Renoster arctotis)

Oxalis purpurea
(Purpple leaf sorrel)

Hibiscus aethiopicus
(Dwarf wild hibiscus)

Leucanthum superbum
(shasta daisies)

Euryops pectinatus
(Golden euryops)

Carpobrotus edulis
(Sour fig)

- Eco-Textile Waste water purification Nocturnal flowering plants

Silene capensis
(African dream root)

Zaluzianskya capensis
(Drumsticks)

Silene burchelli var.angustifolia (Gunpowder plant)

Miscanthus junceus
(Broom grass)

Leersia hexandra
(Southern cutgrass)

Calamagrostis epigejos
(Bushgrass)

Juncus rigidus and oxicarpa
(Matting rush)

Sporobolus africanus
(Paramatta grass)

Isolepsis prolifera
(Fibre-optic grass) (m)

Cyperus textilis
(Umbrella Sedge)

Setaria incrassata
(Vlei bristle grass)

7.2.2.4 Plants to purify contaminated water

Planting palette colour changes from red, pink, violet, orange, yellow to brown and green as the water purification ends in a pond.

Mechanisms
Rhizofiltration.

Function
Organic and inorganic contaminants filtered from water through roots and soil

7.2.2.5 Trees

Along contaminated water purification

Function
Shade; Deep taproot; Nitrogen-fixing roots

Along cut-off swale
Function
Attracts birds and butterflies - habitat recreation. Mostly evergreen trees provide shade assist against evaporation.

Along opened-up Spruit
Function
Attracts birds and butterflies - habitat recreation. Mostly evergreen trees provide shade assist against evaporation. Small trees provide scale of intimacy.


Eragrostis inamoena (Tite Grass)


Melinis nerviglumis (Bristle-leaved red top) (m)


Paspalum distichum (Water finger-grass)


Panicum repens (Couch panicum) (a)


Isolepsis prolifera (Fibre-optic grass) (m)

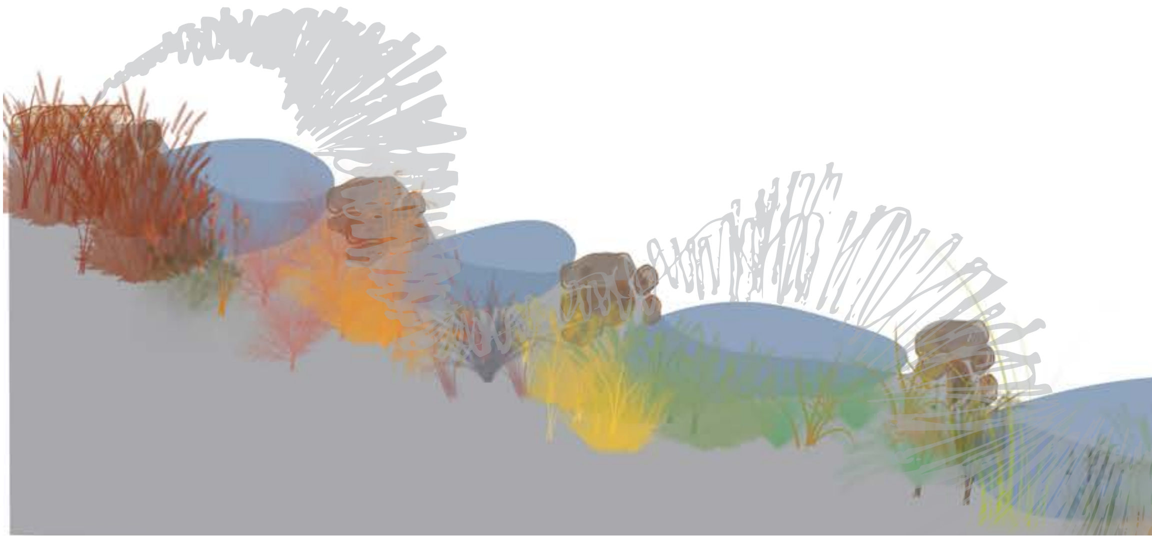

Leersia hexandra (Southern cutgrass)

Trees - Along contaminated water purification


Ziziphus mucronata (Buffalo thorn)


Erythrina zeyherri (Plough-breaker)


Senegalia nigrescens (Knob-thorn)



Water processes

- Contaminated water purification


Mentha aquatic (Water mint) (a)


Berkheya coddii (South African Aster)


Festuca scabra (Munniksgras)


Miscanthus junceus (Broom grass)


Cyperus sexangularis (Bushveld grass)


Schoenoplectus corumbosus/ brachycera (Plume sedge)


Senecio reptans


Scleria poiformis


Typha capensis (Bulrush) (a)


Cyperus textilis (Umbrella Sedge)


Vallisneria aethiopica (Vallis) (a)


Marsilea schelpiana (Water clover) (a)

Trees

- Along cut-off swale


Halleria lucida (Fuchsia tree)


Combretum erythrophyllum (Riverbush willow)


Schotia brachypetala (Weeping boer-bean)

Trees

- Along opened up Spruit


Celtis africana (White stinkwood)


Kiggelaria africana (Wild peach)


Searsia leptodictya (White karee)


Buddleja saligna (False olive)

7.2.3 Communal landscape planting strategy

Plants and tree species enhancing the intimacy of scale and providing interest and complexity.

7.2.3.1 Water-wise, ornamental plant species

The aim is to select *water-wise* (Regional to Gauteng) species and or species from the *Soweto Highveld Grassland Vegetation Type.* Species specified in this planting strategy need to tend to be more ornamental. It is combined with indicator species: Petroleum tolerant- and petroleum intolerant species to serve as an active safe environment indicator.

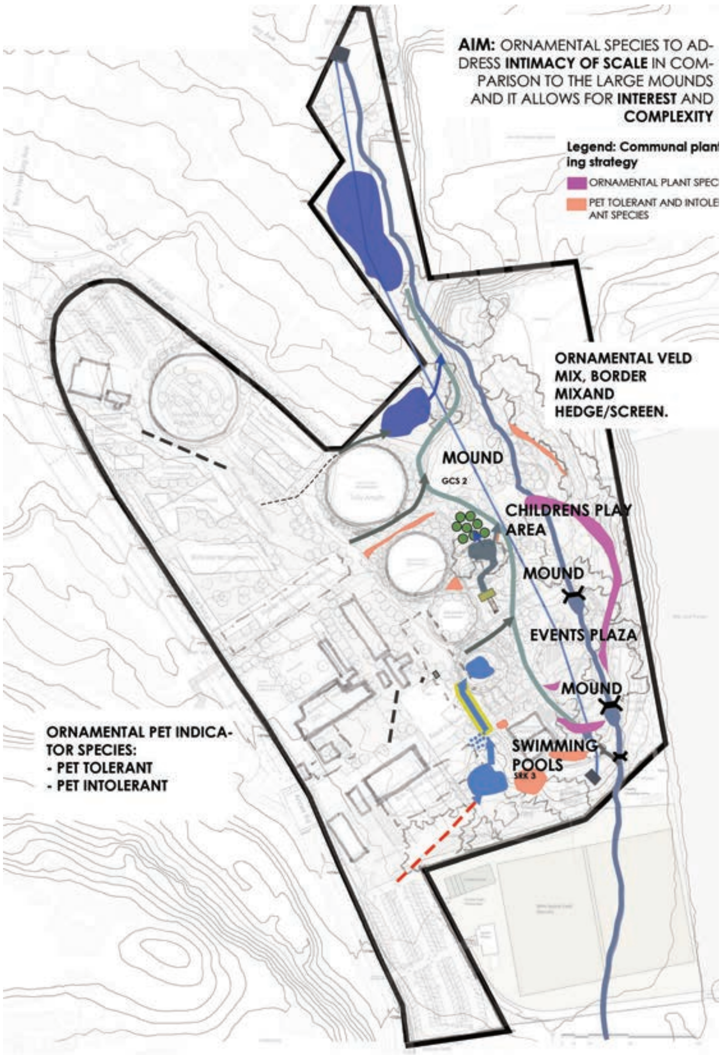


Fig 7.26. Communal planting strategy (Author, 2017)

Communal landscape planting strategy
- Water-wise, ornamental plant species


Gnidia capitata
(Kerrieblom)


Helichryssum petiolare
(Everlasting)


Dierama medium
(Hair-bell)


Ledebouria ovatifolia
(Mottled leave ledebouria)


Aristida junciformis
(Ngongoni three-awn)


Clerodendrum myricoides
(Cat's whiskers)


Eucomis autiumnalis
(Pineapple lily)


Aristida junciformis
(Ngongoni three-awn)


Dodonaea viscosa Jacq var. angustifolia (Sand olive)


Aloe verecunda
(Grass aloe)


Hypoxis rigidula
(Silver-leafed star)


Freesia grandiflora
(Large red iris)


Portulacaria afra "prostrata"
(Porkbush);


Delosperma herbeum
(Highveld white vygie)


Asparagus falcatus
(Large forest asparagus)


Felicia muricata
(Aster muricatus)


Haemanthus humillis subsp. hirsutus, H. montanus
(Mountain paintbrush)

Tecomaria capensis
(Cape honeysuckle)

Dietes iridoides
(African iris)

Bulbine frutescens
(Snake flower)

7.2.3.2 Proposed indicator plant species

These plant species are indicators of the presence of Petroleum substances in the soil This list are based on a study conducted by British Petroleum (BP) and the indigenous species were selected.

The Proposed petroleum tolerant plant species are predominantly in shades of yellow.

The proposed petroleum intolerant plant species are predominantly in shades of white, which can be indicative of purified soil.

Artemisia affra
(Wormwood)

Buxus microphylla
(Boxwood)

7.2.2.3.3 Slope stabilisation adjacent to gas tank foundation and cooling ponds

These species are selected to stabilise very steep banks and are well-known for hardiness and soil stabilisation roots.

7.2.2.3.4 Trees

Along main routes: *Heteropyxis natelensis*
Function
Tree selected for upright form and white bark, medium size evergreen tree

Heteropyxis natelensis
(Lavender tree)

Clump trees: *Nuxia congesta; Eucla crispa var. crispa; Olea europaea subsp. africana*
Function
Attracts birds and butterflies - habitat recreation. Mostly evergreen small trees - provide shade and scale of intimacy.

Nuxia congesta
(Common wild elder)

Eucla crispa var. crispa
(Blue guarri)

Restoration of steep slope: *Combretum molle; Mystroxylon aethiopicum; Englerophytum magalismontanum; Celtis africana*
Function
Trees selected from the Reef Mountain Bushveld that is well adapted to ridges and forest margins.

Combretum molle
(Velvet bush willow)

Mystroxylon aethiopicum
(Spoonwood)

Swimming pools and play areas: *Celtis africana; Buddleja saligna; Halleria lucida; Pappea capensis*
Function
Large and smaller trees at swimming pool providing shade and scale of intimacy. Evergreen tree at play area with edible berries.

Communal landscape planting strategy

- PET tolerant indicator plant species

Strelitzia reginae
(Bird of paradise)

Moraea bicolor
(Fortnight lily)

Tulbaghia violacea
(Wild garlic)

Sedum mexicana

- PET intolerant indicator plant species

Carissa macrocarpa
(Natal Plum)

Euryops pectinatus
(Green-leaved Euryops)

Trachelospermum jasminoides (Star jasmine)

Delosperma cooperii
(White ice plant)

Slope stabilisation species

Lantana rugosa
(Bird's brandy)

Ancylobotrys capensis
(Wild apricot)

Tarconanthus camphoratus (Camphor bush)

Olea europaea subsp. africana (Wild olive)

Englerophytum magalismontanum

Celtis africana
(White stinkwood)

Buddleja saligna
(False olive)

Halleria lucida
(Fuchsia tree)

Pappea capensis
(Jacket plum)

7.3 Technical concept

6 Main design elements

The technical concept was derived from aspects of the site and the design leading to design elements which as been extrapolated, see figure 7.1 and 7.2
The following design elements have been extrapolated: Mounds; forest; bridge; path; river and hole.

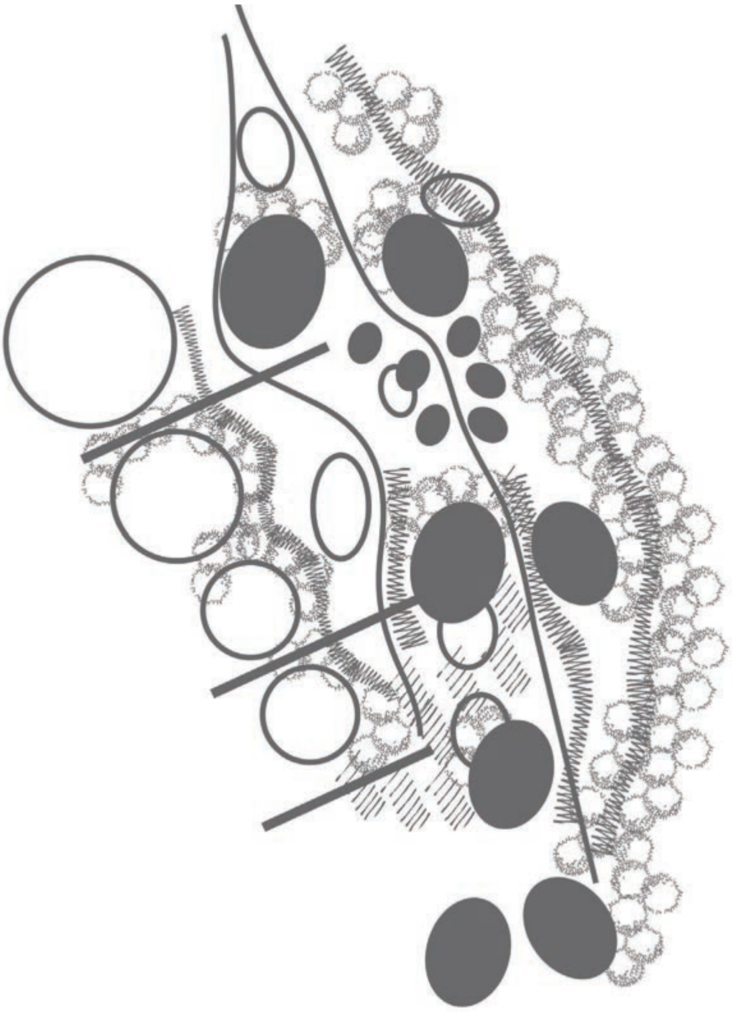


Fig 7.27. Main design elements (Author, 2017)

6 Main design elements extrapolated

1. Mounds - relates to verticality

Gas tanks
Representative of history of the site and the past economic uprising.

Mount
Universal symbol for burial place. From Bosnia to Senegambia, ancient civilisations with no contact. Inherent symbol.

Mound
Reminiscent of highveld landscape, accessable for active and passive activities for the community.

Experience

Burial of exploitation ways, seeing the large impact of soil pollution.
As soil rehabilitated and scraped -new narrative is taking place.

Visual landmark.

Pleasure and security in occupying a higher position.

2. Forest - relates to verticality

Nature taking over/ mutations on built environment

Glade -forest clearing provides gathering space

Pergola structure relates to enclosure and shelter

The arrival spaces becomes open gathering places allowing for people to come together.

Intimacy of scale is enhanced under the shelter of a pergola in relation with openness and large mounds.

3. Bridge - linearity of gas production

Continues line of historic gas flow into landscape
From where the landscape wil be experienced in earllier stages
Straight line, historical reference into future.

Bridge required for access of contaminated landscape.

The level of transcience increases with the onset of height and a better perspective can be gained of the site processes as part of the intermezzo layer.

4. Path - horisontal plane or datum

Horisontal plane or datum on which nature mutates onto structures simulating lichen pattern

Visual reference point to the park, revealing surface and remnants of pollution e.g old pieces of tar and bricks.

5. River - Curved line/ organic

Spruit opened up - water utilised to purify development water. Line follows lowest points.

Water attracts people through sound, reflection, texture, light, movement and coolness of the microclimate created.

6. Hole - oval shape indicating historical remnants

History

Excavated contaminated soil leaves oval shaped holes in the landscape.

The holes are re-purposed whilst retaining the memory of a remnant.

Ecological transformation takes place, in time hole will be filled with bio-mass shed as leaves.

Exploitation of environment revealed through the onlook of the holes.

Fig 7.28. Main design elements extrapolated (Author, 2017)

The approach to the material palette is symbolic to the former use of the site: a coal to gas manufacture plant. Coal that is derived from the earth are heavyweight in comparison with the lightweight end-product of the process, which is gas. Therefore, the closer to the earth the material was used, the heavier the properties of the material utilised and the closer to the sky a lighter-weight material was used.
It encourages community participation through the pergola structures that would be maintained as part of horticultural therapy.

7.4 Materials

As described above, the material selection was based on heavyweight to lightweight materials as the transience level increases with height. The chosen material palette consists of the following materials:

- Bamboo poles
- Stainless steel wire rope
- Mycelium bricks
- *Eucalyptus grandis*
- Galvanised mild steel
- Reclaimed 'British Steel' tubes
- Geomat
- Geosynthetic clay liner

A short description of each material will follow.

Bamboo
Bamboosa balcooa has been naturalized in South Africa and grows well without irrigation. This will be grown on the areas not contaminated on the site, prior to any development during stage 1. It will be used as building material for the bridges built during stage 4 as well as for balustrades in the later stages.

Fig 7.29 Mycelium bricks as building material (Mycoworks.com, 2017)

Fig 7.30. Various sizing of SA grown bamboo poles (Brightfields.co.za, 2017)

Stainless steel wire rope
This material was selected for its durability, tensil strength. As it will stay in tension on the pergolas outdoors.

Fig 7.31. Stainless steel wire rope (stainlessdirect.co.uk, 2017)

Fig 7.32. Fitting swage eyes (stainlessdirect.co.uk, 2017)

Fig 7.33. Hook eye turnbuckle cable tensioner (ebay.com, 2017)

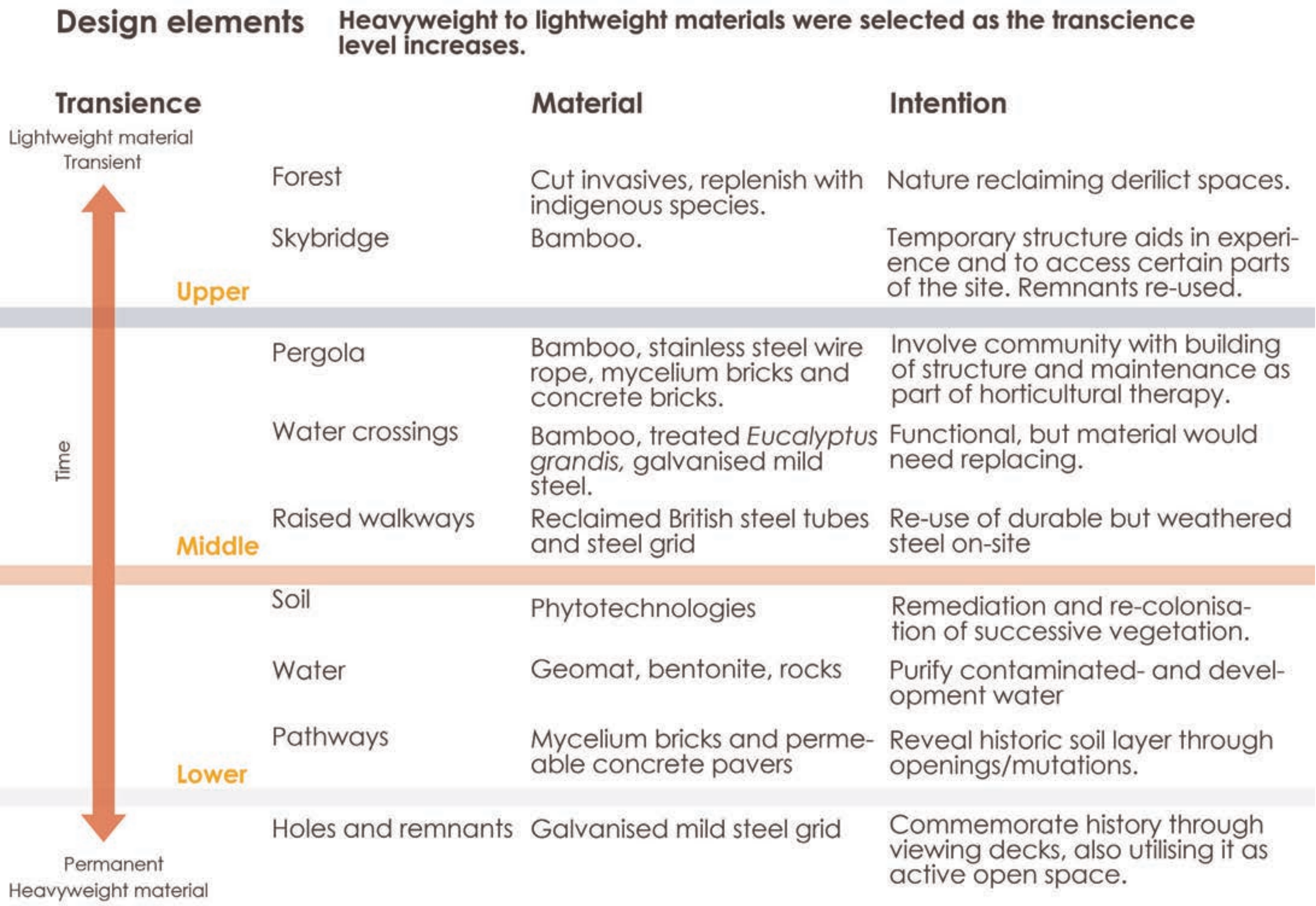
Mycelium bricks
It is very strong, mold-, fire- and water resistant building material. However,it is in it;s nature to degrade. This aspect will be embraced in the design. When it degrades, the fruit starts to form (mushrooms). Mushrooms absorbs soil vapours and this will be used to absorb the soil vapours absorbed by the old tar remnants and building materials (bricks). It is very easy to make, it can be made into any shape by means of a mould, see Figure 7.43. It will be made on-site in a building and will also contribute in job creation. One of the programmes deals with sustainable energy research.

This will also contribute to skill development for the people/students that visit last-mentioned centre.

Fig 7.34. Eucalyptus grandis planks (Somtim.co.za, 2016)

Fig 7.35. Galvanised mild steel I-beams (Global-sources.com, 2017)

Fig 7.36. Reclaimed 450mm dia 'British Steel' round hollow tubes found on-site (Author, 2017)



Design elements **Heavyweight to lightweight materials were selected as the transcience level increases.**

Transience		Material	Intention
Lightweight material Transient			
Upper	Forest	Cut invasives, replenish with indigenous species.	Nature reclaiming derilict spaces.
	Skybridge	Bamboo.	Temporary structure aids in experience and to access certain parts of the site. Remnants re-used.
Middle	Pergola	Bamboo, stainless steel wire rope, mycelium bricks and concrete bricks.	Involve community with building of structure and maintenance as part of horticultural therapy.
	Water crossings	Bamboo, treated *Eucalyptus grandis*, galvanised mild steel.	Functional, but material would need replacing.
	Raised walkways	Reclaimed British steel tubes and steel grid	Re-use of durable but weathered steel on-site
Lower	Soil	Phytotechnologies	Remediation and re-colonisation of successive vegetation.
	Water	Geomat, bentonite, rocks	Purify contaminated- and development water
	Pathways	Mycelium bricks and permeable concrete pavers	Reveal historic soil layer through openings/mutations.
	Holes and remnants	Galvanised mild steel grid	Commemorate history through viewing decks, also utilising it as active open space.
Permanent Heavyweight material			

Fig 7.37. Material palette based on transience level (Author, 2017)

Galvanised mild steel
I-beams,baseplate and steel grating will be used.

Permeable concrete paver
Bosun provides a concrete paver in Gauteng which is permeable, which is very important to assist with the soil quality and allows water to filter to the groundwater table. It is a very economic option to use these for paving surface in combination with mycelium bricks as edge.

Geomat and geo-synthetic clay liner
These materials are chosen as functional solutions to keep water in the channels and to keep other possible contaminants from the soil out.

Fig 7.38. Bosun bevel paver, autumnblend shade (Bosun.co.za, 2017)

Fig 7.39. Corobrik and primrose bricks found across the site (Author, 2017)

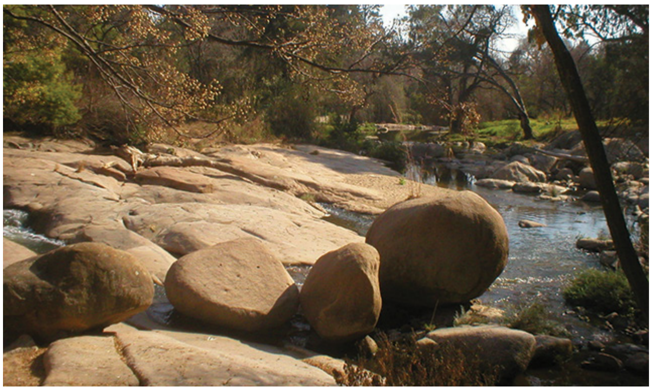


Fig 7.40. Rocks and banks found along the Braamfontein Spruit (Megaplex.co.zs, 2017)

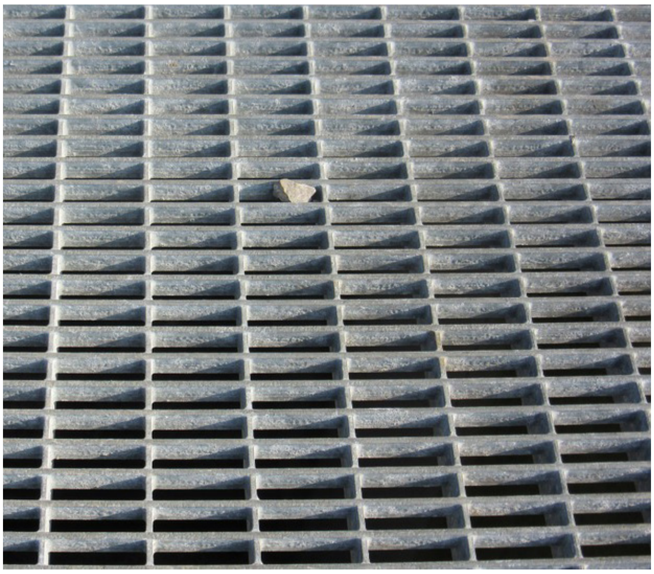


Fig 7.41. Galvanised mild steel grating (Pixabay.com, 2017)

Fig 7.42. Geomat (, 2017)

Stainless steel wire rope
This material was selected for its durability, tensil strength. As it will stay in tension on the pergolas outdoors.

Fig 7.43. Geosynthetic clay liner - Envirofix (Kaytech.co.za, 2017)

Timespan: 2 weeks -
a super-strong, water-, mold- and fire-resistant building material.

1. Collect mushroom sample

2. Prepare the agar

3. Mushroom tissue into agar

4. Prepare the substrate for mushroom expansion
Organic waste
Sugar
Cat food
Energy drink

5. Place mushroom mass into the substrate and allow it to increase in volume (3-7 days)

6. Remove mushroom mass from jar. Break into pieces and place into brick mould.

7. Remove the brick from the mould and wait for it to strengthen (1 week)

7. Once dry, put the brick into an oven to kill the organism

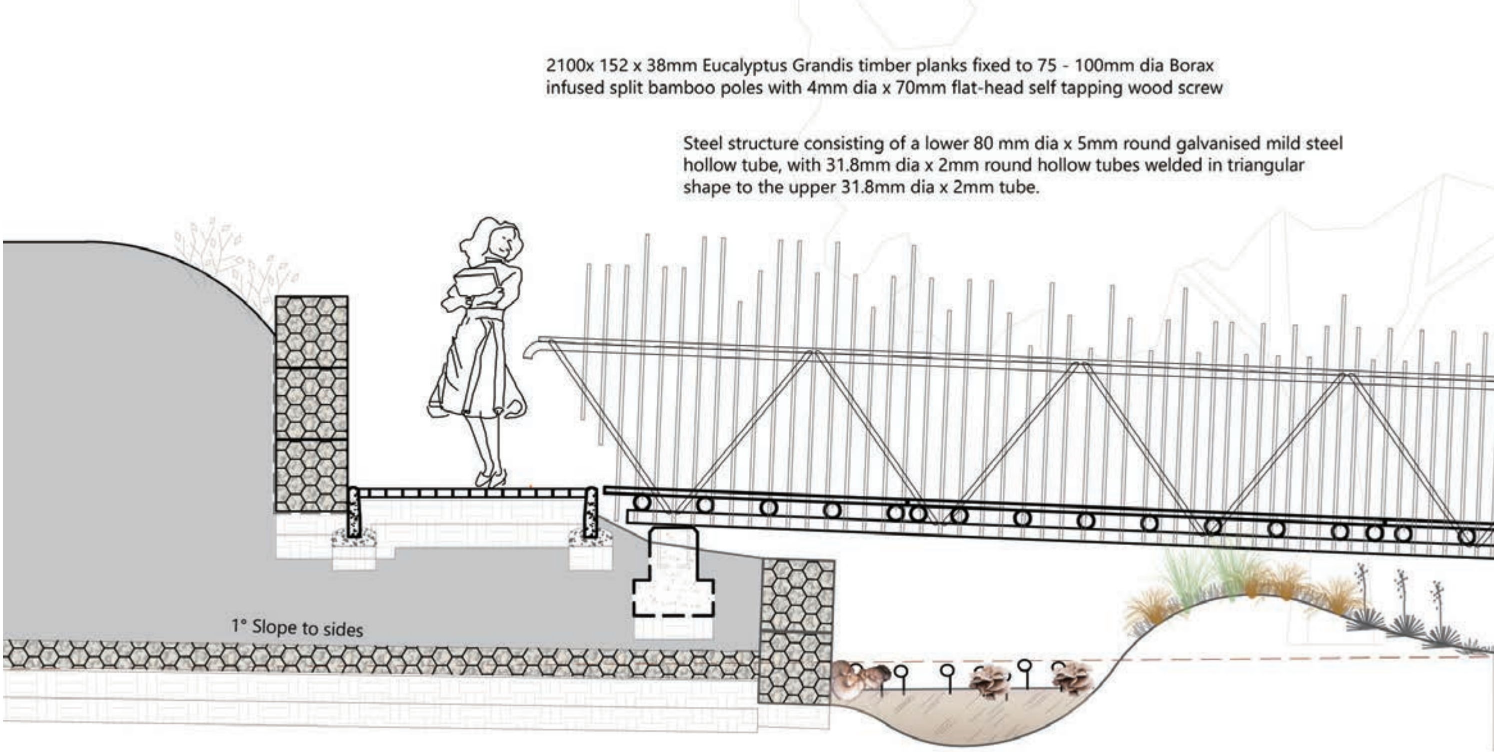
7. Complete brick

Fig 7.44. Mycelium brick process (Mycoworks.com, 2017)

7.5 Technical details

Most of the technical details described derives from Section A-A, C-C, D-D and G-G as it cuts through the most prominent landscape structures relating to natural restoration, enhancement of community identity and exploitation of human health and the environment. As per sections, the details circled will be described in more detail below. The details will indicate material use, fastening measures, levels, sub-soil layers and dimensions.

7.5.1 Detail 1: Bridge crossing the Spruit, fixed to rehabilitated mound
7.5.2 Detail 2: Stepped pavilion
7.5.3 Detail 3: Pergola structure
7.5.4 Detail 4: Water directed into cut-off swale/ children's play area
7.5.5 Detail 5: New paving surface transition to old bricks. Soil vapours from old bricks absorbed through mushrooms (degrading mycelium bricks)
7.5.6 Detail 6: Hole at children's play area re-purposed



2100x 152 x 38mm Eucalyptus Grandis timber planks fixed to 75 - 100mm dia Borax infused split bamboo poles with 4mm dia x 70mm flat-head self tapping wood screw

Steel structure consisting of a lower 80 mm dia x 5mm round galvanised mild steel hollow tube, with 31.8mm dia x 2mm round hollow tubes welded in triangular shape to the upper 31.8mm dia x 2mm tube.

200 X 100 X 50 mm Bosun autumnblend Bevel Bond, concrete pavers stacked in herringbone pattern on 20mm Sand blinding layer on 150 mm layers of compacted clean in-situ soil to 93% MOD AASHTO. Sand is brushed in between the pavers. Edge between paving surface and bridge surface consists of 330(l) x 300(h) x 75(w)mm Vanstone KC5 Light Duty upright pedestrian kerb/ edge beam bedded into 300 x 100mm concrete haunching.

6000 x 2000 x 170 mm Kaybion matress (Geo-mat) an
to 2000x 500x 500mm Kaybion Gabion basket..
Envirofix Geosynthetic clay liner from Kaytech prevents
seeping through and protects against contaminants in

In-situ rocks with 200-500 mm dia to slow water veloci
tightened to Kaybion matress with galvanised steel wi

150 mm layers of compacted clean in-situ soil to 93% MOD AASHTO.

Fig 7.45. Bridge crossing over Spruit fixed to rehabilitated passive mound, 1:50 (Author, 2017)

Detail 1: Bridge crossing the Spruit, fixed to rehabilitated mound

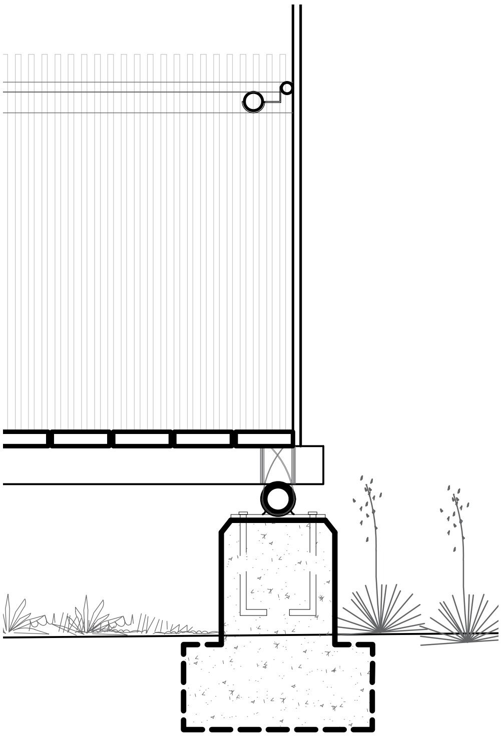
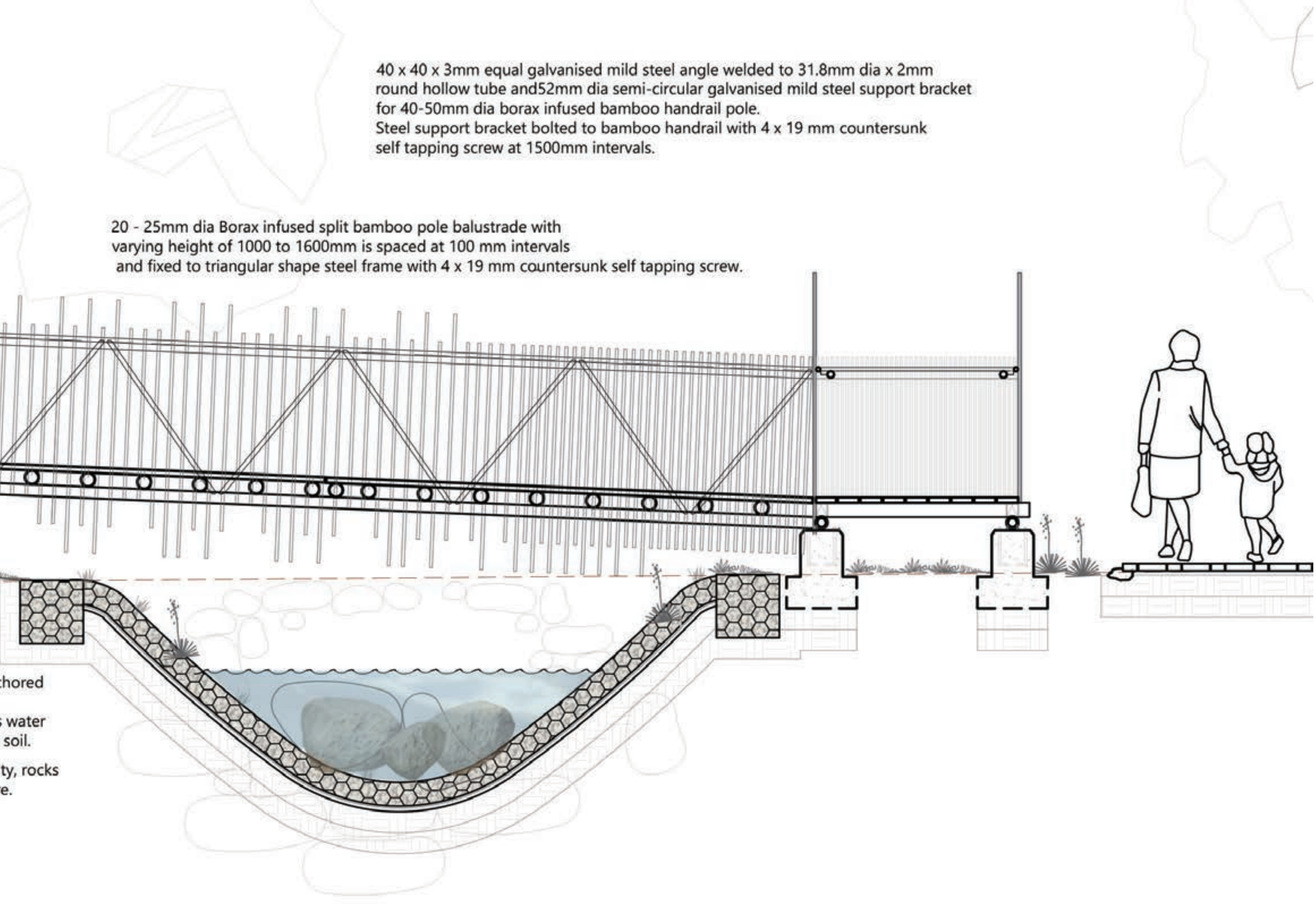


Fig 7.46. Detail where bridge components are fixed to concrete footing, scale 1:20 (Author, 2017)



40 x 40 x 3mm equal galvanised mild steel angle welded to 31.8mm dia x 2mm round hollow tube and52mm dia semi-circular galvanised mild steel support bracket for 40-50mm dia borax infused bamboo handrail pole.
Steel support bracket bolted to bamboo handrail with 4 x 19 mm countersunk self tapping screw at 1500mm intervals.

20 - 25mm dia Borax infused split bamboo pole balustrade with varying height of 1000 to 1600mm is spaced at 100 mm intervals and fixed to triangular shape steel frame with 4 x 19 mm countersunk self tapping screw.

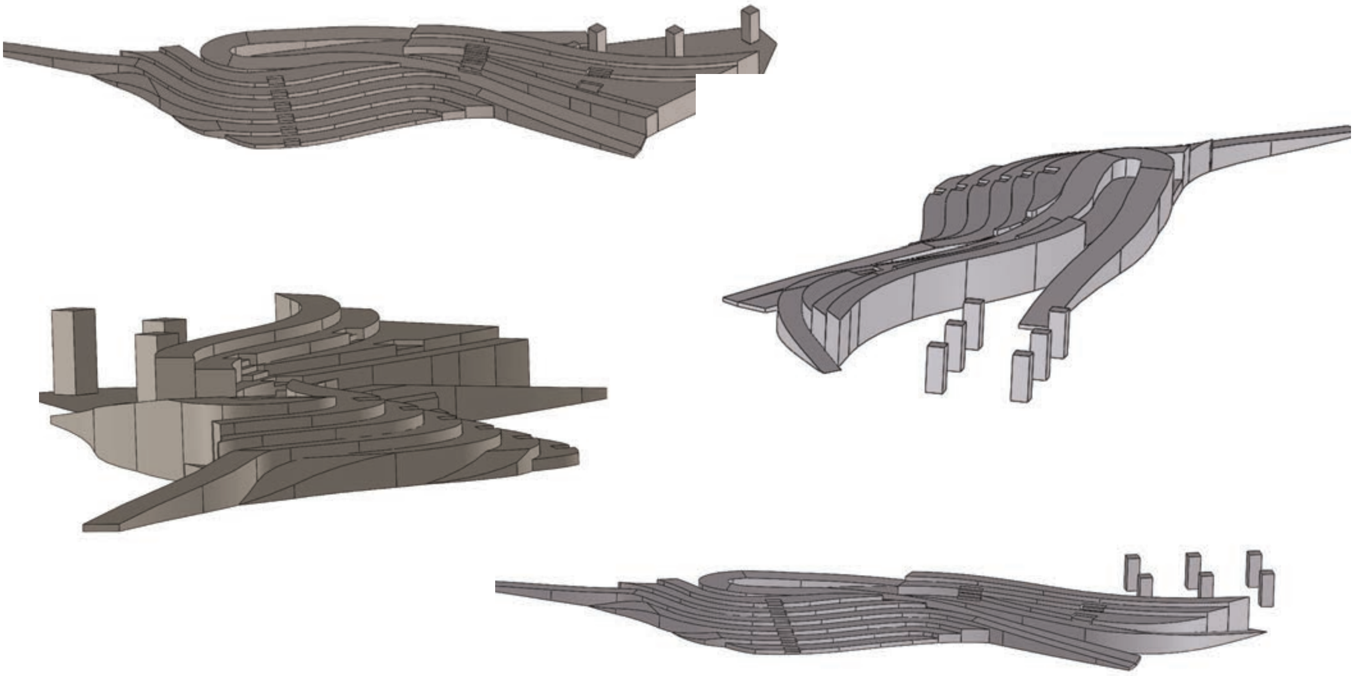


Fig 7.47. Previous spatial explorations, not to scale Author, 2017)

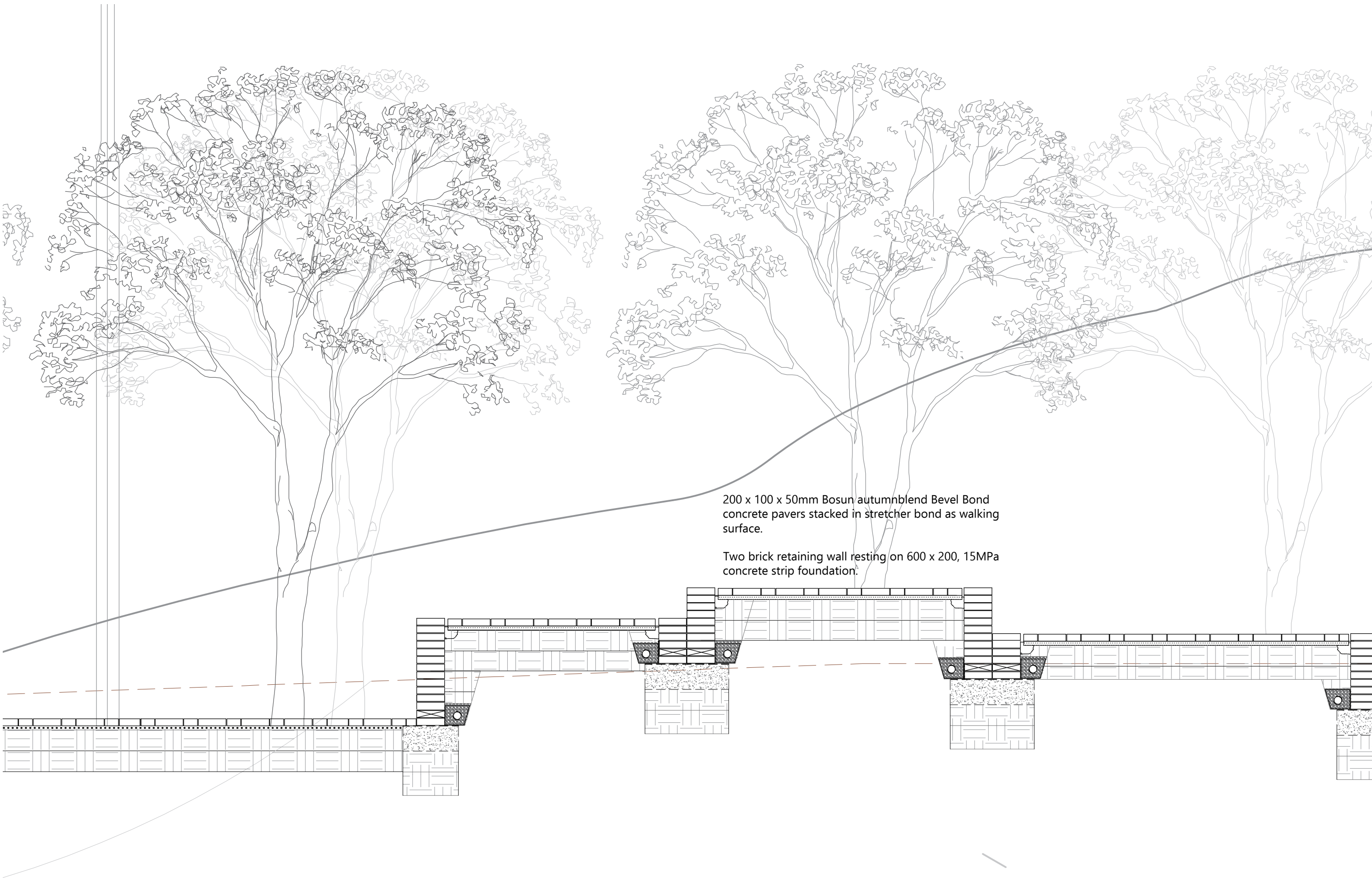


Fig 7.48. Mounded pavilion, scale 1: 50 (Author, 2017)

Detail 2: Mounded pavilion

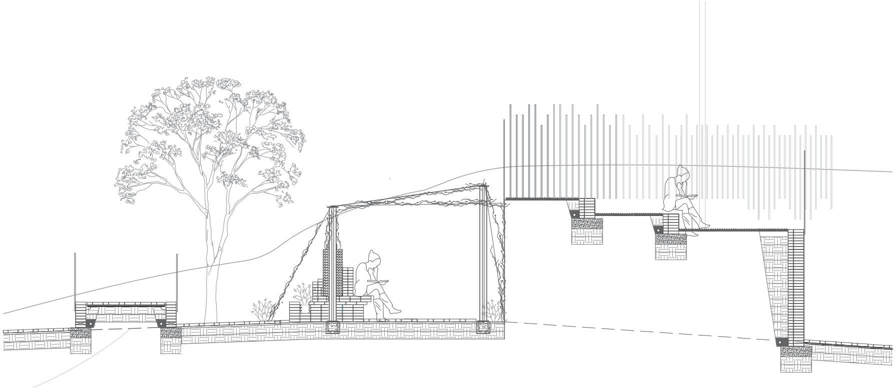
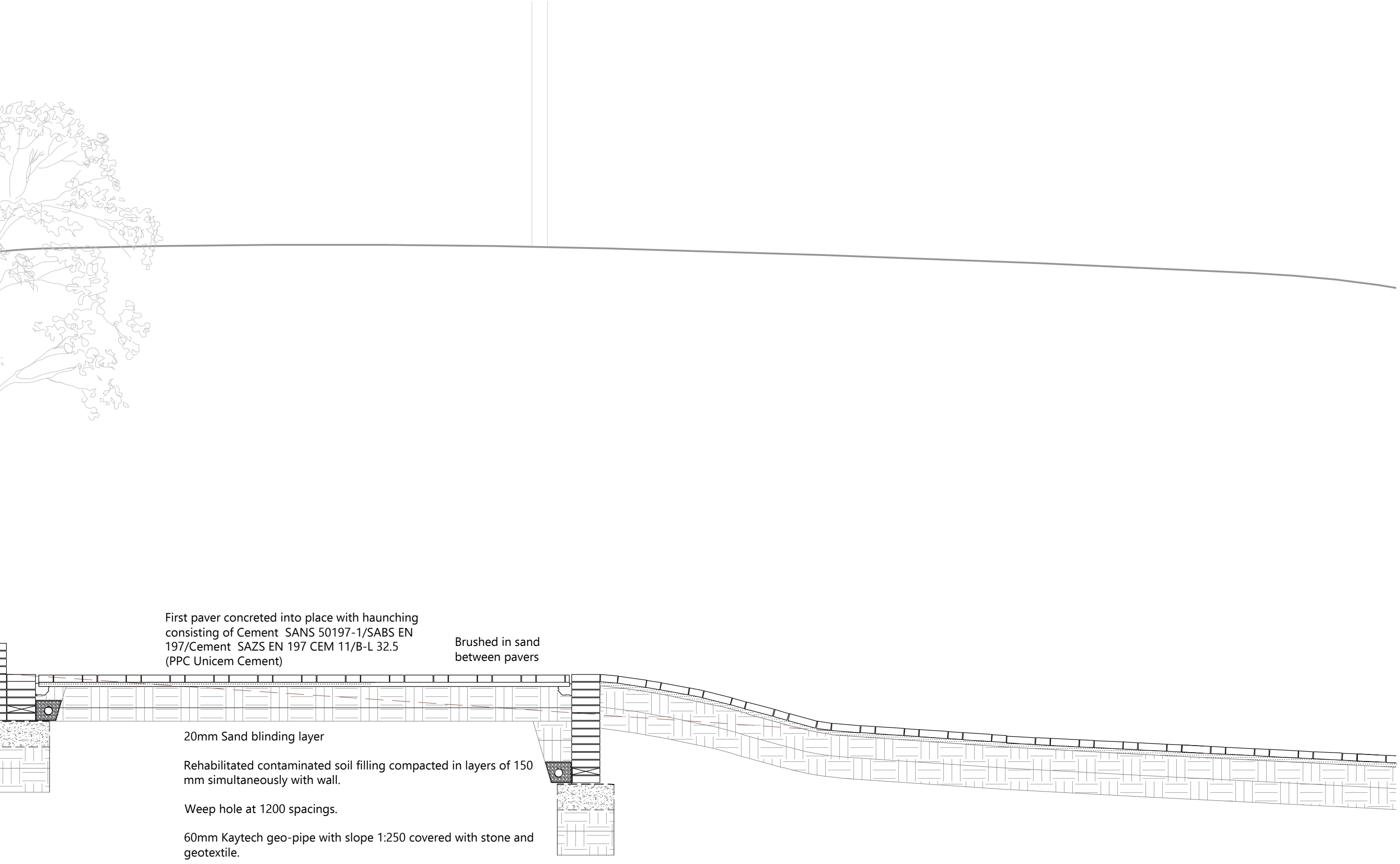


Fig 7.49. Development of mounded pavilion, not ot scale (Author, 2017)



First paver concreted into place with haunching consisting of Cement SANS 50197-1/SABS EN 197/Cement SAZS EN 197 CEM 11/B-L 32.5 (PPC Unicem Cement)

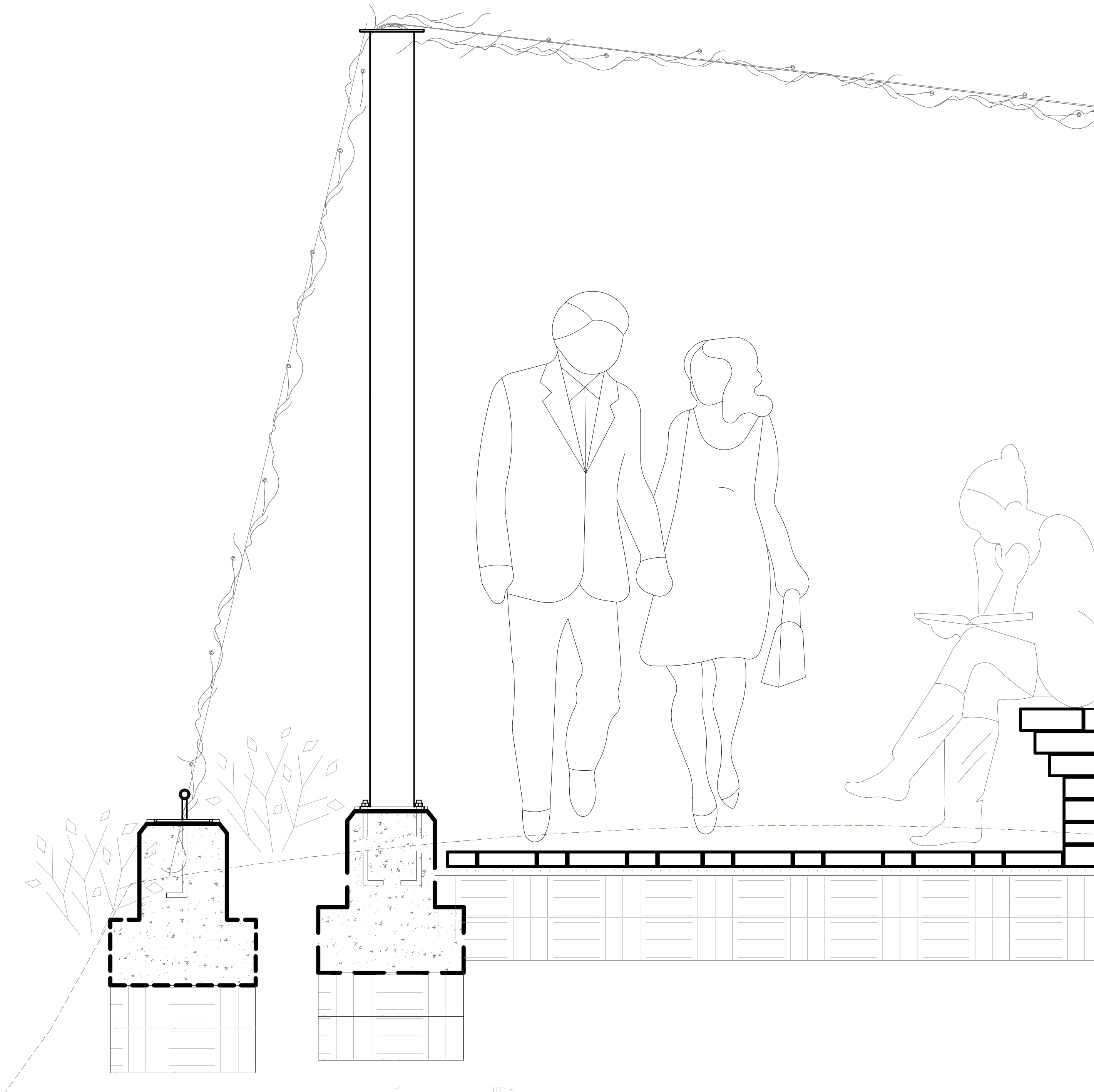
Brushed in sand between pavers

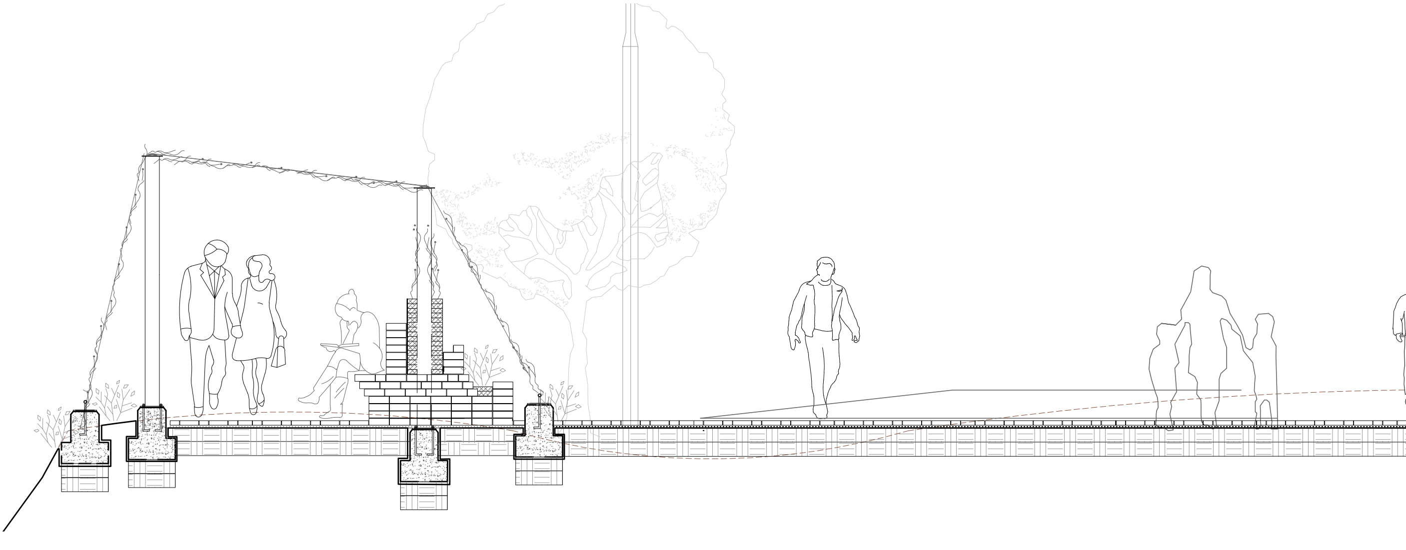
20mm Sand blinding layer

Rehabilitated contaminated soil filling compacted in layers of 150 mm simultaneously with wall.

Weep hole at 1200 spacings.

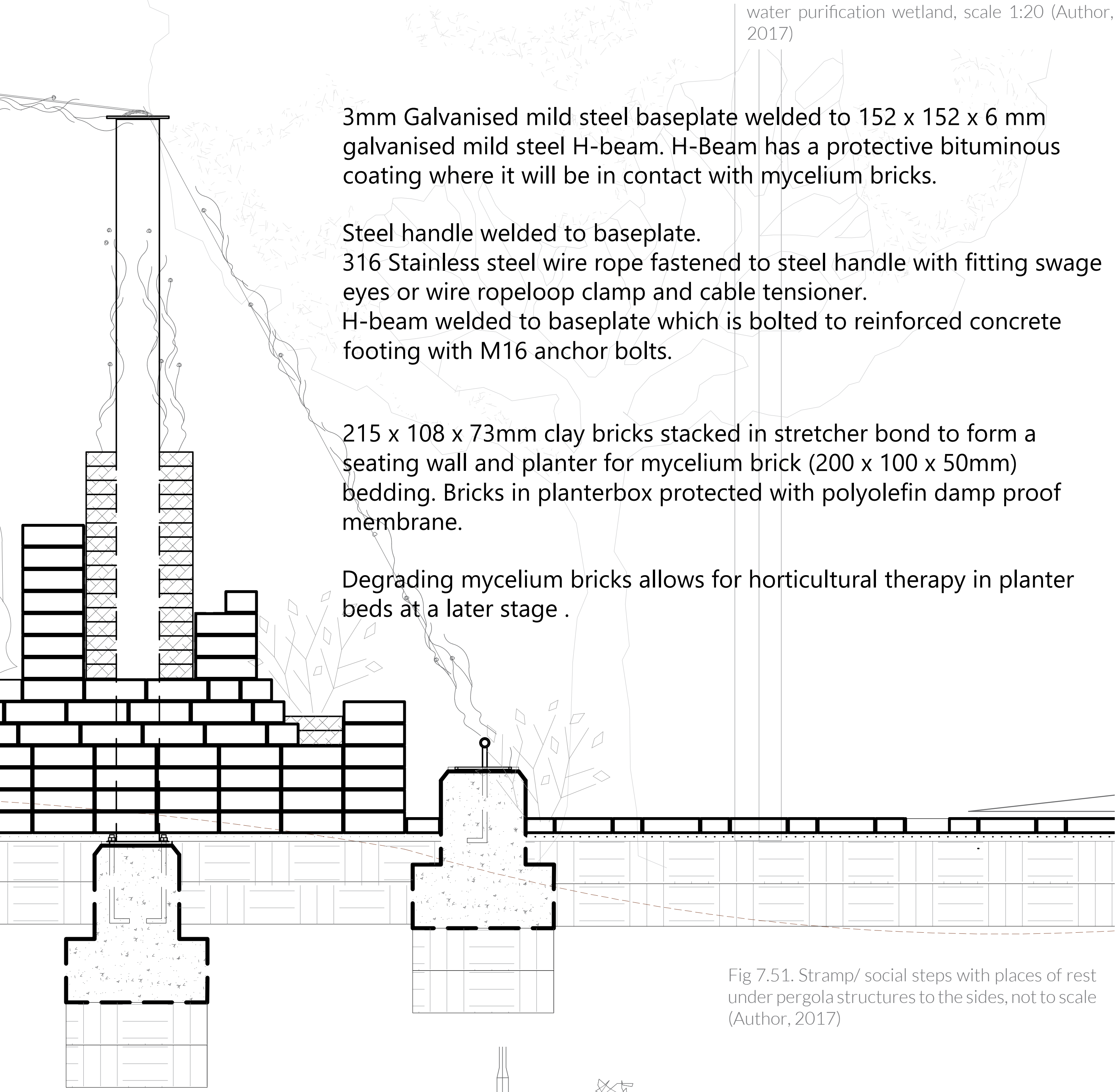
60mm Kaytech geo-pipe with slope 1:250 covered with stone and geotextile.





Detail 3a: Pergola structure

Fig 7.50. Pergola structure with horticultural therapy planters, seating overlooking Eco-textile water purification wetland, scale 1:20 (Author, 2017)



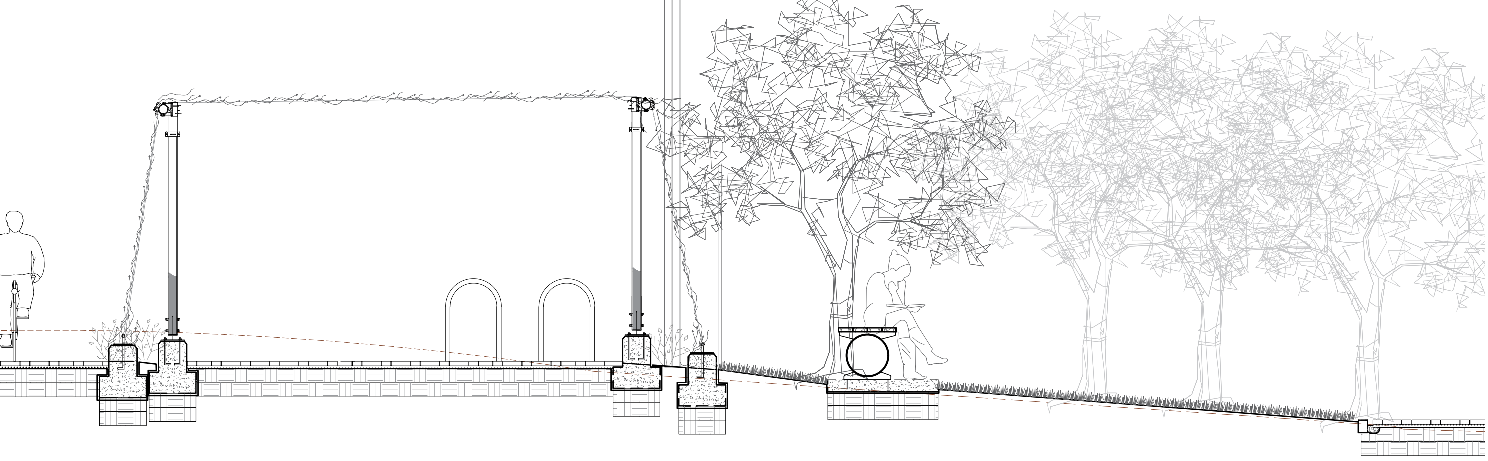
3mm Galvanised mild steel baseplate welded to 152 x 152 x 6 mm galvanised mild steel H-beam. H-Beam has a protective bituminous coating where it will be in contact with mycelium bricks.

Steel handle welded to baseplate.
316 Stainless steel wire rope fastened to steel handle with fitting swage eyes or wire ropeloop clamp and cable tensioner.
H-beam welded to baseplate which is bolted to reinforced concrete footing with M16 anchor bolts.

215 x 108 x 73mm clay bricks stacked in stretcher bond to form a seating wall and planter for mycelium brick (200 x 100 x 50mm) bedding. Bricks in planterbox protected with polyolefin damp proof membrane.

Degrading mycelium bricks allows for horticultural therapy in planter beds at a later stage .

Fig 7.51. Stramp/ social steps with places of rest under pergola structures to the sides, not to scale (Author, 2017)



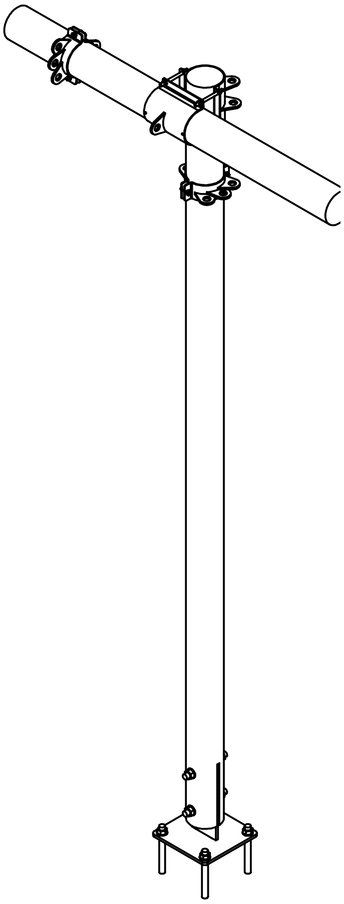
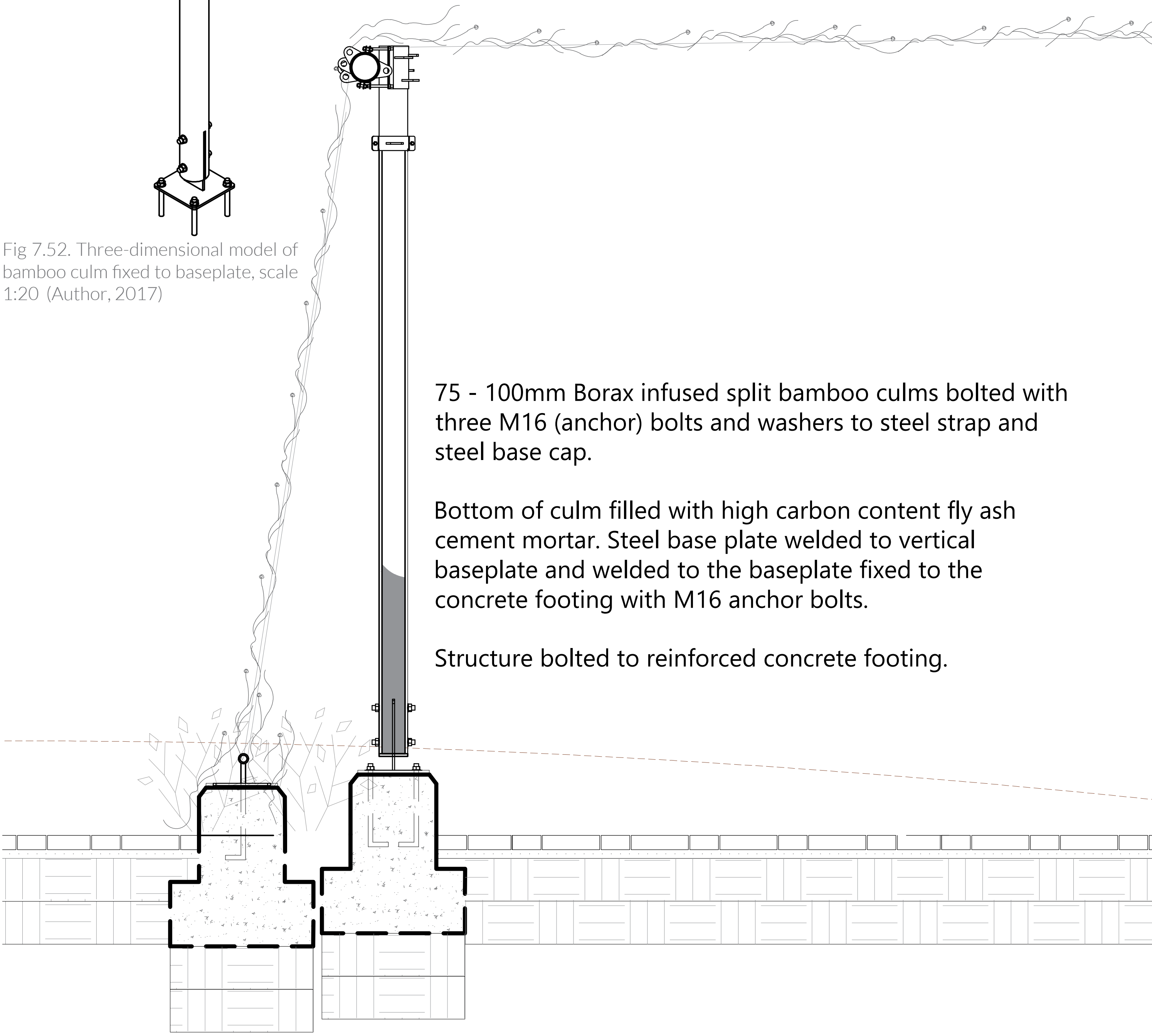


Fig 7.52. Three-dimensional model of bamboo culm fixed to baseplate, scale 1:20 (Author, 2017)



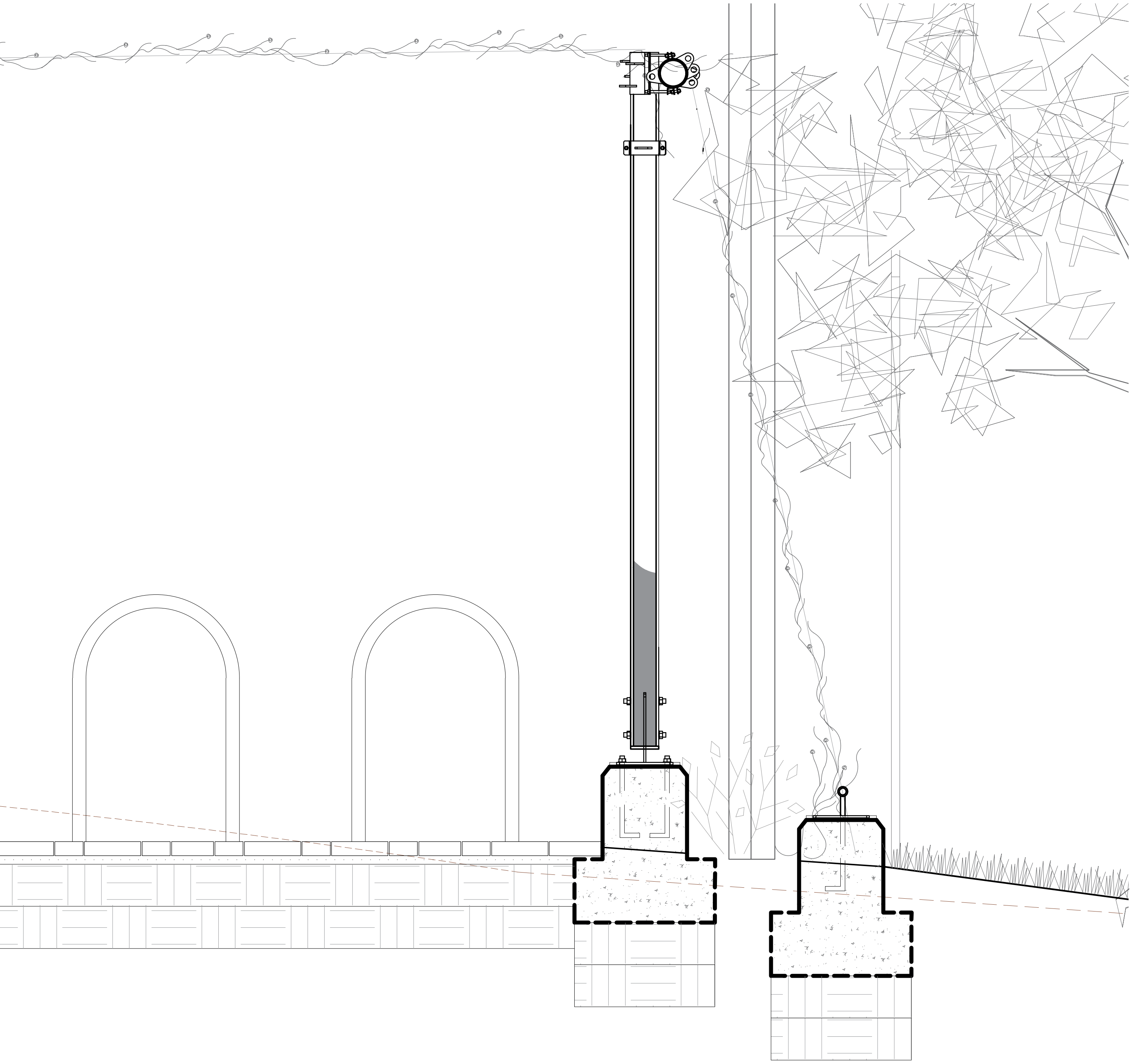
75 - 100mm Borax infused split bamboo culms bolted with three M16 (anchor) bolts and washers to steel strap and steel base cap.

Bottom of culm filled with high carbon content fly ash cement mortar. Steel base plate welded to vertical baseplate and welded to the baseplate fixed to the concrete footing with M16 anchor bolts.

Structure bolted to reinforced concrete footing.

Detail 3b: Pergola structure

Fig 7.53. Bamboo culms of former bridge re-appropriated into pergola structure to allow shade for bicycle stands, scale 1:20 (Author, 2017)



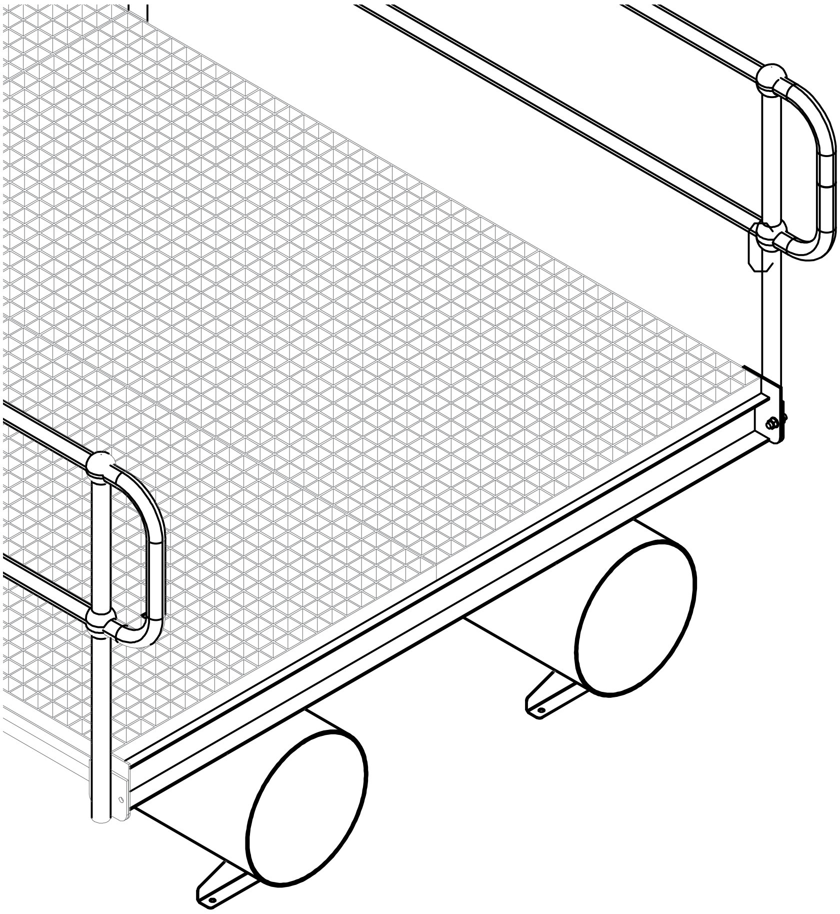
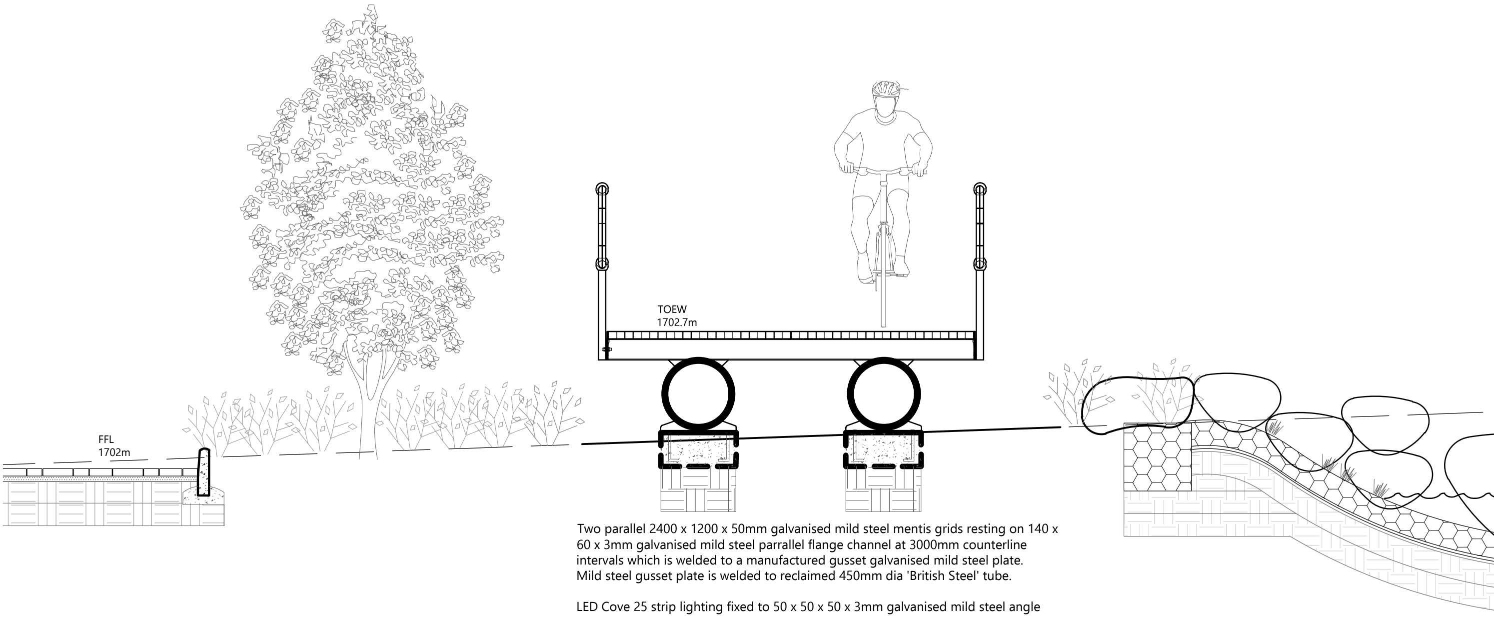


Fig 7.54. Three-dimensional elevated walkway detail, scale 1:20 (Author, 2017)

Fig 7.55. Raised walkway (Lepamphlet.com, 2017)



Two parallel 2400 x 1200 x 50mm galvanised mild steel mentis grids resting on 140 x 60 x 3mm galvanised mild steel parrallel flange channel at 3000mm counterline intervals which is welded to a manufactured gusset galvanised mild steel plate. Mild steel gusset plate is welded to reclaimed 450mm dia 'British Steel' tube.

LED Cove 25 strip lighting fixed to 50 x 50 x 50 x 3mm galvanised mild steel angle iron, which is welded to the steel grid.

140mm dia round hollow 'British Steel' steel tubes fixed to to 8mm galvanised mild steel baseplate at 3000mm intervals with M16 bolts. Baseplate bolted to 225mm

Fig 7.56. Detail 4: Water directed into cut-off swale and adjacent children's play area. scale 1:50 (Author, 2017)

Detail 4: Water directed into cut-off swale and adjacent children's play area

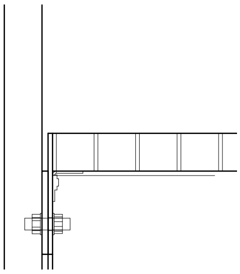


Fig 7.57. LED light strip fixed to walkway scale 1:10 (Author, 2017)

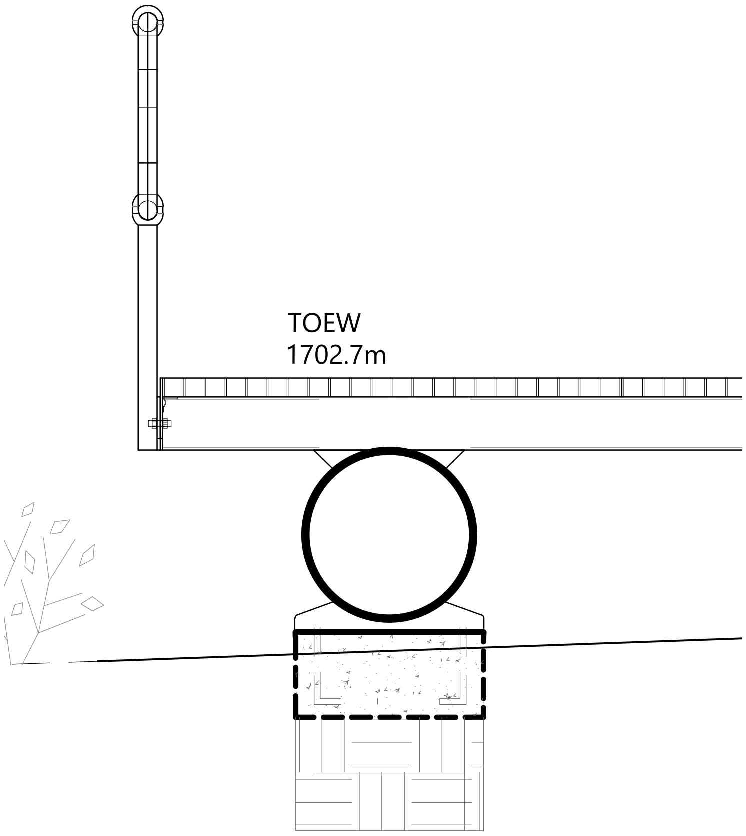
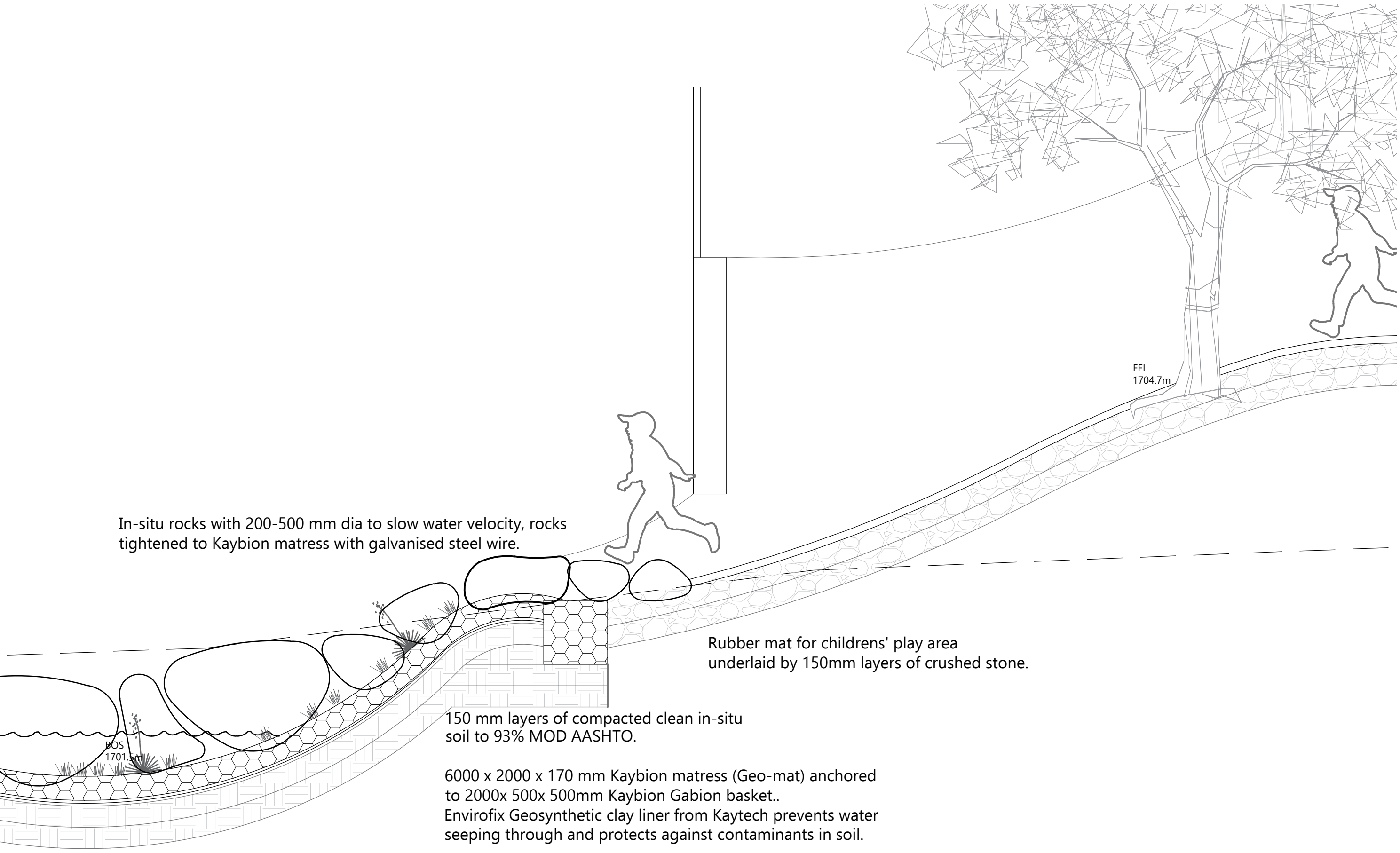


Fig 7.58. Elevated walkway detail, scale 1:20 (Author, 2017)



In-situ rocks with 200-500 mm dia to slow water velocity, rocks tightened to Kaybion matress with galvanised steel wire.

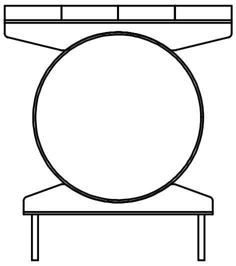
Rubber mat for childrens' play area underlaid by 150mm layers of crushed stone.

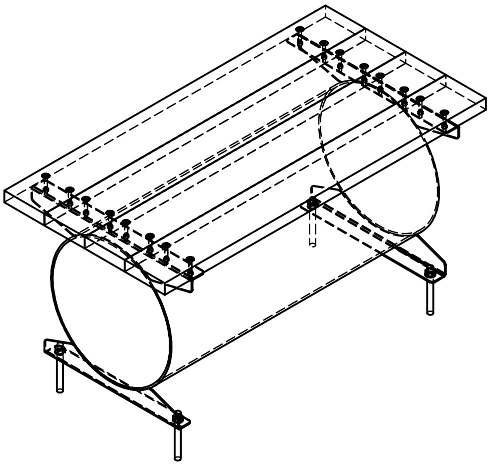
150 mm layers of compacted clean in-situ soil to 93% MOD AASHTO.

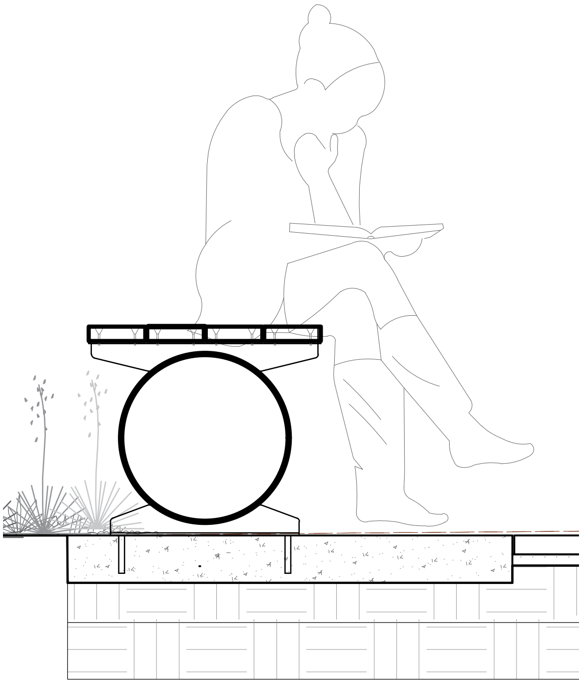
6000 x 2000 x 170 mm Kaybion matress (Geo-mat) anchored to 2000x 500x 500mm Kaybion Gabion basket..
Envirofix Geosynthetic clay liner from Kaytech prevents water seeping through and protects against contaminants in soil.

Fig 7.59. Three dimensional view of bench, scale 1:20 (Author, 2017)

Fig 7.60. Bench consisting of reclaimed 'British Steel' combined with a '***Eucalyptus grandis***' seating surface,scale 1:20 (Author, 2017)

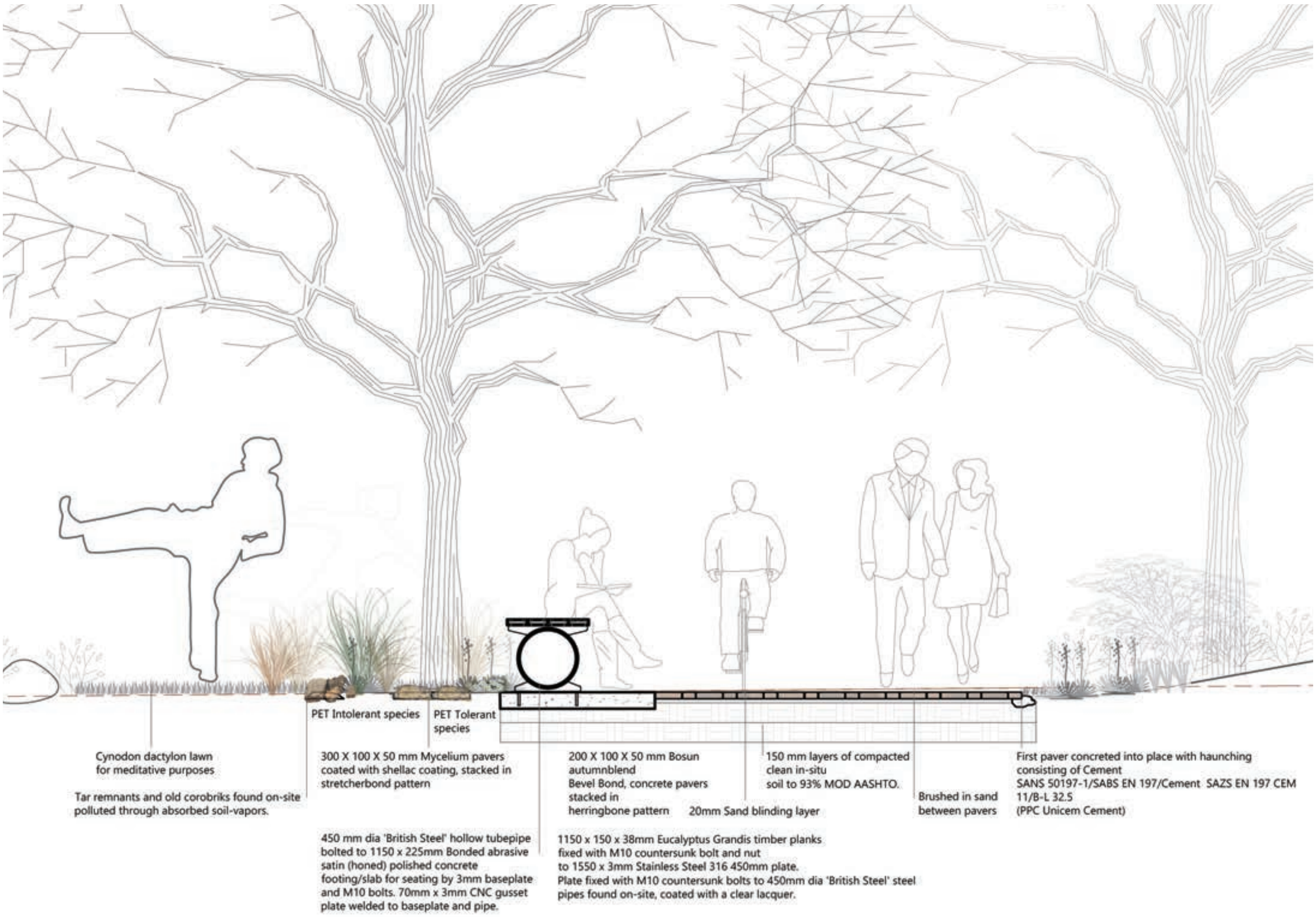






Detail 5: New paving surface transition to old bricks. Soil vapours from old bricks absorbed through mushrooms (degrading mycelium bricks)

Fig 7.61. New paving surface transition, scale 1:50 (Author, 2017)



CHAPTER EIGHT

Conclusion

Chapter overview
In this Chapter the concluding factors will be discussed as a reflection on the hypothesis to the Research Question stated at the beginning of the study.

Conclusion to this study

Community Identity is the antidote to **individualist consumerism** and this intangible value can become part of an **open narrative** in an abandoned **post-industrial landscape** healed through the process of natural **restoration**.

The social value the Johannesburg, Cottesloe, Gas Works held was perceived by the author to be the most significant which led to the focus on urban regeneration and social cohesion. To marry the socially and spatially segregated areas in the city, Clifford's (2015) principles of "*co-presence, interaction, interlocking of understandings and practices*" are applied, which will create new meanings to spaces that once posed a cultural limitation. The Cottesloe Gas Works has value and should be integrated into the surrounding community for benefit of both. A mutualistic relationship between the site and the people can and should co-exist.

This project could be made viable through Public-Private Partnerships, such as the applicable state-owned departments, NGO's such as Earth Keeper and other private institutions such as banks and surrounding Universities. The City of Johannesburg Gas Department also has a liability to remediate the associated pollution. The community will also play a vital role through community institutions such as Uthando and the Church @ 44.

The main issues have been addressed in this study by proposing measures to remediate the soil and water in incomplete stages as part of an Open Narrative Approach. Phytoremediation are proposed with mostly indigenous species. This project is aimed at the creation of awareness of the negative impacts exploitative endeavours may have, but also the manner to overcome this is presented by applying alternative soil and water purification strategies. The user will be confronted with the highly contaminated soil mounds and would be compelled to question what might have happened and what values or ideologies gave rise to the environmental contamination. By dealing with the associated pollution on-site, the pollution becomes part of the Open Narrative where the user can attain their own experience by witnessing the incomplete stages and movement of soil, water, vegetation and other users in the landscape.
The following principles of the Open Narrative approach were applied in the design: multiplicity, temporality, recuperation of site specifics, value structuring, experience, incomplete stages and a sequence of movement. As part of the Methodology, the three realities/ narratives have been used from where the tangible and intangible can be experienced: a lower, an in-between and upper reality with increasing levels of transience.

The heritage remnants on the site have been re-appropriated into the design proposal. By means of the user inscribing their own narrative, the once negative perception of exploitation of human health and the environment can be changed. Transience becomes part of the experience as the landscape is being healed and the soil mounds shift. The material choice also relates to the transience of the former function of the site. Coal which is heavyweight in materiality changed into gas which is lightweight. Materials are chosen ranging from heavyweight to lightweight as the transience increases with height.
By providing a park of multiplicity, the user may have different experiences every visit as the park offers choice or recombination. The spaces designed can be used in multiple ways such as the stramp. It becomes social steps where people may gather, sit, eat, lunch, learn or move through. If the user requires rest, there are leaved canopies to the sides of the open glade. The events plaza, which is a stepped pavilion, can become a part of the thoroughfare through the park that links the two Universities. It offers choice and recombination by allowing multiple routes up and down the mounded pavilion. The bridges can be used by cyclists, joggers and the meditative park visitor. Multiplicity aims for an all-inclusive design.

The principles outlined by Naomi Klein (2014: 462), involves "*interdependence, reciprocity and cooperation*", which can be said is the essence to Mutualistic endeavours. The mental, social- and environmental well-being of people are promoted by fostering the intangible benefits such as community cohesion. By applying anti-exploitive principles to the design proposal, the intrinsic value nature has in and for itself is evident. The environment benefits by being restored and interconnectedness between various eco-systems may thrive once again, whilst the visitor experiences this ebb and flow of natural systems and may come to the realization of the importance of interconnectedness, in nature and with other people. The activities proposed in the park are not primarily aimed at generating revenue and rather provides a space where community cohesion can be fostered through leisure and recreational activities, sports and working opportunities. The Cottesloe Gas Works is proposed to become a place where social network building may happen and much needed social interaction and co-dependence.

Fig 8.1. Photographs of 1:200 model and final presentation (Author, 2017)

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List of Figures

CHAPTER FIVE 53

CHAPTER SIX 71

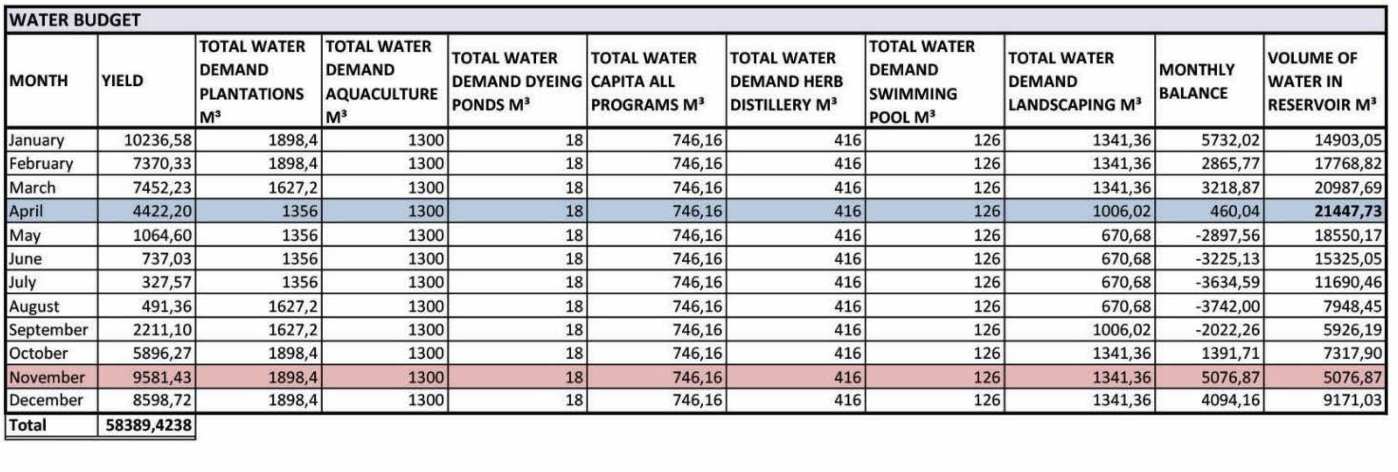
Appendices

AREA 1: 45 880M^2 TOTAL MONTHLY YIELD											
MONTH	PRECIP-ITATION (M)	CO-EFF	ROOF SURFACES (M^2)	MONTHLY YIELD ROOF (M^3)	CO-EFF	PAVING SURFACES (M^2)	MONTHLY YIELD PAVING (M^3)	CO-EFF	SOFT SURFACES (M^2)	MONTHLY YIELD SOFT SURFACES (M^3)	TOTAL MONTHLY YIELD (M^3)
January	0,125	0,9	13423	1510,0875	0,8	20804	2080,4	0,5	11653	728,3125	4318,8
February	0,09	0,9	13423	**1087,263**	0,8	20804	1497,888	0,5	11653	524,385	3109,536
March	0,091	0,9	13423	1099,3437	0,8	20804	1514,5312	0,5	11653	530,2115	3144,0864
April	0,054	0,9	13423	652,3578	0,8	20804	898,7328	0,5	11653	314,631	1865,7216
May	0,013	0,9	13423	157,0491	0,8	20804	216,3616	0,5	11653	75,7445	449,1552
June	0,009	0,9	13423	108,7263	0,8	20804	149,7888	0,5	11653	52,4385	310,9536
July	0,004	0,9	13423	48,3228	0,8	20804	66,5728	0,5	11653	23,306	138,2016
August	0,006	0,9	13423	72,4842	0,8	20804	99,8592	0,5	11653	34,959	207,3024
September	0,027	0,9	13423	326,1789	0,8	20804	449,3664	0,5	11653	157,3155	932,8608
October	0,072	0,9	13423	869,8104	0,8	20804	1198,3104	0,5	11653	419,508	2487,6288
November	0,117	0,9	13423	1413,4419	0,8	20804	1947,2544	0,5	11653	681,7005	4042,3968
December	0,105	0,9	13423	1268,4735	0,8	20804	1747,536	0,5	11653	611,7825	3627,792
Total	**0,713**		13423	**8613,5391**		20804	**11866,6016**		11653	**4154,2945**	**24634,4352**

AREA 2: 28 358m^2 TOTAL MONTHLY YIELD											
MONTH	PRECIP-ITATION (M)	CO-EFF	ROOF SURFACES (M^2)	MONTHLY YIELD ROOF (M^3)	CO-EFF	PAVING SURFACES (M^2)	MONTHLY YIELD PAVING (M^3)	CO-EFF	SOFT SURFACES (M^2)	MONTHLY YIELD SOFT SURFACES (M^3)	TOTAL MONTHLY YIELD (M^3)
January	0,125	0,9	6776	762,3	0,8	11825	1182,5	0,5	9757	609,8125	2554,6125
February	0,09	0,9	6776	**548,856**	0,8	11825	851,4	0,5	9757	439,065	1839,321
March	0,091	0,9	6776	554,9544	0,8	11825	860,86	0,5	9757	443,9435	1859,7579
April	0,054	0,9	6776	329,3136	0,8	11825	510,84	0,5	9757	263,439	1103,5926
May	0,013	0,9	6776	79,2792	0,8	11825	122,98	0,5	9757	63,4205	265,6797
June	0,009	0,9	6776	54,8856	0,8	11825	85,14	0,5	9757	43,9065	183,9321
July	0,004	0,9	6776	24,3936	0,8	11825	37,84	0,5	9757	19,514	81,7476
August	0,006	0,9	6776	36,5904	0,8	11825	56,76	0,5	9757	29,271	122,6214
September	0,027	0,9	6776	164,6568	0,8	11825	255,42	0,5	9757	131,7195	551,7963
October	0,072	0,9	6776	439,0848	0,8	11825	681,12	0,5	9757	351,252	1471,4568
November	0,117	0,9	6776	713,5128	0,8	11825	1106,82	0,5	9757	570,7845	2391,1173
December	0,105	0,9	6776	640,332	0,8	11825	993,3	0,5	9757	512,2425	2145,8745
Total	**0,713**		6776	**4348,1592**		11825	**6744,98**		9757	**3478,3705**	**14571,5097**

AREA 3: 67 457m^2 - 18 916m^2 (CONTAMINATED AREAS) = 48 541m^2 TOTAL MONTHLY YIELD											
MONTH	PRECIP-ITATION (M)	CO-EFF	ROOF SURFACES (M^2)	MONTHLY YIELD ROOF (M^3)	CO-EFF	PAVING SURFACES (M^2)	MONTHLY YIELD PAVING (M^3)	CO-EFF	SOFT SURFACES (M^2)	MONTHLY YIELD SOFT SURFACES (M^3)	TOTAL MONTHLY YIELD (M^3)
January	0,125	0,9	4787	538,5375	0,8	2400	240	0,5	41354	2584,625	3363,1625
February	0,09	0,9	4787	**387,747**	0,8	2400	172,8	0,5	41354	1860,93	2421,477
March	0,091	0,9	4787	392,0553	0,8	2400	174,72	0,5	41354	1881,607	2448,3823
April	0,054	0,9	4787	232,6482	0,8	2400	103,68	0,5	41354	1116,558	1452,8862
May	0,013	0,9	4787	56,0079	0,8	2400	24,96	0,5	41354	268,801	349,7689
June	0,009	0,9	4787	38,7747	0,8	2400	17,28	0,5	41354	186,093	242,1477
July	0,004	0,9	4787	17,2332	0,8	2400	7,68	0,5	41354	82,708	107,6212
August	0,006	0,9	4787	25,8498	0,8	2400	11,52	0,5	41354	124,062	161,4318
September	0,027	0,9	4787	116,3241	0,8	2400	51,84	0,5	41354	558,279	726,4431
October	0,072	0,9	4787	310,1976	0,8	2400	138,24	0,5	41354	1488,744	1937,1816
November	0,117	0,9	4787	504,0711	0,8	2400	224,64	0,5	41354	2419,209	3147,9201
December	0,105	0,9	4787	452,3715	0,8	2400	201,6	0,5	41354	2171,085	2825,0565
Total	**0,713**		4787	**3071,8179**		2400	**1368,96**		41354	**14742,701**	**19183,4789**

WATER CAPITA/DAY (L)			
2100 people per day - 600 workers and permanent residents; 1500 visitors.			
Public People	**Appliances**	**Litres/day/person served**	**Total demand per day (ltr)**
1400	Handwashing: spray taps	1	1400
600	Urinal flushing 8h day	4	2400
128	urinal flushing 24h day	12	1536
400	Dishwashing machine	3	1200
700	WC flushing-urinals provided	4	2800
500	Drinking, food prep and cooking	15	7500
128	Laundry	12	1536
650	Washing dishes	10	6500
	Total liters per day		24872
	Total m^3 per day		24,87
	Total m^3 per month		746,16
	Total greywater m^3 per month		544



WATER BUDGET										
MONTH	YIELD	TOTAL WATER DEMAND PLANTATIONS M³	TOTAL WATER DEMAND AQUACULTURE M³	TOTAL WATER DEMAND DYEING PONDS M³	TOTAL WATER CAPITA ALL PROGRAMS M³	TOTAL WATER DEMAND HERB DISTILLERY M³	TOTAL WATER DEMAND SWIMMING POOL M³	TOTAL WATER DEMAND LANDSCAPING M³	MONTHLY BALANCE	VOLUME OF WATER IN RESERVOIR M³
January	10236,58	1898,4	1300	18	746,16	416	126	1341,36	5732,02	14903,05
February	7370,33	1898,4	1300	18	746,16	416	126	1341,36	2865,77	17768,82
March	7452,23	1627,2	1300	18	746,16	416	126	1341,36	3218,87	20987,69
April	4422,20	1356	1300	18	746,16	416	126	1006,02	460,04	**21447,73**
May	1064,60	1356	1300	18	746,16	416	126	670,68	-2897,56	18550,17
June	737,03	1356	1300	18	746,16	416	126	670,68	-3225,13	15325,05
July	327,57	1356	1300	18	746,16	416	126	670,68	-3634,59	11690,46
August	491,36	1627,2	1300	18	746,16	416	126	670,68	-3742,00	7948,45
September	2211,10	1627,2	1300	18	746,16	416	126	1006,02	-2022,26	5926,19
October	5896,27	1898,4	1300	18	746,16	416	126	1341,36	1391,71	7317,90
November	9581,43	1898,4	1300	18	746,16	416	126	1341,36	5076,87	5076,87
December	8598,72	1898,4	1300	18	746,16	416	126	1341,36	4094,16	9171,03
Total	**58389,4238**									

Rational Method to calculate the SW Peak Flow

$Q=C.A.I$

1. Drainage area of Braamfontein Spruit = 27 420 000m²

2. Distance of longest run-off path = 25 km = 25 000m

3. Elevation difference between the highest and lowest elevation
1780m - 1440m = 340m

4. Concentration time
$t(c) = (0.87 \times L^3/ H) \times 0.385$
$t(c) = 15.39h$
$t(c) = 55\ 404$ sec

5. Season of max rainfall: Summer = 713mm/ year

6. Rainfall intensity for each frequency (from graph)
2 yr - 0.11m/ 55 404sec
5 yr - 0.2m/ 55 404sec
10 yr - 0.26m/ 55 404sec

7. Determine run-off co-efficient, c
Total area = 27 420 000m²
C of 0.5 (Special residential - 1 dwelling per plot)

8. Determine volume of water per sec run-off at peak discharge for each period or frequency with formula
$Q = C.I.A$

2yr = $Q2=C.I2.A$
$= 0.5 \times 27\ 420\ 000m^2 \times 0.11m/55\ 404$ sec
$= 2.6m^3/sec$
5yr = $Q5=C.I5.A$
$= 0.5 \times 27\ 420\ 000m^2 \times 0.2m/ 55\ 404$ sec
$= 4.9m^3/sec$
10yr = $Q10=C.I10.A$
$= 0.5 \times 27\ 420\ 000m^2 \times 0.26m/ 55\ 404$ sec
$= 6.3m^3/sec$

Watercourse (channel) capacity

Parabolic channel
$Q2 = 2.6m^3/sec$
V = 1.85m/ sec (earth/ soil channel swale)
$Q= v.a$
$a=2.6m^3/sec / 1.08m/sec$
$a=2.40m^2$

w choose 5.5m (Cut-off open swale)
$a = 0.67(5.5)d$
$d=0.9$ m

$Q10=v.a$
$a=Q/v$
$6.3m^3/sec/1.85m/sec$
$a=3.4m^2$

$a = 0.67(3)d$
$d=1.69m$

choose d 1.5m (Spruit)
$a=0.67(w).(d)$
$3.4m = 0.67 (w).(1.5)$
$3.4/ 1.005 = w$
$3.3m = w$

The existing underground Braamfontein Spruit will be opened up, which is approximately 1.5m deep. Therefore, to cater for 10 year flood, channels needs to be at least 3.3m wide but provision is made for 5.5m wide. Additionally, provision is made for smaller attenuation dams by means of concrete weirs in order to alleviate downstream flood water. The cut-off open channel will be provided with a constant flow from a 150mm dia mm pipe and will therefore not succumb to flood situations. The depth of the cut-off open swale is proposed to be 0.5m deep and 5.5m wide.

Bedankings

Aan die Een wat alles aan my gegee het. Through You I live, move, breath and have my being (Acts 17:28). Dankie Here, dat U my inspirasie bied, lei en bewaar. "*I will say of the Lord: He is my refuge and my fortress; my God; in Him will I trust.*" Aan U kom al die glorie en eer.

Teksvers wat gedien het as inspirasie vir hierdie projek:

Isaiah 58:12 (The Message)
You'll use the old rubble of past lives to build anew, rebuild the foundations from out of your past. You'll be known as those who can fix anything, restore old ruins, rebuild and renovate, make the community livable again.

Aan my man, daar is nie genoeg woorde om my dank aan jou te bewys nie.

Aan my Ma, dankie vir al Ma se ondersteuning deur die jare, ek sou nie hier gewees het vandag as dit nie vir Ma was nie. Daar was nie 'n tyd van die dag wat Ma nie beskikbaar was nie, Ma was altyd gereed om'n bemoedigende woord te gee.

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