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MACHINE MAN NATURE

BIONIC EVOLUTION

NIKITA EDWARDS


NATURE
MACHINE

B I O N I C   E V O L U T I O N

EXPLORING A PLACE-SPECIFIC REGENERATIVE ARCHITECTURE TO FOSTER SYNERGISTIC RELATIONSHIPS BETWEEN MAN, NATURE AND MACHINE IN THE FUTURE POST-MINING CONTEXT OF CULLINAN

BIONIC EVOLUTION

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Edited by:
Carin Geerdts-Wiid

TO MY PARENTS

THANK YOU FOR YOUR LOVE,
SUPPORT AND UNDERSTANDING

THANK YOU:

ARTHUR, FOR YOUR TIME
AND VALUABLE GUIDANCE

MY HEAVENLY FATHER

ABSTRACT

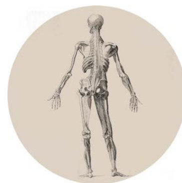
Site: Oak Avenue, Cullinan
25°40’21.54”S
28°31’2.27”E

Current toxic interactions between the systems of *man, nature and machine* in the diamond mining town of *Cullinan* are volatile and cannot be sustained. When the mine and the main economic system regress, how can the remaining dependent cultural and biophysical systems be sustained and what can Cullinan become after the *demise of the machine?* Impending deindustrialisation could mean that Cullinan *will be silenced* and its associated meaning and memory lost.

The architecture of the Age of the Machine represents *contemporary interactions between the biotic and bionic* where industrial buildings, and the introverted town, reflect the *dominance* of the machine over nature. The objective of this dissertation is to set a precedent for *place-responsive regenerative architecture within a post-mining context* that is inspired by *local nature and culture.* An architecture that expresses a new co-evolving mutualistic relationship between the existing town and landscape (cultural and natural systems) will be considered.

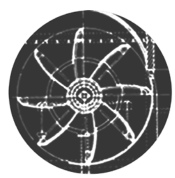
Programme: A local food hub

The intention of this dissertation is to address the future shift of human communities and economic activities back to the alignment and synergy with life processes. A bionic evolution *from the Age of the Machine, to the Age of Life is explored.*



MAN

NATURE



MACHINE

ABSTRAK

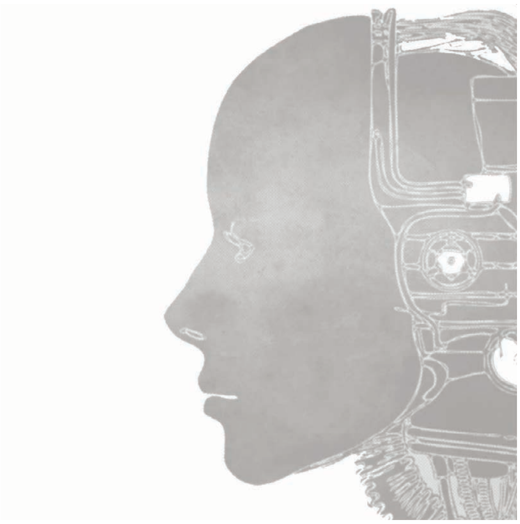
Site: Oak Avenue, Cullinan
25°40’21.54”S
28°31’2.27”E

Huidige toksiese wisselwerking tussen die stelsels van die mens, die natuur en industrialisasie in die diamantmyndorp, Cullinan, is onstabiel en kan nie gehandhaaf word nie. Wanneer die myn en die hoof ekonomiese stelsel agteruitgaan, hoe kan die oorblywende afhanklike kulturele en biofisiese stelsels gehandhaaf word en wat is die toekoms van Cullinan ná die ondergang van die masjien? Dreigende de-industrialisasie kan beteken dat Cullinan gestil kan word en dat sy gepaardgaande betekenis en herinneringe verlore kan raak.

Die argitektuur van die Eeu van Industrialisasie verteenwoordig kontemporêre interaksies tussen die biotiese en bioniese, waar industriële geboue, en die introverte dorp die dominansie van die masjien oor die natuur reflekteer. Die doel van hierdie verhandeling is om ’n presedent te skep vir ’n plek-responsiewe regeneratiewe argitektuur binne ’n post-mynbou verband wat deur plaaslike natuur en kultuur geïnspireer is. ’n Argitektuur wat ’n nuwe mede-ontwikkelende wedersydse verhouding tussen die bestaande dorp en die landskap (kulturele en natuurlike stelsels) weergee, sal oorweeg word.

Program: ’n Plaaslike voedsel middelpunt

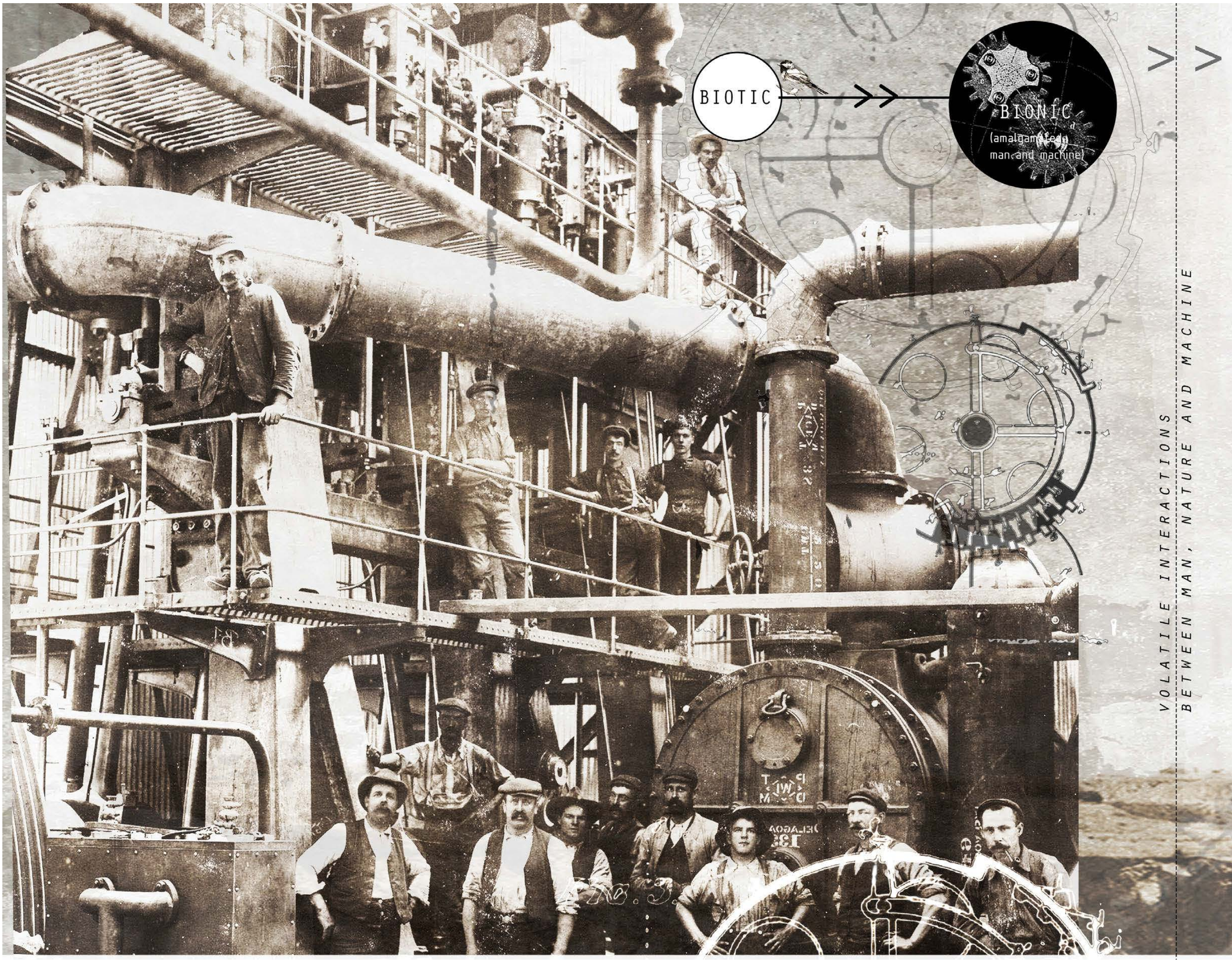
Die doelwit van hierdie verhandeling is om die toekomstige terugbeweeg van menslike gemeenskappe en ekonomiese aktiwiteite in balans en sinergie met lewensprosesse, te bewerkstelling. ’n Bioniese evolusie van die Eeu van Industrialisasie na die Eeu van Lewe word ondersoek.



"No one confessed the Machine was out of hand. Year by year it was served with increased efficiency and decreased intelligence. The better a man knew his own duties upon it, the less he understood the duties of his neighbor and in all the world there was not one who understood the monster as a whole... But Humanity, in its desire for comfort, had over-reached itself. It had exploited the riches of nature too far. Quietly and complacently, it was sinking into decadence, and progress had come to mean the progress of the Machine."

EM Forster, The Machine Stops (1909)

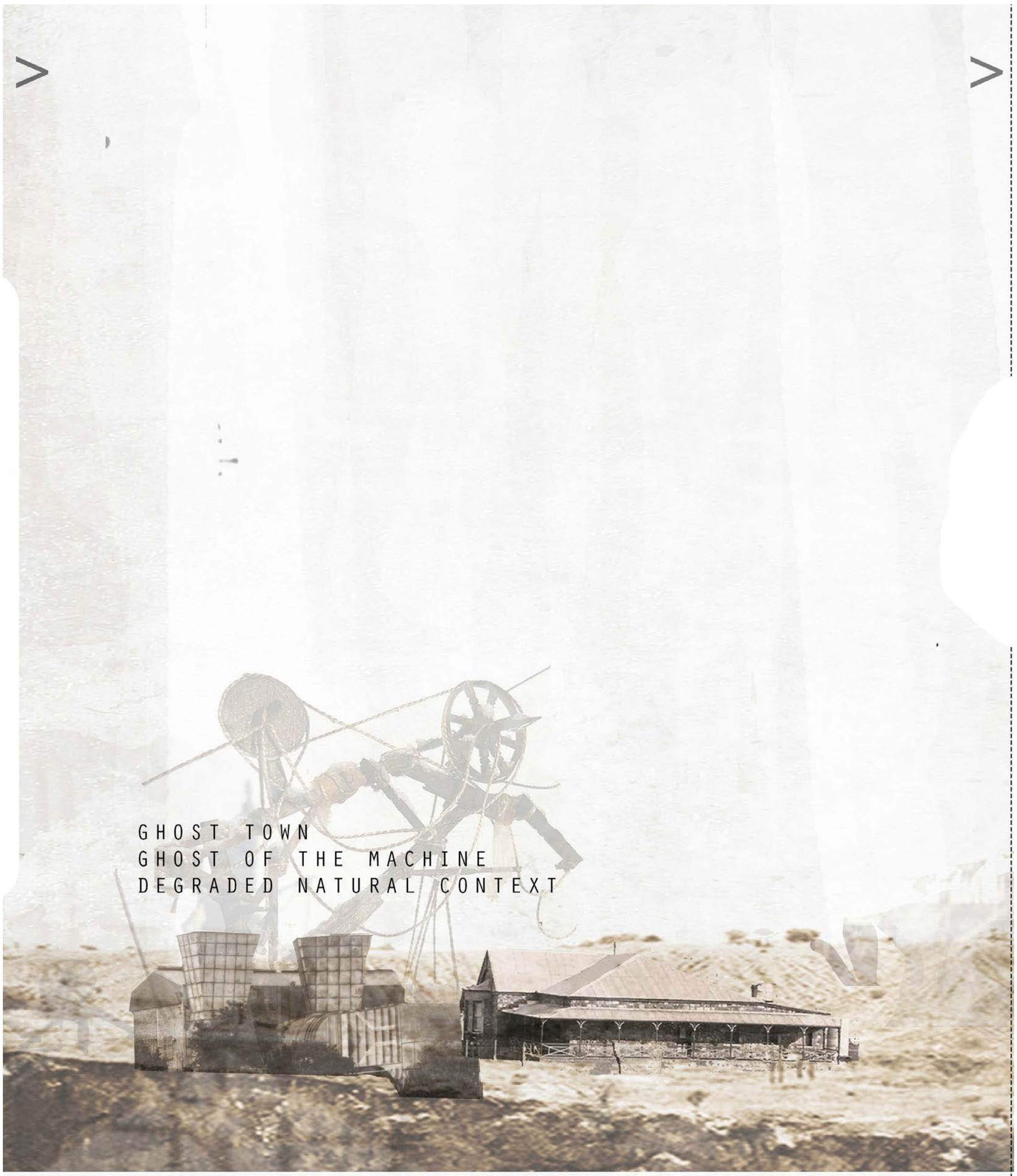
ENSLAVEMENT TO THE MACHINE



OLD RELATIONSHIPS
THE CURRENT CONDITION

Cullinan's changing condition and the changing relationship between man, nature and machine

(Author, 2014)



ADVERSE FUTURE RELATIONSHIPS

AFTER MINE DECOMMISSION

A 'symbionic' architecture for a
Post-industrial Cullinan
(Author, 2014)

ENVISIONED RELATIONSHIPS
THE NEW CONDITION

CO-EVOLVING MUTUALISM BETWEEN MAN, NATURE ANA MACHINE

'Symbionic'

- a combination of the terms 'symbiotic' and 'bionic'

Symbiotic

Interaction between two unlike *natural organisms (the biotic)* living in close physical association, typically to the advantage of both (Oxford University Press, 2013: online). For the purpose of this dissertation, symbiosis refers to a *mutually beneficial* relationship between systems.

Bionic

Bionic or cyborg, refers to the combination of man and technology/machine (Macmillan, 2013: online). It describes society's and Cullinan's contemporary cultural condition.

Instead of the traditional view of symbiosis between natural organisms (the biotic), this dissertation will explore the concept of the 'symbionic' where a synergistic relationship between the place-specific natural and cultural condition (the bionic) is created.

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A STORY OF MAN, NATURE AND MACHINE

Chapter 4 SITE

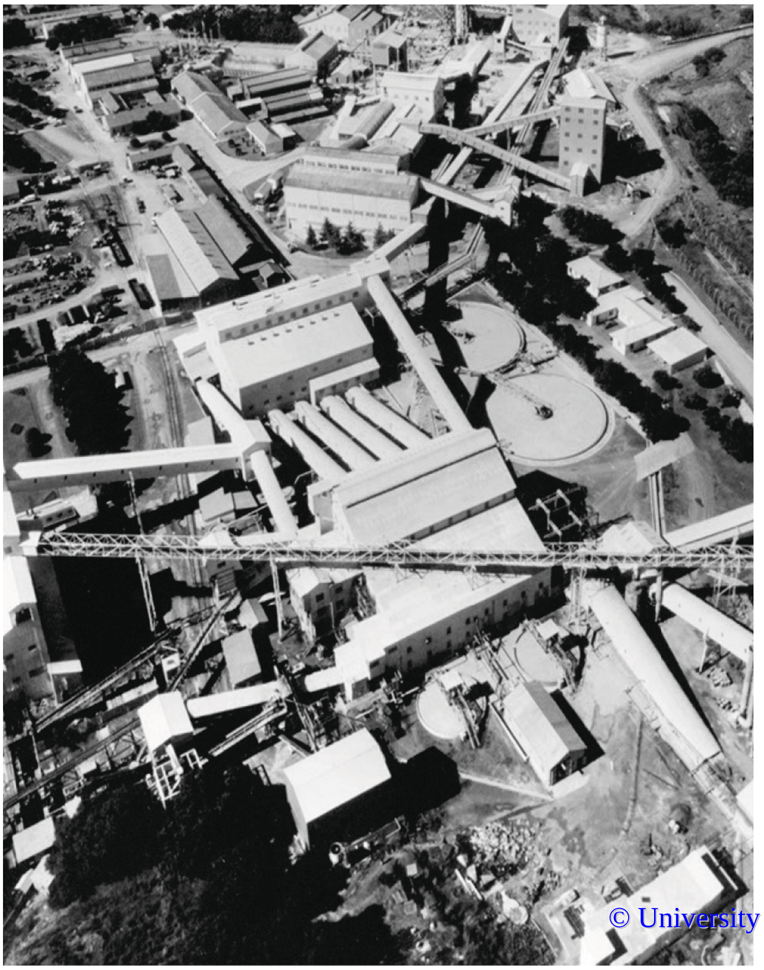
MICROCOSM OF VOLATILE INTERACTIONS

Chapter 5 PROGRAMME

A FOOD REVOLUTION

Chapter 6 CONCEPT AND DESIGN DEVELOPMENT

THE GHOST OF A MACHINE, NATURE'S RESURGENCE AND MEDIATING MAN



CHAPTER 1

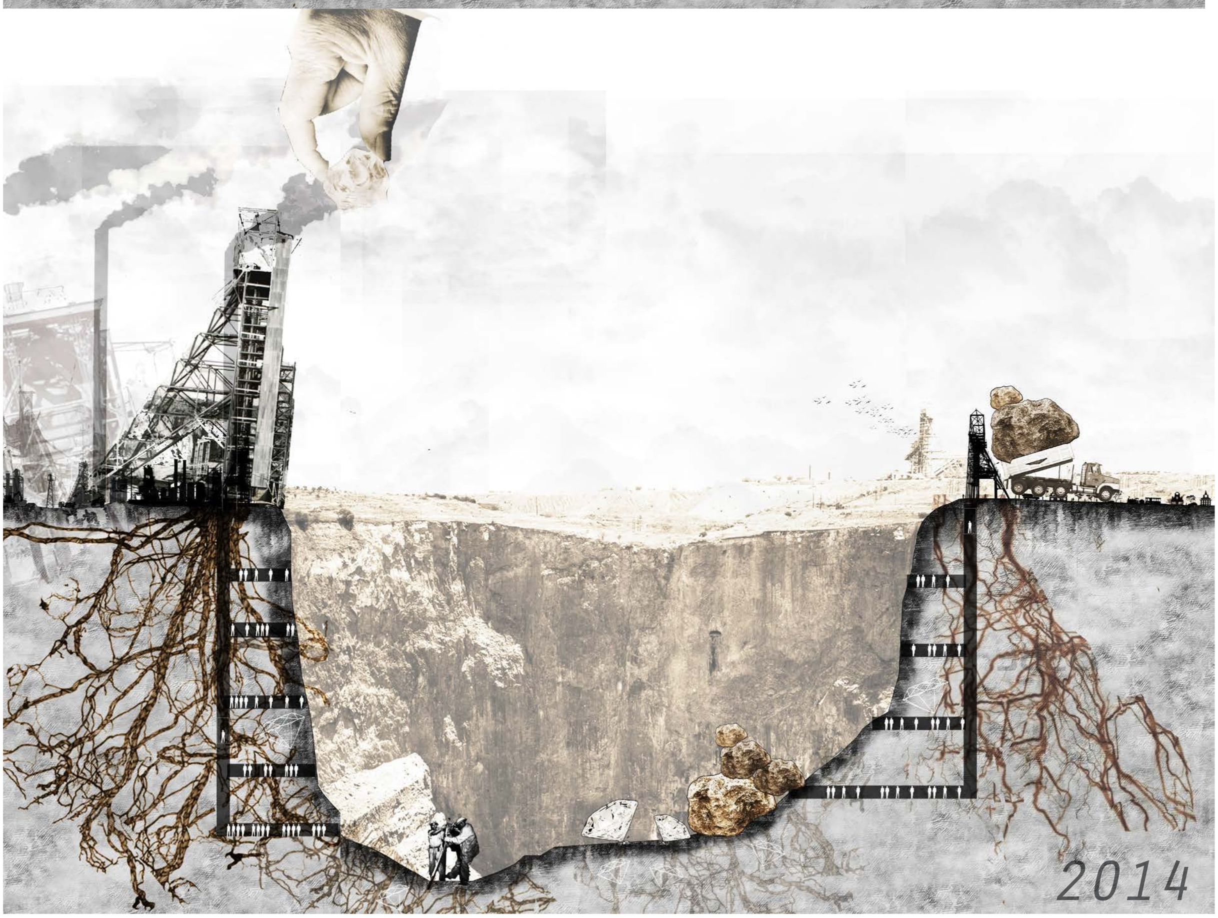
INTRODUCTION

A defunct machine

"The march of the mechanism, while it produces life and fosters it, yet as often makes it difficult and condemns it to extinction"
(Hartley, 1965:127)

Figure 1.1
The three realms that exist in the diamond mining town of Cullinan (Author, adapted from Lincoln archive)

Figure 1.2
The changing condition in Cullinan and the contemporary dominant machine (Author, 2014)



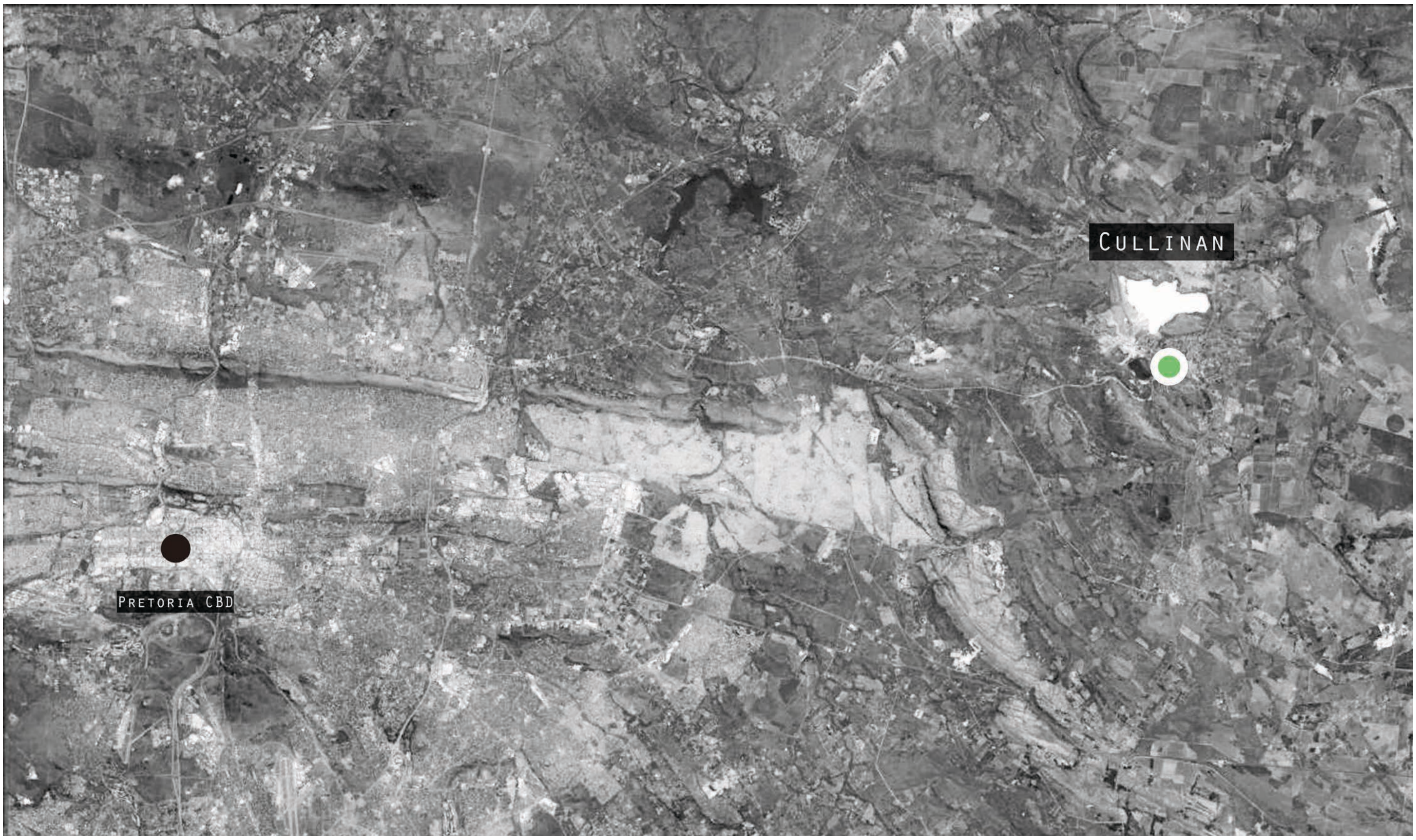


Figure 1.3 *Cullinan is located approximately 37 km away from Pretoria (Author, 2014)*

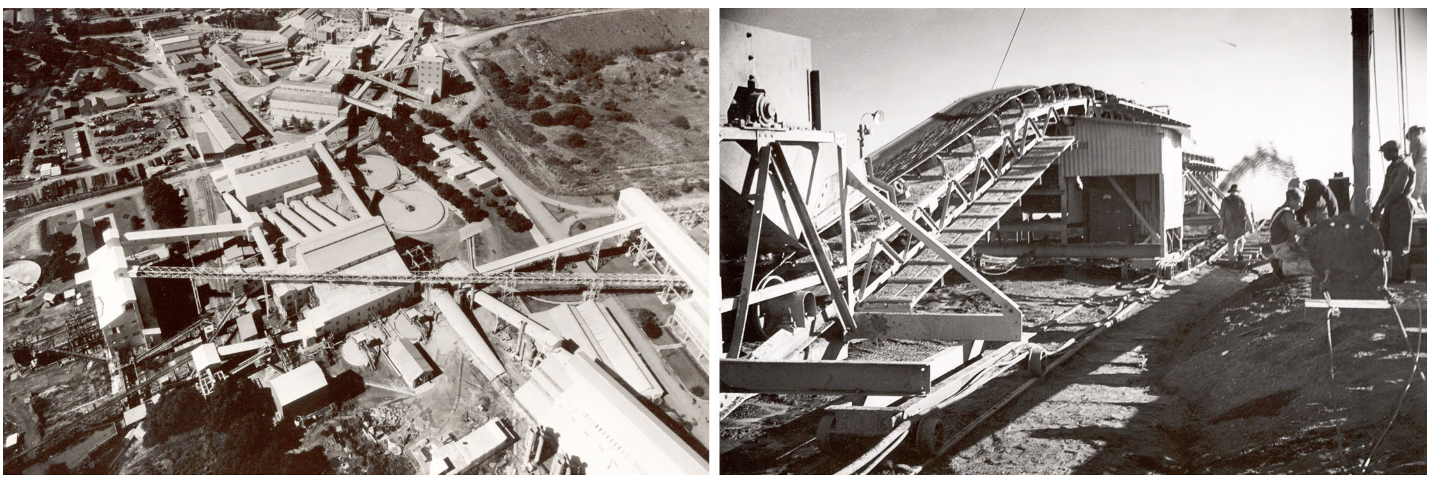


Figure 1.4 *The extant machine in Cullinan (Author, 2014)*

1.1 A DEFUNCT MACHINE

Cullinan's fate

After the present-day machine[1] has victimised its landscape and tired resources, it fades. What is left in its wake are ruins, an expended landscape and a ghost town that speak of a unique story embedded in place. Such heritage sites both construct and are constructed by collective memories and identities (Bohland & Hague, 2009: 110). This rich tangible and intangible cultural, natural and industrial heritage is often lost due to ignorance and comes as a consequence of the failure to foresee this certain transition into a post-industrial context.

The mining town of Cullinan is infamous for the discovery of the world's largest diamond[2]. Over time, the mine transformed the natural landscape and the village flourished as the mine matured. However, man and the machine's current interaction with the environment cannot be sustained. The limits of growth associated with the contemporary Industrial Age means that Cullinan is facing the looming reality of a transition into a post-industrial enclave. According to Petra Mining (Petra Diamonds Limited 2012:online), closure of the mine is anticipated within the next twelve years. Cullinan represents the global reality of post-industrialism and the collapse of Industrial Age systems (Cole ,1973:online), and the Age of the Machine.

1 The machine refers to the mine and current form of industry in Cullinan, and the associated industrial structures.

2 The Cullinan Diamond , the world's largest diamond (3100 carats), was discovered in 1905. The stone was cut into nine major gems, six of which were presented to Queen Mary in 1910 and set in the crown jewels (Lincoln, 2011: 16). Most recently, a very rare blue 29 carat diamond was found in January 2014 and a 122 carat blue diamond in June 2014 (Lincoln 2014: personal communication).

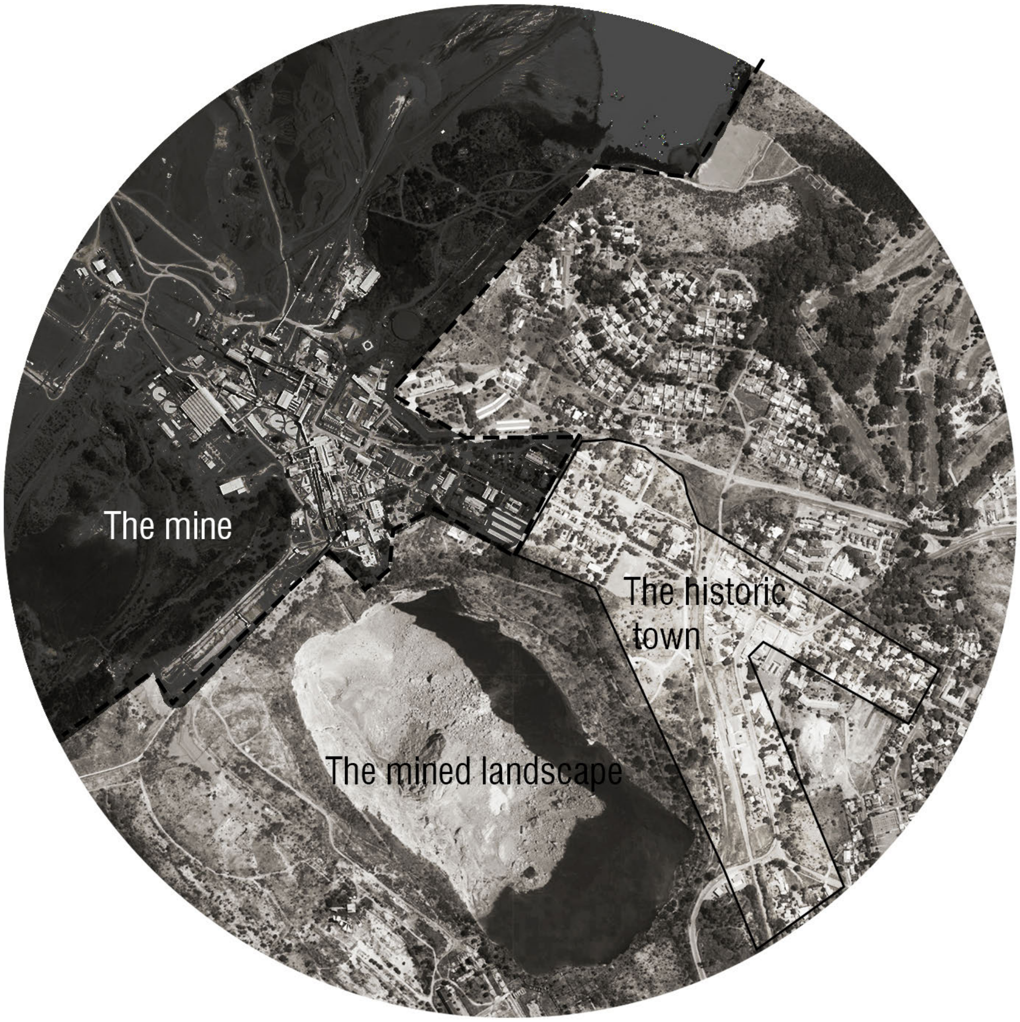


Figure 1.5 *The three systems in Cullinan (Author, 2014)*

Figure 1.6 *The latest important discovery in Cullinan made in June 2014, a 122 carat blue diamond (Petra Diamonds, 2014)*

Figure 1.7 *Aerial photograph of Cullinan with the focus area indicated (Author, 2014)*


OAK AVENUE
THE
CULLINAN
BIG HOLE

1.2 PROBLEM STATEMENT

1.2.1 Systems are close to critical thresholds

Current interactions between the systems of man, nature and machine in Cullinan are volatile and cannot be sustained. The mine serves as a life source to the town, but impending closure and deindustrialisation mean that the economic heart of Cullinan will cease to beat. Cullinan will, therefore, be silenced after the mining machine has exhausted resources. Transitioning into a Post-industrial context means that the cultural, economic and biophysical systems will be close to critical thresholds (Du Plessis 2013:35). When the economic system regresses, how can the remaining systems be sustained?

1.2.2 Relationships after the machine

The notion of the cyborg voices Cullinan's unique identity and the context is clearly illustrative of the toxic dependent relationships between man and machine (the bionic), and between machine and landscape. Currently, the relationship between the town and the mine is one of mutualism[1], while the present machine acts as a debilitating parasitic[1] mediator between man and the landscape. The town is benefiting from the livelihood provided by the mine. The mine, in turn, relies on the people of the town to operate the machine. Together they exploit and harm the natural landscape, leaving it in a state of degradation.

After mine closure (in a post-industrial context), an uncomfortable dialogue described as neutralism[1] will exist between the town and the expended landscape, where two organisms coexist but neither one is harmed or benefited. What response is necessary to address the remaining organisms and their relationship so that Cullinan can be regenerated and sustained after mine closure? As Cullinan's identity is informed by the current bionic system, what can it become after the *demise of the machine?*

1 Terminology is discussed at the end of the chapter

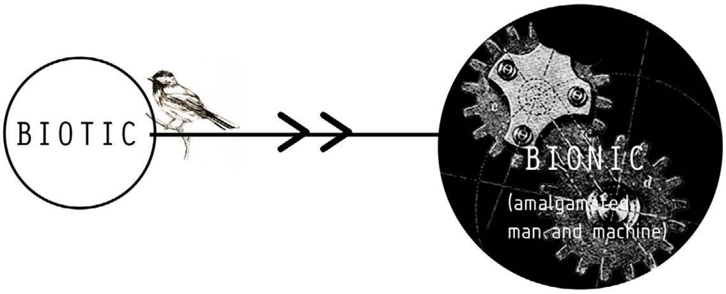
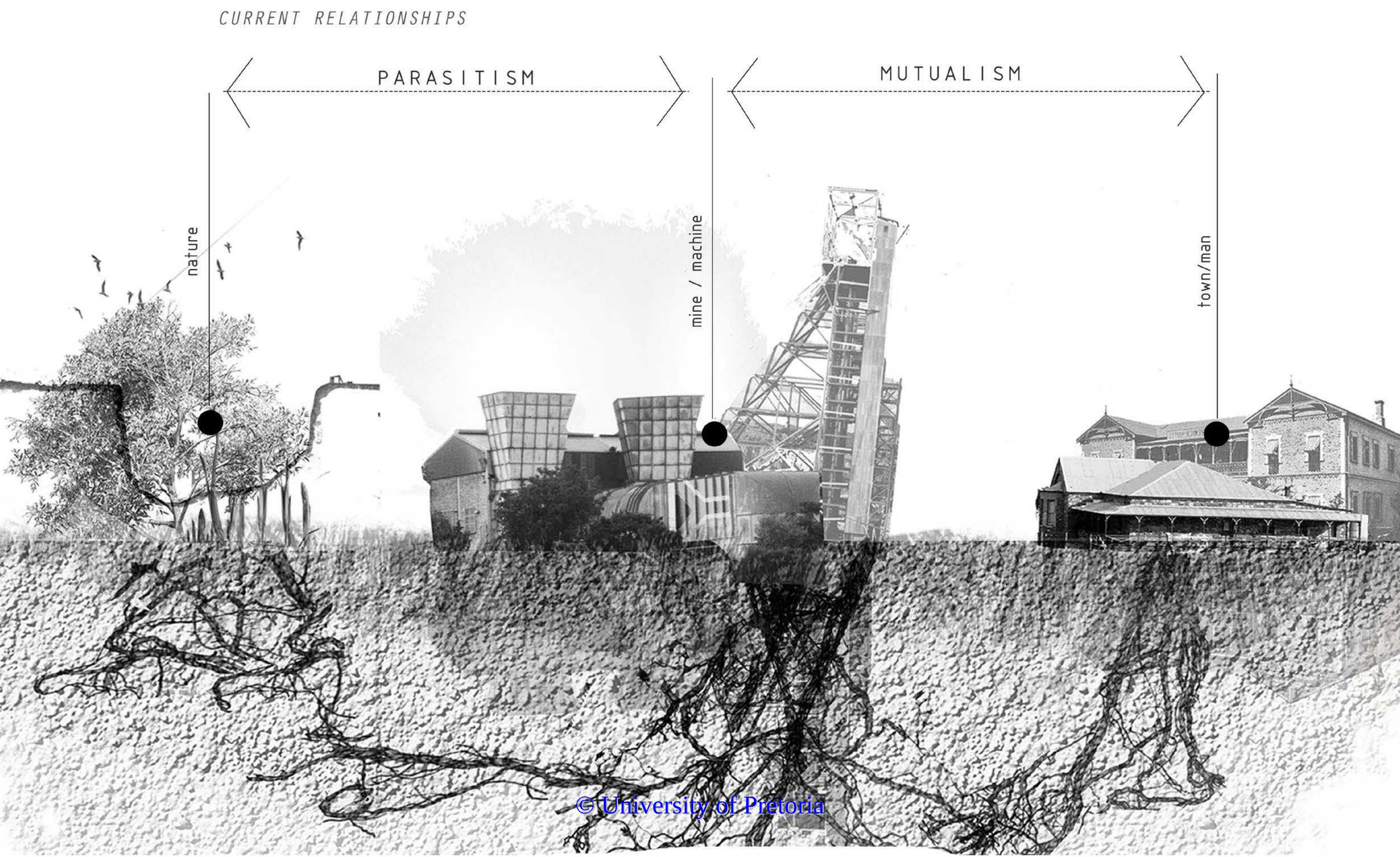


Figure 1.8
The biotic system is currently exploited to support the bionic system (Author, 2014)

***Figure 1.9** Current relationships between systems (Author, 2014)*



1.3 URBAN ISSUES

1.3.1 Fragmentation of the town and mined landscape

The relationships between the extant systems of man, nature and machine are given expression in the fragmented urban fabric. The village of Cullinan has developed as an isolated social organism in close proximity to the mine. The English village linear-type layout that defines its character, has resulted in an introverted urban relationship, devoid of interaction with the natural context (Sharp, 1953:8).

The joint development of the mine and landscape is founded on a practical search for resources, while the town has developed separately from the mine and the degraded heritage landscape, both of which form an integral part of Cullinan's unique identity. Currently, the only point of interaction between the town and the mined landscape is a secluded view-point next to an operating mine ventilation shaft that connects to an underground network of mine tunnels.

1.3.2 Absence of a defined spatial structure

Clear nodes that demarcate points of arrival and orientation in the town are absent, creating a lack of connection between tourists and the town's valuable cultural heritage.

1.3.3 Disconnect between the town fabric and cultural heritage

There is, currently, a clear disconnect between the town and some of its cultural heritage, made evident in the physical divide between the town and the opencast pit. Strong boundaries and hard edges in the town in the form of fences, also prohibit interaction with, or awareness of, the important cultural fabric, such as the buildings of heritage significance along the main Oak Avenue. The value and meaning of these places are consequently not shared.

The mine precinct itself will not be dealt with directly, but will be addressed by other members of the Cullinan Group. Instead, the historic town and the selected site within it will be explored.

Figure 1.10 *Photograph of Cullinan taken in 1930 with Oak Avenue on the right (Lincoln archive)*

Figure 1.11 *The focus area at the core of the historic town along Oak Avenue (Author, 2014)*

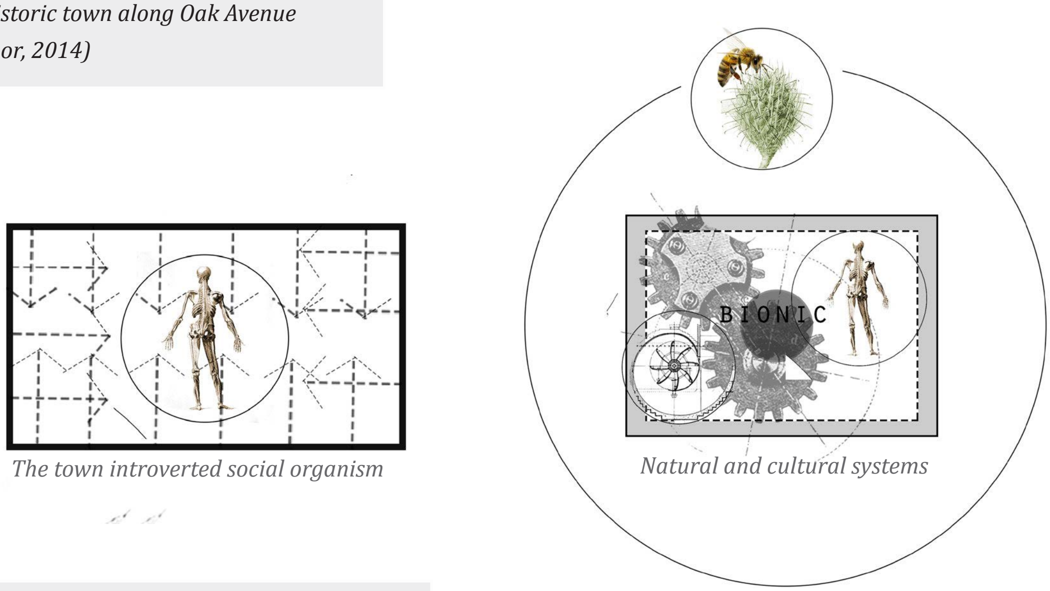


Figure 1.12 *Contained architecture in the Age of the Machine fails to recognize its associated natural and cultural systems (Author, 2014)*

1.4 ARCHITECTURAL ISSUES AND RESEARCH QUESTIONS

Man's relationship with the biosphere has informed architectural expression throughout history. The architecture of the Industrial Age represents the contemporary toxic interaction between the realms of man, nature and machine. The consequent architectural expression, including industrial mine buildings, exists as alien objects isolated within the landscape, reflecting the dominance of the machine over nature. Similarly, the architecture of the associated town or village is introverted and removed from its natural context.

In the Age of Machine, architecture, especially the structures of industry, fails to recognise the broader dynamic natural and cultural systems in which it finds itself, including the associated social organisms of the town and larger natural ecosystems. Concurrently, the current mining machine has devoured the biophysical context, impacting on biodiversity and leaving nature in a state of degradation.

1.4.1 Main question:

- What architecture is required to give expression to a post-industrial enclave and the mutated relationships between man, nature and machine, regenerating the mining town *after* the machine?

1.4.2 Sub-questions:

- How can architecture express the transfigured dialogue between the realms of man, nature and machine, while simultaneously addressing the layered heritage on the site, and the aftermaths of the Age of the Machine on the biophysical context?

- How can architecture and a new form of production begin to engage with the broader cultural and natural contexts?

- After the mining economic system regresses, how can the natural and cultural values associated with Cullinan be preserved and shared so as to avoid the creation of a ghost town with forgotten narratives?

- How can architecture regenerate the rich extant tangible and intangible cultural, industrial and natural heritage of Cullinan, to embody and heighten the unique sense of place and identity, to ensure that the *genius loci* is maintained for future generations?

1.5 RESEARCH METHODOLOGY

Survey-based research is undertaken through correspondence with local historian and former mine employee, John Lincoln, allowing for a holistic understanding of the town's history, influences and the extant condition. Other mine employees, surveyors and residents are also interviewed and consulted to determine the tangible and intangible stratum that forms Cullinan, including its history and the contemporary setting. The context is also mapped to understand the physical town, natural and mining fabric and the linked qualitative content in terms of its unique character. Cullinan's future context is explored by considering proposed plans for the town, mine and natural landscape, especially by the Dinokeng Integrated Tourism Framework.

Historical studies are of value because they establish the story of Cullinan and an understanding of heritage in the town and its significance. This is also achieved through content analysis and qualitative judgements made on the cultural and social setting described in appropriate literature pertaining to Cullinan's history. Sources such as the available *literature* on the timeline and events linked to Cullinan's story are empirically and ephemerally influential, and shed light on the contemporary milieu formed by multiple layers of effects. This also assists in strengthening the argument for an imagined future condition in the context.

Appropriate heritage charters are consulted to determine an approach to the existing heritage fabric and a new architectural response ensuring that the authenticity of the context is maintained. These charters and their specific application are discussed in Chapter 2 and 4.

Literature from the mine in terms of environmental impact assessments are reviewed to establish an understanding of the biophysical context and current intentions for the mine and town. *Theoretical studies* relating to concepts of resilience and regeneration will be investigated in literature to understand our contemporary relationship to the issues surrounding sustainability and man and machine's evolving relationship with the natural context.

Resilience and regeneration's architectural application, specific to place, is discussed in the context and site chapters. Theories relating to post-industrialism and its architectural implications will be explored to support the architectural approach, which includes the notions of place and the reemerging natural condition after the machine. Reference will also be made to relevant *case-studies and precedents* of appropriate architectural interventions that operate within similar contexts.

1.6 THE SITE

1.6.1. Location

The site is located along Oak Avenue , the main axis along which the town developed, and lies at the core of the historic town.

Oak Avenue Park and mine ventilation shaft, Oak Avenue, Cullinan.

25°40'21.54"S
28°31'2.27"E

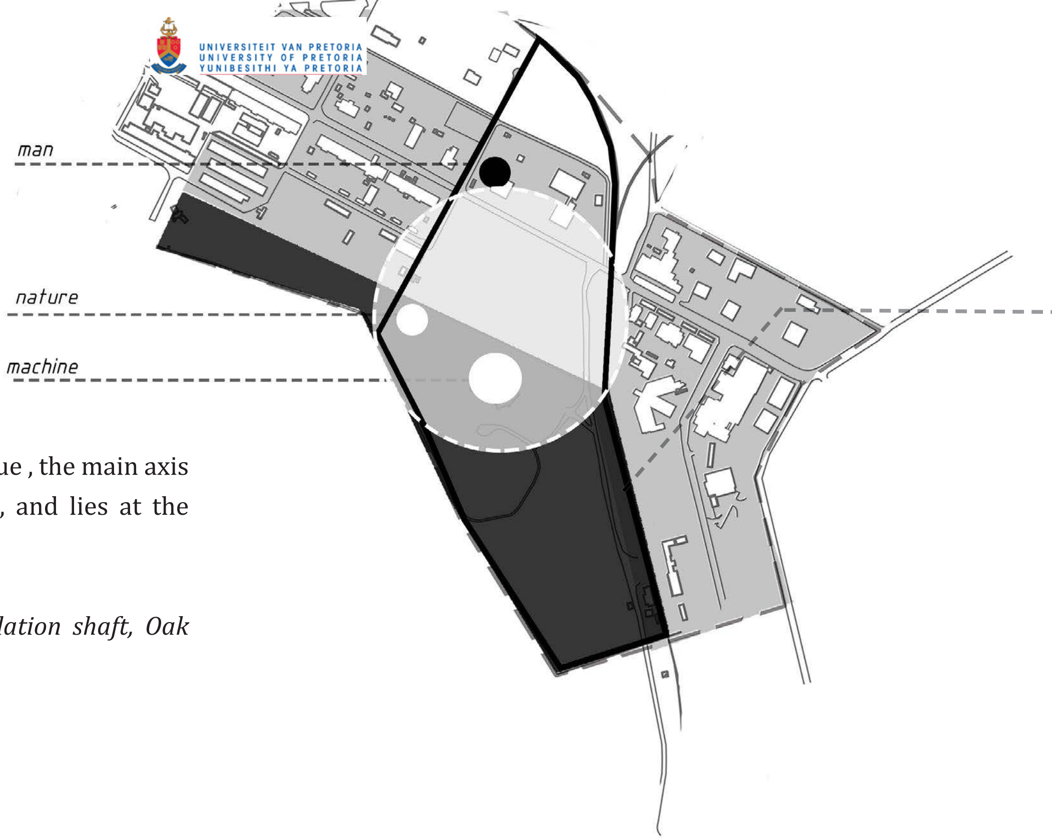


Figure 1.13 *The realms of man, nature and machine on the site (Author, 2014)*

Figure 1.14 *The mine ventilation shaft (B in figure 1.16) and Oak Avenue Park on the right. The mine is visible from the park (Author, 2014)*

Figure 1.15 *The site (Author, 2014)*

A TOWN/ MAN

Introverted social organism

B NATURE

Expended and degraded landscape

C MACHINE

Isolated and introverted parasite

1.6.2 Attributes of the site

The site represents a microcosm of the current interactions between the realms of man, nature and machine (the triad) within Cullinan. When the mine closes, the site will represent the triad's current and future potential relationships, a palimpsest, richly layered with the narratives of each of the three realms. Physical attributes of the site include a secluded historical viewpoint, a mine ventilation shaft and a park, and a sports ground (figure 1.13). A brief overview of the focal site attributes will be given here, but will be explained in greater depth in Chapter 4, along with the associated values and intentions.

1.6.2.1 Man

- The town and Oak Avenue

The site lies adjacent to the main tourist orientation point in Oak Avenue (D in figure 1.16), which includes the town's first two houses, positioned directly across from the site. Lack of accessibility to these parts of the site means that its value and meaning are not experienced or shared. Herein lies an urban and architectural opportunity.

1.6.2.2 Nature

- The park

Oak Avenue Park (C in figure 1.16) is a representation of man's control over nature. However, nature has started to reclaim parts of it. The park was introduced along Oak Avenue in 1905 and has historically hosted various small-scale festivals and events.

- The viewpoint

A in figure 1.16 indicates the only viewpoint that connects the town with the natural and cultural heritage of the mined landscape. It represents man's connection to nature, but is obscurely located and difficult to access. As a consequence, visitors often don't see the opencast pit or are even aware of it when visiting Cullinan.

1.6.2.3 Machine

- The mine ventilation shaft

The ventilation shaft (B in figure 1.16) was constructed on the site in the early 1980s to support the growing network of underground tunnels. The vertical shaft was raise-bored by the first machine of its kind in South Africa and, at the time, represented the largest raise-bore hole (6m diameter) in the world (McGill, 2014: personal communication). The ventilation shaft is therefore of industrial heritage significance.

Figure 1.16

The main site attributes (Author, 2014):

A- The viewpoint

B- The mine ventilation shaft

C- The park

D- The town and Oak Avenue

1.17

1.18

1.19

Figure 1.17 *Oak Avenue (Author, 2014)*

Figure 1.18 *Oak Avenue Park Author, 2014)*

Figure 1.19 *En route to the lookout point (Author, 2014)*

Figure 1.20 *The mine ventilation shaft (Author, 2014)*

1.20

1.7 THE PROPOSED PROGRAMME

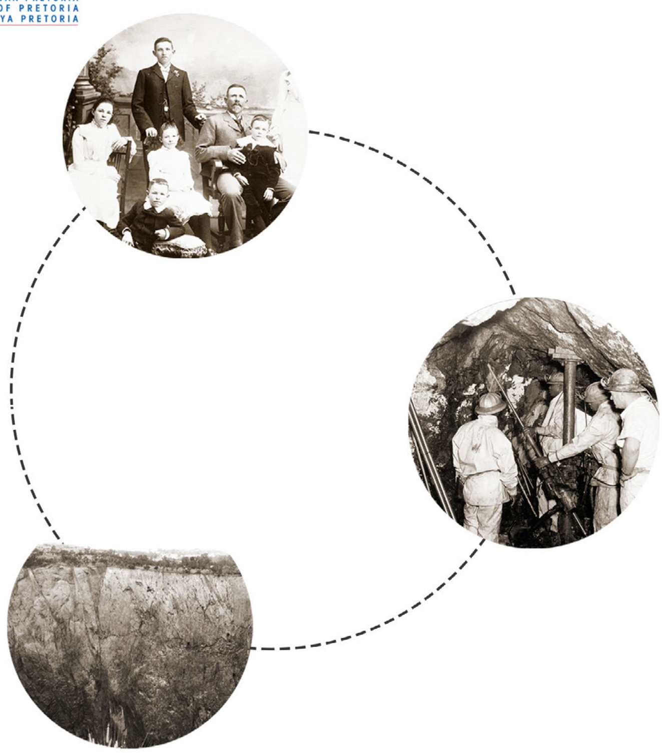
The suggested programme intends to give expression to a post-industrial context, exploring a new way of making. This suggests a departure from the dis-embedding nature of current globalised industry that is reliant on non-renewable and diminishing unrenewable resources. A new economy inspired by local food producers and the growing culinary network within Cullinan and along Oak Avenue will be explored.

The main programme is a local food hub which connects regional producers to consumers and encourages culinary tourism of Cullinan. This includes micro-industry in the form of the making of craft/artisanal foods. The location of the site necessitates a response to the emerging tourist market, as well as the heritage near and on the site. Other social, cultural and recreational activities will serve as sub-programmes, informed by activities that were once associated with the site and park, and form a part of the story of place.

1.8 THEORETICAL APPROACH

The theoretical premise investigates mutating relationships between man, nature and the machine, and a 'bionic evolution' which establishes a new dialogue between amalgamated man and machine, and nature. The theory will explore the inescapable transition from the contemporary 'Age of the Machine' , which is one of toxic interactions, to the 'Age of Life' (Kurokawa 1994:13) by implementing the principles of regeneration and resilience.

The dissertation terms the architecture for a post-industrial enclave as *'symbionic'* in nature, referring to architecture that considers its broader natural and cultural systems within its regional contexts. It also suggests interdependence between systems, rather than the machine's exploitation of the systems to which it is linked.



1.9 PROJECT INTENTIONS

Figure 1.21 Exploring new resilient interactions between the realms of man, nature and machine (Author, 2014)

1.9.1 General

Accommodating new interactions

The general intention is to address the discord and unsustainable nature of interactions between the triad of realms (man, nature and machine) while exploring the mutation of these three systems to accommodate new resilient interfaces.

The intention is also to address the future shift of human communities and economic activities back to the alignment with life processes by envisioning a future condition where the realms of man, nature and machine can exist in a state of co-evolving mutualism, encouraging more synergistic interchanges.

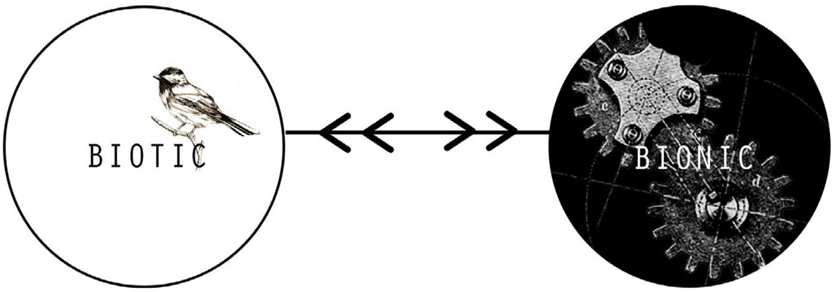
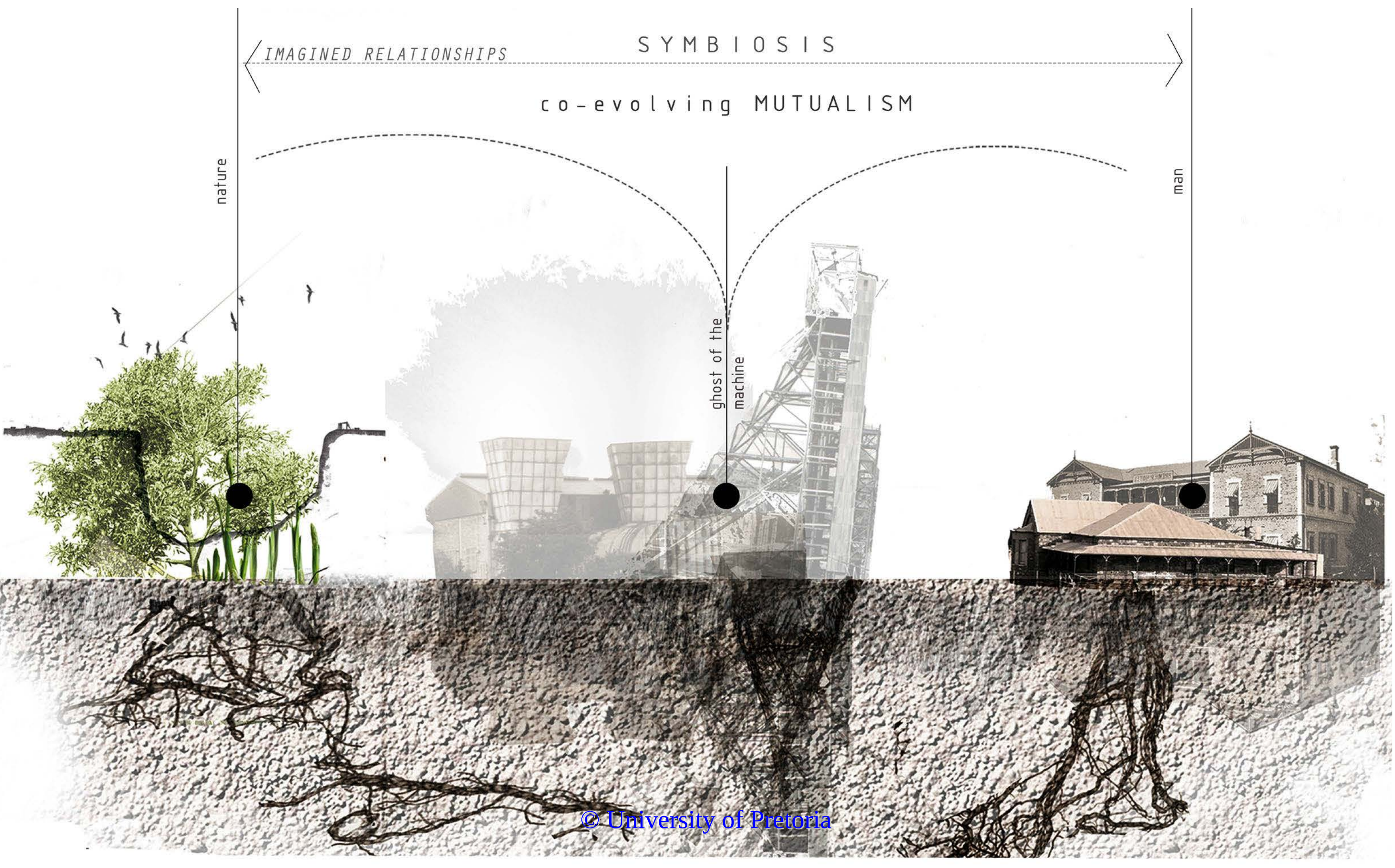


Figure 1.22 *The general intention is to explore synergistic relationships between the remaining cultural and natural systems, and the ruins of past industry (Author, 2014)*



1.9.2 Urban

The urban intention is to give expression to transfigured relationships in the urban fabric, challenging the introverted town fabric and the old representation of production on the site that is distinct and isolated, in the form of the mine ventilation shaft.

The development of a new spatial structure informed by the existing internal town structure will be investigated. This includes the development of defined nodes for tourist orientation and arrival, as well as addressing the hard edges in the town fabric disconnecting people from the cultural heritage.

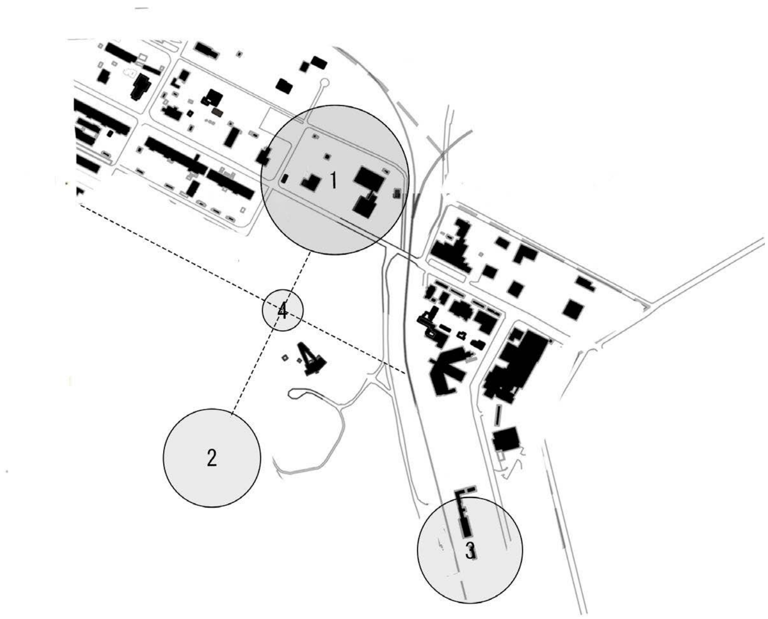


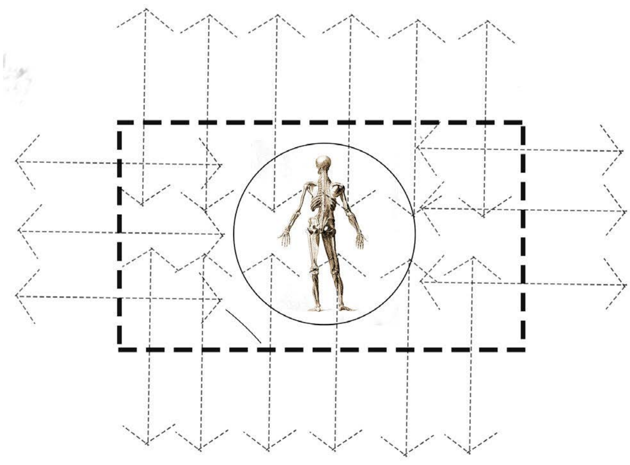
Figure 1.23
The urban intention: introducing a new spatial structure informed by the existing internal structure. Exploring the introduction of nodes for arrival and orientation around the site

(Author, 2014)

1.9.3 Architectural intentions

The architectural intention is to address the ruins of industry, a symbol of the parasitic machine of the Industrial Age, while exploring an architecture which speaks of a new *symbionic* context and transfigured interactions between bionic and biotic. The intention is to also investigate architecture that can support a new sustainable form of production.

The objective of this dissertation is to set a precedent for *place-responsive regenerative architecture within a post-mining context that is inspired by local nature and culture.* An architecture that expresses a new co-evolving mutualistic relationship between the existing town and landscape (cultural and natural systems) will be considered. *This dissertation will investigate an architecture that can transform Cullinan from the bionic to the symbionic.*



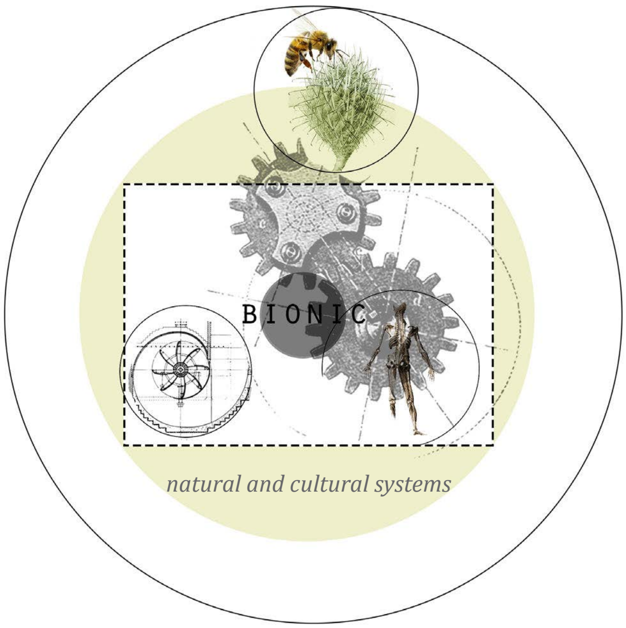


Figure 1.24 *The architectural intention: exploring architecture as extension of local nature and culture (Author, 2014)*

1.10 THE CONCEPT

The concept explores the notion of the *symbionic* architecturally, and future-imagined interactions between man, nature and machine that are synergistic, while being reminiscent of past relationships to which the existing physical and intangible heritage on the site is testament. Architecture is explored as growing from the evolving system in which it is founded, and resulting spatial and systemic outcomes of this will be explored for the Age of Life.

1.11 DELIMITATIONS

As a consequence of the size of the site, detailed design will be delimited to a selected part of the site where the interactions between the triad can be best explored.

The larger precinct vision has been limited to the immediate focus area of the discussed site. Therefore, the dissertation does not aim to address the larger town or mining context, but rather the proposed site which represents a microcosm of Cullinan's natural, cultural and industrial systems.

The proposed programme is of a fairly large scale and intends to plug into a larger regional farming system. The dissertation will explore the programme and production only within the context of the site and not within the larger region of Cullinan and the surrounding farms. The horticulture and plant production on site will not be designed to a detailed level. Instead, focus will be placed on the architecture, responsive to the age after the machine.

1.12 ASSUMPTIONS

A decommissioned mine

The project will work within the future context of a decommissioned mine (within the next 12 years).

1.13 SYNOPSIS

PROJECT VISION

This dissertation will re-envision an architecture that addresses a post-mining context and the residual systems after the demise of the machine, through regeneration. Neglecting to address this transition has characteristically led to the failure of the remaining systems, resulting in the creation of ghost towns and forgotten narratives unique to place.

The intervention intends to support a new dialogue between the remaining cultural and natural systems in a post-industrial context by exploring the idea of a more resilient *symbionic* approach created by a place-specific regenerative architecture.

Urban vision

The dissertation will expand on the group vision for Cullinan that focuses on the transition from a mining town to a future context for industry that supports agriculture in Cullinan and its surrounds.

The town will be re-envisioned so as to support the growing tourist market, while addressing the disconnection between the natural and cultural heritage.

Architectural vision

After the machine, a *symbionic* architectural response will be explored that optimises natural systems and accommodates mutualism between bionic and nature. A new productive focus that is able to express the notion of the *symbionic* will be introduced to Cullinan. This will ensure that Cullinan's identity which lies in the notion of the bionic, is not lost.

Figure 1.25 *Vision for a post-mining context in Cullinan illustrating transfigured interactions between man, nature and machine (Author, 2014)*

1.14 TERMINOLOGY

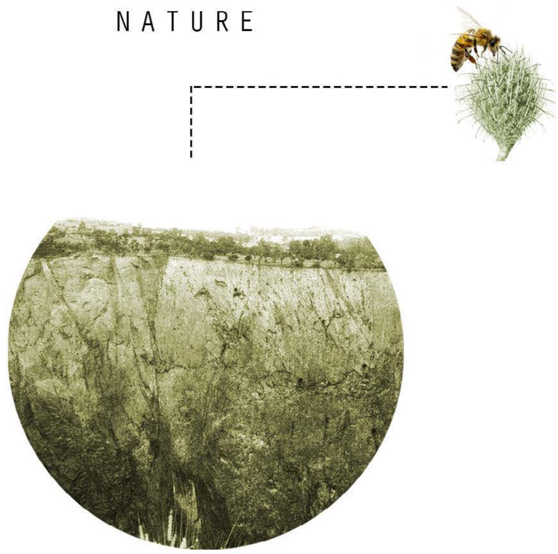


Figure 1.26 *The three systems of man, nature and machine (Author, 2014)*

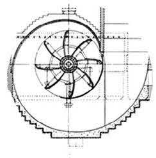
Nature and environment

Nature is a complex organism that is both feared and celebrated and can be described as that which takes place without the agency of man (Hofstra & Huisingh, 2013:461). But, the human-nature relationship is complex. Man is in nature, but he acts upon it, thereby emancipating himself of it, therefore man is both part and apart from nature (Hofstra & Huisingh, 2013:462). However, the term ***environment*** is adopted here as a term which includes both nature and culture, and describes the notion of the reciprocal transformation of human by the natural and vice versa (Bourdeau, 2004:9).

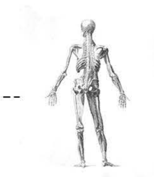
Biotic

The term will cover living systems and the factors that affect living systems within nature and an ecosystem.

MACHINE



MAN



Machine

Refers to technology, which is the application of scientific knowledge for practical purposes, especially in industry (Oxford Dictionary, 2012:online). Machines are devices created by man as a consequence of scientific knowledge and development.

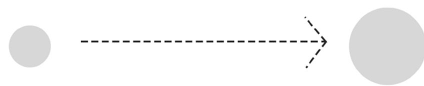
Man:

Of, or characteristic of people, as opposed to God or animals or machines (Oxford Dictionary, 2012: online).

Bionic

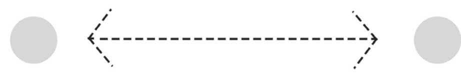
A person whose physical abilities are extended beyond ordinary human limitations by mechanical elements built into the body (Oxford Dictionaries, 2012:online), resulting in amplified capabilities. In this dissertation,the term refers to the man-machine amalgamation as seen in contemporary industry. Cyborg implies a dissolution of the boundary between man and machine and this ever-growing dependency characterizes the Industrial Age.

Types of biotic (natural organism) interactions :



Parasitism

One organism (called parasite) benefits at the expense of another organism usually of different species (called host). The association may also lead to the injury of the host (Oxford University Press, 2012:online).

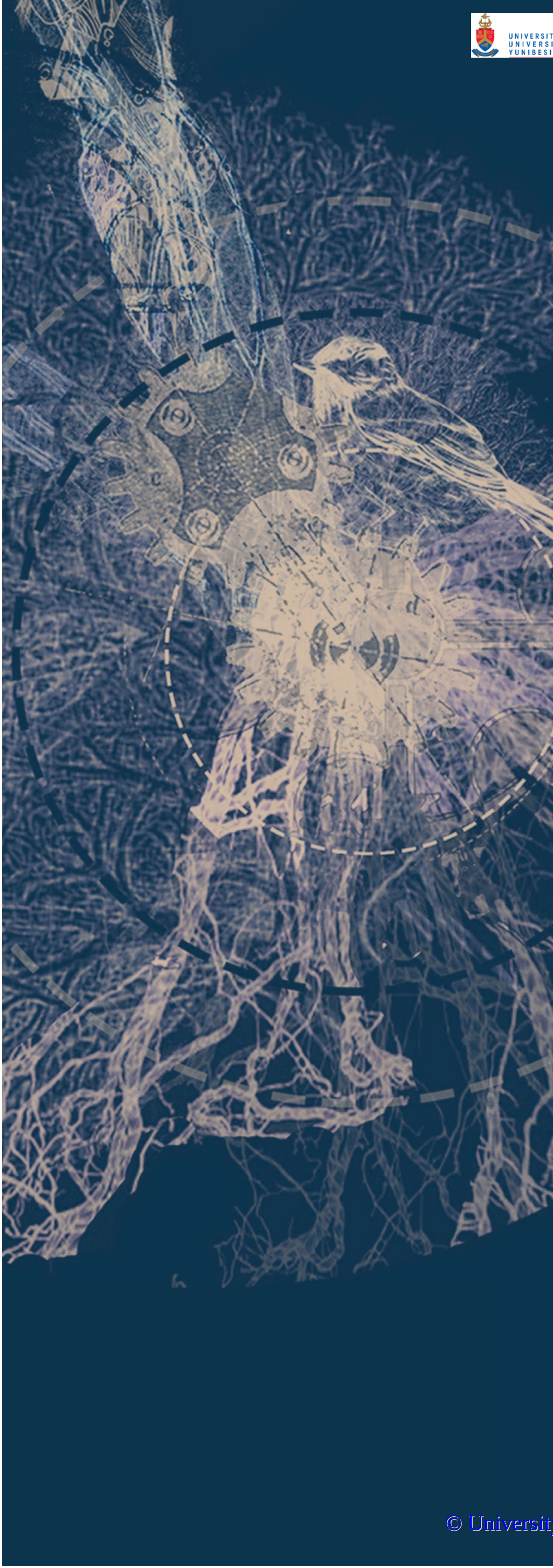


Symbiosis

Interaction between two natural organisms living in close physical association, typically to the advantage of both (Oxford University Press, 2013:online). In this dissertation symbiosis is assumed to be a mutually beneficial relationship.

Neutralism

Neutralism is the most common type of inter-specific interaction where neither population directly affects the other. What interactions occur are slight and indirect (Moon et al, 2012: online).



CHAPTER 2

THEORY

Bionic evolution

Exploring mutating relationships between *man, nature and machine*

"The world is moving towards a new evolving order" (Kurokawa, 1994: 6)

Chapter 2 discusses the extant relationships between man, nature and machine that beckon the re-scripting of the dialogue between these realms. The evolution to a '*symbionic*' architectural approach will be imagined with the related concepts of regeneration and resilience, in addition to the notion of the specificity of place and post-industrial identity. The architectural manifestation of the interaction between the three realms is also discussed.

Figure 2.1 *The Age of the Machine: our contemporary condition of Industrialism.*

Figure 2.2 *Image from the television series of the short story 'The Machine Stops' by EM Forster that envisions the fall of humanity and nature as a consequence of the rising machine (BBC, 1966)*

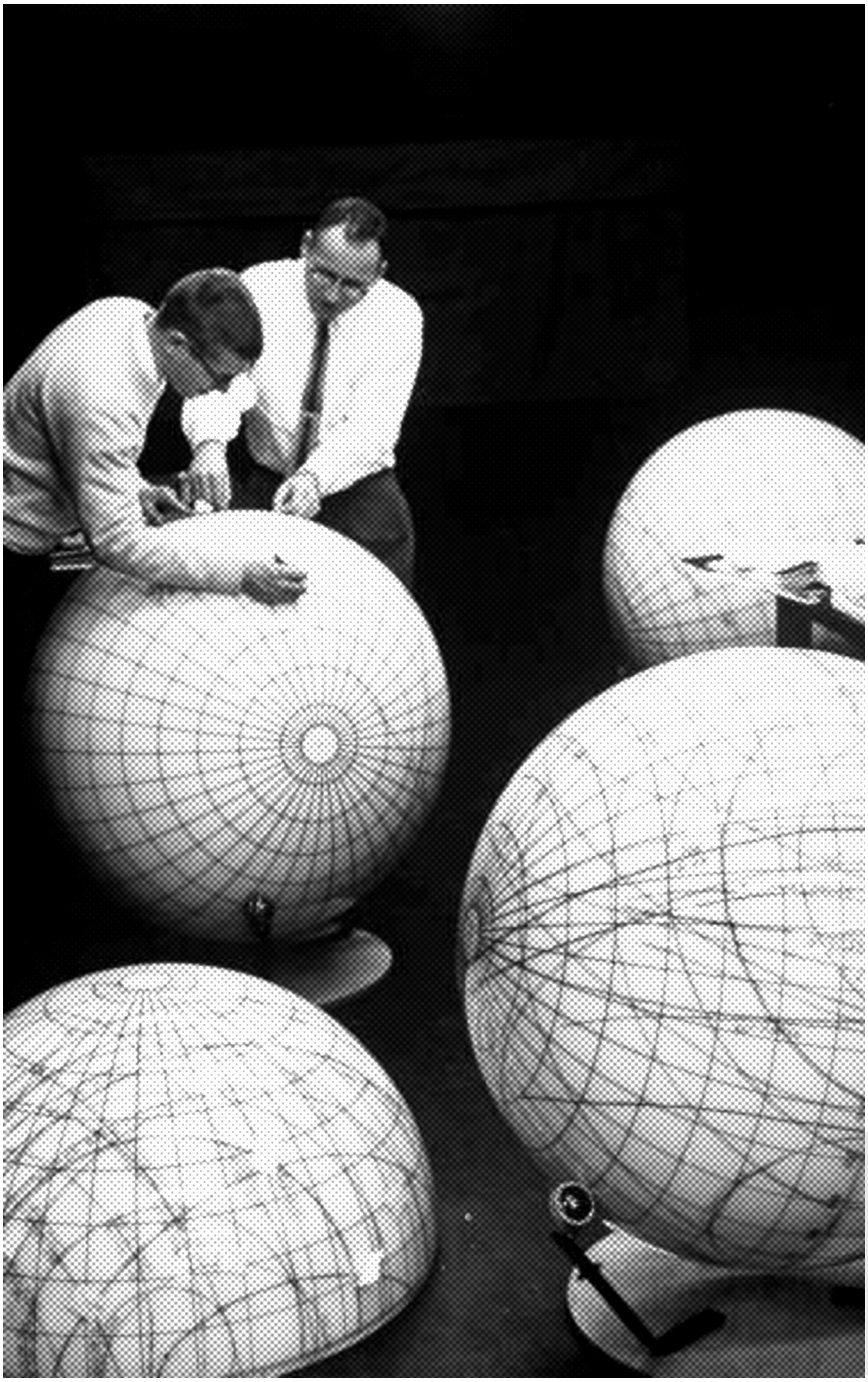
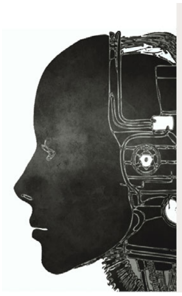


Figure 2.3

"Modern societies are developing an infernal spiral that levels everything in its path"

(Barthelemy, 2013)



2.1 OUR CURRENT CONDITION: THE AGE OF THE MACHINE

2.1.1 Nature and man in the unmaking

The Age of the Machine can be defined as one of mass-production and technology. The machine seemed to promise the rosiest of futures and no one thought to doubt it (Kurokawa, 1994:16). However, our contemporary age is now driven by a misled perception of the 'progress' of man towards a Utopia founded on industrialism. Current industrial and economic systems are responsible for volatile and vulnerable cultural and natural systems to which they are intricately linked, meaning the destruction of the living world for the advance of the machine.

The history of industrialism has been one associated with waste, natural degradation and the movement to a homogeneous global culture. Consequently, positive interaction between the current bionic system and nature has diminished as an outcome of these forces of obliteration and estrangement. Humanity and industry, which rely on the support and services of ecosystems, are major forces in global change and are responsible for influencing ecosystem dynamics from local environments to the larger biosphere (Folke, 2006:253). Population growth, construction and consumption of the built environment and industry, associated with fossil fuel consumption, is the source of air, soil and water contamination, widespread destruction of habitats and

"Human culture is rapidly evolving and, as some suggest, may well be an advanced manifestation of nature. But culture has attained nowhere near the level of complexity of the natural world and it is in danger of unbalancing. "

(Stairs , 2010:40)

biodiversity, resource depletion, waste generation, atmospheric degradation and global climate change (Kellert, 2005:92) (Kellert, 2005:90). Dependence on non-renewable resources and fossil fuels necessitates a re-evaluation of these unsustainable and toxic relationships.

The current global system of production has its origins in the Industrial Revolution which was initiated in Britain in the mid-18th century and was seen as a new way of making things (Nuttgens, 1983:240). It began with the exploitation of natural resources, especially water and coal, and elicited an objective view of nature. Orr (2010:416) discusses our contemporary condition and states that the more that man dwells in his own creations, the more uncomfortable he becomes with nature that lies beyond direct control. He states (2010:416) that biophobia describes the culturally acquired urge to affiliate with technology and the machine, and nature is regarded as nothing more than a resource.

While the current industry and economy is founded on linear growth, nature's behaviour is cyclical. Current industry is operating at a faster rate than biotic systems can recover (Von Agner, 2004:5). The comparative fragility of biotic systems relative to that of industry means that we are nearing natural resource limits. Static linear methods associated with the current machine threaten society with fossilisation, or, in the long-term, with collapse (Hofstra & Huisingh, 2013:462) and we are, therefore, currently plagued by the consequences of the dichotomy between man, industry and nature.

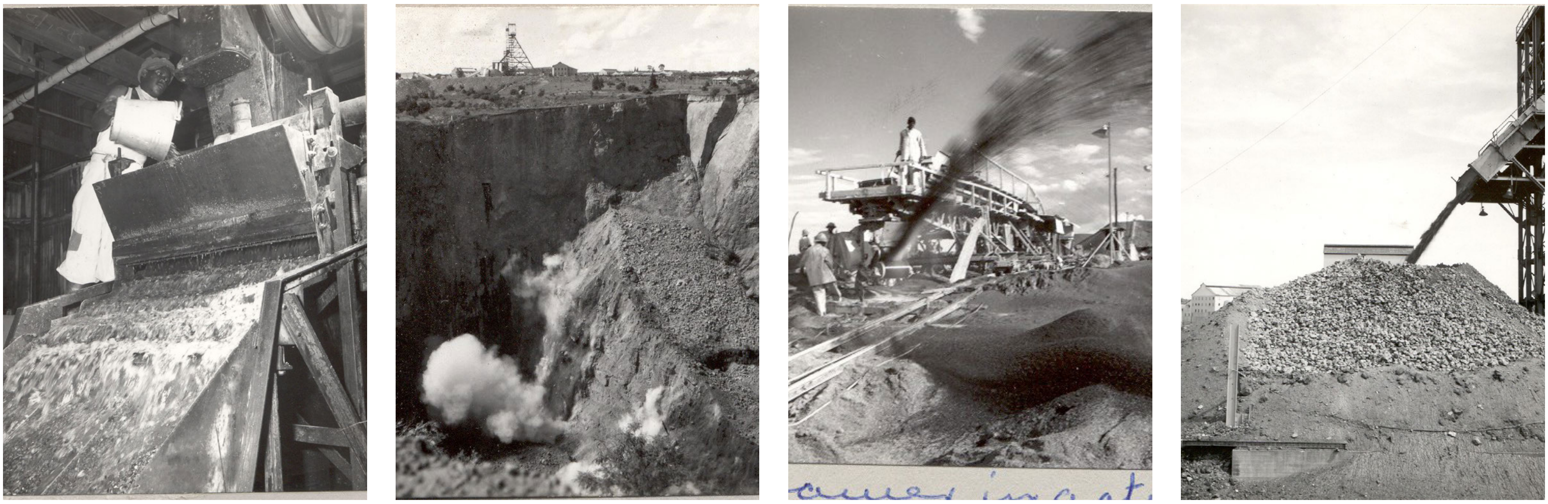


Figure 2.4 *The physical impacts of the contemporary mining machine in Cullinan (Lincoln archive)*

2.1.2 The mining industry

Mining and mining communities form an integral part of our cultural, national and social identities, but what happens when mining leaves a community (Colin & Joliffe, 2011:247)? The mining industry is unsustainable on all fronts (Cole, 2010:480) and resource depletion is a sure reality. After this parasitic mono-functional model of industry has executed environmental destruction, the mine is decommissioned.

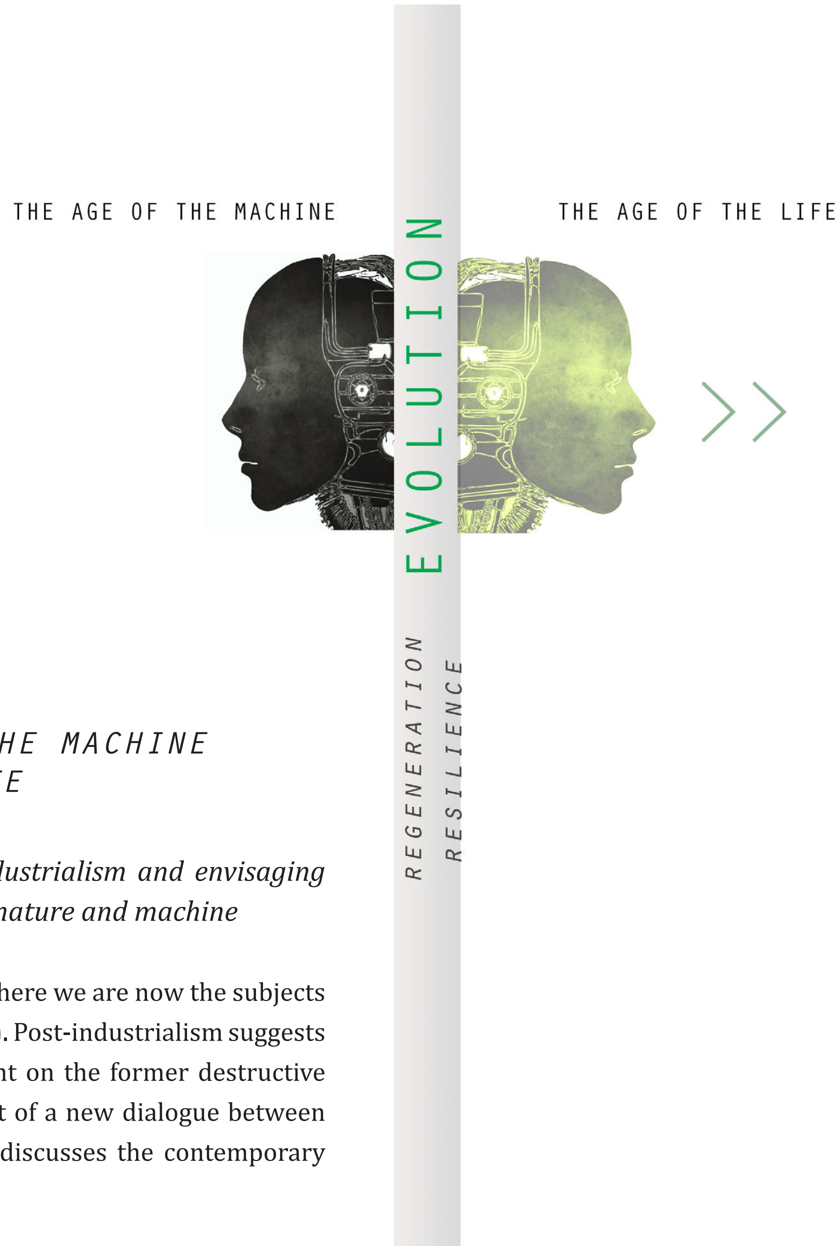
The natural impacts of diamond mining include the degradation of biodiversity of local fauna and flora, poor water management and pollution, soil erosion and high resource consumption, in the form of energy and oil (Venter, 2009:441). Typically deindustrialisation leaves a legacy of high unemployment, depopulation, decaying buildings and disfigured landscapes (Cole, 2010:485). The end of the mining industry in a place results in the genesis of a ghost town, and consequently in the loss of cultural heritage and memory, as well as blighted natural systems.

A radical change is required for the earth to remain fit for human habitation which requires us to address the current mechanistic world view (Mang & Reed, 2011:23) and approach to production that debilitates other linked systems and leaves them in a state of ruin.

Figure 2.5 Industrial building: the mine ventilation shaft in Cullinan (Author, 2014)

2.1.3 Industrial architecture

The architecture of industry originated during the Industrial Revolution with the sole function of housing the machine with great efficiency. Structures were designed to accommodate the needs of a changing society at the time (Nuttgens, 1983:240). A transformation in available building technologies was a major influence in industrial buildings and new universally applied structural systems were introduced. Consequently, the architecture failed to respond to the uniqueness of place, typically disregarding broader social and ecological systems in terms of their influence or impact upon them. Introverted mine buildings, such as those in Cullinan (see figure 2.5), define the architecture of the machine and the current bionic system, which inspired the development of the modern movement. These static architectural responses fail to address dynamic systems and their lack of adaptability and the single-functioned nature of these buildings mean that they are abandoned after they have served their original purpose, thereby creating post-industrial wastelands after the Age of Machine. These remnants are imbued with cultural meaning, but lack the ability to respond to a mutating condition, which means that the structures and associated narratives are often lost.



2.2 THE EVOLUTION: FROM THE *AGE OF THE MACHINE* TO THE *AGE OF LIFE*

2.2.1 Addressing the aftermath of Industrialism and envisaging mutating relationships between man, nature and machine

We are living in a major paradigm shift where we are now the subjects of intense reflection (Kurokawa, 1994:24). Post-industrialism suggests the decline of a society that is dependent on the former destructive model of industry, and the establishment of a new dialogue between bionic and biotic. Du Plessis (2012:35) discusses the contemporary disturbances in perception:

"Our cultural, economic and biophysical environments are all close to critical thresholds which, once crossed, will see a collapse of the status quo and a period of transition to a new normal."

Figure 2.6 *The bionic evolution (Author, 2014)*

CURRENT CONDITION

THE AGE OF THE MACHINE

BIONIC EVOLUTION

> SYSTEMS ARE AT CRITICAL THRESHOLDS

> THE CONTEMPORARY BIONIC SYSTEM IS A DEBILITATING PARASITE

> THE ARCHITECTURAL MANIFESTATION IS A REFLECTION OF THE DESTRUCTIVE INTERFACE BETWEEN SYSTEMS

FUTURE CONDITION

THE AGE OF LIFE

> RESILIENCE AND REGENERATION

> AN APPROACH TO RESIDUAL LOCAL NATURAL AND CULTURAL SYSTEMS (AFTER MINE CLOSURE)

> THE 'SYM-BIONIC' AND ARCHITECTURAL MANIFESTATION OF NEW SYNERGIES BETWEEN THE THREE REALMS OF MAN, NATURE AND MACHINE

Figure 2.7 *An outline of the theoretical investigation (Author, 2013)*

2.3 SUSTAINABILITY: RESPONDING TO CHANGING SYSTEM DYNAMICS

The idea of sustainability and its application has evolved since the mid-20th century (Bourdeau, 2004:10), shifting from concerns about meeting human needs while reducing environmental impact, a minimal condition for survival (Braungar & McDonough, [sa]: online), to how cope with the discussed inevitable transitions (Du Plessis, 2012:35). The ecological imperative has been spurred on by the concern of staying within the biophysical carrying capacity of the planet (Bourdeau, 2004:9). A brief outline of the development of sustainability is discussed to situate our contemporary condition and the envisioned response for the age after the machine.

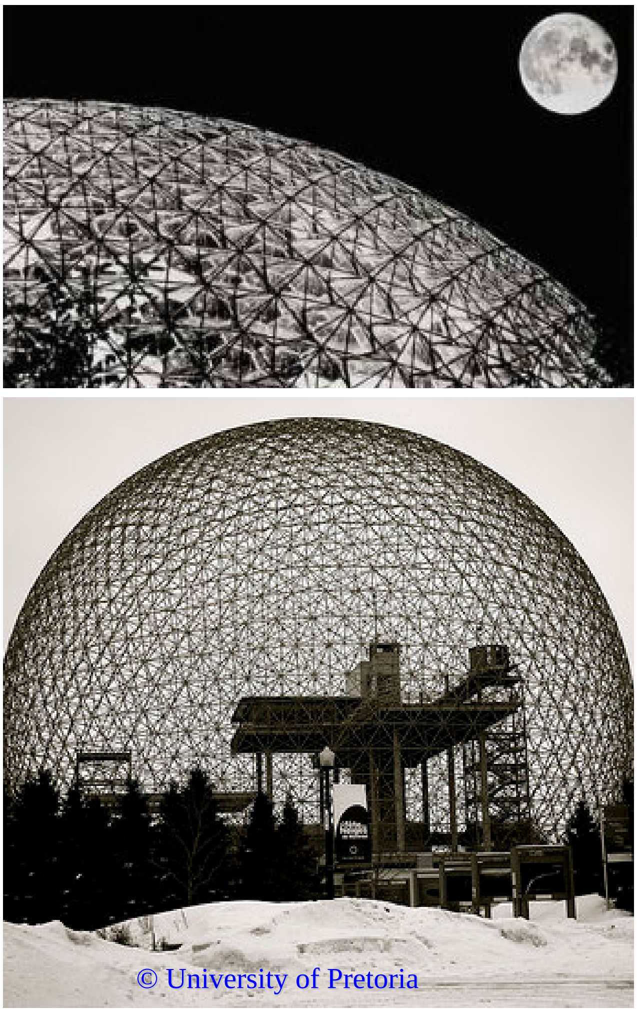


Figure 2.8

Buckminister Fuller's Montreal Biosphere, progressive in its approach to sustainability and resource efficiency in the 1960s

In the 1960s, modern architecture expressed the desire to create order within dynamic natural and cultural settings and existed in the realm of a social and economic plan based on rationalisation (Nuttgens, 1983:266). There were, however, visionary niche activities and technological explorations of greening that were initiated, described as an 'environmental awakening' (Deviren & Tabb, 2014:30). But the oil crisis of the early 1970s became the turning point in terms of sustainable development, where more consideration was given to alternative energy sources (Nuttgens, 1983:287). From the 1980s onwards, post-modernism and Critical Regionalism were explored, responding to regional contexts and considering the human experience. A vernacular response, and environmental performance was considered, re-scripting old modernist sensibilities and the consequent architectural placelessness. Between the 1980s and today, the concept of superficial greening of architecture has transformed into the idea of sustainability.

In our contemporary society, sustainability has become a mainstream practice. However, the complexities of natural systems are often handled with a set of unwavering guidelines such as building assessment tools which intend to aid in determining the success of the 'greening' of architecture. However, in addition to this, sustainability has to be recognised as a cyclical ecology rather than static universal strategies. What defines sustainability in our contemporary condition as sustainable pluralisms define the 21st century (Deviren & Tabb, 2014:76). Resilience, hybridity, dynamism, connectivity, regeneration, integration, and social equity are, according to Deviren & Tabb (2014:134), defining terms for the next step in our sustainable progression and the evolution. This necessitates a fundamental shift and provides a challenge for our contemporary society, which is to create a bridge between a society engrossed in consumption and an evolved condition in which the three systems of man, nature and machine are interdependent.

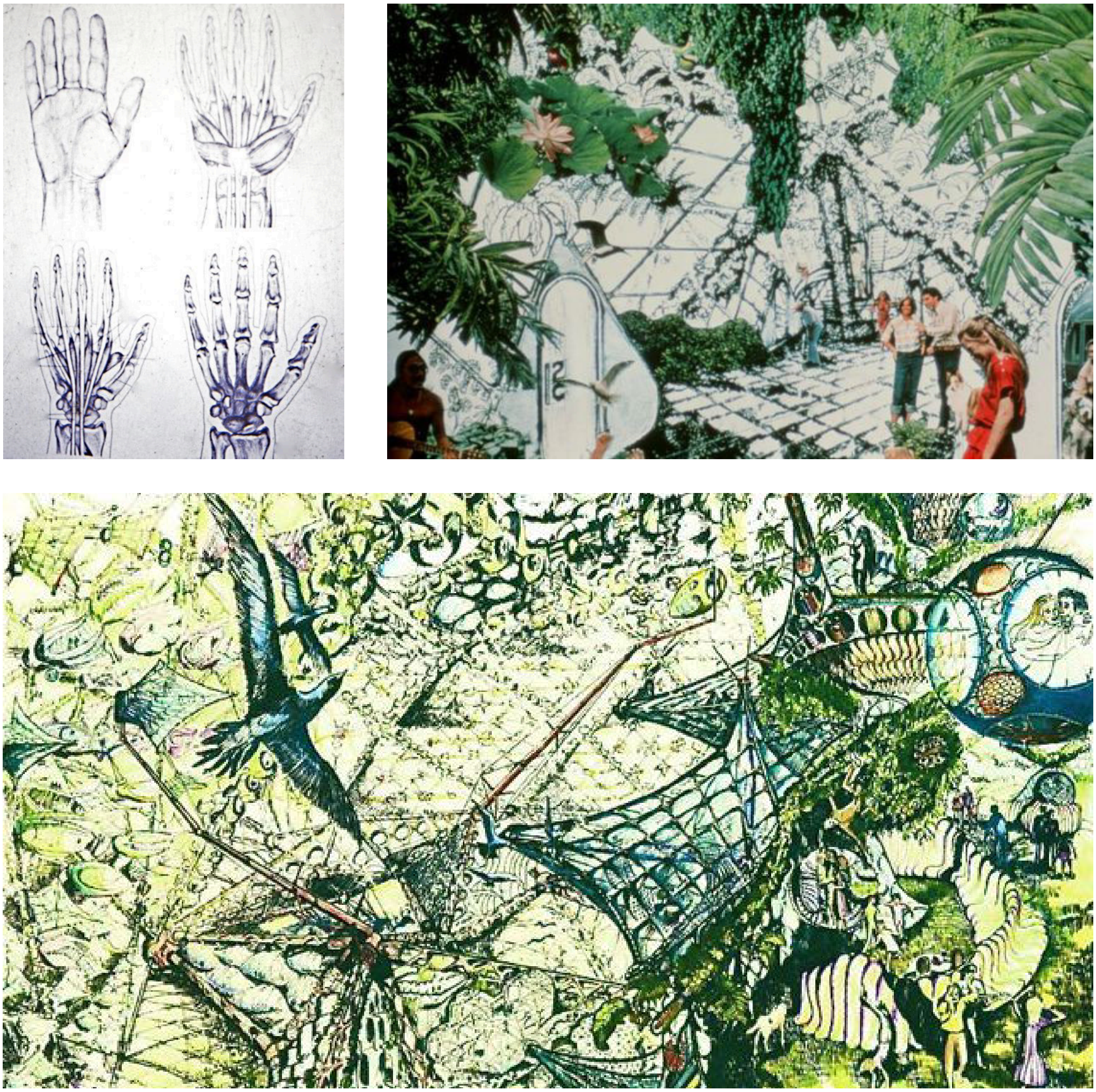


Figure 2.9 *Architect Glen Small investigated revolutionary new architectural ecologies in the 1970s. His project, Biomorphic Biosphere, assumed an alternative approach to sustainable synthesis between man, nature and machine.*

2.4 RESILIENCE AND REGENERATION

Regeneration and resilience are strategies that can facilitate the next phase in the evolution towards a synergy of natural, cultural and mechanical systems. These concepts surpass superficial applications of greening and revisit the foundation of sustainable thinking.

Regenerative and resilience thinking originated when the assumptions of resource management were challenged by new a understanding of the dynamics of change in complex social-ecological systems, challenging the model of the Modernist control paradigm and the treatment of human and ecological systems as separate. These concepts accommodate fundamental transformations between the three systems of man, nature and machine and facilitate an adaptive response to systems and nature's cyclical character.

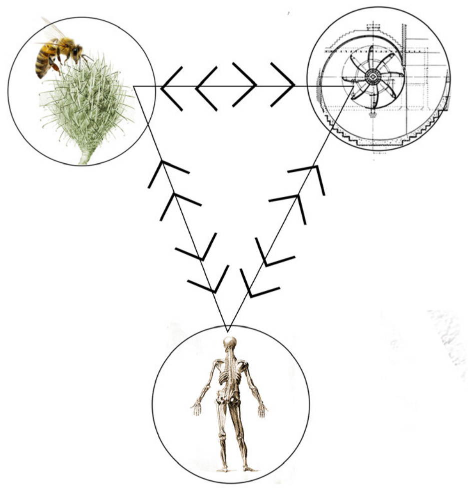
2.4.1 Definition of concepts:

Regeneration represents the transformation and renewal of a system, increasing its regenerative capacity (Du Plessis, 2012:35). It is a measure of the persistence of a system, and its ability to absorb change (Brand & Jax, 2007:24).

Resilience represents the life-sustaining aspect of nature that yields to external forces, thereby preventing the system from failing through its adaptive capacity to survive coming changes (Du Plessis, 2012:35). It is the magnitude of disturbance that can be absorbed before the system changes its structure (Brand & Jax, 2007:26).

2.4.2 Regeneration and resilience as place-driven concepts

Mang & Reed (2011:28) discuss place as being a unique, multi-layered network of living systems within a geographic location that results from complex interactions, through time, of the natural ecology (climate, mineral and other deposits, soil, vegetation, water and wildlife) and culture (expressions of values, economic activities, forms of association). Each place has its own unique natural, human and cultural history and future, growing and evolving, continuously influenced by the larger system in which it is embedded (Mang & Reed, 2011:32). The notion of place can be viewed as a regenerative concept as regeneration can be regarded as an extension of its context. A regenerative architectural response is thereforeplace-specific and grows from the multiple informants associated with its setting.



William McDonough developed the Hannover Principles in 1992 as a new approach that advocates a regenerative architectural response, considering the new interface between natural, cultural and industrial systems. These principles are the most appropriate interpretation of regenerative design. The most relevant principles are given here (McDonough, 2002):

THE HANNOVER PRINCIPLES

Insist on rights of humanity and nature to co-exist in a healthy, supportive, diverse and sustainable condition.

Recognise interdependence. The elements of human design interact with and depend upon the natural world, with broad and diverse implications at every scale. Expand design considerations to recognising even distant effects.

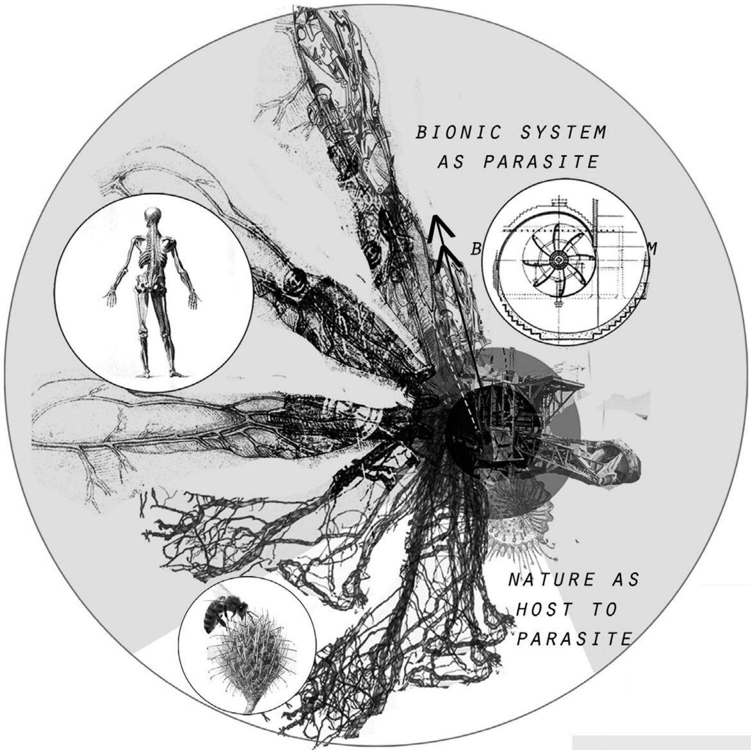
Respect relationships between spirit and matter. Consider all aspects of human settlement including community, dwelling, industry and trade in terms of existing and evolving connections between spiritual and material consciousness.

Accept responsibility for the consequences of design decisions upon human well-being, the viability of natural systems and their right to co-exist.

Eliminate the concept of waste. Evaluate and optimize the full life-cycle of products and processes, to approach the state of natural systems, in which there is no waste.

Rely on natural energy flows.

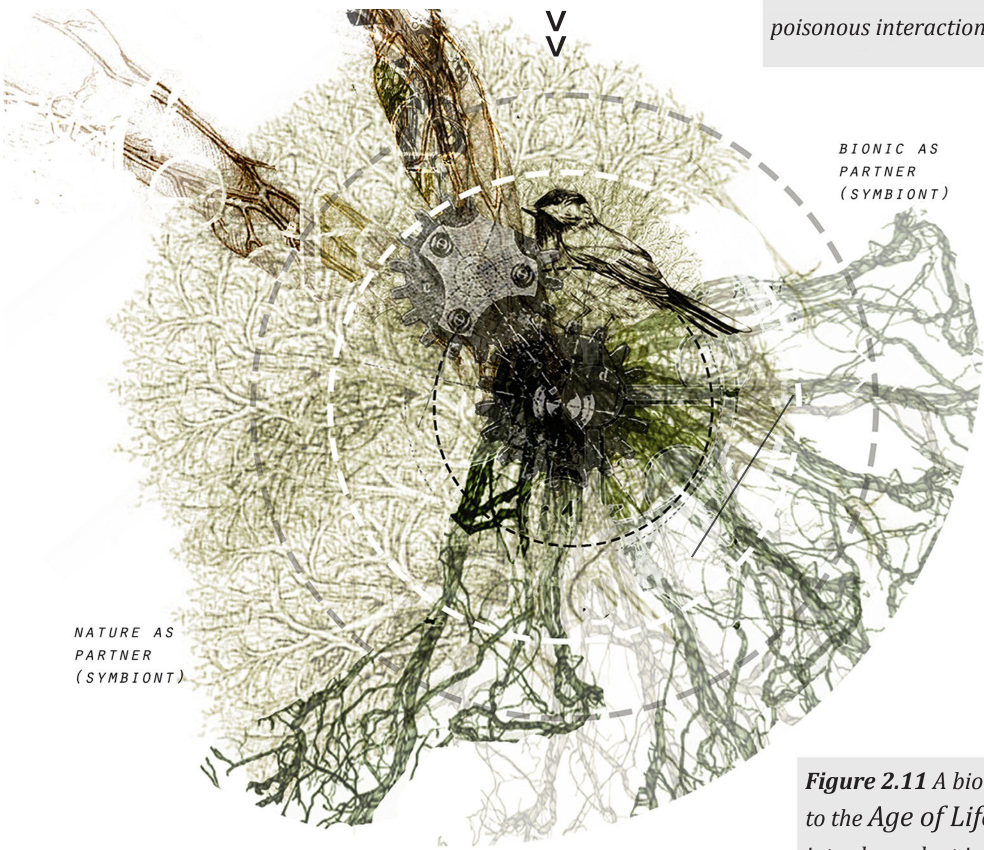
Understand the limitations of design. No human creation lasts forever and design does not solve all problems. Those who create and plan should practice humility in the face of nature. Treat nature as a model and mentor, not as an inconvenience to be evaded or controlled.



SYSTEMS AT
CRITICAL
THRESHOLDS

TRANSITION

Figure 2.10 *The Age of the Machine and the resultant poisonous interactions (Author, 2014)*



SYMBIOTIC
INTERCHANGES
BETWEEN SYSTEMS
RESILIENT AND
CO-EVOLVING
MUTUALISTIC
INTERACTIONS

Figure 2.11 *A bionic evolution to the Age of Life and resilient interdependent interactions (Author, 2014)*

2.5 THE SUCCESSIVE PHASE IN THE EVOLUTION

This dissertation imagines a future condition and foreseeable successive phase in the evolution of regenerative and resilient design as a direct extension of place and context. Expanding on the discussed concepts, future fundamental shifts between the triad are envisaged, influencing design as a reflection of the reciprocity between the three systems of man, nature and machine, referred to in this dissertation as the *'symbionic'.*

TERMING TRANSFIGURED RELATIONSHIPS

THE SYMBIOTIC AND *'SYMBIONIC'*

2.5.1 The Symbiotic

"Symbiosis is a key word for the 21st century" (Kurokawa, 1994:13)

Symbiosis comes from the Greek "*sym"* which means "with" and *"bios"* which means "life", therefore it refers to "the state of living with" (Steffen, 1982:1). The term refers to the interdependence of life and the mutual benefit of two biotic organisms in a positive dynamic relationship, where a level of understanding is developed, despite differences (Kurokawa, 1994:13).

2.5.2 The Symbionic

The notion of the bionic, or cyborg, is strongly linked to Cullinan's identity and the Age of the Machine. However, instead of an incapacitating parasitic interface, a *symbionic* interaction suggests a reciprocal synergistic relationship between the bionic and biotic (nature), rather than two natural organisms. Like symbiosis, this relationship is not only about accord, but autonomy of the parts. Emphasis on the intermediate ambiguous space between symbionts is important (Kurokawa, 1994:13), as well as the dynamic interface and interchanges that occur between them. The concept does not imply that systems be merged, but rather that unique characteristics should be retained while allowing for dynamic dialogue at their interfaces in terms of spatial and systemic interchanges.

Cullinan can serve as a precedent for facilitating an evolution between these realms.

2.6 A CONTEXTUAL REGENERATIVE RESPONSE

RESPONDING TO THE NATURAL AND CULTURAL CONDITIONS OF PLACE

A *symbionic* relationship recognises place-specific architecture as part of a larger interwoven natural and cultural system. Therefore, an approach to these systems associated with place will be discussed in greater detail. Proposed future interaction with natural systems is explored through the concept of biophilia (the term *'philia'* referring to the love of something) which challenges our contemporary dependence on the machine, described as technophilia. Secondly, integration with natural systems as a functional extension of the contemporary bionic systems is explored through the tenets of permaculture, challenging present-day industry with a new way of making. The architectural response to the cultural systems of place considers heritage as the embodiment of a place's identity and meaning. Consequently, an approach to tangible and intangible heritage fabric is considered with the aid of appropriate heritage charters.

"The interplay between man and nature is a unique specificity in which desired and actual behavior bring constraints of a new type"

(Hofstra & Huisingh, 2013:462).

Figure 2.12 *Biophilia: Man recognises himself as a part of the complexities of larger interwoven systems. It suggests revisiting our mental, spiritual and physical connections with nature.*

2.6.1 NATURAL SYSTEMS

2.6.1.1 The Biophilic Revolution

One of the predominant causes of man's alienation from nature is as a consequence of the built environment which has excessively consumed energy, fresh water and natural resources (Kellert, 2005:91). Buildings today reflect no understanding of ecology or ecological processes, or cognisance of their role in the larger web of life (Kellert, 2005:92). What remains of our natural condition can still be salvaged by reconsidering our relationship with it.

Orr (2010:416) describes biophilia as the impulse to affiliate with other life forms, an absolute departure from the divergent concept of technophilia associated with our current milieu. The brain developed in a biocentric, not machine-regulated world (Stairs, 2010:40), meaning that the distorted idea of human dominance with machine at our employ should be reconsidered, establishing a new decorum that is exercised towards nature.

Biophilia is also about the recovery of sense of *genius loci* and becoming deeply rooted within a place so that a '*philia'* for it can be developed, therefore man will be inclined to protect it .

Biophilic design and the bionic evolution

Biophilia calls for the establishment of more natural places and places of the imagination (Orr, 2010:205), establishing a spatial connection with nature, acknowledging biodiversity and recognising nature as mentor. According to Stairs (2010:42), design should reflect a mutual reciprocity between the exploits of man and nature, and a movement to 'eco-technological equilibrium'. The machine has become an inherent characteristic of our contemporary culture and a completely separate path is an unrealistic notion. We cannot simply subtract the machine. Instead, it should be designed to become a sustainable part of our natural world (Stairs, 2010:43). The application of biotechnic or life-centered technologies of interdependence between systems implies a bionic evolution.

2.6.1.2 Permaculture: a new way of making

"... the being is not contained to itself but gives the productive excess to the surrounding and vice versa. A building is not a unit but a part of a network where it imbibes and shares its energy thus increasing the efficiency of the chain as a whole " (Lehaya, 2010:online).

Figure 2.13 *In the Industrial Age man is not a part of the plurality of life, but apart from it (Sergyshkin, 2014)*

Humankind is embedded in an environment in which matter and energy is exchanged (Hofstra & Huisingh, 2013:462). The current industrial productive system that takes, makes and wastes calls for industrial reforms (Braungar & McDonough [sa]: online), rethinking man's traditional linear perception of nature that failed to recognise the possibilities of collaborative relationships and feedback cycles of resources in the context of larger holistic systems.

The proposed programme[1] for a food hub incorporates a new way of producing that challenges traditional methods of production, exploring architecture that can facilitate the making of food and energy, creating no adverse waste and fostering diversity (Kellert, 2005:95). Nature is an open system model for this and provides space to its complexity, flows and processes, feedbacks and control mechanisms and cycles (Hofstra & Huisingh, 2013:462). This web of interdependencies should inspire a new approach and future production and processing can ensure the closed-loop flow associated with both technical and biological nutrients (see figure 2.14). Energy can also be harnessed and stored, reconsidering energy flows in an industrial system (Holmgren, 2012 :online).

This new approach attempts to respect nature's limits, while abandoning narrow prejudices for holistic thinking that allows for the profit of both man and nature.

Permaculture is an ecological design approach that weaves man and nature together to create dynamic systemic interactions where bionic systems feed and are fed by the living biotic systems in which they occur. This means the re-coupling of human systems with the evolution of natural systems and, consequently, the alignment with life processes (Mang & Reed, 2011:26).

1 The programme is discussed in Chapter 5

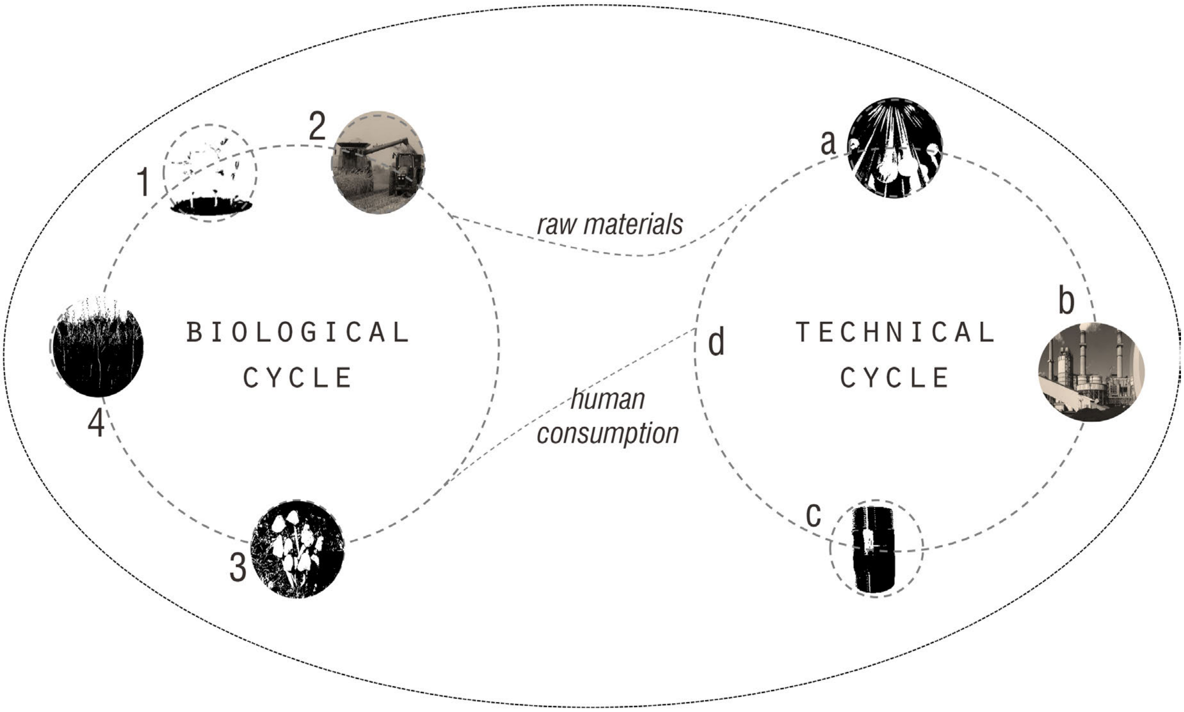


Figure 2.14 *The interactions between two metabolisms: the biosphere and the technosphere (cycles of nature and industry respectively) as biological and technical nutrients, and the creation of closed-loop systems (Author, adapted from McDonough 2002)*

1 and 2- Cultivation and harvesting
3- Decomposition
4- Nutrients

a- Materials
b- Production
c- Product
d- Disassembly and waste separation

2.6.2 CULTURAL SYSTEMS

PLACE, HERITAGE AND IDENTITY

The Industrial Age cultivates a movement towards mass culture and consequent placelessness, resulting in an ensuing risk of the collapse of memory associated with place (Nora, 1989:7). As opposed to Industrialism, which has led to the enslavement to the machine and homogeneity, a post-industrial context should begin to value cultural dimensions which constitute the spirit of place (Barthelemy, 2013:online).

According to Bohland & Hague (2009:109), concepts of heritage and identity are beginning to come to the fore in our current era of globalisation, an escalating global phenomenon that is focused on the reinterpretation of the past and articulating identities. Heritage sites and places are being revered by people as repositories of a group's identity (Bohland & Hague, 2009:110), with a mounting interest in the local and history of place in a changing world. Wendell (1972:38) poses the question as to whether the scars of the present establishment should be healed, or enshrined and preserved as testaments of the so-called glories of our history. The influence of the Industrial Age should not simply be erased and forgotten as the global process of Industrialisation observed over the past two centuries constitutes a major phase of human history, making its heritage particularly important (TICCIH, 2011:1). It represents a unique layer of mankind's cultural narrative, hence a marriage of Industrial Age memory and post-industrial interventions is necessary. This approach ensures that memory of place is retained through meaningful fabric that acts as a vessel connecting us to our past condition, while exploring future evolving dynamics.

Figure 2.15 *The ghost town of Kolmanskop in Namibia, a once flourishing diamond mining town*

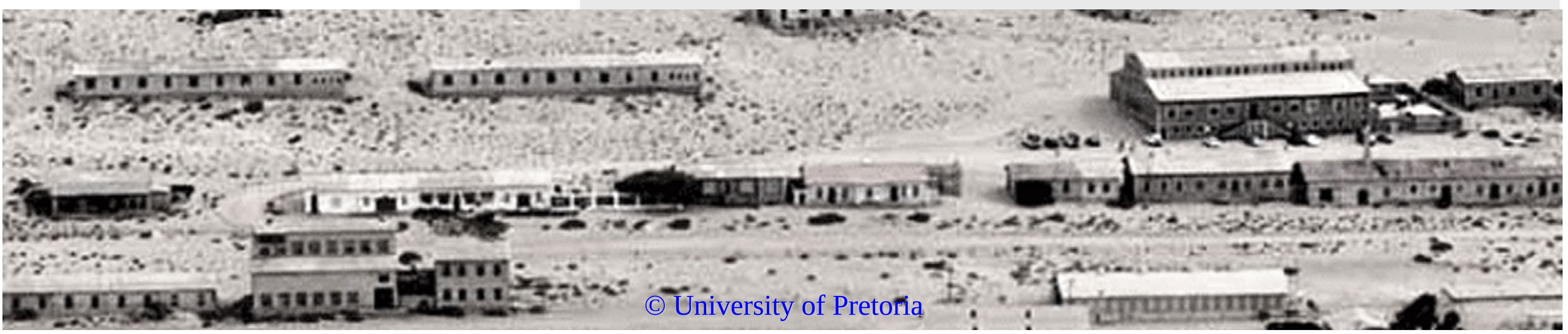


Figure 2.16 *Cullinan's intangible heritage*
a- Cullinan as an army base during World War II, the military arriving at the station.
b- Early photograph of Oak Avenue (Lincoln archive)

Outlining an approach to heritage

The mining industry impacts on the physiognomy of the natural landscape, the social organism of a town and it also leaves the remains of its own rusted skeletons. Often the first reaction to the period following mine closure is to erase all traces of the past, eliminate old scars on the landscape, and to ensure that industrial buildings return to the landscape to an assumed pre-industrial character (Cole, 2010:483). Instead, it is important to recognise the tangible and intangible heritage associated with a site as traces of past narratives and memory.

The selected site is a palimpsest of heritage introduced at different phases. The charters that will be discussed have been selected for the purpose that they reflect on this rich stratum of empirical and ephemeral heritage that give the site its uniqueidentity. A brief outline of the intended position to heritage is discussed, but the specific application to the context will be discussed in greater detail in chapters 3 and 4.

The ephemeral and empirical

Cultural and natural heritage significance

The legacies we inherit stem from both nature and culture (Lowenthal, 2005:82). Cultural significance is embodied in the place itself which includes its fabric, setting, use, associations, meanings and related objects (Burra Charter, Article 1.2 1999:2). Natural significance of a site refers to the importance of ecosystems, biological diversity and geodiversity (Burra Charter, Article 1.3 1999:4) which also form a part of the identity of place .

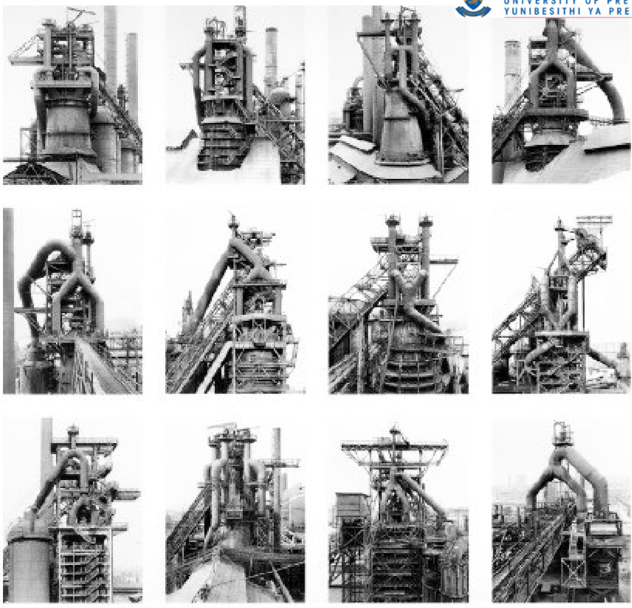


Figure 2.17 *Photographic series of abandoned industrial structures (Becher, 1988)*

Article 3.1 (1994:3) of the Burra Charter suggests states:

"... do as much as is necessary to care for a place and make it usable, but otherwise change as little as possible in order to retain associated cultural values" Burra Charter (1999:1).

Principle 3.1 of the Ename Charter (2008:9) also advocates an approach where the significance of the site should be explored in its multi-faceted contexts, considering all aspects of the site's cultural, social and environmental values.

Industrial heritage

Removing industrial heritage from the landscape would undermine the environmental context of this genre of social history, which is closely tied to the land and local communities (Cole, 2010:485). Cole (2010:485) suggests that opportunities for the survival of mining heritage landscapes could lie in the juxtaposition of the industrial and pastoral- placing industry as just one phase affecting landscape over the centuries.

The ICOMOS-TICCIH Charter (2011:2) defines industrial heritage as comprising sites, structures, areas and landscapes, as well as related machinery and objects that provide evidence of past or ongoing industrial processes of production or the extraction of raw materials and their transformation into goods. It states (2011:1) that besides the tangible heritage associated with industry, engineering and architecture, it includes many intangible dimensions embodied in memories and social life of associated communities. Industrial heritage also reflects on the profound relationship between the cultural

*"The concrete expression of the idea of the durability of humankind, the irrefutable trace left by the great human chain which, from one generation to the next, has helped to create our everyday environment.
It makes us aware of the 'duration' of history, the 'solidity' of time on which to base the ideas of chronology and continuity"*

(Barthelemy 2013)

and natural environment and the multifaceted social and cultural heritage that shaped the life of communities.

The ephemeral

The UNESCO Convention on intangible heritage (2003) defines intangible cultural heritage as representations, expressions, knowledge and skills, as well as objects and spaces associated therewith, that communities recognise as part of their cultural heritage. This provides a place with a sense of identity (UNESCO, 2003). The Kimberly Declaration for the safeguarding of intangible cultural heritage (2003) recognises the indivisibility of tangible and intangible heritage which give values, meaning and context to objects and places. There are a multiplicity of values that can be associated with a site which relate to the symbolism, identity, culture, living traditions, remembrance, the environment and nature (Kimberly Declaration, 2003). The intention is to give expression to the intangible memory of the site and to nurture greater understanding of its underlying meanings, symbolism and values.

2.7 THE ARCHITECTURAL MANIFESTATION

The 'three modes of relationship'

For the greater part of the 20th century, the society of industry was producing visible technologies, and architecture existed as an analogy to these visible machines (Lahaye, 2010: online). This resulted in architecture built on the phenomenon of universalisation. Industrial structures are essentially internalised and focused on the optimisation of the machine, and its authority over its context which exemplifies Industrialism. In a post-industrial context, failing systems need to be resuscitated through a new *symbionic* architecture.

Frampton (1983:21) suggests a position that distances itself equally from the Enlightenment myth of progress and from a reactionary, unrealistic impulse to return to the architectonic forms of the preindustrial past. Architecture must mediate the impact of universal civilization with elements derived indirectly from the particularities of place finding its inspiration in such things as local light quality, tectonic derived from local structural mode or topography of a given site (Frampton, 1983:21). This has relevance to the situation in which Cullinan will find itself in the near future context of a decommissioned mine.

Rainey (1994) discusses the relationship between architecture and landscape as an expression of cultural values and relationship with place. The history of architecture reveals three basic modes of relationship between architecture and its context as representations of the relationship human beings have to nature: *contrast, merger and reciprocity* (Rainey, 1994:4).

How architecture relates to its context is largely determined by an explicit or implicit view of the relationship between the realms of man, nature and machine and design which, in essence, gives form to these values (Rainey 1994:6). These three strategies based on the convictions about the relationships between the triad of realms explored according to Rainey (1994) :

Contrast: Respecting the residue of past narratives

Architecture that juxtaposes the natural and cultural landscape *contrasts*, creating a powerful counterpoint to the setting. There is no transitional space to act as a bridge between the architecture and setting, which highlights the intrinsic quality of each, while expressing the conviction of nature as a realm apart, with its own separate processes, ecosystems and characteristics. This strategy is present in the exisiting condition of Cullinan where the remains of the machine contrast with its context.

Engagement with the cultural systems of place means the preservation of memory and identity associated with place. The particularities of the context should inform the response and give expression to the ghosts of the past while the new stratum should assist in linking people to the narrative of the site, allowing the architecture to become a vessel to express on-site narratives and historical residue. The new architecture should express a juxtaposition between old and new expressions of relationships.

Merger

Merger is the opposite of contrast. Merging architecture is integrated with the natural and cultural landscape where building becomes an extension of its context and a part of the topography or even placed underground. This mode understands nature as a power which transforms man and his endeavors, valued both in terms of its quantitative an qualitative influence on man and architecture. Nature is viewed rationally as a complex realm of processes that man should respect and become a part of the cycle for survival, simultaneously evoking a sense of feeling in the psyche, biophilia. Merger signifies man's harmonious integration and design with nature.

Reciprocity

- *Extroversion: New natural and cultural spatial and systemic connections*

Reciprocity explores architecture that spatially transitions and mediates between nature and building. The formal strategies of this mode are diverse and can be expressed through form, space and materiality. This dissertation adopts this strategy as mediating between the realms of man, machine and nature, creating a link and interstitial space that spans the modes of contrast and merger. Where parasitic industrial architecture of the Age of the Machine is withdrawn, a post-industrial architecture is defined by extroversion. Which suggests new systemic and spatial connections. This refers to a dissolution and adaptation of architectural boundaries to facilitate synergistic interactions of the bionic with nature and culture that both define the identity of place.

Kurokawa (1994: 20) states that the intermediary space between these realms allows for vibrant synergies. This means the spatial inter-permeation of indoor and outdoor and systemic interactions between production and ecosystems. Although architecture should explore future interactions between the trio of systems as a co-evolutionary whole, each of these systems should be identified as unique with their own defining characteristics.

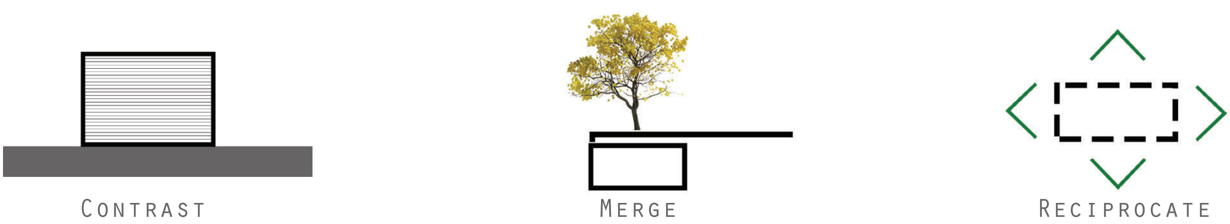


***Figure 2.18** Rainey's three modes of architectural expression (Author, 2014)*

2.8 A SYNOPSIS

The theoretical investigation considers the *evolution of the relationship between man, nature and machine* and the architectural manifestation of this in the Age of the Machine and the Age of Life.

Regeneration and resilience are considered by reviewing new system dynamics in a future post-industrial condition, giving expression in a *symbionic* architectural response which recognises the systems of *man, nature and machine* as autonomous, but with dynamic and interdependent spatial and systemic thresholds. The bionic's new relationship to the biotic is explored both *spatially and systemically* through the concepts of biophilia and permaculture respectively. Existence of the *current condition* is acknowledged through the discussed approach to heritage which intends to retain the significant fabric of the 'old machine', speaking of past narratives. Changing strategies are adopted to reflect the existence of these three realms on the site, including *past and future conditions*. Architecture within the imagined future condition establishes itself in *broader natural and cultural systems of place*, recognising past narratives as well as new resilient future interactions, simultaneously retaining the *unique characteristics of man, nature and machine.*

Figure 2.19 *Envisioning the Age of Life and the concept of the symbionic. An illustration of the short story The Machine Stops by EM Forster (1908) after the machine's reign (Freise, 2009)*

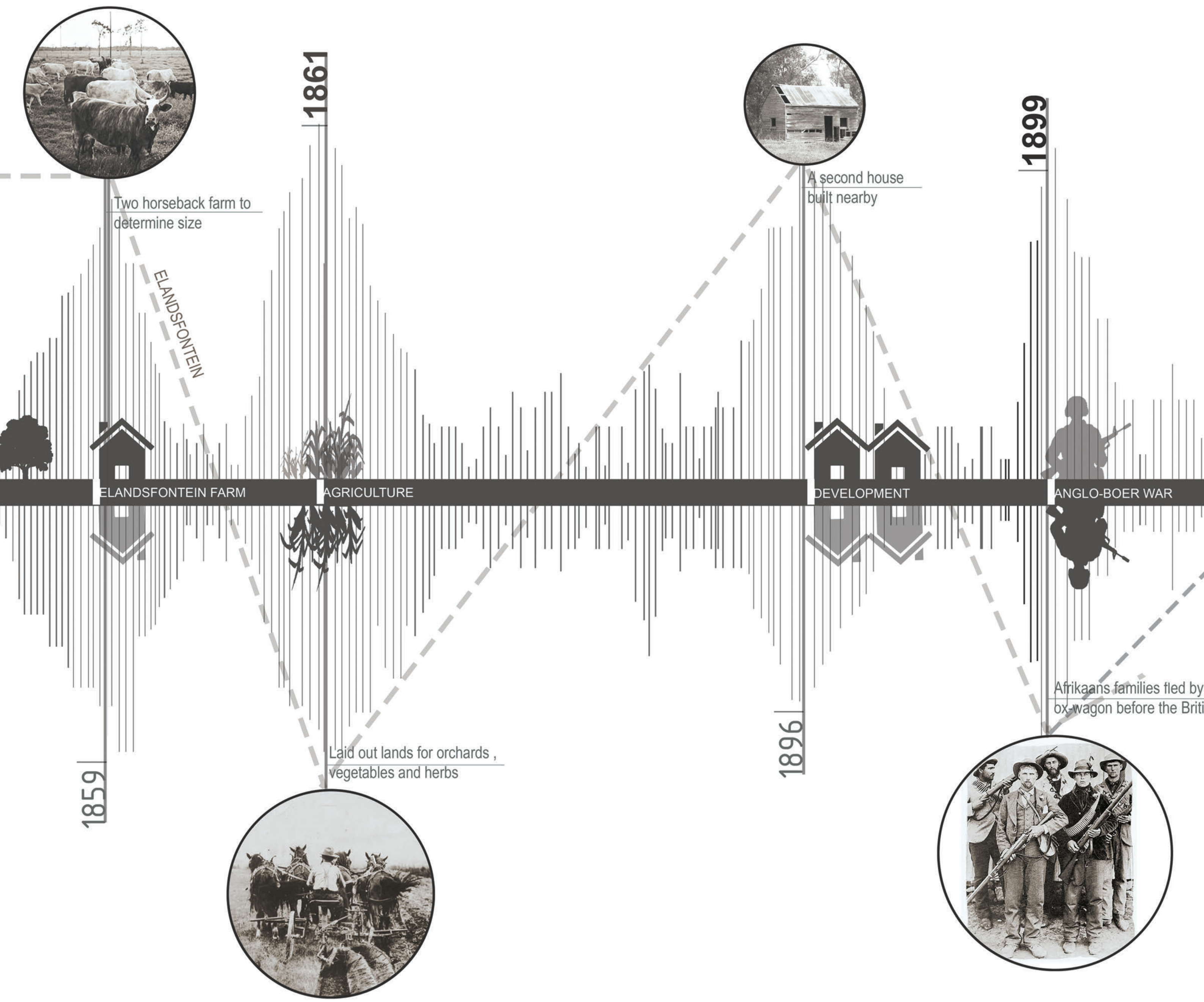
CHAPTER 3

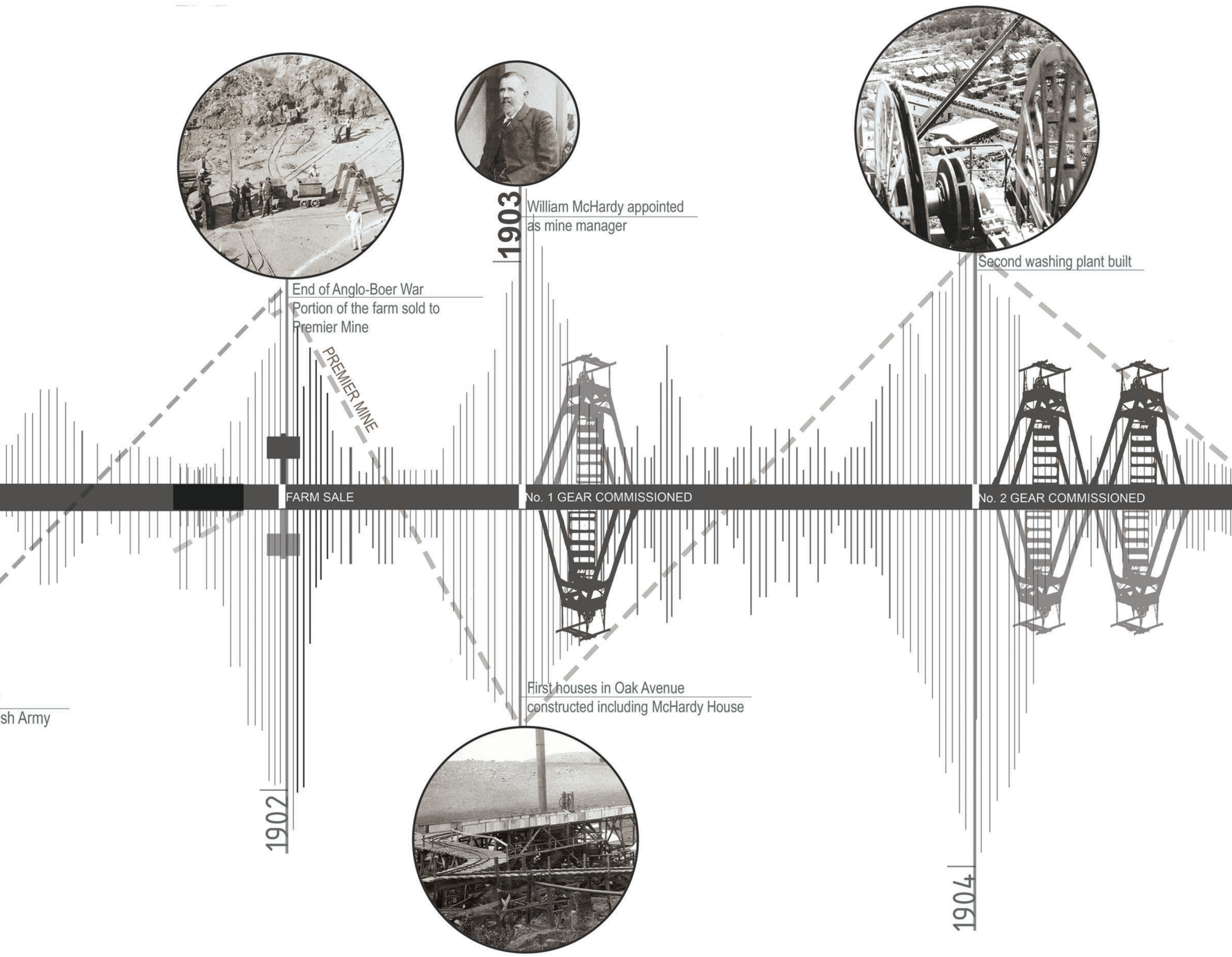
CONTEXT

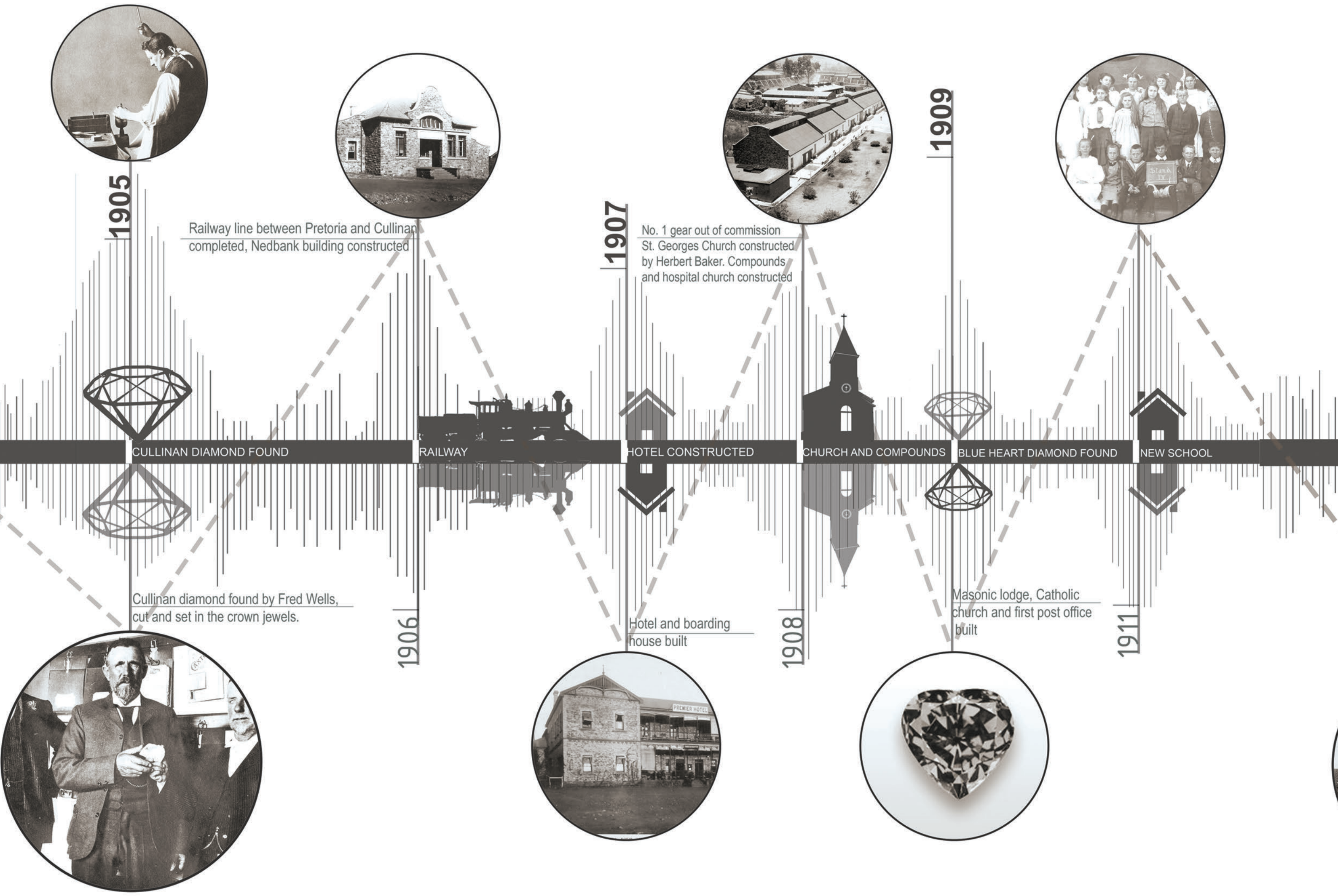
A story of ***man, nature*** *and* ***machine***

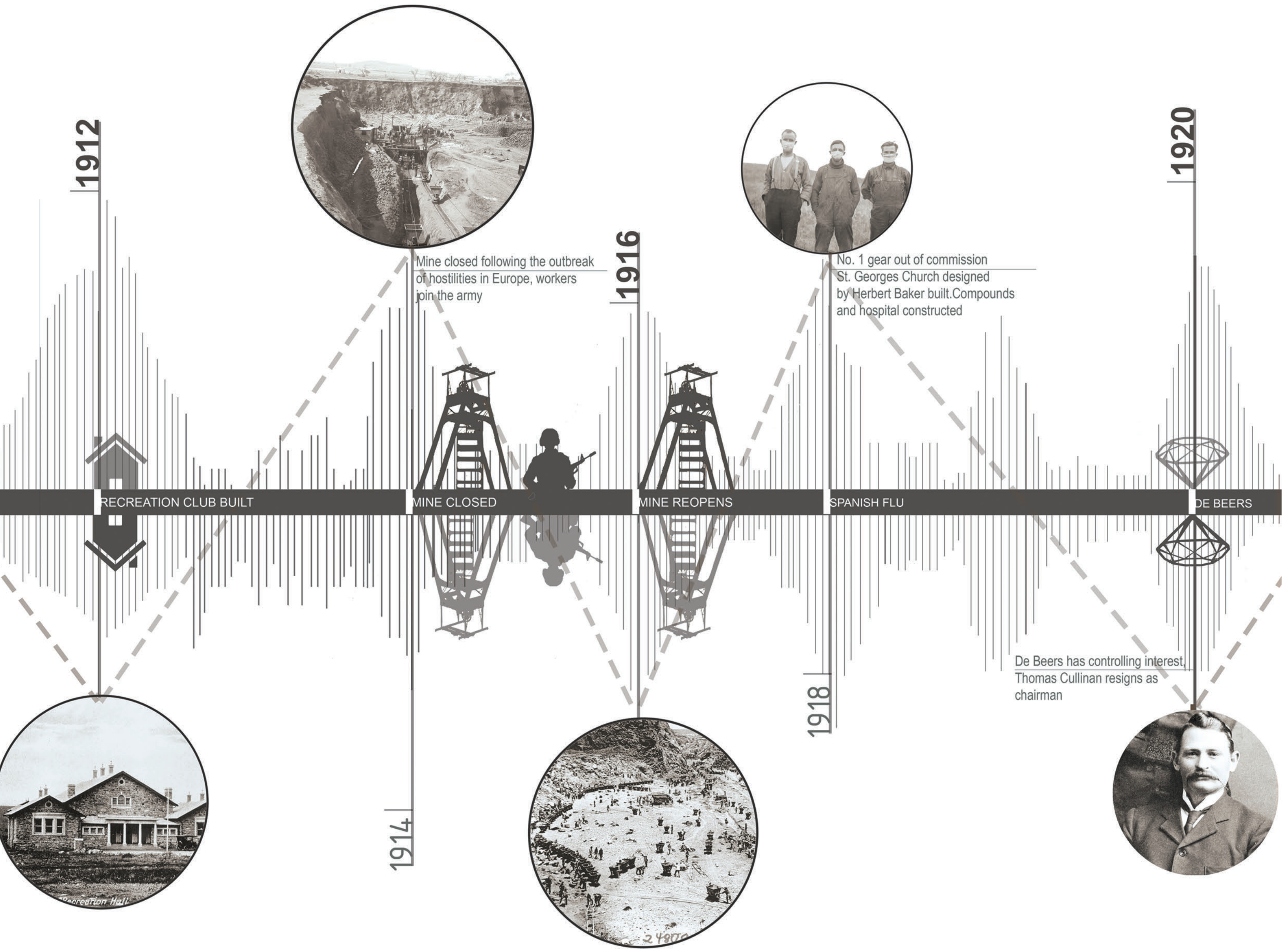
Chapter 3 will explore the macro-context of Cullinan, including its *history* and characteristics, as well as the Cullinan Group's *urban vision*. The story of the *volatile* interface between the *realms of man, nature and machine* will be discussed within this context. These three systems are indivisibly linked, and the reality of a future obsolete machine as a result of the depletion of natural resources in Cullinan, means inevitable *systemic transfigurations.* Conclusions will be drawn from some of the contextual influences, including the *physical, historical and social attributes.*

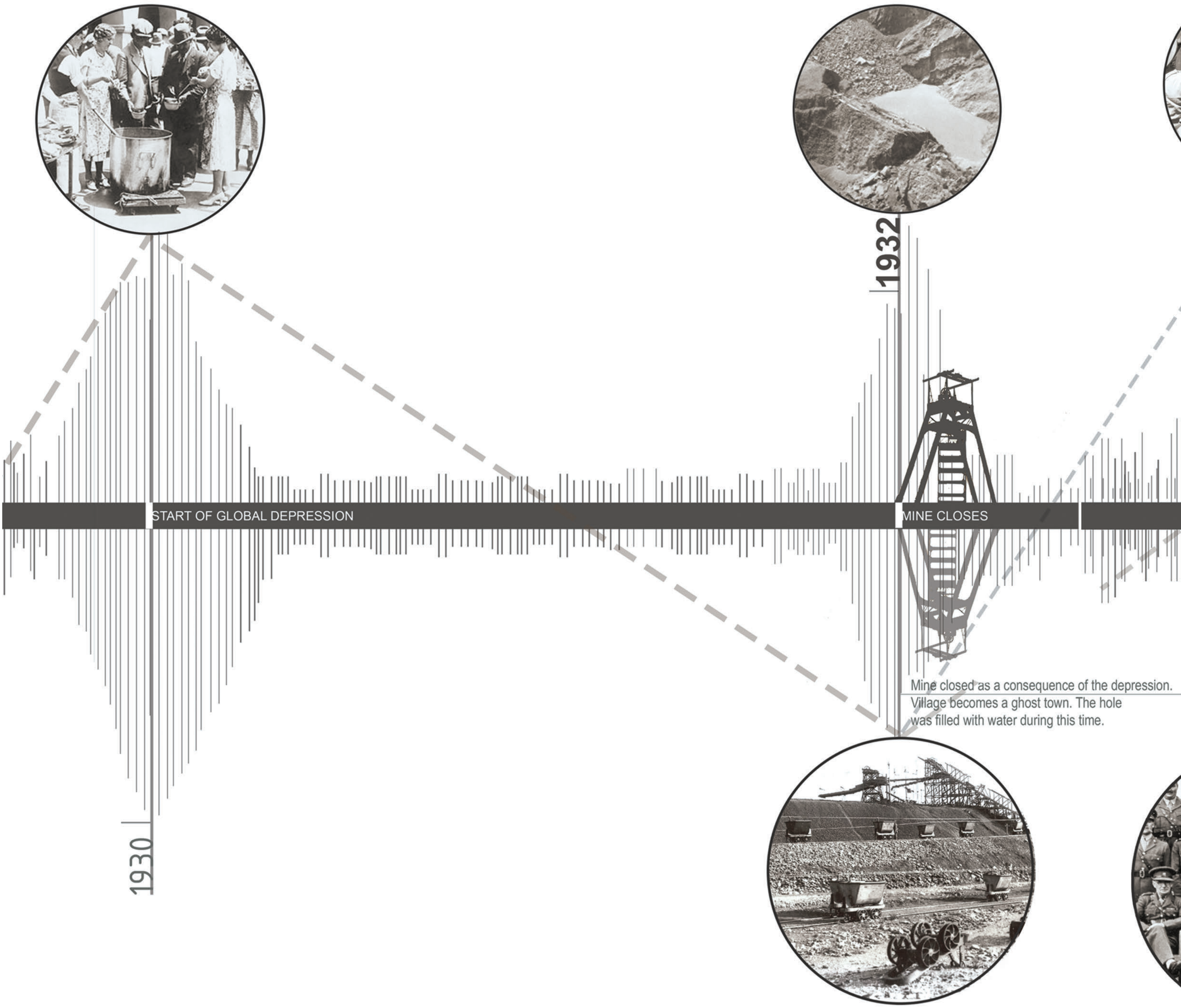
__Figure 3.1__ A timeline indicating significant events in Cullinan's history: the story of man, nature and machine (Author, 2014)

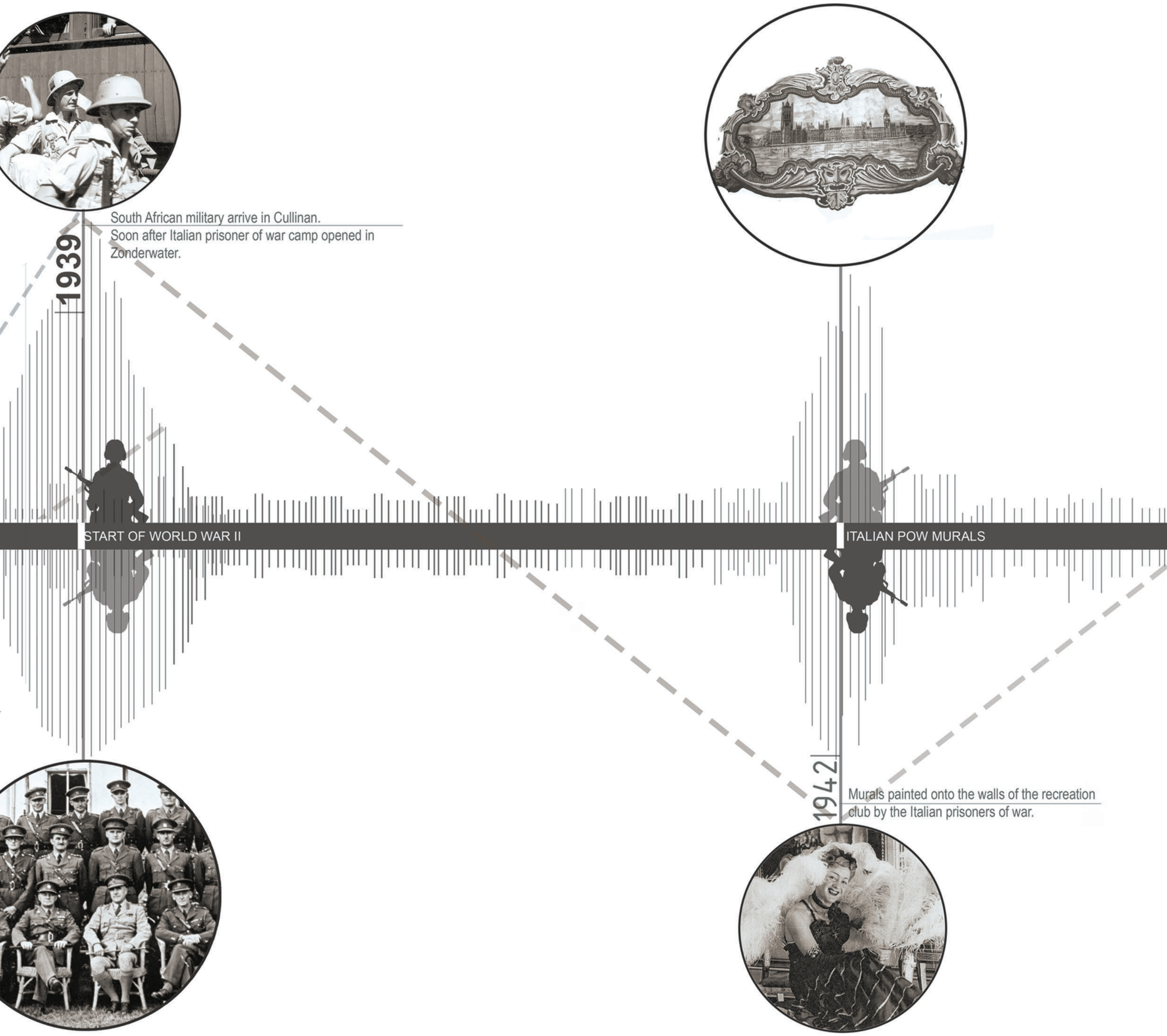


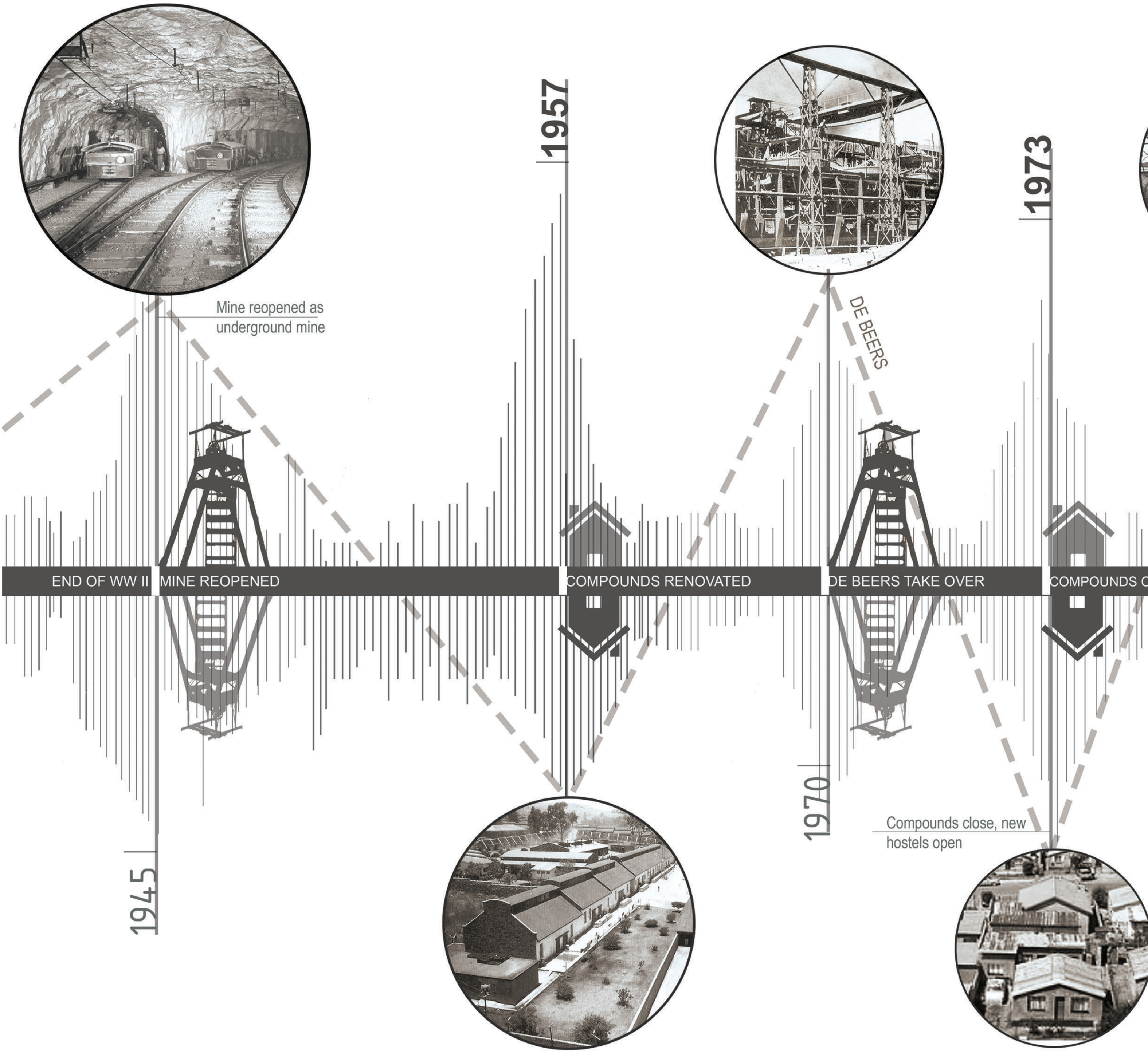

End of Anglo-Boer War
Portion of the farm sold to Premier Mine
PREMIER MINE
FARM SALE
1902
sh Army
1903
William McHardy appointed as mine manager
No. 1 GEAR COMMISSIONED
First houses in Oak Avenue constructed including McHardy House
Second washing plant built
No. 2 GEAR COMMISSIONED
1904

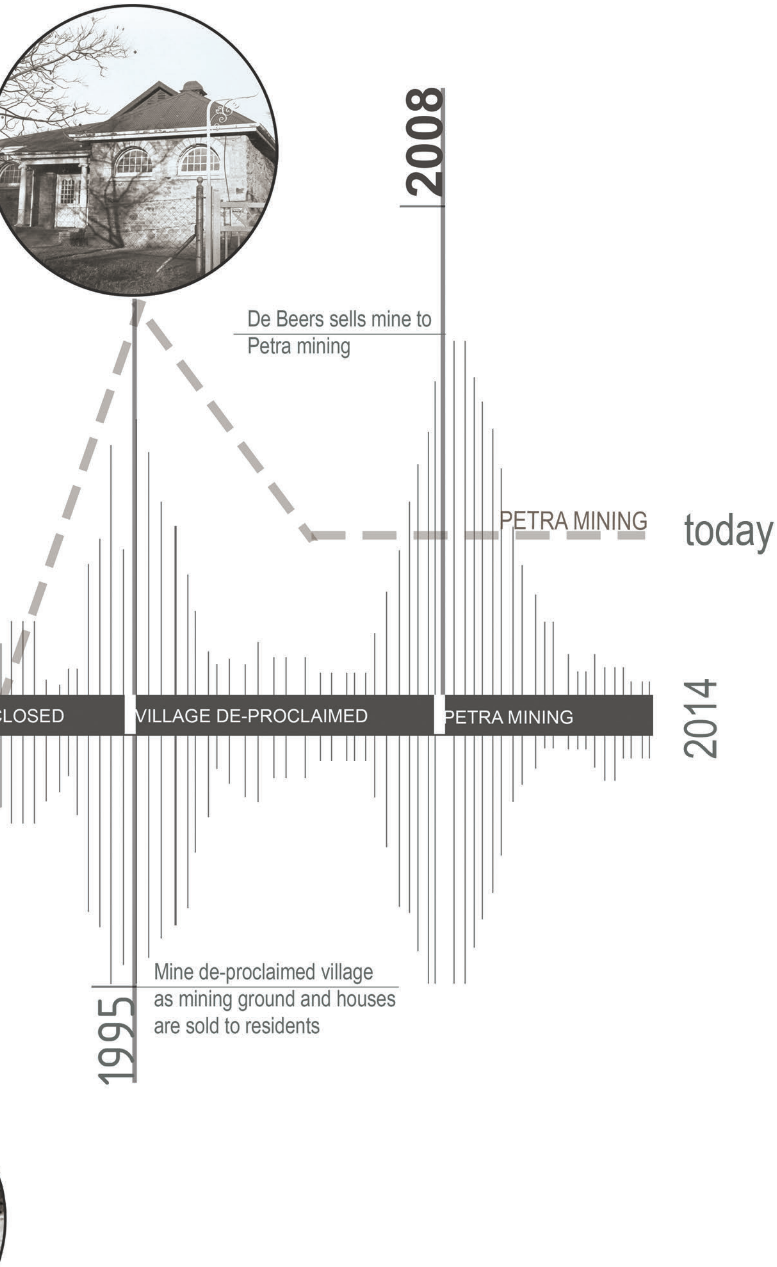

1905
CULLINAN DIAMOND FOUND
Cullinan diamond found by Fred Wells, cut and set in the crown jewels.
Railway line between Pretoria and Cullinan completed, Nedbank building constructed
1906
RAILWAY
1907
HOTEL CONSTRUCTED
Hotel and boarding house built
No. 1 gear out of commission St. Georges Church constructed by Herbert Baker. Compounds and hospital church constructed
1908
CHURCH AND COMPOUNDS
1909
BLUE HEART DIAMOND FOUND
Masonic lodge, Catholic church and first post office built
1911
NEW SCHOOL


1912
RECREATION CLUB BUILT
Mine closed following the outbreak of hostilities in Europe, workers join the army
1914
MINE CLOSED
1916
MINE REOPENS
No. 1 gear out of commission
St. Georges Church designed by Herbert Baker built.Compounds and hospital constructed
1918
SPANISH FLU
1920
DE BEERS
De Beers has controlling interest, Thomas Cullinan resigns as chairman


1932
START OF GLOBAL DEPRESSION
MINE CLOSES
Mine closed as a consequence of the depression.
Village becomes a ghost town. The hole
was filled with water during this time.
1930


South African military arrive in Cullinan.
Soon after Italian prisoner of war camp opened in Zonderwater.
1939
START OF WORLD WAR II
ITALIAN POW MURALS
1942
Murals painted onto the walls of the recreation club by the Italian prisoners of war.


1957
1973
Mine reopened as
underground mine
DE BEERS
END OF WW II
MINE REOPENED
COMPOUNDS RENOVATED
DE BEERS TAKE OVER
COMPOUNDS C
1970
Compounds close, new
hostels open
1945


2008
De Beers sells mine to
Petra mining
PETRA MINING
today
CLOSED
VILLAGE DE-PROCLAIMED
PETRA MINING
2014
Mine de-proclaimed village
as mining ground and houses
are sold to residents
1995

3.1 CONTEXTUAL INFLUENCES
REASONS FOR SITE SELECTION

3.1.1 The aftermath of the mine

Present-day Cullinan is a reflection of a contemporary global condition where the extant relationships between nature (exploited landscape), the machine (the mine) and man (the town) are volatile and cannot be sustained. After mine decommissioning, economic opportunities will most likely be sought elsewhere, in cities, resulting in the loss of the value of these small heritage towns. The context has instigated the exploration of post-industrial possibilities discussed in the theoretical approach. Cullinan can serve as a precedent for shifts that explore a *bionic evolution,* especially in small towns of rich concomitant values.

3.2 THE STORY OF MAN,NATURE AND MACHINE IN CULLINAN

Cullinan has significance in South African history as the site of the discovery of the world's largest diamond, the Cullinan Diamond, in 1905 (figure 3.3). After its discovery, the stone was cut into nine major gems which were held in reserve for the crown jewels and presented to Queen Mary in 1910 (Lincoln, 2011:16). The largest stone, the Cullinan 1, or the Great Star of Africa, is set in the Imperial Scepter (see figure 3.4). Other important gem discoveries have since been made in Cullinan, including the Blue Heart Diamond, Centenary Diamond, Golden Jubilee, Star of Josephine and most recently, in January and June 2014, valuable blue diamonds were unearthed.

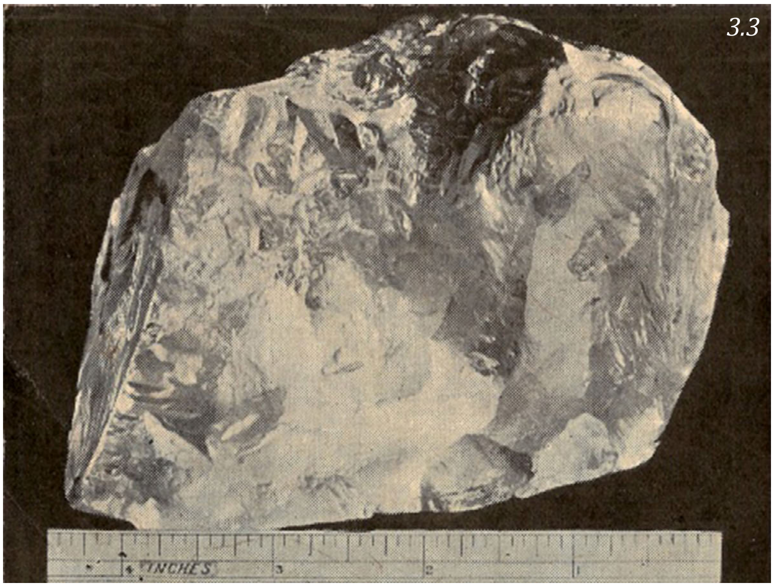
3.2

Figure 3.2 *Fred Wells is credited for the discovery of the Cullinan Diamond on the 25th of January 1905.*

Figure 3.3 *The Cullinan Diamond before it was cut.*

Figure 3.4 *The Queen and the Crown Jewels, with the Imperial Scepter below.*

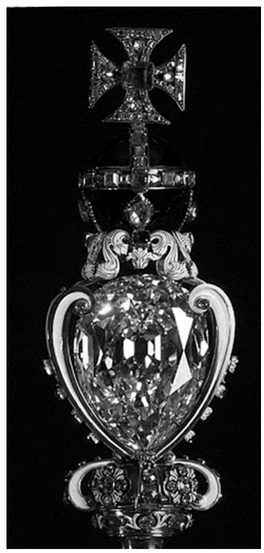
Figure 3.5 *Cutting the diamond in 1906.*



3.3

3.4

3.5



Major events in Cullinan's history are outlined in the timeline (see figure 3.1) and storyboard (figure 3.6). The orchards, herb and vegetable gardens and cattle grazing land of the Elandsfontein farm were flattened in 1902 when the farm was sold to Thomas Cullinan and the Premier Mine. Opencast diamond mining of the volcanic Kimberlite pipe began in the same year using open bench mining techniques (Venter, 2012:268). The mine flourished and the town of Cullinan grew as an introverted social organism (Sharp, 1953:1), developing in the fashion of a typical British village (see figure 3.7). While the mine depended on the people of Cullinan to operate the consuming machine, the people of Cullinan in turn depended on the mine as a source of livelihood.

The early architecture of the town is Victorian and derived from pattern books and the products of industrialisation (Artefacts, 2013: online). Corrugated iron was predominantly used as roofing material and the structure embellished by prefabricated catalogue components. Often, expressions of the style would be found in the homes of mining magnates or the entrepreneurs that followed in their wake (Artefacts, 2013: online). The oldest structures occur along Oak Avenue, which represent the historic town fabric, including the first houses in Cullinan, McHardy House (1903) and Oak House (1904). The village eventually developed a town as a consequence of the mine's rapid growth.

Between the wars, man and machine's relationship with nature changed (see figure 4 of 3.8). The machine was dormant between 1914 and 1916 and the mine closed again in 1932 as a result of the Depression (Lincoln, 2011:70). The hole filled with water and the village became a virtual ghost town (Lincoln, 2011:89). The military arrived in Cullinan in 1939, possibly as a consequence of the vacant houses, abundance of open veld in which to practise manoeuvres (Lincoln, 2014: correspondence) and connection to the early railway system. The military constructed a large Italian prisoner of war camp in Zonderwater, situated near Cullinan (Lincoln, 2011:89).

Operations resumed again in 1945 and the hole was dewatered (Lincoln, 2011:100). A gabbro sill intrusion that extends across the Kimberlite pipe was subsequently discovered, prompting underground mining development.

The opencast pit has grown as a consequence of man and machine (see figure 3.22). This scar and the connected tunnels that have spread beneath Cullinan's surface will soon be abandoned, followed by the town, in search of new exploits.

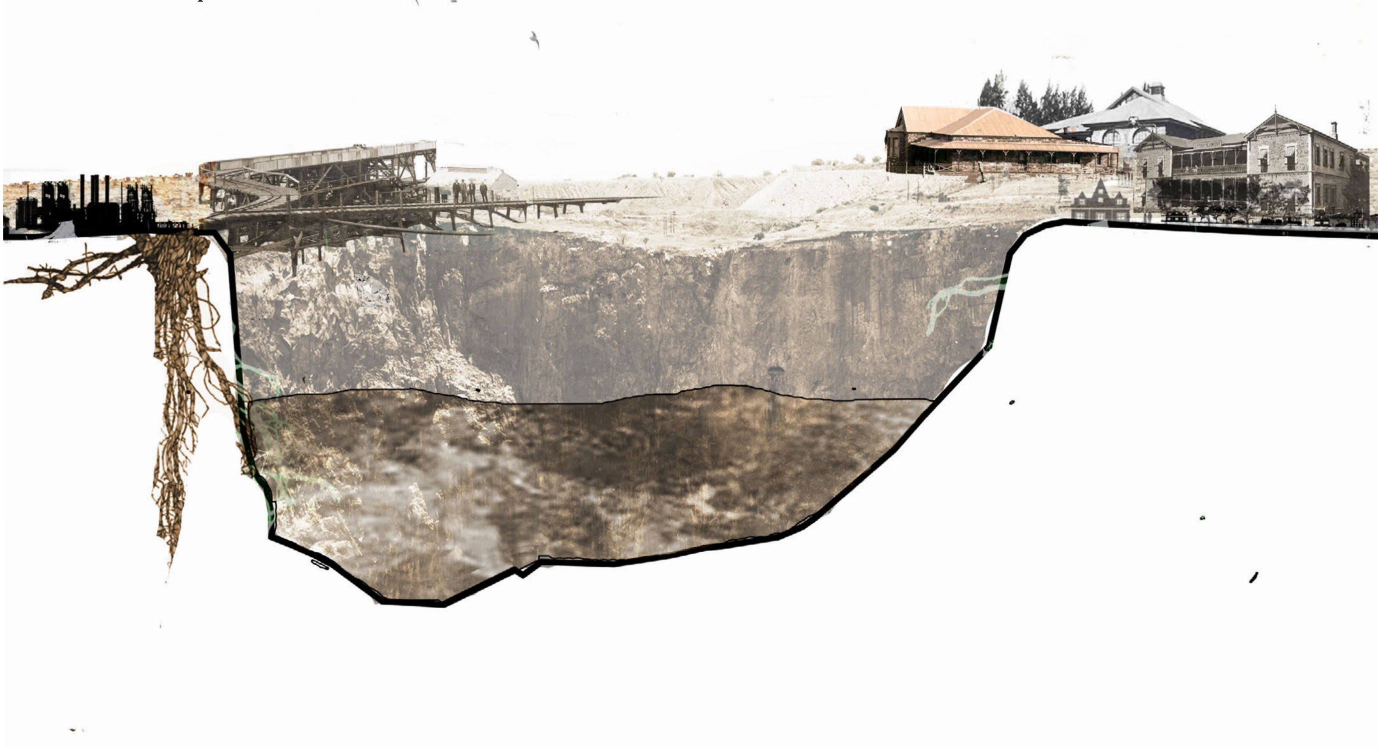
Figure 3.6 *A storyboard of Cullinan's history and the changing interface between man, nature and machine (Author, 2014)*

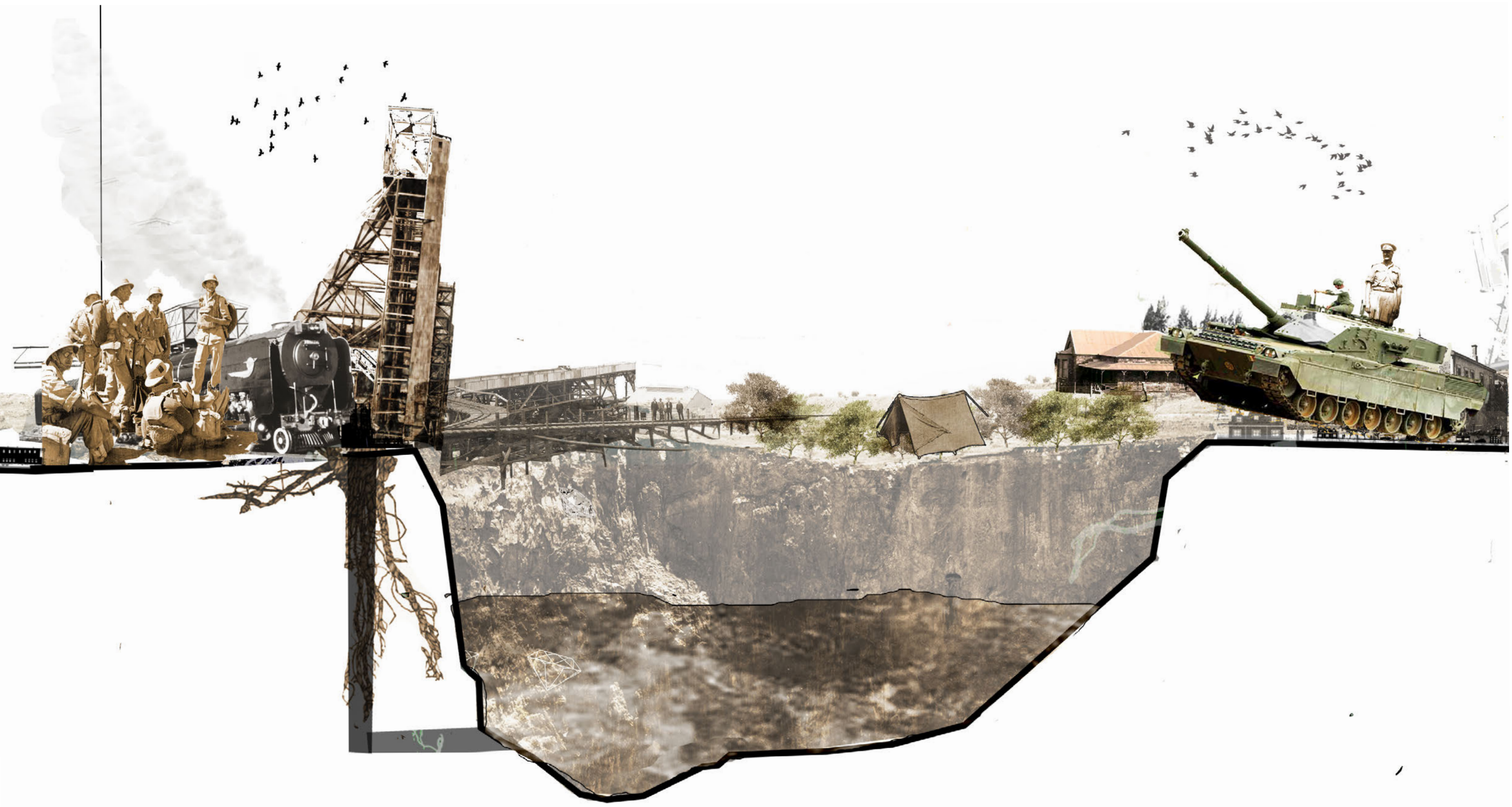
1 The farm of Elandsfontein, where man and nature once existed in mutualistically.

2 The land was sold to the Premier Mine and man started to intervene and impact upon the landscape.

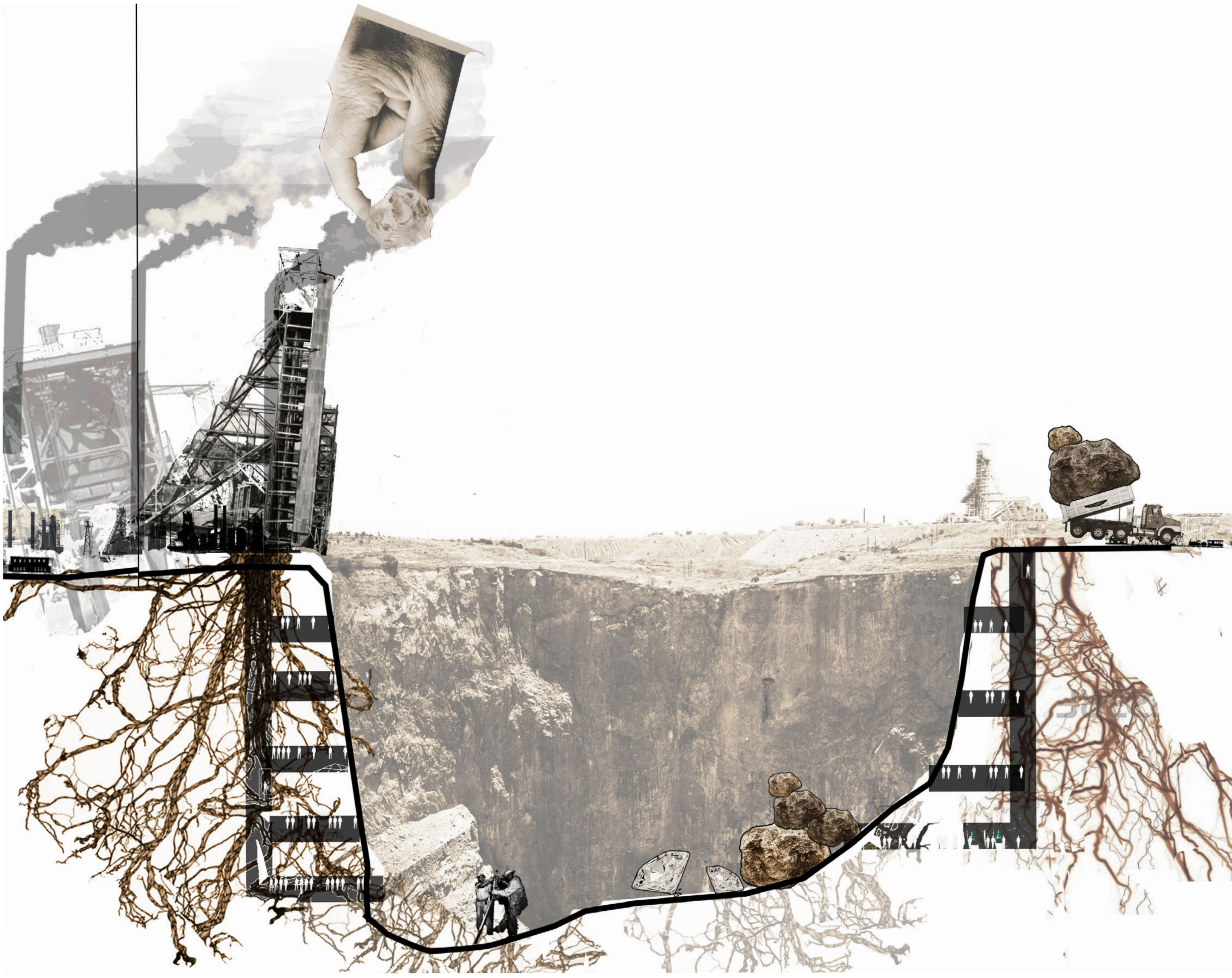
3 The mine and town developed , the machine (mine) grew as a parasite.

4 The machine became dormant as a consequence of the Depression and World Wars.





5 The machine extended underground after World War II.



6 Today, the machine is a powerful and draining parasite, exploiting nature. Man and the town is dependent on the machine.

3.3 THE DEVELOPMENT OF THE TOWN

An overview of the development of Cullinan, from a typical British village to a town, as a consequence of the mine and its exploits is discussed below, reflecting on important influences that informed the town's contemporary character.

Characteristics of a typical English village according to Sharp (1953):

- It is of either a roadside/linear type or a square enclosed type. Cullinan is an example of the former.

- The outline pattern is immediately apprehensible and is in a 'ladder pattern' (figure 3.7). Buildings and plots are placed perpendicularly to the main road resulting in the formality of space

- Main buildings are sited at the end or turn in a road,facing inward towards the road and do not interact with the natural context.

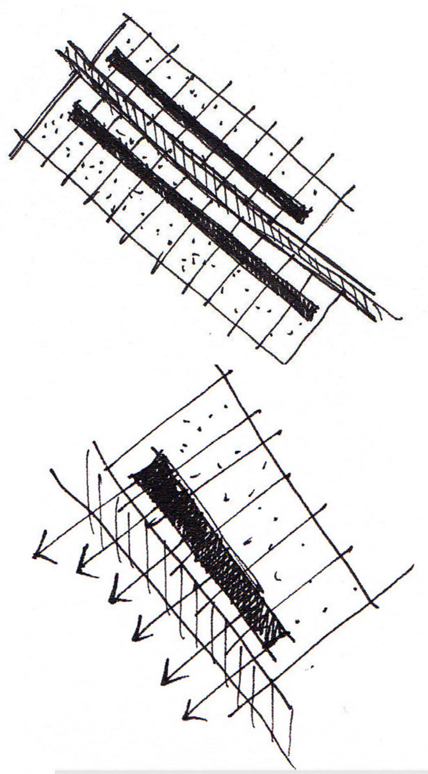


Figure 3.7 *Characteristics of the British Village (Author adapted from Sharp, 1953)*

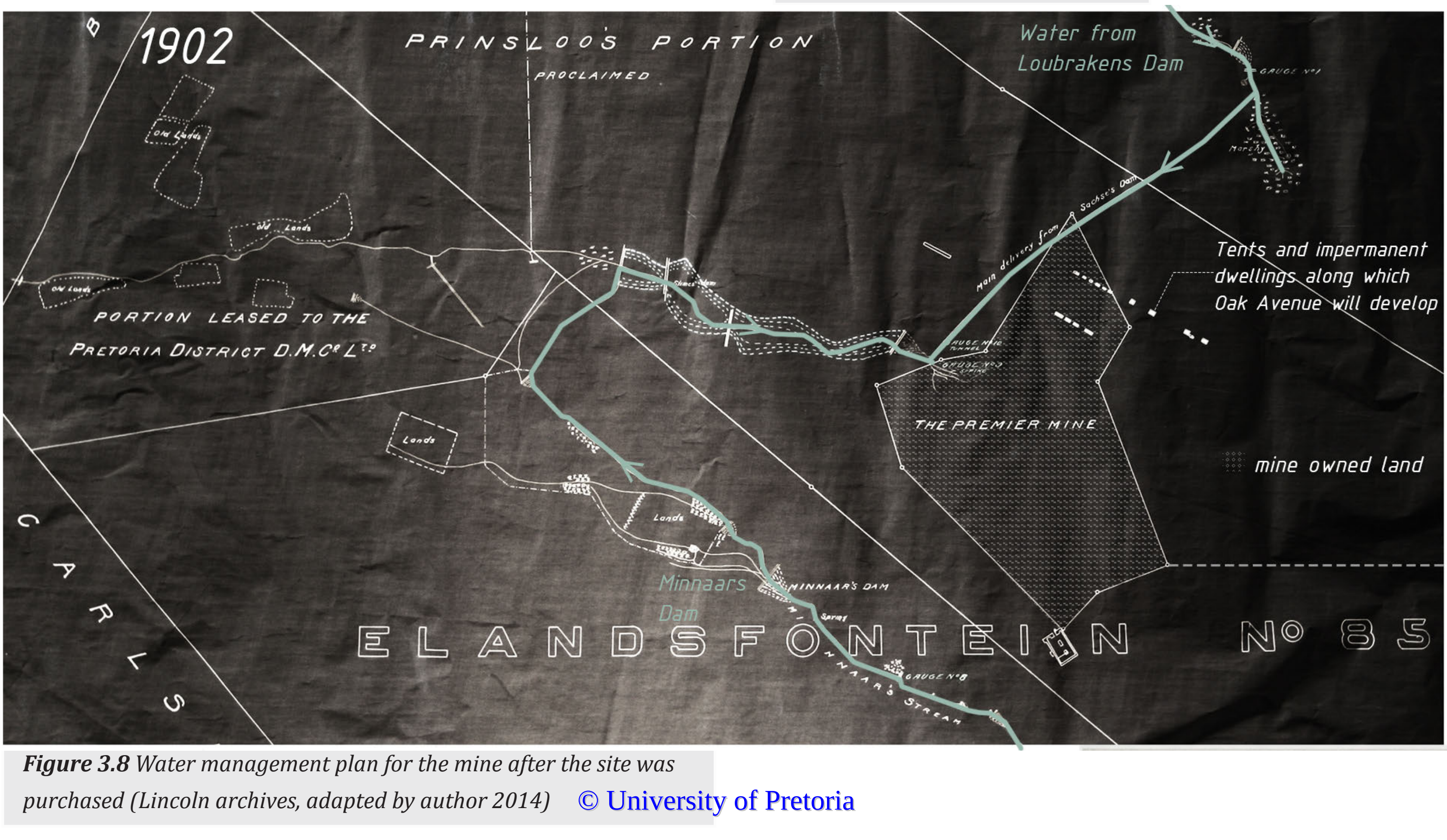
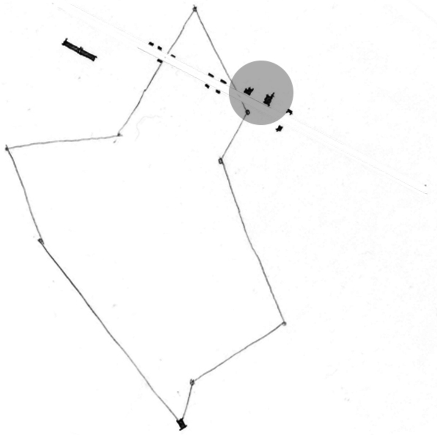


Figure 3.8 *Water management plan for the mine after the site was purchased (Lincoln archives, adapted by author 2014)*

1



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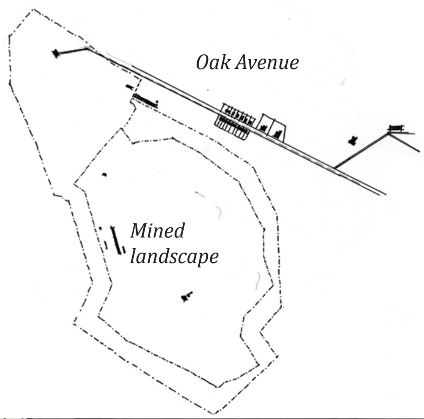


Figure 3.9

The development of the town and Oak Avenue (Author, 2014)

1 The early mine boundary and first buildings along Oak Avenue.

2 Fences were introduced around the open pit in 1904, Oak Avenue developed as a connection to the mine and axis of the village.

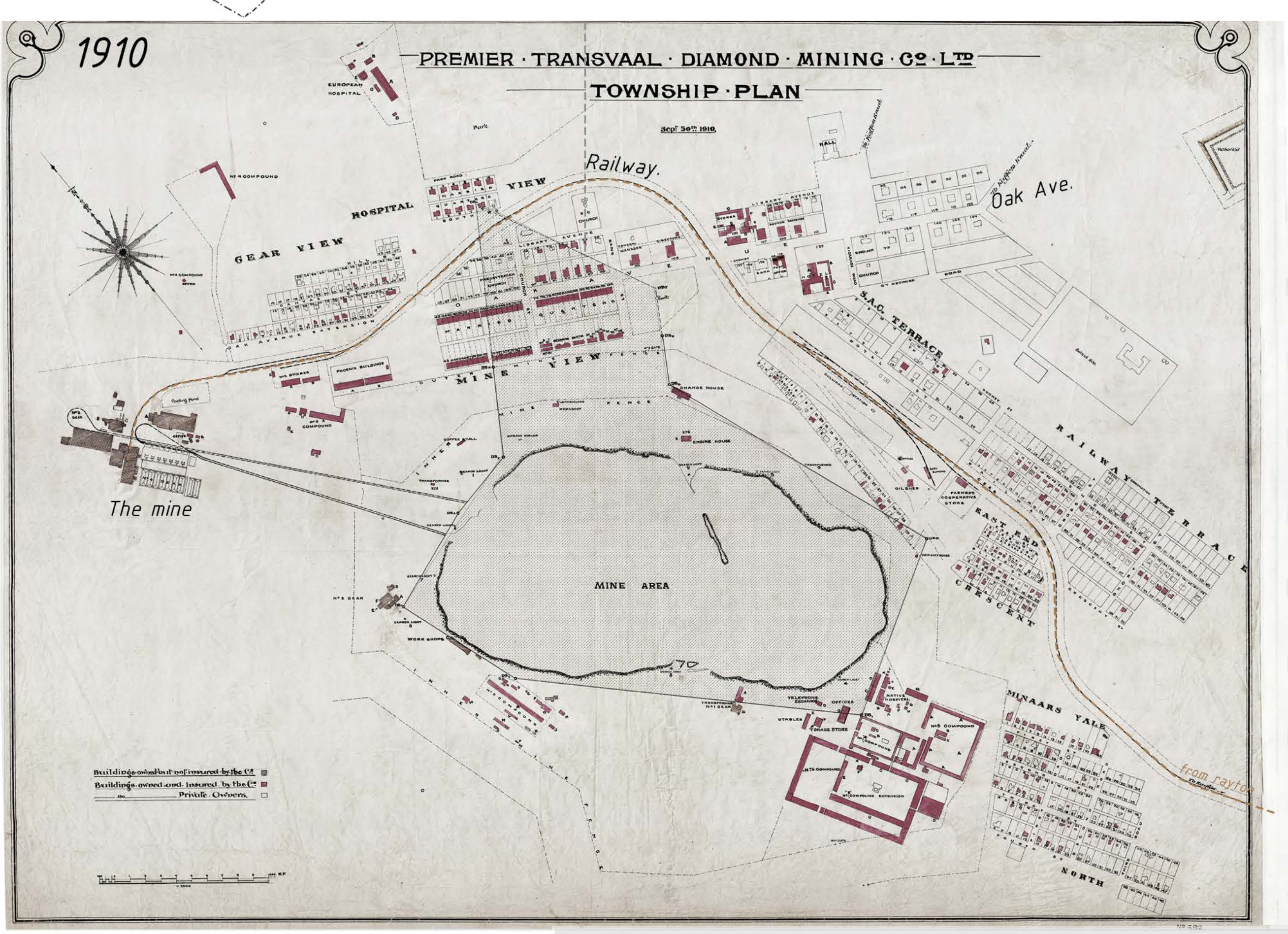


Figure 3.10 *A survey of the village conducted in 1910 (Lincoln archive)*

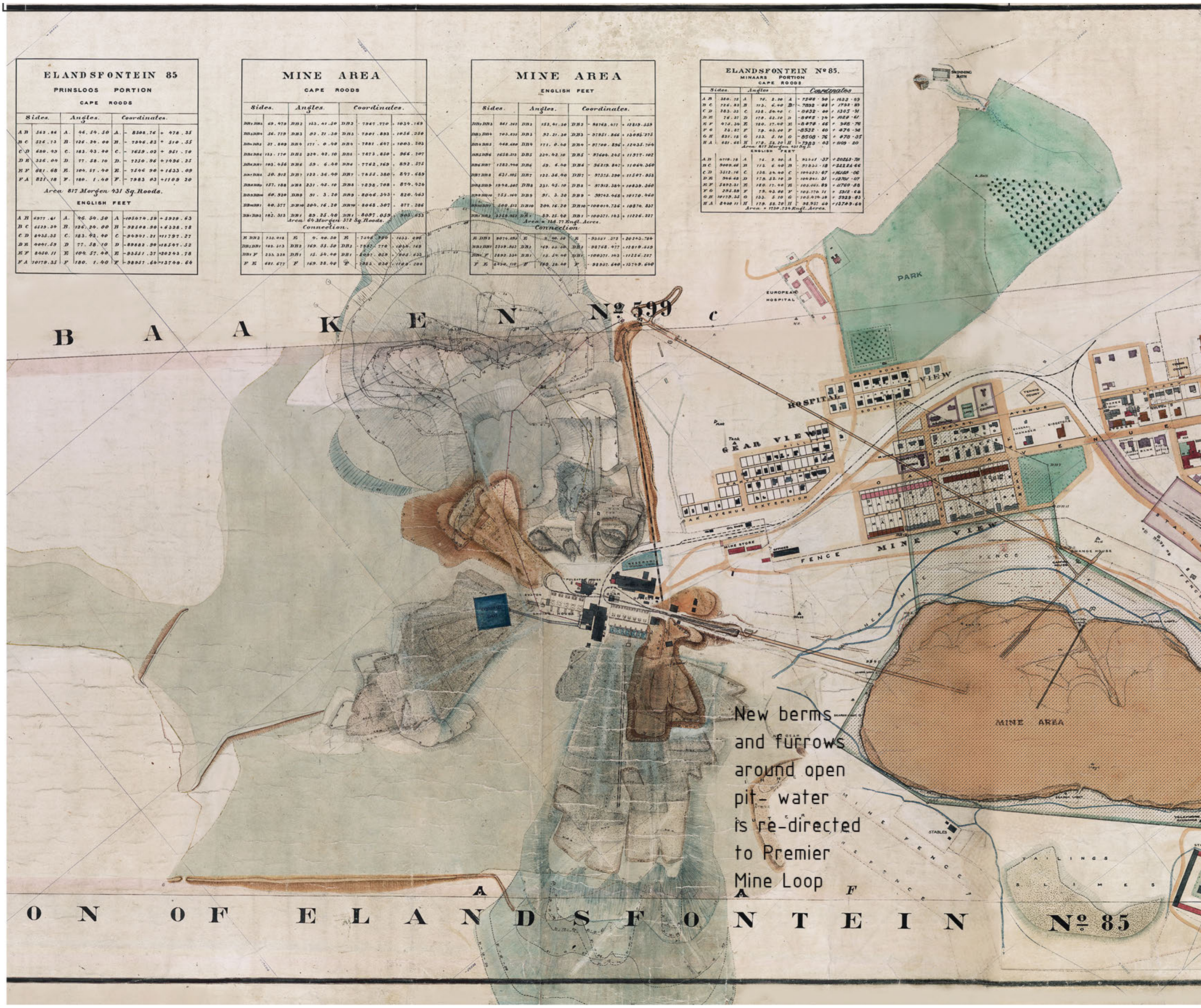
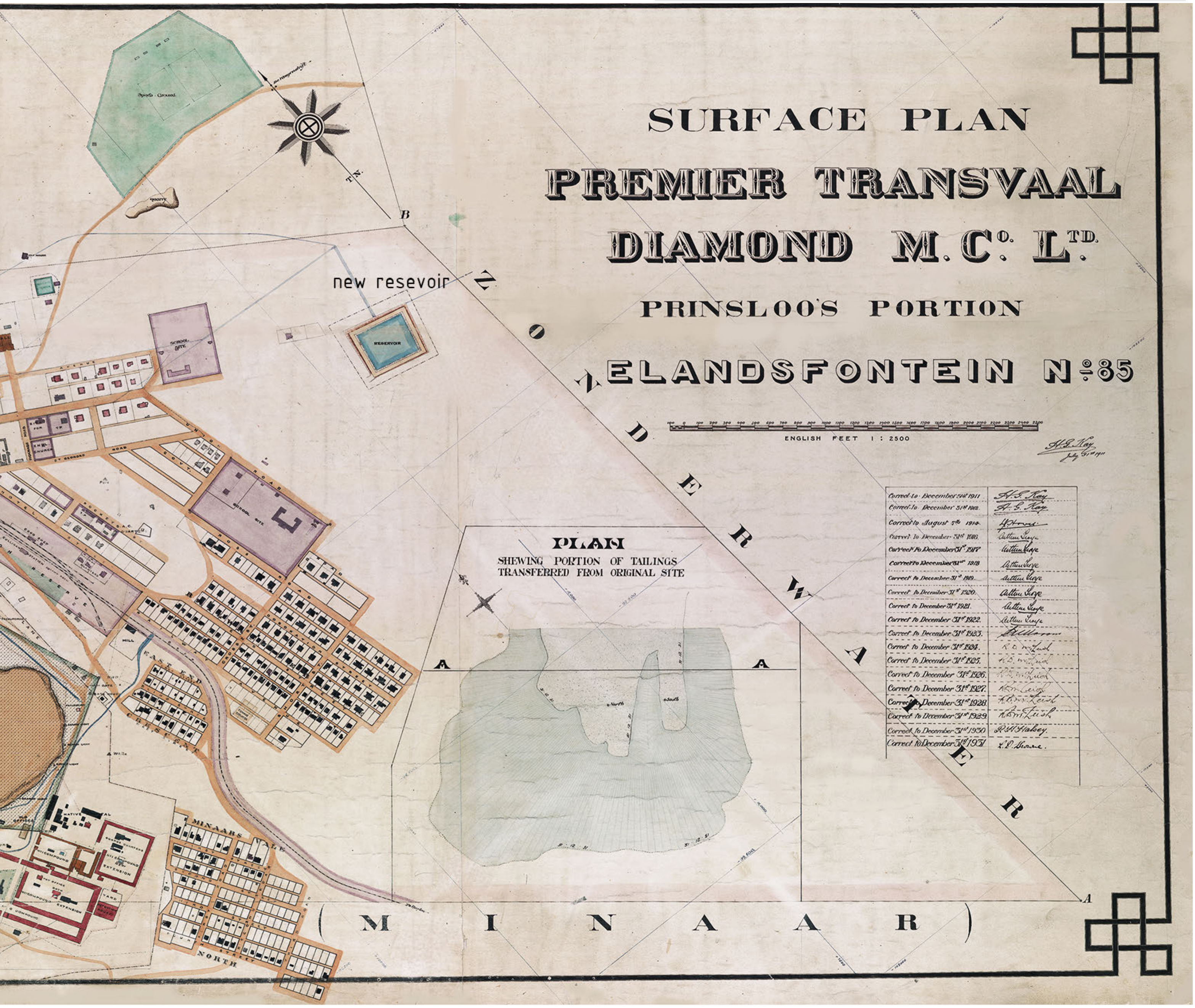

ELANDSFONTEIN 85
PRINSLOOS PORTION
MINE AREA
CAPE ROODS
MINE AREA
ENGLISH FEET
ELANDSFONTEIN Nº 85.
MINAARS PORTION
B A A K E N Nº 599
PARK
EUROPEAN HOSPITAL
HOSPITAL
GEAR VIEW
MINE VIEW
FENCE
MINE AREA
STABLES
New berms
and furrows
around open
pit- water
is re-directed
to Premier
Mine Loop
ON OF ELANDSFONTEIN Nº 85

Figure 3.11

Mine surface plan indicating extension of the town, and the mine water strategy completed in 1931 (Lincoln archive)



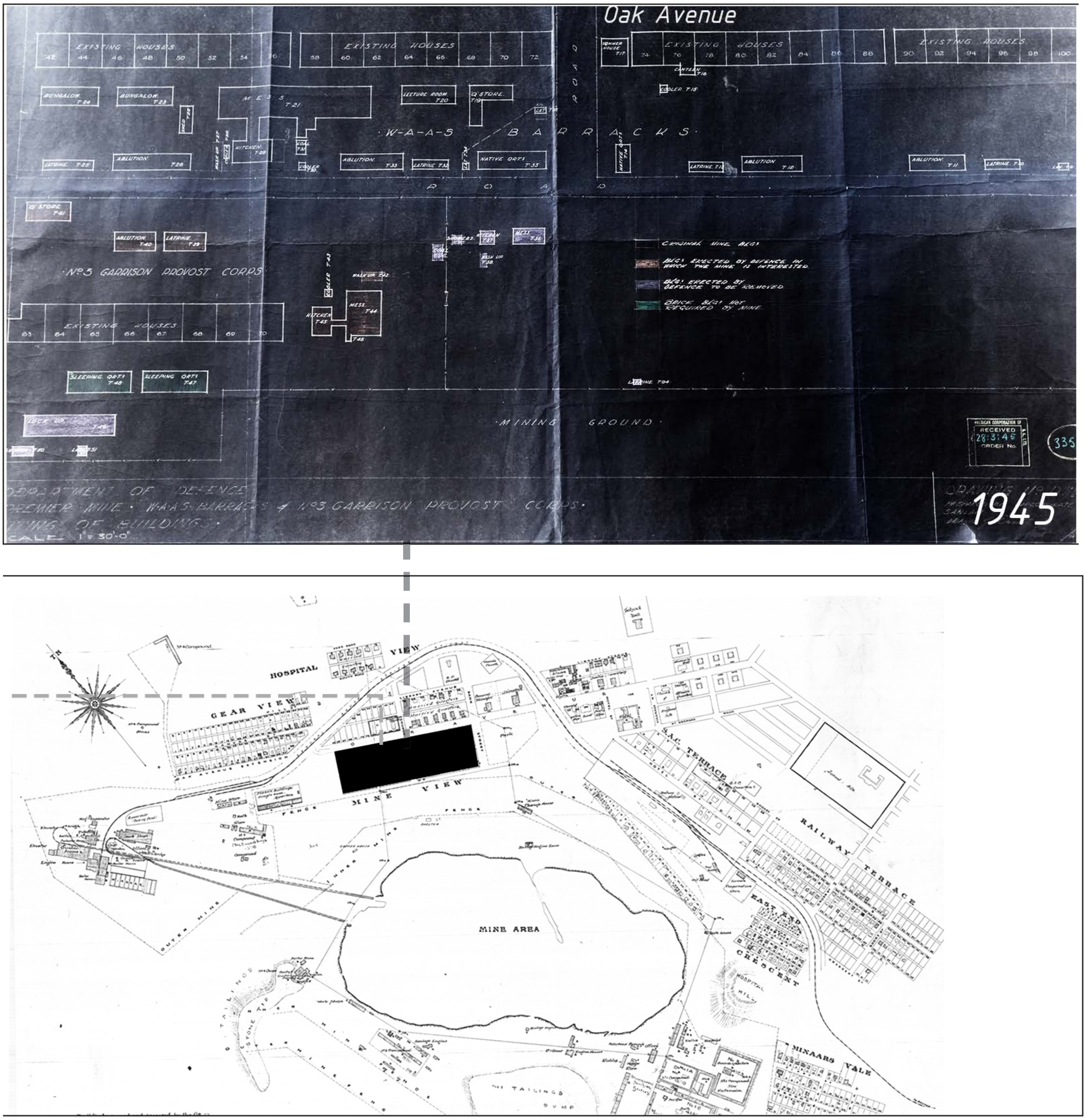
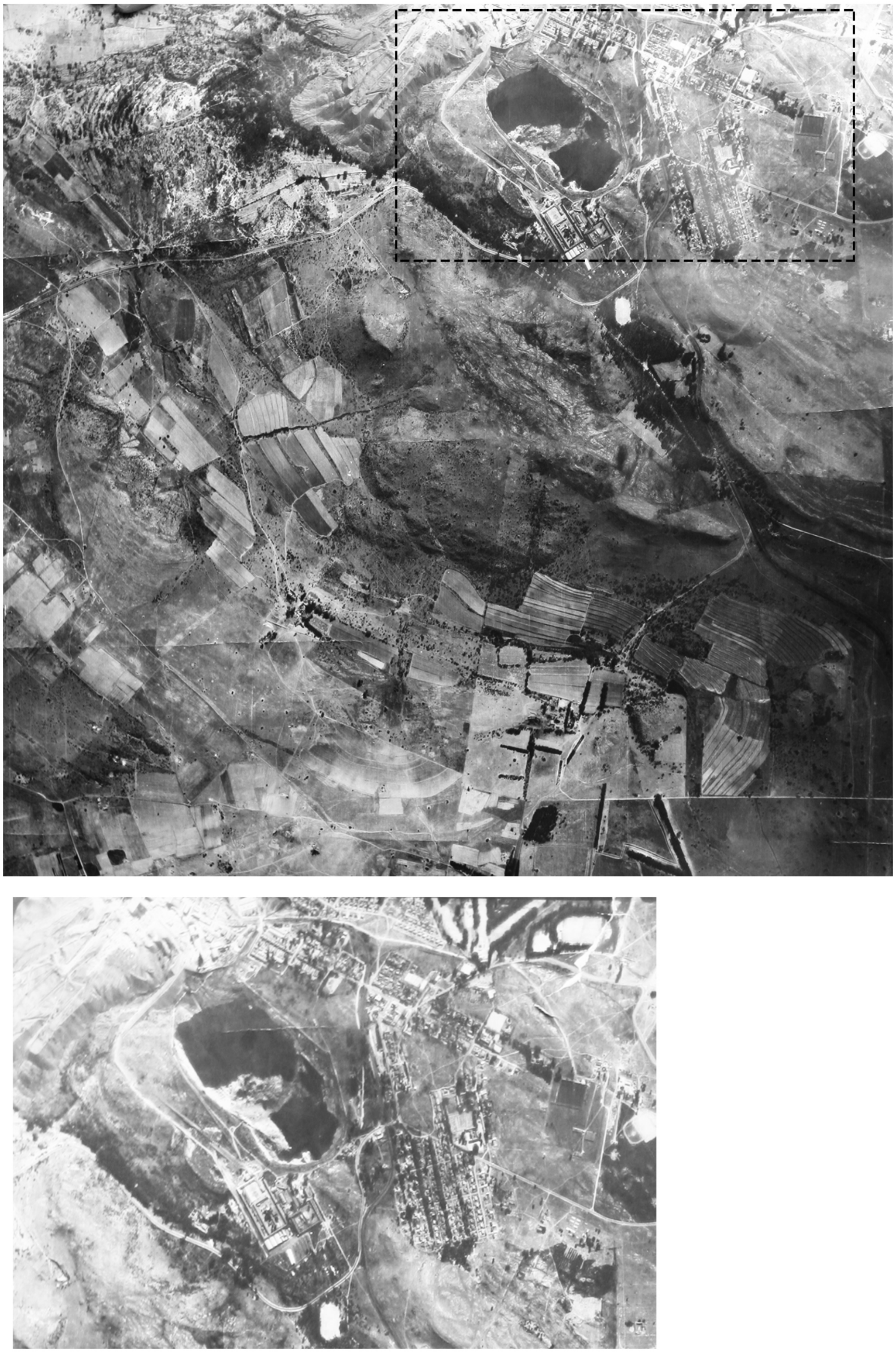


Figure 3.12

The. Department of Defence's design for Oak Avenue barracks and garrison used by the women of the Defence Force. The plan indicates how the village transformed during World War II and the mine's plans for buildings after the war (Lincoln archives adapted by author, 2014)



1962

Figure 3.13

Aerial photograph taken in 1962 indicating Cullinan's location within the larger farming network (Lincoln archive)

Figure 3.14

A survey of the village completed in 1973 (Lincoln archive)

3.4 STATEMENT OF HERITAGE SIGNIFICANCE
THE CONTEXT OF CULLINAN

Cullinan exhibits a multiplicity of associated values. These include social, industrial, natural, cultural, historical, aesthetic and architectural values. The town, mine and expended landscape represent a unique narrative embedded in place including the story of diamond mining in South Africa and the event of the discovery of the world's largest diamond. The town also reflects on the unique narratives of the villagers who lived in Cullinan and worked for the mine, as well as South Africa's role in the World Wars. A dependent relationship between man and the environment is embedded in its fabric.

The Burra Charter (1999:1) states that places of cultural significance enrich people's lives and often provide a deep sense of connection to community and landscape, and past and lived experiences. The mine, town and landscape are social, cultural and economic assets (UNESCO, 2012:5) and Cullinan's value and meaning should be exposed to society, and the sense of place retained after future mine closure. The heritage of the town has potential to serve as a tourism resource, ensuring Cullinan's sustainability.

Instead of uncontrolled development that may negatively impact the character of the town (UNESCO, 2012:5), the unique narrative linked to the town fabric, natural context and mine, as well as the heritage resources of significant value, need to be respected, preserved and expressed. The historic urban landscape needs to retain the characteristics and values linked to its history and collective memory (UNESCO, 2012:7). Therefore, urban fabric is to be respected in future possible development within the Cullinan Group's proposed urban strategy, responding to the unique and existing patterns. Sustainable development within the context will ensure the preservation of these existing resources (UNESCO, 2012: 5).

3.5 PRESENT-DAY CULLINAN

Cullinan can be approached from either the R515, which is linked to the N4 Pretoria/Witbank highway, or from the R513. A railway connects Cullinan to Pretoria and is used by tourists (Venter, 2012:35). Major routes to and from Cullinan are indicated in Figure 3.18. The town has a population of approximately 4 000 people (Venter, 2012: 248).

3.5.1 The mine

Petra Mining took over from De Beers in 2008 and continues to practise industrial processing for the mining of diamonds.

3.5.2 Tourism and heritage

Cullinan is becoming increasingly popular with tourists who tour the mine and the historical town. The town has consequently developed to support the growing tourist industry, especially along Oak Avenue, and is the second largest source of income in the town, after the mine (Lincoln, 2011:124). Cullinan also forms part of the Dinokeng Geo-spatial Tourism Development Project of the Gauteng Provincial Government (Dinokeng, 2002:9), which aims to establish a tourist destination in Gauteng close to urban centers. Cullinan represents one of the strongest tourism nodes in the Dinokeng area and the region as a whole (Dinokeng, 2002:9).

The opencast pit is the visible physical impact of the mine on the landscape and is considered to be a major tourist attraction with approximately 30 000 tourists visiting Cullinan annually (Venter, 2012:191).

Figure 3.15 *The steam train used by tourists (Lincoln, 2011)*

Figure 3.16 *Oak Avenue's restaurants and shops (Author, 2014)*

Figure 3.17 *Mine and historic town tours (Lincoln, 2011)*

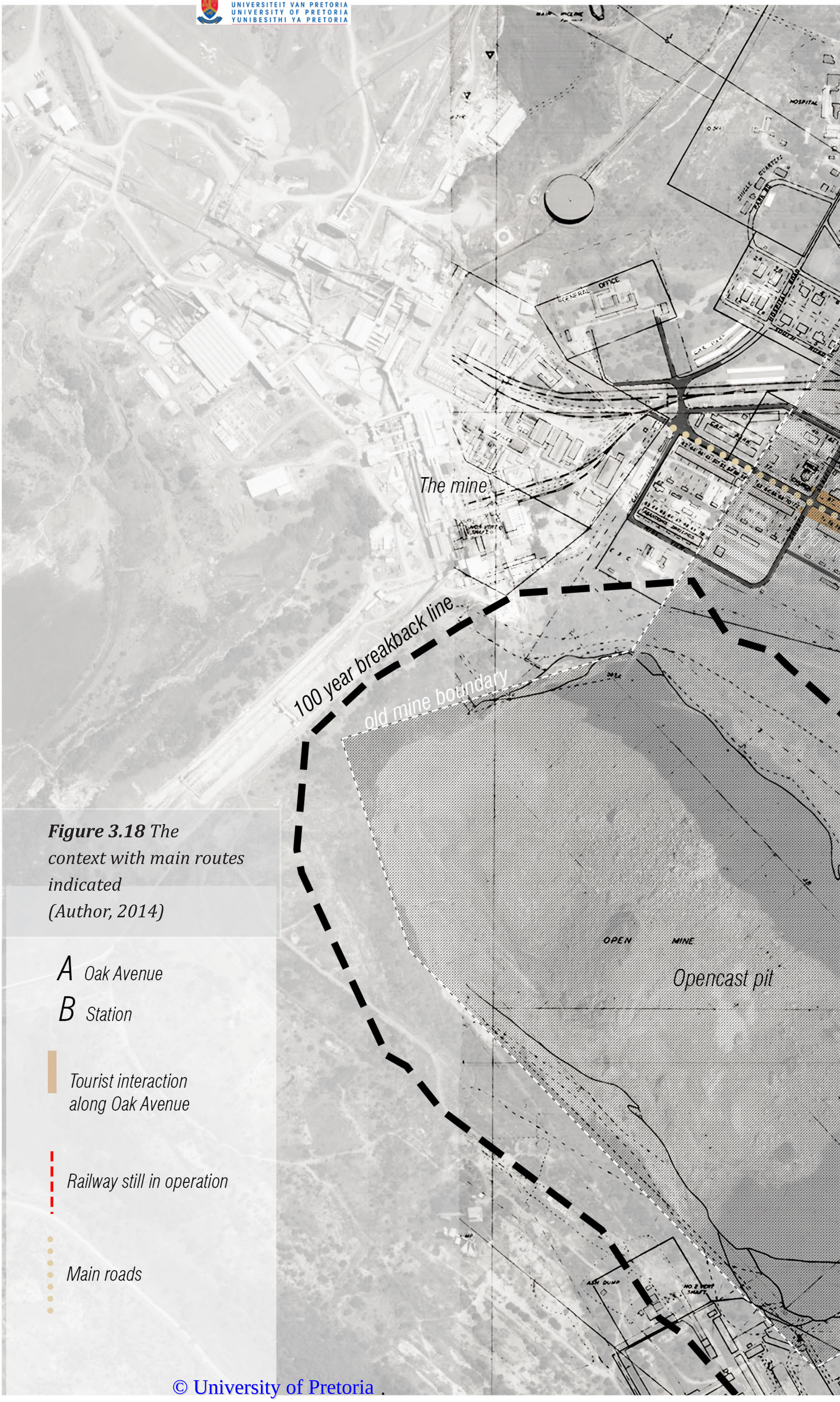


Figure 3.18 *The context with main routes indicated (Author, 2014)*


Q
GOLF COURSE
CAMP ROAD
GOLF CLUBHOUSE
A
Oak avenue park
TENNIS COURTS
GENERAL MANAGERS RESIDENCE
LOUWSBAKEN NO
ELANDSFONTEIN NO
F
HOTEL
G
SCHOOL
B
R515
VENTER MOTORS
The compounds

Figure 3.19 *General contemporary land use in Cullinan (Author, 2014)*

Figure 3.20 *Identified land use (Cullinan Group, 2014)*

c-commercial
e- education
r- residential
m-mine
ar- abandoned ruins
f- farming

The region is identified as a rural area, characterised by nature conservation and mixed agricultural land uses. Heritage and conservation initiatives in the area are boosting the number visitors to Cullinan that either arrive by vehicle or the old steam railway owned by the Friends of the Rail (Figure 3.15). Cullinan is associated with cultural, mining, culinary and ecotourism. Some of the main tourist attractions and activities, according to Dinokeng (2002:10), include: the Victorian town and cultural heritage, surface and underground mine tours, historical town tours, restaurants, craft foods, art galleries, flower markets, shops that sell products from surrounding farms, and tea gardens. Ecotourism is gaining popularity, which also includes bird-watching in the area.

3.5.3 Agriculture:

Thomas Cullinan (1862-1936) purchased the Elandsfontein farm from Willem Prinsloo, a cattle rancher and farmer in 1903 (Lincoln, 2011:5). It was a rural area scattered with small farms and associated with fruit production. Today, the nearby Willem Prinsloo Agricultural Museum displays some of the historical agricultural practices used on the Elandsfontein farm before mining commenced on the site.

Cullinan currently forms part of a larger agricultural hub. The greater area comprises of small-scale commercial farmers, with the primary land use being intensive agriculture (Venter, 2012:24), and is considered to be one of the key economic sectors. Today, the land that is not owned by the mine is being used by farmers for livestock grazing and crop cultivation. In the future context of a decommissioned mine, reverting to this as a source of income serves as a viable option.

1903

1911

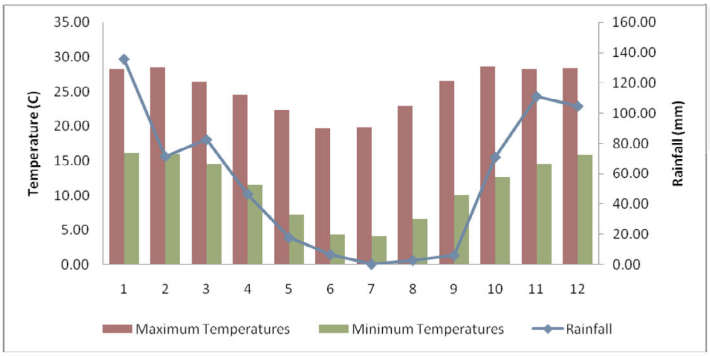


Figure 3.21

Regional temperature and rainfall (Venter, 2012)

3.5.4 Conservation

The Premier Game Park was introduced by the mine as part of their rehabilitation strategy. The Windybrow Game Park, Buffelsdrift Conservancy and Cullinan Park Conservancy are also located in close proximity to Cullinan (see figure 3.20).

35.5 Topography

The influence and dominance of man and the machine over nature is made evident in the disfigured and unstable topography. Both opencast and underground mining methods have impacted on the physiognomy of the landscape (see figures 3.22). The open pit spans an area of 42ha and is approximately 400 m deep. Mining is continuing today at more than 750 m below ground (Venter 2012:309).

Ongoing mining continues to affect the stability of the hole, increasing the break-back zone. The instability of the opencast pit rim poses a possibility of subsidence and is taken into consideration by the mine who foresee a 1 m/year fall in (figure 3.18 indicates the 100 year break-back line).

3.5.6 Regional climate

Cullinan is located within the Highveld climatic region, with warm to hot summers and moderate winters and rainfall occurring mostly in the form of thunderstorms, not unlike Pretoria's climatic condition. Temperature and rainfall distribution indicate that the most likely period for vegetation growth would be in the months of October to March (Venter 2012:43). Architectural implications of the climatic condition are discussed in chapter 7.

3.5.7 Geology

Cullinan is situated on the eastern foothills of the Magaliesberg range and has a rich geological history. Kimberlite is the underground ore deposit within an extinct volcanic pipe, the largest mined in South Africa, and is situated within the 3 billion -year-old Kaap-Vaal Craton. The underlying geology in the area adjacent to the Kimberlite pipe consists predominantly of quartzite of the Pretoria Group, Transvaal Sequence and Felsite (Venter, 2012:51).

1930 1950

Figure 3.22

The growing open pit represents man and machine's impact on the natural context (Lincoln archive, compiled by author)

The Felsite rock surrounding the pipe on the surface extends to a depth of 400 m (Venter, 2012:41).

3.5.8 Biodiversity

The mining exploits of man and the machine have impacted negatively on the living systems and ecosystems in the area. Some of the impacts include the loss of vegetation and habitat, hydrological impacts, increased soil erosion, and the introduction of invader plant species.

The ecosystem in which the Cullinan mine operates is between the savannah and grassland biomes (Venter 2012:58). The area also falls within three vegetation units, namely: Marikana Thornveld, Central Sandy Bushveld and Rand Highveld Grassland. The Marikana Thornveld and Rand Highveld Grassland are endangered vegetation types and have been impacted on by mining operations. A large majority of the indigenous plant species have been affected by the mine which has caused barren surfaces, alien to endemic biota. Patches of land without vegetation cover are vulnerable to wind and surface water erosion. Any physical disturbance to the soil gives rise to favourable conditions for the invasive plant species (Venter, 2012:193).

The area surrounding the opencast pit is in a state of degradation, but there are signs of indigenous plants re-establishing themselves (Venter, 2012:60). Ongoing mining has also influenced local biodiversity in the form of birds and insects in the region (Venter, 2012:21).

3.5.9 Water

Cullinan is located in the upper region of two sub-catchments; the Premier Mine Loop and the McHardyspruit. These water bodies form part of the upper Pienaars River catchment area. The McHardyspruit joins the Premier Mine Loop to form the Premierspruit. McHardy Stream and Premier Mine Loop consequently form part of the upper Pienaars River catchment area.

Stormwater run-off from the town is harvested by the mine and water is also diverted from the opencast pit though berms and stormwater channels. Both of these sources are then redirected to the Premier Mine Loop for use in the industrial processes. Waste water is redirected to the silt dam while the opencast pit is also dewatered regularly.

1955

1960

1966

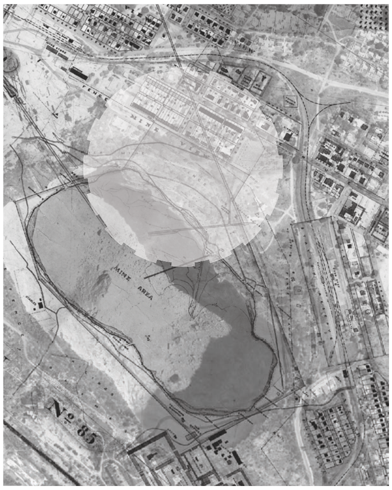
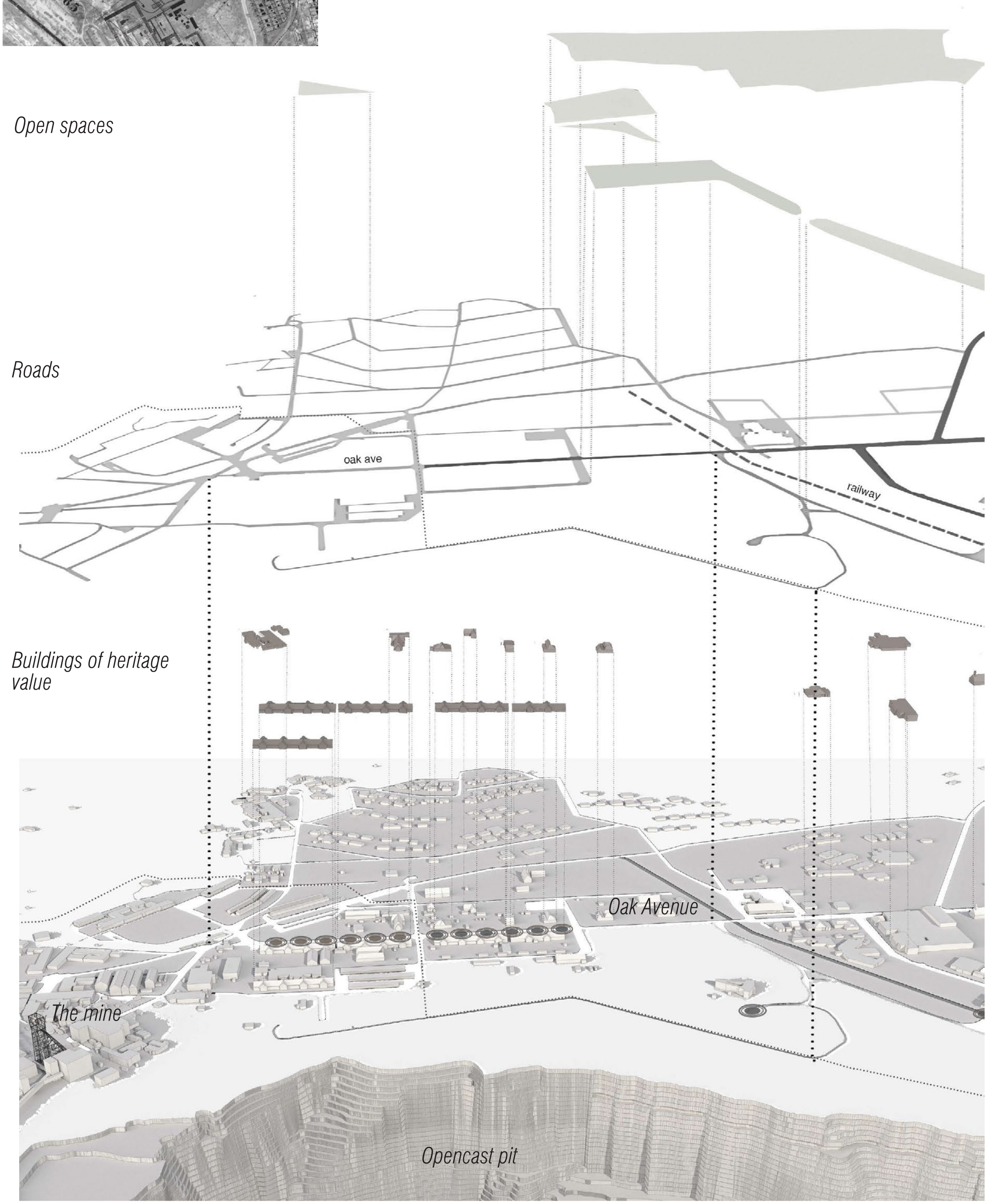
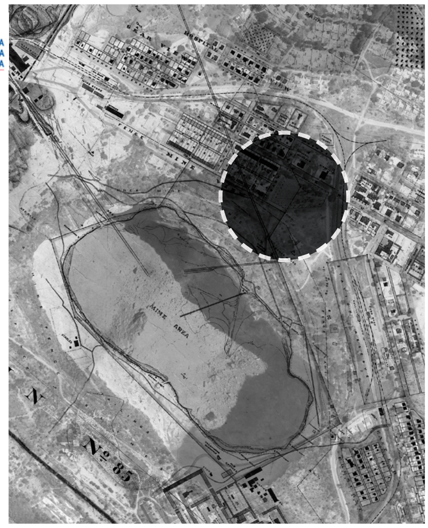


__Figure 3.23__ Important heritage fabric along Oak Avenue (Cullinan Group, 2014)




6
5
4
OPEN MINE
Opencast pit
19
18

Figure 3.24 *Important heritage fabric within Cullinan, and tourist interaction (Author, 2014)*



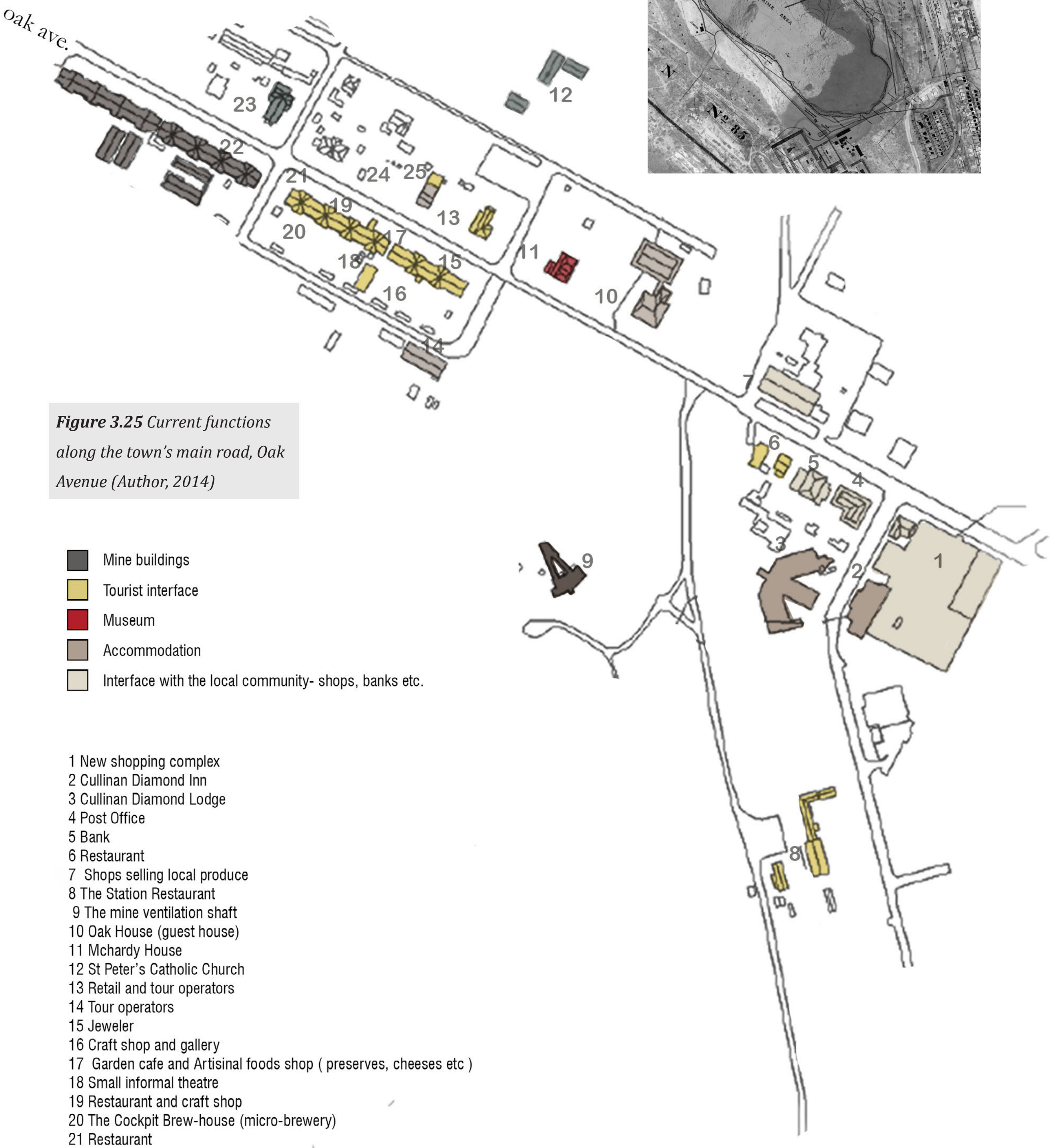


Figure 3.25 *Current functions along the town's main road, Oak Avenue (Author, 2014)*

- Mine buildings
- Tourist interface
- Museum
- Accommodation
- Interface with the local community- shops, banks etc.

1 New shopping complex
2 Cullinan Diamond Inn
3 Cullinan Diamond Lodge
4 Post Office
5 Bank
6 Restaurant
7 Shops selling local produce
8 The Station Restaurant
9 The mine ventilation shaft
10 Oak House (guest house)
11 Mchardy House
12 St Peter's Catholic Church
13 Retail and tour operators
14 Tour operators
15 Jeweler
16 Craft shop and gallery
17 Garden cafe and Artisinal foods shop (preserves, cheeses etc)
18 Small informal theatre
19 Restaurant and craft shop
20 The Cockpit Brew-house (micro-brewery)
21 Restaurant
22 Mine
23 Presbyterian church
24 Playground and machine museum
25 Tea garden and tour operators

3.6 EXISTING PROPOSALS FOR CULLINAN AND SURROUNDS

Some of the previous proposals made for Cullinan and the region will be outlined so as to identify key issues and important objectives in the urban framework that can be addressed by the Cullinan Group[1].

The Tshwane 2055 vision (2013)

The vision recognises Cullinan as an important tourist node with retail, residential and light industrial development. Lekwane (2013:50) states that a plan is being established to develop a sustainable agricultural village between Cullinan and Rayton to support residents from these towns, expanding on existing regional agricultural potential.

Dinokeng Integrated Tourism Development Framework (DITDF, 2008)

The DITDF (2008) acknowledges that transformation of the rural and historic nature of the town risks damaging the sense of place that is associated with the mine and its related tourism functions. The town has intrinsic tourism value, but requires further development of its tourist resources, especially in terms of accommodation and information access. Cultural and natural resources must be conserved and utilised sustainably for the development of the Dinokeng area. Tourism-focused development, associated with diamond mining, Victorian history and rural living, is therefore a priority for Cullinan.

Some of the suggested facilities include:

1. Tourist routes within the town
2. Picnic areas with a bandstand
3. Accommodation for theatre and music events
4. Using the park area for outdoor exhibitions

Petra Diamond Mine's Closure Strategy (2012)

The mine will remove all unnecessary structures and cognisance will be taken of structures required for tourism or of historical value (Venter, 2012:340). Post mine-closure, the majority of the area will become part of the Premier Game Park and all adjoining land will be included as additions to it. The impact on the landscape will be permanent and the opencast pit will remain as a historical and tourist attraction (Venter, 2012:370). The pit will be allowed to fill up with water. During the decommissioning phase it is also suggested that invasive vegetation be removed, allowing for the regrowth of natural vegetation (Venter, 2012: 327).

1 The Cullinan Group includes MProf (Arch) students: Paige du Toit, Nikita Edwards, Natasha Laurent, Marcel Mattheus, Walter Raubenheimer and MProf (LArch) student: Hugo van Niekerk.

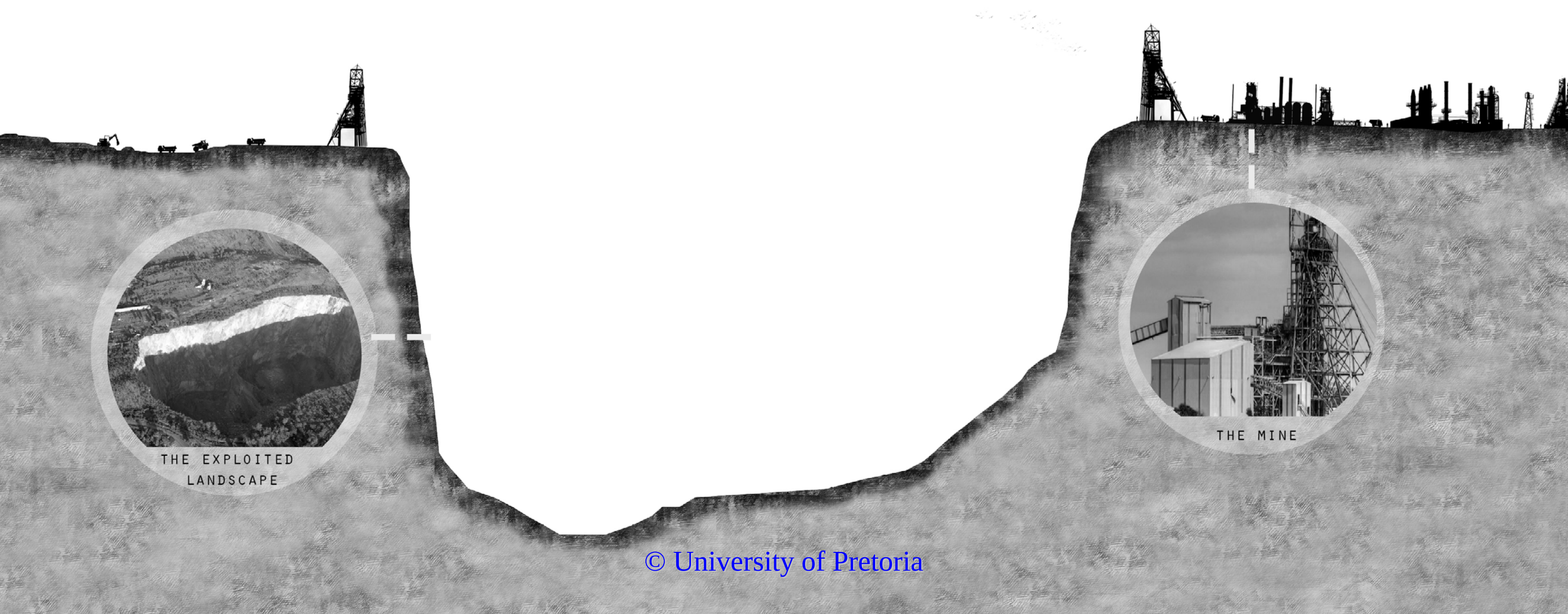
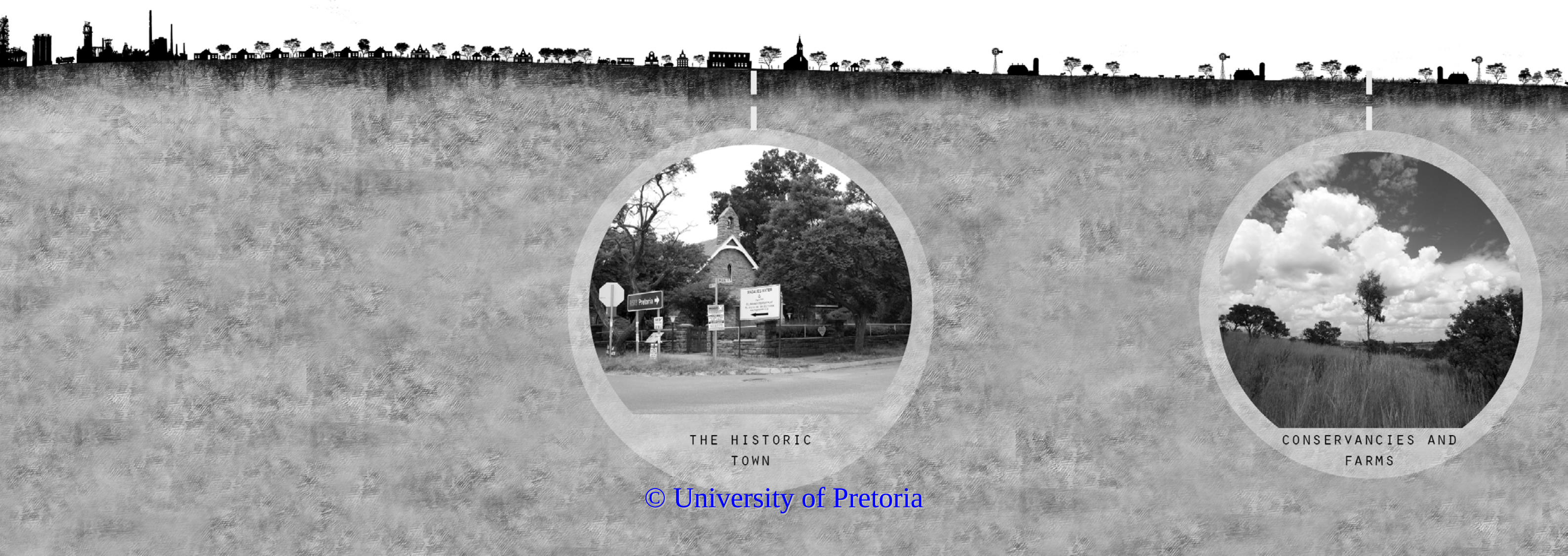

THE EXPLOITED
LANDSCAPE
THE MINE

Figure 3.26

A section through the scar in the landscape, mine and town today indicating the relative scale of man and machine's impact on the context

(Cullinan Group, 2014)



3.7 CULLINAN GROUP INTENTIONS

The Cullinan Group operates within the future context of post-operational mine closure in Cullinan and intends to establish *'A Guide to Subverting the Machine'* within this future context, investigating an appropriate response to this foreseen condition. The group intentions include:

- Introducing new resilient means of generating income in order to sustain Cullinan and its associated values. Cullinan's potentials as an important tourist node and agricultural hub are acknowledged and should be incorporated within the proposed framework. The intention is to reintroduce craftsmanship in response to the impacts of the industrial and the mechanised context, transferring skills and knowledge and uplifting the local community, ensuring future economic development.

- Remediating the scarred context. The mine has impacted negatively on the larger ecological system and remediation as a strategy should be incorporated in the vision.

- Establishing a connection between tangible and intangible attributes. The extant discord in Cullinan between the mine, town fabric and mined landscape is recognised and is to be addressed in the framework proposal.

Figure 3.27

A summary of the Cullinan Group's intentions (Cullinan Group, 2014)


orchards
orchards
STUDY AREA: MINE
Walter Raubenheimer
Marcel Mattheus
vetiver /
grain crops
parks
STUDY AREA: CULLINAN TOWN
& VENT SHAFT
Nikita Edwards
natural
landscape
orchards
productive
vegetation
Hemp production
Hemp production
STUDY AREA: COMPOUND
Paige du Toit
Natasha Laurent
Hugo van Niekerk (Landscape Architecture)

3.8 CULLINAN GROUP FRAMEWORK

RE-ENVISIONING THE MACRO-CONTEXT

AGRICULTURE 1	> Cullinan should become the core of the larger regional agricultural hub and a new agricultural strip should be introduced around the big hole to support new local micro-industries related to agriculture
TOURISM and HERITAGE 2	> The vision will expose the heritage value of Cullinan to society and use it as a source of revenue and support for the community > Tourists will become a market for produced commodities > The large open pit should be retained as is after mine closure as it is an important part of Cullinan's narrative and also a major tourist attraction. The impact of the instability of the hole is recognized. A new 'agricultural route' for tourists is established around the hole marking the 100 year breakline of the hole. Existing mine pumps used to currently dewater the hole will be used to remove water from the hole, when necessary, to support surrounding agriculture
LIGHT INDUSTRY 3	> Support those who have been trained in the community > Generate new income and resources in a resilient manner > In Cullinan, there potential to reuse old industrial buildings for new forms of production
ECOLOGICAL 4	> The scarred landscape consisting of mine dumps in the form of kimberlite trailing's and the slime dam needs to be rehabilitated in order to prevent its negative effect on the ecology and industries (such as tourism and agriculture). > The plant species used for rehabilitation and remediation must not be invasive and must be able to establish a new habitat for endemic species and endangered species like the Rand Highveld Grassland vegetation type.
EDUCATION 5	> Support and educate the unemployed community and Refilwe > Resilience is created through complexity of activities THE VISION

Figure 3.28

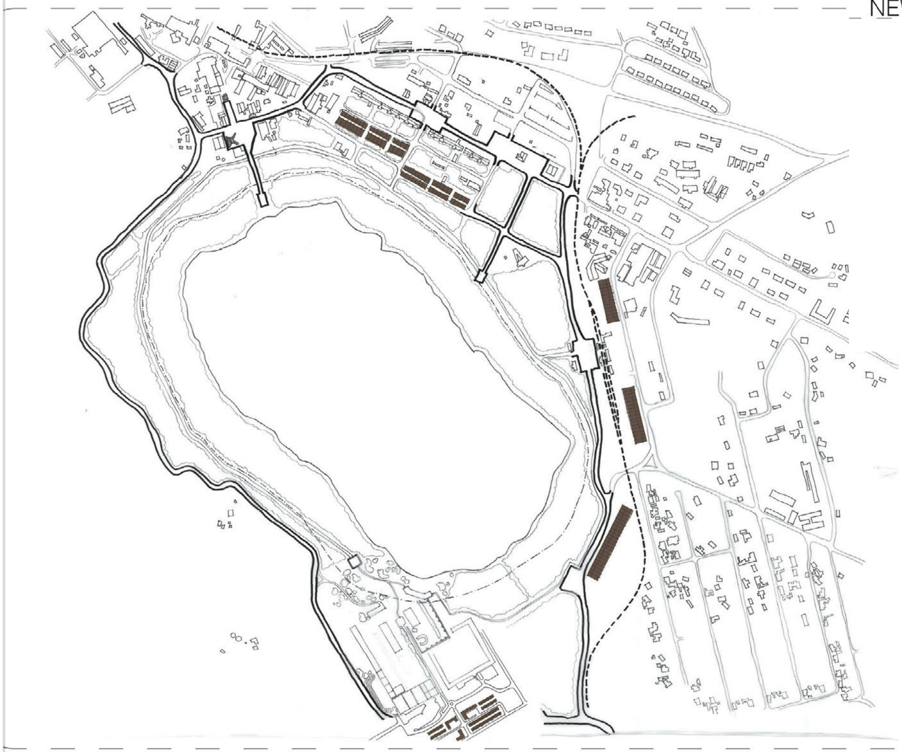
The urban framework and summary of the Cullinan Group's vision (Cullinan Group, 2014)

PRIMARY AND SECONDARY ROUTES

Primary Route
Secondary Route

Description:
The primary route focuses on connecting the decommissioned mine; the existing town and the old mining compounds. The route continues around the excavated hole allowing people to view the scar in the landscape from all angles. Along the primary route new public squares have been designed to define certain areas of the town and to create more of a pedestrian friendly route where shops and restaurants can spill out onto these spaces.
The secondary routes are then allocated closer to the hole. These routes are designed for pedestrians and bicycles. It allow people to meander around the hole to the different interventions and viewing points.

NEW DEVELOPMENT



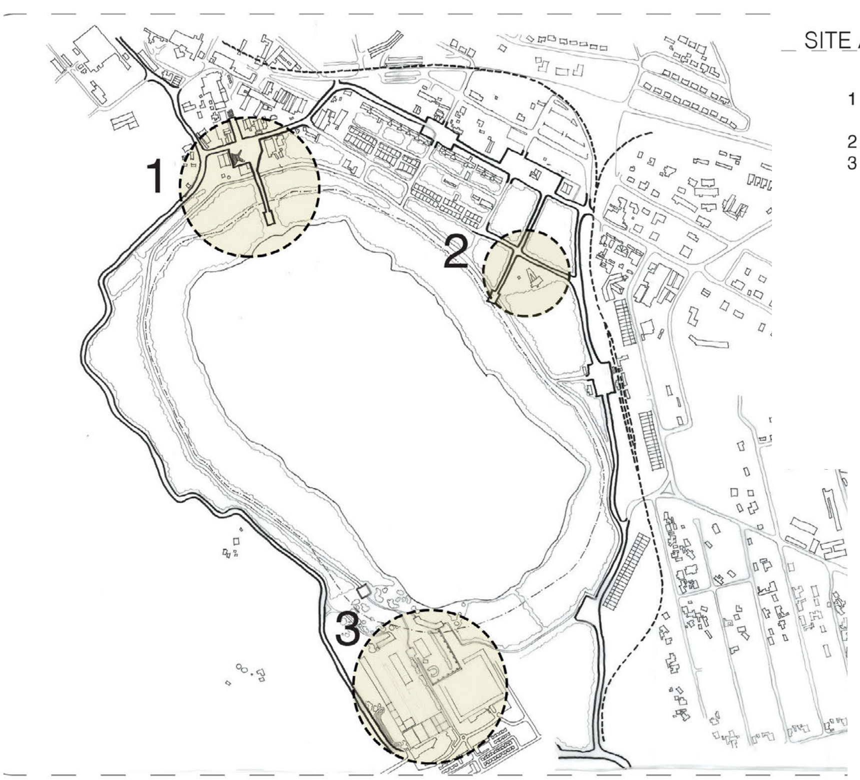
New Development

Description:
The new development throughout the town will mainly contain accommodation and facilities for agricultural based education. This development is again centred around the scar in the landscape.

GREEN SPACES

- Natural Bushveld
- Productive land
- Recreation space

Description:
The existing landscape has been developed into a productive landscape where all the new interventions plug into.
On the eastern side of the hole the natural bushveld has been retained with smaller sections of production closer to the town.
The main belt of productive landscape is allocated on the western side of the hole. This agriculture contains orchards, hemp, and vegetable farming.
Along Oak Avenue (the main street in town) new recreational green spaces have be designed for the new accommodation as well as a space for festivals and events.



SITE ALLOCATIONS

1	MINE:	Walter Raubenheimer
		Marcel Mattheus
2	TOWN:	Nikita Edwards
3	COMPOUND:	Natasha Laurent
		Paige Du Toit
		Hugo van Niekerk (landscape architect)

Figure 3.29
The urban framework and summation of the Cullinan Group's vision (Cullinan Group, 2014)

MAN

Figure 3.30

Figure 3.31

NATURE

Figure 3.32

Figure 3.33

MACHINE

Figure 3.34

Figure 3.35

Figure 3.30
Early image of a family in Cullinan (Lincoln archive)

Figure 3.31
A weekend market in Oak Avenue (Author, 2014)

Figure 3.32 and Figure 3.33
The disfigured landscape and nature re-establishing itself in the context (Author, 2014)

Figure 3.34 and 3.35
The mining machine (Lincoln archive, 1960s)

3.9 CONCLUDING STATEMENT

MAN, NATURE AND MACHINE IN PRESENT-DAY CULLINAN

The traces of man, nature and machine and their interlaced history have shaped Cullinan's contemporary condition.

The remnants of man line the avenues with the aging historical houses, museums, banks and shops once belonging to early mine workers and their families. Today, tourists and visitors animate Cullinan over weekends, reflecting the continuing narrative of man's changing relationship with the context.

Nature (the landscape and associated dependent living systems) has been manipulated by man and machine and its condition has changed over time from an untouched setting to farmlands, and now an exploited and scarred landscape. Nature, although mistreated, still exists as a latent element, lurking beneath the disfigured surface of Cullinan's mined setting and slowly budding and reclaiming parts of its territory. The imminent defunct mine will encourage nature's presence to mature in the future and in synergy with man and machine.

The contemporary devouring mining machine will inevitably vanish, but its memory will retained in its stained, rusted remains and its influence undeniably inscribed in the remaining natural and cultural realms as a testament to Cullinan's palimpsest, history and identity.

CHAPTER 4

SITE

A microcosm of volatile interactions

Chapter 4 will discuss the site as a representation of the relationships that are extant between man, nature and machine in the larger context of Cullinan. The precinct vision for the site will also be discussed as an extension of the theoretical premise.

4.1 SELECTING THE SITE

The area of focus selected represents a microcosm of the relationship between man, nature and machine that currently exists in Cullinan, and includes the manifest traces of these three realms.

The site's locality means that it serves as a very important interface with tourists, acting as a threshold between the town and mined landscape, as well as a threshold into the culinary route in Oak Avenue. The route used by visitors after a trip on the popular steam train, connecting the Cullinan station to Oak Avenue, runs parallel to the site.

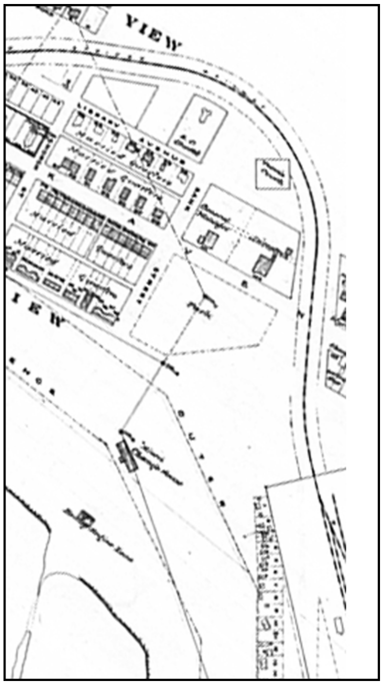
Figure 4.1 *The site location at the core of the historic town (Author, 2014)*

A- Viewpoint
B- The ventilation shaft
C-Oak Avenue Park
D- Oak Avenue
E- Route from the station to Oak Avenue

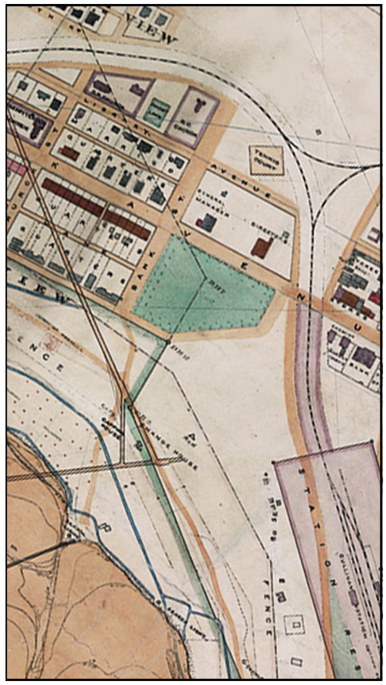
Figure 4.2 *Model of the site (Author, March 2014)*

1910

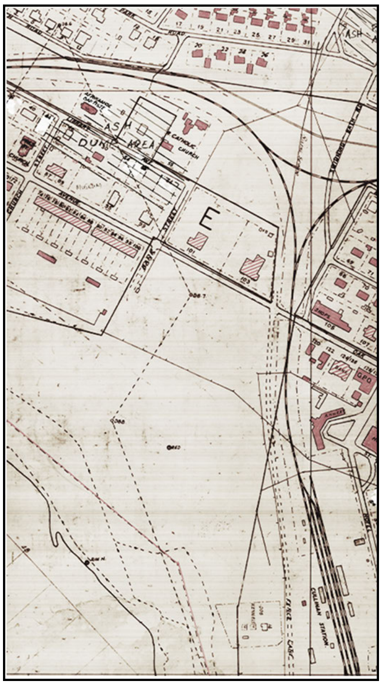
1920



1931



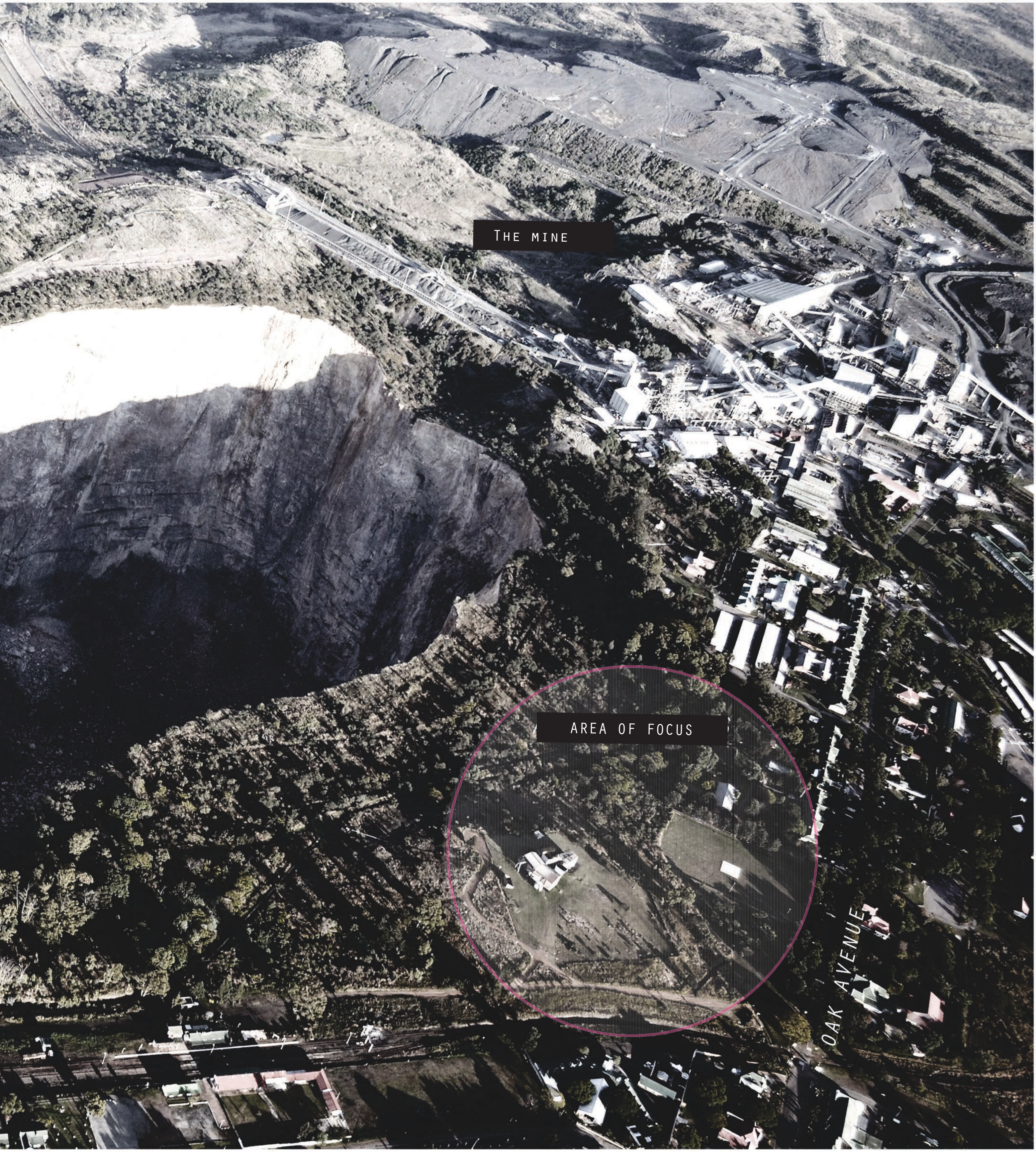
1973



2014

Figure 4 .3 The development of the site and the triad of man, nature and machine within the focus area. *Before 1905, the site existed in an untouched natural condition before the falling under the control of man, tangibly represented by the introduction of Oak Avenue, McHardy and Oak House respectively. Man controlled and manipulated the surrounding context. It remained in this state for approximately eighty years before the machine (mine ventilation shaft) was introduced to the site to support the underground workings . Site topography has been altered to support both the town and the machine (Lincoln archive, compiled by author).*

Figure 4.4 *The site within the larger context*
(Mine archive, adapted by author, 2014)


THE MINE
AREA OF FOCUS
OAK AVENUE


THE CULLINAN HOLE
430M LEVEL

Figure 4.5 *The existing site with underground tunnel network indicated (Mine archive, adapted by author, 2014)*

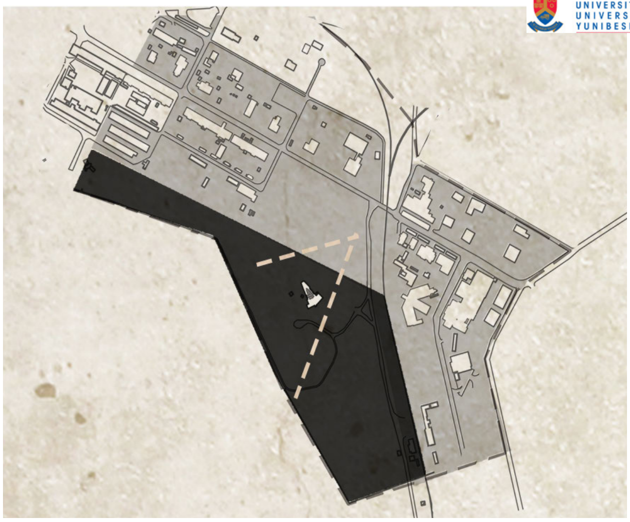


Figure 4.6 *(Author, 2014)*

"Memory attaches itself to sites " (Nora, 1989:23)

The humming machine is a part of a powerful unseen network, but its function is not immediately apparent. Oak Avenue Park contrasts with the machine as a consequence of its silent nature and summons images of possible associated histories and activities once held within in it, and that form a part of the site's untold palimpsest and memory.

"The Machine still linked them.... beneath the roots of the mountains, ran the wires through which they saw and heard the enormous eyes and ears that were their heritage, and the hum of many workings..."

EM Forster, The Machine Stops (1909)

4.2 URBAN ISSUES

4.2.1 Fragmentation and disconnect

The fragmented relationships between man, nature and machine are given expression in the urban fabric. The town is introverted and fails to acknowledge or interact with nature or the machine on the site. The machine (ventilation shaft) is isolated on the site, portraying its dominance, and exists as an alien object within the landscape. There is a clear disconnect between the three realms which is an expression of their contemporary interactions.

4.2.2 A lack of a defined spatial structure

A defined spatial structure that delineates nodes for arrival and orientation is lacking in the urban fabric, and their absence means that visitors fail to interact with the valuable cultural significance associated with the town, mine and landscape. The urban fabric is also physically severed from the town's cultural heritage as a consequence of hard edges that prohibit people from interacting more freely with the significant sites and buildings.

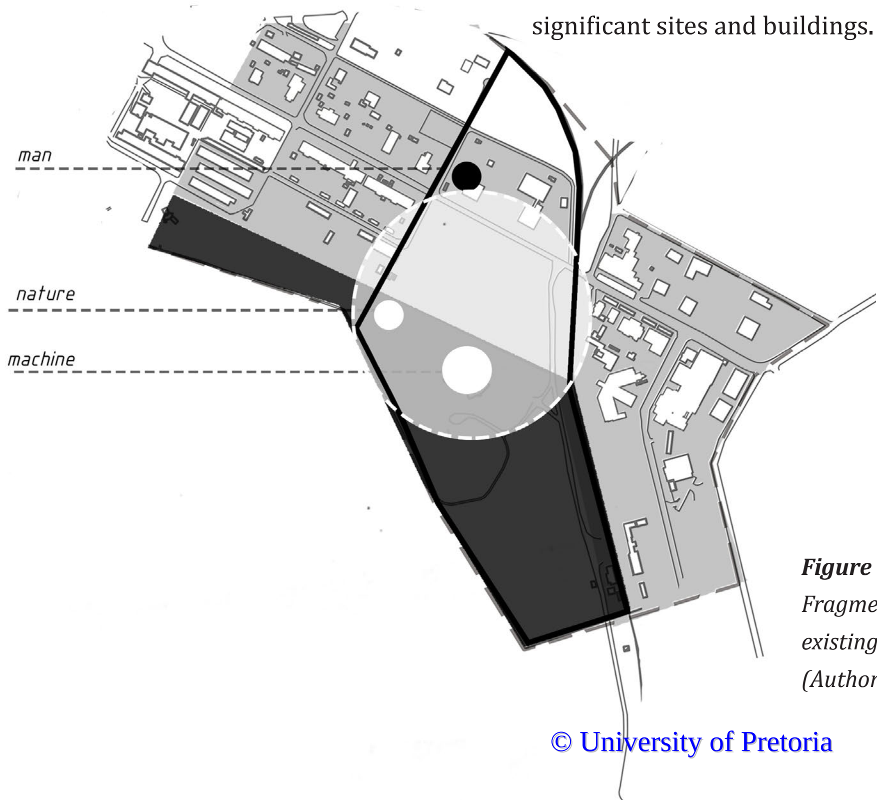
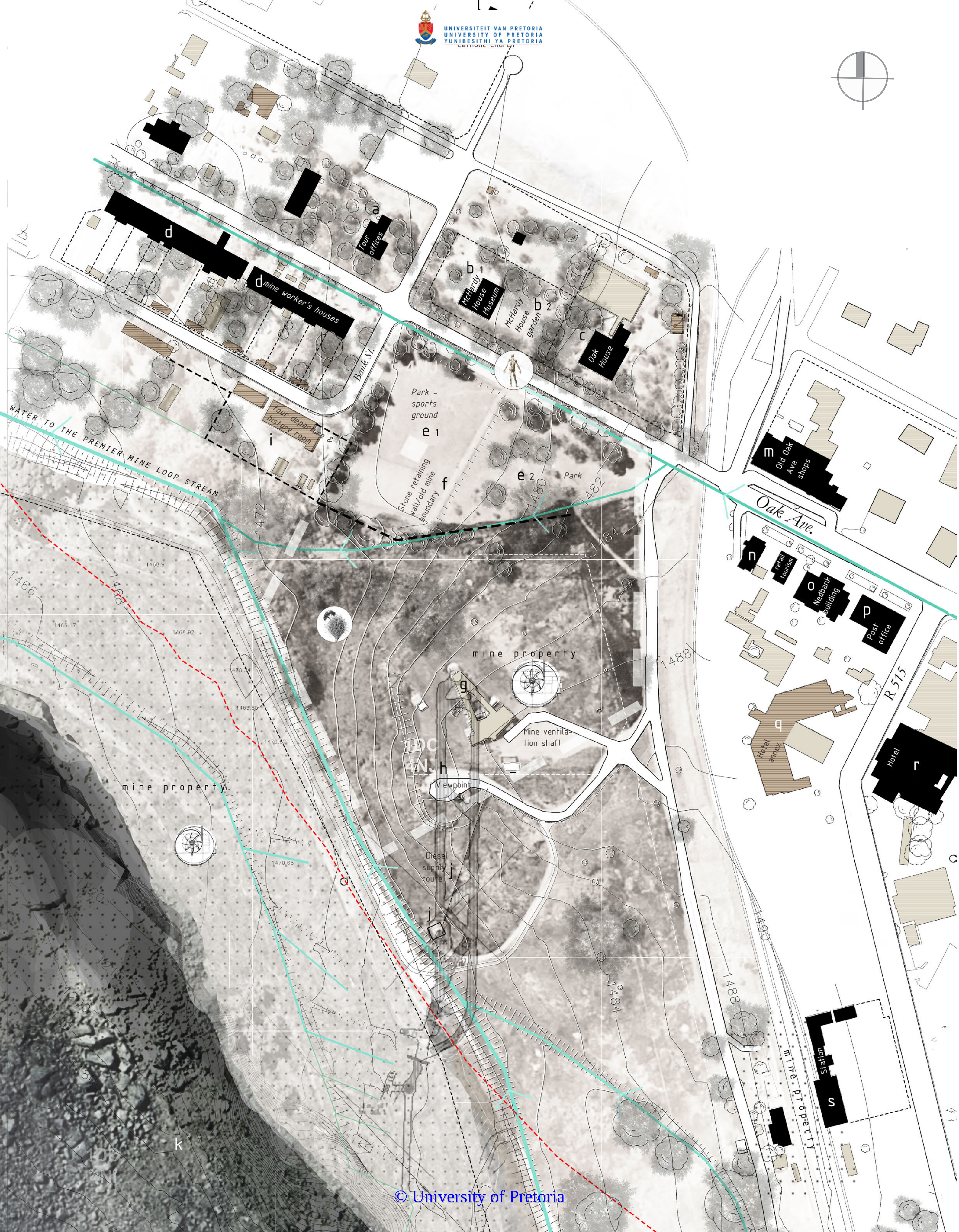


Figure 4.7
Fragmentation of the existing site
(Author, 2014)

4.3 SITE ATTRIBUTES

Layering of the influences of man, nature and machine are represented in the physical fabric of the site. The site's tangible attributes will be discussed in terms of their origins, history, values and their future potentials. The intentions for these physical traces of the past that also reflect on a rich intangible history, will be discussed.


a
Tour offices
b 1
McHardy House Museum
b 2
McHardy House garden
c
Oak House
d
d
mine worker's houses
Bank St.
tour departure & history room
i
WATER TO THE PREMIER MINE LOOP STREAM
Park - sports ground
e 1
e 2
Park
f
Stone retaining wall/old mine boundary
mine property
g
Mine ventilation shaft
h
Viewpoint
Diesel supply route
j
j
mine property
k
m
Old Oak Ave. shops
Oak Ave.
n
retail tourism
o
Nedbank building
p
Post office
R 515
q
Hotel annex
r
Hotel
s
Station
mine property
1472
1480
1482
1484
1488
1490
1484
1488
1466
1468

a- *Tourism offices originally constructed in 1904 to house the Nederlandse Bank.*

b1- *McHardy House Museum built for the first general manager of the mine (1903)*

b2- *McHardy House garden (1904)*

c- *Oak House built for the resident director (1904)*

d- *Oak Avenue miner worker's houses (1905)*

e 1- *Park (1905)- graded to serve as a sports field in the 1960's*

e 2- *Park (1905)- picnic area, more natural/untouched*

f- Stone retaining wall (1960's) following line of early mine boundary

g - Mine ventilation shaft (1988)

h- Viewpoint (1988)

i- *Tourism office, mine and town historical tour departure & history room*

j- Diesel supply route that used to support underground workshop

k- The big hole

l- *St. Peter's Catholic Church (1910)*

m,n- Old Oak Ave. shops (1905) Barber shop/chemist etc Hotel (1905)

o- Nedbank building (1906)

p- Post office (1906)

q- Hotel annex (mid 1940's) constructed to accommodate the army

r- Hotel (1908)

s- Station (1906)

more recent structures under 50 years old

buildings over 75 years old

buildings over 100 years old

hard edge

100 yr breakline

water

Figure 4.6
The existing site, with physical attributes indicated (Author, 2014)

4.3.1 MAN

4.3.1.1 OAK AVENUE

Origins and history

Oak Avenue (1903) is Cullinan's main road and the axis along which the town developed, originally creating the only physical connection to the mine in the early twentieth century. Before the permanent residences were introduced along Oak Avenue, tents were pitched along its length by the early mine workers.

A section of the route was cordoned off with fencing and guard huts during World War II (see figure 3.22), while the empty houses were used to accommodate the women of the South African Army when the mine was closed until 1945 (Lincoln, 2011:91).

Value

Oak Avenue has historical and associative value as it embodies a unique narrative representing a palimpsest of Cullinan's history.

Potential and intentions

This important heritage resource must be preserved in light of its said value. The hard edges around the cultural heritage connected to Oak Avenue should be addressed and removed to allow for greater public interaction with them. The oak trees that line the route, and after which Oak Avenue was named, are also significant and have age value. They should therefore be retained and protected.

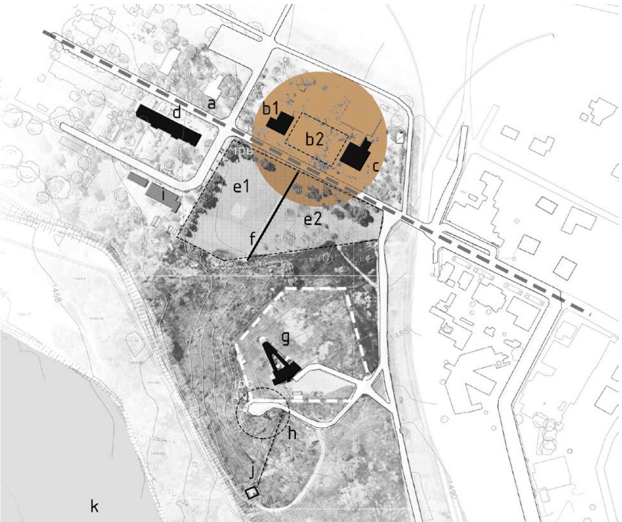
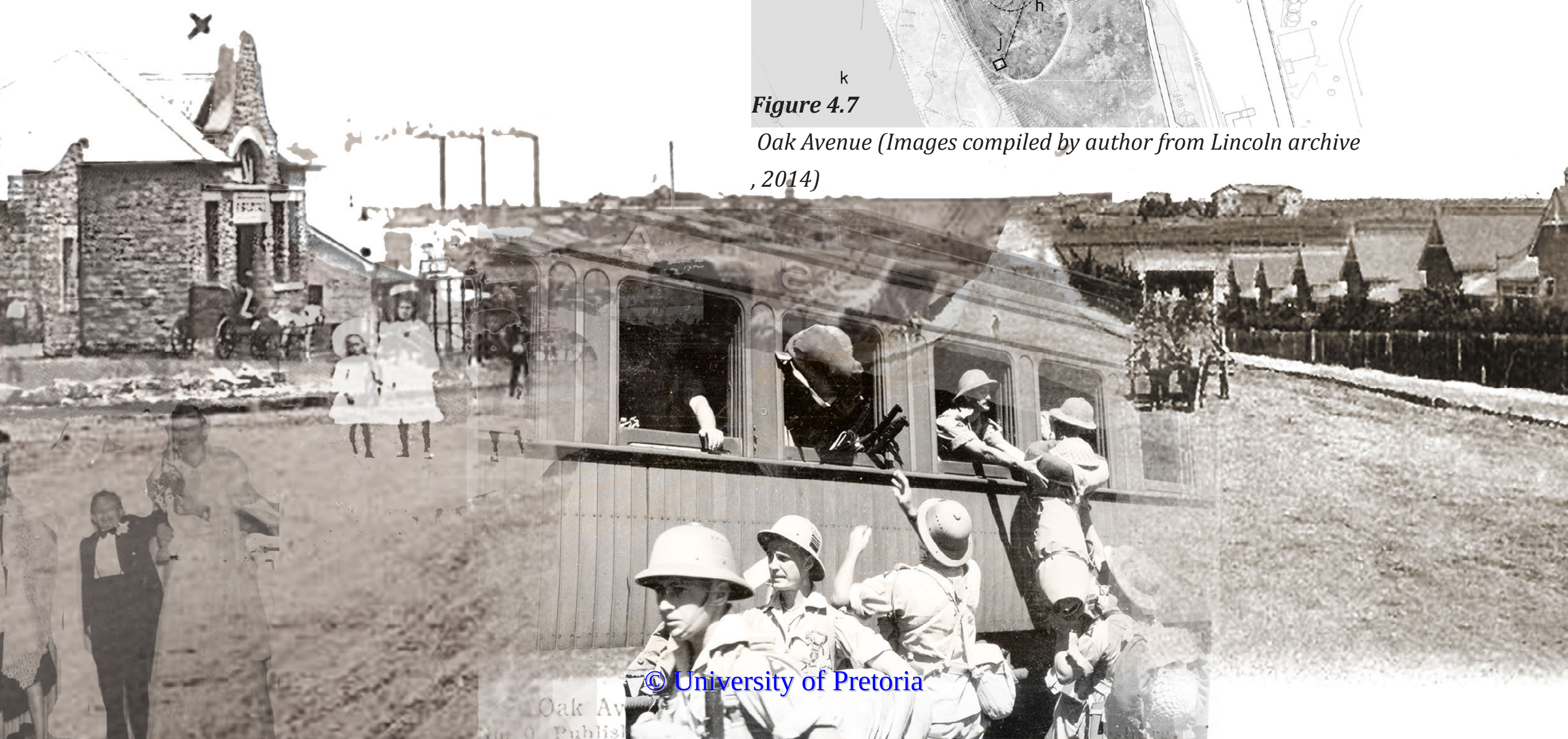


Figure 4.7

Oak Avenue (Images compiled by author from Lincoln archive , 2014)



4.3.1.2 MCHARDY HOUSE AND OAK HOUSE

McHardy House and the McHardy House Gardens (b in figure 4.6)

Origins and history

The McHardy House is a single storey Victorian timber frame and corrugated iron dwelling, now a house museum. It was the first permanent residence in Cullinan and was constructed in 1903 for the General Manager of the mine at the time, William McHardy (Lincoln, 2001:206). The formal rose garden (b2 in figure 4.6 and 1-3 in figure 4.10) was established by the family in the same year and a small orchard was located in the back garden, shared with Oak House. The family occupied the house until 1997.

Oak House (c in figure 4.6)

Origins and history

Oak House is a large face brick dwelling and one of the exceptional dwellings in the village constructed with dressed stone masonry (Venter 2012:226). The house was built adjacent to the McHardy House in 1904 for Cullinan Diamond Mine's resident director, Ross Frames. Additions to the house came in the 1980s to accommodate a guest house, which is still in use today.

Values

McHardy and Oak House are both of architectural value, serving as examples of Victorian architecture within the South African context. It is important that the historical values of the houses be shared as a significant part of the village's history

Potential and intentions

These houses and connected gardens are in good condition and have been well maintained. McHardy House should remain in its current condition and retain its function as a museum. However, because of the values associated with the fabric of Oak House, the later additions to it should be removed and the area they occupy be re-established as the original gardens and orchards. Both houses are to form part of the proposed Orientation and Information Square and Museum Precinct in the site vision (figure 4.40). Their location at the core of the historical town allows them to serve as an easily accessible point of arrival for tourists and departure point for the historical town tour.

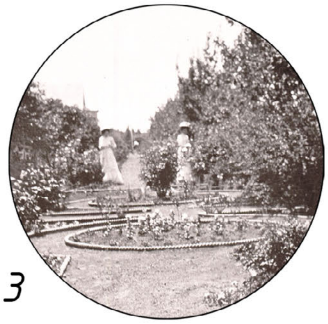
Oak House will become a museum and abandon its function as a guest house which limits visitor interaction with it, while the hard edges around the properties should be removed for the same reason.

Figure 4.10 *The houses and gardens of Oak Avenue (images compiled by author from Lincoln archive, 2014)*

The first permanent residences in Cullinan


1


2


3


4

1 McHardy House
2 & 3 McHardy House garden
4 McHardy family
5 Oak House


5


6 *The Italian prisoner of war fountain*


7 *The mine-worker's houses along Oak Avenue*


8 *The McHardy family outside the McHardy House in the early 1900's*

The intention of the residents of Cullinan, according to the local historian (Lincoln, 2014: correspondence) is to relocate the Italian Prisoner of War fountain (6 in figure 4.10), currently located near the compounds on the other side of the opencast pit, to the center of the McHardy House gardens to reflect on Oak Avenue's association with the World Wars and expose visitors to this facet of Cullinan's narrative.

The Old Nederlandse Bank building (a in figure 4.6) is situated in close proximity to Oak and McHardy House and was constructed in 1904, changing its function in 1906 to a magistrate's court. It also serves as an example of Victorian architecture and is currently used by a tour operating company. The building should retain its function and also form part of the proposed Orientation Square.

Mine worker's houses :

The sandstone mine workers houses along Oak Avenue were constructed in 1905 (7 in figure 4.10). They currently accommodate Cullinan's restaurants, shops and a craft beer brewery associated with the emergent 'culinary route'.

Figure 4.11

A proposal made in the 1980's for the development of the gardens surrounding Oak and McHardy House (Lincoln archive, adapted by author, 2014)

4.3.2 NATURE

Figure 4.12 *Oak Avenue Park (Author, 2014)*

4.3.2.1 OAK AVENUE PARK

Origins and history

Oak Avenue Park was introduced along Oak Avenue in 1905 and is a representation of 'controlled nature' which can therefore be considered to be of both man and nature. However, nature is beginning to reclaim a majority of the unkept park, where indigenous plants are emerging. The park has a rich intangible history associated with it as it used to host festivals and events but no longer accommodates them (Lincoln, 2014: correspondence).

The existing stone retaining wall was constructed on the site in the 1960s to support the sports ground, used predominantly for hockey and soccer by mine workers and school children (see figures 4.16). The wall follows the line that demarcates an early mine boundary (see figure 4.15) and if the line of the stone wall is extended in the direction of the big hole, it would demarcate an early mine workers entrance and the location of change rooms that have since both been removed.

Today, the park is used by visitors, who arrive by either vehicle or the steam train, as a picnic area and sports ground over weekends. A small food and craft market is sometimes held along the periphery of the site, along Oak Avenue.

Value

The park represents an important part of Cullinan's social history and the story of the lives of the mine workers and their families. It also represents the relationship that man and the machine have with the natural condition in Cullinan. Nature and the topography have been shaped to support the functions of both man and machine.

Potential and intentions

Intangible heritage associated with the site is of the highest value and should be given expression in the new intervention by making visitors aware of past uses. Some of the successful past programmes

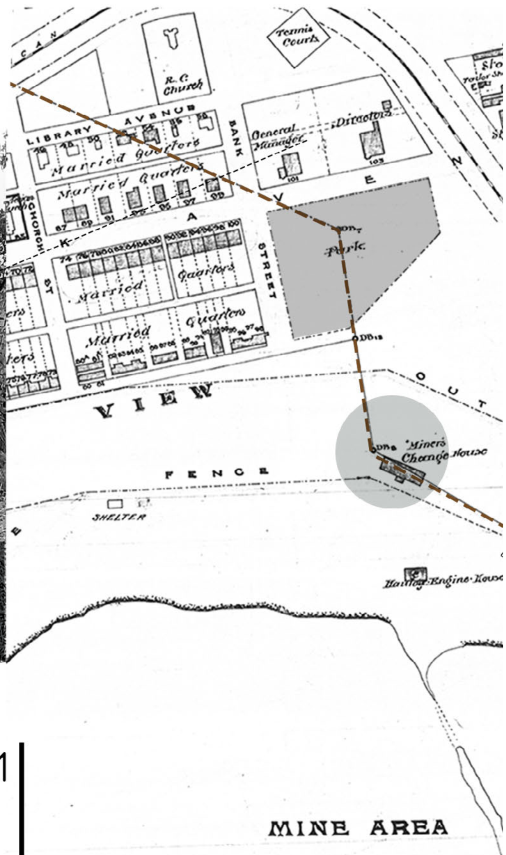
Figure 4.13 *Some early photographs indicating some of the activities, picnics, sports days and social gatherings that once took place in Oak Avenue Park. These narratives form a part of the site's intangible heritage and associated memory (Lincoln archive, compiled by author, 2014)*

associated with the site should be reintroduced to accommodate the local community and tourists. This will be discussed in greater detail in Chapter 5. The tangible traces that reflect on the site's narratives which are also vessels of the intangible memory of the site, should be retained.

A- The old stone wall
B- Oak Ave
C- Ventilation shaft
E1- Sports ground/ old festival grounds
E2- More natural side of the park

Figure 4. 14
The stone retaining wall in Oak Avenue Park (Author, 2014)

***Figure 4.15** The stone wall was established on the line of the early mine boundary (Lincoln archive, adapted by author, 2014)*



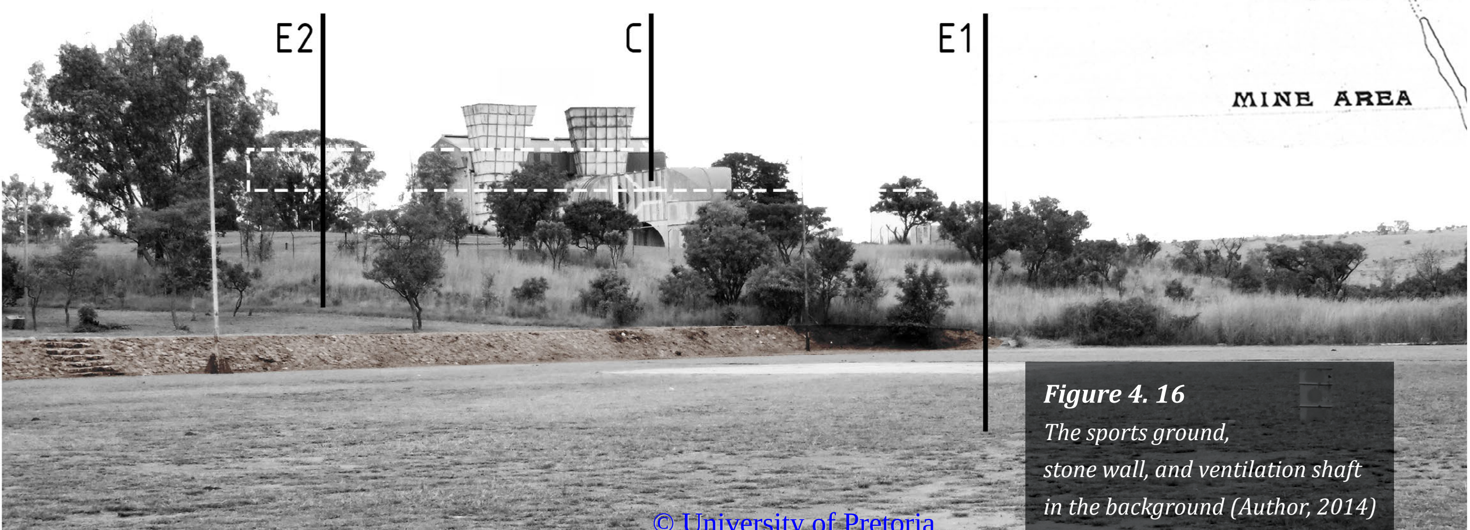


Figure 4. 16
The sports ground, stone wall, and ventilation shaft in the background (Author, 2014)

4.3.2.2 *THE LOOKOUT POINT*

Origins

The obscurely located viewpoint of the opencast pit was introduced to the site in the late 1980s and offers the only view of the hole from the town. Visitors are often unaware of its existence.

Figure 4.17 *The lookout point (Author, 2014)*

A-The opencast pit
B-The viewpoint
C-The ventilation shaft

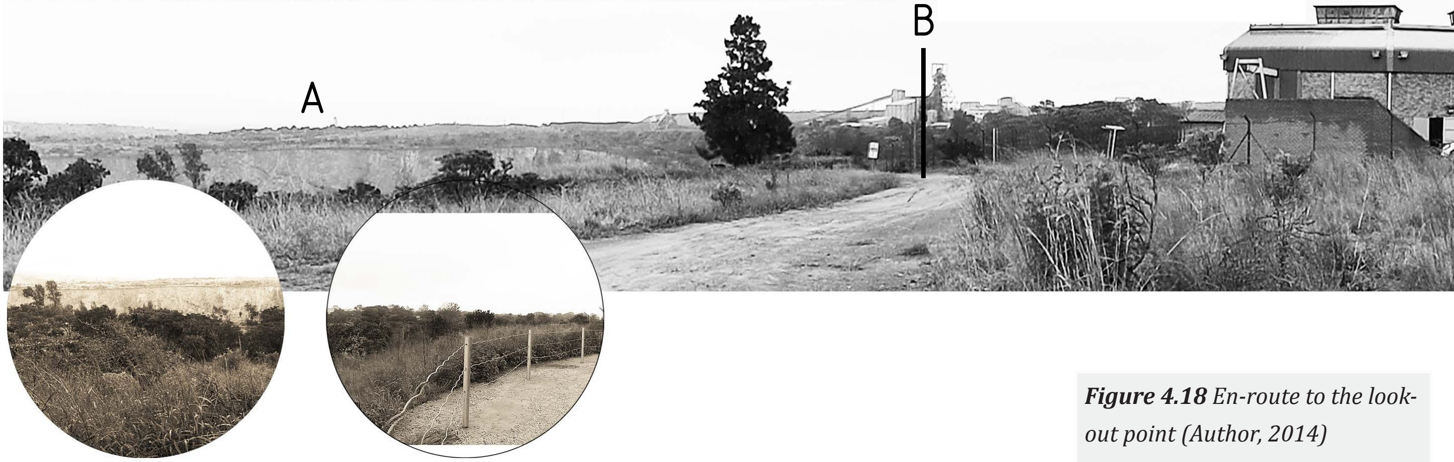


Figure 4.18 *En-route to the look-out point (Author, 2014)*

4.3.2.3 THE OPENCAST PIT

Origins

The dynamic scar in the landscape has grown and transformed for over a century as a consequence of the mine and the ongoing search for resources. It represents the consequences of the machine realised in a distorted, consumed natural condition that typifies our contemporary milieu.

Value

The hole has associated value as the disfigurement of the topography has become a physical representation of the machine's destruction. The hole is the largest opencast mining pit in South Africa and is therefore of technological value and an important cultural landscape.

Potential and intentions

The Cullinan Group's intention for the opencast pit is to retain it as an exposed scar in the landscape, allowing nature to reclaim the surrounding territory over time. The hole will eventually fill with water which will either remain in the open pit, or be pumped out to irrigate the proposed new agricultural strip. Greater public awareness and visibility of this scar is necessary and should be easy to visually access.

Figure 4.19 *The location of the big hole relative to the site (Author, 2014)*

Figure 4.20 *The expended landscape in Cullinan, with the town pictured in the background (Lincoln archive, 1955)*

4.3.3 THE MACHINE

4.3.3.1 THE MINE VENTILATION SHAFT

Origins, history and use

The humming mine ventilation shaft , also referred to as the North Main Fan, was constructed in 1989 and is one of two ventilation shafts that are placed around the perimeter of the opencast pit. The other ventilation shaft, or South Fan, is located closer to the mine (Figure 4.22). The shaft was designed by the local mine engineers and is part of a larger underground ventilation network. Air intake holes are strategically placed around the open pit and the stale air from the underground workings is drawn out by two centrifugal fans located within the ducts. These fans are driven by motors housed within the enclosed steel frame supporting structure.

Value

Because the building is younger than 60 years, its fabric is not protected. However, the fact that the shaft was the largest raise-bore hole of its time (6.6m diameter) in the world, means that the building is of industrial technological significance.

The building and connecting ducts are a physical representation of the parasitic relationship that exists between man, nature and the machine in the Industrial Age and therefore has value as a visible representation of this phase of history.

Figure 4.21 *The location of the mine ventilation shaft on the site (Author, 2014)*

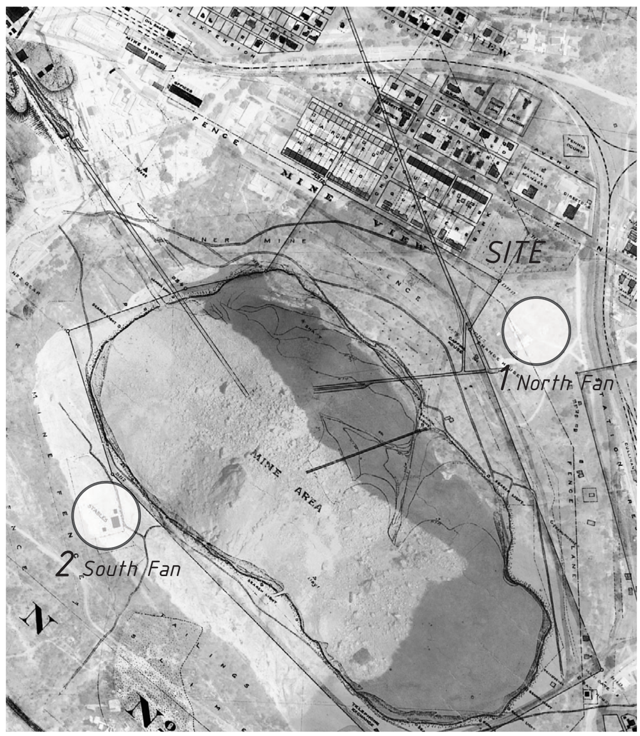
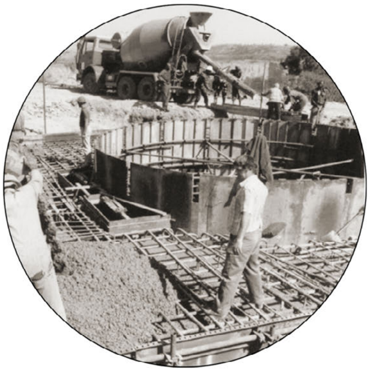


Figure 4.22 *The location of both surface ventilation shafts (Author, 2014)*

1



2

3

4

5

Figure 4.23 *The ventilation shaft and its history*

1- An image of miners in the underground tunnels (Mine archive)

2 and 3- The construction of the ventilation shaft and the raise-bored hole that connects to the underground workings (McGill, 2014)

4- An old raise-bore machine on display near the mine (Author, 2014)

5- The ventilation shaft today (Author, 2014)

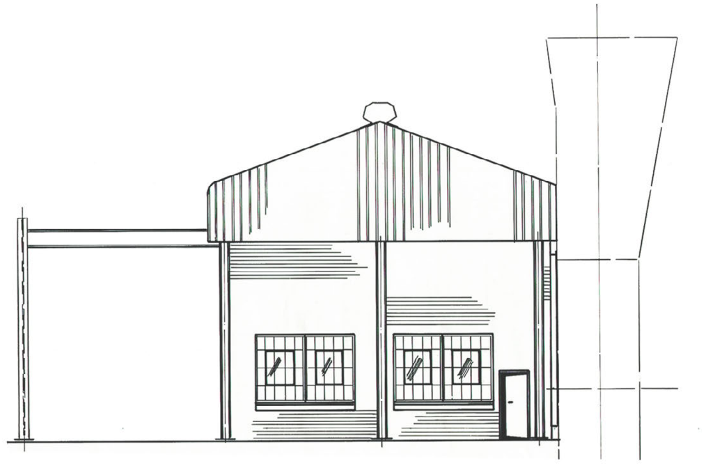


Figure 4.24 *An elevation and section of the ventilation shaft's supporting structure which houses the motors for the centrifugal fans (Mine archive, 1988)*

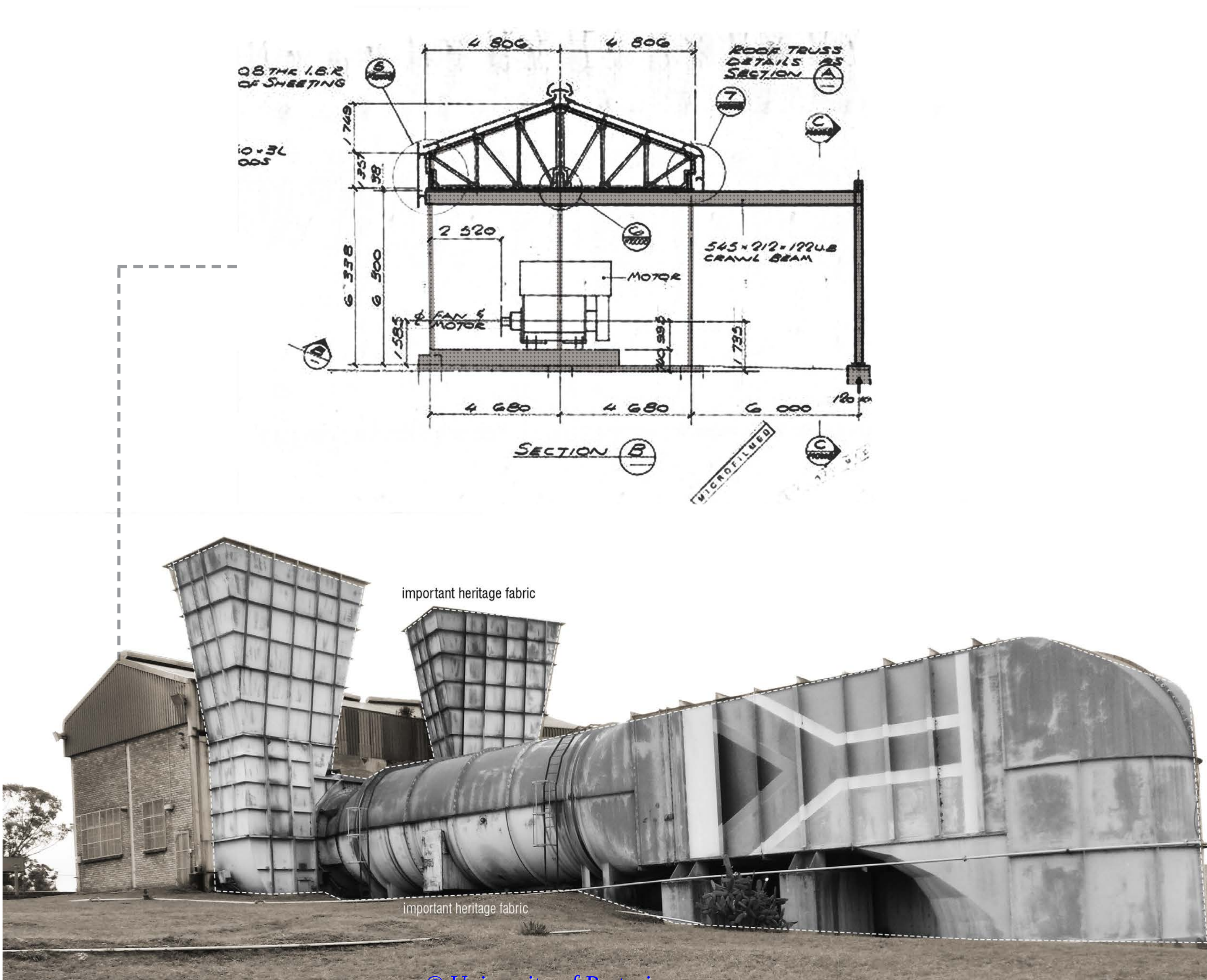


Figure 4.25 *The dominating ventilation shaft (Author, 2014)*

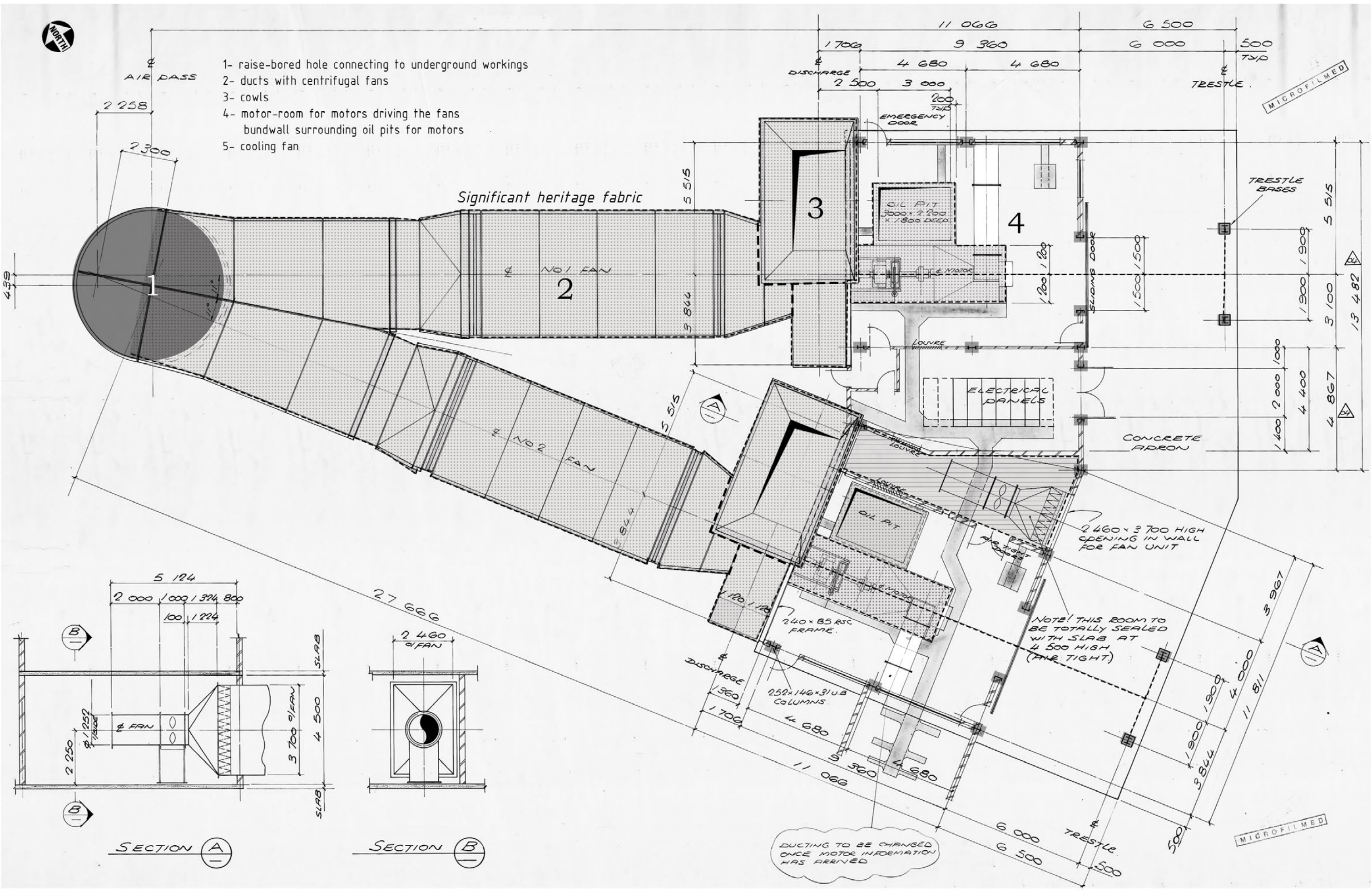


Figure 4.26

A plan of the ventilation shaft. The significant fabric which contributes to the narrative of its function is hatched or shaded (Author, 2014)

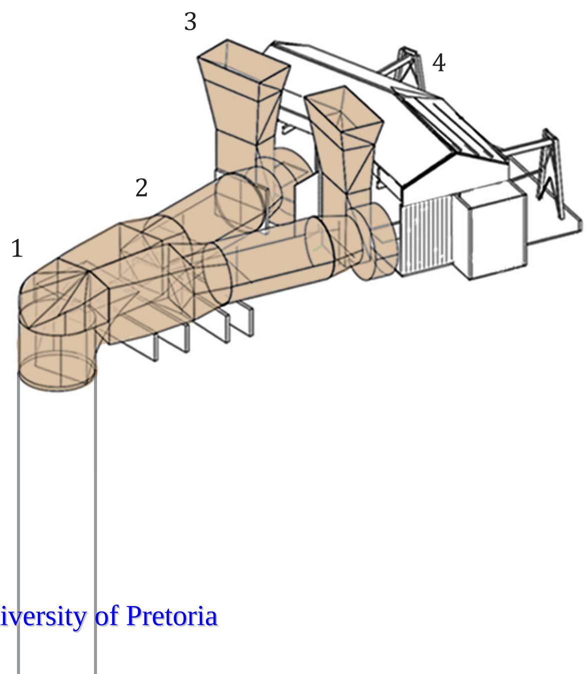


Figure 4.27

Connecting ducts (Author, 2014)

1- Raise-bore hole connecting to tunnels below the surface

2- Ducts

3-Cowls

4- Attached structure housing the motor rooms

Figure 4.28 *Inside the motor rooms (Author, 2014)*

Figure 4.29 *Heritage fabric (Author, 2014)*

Potential and intentions

Part of the mine's post-closure strategy is to remove the majority of the surface infrastructure, including the two ventilation shafts, and cap their connection to the underground network. Venter (2012:328) states that these shafts pose a safety hazard if they are not correctly sealed off. The TICCIH Charter (2011:6) states that industrial heritage dimensions and values should be communicated as it illustrates important aspects of local and national history over time.

Rather than demolishing the mine's surface infrastructure after closure, the significant fabric that contributes to the *narrative and original function* of the ventilation shaft should be preserved. Principle 2 of the TICCIH Charter (2011:3) states that the value of industrial heritage is intrinsic to the structures or sites themselves (their material fabric, machinery, components and setting). In the case of the ventilation shaft, the significant fabric includes the raise-bore hole that connects to the underground workings, the ducts and cowls, the fans, motor-rooms and oil pits. *This fabric's value is in that it acts as a physical symbol of the current relationships and condition between man, nature and the machine while forming part of the ventilation shaft's functional system. Although the shaft is not old, it does have technological value and the retention of this fabric comes predominantly as a consequence of its tangible representation of the dominant parasite in Cullinan.*

It is suggested that adaptive reuse[1] is often the most sustainable way to ensure conservation of these sites, but new uses should respect significant material (TICCIH Charter 2011: Article 1.9). Part of the infrastructure of the old building can be reused to support a new function. Figure 4.25 shows one of the three separate small storage structures constructed on the site in the mid 1990s (McGill, 2014: correspondence). They are not of significance, nor do they contribute to the narrative of the ventilation shaft, and can therefore be removed.

The raise-bore hole connects to the 430 m level below ground (see figure 4.31) which forms part of the ventilation shaft's network and contributes to its narrative. The public should be made aware of the underground mine tunnels for this reason. The role and design response to the ventilation shaft and its linked tunnel network is discussed to a greater extent in the design chapter.

1 Adaptive reuse according to Article 1.9 of the Burra Charter (1999:2) means modifying a place to suit the existing use or a proposed use.

4.3.3.2 THE UNDERGROUND MINE TUNNELS AND THE DIESEL SUPPLY ROUTE

Origins and use

The ‘roots’ of the machine, the mine tunnel network, began to spread beneath the surface of the site in the 1980s. The diesel supply route on the site (Figure 4.30) used to support an old underground workshop 430 m below the surface. The tank was filled on the surface and gravity-fed to diesel powered machinery and LHDs (load haul dumps) below (McGill, 2014: correspondence).

Value

The diesel supply tank and connecting surface diesel pipe represent the site’s connection to the underground network and tunnel that also links to the raise-bore hole of the mine ventilation shaft. The tunnels are a significant part of the mine’s history and heritage and should be articulated on the surface as currently no-one is aware of their existence under the site.

Potential and intentions

The connection between the diesel supply tank and raise-bore hole should be given expression so as to educate the public about the functions of the machine on the site and the extent of its influence on the landscape, part of its narrative as parasite.

Figure 4.30 *The diesel supply route connecting to underground workshops below the site (Author, 2014)*

a mine ventilation shaft
b old diesel supply pipe
c old diesel supply hole to underground workshop

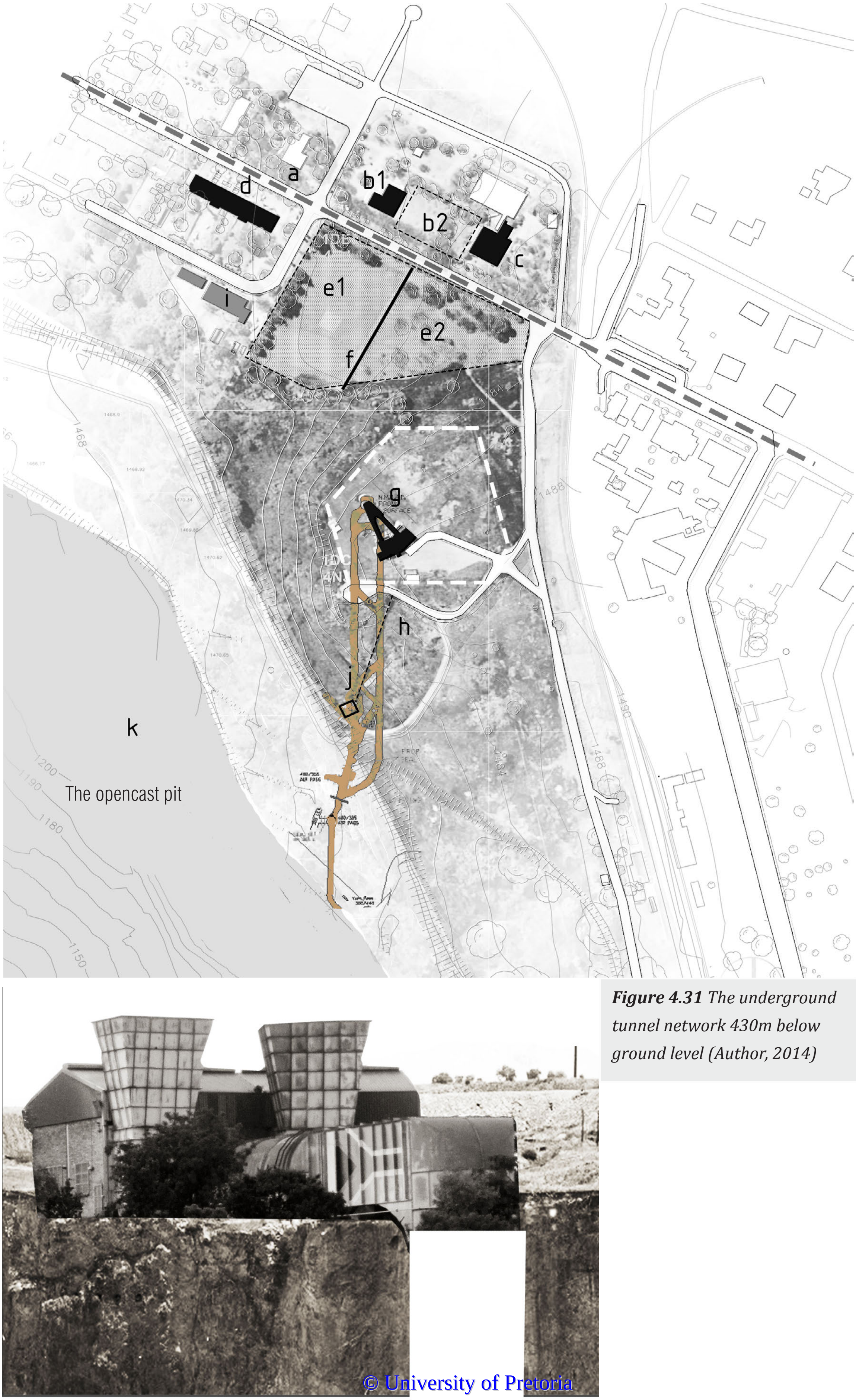


***Figure 4.31** The underground tunnel network 430m below ground level (Author, 2014)*

4.4 STATEMENT OF HERITAGE SIGNIFICANCE
THE SITE

The site has a multi-layered history reflective of Cullinan's unique story, etched with the intangible memory and tangible influences of man, nature and the machine, articulating their current associations. Multiple site attributes reflect technological, industrial, natural, cultural, associative and historical values. Consequently, the site has the inherent potential to become a catalyst, resuscitating the core of the historical town as a tourist node and point of orientation. Visitors should be connected to the multiplicity of heritage layers and the site meaning[1] and intangible memory should be given expression (UNESCO, 2003). When the cultural significance of place isn't apparent, it should be explained through interpretation[2].

All new interventions should acknowledge and respect the site's character, setting and cultural and natural significance (Ename Charter 2008:10). Any new layer added to the site's palimpsest should be readily identifiable as such while respecting the traditional site functions and not compromising the history and memory associated with it. The site's values should be safeguarded by conserving[3] important heritage fabric, especially applicable to Oak Avenue, McHardy and Oak Houses, as well as the fabric of industrial technological significance associated with the ventilation shaft, a symbol of the 'Era of Industry' which represents its own unique relationships.

The successive phases of the site's evolution and the traces of their influence that reflect this should be respected as they all contribute to the site's multi-faceted layers and narratives. For instance, some of the decay on the ducts of the ventilation shaft adds to its story and the narrative of the site's timeline. The natural condition of the park and surrounding landscape also forms an integral part of the site's historical, natural and cultural significance and should be given expression in the site proposal.

---

1 Article 1.16 of the Burra Charter (1999) states that *Meanings* denote what a place signifies evokes or expresses. These generally relate to intangible aspects such as symbolic qualities and memories.

2 The Ename Charter (2008:4) defines interpretation as a range of potential activities intended to heighten public awareness and enhance the understanding of cultural heritages sites. The Ename Charter (2008) includes multiple principles to facilitate the interpretation and presentation of these sites which includes: Access and understanding and the communication of meaning, safeguarding the tangible and intangible values of a site in their natural and cultural contexts , respecting the authenticity of these cultural heritage sites by communicating the significance of their historic fabric and cultural values.

3 Article 1.4 : Conservation means all the processes related to looking after a place so as to retain its cultural significance. It is based on the respect for the existing fabric, use, associations and meanings. Conservation of a place should identify and consider all aspects of natural and cultural heritage associated with a site without unwarranted emphasis on one over the other

Figure 4.32 *Oak Avenue Park's intangible narrative. Reintroducing festivals to the site (Author, 2014)*

4.5 THE PRECINCT VISION

4.5.1 Intentions and the site today

The western part of the site is a sports ground, occasionally used by the locals and tourists, while the eastern part is being reclaimed by nature and is used for picnics. The grounds occasionally host small scale events, but not to the extent that it used to. Markets are sometimes held along the periphery of the park over weekends.

The remote ventilation shaft is still in operation and visually dominates the site, but interaction with it is limited as a consequence of the surrounding fence. The lookout point adjacent to the ventilation shaft offers the only view of the opencast pit and, although its location is concealed, is still used.

The site vision must reflect on the theoretical premise and the notion of the *symbionic.* The site's current narrative should be contrasted with a new narrative, a successive phase in the site's ongoing story and evolution, expressing future symbiosis between the three realms with resilient interdependencies. This means facilitating exchanges on the site between attributes belonging to man, nature and the machine in response to their contemporary disconnect. A new spatial structure, informed by the existing internal structure of the town and site, should be introduced allowing for the definition of nodes for arrival and orientation.

Figure 4.33 *Proposed site functions (Author, 2014)*

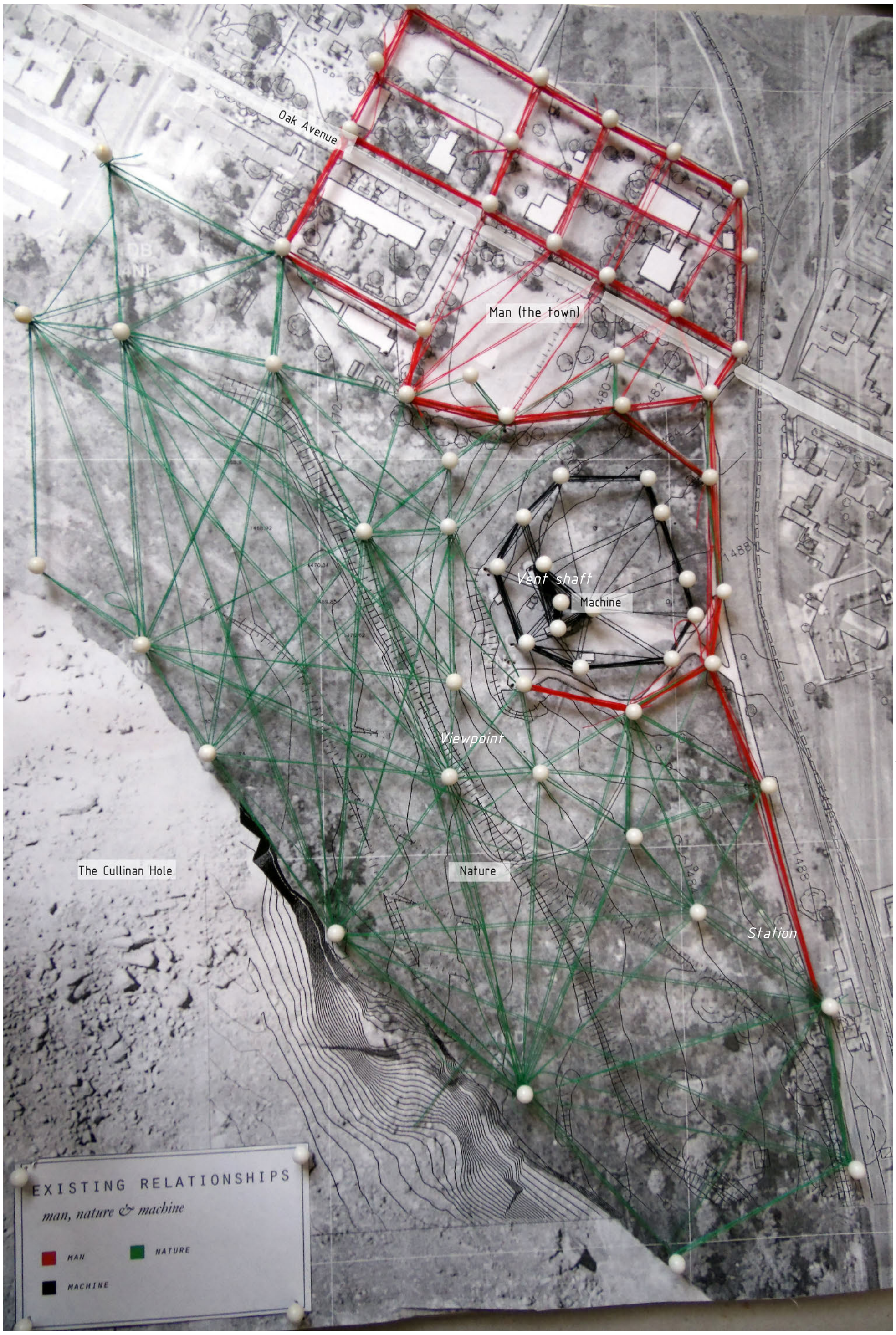


Figure 4.34 *Model exploration of the contemporary site condition (Author, April 2014)*

The dominant machine (ventilation shaft) is isolated on the site and man's interaction with the mined landscape is limited. The only breach in the boundary between the town and landscape is a single viewpoint that is obscurely located within the town (close to the station).

MAN

NATURE

MACHINE

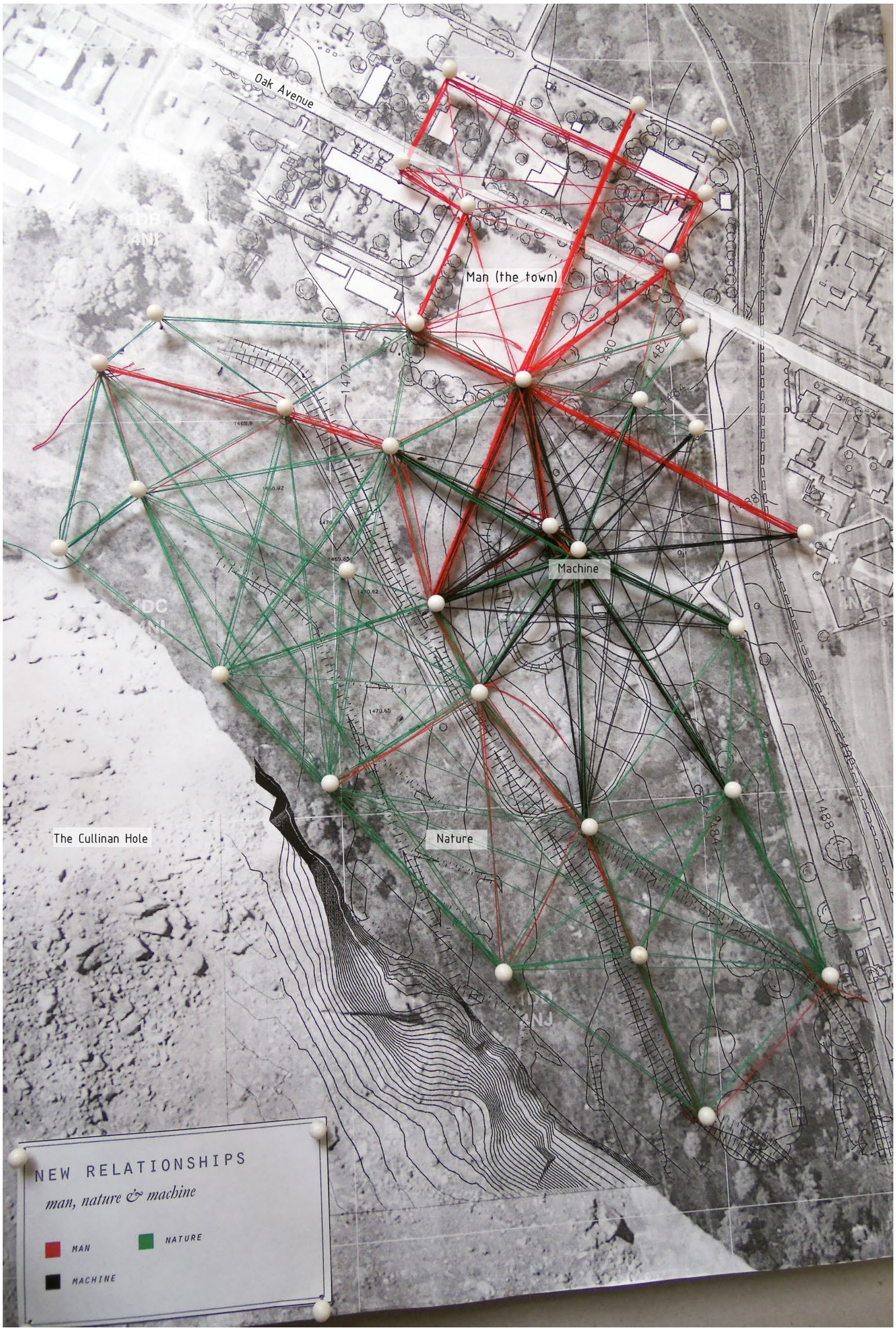


***Figure 4.35** Envisioning a future site condition (Author, April 2014)*

New relationships are envisioned on the site between the three realms of man, nature and machine in a post-industrial setting. Man interacts with both the machine and nature on the site.

MAN

NATURE

MACHINE

Vision development and explanation (Author, 2014):

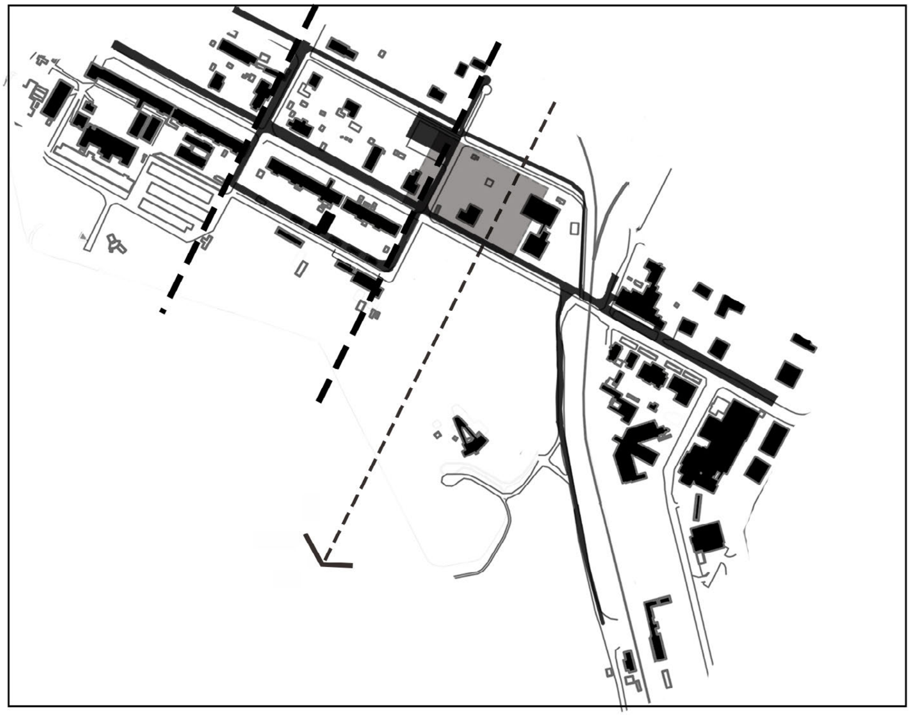


Figure 4.36 *The line of the stone wall is extended into the landscape, connecting man to a new proposed viewpoint (Author, 2014)*

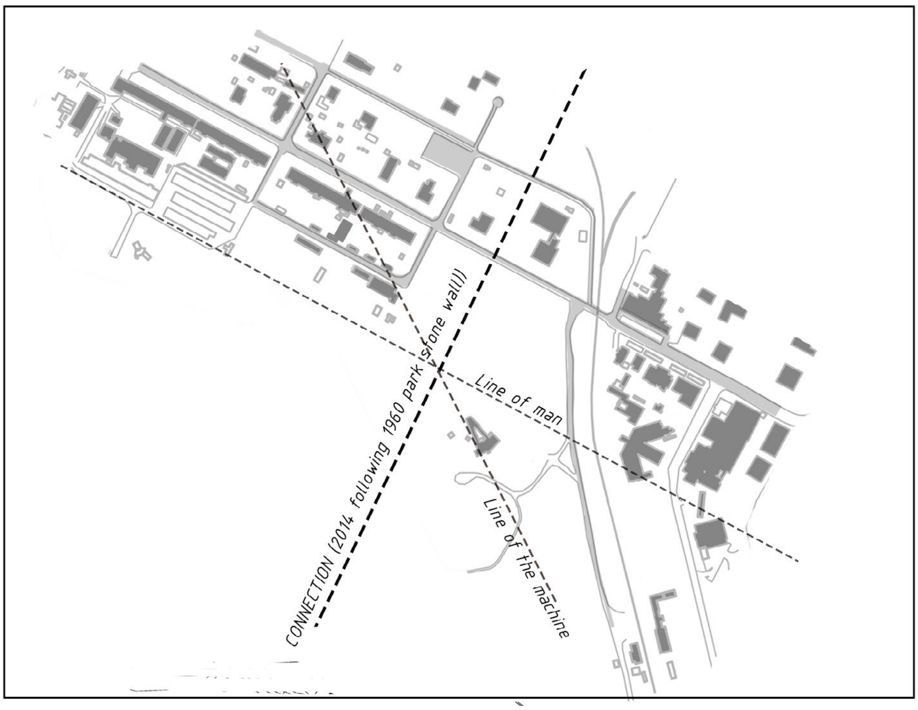


Figure 4.37 *The lines of man, nature and machine are mapped on the site, which includes the influences of the town grid, stone wall and ventilation shaft. These inform the new spatial structure (Author, 2014)*

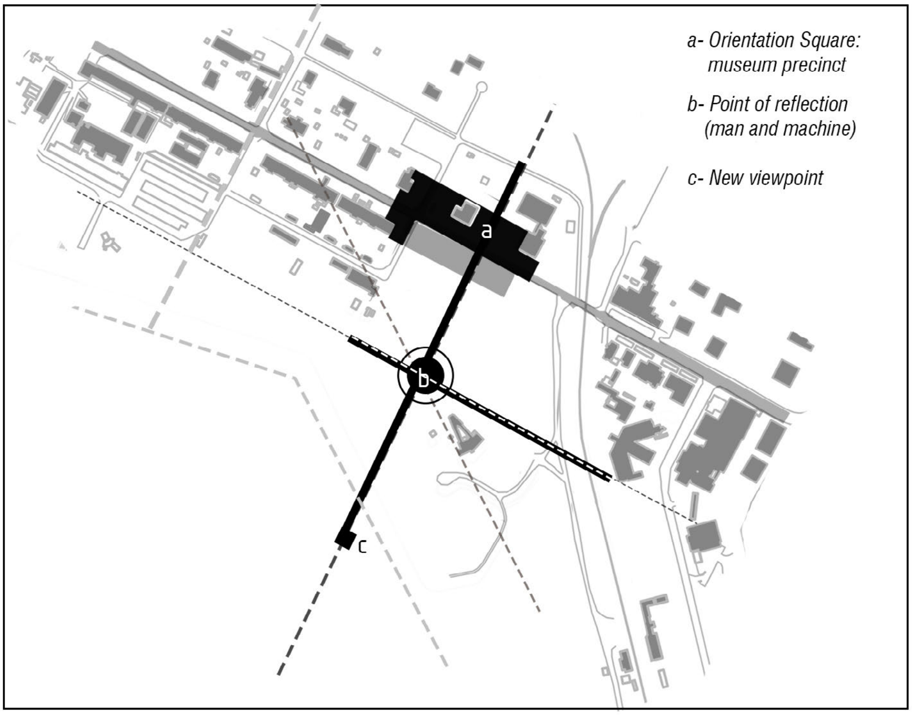


Figure 4.38 *The proposed spatial structure , introducing new tourist nodes (points of arrival and orientation) at the old houses (Oak and McHardy House and gardens) and the station (Author, 2014).*

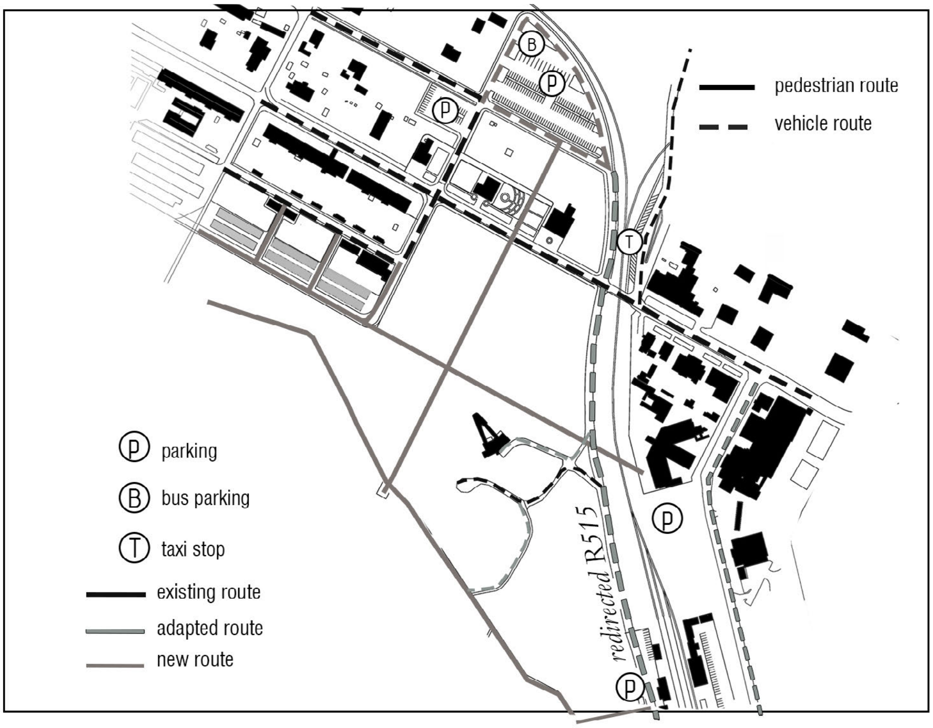


Figure 4.39 *New routes and parking for visitors (Author, 2014)*

Figure 4.40 Micro-context vision (Author, 2014)

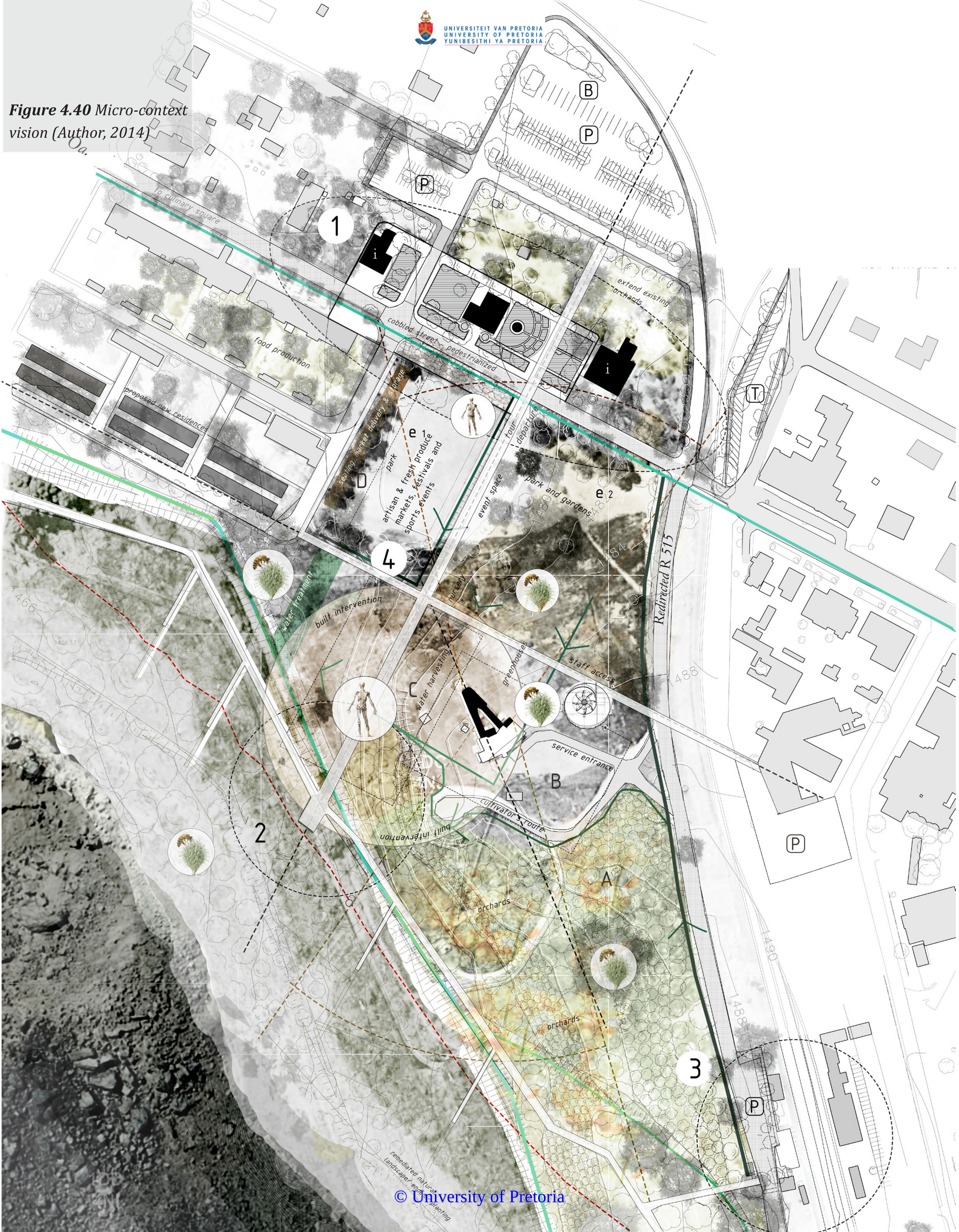


Figure 4.41 *Existing site (Author, 2014)*

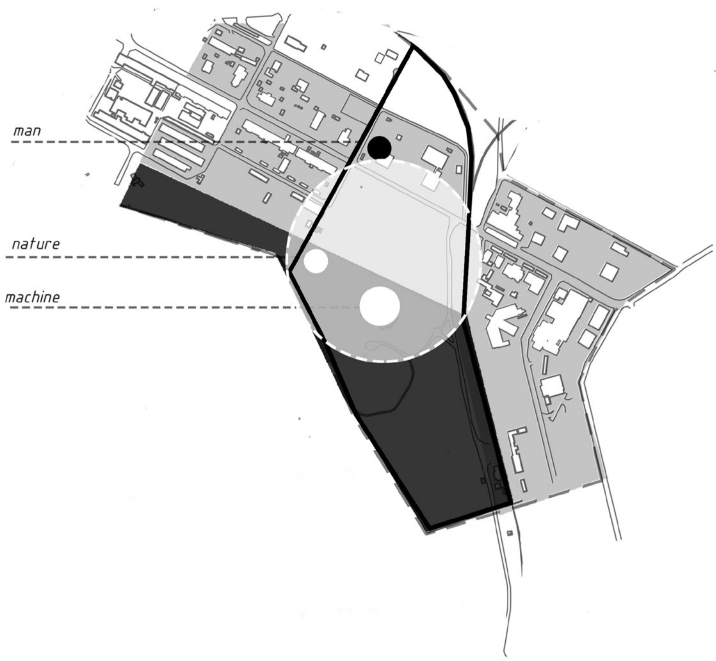
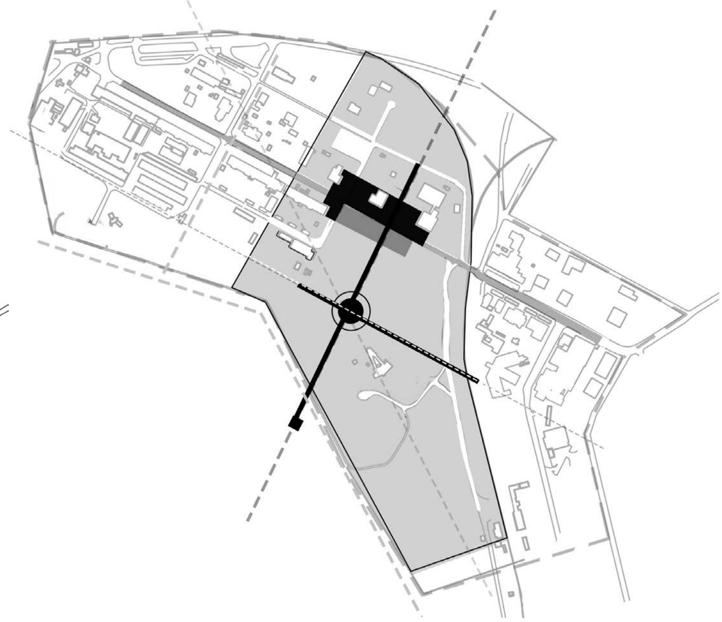


Figure 4.42 *Proposed spatial framework (Author, 2014)*



Existing route

Adapted route

New route

(P) Parking

(B) Bus parking

(T) Taxi stop

i information point

Nodes

1 Orientation Square : Museum Precinct with Italian Prisoner of War fountain

2 Viewpoint at historical breach in boundary between town and landscape

3 Station arrival and information point

4 Point of reflection

i Orientation & information point

Main activities

A Productive landscape

B Primary processing

C Secondary processing & public interface

D Artisinal & fresh produce market

100 yr breakline

existing water route

new water route


SITE VISION
PROPOSED INTERVENTIONS
Existing water route
Proposed water route
Rehabilitated landscape
Agricultural route
Orchards
Old route to mine boundary reused as cultivator's route
New view-point
THE CULLINAN HOLE
TO COMPOUNDS
REDIRECTED R515
P

Figure 4.43 *The site vision (Author, June 2014)*

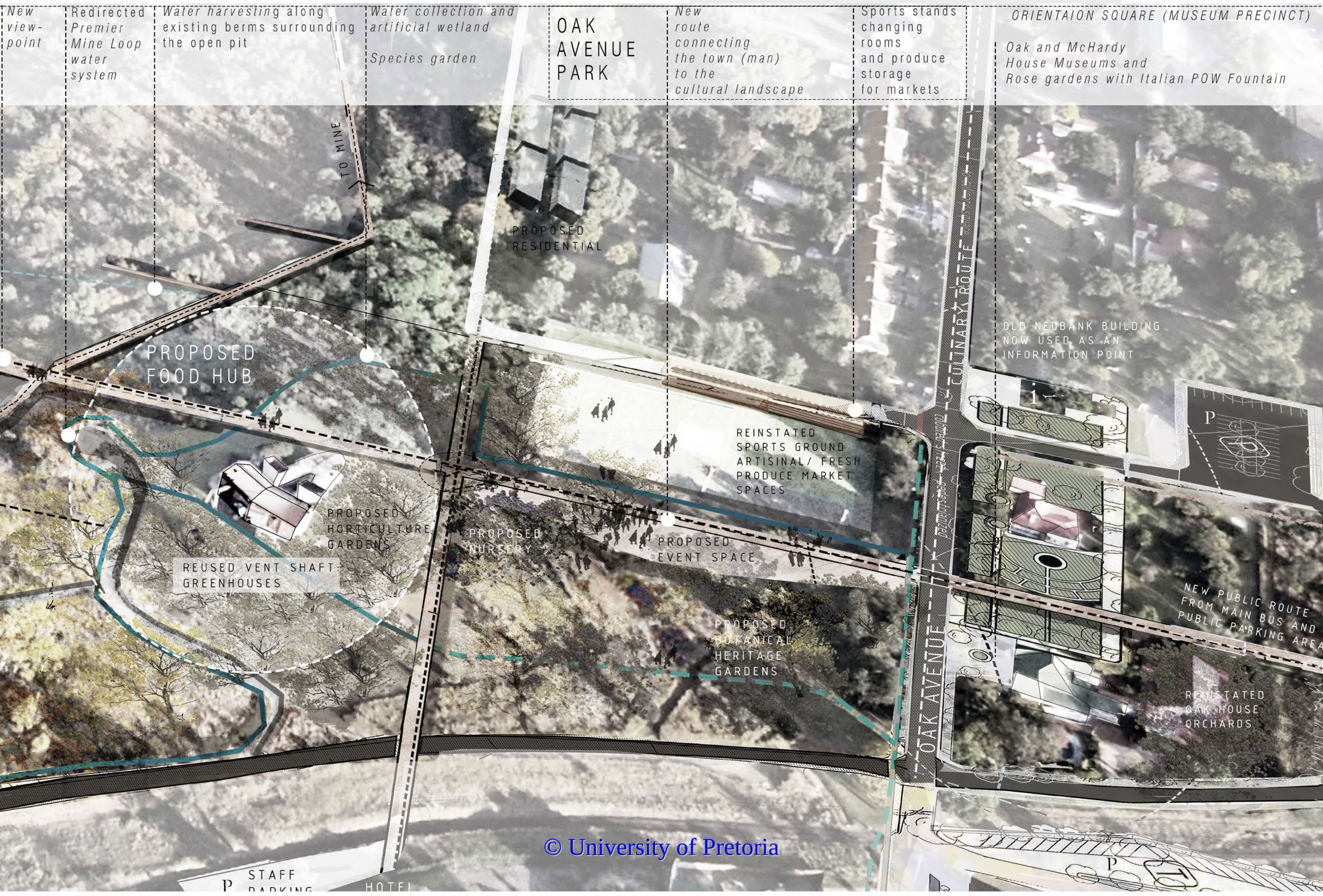


Figure 4.44 *Perspective of the envisioned Oak Avenue Park (Author, May 2014)*

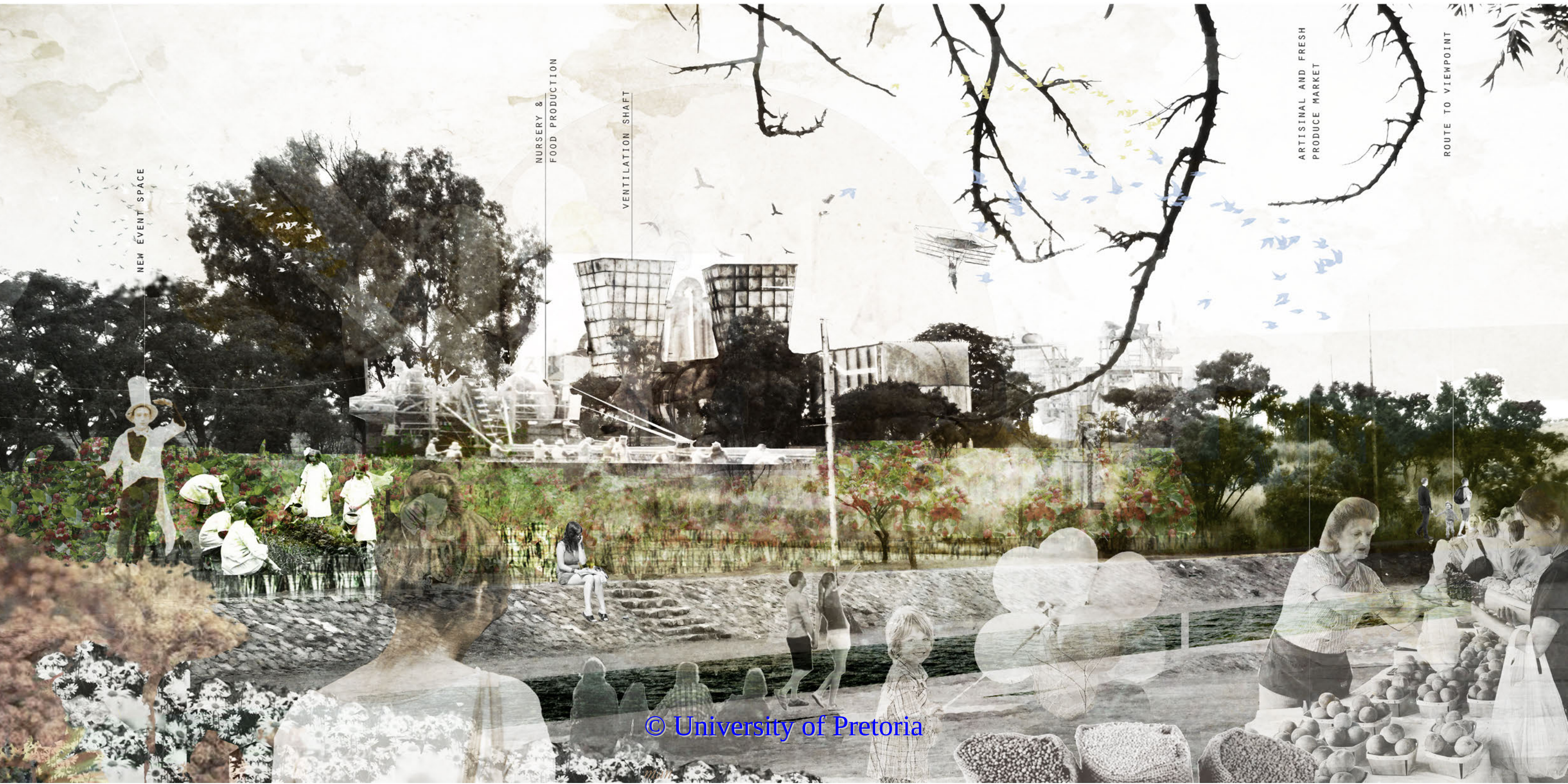
EVENT SPACES

NURSERY

VENTILATION SHAFT

ROUTE TO VIEWPOINT

ARTISAN AND FRESH PRODUCE MARKETS



CHAPTER 5

PROGRAMME

A food revolution: Reconciling nature, handcraft and a 'new' machine

Where the Industrial Age is defined by a movement towards homogeneity, the age after the machine is defined by *diversity, place* and *nature*. This chapter will discuss the proposed programme, a regional *food hub,* as a reflection of *new relationships* and exchanges between man, nature and machine. Future *localised food systems* will be explored as an expression of the *Age of Life.*

Figure 5.1 *A local food hub (Author, 2014)*

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YUNIBESITHI YA PRETORIA

A FOOD PHILOSOPHY

Food, taste and its systems, the raw materials of our region, the flavours that say something about us and imbue the foods we eat with a connection to this place and this time, should be explored. Diversity is our starting point and our goal. It forms a loop of feedback mediated by ecology, necessity, and appetite. The pursuit of good food is in itself also the pursuit of bio-cultural diversity. Diversity – of autochthonous genetic material, of organisms, of cultural practices, of ideas – is what keeps our world at its most robust, able to perpetuate itself indefinitely. Diversity is the cloth that weaves our fates together.

The Nordic Food Lab, Denmark (2013)

5.1 DEFINING '*FOOD SYSTEM*'

By and large, contemporary society regards food as a consumable devoid of a history or context. Our contemporary society exists in a perpetual cycle of production, consumption and disposal, which will continue until our finite resources are exhausted.

In reality, food belongs to a larger multifaceted network and has a story. The term 'food system' refers to all aspects involved in the making of food (FAO 2011: online) including food production (growing and harvesting), food processing (added-value production) and food distribution (sold to consumers) (see figure 5.2).

There are two major food systems: the global industrial food system and the alternative local or regional food system.

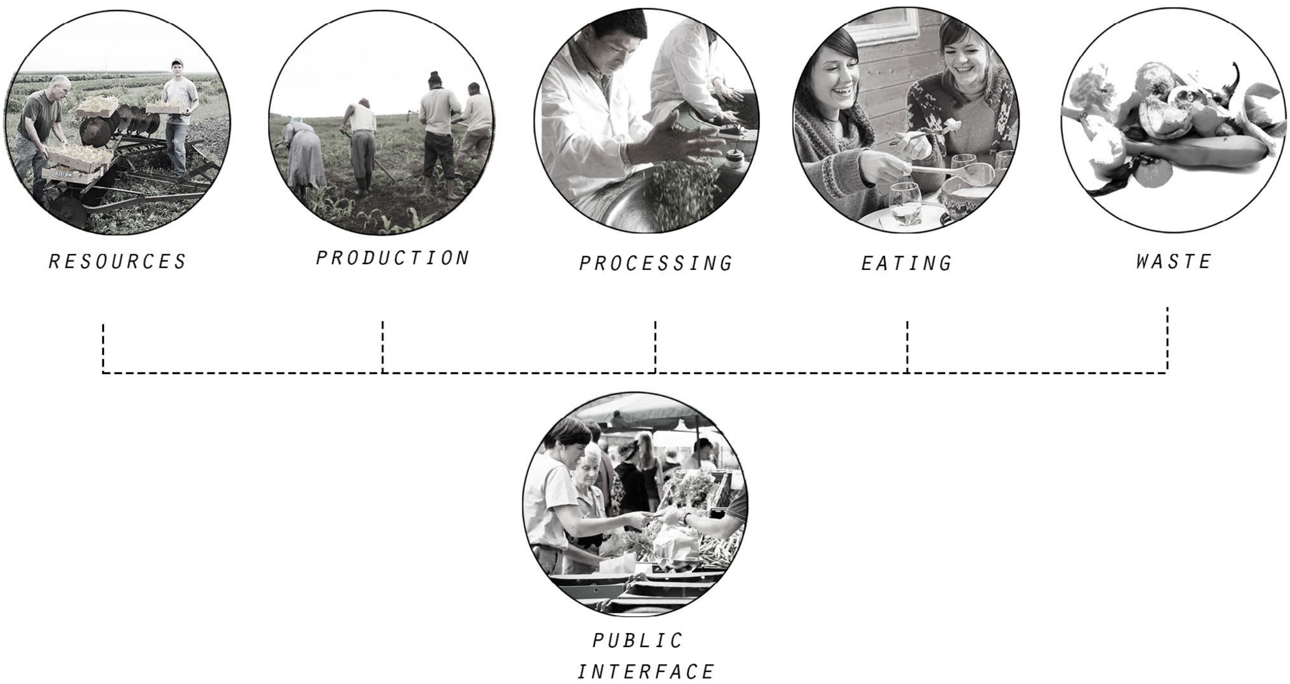
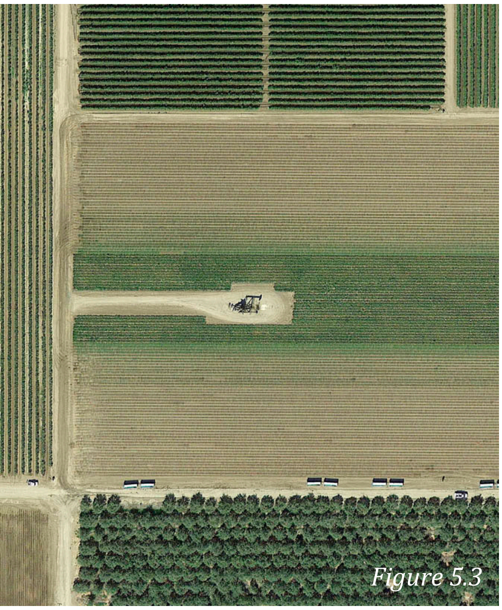


Figure 5.2 *The components of a food system (Author, 2014)*



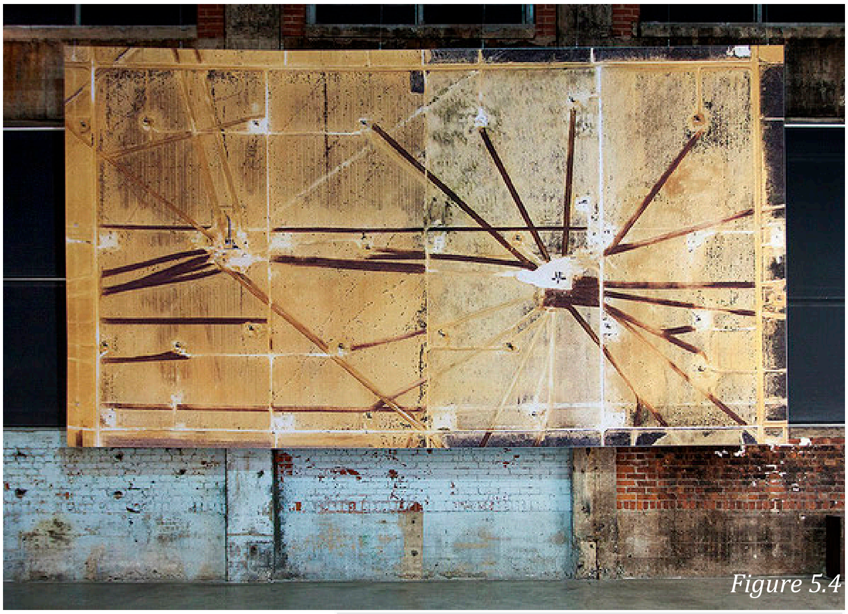


Figure 5.3 and 5.4 *Photographs illustrating the impacts of industrial agriculture (Henner, 2013)*

5.2 THE ESTABLISHED FOOD SYSTEM
THE GLOBAL INDUSTRIAL FOOD SYSTEM

Present-day globalised food systems neglect the larger multi-dimensional food structure that integrates facets such as climate, natural resources, people and culture. Mainstream food systems reflect on our contemporary condition and depend on the finite resource of fossil fuels largely initiated on industrial farms where monoculture is practised. The focus is placed on amplifying the quantity of food produced to support economic growth. Products are subsequently processed on a large-scale and may be distributed nationally or internationally to supermarkets and fast-food chains by large transnational food companies (Sustainable Table 2014: online). This has impacted on global food consumption, as well as health and quality of life.

As a consequence of the global food economy, the majority of society remains ignorant of the processes and system linkages related to water, energy and waste in food systems, consequently leading to unsustainable consumption. This has had an unfavourable impact on ecosystems and food diversity. Large-scale food production and farm consolidation has also had implications for smaller-scale regional producers. Our rural productive landscapes have been drained of people and filled with machines.

There are numerous influences necessitating a change in our current food system:

- Globalisation is impacting on food security and the agricultural sector (FAO, 2011:online).

Figure 5.5 *Contemporary mono-culture and the consequent impact on environmental systems (Henner, 2013)*

- To satisfy a rapidly growing population, food production will have to increase by 70% by 2050 to support a predicted population of 9 billion people (FAO, 2011:online). This also implies that production in developing countries will have to double (FAO, 2011:online).

- Natural resources are subject to increasing pressure as a consequence of human activities. With a growing world population, resources that support human life (food, freshwater, energy and biodiversity) are under strain.

- Climate and environmental changes have become a reality.

Figure 5.6 *Comparison photographs indicating how our world has rapidly transformed. The image on the left was taken in the First World War where the fields below show a variety of crops grown for local consumption by local producers in France. The image on the right depicts contemporary monoculture in the form of wheat produced for global consumption leading to bio-homogeneity (Bunch).*

Figure 5.7 *The proliferation of supermarkets.*

Figure 5.8 The neighbourgoods market.

Figure 5.9 Oxfam's campaign against contemporary homogeneous food systems.

5.3 A FOOD REVOLUTION
AN ALTERNATIVE LOCAL FOOD SYSTEM

The way society perceives and interacts with food needs to alter as a consequence of our rapidly changing world. The major driver of change is the decline in the availability of fossil fuels which compels a review of food production, processing, consumption and waste cycles, beckoning the implementation of a more resilient food structure.

To satisfy a growing population, small-scale rural food production that implements more sustainable methods of production is necessary (FAO, 2011: online). Agro-ecology advocates a more sustainable approach to farming and food production by rethinking resource consumption, suggesting an integrated ecosystem approach to resources (FAO, 2011: online). Essentially, it suggests a reduction and eventual eradication of reliance on large-scale industrial agriculture and a movement to small-scale food horticulture that is suited to place.

A local/regional food system is used to describe food systems that are geographically localised rather than nationally or internationally (Sustainable Table, 2011:online). Food is grown and cultivated close to consumers and distributed over shorter distances. The term local/regional food also suggests food that is produced in a sustainable fashion and adopts an integrated ecosystemic approach.

A local food production and distribution network starts on small-scale farms and products are then either processed on the farm itself or transported to smaller nearby processors for added-value farm products. It is becoming increasingly popular for farmers to process their own added-value products. This is referred to as a 'food hub', a surfacing trend. Products are then sold to consumers through farmers markets or local shops. These local food systems can also help support local economies and generate jobs (Sustainable Table, 2014: online), keeping food production local and enhancing the sense of place and community, which means shorter food chains, strong urban/rural linkages and sound management of natural resources (FAO, 2011:27) .

Industrialisation had squandered beauty associated with place for a misguided idea of progress (Slowfood, 2013:13) and market-focused industrial agriculture has destroyed landscapes for economic expansion. A local food system reinforces man's connection to nature and place by making people aware of the origin of food, and cycles and living connections associated with it.

The food revolution is encapsulated in the following statement:

"...The notion relates back to the biophilia revolution and the decision we must make to rediscover and re-inhabit our places and regions, finding in them sources of food, livelihood, energy, healing, recreation,and celebration.... Whether one calls it 'bioregionalism' or 'becoming native to our places' . It means rebuilding family farms, rural villages, towns, communities, and urban neighborhoods. It means restoring local culture and our ties to local places, where biophilia first takes root. It means reweaving the local ecology into the fabric of the economy and life patterns while diminishing use of the automobile and our ties to the commercial culture. It means deciding to slow down, hence more bike trails, more gardens, and more solar collectors. It means rediscovering and restoring the natural history of our places... it means finding our place and digging in."

(Orr, 1993: 420)

Figure 5.10 *The Shepparton food hub public gardens (Pollen Studio, 2012)*

5.4 FOOD HUBS
THE EMERGENT LOCAL FOOD SYSTEMS

Local food hubs support regional producers and connect them to consumers and serve a multiplicity of functions (see figure 5.10), acting as a drop-off point for nearby farmers and pick-up point for consumers. They also integrate light food processing and can assist the market reach of small-scale production facilities, help create jobs, and allow consumers access to produce and regional foods (Sustainable Table, 2014: online). They encourage tourism and provide ecosystemic services contesting traditional methods of food production.

Programmatic precedent

The Shepparton Food Hub in Australia serves as an example of the proposed programme. Like Cullinan, Shepparton forms part of a larger agricultural system and centralises local food services, while educating the community about them. Food production takes place on site and seasonal harvest table events are held for tourists. The programme also includes a market area, test kitchen, nursery and shop, as well as edible, communal, research and indigenous gardens. Food is recognised as a part of the services of horticulture and the garden (Pollen Studio, 2013:online).

The value of the Shepparton food hub as a programmatic precedent is that it serves as a resource in terms of what this new typology entails functionally. The social implications of the project are also important in terms of how the intervention plugs into its larger community and facilitates a dialogue with local food producers, centralising local food services into a single facility. The programme regenerates and reawakens interest in the area by making use of a growing characteristic of the region.

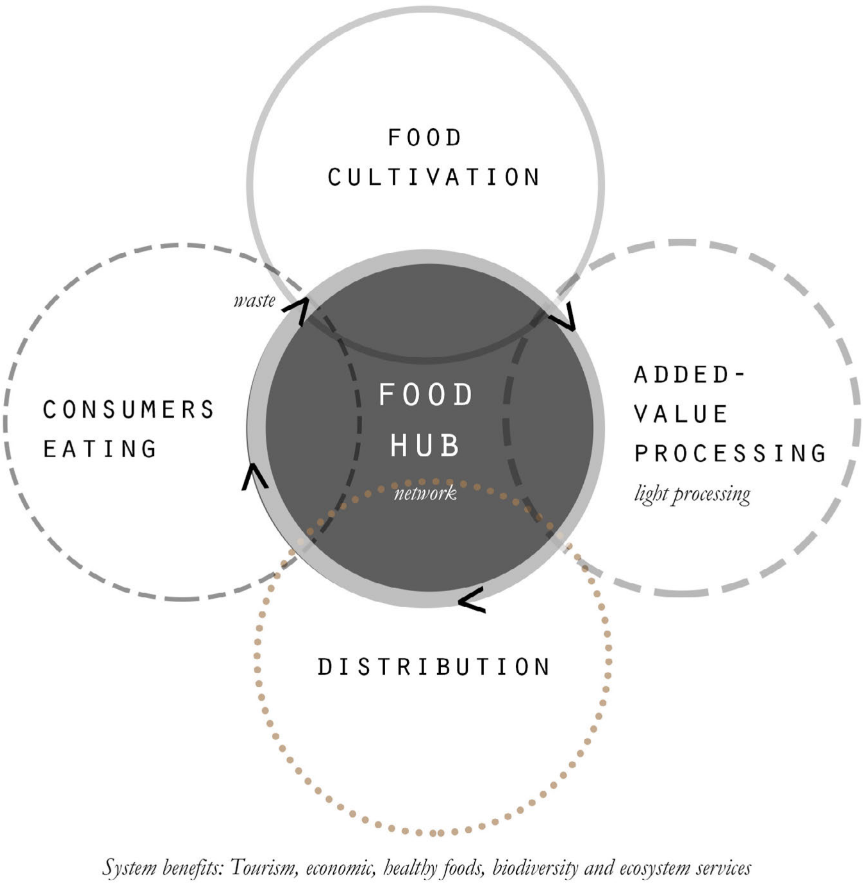


Figure 5.11 *A food hub and its functions (Author, adapted from Hrzic, 2012)*

5.5 BIODIVERSITY VS BIOHOMOGENEITY

Resilience thinking:

Industrial agriculture = ***monoculture***
Small farms = ***biodiversity***

"Weeds + trees + crops + insects + soil = An integrated food web allowing biota to self-regulate = A self-regulating, multi-layered farm that requires little maintenance and no pesticides."
(Knoll 2014: online)

Kurokawa (1994:10) states that diversity is what will begin to define the 21st century while the United Nations declared our decade as the 'Decade of Biodiversity' (Slowfood, 2013:10).

*"**Biological diversity** – or biodiversity – is the term given to the variety of life on Earth. It is the variety within and between all species of plants, animals and micro-organisms and the ecosystems within which they live and interact" (WWF, 2013: online).*

Proliferation of supermarkets and the intensive farming practises associated with industrial agriculture is resulting in biohomogeneity, implying a loss of biodiversity and a damaging impact on place-specific ecosystems. The current system is increasing the fragility of ecosystems by decreasing their complexity, meaning that these systems are unable to adapt to future shocks. Slowfood (2013:10) predicts a projected extinction of ten percent of living species by the end of the century. A system with high complexity and biodiversity has the ability to adapt to climate change (Slowfood, 2013:11) and other disturbances and offers us services. If we continue with current systems of food production, biological diversity will rapidly decrease.

Regional food production would aid in the conservation of both biological and cultural diversity and will retain the *genius loci*. Biodiversity also has the added benefits of aesthetic value and promotes tourism in a region while facilitating human activities associated with craft food production (Slowfood, 2013:11). Food should not be a threat to biodiversity, although we find ourselves in a problematic paradoxical situation where food demand is increasing while there is a rising threat to our ecological systems and species.

5.5.1 VICTIMS OF 'PROGRESS'

The 'Colony Collapse Disorder' describes the rapid decline of bee populations globally. Bees are one of the species suffering from the impacts of our current food system and are dying from a variety of factors including pesticides, drought, habitat destruction, nutrition deficit, air pollution and climate change (Greenpeace, 2014:online). A large portion of the food we eat is dependent on natural insect-mediated pollination, a primary ecosystem service that bees provide. A single bee colony can pollinate up to 300 million flowers each day (Greenpeace, 2014:online), and up to a third of our crops are pollinated by bees and other pollinators, and up to 90% of all wild plants exist thanks to bees and other pollinating insects (Greenpeace, 2014:online). The extinction of bees would result in a significant decrease in food production as they provide a very important ecosystem service to biodiversity and food production and should become an integral part of new regional food production facilities.

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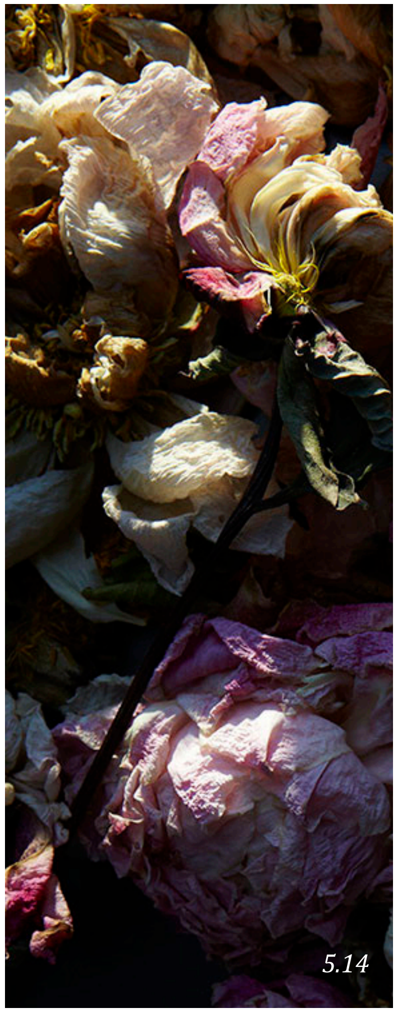
5.13



5.14

5.5.2 ECOLOGICAL FOOD PRODUCTION

Ecological farming is the overarching new policy trend that will stabilise human food production, preserve wild habitats and protect the bees, according to Greenpeace (2014:online). Ecological farming resists insect damage by avoiding large scale monocrops, and preserving ecosystem diversity, assisting in the protection of native plant species. This approach returns soil nutrients with natural composting systems, avoids soil loss from wind and water erosion, and avoids pesticides and chemical fertilisers. It takes advantage of the natural ecosystem services, water filtration, pollination, oxygen production, and disease and pest control.

5.15

Figure 5.16
Identifying existing networks (Author, 2014)

■ culinary route: restaurants, tea gardens, craft brewery

5.6 CULLINAN

INTERWEAVING LOCAL FOOD PRODUCERS,THE LOCAL CULINARY NETWORK, TOURISTS AND CONSUMERS

Article 7.2 of the Burra Charter (1999) states that a compatible use for a site of heritage significance is one which respects the cultural significance of a place and its associations and meanings. The programme intends to plug into existing networks identified in and around Cullinan and to reflect on the discussed narrative and uses once associated with the site.

5.6.1 Local agriculture

The farming and food production network in and around Cullinan should be supported as a developing economic system, and traditional production in a region should be valued in a post-industrial setting (Slow Economy, 2014:13). Flower production is an emerging market that encourages employment in the area on account of its intensive farming method. The Harmonie Protea Farm, located near Cullinan, produces over 30 varieties of fynbos and proteas which are sold locally at markets and distributed to a larger network, including Pretoria. Honey is also farmed in the area along with various fruits. Honey products produced in the area are sold in Culllinan from the Hasslers Honey Farm.

The key strength of this rural setting with its significant agricultural base is its central location and access to important distribution points (Venter 2012:257). Cullinan is situated in close proximity to Pretoria and other smaller towns, such as Rayton.

Agriculture and food is also a part of Cullinan's history. In 1896, Willem Prinsloo distilled peach

5.17

5.18

5.19

brandy using peaches sourced from local orchards on the site where Cullinan stands today. The product and craft unique to the area used to be celebrated at an annual Mampoerfees.

5.6.2 Cullinan as a growing culinary attraction

There is an apparent growing culinary interest in Cullinan, especially along Oak Avenue. Currently, tourists visit the main road to purchase products from surrounding farms and those that are locally produced, as well as to eat at the local restaurants. The popular micro-brewery in Oak Avenue produces craft beers and is visited regularly by tourists.

5.6.3 Local festivals:

The Cullifest: the Cullinan Protea and Garden Expo.

The Cullifest is held annually. It used to be held in Oak Avenue Park but has since moved to a rural setting outside of Cullinan diverting attention from Oak Avenue. The festival accommodates local growers of South African indigenous plants and flowers, most specifically fynbos and proteas. It also caters for an indigenous plant exhibition and flower show where local foods are also sold (including local preserves), along with fresh produce from local farms.

5.7 OUTLINING THE DETAIL PROGRAMME

5.7.1 Programmatic intentions

The programme should:

- Support the growing tourist industry in Cullinan as an important source of sustainable income. This includes the growing food-associated tourist network.

- Support the community through skills development and employment.

- Encourage locally produced food and food products, growing Cullinan's culinary network.

- Address the site's loss of biodiversity associated with mining practises.

- Introduce sustainable food systems to the region suited to the notion of a post-industrial milieu, educating people about resilient food production and processing.

- Contribute to the authenticity of the destination by reflecting on the site's past associations and not detracting from them. The programme must grow from place and respect tangible and intangible heritage associated with the site.

- Facilitate a new resilient re-scripted dialogue between the systems of man, nature and machine in Cullinan with a food revolution.

Figure 5.20 *Craft food in a post-industrial context (Author, 2014)*

5.7.2 Main programme : a local food hub

Production and processing:

1- Horticulture

Biodiversity should be encouraged with on-site plant production for edible and non-edible purposes. Unlike large-scale agriculture, horticulture is of a small-scale and is concerned with biodiversity and forms part of local food systems (which includes ecologically integrated approach and biodiversity). Horticultural production on-site would include orchards, a herbary, flower production and green-houses. An apiary will be introduced to support this and raw products from surrounding farms will also be used and processed at the facility.

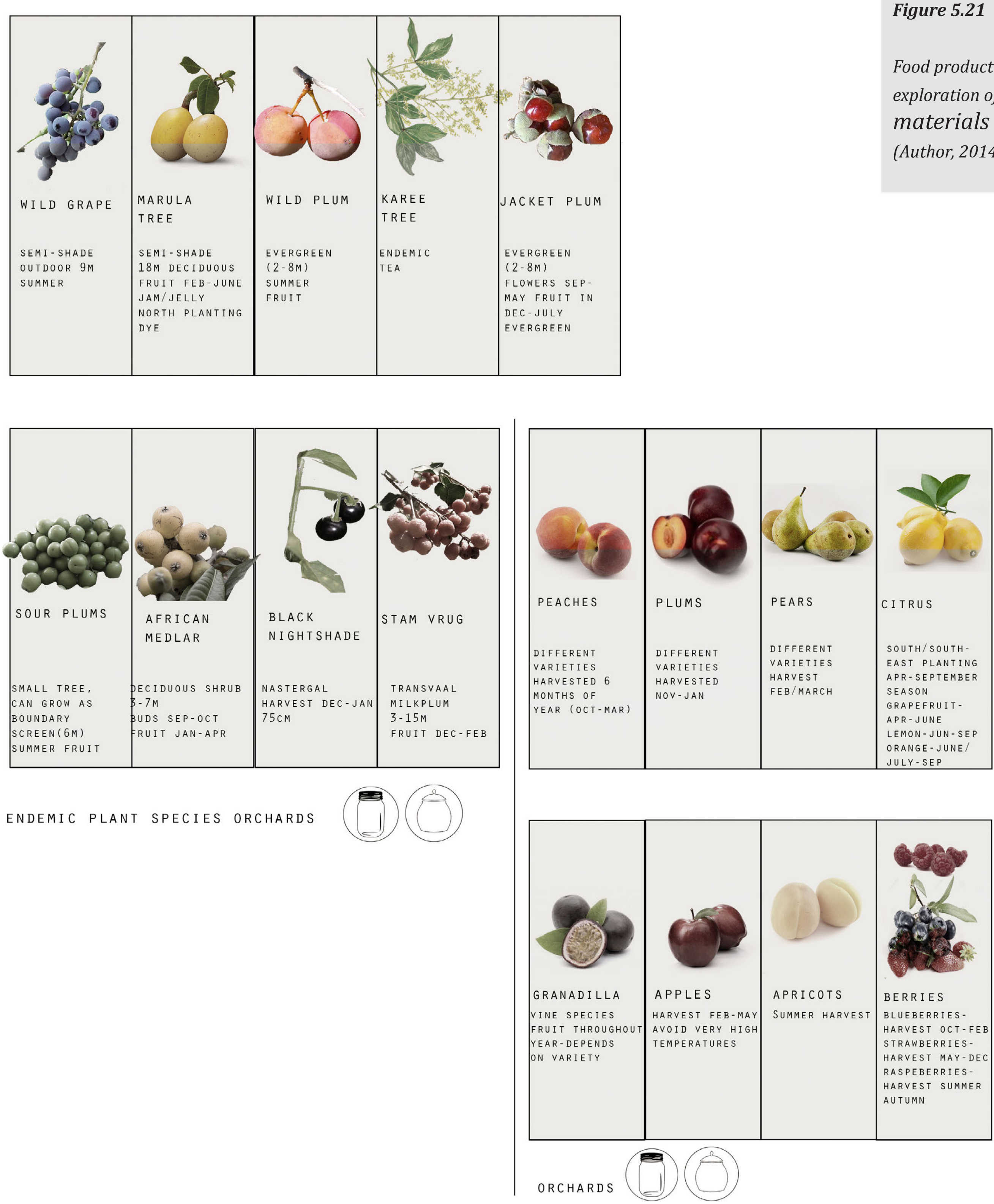
2- Craft/artisanal foods- Micro-industry and processing

Craft/artisanal foods: Food made by hand , with skill.

The facility will include a form of micro-industry related to craft foods. The notion of a return to a craft-based economy is a pre-industrial nostalgia and the post-industrial culture should not romanticise the hand-made- but recognise and include the role of the machine after the Age of Industry (McGuirk, 2012). The Nordic Food Lab (2013) describes this transition as one that bridges the science/craft divide using remnants of the advances of the machine with craft food development. This means incorporating hybridity of craft and machine in the production and processing of food. Where the old food system is defined by machines and factory workers, a new food system includes craftspeople to a much greater extent in the food cycle. Technology on a global scale should be integrated with traditional methods of production unique to place and not a homogenised machine, reconciling nature, craft and a 'new' machine integrated with place.

Figure 5.21

Food production and exploration of raw materials
(Author, 2014)



BASIL — FULL SUN, ANNUAL

THYME — PERENNIAL, EVERGREEN, FULL SUN

LAVENDER — FULL SUN

ROSEMARY — PERENNIAL, EVERGREEN, FULL SUN

SAGE — PERENNIAL

ELDERFLOWER — PERENNIAL, DECIDUOUS, FLOWER SUMMER, BERRIES AUTUMN

MINT — PERENNIAL, WINTER, FULL SUN

LEMON VERBENA — PERENNIAL, DECIDUOUS, FULL SUN

TARRAGON — PLANT UNDERCOVER

CHAMOMILE — FLOWERS ALL YEAR, SEMI-SHADE

CORIANDER — ANNUAL, FULL SUN

GINGER — PLANT SEP-NOV, SUN

COLOURS

TURMERIC — PERENNIAL

RASPBERRIES CRANBERRIES

PURPLE BASIL — PERENNIAL

MARJORAM — PERENNIAL, FULL SUN

HERBARY *TEAS, DRIED HERBS, FLAVOURING, INFUSING, COLOURS, PIGMENTS, PRESERVES, INFUSED-HONEY*

APPLE BLOSSOM — FULL SUN

CALENDULA — WINTER ANNUAL, FULL SUN, APR-NOV

DANDELION — PARTIAL SHADE

PROTEAS — FULL SUN

ROSES

ORANGE BLOSSOM

HIBISCUS — FULL SUN, SEMI-SHADE

JASMINE — FULL SUN/ SEMI-SHADE

LAVENDER — FULL SUN, PARTIAL SHADE

FLOWERS *FLOWER MARKETS, FLAVOURING, INFUSING,*

5.7.3 Sub-programmes

A social interface with tourists and local community

A visitor reception and eating space

Interaction with production and processing is encouraged. This includes fresh produce and artisanal food markets, retail, a tasting room and restaurant, productive gardens and test kitchens.

Cultural and heritage

Interpretation and uncovering the site's associated heritage.

Recreation

The programme will facilitate events and festivals associated with food, seasonal harvest table events, a sports ground for tourists and the local community, picnic spaces and gardens. Festivals will include the local Cullifest and the biannual flower and horticulture show in Cullinan. Along with the larger festivals, it is suggested that smaller scale markets that accommodate local farmers and producers be hosted weekly in the park.

Ecology and biodiversity

The programme intends to support the growing ecotourism in the region. Endemic plant species are to be grown in the nursery for site rehabilitation of the degraded area around the hole and in the larger Cullinan region.

5.7.4 Possible clients

Possible clients include:

Dinokeng Tourism

The Local Food Movement Initiative

South African National Biodiversity Institute (SANBI). South Africa is one of the most biologically diverse countries in the world. The Institute focuses on ecosystem restoration and rehabilitation and manages botanical gardens and is also concerned with regional ecotourism.

South African Apiculture Federation

African Honey Bee has its focus on skills development with regards to beekeeping and honey extraction.

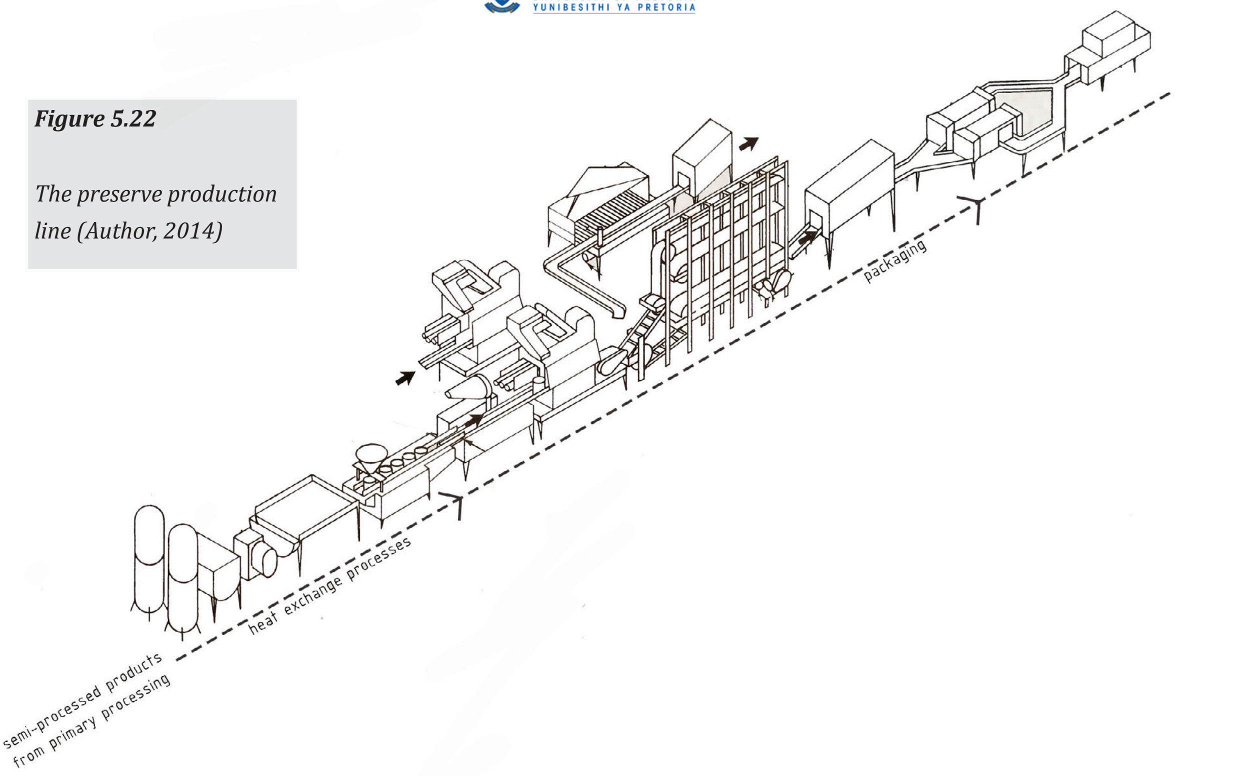


Figure 5.22

The preserve production line (Author, 2014)

Preserve production and processing:

Jams, marmalades and jellies

A mixture of fruit (fresh or semi-processed), sugar or honey and pectin is heat-treated until it is of the right consistency. They could be made of a multiplicity of ingredients, including herbs and edible flowers.

Dried herbs and teas

Product is harvested, and goes through the process of withering, rolling, roll breaking, fermenting, drying, grading and packaging.

Apiculture and honey extraction

This includes the fixed apiary, 100 m away from the public interface, for bee-hives as well as foraging sources, including a wide variety of plant species and endemic plant species. Water should be located in close proximity to the hives, be shaded in summer and protected from the public.

Honey extraction

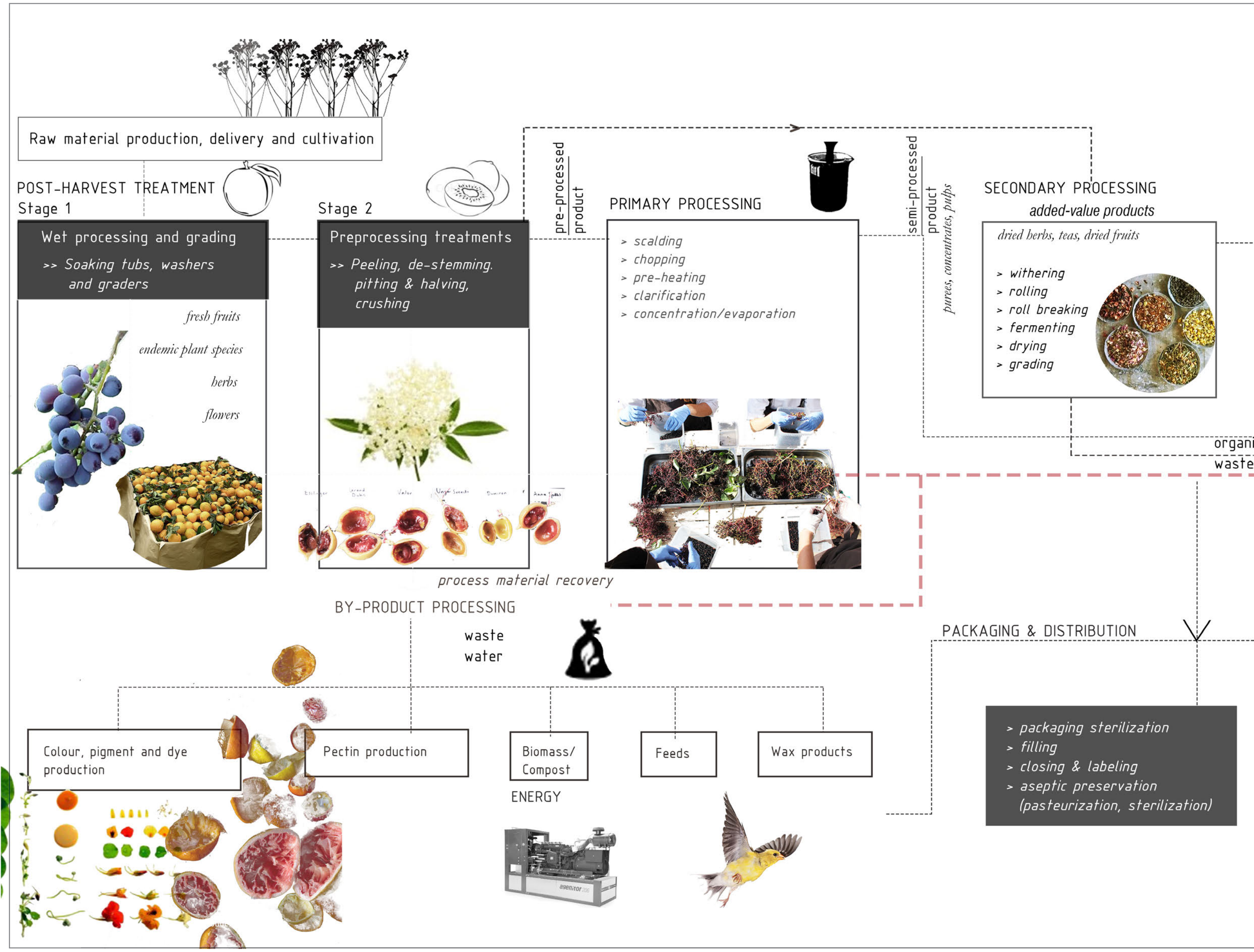
Honey can either be processed from hives on site or from local farms, in the extraction facility. The process involves the harvesting of the honey, preparation, manual or mechanical uncapping, extraction, gravity clarification, filtering, bottling and packaging. The honey can also be infused with herbs and flowers and honey products can be raw, filtered or creamed. Storage is required for hives as well as the finished products. The main by-product is wax which can be melted and reused in the hives. Honey would also be used in the production of meads, which involves fermentation resulting in the production of honey wines. The meadery requires space for fermentation of the product before it is bottled and sold.

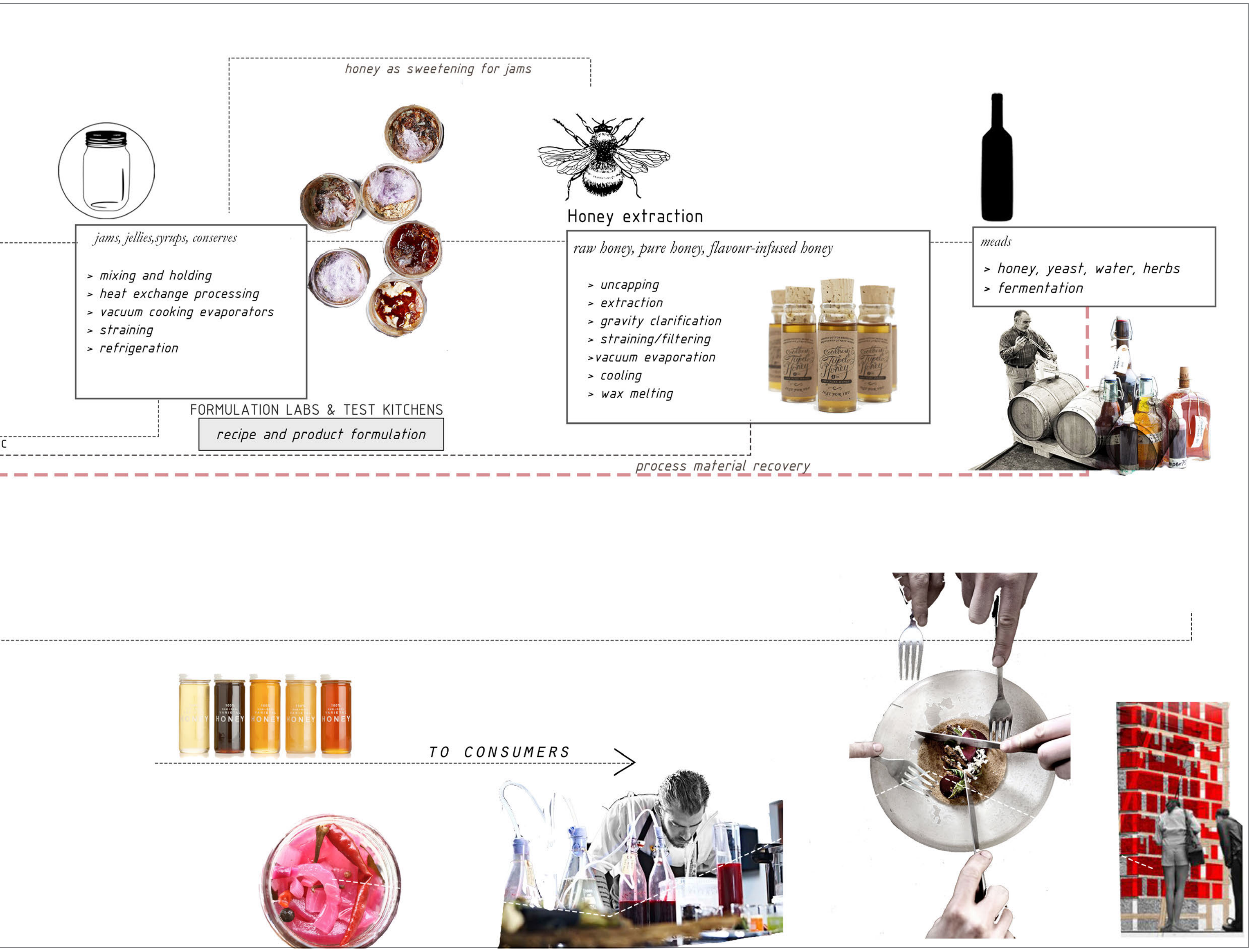
By-product processing

The by-products include the production of pigment and dyes which can be used in the proposed textile mill to be located within the nearby old mining compounds.

Figure 5.23

Added-value products and involved processes (Author, 2014)




honey as sweetening for jams
jams, jellies,syrups, conserves
> mixing and holding
> heat exchange processing
> vacuum cooking evaporators
> straining
> refrigeration
FORMULATION LABS & TEST KITCHENS
recipe and product formulation
Honey extraction
raw honey, pure honey, flavour-infused honey
> uncapping
> extraction
> gravity clarification
> straining/filtering
>vacuum evaporation
> cooling
> wax melting
meads
> honey, yeast, water, herbs
> fermentation
c
process material recovery
HONEY
TO CONSUMERS

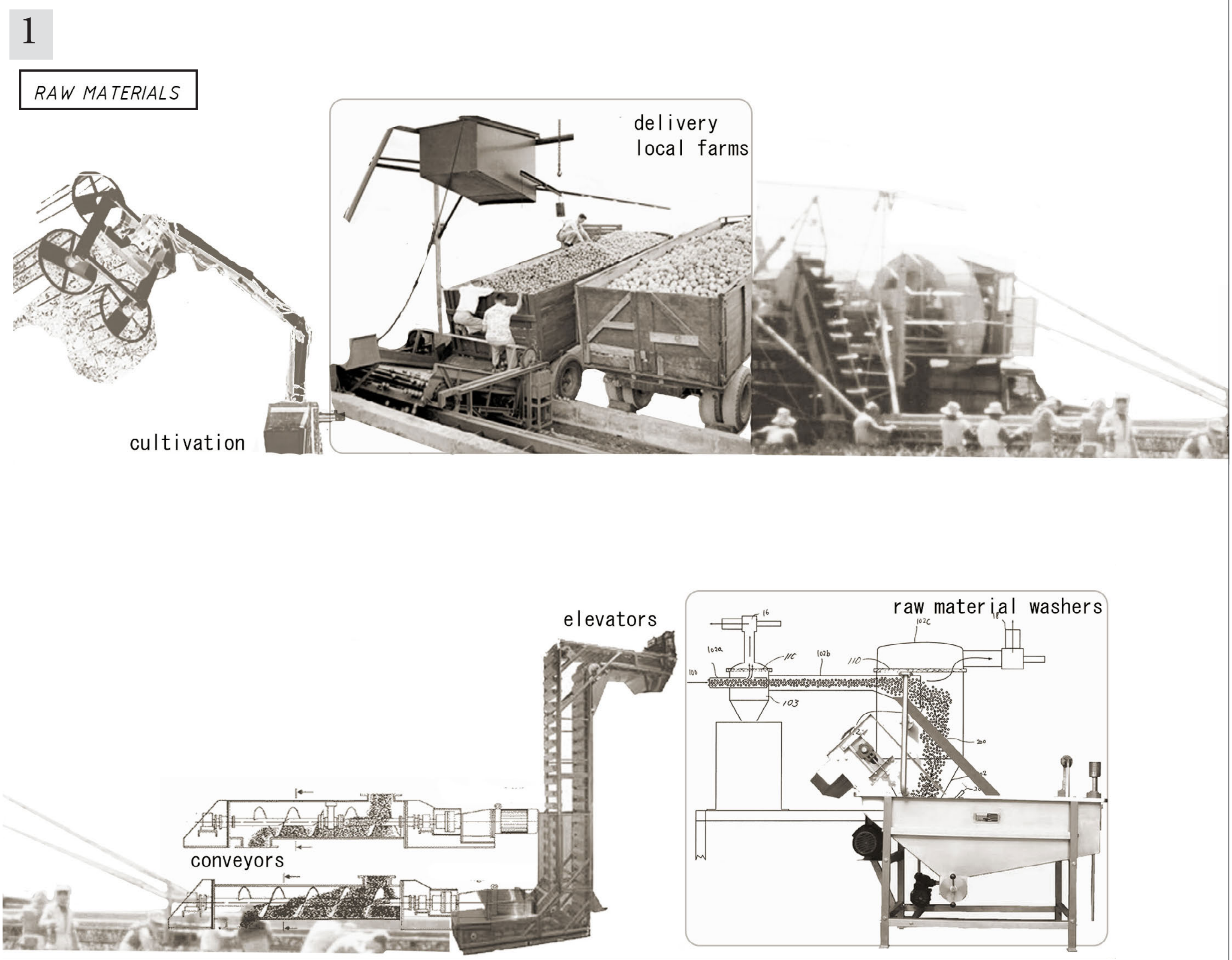
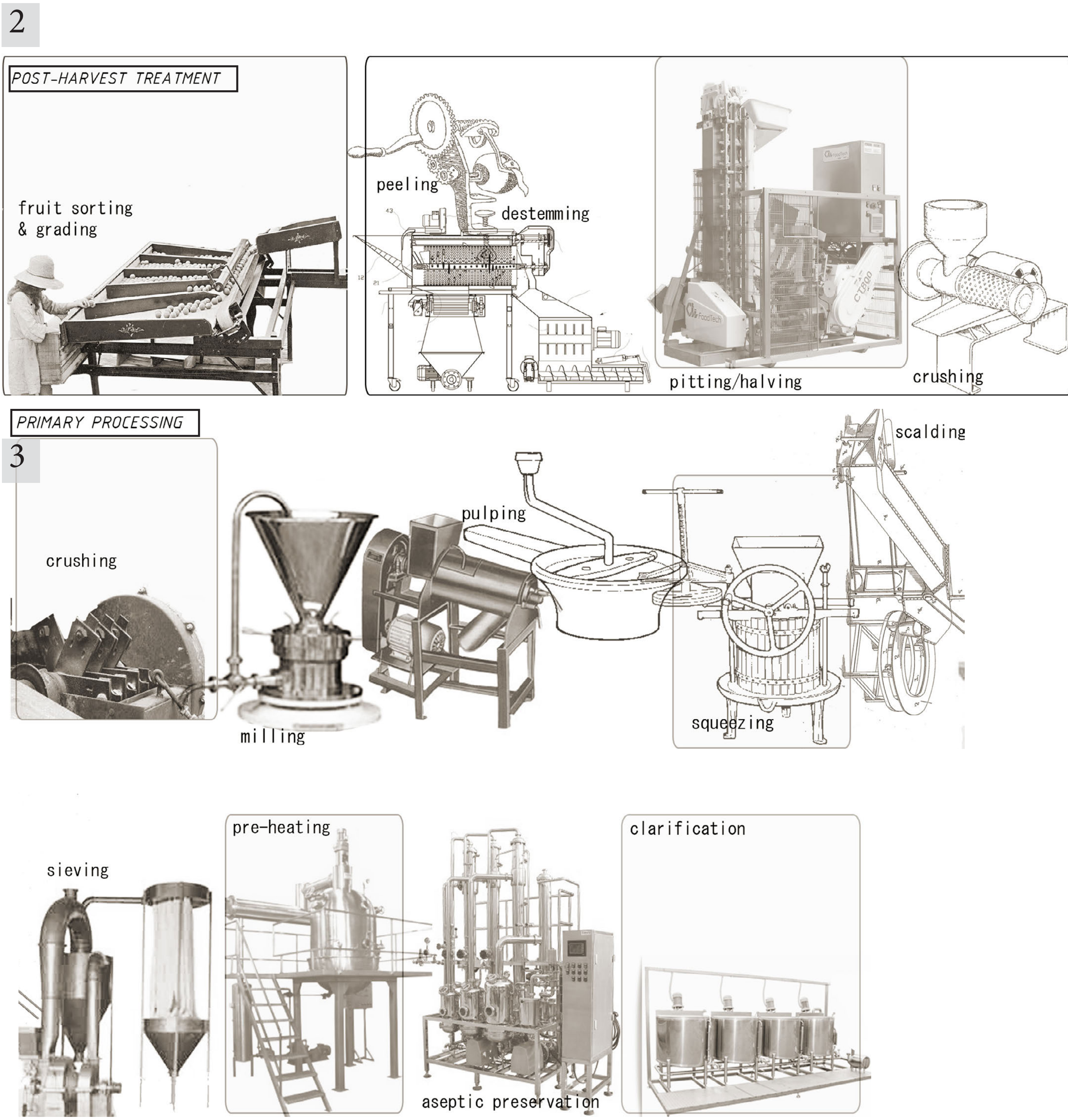
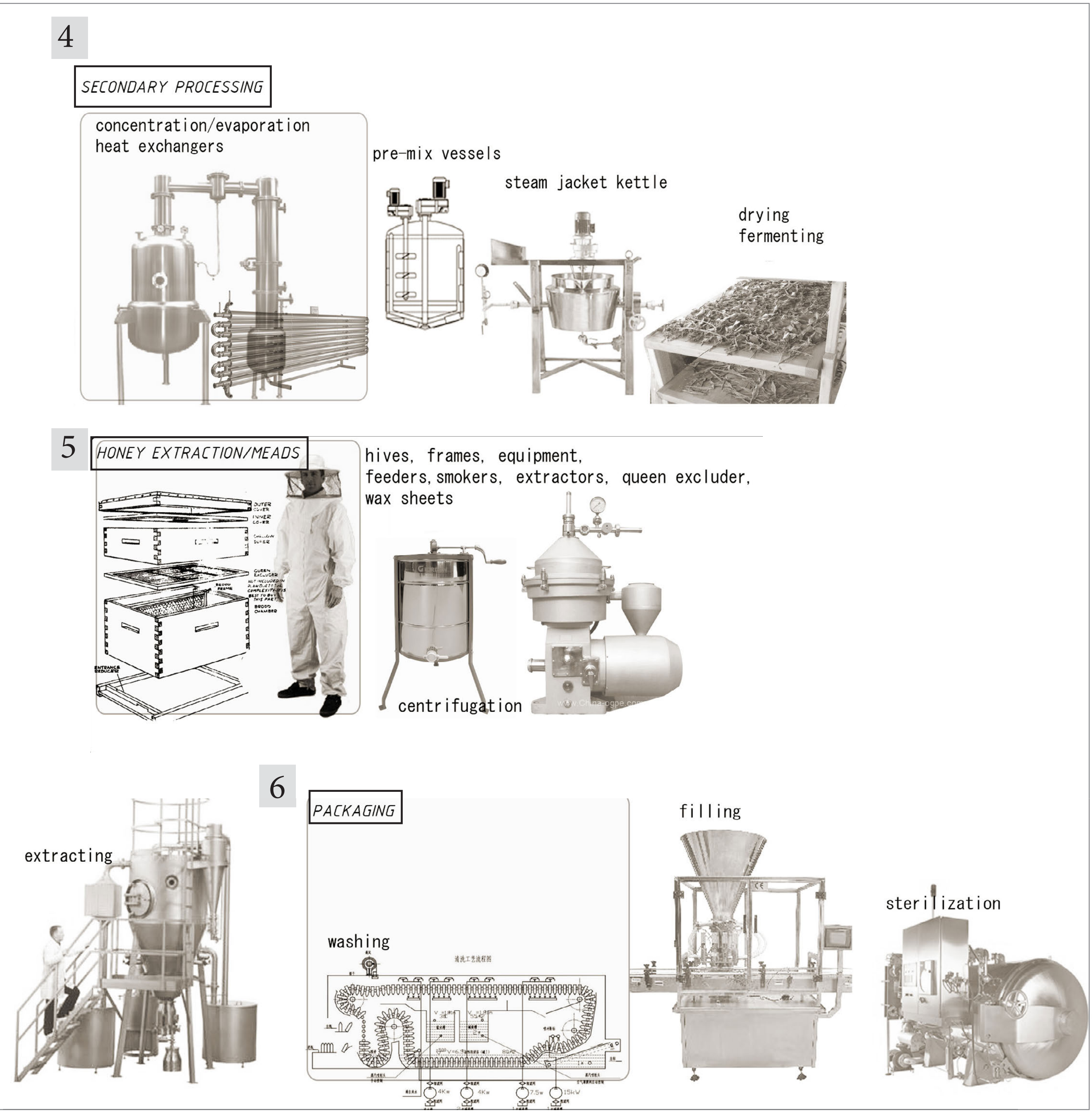


Figure 5.24 *Craft and the machine. A combination of hand and mechanical associated processes (Author, 2014)*


2
POST-HARVEST TREATMENT
fruit sorting
& grading
peeling
destemming
pitting/halving
crushing
PRIMARY PROCESSING
3
crushing
milling
pulping
squeezing
scalding
sieving
pre-heating
aseptic preservation
clarification


4
SECONDARY PROCESSING
concentration/evaporation
heat exchangers
pre-mix vessels
steam jacket kettle
drying
fermenting
5
HONEY EXTRACTION/MEADS
hives, frames, equipment,
feeders, smokers, extractors, queen excluder,
wax sheets
centrifugation
extracting
6
PACKAGING
filling
washing
sterilization

5.8 RESOURCES AND INTEGRATED ECOLOGICAL SYSTEMS

Sustainable food production should have a low impact on resources while using an integrated ecological systems approach. New local and sustainable food systems should address the waste associated with industrialised food systems. Food production both consumes and produces energy (bioenergy), which can be reused by reconsidering the interface between biological and technical cycles, integrating their processes and creating a closed loop for nutrients, within the system. Waste products from processing are reused for by-product processing or as a source of energy.

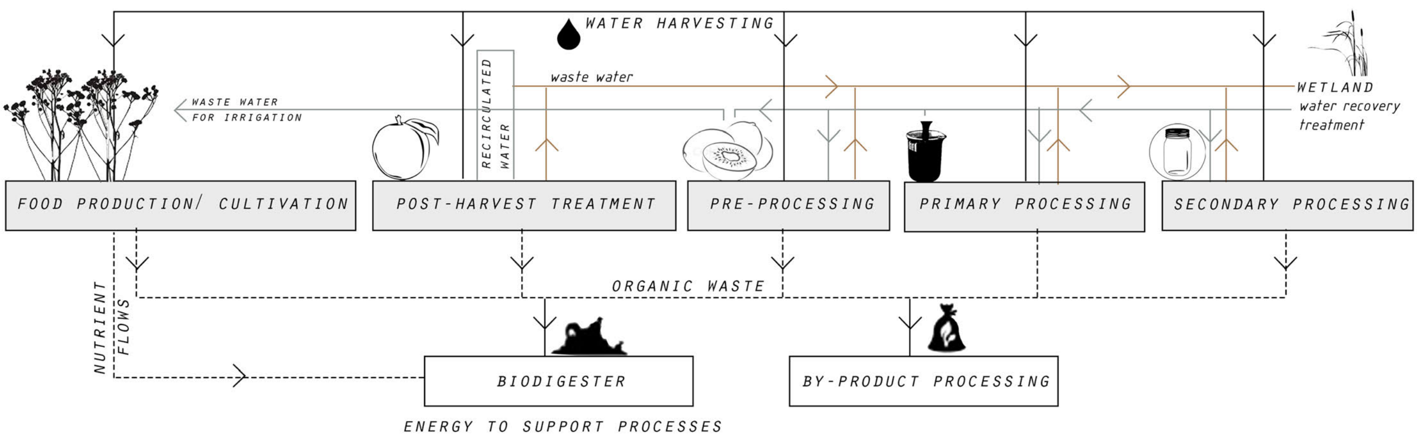


Figure 5.25 *On-site integrated ecologies and resource management for a regional food system (Author, 2014)*

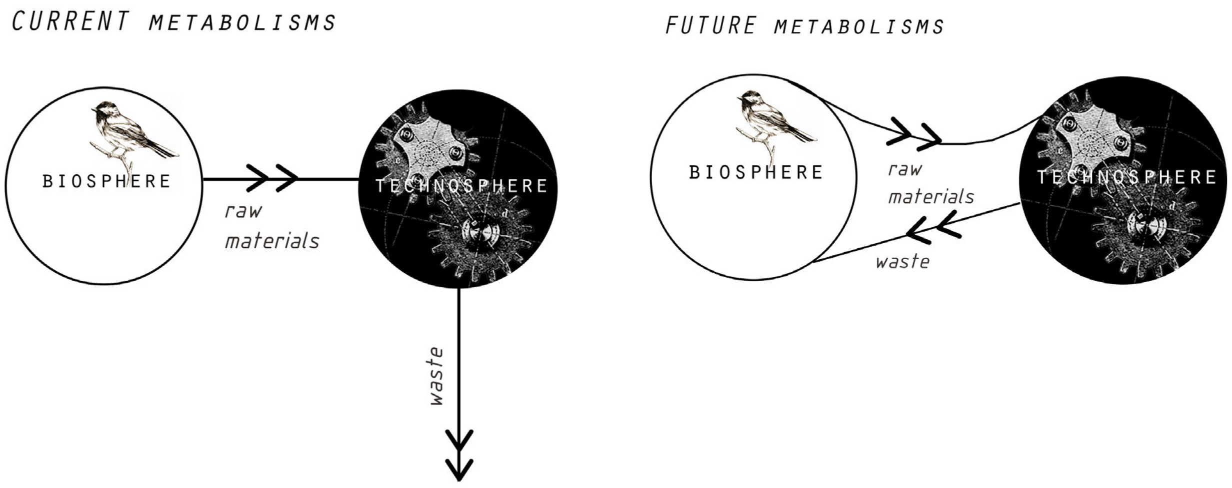


Figure 5.26 *Future integration of the biological and technical cycles in production (Author, 2013)*

Figure 5.27 *By-product processing and waste reuse.*

5.9 DEFINING THE FUNCTIONAL AND SPATIAL REQUIREMENTS

OAK AVENUE PARK *AREA 1*

Sports

- *Sports ground*
- *Storage facilities for equipment*
- *Changing rooms*
- *Public WCs*
- *Seating*

Artisanal and fresh produce markets

- *Delivery and parking spaces for local farmers*
- *Storage for produce*
- *Area for informal weekly food markets*
- *Public parking*
- *Public WCs*

Picnics

- *Picnic area*
- *Water harvesting/interaction area*

Festival and event space

- *Storage for events*
- *Area for event/ festival and exhibition spaces*
- *Public WCs*
- *Ticket offices*

OAK AVENUE PARK *AREA 2*

Tour departure

- *Seating*
- *Ticket office*
- *Tour vehicle departure point*

Nursery, indigenous and heritage gardens

- *Indigenous plant species gardens*
- *Bird watching*
- *Nursery*
- *Security control room*

Event space

- *Storage for event equipment*
- *Seating*
- *Public WCs*

FUNCTION/SPACES		REQUIREMENTS
RAW MATERIAL PRODUCTION		
Staff spaces ('Field house') Changing & wash rooms		Showers and wcs for under 30 field staff. Easy staff access and separate from the public, easy to clean/service.
Kitchenette/break spaces	40 m²	Easy staff access from orchards/greenhouses, ventilation and storage.
Store and first aid room	10 m²	Easy staff access from orchards/greenhouses and post-harvest treatment facility.
Productive landscape: orchards,greenhouses		To meet plant requirements. Full-sun, shade and semi-shade. Greenhouses heated in winter for herbs and flowers.
Organic product store, cold rooms	± 1/4th the area of production space.	0-4 °C (this applies to all cold stores). Refrigerated insulated rooms. Stacking space for the fruit. Dark dry spaces.
Equipment/ implement storage	20 m²	Easy access service space for field implements and equipment repair.
RAW MATERIAL DELIVERY *DELIVERY FROM LOCAL FARMS*		
Service entrance and delivery docs		
Materials reception and weighing	50 m²	
Access to waste and by-product processing area		
Material/ingredient stores	50 m²	
Fruit conveyors and elevators (connecting production and processing areas)		
POST HARVEST TREATMENT *RAW MATERIAL PREPARATION*		
Staff spaces		Shared fieldhouse as above.
Sorting, grading and washing spaces	100 m² (Adlum:2014)	Indoor/outdoor drained areas (wet processing). Well-lit and ventilated. Raw material is usually processed at temperatures at 12-20 °C . Easy to clean.
Cold rooms	1/4th the area of production space.	0-4 °C (this applies to all cold stores). Refrigerated insulated rooms. Stacking space for the fruit. Dark dry spaces.
Drying room	40 m²	Temperature controlled, in close proximity to existing ventilation shaft fans and space for stacking. Access to outdoor space for drying.

FUNCTION/ SPACES		REQUIREMENTS
PRIMARY AND SECONDARY PROCESSING		
Staff spaces *Changing & wash rooms*		Showers and WCs for under 30 processing staff. Easy staff access separated, easy to clean/ service access and ventilation. Separate from processing area
Kitchenette/break spaces	40 m^2	Natural light, private, access to outdoor gardens/seating.
Processing spaces *(separate areas for primary and secondary processes)*	± 200 m^2 each for separate processing spaces (Aldum, 2014)	Sloped floor surface for draining. Easy to clean and maintain,well lit and ventilated. Some double-height spaces to support larger equipment. Flexible linear process layout with access to service spaces and storage. Relationship with outdoor spaces and easy material movement between processes. Access to supporting kitchens and prep spaces. Separated visual public access. spaces. Workbenches between equipment.
Inter-process buffer storage and final rotation stores	± 1/4th the area of production space.	Cold stores and ingredient stores. Dark and dry. Insulated refrigeration stores. Easy access from processing spaces. Easy to clean.
Control rooms/supervisor office	20 m^2	Visual access of production spaces.
Staff and material circulation		Separated route for larger load material movement. Easy access between processes and packaging. Well lit and easy to clean.
Kitchen and preparation spaces		Sloped floor for drainage, light and ventilation. Stores. Workstations and prep areas. Direct access to processing area.
Equipment maintenance	10 m^2	Easy access to processing equipment. Equipment storage,
Plant room	20 m^2	
Conveyors		Linking processing areas.
ADMINISTRATION FOR PROCESSING FACILITY		
Staff spaces		Private area
Ablutions		WCs for under 30 staff.
Kitchen and dining area *Trainng space*	80 m^2 with training area	Break spaces as above. Access to outdoors, gardens and outdoor seating spaces. Access to outdoors, gardens and outdoor seating spaces.
Meeting room	20 m^2	Private
Offices	15 m^2 (2)	Private

For a medium-sized facility, total processing space can range between approximately 800-1500 m^2

(Adlum 2014)

FUNCTION/SPACES		REQUIREMENTS
HONEY EXTRACTION AND MEADERY		
Staff spaces		Shared with other processing area's staff rest spaces.
Access to apiary with changing area		Apiary located 100m away from public.
Equipment store		Easy access from outdoors.
Organic store, honey ripening room	50 m2	Room temperature storage space.
Extraction, processing area	± 100 m^2	Sloped floor surface for draining. Easy to clean and maintain, well lit and ventilated. Some double-height spaces to support larger equipment. Flexible linear process layout with access to service spaces and storage. Relationship with outdoor spaces and easy material movement between processes. Access to supporting kitchens and prep spaces. Separated visual public access. spaces. Workbenches between equipment.
Stores and cold stores	± 1/4th the area of production space.	0-4 °C (this applies to all cold stores). Refrigerated insulated rooms. Stacking space for the fruit. Dark dry spaces.
Wax melting and workshop		Separate area. Processing space as above. Bottling area.
Meadery- processing area *- fermentation rooms* *- stores*	± 100 m^2	Separate area. Processing space as above. Bottling area. Processing area requirements as above.
BY-PRODUCT AND WASTE MANAGEMENT		
Waste processing area		Separate, but accessible from all production spaces. Out of site from public.
By-product processing area	± 50 m^2	Storage and work spaces
WATER		
Water harvesting and treatment		
Pump rooms		

FUNCTION/ SPACES		REQUIREMENTS
PUBLIC INTERFACE WITH PRODUCTION		
Reception	40 m^2	Easy public access, and connection to facility management
WCs	± 200 people expected per day	Easy public access, well ventilated, easy to service. Close to restaurant, tasting rooms and reception.
Facility management (offices)	30 m^2	Separated from busy public spaces, but accessible from reception area.
Private tasting room (for clients)	30 m^2	View over facility. Accommodate approximately 10 people. Kitchenette.
Market and retail	100 m^2 indoor	Central location and high visibility. Market and retail storage.
Tasting rooms and test kitchens	200 m^2 indoor	Views of facility and food system. Separate kitchen space, public visual access. Private prep spaces,waste courtyard, storage.
Restaurant		Indoor/outdoor seating. Outdoor seating shaded with views into industry. Kitchen with storage. Views over the site.
Gardens and viewing spaces		Public seating , bird viewing and seating spaces.
Nursery	20 m^2 indoor	Outdoor space, office and store. Easy public access.
Food and heritage routes		Link to the on-site heritage and food production system.
PACKING HOUSE *PACKAGING AND DISTRIBUTION*		
Holding room/ tanks and buffer storage for products	20 m^2	Link to the on-site heritage and food production system.
Packaging store- jars/trays etc	15 m^2	Easy access from filling and closing rooms.
Filling and closing process area *Aseptic heat treatment area for pasteurization and sterilization*	60 m^2	Floor drain, easy to clean, maintain. Well lit. Easy access from holding rooms and final product store. Setting area for products within the room (at room temperature) after filling and before cold storage.
Supervisor/ check-off office	15 m^2	Access to facility and distribution.
Packaged product store room	50 m^2	Cold refrigerated space and area at room temperature. Dark and dry spaces, ventilated. Link to load assembly and collection area.
Loading bays		Access to load assembly area and distribution office.

5.9 OUTLINING DESIGN REQUIREMENTS

The size of the processing facility lies between small-scale home production and large-scale commercial industry. Food processing spaces need to comply with the HACCP: Hazard Analysis Critical Control Points (Adlum 2014: correspondence), described as the location or processing step where control must be exercised at different parts of the stages including harvesting, primary production and washing processing, packaging and distribution. The best way to accomplish this is to segregate spaces for processing, compartmentalising them and to separately manage these processes (Sinha, 2012:300), with separate intermediate buffer storage between processes.

According to Aldum (2014:correspondence) and Sinha (2012) design of food processing spaces should allow for:

- Ease of cleaning. Walls and floors should have an easy to clean impervious, inert surface

- The drainage of water

- Counter-current waste streams to processing streams
- Good ventilation in the processing spaces

- Separate storage spaces in close proximity to the processing spaces

- Well lit processing spaces

- Flexibility of spaces to accommodate changing equipment and so that manufacturing in the future can vary

Fruit processing involves a series of defined procedures (sorting, classifying, washing, chopping) and processes (heat treatment, cooling, boiling). Basic production and processing activities in brief:

Delivery and on-site production
Fruit and products from local farmers and produced on the site.

Post-harvest treatment
Before processing, fruit and raw materials are sorted on roller tables and are then washed to remove surface contamination. Warm and cold water basins with spray nozzles are used.

Primary processing
Primary processing includes the production of semi-finished products including pastes, purees, dried products and pulps, later used for the production of other food products, including jams, jellies and syrups. Different fruits require different treatments such as heating or crushing and materials are peeled, pitted, pulped and/or crushed.

Secondary processing
Production of jams, jellies, syrups, honeys, meads and confectionery. Boiling and cooking processes are conducted in open steam jacketed kettles.

Staff and ablutions are to be located separately from processing and finished product area.

Packaging
Containers are heat-treated before filling by using an aseptic filling and closing system to preserve the products. A space should be provided for holding rooms and pre-cooling prior to filling and closing. Jars are filled on roller conveyors. After preliminary setting, trays with filled jars are moved to the cooling room to be air cooled before stored and dispatched.

5.10 THE PROGRAMMATIC VISION

The programme suggests the exploration of architecture that relates to the productive landscape and people's interaction with food systems. The social programmes and public interface with the facility is key and will be taking the form of the mentioned tasting rooms, markets and test kitchens as well as the horticultural gardens and nursery. Visitors should become aware of the multifaceted nature of a food system and should therefore be exposed to the various stages involved in a food cycle. This means that the architecture needs to become a mediator between man, nature, the productive landscape, and the machine. The latter includes the old machine extant on the site, the mine ventilation shaft, and the new machine, the new micro-industry processing facility incorporating a new way of making.

Well-rooted local economies and food artisans could be the leading players of conviviality (Slowfood, 2013:20). Sustainable local food production is acknowledged and promoted as a further strong point and an element of protection for a community and a site's cultural and natural heritage.

The programme and food revolution facilitates a new sustainable dialogue between man, machine and nature, healing shattered connections. People visit Cullinan to see the sites and escape to a place with a slower pace. This is a place where they can enjoy good food and the natural and cultural context associated with it. The facility intends to connect people to on-site heritage and on-site ecologies.

Future food systems cannot only stop harming the environment, but give back to place.

Figure 5.28 *Oak Avenue Park (Author, 2014)*

Figure 5.29 *Oak Avenue restaurants (Author, 2014)*

5.30

CHAPTER 6

CONCEPT AND DESIGN DEVELOPMENT

The ghost of a machine, nature's resurgence and mediating man

Chapter 6 discusses the concept and expression of imagined *symbionic* relationships between man, nature and machine on the site and an envisioned mutated future condition. The design exploration is discussed as a response to the informants extracted from the previous chapters and the conceptual approach.

This chapter is divided into two parts. Part 1 explores the design informants, concept and early design explorations. Part 2 discusses the design response and its relation to the triad.

Figure 6.1

Perspective of public tasting rooms (Author, August 2014)

PART 1

CONCEPT AND DESIGN DEVELOPMENT

6.1 A SUMMARY OF DESIGN INFORMANTS

From the previous chapters several key informants have been established that guide the conceptual and design exploration. These informants include the *project intentions, theoretical premise, site, the precinct framework and vision,* as well as the *programmatic requirements*. The synthesis of these provide design clues and, together, lead to the development of the overall concept and its resulting architectural language. These informants will be reiterated in brief:

6.1.1 Project Intentions [1]

The present-day site is a testament to contemporary interactions between the triad of man, nature and machine, where the machine dominates. The intention is to facilitate the impending shift in the mutating relationship between these realms in Cullinan.

The architectural intention is to:

- Set a precedent for a regenerative architectural design response firmly rooted in local nature and culture.

- Explore and express the mutation of the relationships between the triad towards a more resilient structure, investigating this manifestation architecturally.

- Facilitate the imagined transition of man and machine (industry) back to the alignment with natural processes, and their mutually beneficial systemic interchanges.

6.1.2 Theoretical premise

The theoretical approach investigates the concepts of resilience and regeneration. The architecture should regenerate its context, renewing and evolving systems, ensuring that residual natural and cultural systems are not left to fail after mine closure.

This implies that the architecture:

- Supports complexity and diversity in bionic and biotic systems and their interfaces, allowing the system to adapt to possible future disturbances. This implies a revision of the interface between natural ecologies, industry and man reconsidering sustainable socio-ecological systems in a future context.

- Accommodates resilience by recognising and growing existing identified networks unique to

1 See Introduction Chapter 1 for dissertation issues and intentions.

Figure 6.2

The three realms

(Adapted by author from Lincoln archive, 2014)

Man Nature Machine

place. These identified networks include tourists, local farmers and food producers, the local community and the food-related networks in Cullinan.

- Should also recognise the cultural systems associated with place in the form of the traces left by man and machine (heritage) ensuring that memory and cultural identity is not lost.

The concepts of biophilia and permaculture[2] are investigated in response to this new interplay between the bionic and bionic, exploring their architectural manifestation, spatially and systemically.

The theoretical approach directs the architectural response in terms of the physical expression of interaction between bionic and biotic, in alignment with Rainey's (1994) 'three modes' of expression of the bionic/biotic relationships [3].

6.1.3 Site and context

The ephemeral and empirical site conditions, idiosyncrasies and extant fabric must be recognised in the design response, aligning with the theoretical discourse and project intentions. The site is a rich natural and cultural context from which to draw. These qualities need to be considered in the response in terms of their influential geometries, interfaces and connections in the architectural response. The architecture should reinforce the intentions for heritage fabric discussed in Chapter 4[4].

The extant natural site ecologies should be interwoven with the new industrial intervention, cultivating a dialogue with the architecture.

6.1.4 Urban framework and precinct design[5]

The design should respond to the precinct vision and spatial framework, which intends to create a connection between the town and the opencast pit, establishing new connections between man, nature and machine on the site that currently exist in discord.

2 See Chapter 2 for the discussion of these principles.

3 See Chapter 2 for the discussion of these three 'modes' of architectural expression.

4 The detailed approach to the specific attributes is given in Chapter 4.

5 The precinct vision for the site is discussed at the end of Chapter 4 .

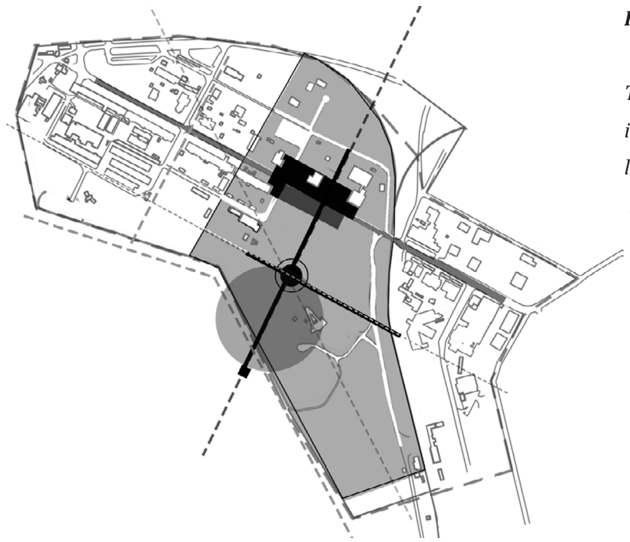


Figure 6.3

The architectural intervention's location on the site (Author, 2014)

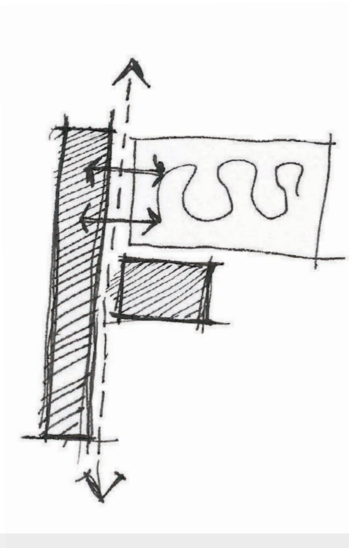


Figure 6.4

Early exploration of the programmatic response (Author, 2014)

The architectural intervention is sited to the south of the Oak Avenue Park (after the point of reflection in the spatial framework) (figure 6.3). The park is retained as an open green space within the town fabric. The intervention should draw energy from the new route (the extension of the stone wall) linking Oak Avenue to a new viewpoint overlooking the Cullinan hole, informing the architectural interface with the public.

The ventilation shaft has already impacted on this part of the site and the proposed placement of the building allows for interaction with the remnants of the machine.

6.1.5 Programmatic informants

The programme necessitates a unique functional and systemic architectural response and intends to create a new dialogue with industry. That allows for interaction with socio-ecological systems, subsequently adjusting the boundary between production (machine), man and nature. The architecture should encourage an understanding of the local food system and the story of food associated with place.

Main programmatic aspects[6] that need to be addressed in the architectural response include:

- Provision of separate areas for processing, inter-process buffer storage facilities for the materials between stages, as well as kitchens and preparation spaces. Easy circulation for people and materials between these spaces is important.

- The programme requires that the processing spaces are flexible enough to accommodate changing equipment and processes according to Aldum (2014 : correspondence). The height of some spaces needs to correspond to equipment requirements.

- Levels of public interaction with the facility should be considered, through either direct spatial or visual connections, determined by the programmatic function of spaces.

- Detail investigation of other guidelines that influence system design (such as waste, water and light) will be discussed in the technical chapter.

6 The programme and its requirements are discussed in greater detail in chapter 5.

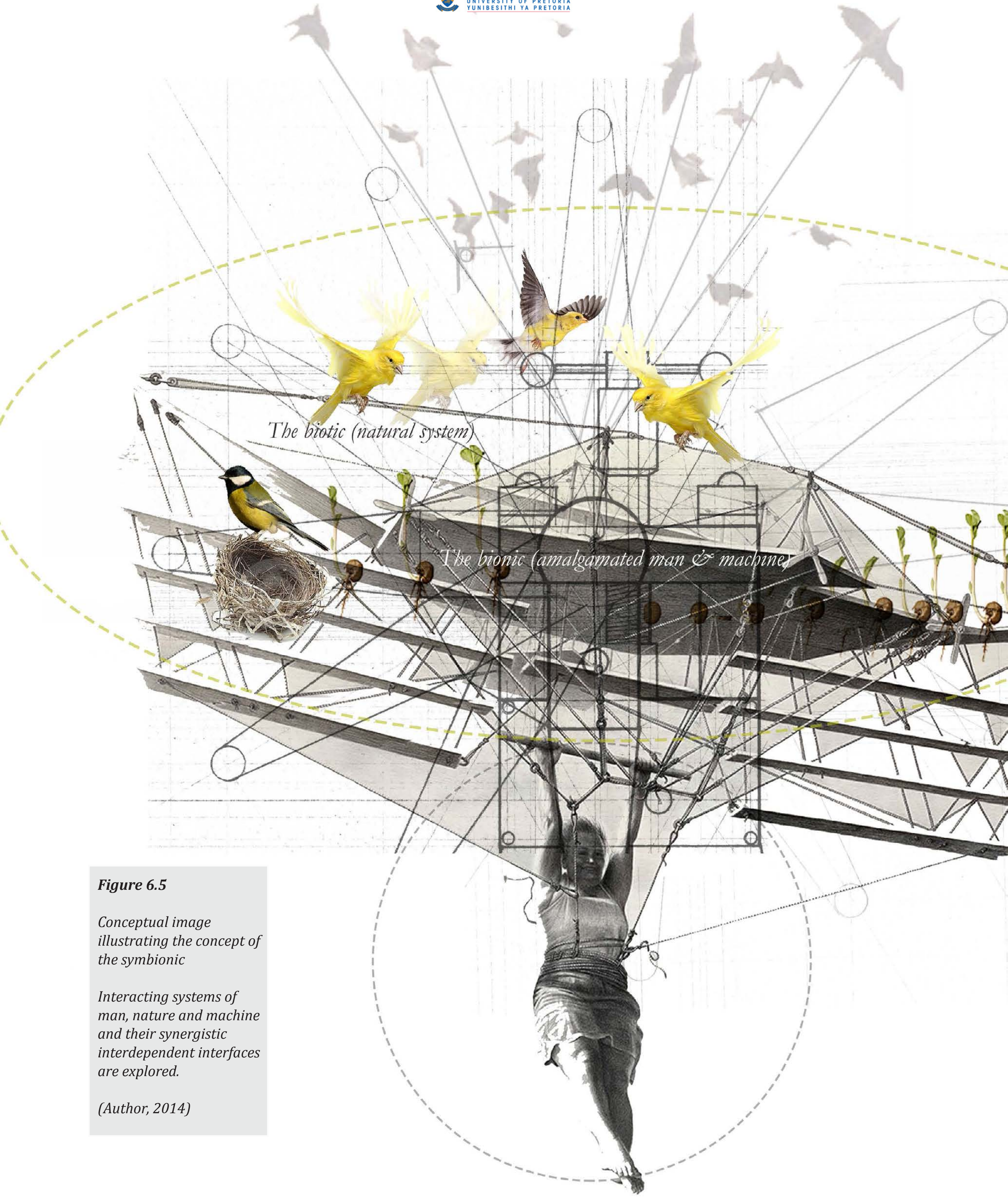


Figure 6.5

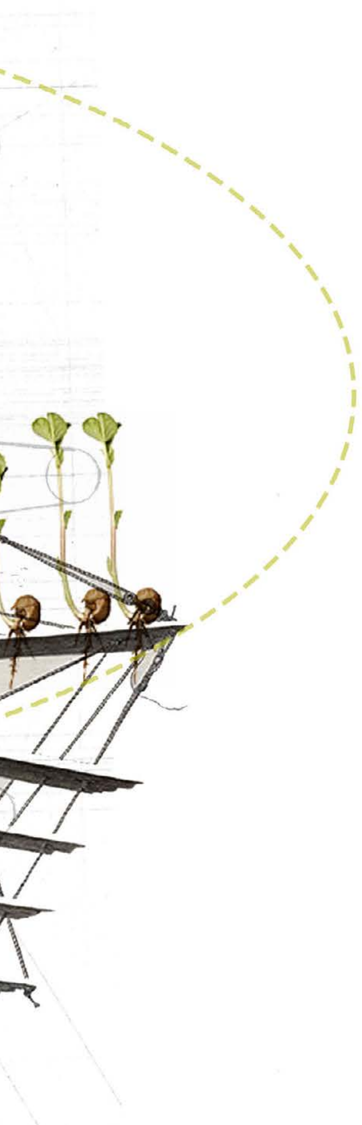
Conceptual image illustrating the concept of the symbionic

Interacting systems of man, nature and machine and their synergistic interdependent interfaces are explored.

(Author, 2014)

6.2 THE CONCEPT

THE SYMBIONIC



The aforesaid informants guided the conceptual development, driving design decisions on a multiplicity of scales. The unique *story of man, nature and machine* in Cullinan informs the response to *place* and the approach to *existing natural and cultural systems* (the scarred landscape and heritage respectively). The extant tangible and intangible *site condition,* from the current reign of the parasite in Cullinan, also informs the concept which should respond appropriately to the traces or 'ghost' of the contemporary narrative representing the current epoch, defined in this dissertation as the Age of the Machine.

The concept aligns with the dissertation *intentions,* imagining anticipated future condition of mutating and transfigured relationships between the three realms: *the bionic evolution.* In order to regenerate and ensure resilience of the town, as outlined in the theoretical investigation, the interfaces and interactions between the dynamic systems of man, nature and machine are envisioned, *evolving* from the parasitic to the *symbionic*[1]. Future synergies between the three realms are explored *architecturally and systemically*. The *programme* and new form of production act as a vehicle for this exploration and the realisation of the concept stemming from contextual influences, while biological and technical cycles are re-envisioned to reflect a future *symbionic* condition and relationships between the triad.

Architecture firmly rooted in place and as participant within its socio-ecological system creates future resilient interdependencies between the three realms of man, nature and machine, expressing these conditions and their vibrant interfaces. The design should translate both empirical and ephemeral dialogues between these three conditions extant on the site. The architectural exploration and translation of the concept will be discussed in this chapter.

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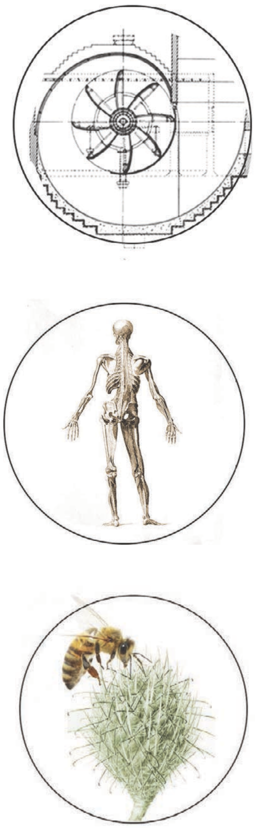
*1 The full **definition** of this term is provided in Chapter 1 and in the theoretical discourse.*

Figure 6.6 *The concept explores the evolution from the current condition, the Age of Machine, to an imagined future condition of the symbionic (Author, 2014)*

6.3 EXPRESSING THE CONCEPT ARCHITECTURALLY

The architectural manifestation of the concept gives tangible expression to the *symbionic* through Rainey's (1994) strategies of architectural expression discussed in the theoretical discourse (chapter 2). These 'modes' of expression embody the reflection of man's changing dynamic with the machine and nature and therefore give architectural expression to transitions that exist across the site.

How architecture relates to its context is largely determined by the view of the relationship between the realms of man, nature and machine. Design, in essence, gives form to these values (Rainey, 1988:6), articulating current and future narratives associated with the context. The variations are explored in terms of the degrees of the building's integration with landscape and its scale. An appropriate architectural language that addresses the three systems of man, nature and machine on the site is explored.



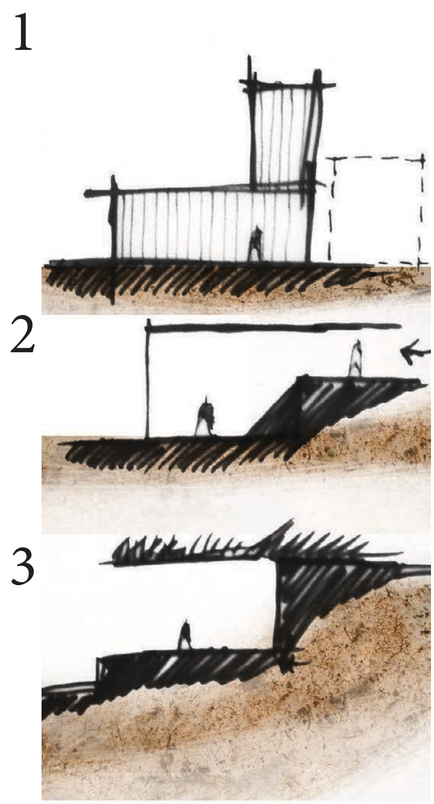


Figure 6.7

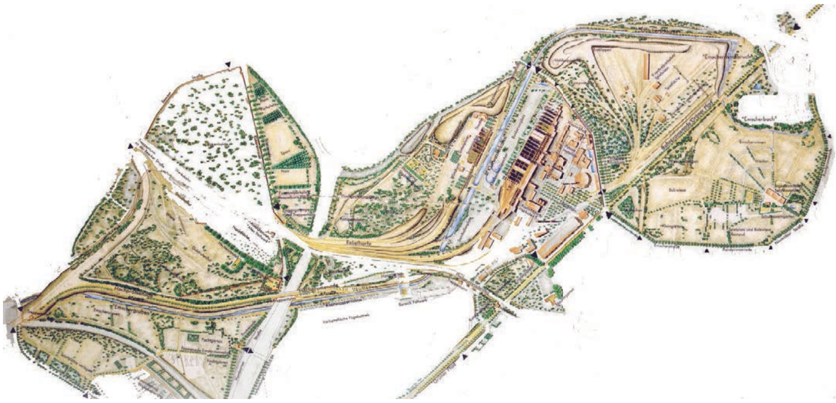
Early conceptual sketches of the architecture, considering a response to man, nature and machine (Author, 2014)

1- Contrast indicating an approach to heritage and the existing narrative of the machine (mine ventilation shaft).

2- Man mediating between the conditions of nature and machine.

3- Merging with the natural context.

PRECEDENTS

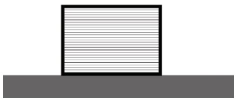


6.4 CONCEPTUAL AND DESIGN PRECEDENTS

Figure 6.8 *Latz and Partner's design for Landschaftspark, Duisburg Nord (Guixer, 2000)*

PRECEDENT

6.4.1 The machine



Architecture of contrast

Landschaftspark
Duisburg-Nord, Germany
Latz and Partner
2000

Landschaftspark is an urban landscape park and regenerative design introduced to renew an old industrial mining site (a former steel plant). The closure of industry in the area resulted in economic and ecological ruin, social change and loss of cultural significance (Reed, 2005:27). The project reflects an emergent architectural approach to post-industrial parks (Stilgenbauer, 2005:6), introducing a public programme that engages with this industrial heritage site, also functioning as a gathering and event space. Latz and Partner recognises the relics of past industry as 'giant' objects located in the landscape that can function as landmarks, speaking of *genius loci* of the site (Guixer, 2000:online). A combination of nature and industry is reflected in the design, resulting in a rich expression of historical narrative.

Figure 6.9 *Celebrating industrial fabric and creating contrast (Schulz, 2012)*

Figure 6.10 *Park and public interaction with the remnants of industrial fabric (Landezine, 2011)*

Figure 6.11 and 6.12 *Contrast between the dominating industrial remnants and the natural condition (Schulz, 2012)*

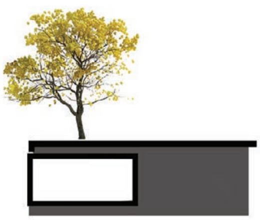
Design principles and relevance

The project is located within a similar physical and theoretical context and the design sets a precedent for a response to extant industrial fabric consistent with the architectural expression of *contrast*. The deindustrialised site is recognised for its ecological and social roles, regenerating and encouraging resilience in an area, and maintaining the remnants of old industry as alien objects on the site. The intervention contrasts with the industrial narrative by giving these machine objects space, as opposed to contending with them. There are, however, functional linkages reusing some of the existing infrastructure to support the new intervention. The design response also 'narrates', facilitating a new dialogue between man, heritage and nature on the site.

PRECEDENT

6.4.2 Nature

Merging architecture



Igualada Cemetery Park

Barcelona, Spain

Enric Miralles and Carme Pinós

1994

The Igualada Cemetery blends almost seamlessly into the landscape and site of a former quarry as if it is an extension of it and a physical extension of the natural aspects of life, expressing new interactions and relationships with the landscape (Reed, 2005:110). Most of the architectural decisions reflect integration with the natural context and changing topography, from embedding and carving the building into the landscape, to the material selection including stone from the site and aged concrete.

A large plaza-like path lined with a sloping wall (see figure 6.13) guides people through the site, connecting them with different parts of the building (Reed, 2005:110). The continuous wall follows and strengthens this route, changing its nature along its course in response to the site and activities along its length.

Figure 6.13 *The architecture integrated with its context (Kroll, 2013)*

Figure 6.14 *Merging with the site. and morphing topography (Kroll, 2005)*

Figure 6.15 *The route through the site and the sloping wall (Kroll, 2013)*

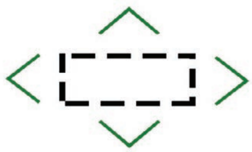
Design principles and relevance

Like the Landschaftspark, the project is a regenerative architectural response that renews the site after a former industrial process. The cemetery sets a precedent for an architecture that merges with context and grows from place and landscape, becoming part of it. It represents architecture that *merges* with nature. Design elements such as the wall running through the landscape and public interaction with the route are of value as they establish a connection between man and the context.

PRECEDENT

6.4.3 Man

A mediating architecture



Inca Public Market

Mallorca, Spain

Charmaine Lay and Carles Muro

2011

The Inca Public Market is a food market that reflects a dynamic exchange between internal and external conditions. The architecture is transformed by its context, while transforming it. Horizontal elements define the market spaces reflecting the interstitial mediating space between internal and external spaces. The floor surface changes and morphs forming the route and seating, making the public aware of functions that occur below them.

A pergola runs parallel to the street and transmutes, changing its height and levels of transparency mediating indoor and outdoor conditions and spatially defining the different functions beneath it. The roof form also changes internally to light and ventilate the market spaces. The pergola is a tectonic element and an element of continuity within the public realm.

Design principles and relevance

The project sets a precedent for architecture within the realm of man on the site and the mode of reciprocity, connecting conditions and defining the public interface with the architecture.

Figure 6.16 *The changing floor plane in the public realm (Frameweb, 2013)*

Figure 6.17 *The mediating roof element (Frameweb, 2013)*

DESIGN DEVELOPMENT

6.5 THE SPATIAL INTENTION

Man, nature and machine, and the three modes of architectural expression that reflect on their relationships, inform the spatial intention. The making of space is influenced by the changing dynamics that occur between bionic and biotic on the site and the programme. Biophilia replaces technophilia and re-scripts the dialogues among the triad, adapting architectural boundaries with the dynamic and cyclical natural condition. The new intervention should, however, also provide spatial connections to the existing machine, its ephemeral quality and linkages to its 'roots'- the unseen underground mining tunnel network and its surface remains in the form of a rusted skeleton of past industry. The ghost of the machine remains as a symbol of the parasite that once devoured Cullinan. Spatial connections should be made with both cultural and natural locale, while portraying new relationships through the lightness or heaviness of spaces, degrees of transparency and physical and spatial linkages between interior and exterior conditions. Expressing the spatial languages and palimpsest of man, nature, machine and their thresholds is discussed in the design explanation at the end of this chapter.

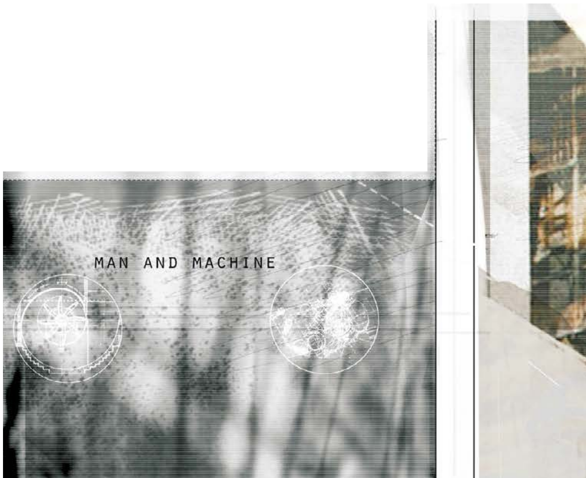


Figure 6.18 Spatial intention

A conceptual image exploring changing characteristics, system interactions and spatial layering as a response to the future and extant site dynamics between man, nature and machine as well as the envisioned programme

(Author June, 2014)

6.6 THE SYSTEMIC INTENTION

6.6.1 The 'new machine'

The 'new machine' refers to imagined future industry, and the transmuted relationship between bionic and biotic *systemically*. The programme reviews industry as a reflection of new system exchanges that are resilient, unlike the current machine represented on the site by the ventilation shaft. Passive and mechanical systems are combined to support the programme which challenges contemporary food systems and production. The re-coupling of technical systems with extant ecological systems and cycles on the site is investigated in line with the tenets of permaculture.

6.6.2 The machine and nature

The ventilation shaft and its current operation is a linear system representing contemporary resource inefficient industry (figure 6.19). This machine should retain its narrative as a mechanical 'lung' that currently supports the underground tunnel network, but should also be functionally adapted to support the new intervention after mine closure. The old machine is re-envisioned to operate as a component of a larger closed-loop cycle within its context.

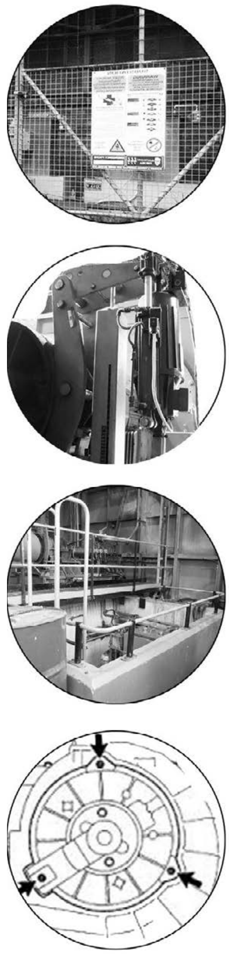
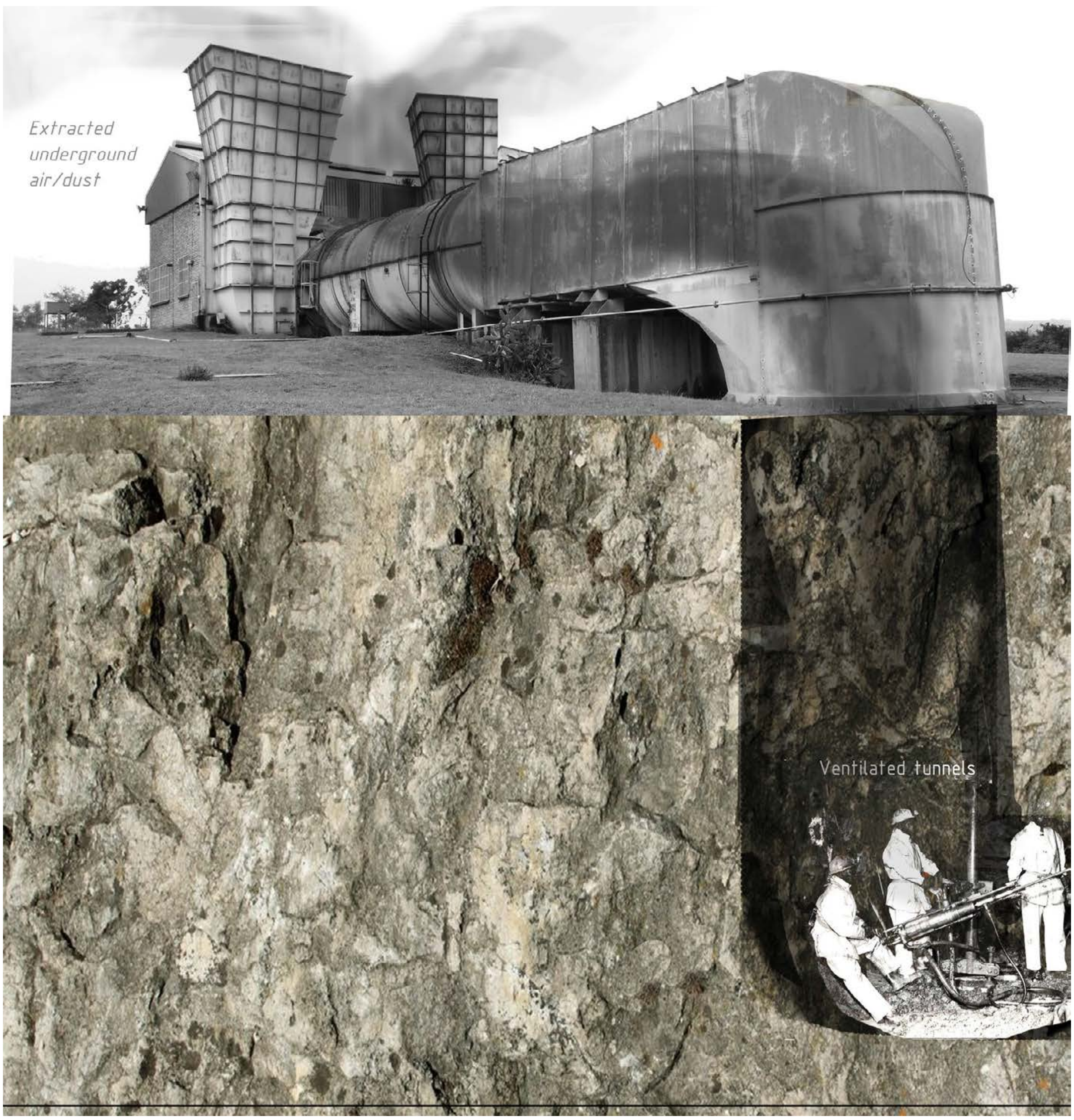


Figure 6.19 *(Author, 2014)*

The current machine

The current ventilation shaft is powered by a small electrical substation on the site. Motor-driven fans extract the stale underground air from the tunnels, thereby supporting the mineworkers.


Extracted
underground
air/dust
Ventilated tunnels

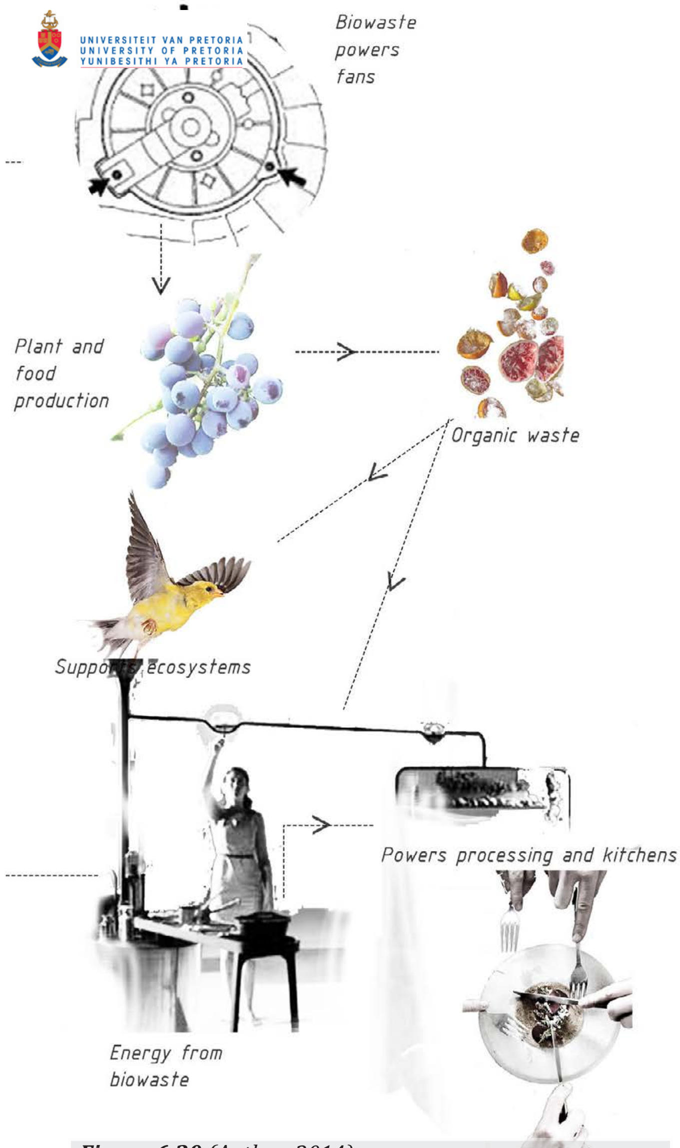
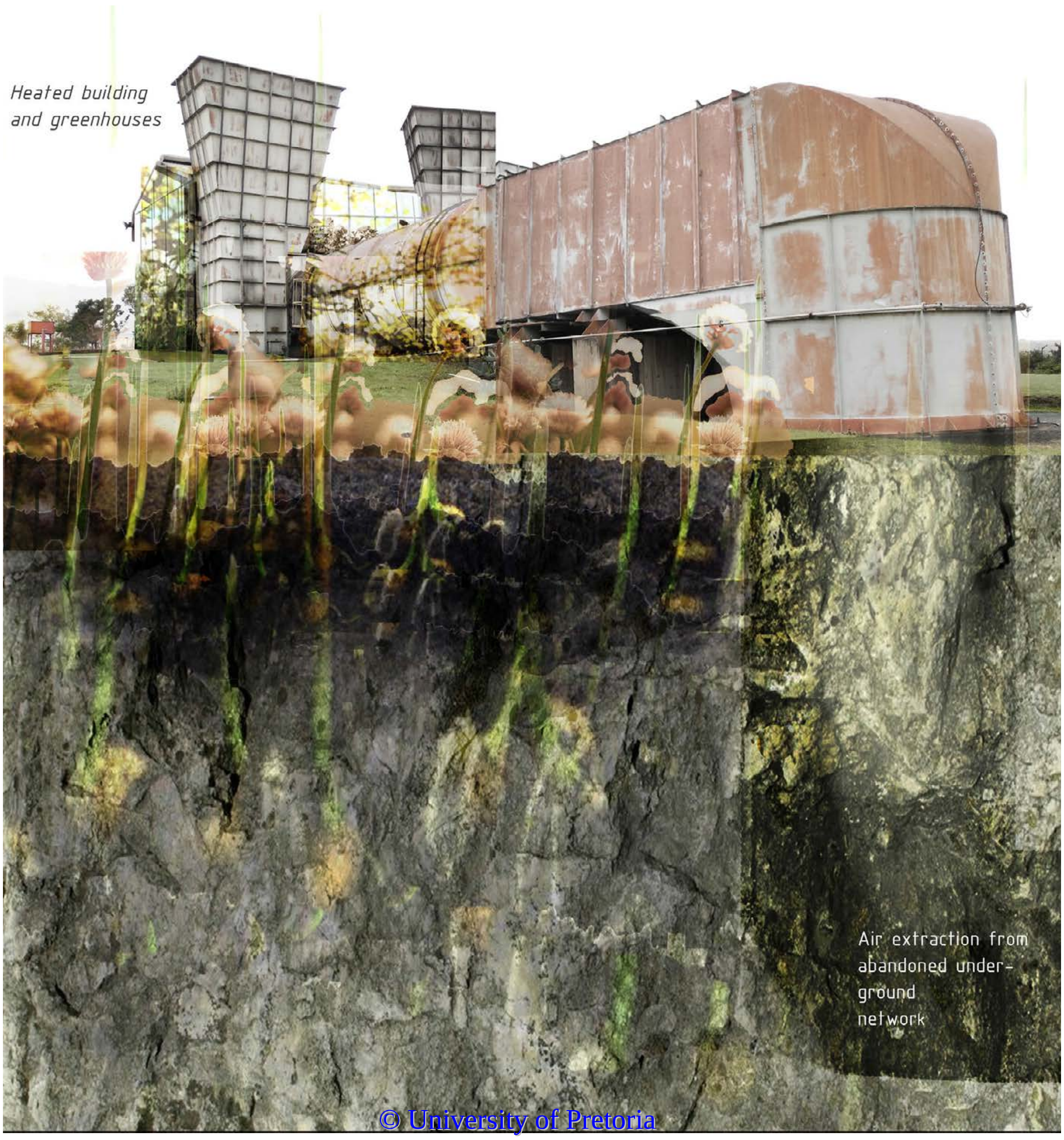


Figure 6.20 *(Author, 2014)*

The future machine

The existing infrastructure of the machine is repurposed to functionally support the future machine and forms part of an interconnected network that integrates man, nature and machine into the new programme. The electrical substation is replaced by biodigesters which are fueled by organic waste from the site and facility with the purpose of powering fans in the ventilation shaft structure, adaptively reused as a greenhouse and extended to the northern part of the site. These fans extract air from the abandoned underground tunnel network to heat the greenhouses, discussed in more detail in the technical investigation (chapter 7). Nature supports man and the machine, which in turn, support nature, realising new synergies.


Heated building
and greenhouses
Air extraction from
abandoned under-
ground
network

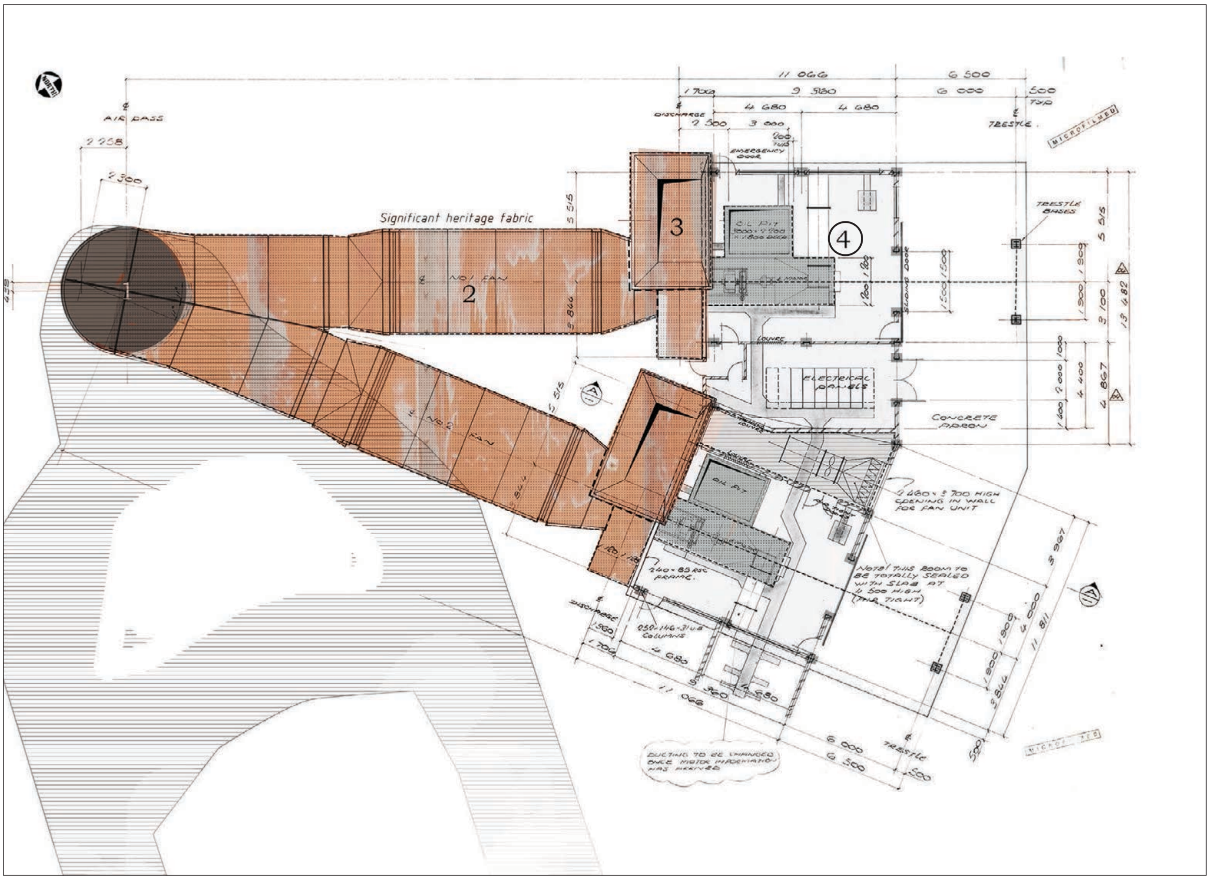


Figure 6.21 *(Author, 2014)*
The 'breathing' ventilation shaft is retained to support new life on the surface. The existing structure (4) , which protects the motor rooms connected to the ducts, is adaptively reused to support greenhouses.

6.6.3 The machine and man

The proposed micro-industry intends to address the existing margin between industry and the public. The adaptation of this boundary through the architecture should allow for increased interaction between industrial and socio-ecological systems. Man should be able to interact with new integrated technical and biological systems to gain an understanding of their workings in the processes on the site.

Figure 6.22
Exsiting fabric of the machine
(Author, 2014)

6.7 APPROACH TO EXISTING FABRIC

The machine

The ventilation shaft exists as an isolated, dominating object in the landscape representing current parasitic interactions between man, nature and machine. Because of its *alien* quality and associations, the intention is to retain its power in the landscape, evoking a memory of past relationships between the triad and a sense of continuity in the expression of man's ongoing changing relationship with nature and machine. The new intervention is the next phase in the evolution but the architecture has to allow an understanding and visual access to the remnants of this machine on the site in the future condition of a closed mine as a memory of old interactions.

The complete network associated with the shaft, including the connected underground mining tunnel, must be communicated through the new intervention, portraying its narrative and function. The scale of the structure that covers the motor-rooms (4 in figure 6.21 and 6.22) also expresses the dominance of the current condition powerfully asserting its presence in the context, and can be functionally reused to support the greenhouses. The new architecture intends to create juxtaposition with the existing fabric, expressing symbiosis and changing its nature across the site to facilitate new relationships between the triad.

Nature

On-site natural elements will not only support the design systemically, but influence it experientially. Nature is a *cyclical element* and its dynamic, *evolving character* can be given expression through the new intervention. Gardens and productive landscape are located throughout the site and amalgamate with the new building.

New water routes will demarcate edges and thresholds, running along the extent of the building from the highest part of the site (the shaft) to the proposed production facility at the lowest point of the site.

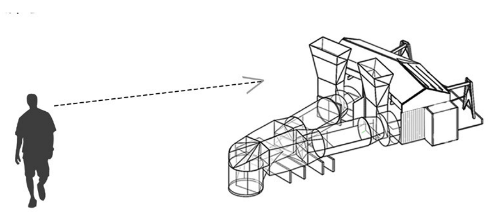


Figure 6.23
Model of the ventilation shaft and investigation of the approach to heritage fabric, reusing the existing structures for food production
(Author May, 2014)

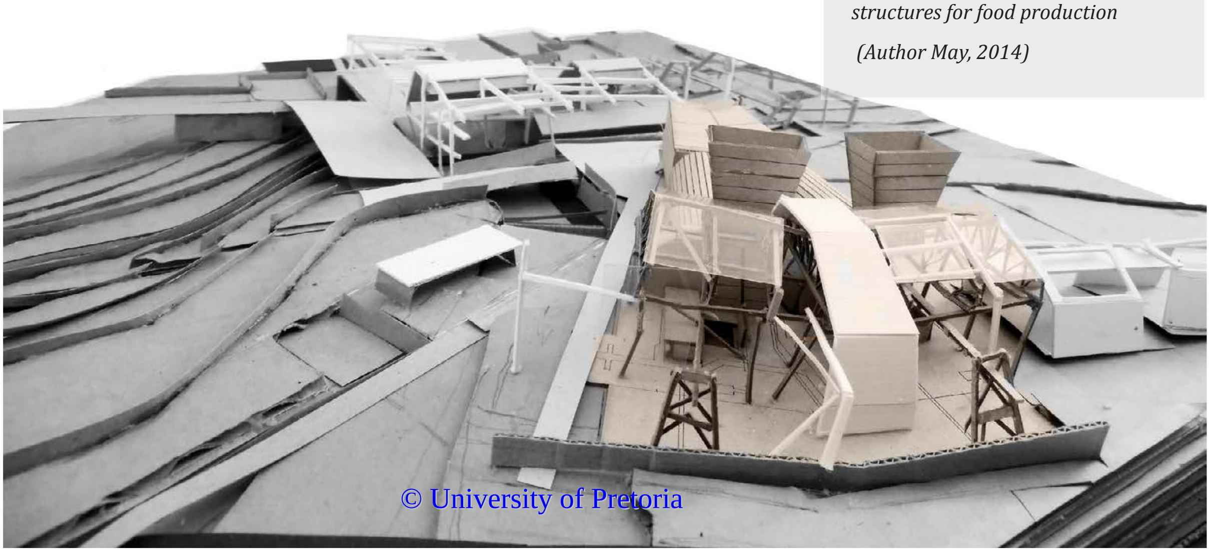


Figure 6.24

The stone retaining wall in Oak Avenue Park (Author, 2014)

6.8 THE CONCEPT IN CONTEXT

The concept and re-scripted dialogues between *realms* is considered *on site.* A contour running parallel to the new route (an extension of the stone wall [figure 6.24] connecting the town to the viewpoint) has remained untouched by both man and machine (the current amalgamated system representing the existing bionic system in Cullinan) (Fig 6.25). The topography of the park has been altered by man to accommodate the sports ground, and the immediate area surrounding the ventilation shaft has also been graded to support the machine. This contour, although a constructed representation of nature by man, acts as the embodiment of the future transfigured synergies between the realms within the context. It influences geometries of the architectural intervention and together with the new route, the contour will define the realm of man on the site.

The intervention also acts as a 'platform' connecting man to the cultural and natural realms on the site (Fig 6.26). To the east of the route, the new architecture establishes a connection to heritage fabric, the ventilation shaft situated on this 'platform'. The western side of the route is the most unaffected part of the site where the architecture establishes a stronger connection to nature.

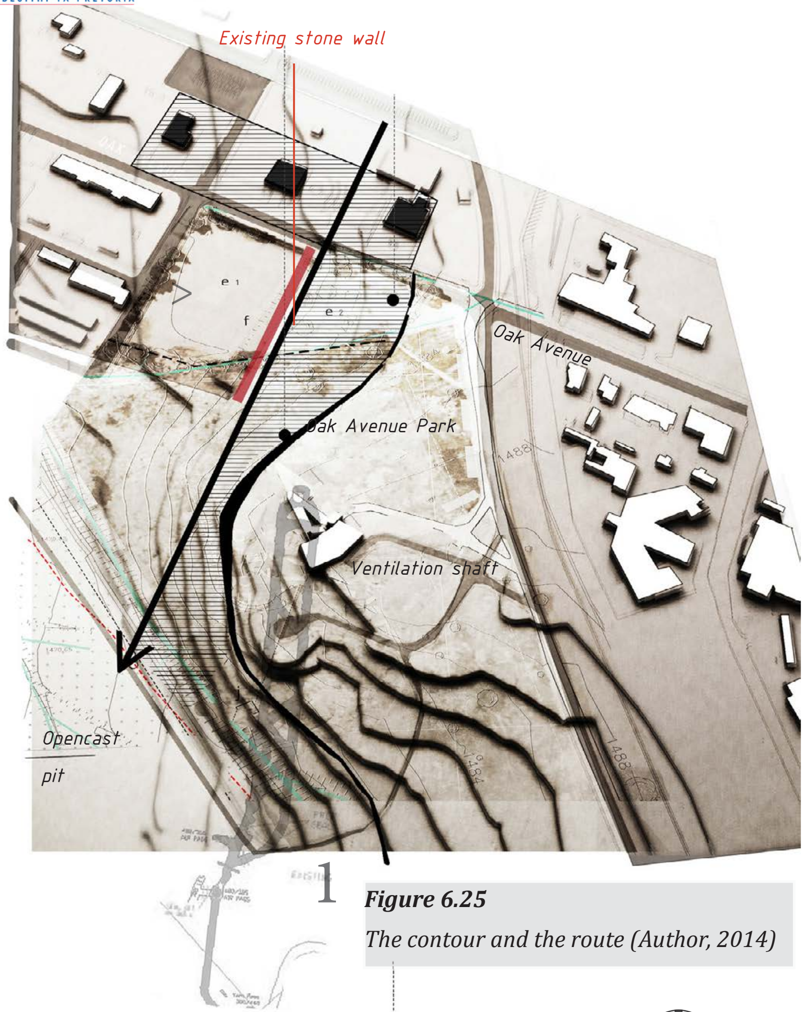


Figure 6.25

The contour and the route (Author, 2014)

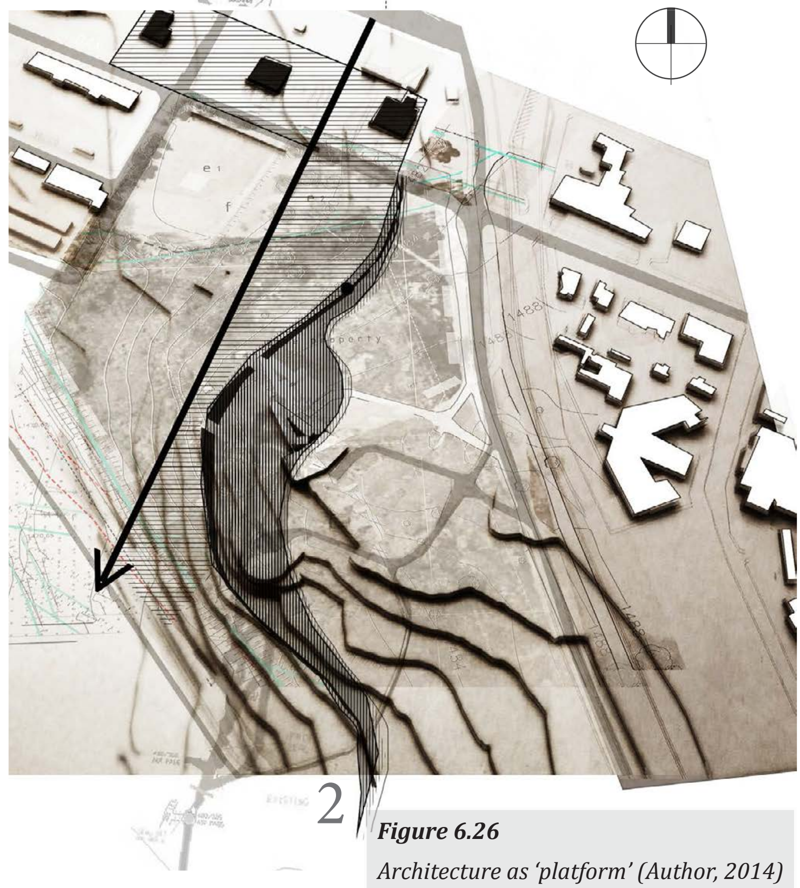


Figure 6.26

Architecture as 'platform' (Author, 2014)

Figure 6.27

The concept on the site

The realm of man exists along the main route and contour (1), while the architecture acts as platform connecting man to nature and machine (2). Although vibrant synergous interfaces are explored, these three realms should remain distinctly identifiable on the site in response to existing site attributes (Author, May 2014)

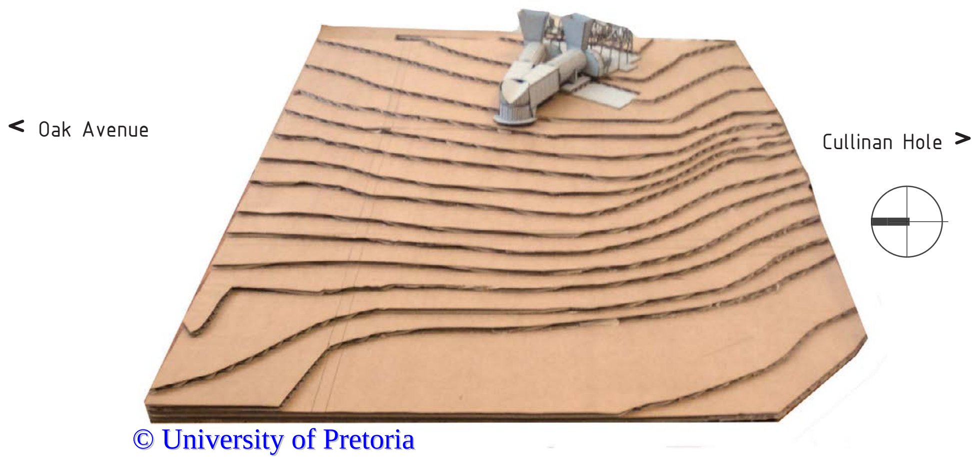
6.9 DESIGN EXPLORATION

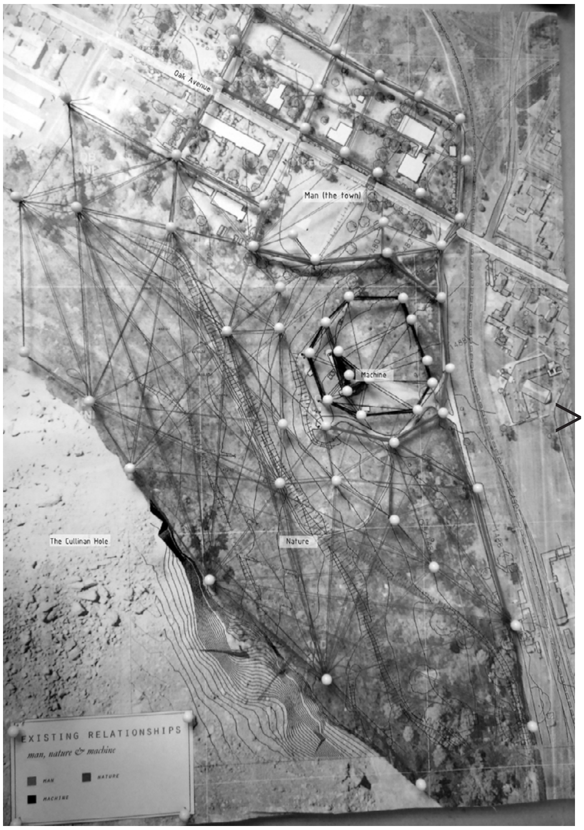
THE DESIGN EVOLUTION AND ITERATIONS

Early design exploration was initiated with models in order to gain an understanding of the relationships and influencing geometries on and around the site. The topography also necessitated a three-dimensional exploration as the site has a steep gradient, with the highest point marked by the ventilation shaft and the lowest point on the west close to Bank Street.

The site's multiple influences and geometries resulted in several design iterations and this section discusses the sequential design evolution.

Figure 6.28
The site before design exploration (Author, 2014)





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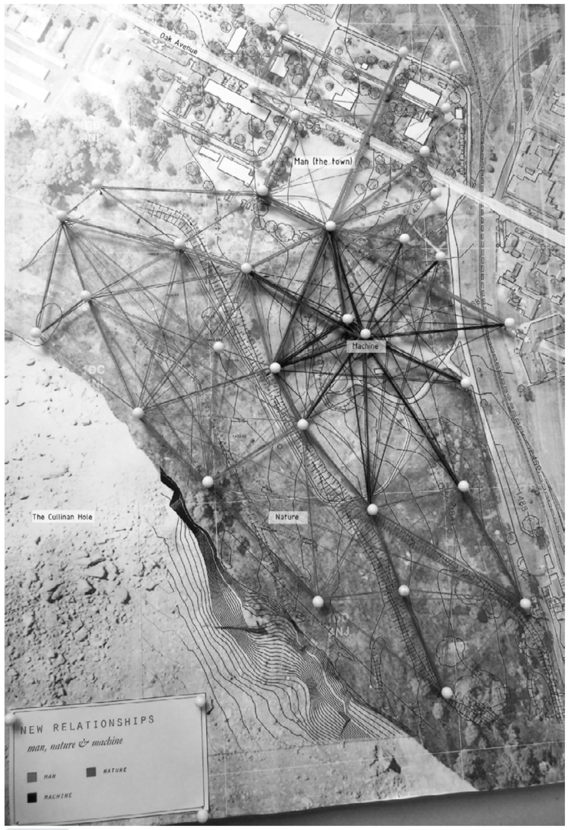


6.8.1 MODEL EXPLORATION

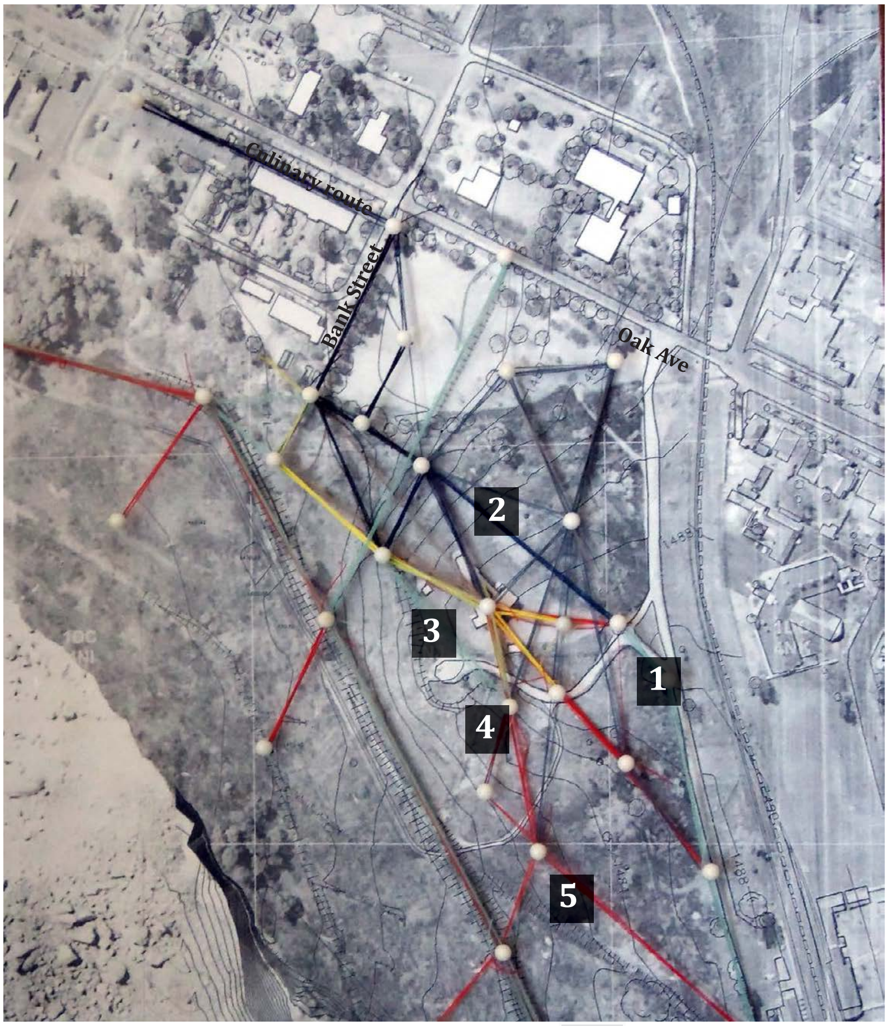
1

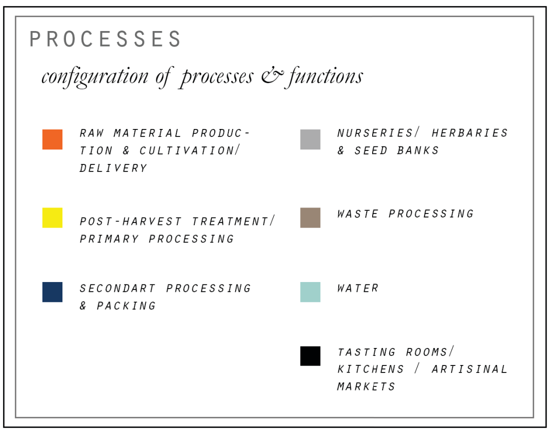
(Author, March 2014).

A reflection of old and new relationships

The existing tangible and intangible linkages and the dialogue between man, nature and machine had to be established on the site to determine the architectural response that has to reflect current and future interactions between these realms, while responding to site memory and its underlying meanings and associations.

Models that determine these realms within the context of the site were subsequently explored. These are discussed in the site chapter (Chapter 4).





2

Determining programme flows on the site.

(Author, April 2014)

1- Service route/delivery

2- Park and nursery

3- Secondary processing and market

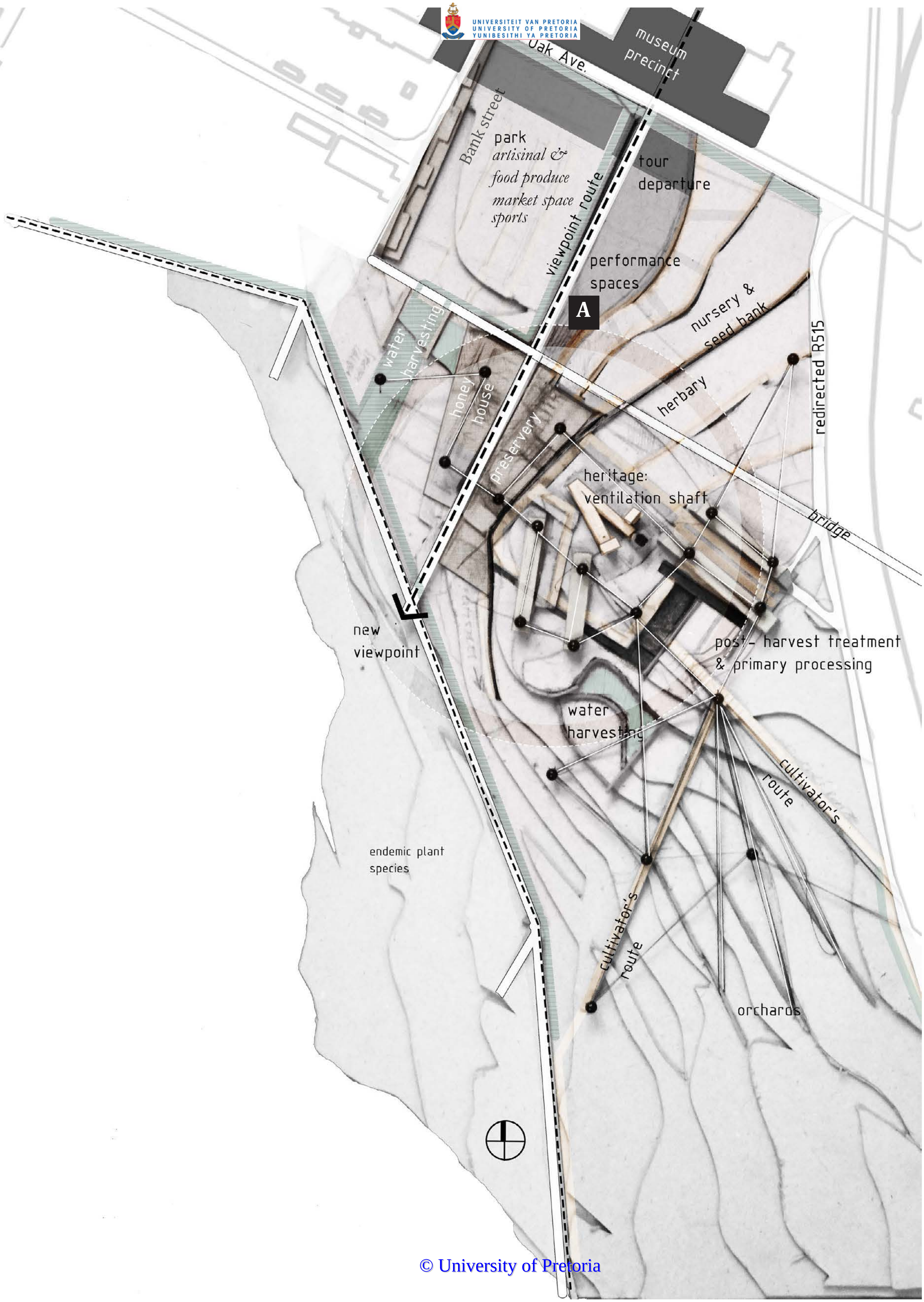
4- Post-harvest treatment

5- Raw material cultivation

Programmatic layout

Linear programmatic process flows and functional layout is explored on the site, responding to its extant site attributes, fabric and narrative. Man's interaction with new industry and its relation to the proposed route is also considered within the programmatic response. New production is located around the ventilation shaft employing existing infrastructure to support the new programme, including extant service routes.

Product distribution from Bank Street, which connects to Oak Avenue and the culinary route, is a functional decision. The ventilation shaft and the connected service route, linking the ventilation shaft to the relocated R515, was established as the main delivery area early in the design, because of its location. In response to site topography, the production process begins at the top of the slope at the ventilation shaft and flows to the lower part of the site, before the final product is distributed.


Oak Ave.
museum precinct
Bank street
park
artisinal &
food produce
market space
sports
viewpoint route
tour departure
performance spaces
A
nursery & seed bank
redirected R515
water harvesting
honey house
preservery
herbary
heritage: ventilation shaft
bridge
new viewpoint
post- harvest treatment & primary processing
water harvesting
cultivator's route
endemic plant species
cultivator's route
orchards

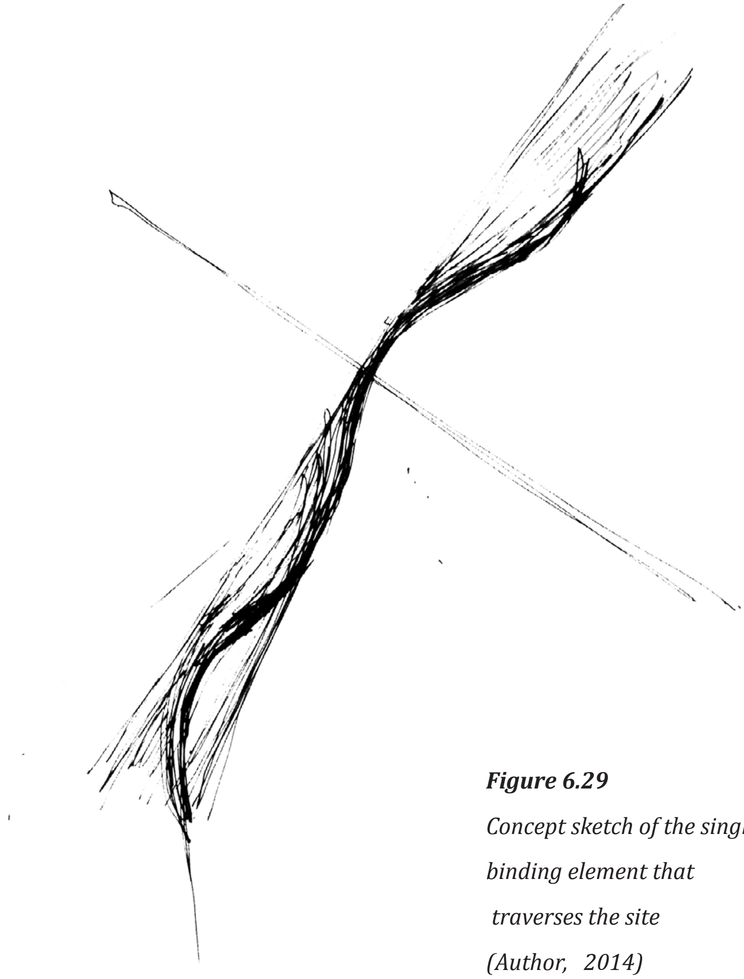


Figure 6.29

Concept sketch of the single binding element that traverses the site (Author, 2014)

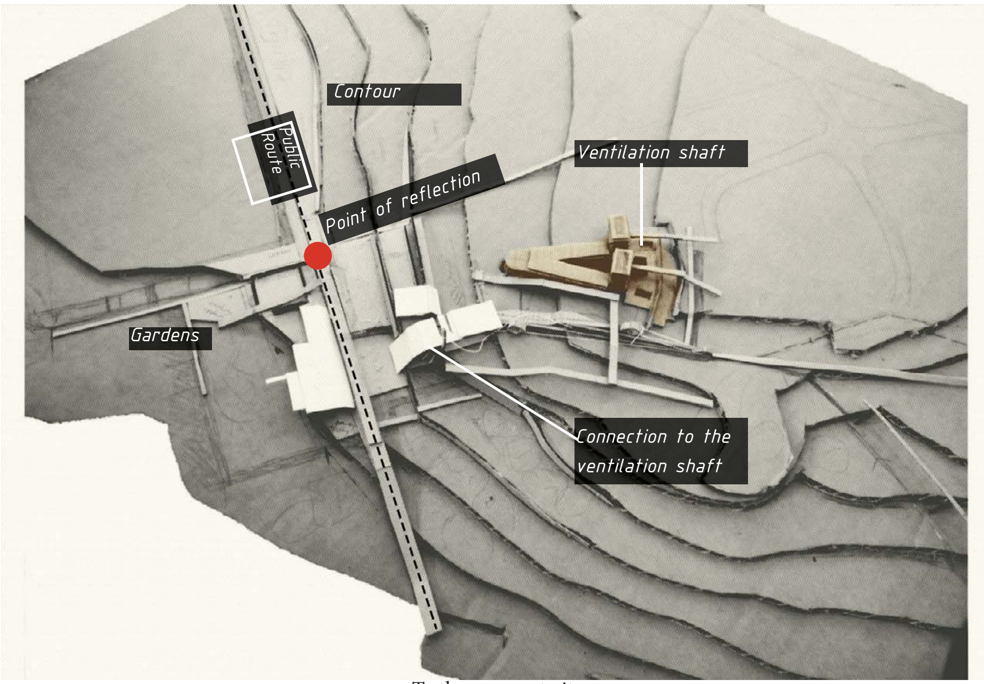
3

(Author, April 2014)

The articulation of the main linking route is initially conceptualised as a single binding wall element (A on model 3) expressing the untouched contour. The element originates at Oak Avenue, traverses the extent of the park and the ventilation shaft, and tapers off into the landscape to the south. Public event and seating spaces are defined using walls and terraces within the park.

Architecture along this connecting element is developed, exploring the changing relationships occurring along its length. Part of the wall will support the new architectural intervention and programme, therefore becoming a central design driver. However, focus on this meant that other extant influential geometries had to be revisited to determine their hierarchy and how they would consequently inform the design response.

To Oak Avenue



To the opencast pit

4

(Author, May 2014)

The design is developed along the route connecting the town to the opencast pit.

Transitions

In order to ascertain the full complexity of the site influences and geometries, transitions that occur across the site were mapped (figure 6.30) so as to appropriately respond to them in the design.

The route from Oak Avenue to the hole narrows at the 'point of reflection' on the site, then widens creating viewing areas, gardens, seating, and interaction with the remediated natural context.

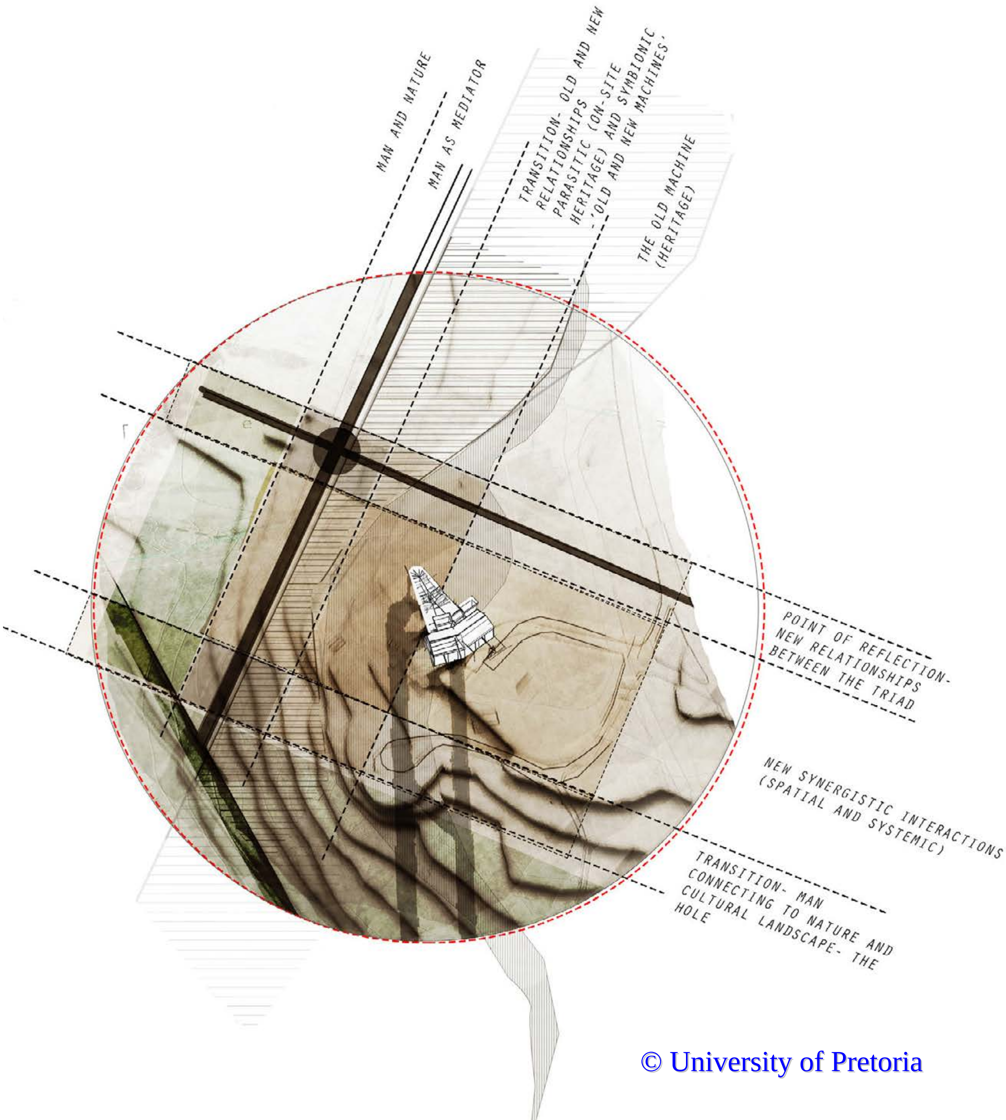
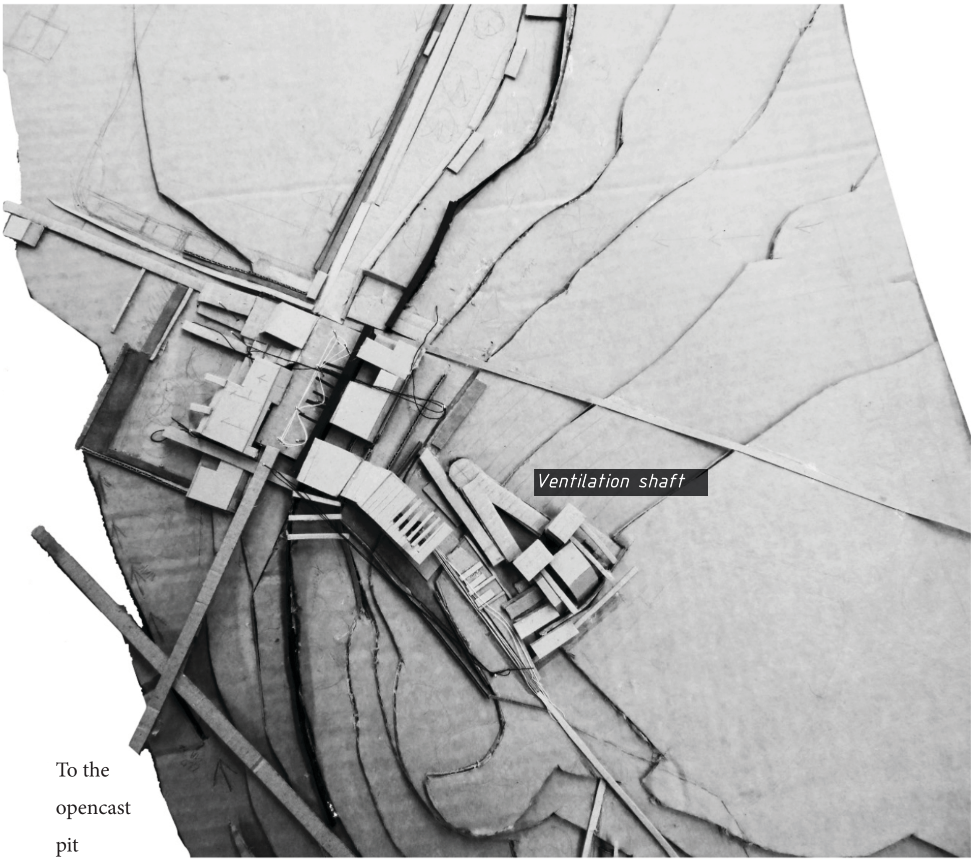


Figure 6.30
Determining the transitions between the three realms on the site.

(Author, May 2014)

To Oak Avenue



To the
opencast
pit

5

Articulating connections to the existing fabric (Author, April 2014)

Initially, the scale of the architecture that connects the old and new was a large connecting element that 'moves up' the slope, linking the dominant architecture of the ventilation shaft to the new route and contour. However, it was too obtrusive, competing with the existing machine and challenging the conceptual intentions and approach to extant fabric. This response prohibits views of some of the significant heritage fabric from the station approach, and impacts on a complete understanding of the shaft as a conspicuous object in the context.

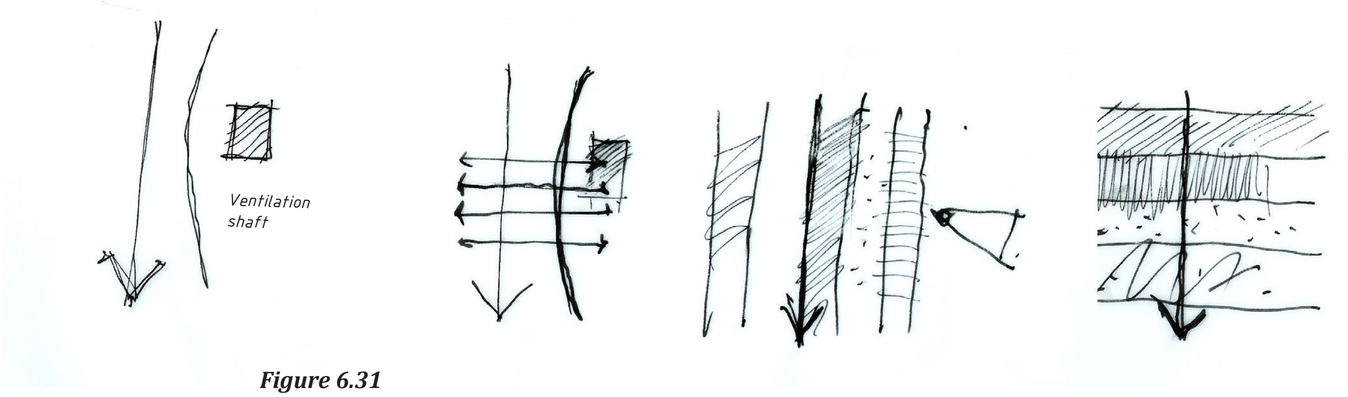
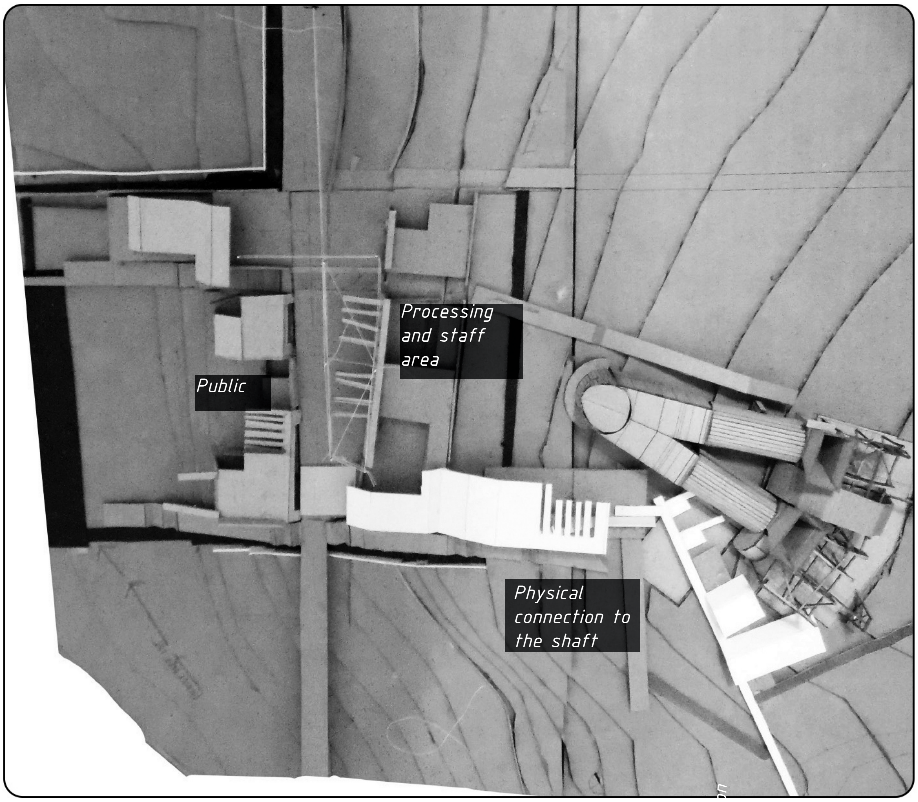


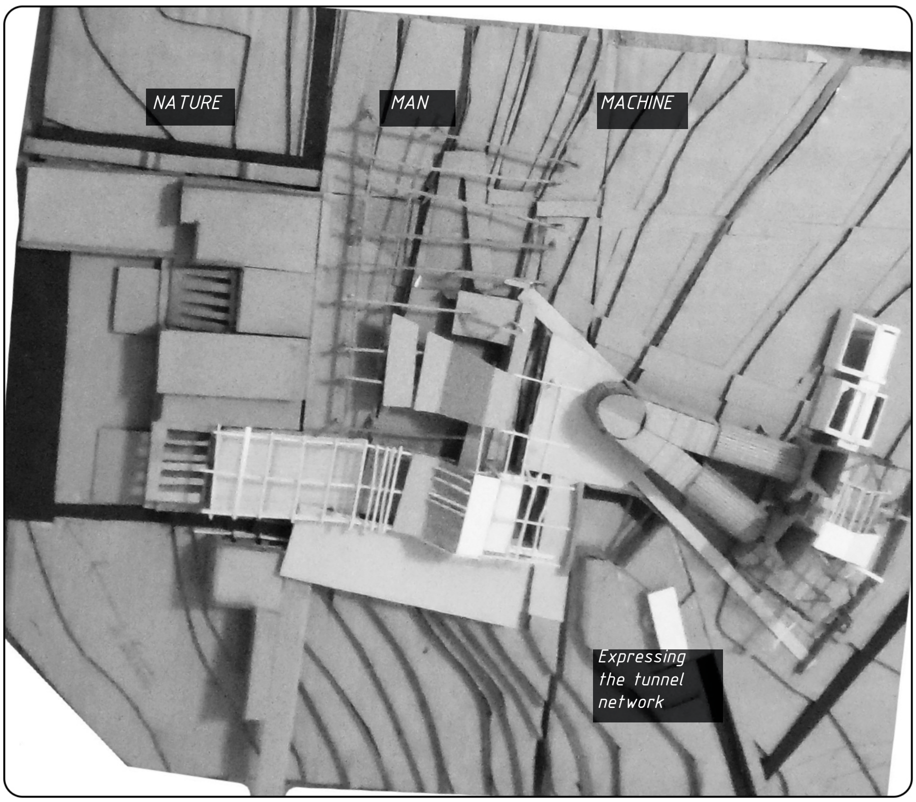
Figure 6.31

Investigating site transitions between the three conditions (Author, May 2014)



6

(Author, May 2014)



7

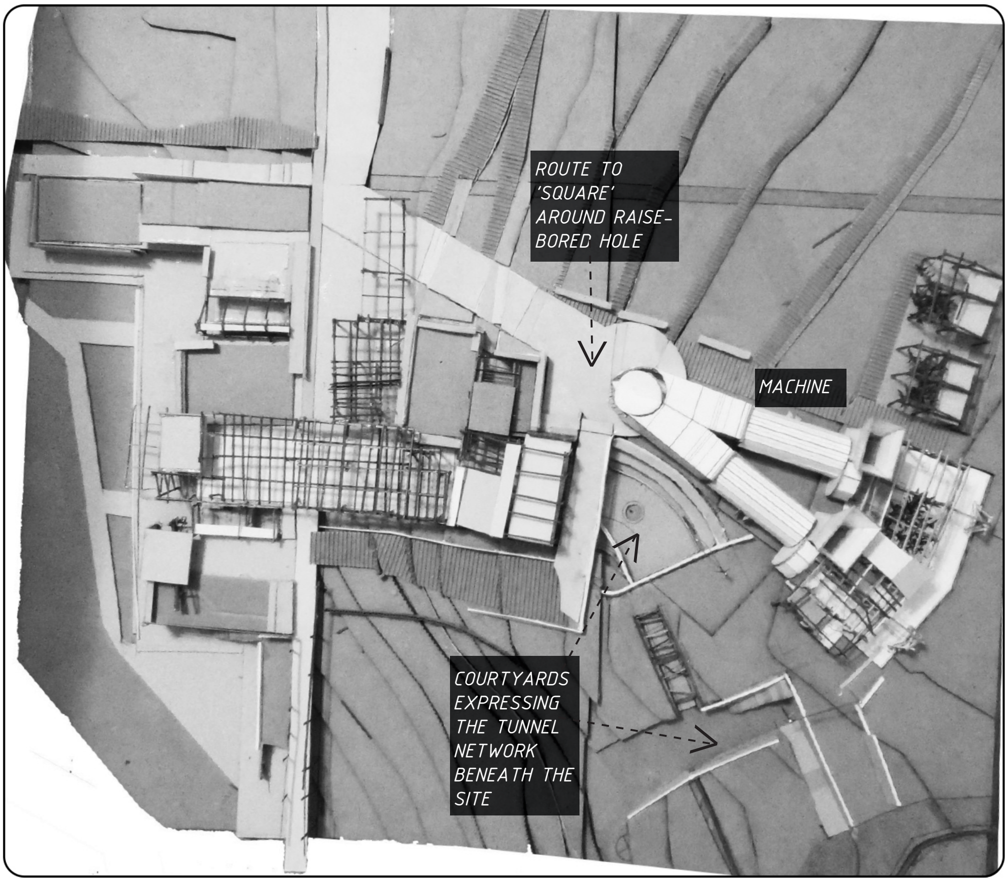
(Author, June 2014)

Model 6 introduces the production spaces on the same level as the main route, thereby encouraging man's interaction with programmatic activities. The main public interface steps down from the public route into the lower part of the slope, which was later revised as it created a disconnect in the public spaces. The placement of production and the public interface (tasting rooms, test kitchens and reception) were subsequently swapped to maintain public interaction along the main route. The production and processing spaces are linked beneath the public walkway connecting the ventilation shaft to the production facility.

The junction between the new intervention and ventilation shaft is revised providing space around the shaft to express it as an object. In terms of scale and hierarchy, the cowls of the shaft remain the highest part of the site and visible expression of the machine.

In early models, the underground tunnel network remains unexpressed. Model 7 starts to investigate an unobtrusive response to this in the architecture, contrasting the surface condition.

The influence of the geometries of the ventilation shaft are considered, as well as how to create a physical relationship between people and this part of the site, exploring the notion of architecture as 'platform'.



8

(Author, July 2014)

A physical linking route connects the realm of man to the machine and new productive route, a reflection of the underground tunnel network.

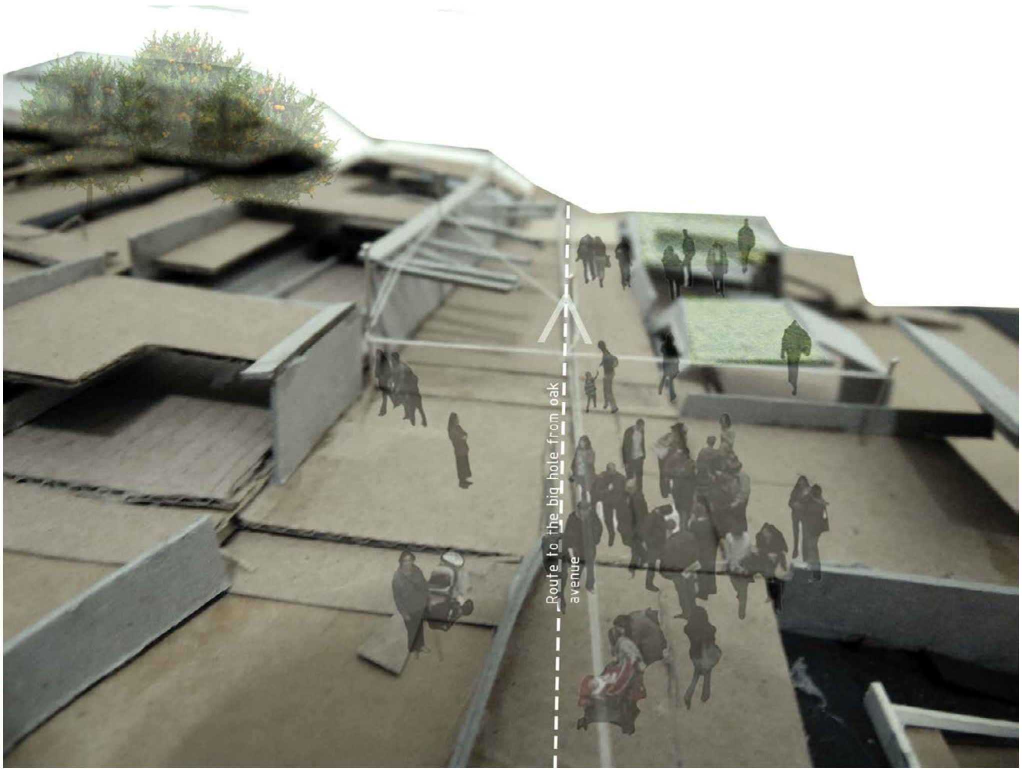


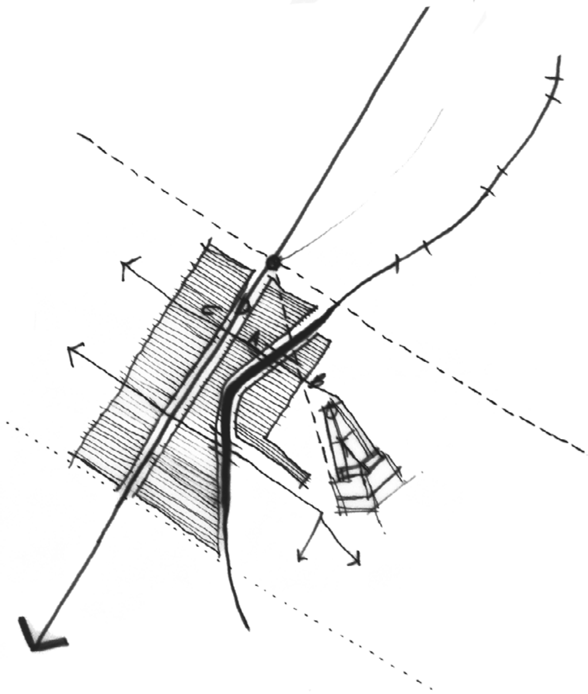
Figure 6.32

Approach from Oak Avenue (Author 2014)

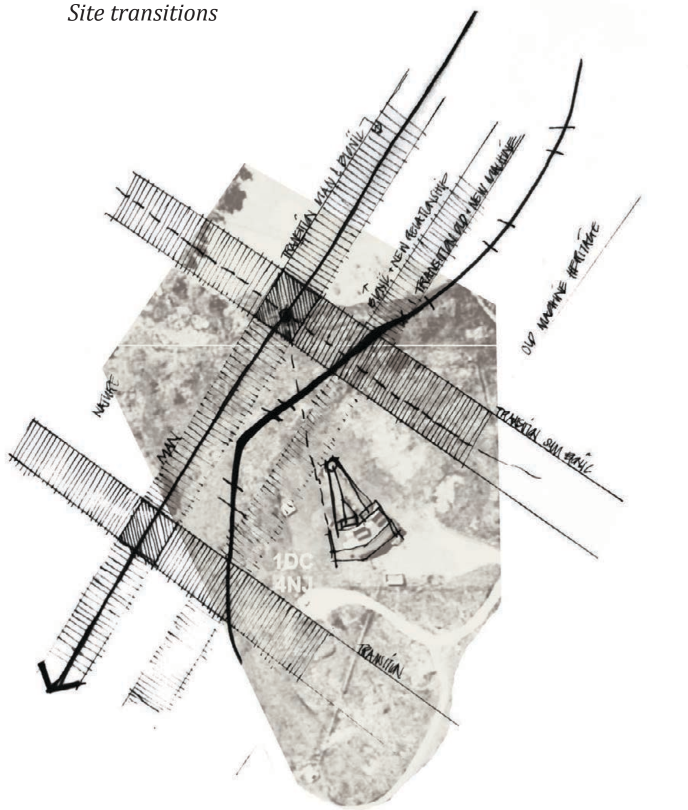
Figure 6.33
Plan iterations
(Author, 2014)

6.10 DEVELOPING THE PLAN

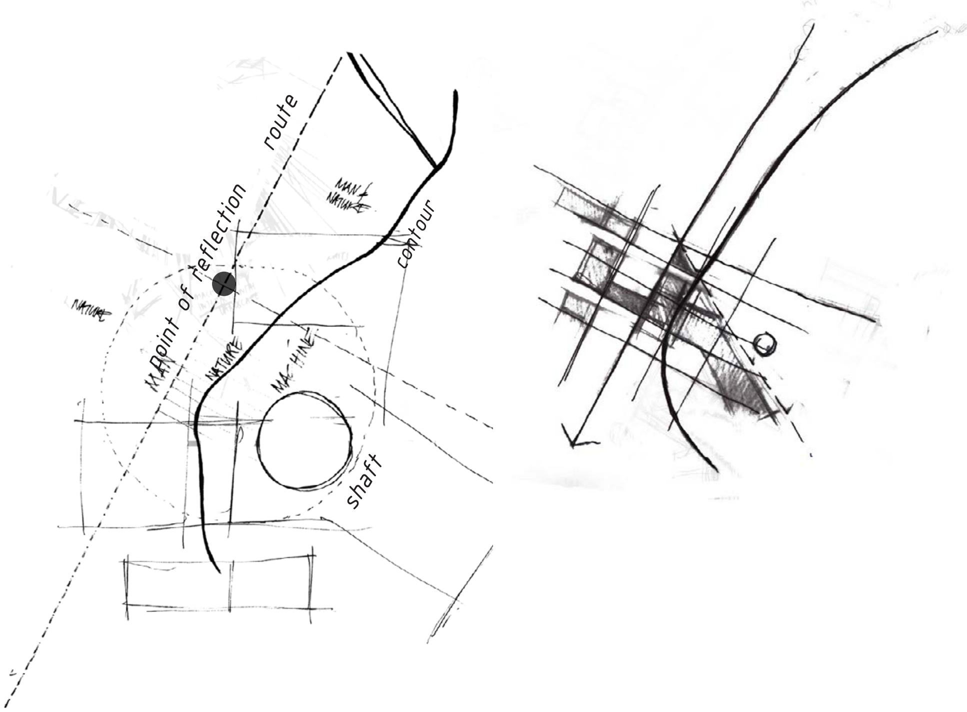
1 *Route, contour and realm of man*



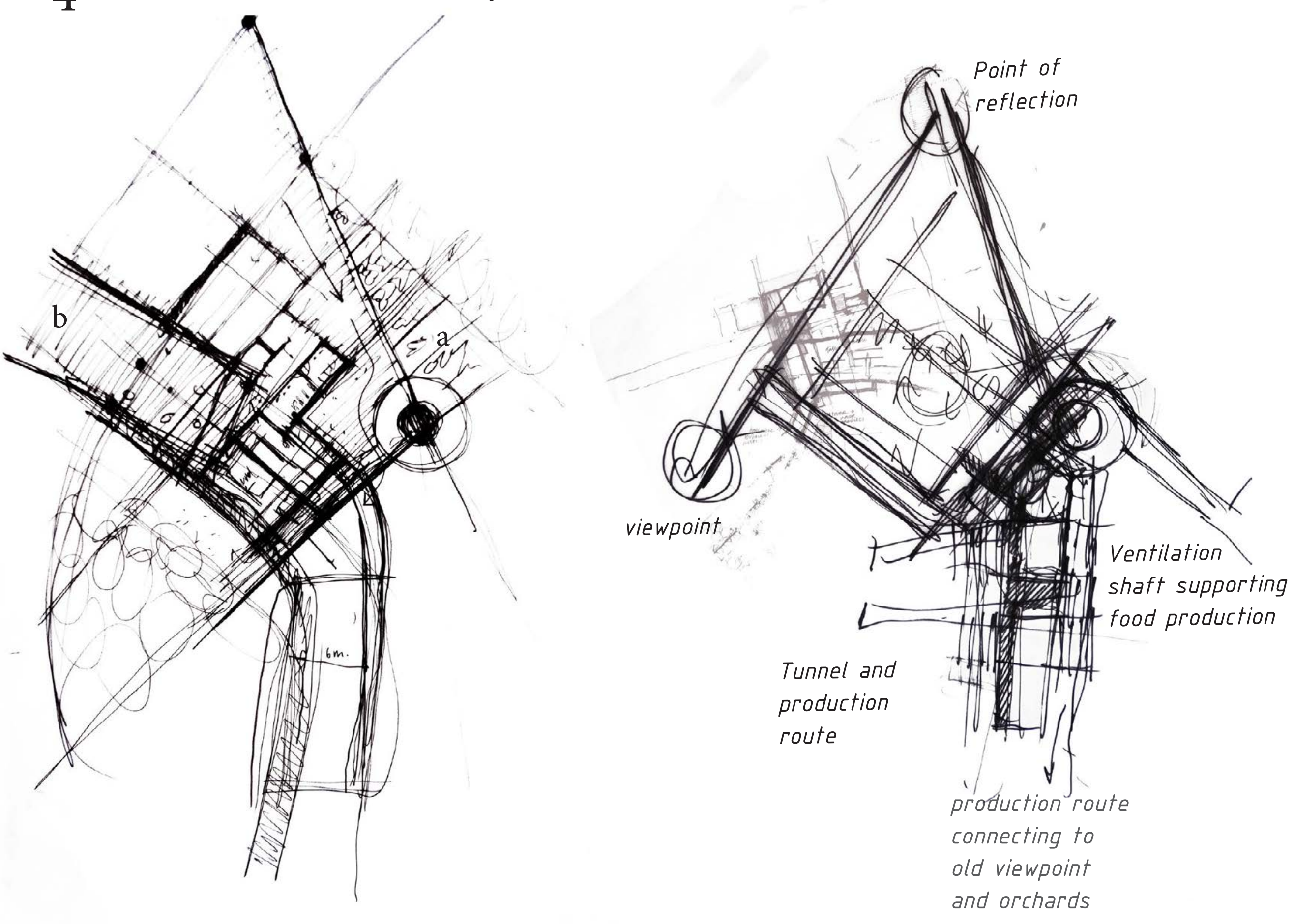
2 *Site transitions*



3 *Establishing and layering the underlying ordering geometries*



4 *Connection to the ventilation shaft*



6.11 DEVELOPING THE SECTION

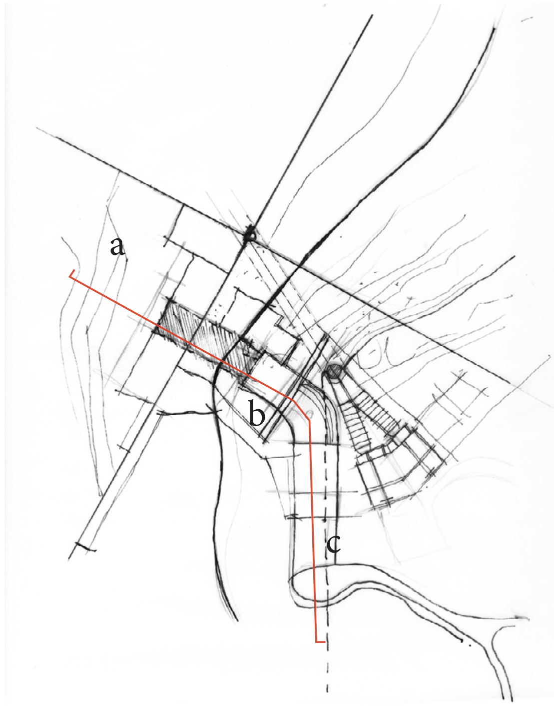
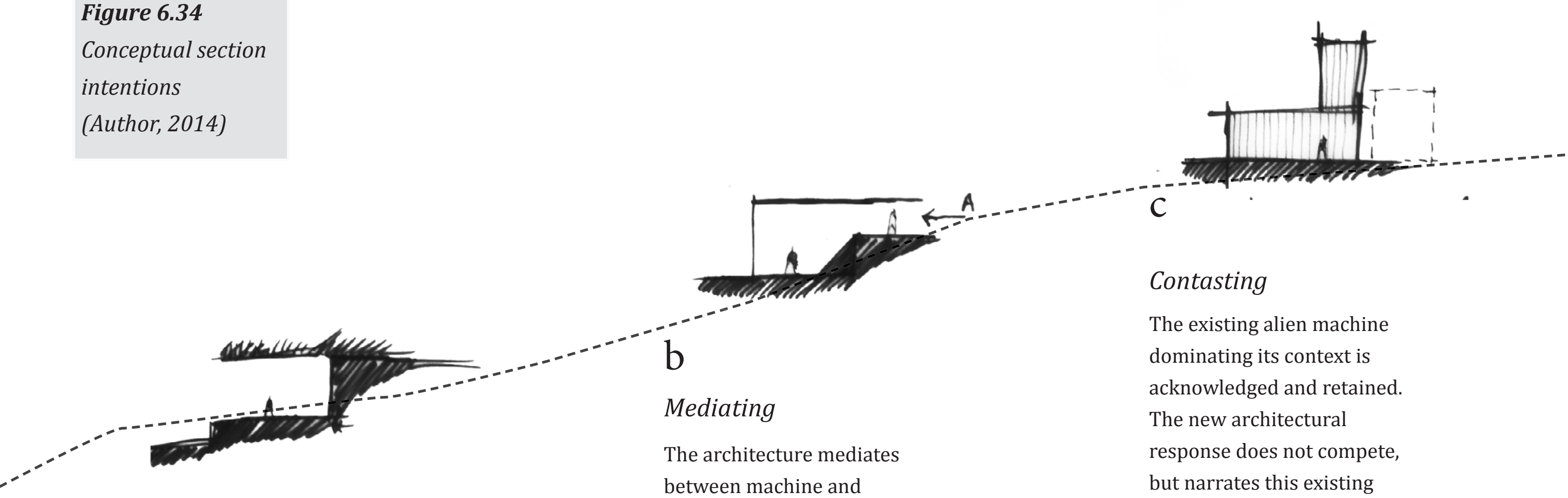


Figure 6.34
Conceptual section intentions
(Author, 2014)



c

Contasting

The existing alien machine dominating its context is acknowledged and retained. The new architectural response does not compete, but narrates this existing condition.

b

Mediating

The architecture mediates between machine and nature.

a

Merging

Architecture becomes an extension of the natural realm on the site, terracing into the slope.

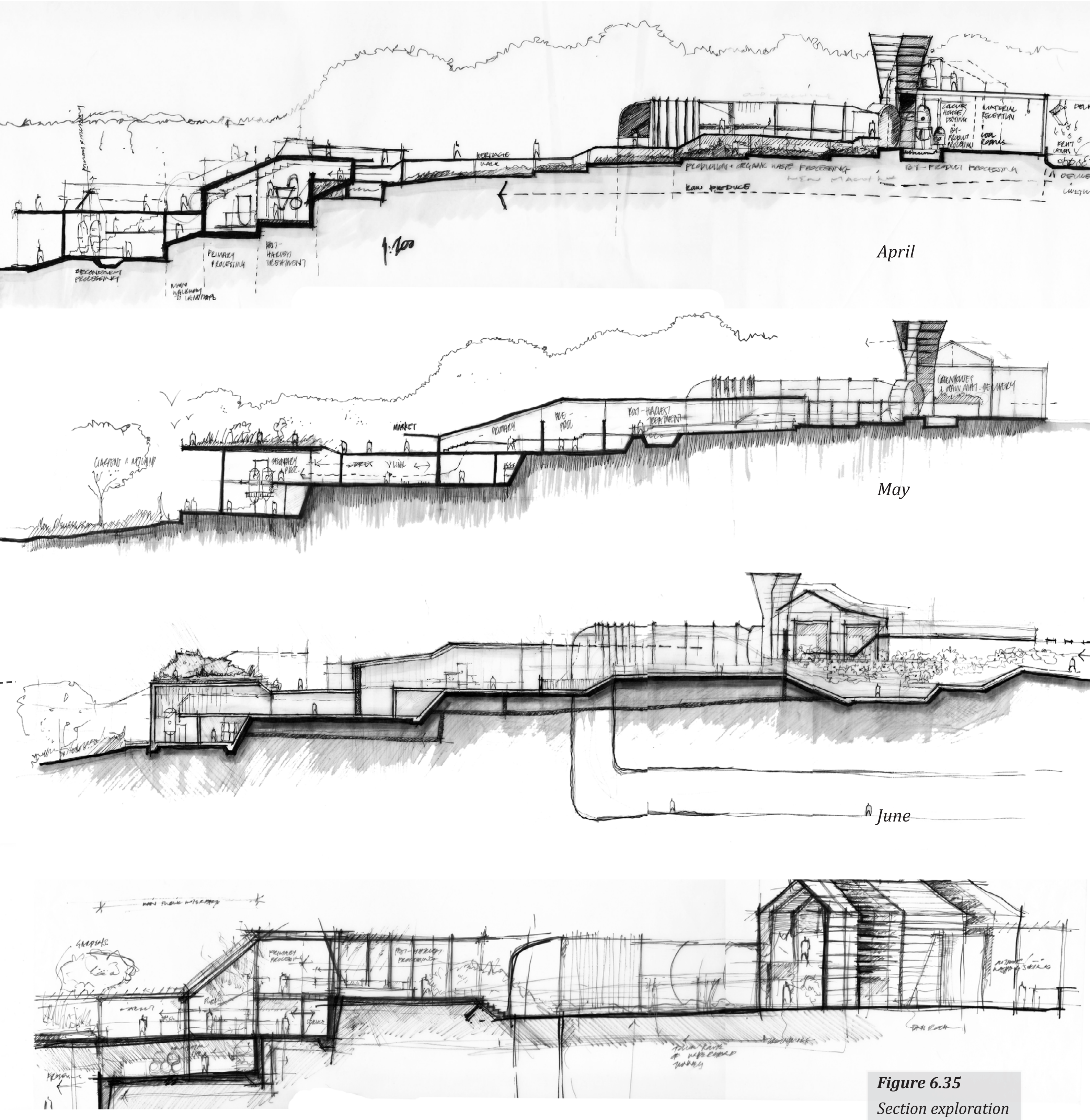
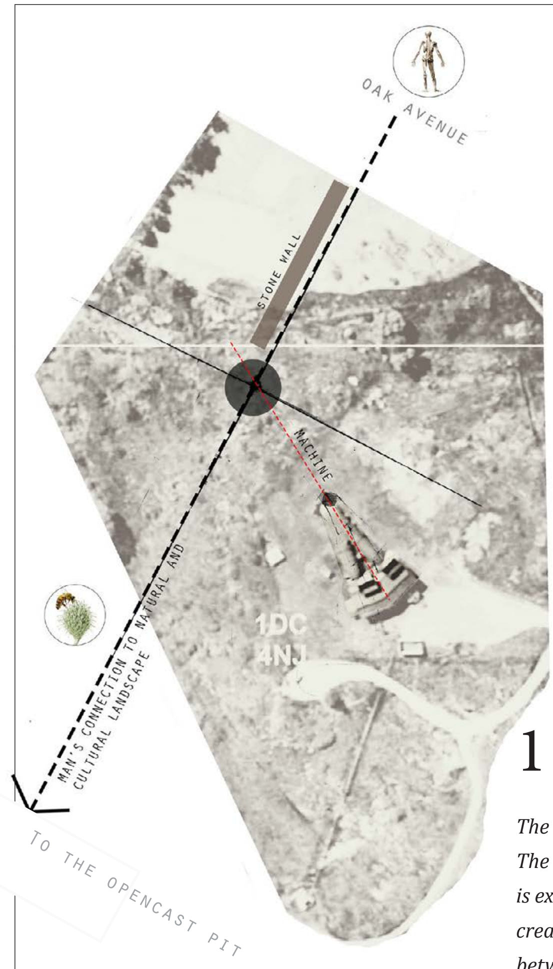


Figure 6.35
Section exploration
(Author, 2014)

PART 2

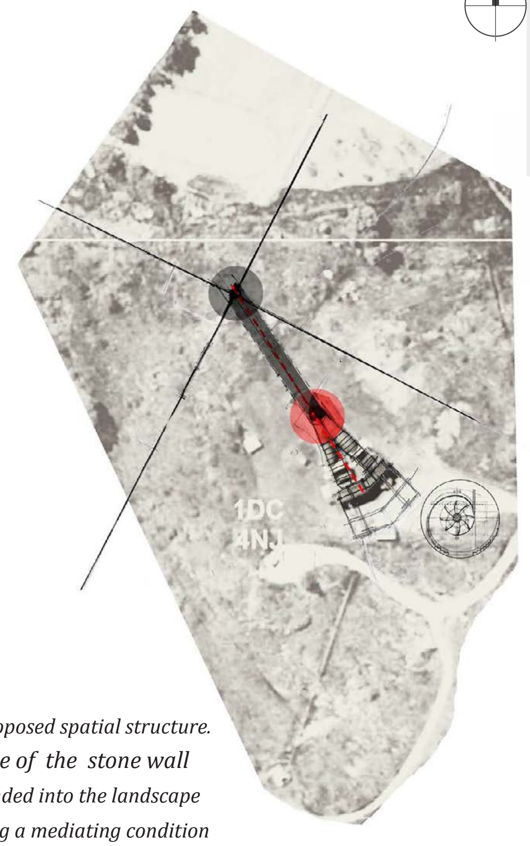
THE DESIGN

Figure 6.36
The final planning response to influencing site geometries
(Author, 2014)



1

The proposed spatial structure. The line of the stone wall is extended into the landscape creating a mediating condition between machine and nature on the site.



2

A connection between the main route and ventilation shaft and raise-bored hole is established.

3

The unaffected natural contour represents new synergies between the triad.

4

A-
The architecture acts as platform connecting to the extant fabric and providing an understanding of the programme.

B-
The expression of the tunnel network is articulated on the surface.

C-
The geometry of the tunnel is extended across the connecting route. This element traverses the realm of machine, man and nature. It also reflects the connection below the public pathway between the production spaces. This geometry becomes an important mediating element.

6.12 THE PLAN

Figure 6.36 reflects on the final planning response to important influencing site attributes, based on their hierarchy and interaction.

D-

Architecture adjacent to the route to the ventilation shaft is articulated and steps back creating public spaces

E-

The architecture between the three realms is considered, ensuring that each remains distinct, but the spaces between are expressed. The building geometry expresses the junction between man and machine with a courtyard space between the route and building.

5

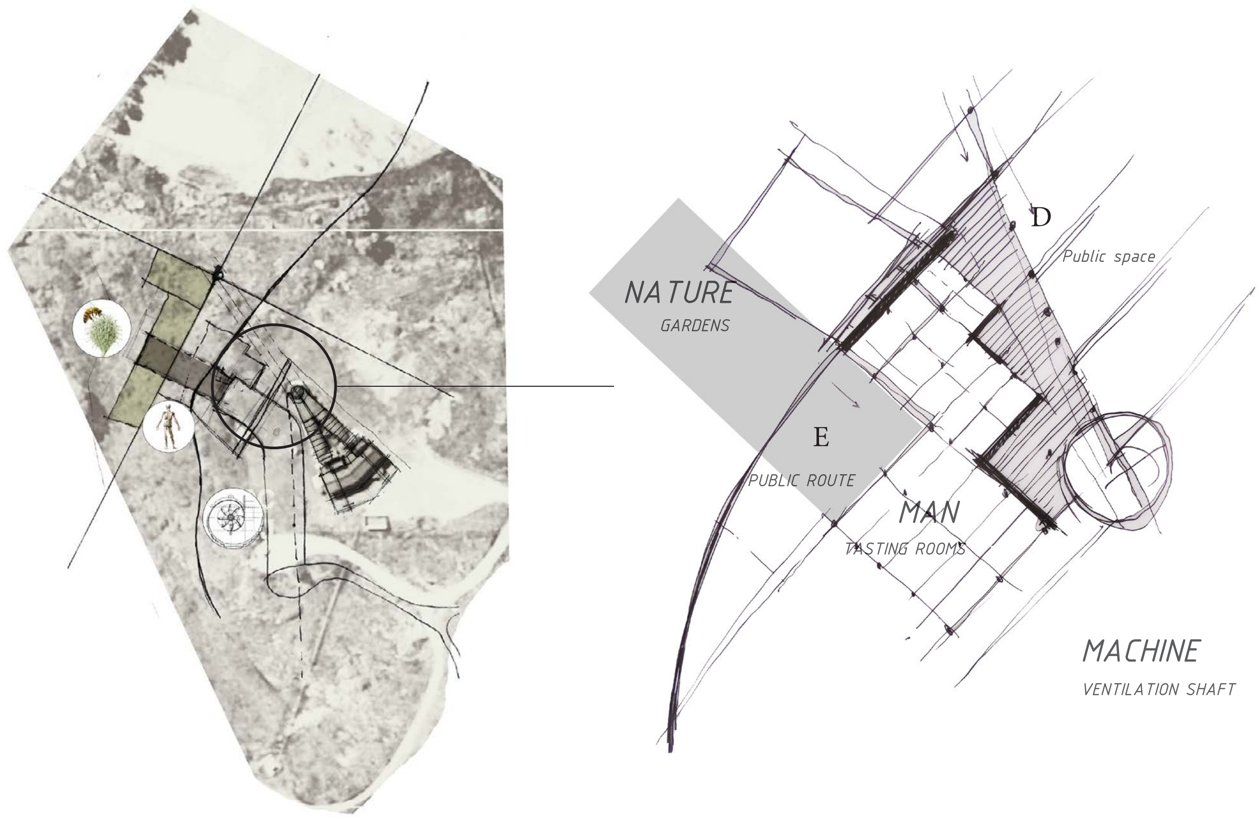


Figure 6.37

Diagrammatic image of final plan indicating the realms of man, nature and machine (Author, 2014)


MAN'S CONNECTION TO NATURAL AND
CULTURAL LANDSCAPE
LINE MARKS OLD MINE BOUNDARY
(EXTENSION OF STONE WALL)
NEW RELATIONSHIPS
THE OLD AND NEW MACHINE
MAN AS MEDIATOR
NATURE

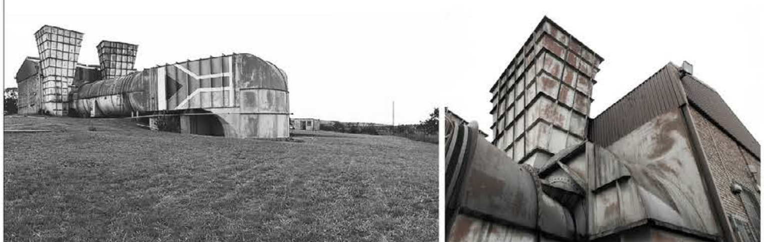

Bank Street
To mine
Opencast pit
To station
SITE PLAN
1:500
1- Oak Avenue
2- New route along stone wall through oak avenue park
3- Restored sports ground
4- Market and event space
5- Nursery
6- Food and heritage route
7- Existing mine ventilation shaft
8- Greenhouses
9- Material delivery
10- Cultivators route
11- Retention dam
12- Raw product processing
13- Water channel
14- Public tasting rooms
15- Public roof gardens
16- Viewing platforms
17- Lower level production
18- Retention dam
19- Agricultural routes surrounding opencast pit
20- Productive landscape/ orchards

1 Oak Avenue Oak House

McHardy House and Gardens

Oak Avenue Park

2 The stone wall



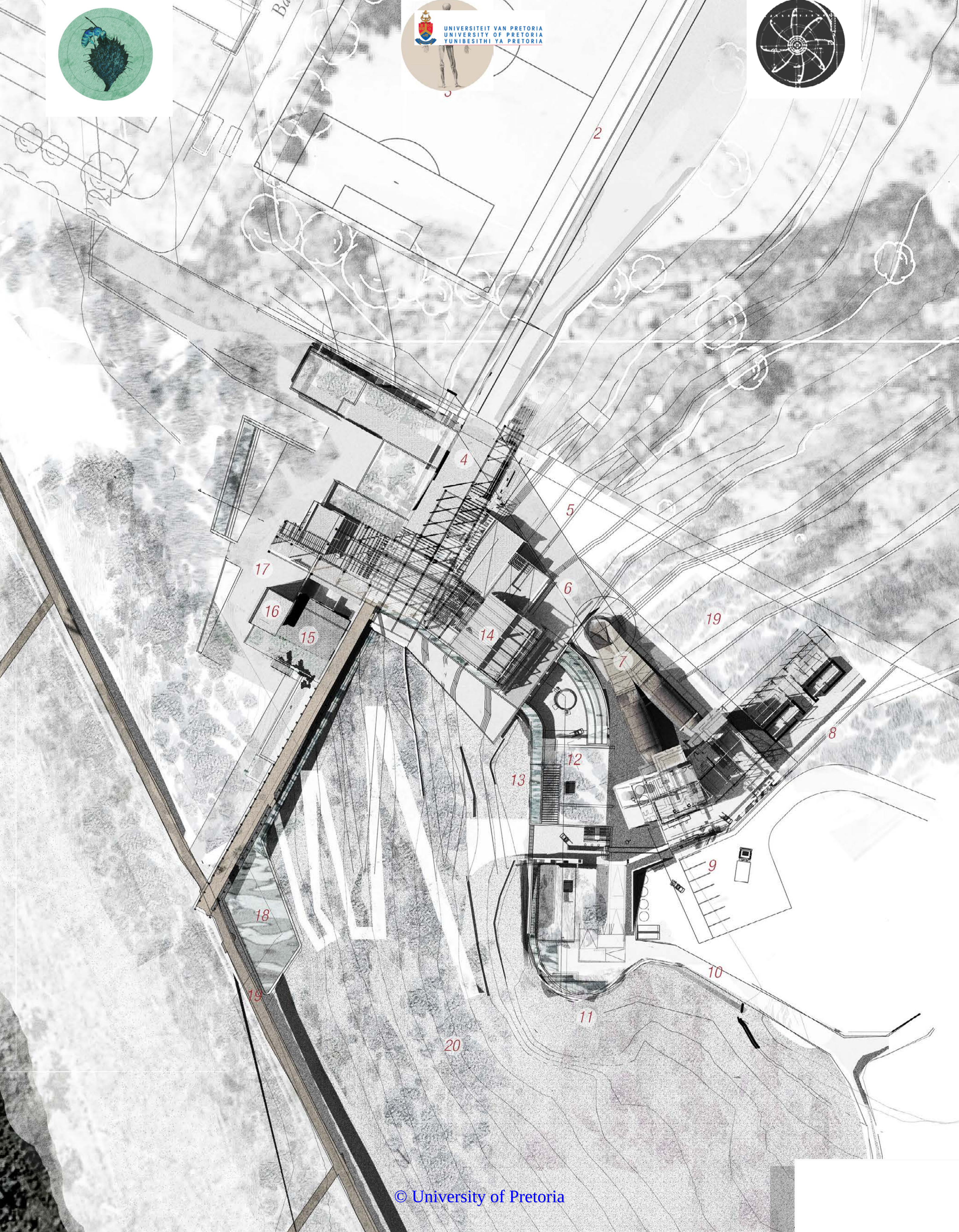
7 Mine ventilation shaft

19 Opencast pit

Figure 6.38

Site plan, NTS

(Author, October 2014)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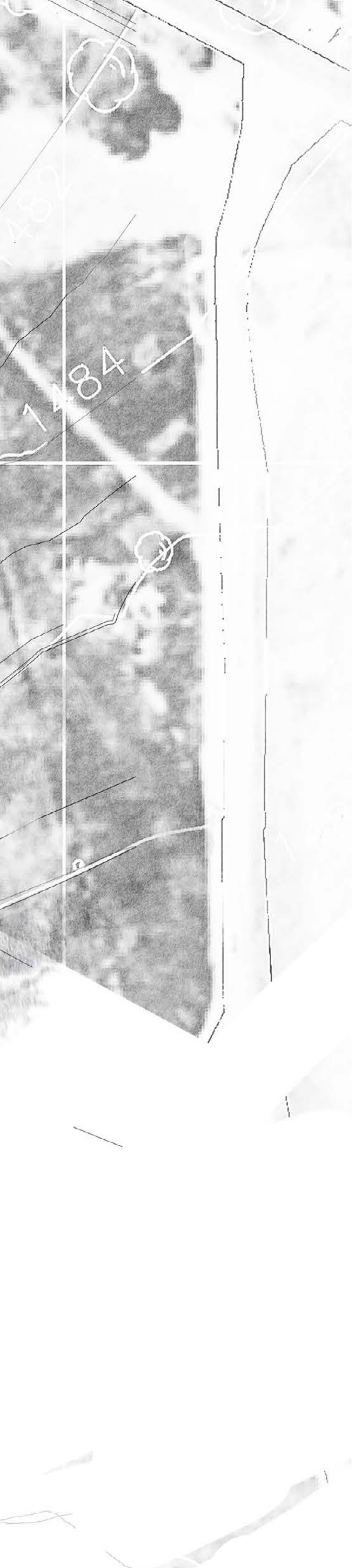
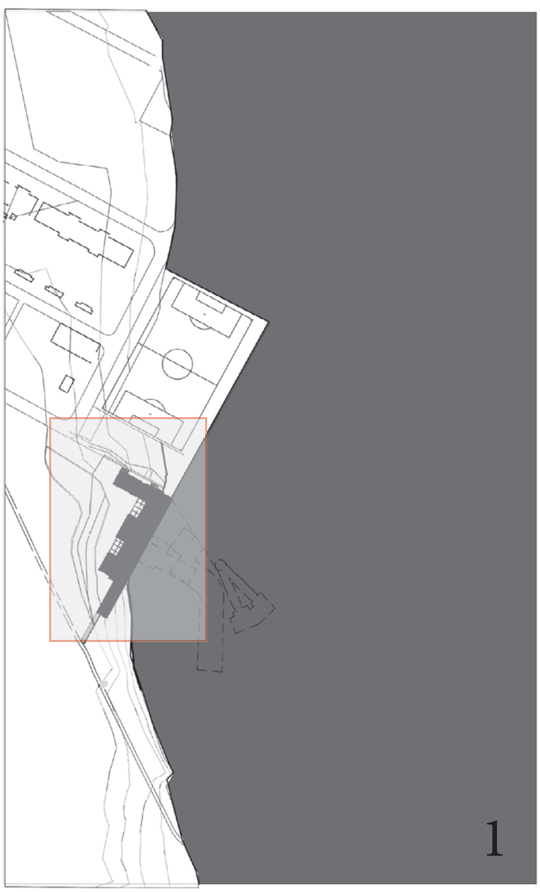
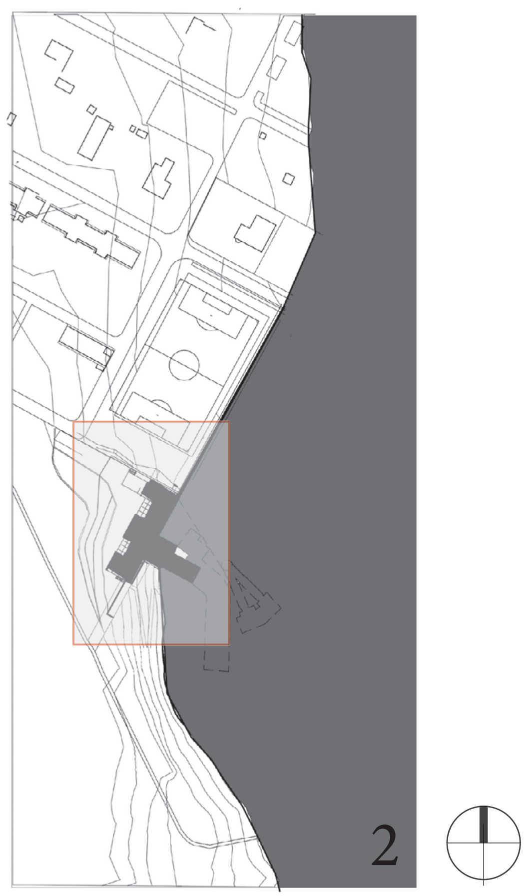


2- NEW ROUTE ALONG STONE WALL THROUGH OAK AVENUE PARK
3- RESTORED SPORTS GROUND
4- MARKET AND EVENT SPACE
5- NURSERY
6- FOOD AND HERITAGE ROUTE
7- EXISTING MINE VENTILATION SHAFT
8- GREENHOUSES
9- MATERIAL DELIVERY
10- CULTIVATORS ROUTE
11- RETENTION DAM
12- RAW PRODUCT PROCESSING
13- WATER CHANNEL
14- PUBLIC TASTING ROOMS
15- PUBLIC ROOF GARDENS
16- VIEWING PLATFORMS
17- LOWER LEVEL PRODUCTION
18- RETENTION DAM
19- AGRICULTURAL ROUTES SURROUNDIG OPENCAST PIT
20- PRODUCTIVE LANDSCAPE/ ORCHARDS



LOWER LEVEL 2



LOWER LEVEL 1

Figure 6.39

Plan levels indicated in the context of the larger site and in relation to the topography (Author, 2014)

MAIN PUBLIC LEVEL

UPPER LEVEL-VENTILATION SHAFT

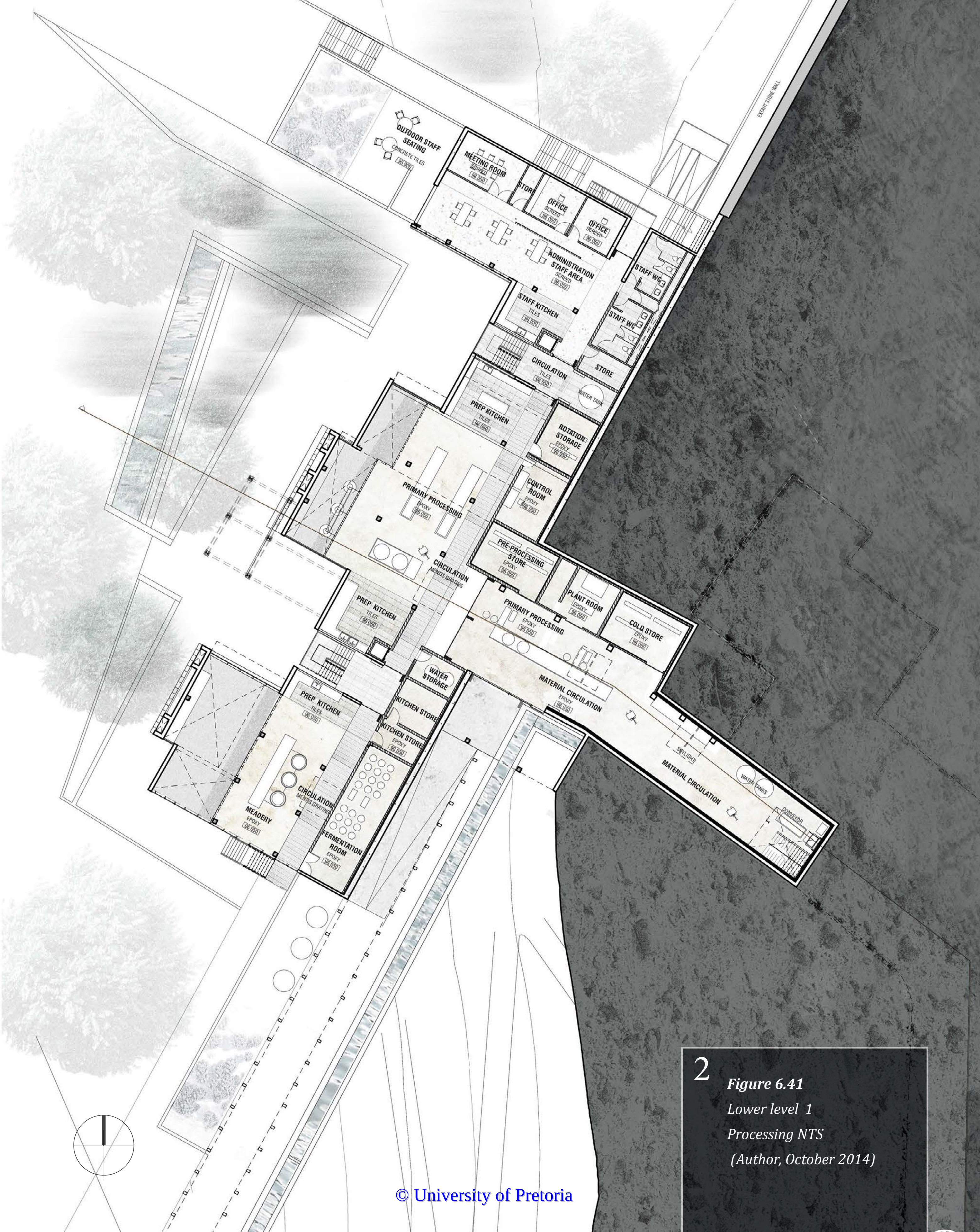
1

Figure 6.40

Lower level 2

Processing NTS

(Author, October 2014)



2

Figure 6.41

Lower level 1

Processing NTS

(Author, October 2014)

3

Figure 6.42

Ground floor

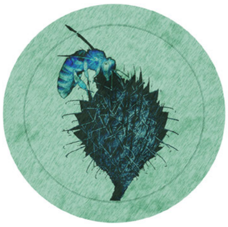
Main public level

NTS

(Author, October 2014)

4

Figure 6.43
Upper level
Ventilation shaft
NTS
(Author, October 2014)



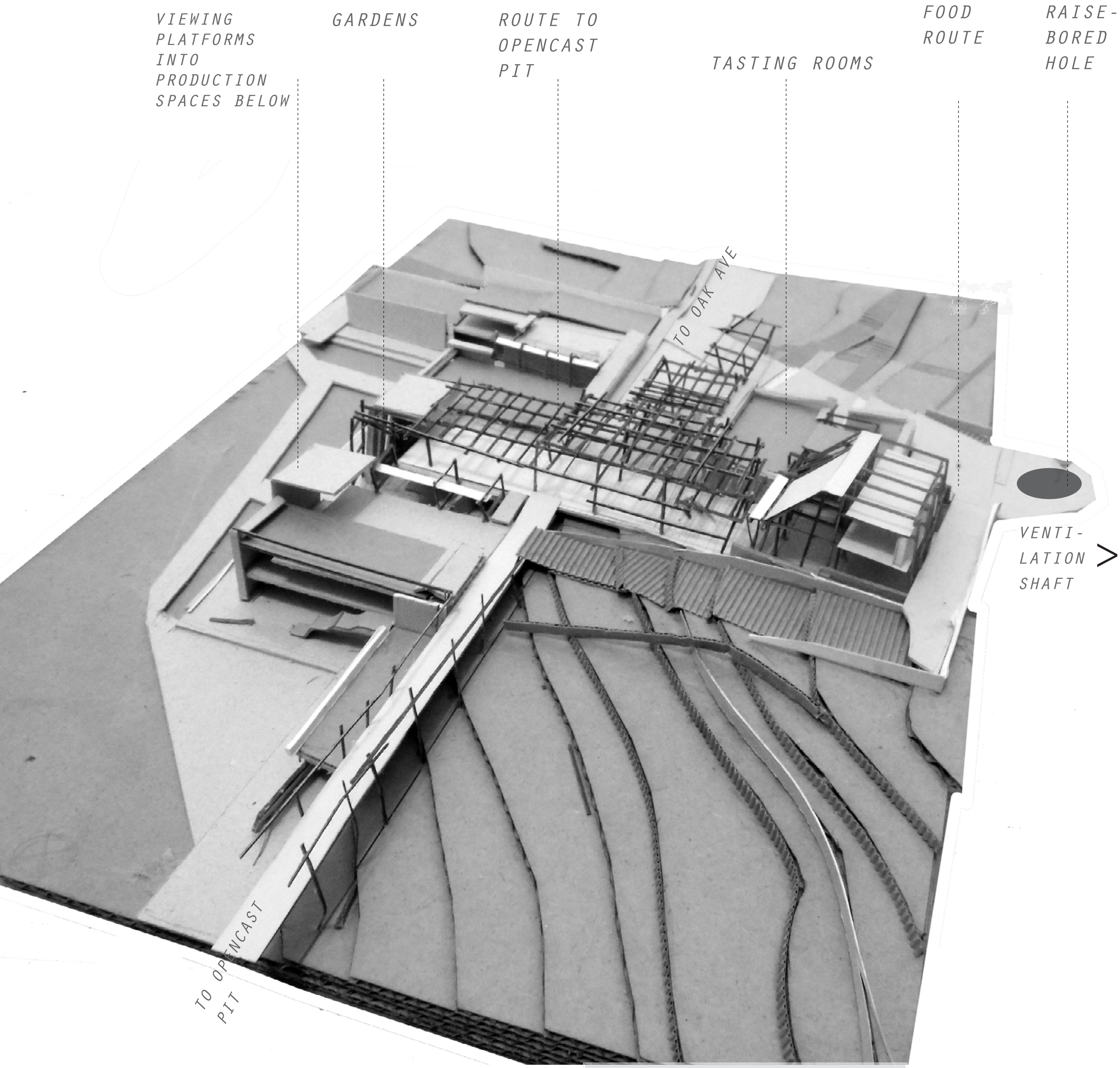


Figure 6.44

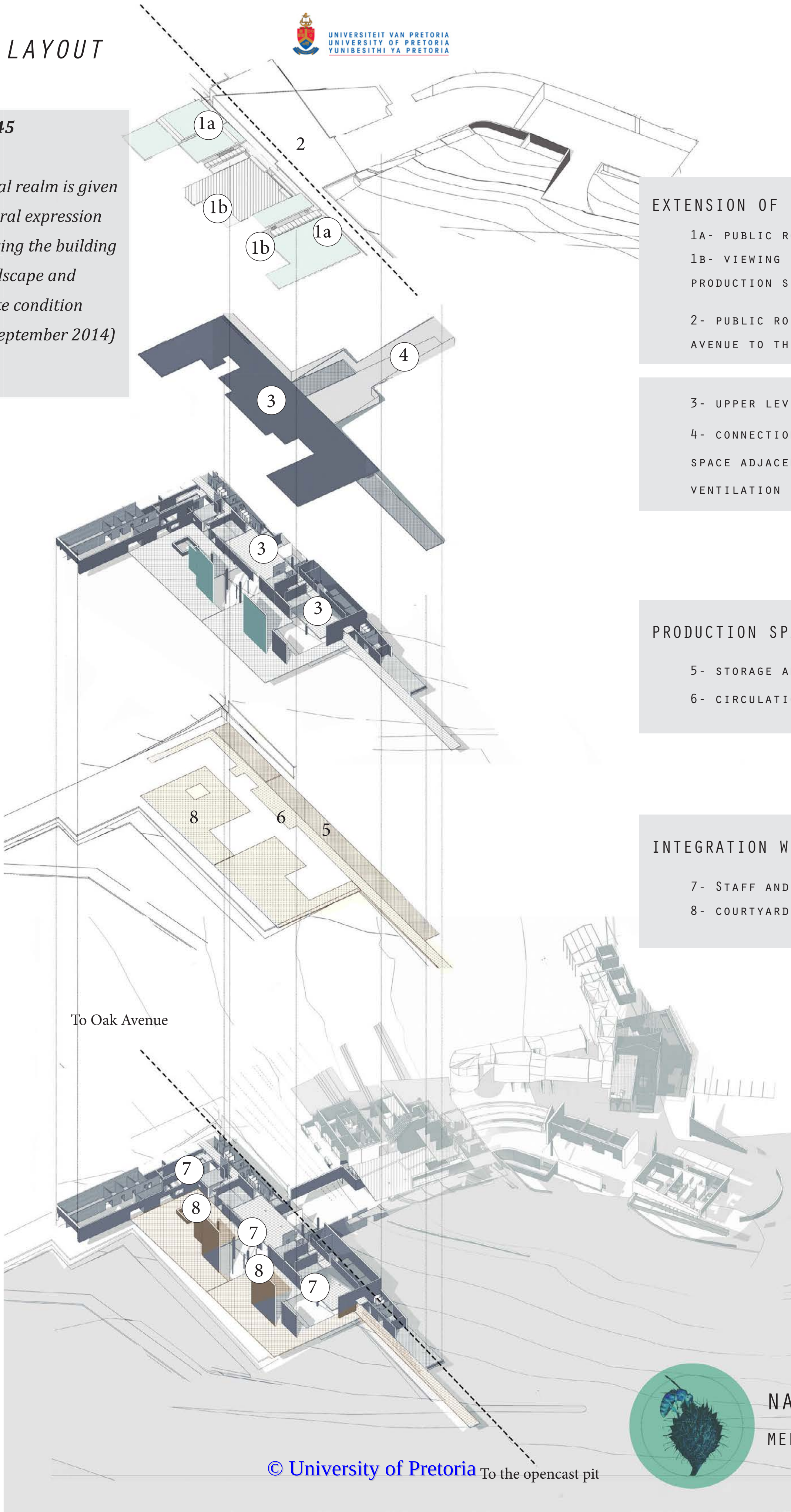
Model without the ventilation shaft indicated (Located to the right)

August , NTS

(Author, August 2014)

Figure 6.45

The natural realm is given architectural expression by immersing the building in the landscape and natural site condition (Author, September 2014)



EXTENSION OF OAK AVENUE PARK

1A- PUBLIC ROOF GARDENS
1B- VIEWING PLATFORM INTO PRODUCTION SPACES BELOW

2- PUBLIC ROUTE CONNECTING OAK AVENUE TO THE OPENCAST PIT

3- UPPER LEVEL PROCESSING
4- CONNECTION TO PROCESSING SPACE ADJACENT TO THE VENTILATION SHAFT

PRODUCTION SPACES

5- STORAGE AND SERVICE SPACES
6- CIRCULATION

INTEGRATION WITH LANDSCAPE

7- STAFF AND PROCESSING SPACES
8- COURTYARDS

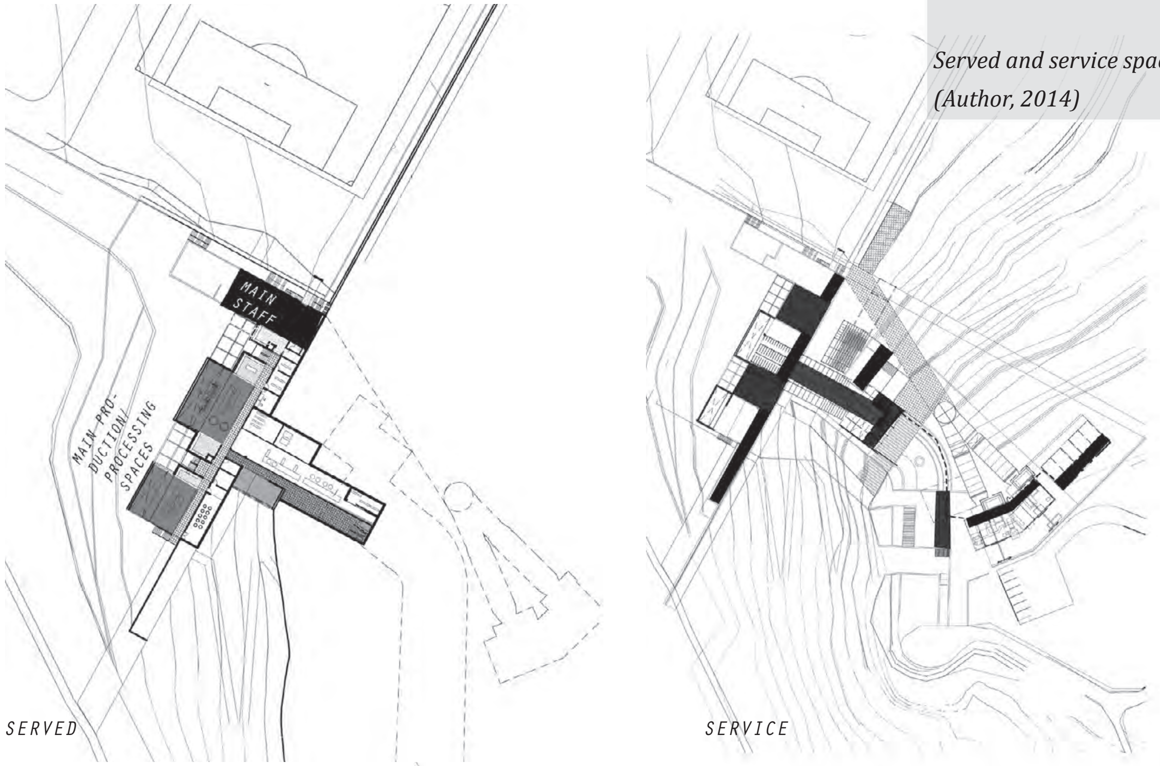


Figure 6.46

Served and service spaces (Author, 2014)

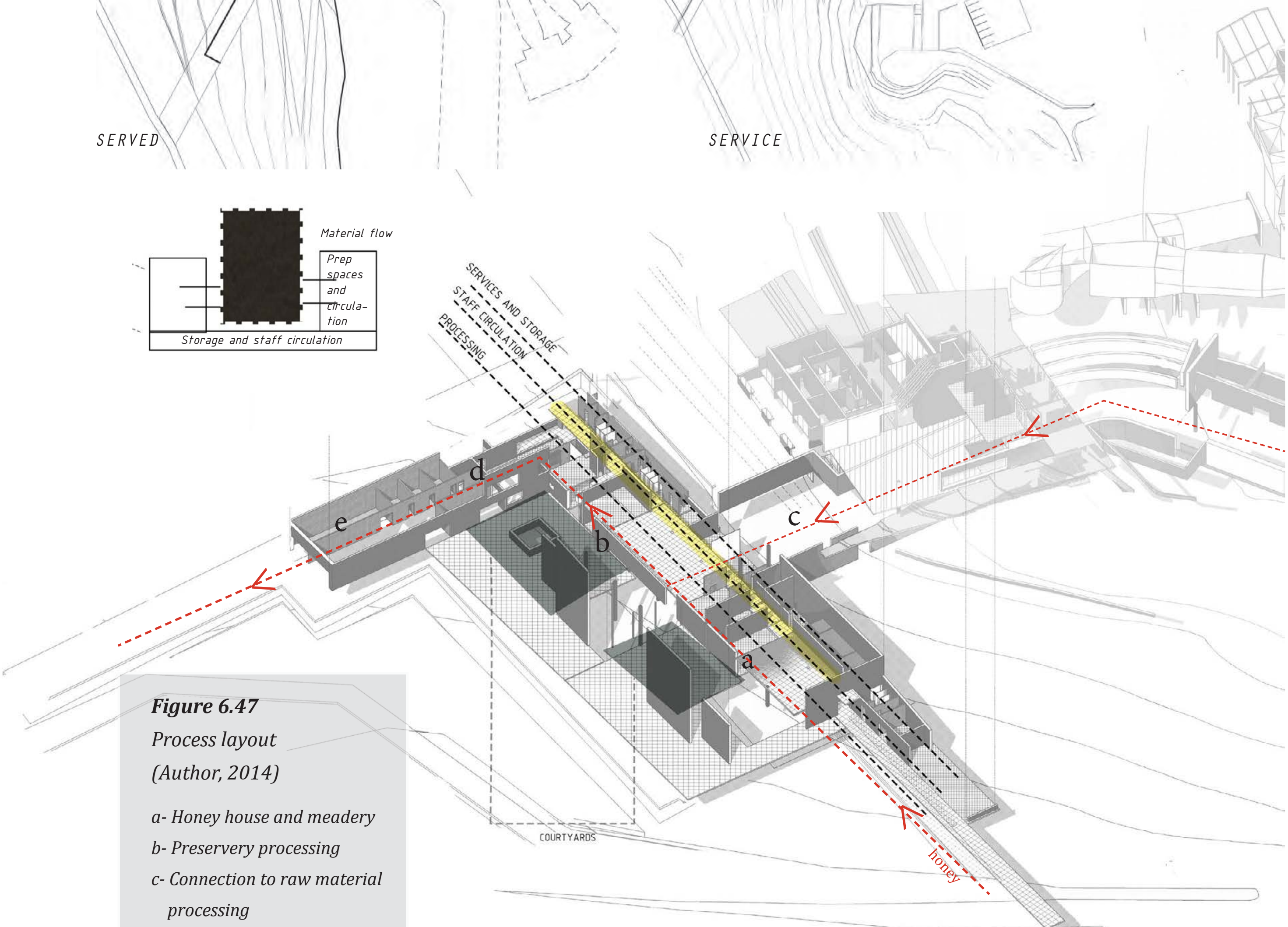


Figure 6.47

Process layout

(Author, 2014)

a- Honey house and meadery

b- Preservery processing

c- Connection to raw material processing

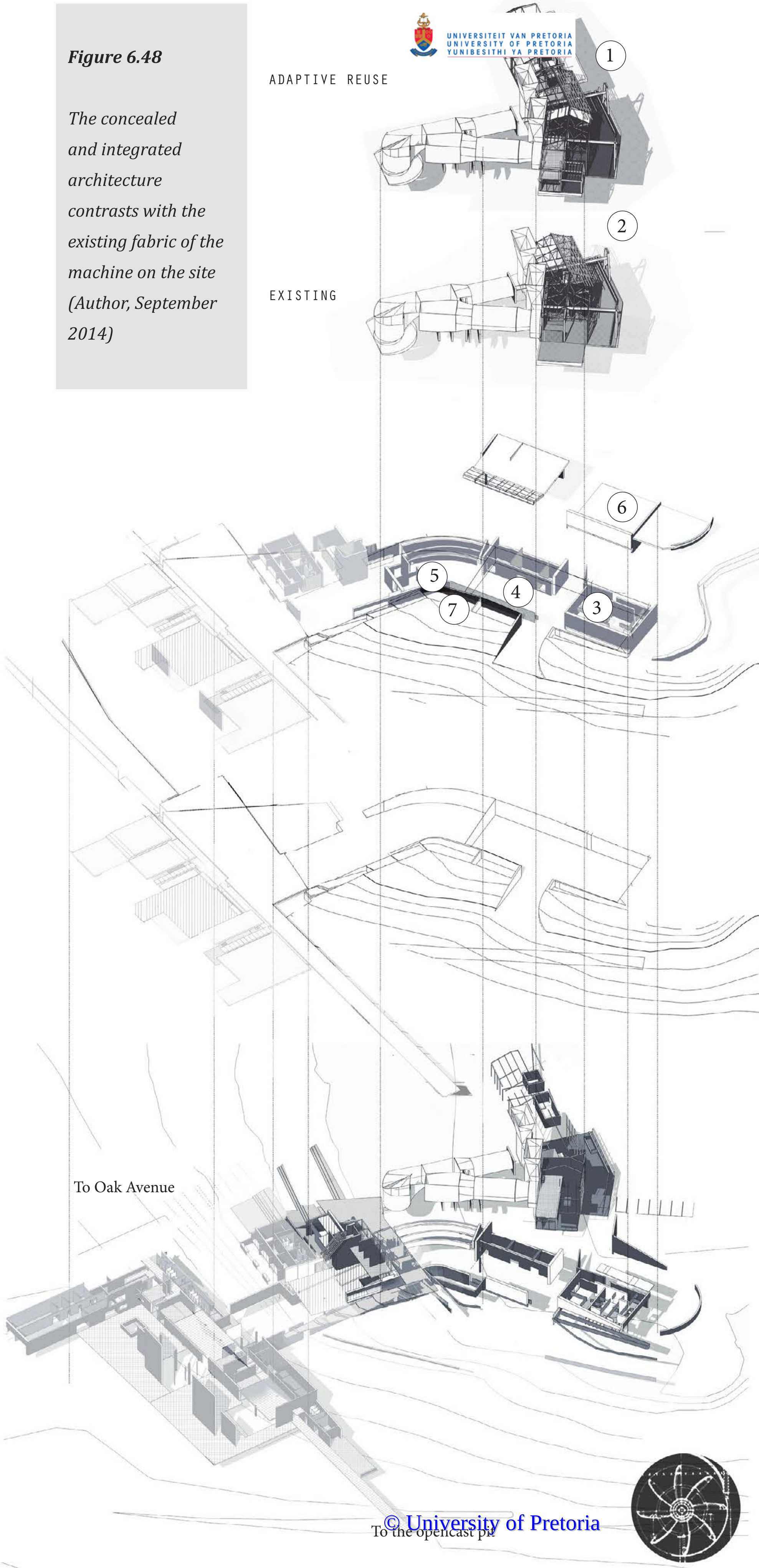
d- Packaging

e- Despatch

Process flow

Figure 6.48

The concealed and integrated architecture contrasts with the existing fabric of the machine on the site (Author, September 2014)



RAW MATERIAL PREPARATION

1-GREENHOUSES

2-WASTE PROCESSING

RAW MATERIAL PREPARATION

3- STAFF FIELD-HOUSE

4- RAW PRODUCT STORAGE

5- WATER STORAGE AND WASHING COURTYARD

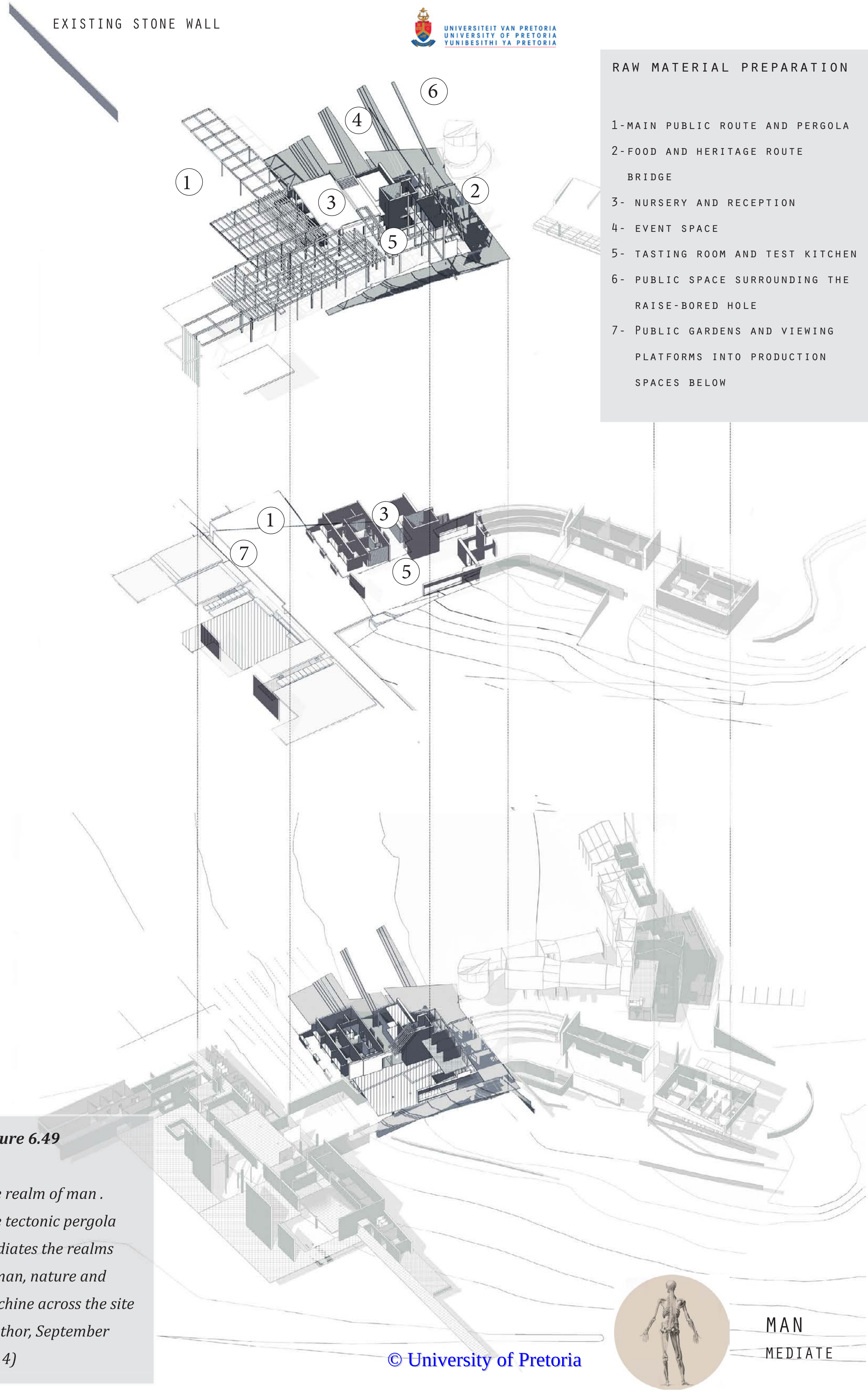
6- PRODUCTION ROOF GARDENS

7- WATER CHANNEL

SUB-SURFACE EXPRESSION OF TUNNEL NETWORK

MACHINE

CONTRAST



RAW MATERIAL PREPARATION

1-MAIN PUBLIC ROUTE AND PERGOLA

2-FOOD AND HERITAGE ROUTE BRIDGE

3- NURSERY AND RECEPTION

4- EVENT SPACE

5- TASTING ROOM AND TEST KITCHEN

6- PUBLIC SPACE SURROUNDING THE RAISE-BORED HOLE

7- PUBLIC GARDENS AND VIEWING PLATFORMS INTO PRODUCTION SPACES BELOW

Figure 6.49

The realm of man . The tectonic pergola mediates the realms of man, nature and machine across the site (Author, September 2014)

Figure 6.50

Food and heritage route. Public interaction with the story of food:

1- Productive landscape

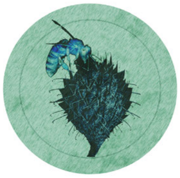
2- Raw material handling

3- Food preparation, market, tasting and eating

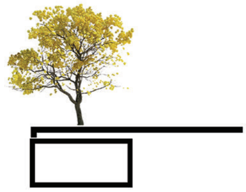
4- View into production and processing spaces

(Author, 2014)

6.14 THE SECTION



Integration with nature (merging)



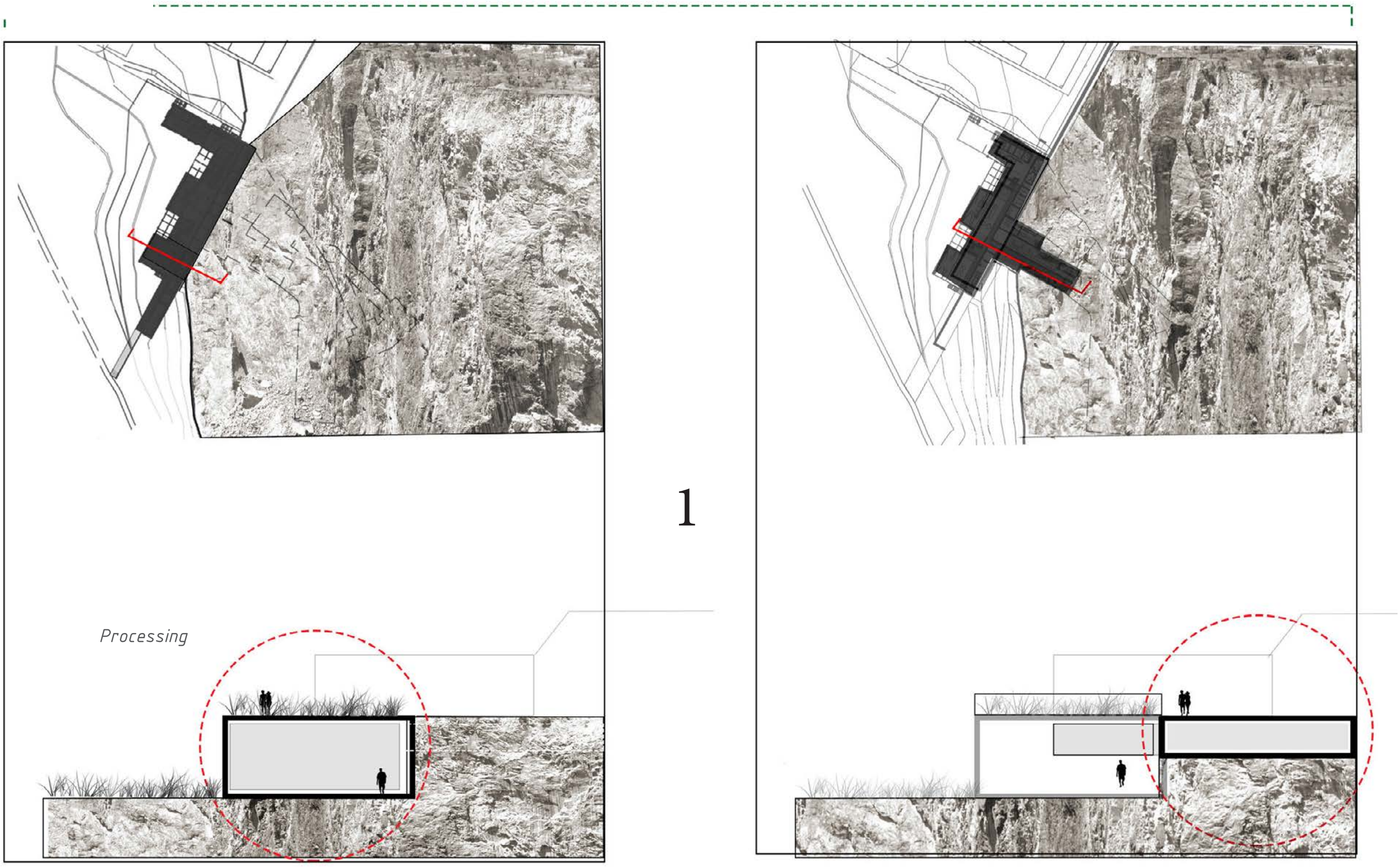


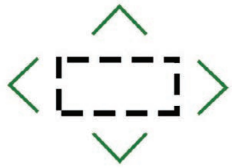
Figure 6.51
Diagrammatic explanation of the changing response of the section across the site (Author, 2014)

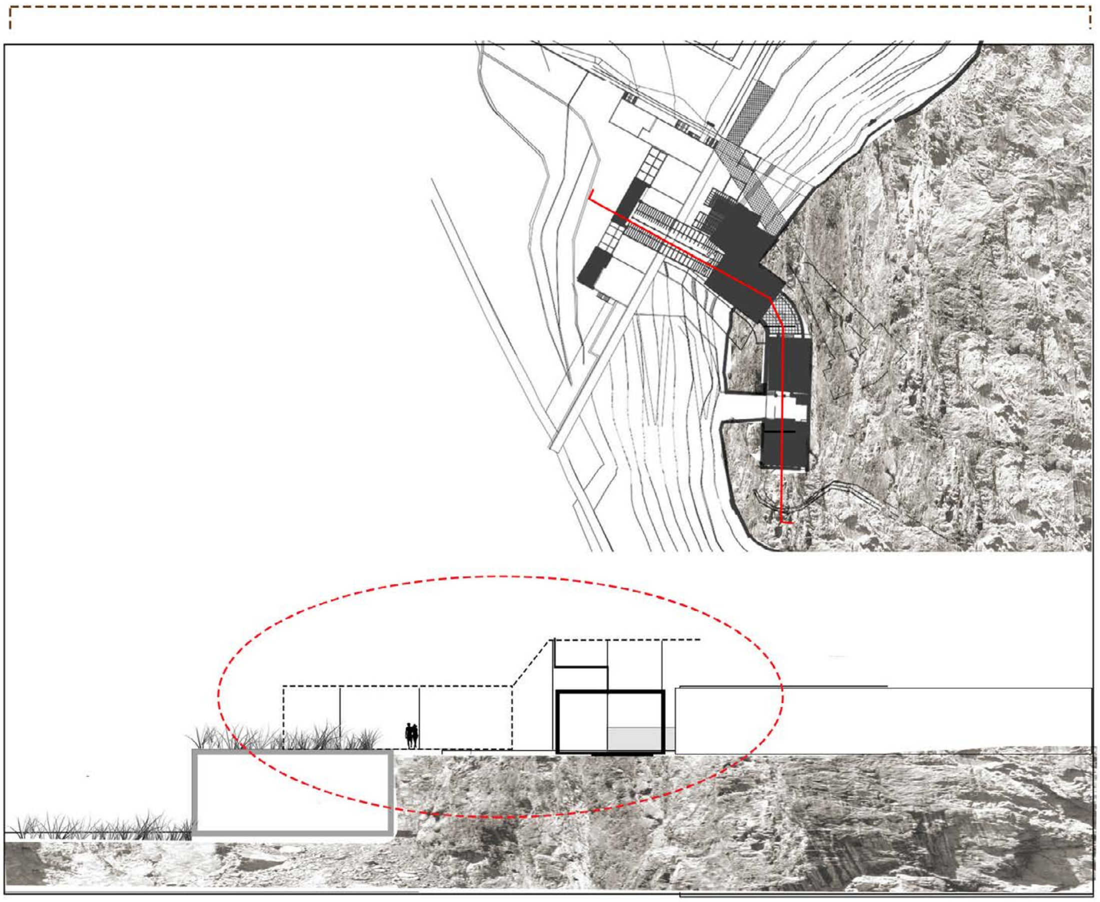
1- Merging with the natural condition

2- Mediating between the three conditions in the realm of man

3- Retaining the contrast of the existing machine on the surface.

Man (mediation)





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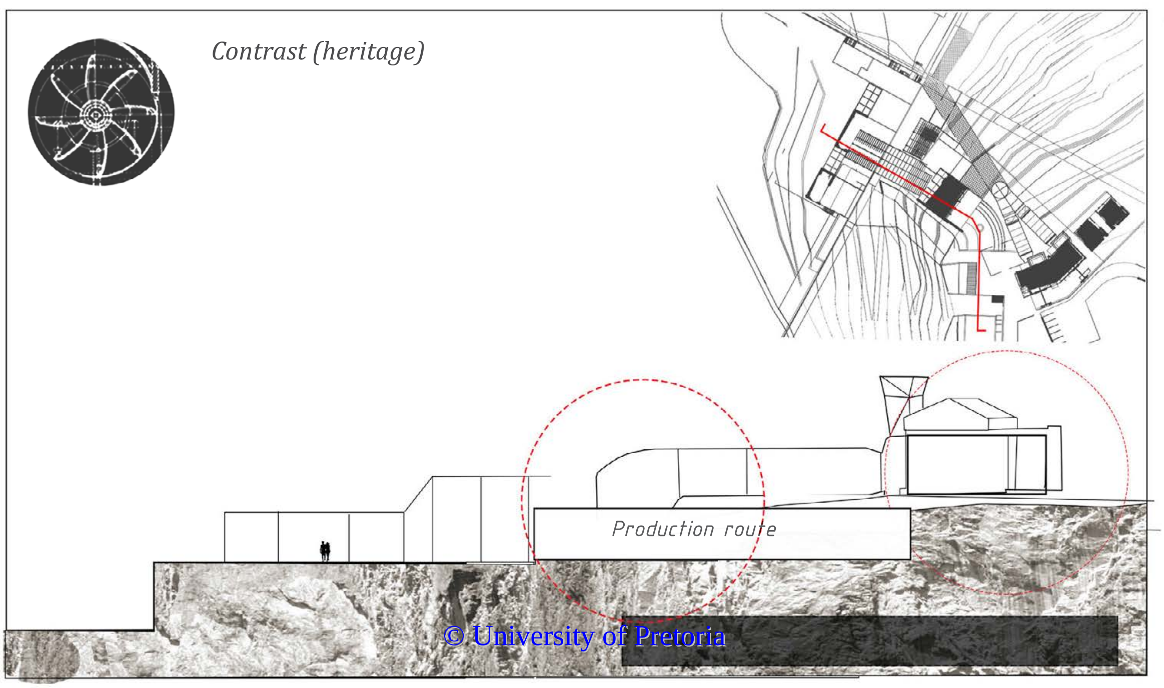

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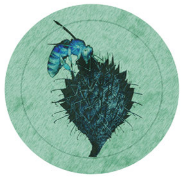
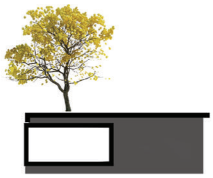
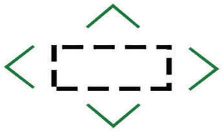






Nature

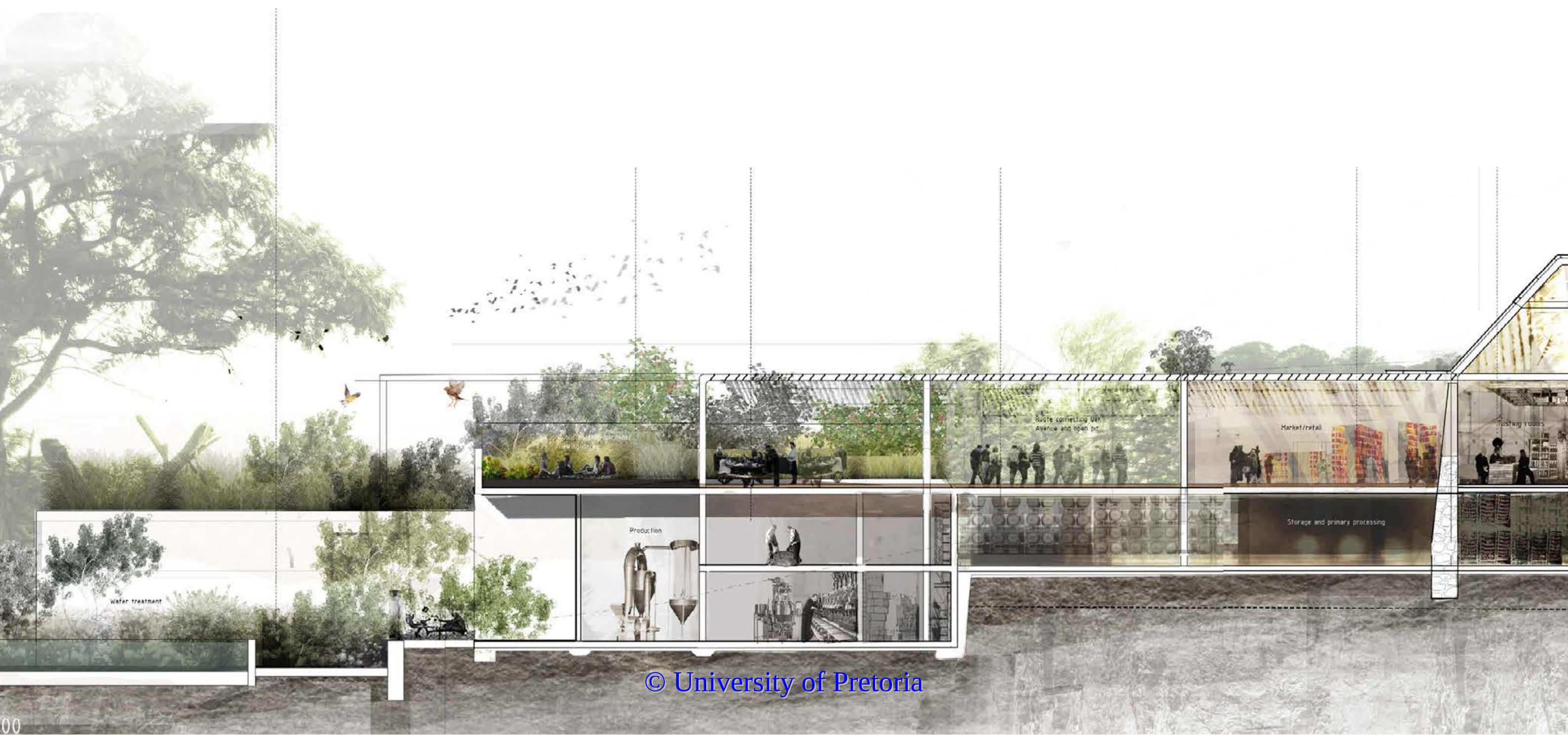
Man

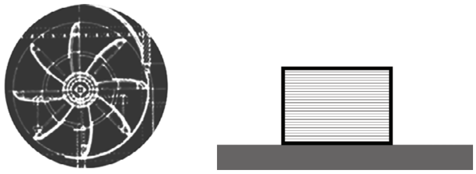
Merger- integration with nature

Reciprocity- mediation between the realms

Figure 6.52

Section spatial exploration. The ground connects the three conditions, where the tectonic pergola defines each on the surface changing height and stepping up to meet the scale of the shaft NTS (Author, June 2014)





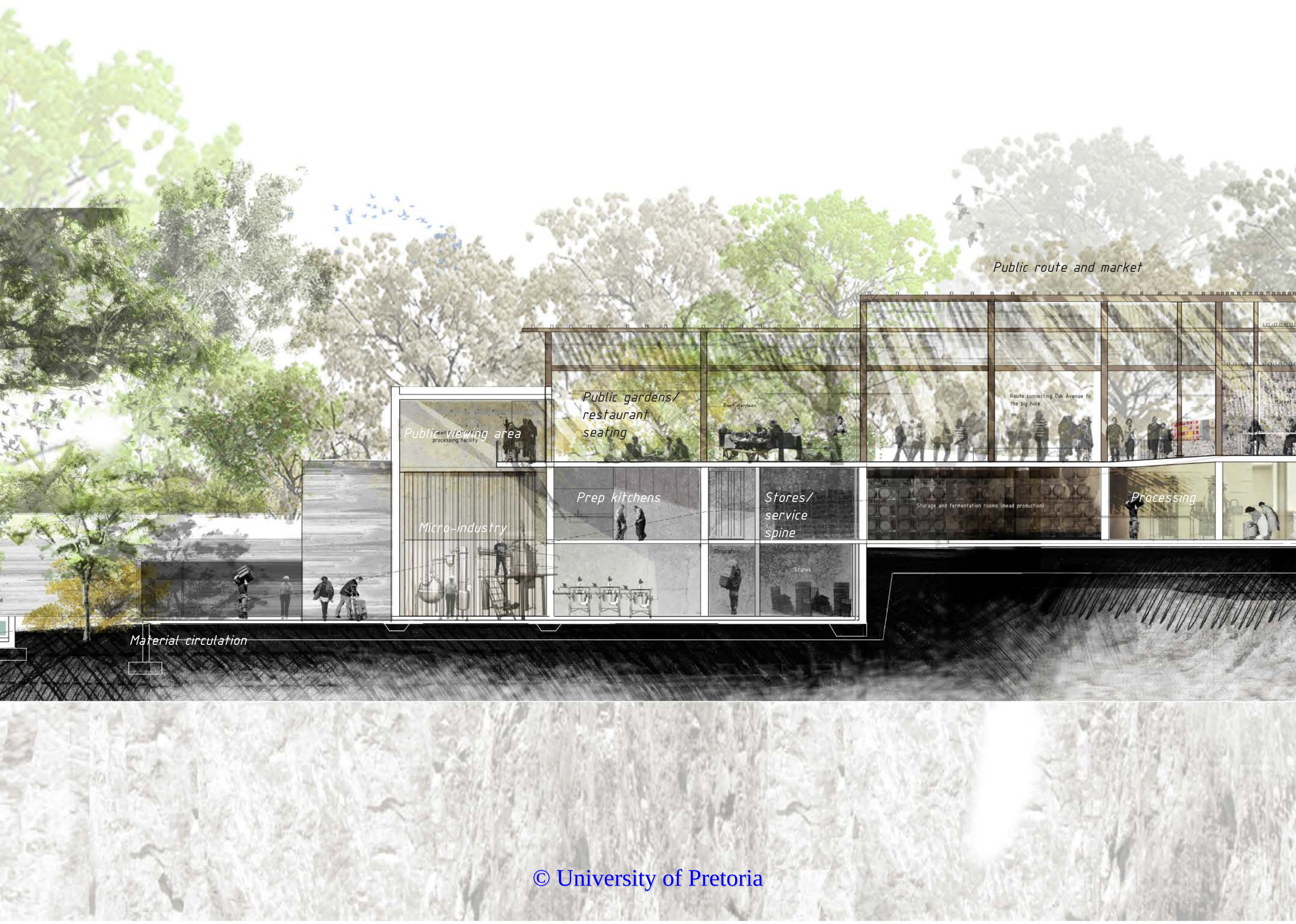
Machine

Contrast- the ventilation shaft

Figure 6.53

Section spatial exploration

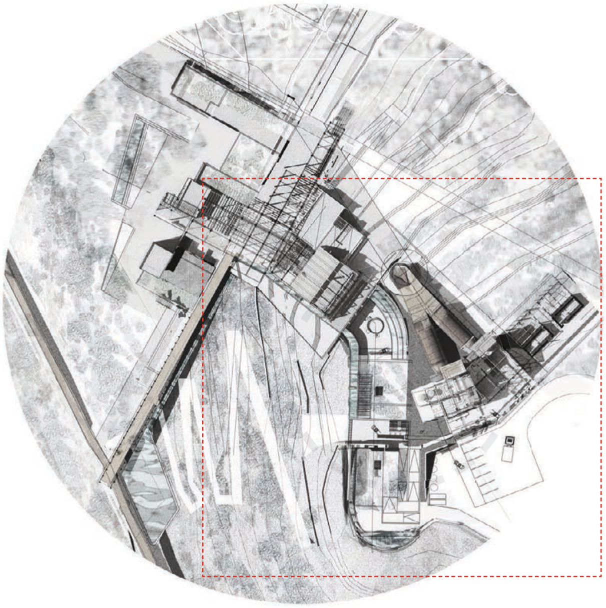
July , NTS (Author, 2014)

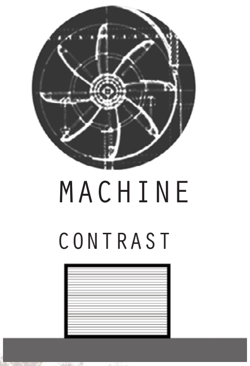



Ventilation shaft
Greenhouse
Admin
Food and heritage
walk
Tasting
spaces/
retail
kitchen
Water harvesting and
washing courtyard
Post-harvest treatment
Staff
'fieldhouse'
Material delivery
Waste sorting
Productive landscape
SECTION 1

DESIGN SYNOPSIS

THE THREE CONDITIONS





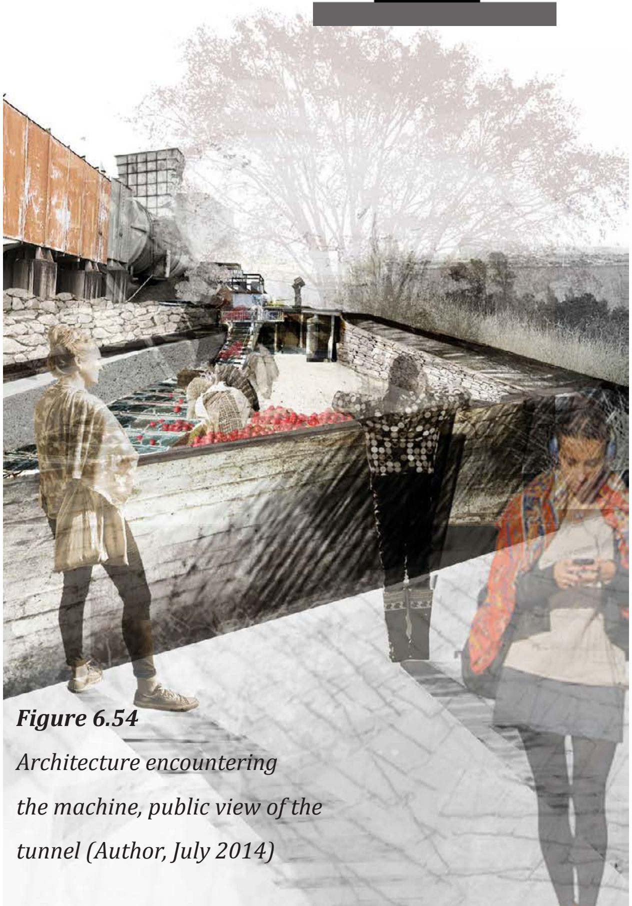


Figure 6.54

Architecture encountering the machine, public view of the tunnel (Author, July 2014)

6.15 ENCOUNTERING THE MACHINE

The new architecture that encounters the extant breathing machine acknowledges the ventilation shaft's associated character of *contrast- an alien, mechanical lung commanding its context*. Therefore the new building *discretely rises up from the realm of man to meet it* without competing with its scale, allowing the massive ducts and cowls to continue to dominate. *The architecture translates the shaft's function as an exhaling machine, rooted as a parasitic element in its context and a ghostly reminder of the dead cyborg that once devoured the devastated landscape.*

The point of encounter is marked by 'holes' (courtyards) punctured into the degraded surface as a physical expression of the memory of the now abandoned mine tunnels beneath the site (5 of figure 6.48). It is here that raw materials, fruits from the remediated context, are visibly prepared under the shade of fruit trees and adjacent to the trickling channel filtering water from the large opencast pit (7 of figure 6.48). The monolithic expression of the tunnel is concealed below the productive landscape, but opens in parts, lighting the work spaces below where raw material is stored.

A route bridges the realm between the old and new conditions (figure 6.55), forming a public space surrounding the large raise-bore hole where the existing machine meets and extends into the depths of the earth. The route narrates Cullinan's food system, a unique story embedded in place .

The machine continues to support life, now on the surface, retaining its identity as a respirator, exhaling air from the depths of the earth. Old motor rooms attached to the shaft support new greenhouses, heated by the fans and using the old oil pits to support the horticultural programme (figure 6.58). The greenhouses are extended into the park and landscape to the north overlooking the public harvest gardens.

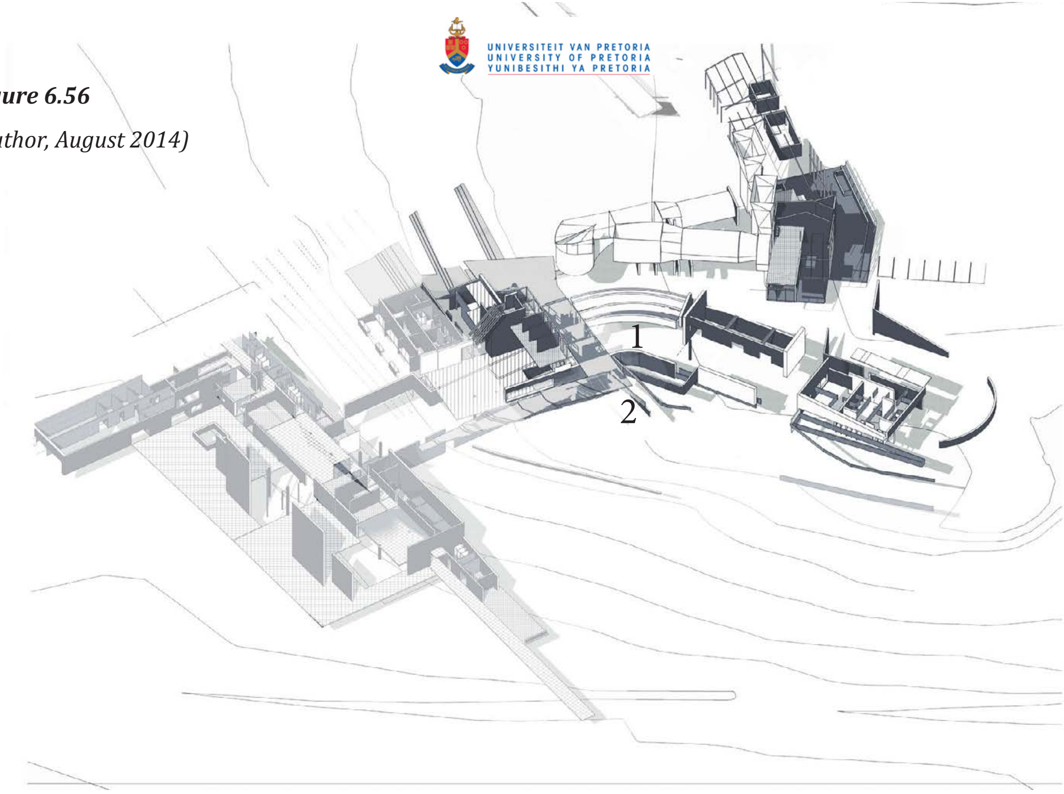
Figure 6.55

The bridge

(Author, September 2014)

Figure 6.56

(Author, August 2014)



1- WATER STORAGE AND WASHING COURTYARD

2- WATER CHANNEL

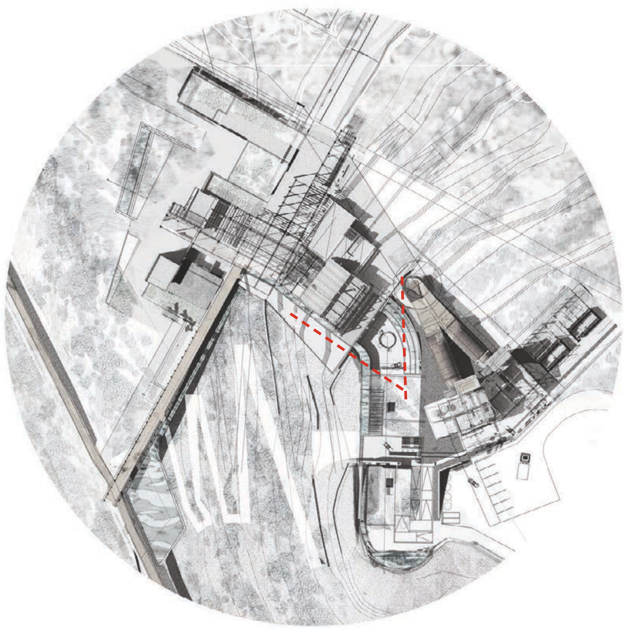


Figure 6.57

Perspective from the productive landscape of next to the ventilation shaft
(Author, October2014)

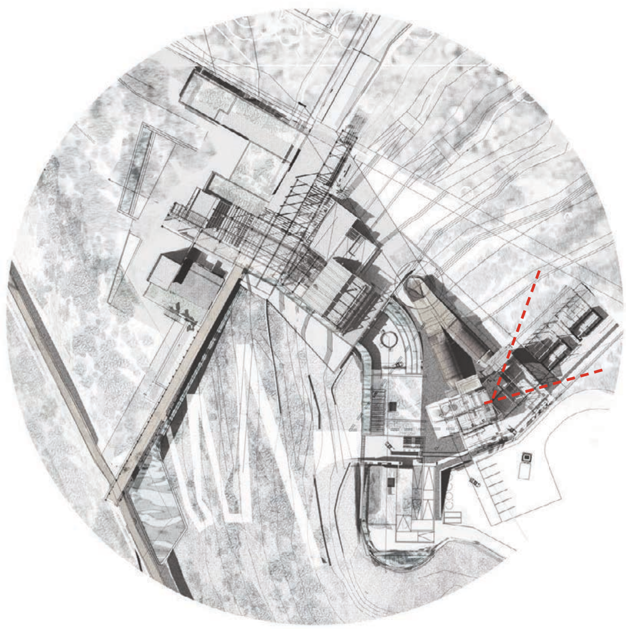
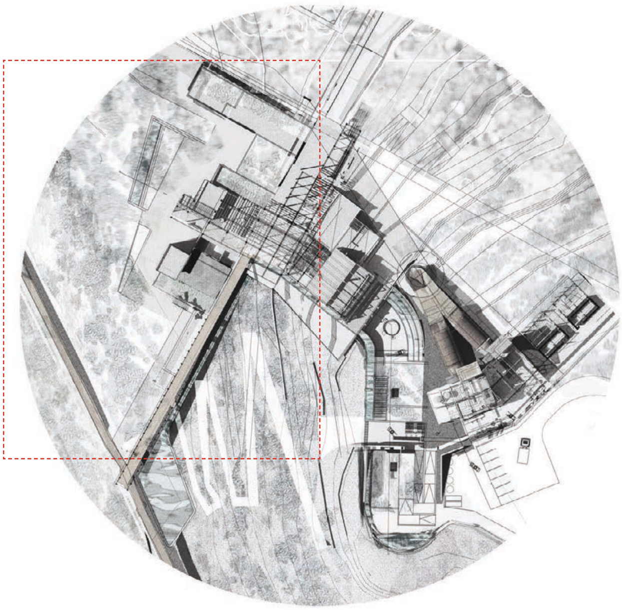


Figure 6.58

Interior view of extant motor rooms attached to the ventilation shaft and reused as a greenhouse for floriculture.

The 'new machine' : the ventilation shafts supports plant production (Author, October 2014)

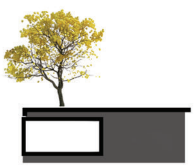


6.16 NATURE'S RESURGENCE

Beneath Oak Avenue Park, processing of produce occurs inconspicuously, apart from viewing platforms protruding from the gardens announcing its presence along the public route (1b in figure 6.45). The planted public roof gardens (1a in figure 6.45) form an extension of the natural condition of the park, recessed in parts to light staff courtyard spaces below. Nature's identity as a complex organism, with a faster rate of change than either man or machine, influences the architectural expression as firmly embedded in the landscape. This part of the building is therefore a *dynamic element* which alters and mutates the perception of the architecture as a *growing* entity, allowing plants to consume it over time. The mined opencast pit and ventilation shaft are visible from the roof gardens.

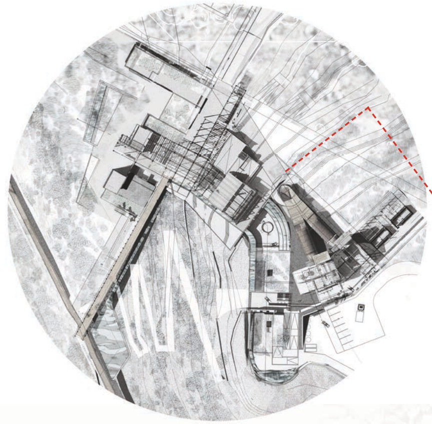
NATURE

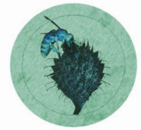
MERGE



Staff spaces and courtyards below interact with the natural context implementing the concepts related to biophilic design, spatial and visual connections are maintained throughout the facility within the natural condition.

Architecture as a merged element integrated with the site topography means that fruit and product stores can be better regulated at constant temperatures. Processing spaces connect to service cores (figure 6.46), test kitchen spaces and the staff circulation reflected on the surface (the route defining the realm of man), with skylights growing from the walkway and forming seating. Intermediate storage of products between processes supports the more open and flexible processing spaces opening to the north, facing the park, and to the south, overlooking the scarred landscape.





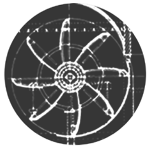
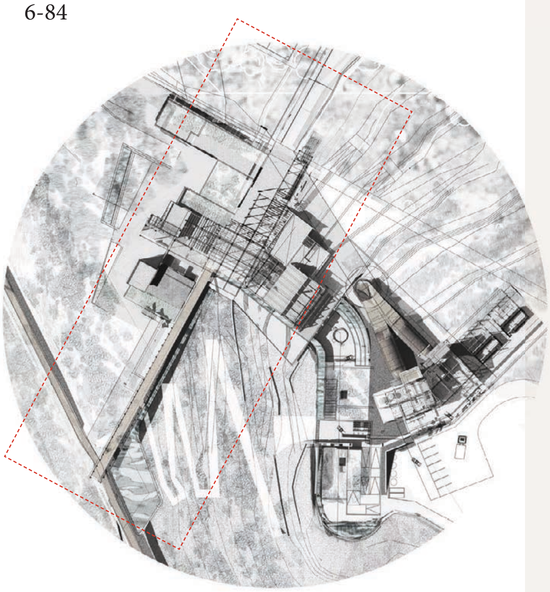
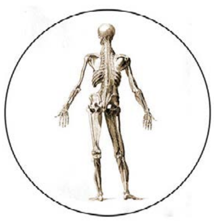


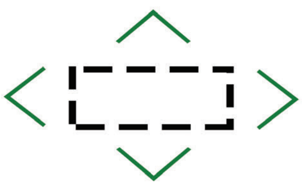
Figure 6.59
Approach from Oak Avenue Park illustrating the three conditions across the site, and activities along the route (Author, October 2014)





MAN

MEDIATE



6.17 MEDIATING MAN

The realm of man exists as an interstitial space bridging the ghost of the machine and resurging nature and is defined by a tectonic pergola (1 in figure 6.49) that changes its character to define the triad of realms and their thresholds, blurring the boundaries between conditions. The continuous joining element's changing identity and spatiality is heightened by varying degrees of transparency along its length, stepping down into the processing spaces below and rising to meet the machine above. The public tasting space and test kitchen are asserted by the roof form. Where these three realms intersect is visually defined by overlapping parts of this light, mediating structure.

The contour-defining wall element winds through the landscape, recessed in parts to support the market activities, originating from the park to the north and fading into productive landscape to the south forming seating and terraces.

re 6.60
Public test kitchen
(Author, October 2014)

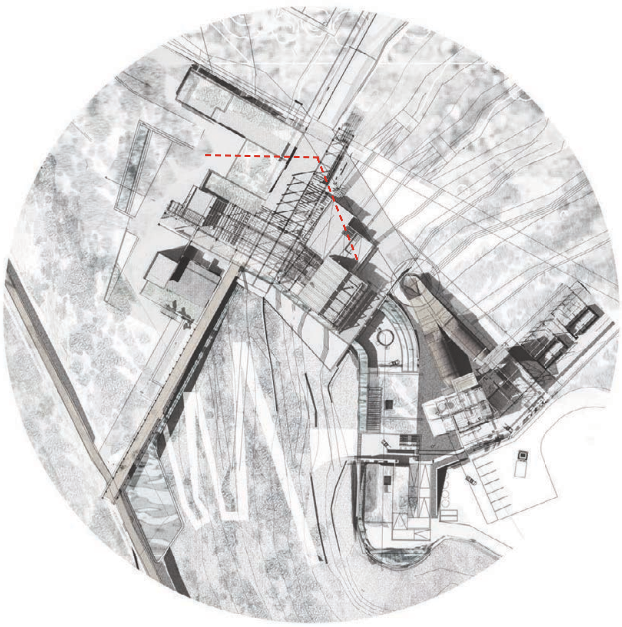


Figure 6.61
The market and triad of realms defined by the stepping pergola (Author, October 2014)

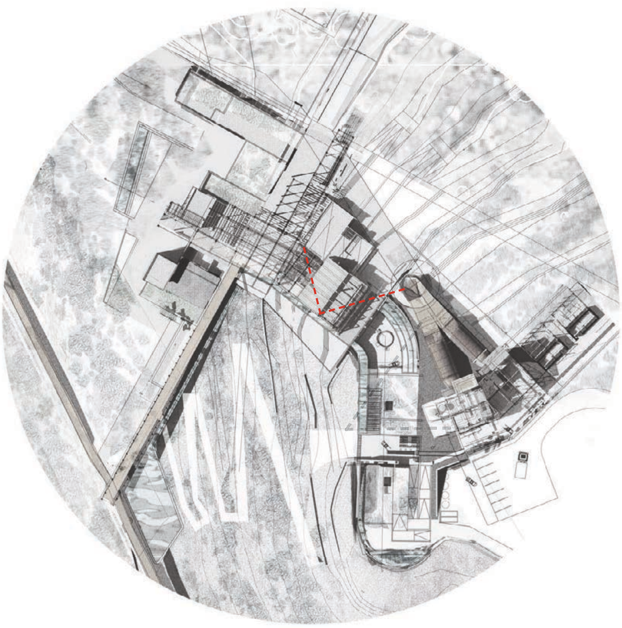
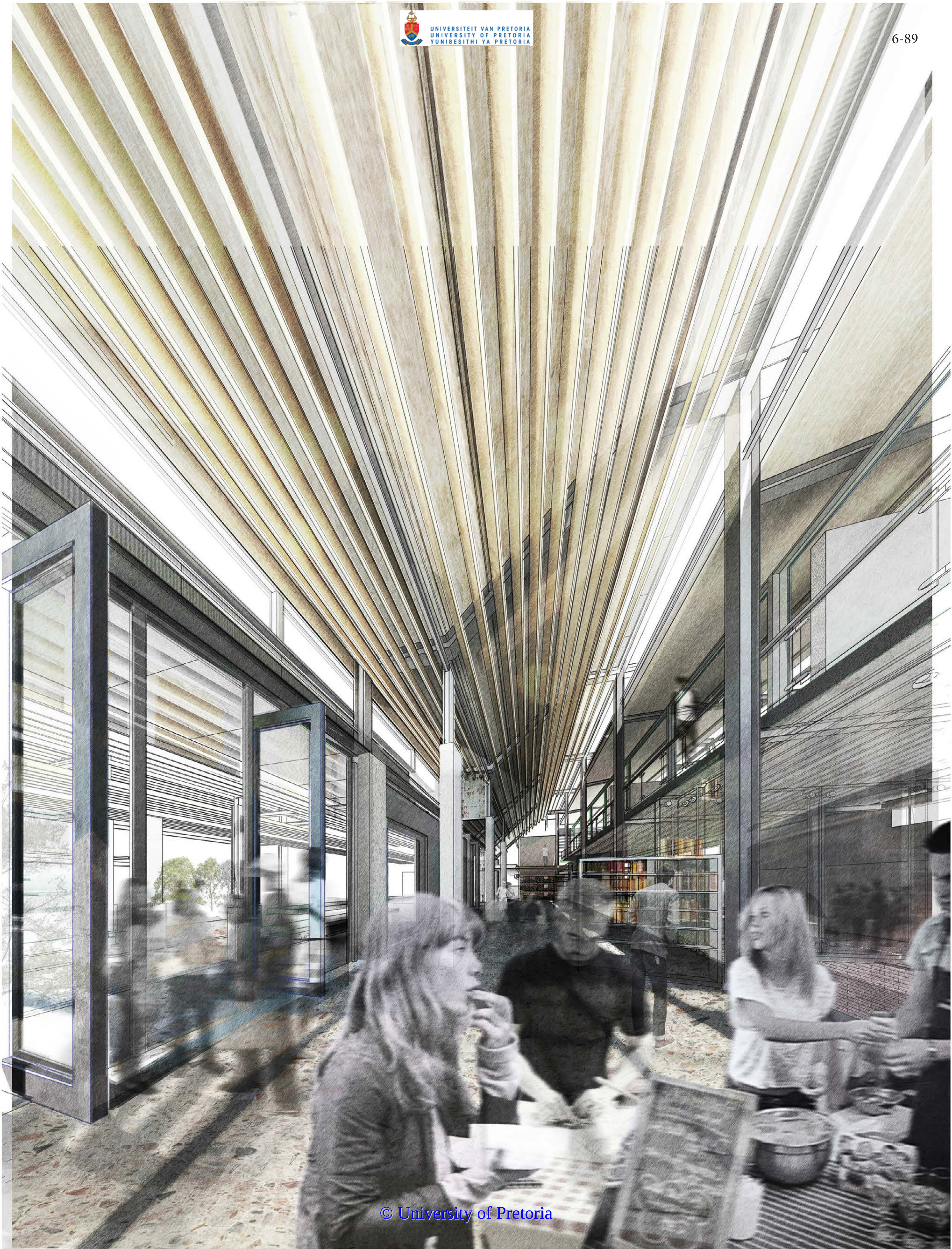


Figure 6.62

The tasting area and retail space

(Author, October 2014)



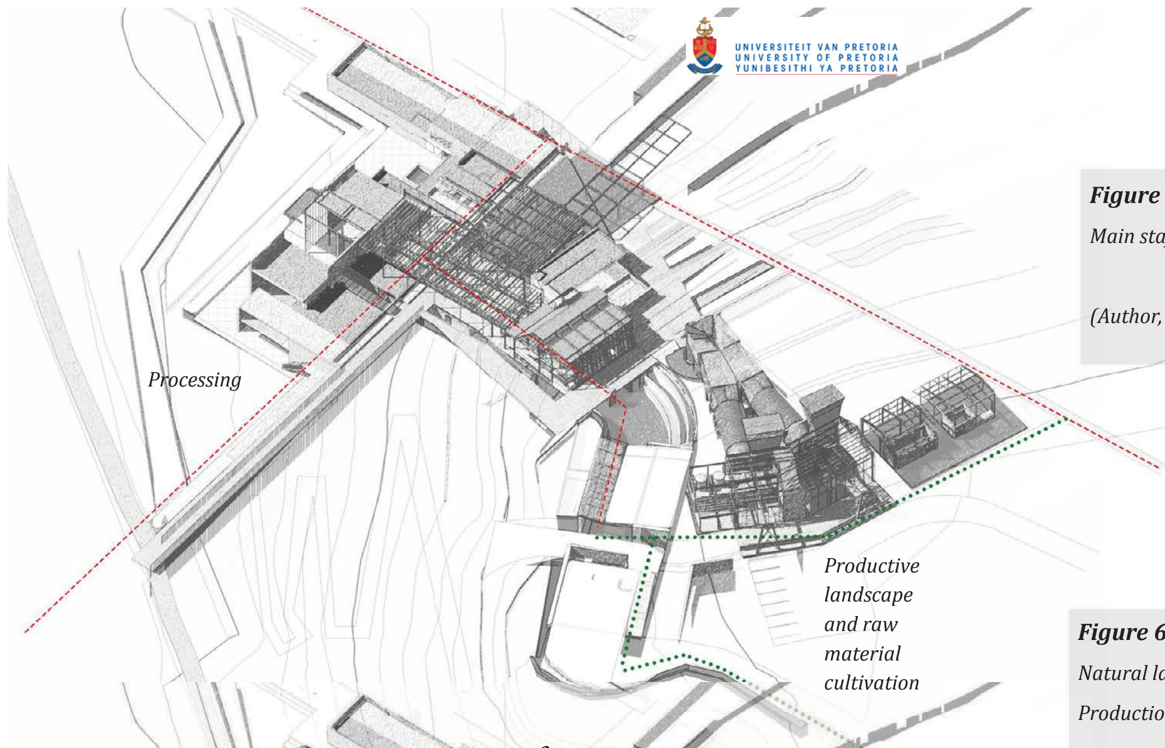


Figure 6.63

Main staff circulation routes

(Author, 2014)

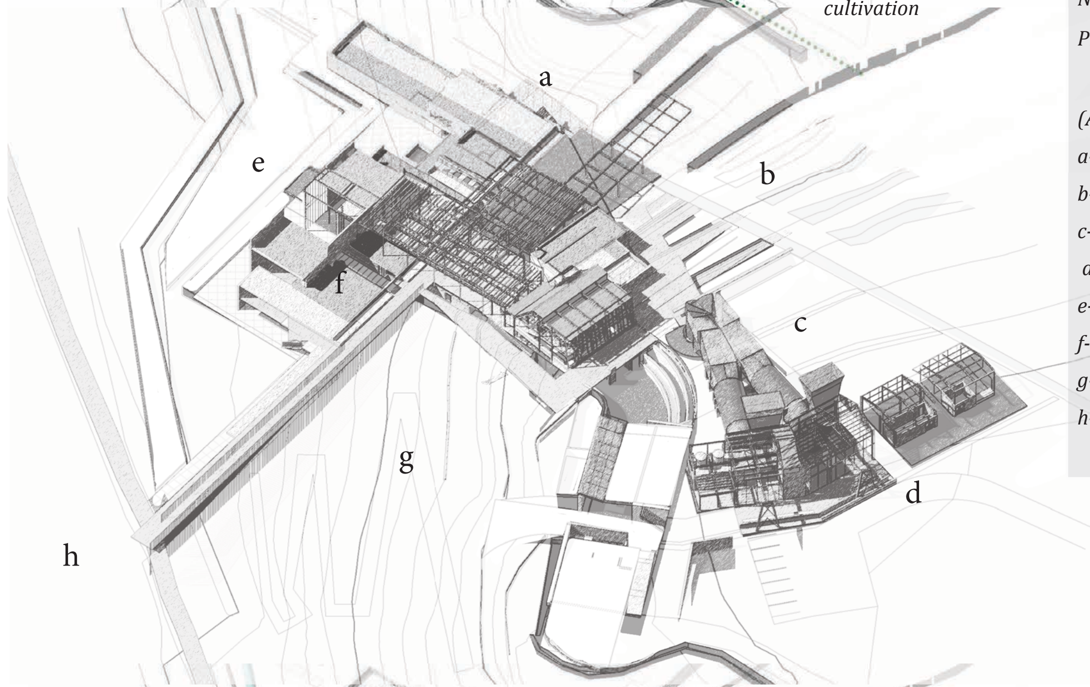


Figure 6.64

Natural landscape

Production and gardens

(Author, 2014)

a- Festival/sportsground

b- Park

c- Public harvest garden

d- Flower and herb production

e- Staff gardens

f- Public roof gardens

g- Orchards

h-Endemic planting

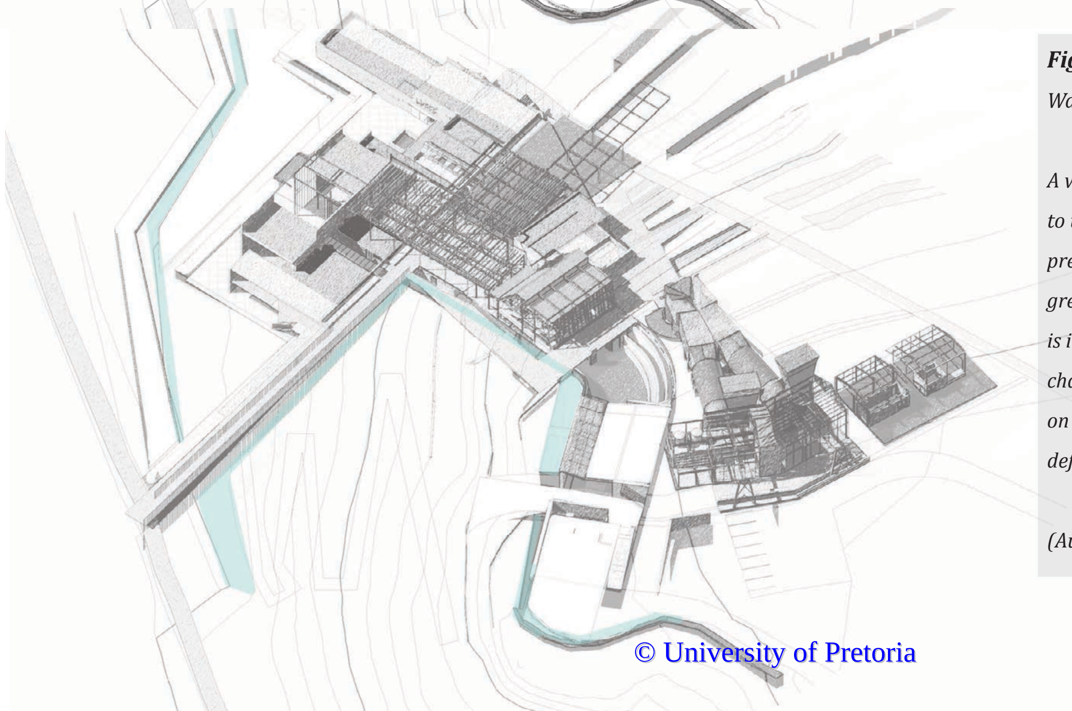


Figure 6.65

Water

A water channel runs adjacent to the building, used predominantly for irrigation and grey water. Water as material is investigated in the technical chapter. In the design it represents on of the natural cyclical elements defining the natural condition.

(Author, 2014)


DETAIL 2
DETAIL 1
ADMINISTRATION
BRIDGE
PUBLIC ROUTE FROM OAK AVENUE PARK
MARKET STALLS
VIEWING PLATFORM
PRIMARY PROCESSING
SECONDARY PROCESSING
CIRCULATION AND STORAGE
MATERIAL CIRCULATION
COLD STORE

Figure 6.67
Final section, NTS

(Author, November 2014)

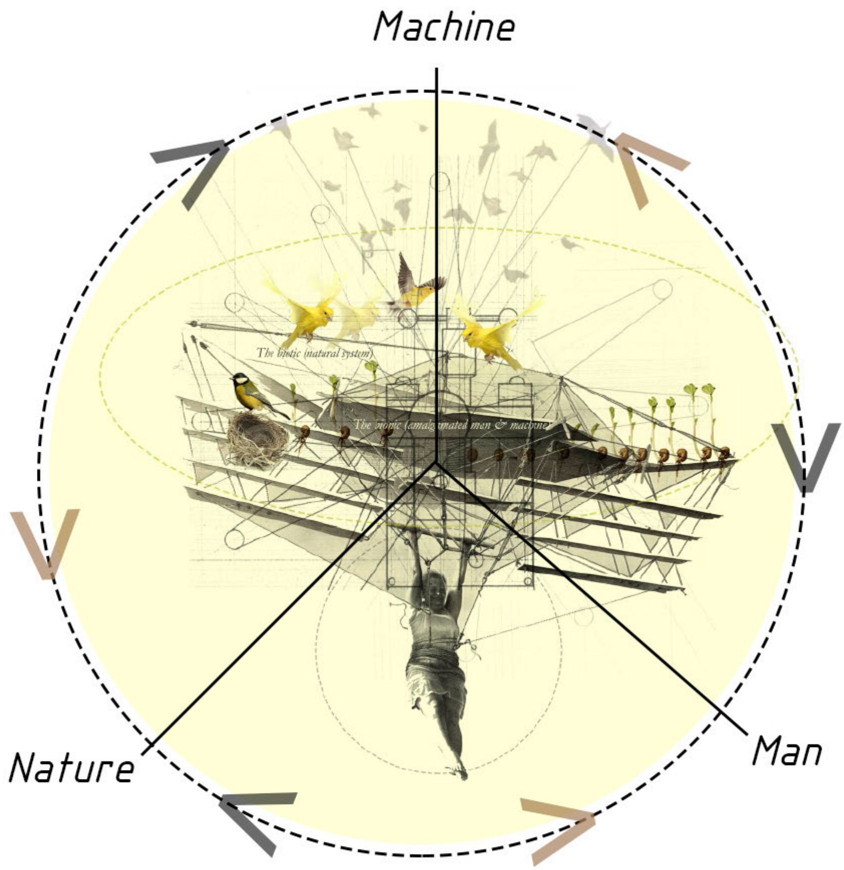
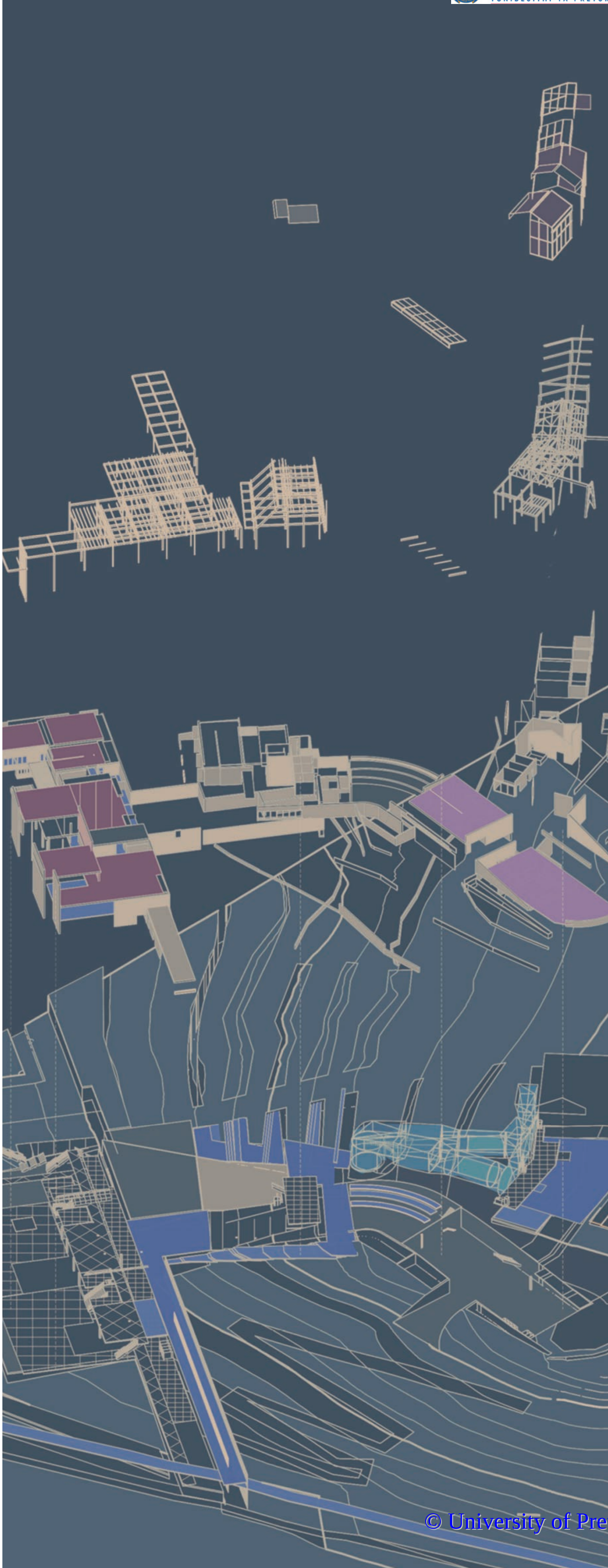


Figure 6.68 *(Author, 2014)*

The systems of man, nature and machine support one another to reflect new synergistic interchanges for the mutual benefit of these systems, creating new cyclical exchanges. New 'symbionic' system exchanges are to the profit of all the systems involved.



CHAPTER 7

TECHNICAL INVESTIGATION

The making of man, nature and machine

Chapter 7 discusses the technical resolution and the making of the architectural expression of man, nature and machine.

Figure 7.1

The fabric of the existing machine on the site (Author, 2014)

7.1 TECHNICAL CONCEPT

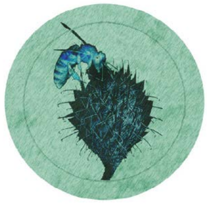
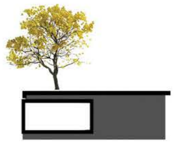
Current and foreseen system dynamics between man, nature and machine have been explored on macro and micro-scales, ranging from the larger site and context, the design and, in this chapter, building assembly. Each of these systems, the breathing machine, resurfacing nature and their reciprocity defined by the realm of man, has its own unique traits and should remain distinctly identifiable as such, while exploring the technical expression of their interfaces through materiality, systems and detailing. Because this dissertation explores an architecture that regenerates from a strong founding in place, the site and its associated attributes are an important influence in informing the making of architecture. All three realms are established and informed by place and tangibly represented in the existing site characteristics and fabric. The technical exploration, therefore, expresses the future locale within extant natural and cultural systems.

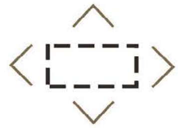
Material selection is also informed by the existing fabric and the remnants of the triad that remain on the site. Materials are either reused or modified. New materials are not only selected as expression of the triad, but are also informed by the three theoretical strategies as architectural response, a tangible reflection of nature, machine and man, namely *merging, contrasting and mediating respectively.*

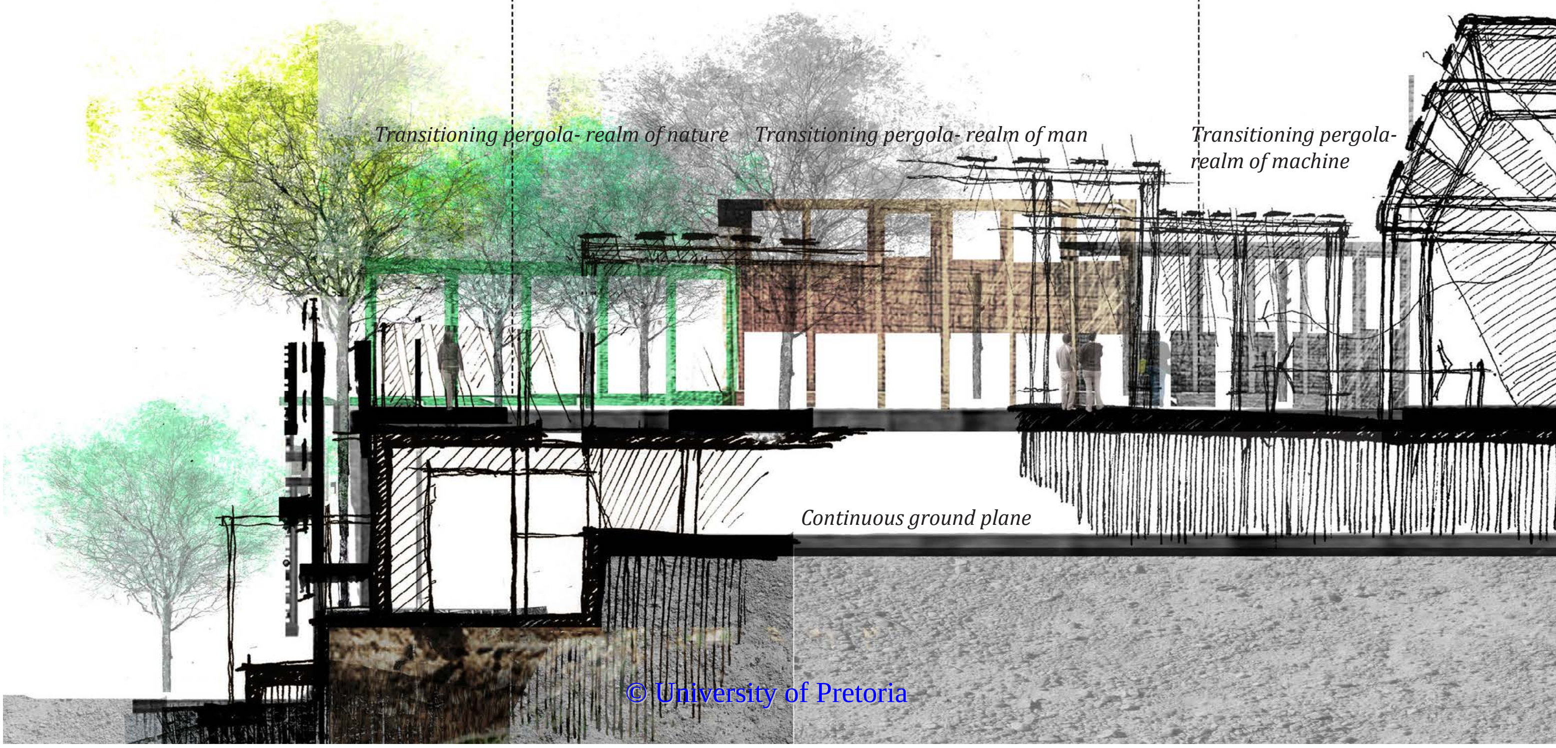
The three main construction details explore where man meets the conditions of machine and nature.

NATURE
MERGE

MAN
MEDIATE



MACHINE
CONTRAST

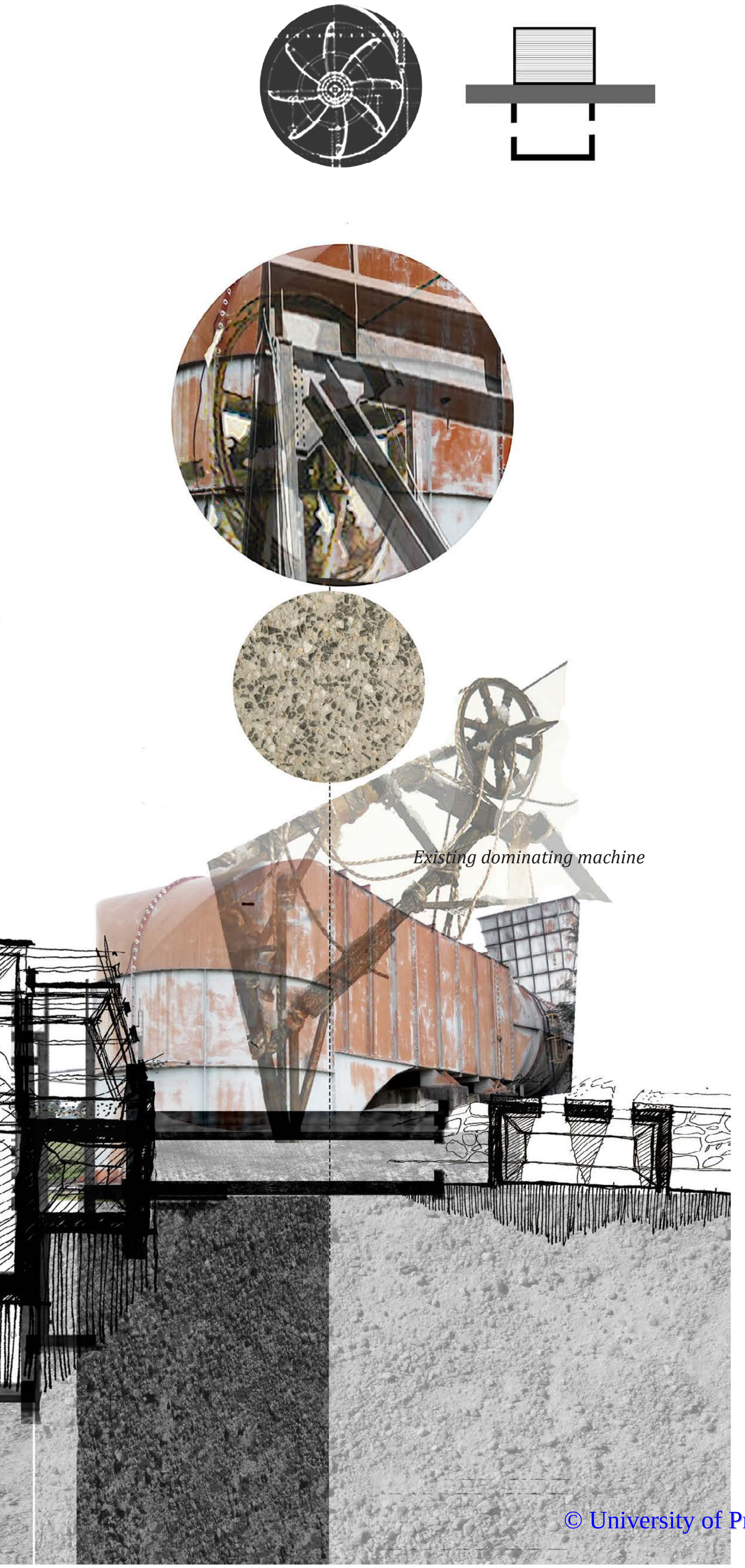
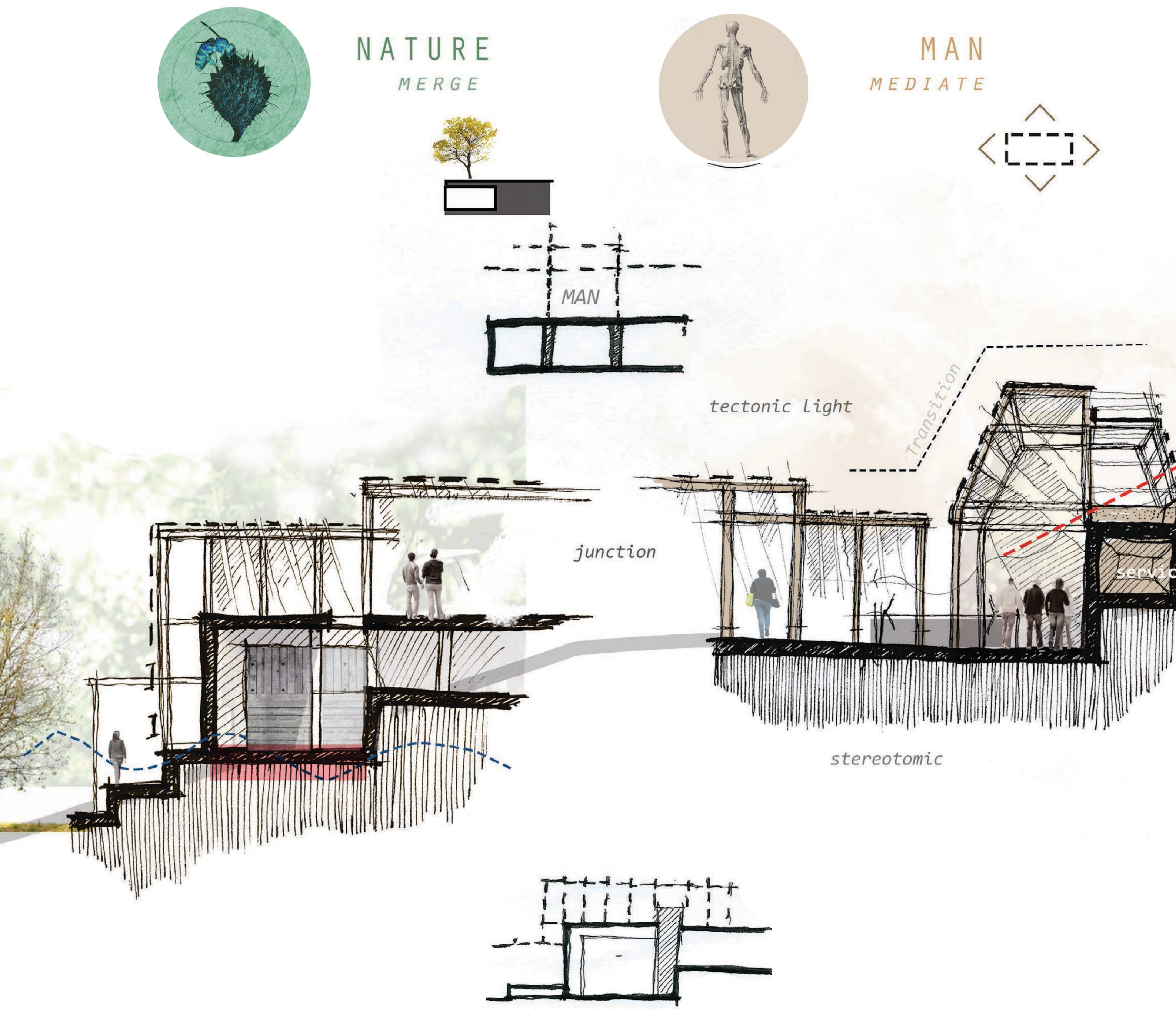


Figure 7.2

Illustration of the technical concept as extension of the exploration of the three conditions of man, nature and machine.

(Author, 2014)


NATURE
MERGE
MAN
MEDIATE
MAN
tectonic light
Transition
junction
stereotomic

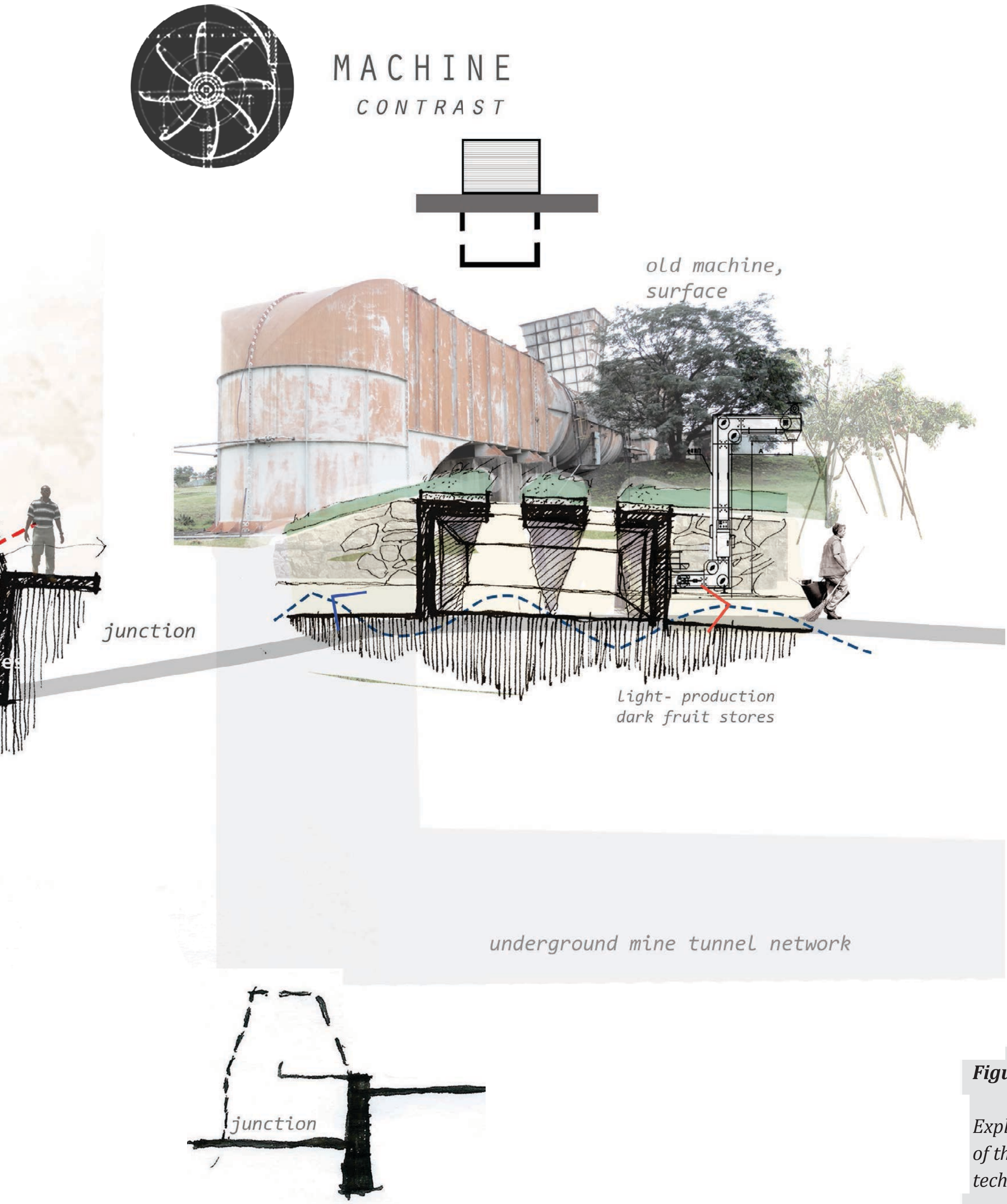
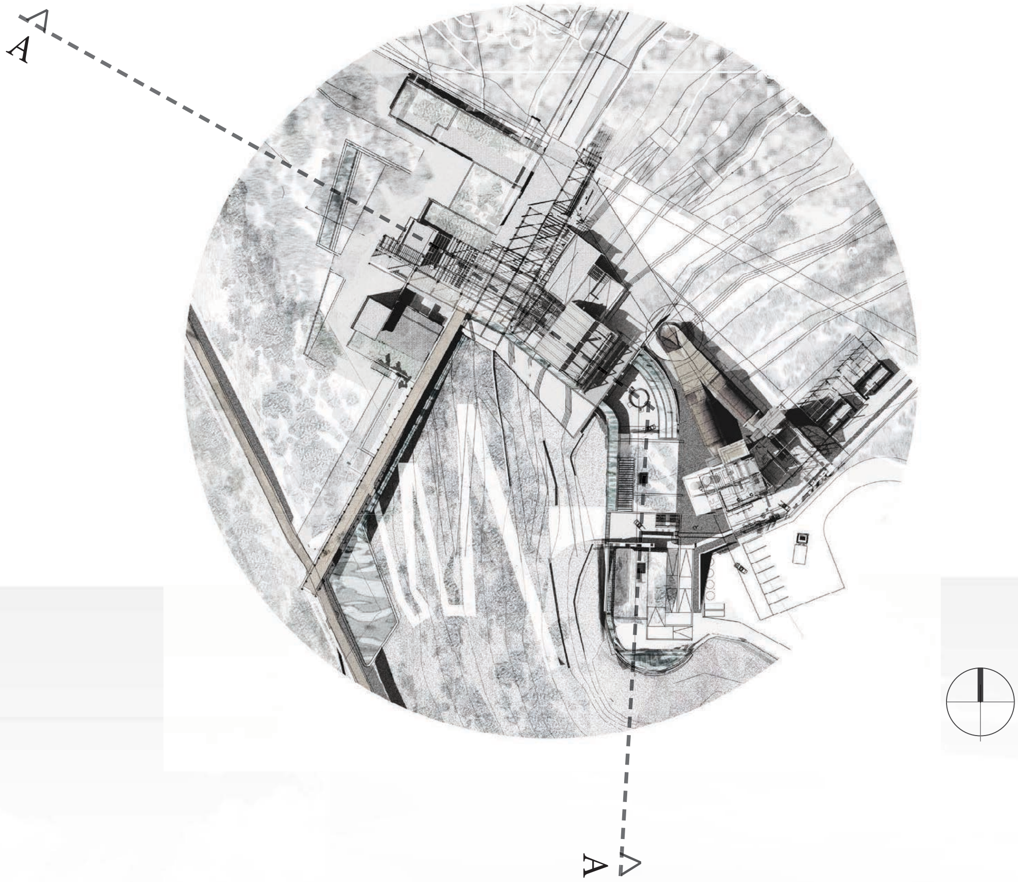


Figure 7.3

Exploring the characteristics of the three realms within the technological concept

(Author, August 2014)


A
A


PUBLIC ROUTE FROM OAK AVENUE PARK
MARKET STALLS
OUTDOOR TASTING AREA
VIEWING PLATFORM
PRIMARY PROCESSING
SECONDARY PROCESSING
COLD STORE
CIRCULATION AND STORAGE
MATERIAL CIRCULATION

Figure 7.4

Section A-A, November (Author, 2014)

7.2 NATURE

7.2.1 Materiality

Plants, water and air are the biotic elements which give definition to the resurging natural realm on the site. The architectural expression of this *natural condition* is embedded in the context and grows from the ground to act as a *supporting frame* for these elements. Parts of the building are earth-sheltered and stereotomically founded as a monolithic extension of the ground condition, terracing from the existing slope.

Felsite is a hard, strong rock (Venter, 2102:41) that surrounds the diamond-bearing Kimberlite pipe. Felsite can be found on the site and alludes to the natural condition. Stone from the site and waste rock from the mine, including uncrushed Kimberlite, will be used to form a continuation of the existing stone wall that traverses the park. The material will also be crushed and used as exposed coarse aggregate in the concrete walls and to form planters. Concrete and stone represent the stereotomic, and timber the tectonic. Old eucalyptus trees are abundant in Cullinan, therefore the use of saligna in the building will become an extension of the narrative of place.

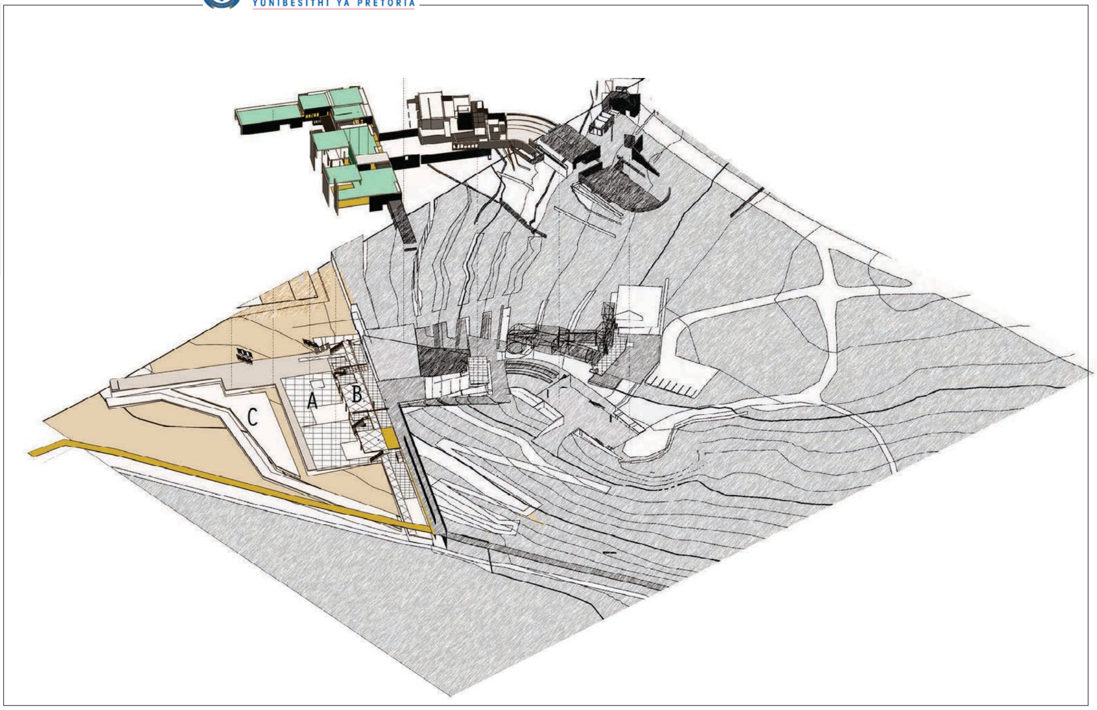
Because natural biotic elements are the primary materials on this part of the site, they should be able to influence their architectural frame, staining the concrete and stone structure over time and even growing from it. This part of the site therefore considers the mutual, reciprocal transformation of architecture on nature and vice versa, although nature will prevail. This part of the building will eventually become a physical continuation of Oak Avenue Park once it has been 'consumed' by the reemerging landscape. The natural is dynamic and, in order to support the exploration of future resilience between the three systems, the natural context has to be recognised for its cyclical character and be expressed as such.

Figure 7.5
Existing materials on the site belonging to the natural realm, including the stone wall in the park (Author, 2014)

Figure 7.6

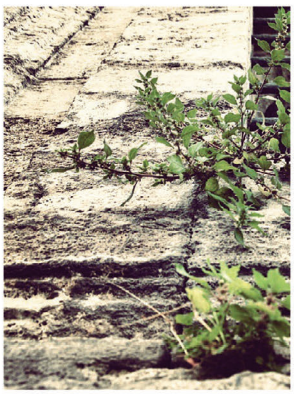
The natural condition on the site

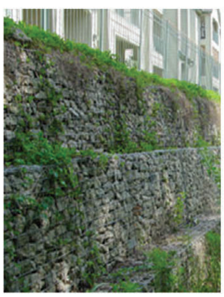
(Author, 2014)



Felsite
Coarse aggregate

The building as a 'frame' for the biotic





Stone gabions

Stained concrete walls, the imprint of nature

Timber-saligna

Planting

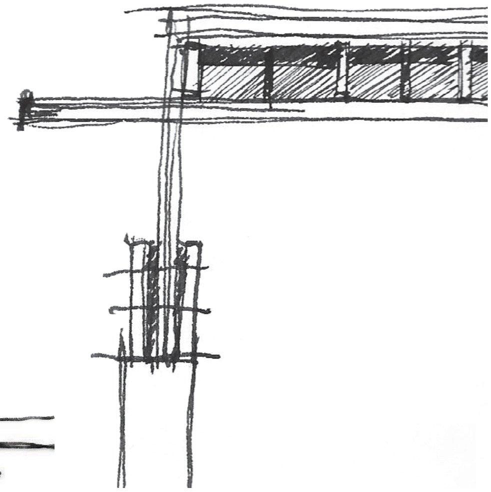
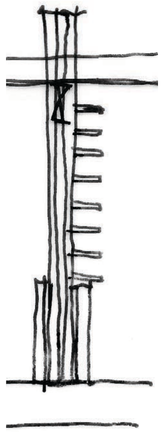
Figure 7.7
Nature : material palette

(Compiled by author, 2014)

7.2.2 Detail exploration

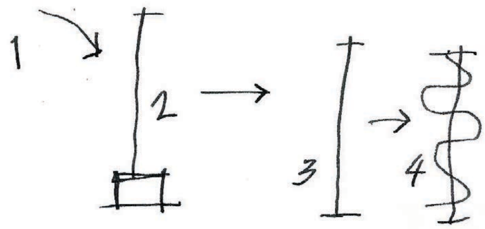
In order to align with the intentions for this part of the site and the *natural condition*, the junction detailing should express various elements such as ground, wall and transitioning pergola, as integrated extensions of one another, which expands on the identified strategy of merging with site. The stereotomic concrete walls act as thermal mass, facing the western sun and supporting the planting structures.

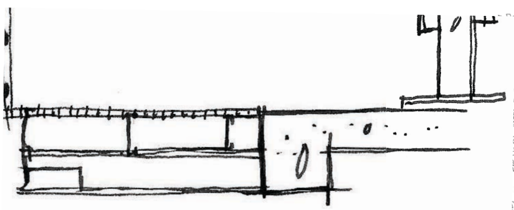
Figure 7.8
Nature: detail exploration (Author, August and September 2014)

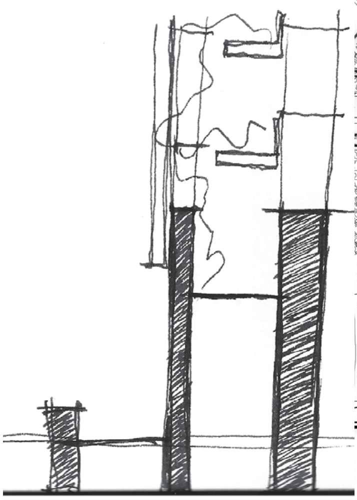
Tectonic timber structure- an extension of the pergola defining the public route

Exploring the changing column articulation along the mediating pergola structure

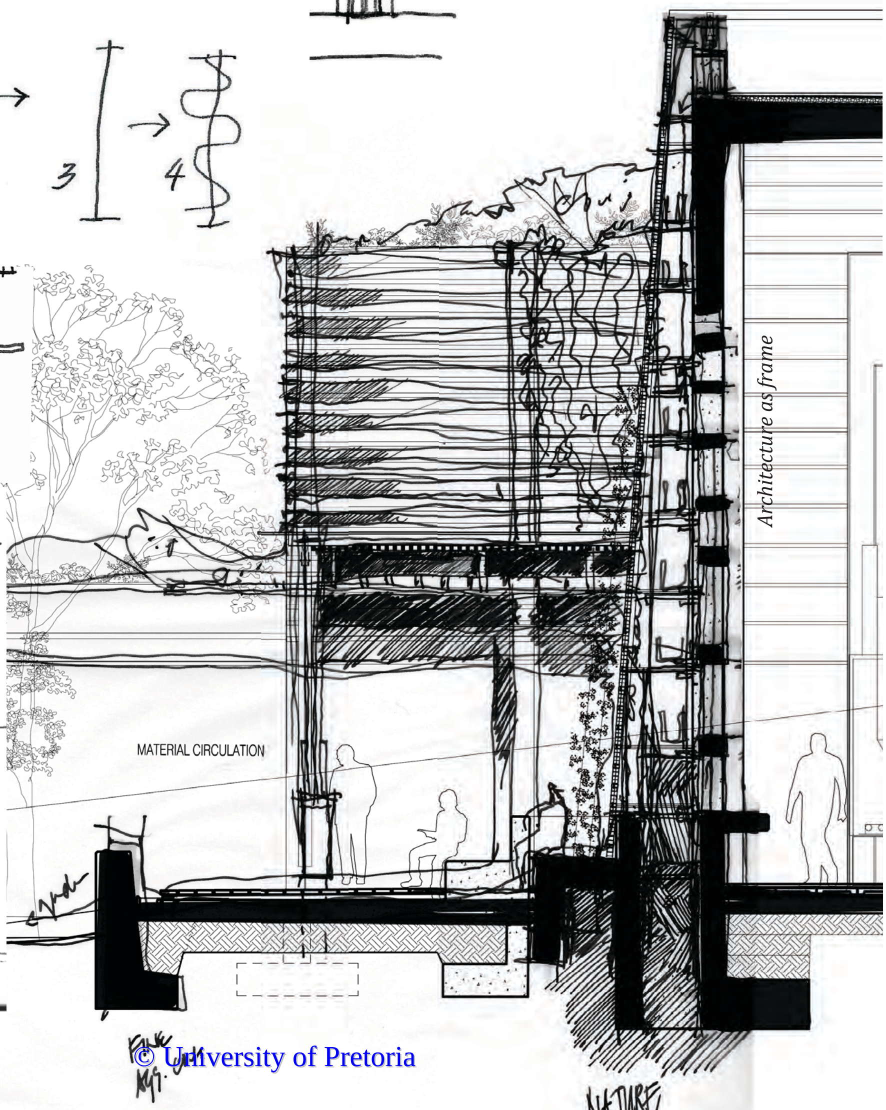


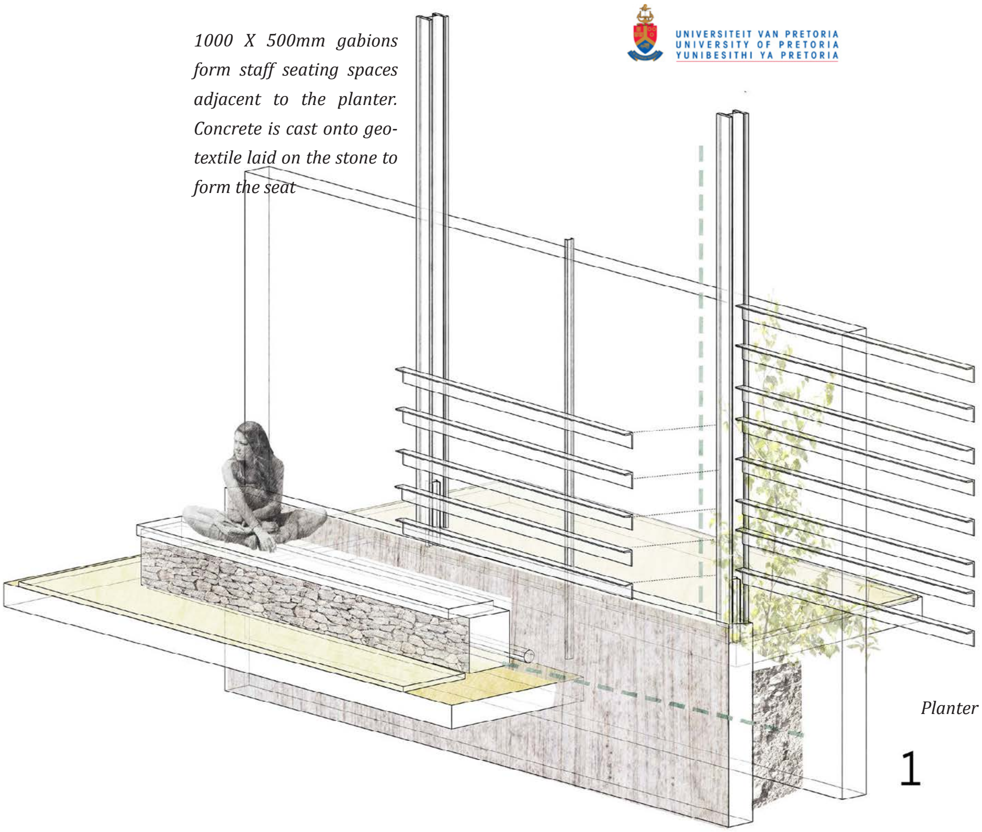


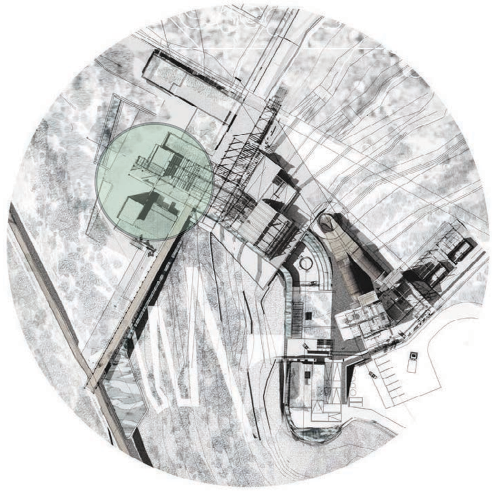
Cantilevering viewing platforms



Planters







Planting screens located on the site

Figure 7.9
Detail exploration of the planting screen and water harvesting system from the roof gardens

(Author, October 2014)

Figure 7.10

Existing materials on the site belonging to the machine (Author, 2014)

7.3 MACHINE

7.3.1 Materiality

The story of the *machine* on the site is expressed through the retained fabric of the *ventilation shaft.* Parts of the machine are disassembled and reused in the new structure, and the parts that speak of its narrative are retained and given expression. The old rusted ducts are retained in their current form, aged by the elements. The shaft has weathered over time and stained the concrete platform surrounding its connection to the earth, which is a tangible representation of the impact of the machine on the site. The cladding of the current steel structure, which houses the motor-rooms for the fans, is replaced with glazing and louvres for the proposed greenhouses. Bricks and metal sheeting from the structure are reused in the new structure: Bricks are packed into some of the gabions forming seating, while metal sheeting is reused as cladding in the new parts of the building. McGill (2014: correspondence) states that local brick production using the old Kimberlite tailings from the mine is being investigated. These bricks can be used for internal walls, and will also make reference to the narrative of the mining machine.

Below the surface, the architecture that expresses the tunnel as a part of the earth, is explored as a continuous stereotomic element, using fine crushed Kimberlite aggregate from the mine to represent the memory of the underground mining network. The colour will vary-depending on the stone and fine aggregate used.

Figure 7.11

Machine material palette (Compiled by author, 2014)

Crushed Kimberlite (mine waste rock)

Existing bricks and bricks made using old Kimberlite tailings

Extant fabric

Fine aggregate

Steel

Glazing for cladding the existing structure for greenhouses

Coarse aggregate

Dry-packed stone

Dry packed stone- felsite and quartzite

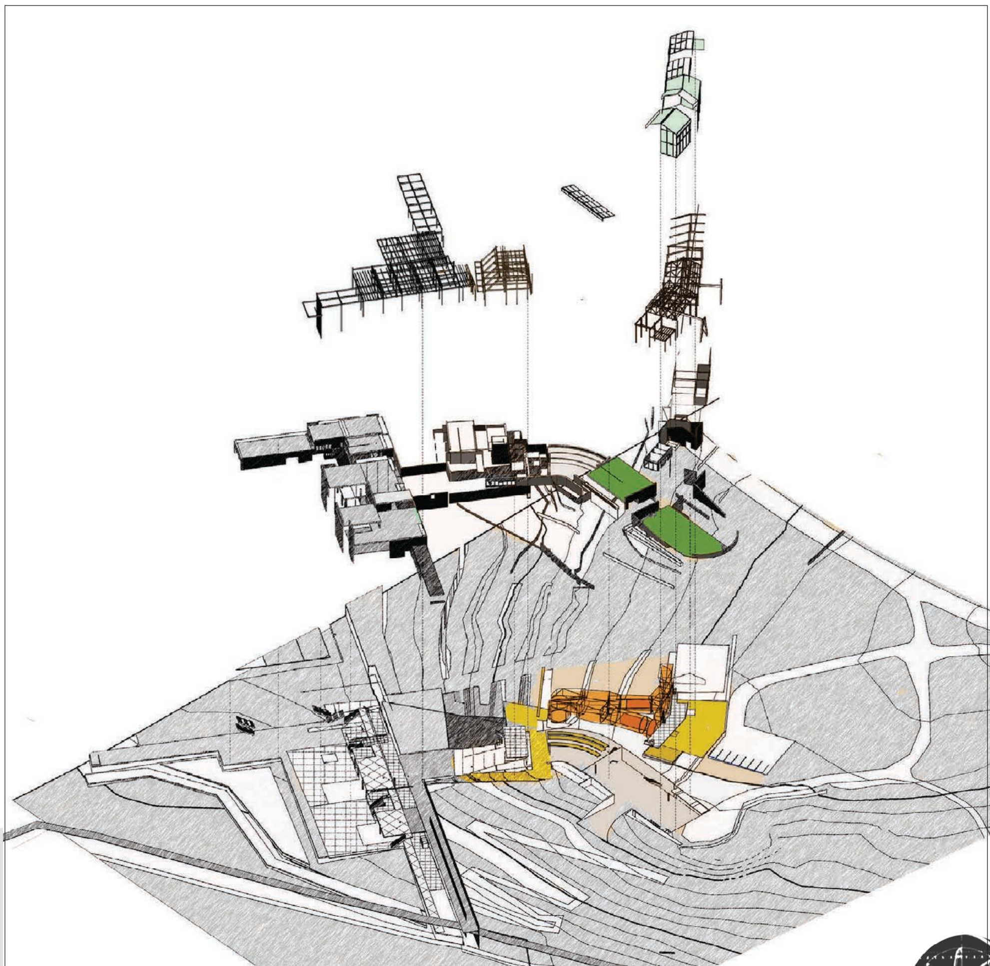


Figure 7.12
The condition of machine on the site (Author, 2014)

7.3.2 Detail exploration

The machine is given definition on the surface and subsurface (figure 7.16), an expression of the shaft above and tunnels below respectively. Detail expression alludes to the exposed industrial connections of the existing steel structure, a symbol of the machine and a reinterpretation of the industrial detailing (figure 7.13). Like the current machine, connections and components of the structure are expressed, contrasting the merged permanence of the architecture belonging to the natural condition. Connections between some elements are separated to create visible shadow lines between components (figure 7.14). The proposed steel structure, defining the tasting rooms, exists as the transitioning element between machine and man, belonging to both. The materiality and connections of this space are outlined here and later when discussing the realm of man.

The 'sub-surface machine' courtyards harvest and treat water and are also spatially defined by coarse aggregate terracing concrete walls. Dry-packed stone and brick from the ventilation shaft is reused in mesh baskets, continuing the narrative of the tunnel and creating retaining walls defining the threshold into the orchards and natural landscape. This unobtrusive stereotomic element reflects a contrasting architecture to the existing fabric, heavy and firmly founded in the site. Concrete is cast in-situ as a single continuous element, contrasting the steel tectonic architecture of the machine on the surface.

1

2

3

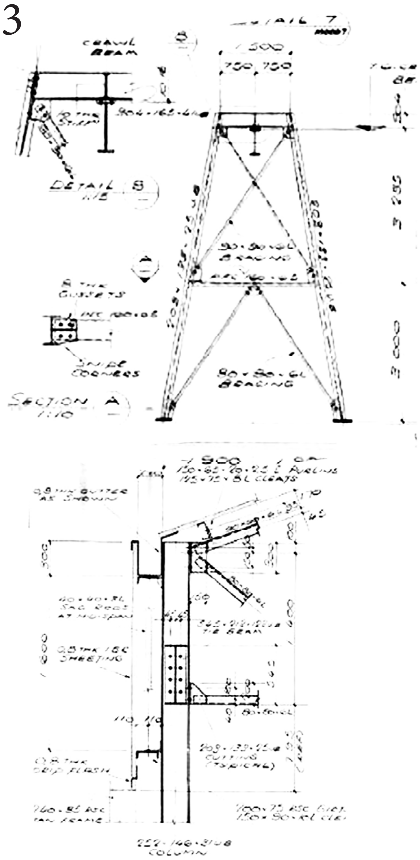


Figure 7.13
Machine connections

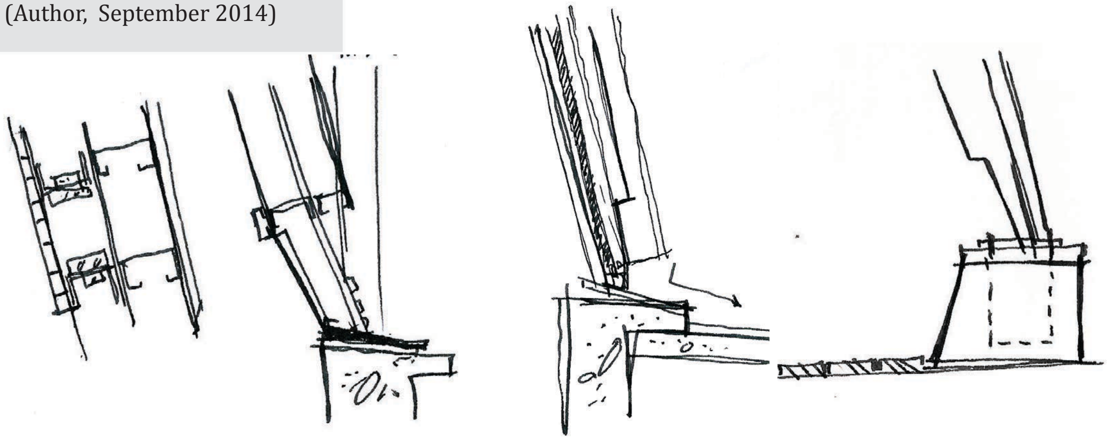
1- Connection to the earth (Author, 2014)

2- Roof connections expressing separate components (Author, 2014)

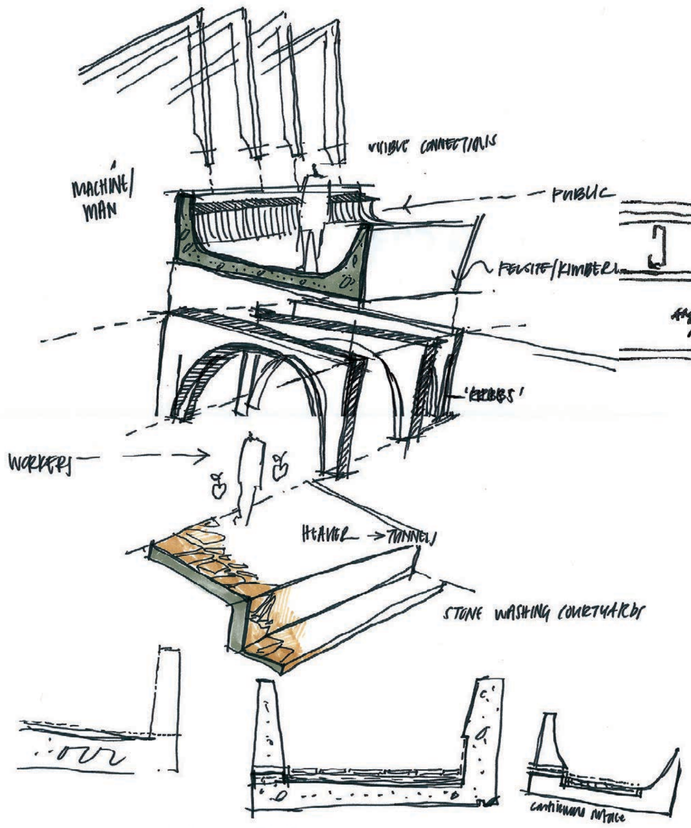
3- Details of the existing motor-rooms constructed in the 1980s (Mine archive)

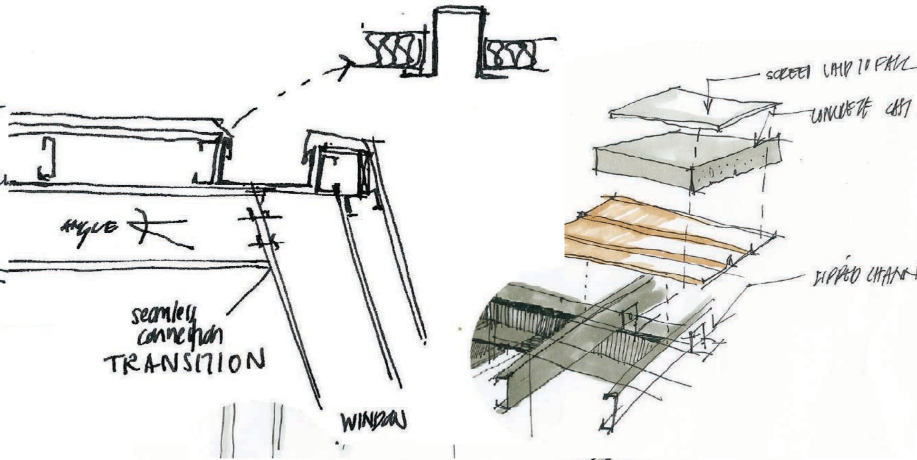
Figure 7.14

Machine detail exploration
(Author, September 2014)

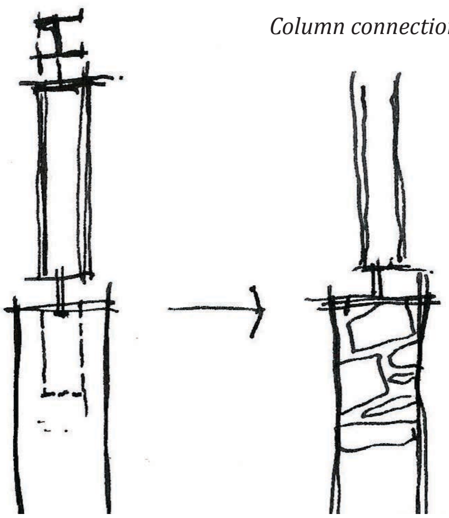


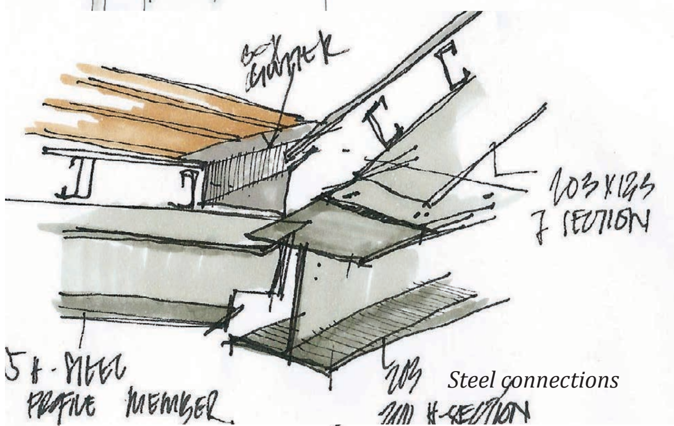
Exploring the expression of the machine above and below the surface. Steel and coarse aggregate concrete each represent components of the machine.



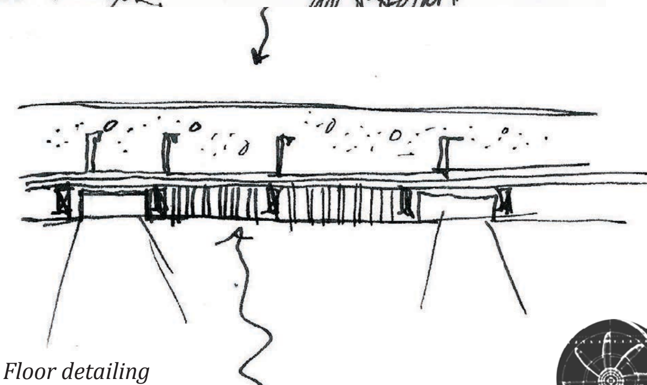


Column connections





Steel connections



Floor detailing

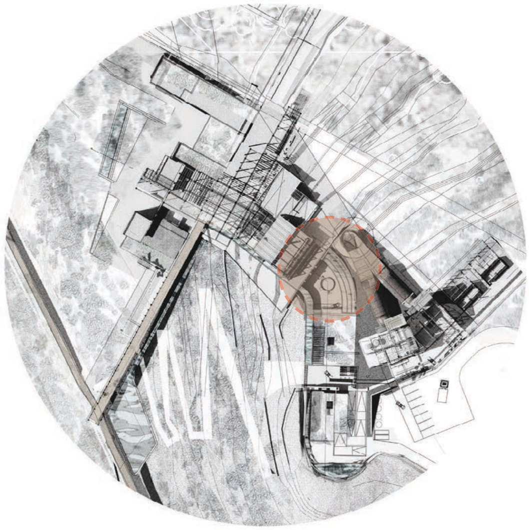


Figure 7.15 Location on the plan
(*Author, 2014)*

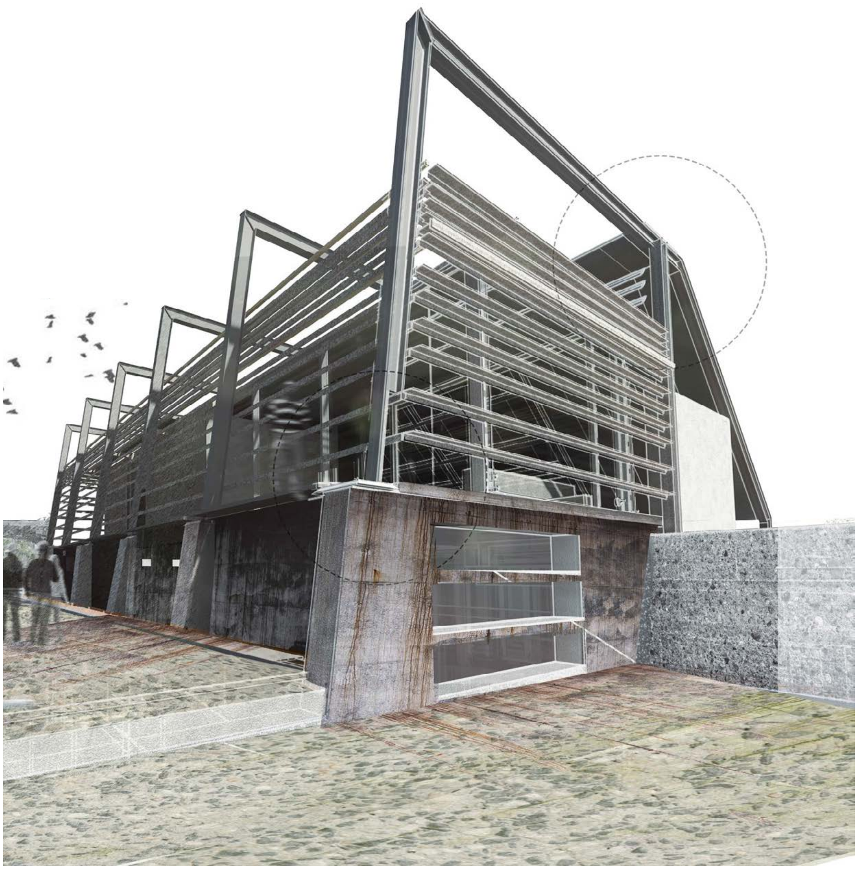


Figure 7.16

The new surface and sub-surface expression *where the new architecture encounters the machine (see figure 7.15 for location on plan). The tectonic structure will stain the stereotomic walkway over time.*
(Author, October 2014)

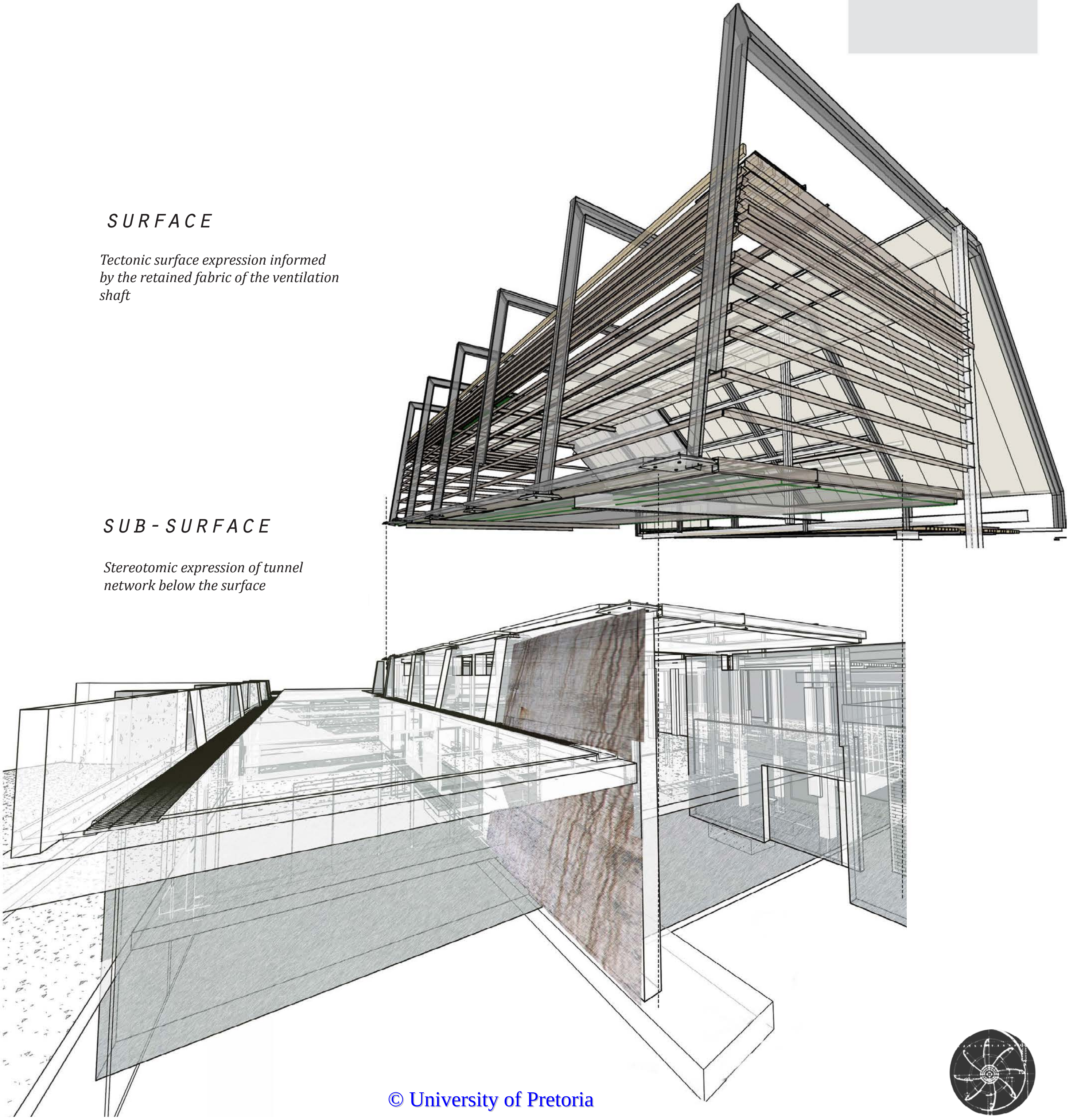


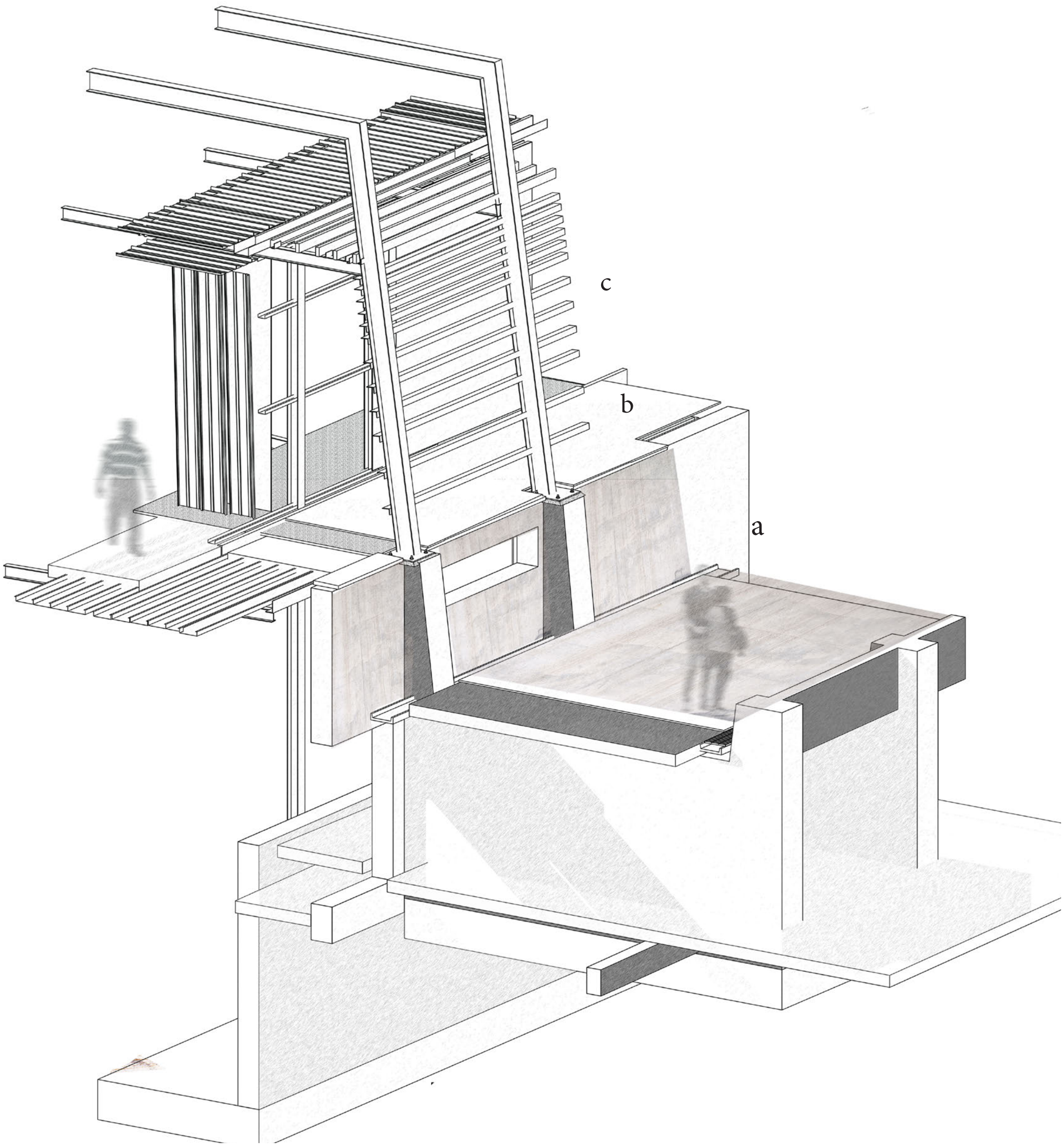
Figure 7.17

Exploration of new surface and subsurface expression of the machine (Author, October 2014)

a- The stereotomic cast-in-situ base

b- Expressing the connection between surface and sub-surface components

c- The tectonic structure that will stain the stereotomic bridge over time


c
b
a

7.4 MAN

7.3.2 Materiality and detail exploration

Man is an extension of the manipulated natural landscape (the park and stone wall) and the machine which together form the current *bionic system*. The new intervention introduces man to the site as a *mediator* between nature and machine, the material selection therefore becomes an extension of them and a visual expression of their new reciprocity. The bridging pergola element defines this interstitial space, but then transmutes to become part of the machine to the east of the site, and part of nature to the west, assuming their characteristics. As man lies between these polarities, the material expression should express their dualism with this transitional element, combining the two conditions where they intersect along the main route in terms of both materiality and connections.

The ground and wall conditions extend from nature and machine, with the use of stone as aggregate in the cast-in-situ concrete walls. The tectonic pergola structure (see figure 7.21) changes from timber (saligna) in the natural condition to steel in the realm of the machine. In the natural condition it is grounded, but separates itself from the roof and ground as it rises up to meet the machine, to visibly express its connections.

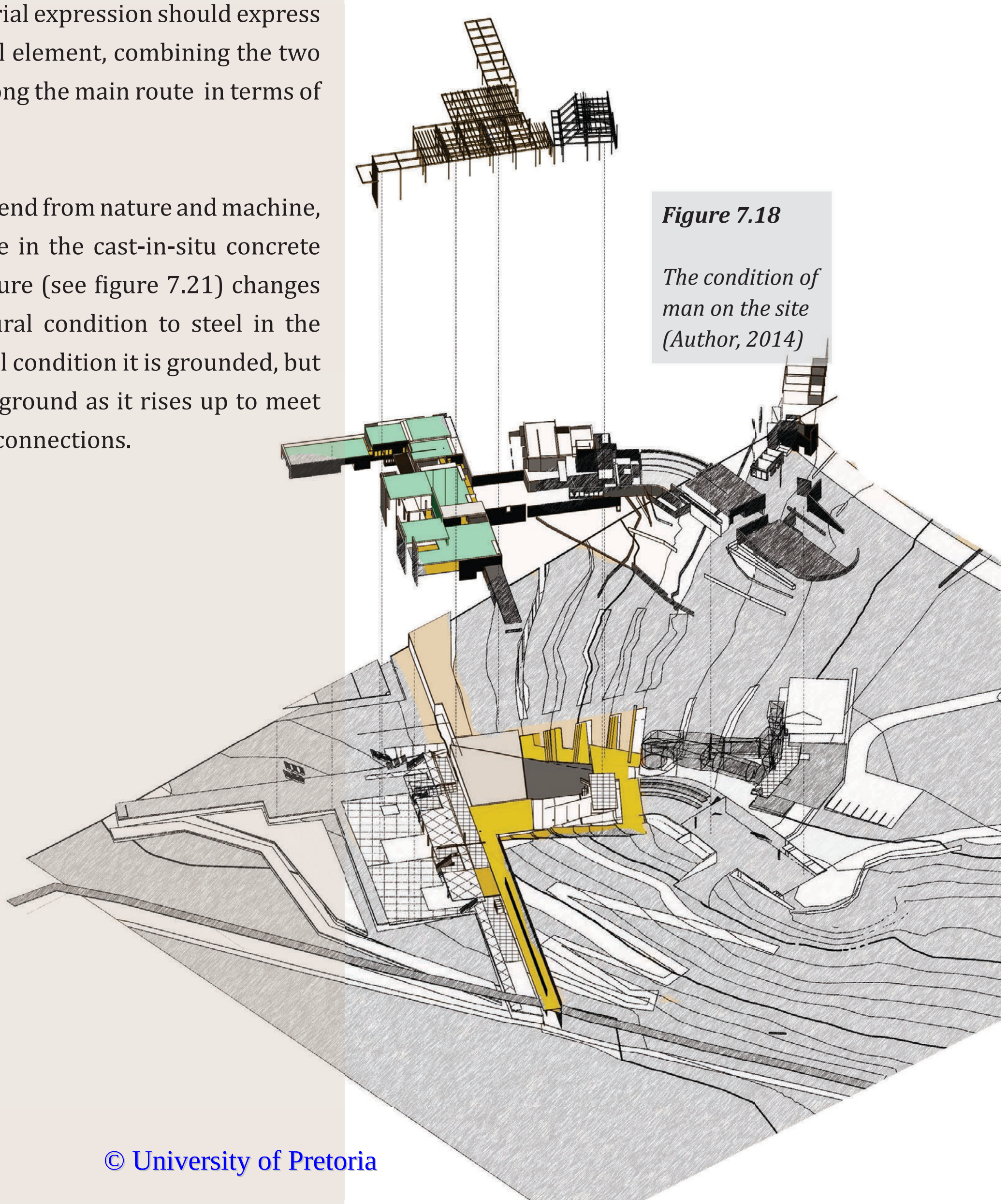


Figure 7.18

The condition of man on the site (Author, 2014)

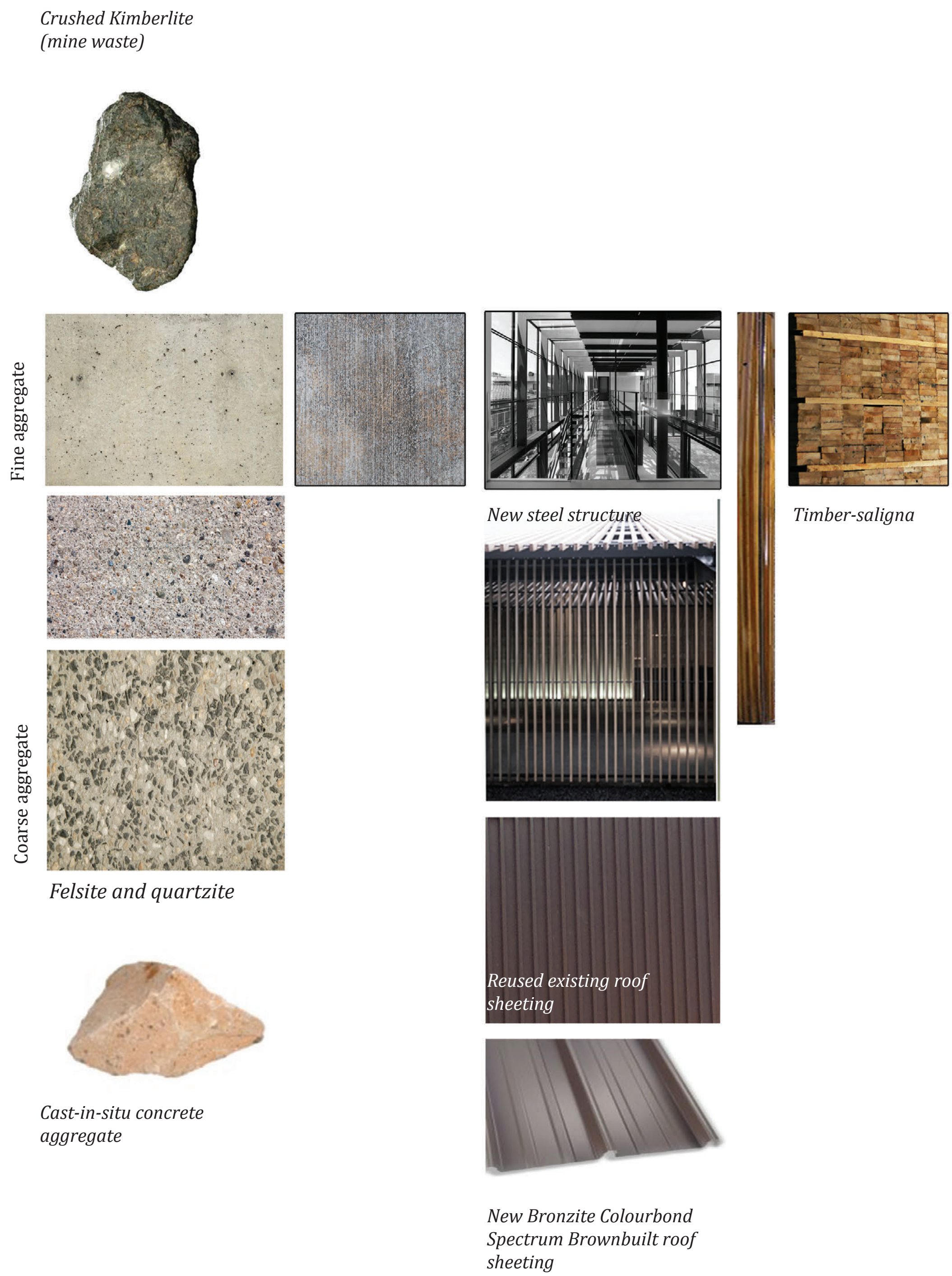
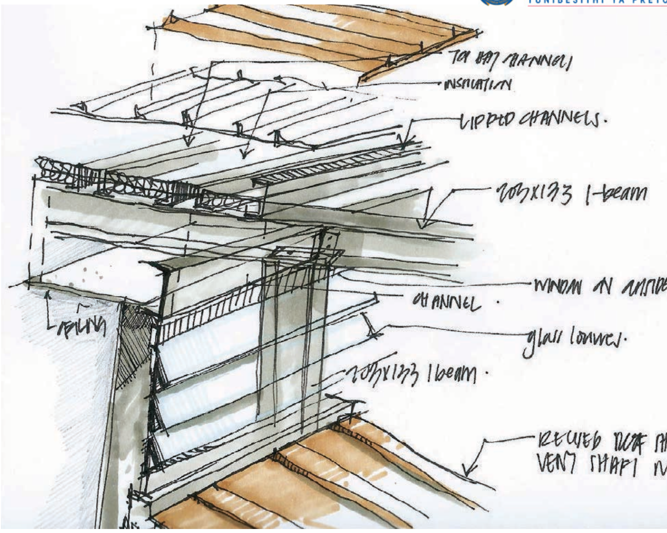


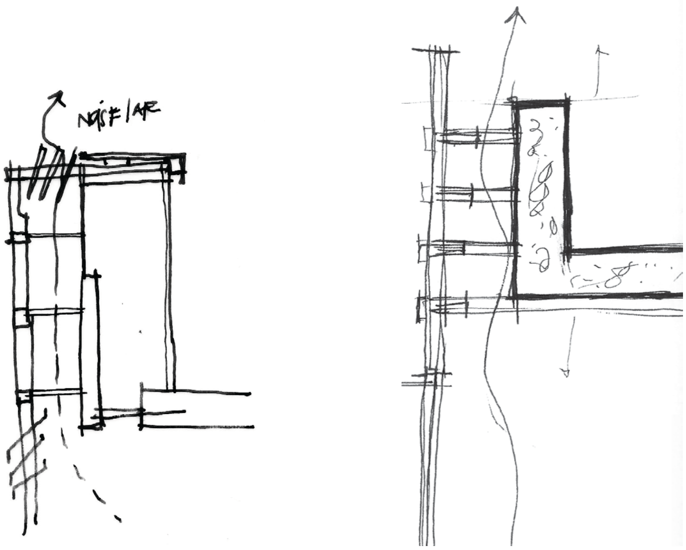
Figure 7.19

Man: material palette (Compiled by author, 2014)



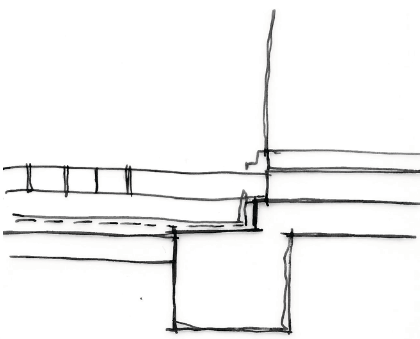
Louvers ventilating the tasting rooms

Steel column connections



Separating the glass viewing screen and structure allowing for ventilation

Figure 7.20
Detail exploration
(Author, September 2014)



Exploring thresholds between internal and external conditions

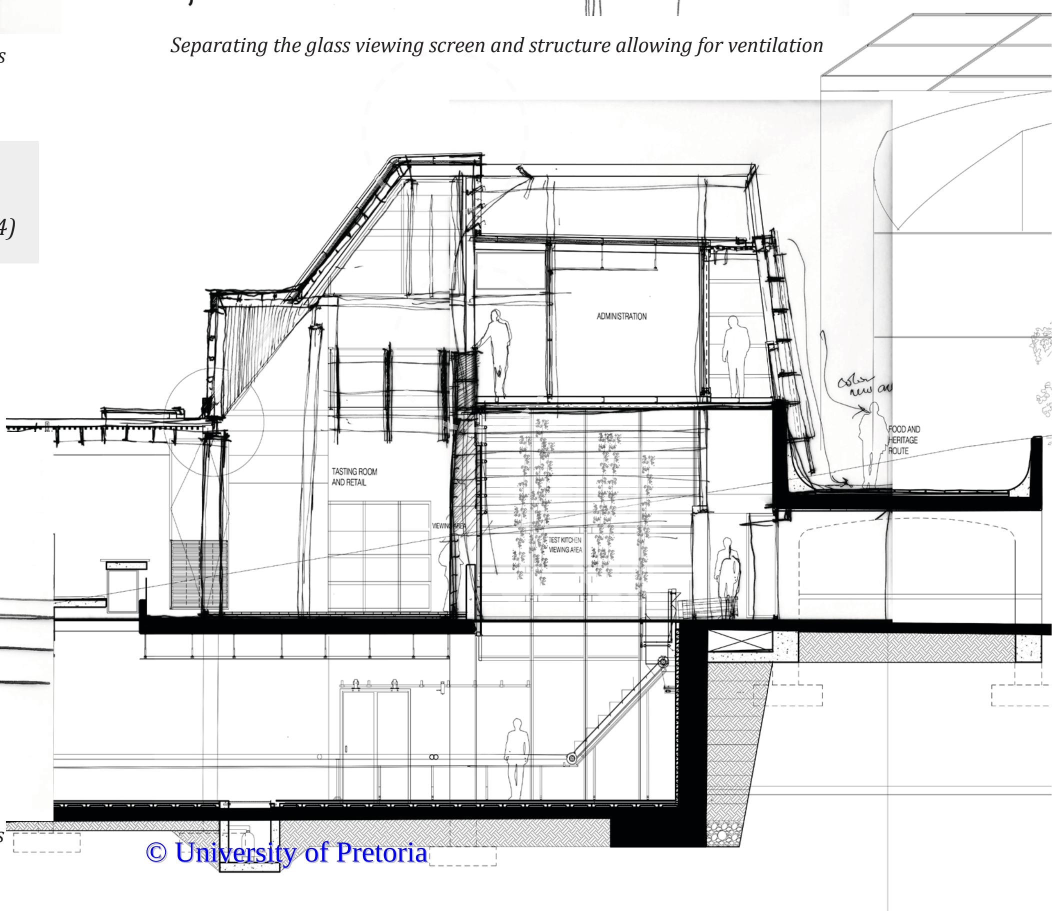
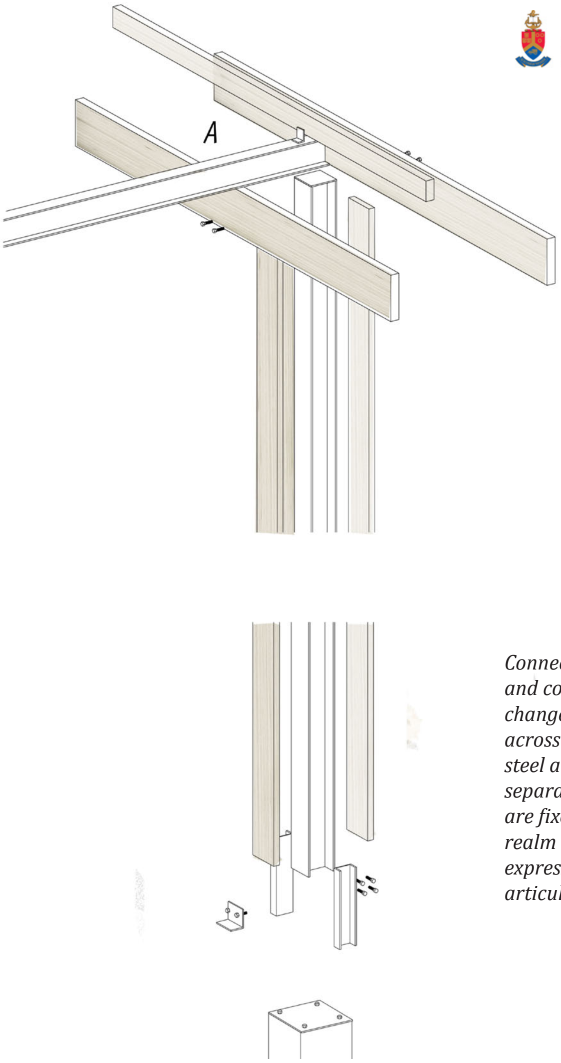


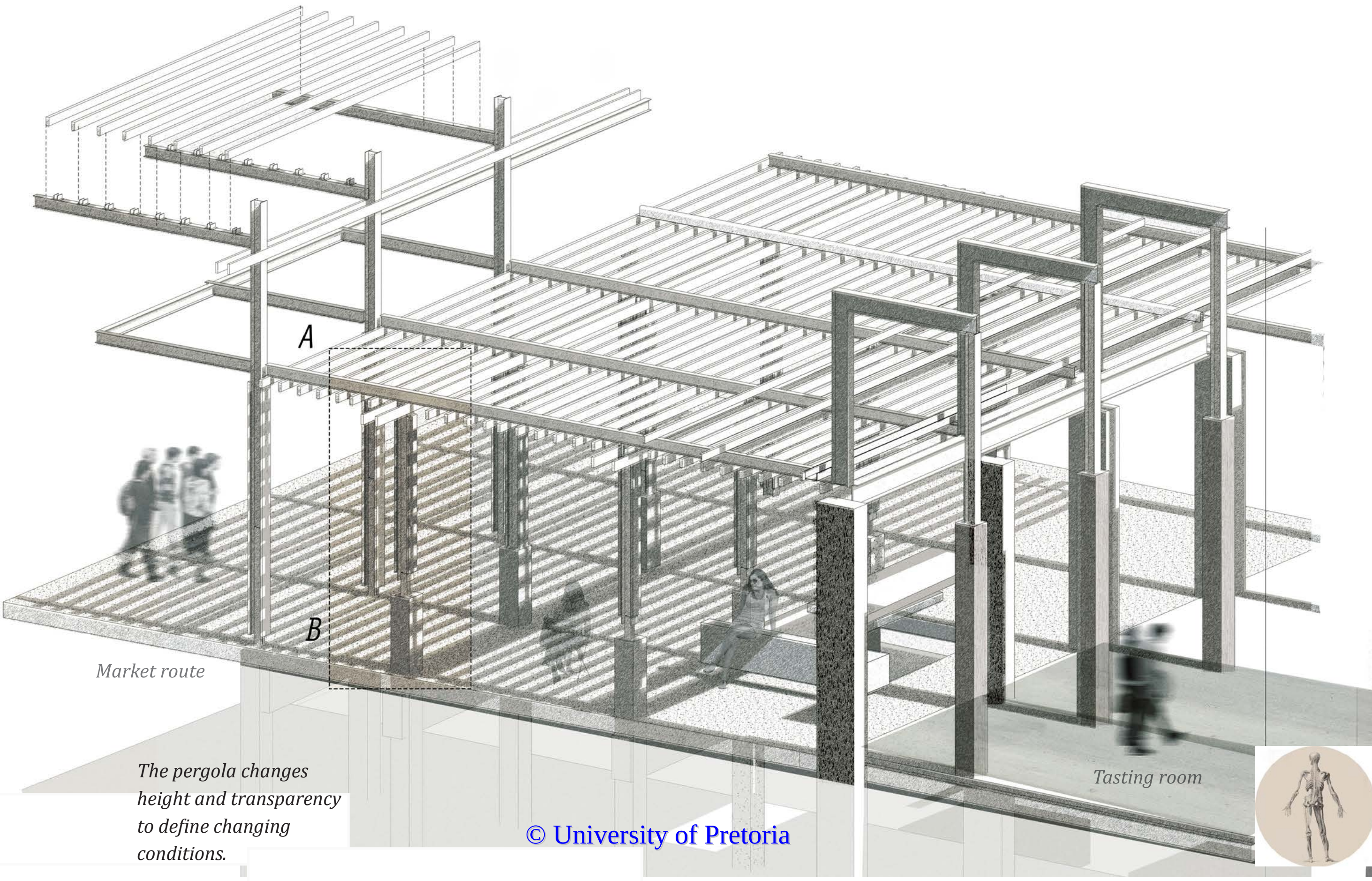
Figure 7.21

Detail exploration of the pergola

(Author, September 2014)



Connections between timber, steel and concrete, defining the pergola, change depending on the conditions across the site. Closer to the machine, steel and timber elements are separated to create shadow lines and are fixed to concrete bases. In the realm of nature, connections are less expressed and more timber is used to articulate column connections.



The pergola changes height and transparency to define changing conditions.

7.5 CONSTRUCTION DETAILS

Where man meets nature and machine

The three main construction details express the connection of man with the conditions of nature and machine in the main tasting space (indicated in Figure 7.22).

Figure 7.22

The tasting space, where the three conditions meet, is defined in the articulation of the structure (Author, 2014)

1
The cast-in-situ stereotomic base integrated with the site

2
Horizontal plane defining the main public route and administration spaces above. An extension of the stereotomic base. Skylights and seating protrude from the surface lighting workspaces below

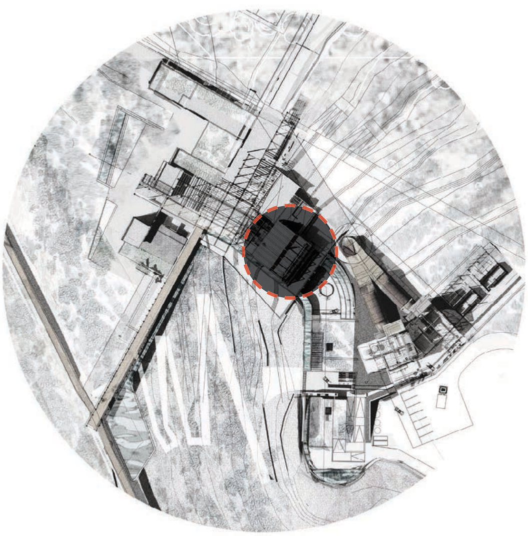
3
The tectonic steel and timber structure of the roof that steps up to the bridge

4
The structure clad with Colourbond Spectrum Brownbuilt sheeting and clad internally with aged steel sheets from the ventilation shaft

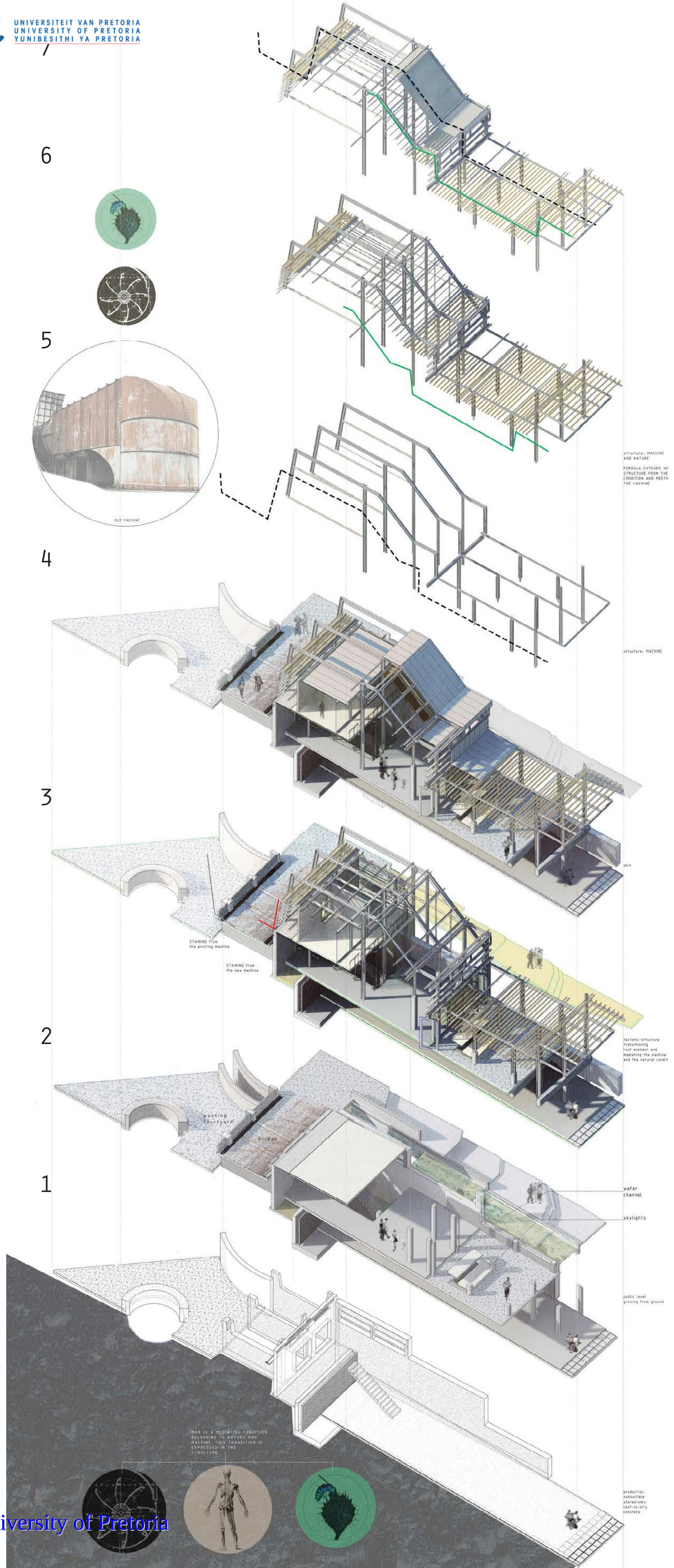
5
The main galvanised steel structure that communicates the narrative of the machine

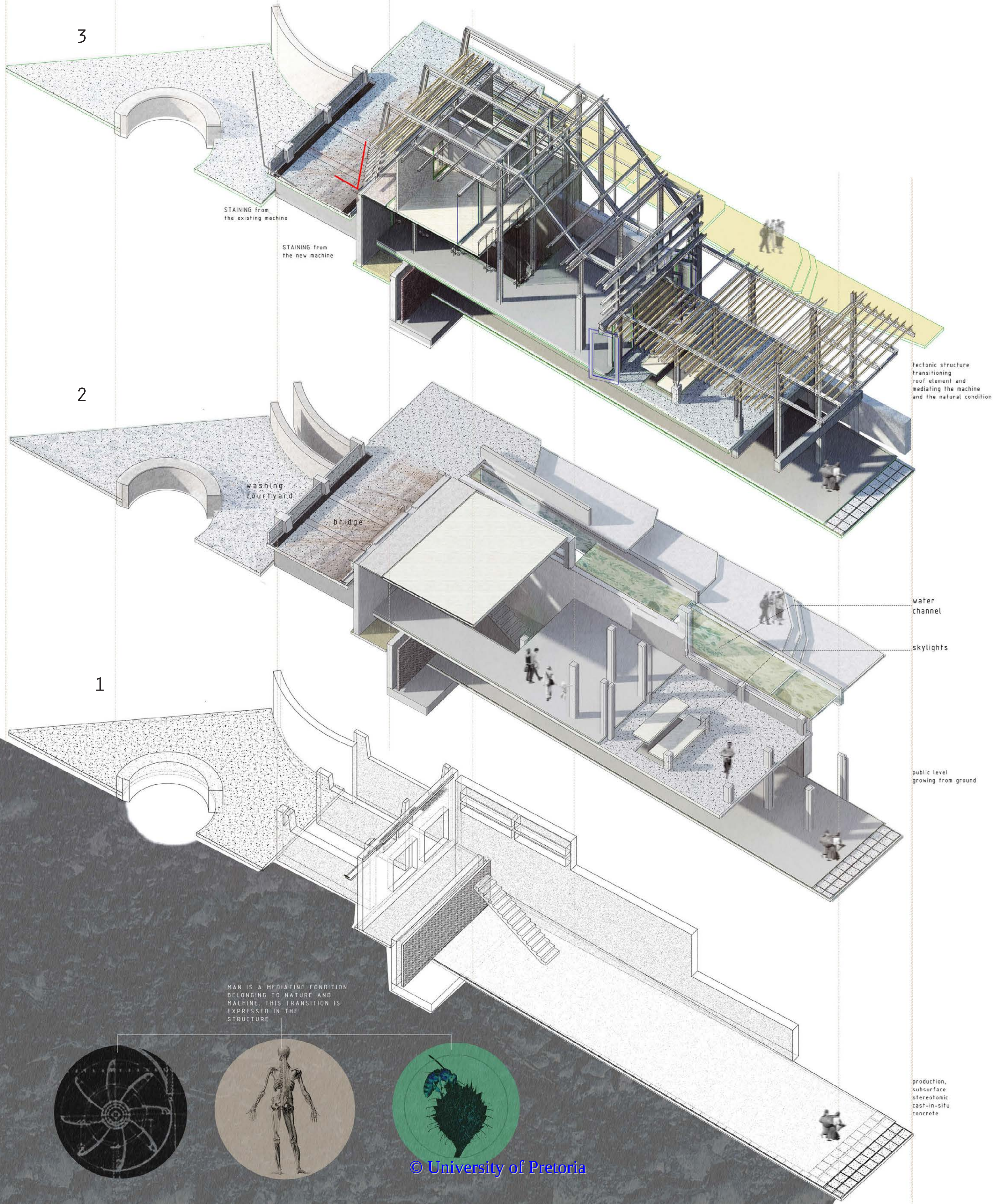
6
The timber pergola, the narrative of the natural condition, extends into the interior forming the ceiling which rises to meet the scale of the ventilation shaft

7
Where machine and nature meet, defining the intermediate realm of man, the public tasting space, mediating between the realms of machine and nature

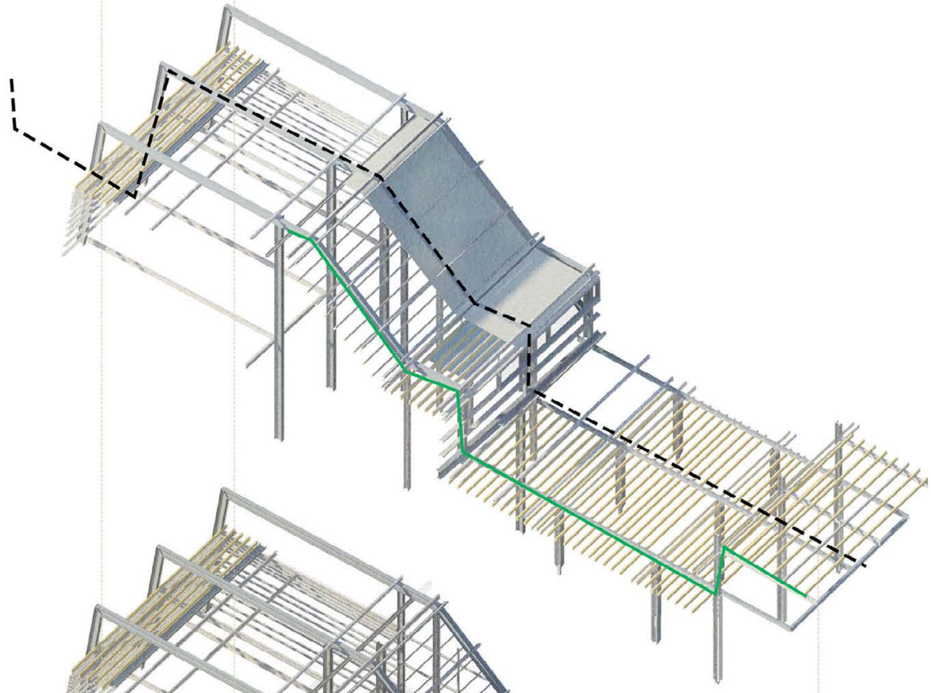


The tasting space




3
STAINING from
the existing machine
STAINING from
the new machine
tectonic structure
transitioning
roof element and
mediating the machine
and the natural condition
2
washing
courtyard
bridge
water
channel
skylights
1
public level
growing from ground
production,
subsurface
stereotomic
cast-in-situ
concrete
MAN IS A MEDIATING CONDITION
BELONGING TO NATURE AND
MACHINE. THIS TRANSITION IS
EXPRESSED IN THE
STRUCTURE

7



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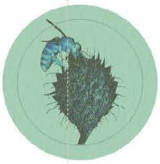

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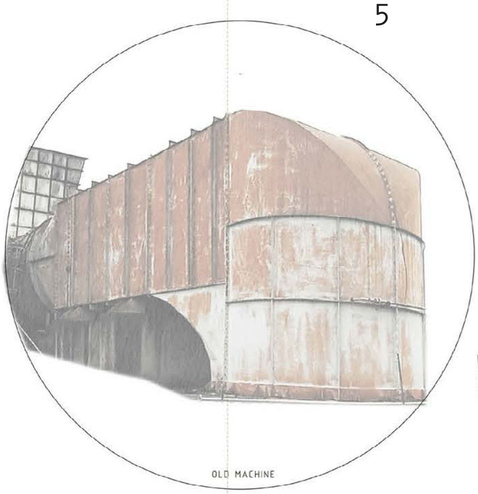
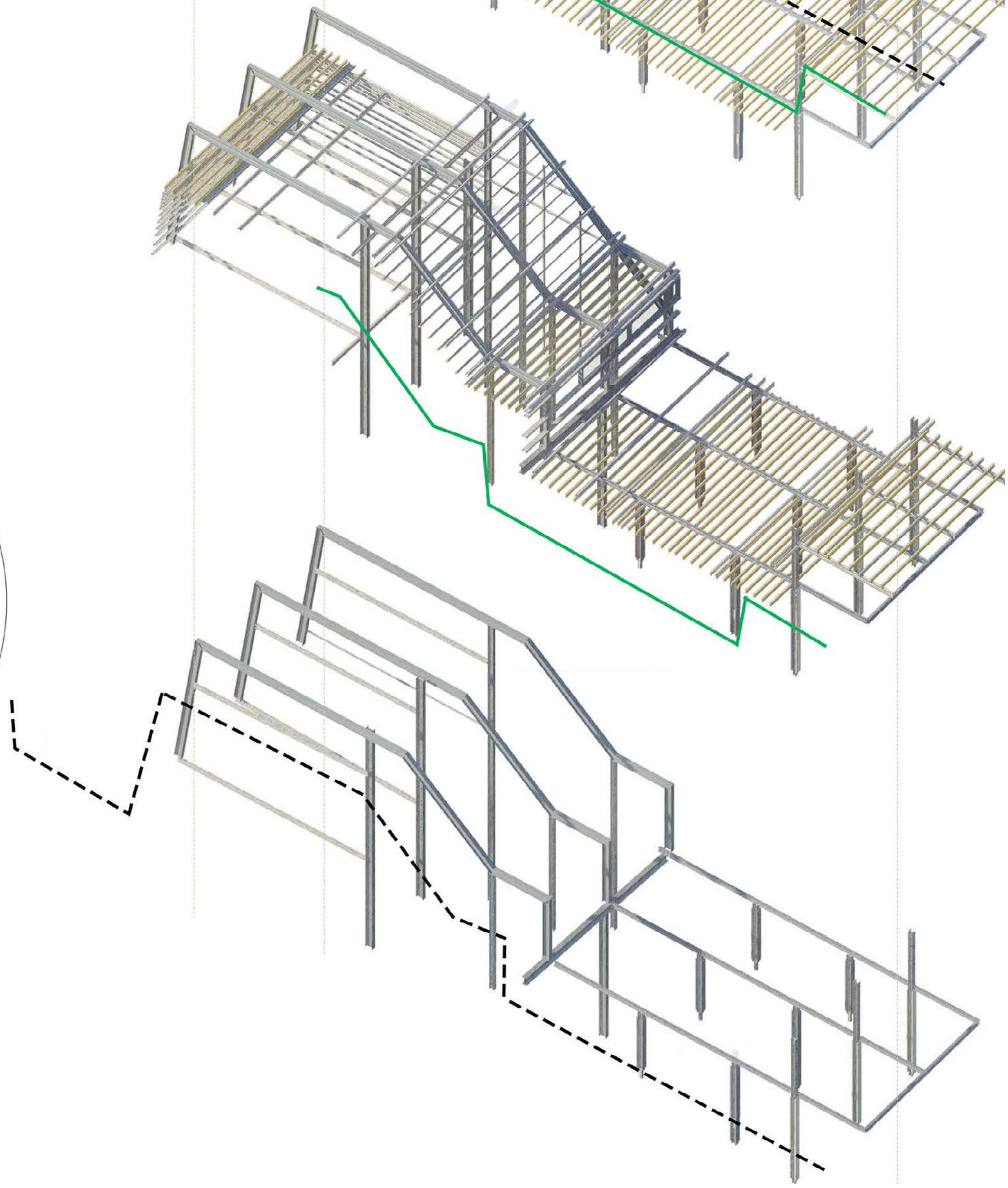
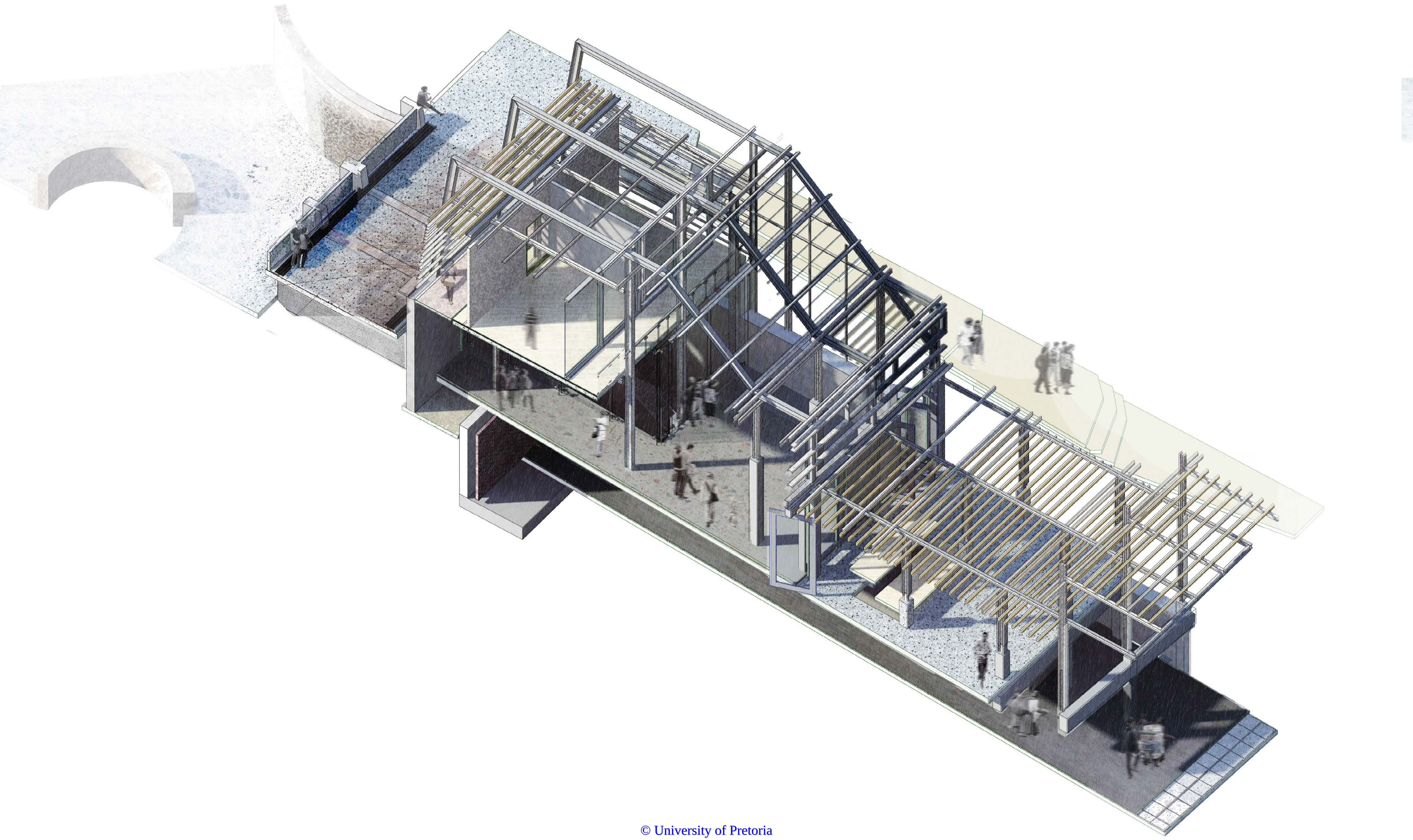
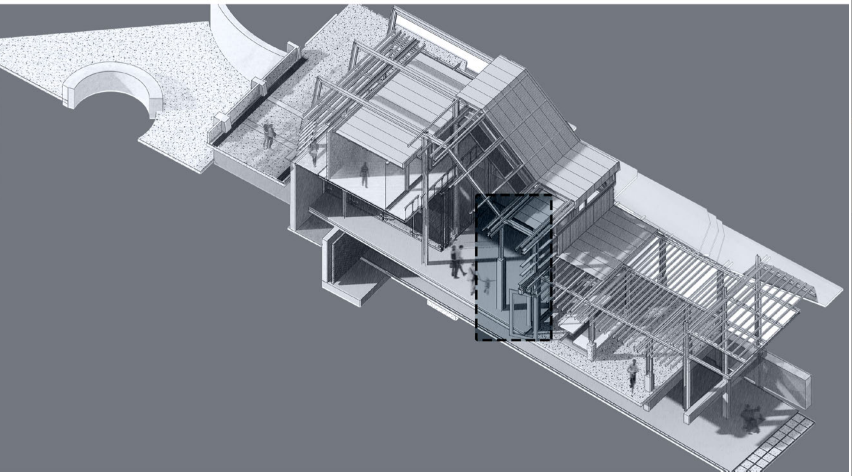







DETAIL 3
DETAIL 2
DETAIL 1



DETAIL 1

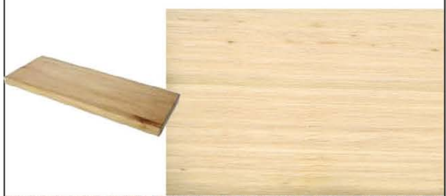
Detail 1 is of the threshold into the tasting room, defining the transition between man and nature.

Reused roof sheeting from old mine buildings dumped on the site, used for interior cladding.

BROWNBUILT COLORBOND SPECTRUM in Bronzite. Light reflects off the metallic mica particles in the finish. The appearance of the pre-painted steel surface will consequently change depending on the viewing angle.

ISOVER ULTIMATE rigid compressed mineral wool combines the advantages of glasswool (thermal insulation, light weight, ease-of-use and environmental benefits) with high-temperature and fire-resistant properties.

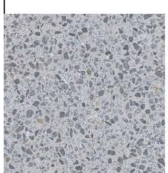
SISALATION REFLECTIVE FOIL acts as both an insulation radiant barrier and waterproofing barrier.



EUCALYTUS is a hardwood and part of Cullinan's narrative and represents the natural condition. The timber is finished with clear polyurethane sealer.

ORIENTED STRAND BOARD

Is an engineered wood particle board formed by adding adhesives and then compressing layers of wood strands (flakes) in specific orientations. The OSB will contrast the pergola structure with a rough and variegated surface. The material represents change occurring between machine and nature on the site.



STONE AGGREGATE from the site (FELSITE) is reused as aggregate with a sandblasted smooth finish.

STONE AGGREGATE from the mine tailings (KIMBERLITE) is reused as fine aggregate in cast-in-situ concrete.

Figure 7.23

Detail 1 materiality (Author, October 2014)

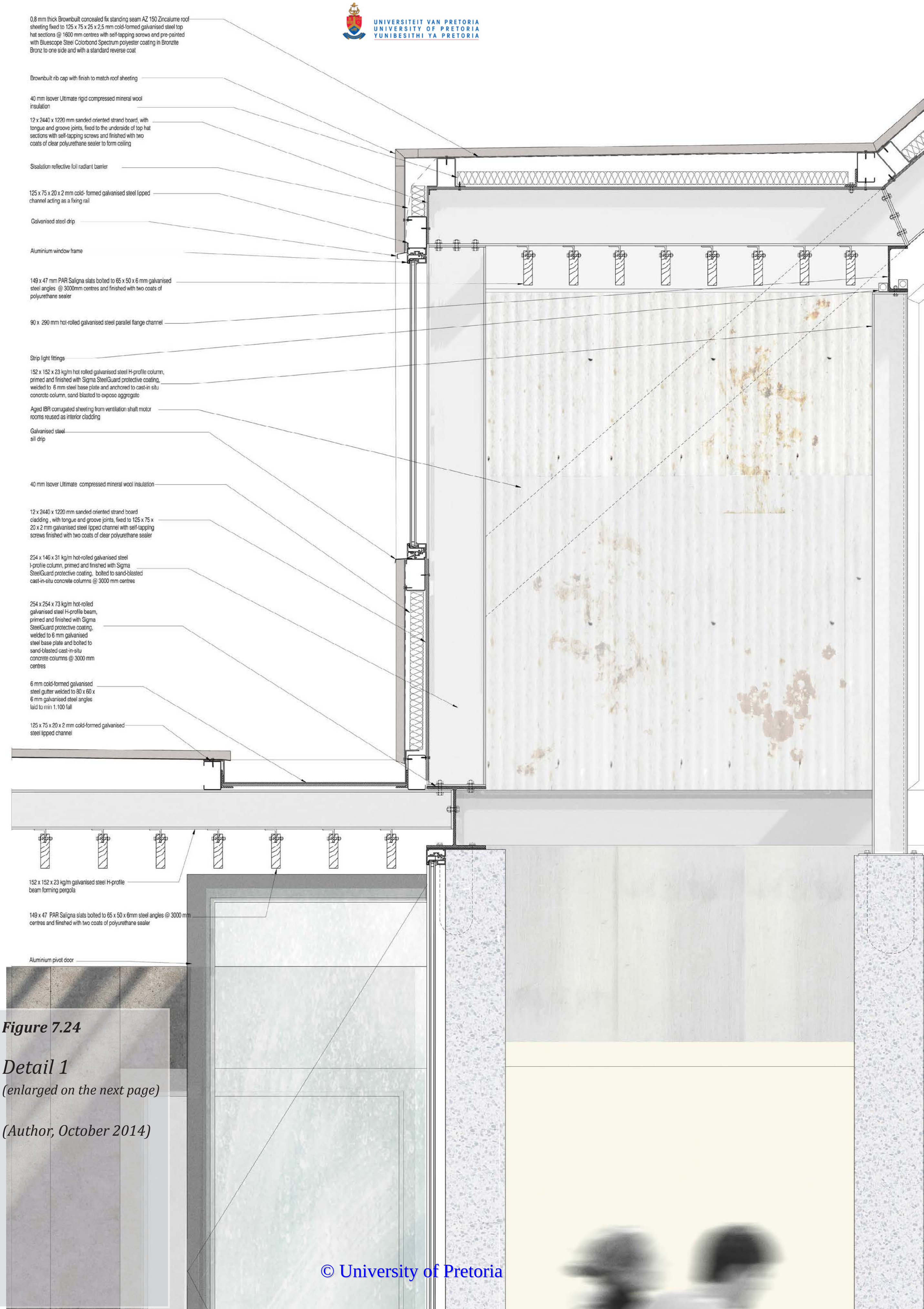
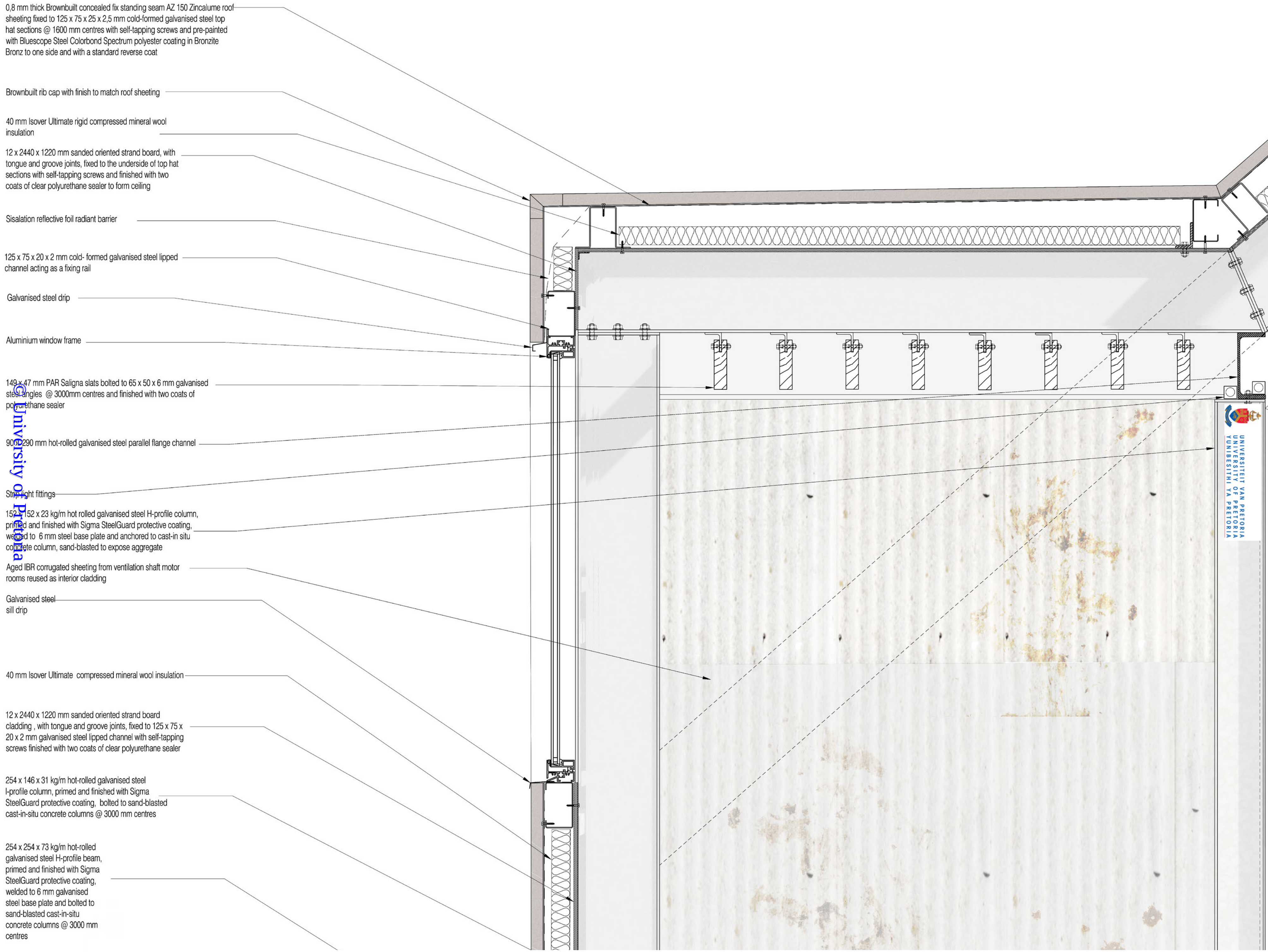


Figure 7.24

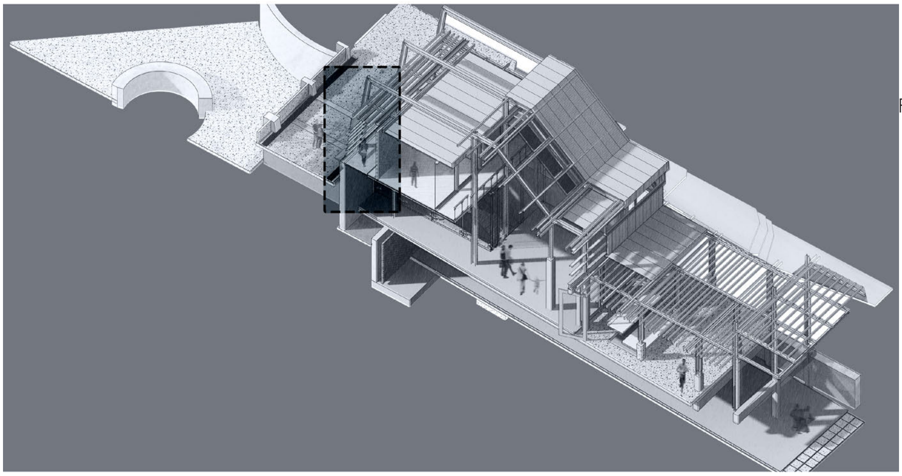
Detail 1
(enlarged on the next page)

(Author, October 2014)

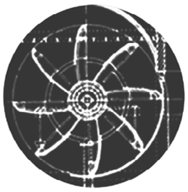


0,8 mm thick Brownbuilt concealed fix standing seam AZ 150 Zincalume roof sheeting fixed to 125 x 75 x 25 x 2,5 mm cold-formed galvanised steel top hat sections @ 1600 mm centres with self-tapping screws and pre-painted with Bluescope Steel Colorbond Spectrum polyester coating in Bronzite Bronz to one side and with a standard reverse coat
Brownbuilt rib cap with finish to match roof sheeting
40 mm Isover Ultimate rigid compressed mineral wool insulation
12 x 2440 x 1220 mm sanded oriented strand board, with tongue and groove joints, fixed to the underside of top hat sections with self-tapping screws and finished with two coats of clear polyurethane sealer to form ceiling
Sisalation reflective foil radiant barrier
125 x 75 x 20 x 2 mm cold- formed galvanised steel lipped channel acting as a fixing rail
Galvanised steel drip
Aluminium window frame
149 x 47 mm PAR Saligna slats bolted to 65 x 50 x 6 mm galvanised steel angles @ 3000mm centres and finished with two coats of polyurethane sealer
90 x 290 mm hot-rolled galvanised steel parallel flange channel
Strip light fittings
152 x 152 x 23 kg/m hot rolled galvanised steel H-profile column, primed and finished with Sigma SteelGuard protective coating, welded to 6 mm steel base plate and anchored to cast-in situ concrete column, sand-blasted to expose aggregate
Aged IBR corrugated sheeting from ventilation shaft motor rooms reused as interior cladding
Galvanised steel sill drip
40 mm Isover Ultimate compressed mineral wool insulation
12 x 2440 x 1220 mm sanded oriented strand board cladding , with tongue and groove joints, fixed to 125 x 75 x 20 x 2 mm galvanised steel lipped channel with self-tapping screws finished with two coats of clear polyurethane sealer
254 x 146 x 31 kg/m hot-rolled galvanised steel I-profile column, primed and finished with Sigma SteelGuard protective coating, bolted to sand-blasted cast-in-situ concrete columns @ 3000 mm centres
254 x 254 x 73 kg/m hot-rolled galvanised steel H-profile beam, primed and finished with Sigma SteelGuard protective coating, welded to 6 mm galvanised steel base plate and bolted to sand-blasted cast-in-situ concrete columns @ 3000 mm centres
UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA


254 x 254 x 73 kg/m hot-rolled galvanised steel H-profile beam, primed and finished with Sigma SteelGuard protective coating, welded to 6 mm galvanised steel base plate and bolted to sand-blasted cast-in-situ concrete columns @ 3000 mm centres
6 mm cold-formed galvanised steel gutter welded to 80 x 60 x 6 mm galvanised steel angles laid to min 1:100 fall
125 x 75 x 20 x 2 mm cold-formed galvanised steel lipped channel
152 x 152 x 23 kg/m galvanised steel H-profile beam forming pergola
140 x 47 PAR Saligna slats bolted to 65 x 50 x 6mm steel angles @ 3000 mm centres and fiinshed with two coats of polyurethane sealer
Aluminium pivot door



DETAIL 2



Where the connection between ground and machine (the ventilation shaft) is currently expressed in the stained surfaces surrounding the ducts, the new architecture that meets that extant machine defines its connection with ground in a similar fashion. Weathering steel will stain the bridge creating a different colour to the existing patterned stains surrounding the ducts (indicated in figure 7.25). This will define the stained route as the intermediate transitioning element (the bridge) connecting old and new, tangibly representing the present and future influences of both.

EXISTING

Reused roof sheeting from extant motor rooms.

Stained surfaces surrounding the existing ducts.

STONE AGGREGATE from the site (FELSITE) is reused as aggregate in the bridging walkway and concrete wall.

WEATHERING STEEL will create a different colour to the extant patina and patterned stains surrounding the ducts.

Figure 7.25

Detail 2 materiality
(Author, October 2014)

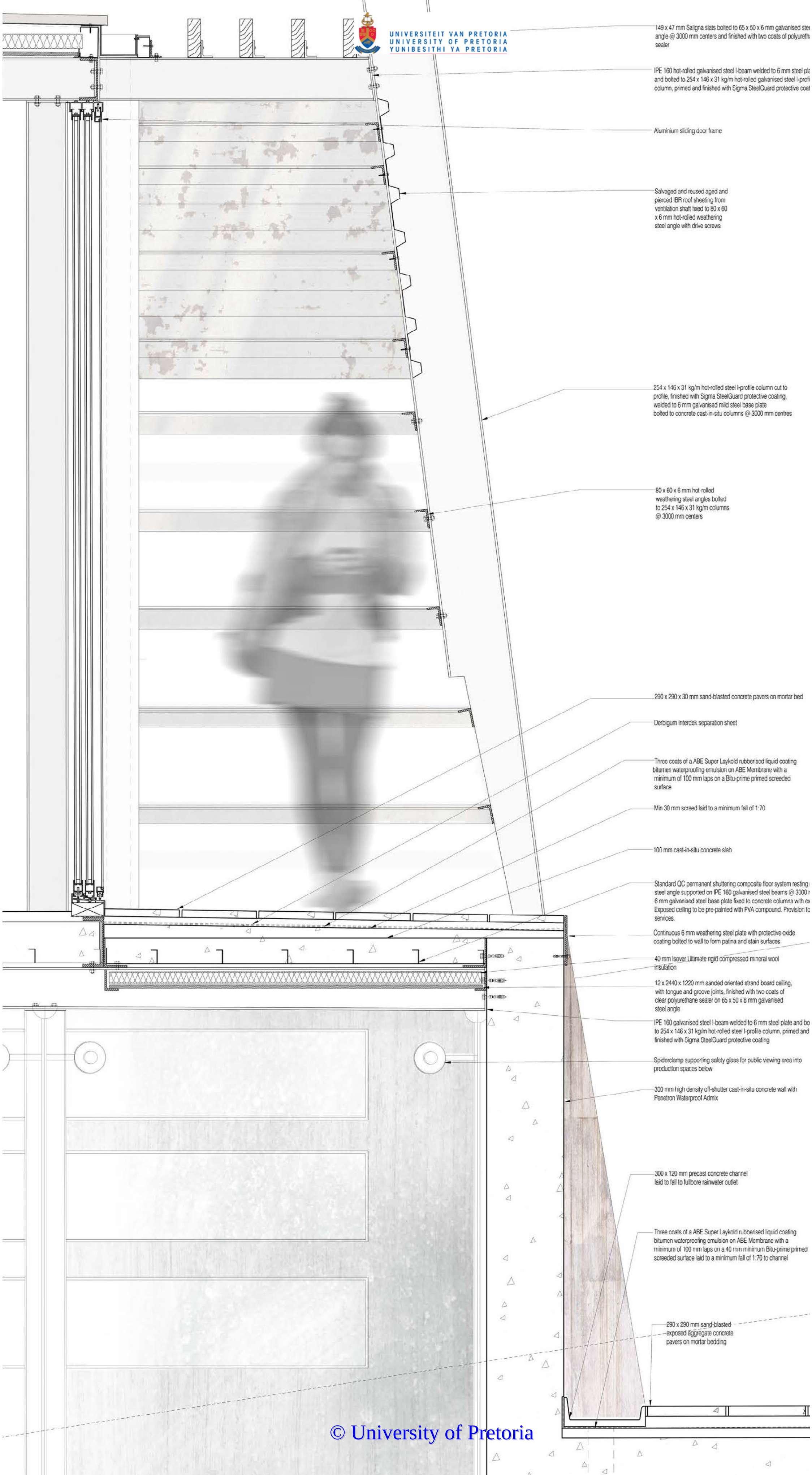
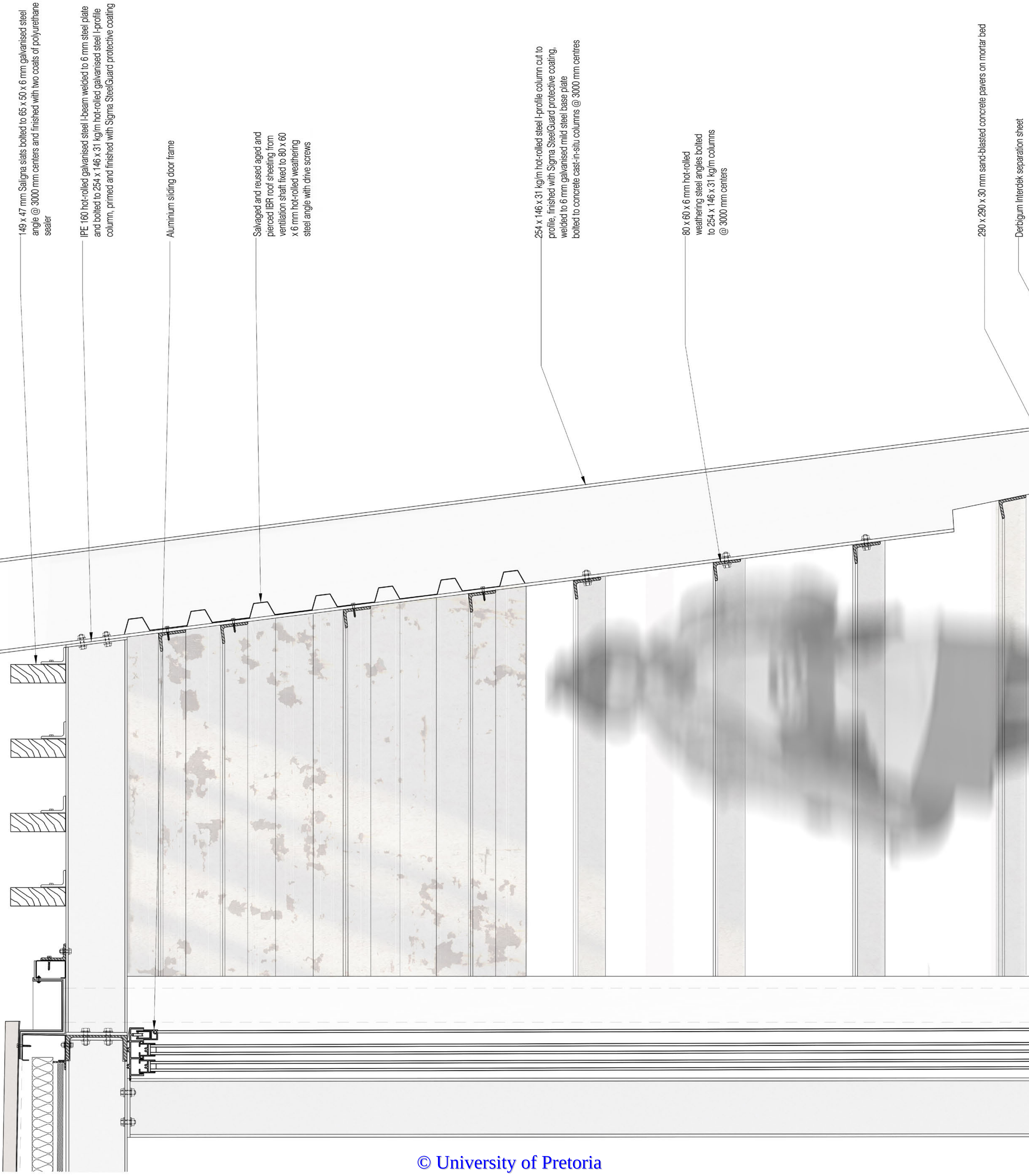
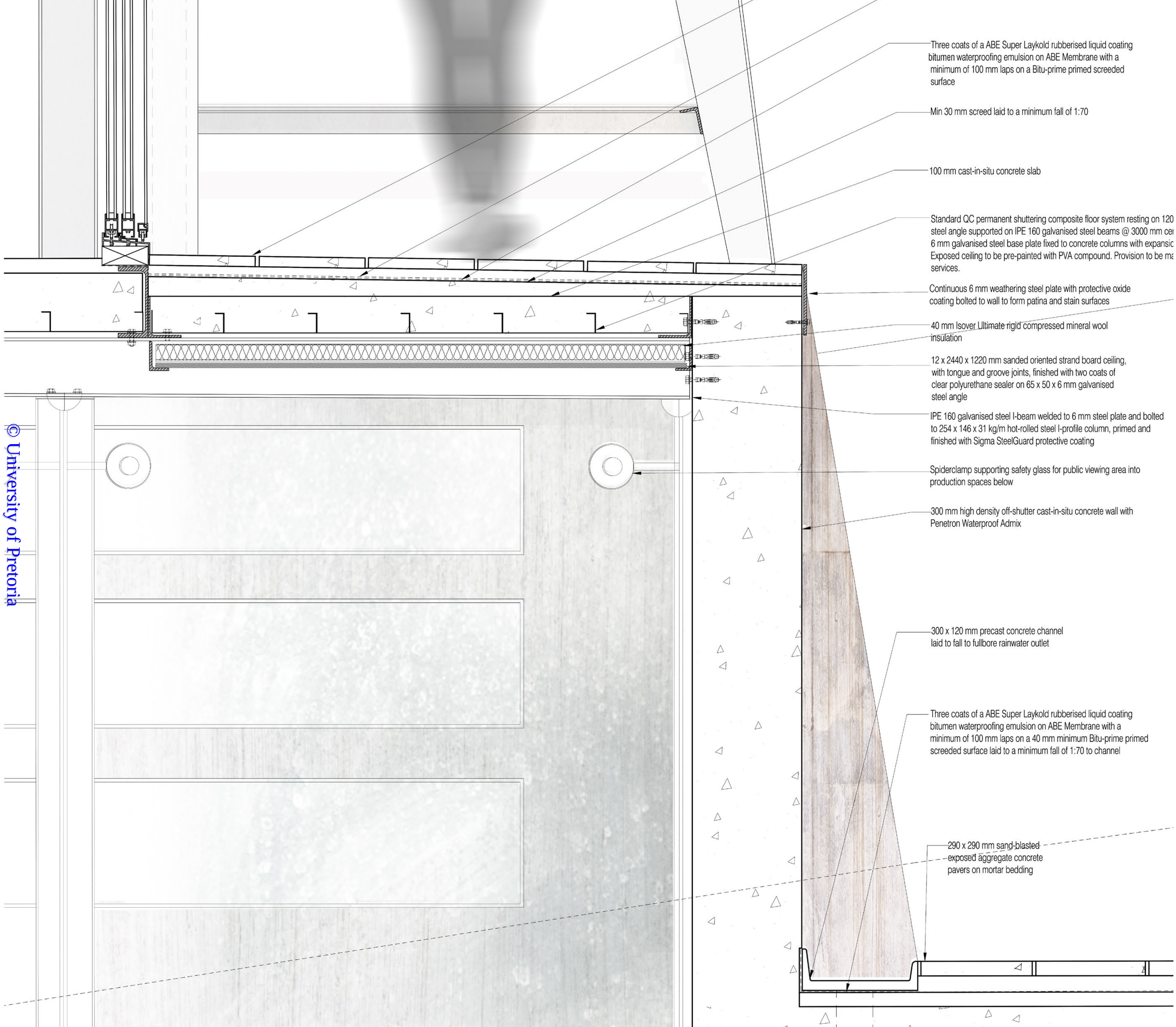


Figure 7.26
Detail 2:
Bridge detail (enlarged on the next page)

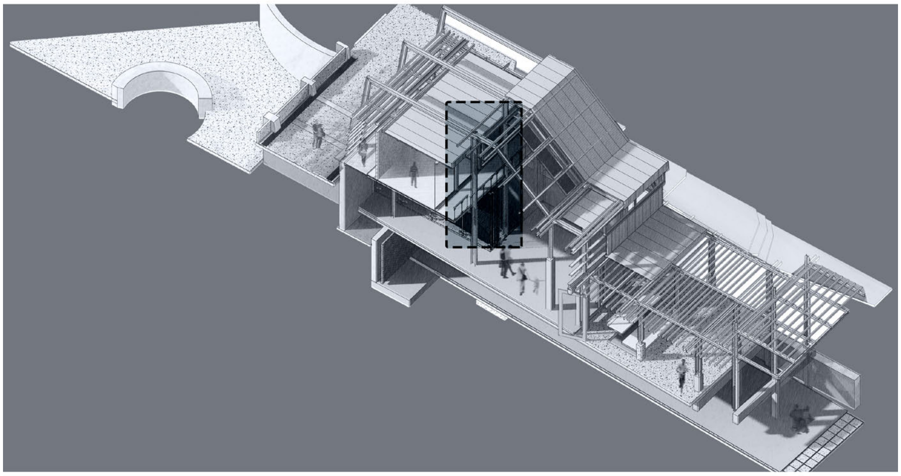
(Author, October 2014)


149 x 47 mm Saligna slats bolted to 65 x 50 x 6 mm galvanised steel angle @ 3000 mm centers and finished with two coats of polyurethane sealer
IPE 160 hot-rolled galvanised steel I-beam welded to 6 mm steel plate and bolted to 254 x 146 x 31 kg/m hot-rolled galvanised steel I-profile column, primed and finished with Sigma SteelGuard protective coating
Aluminium sliding door frame
Salvaged and reused aged and pierced IBR roof sheeting from ventilation shaft fixed to 80 x 60 x 6 mm hot-rolled weathering steel angle with drive screws
254 x 146 x 31 kg/m hot-rolled steel I-profile column cut to profile, finished with Sigma SteelGuard protective coating, welded to 6 mm galvanised mild steel base plate bolted to concrete cast-in-situ columns @ 3000 mm centres
80 x 60 x 6 mm hot-rolled weathering steel angles bolted to 254 x 146 x 31 kg/m columns @ 3000 mm centers
290 x 290 x 30 mm sand-blasted concrete pavers on mortar bed
Derbigum Interdek separation sheet


Three coats of a ABE Super Laykold rubberised liquid coating bitumen waterproofing emulsion on ABE Membrane with a minimum of 100 mm laps on a Bitu-prime primed screeded surface
Min 30 mm screed laid to a minimum fall of 1:70
100 mm cast-in-situ concrete slab
Standard QC permanent shuttering composite floor system resting on 120 steel angle supported on IPE 160 galvanised steel beams @ 3000 mm cei 6 mm galvanised steel base plate fixed to concrete columns with expansic Exposed ceiling to be pre-painted with PVA compound. Provision to be ma services.
Continuous 6 mm weathering steel plate with protective oxide coating bolted to wall to form patina and stain surfaces
40 mm Isover Ultimate rigid compressed mineral wool insulation
12 x 2440 x 1220 mm sanded oriented strand board ceiling, with tongue and groove joints, finished with two coats of clear polyurethane sealer on 65 x 50 x 6 mm galvanised steel angle
IPE 160 galvanised steel I-beam welded to 6 mm steel plate and bolted to 254 x 146 x 31 kg/m hot-rolled steel I-profile column, primed and finished with Sigma SteelGuard protective coating
Spiderclamp supporting safety glass for public viewing area into production spaces below
300 mm high density off-shutter cast-in-situ concrete wall with Penetron Waterproof Admix
300 x 120 mm precast concrete channel laid to fall to fullbore rainwater outlet
Three coats of a ABE Super Laykold rubberised liquid coating bitumen waterproofing emulsion on ABE Membrane with a minimum of 100 mm laps on a 40 mm minimum Bitu-prime primed screeded surface laid to a minimum fall of 1:70 to channel
290 x 290 mm sand-blasted exposed aggregate concrete pavers on mortar bedding

DETAIL 3

Detail 3 of the roof of the tasting space reflects on the transition between nature and machine, defining the mediating realm of man.



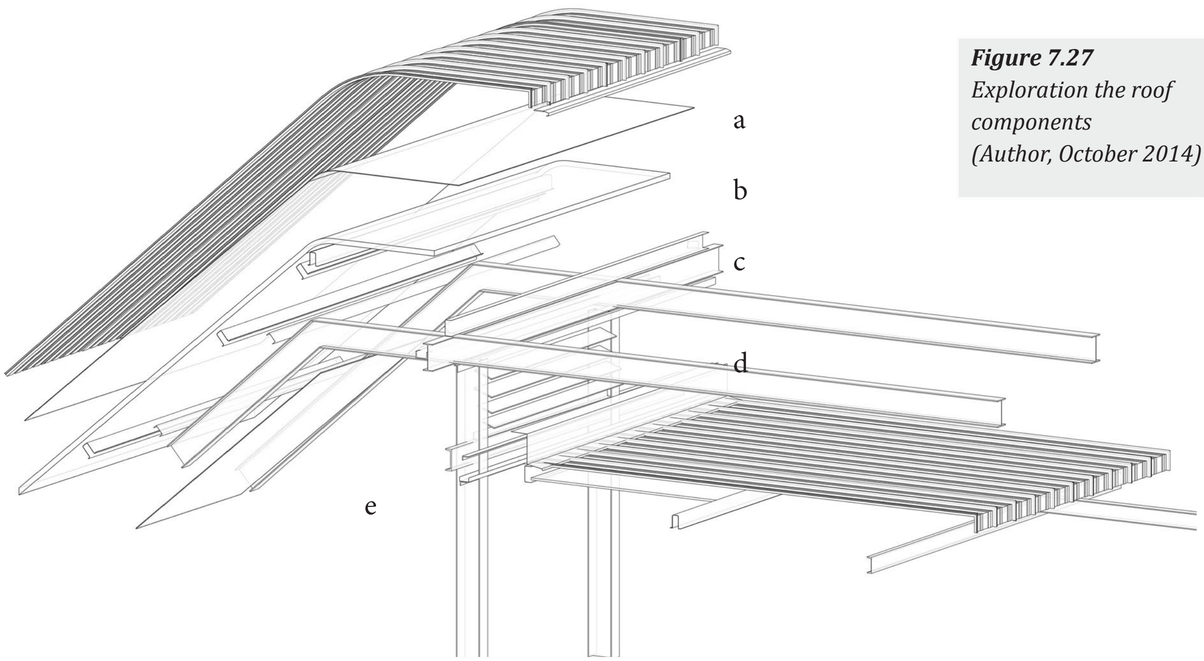


Figure 7.27
Exploration the roof components
(Author, October 2014)

a- Brownbuilt roof sheeting
b- Sisalation reflective foil
c- Rigid mineral wool insulation
d- Galvanized steel structure
e- Extended pergola structure forming the ceiling

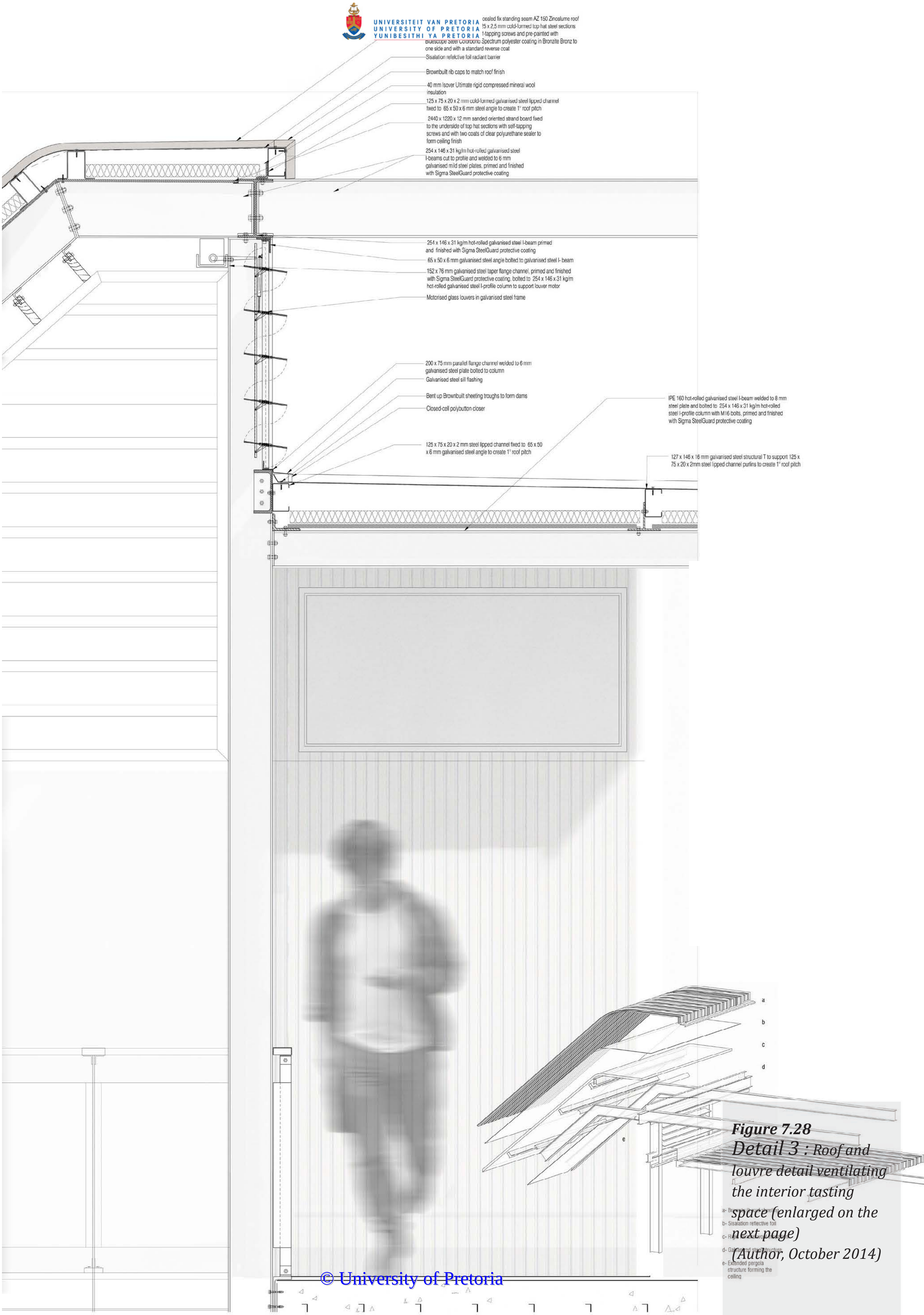
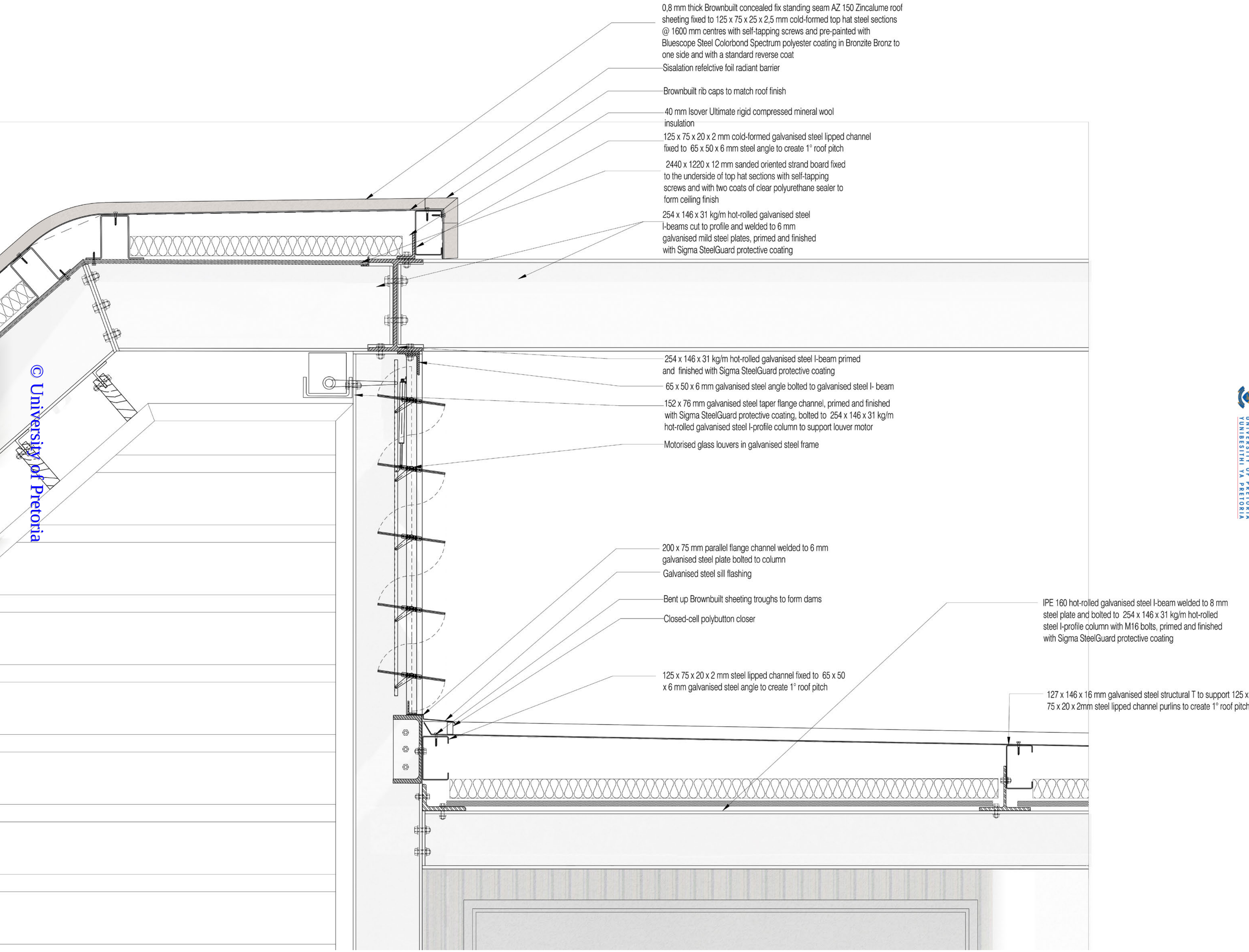


Figure 7.28
Detail 3 : Roof and louvre detail ventilating the interior tasting space (enlarged on the next page)
(Author, October 2014)


0,8 mm thick Brownbuilt concealed fix standing seam AZ 150 Zincalume roof sheeting fixed to 125 x 75 x 25 x 2,5 mm cold-formed top hat steel sections @ 1600 mm centres with self-tapping screws and pre-painted with Bluescope Steel Colorbond Spectrum polyester coating in Bronzite Bronz to one side and with a standard reverse coat
Sisalation refelctive foil radiant barrier
Brownbuilt rib caps to match roof finish
40 mm Isover Ultimate rigid compressed mineral wool insulation
125 x 75 x 20 x 2 mm cold-formed galvanised steel lipped channel fixed to 65 x 50 x 6 mm steel angle to create 1° roof pitch
2440 x 1220 x 12 mm sanded oriented strand board fixed to the underside of top hat sections with self-tapping screws and with two coats of clear polyurethane sealer to form ceiling finish
254 x 146 x 31 kg/m hot-rolled galvanised steel I-beams cut to profile and welded to 6 mm galvanised mild steel plates, primed and finished with Sigma SteelGuard protective coating
254 x 146 x 31 kg/m hot-rolled galvanised steel I-beam primed and finished with Sigma SteelGuard protective coating
65 x 50 x 6 mm galvanised steel angle bolted to galvanised steel I- beam
152 x 76 mm galvanised steel taper flange channel, primed and finished with Sigma SteelGuard protective coating, bolted to 254 x 146 x 31 kg/m hot-rolled galvanised steel I-profile column to support louver motor
Motorised glass louvers in galvanised steel frame
200 x 75 mm parallel flange channel welded to 6 mm galvanised steel plate bolted to column
Galvanised steel sill flashing
Bent up Brownbuilt sheeting troughs to form dams
Closed-cell polybutton closer
125 x 75 x 20 x 2 mm steel lipped channel fixed to 65 x 50 x 6 mm galvanised steel angle to create 1° roof pitch
IPE 160 hot-rolled galvanised steel I-beam welded to 8 mm steel plate and bolted to 254 x 146 x 31 kg/m hot-rolled steel I-profile column with M16 bolts, primed and finished with Sigma SteelGuard protective coating
127 x 146 x 16 mm galvanised steel structural T to support 125 x 75 x 20 x 2mm steel lipped channel purlins to create 1° roof pitch

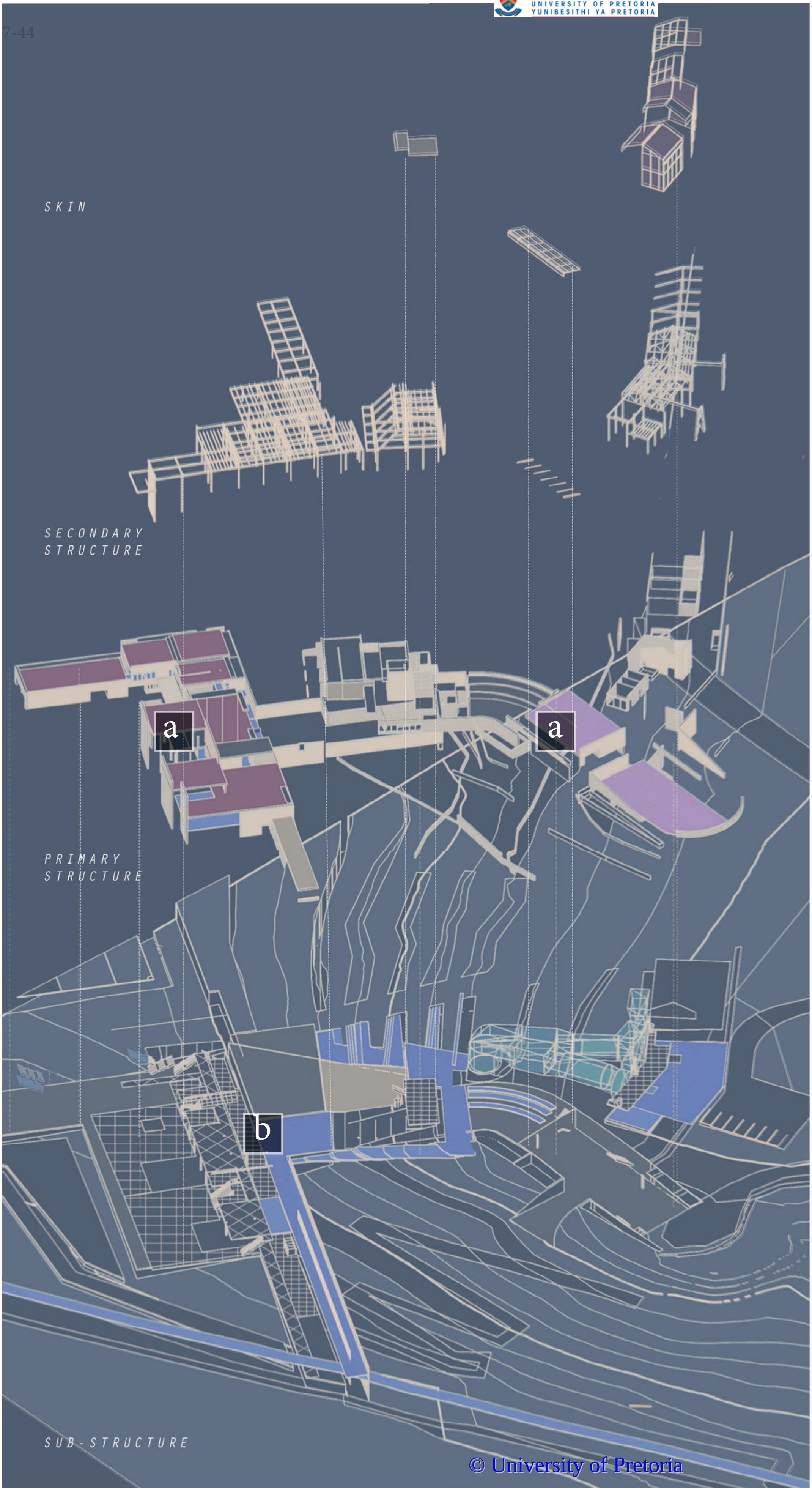


Figure 7.29

Structure
(Author, September 2014)

Figure 7.30

The aged recycled steel sheeting from existing motor rooms (Author, 2014)

Figure 7.31

Reused corrugated roof sheeting from old mine buildings dumped on the site, reused as interior cladding

7.6 OVERVIEW OF BUILDING STRUCTURE

7.6.1 *Substructure*

A morphing ground plane extends across the site and three realms as a continuous element carved into the landscape, manipulated to harvest water from the natural slope. The site geology comprises sedimentary soil weathered from felsite and quartzite parent material. These soil conditions mean that columns are founded on concrete pads (Von Geyso, 2014), the same system as the extant ventilation shaft foundation system.

Processing spaces require sloped floors that can be easily drained and cleaned. As a consequence of this, and the fact that the building is integrated with the natural slope, water is allowed to enter the building using cavity construction. The collected water is pumped to the grey water treatment system on the western edge of the building, following the natural site gradient, or is used for irrigation of the gardens adjacent to it.

7.6.2 *Primary structure*

The primary structure of cast-in-situ concrete and stone is a permanent monolithic extension of the ground and provides thermal mass. In order to support the roof gardens, a minimum column sizing of 300 x 300 mm and a maximum spacing of 4 000 mm, supporting a 300 mm cast-in-situ concrete slab is necessary (Von Geyso, 2014). Expansion joints are required at 30 m intervals. In this instance, one expansion joint per roof is introduced. The concrete slabs (b in figure 7.29) are insulated with 80 mm high-density IsoBoard, with a layer of plywood to protect waterproofing, especially necessary along the main public walkway above processing spaces below. The green roofs (a in figure 7.29) make use of a Neopor EPS DipSystem, which acts as a hybrid irrigation and insulation system used to form the direct greenroof system (figure 7.32). The drainage slots are situated to the underside of the board, and water retention dimples are moulded into the top part of the sheets (figure 7.33). A Neopor EPS DipSystem planting board offers the same R-value as an IsoBoard sheet of the same thickness.

Figure 7.32

Direct green roof system (Adapted by author from Greenstate, 2012:41)

a- Growing medium
b-Bidum A2 geotextile fabric
c-DipSystems roof garden planter boards (hybrid drainage and insulation)
d- 250 micron polyethylene sheets
e-Derbigum CG4H (horticultural) on one layer Dergigum CG3 waterproofing membrane slab
f- Screed laid-to-fall on cast-in-situ concrete slab

The cast-in-situ concrete walls change in appearance across the site, in terms of the density and size of aggregate used, from both the site and mine. The coarse aggregate cast-in-situ walls are sandblasted to expose the aggregate which makes up approximately three-quarters of the material volume (Bell & Rand, 2006:55). The interior surfaces in the processing spaces should be impermeable and smooth for hygiene requirements linked to the programme.

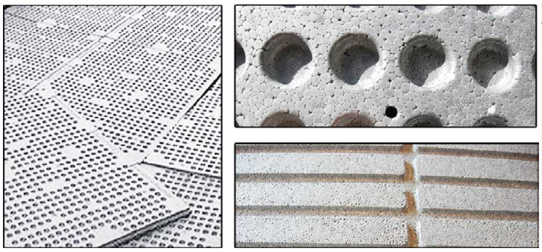
7.6.3 *Secondary structure*

The main steel structure consists of 254 x 146 x 41 kg/m galvanized hot-rolled steel I-profile sections finished with intumescent paint for fire protection. IPE 160 steel sections are connected to this main frame to support the administration spaces. The concrete slab for these spaces is cast on QC floor permanent shuttering.

Grid spacing varies to define the three separate realms of man, nature and machine, while supporting the changing height of the timber pergola. Near the ventilation shaft, the module of the machine (6 m raise-bore hole dimension connecting to the tunnels) is reflected in the 3 x 6 m module of the tasting rooms.

7.6.4 *Skin*

Metal sheets from the extant ventilation shaft are reused to clad the east-facing staff spaces (see figure 7.26 detail) protecting the adjacent spaces from early morning sun while changing the degree of permeability of this facade (figure 7.16). Weathering steel angles are also used to shade the administration spaces from eastern sun, while staining the stereotomic bridge element below (see figure 7.26 for detail). Old, rusted s-profile rusted sheets that have been left on the site by the mine, pierced with small holes (figure 7.30), are used to clad the interior public tasting space (figure



A

B

Figure 7.33
Neopor EPS Greenroof DipSystems planting boards (DipSystems, 2014)

A- Water retention dimples

B- Drainage slots

7.24 detail), retaining the narrative of the old machine. These sheets have been used previously to clad structures in the mine precinct prior to cladding the steel-framed ventilation shaft motor-rooms (McGill, 2014). The pergola is constructed with a combination of steel and saligna. 224 x 47mm saligna beams, finished with a clear polyurethane sealant, span the 3m interval between the 152 x 152 x 23 kg/m steel H-profile columns. In places, the saligna pergola extends into the interior spaces. Oriented strand board (OSB) is a wood particle board with a rough, variegated surface and will create contrast with the smooth finish of the pergola. The OSB is predominantly used in the tasting space where the roof structure steps up towards the machine to the east of the site.

Brownbuilt Zincalume sheets with a Bronzite Colorbond Spectrum finish clad the roof of the steel structure. The sheeting is supported by 125 x 75 x 25 x 2,5 mm cold-formed top-hat sections at 1 600 mm centres and the space is insulated with Isover Ultimate rigid compressed mineral wool. Sisalation reflective foil forms a combined radiant and waterproofing barrier.

Planting screens (figure 7.9) form a part of the buffer walls facing the western sun. Water from the public green roofs is harvested and trickle down these walls before entering the grey water treatment cell below.

7.7 SYSTEM EXPLORATION

The exploration of building systems expands on interactions between the triad, informed by the theoretical investigation and concept of the *symbionic.* System exchanges between the biotic and bionic are considered in the design, enhancing environmental building performance, thermal comfort and resource use in terms of waste and water. Implemented systems also explore a response to the programme, considering food systems within closed-loop cycles that are integrated with the broader systems of production inherent in the existing site.

Influencing factors related to existing networks will be briefly restated to contextualise the proposed responses, specifically to water, the functional adaptive reuse of the ventilation shaft, their integration with the existing condition and the consequent evolution of system dynamics between man, nature and machine.

7.8 OUTLINING EXTANT SYSTEMS

Two mine ventilation shafts are currently located along the periphery of the big hole (figure 7.36). Focus will be placed on the main north fan, located on the site.

The ventilation shafts connect to tunnels at 430 m below the surface and form a part of the return airway system (McGill, 2014:correspondence). The ventilation shaft forms part of a 'push-pull' system with air intake holes strategically placed around the pit. Air is directed through the subsurface tunnel network with exhaust air drawn out from ventilation shafts with two centrifugal fans. These fans are powered by large motors within the connected steel structure.

The airflow cannot be guaranteed due to sub-surface ground movement, so each tunnel is equipped with a pressurisation fan (Venter, 2012:484). Sometimes air is reused in the production areas underground, depending on its quality. Currently, the air expelled from underground contains dust particles and carbon dioxide, a consequence of the explosives used for blasting in

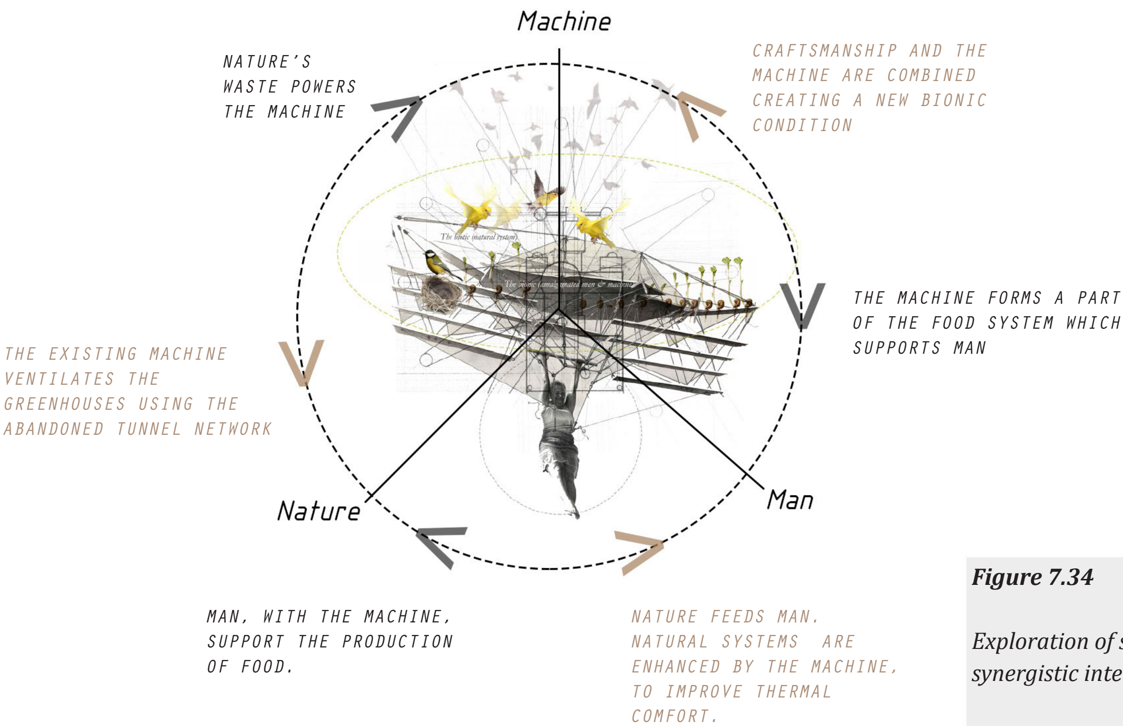


Figure 7.34

Exploration of symbionic synergistic interactions

(Author, 2014)

the tunnels, and diesel fumes from underground workshops and vehicles. Separate dust extraction systems and air filters are located in each tunnel to prevent the liberation of dust into the ambient air (Venter, 2012:484). Fall-out and air-borne dust particles were measured near the north ventilation shaft and it was found that the potential pollution is negligible (Cullinan Diamond Mine, 2010). The humidity of the expelled air also varies depending on seasons.

In the post-operational mining context in which this dissertation is situated, the tunnels will be abandoned and blasting pollution, along with diesel fumes from underground vehicles and workshops, will no longer influence the expelled air quality.

The opencast pit is 42 ha in size with a 176 ha catchment area that naturally drains into it. Currently, the total amount of water removed by both pumping and mining is estimated to be close to 1200m^3/day, which includes infiltration of precipitation via the open pit, crack zones and groundwater discharge (Venter, 2012:36).

This water predominantly contains Kimberlite sediment. Diamond mining is a clean process and there is no acid mine or rock drainage (Venter, 2012:330) typical of metal or coal mines. A chemical analysis recently conducted on the water from the opencast pit revealed that it is of an acceptable quality and that rock geochemistry has no adverse effects (McGill, 2014: correspondence). This water is consequently of drinking standard (Venter, 2012:330).

Figure 7.35
Underground infrastructure (Lincoln archive)

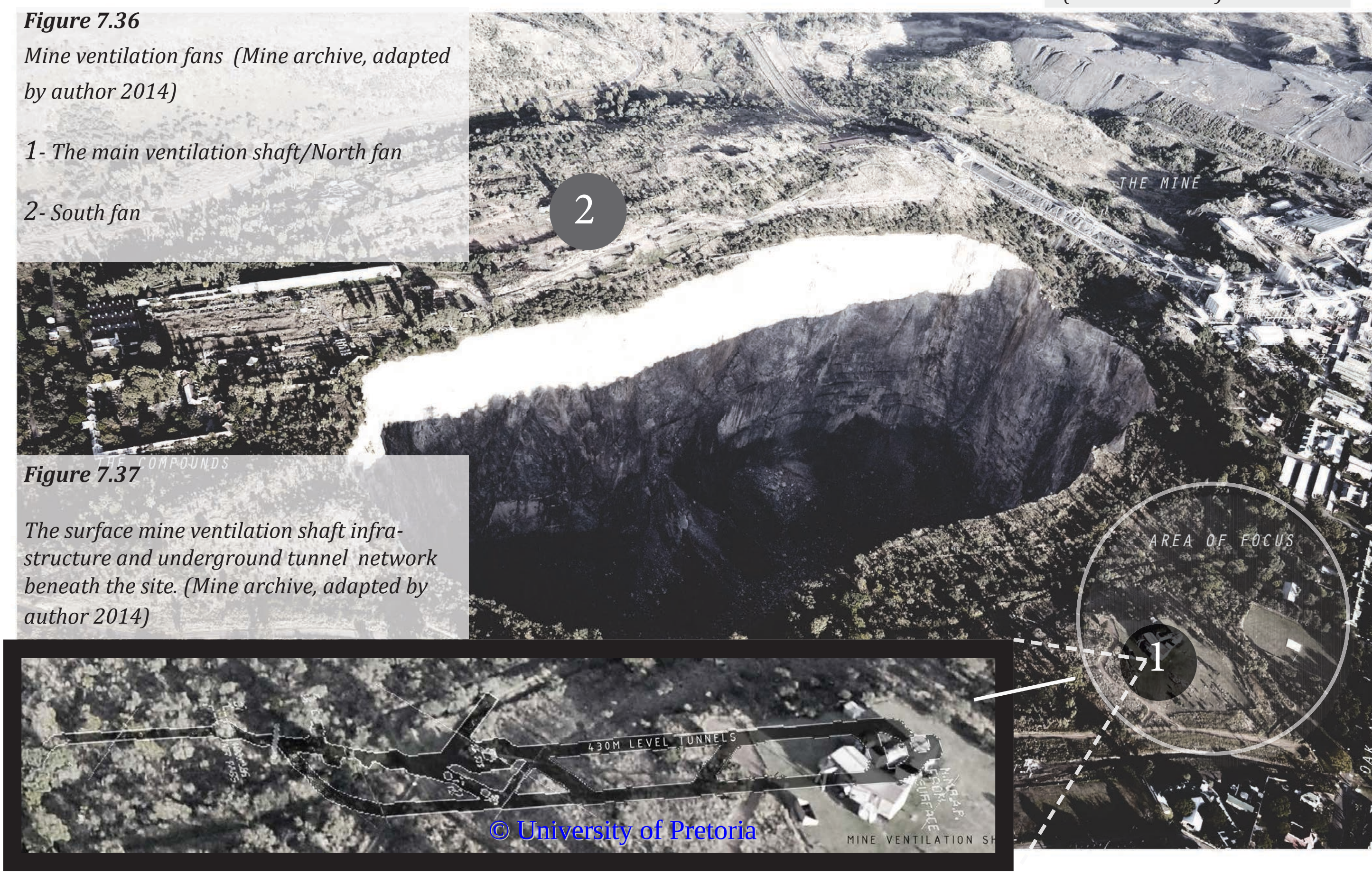


Figure 7.36
Mine ventilation fans (Mine archive, adapted by author 2014)

1- The main ventilation shaft/North fan

2- South fan

Figure 7.37

The surface mine ventilation shaft infra-structure and underground tunnel network beneath the site. (Mine archive, adapted by author 2014)

7.9 MUTATING DYNAMICS: SYSTEM INTEGRATION

7.9.1 Water

The intention of the Cullinan Group is to use the water from the opencast pit within the proposed interventions. Because of the size of the catchment area of the hole (A1 on figure 7.38, C indicates the site) and the significant water catchment area naturally draining into it, water from the opencast pit is more than sufficient to meet demands for irrigation purposes and for use within the facility, serving as the primary water source. Originally storm water from the town (B on figure 7.38) was to be used to supplement this source, but water calculations (to follow) indicate that it is not required.

The full strategy is indicated in figure 7.41. Two separate water systems are introduced to the site for irrigation and for use within the building, supplemented with clean harvested roof water. Some of the water diverted from the pit using existing berms (A2 on figure 7.38) is redirected for irrigation use. This water is stored in a series of retention dams on the site.

Cut-off drains at a 1:120 fall are introduced, harvesting water from the steeper slopes and releasing it slowly over time, irrigating surrounding vegetation and reducing erosion of the productive landscape. A cut-off drain is also placed adjacent to the stone wall in the park, harvesting water to supplement irrigation of the sports ground.

The water demands for the facility can be reduced by the use of appropriate fittings and fixtures. New production and processing systems use dry methods of washing and preparing fruit and raw products, and recirculate water, significantly reducing consumption (Sinha, 2012:328).

The water calculations that will follow establish demand and tank sizes for on-site water storage required.

Figure 7.38

An investigation of catchment areas and possible water sources (Author, 2014)

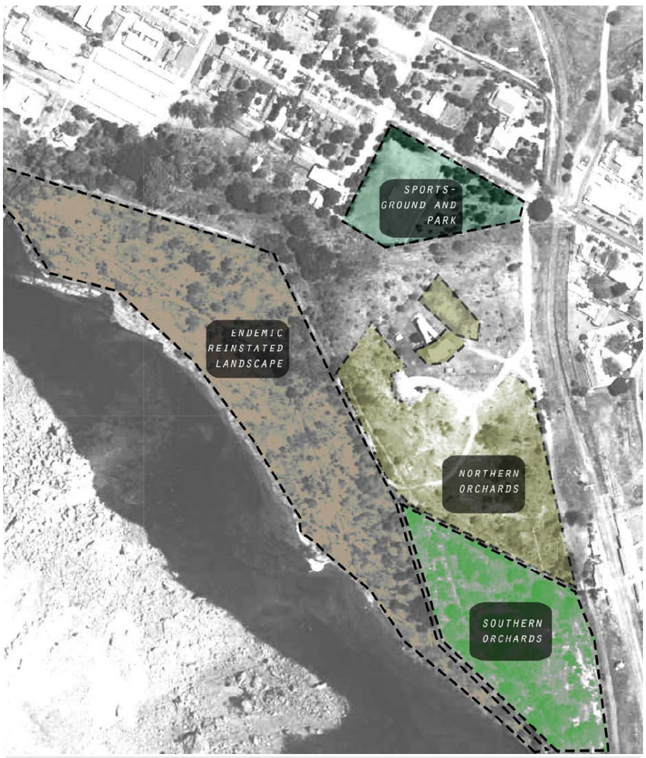


Figure 7.39
Site planting and irrigation demand (Author, 2014)

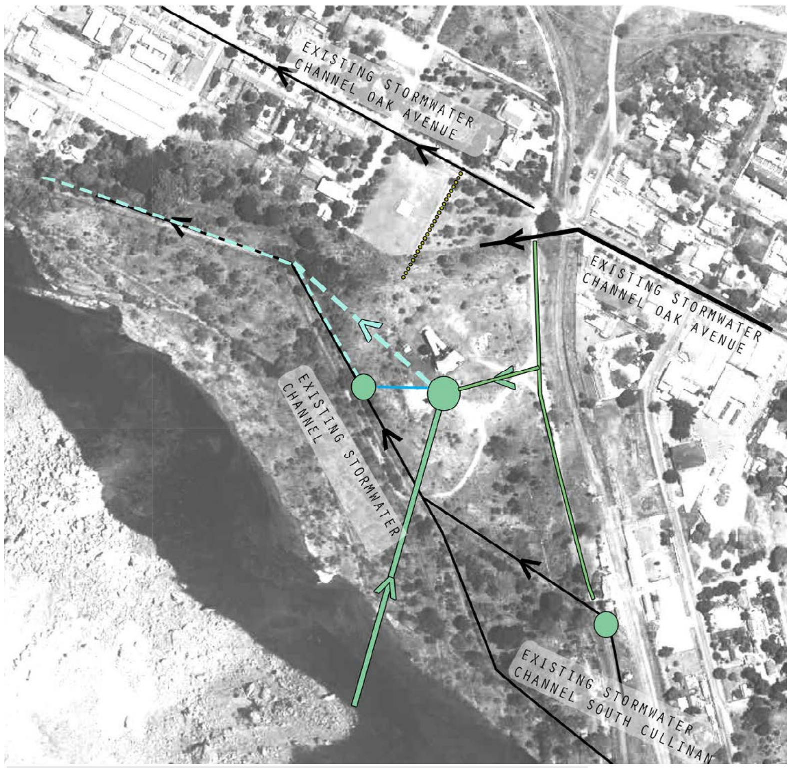


Figure 7.40
Water reticulation and storage on the site (Author, 2014)

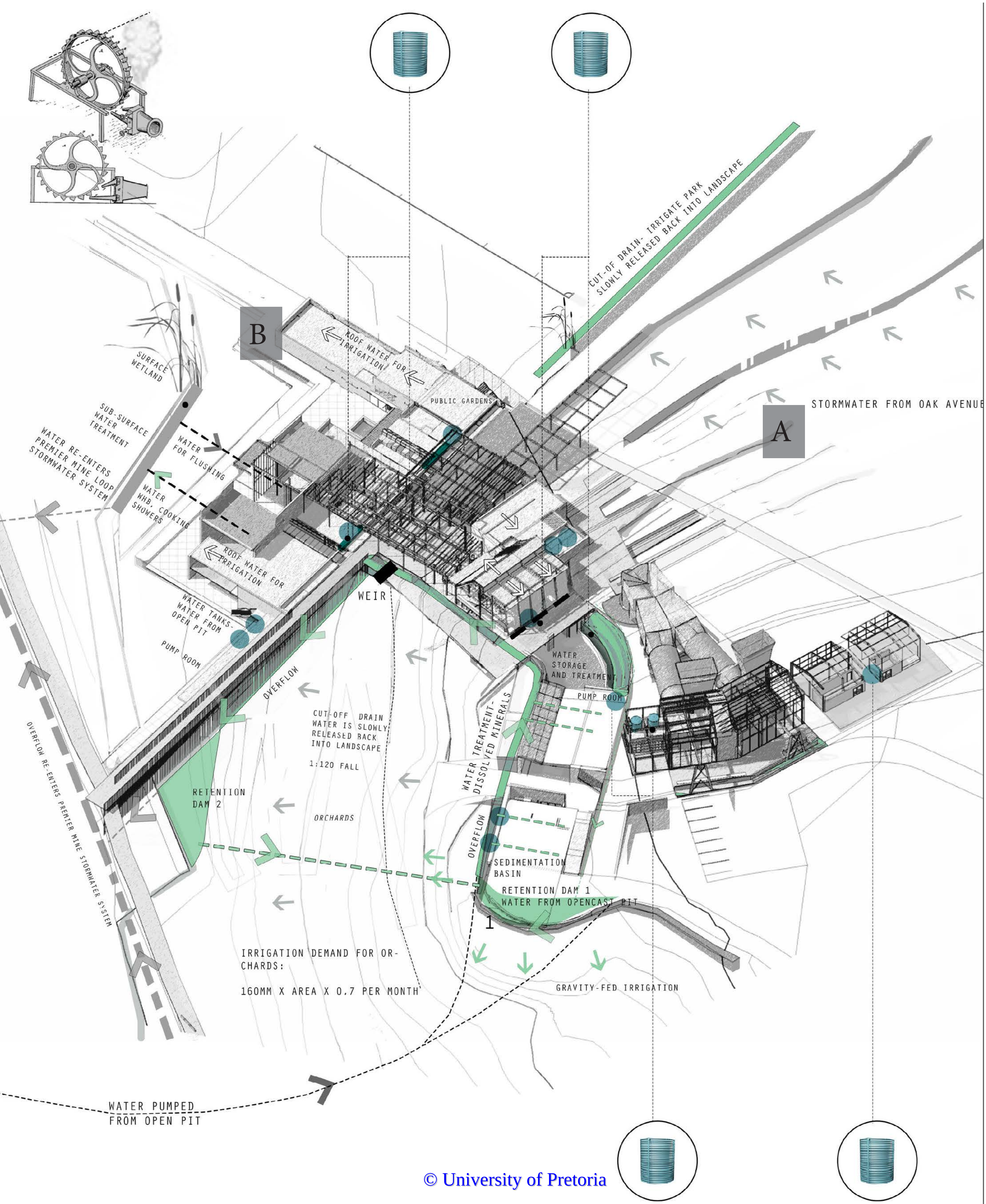

CUT-OF DRAIN- IRRIGATE PARK
SLOWLY RELEASED BACK INTO LANDSCAPE
B
ROOF WATER FOR IRRIGATION
SURFACE WETLAND
PUBLIC GARDENS
STORMWATER FROM OAK AVENUE
A
SUB-SURFACE WATER TREATMENT
WATER FOR FLUSHING
WATER RE-ENTERS PREMIER MINE LOOP STORMWATER SYSTEM
WATER WHB, COOKING SHOWERS
ROOF WATER FOR IRRIGATION
WEIR
WATER TANKS- WATER FROM OPEN PIT
PUMP ROOM
OVERFLOW
WATER STORAGE AND TREATMENT
PUMP ROOM
CUT-OFF DRAIN WATER IS SLOWLY RELEASED BACK INTO LANDSCAPE
1:120 FALL
WATER TREATMENT- DISSOLVED MINERALS
RETENTION DAM 2
ORCHARDS
OVERFLOW RE-ENTERS PREMIER MINE STORMWATER SYSTEM
OVERFLOW
SEDIMENTATION BASIN
RETENTION DAM 1
WATER FROM OPENCAST PIT
1
IRRIGATION DEMAND FOR OR-
CHARDS:
160MM X AREA X 0.7 PER MONTH
GRAVITY-FED IRRIGATION
WATER PUMPED
FROM OPEN PIT

Figure 7.41 *Water strategy (Author, 2014)*

A *Water is pumped from the opencast pit weekly and stored in a retention dam, acting as a sedimentation basin. This water is used for irrigation or directed for use within the building, predominantly for production areas and kitchens. A channel filters the water, which requires little treatment, removing any dissolved minerals. Water used for the public test kitchen is stored in the washing courtyard and receives secondary UV treatment before use. Waste water from fruit washing and preparation can be used to irrigate the surrounding gardens.*

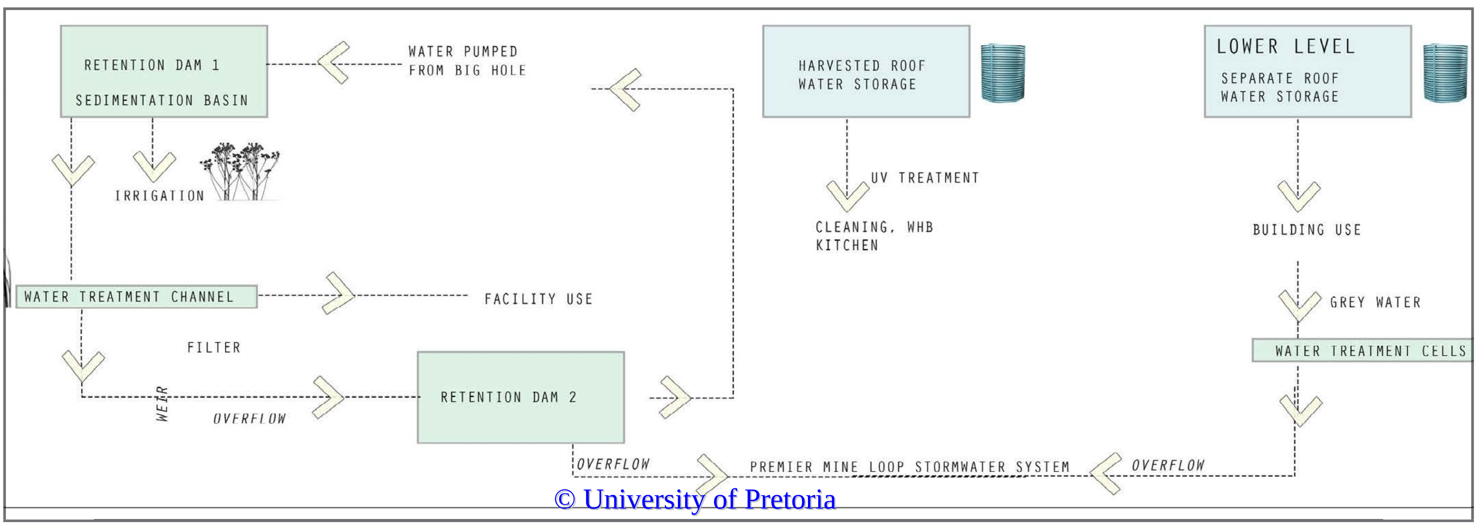
B *Water pumped from the opencast pit is stored in a series of tanks for use within the processing spaces. Grey water is directed to a sub-surface wetland, an anaerobic system that will eradicate any soap residue. It is then directed to a surface wetland cell, adjacent to the staff courtyards, before re-entering the Premier Mine Loop water system, a series of existing stormwater channels surrounding the opencast pit that currently redirects water away from the pit to the McHardy Spruit, located close to the mine precinct.*

1 OPENCAST PIT WATER STORAGE AND TREATMENT FOR *IRRIGATION*

2 WATER STORAGE FOR FACILITY FROM *OPENCAST PIT AND ROOFS*

Figure 7.42

Water reticulation strategy (Author, 2014)



Water calculations

Opencast pit yield:

Using one fifth of the total catchment area :

Yield (m3)= PxAxC
P (m) Precipitation
A (m2) Area
C Runoff coefficient

OPENCAST PIT YIELD	P (m)	A (m^3)	C	Monthly yield (m^3)
Jan	0.136	1040500	0.35	49528
Feb	0.076	1040500	0.35	27677
Mar	0.082	1040500	0.35	29862
Apr	0.051	1040500	0.35	18573
May	0.013	1040500	0.35	4734
June	0.007	1040500	0.35	2549
July	0.003	1040500	0.35	1093
Aug	0.006	1040500	0.35	2185
Sep	0.022	1040500	0.35	8012
Oct	0.071	1040500	0.35	25856
Nov	0.098	1040500	0.35	35689
Dec	0.11	1040500	0.35	40059
Total				245818

Irrigation demand:

(refer to figure 7.37 indicating demand)

NORTHERN PRODUCTIVE LANDSCAPE/ORCHARDS (includes greenhouses and public harvest gardens)

IRRIGATION DEMAND	Irrigation depth/month	Area (m^2)	Demand (m^3)
Jan	0.16	30600	4896
Feb	0.16	30600	4896
Mar	0.16	30600	4896
Apr	0.16	30600	4896
May	0.16	30600	4896
June	0.16	30600	4896
July	0.16	30600	4896
Aug	0.16	30600	4896
Sep	0.16	30600	4896
Oct	0.16	30600	4896
Nov	0.16	30600	4896
Dec	0.16	30600	4896
			58752

Irrigation water budget:

WATER BUDGET	1/5th of water distributed around hole (m^3)	Demand (m^3)	Difference (m^3)
Jan	9906	4896	44632
Feb	5535	4896	22781
Mar	5972	4896	24966
Apr	3715	4896	13677
May	947	4896	-162
June	510	4896	-2347
July	219	4896	-3803
Aug	437	4896	-2711
Sep	1602	4896	3116
Oct	5171	4896	20960
Nov	7138	4896	30793
Dec	8012	4896	35163
	49164	*58752*	

Retention dams

The main retention dam, storing water pumped from the opencast pit, is sized for one week's irrigation demand (figure 7.43). Water from the hole used in other parts of the facility have separate water storage and cleaning systems. An overflow dam is provided at the lower part of the site, also used for irrigation. A similar demand near the station for the southern orchards will require a dam with a similar capacity.

Remaining harvested water after irrigation:

Water remaining per month for other uses from the opencast pit (m^3)
187066

15588 m^3 per month

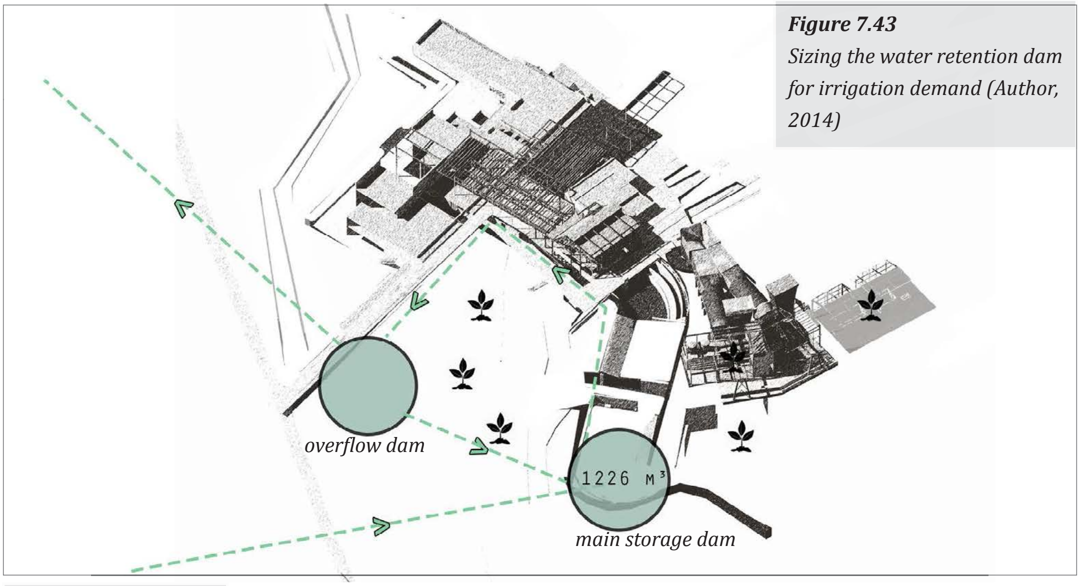


Figure 7.43
Sizing the water retention dam for irrigation demand (Author, 2014)

Facility water:

EASTERN PART OF FACILITY
30 field workers and post- harvest treatment staff
DEMAND

FIELD WORKER CHANGING ROOMS

END USE	l/pp/pd	No of people	Total l/pd	m^3/pd
WC	12	30	360	0.36
WHB and SINK	2	30	60	0.06
Showers*	38	30	1140	1.14
TOTAL:			1560	1.56
			per month (m^3)	43.68

Water from the pit can be used for showers
Waste water from post-harvest treatment is used for flushing after it has been reirculated

1 10 000l tank tank for greywater/flushing
3 10 000l tanks for whb, showers and kitchen use

*Water efficient shower head: 3.8l/min, assuming a 10 minute shower per day

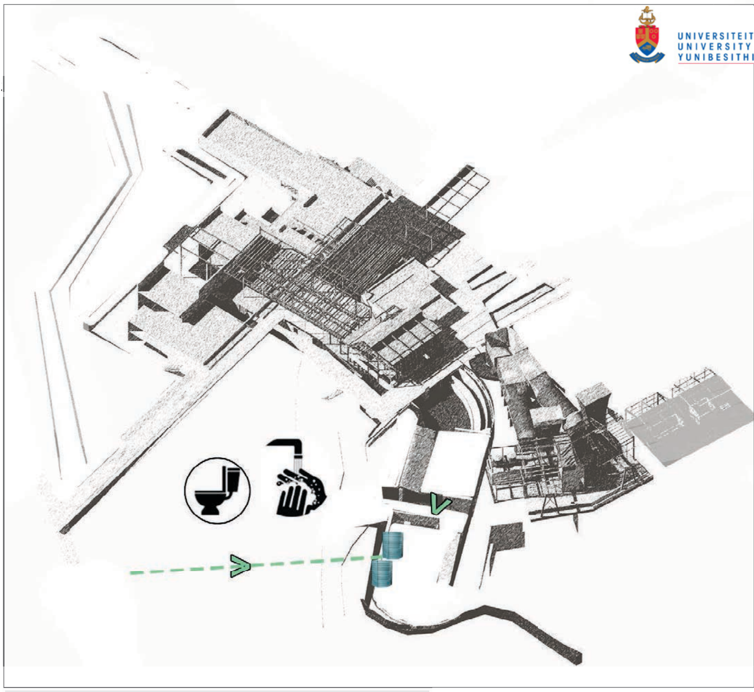


Figure 7.44
Staff field-house water (Author, 2014)

Figure 7.45

Public ablutions (Author, 2014)

Public spaces
Ablutions:

DEMAND

MAIN PUBLIC INTERFACE	for an A1 occupancy with an average of 200 visitors per day			
END USE	l/pp/pd	No of people	total l/pd	m^3/pd
WC	6	200	1200	1.2
URINALS	7.5	150	1125	1.125
WHB	1	200	200	0.2
RESTAURANT USAGE	65	200	13000	13
TOTAL:			15525	15.525
			per month (m^3)	15 525 L

ROOF CATCHMENT 240 m^2 X 0.9 EFFECTIVE CATCHMENT 216 m^2

WATER BUDGET	P (m)	A (m^3)	IN TANK (m^3)	LEFT OVER (m^3)	DEMAND WASH HAND BASINS (m^3)	REMAINING IN TANK (m^3)
Jan	0.136	216	29.376	0	5.6	23.776
Feb	0.076	216	16.416	40.192	5.6	34.592
Mar	0.082	216	17.712	52.304	5.6	46.704
Apr	0.051	216	11.016	57.72	5.6	52.12
May	0.013	216	2.808	54.928	5.6	49.328
June	0.007	216	1.512	50.84	5.6	45.24
July	0.003	216	0.648	45.888	5.6	40.288
Aug	0.006	216	1.296	41.584	5.6	35.984
Sep	0.022	216	4.752	40.736	5.6	35.136
Oct	0.071	216	15.336	50.472	5.6	44.872
Nov	0.098	216	21.168	66.04	5.6	60.44
Dec	0.11	216	23.76	84.2	5.6	78.6

MAX TANK 66.04 M3 =66 000L 3 20 00L 1 10 00L
SIZE REQUIRED REMAINING WATER FROM EACH MONTH CAN SUPPLEMENT TOILET FLUSHING
GREYWATER IS USED FOR IRRIGATION OF KITCHEN GARDENS

WALKWAY CATCHMENT 620 m^2 X 0.9 EFFECTIVE CATCHMENT 558 m^2

WATER BUDGET	P (m)	A (m^3)	IN TANK (m^3)	LEFT OVER (m^3)	DEMAND WC (m^3)	REMAINING IN TANK (m^3)
Jan	0.136	558	75.888	0	33.6	42.288
Feb	0.076	558	42.408	84.696	33.6	51.096
Mar	0.082	558	45.756	96.852	33.6	63.252
Apr	0.051	558	28.458	91.71	33.6	58.11
May	0.013	558	7.254	65.364	33.6	31.764
June	0.007	558	3.906	35.67	33.6	2.07
July	0.003	558	1.674	3.744	33.6	-29.856
Aug	0.006	558	3.348	-26.508	33.6	-60.108
Sep	0.022	558	12.276	-47.832	33.6	-81.432
Oct	0.071	558	39.618	-41.814	33.6	-75.414
Nov	0.098	558	54.684	-20.73	33.6	-54.33
Dec	0.11	558	61.38	7.05	33.6	-26.55

MAX TANK 83.000 M3 =83 000 L 5 20 00L
SIZE REQUIRED THIS WOULD BE SUPPLEMENTED WITH KITCHEN WASTE WATER

Test kitchen and restaurant:

Water for the public test kitchen and restaurant, for a maximum of 300 customers daily, is stored in the adjacent courtyard (figure 7.46)

WATER BUDGET RESTAURANT	
DEMAND PER MONTH (m^3)	
364	364 000L

Processing spaces:

WESTERN PART OF FACILITY

PROCESSING	
PROCESSING OF HONEYS/ MEADS/ PRESERVES	8 m^3/ton of product (Sinha 2012: 315), including kitchen use and cleaning

For a medium-scale facility, approximately 1 ton of product is produced monthly (Aldum 2014, correspondence)

8m3 per month
4 x 20 000l tanks
Waste water from cooking processes is either used directly for flushing or treated for showers and hand-washing

STAFF ABLUTIONS AND CHANGE ROOMS — for an A1 occupancy with an average of 200 visitors per day

END USE	l/pp/pd	No of people	total l/pd	m^3/pd
WC	12	25	300	0.3
WHB	2	25	50	0.05
SHOWERS	38	25	950	0.95
TOTAL:				1.3
			per month (m^3)	36.4
				36 400 L

4 X 10 000L TANKS
For separate flushing and greywater

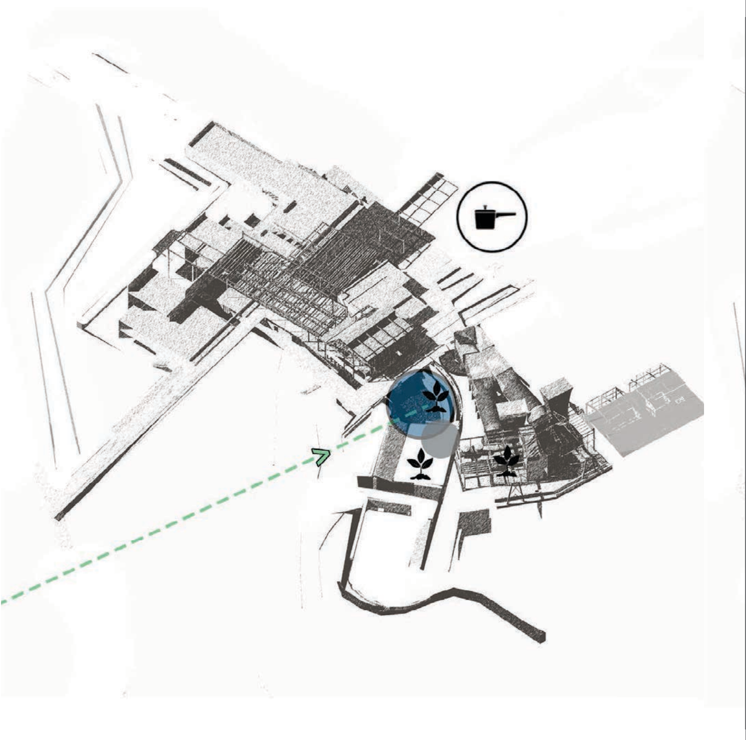


Figure 7.46

Test kitchen (Author, 2014)

Figure 7.47

Processing spaces (Author, 2014)

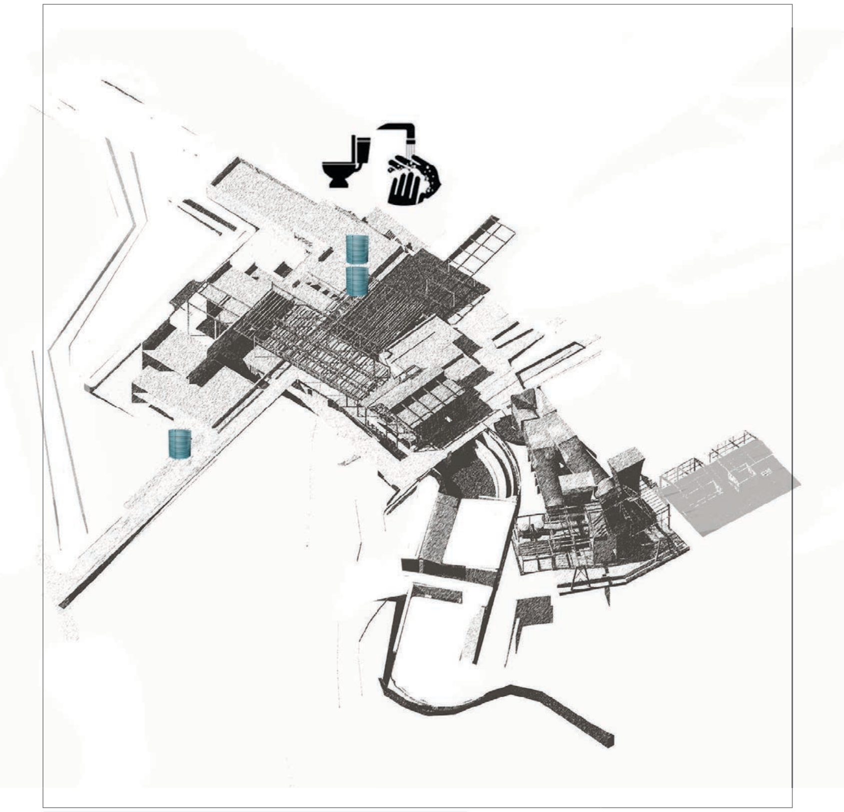


Figure 7.48

Staff ablutions (Author, 2014)

7.9.2 The new machine

Waste and the ventilation shaft

The mine ventilation shaft will retain its narrative as a 'breathing' mechanical system after mine-closure. The concept of the evolution of its function from old to new machine is discussed in the design chapter. Air will continue to be extracted from abandoned mine tunnels 430 metres below the surface in the future condition of a post-operational mine. The expelled air will regulate temperature within greenhouses supporting floriculture and plant production, adaptively reusing the old motor rooms (figure 7.49). Figure 7.47 shows the proposed greenhouses cladd with Rion UV polycarbonate glazing panels, allowing for light diffusion and heat insulation, along with mechanically operated shading.

Because the dissertation focuses on the making of architecture, planting design for the site is not addressed in detail as outlined in the delimitations of chapter 1, but an overview of planting requirements are given to contextualise the response (also refer to figure 5.21 in the programme chapter).

According to Hill (2013):

Floriculture, along with the larger-scale production of herbs and seedlings, requires a regulated and controlled environment, avoiding significant fluctuation between day and night temperatures. In winter, temperatures should not be lower than 7˚C, especially for specialist flowers. Figure 7.49 indicates Cullinan's temperatures, measured in 2010 and 2011, with minimum temperatures lower than 7˚C for 5 months of the year. Based on this, additional heating may be a

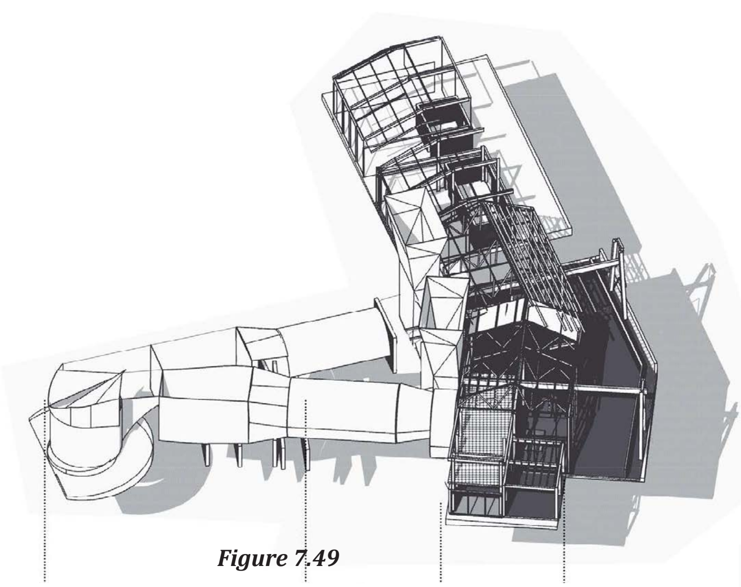


Figure 7.49

Greenhouses supported by the air extracted from abandoned mine tunnels (Author, 2014)

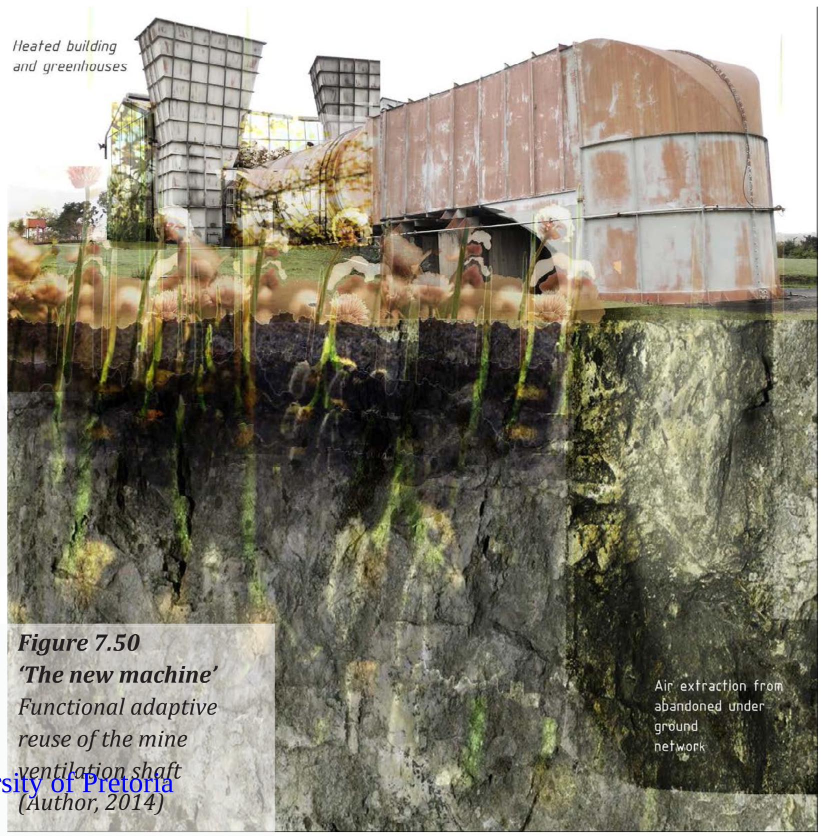


Figure 7.50
'The new machine'
Functional adaptive reuse of the mine ventilation shaft (Author, 2014)

necessary requirement for flower production, depending on the plant species. Some herbs also require additional heating to extend their growing time. In summer, temperatures above 29˚C can negatively affect production, therefore ventilation is required and can be achieved by allowing for cross-ventilation of the greenhouses.

A supplementary system that regulates greenhouse temperatures can extend growing time into spring and autumn. This would be a valuable addition, especially for the proposed programme which is reliant on year-round plant production.

The biotic will therefore be supported by the bionic system of the adaptively reused ventilation shaft, the breath of the old machine, supporting plant life, a narrative of its previous function and the expanse of tunnel networks beneath it.

Waste and feedback loops

New systems explore the building as part of the larger ecology, where the building feeds and is fed by the larger system in which it is embedded. A more sustainable food system is introduced by using the surplus from production (waste recovery) to support plant production, aligning with the theoretical exploration of the tenets of permaculture.

Organic waste from the food hub can serve as a very valuable raw material for other products (by-product processing), be composted for the productive landscape or used for power generation and regulating the internal condition of the greenhouses. This valuable residue, predominantly from fruit waste such as fruit peelings and scraps, is a good biomass source because of its high sugar and energy content.

Organic waste from food production on the site and the kitchens is consequently used in anaerobic biodigesters to produce biogas, in turn used to drive steam wheels powering the greenhouse fans for maintaining suitable winter growing conditions.

The bio-chemical conversion process is preferred for wastes with a high percentage of organic biodegradable matter and high moisture content (Zafar, 2008: online). Fruit and organic waste is composted in oxygen free conditions. Anaerobic stabilisation of 1 kg organic material leads to the formation of about 0.75m3 gas, which contains methane, carbon dioxide, and other gases (Sinha, 2012: 328). The remaining dry residue, or digestate, can be used as compost for the orchards and productive landscape, or sold to local farmers.

The amount of organic and fruit waste produced is dependent on seasonal production on and off site, and will therefore vary. A sufficient amount of energy is required to run the fans for the greenhouses in winter, but because the exact value of available waste cannot be foreseen, this energy source is augmented with parabolic solar collectors.

In order to determine the approximate sizes of anaerobic biodigesters required, the quantity of waste made available by the facility is determined as a factor of the approximate value of final product produced (kg of waste/ton of value-added product). It also varies depending on the raw product and the involved processes. Sinha (2012:330) gives an estimated average of 500 kg per ton. The facility would produce an average of

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
2010	15.2	13.7	13.0	9.9	7.8	-0.4	1.6	1.6	7.5	7.7	12.0	13.3
2011	14.1	13.1	12.6	7.2	4.0	1.3	1.6	3.1	7.9	6.7	11.5	13.9

Figure 7.49

Minimum temperatures, in ˚C, for Cullinan (Venter, 2014)

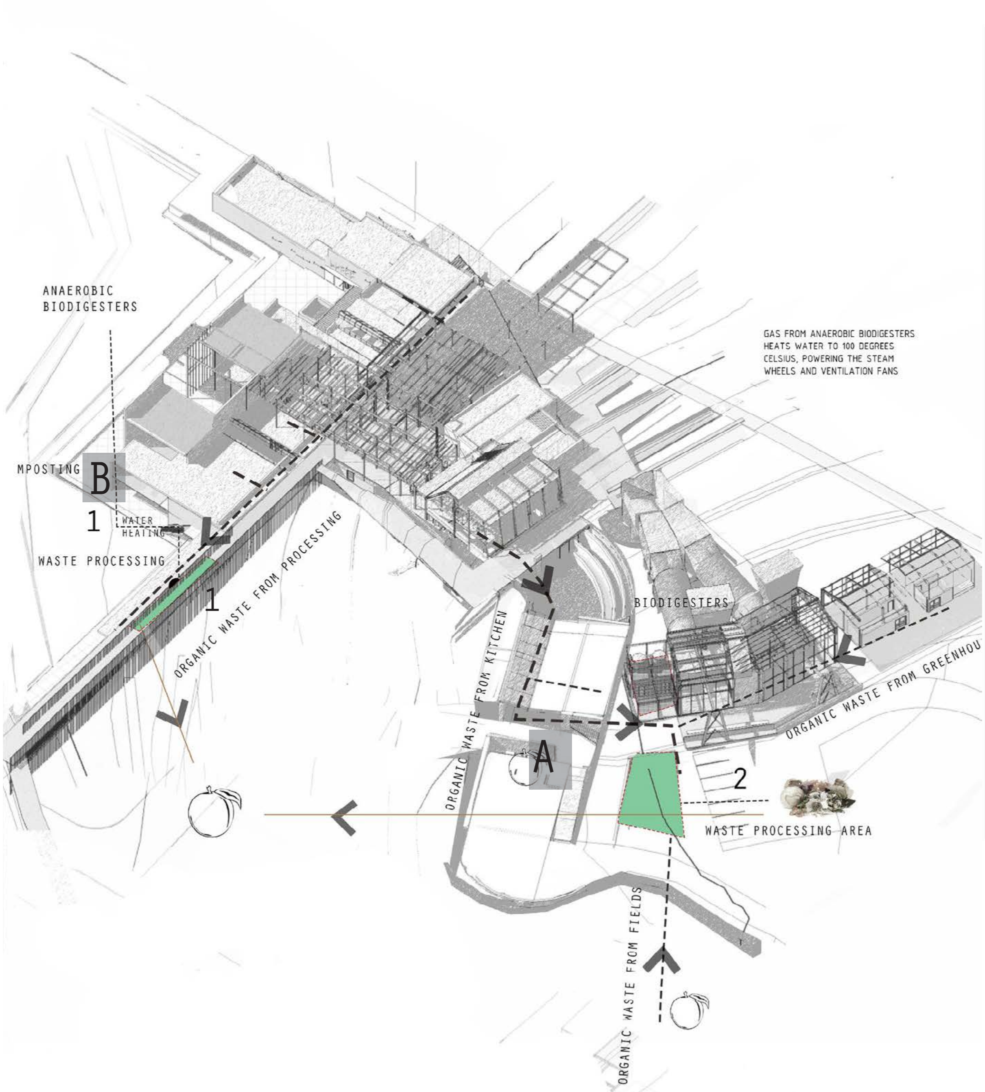


Figure 7.51

Waste strategy

(Author, 2014)

To meet programmatic requirements, waste flows are made counter-current to production and processing flows.

A- Waste from raw product preparation is redirected to waste area 2, where organic waste material from surrounding farms is also sorted and used in anaerobic digesters.

B- Waste flow from the processing facility is redirected to composting area 1.

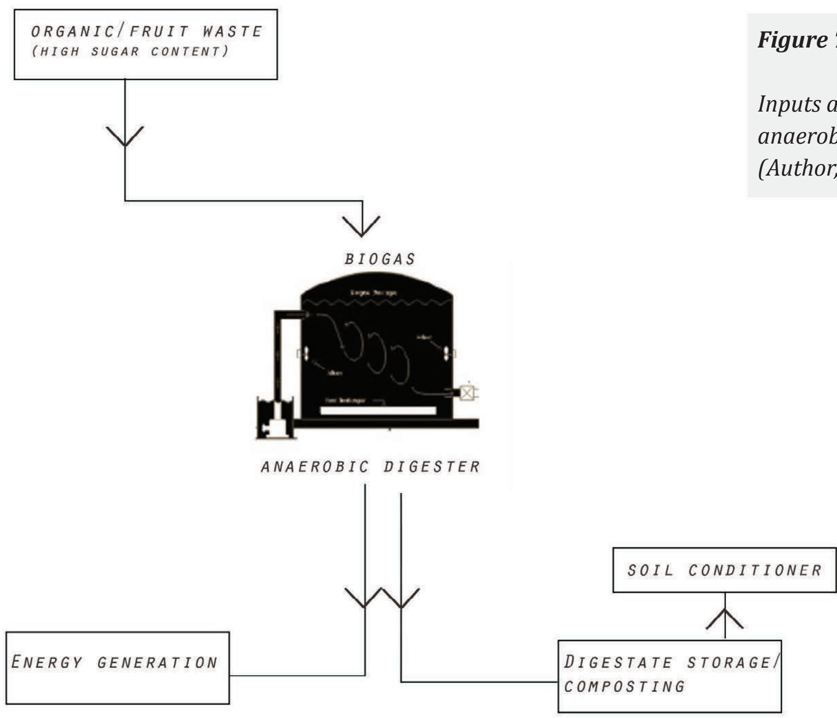


Figure 7.52

Inputs and outputs of the anaerobic digesters
(Author, 2014)

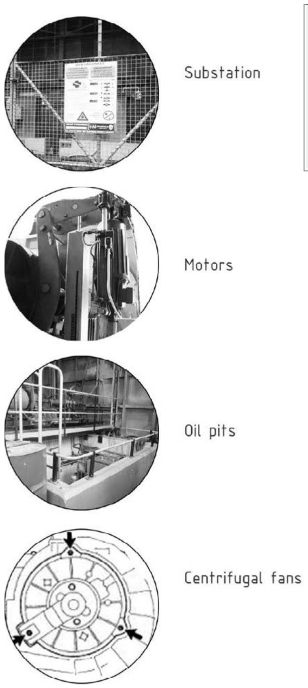


Figure 7.53

The extant system (Author, 2014)

1 to 2.5 ton of finished product per month, with seasonal variability (an average value provided by Aldum [2014: correspondence]). 1 000 kg from the processing facility is estimated as a maximum monthly value with the restaurant facility and gardens, forming a combined total of 200 kg of organic waste per day. 4 x 50 kg capacity 2,16 m diameter x 2,225 m height BioGas Pro6 biodigesters, each with a 6 000 litre capacity is specified, to be placed in close proximity to the greenhouses.

The anaerobic digesters and the organic waste energy source, supplemented with parabolic solar collectors, will heat water to 100˚C, producing steam to drive the steam turbines. The steam energy is used to turn the blades of the turbine, creating rotational energy, which is attached to a generator (figure 7.54).

This waste treatment facility is located adjacent to the old motor rooms replacing the existing substation, speaking of its memory, but changing from an unsustainable to a sustainable source of energy production.

Residual digestate from the anaerobic digesters is redirected to composting pits to be used as soil conditioner in the landscape, orchards, greenhouses and gardens, or sold to local farmers.

The ventilation shaft currently produces a ‘hum’ while extracting air from the subsurface mining tunnel system. The average measured decibel level produced by the fans within the motor rooms is approximately 50dbA. Levels were measured within the park, at 30-40 m from the shaft and a maximum of 32 dbA was recorded (Cullinan Diamond Mine, 2012). The public bridge is located just over 30 m away from the fans, which would operate for part of the winter months and not impinge on normal conversation (it does not exceed the maximum of 45 dbA for a rural context).

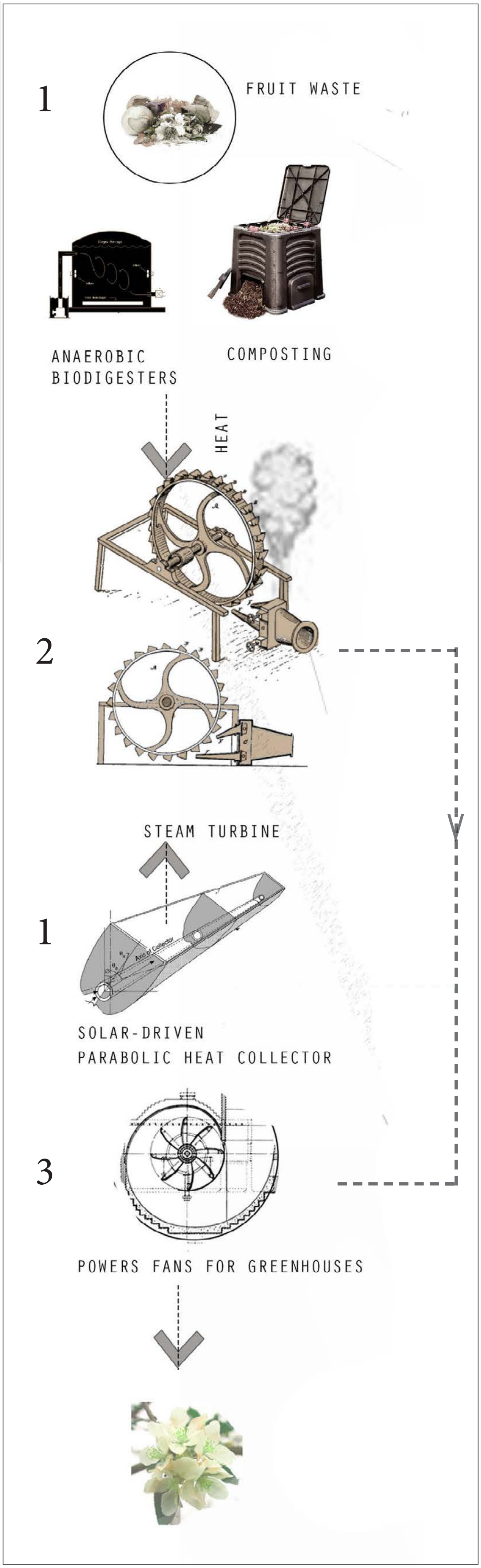
Figure 7.54

New energy production system (Author, 2014)

1- Energy sources

2- Steam from water in a boiler is pumped into the steam turbine, spinning the blades.

3- The turbine is attached to a generator by a rotating shaft, creating electricity. Low energy cooled steam is released into the ambient air, using the existing cowl.



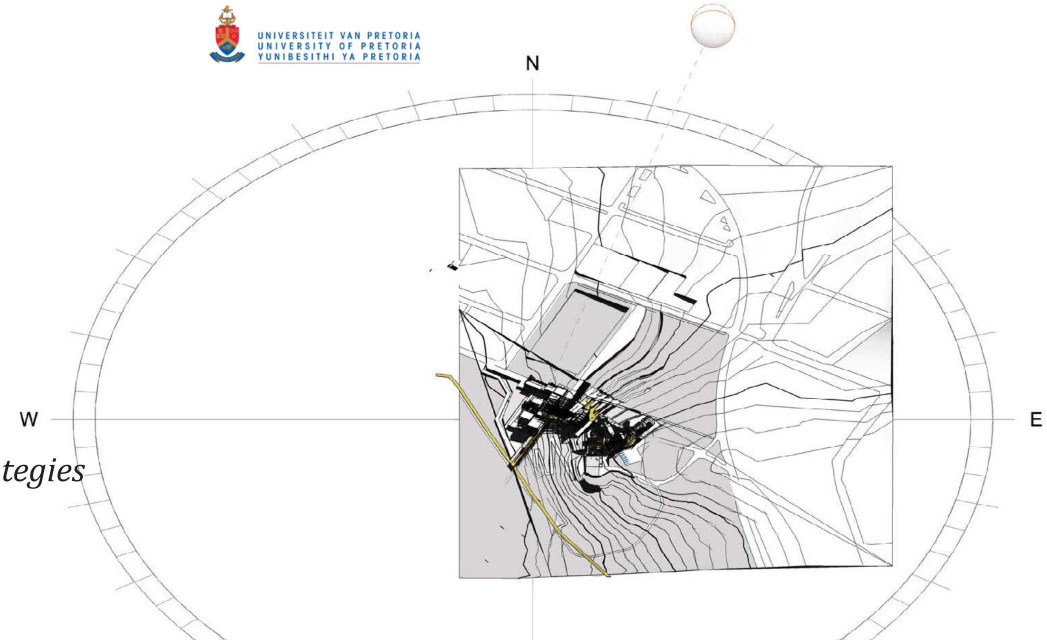


***Figure** 7.55*
Building located on the site
(Author, 2014)

7.9.3 Passive climatic strategies

7.9.3.1 Overall strategy

Thermal comfort describes the relationship of man to his context. Buildings should cultivate relationships with the complex systems they interact with, including the people who occupy them. Groák (1992:15) states that the object-subject relationship is not a stable and clearly defined one, therefore a holistic and systemic approach must to be adopted. Bionic and biotic amalgamated systems are investigated in order to attain the requisite comfort levels, depending on functional and programmatic spatial requirements.

Cullinan's temperature and climatic condition varies slightly from Pretoria's. Figure 7.55 indicates appropriate design strategies for Cullinan which can assist in extending the comfort band. A combination of passive strategies are explored in order to maintain comfortable indoor conditions. For the region, Holm (1996:69) states that facades should be shaded in summer while a well-insulated envelope and solar gain is required for winter. Thermal mass is an appropriate strategy for half of the under-heated period and the entire overheated period (Holm, 1996:70). Thermal mass and night-purging, will assist in extending the comfort-band in summer.

A detail analysis of the main processing space below the public gardens is discussed (figure 7.61), determining thermal comfort and lighting levels and the necessary iterations to the space. Overall heating and cooling strategies are discussed in figures 7.58 and 7.59 respectively.

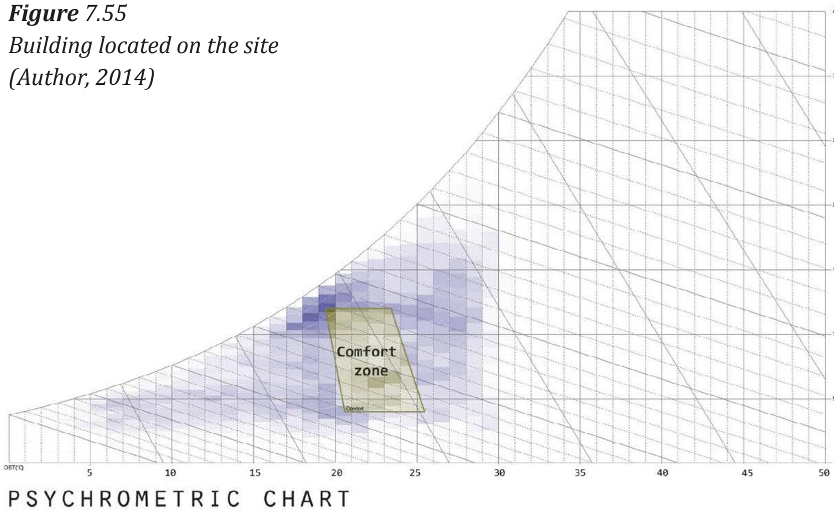


***Figure** 7.56*
Psychrometric Chart for Cullinan
(Adapted by author from Ecotect, 2014)

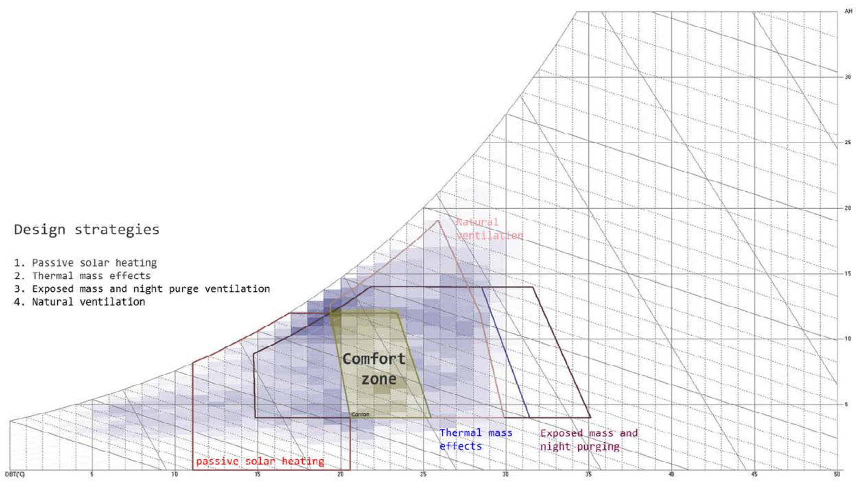


***Figure** 7.57*
Proposed design strategies
(Adapted by author from Ecotect, 2014)

Heading

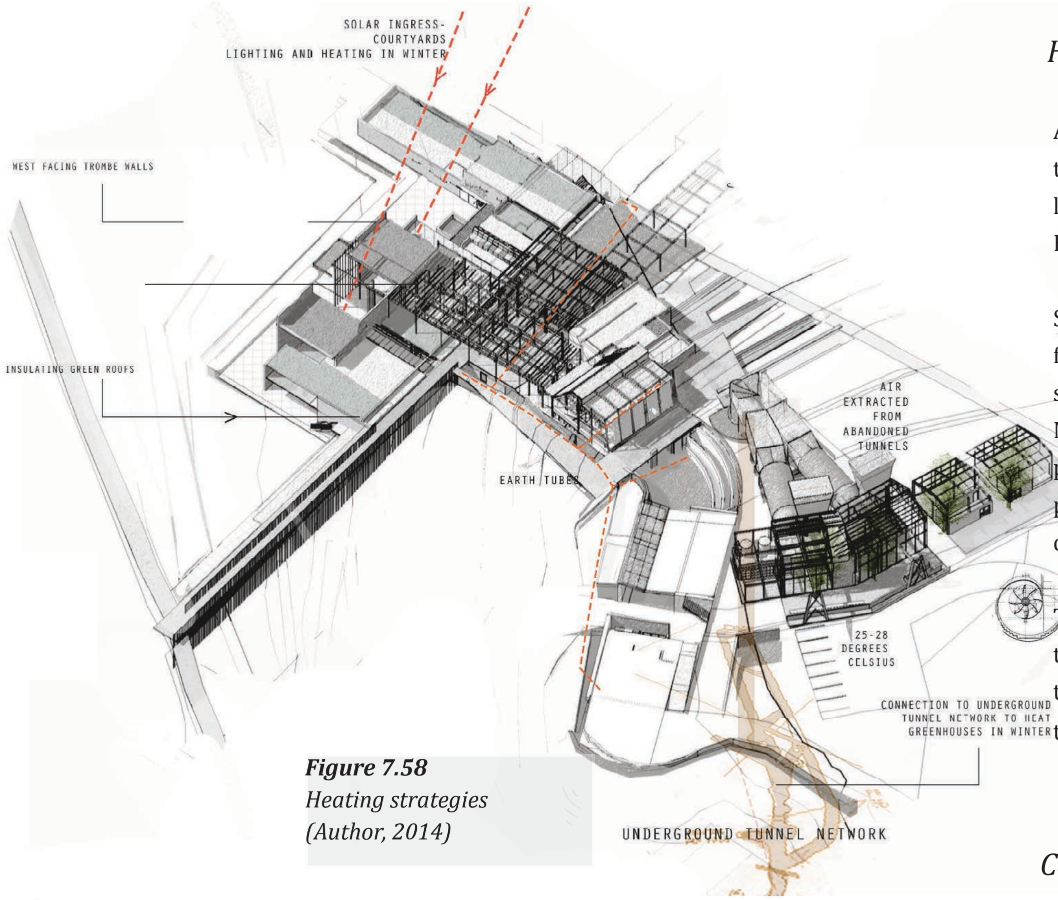


Figure 7.58
Heating strategies
(Author, 2014)

An earth tube system will aid in regulating the building's internal condition. Earth tube length and size is discussed at the end of the Ecotect study, to follow.

Solar ingress from the north and natural light from the south is allowed into the processing spaces by separating them with courtyards. Material conductivity and insulation and proposed west-facing trombe walls in the processing space will also reduce heating demand.

The greenhouses will be able to maintain temperatures between 25-28 °C, considering the 400 m depth of the tunnels from which the air is extracted.

Cooling

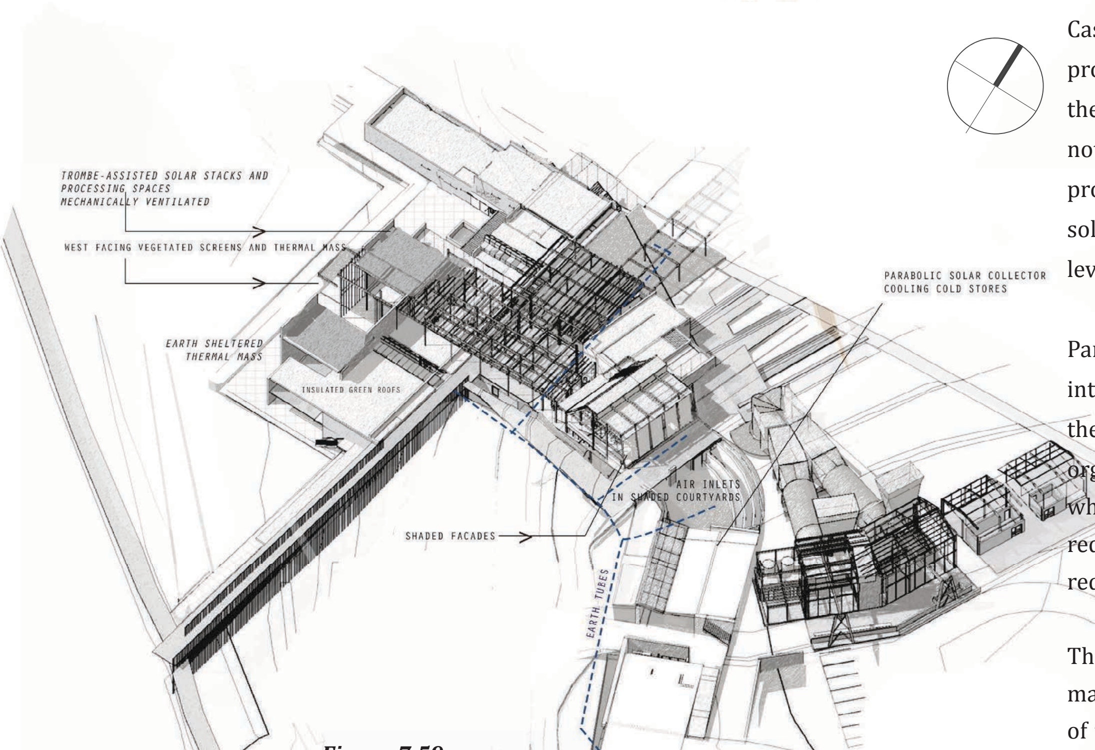


Figure 7.59
Cooling strategies
(Author, 2014)

Cast-in-situ west-facing concrete walls provide thermal mass, storing heat during the day, and releasing it when the space is not occupied, ventilating spaces at night. The proposed planted screens will reduce direct solar gain and increase internal comfort levels.

Part of the building is earth sheltered, terraced into the slope, which will assist in regulating the temperature of the indoor condition and organic product stores. Parts of the building, where fruit is prepared for cooking, would require mechanical ventilation to maintain required temperatures between 12-20 °C.

The earth tube system will also be used to maintain comfortable temperatures in some of the spaces in summer months, with inlets in the cooler shaded garden, away from thermal mass, with air outlets/diffusers in the floor. This system, used in conjunction with trombe-assisted solar stacks, will allow for the ventilation of the lower level processing spaces.

7.9.3.2 *Ecotect analysis*

Thermal comfort and lighting

An Ecotect analysis is conducted on the main processing space (figure 7.60), determining whether the space lies within the thermal comfort band for the majority of the year. The analysis is initiated with a base analysis, followed by a series of iterations, exploring strategies to assist in improving thermal comfort and lux levels.

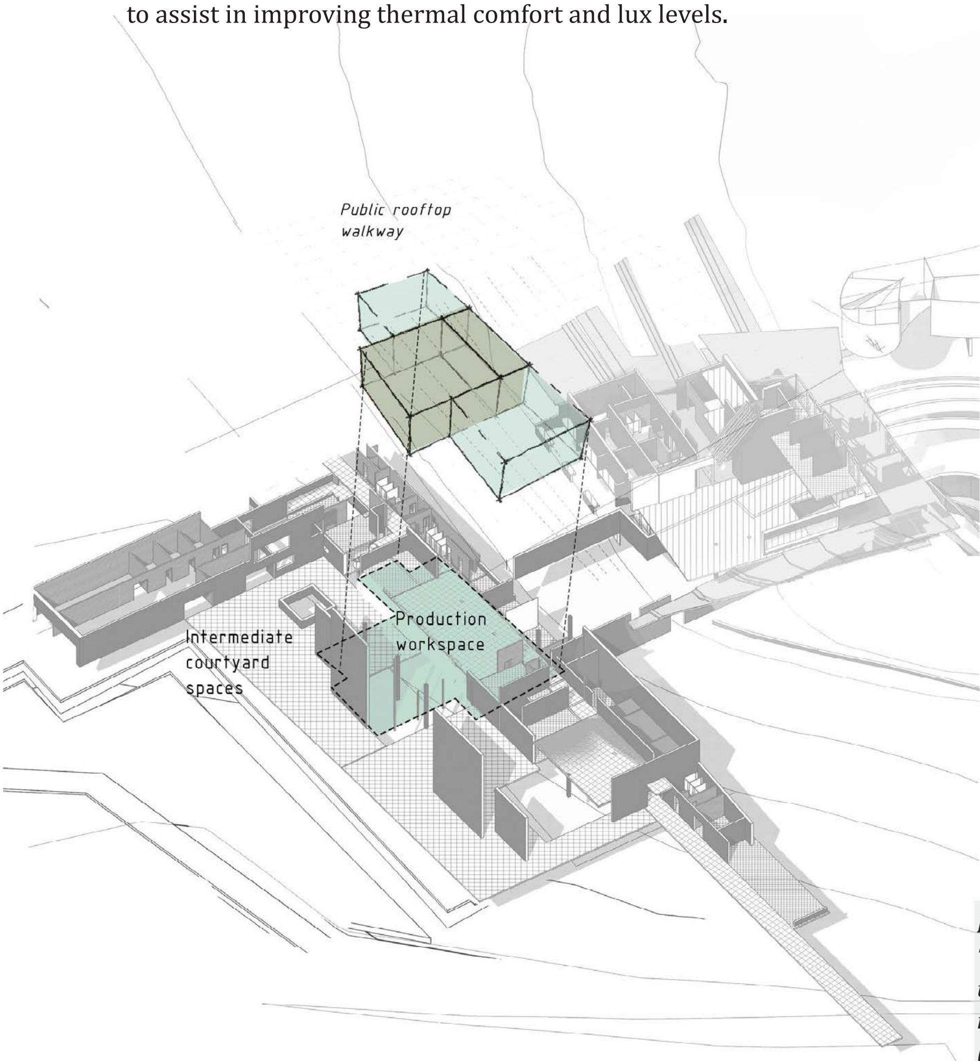
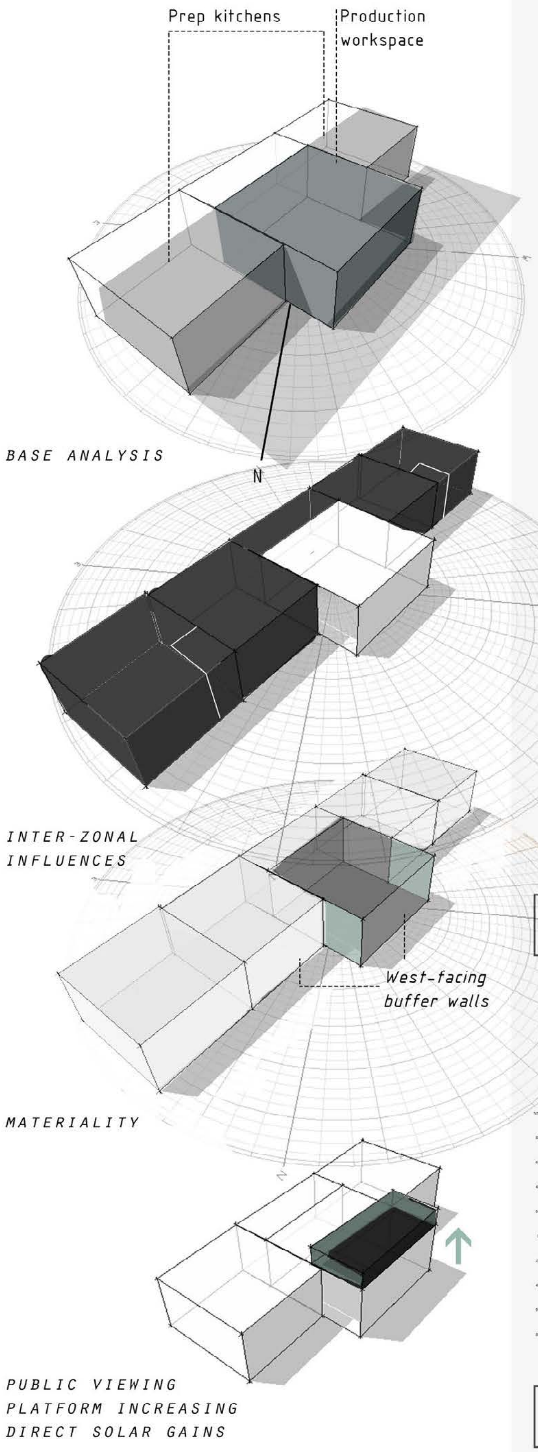


Figure 7.60
The space investigated in the Ecotect analysis, and the immediate influencing zones (the kitchen prep spaces) (Author, 2014)



Occupancy 08:00-17:00 weekdays and Saturdays for a maximum of 10 people in that space

Production area internal load for cooking and preparation spaces - 115W/day

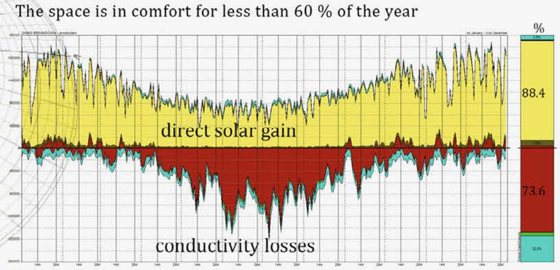
A desired comfort band of 18-26 Degrees Celsius is used

BASE ANALYSIS

The production workspace and connected adjacent zones are recognised, creating voids between these spaces to determine their influence. The main zone (prep kitchen and production workspace) and adjacent zones were modeled as frameless glass boxes, with 150mm concrete roof and floor slabs, are used as a benchmark for conductivity values, gains, losses and thermal comfort levels.

Although the area for fruit preparation requires mechanical ventilation, these cooking and preparation spaces can be maintained at temperatures between 18 - 26 °C. Most of the products should be left to cool at room temperature after cooking.

The space is in comfort for less than 60 % of the year

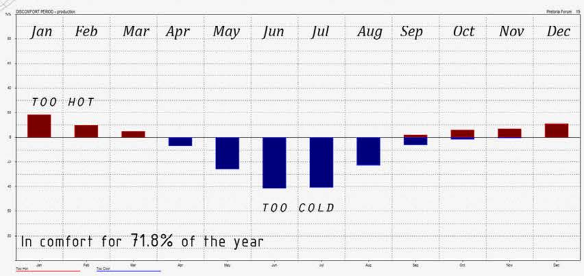


graph indicating main gains and losses

1

ITERATION 1

Materiality is altered. 300mm cast-in-situ thermal mass concrete retaining walls are introduced to the west-facing facade. Glazing is limited to the north and south-facing facades. 250mm floor and 300mm roof concrete slabs replace the 150mm slabs, increasing thermal mass. This is measured without insulation.



graph indicating over heated and under heated periods

2

ITERATION 2

Direct solar gain in winter is increased. The influence of the public viewing platform into the production spaces below is considered and discomfort in winter is decreased slightly, but conductivity losses increase.

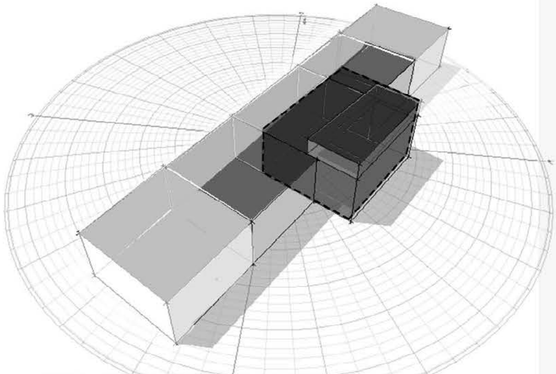
3

ITERATION 3.1

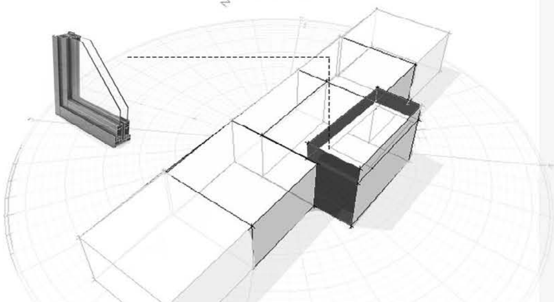
Conductivity losses are addressed by insulating the concrete roof with 80mm high-density rigid EPS. The U-value of the green roof is not taken into consideration because they are considered to be saturated at times, with varying moisture content. A U-value is, therefore, difficult to attain.

A combined insulation and drainage layer is introduced for the planted roof area. 80mm Isoboard layer protects waterproofing and insulates the rest of the slab.

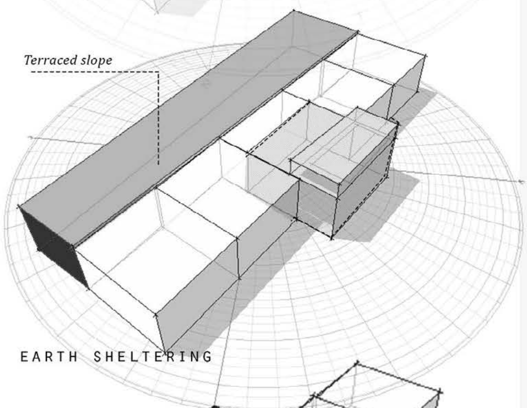
Figure 7.61
Ecotect analysis and iterations
(Author, 2014)



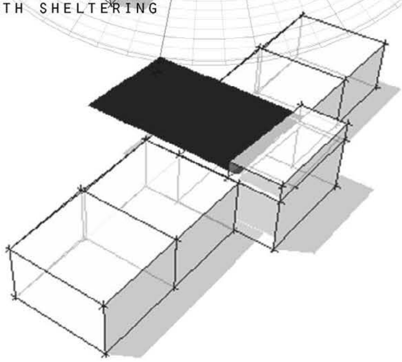
ROOF CONDUCTIVITY LOSSES



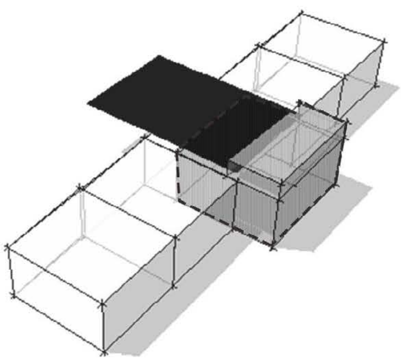
GLAZING CONDUCTIVITY LOSSES

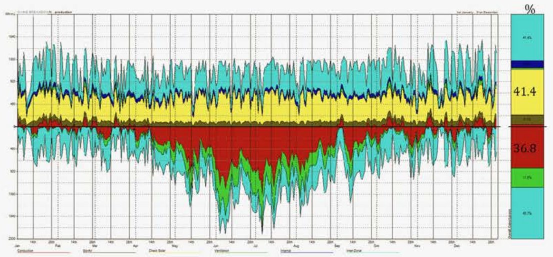


EARTH SHELTERING



SHADING PERGOLA





The graph indicates reduced direct gains and conductivity losses. The zone is in comfort for 76% of the year.

iteration 3.2

Frameless single-glazing is changed to double-glazing with an aluminium frame, improving the U-value. Discomfort in winter is decreased and the building is in comfort for 78% of the year.

With west and east-facing glazing, solar radiation is the critical factor. With south-facing glazing, conductance is the critical factor. The influence of the area of glazing on lux level is investigated later.

4

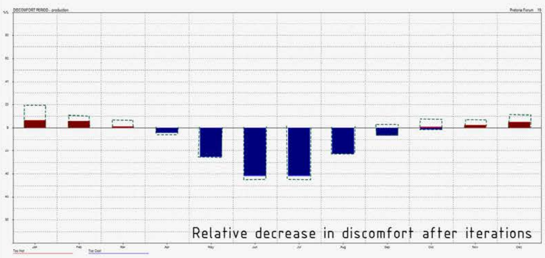
iteration 4

The effect of earth sheltering on the zone is determined. The relative location of the zone to the slope means that very little impact from earth sheltering is recorded.

5

iteration 5

The east-facing facade is shaded with timber slats, which also shades a large part of the roof of the zone investigated, reducing direct solar gain. The zone is located within the comfort band for 80,1% of the year. Conductivity and direct solar gain as a consequence of glazing area and shading has been significantly reduced.



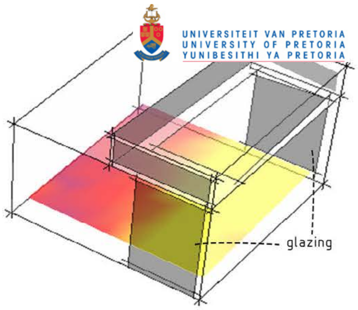
6

iteration 6: natural lighting

Iteration of glazing is explored to meet lighting requirements (400 lux level for the workspace and at least 100 lux level for circulation spaces).

Natural lighting in the main workspace is investigated, and lux levels are recorded at worktop height.

A balance between thermal comfort and lighting levels has to be achieved. Decreasing glazing area will reduce lux levels, but decrease direct solar gains in winter, compromising internal thermal comfort levels.

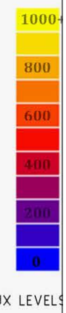


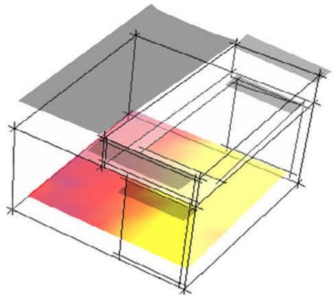
6.1

iteration 6.1

BASE ANALYSIS

Lux levels are too high in parts, creating uncomfortable glare.



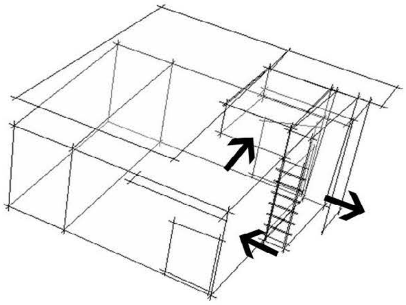


OVERHANGS

6.2

iteration 6.2

The pergola and overhangs over glazing are extended to reduce direct solar ingress. Changes to lux levels are minimal, and are still too high.



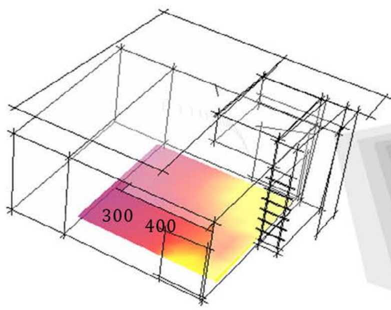
STEPPED FACADE

6.3

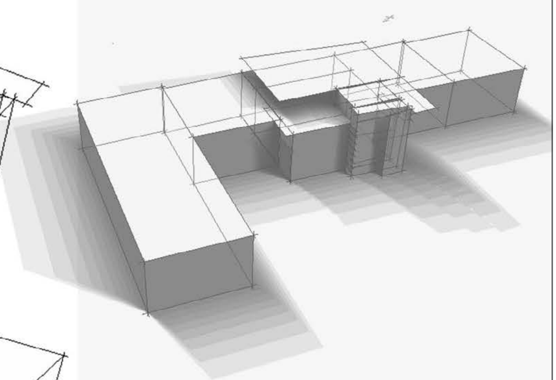
ITERATION 6.3

The viewing platform is stepped back, and the west facing facade is recessed slightly, reducing glazing area while allowing for more even light distribution in the space.

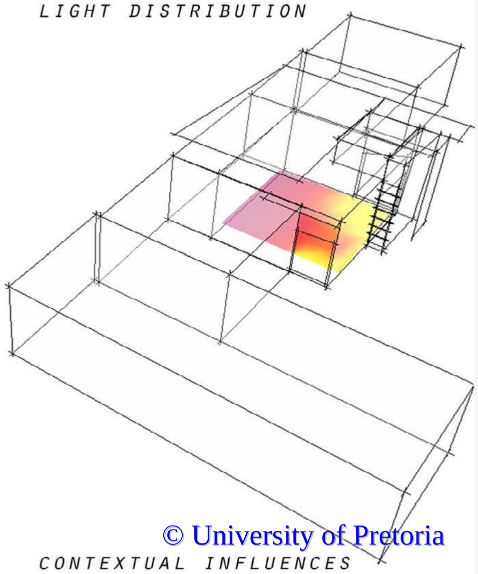
Glare is significantly reduced and lux levels are more evenly distributed in the space.



LIGHT DISTRIBUTION



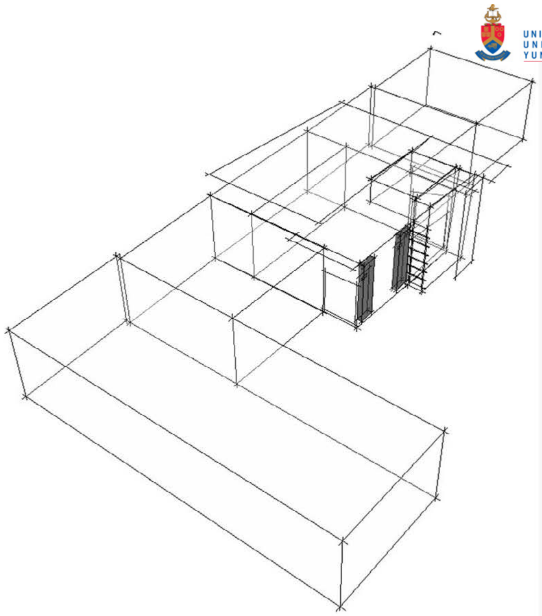
The influence of the context is taken into consideration, including the wing that extends out towards the north. Lux levels are lower, with decreased glare.



CONTEXTUAL INFLUENCES

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

7



EARTH TUBES AND
TROMBE-ASSISTED SOLAR STACKS

With the iterations made for glazing, the comfort level for the space, for the stated comfort band of 18-26°C, is increased to 84% as a result of decreased glazing area and overhangs.

The introduction of trombe-assisted solar stacks will assist in reducing discomfort, predominantly in summer.

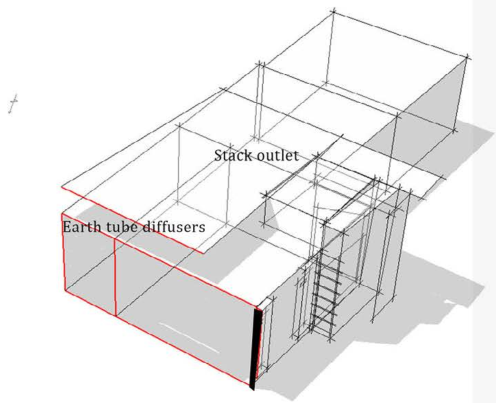
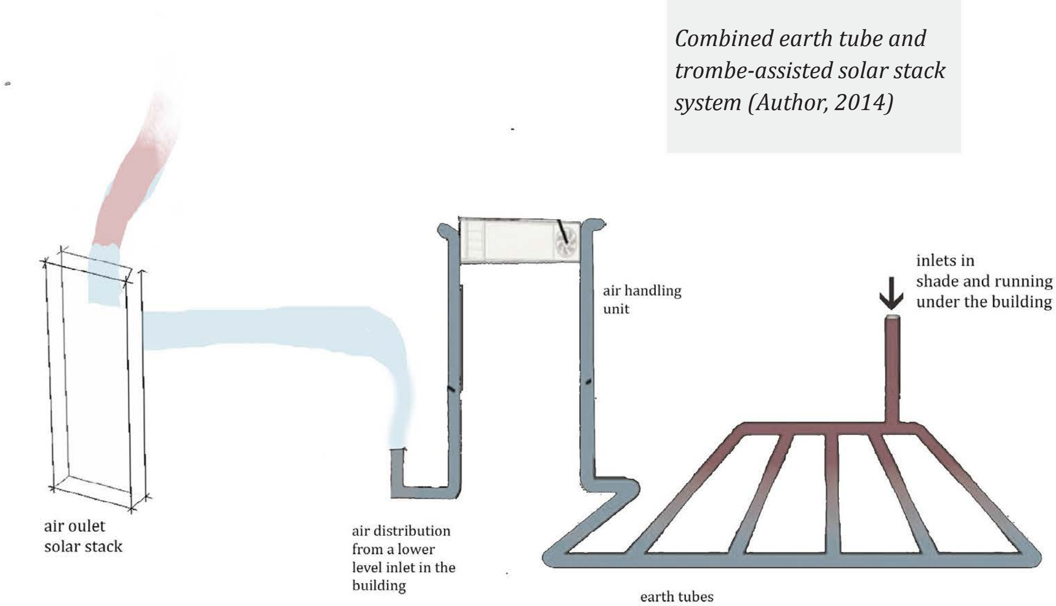


Figure 7.62

Combined earth tube and trombe-assisted solar stack system (Author, 2014)



Calculating earth tube length:

Increased earth tube length increases heat transfer with the soil conditions. However, if the earth tube is too long, it is more difficult to move air through it effectively. The longest suggested length is 73 m (Grondzik & Kwok, 2007:163). For an air change rate of 5 per hour, for the volume of the production space investigated (1000 m^3), an airflow rate of 5000 m^3 per hour is required resulting in 150mm diameter earth tubes at 70m lengths running below the building. The tubes do not need to be laid at a depth of more than 600mm (figure 7.63) in order to attain regulated internal condition with outflow air at approximately 25 ˚C. Air intake should occur away from thermal mass, in a cooler part of the site. Air intake is located to the lower parts of the site adjacent to the shaded grey water wetland for the processing spaces, and the water channels near the upper part of the site.

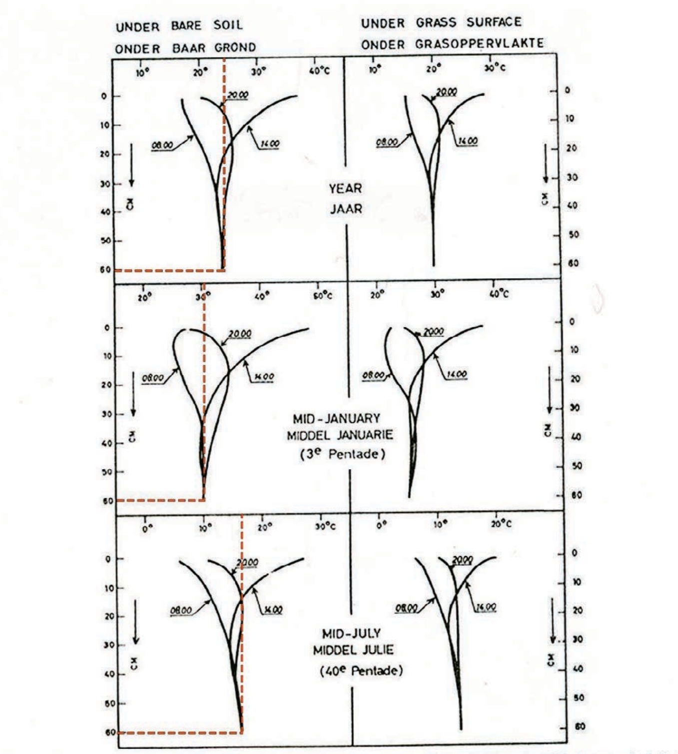


Figure 7.63

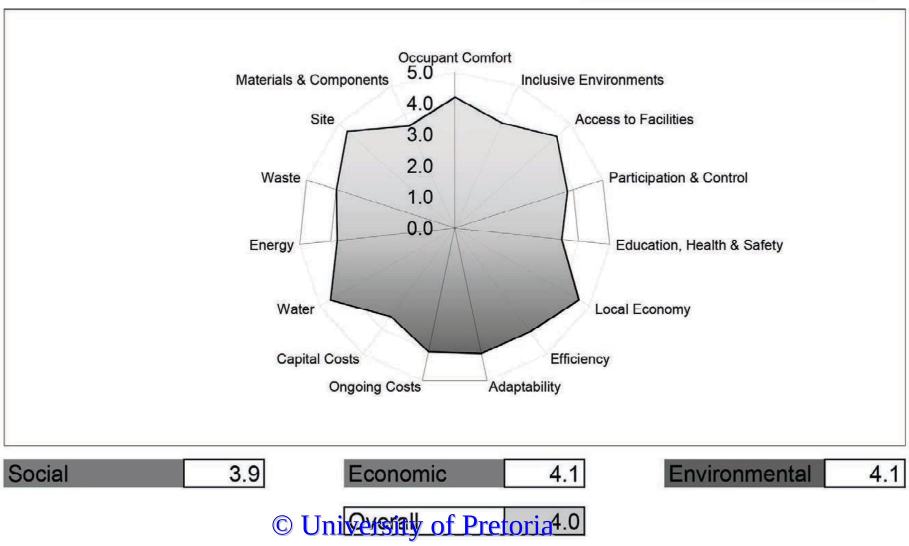
Variation of earth temperatures at increasing depths below the surface (Holm, 1996)

7.9.4 SBAT rating

The SBAT rating system considers multiple criteria in determining the sustainability of a building including social, economic and environmental factors. The rating (figure 7.64) considers factors such as the project's intention to regenerate the context, material sourcing and system integration.

Figure 7.64

SBAT rating (Author, 2014)



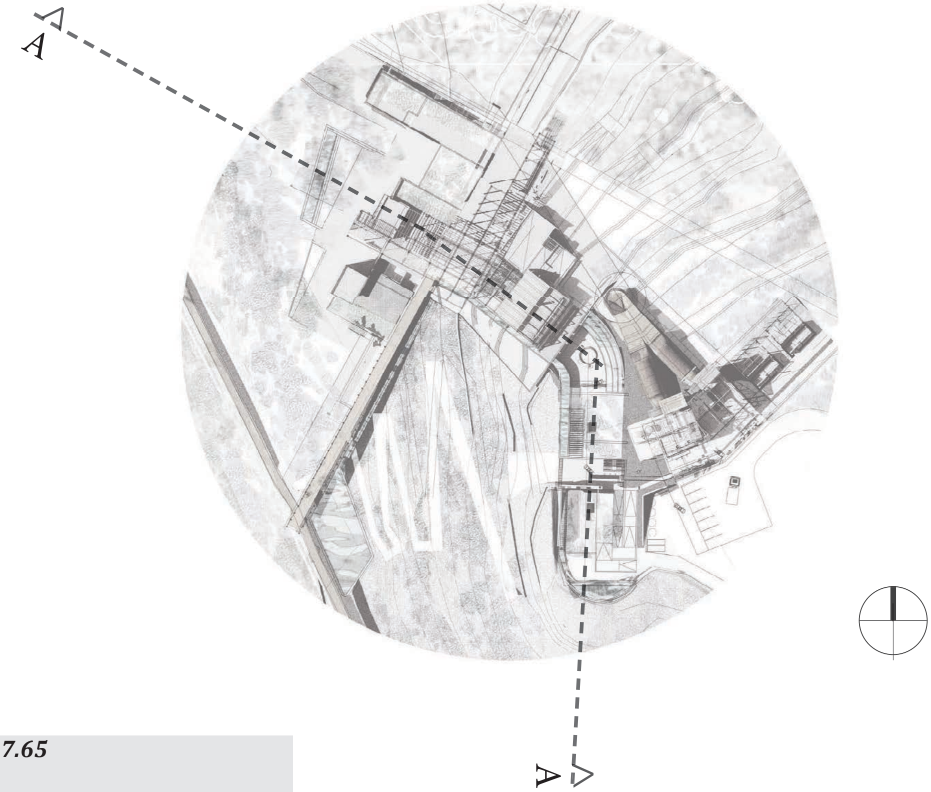
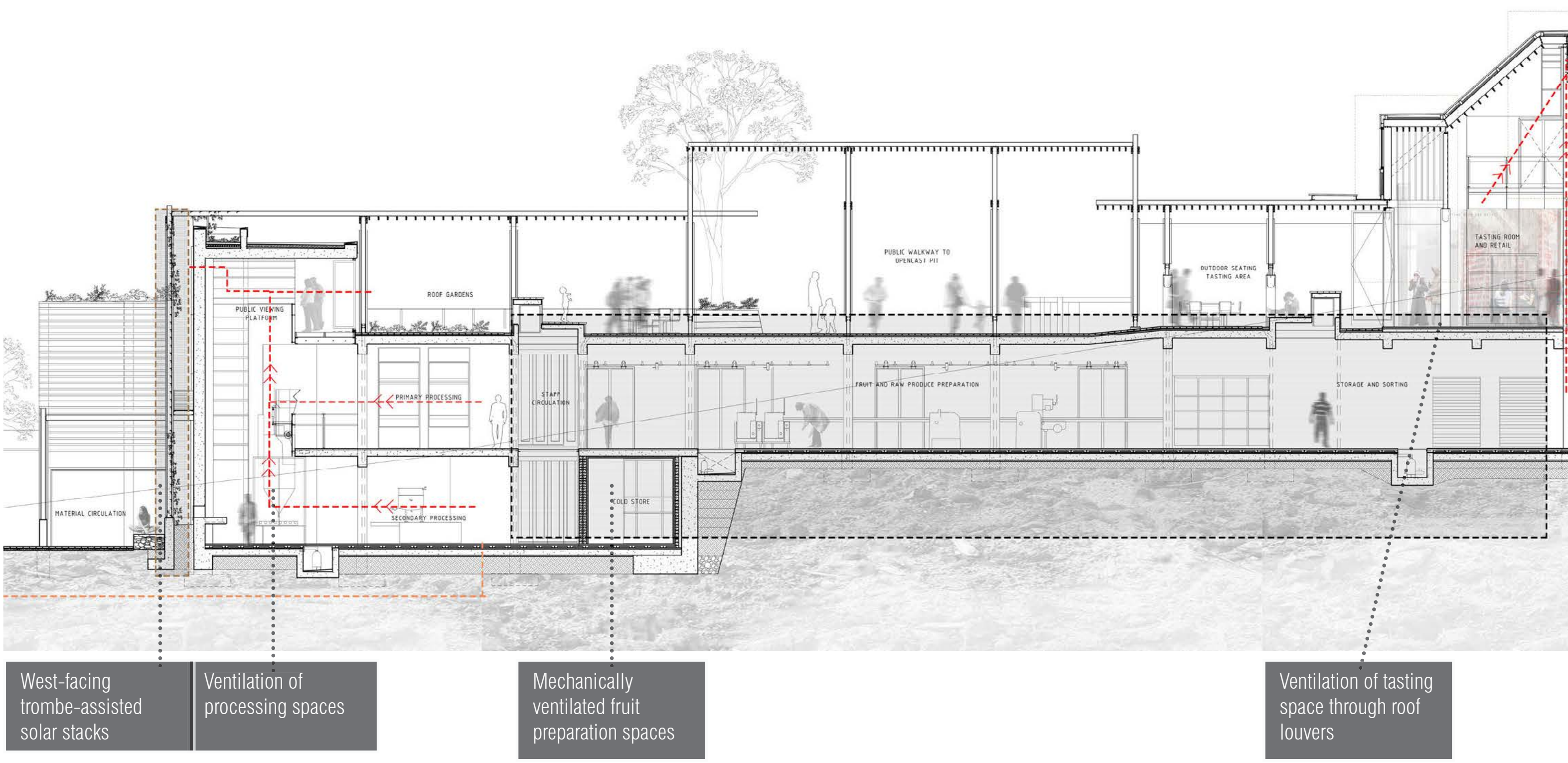
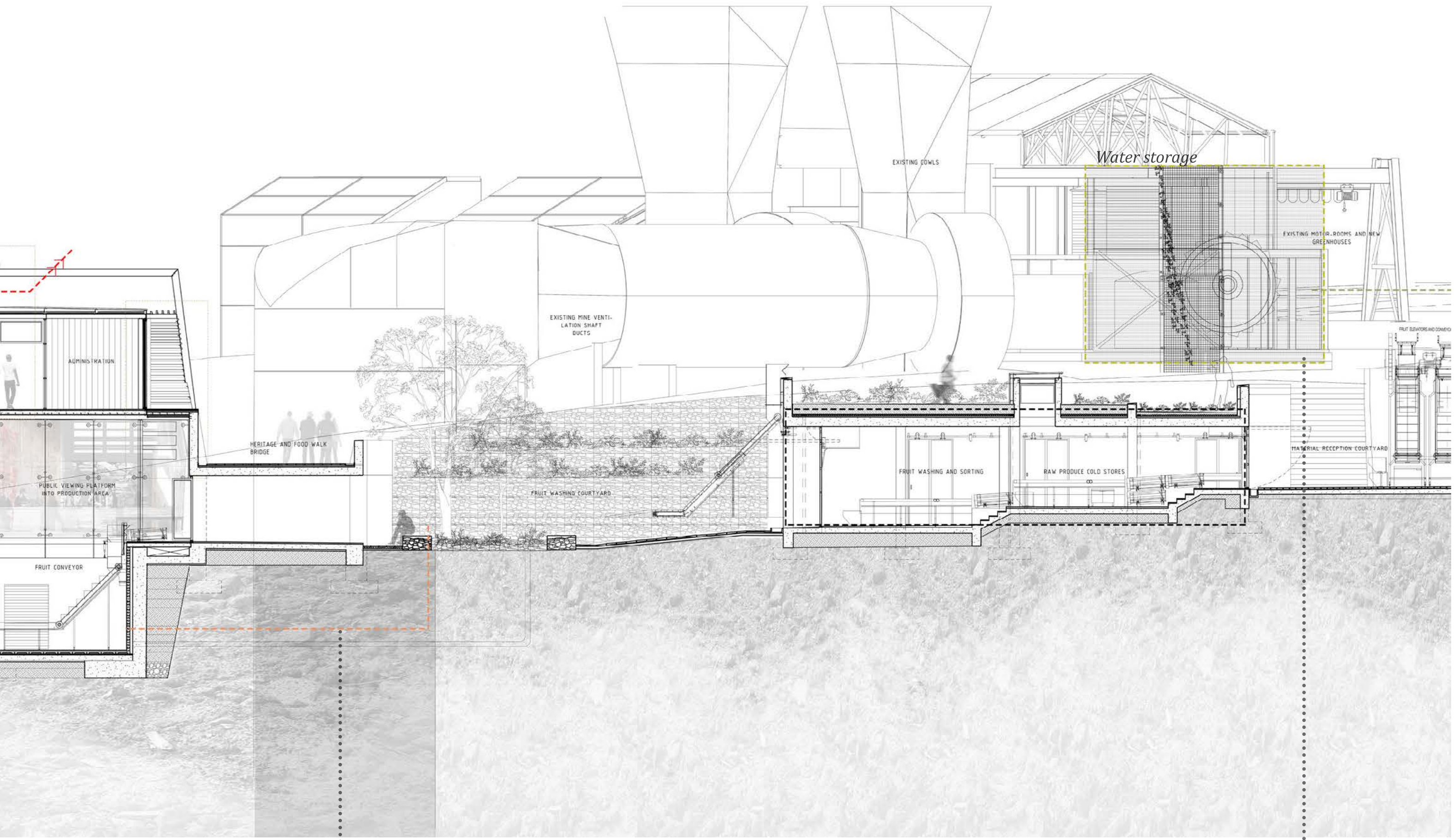


Figure 7.65

Passive strategies indicated on part of the section (Author, 2014)



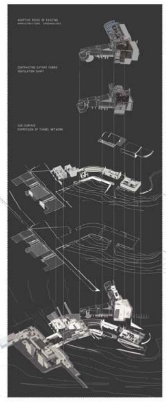


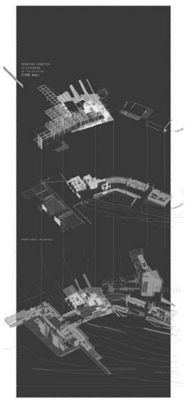
Earth tubes with air inlets in the shaded gardens

Anaerobic digesters and steam turbines adjacent to the waste yard and green house

FINAL REVIEW

Selected presentation drawings and models from the final design and technical review on 28 November 2014 (All images Author, 2014)

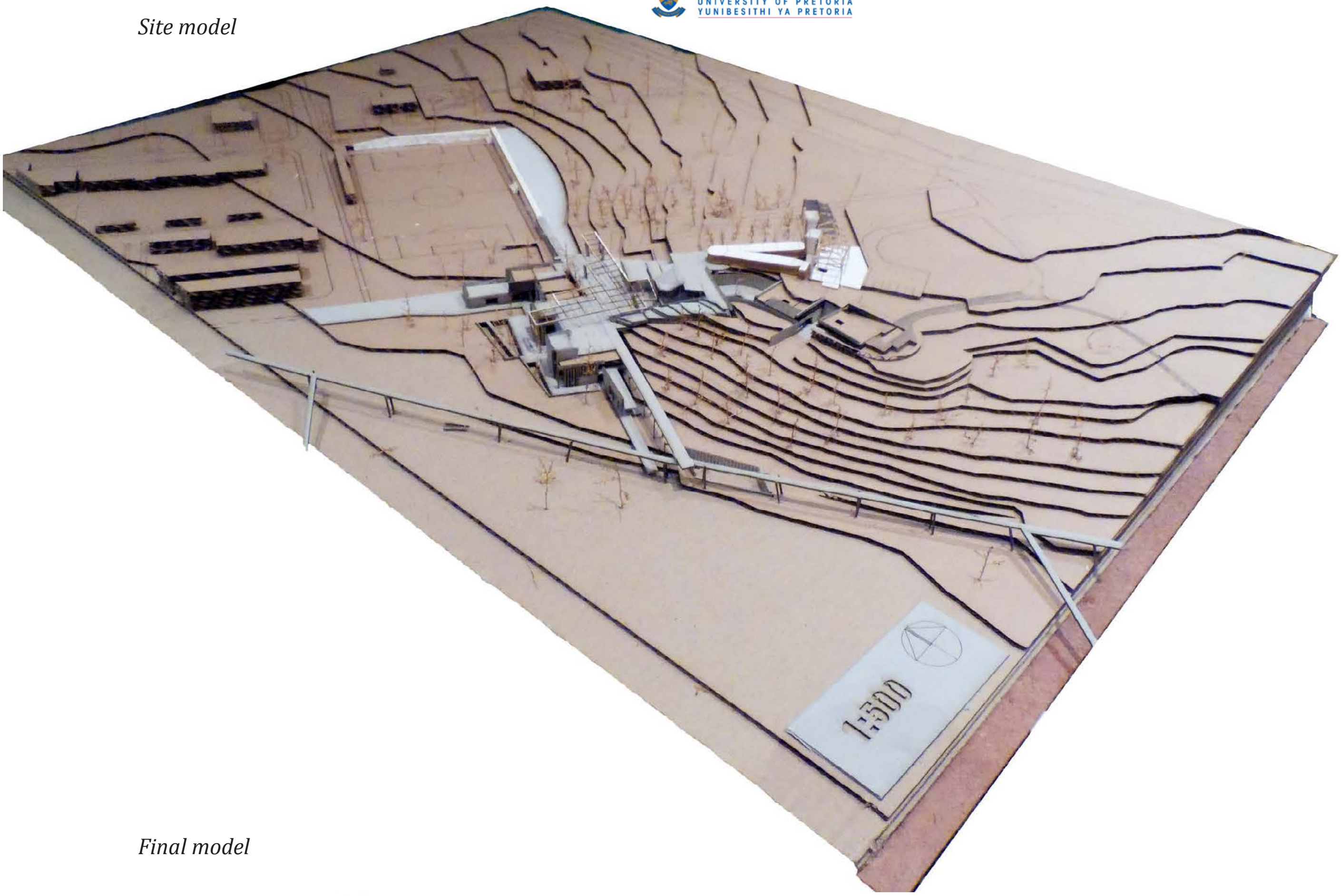




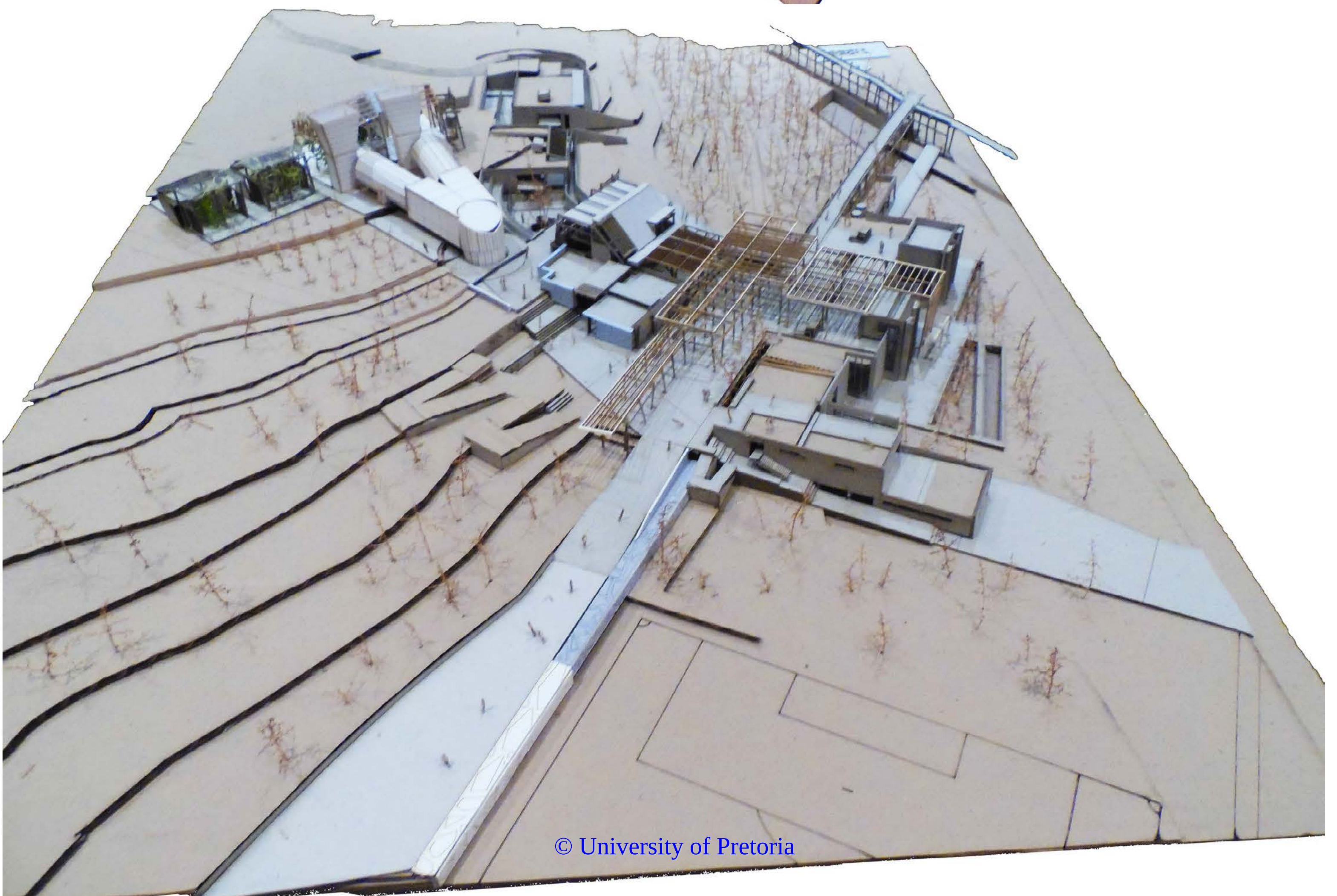

THE SECTION


STRUCTURE

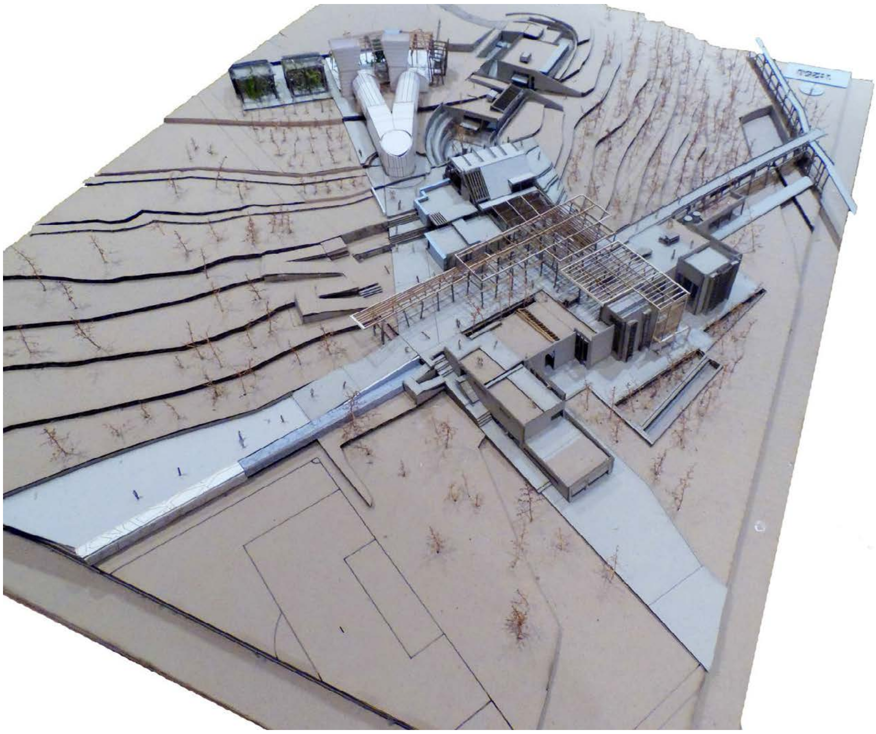
Site model

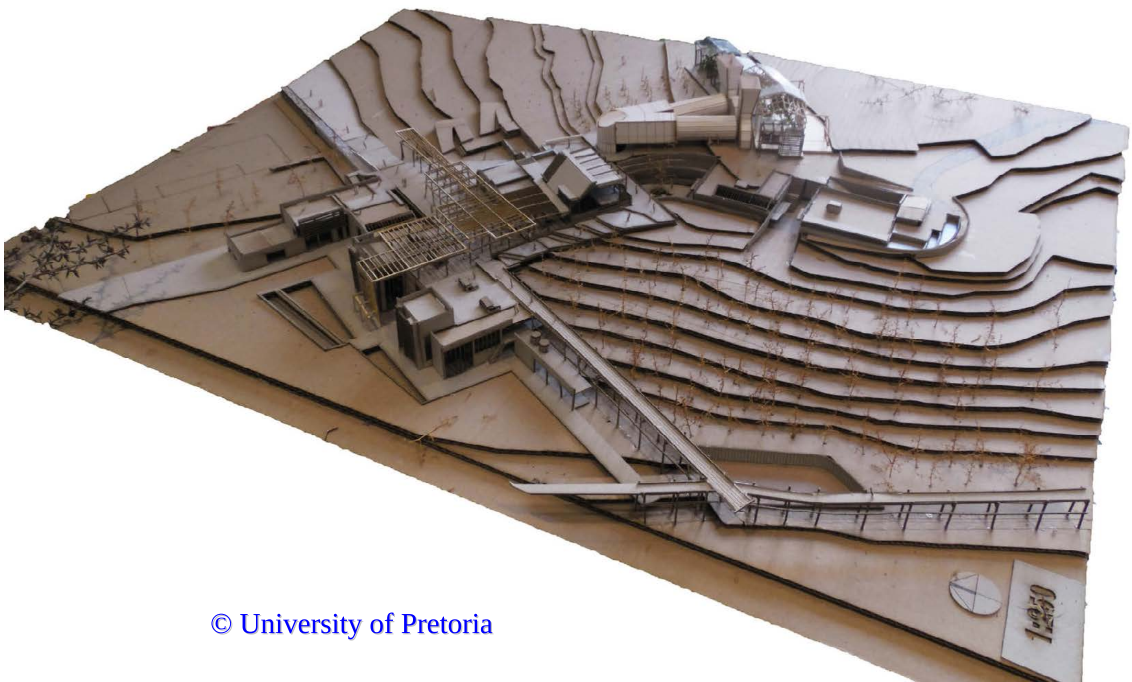


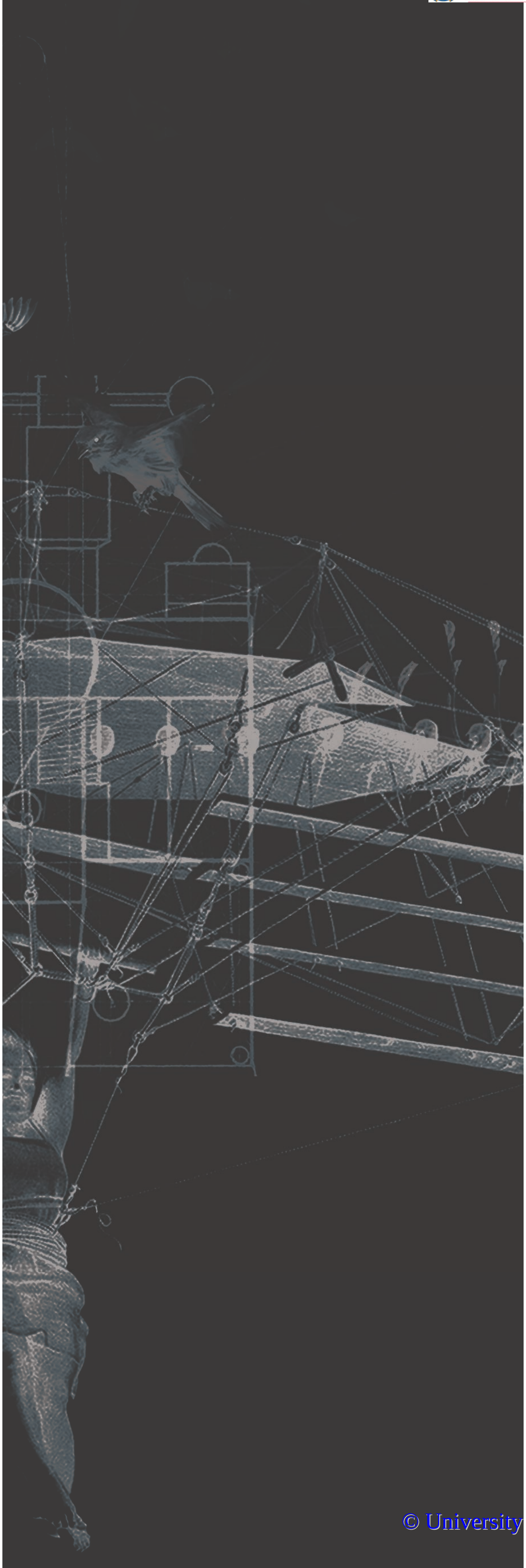
Final model



Detail model



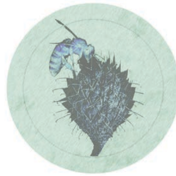




CHAPTER 8

CONCLUSION

The mutated condition


THE EVOLUTION

After the mine is decommissioned in Cullinan, the triad of *man, nature* and *machine* will exist in an *evolved condition* and will tangibly reflect the transition from the current 'Age of the Machine' to the 'Age of Life'. The objective of this dissertation is to explore the possible future relationships between residual systems in a post-operational mining context and on a site that has been inscribed with the traces of the three explored realms for over a century.

Where residual natural and cultural systems are typically left to fail after the machine in mining towns, destroying values and narratives associated with them, this dissertation considers the *regeneration and resilience* of these places of rich concomitant value.

Architectural expression of the triad, their interlaced memory and future *symbionic* interfaces, is explored through a founding in the unique *natural and cultural locale* which contrasts the introverted expression of the machine.

The narrative of Cullinan's food system, tourism, and the resurging natural context contribute to the definition of the identity of place. The programme envisions a future *food revolution*, challenging globalising systems and reintroducing biodiversity which has suffered as a consequence of the cyborg's exploits.

The humming machine that dominates the site will continue to breathe, a ghost and memory of Cullinan's past. The narrative of the machine will make visitors mindful of the unseen roots of the ventilation shaft beneath the surface, as well as the narrative of the past *parasitic interface* which juxtaposes future *synergistic interchanges,* expressed in the architectural response. The devoured context, the scar in the landscape, also remains as a testament to the parasitic condition, while the natural realm will reemerge from the disfigured surface and Oak Avenue Park.

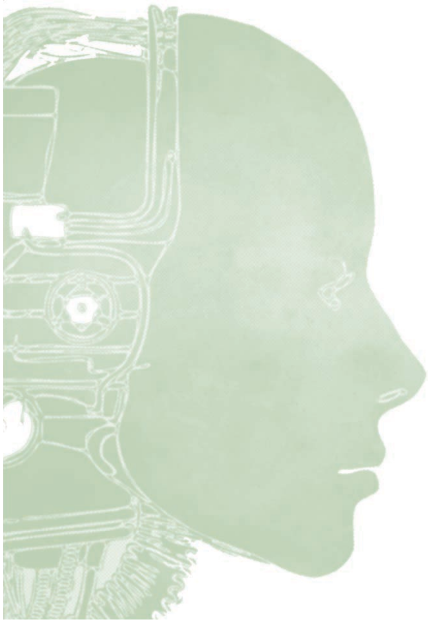
The architecture articulates the three systems of man, nature and machine within the context of the site, reflecting on the distinct characteristics of each system while considering the dynamic boundaries between the triad both *spatially and systemically*. To reflect new relationships, the realm of man stretches spatially into the mechanical and natural realms acting as a mediating condition. The making of architecture includes the reuse of material traces of the three elements on the site, reminiscent of the past conditions of man, nature and machine.

Technical and biological systems are interwoven creating closed-loop cycles and increasing resilience through a new way of making that is unique to place.

The successive phase in the *bionic evolution* defining the changing relationship between the realms of *man, nature and machine* is one where:

Toxic and volatile relationships have mutated to create *synergous interchanges. Volatile dynamics* have mutated to create *resilient interdependencies* and the distinct realms of *man, nature and machine* have mutated to a future *symbionic* state of *co-evolving mutualism.*

"... silence was completed, their hearts were opened, and they knew what had been important on the earth. Man, the flower of all flesh, the noblest of all creatures visible,..strangled in the garments that he had woven. Century after century had he toiled, and here was his reward. Truly, the garment had seemed heavenly at first, shot with colours of culture, sewn with the threads of self-denial. And heavenly it had been so long as man could shed it at will and live by the essence that is his soul.. "



EM Forster, The Machine Stops (1909)

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